Appendix A

Fissure Investigation Field Report

Memo

To: Norman N. Norrish (Wyllie & Norrish Rock Engineers)

Robert L. Burk (Burk GeoConsult, LLC)

From: Balin B. Strickler

Date: September 18, 2007

Re: I-90 2007 Geotechnical Investigation – Slide Curve Fissure Investigation

---

On Tuesday, September 11, 2007 Wilder Construction completed their scaling and excavation activities associated with the ongoing investigation of Fissures #1, #2 and #3 located approximately half way up the Slide Curve re-graded area on I-90 near Mile Post 59. Subsequent to the completion of the excavation activities the following tasks were completed by Balin B. Strickler:

1. Mark all excavations and points of interest within the excavated area with a unique and identifiable numbering system;
2. Complete structural mapping of excavated areas;
3. Identify and mark points of like origin within the main Fissure #2 excavation (St. 2-400);
4. Identify 3 to 4 locations along the main Fissure #2 excavation for maximum excavated depth measurements;
5. Coordinate and direct URS subcontracted survey crew to locate the areas of excavation and the points identified under Task 3 and 4;
6. Complete video camera survey of openings/voids exposed during the excavation activities;
7. Collect oblique aerial photographs of project area;
8. Prepare this memorandum documenting the field activities and investigation results.

The following attachments are included to this memorandum:

1. Figure #1 – Slide Curve Re-Graded Area
2. Figure #2 – Fissure #2 and #3 Excavations
3. Figure #3 – Fissure #2 Vectors of Movement
4. Table 2 – Summary of Excavations
5. Table 5 – Summary Survey Data Sheet

2530 Twinoaks Drive
Prescott, AZ 86305
(928) 541-9895

Summary of Fissure Excavations

Fissure #1

Fissure #1 was exposed with one excavation approximately 20 feet long and up to 3.5 feet deep. The Fissure was located across the middle of the former access road used during the regarding activities. Apparent bedrock was exposed on the upslope side with 1 to 3 feet of overburden (mixed fill and colluvium) which thickened to the north. A downslope block of rock was observed with 0.8 feet of separation at the top and 0.5 feet of separation near the bottom of the block. At the bottom of the detached block, apparent bedrock was encountered with the continuation of the joint observed (aperture of less than 1 cm). A blast hole was present within the downslope block. The orientation of the discontinuity along which the separation occurred is [72, 071]. This orientation is similar to the regional joint set observed throughout the Slide Curve area and specifically up slope from the excavation where orientations of [87, 086], [82, 096] and [86, 074] were measured. Based on the aforementioned it appears that this Fissure was caused by blasting and road construction during the re-grading activities completed in the 1970's and is limited in extent.

Fissure #2

Fissure #2 was exposed with eight excavations spanning more than 200 feet laterally across the slope (Figure 1). The general strike of the Fissure was measured at 350 – 355 degrees with local variations observed. The maximum observed depth of this Fissure (Station #2-413) was greater than 20 feet; however this was the limit of the exploratory method and does not necessarily represent the maximum depth of the Fissure. Evidence of a back scarp was observed in several of the excavated areas with orientations of [70 – 78, 076 – 079]. Measured separation (Station #2-400 and #2-600) between the two bedrock blocks ranged from 2.0 to 2.3 feet. Post re-grading movement is apparent (but not quantifiable) due to depressions noted in the fill to the north (between Stations #2-100 and #2-300) and an overhanging block of intact bedrock at Station #2-600. Additional analysis of the Whiteshield survey data should provide more accurate distances and orientations than those included within this summary.

Fissure #3

The lateral and vertical extent of Fissure #3 was explored with seven excavations spanning more than 125 feet laterally across the slope (Figure 1). The general strike of the Fissure was measured at 005 – 010 degrees with local variations observed. The maximum observed depth of this Fissure (Station #3-301) was greater than 30 feet; however this was the limit of the exploratory method and does not necessarily represent the maximum depth of the Fissure. Evidence of a back scarp was observed in two of the excavated areas with orientations of [86, 087] and [70, 275]. Measured separation at Station #3-100 between the two bedrock blocks was approximately 1.7 feet. Station #3-100 represents the northern most limits of Fissure #3 as identified by excavation. Based on the video camera survey the Fissure does extend at least another 32 feet north however it was not exposed due to thick overburden/bedrock overlying the void space. The southern termination of the Fissure appears to be with Fissure #2 based on the observed strike between Station #3-100 and #3-200. The excavations advanced between Fissure #2 and Station #3-200 did not encounter any openings or voids; however this may be due to thicker overburden as observed at the northern extent of Fissure #3. Additional analysis of the Whiteshield survey data should provide more accurate distances and orientations than those included within this summary.

The following pages provide a summary of work completed by Task as outlined on Page 1.

2530 Twinoaks Drive
Prescott, AZ 86305
(928) 541-9895

Task 1

16 separate locations were excavated during the investigation of Fissures #1 through #3. The numbering system has a primary number based on the number from the Fissure. The secondary number represents the number of the investigation for that fissure and the associated point of interest for that investigation. For example, #2-405 represents Fissure #2, excavation #4 and point of interest #5. For points selected from Task 3 an A and B were used for that specific point to correspond with the upslope (A) and down slope (B) point. The following table represents the number of excavations and points of interest per Fissure.

Table 1

Fissure Number	Number of Excavations	Surveyed Points of Interest
Fissure #1	1	2
Fissure #2	8	26
Fissure #3	7	7

Figure 1 provides an overview of Stations and lateral extent of Fissures #2 and #3.

Task 2

Structural mapping was completed, as possible, for all excavations. A combination of the ISRM Standard for Description for Discontinuities and recommended data collection from the FHWA Rock Slopes manual were used. Detailed mapping was completed on Fissure #2 at Station #2-400 and on Fissure #3 at Station #3-100. Other discontinuity mapping was limited due to the size of the excavation. Table #2 (attached) provides a summary of discontinuity data and excavation data from the mapping effort.

Task 3

In order to quantify direction and amount of displacement along the Fissure #2, seven locations interpreted to be connected prior to movement were identified. The locations were selected based on careful review of the upslope and downslope bedrock faces. Areas of intersecting joints or irregular surfaces were prioritized during the review. Each location was marked, labeled and measured using a Brunton Transit and steel tape measure. The locations were subsequently surveyed by Whiteshield for a more accurate data set. The seven points are summarized below.

Table 3

Location	Dip, dip direction (true north)	Distance (feet)
#2–405 A to B	14, 278	2.26
#2–406 A to B	21, 244	2.31
#2–407 A to B	20, 254	2.27
#2–408 A to B	22, 241	2.30
#2–410 A to B	23, 243	2.10

2530 Twinoaks Drive
Prescott, AZ 86305
(928) 541-9895

#2–411 A to B	18, 255	2.11
#2–412 A to B	19, 246	2.18

Task 4

Four locations along Fissure #2 at Station #2-400 were selected and marked in order to obtain more accurate depth measurements of the excavated area. A steel tape was used to measure the depth of excavation from the surveyed location. Each location was subsequently surveyed by Whiteshield. The four points and the associated depths are listed below:

Table 4

Fissure #2 Location	Depth (feet below point)
#2-401	6.3
#2-402	7.1
#2-403	7.1
#2-404	8.1

Task 5

On Wednesday September 12, 2007 Whiteshield, subcontractor to URS Corporation, was onsite to complete survey work as directed by B. Strickler. The contractor used RTK survey methods to locate the various excavated areas for Fissure #1 (1 excavation), Fissure #2 (8 excavations) and Fissure #3 (7 excavations). Locations within Station #2-400 related to Task 3 and 4 were surveyed using a local coordinate system and transit with prism or reflectorless methods. 3 or 4 locations within Station #2-400 were surveyed with both methods to allow for translation of the transit data into real space as collected using the RTK methods. According to the Survey Chief, accuracy of the RTK methods between points ranged between 0.1 and 0.2 feet and for the transit/prism methods between 0.01 and 0.05 feet. The survey chief did note that one point using the transit methods was not accurately surveyed due to its location on the rock face. This point may have an accuracy of 0.1 to 0.2 feet. The point was not recorded by the survey crew. The excel data sheet from the survey work is attached as Table 5.

Task 6

A downhole video camera unit was mobilized to the site on Tuesday September 11 and video surveys of various void spaces uncovered during the excavation were completed on the 11th and 12th. The DVD of the surveys has been provided to Wyllie & Norrish Rock Engineers. The following table summarizes the camera survey.

Table 6

Station #	Run Sequence	Trend, Plunge	Maximum Depth	Maximum Length
#2-413	8	50, 038	~ 18 feet	~ 15 feet

2530 Twinoaks Drive
Prescott, AZ 86305
(928) 541-9895

#2-601	7	39, 167	~ 10 feet	~ 13 feet
#3-101	2	30, 006	~ 20 feet	~ 32 feet
#3-101	2	47, 005	~ 27 feet	~ 32 feet
#3-201	6	39, 191	~ 10 feet	~ 9 feet

Trend and Plunge are represented in degrees using a magnetic declination of 17 degrees East. Maximum Depth and Length are the distances estimated from the point of the camera at its maximum extension in relation to the Station #. Actual depths from ground surface at these locations will vary based on the actual ground surface at that point.

Task 7

Aerial oblique photographs of the project area were shot on September 12, 2007. The photographs were taken to document the lateral extent of the investigation and to provide base photographs for reporting of results.

If you have any questions regarding this memorandum please contact Balin B. Strickler at (928) 830-4662 or at balin@strickleraz.com.

2530 Twinoaks Drive
Prescott, AZ 86305
(928) 541-9895

Table #2
Summary of Excavations

Station #	Excavated Depth	Downhole Camera	Voids Found	Approximate Depth	Notes
Fissure #1, general strike of ~340 - 345					
1-100	3.5 feet	No	Yes	3.5 feet	Likely blast related separation of discontinuity surface caused during road construction; evidence of blast hole in downslope block
					Joint set 1; [72, 071]
Fissure #2, general strike of ~350 - 355					
2-100	1 - 2 feet	No	Yes	4 - 5 feet	Minor fill depression along strike between Stations 2-100 to 2-300
2-200	1 foot	No	Yes	5- 6 feet	Minor fill depression along strike between Stations 2-100 to 2-300
2-300	1 foot	No	Yes	4 feet	Minor fill depression along strike between Stations 2-100 to 2-300
2-400	5 to 7 feet	Yes	Yes	Refer to Camera Survey Data	Possible back scarp; [73-76, 077-091]
					Joint set 1; [26-35, 307-330]
					Joint set 2; [68-74, 347-002]
					Joint set 3; [54-61, 169-183]
					Separation of rock = ~ 2.1 to 2.3 feet (measured)
2-500	1 foot	No	Yes	See Note #2-400	Possible back scarp; [70, 076]
2-600	1 foot	Yes	Yes		Possible back scarp; [77, 076]
					Joint set 1; [78, 073]
					Joint set 2; [18, 116]
					Joint set 3; [42, 206]
					Separation of rock = ~ 2.0 feet (measured)
2-700	1 - 2 feet	No	Yes	5 - 7 feet	Possible back scarp; [71, 079]
					Joint set 1; [47, 198]
2-800	1 - 2 feet	No	Yes	3 - 4 feet	Possible back scarp; [79, 096]
Fissure #3, general strike of ~005 - 010					
3-100	1 - 2 feet	Yes	Yes	See Note #2-400	Possible back scarp; [70, 275]
					Joint set 1; [36, 333]
					Joint set 2; [72, 034]
					Separation of rock = ~ 1.7 feet (measured)
3-200	1 foot	Yes	Yes	See Note #2-400	Possible back scarp; [86, 087]
					Joint set 1; [44, 204]
3-300	3 feet	No	No	N/A	Excavation encountered broken up rock, possibly disturbed bedrock
3-400	2 - 3 feet	No	No	N/A	Excavation encountered broken up rock, possibly disturbed bedrock
3-500	1 - 2 feet	No	No	N/A	Excavation encountered soils and colluvial/fill rocks
3-600	1 - 2 feet	No	No	N/A	Excavation encountered soils and colluvial/fill rocks
					Excavation encountered soils and colluvial/fill rocks

Table 5
Summary Survey Data Sheet

I-90 Snoqualmie Pass East - Hyak to Keechelus

2007 Miscellaneous Geotech points

(Combine Factor = 0.99988231 West Control) WSDOT PD = SPC / CF + 328083.333

Units: U.S. Feet

Vertical: NAVD 1988

Zone: Washington Coordinate System, South Zone, NAD 1983/91

West Local Datum Plane

WSI-ID	Northing	Easting	Elevation	Description
19600	1062652.88	1754788.35	2763.72	G;1-101
19601	1062630.69	1754789.67	2765.52	G;1-102
19595	1062850.36	1754721.86	2730.68	G;2-401
19596	1062844.98	1754720.91	2732.17	G;2-402
19597	1062842.35	1754721.23	2729.72	G;2-403
19598	1062838.03	1754721.90	2730.39	G;2-404
19580	1062851.32	1754722.52	2730.77	G;2-405A
19593	1062850.90	1754720.38	2730.10	G;2-405B
19583	1062847.98	1754721.90	2730.50	G;2-406A
19590	1062847.42	1754719.76	2729.79	G;2-406B
19585	1062846.43	1754721.94	2729.72	G;2-407A
19588	1062845.99	1754719.64	2729.01	G;2-407B
19584	1062846.86	1754721.82	2730.57	G;2-408A
19589	1062846.36	1754719.72	2729.77	G;2-408B
19586	1062844.60	1754721.27	2728.35	G;2-410A
19587	1062844.13	1754719.42	2727.48	G;2-410B
19582	1062849.78	1754722.70	2728.75	G;2-411A
19591	1062849.37	1754720.67	2728.16	G;2-411B
19581	1062850.85	1754722.26	2729.67	G;2-412A
19592	1062850.44	1754720.20	2729.00	G;2-412B
19594	1062857.84	1754721.07	2733.69	G;2-413
19578	1062806.40	1754739.70	2739.90	G;3-201
19577	1062898.15	1754730.30	2746.10	G;3-601
19561	1062932.19	1754704.33	2731.27	G;STA 2-101
19562	1062907.33	1754710.95	2734.60	G;STA 2-201
19563	1062894.47	1754709.61	2731.45	G;STA 2-301
19564	1062818.73	1754723.49	2728.53	G;STA 2-501
19565	1062798.46	1754728.67	2732.58	G;STA 2-601
19568	1062767.36	1754730.91	2731.19	G;STA 2-701
19569	1062747.04	1754732.85	2734.05	G;STA 2-801
19571	1062845.61	1754747.53	2749.59	G;STA 3-101
19566	1062796.54	1754739.64	2739.03	G;STA 3-301
19567	1062786.45	1754737.95	2739.08	G;STA 3-401
19572	1062886.40	1754750.07	2760.91	G;STA 3-501
19570	1062793.47	1754752.48	2747.99	G;STA 3-701

Provided by Whiteshield

Figure #1 – Slide Curve Re-Graded Area

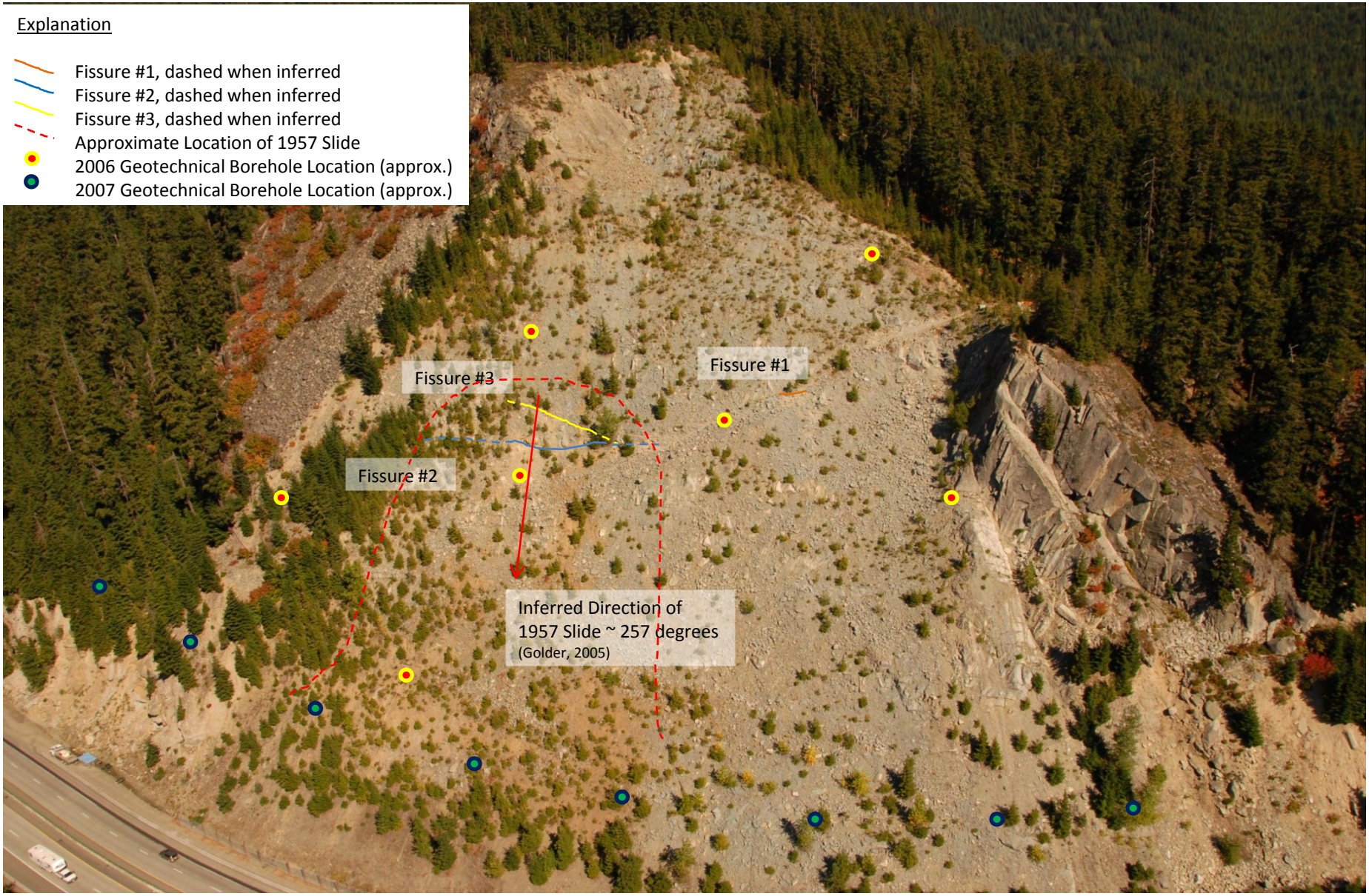


Figure #2 – Fissure #2 and #3 Excavation

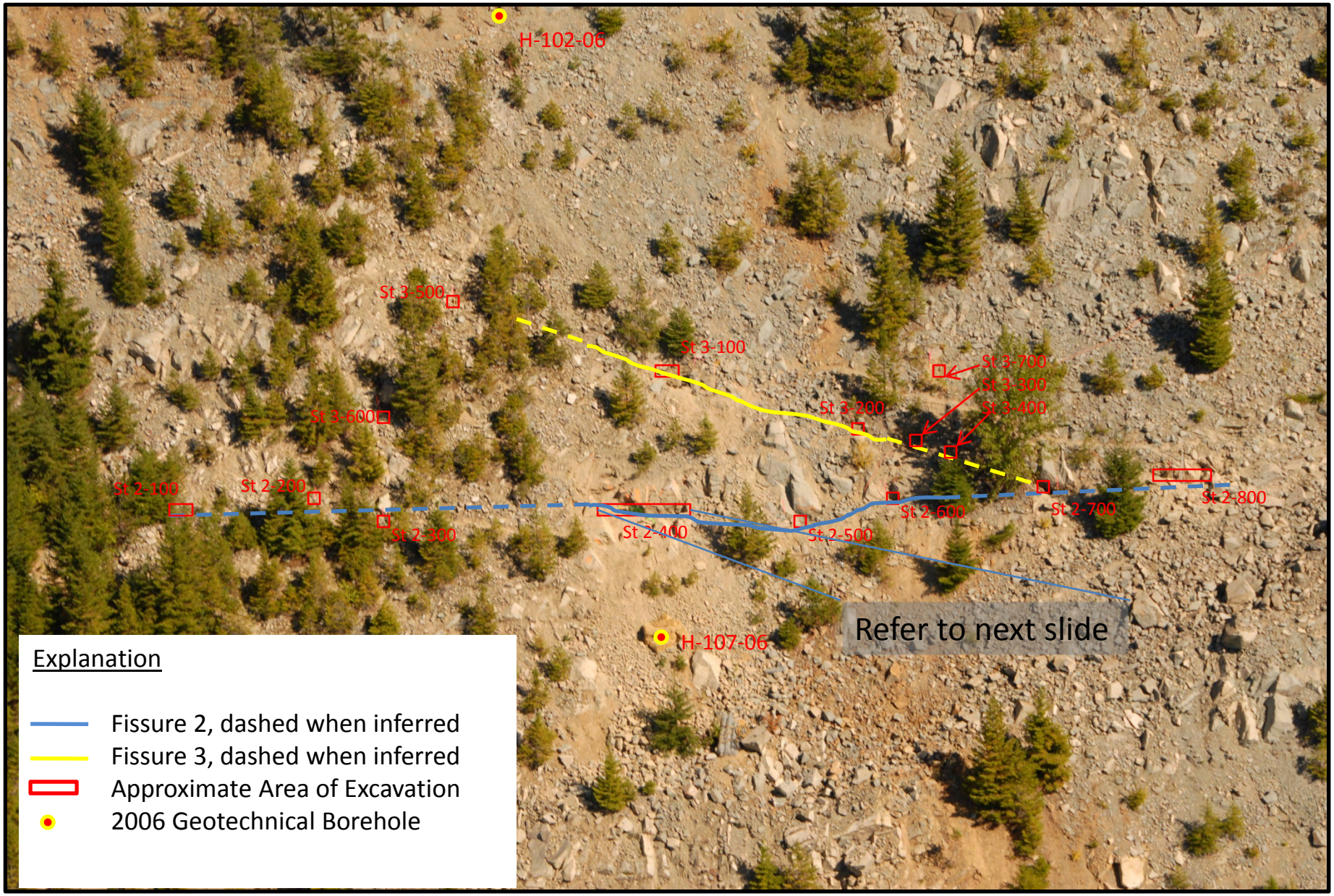
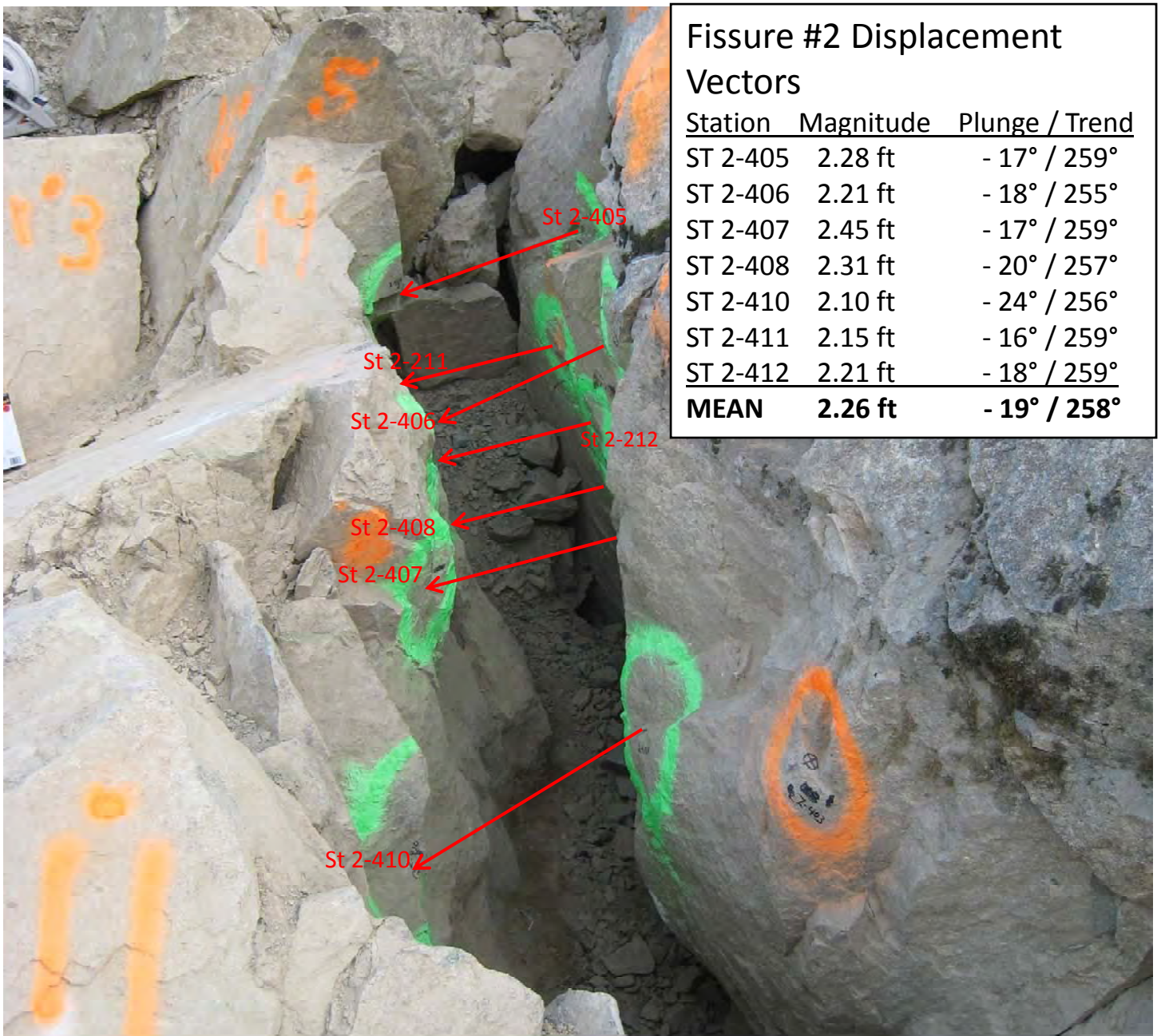


Figure #3 – Fissure #2 Vectors of Movement



Fissure #2 Displacement Vectors

Station	Magnitude	Plunge / Trend
ST 2-405	2.28 ft	- 17° / 259°
ST 2-406	2.21 ft	- 18° / 255°
ST 2-407	2.45 ft	- 17° / 259°
ST 2-408	2.31 ft	- 20° / 257°
ST 2-410	2.10 ft	- 24° / 256°
ST 2-411	2.15 ft	- 16° / 259°
ST 2-412	2.21 ft	- 18° / 259°
MEAN	**2.26 ft**	**- 19° / 258°**

Appendix B

Borehole Logs

ROCK DESCRIPTION: ROCK TYPE, rock color, grain size, weathered state, rock strength, structure, discontinuity spacing, discontinuity condition. [Formation Name]

Grain Size

Grain Size	Description	Criteria
Less than 0.04 inches	Fine grained	Few crystal boundaries/ grains distinguishable in the field or with a hand lens.
0.04 to 0.2 inches	Medium grained	Most crystal boundaries/ grains distinguishable with the aid of a hand lens.
Greater than 0.2 inches	Coarse grained	Most crystal boundaries/ grains distinguishable with the naked eye.

Degree of Weathering

Term	Description	Grade
Fresh	No visible signs of rock material weathering; perhaps slight discoloration in major discontinuity surfaces.	I
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering, and may be somewhat weaker externally than in its fresh condition.	II
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as corestones.	III
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as discontinuous framework or as corestone.	IV
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil	All rock material is converted to soil. The mass structure and material fabric is destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Rock Type

Rock Name	Characteristics
Pyroclastic Breccia	Pyroclastic rock whose average pyroclast size exceeds 2.5 inches and in which *angular* pyroclasts predominate.
Agglomerate	Pyroclastic rock whose average pyroclast size exceeds 2.5 inches and in which *rounded* pyroclasts predominate.
Lapilli Tuff	Pyroclastic rock whose average pyroclast size is 0.08 to 2.5 inches.
Ash Tuff	Pyroclastic rock whose average pyroclast size is less than 0.08 inches.

Discontinuity Condition

Condition	Description
Excellent Condition	Very rough surfaces, no separation, hard discontinuity wall.
Good Condition	Slightly rough surfaces, separation less than 0.05 inches, hard discontinuity wall.
Fair Condition	Slightly rough surface, separation greater than 0.05 inches, soft discontinuity wall.
Poor Condition	Slickensided surfaces, or soft gouge less than 0.2 inches thick, or open discontinuities 0.05 to 0.2 inches.
Very Poor Condition	Soft gouge greater than 0.2 inches or open discontinuities greater than 0.2 inches.

Relative Rock Strength

Grade	Description	Field Identification	Uniaxial Compressive Strength (Approx)
R0	Extremely Weak Rock	Indented by thumbnail	0.04 to 0.15 ksi
R1	Very Weak Rock	Specimen crumbles under sharp blow with point of geological hammer, and can be cut with a pocket knife.	0.15 to 3.6 ksi
R2	Moderately Weak Rock	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	3.6 to 7.3 ksi
R3	Moderately Strong Rock	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer point.	7.3 to 15 ksi
R4	Strong Rock	Specimen breaks with one firm blow from the hammer end of a geological hammer.	15 to 29 ksi
R5	Very Strong Rock	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 29 ksi

Discontinuity Spacing

Description	Spacing of Discontinuity
Very Widely Spaced	Greater than 10 ft.
Widely Spaced	3 ft to 10 ft.
Moderately Spaced	1 ft to 3 ft.
Closely Spaced	2 inches to 12 inches
Very Closely Spaced	Less than 2 inches

$$\text{Core Recovery (\%)} = \frac{100 \times \text{Length of Core Recovered}}{\text{Length of Core Run}}$$

$$\text{RQD (\%)} = \frac{100 \times \text{Length of Core in pieces} > 4 \text{ inches}}{\text{Length of Core Barrel}}$$

wyllie & norrish ROCK ENGINEERS

Figure B.1

Explanation and References

SOIL DESCRIPTION: SOIL TYPE, angularity, density, color, moisture. [Deposition Type]

Soil Constituent Definition

Soil Constituent	Description
Boulder	Particles of rock that will not pass through a 12 in. opening.
Cobble	Particles of rock that will pass through a 12 in. opening, but will not pass through a 3 in. opening.
Gravel	Particles of rock that will pass through a 3 in. opening, but will not pass a 0.19 in. (4.75 mm) opening.
Sand	Particles of rock that will pass through a 0.19 in. (4.75 mm) opening, but will not pass a 0.003 in. (0.075 mm) opening.
Silt	Soil that will pass through a 0.003 in. (0.075 mm) opening that is *non-plastic* or very slightly plastic and exhibits *little or no strength* when air-dried.
Clay	Soil that will pass through a 0.003 in. (0.075 mm) opening that can be made to exhibit *plasticity* (putty-like properties) within a range of water contents, and exhibits *considerable strength* when air-dried.
Organic Soil	Soil that contains enough organic particles to influence the soil properties.
Peat	Soil that is composed primarily of vegetable tissue in various stages of decomposition usually with an organic odor, a dark brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

Angularity Classification

Description	Criteria
Angular	Coarse grained particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Coarse grained particles are similar to angular description but have rounded edges
Subrounded	Coarse grained particles have nearly plane sides but have well rounded corners and edges
Rounded	Coarse grained particles have smoothly curved sides and no edges

Moisture Conditions

Moisture Description	Criteria
Dry	Absence of moisture; dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

Density of Cohesionless Soils

SPT N (Blows/Foot)	Relative Density
0 to 4	Very Loose
5 to 10	Loose
11 to 24	Medium Dense
25 to 50	Dense
Over 50	Very Dense

Consistency of Cohesive Soils

SPT N (Blows/Foot)	Consistency
0 to 1	Very Soft
2 to 4	Soft
5 to 8	Medium Stiff
9 to 15	Stiff
16 to 30	Very Stiff
31 to 60	Hard
Over 60	Very Hard

USCS Soil Classification

Major Divisions			Group Symbol	Typical Names
Course-Grained Soils More than 50% retained on the 0.075 mm (No. 200) sieve	**Gravels** 50% or more of course fraction retained on the 4.75 mm (No. 4) sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands 50% or more of course fraction passes the 4.75 (No. 4) sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils More than 50% passes the 0.075 mm (No. 200) sieve	**Silts and Clays** Liquid Limit 50% or less		ML	Inorganic silts, very fine sands, rock four, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly/ sandy/silty/lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid Limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils

wyllie & norrish ROCK ENGINEERS

Figure B.2

Explanation and References

Borehole logs were prepared under the direction of Wyllie & Norrish Rock Engineers Inc. Original field logs contain detailed source information.

All colors designated in conformance with the Rock-Color Chart, Geological Society of America, 1991

Rock strength values provided on the gINT log represent those values obtained by performing field Diametral Point Load Tests (PLT-D) or Axial Point Load Tests (PLT-A) at specific test depths. Only valid failure results (passing through the plane of the platens) are represented on the log.

Standard Penetration Test (SPT) values provided on the gINT log were completed in general accordance with ASTM D 1586. The sampler was advanced into relatively undisturbed soil in three 0.5 foot increments (unless refusal conditions were encountered) using a 140 lb weighted cathead hammer falling a vertical distance of 30 inches. The blowcount, n, is indicated on the log as the number of blows required to advance the sampler through the final 1.0 foot of penetration or another specified distance if refusal conditions were encountered.

References:

American Society for Testing and Materials (ASTM), 1985, D 2487-83, *Classification of Soils for Engineering Purposes: Annual Book of ASTM Standards*. Vol. 04.08, pp 395-408.

American Society for Testing and Materials (ASTM), 1987, D 1586-84, *Standard Method for Penetration Test and Split – Barrel Sampling Soils: Annual Book of ASTM Standards*. Vol. 04.08.

Geological Society of America (GSA), 1991, Rock Color Charts, Boulder Colorado.

International Society for Rock Mechanics (ISRM), 1985, Suggested Methods for Determining Point Load Strength.

Washington State Department of Transportation (WSDOT), Geotechnical Design Manual M 46-03. September, 2005.

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01978

HOLE No. RKS-20-07

Sheet 1 of 4

Job No. 03-2007 SR 90 Elevation 2580.8 ft (786.6 m)

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector A. Shriver

Start September 22, 2007 Completion September 23, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-2

Station 1397+12 Offset 75 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 734779.82 Easting 1426252.43 Latitude 47°20'41.896"N

Longitude 121°21'49.937"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				57 / N/A			1		**SILTY GRAVEL [GM],** fine to coarse, angular to subangular GRAVEL, cobbles and boulders, with fine to coarse sand, with silt and clay, medium dense, moist. [Colluvium and Anthropogenic Fill]		
	1								**GRAVEL [GP - GM],** fine to coarse, subangular to subrounded GRAVEL, with fine to coarse sand, trace silt and clay, medium dense, pale yellowish brown to dark yellowish brown (10YR 6/2 - 10YR 4/2), moist. [Colluvium and Anthropogenic Fill]		
5								SPT n=26	Blow Counts/0.5' = 27, 12, 14 [n = 26, Recovery = 0.0'/1.5']		
	2			117 / 0.0			2				
10	3			100 / 0.0			3		**META-WELDED LAPILLI DACITE TUFF,** medium light gray to medium gray (N6 - N5), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, fresh (I), moderately weak to moderately strong (R2 - R3) rock, discontinuities are closely spaced and in fair to good condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
				100 / 1.2	R3		4	PLT - D			
	4								At 12.8 to 14.6 feet bgs - becomes slightly weathered (II) rock, discontinuities become closely spaced and in good to very poor condition		
15									Discontinuities become moderately to closely spaced at very widely spaced intervals and in good condition		
	5			92 / 0.0	R4 R3		5	PLT - D PLT - A		▽	
20	6										

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01978

HOLE No. RKS-20-07

Job No. 03-2007 SR 90 Elevation 2580.8 ft (786.6 m)

Sheet 2 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become moderately to closely spaced at very widely spaced intervals and in good condition		
				110 / 0.4			6				
	7										
25											
	8			95 / 0.0			7				
					R3			PLT - D			
				103 / 0.0	R3		8	PLT - D			
	9										
30											
				83 / 0.3			9				
									At 32.1 to 32.2 feet bgs - discontinuity poor condition		
	10										
35				140 / 0.0	R1		10	PLT - A			
	11			100 / 0.2	R3		11	PLT - D	At 36.2 to 37.9 feet bgs - becomes slightly weathered (II), moderately weak (R2) rock, discontinuity in fair condition		
	12										
40				96 / 1.0			12				
	13								Discontinuities become moderately to closely spaced and in poor to good condition		
45											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01978

HOLE No. RKS-20-07

Job No. 03-2007 SR 90 Elevation 2580.8 ft (786.6 m)

Sheet 3 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
					R3			PLT - D			
	14			98 / 0.4			13				
									Discontinuities become moderately to closely spaced at very widely spaced intervals and in good condition		
	15										
50											
				88 / 0.0			14		At 51.1 to 51.3 feet bgs - 0.2 feet core loss associated with driller mislatch		
	16								At 52.2 to 52.5 feet bgs - 0.3 feet core loss		
55											
	17			107 / 0.0			15				
			>>								
					R2			PLT - D			
	18			95 / 0.5			16		At 59.2 to 59.3 feet bgs - discontinuity in good condition		
60											
				102 / 0.6			17			▼	
	19								At 62.6 to 64.0 feet bgs - becomes slightly to moderately weathered (II - III), extremely weak to very weak (R0 - R1) rock, discontinuities become closely spaced and in poor condition		
			>>								
65											
	20			98 / 0.2			18				
	21										
70											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01978

HOLE No. RKS-20-07

Job No. 03-2007 SR 90 Elevation 2580.8 ft (786.6 m)

Sheet 4 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				102 / 0.0	R3		19	PLT - D	Discontinuities become moderately to closely spaced at very widely spaced intervals and in good condition		
75	22, 23										
80	24, 25								Borehole completed to 76.1 feet bgs on September 21, 2007. Borehole was overcased with HWT casing to 7.3 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 3, 2007. Groundwater was measured at approximately 16.1 feet bgs during drilling activities and at 61.3 feet on October 3, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on October 4, 2007.		
85	26										
90	27, 28										
95											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01978

HOLE No. RKS-21-07

Job No. 03-2007 SR 90 Elevation 2579.6 ft (786.3 m)

Sheet 1 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector K. Yang

Start October 11, 2007 Completion October 16, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-1

Station 1398+88 Offset 74 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 734613.39 Easting 1426246.11 Latitude 47°20'40.253"N

Longitude 121°21'50.003"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				68 / 0.8			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, with fine to coarse sand, cobbles, boulders, loose, pale brown (5YR 5/2), moist. [Colluvium and Anthropogenic Fill]		
	1								**META-WELDED LAPILLI DACITE TUFF,** light bluish gray (5B 7/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 50%), slightly welded, slightly weathered (II), moderately weak (R2) rock, discontinuities are moderately to closely spaced at very widely spaced intervals and in good condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
5				100 / 0.0	R2		2	PLT - D	At 4.5 to 4.8 feet bgs - discontinuity in poor condition At 5.3 feet bgs - becomes fresh (I), strong (R4) rock		
	2										
10	3			100 / 0.0			3				
	4				R3 R3			PLT - A PLT - D			
15				100 / 0.8			4		Becomes moderately strong to strong (R3 - R4) rock		
	5										
									At 17.7 to 18.2 feet bgs - becomes slightly to moderately weathered (II - III), very weak to moderately weak (R1 - R2) rock, discontinuities become closely spaced in very poor to good condition		
20	6										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01978

HOLE No. RKS-21-07

Job No. 03-2007 SR 90 Elevation 2579.6 ft (786.3 m)

Sheet 2 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				98 / 0.0			5		Discontinuities become moderately to closely spaced at very widely spaced intervals and in good condition		
	7										
25					R3			PLT - D			
				100 / 0.6	R3		6	PLT - A			
	8										
	9										
30									At 29.8 to 33.7 feet bgs - becomes light brown (5YR 5/6), moderately to highly weathered (III - IV), extremely weak to very weak (R0 - R1) rock, discontinuities become closely to very closely spaced and in fair to very poor condition		
				100 / 2.4			7				
	10										
35									At 34.5 to 34.7 feet bgs - discontinuity in poor to very poor condition At 34.7 feet bgs - becomes medium light gray to light gray (N6 - N7), fresh (I), moderately strong to strong (R3 - R4) rock, with light brown (5YR 5/6), slightly weathered (II), moderately strong (R3) rock enveloping discontinuities, discontinuities become very widely spaced and in fair to good condition		
				98 / 0.2	R4		8	PLT - D			
	11										
	12										
40					R2			PLT - A			
				99 / 0.0	R1		9	PLT - D			
	13										
					R4			PLT - A			
					R3			PLT - D			
45											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01978

HOLE No. RKS-21-07

Job No. 03-2007 SR 90 Elevation 2579.6 ft (786.3 m)

Sheet 3 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				102 / 0.0			10		Discontinuities become very widely spaced and in fair to good condition		
	14										
				>>							
	15										
50				90 / 0.2			11				
	16										
55				120 / 0.0			12				
	17			>>							
				100 / 0.0	R3		13	PLT - D			
	18										
60				98 / 0.0			14				
	19										
65				100 / 0.0			15				
	20										
	21				R3 R2			PLT - D PLT - D			
70											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01978

HOLE No. RKS-21-07

Job No. 03-2007 SR 90 Elevation 2579.6 ft (786.3 m)

Sheet 4 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Borehole completed to 70.0 feet bgs on October 16, 2007. Borehole was overcased with HWT casing to 3.5 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 18, 2007. Groundwater was measured at approximately 33.2 feet bgs during drilling activities and at 34.5 feet on October 18, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on October 20, 2007.		
	22										
75	23										
	24										
80											
	25										
85	26										
	27										
90											
	28										
95											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01978

HOLE No. RKS-22-07

Sheet 1 of 3

Job No. 03-2007 SR 90 Elevation 2583.7 ft (787.5 m)

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector K. Yang

Start October 17, 2007 Completion October 17, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-1

Station 1400+04 Offset 79 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 734504.45 Easting 1426258.64 Latitude 47°20'39.180"N

Longitude 121°21'49.803"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				82 / 1.8			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, with fine to coarse sand, cobbles, boulders, loose, pale brown (5YR 5/2), moist. [Colluvium and Anthropogenic Fill]		
	1								**META-WELDED LAPILLI DACITE TUFF,** moderate reddish brown (10R 4/6), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, moderately weathered (III), very weak (R1) rock, discontinuities are closely spaced and in good to very poor condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
5									At 4.7 to 5.5 feet bgs - becomes highly weathered (IV), extremely weak (R0) rock		
	2			98 / 1.3	R2		2	PLT - D			
									At 8.1 to 8.4 feet bgs - becomes highly weathered (IV), extremely weak (R0) rock		
	3				R1			PLT - D	Becomes light gray to medium light gray (N7 - N6), fresh (I), moderately weak to moderately strong (R2 - R3) rock, discontinuities become moderately to closely spaced and in good to fair condition		
10				56 / 2.9			3		At 10.1 to 10.3 feet bgs - discontinuity in poor to very poor condition		
	4			133 / 0.8			4				
			>>								
15					R2			PLT - D			
	5			96 / 1.7	R1		5	PLT - D	At 15.5 to 20.5 feet bgs - becomes moderate reddish brown (10R 4/6), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock, discontinuities become closely spaced and in fair to poor condition		
20	6										

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01978

HOLE No. RKS-22-07

Job No. 03-2007 SR 90 Elevation 2583.7 ft (787.5 m)

Sheet 2 of 3

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				104 / 1.3			6		Becomes light gray to medium light gray (N7 - N6), fresh (I), moderately strong to strong (R3 - R4) rock, discontinuities become moderately spaced and in fair to good condition At 21.3 to 22.5 feet bgs - becomes moderate reddish brown (10R 4/6), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock, discontinuities become closely spaced and in poor to good condition		
25	7			106 / 0.6	R4		7	PLT - D	At 25.0 feet bgs - becomes strong (R4) rock At 25.3 to 25.5 feet bgs - becomes slightly weathered (II), moderately strong to strong (R3 - R4) rock		
	8		>>								
30	9								At 28.9 to 29.0 feet bgs - becomes slightly weathered (II), moderately strong to strong (R3 - R4) rock		
				98 / 0.4			8		Becomes strong to very strong (R4 - R5) rock		
	10				R5			PLT - A			
35				100 / 1.1	R4		9	PLT - D			
	11										
									At 37.5 to 38.1 feet bgs - becomes slightly weathered (II), moderately strong to strong (R3 - R4) rock, discontinuities become closely spaced and in fair to poor condition		
	12										
40				99 / 0.4			10		Discontinuities become moderately to closely spaced and in good condition		
	13										
45											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01978

HOLE No. RKS-22-07

Job No. 03-2007 SR 90 Elevation 2583.7 ft (787.5 m)

Sheet 3 of 3

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
					R5			PLT - D	Discontinuities become moderately to closely spaced and in good condition		
	14			100 / 1.4	R4		11	PLT - A	At 45.7 to 47.6 feet bgs - becomes slightly weathered (II), moderately strong to strong (R3 - R4) rock		
									At 47.2 to 47.6 feet bgs - discontinuity in poor to very poor condition		
	15										
50											
				100 / 0.4			12		At 50.2 to 50.8 feet bgs - discontinuity in poor to very poor condition		
									At 52.0 to 53.2 feet bgs - discontinuity in poor to very poor condition		
	16										
55											
	17			100 / 0.4			13		At 55.5 to 56.9 feet bgs - becomes slightly weathered (II), moderately strong to strong (R3 - R4) rock		
					R4			PLT - D			
					R4			PLT - D			
	18										
60											
									Borehole completed to 60.5 feet bgs on October 17, 2007. Borehole was overcased with HWT casing to 3.5 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 18, 2007. Groundwater was measured at 26.4 feet on October 18, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on October 20, 2007.		
	19										
65											
	20										
	21										
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02073

HOLE No. RKS-23-07

Sheet 1 of 4

Job No. 03-2007 SR 90 Elevation 2584.0 ft (787.6 m)

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector K. Yang

Start October 18, 2007 Completion October 19, 2007 Well ID# RKS-23-07

Equipment Skid-Mounted Burley 5500-1

Station 1400+98 Offset 74 Feet Left Casing Stick-up Monument

Method HQ3 Triple Tube Wireline

Northing 734415.55 Easting 1426266.28 Latitude 47°20'38.303"N

Longitude 121°21'49.678"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				92 / 0.9			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, with fine to coarse sand, cobbles, boulders, loose to dense, pale brown (5YR 5/2), moist. [Colluvium and Anthropogenic Fill]		
	1			98 / 0.2	R4		2	PLT - A	**META-WELDED LAPILLI DACITE TUFF,** greenish gray to medium bluish gray (5G 6/1 - 5B 5/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, fresh (I), strong (R4) rock, discontinuities are closely spaced and in poor condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
5									Becomes medium bluish gray (5B 5/1) rock, discontinuities become widely spaced and in very poor to good condition, discontinuities in very poor condition occur at a 45 to 50% frequency		
	2				R5			PLT - D			
				95 / 0.4			3				
10	3										
	4			86 / 1.6			4		Becomes strong to very strong (R4 - R5) rock, discontinuities becomes moderately to closely spaced and in fair to good condition At 13.9 to 14.1 feet bgs - 0.2 feet core loss at discontinuity in very poor condition		
15											
	5								At 16.6 to 16.8 feet bgs - 0.4 feet core loss at discontinuity in very poor condition		
				92 / 1.1	R5		5	PLT - D			
20	6										

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02073

HOLE No. RKS-23-07

Job No. 03-2007 SR 90 Elevation 2584.0 ft (787.6 m)

Sheet 2 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									At 20.1 to 21.1 feet bgs - becomes slightly weathered (II), strong (R4) rock, 0.1 to 0.2 feet core loss at discontinuity in very poor condition		
	7								Becomes light brown (5YR 6/4), slightly weathered (II), moderately strong to strong (R3 - R4) rock, discontinuities become closely to very closely spaced and in poor to good condition, discontinuities in poor condition occur at less than 10% frequency, discontinuities in fair condition occur at a 10 to 30% frequency		
				98 / 3.3			6				
25					R4			PLT - D	At 23.4 to 23.5 feet bgs - 0.1 feet core loss		
	8				R4			PLT - A	At 24.2 to 24.8 feet bgs - discontinuity in very poor condition		
									At 27.0 to 27.7 feet bgs - discontinuities in poor to very poor condition		
									At 27.7 to 28.1 feet bgs - becomes moderately weathered (III), very weak (R1) rock, discontinuity in very poor condition		
				90 / 1.3			7				
	9								Becomes medium bluish gray (5B 5/1), fresh to slightly weathered (I - II), strong (R4) rock, discontinuities become closely to very closely spaced and in fair to good condition, discontinuities in poor condition occur at less than 10% frequency, discontinuities in fair condition occur at a 5 to 20% frequency		
30									At 28.6 to 29.1 feet bgs - 0.5 feet core loss, core break at top of run does not match core break of previous run		
	10										
				98 / 2.7			8		At 33.6 to 33.7 feet bgs - 0.1 feet core loss, core break at top of run does not match core break of previous run		
35									At 34.1 to 34.4 feet bgs - discontinuity in very poor condition		
	11									▽	
									At 37.5 to 37.6 feet bgs - discontinuity in very poor condition	▼	
				99 / 1.8	R4		9	PLT - D	At 38.6 to 38.7 feet bgs - 0.1 feet core loss, core break at top of run does not match core break of previous run		
	12										
40											
	13								Becomes pale blue (5B 6/2), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become widely spaced and in good condition		
				102 / 0.4			10				
45											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02073

HOLE No. RKS-23-07

Job No. 03-2007 SR 90 Elevation 2584.0 ft (787.6 m)

Sheet 3 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become widely spaced and in good condition		
	14			>>							
					R3			PLT - D			
				96 / 0.2			11				
	15										
50											
					R5			PLT - A			
	16										
				116 / 0.3			12				
55				>>							
	17										
				104 / 3.1			13		Becomes light bluish gray to light brown (5B 7/1 - 5YR 5/6), slightly weathered (II), moderately strong to strong (R3 - R4) rock, discontinuities become closely to very closely spaced and in good to very poor condition, discontinuities in poor and very poor condition occur at a 20 to 40% frequency, discontinuities in good condition occur at a 5 to 20% frequency		
	18			101 / 2.8	R4		14	PLT - D			
60											
	19										
				79 / 1.3	R3		15	PLT - D			
65											
	20				R4			PLT - D	Borehole completed to 65.4 feet bgs on October 19, 2007. Borehole was overcased with HWT casing to 1.8 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 19, 2007. Borehole completed with one vibrating wire piezometer at 63.0 feet bgs on October 20, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 37.1 feet bgs during drilling activities and at 37.7 feet on October 19, 2007 prior to beginning optical borehole survey.		
	21										
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02073

HOLE No. RKS-23-07

Job No. 03-2007 SR 90 Elevation 2584.0 ft (787.6 m)

Sheet 4 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									VWP #92089 = 61.5 to 63.0 feet bgs #10-20 silica sand filter pack from 55.0 to 65.4 feet bgs Grout mix from 0.0 to 55.0 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 25 lbs pure bentonite powder Well Tag # = APC 413		
	22										
75	23										
	24										
80											
	25										
85	26										
	27										
90											
	28										
95											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-24-07

Sheet 1 of 3

Job No. 03-2007 SR 90 Elevation 2580.9 ft (786.7 m)

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector A. Shriver

Start November 1, 2007 Completion November 2, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-2

Station 1401+96 Offset 74 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 734324.19 Easting 1426285.1 Latitude 47°20'37.403"N

Longitude 121°21'49.390"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				50 / 0.0			1		**GRAVEL [GM],** fine to coarse, angular to subangular GRAVEL, cobbles and boulders, with fine to coarse sand, trace silt and organics, medium dense, moist. [Colluvium and Anthropogenic Fill]		
5	1										
	2			90 / 1.1			2		**META-WELDED LAPILLI DACITE TUFF,** dark greenish gray (5G 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, fresh (I), very strong (R5) rock, discontinuities are closely spaced and in good to poor condition, discontinuities in poor condition occur at a 10 to 25% frequency, discontinuities in good condition occur at a 30 to 50% frequency. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
10	3			102 / 2.0	R4		3	PLT - D	At 10.9 to 11.4 feet bgs - discontinuity in very poor condition		
	4								At 12.4 to 13.6 feet bgs - becomes fresh to slightly weathered (I - II), moderately weak to moderately strong (R2 - R3) rock		
15	5			89 / 0.4	R5		4	PLT - D	Discontinuities become moderately to closely spaced at widely spaced intervals and in fair to good condition		
20	6										

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-24-07

Job No. 03-2007 SR 90 Elevation 2580.9 ft (786.7 m)

Sheet 2 of 3

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become moderately to closely spaced at widely spaced intervals and in fair to good condition		
				116 / 0.7			5				
	7										
				107 / 0.6			6				
25									Becomes rock with fine to medium grained phenocrysts and lapilli-sized entrained clasts up to 65%		
	8			100 / 0.6			7				
	9				R5			PLT - D			
30					R5			PLT - A			
				100 / 0.4			8				
	10										
35											
	11			88 / 1.1			9		At 36.0 to 37.0 feet bgs - discontinuity in very poor condition Discontinuities become widely spaced and in fair to good condition		
	12										
40											
				116 / 0.0	R4 R5		10	PLT - D PLT - A			
	13				R5			PLT - D			
				112 / 0.3			11				
45											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-24-07

Job No. 03-2007 SR 90 Elevation 2580.9 ft (786.7 m)

Sheet 3 of 3

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become widely spaced and in fair to good condition		
	14			98 / 0.0			12				
	15										
50					R5 R5			PLT - A PLT - D			
				98 / 0.2			13				
	16										
55											
	17			105 / 0.0			14				
				>>							
	18				R4			PLT - A			
60					R5 R5			PLT - A PLT - D			
				98 / 0.2			15				
	19										
65											
	20								Borehole completed to 65.1 feet bgs on November 2, 2007. Borehole was overcased with HWT casing to 5.2 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on November 3, 2007. Groundwater was measured at 23.7 feet on November 3, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on November 7, 2007.		
	21										
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-25-07

Sheet 1 of 3

Job No. 03-2007 SR 90 Elevation 2589.2 ft (789.2 m)

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector K. Yang

Start November 7, 2007 Completion November 8, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-1

Station 1402+98 Offset 89 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 734236.02 Easting 1426326.82 Latitude 47°20'36.538"N

Longitude 121°21'48.770"W

County Kittitas Subsection NE Quarter Section 02 Range 11E Township 21N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				29 / N/A			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, with fine to coarse sand, cobbles, boulders, loose to dense, dark yellowish brown to grayish green (10YR 4/2 - 10G 4/2), moist. [Colluvium and Anthropogenic Fill]		
				95 / N/A			2				
	1										
5				175 / N/A			3				
				N/A			4				
				N/A			5				
	2										
				71 / N/A			6				
10	3			70 / 0.6			7				
	4										
15				98 / 1.2	R4		8	PLT - D	**META-WELDED LAPILLI DACITE TUFF,** grayish green (10GY 5/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, fresh to slightly weathered (I - II), moderately weak to moderately strong (R2 - R3) rock, discontinuities are moderately to closely spaced and in good to very poor condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
	5				R1			PLT - D	At 17.3 to 17.4 feet bgs - 0.1 feet core loss at location of discontinuity in poor to very poor condition Becomes fresh (I), strong (R4) rock.		
	6								At 19.4 to 20.1 feet bgs - becomes fresh to slightly		
20											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-25-07

Job No. 03-2007 SR 90 Elevation 2589.2 ft (789.2 m)

Sheet 2 of 3

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				98 / 0.8			9		weathered (I -II), moderately strong to strong (R3 - R4) rock At 20.1 to 20.3 feet bgs - 0.2 feet core loss at location of discontinuity in very poor condition		
	7								Discontinuities are moderately to closely spaced and in good to very poor condition, discontinuities in poor to very poor condition occur at a 30 to 35% frequency, discontinuities in fair condition occur at 30 to 35% frequency		
25				103 / 0.6			10				
	8		>>								
					R4			PLT - D			
	9										
30				99 / 1.4	R4		11	PLT - A	At 29.9 to 30.8 feet bgs - becomes dusky yellow green (5GY 5/1), slightly weathered (II), moderately strong to strong (R3 - R4) rock		
	10								At 33.3 to 33.6 feet bgs - becomes dusky yellow green (5GY 5/1), slightly weathered (II), moderately strong to strong (R3 - R4) rock at location of discontinuity in very poor condition		
35				96 / 0.4			12		Discontinuities become moderately to closely spaced and in fair to good condition		
	11										
				102 / 0.0			13				
			>>		R3 R4			PLT - D PLT - A			
	12										
40				98 / 0.8			14				
	13								Becomes pale green to grayish green (10G 6/2 - 10GY 5/2), fresh (I), strong (R4) rock, with dusky yellow green (5GY 5/2), fresh to slightly weathered (I - II), moderately strong to strong (R3 - R4) rock enveloping discontinuities, discontinuities become closely spaced at widely spaced intervals and in fair		
45											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-25-07

Job No. 03-2007 SR 90 Elevation 2589.2 ft (789.2 m)

Sheet 3 of 3

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				100 / >0.6			15		to good condition		
	14				R4			PLT - D			
									Discontinuities become closely spaced at widely spaced intervals and in fair to good condition		
									At 48.3 to 50.0 feet bgs - discontinuity in very poor condition		
	15										
50				100 / 0.8			16				
									At 51.8 to 52.3 feet bgs - becomes slightly weathered to moderately weathered (II - III), moderately weak to moderately strong (R2 - R3) rock, discontinuity in very poor condition		
	16								At 52.4 to 52.8 feet bgs - becomes moderately weathered to highly weathered (III - IV), extremely weak (R0) rock		
									At 52.8 feet bgs - becomes grayish green (10GY 5/2), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become very widely spaced and in fair to good condition		
55				100 / 0.0			17				
	17										
	18				R4			PLT - D			
60				100 / 0.0	R4		18	PLT - A			
	19				R5			PLT - D			
65									Borehole completed to 64.9 feet bgs on November 8, 2007. Borehole was overcased with HWT casing to 6.1 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on November 8, 2007. Groundwater was measured at approximately 21.9 feet bgs during drilling activities and at 28.7 feet on November 8, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on November 9, 2007.		
	20										
	21										
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-26-07

Sheet 1 of 3

Job No. 03-2007 SR 90 Elevation 2574.1 ft (784.6 m)

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector K. Yang

Start November 3, 2007 Completion November 5, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-1

Station 1404+96 Offset 81 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 734060.35 Easting 1426388.1 Latitude 47°20'34.811"N

Longitude 121°21'47.853"W

County Kittitas Subsection NE Quarter Section 02 Range 11E Township 21N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
								SPT n=50/0.4'	**GRAVEL [GM],** silty GRAVEL, with fine to coarse sand, cobbles, boulders, loose to dense, moderate yellow brown (10YR 5/4), moist. [Colluvium and Anthropogenic Fill] Blow Counts/0.5' = 50/0.4' [n = 50/0.4', Recovery = 0.1'/0.4']		
	1			75 / N/A			1				
				22 / N/A			2		**GRAVEL [GP],** angular GRAVEL, with cobbles, boulders, dense, light brown (5YR 5/6), moist. [Colluvium and Anthropogenic Fill]		
5											
	2										
								SPT n=28	**SILTY SAND [SM],** silty SAND, with gravel, cobbles, boulders, loose to dense, dusky yellow brown (5Y 6/4), moist. [Colluvium and Anthropogenic Fill] Blow Counts/0.5' = 9, 15, 13 [n = 28, Recovery = 0.8'/1.5']		
10	3			0 / N/A			3				
									GRAVEL [GP], angular GRAVEL, with sand and cobbles, boulders, very dense, light brown (5YR 5/6), moist. [Colluvium]		
	4							SPT n=50/0.3'	Blow Counts/0.5' = 21, 50/0.4' [n = 50/0.4', Recovery = 0.7'/0.8']		
15				119 / N/A			4				
	5										
				100 / 2.0	R4		5	PLT - D	**META-WELDED LAPILLI DACITE TUFF,** medium bluish gray (5B 5/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, fresh (I), strong (R4) rock, discontinuities are closely spaced and in good to poor condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
	6			100 / 3.9			6				
20											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-26-07

Job No. 03-2007 SR 90 Elevation 2574.1 ft (784.6 m)

Sheet 2 of 3

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									At 20.0 to 23.7 feet bgs - becomes fresh to slightly weathered (I - II), moderately strong (R3) rock, discontinuities become very closely spaced and in good to very poor condition		
									At 22.0 to 23.2 feet bgs - Becomes moderately weak (R2) rock		
	7			100 / 4.0			7				
25									Discontinuities become closely to very closely spaced and in good to fair condition		
	8			100 / 1.5			8				
					R3			PLT - D			
				96 / 1.7			9				
	9								At 29.2 to 30.4 feet bgs - becomes light olive gray (5Y 6/1), slightly weathered (II), moderately strong (R3) rock, discontinuities become closely spaced and in poor to very poor condition		
30											
					R4			PLT - D			
	10										
					R5			PLT - A			
				104 / 0.4			10		Becomes strong to very strong (R4 - R5) rock, discontinuities become moderately to closely spaced and in fair to good condition		
35											
	11										
				96 / 2.9			11				
				118 / 0.0			12				
	12										
40									Becomes dark greenish gray (5G 4/1) rock		
				91 / 1.7			13				
					R4 R5			PLT - D PLT - A	At 41.6 to 42.2 feet bgs - discontinuity in poor condition		
	13										
				106 / 0.5			14				
45											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-26-07

Job No. 03-2007 SR 90 Elevation 2574.1 ft (784.6 m)

Sheet 3 of 3

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	14			>>					Discontinuities become moderately to closely spaced and in fair to good condition		
				103 / 1.3			15				
									Discontinuities become moderately to closely spaced and in good condition		
	15			95 / 1.9			16		At 49.0 to 49.3 feet bgs - discontinuity in poor condition		
50											
	16			123 / 0.7 >>			17				
				98 / 0.3	R5 R5		18	PLT - D PLT - A			
55											
	17										
				105 / 1.0 >>			19				
	18			89 / 0.0			20				
60									Borehole completed to 59.7 feet bgs on November 5, 2007. Borehole was overcased with HWT casing to 17.5 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on November 7, 2007. Groundwater was measured at approximately 42.5 feet bgs during drilling activities and at 42.4 feet on November 7, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on November 8, 2007.		
	19										
65											
	20										
	21										
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02073

HOLE No. RKS-27-07

Sheet 1 of 4

Job No. 03-2007 SR 90 Elevation 2585.6 ft (788.1 m)

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector K. Yang

Start October 31, 2007 Completion November 2, 2007 Well ID# RKS-27-07

Equipment Skid-Mounted Burley 5500-1

Station 1405+98 Offset 74 Feet Left Casing Stick-up Monument

Method HQ3 Triple Tube Wireline

Northing 733972.29 Easting 1426427.57 Latitude 47°20'33.946"N

Longitude 121°21'47.266"W

County Kittitas Subsection NE Quarter Section 02 Range 11E Township 21N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				87 / N/A			1		**SILTY GRAVEL [GM],** silty, angular to subangular GRAVEL, with sand, cobbles, and boulders, trace organics, loose to dense, dark yellowish brown to medium light gray (10YR 4/2 - N6), moist. [Colluvium and Anthropogenic Fill]		
	1			78 / N/A			2		**GRAVEL [GP],** angular to subrounded GRAVEL, with cobbles, boulders, and sand, medium dense to very dense, light brownish gray to medium bluish gray (5YR 6/1 - 5B 5/1), moist. [Colluvium and Anthropogenic Fill]		
5											
	2										
				74 / N/A			3				
10	3										
				83 / N/A			4				
	4										
				40 / N/A			5				
15											
	5								**GRAVEL [GP - GM],** angular to subrounded GRAVEL, with sand, cobbles, boulders, and silt, medium dense to very dense, light brown (5YR 5/6), moist. [Colluvium and Anthropogenic Fill]		
				97 / 0.9			6				
	6								**META-WELDED LAPILLI DACITE TUFF,** light		
20											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02073

HOLE No. RKS-27-07

Job No. 03-2007 SR 90 Elevation 2585.6 ft (788.1 m)

Sheet 2 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									brown to medium light gray (5YR 5/6 - N6), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 50%), slightly welded, slightly weathered (II), moderately strong (R3) rock, discontinuities are closely spaced and in good to fair condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
				106 / 0.6	R3		7	PLT - D			
	7								At 22.5 to 23.0 feet bgs - discontinuity in very poor condition		
				98 / 1.8			8		Becomes light gray (N7), fresh (I), strong (R4) rock, discontinuities become closely spaced and in good to poor condition		
25											
	8				R3			PLT - D	At 25.5 to 28.2 feet bgs - becomes light brown (5YR 5/6), slightly weathered (II), moderately weak (R2) rock		
				100 / 0.6	R4		9	PLT - D	Becomes grayish green to light gray (10G 4/2 - N7), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become moderately to closely spaced at widely spaced intervals and in good condition		
	9										
30									At 30.1 to 30.8 feet bgs - becomes light brown (5YR 5/6), slightly weathered (II), strong (R4) rock, discontinuity in very poor condition		
									At 31.4 to 31.7 feet bgs - becomes light brown (5YR 5/6), slightly weathered (II), strong (R4) rock		
	10								At 31.9 to 32.2 feet bgs - discontinuity in very poor condition		
				100 / 0.4	R4		10	PLT - D			
35											
	11										
					R5			PLT - A			
				102 / 0.0			11				
	12										
40											
	13										
					R4			PLT - D			
				100 / 1.0			12		Becomes grayish green to grayish olive green (10G 4/2 - 5GY 3/2), fresh (I), strong (R4) rock, discontinuities become moderately to closely spaced and in poor to good condition, discontinuities in poor		
45											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02073

HOLE No. RKS-27-07

Job No. 03-2007 SR 90 Elevation 2585.6 ft (788.1 m)

Sheet 3 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									condition occur at a 5 to 15% frequency		
	14										
				98 / 1.6			13				
	15										
50											
	16				R5			PLT - D			
				94 / 1.1			14				
					R5			PLT - A	Becomes grayish green (10G 4/2), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become moderately to closely spaced and in good condition		
55	17										
	18		>>	120 / 1.7			15				
60				108 / 1.4	R5		16	PLT - A			
			>>						Discontinuities become closely to very closely spaced and in good condition		
	19				R3 R5			PLT - D PLT - D			
				98 / 2.4			17				
65	20										
	21			96 / 1.7			18				
70											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02073

HOLE No. RKS-27-07

Job No. 03-2007 SR 90 Elevation 2585.6 ft (788.1 m)

Sheet 4 of 4

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	22				R5			PLT - A	Discontinuities become closely to very closely spaced and in good condition		
					R5			PLT - D	At 73.2 to 73.4 feet bgs - discontinuity in poor condition		
				113 / 1.3			19				
75	23								Borehole completed to 75.1 feet bgs on November 2, 2007. Borehole was overcased with HWT casing to 8.0 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on November 3, 2007. Borehole completed with one vibrating wire piezometer at 73.1 feet bgs on November 7, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 32.3 feet bgs during drilling activities and at 21.2 feet on November 3, 2007 prior to beginning optical borehole survey.		
	24										
80									VWP #92946 = 71.6 to 73.1 feet bgs #10-20 silica sand filter pack from 60.0 to 75.1 feet bgs Grout mix from 0.0 to 60.0 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 25 lbs pure bentonite powder Well Tag # = APC 408		
	25										
85	26										
	27										
90	28										
95											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-28-07

Sheet 1 of 5

Job No. 03-2007 SR 90 Elevation 2631.0 ft (801.9 m)

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector M. Hommeyer

Start October 23, 2007 Completion October 25, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-1

Station 1407+12 Offset 114 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 733904.14 Easting 1426518.35 Latitude 47°20'33.283"N

Longitude 121°21'45.937"W

County Kittitas Subsection NE Quarter Section 02 Range 11E Township 21N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				60 / >13.3			1		**SILTY GRAVEL [GM],** silty, angular to subangular GRAVEL, with sand, cobbles, and boulders, trace organics, loose to dense, dark yellowish brown to medium light gray (10YR 4/2 - N6), moist. [Colluvium and Anthropogenic Fill]		
5	1			100 / >5.6			2		**META-WELDED LAPILLI DACITE TUFF,** light brown to moderate yellow brown (5YR 4/6 - 10YR 5/4), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, highly weathered (IV), extremely weak (R0) rock. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
	2			102 / >3.6			3		Becomes dusky yellow green to dark greenish gray (5GY 5/2 - 5GY 4/1), moderately weathered (III), very weak (R1) rock, discontinuities become very closely spaced and in fair to poor condition		
10	3			100 / 0.8			4		At 9.0 to 9.9 feet bgs - becomes olive gray to dark greenish gray (5Y 4/1 - 5GY 4/1), moderately to highly weathered (III - IV), extremely weak to very weak (R0 - R1) rock At 9.9 to 11.3 feet bgs - becomes pale yellowish green to grayish green (10GY 7/2 - 10GY 5/2), slightly weathered (II), moderately weak (R2) rock Becomes olive gray (5Y 4/1), slightly weathered (II), very weak (R1) rock, discontinuities become closely spaced and in poor to fair condition		
	4								Becomes slightly to moderately weathered (II - III) rock		
15	5			100 / >1.6			5		Becomes moderately weathered (III) rock		
20	6										

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-28-07

Job No. 03-2007 SR 90 Elevation 2631.0 ft (801.9 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				100 / 1.0	R3		6	PLT - D	Becomes light bluish gray to medium light gray (5B 7/1 - N6), fresh (I), moderately weak to moderately strong (R2 - R3) rock, with moderate yellow brown (10YR 5/4), slightly to moderately weathered (II - III) rock enveloping discontinuities, discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 30 to 45% frequency		
25	7				R4			PLT - A			
	8			102 / 0.4			7		Becomes yellowish gray to moderate brown (5Y 7/2 - 5YR 4/4), moderately weathered (III), very weak to moderately weak (R1 - R2) rock, discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 40 to 50% frequency		
	9				R2			PLT - A			
30					R2			PLT - D			
				102 / 1.2			8				
	10									▽	
35									Becomes light bluish gray to medium light gray (5B 7/1 - N6), fresh (I), moderately weak to moderately strong (R2 - R3) rock, with moderate yellow brown (10YR 5/4), slightly to moderately weathered (II - III) rock enveloping discontinuities, discontinuities become moderately to closely spaced and in good condition At 35.6 to 36.6 feet bgs - becomes very weak to moderately weak (R1 - R2) rock At 38.0 to 39.6 feet bgs - becomes very weak to moderately weak (R1 - R2) rock		
	11			98 / 0.4			9				
	12										
40					R4			PLT - D	Becomes light bluish gray to medium light gray (5B 7/1 - N6), fresh (I), moderately strong (R3) rock, with moderate brown (5YR 4/4), slightly to moderately weathered (II - III), moderately weak (R2) rock enveloping discontinuities, discontinuities become moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 5 to 15% frequency		
				100 / 2.0			10				
	13										
45											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-28-07

Job No. 03-2007 SR 90 Elevation 2631.0 ft (801.9 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
					R2			PLT - D	Discontinuities become moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 5 to 15% frequency		
	14										
				98 / >2.4			11		At 46.6 to 47.4 feet bgs - becomes yellowish gray to light olive gray (5Y 7/2 - 5Y 5/2), moderately to highly weathered (III - IV) extremely weak (R0) rock, discontinuity in very poor condition At 47.4 feet bgs - becomes moderately weathered (III), extremely weak to very weak (R0 - R1) rock, discontinuities become closely to very closely spaced and in good to poor condition At 49.9 feet bgs - becomes slightly weathered (II) very weak to moderately weak (R1 - R2) rock At 50.4 to 51.4 feet bgs - becomes light greenish gray to medium bluish gray (5G 8/1 - 5B 5/1), fresh (I), moderately strong (R3) rock		
	15										
50											
				100 / 2.6			12		At 51.6 to 52.0 feet bgs - becomes slightly to moderately weathered (II - III), extremely weak (R0) rock At 52.0 feet bgs - becomes yellowish gray to light olive gray (5Y 7/2 - 5Y 5/2), very weak to moderately weak (R1 - R2) rock		
	16										
55					R4			PLT - D	Becomes light gray to medium gray (N7 - N5), fresh (I), moderately strong to strong (R3 - R4) rock, discontinuities become widely spaced and in good condition		
	17										
				92 / 0.0			13				
	18										
60											
				88 / 0.5			14				
	19										
				132 / 0.0	R4		15	PLT - A			
65			>>		R3			PLT - D			
	20										
				102 / 0.2			16		Becomes strong (R4) rock		
	21		>>								
70											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-28-07

Job No. 03-2007 SR 90 Elevation 2631.0 ft (801.9 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
					R4			PLT - D	Discontinuities become widely spaced and in fair to good condition		
	22			100 / 0.0			17				
75	23										
				100 / 0.0	R4		18	PLT - D			
	24				R4			PLT - A			
80									Discontinuities become widely to very widely spaced and in fair to good condition		
	25			97 / 0.3			19				
85	26			107 / 0.0			20		Becomes greenish gray to dark greenish gray (5G 6/1 - 5G 4/1) rock		
				100 / 0.0			21				
	27				R4			PLT - D			
90					R4			PLT - A			
	28			100 / 0.0			22				
95											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-28-07

Job No. 03-2007 SR 90 Elevation 2631.0 ft (801.9 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29								Discontinuities become widely to very widely spaced and in fair to good condition		
				98 / 0.0			23		Becomes strong to very strong (R4 - R5) rock		
	30				R5 R5			PLT - D PLT - A			
100									Discontinuities become widely to very widely spaced and in fair to good condition, healed discontinuities occur as very closely spaced at widely spaced intervals.		
	31			100 / 0.0			24				
105	32										
				100 / 0.6	R4		25	PLT - D			
	33										
110									Borehole completed to 110.0 feet bgs on October 25, 2007. Borehole was overcased with HWT casing to 1.6 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 31, 2007. Groundwater was measured at approximately 33.1 feet bgs during drilling activities and at 70.5 feet on October 25, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on November 2, 2007.		
	34										
115	35										
	36										
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-29-07

Job No. 03-2007 SR 90 Elevation 2638.4 ft (804.2 m)

Sheet 1 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector K. Yang

Start October 20, 2007 Completion October 22, 2007 Well ID# Not Applicable Equipment Skid-Mounted Burley 5500-1

Station 1407+91 Offset 104 Feet Left Casing Not Applicable Method HQ3 Triple Tube Wireline

Northing 733838.83 Easting 1426552.72 Latitude 47°20'32.642"N Longitude 121°21'45.428"W

County Kittitas Subsection NE Quarter Section 02 Range 11E Township 21N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				94 / 2.3			1		**GRAVEL [GP],** angular GRAVEL, with sand and cobbles, boulders, trace organics, loose, pale brown (5YR 5/2), moist. [Colluvium and Anthropogenic Fill]		
	1								**META-WELDED LAPILLI DACITE TUFF,** grayish olive (10Y 4/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 50%), slightly welded, slightly weathered (II), moderately strong (R3) rock, discontinuities are closely spaced and in poor condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
5				94 / 1.1	R2		2	PLT - D			
	2								Becomes fresh to slightly weathered (I - II) rock		
10	3			112 / 1.4	R3		3	PLT - D	Becomes grayish olive to light olive gray (10Y 4/2 - 5Y 5/2), fresh (I), moderately strong to strong (R3 - R4) rock, discontinuities become closely spaced and in poor to good condition, discontinuities in poor condition occur at a 5 to 10% frequency		
	4			92 / 1.7			4				
15				102 / 1.8			5				
	5								Flow boundary contact, no infilling, becomes grayish olive to grayish green (10Y 4/2 - 10GY 5/2) strong (R4) rock		
20	6										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-29-07

Job No. 03-2007 SR 90 Elevation 2638.4 ft (804.2 m)

Sheet 2 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				102 / 1.2			6		Discontinuities become closely spaced and in poor to good condition, discontinuities in poor condition occur at a 5 to 10% frequency Becomes dusky yellow green to grayish green (5GY 5/2 - 10GY 5/2) rock		
	7										
25				102 / 0.6			7				
	8				R4			PLT - D			
									Becomes dusky yellow green (5GY 5/2), fresh to slightly weathered (I - II), moderately strong to strong (R3 - R4) rock		
	9										
30				100 / 0.8			8		Becomes dusky yellow green to grayish green (5GY 5/2 - 10GY 5/2), fresh (I), moderately strong to strong (R3 - R4) rock, discontinuities become very widely spaced and in good condition At 31.6 to 32.2 feet bgs - discontinuities in very poor condition		
	10										
35				84 / 0.0	R3		9	PLT - D	Becomes pale green to greenish gray (10G 6/2 - 5G 6/1), strong to very strong (R4 - R5) rock		
	11										
	12										
40				100 / 0.0			10		Discontinuities become very widely spaced and in good condition	▽	
	13			108 / 0.0			11				
45				>>							

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-29-07

Job No. 03-2007 SR 90 Elevation 2638.4 ft (804.2 m)

Sheet 3 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	14			92 / 0.0	R4		12	PLT - D	Becomes grayish blue green (5BG 5/2) rock, discontinuities become very widely spaced and in good condition		
				124 / 0.0			13				
	15		>>								
50				98 / 0.6			14				
	16								Becomes dusky yellow green to light olive gray (5Y 5/2 - 5GY 5/2), strong (R4) rock, discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 38 to 43% frequency		
					R4			PLT - D			
55				100 / 0.4			15				
	17									▼	
	18										
60					R5			PLT - A			
				100 / 0.8			16				
	19										
									At 63.5 to 64.0 feet bgs - becomes slightly weathered (II), moderately strong to strong (R3 - R4) rock		
65									At 64.5 to 65.1 feet bgs - becomes slightly weathered (II), moderately strong to strong (R3 - R4) rock		
	20			98 / 0.6			17				
					R5			PLT - D	Becomes dusky yellow green to grayish green (5GY 5/2 - 10GY 5/2), strong to very strong (R4 - R5) rock, discontinuities are closely spaced at moderately spaced intervals and in fair to good condition		
	21								At 68.4 to 69.2 feet bgs - discontinuity in very poor condition		
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-29-07

Job No. 03-2007 SR 90 Elevation 2638.4 ft (804.2 m)

Sheet 4 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				100 / 1.0	R4		18	PLT - D	At 70.1 to 72.0 feet bgs - becomes pale blue to light olive gray (5B 6/1 - 5Y 5/2), fresh to slightly weathered (I - II), moderately strong to strong (R3 - R4) rock		
	22								Becomes pale blue (5B 6/2) rock, discontinuities are closely spaced at moderately spaced intervals and in fair to good condition		
					R5			PLT - A			
75									At 74.2 to 75.1 feet bgs - becomes fresh to slightly weathered (I - II), moderately strong to strong (R3 - R4) rock		
	23			100 / 0.8			19				
	24										
80				100 / 0.4			20		Becomes pale blue (5B 6/2), fresh (I), strong to very strong (R4 - R5) rock, with light olive brown (5Y 5/6), slightly weathered (II), moderately strong to strong (R3 - R4) rock enveloping discontinuities, discontinuities are closely spaced at moderately spaced intervals and in fair to good condition		
	25										
					R5 R5			PLT - D PLT - A			
85	26			98 / 0.8			21				
	27										
90				98 / 3.9			22		At 90.0 to 90.2 feet bgs - 0.2 feet core loss, core break at top of run does not match core break of previous run Becomes light brown to moderate brown (5YR 5/6 - 5YR 4/4), slightly to moderately weathered (II - III), moderately weak to moderately strong (R2 - R3) rock, discontinuities become very closely spaced and in very poor to very poor condition		
	28										
95											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-29-07

Job No. 03-2007 SR 90 Elevation 2638.4 ft (804.2 m)

Sheet 5 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29			98 / 5.5	R3		23	PLT - D	Becomes slightly weathered (II), moderately strong (R3) rock, discontinuities become very closely spaced and in good to fair condition		
	30				R5			PLT - D	At 97.9 to 98.9 feet bgs - becomes fresh to slightly weathered (I- II), moderately strong to strong (R3 - R4) rock		
100				102 / 2.5			24		Becomes light bluish gray to medium light gray (5B 7/1 - N6), fresh (I), strong (R4) rock, discontinuities become closely spaced and in good condition		
	31				R5			PLT - D			
									Becomes light brown (5YR 5/6), slightly weathered (II) rock		
105	32			98 / 3.7			25		Becomes moderate brown (5YR 4/4), slightly weathered (II), moderately strong (R3) rock		
	33								At 107.7 to 108.3 feet bgs - becomes light bluish gray (5B 7/1), fresh (I) rock		
110				94 / 0.4			26		At 109.0 to 109.8 feet bgs - discontinuities in fair to very poor condition, with 0.1 feet core loss at discontinuity in very poor condition At 110.0 feet bgs - becomes pale blue to grayish blue (5B 6/2 - 5B 5/2), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become moderately to closely spaced at widely spaced intervals and in good condition		
	34										
115	35			112 / 0.0			27		Becomes grayish green (10GY 5/2) rock		
			>>		R4 R4			PLT - D PLT - A			
	36			92 / 1.3			28		At 117.6 to 120.1 feet bgs - becomes dusky yellow green to grayish green (5GY 5/2 - 10GY 5/2), fresh to slightly weathered (I - II) rock		
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-29-07

Job No. 03-2007 SR 90 Elevation 2638.4 ft (804.2 m)

Sheet 6 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	37			108 / 0.4	R4		29	PLT - A	Discontinuities become moderately to closely spaced at widely spaced intervals and in good condition		
				96 / 0.0	R5		30	PLT - D			
125	38										
	39								Borehole completed to 125.1 feet bgs on October 22, 2007. Borehole was overcased with HWT casing to 1.0 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 30, 2007. Groundwater was measured at approximately 40.8 feet bgs during drilling activities and at 58.0 feet on October 30, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on November 2, 2007.		
130	40										
135	41										
	42										
140	43										
145	44										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-30-07

Sheet 1 of 6

Job No. 03-2007 SR 90 Elevation 2645.9 ft (806.5 m)

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector K. Yang

Start September 22, 2007 Completion September 25, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-1

Station 1408+98 Offset 84 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 733749.28 Easting 1426602.23 Latitude 47°20'31.764"N

Longitude 121°21'44.695"W

County Kittitas Subsection NE Quarter Section 02 Range 11E Township 21N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									SILTY GRAVEL [GM], silty coarse GRAVEL, with sand and boulders, trace organics, loose, medium dark gray to medium light gray (N4 - N6), dry. [Colluvium and Anthropogenic Fill]		
5	1			88 / 2.3	R1		1	PLT - D	**META-WELDED LAPILLI DACITE TUFF,** dusky yellow green (5GY 5/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 50%), slightly welded, slightly weathered (II), moderately strong to strong (R3 - R4) rock, discontinuities are closely spaced and in good condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
10	2			100 / 0.4	R4		2	PLT - D	Becomes slightly to moderately weathered (II - III), strong (R4) rock, discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in very poor condition occur at a 15 to 30% frequency		
15	3			106 / 1.5			3		Becomes fresh to slightly weathered (I - II) rock		
20	4			94 / 1.1	R4		4	PLT - D	Becomes moderately strong to strong (R3 - R4) rock		
	5										
	6										

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-30-07

Job No. 03-2007 SR 90 Elevation 2645.9 ft (806.5 m)

Sheet 2 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				104 / 0.4			5		Becomes dusky yellow green to grayish green (10GY 5/2 - 5GY 5/2), fresh (I), strong (R4) rock, discontinuities become widely spaced and in fair to good condition		
	7			>>							
25											
	8			100 / 0.2			6				
	9				R5			PLT - D			
30											
				100 / 0.4			7		Becomes grayish green (10GY 5/2)		
	10										
35											
	11			101 / 0.0			8				
					R5 R5 R4			PLT - D PLT - A PLT - D			
	12			100 / 0.0			9				
40											
				99 / 0.2			10		Becomes fresh (I), very strong (R5) rock		
	13										
45											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-30-07

Job No. 03-2007 SR 90 Elevation 2645.9 ft (806.5 m)

Sheet 3 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Becomes fresh (I), very strong (R5) rock, discontinuities become widely spaced and in fair to good condition		
	14			100 / 0.0			11				
					R5			PLT - D			
					R5			PLT - A			
	15										
50				100 / 0.0			12				
				100 / 1.2	R4		13	PLT - D	At 51.3 to 53.1 feet bgs - becomes dusky yellow green (5GY 5/2), slightly weathered (II), strong (R4) rock, discontinuities become closely to very closely spaced and in fair to poor condition		
	16										
					R5			PLT - A			
55					R5			PLT - D			
	17			100 / 0.0			14				
	18										
60				100 / 0.6			15				
	19									▼	
									At 62.5 to 68.5 feet bgs - becomes dusky yellow green (5GY 5/2), fresh to slightly weathered (I - II), very strong (R5) rock, discontinuities become moderately to closely spaced and in good to fair condition		
					R5			PLT - D			
65					R4			PLT - A			
	20			100 / 0.4			16				
	21										
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-30-07

Job No. 03-2007 SR 90 Elevation 2645.9 ft (806.5 m)

Sheet 4 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				98 / 0.3			17		Becomes fresh (I), very strong (R5) rock, discontinuities become widely to very widely spaced and in fair to good condition		
	22										
				98 / 0.5	R5 R5		18	PLT - D PLT - A			
75	23										
				102 / 0.2			19				
	24		>>								
80									Becomes fresh (I), very strong (R5) rock, discontinuities become very widely spaced and in good condition		
				97 / 0.0			20				
	25										
				56 / 0.0			21				
				115 / 0.0	R5 R5		22	PLT - A PLT - D			
			>>								
85	26										
				100 / 0.0			23				
	27										
90											
				100 / 0.0			24		Becomes fresh (I), strong to very strong (R4 - R5) rock, discontinuities become very widely spaced and in good condition		
	28										
95					R4			PLT - D			

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-30-07

Job No. 03-2007 SR 90 Elevation 2645.9 ft (806.5 m)

Sheet 5 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29										
				98 / 0.0			25				
	30										
100									Becomes fresh (I), very strong (R5) rock, discontinuities become very widely spaced and in good condition		
				100 / 0.0			26				
	31										
105	32										
				107 / 0.0			27				
				100 / 0.0			28				
	33				R5			PLT - D			
110									At 110.3 to 111.5 feet bgs - healed discontinuities occur closely spaced		
				102 / 0.8			29				
	34										
115	35				R3			PLT - D			
				98 / 1.4			30		Becomes grayish green to dusky yellow green (10GY 5/2 - 5GY 5/2), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become closely to very closely spaced and in poor to good condition, discontinuities in poor condition occur at a 10 to 15% frequency		
	36				R4			PLT - D			
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-30-07

Job No. 03-2007 SR 90 Elevation 2645.9 ft (806.5 m)

Sheet 6 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	37			102 / 0.4			31		Becomes grayish green (10GY 5/2), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become moderately spaced at widely spaced intervals and in good to fair condition		
				>>							
125	38										
				100 / 0.0			32				
	39										
					R4			PLT - D			
130					R5			PLT - A			
	40			102 / 0.4			33				
				>>					At 132.7 to 133.9 feet bgs - becomes dusky yellow green (5GY 5/2), slightly weathered (II) rock		
	41				R5			PLT - A			
135					R4			PLT - D			
	42								Borehole completed to 135.9 feet bgs on September 25, 2007. Borehole was overcased with HWT casing to 2.5 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 3, 2007. Groundwater was measured at approximately 73.1 feet bgs during drilling activities and at 62.4 feet on October 3, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on October 3, 2007.		
140											
	43										
	44										
145											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-31-07

Sheet 1 of 6

Job No. 03-2007 SR 90 Elevation 2648.3 ft (807.2 m)

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector K. Yang

Start September 10, 2007 Completion September 19, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-1

Station 1410+45 Offset 110 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 733670.41 Easting 1426717.43 Latitude 47°20'30.998"N

Longitude 121°21'43.009"W

County Kittitas Subsection NE Quarter Section 02 Range 11E Township 21N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									SILTY GRAVEL [GM], silty fine GRAVEL, with sand, cobbles, and boulders, trace organics, loose, grayish orange to grayish orange pink (10YR 7/4 - 5YR 7/2), dry. [Colluvium and Anthropogenic Fill]		
	1								**META-WELDED LAPILLI DACITE TUFF,** grayish green (10GY 5/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 50%), slightly welded, slightly weathered (II), strong (R4) rock, discontinuities are moderately to closely spaced and in good to fair condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
				83 / 0.0	R5		1	PLT - D			
5				107 / 0.4	R5		2	PLT - A	Becomes fresh (I), very strong (R5) rock		
	2		>>						At 6.5 to 6.8 feet bgs - 0.3 feet core loss, discontinuities in very poor condition		
10	3			96 / 1.6			3		Becomes dusky yellow green (5GY 5/2) rock		
				102 / 1.5			4				
	4										
15				64 / 5.7			5				
	5			105 / 0.5			6				
					R5			PLT - A			
	6				R5			PLT - D			
20											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-31-07

Job No. 03-2007 SR 90 Elevation 2648.3 ft (807.2 m)

Sheet 2 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				~~100~~ / 1.6			7		Becomes dusky yellow green (5GY 5/2), fresh (I), very strong (R5) rock, discontinuities become moderately to closely spaced and in good to fair condition		
	7										
25				64 / 3.1			8				
	8								At 26.0 to 26.2 feet bgs - 0.2 feet core loss, discontinuities in very poor condition		
				100 / 0.4			9		Discontinuities become widely to moderately spaced and in fair to good condition		
	9				R5			PLT - A			
30				92 / 0.4			10				
				146 / 0.5			11				
	10			>>							
35				76 / 0.3	R4 R5 R5		12	PLT - D PLT - A PLT - D	At 34.0 to 35.4 feet bgs - fresh to slightly weathered (I - II), strong to very strong (R4 - R5) rock, discontinuities are closely spaced and in good to fair condition		
	11										
	12										
40				140 / 0.0			13				
				>>							
	13			93 / 0.9			14				
					R5			PLT - D			
45											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-31-07

Job No. 03-2007 SR 90 Elevation 2648.3 ft (807.2 m)

Sheet 3 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	14								At 44.8 to 45.8 feet bgs - discontinuities become closely spaced and in good condition Becomes dusky yellow green (5GY 5/2), fresh (I), very strong (R5) rock, discontinuities become widely to moderately spaced and in fair to good condition		
				100 / 0.7			15				
	15										
50				108 / 0.4			16				
					R4 R5			PLT - D PLT - A			
	16		>>								
									At 53.0 to 53.6 feet bgs - discontinuity in poor condition		
55				52 / 1.5			17				
	17								Becomes strong (R4) rock, discontinuities become moderately to closely spaced and in fair to good condition		
									Recovery and RQD percentages represented lower than appear worse than actual conditions associated with driller unable to break core off bottom of borehole		
	18										
60				128 / 0.6			18		Becomes dusky yellow green (5GY 5/2), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become moderately to closely spaced and in good condition		
			>>								
	19			66 / 1.8			19				
65				138 / 0.0	R5 R4		20	PLT - D PLT - A	Becomes very strong (R5) rock, discontinuities become moderately to closely spaced and in fair to good condition		
	20		>>								
				88 / 0.9			21				
	21										
70											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-31-07

Job No. 03-2007 SR 90 Elevation 2648.3 ft (807.2 m)

Sheet 4 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				~~86~~ / 0.5			22				
	22			120 / 1.7			23				
75	23			124 / 0.0	R5		24	PLT - A	Discontinuities become widely spaced and in good condition		
				104 / 0.0			25				
	24										
80											
	25			96 / 0.4			26				
85	26				R5			PLT - D			
					R4			PLT - A			
				106 / 0.2			27		At 87.0 to 87.6 feet bgs - discontinuities become very closely spaced and in good condition Discontinuities become very widely spaced and in good condition		
90	27										
	28			103 / 0.0	R5 R5		28	PLT - D PLT - A			
95											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-31-07

Job No. 03-2007 SR 90 Elevation 2648.3 ft (807.2 m)

Sheet 5 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29										
				92 / 0.2			29				
	30										
100											
	31										
				104 / 0.4	R4 R5		30	PLT - A PLT - D			
105	32			>>							
				84 / 0.0			31				
	33										
110				103 / 0.0			32				
	34			>>							
					R4			PLT - A			
115	35			96 / 0.2	R5		33	PLT - D			
	36										
120											

ROCK SCD BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01979

HOLE No. RKS-31-07

Job No. 03-2007 SR 90 Elevation 2648.3 ft (807.2 m)

Sheet 6 of 6

Project 2007 I-90 Geotechnical Slide Curve Design Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				~~102~~ / 0.0	R5		34	PLT - D	Discontinuities become very widely spaced and in good condition		
	37			>>							
	38										
125				98 / 0.2			35		At 125.2 to 125.4 feet bgs - 0.2 feet core loss, discontinuity in very poor condition		
	39										
130				100 / 0.0			36				
	40										
					R5 R5			PLT - A PLT - D			
	41										
135				100 / 0.6			37				
	42								Discontinuities become moderately to closely spaced and in fair to good condition		
140									Borehole completed to 139.8 feet bgs on September 19, 2007. Borehole was advanced at an angle 66 degrees from horizontal with a direction of 137 degrees. Borehole was overcased with HWT casing to 5.5 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on September 21, 2007. Groundwater was measured at approximately 82.4 feet bgs during drilling activities and at 82.5 feet on September 21, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on October 3, 2007.		
	43										
	44										
145											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-01-07

Sheet 1 of 5

Job No. 03-2007 SR 90 Elevation 2703.2 ft (823.9 m)

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector A. Shriver

Start September 24, 2007 Completion September 26, 2007 Well ID# SI-01-07

Equipment Skid-Mounted Burley 5500-2

Station 1397+28 Offset 247 Feet Left Casing Stick-up Monument

Method HQ3 Triple Tube Wireline

Northing 734671.21 Easting 1426419 Latitude 47°20'40.842"N

Longitude 121°21'47.501"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				82 / 2.3			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, some cobbles and boulders, with yellowish gray (5Y 7/2) fine to coarse sand, trace silt and organics, medium dense, medium gray (N5), moist. [Colluvium and Anthropogenic Fill]		
	1								**META-WELDED LAPILLI DACITE TUFF,** medium dark gray to olive gray (N4 - 5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (10 to 60%), slightly welded, slightly weathered (II), moderately strong to strong (R3 - R4) rock, discontinuities are closely spaced and in good to fair condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
5				100 / 0.4			2		At 2.6 to 3.1 feet bgs - discontinuity in poor to very poor condition		
	2								At 5.0 feet bgs - becomes medium dark gray to medium bluish gray to olive gray (N4 - 5B 5/1 - 5Y 4/1), fresh (I), very strong (R5) rock, with moderate yellowish brown to medium dark gary (10YR 5/4 - N4) rock enveloping discontinuities, discontinuities become moderately to closely spaced and in good to fair condition		
					R5 R5			PLT - A PLT - D			
10	3			102 / 0.2			3				
	4		>>								
15				96 / 1.0			4				
	5				R4 R5			PLT - A PLT - D			
									Becomes medium gray to olive gray (N5 - 5Y 4/1), fresh to slightly weathered (I - II), strong (R4) rock		
20	6										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-01-07

Job No. 03-2007 SR 90 Elevation 2703.2 ft (823.9 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				102 / 1.2			5		Becomes medium gray to olive gray (N5 - 5Y 4/1), fresh to slightly weathered (I - II), strong (R4) rock, discontinuities become moderately to closely spaced and in good to fair condition		
					R5 R5			PLT - A PLT - D			
	7										
25				88 / >3.4			6		At 24.9 to 25.9 feet bgs - becomes dark yellowish orange to moderate yellowish brown (10YR 6/6 - 10YR 5/4), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock At 25.2 to 25.4 feet bgs - 0.2 feet core loss		
	8										
					R5			PLT - D	At 26.9 to 27.3 feet bgs - becomes dark yellowish orange to moderate yellowish brown (10YR 6/6 - 10YR 5/4), slightly weathered (II), moderately weak (R2) rock Becomes dark yellowish orange to moderate yellowish brown (10YR 6/6 - 10YR 5/4), moderately weathered (III), very weak to moderately weak (R1 - R2) rock		
	9										
30				72 / 1.9			7		At 29.5 to 29.9 feet bgs - 0.4 feet core loss At 29.9 feet bgs - becomes slightly to moderately weathered (II - III), very weak to moderately weak (R1 - R2) rock, discontinuities become closely spaced and in fair to very poor condition, discontinuities in fair condition occur at a 15 to 25% frequency At 30.2 to 30.3 feet bgs - 0.1 feet core loss At 30.6 to 30.7 feet bgs - 0.1 feet core loss At 31.0 to 31.2 feet bgs - 0.2 feet core loss		
	10										
									At 33.9 to 34.8 feet bgs - 0.9 feet core loss		
35				100 / 3.8			8				
	11								At 35.7 feet bgs - discontinuities becomes closely to very closely spaced and in good condition		
				79 / >3.2			9				
	12										
									At 39.4 to 40.5 feet bgs - 1.1 feet core loss		
40				88 / 1.6			10		At 40.1 feet bgs - becomes moderately weak to moderately strong (R2 - R3), discontinuities become closely spaced and in poor to very poor condition		
					R4			PLT - D	At 41.5 feet bgs - becomes slightly weathered (II) rock, discontinuities in poor to good condition, discontinuities in poor condition occur at a 10 to 15% frequency	▼	
	13										
									Becomes medium gray to olive gray (N5 - 5Y 4/1), fresh (I), strong (R4) rock	▽	
45											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-01-07

Job No. 03-2007 SR 90 Elevation 2703.2 ft (823.9 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				100 / 1.0			11				
	14								Becomes medium bluish gray to dark greenish gray (5B 5/1 - 5G 4/1), fresh(I), very strong (R5) rock, discontinuities becomes moderately to closely spaced at widely to moderately spaced intervals and in fair to good condition, discontinuities in fair condition occur at a 10 to 15% frequency		
	15				R5			PLT - A			
50				92 / 0.7	R4		12	PLT - D			
									At 51.2 to 51.4 feet bgs - becomes slightly weathered (II), discontinuity in poor condition		
	16								At 53.2 to 53.7 feet bgs - 0.5 feet core loss associated with redrill of slipped core		
55				100 / 0.6			13				
	17										
	18										
60				88 / 0.2			14				
	19				R4			PLT - D			
					R4			PLT - A			
65				116 / 0.7			15				
	20		>>						At 66.2 to 66.7 feet bgs - discontinuity in very poor condition		
				96 / 0.4			16				
	21										
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-01-07

Job No. 03-2007 SR 90 Elevation 2703.2 ft (823.9 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				102 / 1.0	R5		17	PLT - A	Becomes dark greenish gray (5G 4/1), fresh(I), very strong (R5) rock, discontinuities becomes moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 20 to 30% frequency, discontinuities in fair condition occur at a 20 to 30% frequency		
	22				R5			PLT - D			
75				90 / 1.6			18				
	23										
									At 77.4 to 79.2 feet bgs - becomes olive gray (5Y 4/1), slightly weathered (II), strong (R4), discontinuities are closely spaced and in very poor to poor condition		
	24										
80				84 / >1.4			19				
	25										
					R4			PLT - D			
									At 84.0 to 84.3 feet bgs - discontinuity in very poor condition		
85	26			76 / 1.6			20		Discontinuities become closely to very closely spaced and in poor to good condition, discontinuities in poor condition occur at a 3 to 7% frequency, discontinuities in fair condition occur at a 40 to 45% frequency		
				163 / 0.7	R5		21	PLT - D			
	27		>>		R5			PLT - A			
90				91 / 1.0			22				
	28										
95				120			23				

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-01-07

Job No. 03-2007 SR 90 Elevation 2703.2 ft (823.9 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29			1.0							
				88 / 2.6	R5 R5		24	PLT - A PLT - D			
	30										
100									Borehole completed to 99.6 feet bgs on September 27, 2007. Borehole was overcased with HWT casing to 1.3 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on September 27, 2007. Borehole completed with slope inclinometer casing to 99.6 feet bgs on September 27, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 49.3 feet bgs during drilling activities and at 41.5 feet on September 27, 2007 prior to beginning optical borehole survey. Slope inclinometer casing = 0.0 to 99.6 feet bgs: RocTest casing type A+ Azimuth = 288 degrees Grout mix from 0.0 to 99.6 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 25 to 30 lbs pure bentonite powder Well Tag # = APC 416		
	31										
105	32										
	33										
110											
	34										
115	35										
	36										
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-02-07

Sheet 1 of 5

Job No. 03-2007 SR 90 Elevation 2702.8 ft (823.8 m)

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector K. Yang

Start September 26, 2007 Completion October 3, 2007 Well ID# SI-02-07

Equipment Skid-Mounted Burley 5500-1

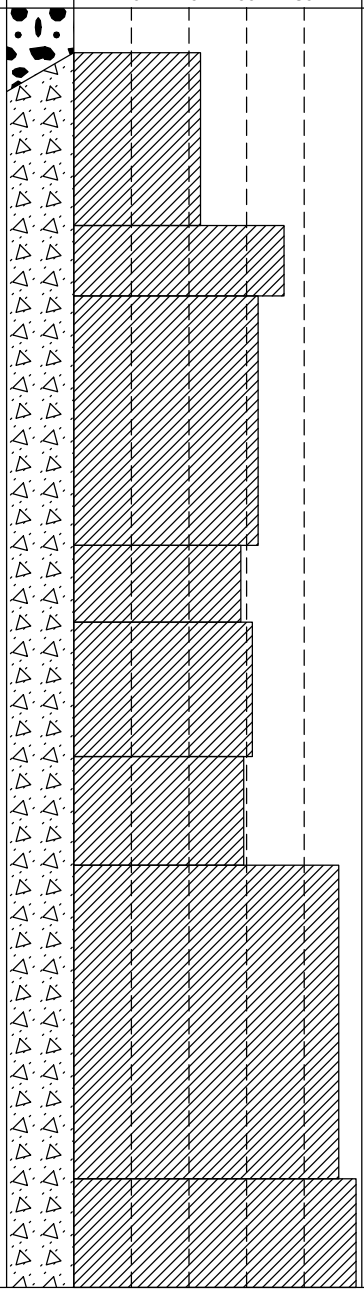
Station 1397+75 Offset 258 Feet Left Casing Stick-up Monument

Method HQ3 Triple Tube Wireline

Northing 734636.45 Easting 1426429.25 Latitude 47°20'40.501"N

Longitude 121°21'47.347"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N



Depth (ft)	Meters (m)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
		78 / >0.5			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, some cobbles and boulders, with fine to coarse sand, trace silt, loose to dense, pale yellowish brown to grayish green (10YR 6/2 - 10GY 5/2), dry. [Colluvium and Anthropogenic Fill]		
	1	109 / 0.0			2		**META-WELDED LAPILLI DACITE TUFF,** medium dark gray to dark greenish gray (N4 - 5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, fresh (I), strong (R4) rock, discontinuities are closely spaced and in very poor condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
5		100 / 1.5			3				
	2		R5			PLT - D	Becomes strong to very strong (R4 - R5) rock, discontinuities become closely to very closely spaced and in poor to good condition, discontinuities in poor condition occur at a 10 to 15% frequency, discontinuities in fair condition occur at a 30 to 40% frequency		
		100 / 2.5			4				
10	3	100 / 1.9			5				
		88 / 0.7			6				
	4	100 / 1.0			7				
15			R5			PLT - A			
	5		R5			PLT - D			
		100 / 0.8			8		Becomes medium bluish gray (5B 5/1), fresh (I), strong to very strong (R4 - R5) rock, with moderate yellowish brown to light brown (10YR 5/4 - 5YR 5/6), slightly weathered (II) rock enveloping discontinuities		
20	6								

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-02-07

Job No. 03-2007 SR 90 Elevation 2702.8 ft (823.8 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 10 to 15% frequency, discontinuities in fair condition occur at a 30 to 40% frequency		
	7										
				108 / 1.9	R4		9	PLT - D	At 23.3 to 24.8 feet bgs - becomes moderate yellowish brown to light brown (10YR 5/4 - 5YR 5/6), slightly weathered (II), strong (R4) rock		
25					R5			PLT - D	At 24.8 feet bgs - becomes light bluish gray (5B 7/1) rock		
	8			100 / 1.2			10				
									Becomes moderate yellowish brown to light brown (10YR 5/4 - 5YR 5/6), slightly to moderately weathered (II - III), very weak to moderately weak (R1 - R2) rock	▼	
				100 / 2.3			11		Becomes slightly weathered (II), moderately strong to strong (R3 - R4) rock, discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 25 to 30% frequency		
	9				R4			PLT - D			
30				100 / 1.62			12				
	10										
				98 / 1.4			13				
35									Becomes grayish green (5G 5/2), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become moderately to closely spaced and in good condition		
	11										
					R5			PLT - D			
				90 / 1.6			14		At 38.3 to 40.4 - becomes moderate yellowish brown to light brown (10YR 5/4 - 5YR 5/6), slightly weathered (II), strong (R4) rock		
	12										
40									At 38.5 feet bgs - discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 40 to 50% frequency		
				103 / 3.5			15		Becomes moderate yellowish brown to light brown (10YR 5/4 - 5YR 5/6), slightly to moderately weathered (II - III), moderately weak (R2) rock		
	13										
				102 / 4.1			16		At 43.4 to 44.2 feet bgs - becomes moderately weathered (III), very weak to moderately weak (R1 - R2) rock, discontinuities become closely spaced and in poor to very poor condition		
45											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-02-07

Job No. 03-2007 SR 90 Elevation 2702.8 ft (823.8 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	14								At 44.2 feet bgs - becomes moderate yellowish brown to light brown (10YR 5/4 - 5YR 5/6), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock, discontinuities become fair to very poor condition, discontinuities in poor to very poor condition occur at a 70 to 80% frequency, discontinuities in fair condition occur at a 20 to 25% frequency		
				100 / 1.4	R4		17	PLT - D	Becomes pale blue (5PB 7/2), fresh (I), strong (R4) rock, discontinuities become closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 13 to 18% frequency		
	15										
50											
	16										
				98 / 1.4			18		At 53.4 to 58.4 feet bgs - healed discontinuities occur greater than 15 per foot		
55											
	17										
					R3			PLT - D			
					R1			PLT - D			
				100 / 2.2			19				
	18										
60											
	19								At 62.2 to 62.6 feet bgs - becomes moderately weathered (III), moderately weak (R2), discontinuities in poor to very poor condition		
				80 / 0.0			20				
				100 / 1.6			21		Becomes pale blue (5PB 7/2), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in very poor condition occur at a 15 to 20% frequency		
65					R5			PLT - D			
	20								At 66.0 to 67.0 feet bgs - becomes moderate yellowish brown to light brown (10YR 5/4 - 5YR 5/6), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock		
	21			100 / 1.6			22				
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-02-07

Job No. 03-2007 SR 90 Elevation 2702.8 ft (823.8 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in very poor condition occur at a 15 to 20% frequency		
	22										
				100 / 1.2			23				
75	23										
				100 / 2.4	R4		24	PLT - D	Becomes moderate yellowish brown to light brown (10YR 5/4 - 5YR 5/6), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock, with moderately weathered (III) rock envelopes discontinuities, discontinuities become closely to very closely spaced and in poor to good condition		
	24			100 / 1.6			25		Becomes slightly weathered (II), moderately strong to strong (R3 - R4) rock		
80											
					R4			PLT - D	Becomes pale blue (5B 6/2), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 13 to 18% frequency		
	25										
				98 / 1.0			26				
85	26										
	27			100 / 1.4			27		Becomes strong (R4) rock, discontinuities become closely to very closely spaced and in poor to very poor condition		
90											
	28										
				100 / 1.8			28		Discontinuities become closely to very closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 30 to 35%		
95											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-02-07

Job No. 03-2007 SR 90 Elevation 2702.8 ft (823.8 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29				R4			PLT - D	frequency		
	30			100 / 1.8	R4		29	PLT - D			
100									Borehole completed to 100.1 feet bgs on October 3, 2007. Borehole was overcased with HWT casing to 1.7 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 4, 2007. Borehole completed with slope inclinometer casing to 100.1 feet bgs on October 4, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 63.4 feet bgs during drilling activities and at 28.0 feet on October 4, 2007 prior to beginning optical borehole survey. Slope inclinometer casing = 0.0 to 100.1 feet bgs: RocTest casing type A+ Azimuth = 295 degrees Grout mix from 0.0 to 100.1 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 30 lbs pure bentonite powder Well Tag # = APC 415		
	31										
105	32										
	33										
110											
	34										
115	35										
	36										
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-03-07

Sheet 1 of 5

Job No. 03-2007 SR 90 Elevation 2703.4 ft (824.0 m)

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector A. Shriver

Start October 3, 2007 Completion October 5, 2007 Well ID# SI-03-07

Equipment Skid-Mounted Burley 5500-2

Station 1398+24 Offset 245 Feet Left Casing Stick-up Monument

Method HQ3 Triple Tube Wireline

Northing 734712.15 Easting 1426418.02 Latitude 47°20'41.246"N

Longitude 121°21'47.522"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				76 / >2.6			1		**GRAVEL [GP - GM],** fine to coarse, angular GRAVEL, some cobbles and boulders, with fine to coarse sand and silt, medium dense, pale yellowish brown to grayish green (10YR 6/2 - 10GY 5/2), moist. [Colluvium and Anthropogenic Fill]		
5	1			98 / >2.7			2		**META-WELDED LAPILLI DACITE TUFF,** pale yellowish brown (10YR 6/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, slightly weathered (II), moderately weak (R2) rock, discontinuities are closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 25 to 30% frequency. [Tuff member of Lake Keechelus, Ohanapecosh Formation] At 3.4 feet bgs - becomes greenish gray (5G 6/1), fresh to slightly weathered (I - II), moderately strong (R3) rock, with olive gray (5Y 4/1) rock enveloping discontinuities At 5.9 feet bgs - becomes medium bluish gray to greenish gray (5B 5/1 - 5G 6/1), fresh (I), strong (R4) rock, discontinuities become closely to very closely spaced and in poor to good condition, discontinuities in poor condition occur at a 13 to 18% frequency		
10	2			102 / 1.4	R4 R5		3	PLT - A PLT - D			
15	3			89 / 3.5			4		Discontinuities become closely to very closely spaced and in good to very poor condition, discontinuities in poor to very poor condition occur at a 35 to 45% frequency		
20	4			127 / 0.0	R5		5	PLT - D			
	5										
	6										

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-03-07

Job No. 03-2007 SR 90 Elevation 2703.4 ft (824.0 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				100 / 0.6			6		Becomes dark greenish gray to medium dark gray (5G 4/1 - N4), strong to very strong (R4 - R5) rock, discontinuities become closely to very closely spaced and in good to very poor condition, discontinuities in poor to very poor condition occur at a 35 to 45% frequency		
	7										
25				94 / 1.1			7		Becomes very strong (R5) rock		
	8				R5			PLT - D	At 26.8 to 27.1 feet bgs - 0.3 feet core loss		
	9										
30				92 / >1.3			8				
	10								At 32.3 to 32.5 feet bgs - 0.2 feet core loss		
35				104 / 0.8	R5		9	PLT - A	Discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 30 to 40% frequency		
	11			>>							
				100 / 0.4	R4		10	PLT - D			
	12										
40				96 / 0.4			11				
	13										
				88 / 0.9			12		Becomes medium bluish gray to greenish gray (5B 5/1 - 5G 4/1), fresh (I), very strong (R5) rock, with olive gray (5Y 4/1) rock enveloping discontinuities		
45											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-03-07

Job No. 03-2007 SR 90 Elevation 2703.4 ft (824.0 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				106 / 1.1			13		Discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 30 to 40% frequency		
	14								At 46.6 to 46.7 feet bgs - 0.1 feet core loss associated with drilling activities		
			>>		R5			PLT - D			
					R5			PLT - D			
	15										
50				98 / 1.2			14				
	16										
55				100 / 1.0			15				
	17								Discontinuities become moderately to closely spaced and in good condition		
	18										
					R5			PLT - A			
60				86 / 0.7			16		At 60.3 feet bgs - discontinuity in very poor condition		
	19										
					R5			PLT - D			
65											
	20			132 / 1.2			17				
									At 66.4 to 67.2 feet bgs - discontinuities become closely spaced and in poor condition		
				72 / 0.0			18				
	21				R5			PLT - D			
					R5			PLT - A			
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-03-07

Job No. 03-2007 SR 90 Elevation 2703.4 ft (824.0 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				112 / 0.7			19		Becomes medium bluish gray to greenish gray (5B 5/1 - 5G 4/1), fresh (I), very strong (R5) rock, with olive gray (5Y 4/1) rock enveloping most discontinuities, discontinuities become moderately to closely spaced and in good condition		
	22			129 / 2.2			20				
				27 / 0.0			21				
75	23			128 / 0.6			22				
				104 / 1.2	R4		23	PLT - D	At 77.8 to 78.8 feet bgs - becomes fresh to slighty weathered (I - II) rock		
	24										
80				88 / 1.1	R5		24	PLT - A	Discontinuities become moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 10 to 15% frequency		
	25										
85	26			112 / 0.4			25		At 85.3 to 85.4 feet bgs - discontinuity in poor condition		
				108 / 0.7			26				
	27										
90				88 / 0.7	R5 R5		27	PLT - D PLT - A			
	28										
95											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-03-07

Job No. 03-2007 SR 90 Elevation 2703.4 ft (824.0 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29			116 / 0.0			28				
			>>		R5			PLT - A			
					R5		29	PLT - D			
	30			92 / 0.9							
100											
	31								Borehole completed to 100.3 feet bgs on October 5, 2007. Borehole was overcased with HWT casing to 4.2 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 5, 2007. Borehole completed with two vibrating wire piezometers at 32.0 feet and 98.0 feet bgs on October 5, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 34.0 feet bgs during drilling activities and at 32.5 feet on October 5, 2007 prior to beginning optical borehole survey.		
105	32								VWP #92060 = 30.5 to 32.0 feet bgs VWP #92083 = 96.5 to 98.0 feet bgs #10-20 silica sand filter pack from 90.0 to 100.3 feet bgs Grout mix from 0.0 to 90.0 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 30 to 35 lbs pure bentonite powder Well Tag # = APC 417		
	33										
110											
	34										
115	35										
	36										
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-04-07

Sheet 1 of 5

Job No. 03-2007 SR 90 Elevation 2741.5 ft (835.6 m)

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector A. Shriver

Start October 6, 2007 Completion October 10, 2007 Well ID# SI-04-07 Equipment Skid-Mounted Burley 5500-2

Station 1398+26 Offset 312 Feet Left Casing Stick-up Monument Method HQ3 Triple Tube Wireline

Northing 734668.77 Easting 1426483.8 Latitude 47°20'40.825"N Longitude 121°21'46.560"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				64 / .9			1		**GRAVEL [GP - GM],** fine to coarse, angular GRAVEL, some cobbles and boulders, with fine to coarse sand and silt, medium dense, pale yellowish brown to grayish green (10YR 6/2 - 10GY 5/2), moist. [Colluvium and Anthropogenic Fill]		
	1								**META-WELDED LAPILLI DACITE TUFF,** olive gray (5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, slightly weathered (II), moderately strong to strong (R3 - R4) rock, discontinuities are moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 10 to 15% frequency. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
5				86 / 0.8			2/3				
	2								Becomes dark greenish gray to medium dark gray (5G 4/1 - N4), fresh (I), strong to very strong (R4 - R5) rock		
					R5			PLT - A	At 8.1 to 8.2 feet bgs - 0.1 feet core loss		
				108 / 0.7			4		Becomes very strong (R5) rock		
10	3		>>		R5			PLT - D			
				120 / 1.0			5		Becomes fresh to slightly weathered (I - II) rock, discontinuities become moderately to closely spaced and in good condition		
	4		>>								
				88 / 2.8			6		Becomes fresh (I) rock		
15	5										
				116 / 0.0			7				
			>>								
	6			78 / 0.5			8				
20											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-04-07

Job No. 03-2007 SR 90 Elevation 2741.5 ft (835.6 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become moderately to closely spaced and in good condition		
					R5			PLT - D			
	7										
25				156 / 0.4			9				
					R5			PLT - D			
	8			99 / 0.3	R5		10	PLT - A			
	9			99 / 0.8			11				
30											
	10										
35				94 / 0.4			12		Becomes medium bluish gray to dark greenish gray (5B 5/1 - 5G 4/1) rock		
	11										
	12			112 / 0.7	R5		13	PLT - A			
40					R5			PLT - D			
					R4			PLT - D			
	13			96 / 2.9			14		At 41.8 to 44.3 feet bgs - becomes fresh to slightly weathered (I - II) rock		
45				100 / 1.0			15				

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-04-07

Job No. 03-2007 SR 90 Elevation 2741.5 ft (835.6 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become closely spaced and in fair to good condition		
	14										
	15			100 / >3.0	R5		16	PLT - D	Becomes medium bluish gray to dark greenish gray (5B 5/1 - 5G 4/1), fresh (I), very strong (R5) rock, with dark yellowish orange to light brown to pale yellowish brown (10YR 6/6 - 5YR 5/6 - 10YR 6/2), slightly weathered (II) rock		
50											
	16								Becomes dark yellowish orange to light brown to pale yellowish brown (10YR 6/6 - 5YR 5/6 - 10YR 6/2), slightly to moderately weathered (II - III), moderately weak to strong (R2 - R4) rock, discontinuities become closely to very closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 12 to 17% frequency, discontinuities in fair condition occur at a 12 to 17% frequency		
				100 / 2.6			17				
55											
	17								At 53.0 to 53.9 feet bgs - discontinuities become very closely spaced and in good condition		
					R4			PLT - A			
				81 / 3.6			18				
	18								At 58.9 to 59.4 feet bgs - 0.5 feet core loss		
				100 / 1.2			19		Becomes medium bluish gray to dark greenish gray (5B 5/1 - 5G 4/1), fresh (I), strong (R4) rock, with dark yellowish orange to light brown to pale yellowish brown (10YR 6/6 - 5YR 5/6 - 10YR 6/2), slightly weathered (II), moderately weathered (R3) rock		
60											
					R5			PLT - D			
	19								At 61.7 to 63.7 feet bgs - 0.2 feet core loss associated with drilling activities		
				94 / 0.4			20				
65											
	20								Becomes medium bluish gray to dark greenish gray (5B 5/1 - 5G 4/1), fresh (I), very strong (R5) rock, discontinuities become moderately to closely spaced at widely spaced intervals and in good condition		
				106 / 0.0	R5		21	PLT - D			
			>>								
	21										
				90 / 0.0			22				
70											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-04-07

Job No. 03-2007 SR 90 Elevation 2741.5 ft (835.6 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become moderately to closely spaced at widely spaced intervals and in good condition		
	22										
75				112 / 2.1			23				
	23				R5			PLT - D			
				112 / 0.5			24				
	24										
80				90 / 0.0			25				
	25										
85				112 / 0.0			26				
	26										
				104 / 0.0			27				
	27				R4			PLT - D			
90				98 / 0.2	R5		28	PLT - A			
	28										
					R5			PLT - D			
95				105 / 1.0			29				

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-04-07

Job No. 03-2007 SR 90 Elevation 2741.5 ft (835.6 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29										
				87 / 0.9			30				
	30										
100									Borehole completed to 99.8 feet bgs on October 10, 2007. Borehole was overcased with HWT casing to 4.2 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 10, 2007. Borehole completed with slope inclinometer casing to 99.8 feet bgs on October 11, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 32.3 feet bgs during drilling activities and at 48.8 feet on October 10, 2007 prior to beginning optical borehole survey. Slope inclinometer casing = 0.0 to 99.8 feet bgs: RocTest casing type A+ Azimuth = 274 degrees Grout mix from 0.0 to 99.8 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 30 lbs pure bentonite powder Well Tag # = APC 414		
	31										
105	32										
	33										
110											
	34										
115	35										
	36										
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-05-07

Sheet 1 of 5

Job No. 03-2007 SR 90 Elevation 2775.5 ft (846.0 m)

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector K. Yang

Start October 5, 2007 Completion October 6, 2007 Well ID# SI-05-07 Equipment Skid-Mounted Burley 5500-1

Station 1398+26 Offset 370 Feet Left Casing Stick-up Monument Method HQ3 Triple Tube Wireline

Northing 734646.22 Easting 1426541.1 Latitude 47°20'40.609"N Longitude 121°21'45.725"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				53 / 1.8			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, some cobbles and boulders, with fine to coarse sand, loose to dense, pale yellowish brown to grayish green (10YR 6/2 - 10GY 5/2), moist. [Colluvium and Anthropogenic Fill]		
	1			90 / 1.3			2		**META-WELDED LAPILLI DACITE TUFF,** pale blue (5B 6/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, fresh (I), strong (R4) rock, discontinuities are moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 30 to 35% frequency. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
5					R2			PLT - D	At 3.4 to 4.2 feet bgs - becomes pale yellowish brown (10YR 6/2), highly weathered (IV), very weak (R1) rock		
	2								At 5.3 to 6.2 feet bgs - becomes moderate reddish orange (10R 6/6), slightly weathered (II) moderately weak (R2) rock		
					R4			PLT - D	Becomes grayish green (5G 5/2), fresh (I), strong (R4) rock, discontinuities become widely spaced and in fair to good condition		
				102 / 0.4			3				
10	3										
	4			100 / 0.0			4		Becomes strong to very strong (R4 - R5) rock		
15					R4 R5			PLT - A PLT - D			
	5										
				100 / 0.8			5				
	6										
20											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-05-07

Job No. 03-2007 SR 90 Elevation 2775.5 ft (846.0 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Becomes grayish green (5G 5/2), fresh (I), strong to very strong (R4 - R5) rock, with dusky yellow green (5GY 5/2), slightly weathered (II), moderately strong to strong (R3 - R4) rock enveloping discontinuities, discontinuities become moderately to closely spaced and in good condition		
	7			100 / 1.0			6				
					R5			PLT - D			
25					R5			PLT - D			
	8										
				100 / 0.6			7				
	9										
30											
	10										
				100 / 0.8			8				
35											
	11				R5			PLT - D			
				100 / 0.6			9		Becomes pale blue (5PB 7/2) where fresh (I) rock, with moderate reddish brown (10R 4/6) where slightly weathered (II) rock		
	12										
40											
					R5			PLT - A			
					R5			PLT - D			
	13										
				100 / 0.8			10				
45											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-05-07

Job No. 03-2007 SR 90 Elevation 2775.5 ft (846.0 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become moderately to closely spaced and in good condition		
	14										
				100 / 0.6			11				
	15										
50											
	16										
				100 / 0.8			12				
55					R5			PLT - D			
	17			112 / 1.1	R5		13	PLT - A			
									Becomes moderate reddish brown (10R 4/6), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock, discontinuities become closely to very closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 18 to 23% frequency		
				90 / 3.1			14		At 57.0 to 69.0 feet bgs - healed discontinuities occur greater than 10 per foot		
	18										
60											
	19				R3			PLT - D			
				100 / 2.2			15				
65											
	20								At 66.0 to 66.6 feet bgs - becomes moderately weathered (III), very weak (R1) rock		
				98 / 1.0			16		At 68.2 to 70.0 feet bgs - becomes moderate reddish brown (10R 4/6), slightly to moderately weathered (II - III), very weak to moderately weak (R1 - R2) rock		
	21										
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-05-07

Job No. 03-2007 SR 90 Elevation 2775.5 ft (846.0 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	22								Becomes yellowish gray to medium bluish gray (5Y 8/1 - 5B 5/1), fresh (I), strong to very strong (R4 - R5) rock, with moderate reddish brown (10R 4/6), slightly weathered (II), moderately strong to strong (R3 - R4) rock enveloping discontinuities, discontinuities become moderately to closely spaced and in good condition		
				100 / 1.2	R4		17	PLT - D			
75	23										
									Becomes greenish gray to medium bluish gray (5Y 6/1 - 5B 5/1) where fresh (I) rock		
	24			100 / 0.6			18				
80									Becomes greenish gray to medium bluish gray (5G 6/1 - 5B 5/1), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become widely to moderately spaced and in good to poor condition		
	25									▼	
				100 / 0.0			19		Becomes very strong (R5) rock		
85	26				R4			PLT - D			
	27			98 / 0.2			20				
90											
	28										
				100 / 0.0			21				
95					R5			PLT - D			

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-05-07

Job No. 03-2007 SR 90 Elevation 2775.5 ft (846.0 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29										
	30			100 / 0.0			22				
100									Borehole completed to 99.8 feet bgs on October 6, 2007. Borehole was overcased with HWT casing to 5.0 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 10, 2007. Borehole completed with one vibrating wire piezometer at 98.0 feet bgs on October 18, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 23.9 feet bgs during drilling activities and at 82.1 feet on October 10, 2007 prior to beginning optical borehole survey. VWP #92082 = 96.5 to 98.0 feet bgs #10-20 silica sand filter pack from 88.0 to 99.8 feet bgs Grout mix from 0.0 to 88.0 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 25 to 30 lbs pure bentonite powder Well Tag # = APC 412		
	31										
105	32										
	33										
110											
	34										
115	35										
	36										
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-06-07

Sheet 1 of 5

Job No. 03-2007 SR 90 Elevation 2728.4 ft (831.6 m)

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector K. Yang

Start October 8, 2007 Completion October 10, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-1

Station 1398+55 Offset 297 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 734399.1 Easting 1426496.88 Latitude 47°20'38.165"N

Longitude 121°21'46.327"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				82 / 0.9			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, some cobbles and boulders, with fine to coarse sand, loose to dense, medium light gray (N6), moist. [Colluvium and Anthropogenic Fill]		
	1			96 / 0.6			2		**META-WELDED LAPILLI DACITE TUFF,** pale blue (5B 6/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, fresh (I), strong to very strong (R4 - R5) rock, discontinuities are widely to moderately spaced and in fair to good condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation] At 4.3 to 5.1 feet bgs - becomes dusky yellow green (5GY 5/2), slightly weathered (II), moderately strong to strong (R3 - R4) rock, discontinuities in poor to very poor condition		
5											
	2				R5			PLT - A			
					R5			PLT - D			
				104 / 0.0			3				
10	3		>>								
					R5			PLT - A			
	4			98 / 0.0			4				
					R4			PLT - D			
15											
	5									▼	
				100 / 0.4			5				
	6										
20											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-06-07

Job No. 03-2007 SR 90 Elevation 2728.4 ft (831.6 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become moderately to closely spaced and in very poor to good condition, discontinuity in poor to very poor condition occur at a 10 to 15% frequency		
	7			100 / 1.0	R4		6	PLT - D			
25									Becomes moderately strong to strong (R3 - R4) rock		
	8										
				102 / 1.8			7		At 27.8 feet bgs - becomes grayish gray (5G 5/2), fresh (I), strong (R4) rock		
	9								At 29.0 to 29.5 feet bgs - becomes dusky yellow green (5GY 5/2), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock		
30					R4 R3			PLT - D PLT - A			
	10			102 / 0.6	R4		8	PLT - A	Becomes grayish green to medium bluish gray (5G 5/2 - 5B 5/1), fresh (I), strong to very strong (R4 - R5) rock, discontinuities become moderately to closely spaced and in fair to good condition		
35			>>								
	11										
				98 / 1.2			9				
	12										
40											
	13			100 / 0.0	R4		10	PLT - D	Discontinuities become very widely to moderately spaced and in fair to good condition		
				100			11				
45											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-06-07

Job No. 03-2007 SR 90 Elevation 2728.4 ft (831.6 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				0.3					Discontinuities become very widely to moderately spaced and in fair to good condition		
	14				R5			PLT - A			
				98 / 0.6			12				
	15										
50											
					R4			PLT - A			
	16				R5			PLT - D			
				102 / 0.2			13				
55											
	17										
				100 / 0.2			14				
	18										
60											
	19										
				100 / 0.4			15				
65											
	20										
					R4			PLT - D			
				100 / 0.2	R4		16	PLT - D			
	21										
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-06-07

Job No. 03-2007 SR 90 Elevation 2728.4 ft (831.6 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become very widely to moderately spaced and in fair to good condition		
	22										
				100 / 0.0			17				
75	23										
					R4			PLT - D			
					R3			PLT - D			
				102 / 0.0			18				
	24										
80				>>							
	25										
				100 / 0.0			19				
					R4			PLT - A			
85	26				R4			PLT - D			
				98 / 0.4			20				
	27										
90											
	28										
				100 / 0.2	R4		21	PLT - D			
95											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-06-07

Job No. 03-2007 SR 90 Elevation 2728.4 ft (831.6 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29										
	30			95 / 0.0			22				
100									Borehole completed to 100.0 feet bgs on October 10, 2007. Borehole was overcased with HWT casing to 2.9 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 11, 2007. Groundwater was measured at approximately 16.9 feet bgs during drilling activities and at 16.9 feet on October 11, 2007 prior to beginning optical borehole survey. Borehole backfilled with bentonite chips on October 19, 2007.		
	31										
105	32										
	33										
110											
	34										
115	35										
	36										
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-07-07

Sheet 1 of 5

Job No. 03-2007 SR 90 Elevation 2656.5 ft (809.7 m)

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector A. Shriver

Start October 11, 2007 Completion October 17, 2007 Well ID# SI-07-07

Equipment Skid-Mounted Burley 5500-2

Station 1398+66 Offset 186 Feet Left Casing Stick-up Monument

Method HQ3 Triple Tube Wireline

Northing 734670.48 Easting 1426357.76 Latitude 47°20'40.829"N

Longitude 121°21'48.391"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				84 / >1.9			1		**GRAVEL [GP - GM],** fine to coarse, angular GRAVEL, some cobbles and boulders, with fine to coarse sand and silt, trace organics, loose to dense, medium light gray (N6), moist. [Colluvium and Anthropogenic Fill]		
	1								**META-WELDED LAPILLI DACITE TUFF,** dark yellowish orange to moderate yellowish brown to pale yellowish brown (10YR 6/6 - 10YR 6/2 - 10YR 5/4), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, moderately to highly weathered (III - IV), very weak to moderately strong (R1 - R3) rock, discontinuities are closely spaced and in poor to good condition, discontinuities in poor condition occur at a 13 to 18% frequency. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
5				88 / 3.2			2				
	2								At 3.5 feet bgs - becomes slightly to moderately weathered (II - III), moderately weak to moderately strong (R2 - R3) rock		
				33 / 2.5			3				
				108 / 2.1			4		Becomes medium bluish gray (5B 5/1), fresh (I), moderately strong (R3) rock, with light brown to medium dark gray (5YR 5/6 - N4), slightly weathered (II), moderately strong (R3) rock, enveloping discontinuities, discontinuities become closely to very closely spaced and in poor to good condition, discontinuities in fair condition occur at a 15 to 20% frequency, discontinuities in poor condition occur at a 5 to 10% frequency		
10	3										
				100 / 2.4			5		Becomes very strong (R5) where fresh (I) rock, with strong (R4) where slightly weathered (II) rock enveloping discontinuities		
	4				R5			PLT - D			
15											
	5			94 / >1.7			6		At 16.6 to 18.5 feet bgs - 0.4 feet core loss, discontinuity in very poor condition		
	6										
20											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-07-07

Job No. 03-2007 SR 90 Elevation 2656.5 ft (809.7 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				104 / 1.7	R5 R5		7	PLT - D PLT - A	Discontinuities become closely to very closely spaced and in poor to good condition, discontinuities in fair condition occur at a 15 to 20% frequency, discontinuities in poor condition occur at a 5 to 10% frequency Becomes light brown to medium dark gray (5YR 5/6 - N4), fresh to slightly weathered (I - II), strong to very strong (R4 - R5) rock enveloping discontinuities		
25	7										
	8			94 / 1.7			8				
30	9										
				104 / 1.3	R4 R5		9	PLT - A PLT - D	Becomes medium bluish gray (5B 5/1), fresh (I), very strong (R5) rock with light brown (5YR 5/6), fresh to slightly weathered (I - II), very strong (R5) rock enveloping discontinuities, discontinuities become moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 15 to 20% frequency		
35	10										
	11			96 / 2.1			10				
40	12										
				100 / 0.8			11				
	13				R5 R4			PLT - A PLT - D			
45											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-07-07

Job No. 03-2007 SR 90 Elevation 2656.5 ft (809.7 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	14								Discontinuities become moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 15 to 20% frequency		
				90 / 2.0			12				
					R5			PLT - D			
	15										
50											
				112 / 1.8			13		Becomes light brown to medium gray (5YR 5/6 - N5), fresh to slightly weathered (I - II), strong (R4) rock		
	16										
				113 / 5.0			14				
55											
	17			94 / 1.2			15		Discontinuities become moderately to closely spaced and in good condition		
	18										
				113 / 0.7			16		Becomes medium bluish gray (5B 5/1), fresh (I), very strong (R5) rock with light brown (5YR 5/6), fresh to slightly weathered (I - II), very strong (R5) rock enveloping discontinuities		
60			>>								
				100 / 1.2			17				
	19										
					R5			PLT - D			
65											
	20										
				100 / 0.8			18				
					R5			PLT - D			
	21										
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-07-07

Job No. 03-2007 SR 90 Elevation 2656.5 ft (809.7 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									Discontinuities become moderately to closely spaced and in good condition		
	22			98 / 1.2			19				
75	23										
				100 / 1.0	R4		20	PLT - D	Becomes light brown to medium dark gray (5YR 5/6 - N4), fresh to slightly weathered (I - II), strong to very strong (R4 - R5) rock		
	24										
80											
	25			98 / 1.6			21				
85	26										
				100 / >2.2	R5		22	PLT - D			
	27										
90									At 90.5 to 91.0 feet bgs - discontinuity in very poor condition		
	28			100 / 0.8			23		At 91.5 to 91.6 feet bgs - 0.1 feet core loss At 91.8 to 92.8 feet bgs - discontinuity in poor condition		
					R5			PLT - D			
95											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02074

HOLE No. SI-07-07

Job No. 03-2007 SR 90 Elevation 2656.5 ft (809.7 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29										
				97 / >2.7			24		At 96.6 to 96.7 feet bgs - 0.1 feet core loss		
	30										
100											
	31								Borehole completed to 100.2 feet bgs on October 17, 2007. Borehole was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 19, 2007. Borehole completed with two vibrating wire piezometers at 41.5 feet and 98.0 feet bgs on October 22, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 47.3 feet bgs during drilling activities and at 47.9 feet on October 19, 2007 prior to beginning optical borehole survey.		
105	32								VWP #92274 = 40.0 to 41.5 feet bgs VWP #92081 = 96.5 to 98.0 feet bgs #10-20 silica sand filter pack from 88.0 to 100.2 feet bgs Grout mix from 0.0 to 88.0 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 30 to 35 lbs pure bentonite powder Well Tag # = APC 410		
	33										
110											
	34										
115	35										
	36										
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-08-07

Sheet 1 of 5

Job No. 03-2007 SR 90 Elevation 2655.1 ft (809.3 m)

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector A. Shriver

Start October 18, 2007 Completion October 20, 2007 Well ID# SI-08-07

Equipment Skid-Mounted Burley 5500-2

Station 1399+01 Offset 192 Feet Left Casing Stick-up Monument

Method HQ3 Triple Tube Wireline

Northing 734605.24 Easting 1426364.62 Latitude 47°20'40.186"N

Longitude 121°21'48.281"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				92 / 0.8			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, some cobbles and boulders, with fine to coarse sand, trace silt and clay, trace organics, loose to dense, moist. [Colluvium and Anthropogenic Fill]		
5	1			75 / 1.3			2		**META-WELDED LAPILLI DACITE TUFF,** medium bluish gray (5B 5/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, fresh (I), strong to very strong (R4 - R5) rock, with light brown to dusky yellowish green (5YR 5/6 - 5GY 5/2), fresh to slightly weathered (I - II), strong to very strong (R4 - R5) rock enveloping discontinuities, discontinuities are closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 15 to 20% frequency, discontinuities in fair condition occur at a 10 to 15% frequency. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
10	2			118 / 1.3			3				
	3		>>		R5			PLT - D		▼	
15	4			120 / 1.7			4				
	5			51 / 1.2			5		At 16.8 to 17.3 feet bgs - becomes light brown (5YR 5/6), slightly weathered (II), moderately strong (R3) rock, discontinuity in very poor condition Becomes highly weathered (IV), extremely weak (R0) rock At 17.4 to 19.55 feet bgs - 2.15 feet core loss		
20	6										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-08-07

Job No. 03-2007 SR 90 Elevation 2655.1 ft (809.3 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			>>	160 / 2.4	R2		6 / 7	PLT - D	Becomes light brown to dark yellowish orange (5YR 5/6 - 10YR 6/6), slightly to moderately weathered (II - III), moderately weak (R2) rock, discontinuities become closely to very closely spaced and in poor to good condition, discontinuities in poor condition occur at a 5 to 10% frequency, discontinuities in fair condition occur at a 7 to 12% frequency		
	7										
25				64 / >4.1			8		Becomes very weak to moderately weak (R1 - R2) rock		
	8								At 26.8 to 27.4 feet bgs - becomes moderately to highly weathered (III - IV), extremely weak to very weak (R0 - R1) rock At 27.4 to 29.2 feet bgs - 1.2 feet core loss		
	9			70 / >14.3			9				
30				104 / 1.2			10		Becomes light brown to moderate yellowish brown (5YR 5/6 - 10YR 5/4), slightly weathered (II), moderately weak (R2) rock		
	10			108 / 1.4			11				
			>>								
35				96 / >3.6			12				
	11										
	12								At 39.2 to 39.9 feet bgs - becomes moderately to highly weathered (III - IV), extremely weak (R0) rock		
40				105 / >5.7			13		Discontinuities become closely to very closely spaced and in poor to good condition, discontinuities in poor condition occur at a 25 to 30% frequency, discontinuities in fair condition occur at a 25 to 30% frequency		
	13			79 / 4.1			14		At 41.3 to 42.1 feet bgs - becomes moderately to highly weathered (III - IV), extremely weak (R0) rock At 42.1 to 42.0 feet bgs - 0.1 feet core loss		
45											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-08-07

Job No. 03-2007 SR 90 Elevation 2655.1 ft (809.3 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	14			108 / 2.1			15		Becomes light brown to moderate yellowish brown (5YR 5/6 - 10YR 5/4), slightly weathered (II), moderately weak to moderately strong (R2) rock, discontinuities become closely to very closely spaced and in poor to good condition, discontinuities in poor condition occur at a 25 to 30% frequency, discontinuities in fair condition occur at a 25 to 30% frequency At 47.8 to 49.9 feet bgs - healed discontinuities at greater than 10 per foot		
	15			113 / 2.6			16				
50				100 / 4.2			17		Becomes dusky yellowish green to light olive gray to light brown (5GY 5/2 - 5Y 5/2 - 5YR 5/6), fresh to slightly weathered (I - II), moderately strong to strong (R3 - R4) rock At 50.6 to 51.2 feet bgs - discontinuity in very poor condition		
	16			71 / 0.7			18		At 52.5 to 53.9 feet bgs - discontinuities in poor condition At 53.8 to 54.8 feet bgs - 1.0 feet core loss associated with driller mislatch		
55	17			100 / 1.8	R5		19	PLT - D	Becomes medium bluish gray (5B 5/1), fresh (I), strong to very strong (R4 - R5) rock, with light brown to dusky yellowish green (5YR 5/6 - 5GY 5/2), slightly weathered (II), strong to very strong (R4 - R5) rock enveloping discontinuities		
	18			97 / 2.8			20		At 59.3 to 59.4 feet bgs - 0.1 feet core loss Becomes dusky yellowish green to light olive gray to light brown (5GY 5/2 - 5Y 5/2 - 5YR 5/6), fresh to slightly weathered (I - II), strong to very strong (R4 - R5) rock, discontinuities become closely to very closely spaced and in poor to good condition, discontinuities in poor condition occur at a 3 to 8% frequency, discontinuities in fair condition occur at a 10 to 15% frequency		
60	19			95 / 3.3	R4		21	PLT - D			
65	20			94 / 103			22				
	21		>>	104 / 0.8			23		Becomes medium bluish gray to dark greenish gray (5B 5/1 - 5G 4/1), fresh (I), very strong (R5) rock, discontinuities become widely to moderately spaced and in fair to good condition		
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-08-07

Job No. 03-2007 SR 90 Elevation 2655.1 ft (809.3 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				92 / 0.4	R5 R5		24	PLT - A PLT - D	Discontinuities become widely to moderately spaced and in fair to good condition		
	22										
				0 / 0.0			25		No recovery, driller unable to break core off bottom of borehole		
75	23			261 / 0.0			26				
				114 / 0.0			27				
	24				R5 R4			PLT - D PLT - A			
80				82 / 0.5			28				
	25										
85	26			69 / 0.6			29				
				150 / 0.3	R5 R5		30	PLT - A PLT - D			
	27										
90				110 / 1.1			31				
	28								Discontinuities become closely to very closely spaced and in good condition		
				100 / 1.4			32				
95											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-08-07

Job No. 03-2007 SR 90 Elevation 2655.1 ft (809.3 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29										
				87 / 0.9			33				
	30										
100											
									Borehole completed to 100.1 feet bgs on October 20, 2007. Borehole was overcased with HWT casing to 5.5 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 21, 2007. Borehole completed with slope inclinometer casing to 100.1 feet bgs on October 21, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 47.4 feet bgs during drilling activities and at 11.4 feet on October 21, 2007 prior to beginning optical borehole survey. Slope inclinometer casing = 0.0 to 100.1 feet bgs: RocTest casing type A+ Azimuth = 270 degrees Grout mix from 0.0 to 100.1 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 25 to 30 lbs pure bentonite powder Well Tag # = APC 411		
	31										
105	32										
	33										
110											
	34										
115	35										
	36										
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-09-07

Sheet 1 of 5

Job No. 03-2007 SR 90 Elevation 2658.3 ft (810.3 m)

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector A. Shriver

Start October 22, 2007 Completion October 23, 2007 Well ID# SI-09-07

Equipment Skid-Mounted Burley 5500-2

Station 1399+77 Offset 198 Feet Left Casing Stick-up Monument

Method HQ3 Triple Tube Wireline

Northing 734540.16 Easting 1426374.45 Latitude 47°20'39.544"N

Longitude 121°21'48.127"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				43 / 0.0			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, some cobbles and boulders, with fine to coarse sand, trace silt and clay, trace organics, loose to dense, moist. [Colluvium and Anthropogenic Fill]		
5	1, 2			88 / 0.7			2		**META-WELDED LAPILLI DACITE TUFF,** medium bluish gray (5B 5/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, fresh (I), very strong (R5) rock, discontinuities are moderately to closely spaced and in poor to good condition, discontinuities in poor to very poor condition occur at a 18 to 23% frequency. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
10	3			98 / 1.1	R5		3	PLT - D			
	4			100 / 0.8			4		Becomes light olive gray to moderate yellowish brown (5Y 5/2 - 10YR 5/4), fresh to slightly weathered (I - II), strong (R4) rock		
15	5			97 / 1.4			5		Becomes light brown to moderate yellowish brown (5YR 5/6 - 10YR 5/4), slightly weathered (II), moderately strong (R3) rock At 15.5 to 15.9 feet bgs - discontinuity in very poor condition At 15.6 to 16.7 feet bgs - becomes moderately to highly weathered (III - IV), extremely weak to very weak (R0 - R1) rock At 16.7 to 17.3 feet bgs - becomes slightly to moderately weathered (II - III), moderately weak (R2) rock Becomes moderate yellowish brown to medium dark gray (10YR 5/4 - N4), slightly weathered (II), moderately weak (R2) rock, discontinuities become moderately to closely spaced and in poor to good		
20	6										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-09-07

Job No. 03-2007 SR 90 Elevation 2658.3 ft (810.3 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									condition, discontinuities in poor condition occur at a 30 to 40% frequency		
				33 / >10.0			6		Becomes light brown to moderate yellowish brown (5YR 5/6 - 10YR 5/4), slightly weathered (II), moderately weak to moderately strong (R2 -R3) rock		
				80 / >10.0			7		At 20.9 to 22.3 feet bgs - 2.1 feet core loss		
	7								At 22.3 feet bgs - becomes moderately to highly weathered (III - IV), extremely weak to very weak (R0 - R1) rock		
25				90 / 2.8			8		At 24.7 to 24.9 feet bgs - 0.2 feet core loss At 24.9 to 26.7 and 29.4 to 31.1 feet bgs - becomes slightly to moderately weathered (II - III), very weak to moderately weak (R1 - R2) rock		
	8										
				84 / >10.0			9				
	9								At 29.4 to 29.9 feet bgs - 0.4 feet core loss		
30				100 / 11.1			10		Discontinuities become very closely spaced and in good condition, occur greater than 10 per foot		
				70 / >13.0			11			▼	
	10									▽	
									At 33.6 to 35.0 feet bgs - becomes slightly to moderately weathered (II - III), very weak to moderately weak (R1 - R2) rock		
35				109 / 1.6			12		At 33.0 to 35.0 feet bgs - 1.0 feet core loss Becomes slightly to moderately weathered (II - III), moderately weak (R2) rock, discontinuities become closely spaced and in good condition		
	11										
				79 / >9.5			13		Becomes highly weathered (IV), extremely weak (R0) rock, discontinuity in poor condition		
	12								At 38.9 to 39.9 feet bgs - 1.0 feet core loss		
40				82 / 0.9			14		Becomes moderately weathered (III), very weak (R1) rock, discontinuities become closely spaced and in poor to very poor condition, healed discontinuities occur greater than 20 per foot		
	13			98 / 0.7			15		Becomes light brown to pale moderate yellowish brown to moderate yellowish brown (5YR 5/6 - 10YR 6/2 - 10YR 5/4), moderately weathered (III), moderately weak (R2) rock, discontinuities become moderately to closely spaced and in good condition		
45									At 44.5 to 44.8 feet bgs - becomes highly weathered		

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-09-07

Job No. 03-2007 SR 90 Elevation 2658.3 ft (810.3 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									(IV), extremely weak (R0) rock		
	14			92 / 0.9			16		At 45.9 feet bgs - becomes light brown (5YR 5/6), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock, discontinuities become closely spaced and in good to poor condition, healed discontinuities occur greater than 10 per foot		
				67 / 2.8			17				
	15										
50				147 / 107			18				
				>>							
				93 / 1.2			19				
	16										
55				100 / 1.9			20		At 55.0 to 55.1 feet bgs - 0.15 feet core loss		
	17								Becomes medium bluish gray (5B 5/1), fresh (I), strong to very strong (R4 - R5) rock, with light brown (5YR 5/6), slightly weathered (II), strong to very strong (R4 - R5) rock enveloping discontinuities, discontinuities are closely to very closely spaced and in good condition		
				100 / 3.0	R4		21	PLT - D			
	18										
60											
				100 / 2.1			22		Becomes dusky yellow green (5GY 5/2) where fresh (I) rock		
	19										
				100 / 1.9			23				
65											
	20										
				98 / 1.8			24		Becomes medium bluish gray to dusky yellow green (5B 5/1 - 5GY 5/2), fresh to slightly weathered (I - II), very strong (R5) rock		
					R5			PLT - D			
	21										
70											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-09-07

Job No. 03-2007 SR 90 Elevation 2658.3 ft (810.3 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	22			94 / 1.7			25		Discontinuities become moderately to closely spaced and in poor condition		
75	23										
				109 / 1.6	R4		26	PLT - D	At 76.5 to 76.7 feet bgs - 0.2 feet core loss Discontinuities become moderately to closely spaced and in fair to good condition		
80	24										
	25			97 / 69			27		Becomes medium bluish gray to dark greenish gray (5B 5/1 - 5G 4/1), fresh (I), very strong (R5) rock, discontinuities become moderately to closely spaced and in poor to good condition , discontinuities in poor condition occur at a 13 to 18% frequency		
85	26			74 / 0.5	R5		28	PLT - D			
	27			115 / 75			29				
90	28			88 / 1.3			30				
95					R5			PLT - D	At 94.4 to 94.85 feet bgs - 0.45 feet core loss		

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card RE02062

HOLE No. SI-09-07

Job No. 03-2007 SR 90 Elevation 2658.3 ft (810.3 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29			113 / 0.8			31		associated with driller unable to break core off bottom of borehole		
				95 / 1.4			32				
	30										
100									Borehole completed to 100.05 feet bgs on October 23, 2007. Borehole was overcased with HWT casing to 4.2 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on November 1, 2007. Borehole completed with slope inclinometer casing to 100.05 feet bgs on November 7, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 33.1 feet bgs during drilling activities and at 32.3 feet on November 1, 2007 prior to beginning optical borehole survey. Slope inclinometer casing = 0.0 to 100.05 feet bgs: RocTest casing type A+ Azimuth = 274 degrees Grout mix from 0.0 to 100.05 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 25 to 30 lbs pure bentonite powder Well Tag # = APC 409		
	31										
105	32										
	33										
110											
	34										
115	35										
	36										
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-10-07

Sheet 1 of 5

Job No. 03-2007 SR 90 Elevation 2664.3 ft (812.1 m)

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector A. Shriver

Start October 24, 2007 Completion October 31, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-2

Station 1400+52 Offset 203 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 734476.68 Easting 1426386.79 Latitude 47°20'38.919"N

Longitude 121°21'47.938"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				68 / N/A			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, some cobbles and boulders, with fine to coarse sand, trace silt and clay, trace organics, loose to dense, moist. [Colluvium and Anthropogenic Fill]		
	1										
5				67 / 0.3			2		At 4.7 to 6.1 feet bgs - 1.4 feet core loss		
	2										
10	3			121 / 0.0			3		**META-WELDED LAPILLI DACITE TUFF,** dark greenish gray to medium dark gray (5G 4/1 - N4), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, fresh (I), very strong (R5) rock, discontinuities are moderately to very closely spaced and in good condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
				72 / 1.1			4				
	4								At 12.8 to 14.1 feet bgs - 1.3 feet core loss		
15					R5 R5			PLT - D PLT - A			
	5			75 / 0.8			5				
									At 18.9 to 19.5 feet bgs - discontinuity in very poor condition		
	6										
20											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-10-07

Job No. 03-2007 SR 90 Elevation 2664.3 ft (812.1 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
									At 19.95 to 21.0 feet bgs - 1.05 feet core loss		
				108 / 0.7			6		Becomes medium bluish gray to dark greenish gray (5B 5/1 - 5G 4/1) rock, discontinuities becomes moderately to very closely spaced and in good condition		
	7										
				96 / 2.2			7			▽	
25					R5			PLT - A			
	8			113 / 0.0	R5		8	PLT - D			
				100 / 1.4			9		Becomes dusky yellow green (5GY 5/2), fresh to slightly weathered (I - II), very strong (R5) rock, discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 15 to 20% frequency, discontinuities in fair condition occur at a 23 to 28 % frequency		
	9			98 / 1.5			10				
30											
				100 / 0.8			11		Becomes dark greenish gray (5G 4/1), fresh (I), very strong (R5) rock		
	10									▼	
					R5 R4			PLT - A PLT - D			
35											
	11			100 / 1.0			12				
	12										
40											
				100 / 0.9	R4		13	PLT - D			
	13										
45				97			14				

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-10-07

Job No. 03-2007 SR 90 Elevation 2664.3 ft (812.1 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				0.6					At 44.4 to 49.1 feet bgs - becomes strong to very strong (R4 - R5) rock, discontinuities become closely to very closely spaced and in good to very poor condition, discontinuities in very poor condition occur at a 55 to 60% frequency, healed discontinuities occur greater than 10 per foot		
	14			100 / 2.3			15				
	15			103 / 2.6			16				
50									Discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 15 to 20% frequency, discontinuities in fair condition occur at a 10 to 20 % frequency		
				100 / 1.4			17				
	16										
				98 / 1.0	R4		18	PLT - D			
55											
	17			102 / 1.3			19				
	18			89 / 1.8			20				
60											
				102 / 0.8	R5		21	PLT - D			
	19										
65											
	20			88 / 0.5			22				
	21			108 / 0.4			23				
70				>>							

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-10-07

Job No. 03-2007 SR 90 Elevation 2664.3 ft (812.1 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				102 / 1.4			24		Becomes medium bluish gray (5B 5/1), fresh (I), strong to very strong (R4 - R5) rock, with light brown (5YR 5/6), slightly weathered (II), strong to very strong (R4 - R5) rock enveloping discontinuities, discontinuities become closely to very closely spaced and in good condition		
	22										
75	23			90 / 2.9	R5 R4		25	PLT - A PLT - D	Becomes strong (R4) rock		
	24										
80				122 / 1.6			26		Discontinuities become closely and very closely spaced and in poor to good condition, discontinuities in poor condition occur at a 10 to 15% frequency, discontinuities in fair condition occur at a 20 to 25% frequency		
	25			>>							
				98 / 1.2			27		At 84.2 to 84.5 feet bgs - discontinuity in very poor condition, observed as fault infilled with clay, silt, and rock fragments as zone of highly to completely weathered (IV - V), extremely weak (R0) rock		
85	26			88 / 1.1			28		At 84.5 to 85.4 feet bgs - Becomes moderately to highly weathered (III - IV), extremely weak to very weak (R0 - R1) rock, healed discontinuities occur greater than 25 per foot At 85.4 to 88.0 feet bgs - becomes light brown to pale yellowish brown (5YR 5/6 - 10YR 6/2), slightly to moderately weathered (II - III), moderately weak to moderately strong (R2 - R3) rock		
	27										
90									At 90.4 to 91.9 feet bgs - 1.4 feet core loss		
				28 / 2.9			29				
	28								Becomes strong to very strong (R4 - R5) rock At 92.5 to 94.8 feet bgs - 3.7 feet core loss associated with driller mislatch		
				48 / >0.8			30				
95											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-10-07

Job No. 03-2007 SR 90 Elevation 2664.3 ft (812.1 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29										
				95 / 1.8			31		Becomes moderately strong (R3) rock		
	30										
100				67 / 0.0			32		At 99.8 to 100.5 feet bgs - 0.7 feet core loss Becomes dark greenish gray (5G 4/1), fresh (I), very strong (R5) rock		
	31			97 / 0.0			33		At 102 to 105.5 feet bgs - becomes moderately strong (R3) rock, healed discontinuities occur at 5 to 10 per foot		
105	32				R5			PLT - D			
	33								Borehole completed to 106.0 feet bgs on October 31, 2007. Borehole was overcased with HWT casing to 3.0 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on November 1, 2007. Groundwater was measured at approximately 24.0 feet bgs during drilling activities and at 33.4 feet on November 1, 2007 prior to beginning optical borehole survey. Borehole backfilled with bentonite chips on November 3, 2007.		
110											
	34										
115	35										
	36										
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-11-07

Job No. 03-2007 SR 90 Elevation 2659.5 ft (810.6 m)

Sheet 1 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector A. Shriver

Start November 3, 2007 Completion November 5, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-2

Station 1401+33 Offset 192 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 734405.78 Easting 1426387.82 Latitude 47°20'38.220"N

Longitude 121°21'47.912"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				79 / 1.0			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, some cobbles and boulders, with fine to coarse sand, trace silt and clay, trace organics, loose to dense, moist. [Colluvium and Anthropogenic Fill]		
	1								**META-WELDED LAPILLI DACITE TUFF,** dark greenish gray (5G 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 45%), slightly welded, fresh (I), strong (R4) rock, discontinuities are closely spaced and in fair to poor condition. [Tuff member of Lake Keechelus, Ohanapecosh Formation] Becomes fresh to slightly weathered (I - II) rock		
5				98 / 2.1			2		Healed discontinuities occur greater than 2 per foot		
	2										
	3										
10				94 / 0.6			3		Becomes olive gray to moderate olive brown (5Y 4/1 - 5Y 4/4), strong to very strong (R4 - R5) rock, discontinuities become moderately to closely spaced and in good condition, healed discontinuities occur 8 to 10 per foot		
	4				R5			PLT - D			
15				111 / 1.0			4		Becomes olive gray to moderate olive brown (5Y 4/1 - 5Y 4/4), fresh (I), very strong (R5) rock, discontinuities become moderately to very closely spaced and in good condition, healed discontinuities occur 6 to 10 per foot		
	5			>>							
	6				R5			PLT - D			
20											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-11-07

Job No. 03-2007 SR 90 Elevation 2659.5 ft (810.6 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				93 / 1.5			5				
									Healed discontinuities occur 1 to 2 per foot to end of borehole		
	7			102 / 0.0			6		Becomes dark greenish gray (5G 4/1) rock, discontinuities become moderately spaced at widely spaced intervals and in poor to good condition		
25				78 / 0.0			7				
	8										
	9										
30				90 / 0.4	R5 R5		8	PLT - D PLT - A			
	10										
35				111 / 77			9				
	11										
	12										
40				92 / 0.4			10				
	13				R5 R5 R4			PLT - D PLT - A PLT - D			
45											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-11-07

Job No. 03-2007 SR 90 Elevation 2659.5 ft (810.6 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	14			103 / 0.0			11		Becomes medium bluish gray (5B 5/1), fresh (I), very strong (R5) rock, discontinuities become moderately spaced at widely spaced intervals and in poor to good condition, discontinuities in poor condition occur at a 5 to 10% frequency, discontinuities in fair condition occur at a 10 to 15% frequency		
	15			111 / 0.5			12				
50				102 / 0.4	R5		13	PLT - D			
	16				R5			PLT - A			
					R5			PLT - D			
55											
	17			98 / 0.0			14				
	18										
60				99 / 1.2	R5		15	PLT - A			
	19				R4			PLT - D			
					R4			PLT - D			
65											
	20			85 / 0.2			16				
	21										
70											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-11-07

Job No. 03-2007 SR 90 Elevation 2659.5 ft (810.6 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				110 / 0.4			17		Becomes dark greenish gray (5G 4/1), fresh (I), very strong (R5) rock, discontinuities become moderately spaced at widely spaced intervals and in fair to good condition, discontinuities in fair condition occur at a 8 to 13% frequency		
	22				R5 R5			PLT - D PLT - A			
				123 / 0.3			18				
75											
	23			86 / 0.5			19				
	24										
80				88 / 0.0	R4 R3		20	PLT - D PLT - A			
	25										
				155 / 0.0			21				
85	26			92 / 0.4			22				
	27										
90				106 / 0.0			23				
	28				R5 R4			PLT - D PLT - A			
95											

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-11-07

Job No. 03-2007 SR 90 Elevation 2659.5 ft (810.6 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29			99 / 0.2			24				
	30										
100					R4			PLT - D			
					R4			PLT - A	Borehole completed to 100.3 feet bgs on November 5, 2007. Borehole was overcased with HWT casing to 2.8 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on November 7, 2007. Groundwater was measured at approximately 53.8 feet bgs during drilling activities and at 53.7 feet on November 7, 2007 prior to beginning optical borehole survey. Borehole backfilled with bentonite chips on November 7, 2007.		
	31										
105	32										
	33										
110											
	34										
115	35										
	36										
120											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-12-07

Job No. 03-2007 SR 90 Elevation 2674.0 ft (815.0 m)

Sheet 1 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector A. Shriver

Start November 6, 2007 Completion November 7, 2007 Well ID# Not Applicable

Equipment Skid-Mounted Burley 5500-2

Station 1401+69 Offset 200 Feet Left Casing Not Applicable

Method HQ3 Triple Tube Wireline

Northing 734754.64 Easting 1426375.76 Latitude 47°20'41.661"N

Longitude 121°21'48.143"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				84 / 0.7			1		**GRAVEL [GP],** fine to coarse, angular GRAVEL, some cobbles and boulders, with fine to coarse sand, trace silt and clay, trace organics, loose to dense, moist. [Colluvium and Anthropogenic Fill]		
	1								**META-WELDED LAPILLI DACITE TUFF,** dark greenish gray (5G 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized entrained clasts (20 to 50%), slightly welded, fresh (I), very strong (R5) rock, discontinuities are moderately to closely spaced and in good to very poor condition, discontinuities in poor to very poor condition occur at a 60 to 65% frequency. [Tuff member of Lake Keechelus, Ohanapecosh Formation]		
5				92 / 1.6			2		At 5.0 to 5.3 feet bgs - 0.3 feet core loss		
	2								At 7.7 to 9.1 feet bgs - becomes light olive gray to greenish gray (5Y 5/2 - 5GY 6/1), slightly weathered (II), moderately weak (R2) rock		
10	3			84 / 3.1			3		Becomes fresh to slightly weathered (I - II), moderately weak to strong (R2 - R4) rock		
				103 / 1.6	R5 R5		4	PLT - A PLT - D		▼ ▽	
	4								Becomes dark greenish gray (5G 4/1), fresh (I), very strong (R5) rock, discontinuities become moderately spaced and in good condition		
15				92 / 0.0			5				
	5										
				110 / 0.4			6				
				>>	R5			PLT - A			
20	6										

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-12-07

Job No. 03-2007 SR 90 Elevation 2674.0 ft (815.0 m)

Sheet 2 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				96 / 0.8	R5		7	PLT - D	Discontinuities become moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 12 to 17% frequency, discontinuities in fair condition occur at a 10 to 15% frequency		
	7										
25				102 / 1.0			8				
	8										
	9										
30				98 / 0.8	R5 R5		9	PLT - D PLT - A			
	10										
35				94 / 1.3			10				
	11										
	12				R4 R5			PLT - A PLT - D			
40				100 / 1.3			11				
	13										
45				110			12				

ROCK SCS BOREHOLES 2007.GPJ 3/5/08

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-12-07

Job No. 03-2007 SR 90 Elevation 2674.0 ft (815.0 m)

Sheet 3 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) (20 40 60 80)	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	14			2.2							
				85 / 0.0			13a				
	15										
50				110 / 1.6			13b		Discontinuities become moderately to very closely spaced and in poor to good condition, discontinuities in poor condition occur at a 28 to 33% frequency, discontinuities in fair condition occur at a 25 to 30% frequency		
					R5			PLT - D			
	16		>>		R4			PLT - A			
55				91 / 2.2			14				
					R3			PLT - D			
	17										
									At 57.2 to 61.6 feet bgs - becomes light olive gray to greenish gray (5Y5/2 - 5G 6/1), fresh (I), strong to very strong (R4 - R5) rock		
				100 / 2.4			15				
	18										
60				104 / 1.5			16				
					R4			PLT - D			
	19			84 / 0.5			17				
65				120 / 0.3			18				
	20		>>						Discontinuities become moderately to very closely spaced and in poor to good condition, discontinuities in poor condition occur at a 5 to 10% frequency		
				107 / 0.8			19				
	21										
					R5			PLT - A			
70					R4			PLT - D			

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-12-07

Job No. 03-2007 SR 90 Elevation 2674.0 ft (815.0 m)

Sheet 4 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
				100 / 1.0			20		Discontinuities become moderately to very closely spaced and in poor to good condition, discontinuities in poor condition occur at a 5 to 10% frequency		
	22										
75				100 / 1.0			21				
	23										
	24										
80				96 / 1.0	R5 R5		22	PLT - A PLT - D			
	25										
85				108 / 3.1			23		At 84.7 to 86.0 feet bgs - discontinuities becomes very closely spaced and in poor condition		
	26			83 / 0.0	R4		24	PLT - D	At 86.4 feet bgs - becomes dusky yellowish green (5GY 5/2), fresh to slightly weathered (I - II), strong to very strong (R4 - R5) rock At 86.8 feet bgs - discontinuities become closely to very closely spaced and in good to poor condition At 87.4 feet bgs - becomes pale yellowish brown to light brown (10YR 6/2 - 5YR 5/6), slightly to moderately weathered (II - III), moderately weak (R2) rock		
	27			94 / 1.5			25		At 88.0 feet bgs - becomes moderately to highly weathered (III - IV), extremely weak (R0) rock At 88.4 to 90.15 feet bgs - 0.75 feet core loss Becomes slightly to moderately weathered (II - III), moderately weak (R2) rock		
90											
	28								At 90.4 feet bgs - becomes slightly weathered (II), very weak to moderately weak (R1 - R2) rock At 90.8 feet bgs - becomes dusky yellowish green (5GY 5/2), fresh to slightly weathered (I - II), strong (R4) rock		
				101 / 0.0			26		At 92.2 feet bgs - becomes dark greenish gray (5G 4/1), fresh (I), very strong (R5) rock, discontinuities become moderately to closely spaced at widely		
95											

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card SE01976

HOLE No. SI-12-07

Job No. 03-2007 SR 90 Elevation 2674.0 ft (815.0 m)

Sheet 5 of 5

Project 2007 I-90 Geotechnical Slide Curve Scarp Investigation

Driller S. Wilson/S. Tunison Lic# 2628

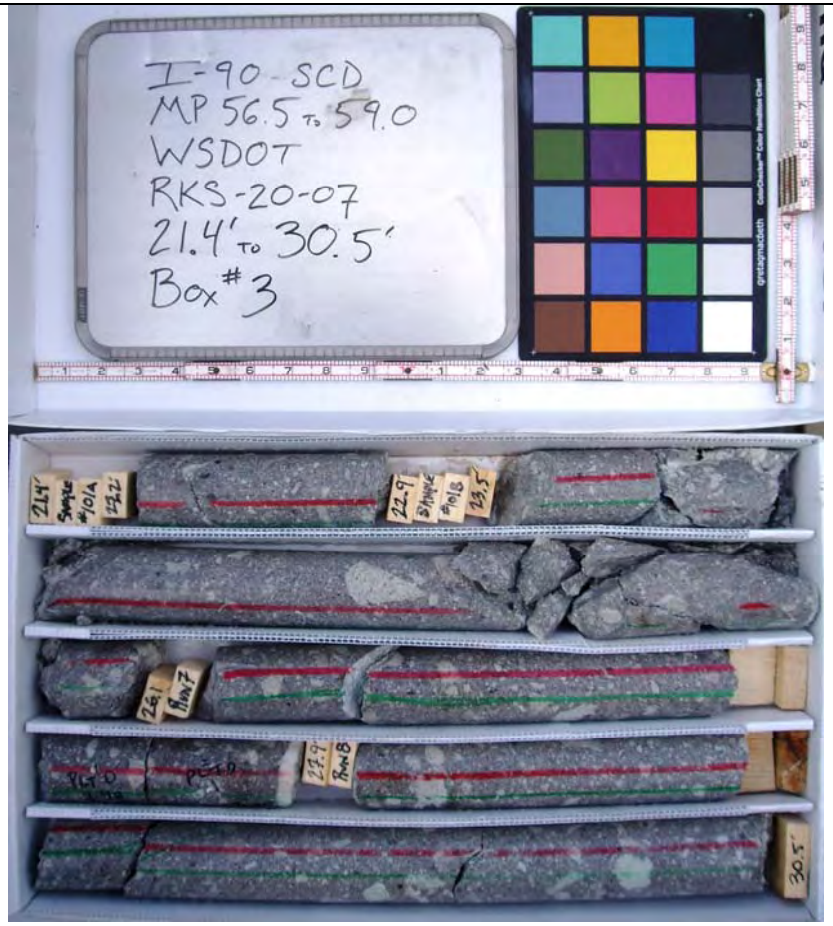
Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. / FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
	29			>>					spaced intervals and in good condition		
					R5			PLT - A			
					R5		27	PLT - D			
				94 / 0.9							
	30										
100									Borehole completed to 99.75 feet bgs on November 7, 2007. Borehole was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on November 8, 2007. Groundwater was measured at approximately 13.1 feet bgs during drilling activities and at 12.2 feet on November 8, 2007 prior to beginning optical borehole survey. Borehole backfilled with bentonite chips on November 8, 2007.		
	31										
105	32										
	33										
110											
	34										
115	35										
	36										
120											

Appendix C

Rock Core Photographs

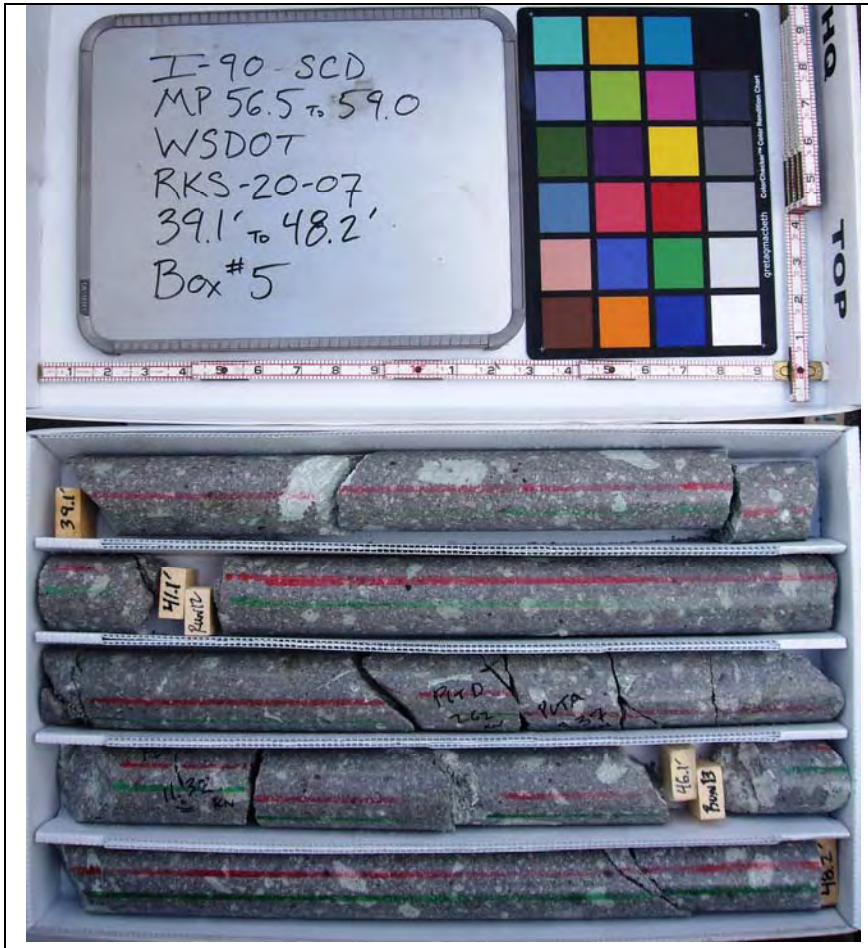
Box #1: 0.0 to 12.1 feet bgs

Box #2: 12.1 to 21.4 feet bgs



Box #3: 21.4 to 30.5 feet bgs

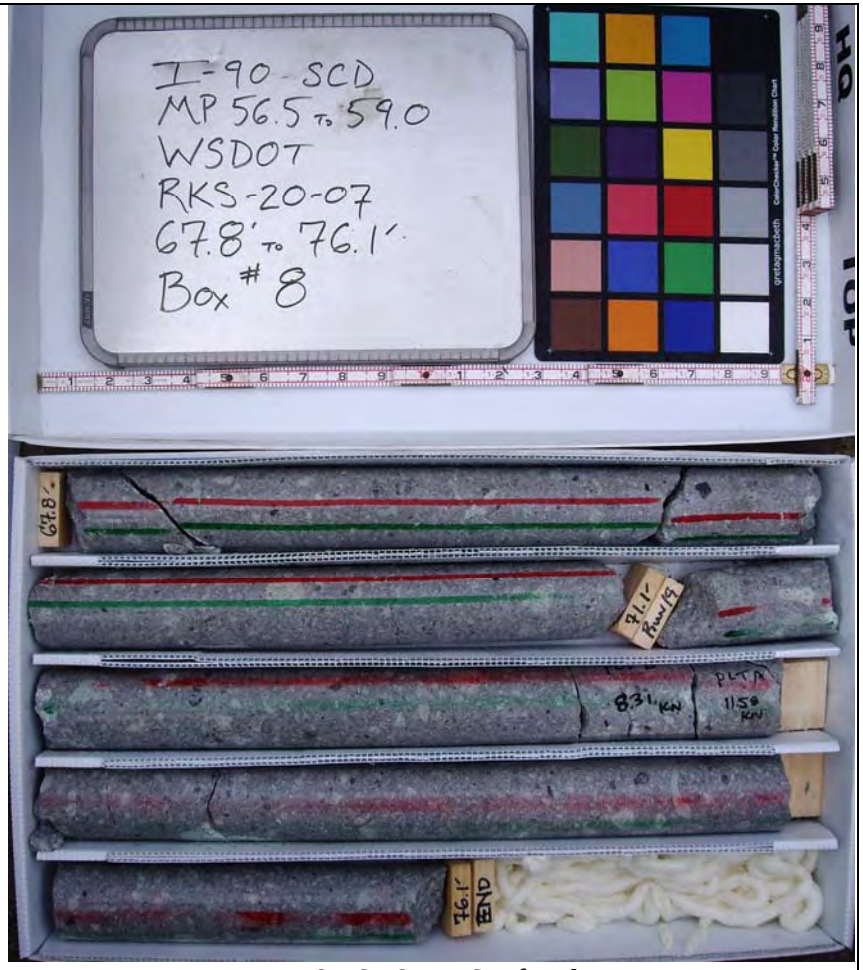
Box #4: 30.5 to 39.1 feet bgs



Box #5: 39.1 to 48.2 feet bgs

Box #6: 48.2 to 57.6 feet bgs

Box #7: 57.6 to 67.8 feet bgs



Box #8: 67.8 to 76.1 feet bgs

RKS-21-07

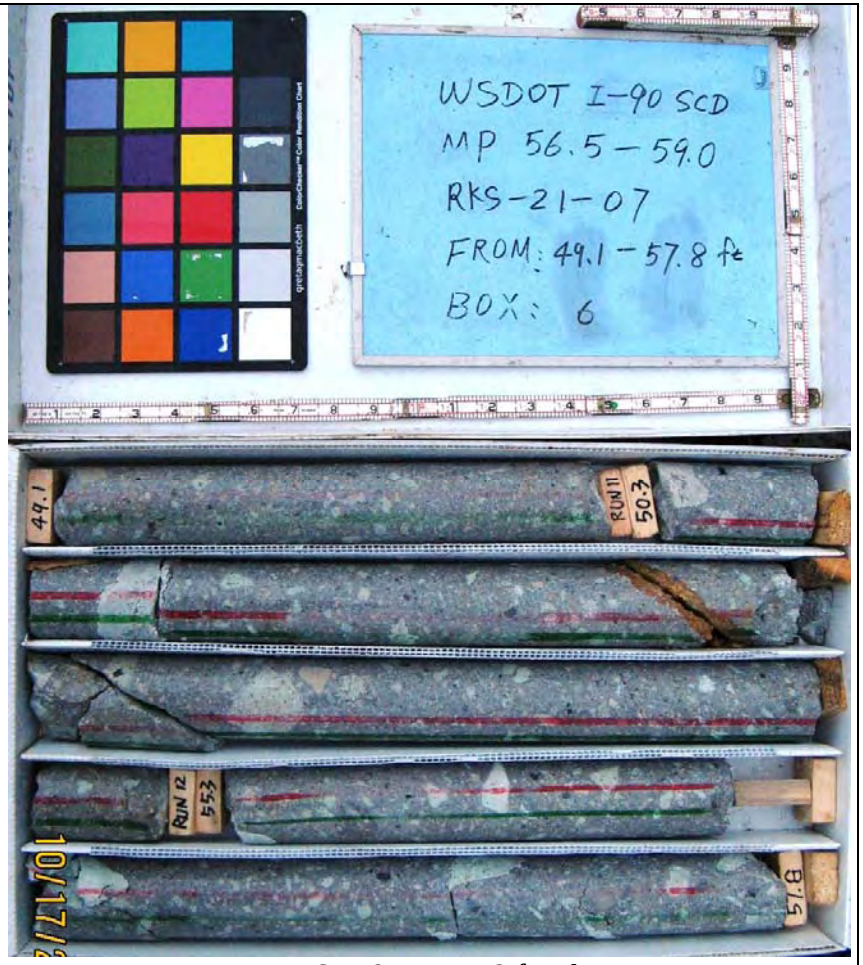
Box #1: 0.0 to 12.2 feet bgs

Box #2: 12.2 to 21.3 feet bgs

Box #3: 21.3 to 30.3 feet bgs

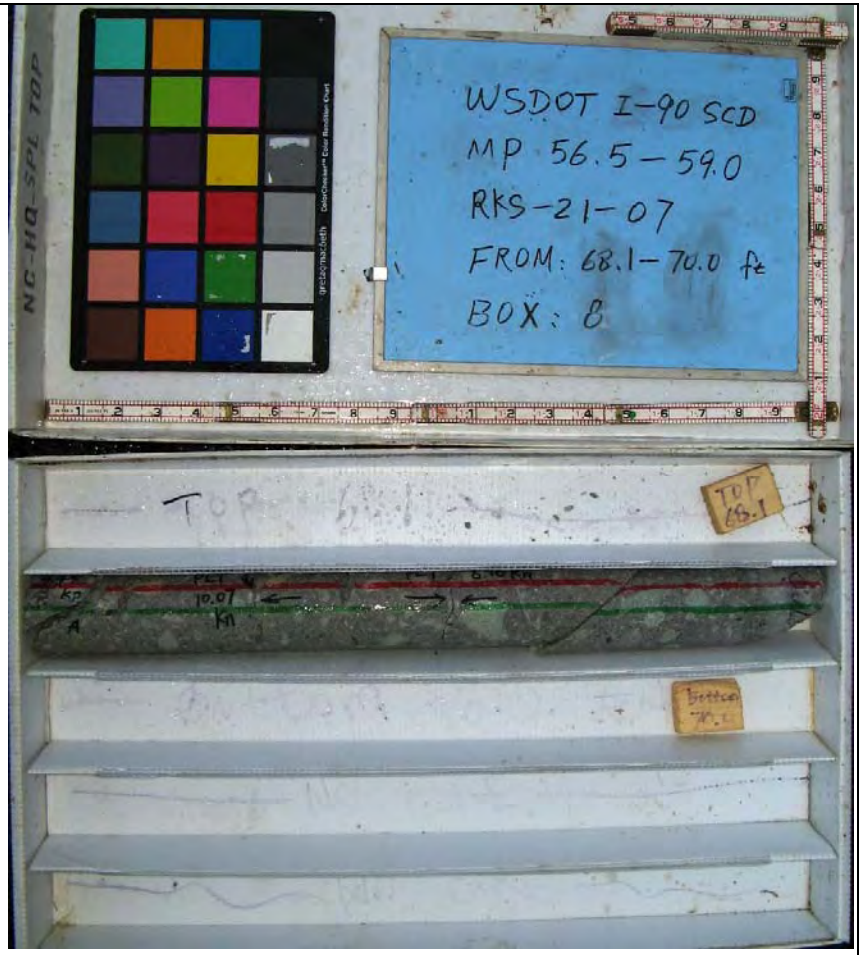
Box #4: 30.3 to 39.9 feet bgs

Box #5: 39.9 to 49.1 feet bgs



Box #6: 49.1 to 57.8 feet bgs

Box #7: 57.8 to 68.1 feet bgs

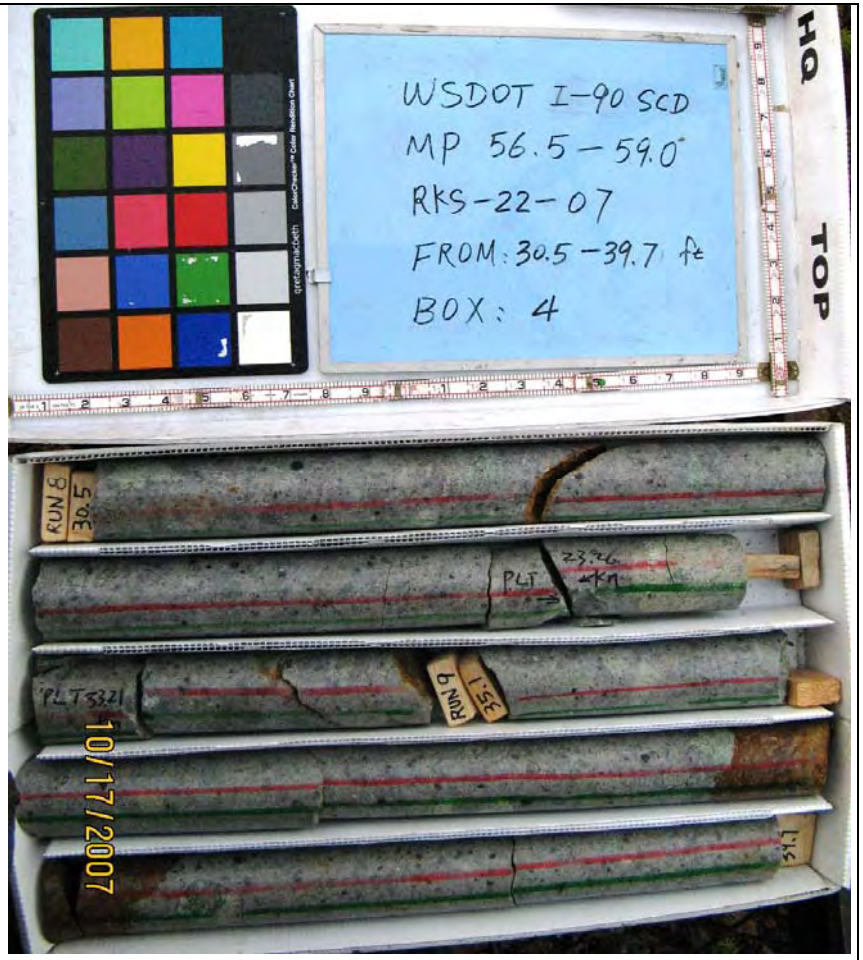


Box #8: 68.1 to 70.0 feet bgs

Box #1: 0.0 to 10.4 feet bgs

Box #2: 10.4 to 21.9 feet bgs

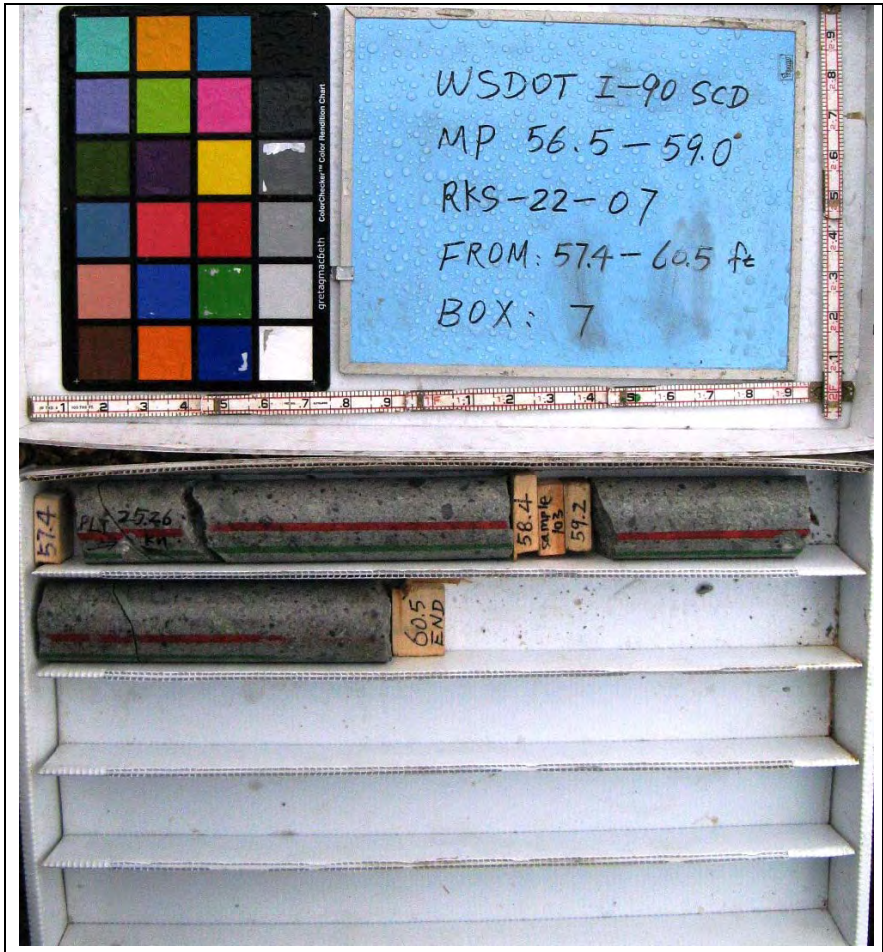
Box #3: 21.9 to 30.5 feet bgs



Box #4: 30.5 to 39.7 feet bgs

Box #5: 39.7 to 49.0 feet bgs

Box #6: 49.0 to 57.4 feet bgs



Box #7: 57.4 to 60.5 feet bgs

RKS-23-07

Box #1: 0.0 to 9.5 feet bgs

Box #2: 9.5 to 20.2 feet bgs

RKS-23-07

Box #3: 20.2 to 31.8 feet bgs

Box #4: 31.8 to 41.2 feet bgs

RKS-23-07

Box #5: 41.2 to 51.1 feet bgs

Box #6: 51.1 to 60.0 feet bgs

Box #7: 60.0 to 65.4 feet bgs

RKS-24-07

Box #1: 0.0 to 12.4 feet bgs

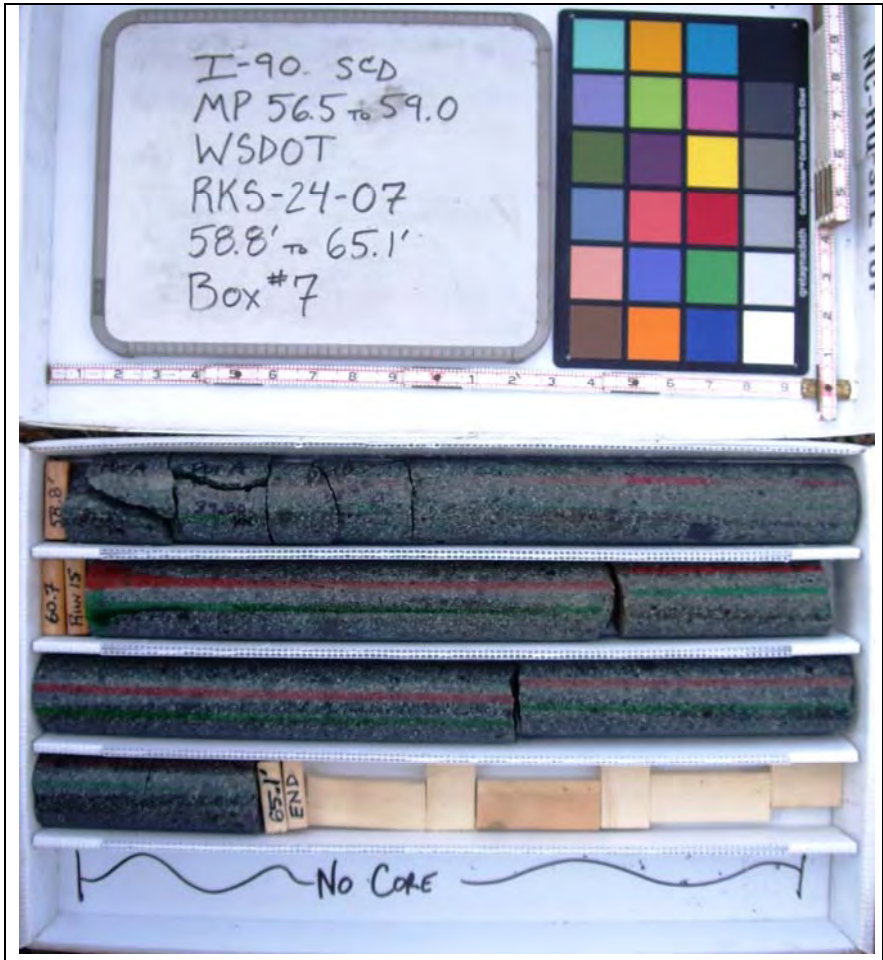
Box #2: 12.4 to 22.1 feet bgs

Box #3: 22.1 to 30.9 feet bgs

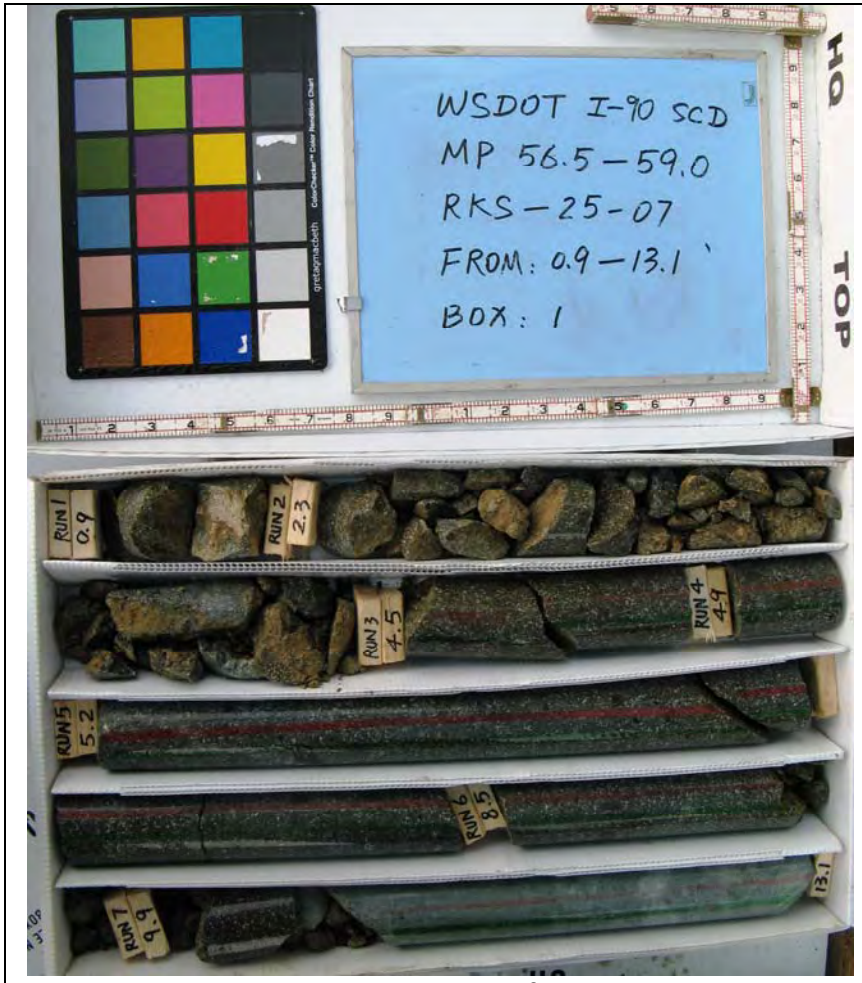
Box #4: 30.9 to 40.7 feet bgs

Box #5: 40.7 to 49.1 feet bgs

Box #6: 49.1 to 58.8 feet bgs



Box #7: 58.8 to 65.1 feet bgs



Box #1: 0.9 to 13.1 feet bgs

Box #2: 13.1 to 22.2 feet bgs

Box #3: 22.2 to 32.4 feet bgs

Box #4: 32.4 to 41.7 feet bgs

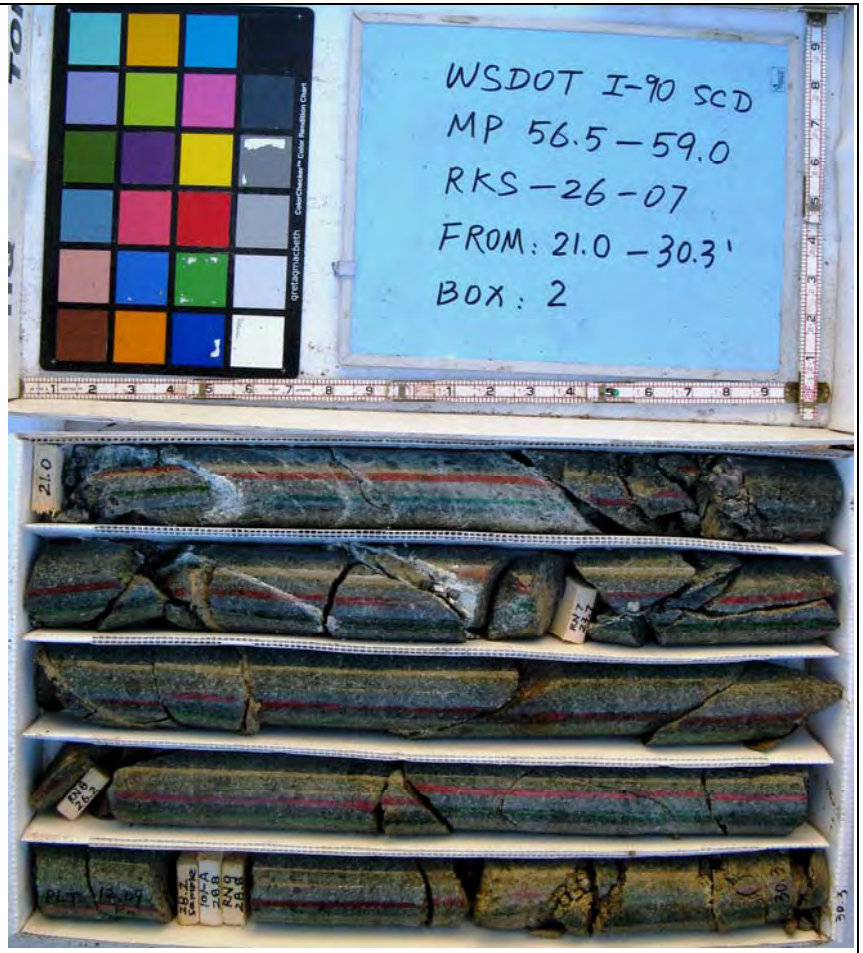
Box #5: 41.7 to 52.1 feet bgs

Box #6: 52.1 to 61.4 feet bgs

Box #7: 61.4 to 64.9 feet bgs

RKS-26-07

Box #1: 3.0 to 21.0 feet bgs



Box #2: 21.0 to 30.3 feet bgs

Box #3: 30.3 to 39.6 feet bgs

Box #4: 39.6 to 48.7 feet bgs

Box #5: 48.7 to 59.1 feet bgs

Box #6: 59.1 to 59.7 feet bgs

Box #1: 2.0 to 13.5 feet bgs

Box #2: 13.5 to 25.8 feet bgs

Box #3: 25.8 to 37.6 feet bgs

Box #4: 37.6 to 47.3 feet bgs

Box #5: 47.3 to 56.4 feet bgs

Box #6: 56.4 to 65.8 feet bgs

Box #7: 65.8 to 75.0 feet bgs

Box #1: 0.0 to 11.6 feet bgs

Box #2: 11.6 to 21.1 feet bgs

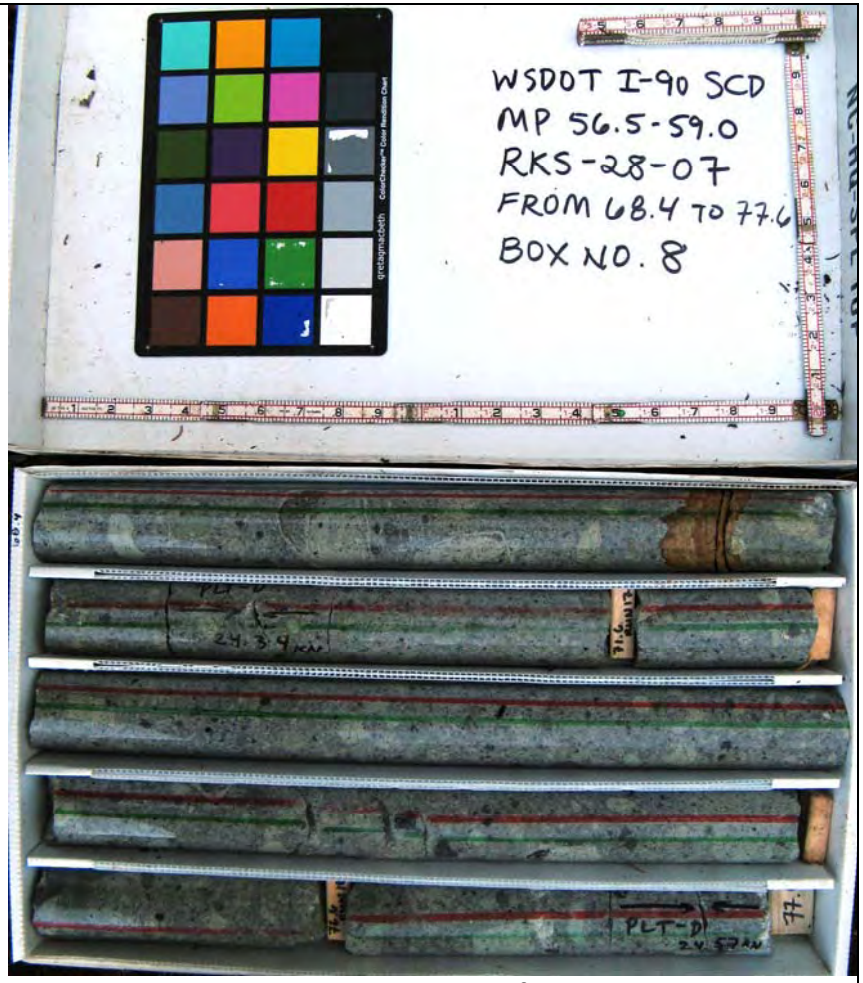
Box #3: 21.1 to 30.1 feet bgs

Box #4: 30.1 to 39.2 feet bgs

Box #5: 39.2 to 49.0 feet bgs

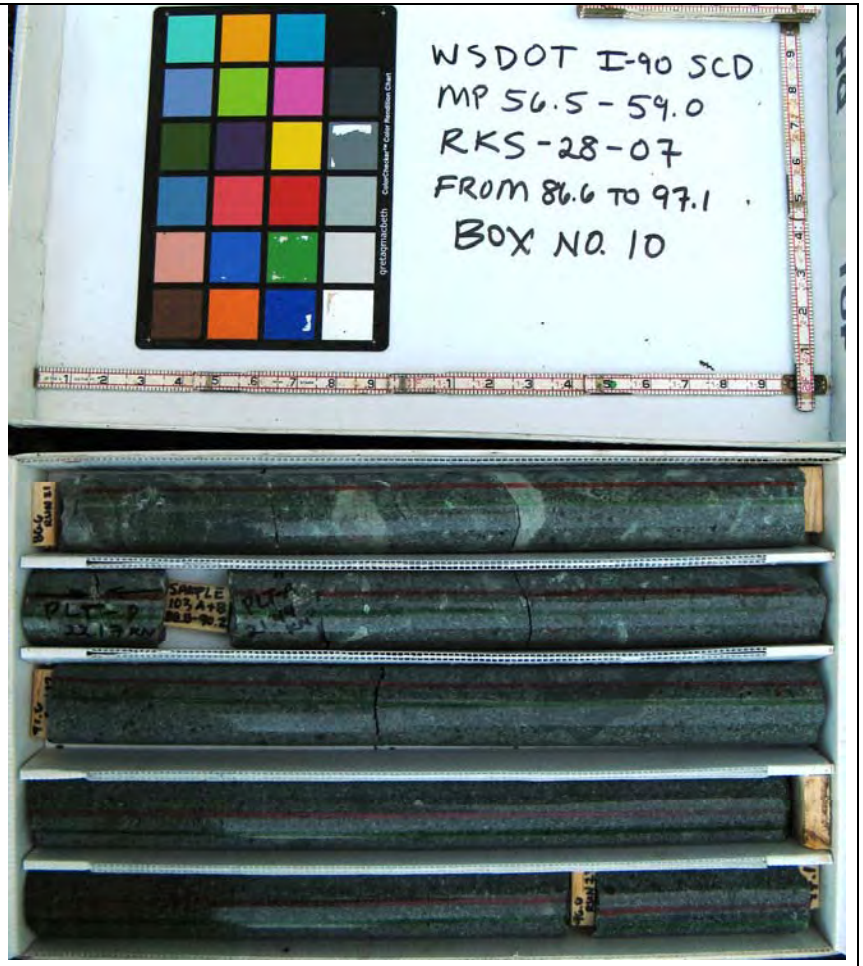
Box #6: 49.0 to 58.1 feet bgs

Box #7: 58.1 to 68.4 feet bgs

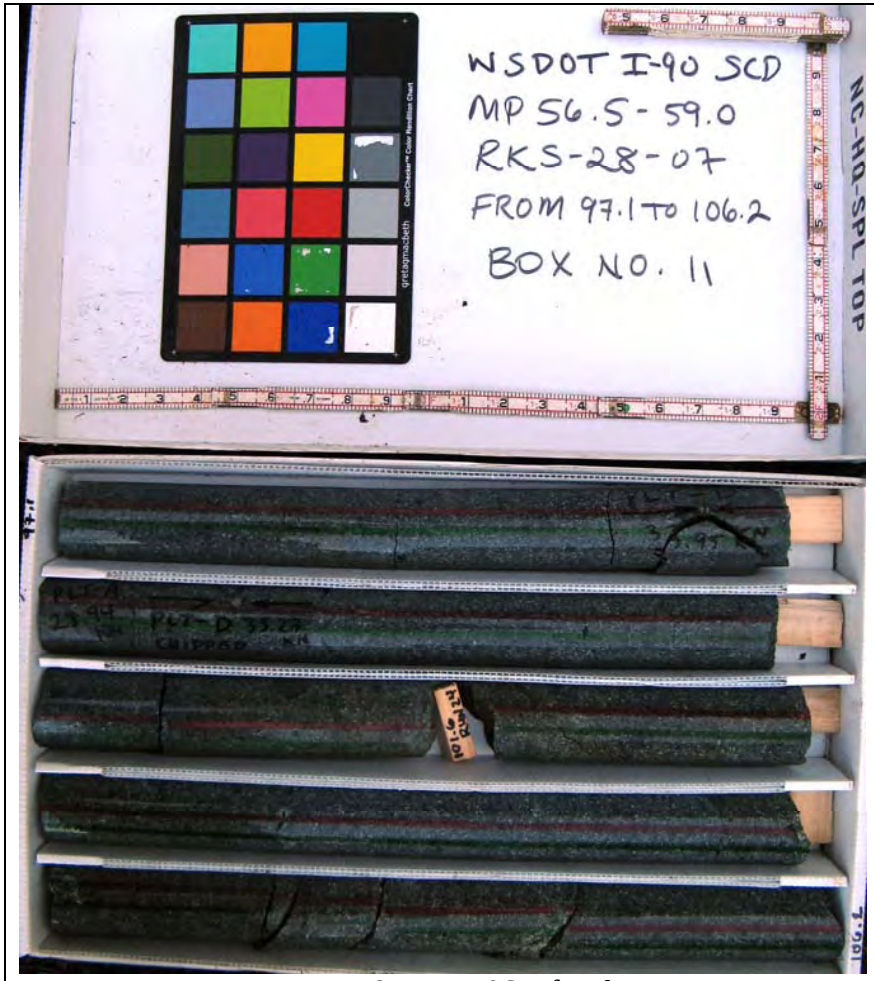


Box #8: 68.4 to 77.6 feet bgs

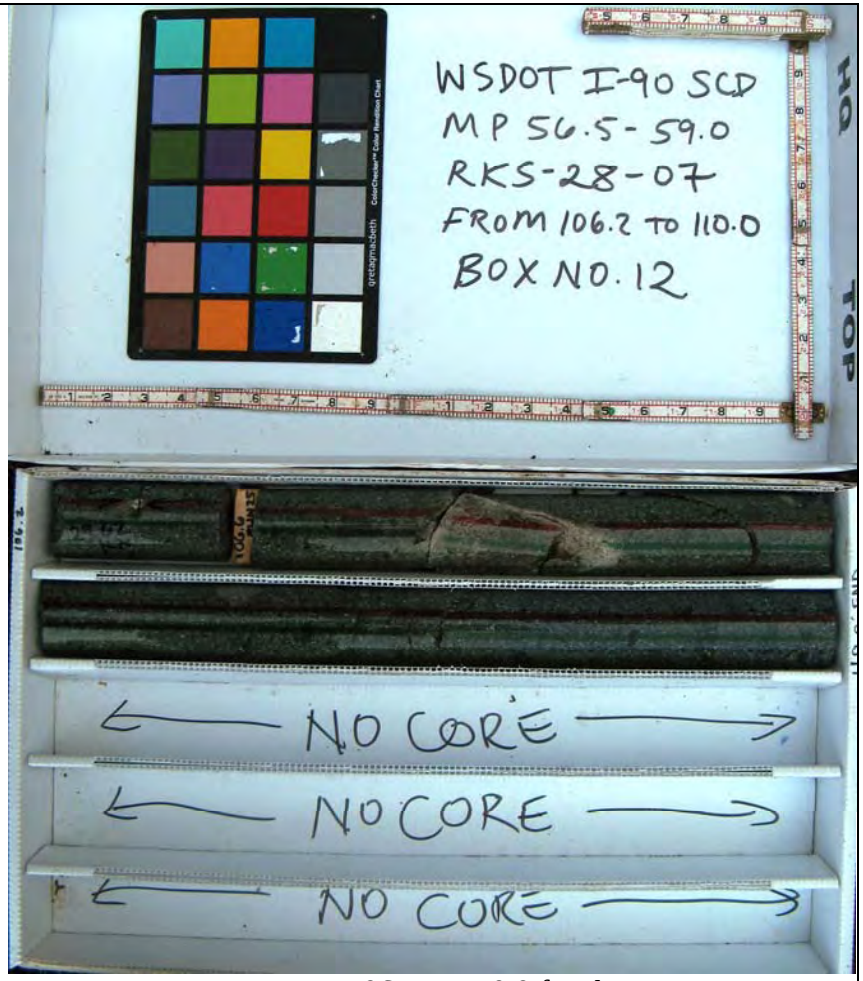
Box #9: 77.6 to 86.6 feet bgs



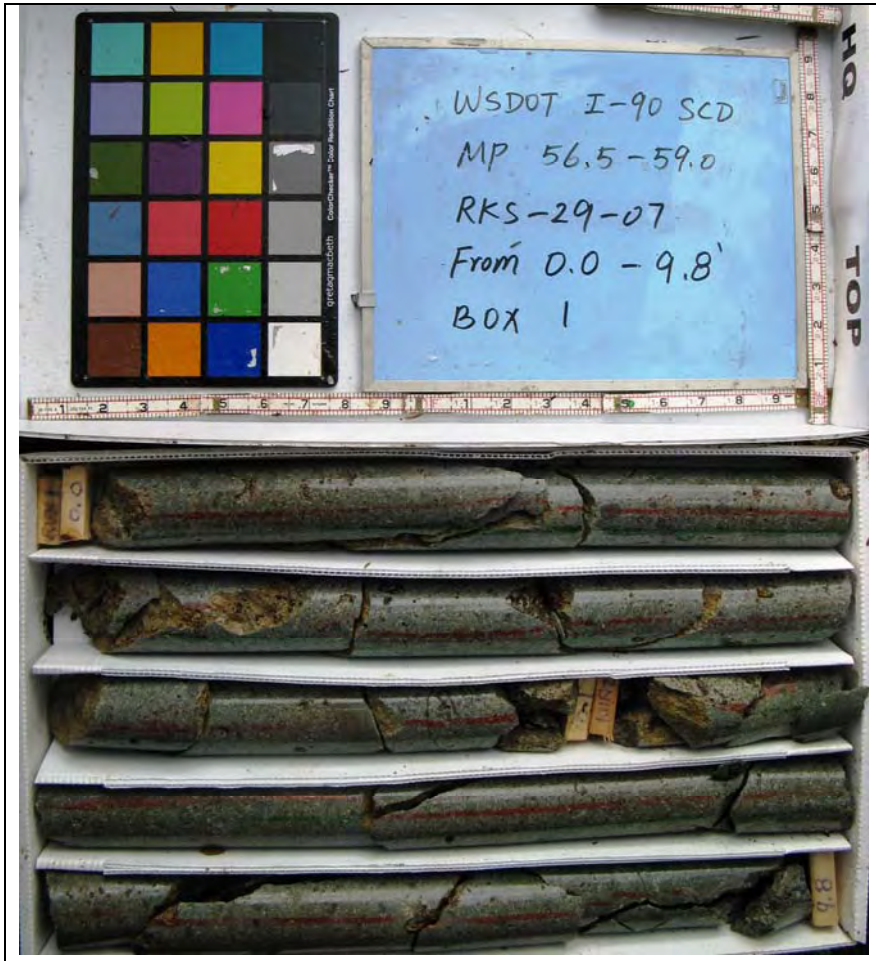
Box #10: 86.6 to 97.1 feet bgs



Box #11: 97.1 to 106.2 feet bgs



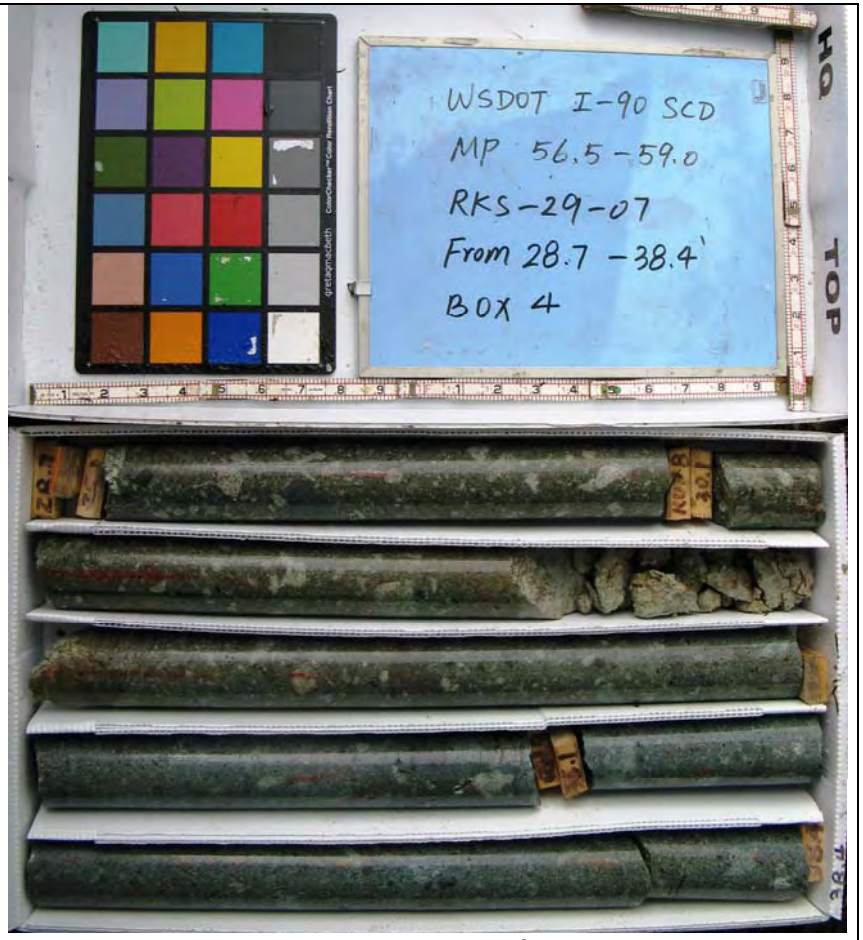
Box #12: 106.2 to 110.0 feet bgs



Box #1: 0.0 to 9.8 feet bgs

Box #2: 9.8 to 18.8 feet bgs

Box #3: 18.8 to 28.7 feet bgs



Box #4: 28.7 to 38.4 feet bgs

Box #5: 38.4 to 47.6 feet bgs

Box #6: 47.6 to 57.3 feet bgs

Box #7: 57.3 to 66.3 feet bgs

Box #8: 66.3 to 76.4 feet bgs

Box #9: 76.4 to 85.6 feet bgs

Box #10: 85.6 to 95.1 feet bgs

Box #11: 95.1 to 104.4 feet bgs

Box #12: 104.4 to 114.5 feet bgs

Box #13: 114.5 to 123.7 feet bgs

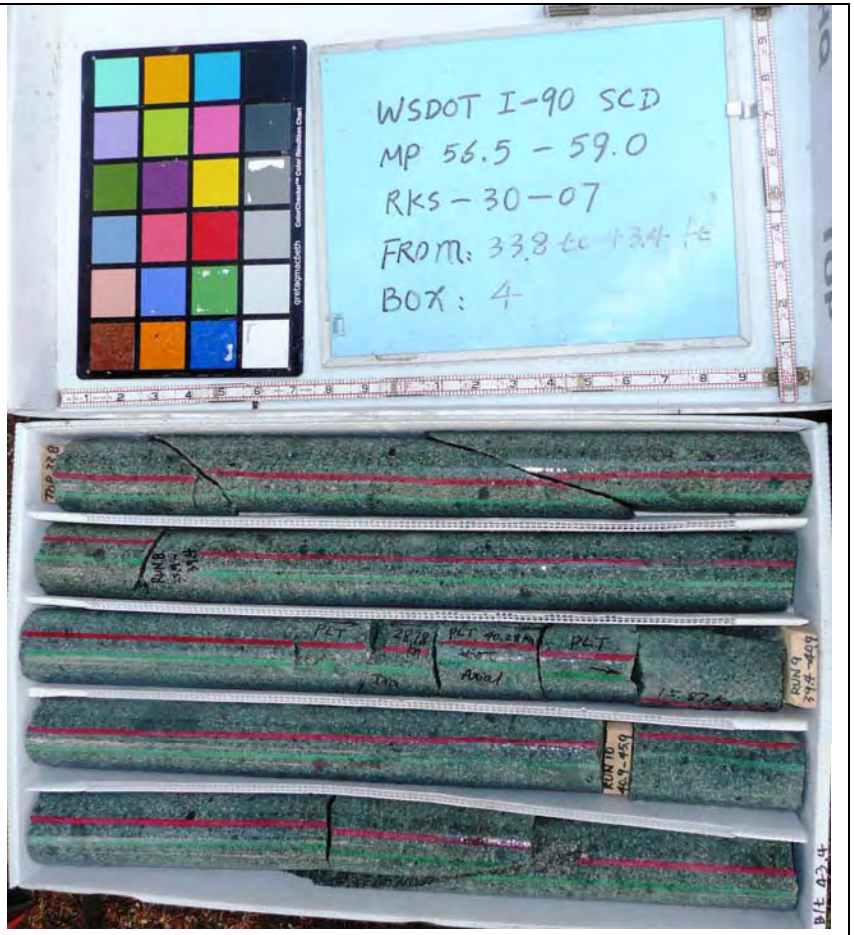
Box #14: 123.7 to 125.0 feet bgs

RKS-30-07

Box #1: 2.5 to 12.1 feet bgs

Box #2: 12.1 to 22.9 feet bgs

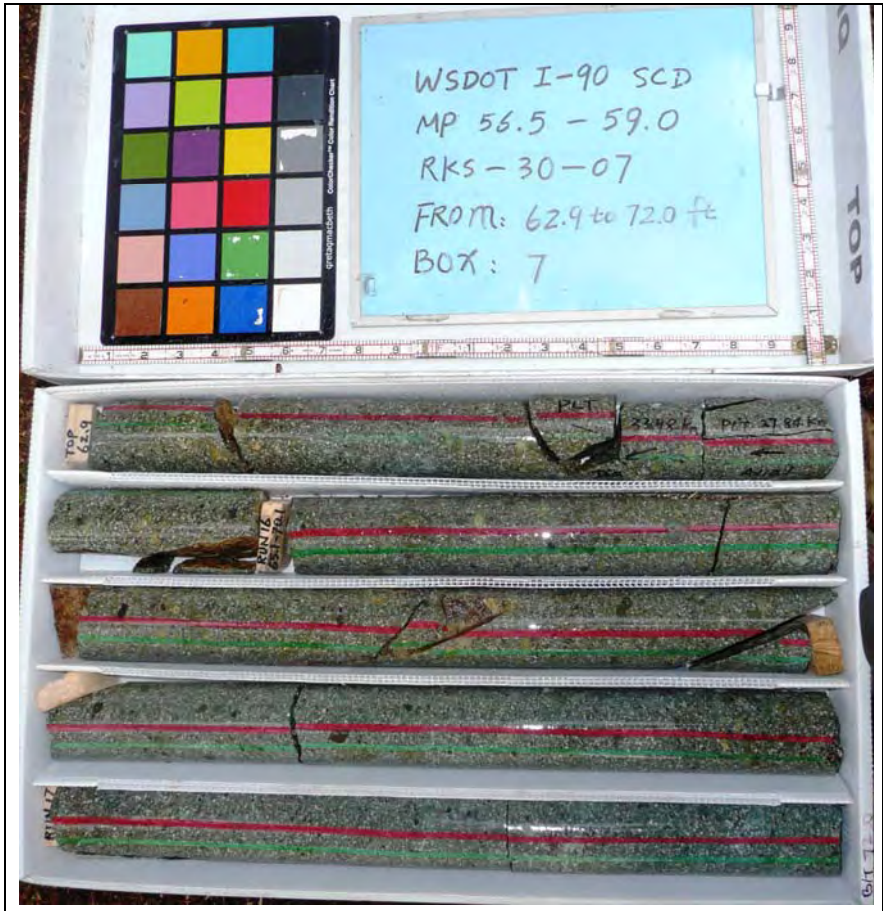
Box #3: 22.9 to 33.8 feet bgs



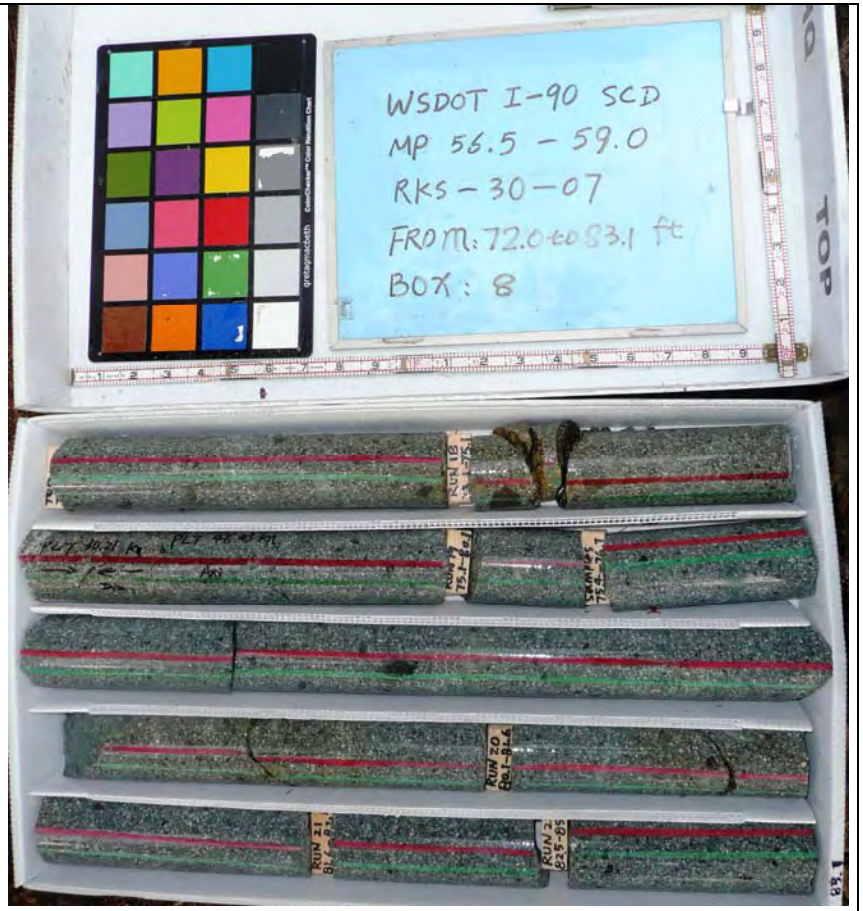
Box #4: 33.8 to 43.4 feet bgs

Box #5: 43.4 to 52.0 feet bgs

Box #6: 52.0 to 62.9 feet bgs

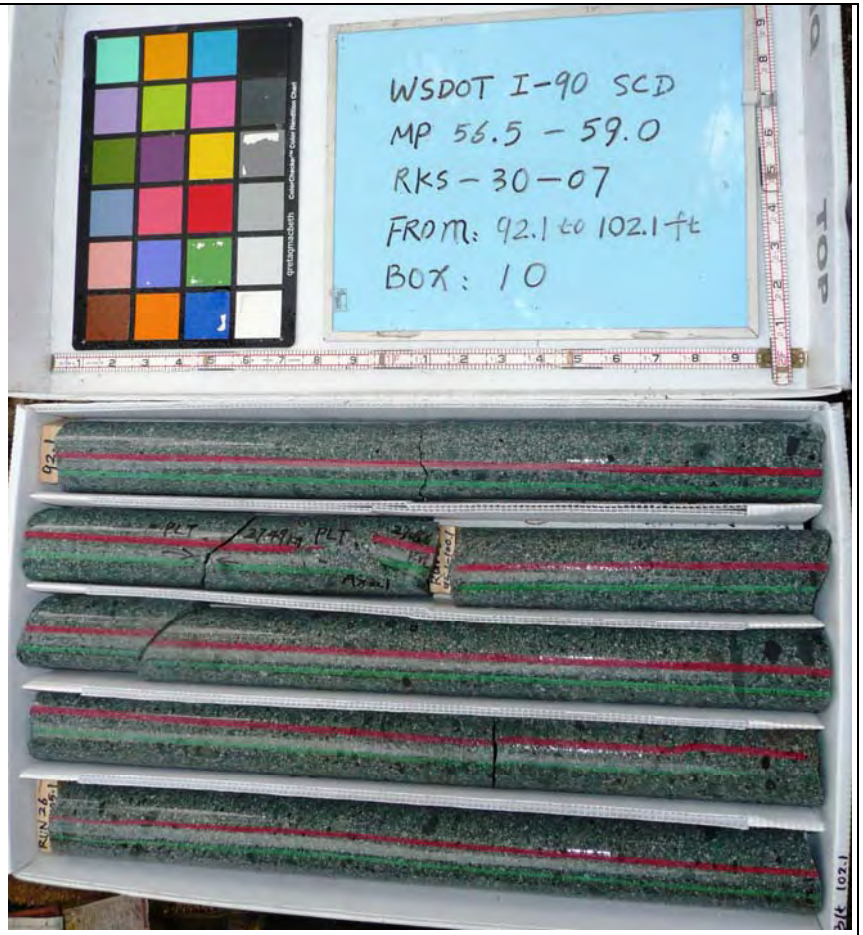


Box #7: 62.9 to 72.0 feet bgs



Box #8: 72.0 to 83.1 feet bgs

Box #9: 83.1 to 92.1 feet bgs

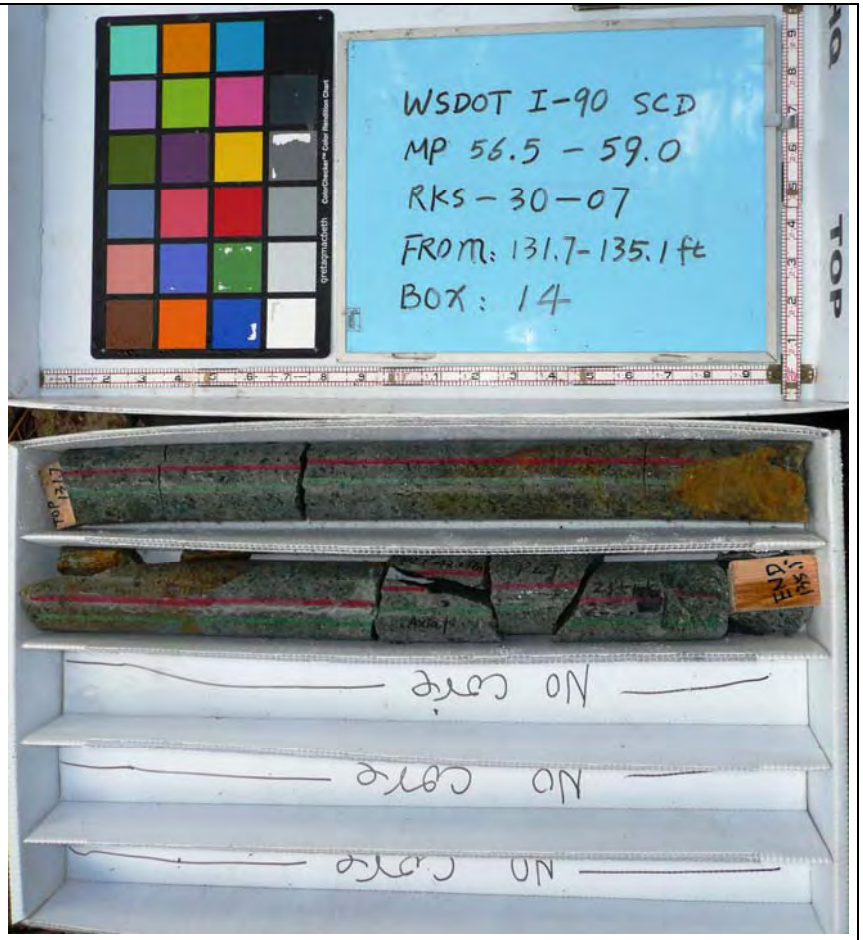


Box #10: 92.1 to 102.1 feet bgs

Box #11: 102.1 to 111.4 feet bgs

Box #12: 111.4 to 122.5 feet bgs

Box #13: 122.5 to 131.7 feet bgs



Box #14: 131.7 to 135.1 feet bgs

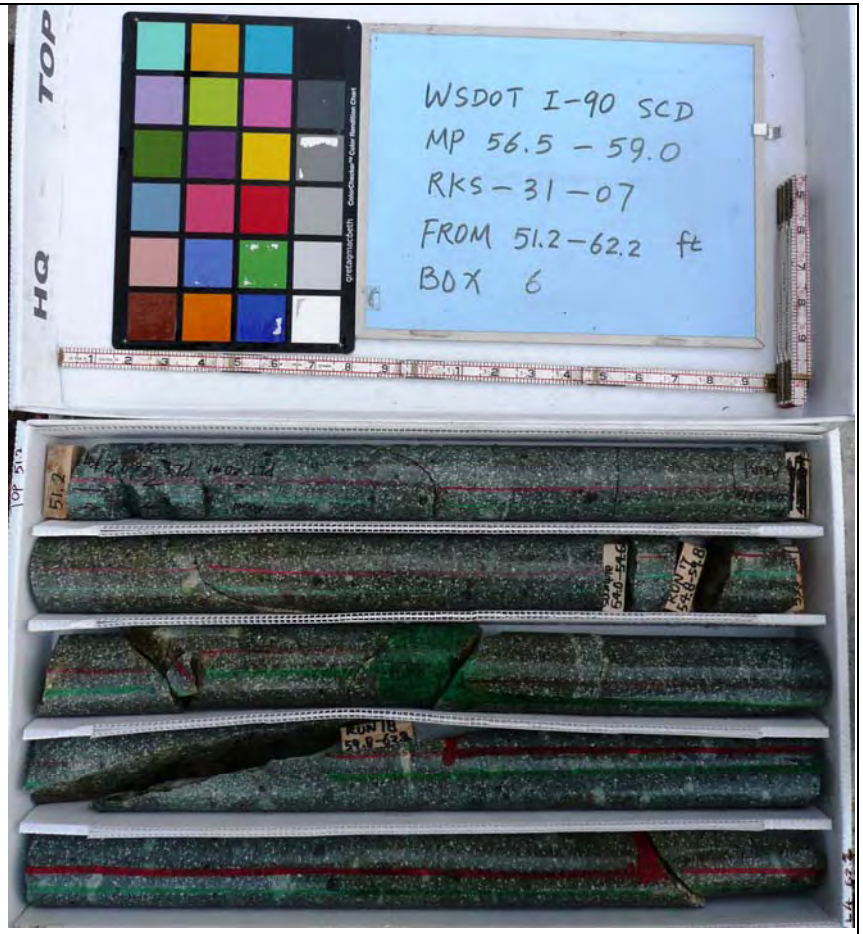
Box #1: 4.2 to 13.2 feet bgs

Box #2: 13.2 to 22.6 feet bgs

Box #3: 22.6 to 32.1 feet bgs

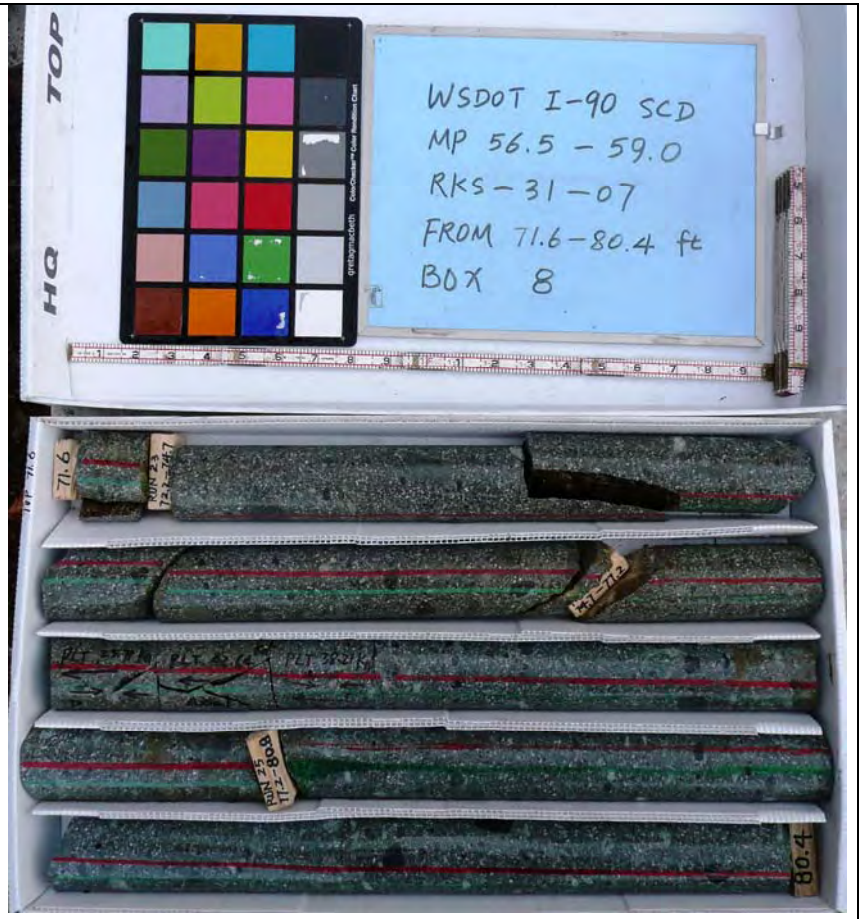
Box #4: 32.1 to 41.7 feet bgs

Box #5: 41.7 to 51.2 feet bgs

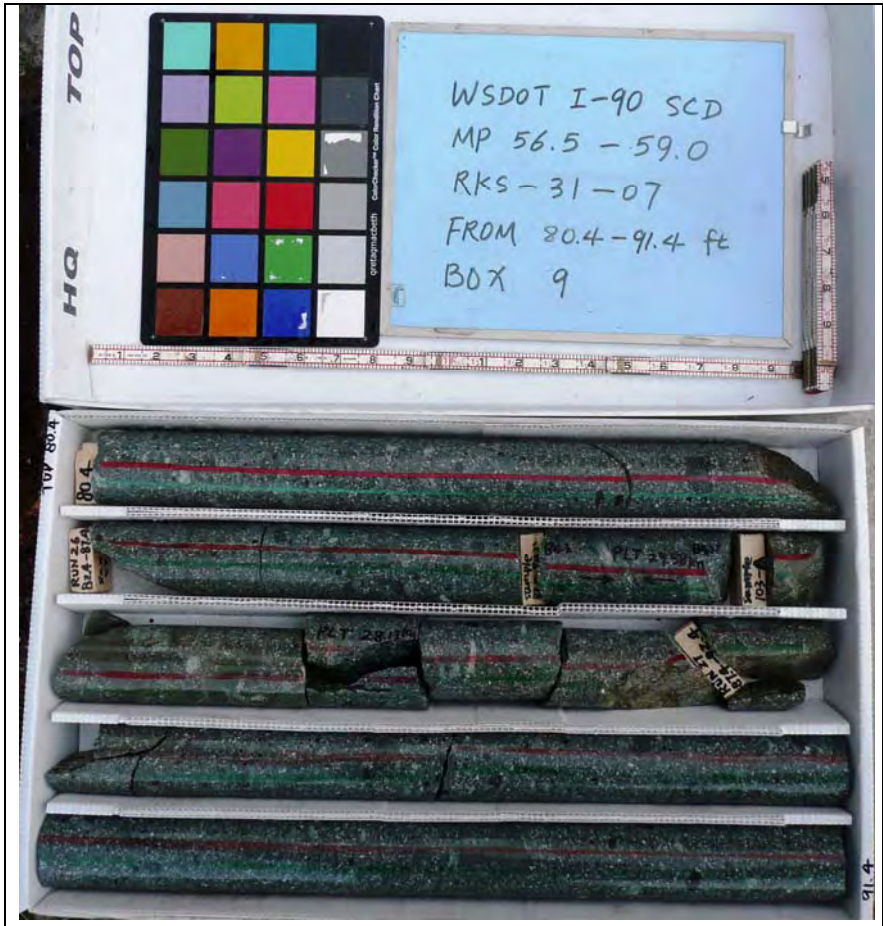


Box #6: 51.2 to 62.2 feet bgs

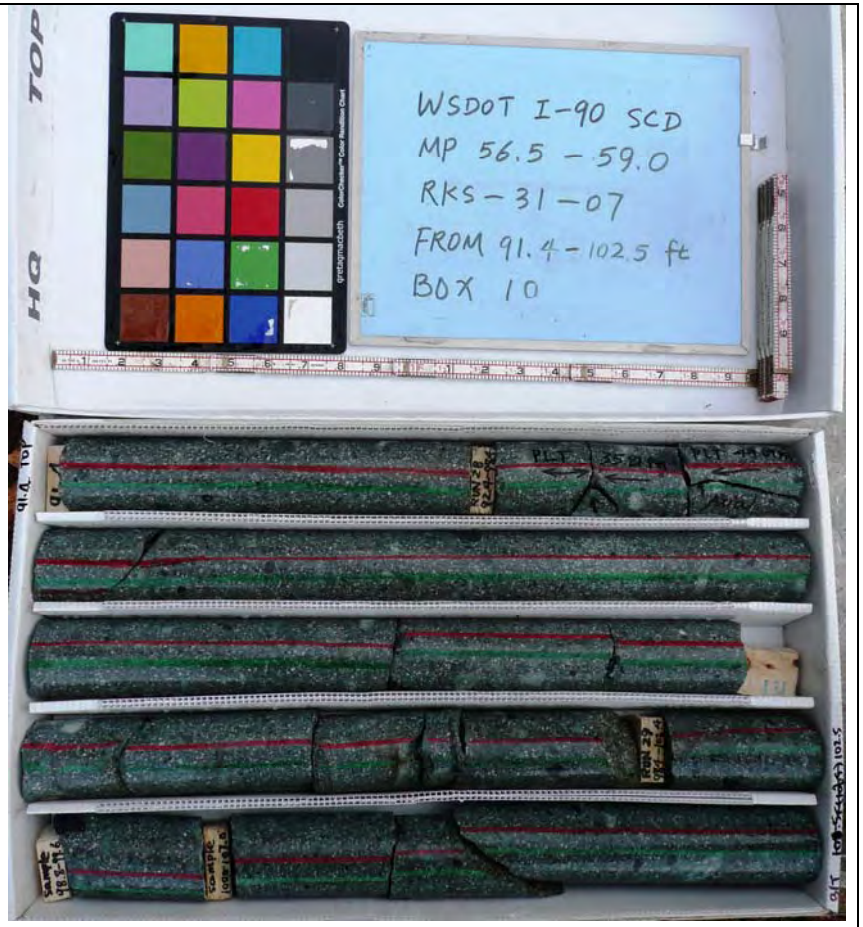
Box #7: 62.2 to 71.6 feet bgs



Box #8: 71.6 to 80.4 feet bgs

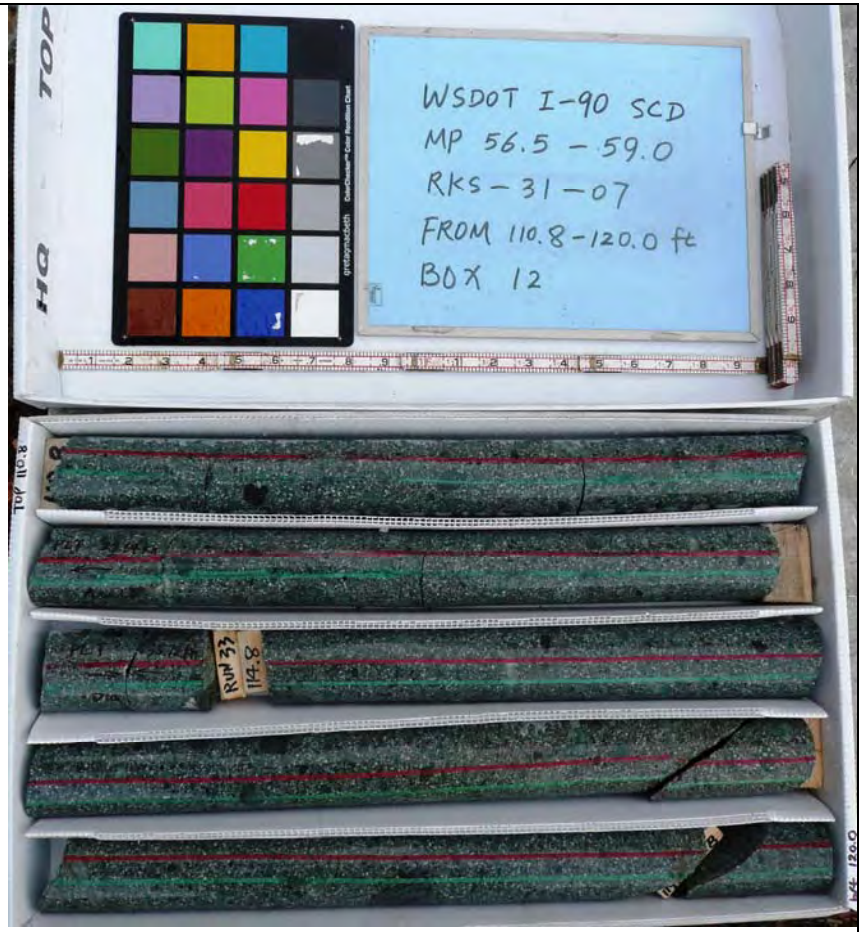


Box #9: 80.4 to 91.4 feet bgs



Box #10: 91.4 to 102.5 feet bgs

Box #11: 102.5 to 110.8 feet bgs



Box #12: 110.8 to 120.0 feet bgs

Box #13: 120.0 to 129.5 feet bgs

Box #14: 129.5 to 139.8 feet bgs

Box #1: 0.0 to 8.9 feet bgs

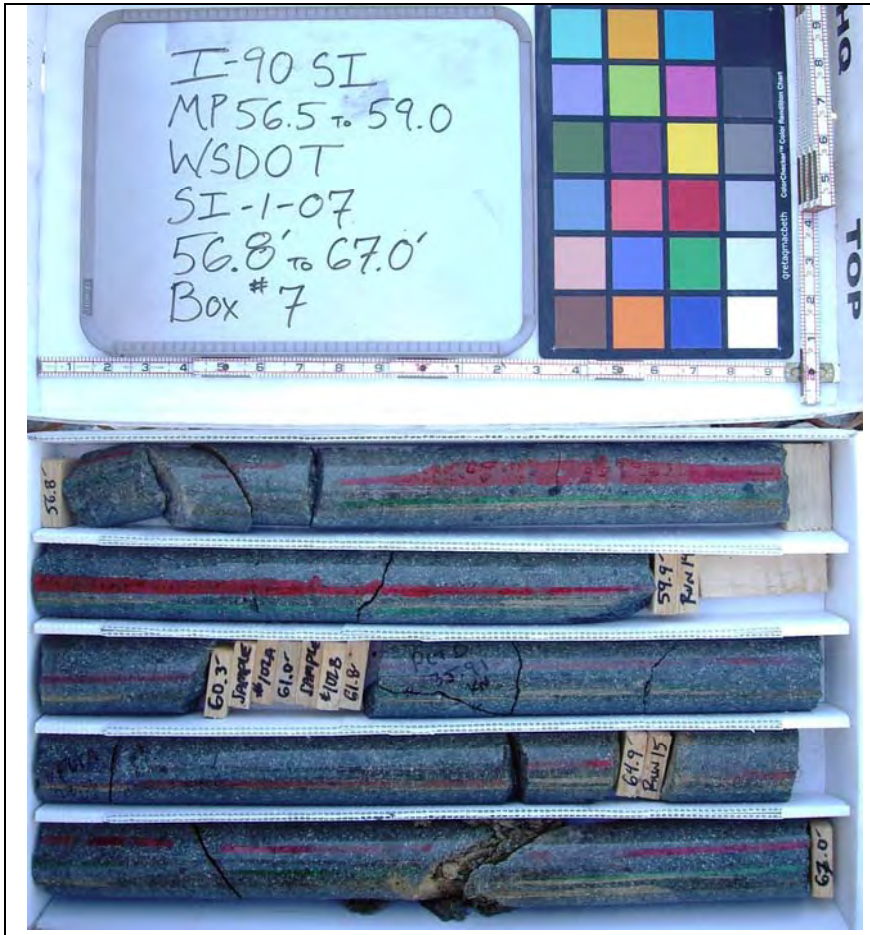
Box #2: 8.9 to 18.1 feet bgs

Box #3: 18.1 to 27.2 feet bgs

Box #4: 27.2 to 37.7 feet bgs

Box #5: 37.7 to 47.5 feet bgs

Box #6: 47.5 to 56.8 feet bgs



Box #7: 56.8 to 67.0 feet bgs

Box #8: 67.0 to 74.9 feet bgs

Box #9: 74.9 to 84.9 feet bgs

Box #10: 84.9 to 92.8 feet bgs

Box #11: 92.8 to 100.1 feet bgs

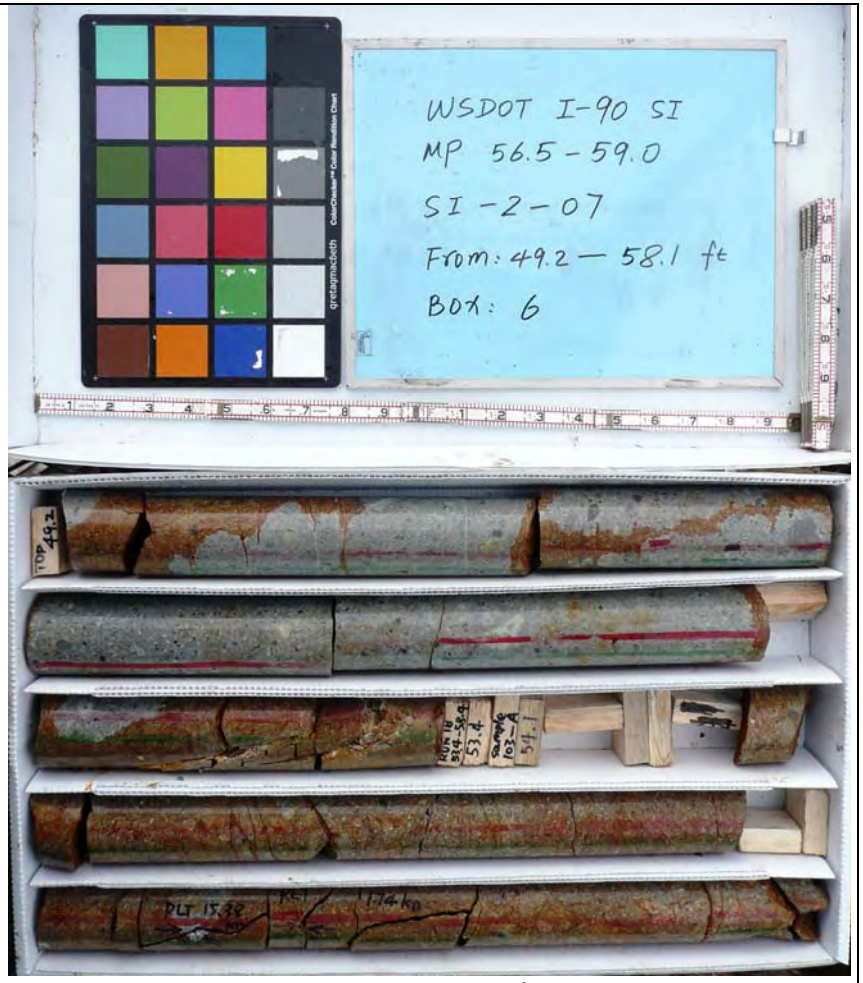
Box #1: 0.7 to 10.1 feet bgs

Box #2: 10.1 to 19.3 feet bgs

Box #3: 19.3 to 29.4 feet bgs

Box #4: 29.4 to 38.6 feet bgs

Box #5: 38.6 to 49.2 feet bgs



Box #6: 49.2 to 58.1 feet bgs

Box #7: 58.1 to 66.5 feet bgs

Box #8: 66.5 to 75.9 feet bgs

Box #9: 75.9 to 84.7 feet bgs

Box #10: 84.7 to 95.0 feet bgs

Box #11: 95.0 to 100.1 feet bgs

Box #1: 0.0 to 10.8 feet bgs

Box #2: 10.8 to 19.6 feet bgs

Box #3: 19.6 to 27.9 feet bgs

Box #4: 27.9 to 38.1 feet bgs

Box #5: 38.1 to 46.8 feet bgs

Box #6: 46.8 to 56.0 feet bgs

Box #7: 56.0 to 66.2 feet bgs

Box #8: 66.2 to 73.8 feet bgs

Box #9: 73.8 to 82.2 feet bgs

Box #10: 82.2 to 90.9 feet bgs

Box #11: 90.9 to 100.3 feet bgs

Box #1: 0.0 to 10.8 feet bgs

Box #2: 10.8 to 19.3 feet bgs

Box #3: 19.3 to 28.9 feet bgs

Box #4: 28.9 to 38.3 feet bgs

Box #5: 38.3 to 47.5 feet bgs

Box #6: 47.5 to 55.4 feet bgs

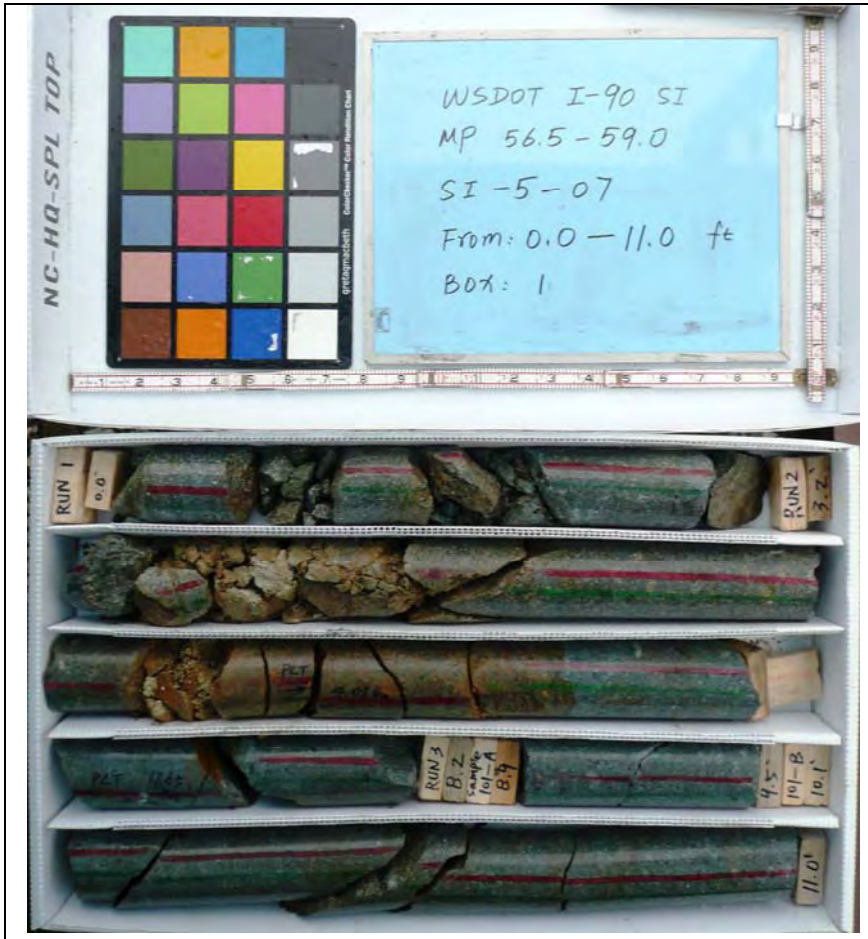
Box #7: 55.4 to 64.6 feet bgs

Box #8: 64.6 to 74.7 feet bgs

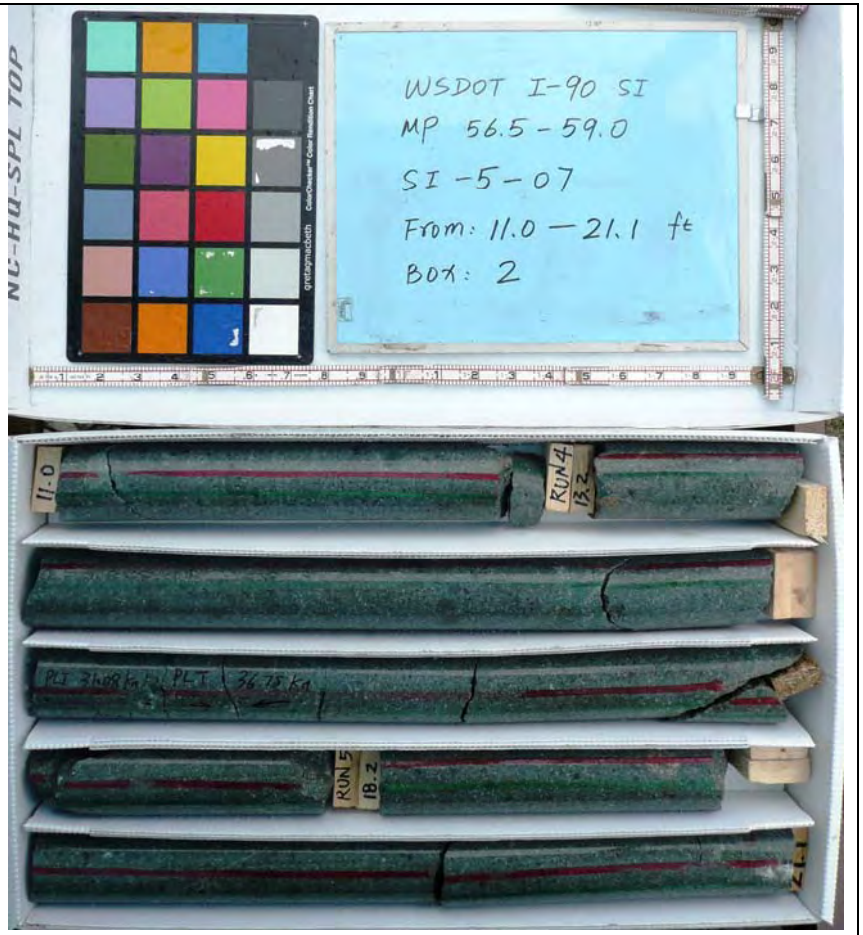
Box #9: 74.7 to 83.4 feet bgs

Box #10: 83.4 to 93.0 feet bgs

Box #11: 93.0 to 99.8 feet bgs



Box #1: 0.0 to 13.2 feet bgs



Box #2: 13.2 to 22.6 feet bgs

Box #3: 22.6 to 32.1 feet bgs

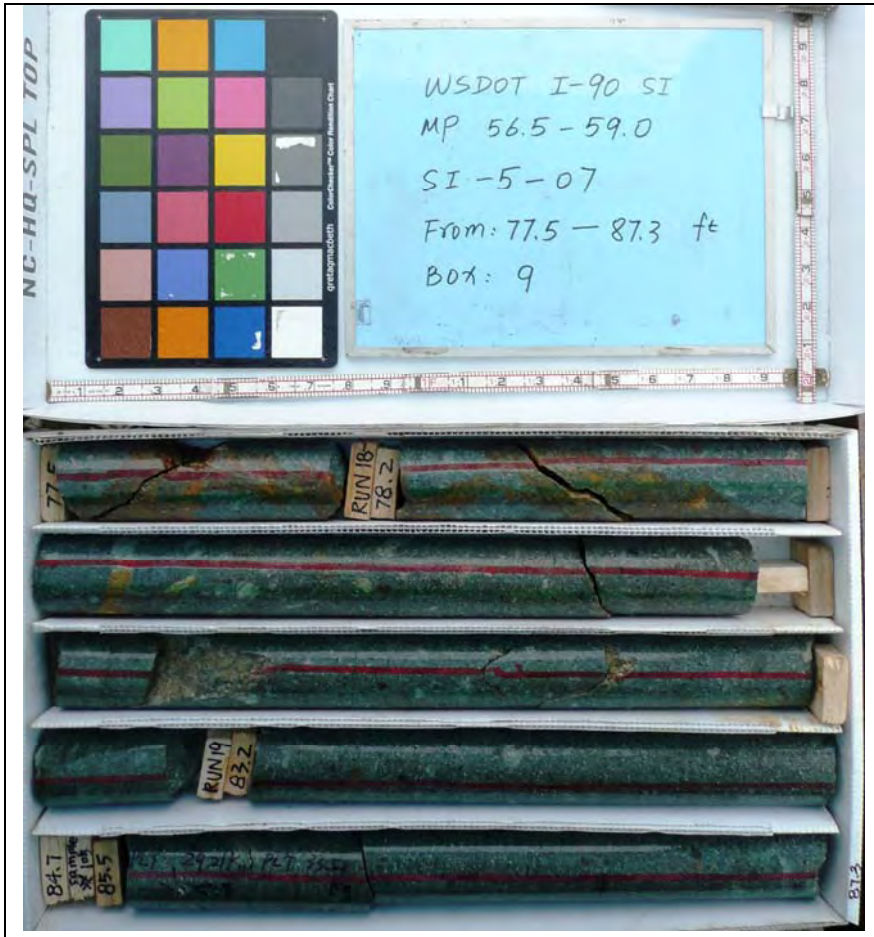
Box #4: 32.1 to 41.7 feet bgs

Box #5: 41.7 to 51.2 feet bgs

Box #6: 51.2 to 62.2 feet bgs

Box #7: 62.2 to 71.6 feet bgs

Box #8: 71.6 to 80.4 feet bgs



Box #9: 80.4 to 91.4 feet bgs

Box #10: 91.4 to 102.5 feet bgs

Box #11: 102.5 to 110.8 feet bgs

Box #1: 0.0 to 10.1 feet bgs

Box #2: 10.1 to 20.5 feet bgs

Box #3: 20.5 to 29.6 feet bgs

Box #4: 29.6 to 38.4 feet bgs

Box #5: 38.4 to 48.9 feet bgs

Box #6: 48.9 to 58.0 feet bgs

Box #7: 58.0 to 67.1 feet bgs

Box #8: 67.1 to 76.2 feet bgs

Box #9: 76.2 to 86.2 feet bgs

Box #10: 86.2 to 95.1 feet bgs

Box #11: 95.1 to 100.0 feet bgs

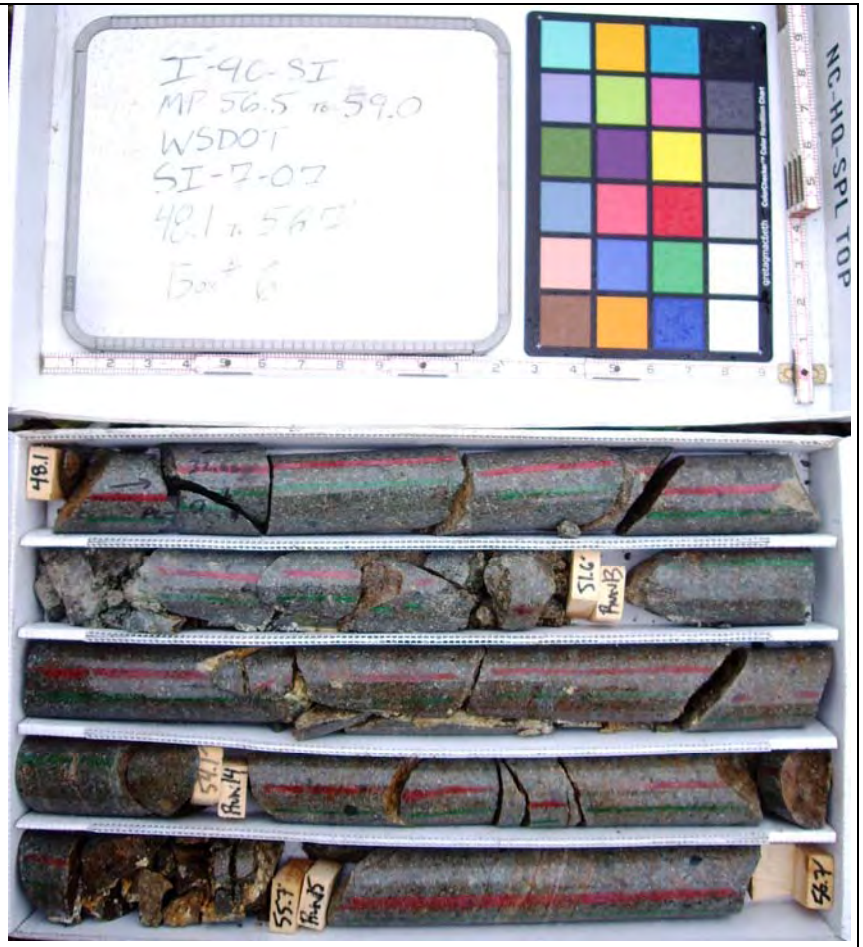
Box #1: 0.0 to 11.6 feet bgs

Box #2: 11.6 to 20.9 feet bgs

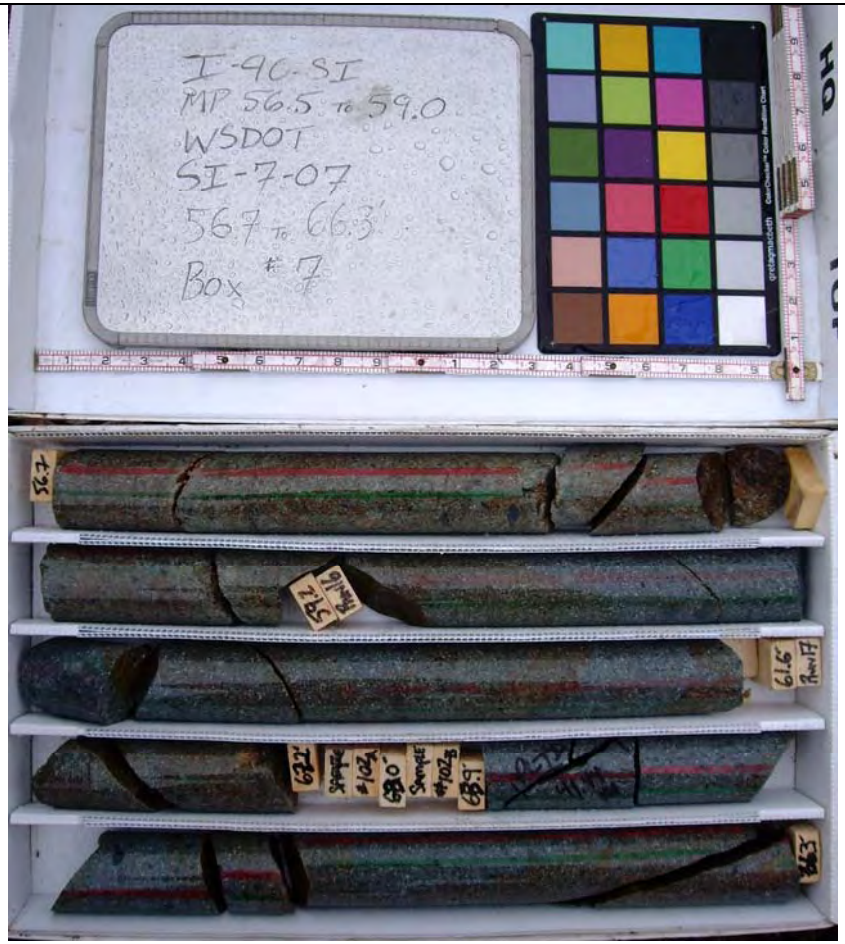
Box #3: 20.9 to 28.9 feet bgs

Box #4: 28.9 to 38.8 feet bgs

Box #5: 38.8 to 48.1 feet bgs



Box #6: 48.1 to 56.7 feet bgs



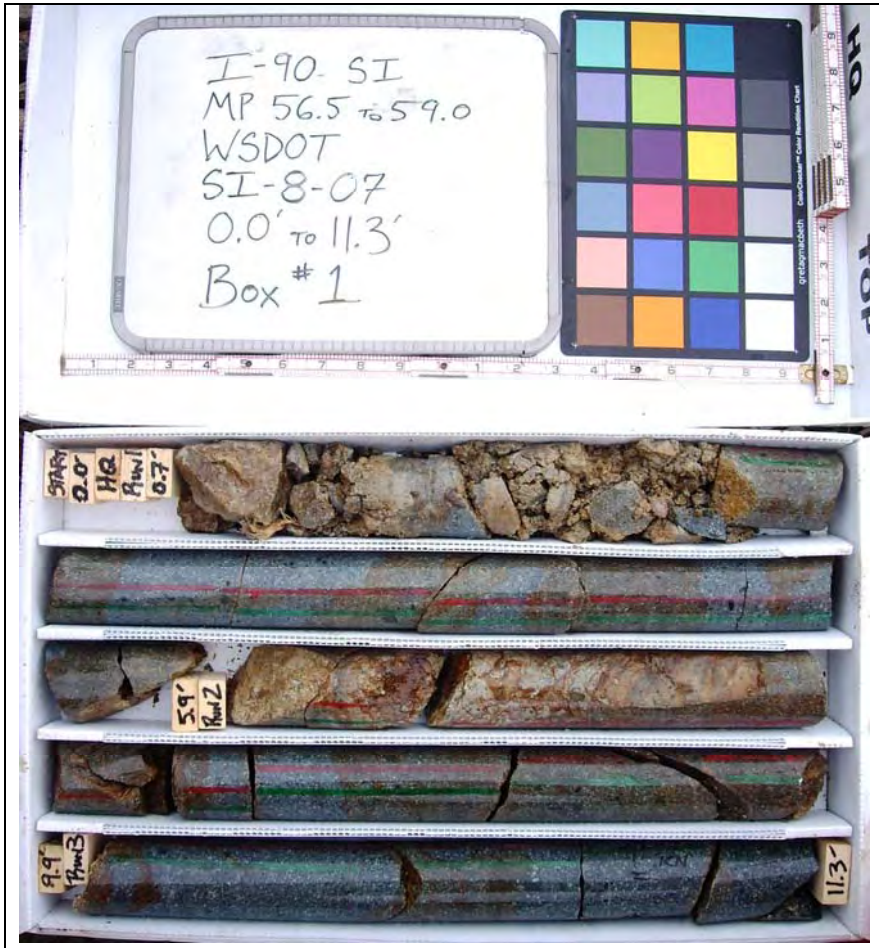
Box #7: 56.7 to 66.3 feet bgs

Box #8: 66.3 to 75.0 feet bgs

Box #9: 75.0 to 84.1 feet bgs

Box #10: 84.1 to 92.9 feet bgs

Box #11: 92.9 to 100.2 feet bgs



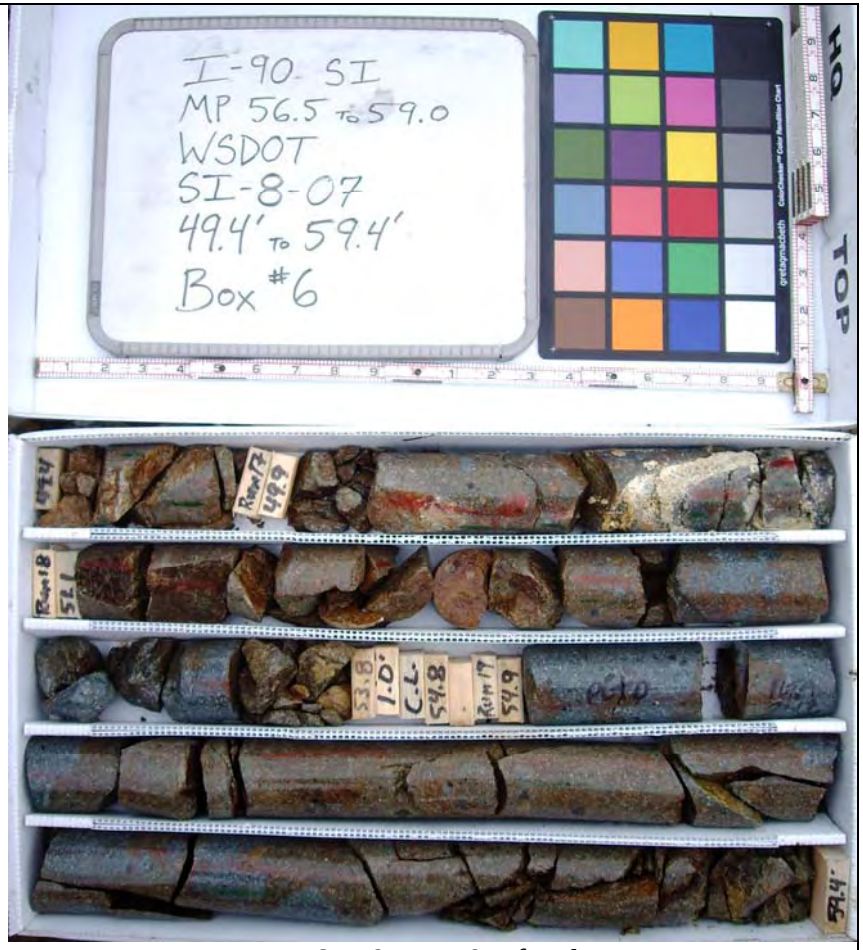
Box #1: 0.0 to 11.3 feet bgs

Box #2: 11.3 to 21.6 feet bgs

Box #3: 21.6 to 31.8 feet bgs

Box #4: 31.8 to 40.7 feet bgs

Box #5: 40.7 to 49.4 feet bgs



Box #6: 49.4 to 59.4 feet bgs

Box #7: 59.4 to 68.2 feet bgs

Box #8: 68.2 to 77.0 feet bgs

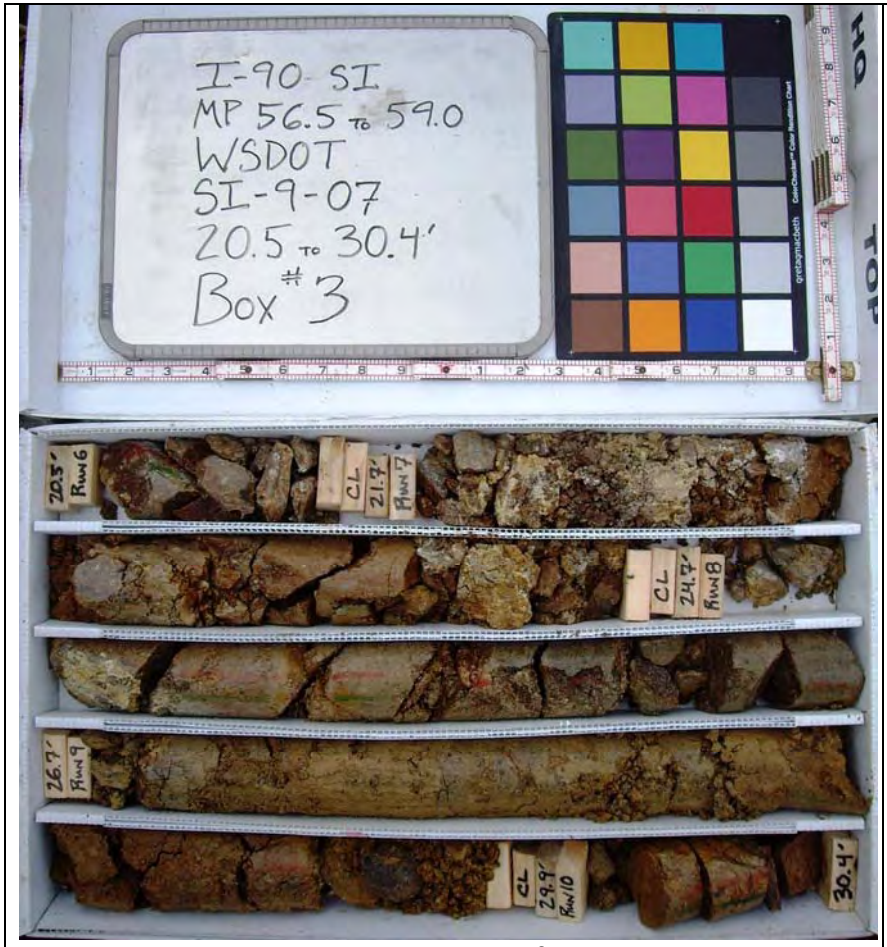
Box #9: 77.0 to 87.5 feet bgs

Box #10: 87.5 to 95.0 feet bgs

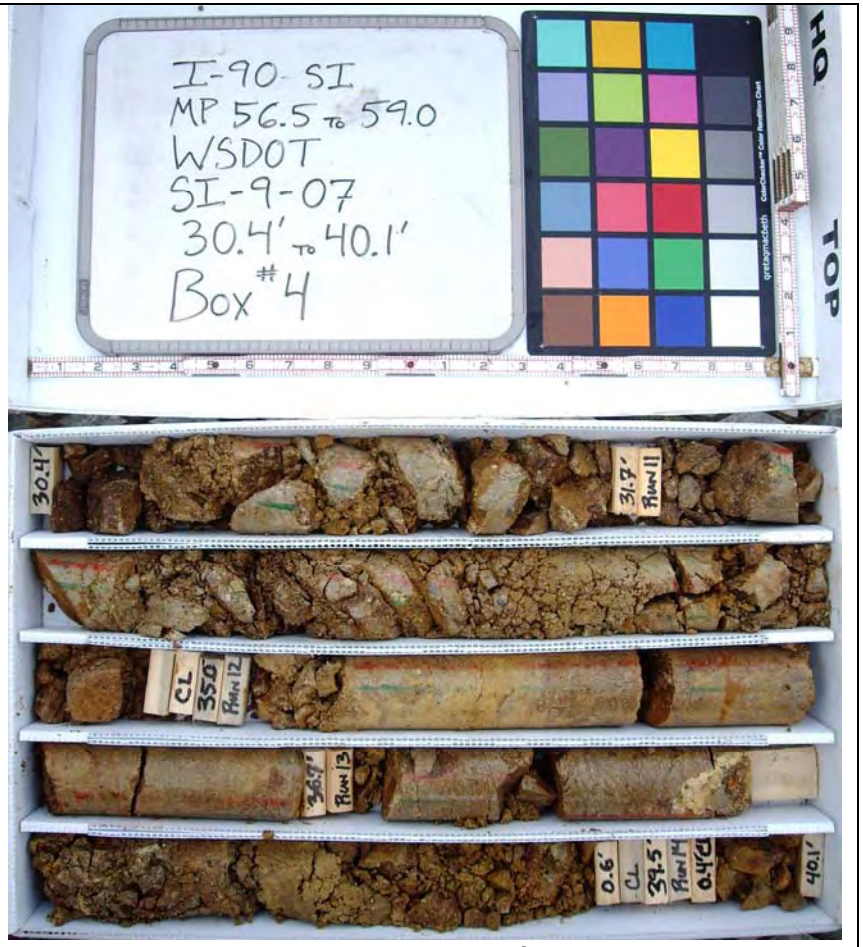
Box #11: 95.0 to 100.1 feet bgs

Box #1: 0.0 to 11.7 feet bgs

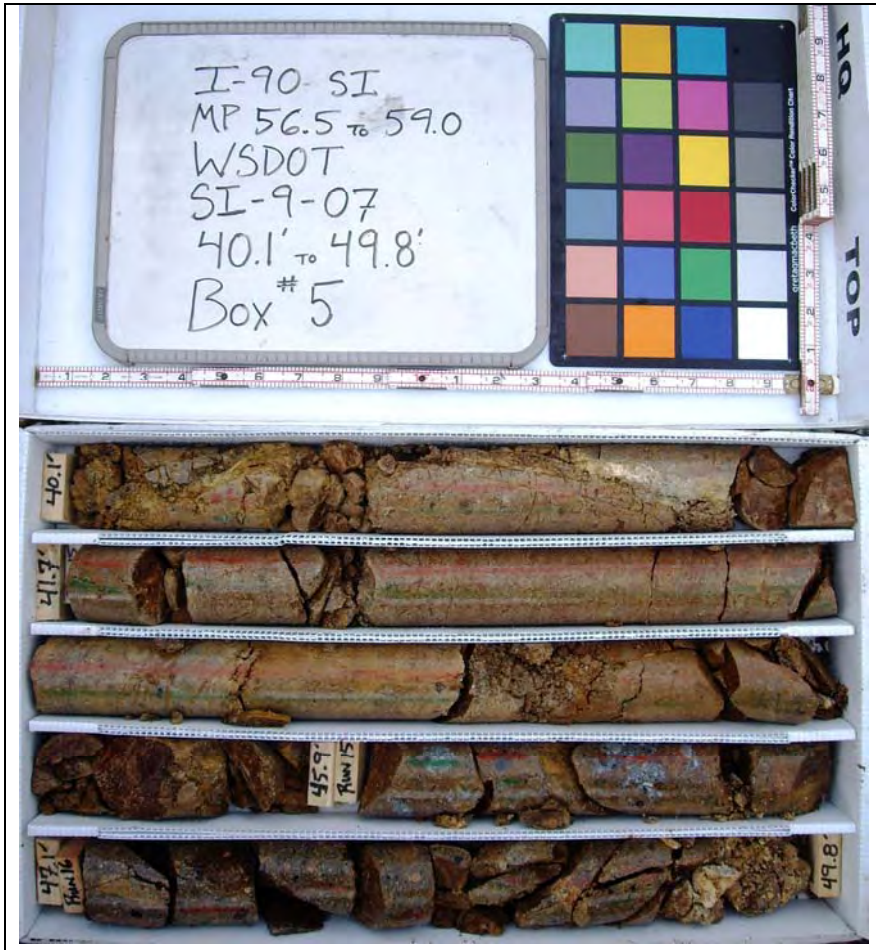
Box #2: 11.7 to 20.5 feet bgs



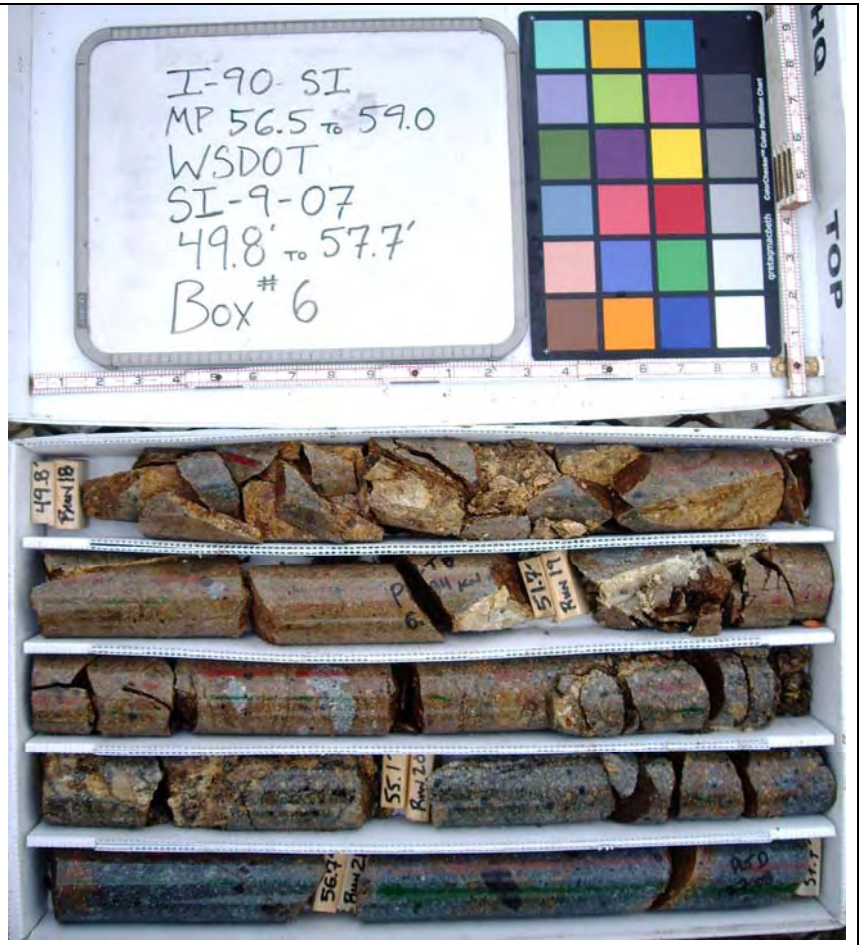
Box #3: 20.5 to 30.4 feet bgs



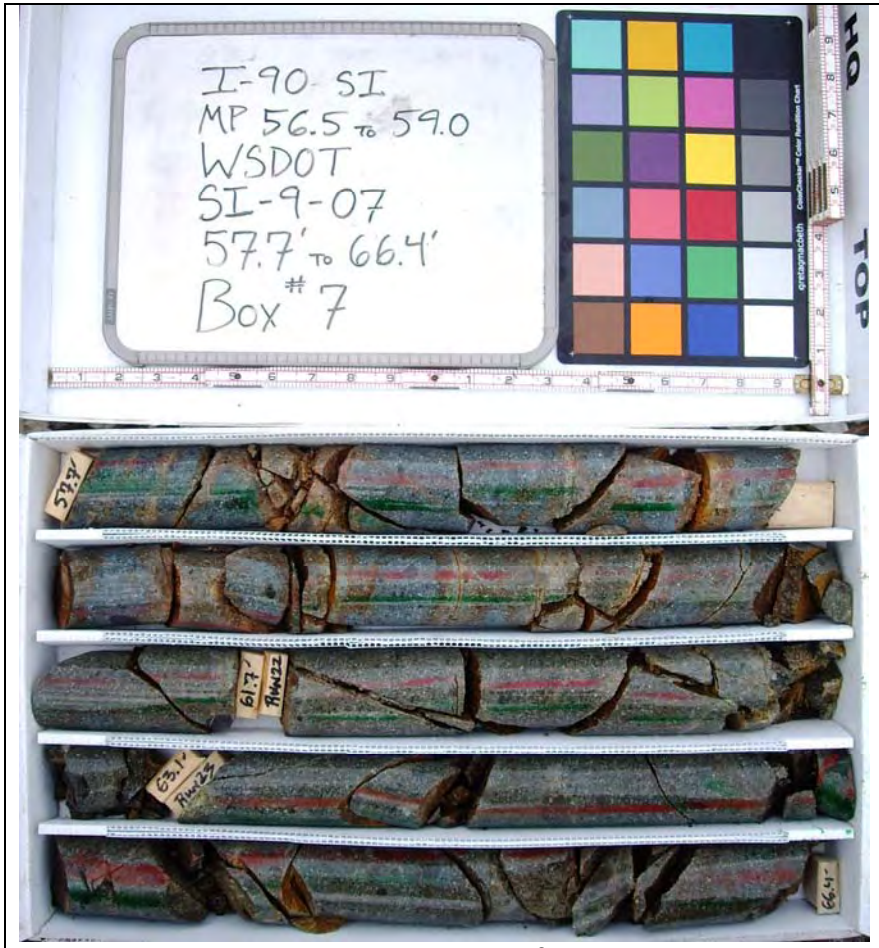
Box #4: 30.4 to 40.1 feet bgs



Box #5: 40.1 to 49.8 feet bgs



Box #6: 49.8 to 57.7 feet bgs



Box #7: 57.7 to 66.4 feet bgs

Box #8: 66.4 to 75.8 feet bgs

Box #9: 75.8 to 83.8 feet bgs

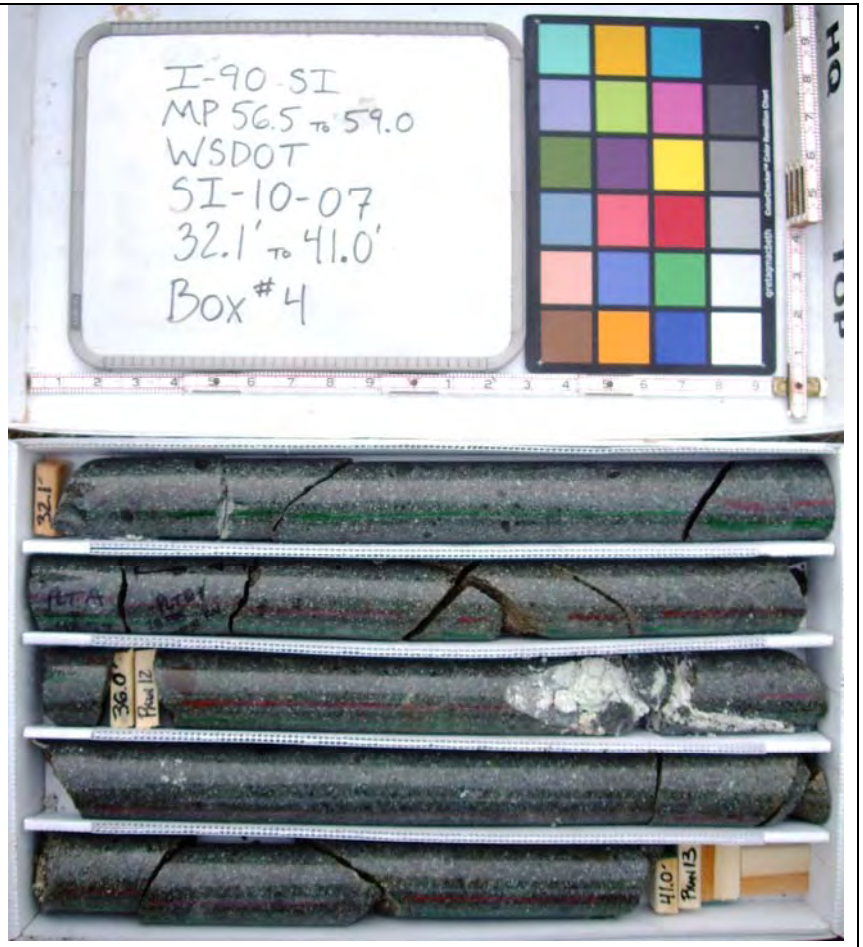
Box #10: 83.8 to 92.0 feet bgs

Box #11: 92.0 to 100.0 feet bgs

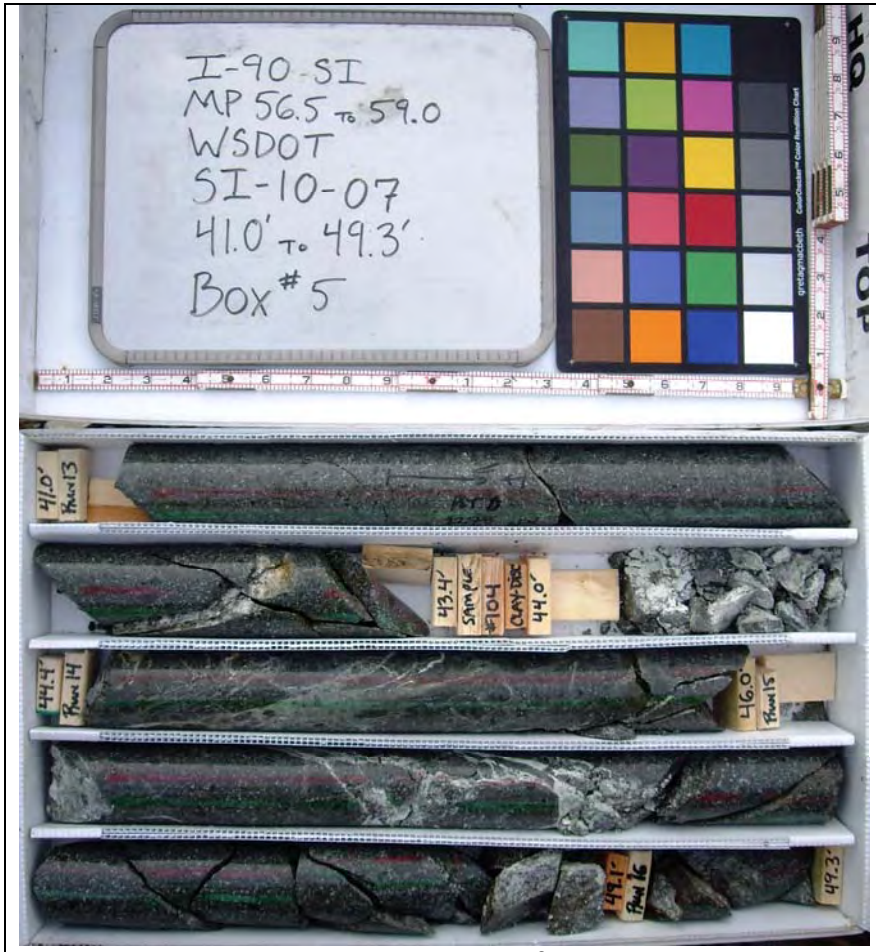
Box #1: 0.0 to 12.0 feet bgs

Box #2: 12.0 to 23.2 feet bgs

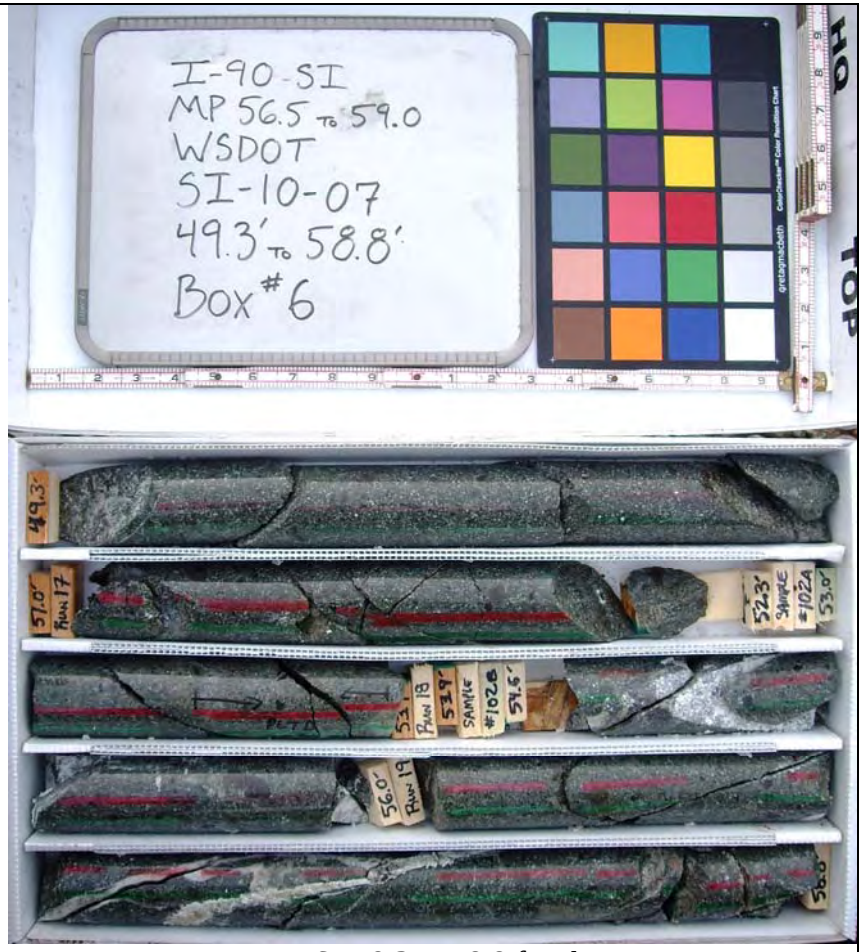
Box #3: 23.2 to 32.1 feet bgs



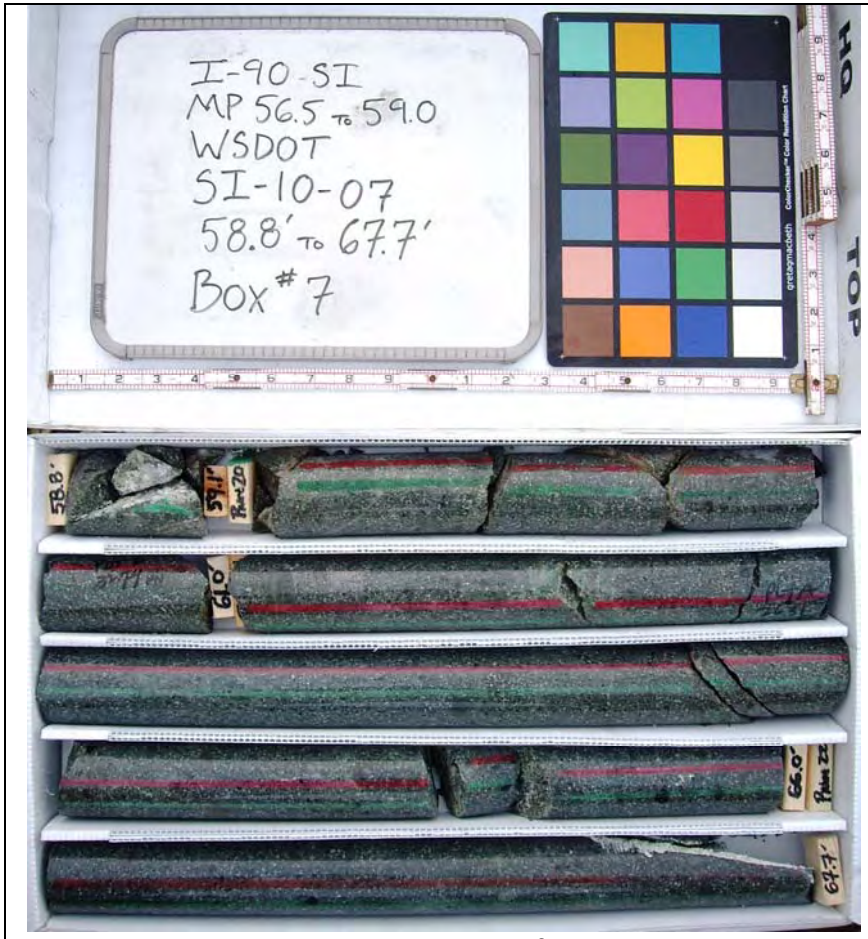
Box #4: 32.1 to 41.0 feet bgs



Box #5: 41.0 to 49.3 feet bgs



Box #6: 49.3 to 58.8 feet bgs

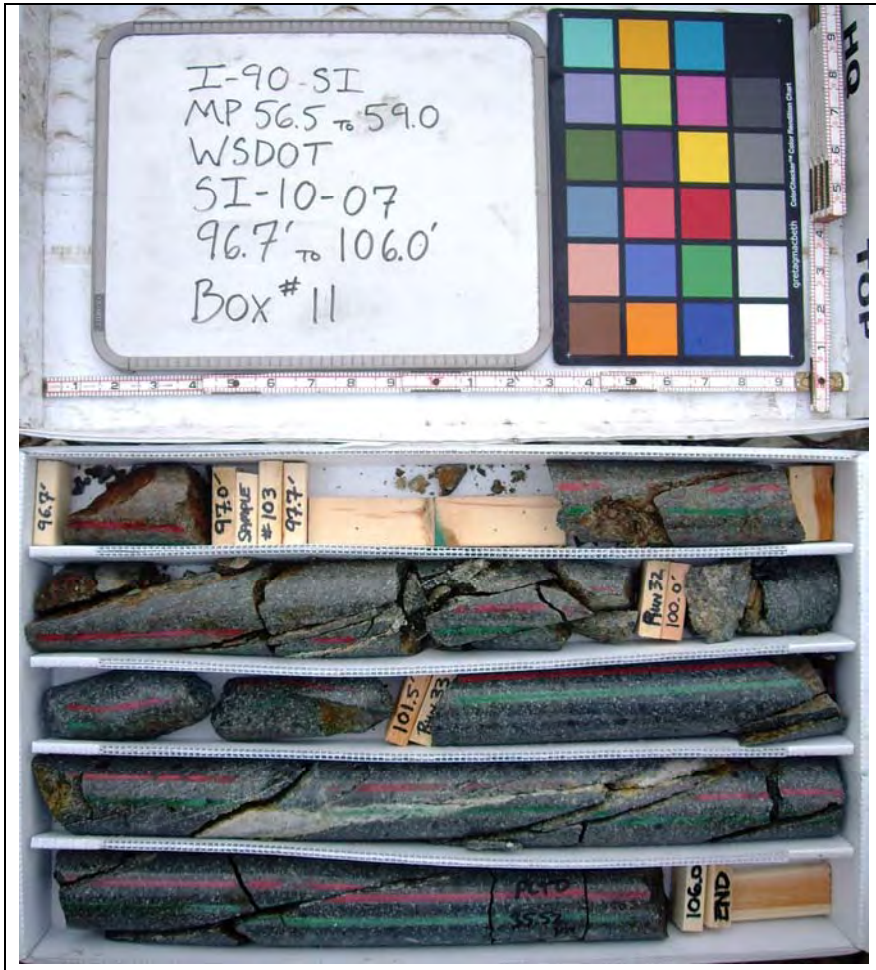


Box #7: 58.8 to 67.7 feet bgs

Box #8: 67.7 to 76.0 feet bgs

Box #9: 76.0 to 84.9 feet bgs

Box #10: 84.9 to 96.7 feet bgs



Box #11: 96.7 to 106.0 feet bgs

Box #1: 0.0 to 9.6 feet bgs

Box #2: 9.6 to 17.9 feet bgs

Box #3: 17.9 to 27.6 feet bgs

Box #4: 27.6 to 36.7 feet bgs

Box #5: 36.7 to 46.3 feet bgs

Box #6: 46.3 to 56.2 feet bgs

Box #7: 56.2 to 65.4 feet bgs

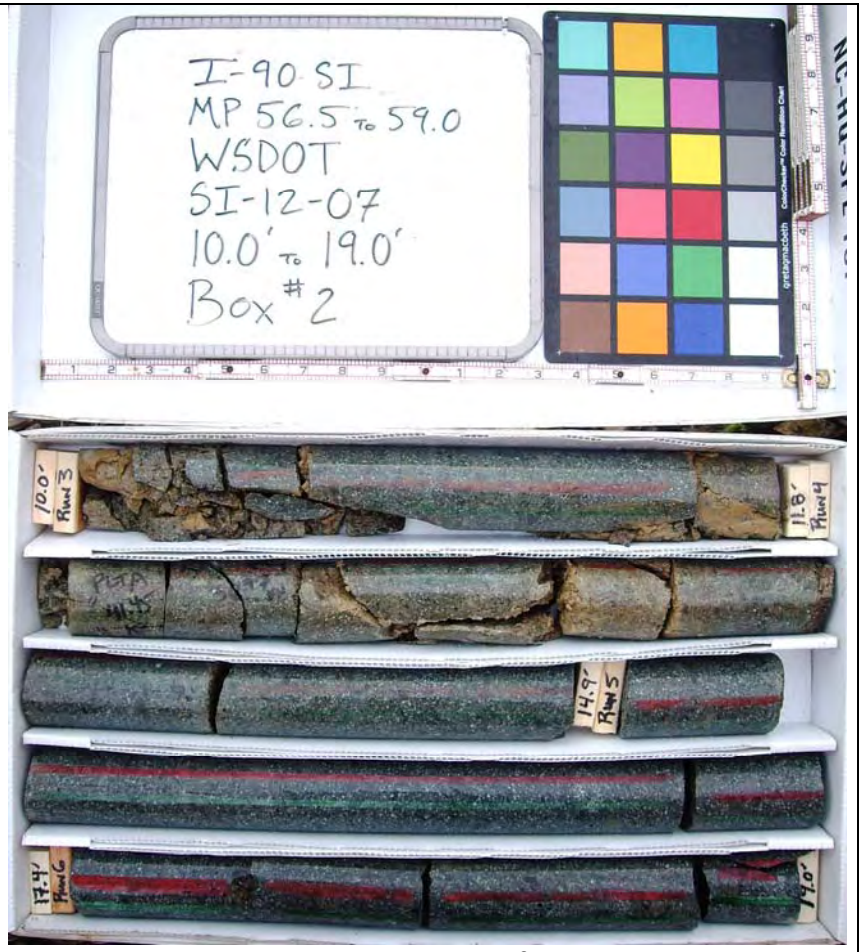
Box #8: 65.4 to 74.4 feet bgs

Box #9: 74.4 to 83.2 feet bgs

Box #10: 83.2 to 93.8 feet bgs

Box #11: 93.8 to 100.3 feet bgs

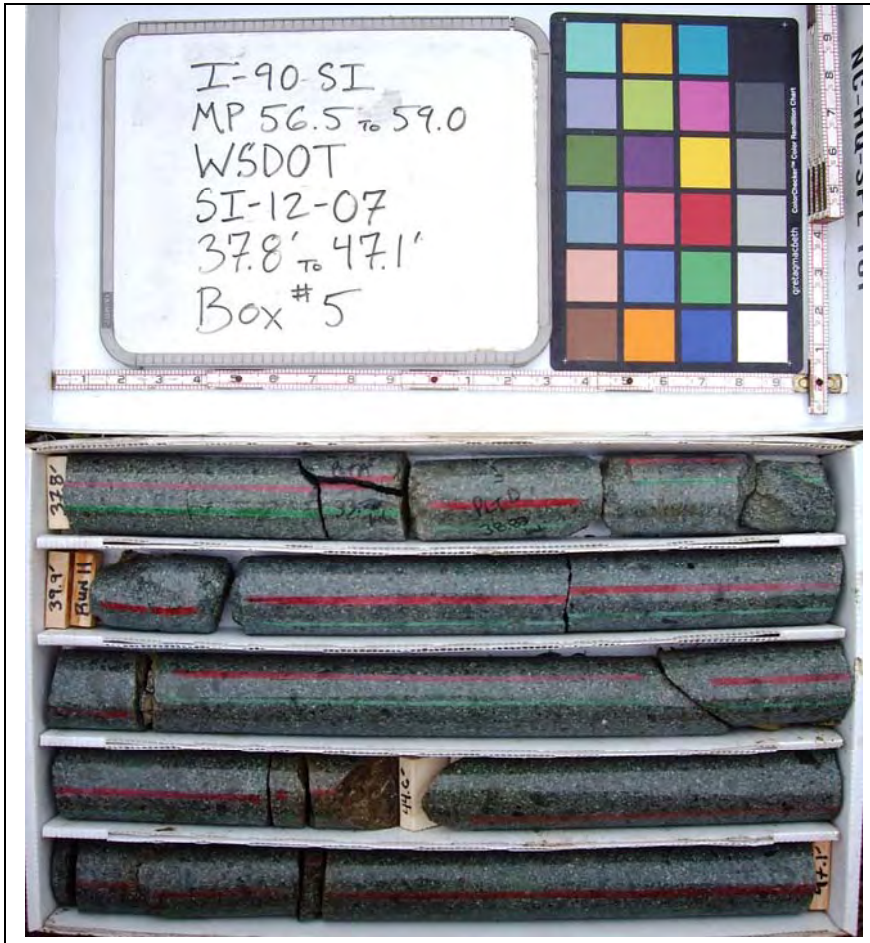
Box #1: 0.0 to 10.0 feet bgs



Box #2: 10.0 to 19.0 feet bgs

Box #3: 19.0 to 29.0 feet bgs

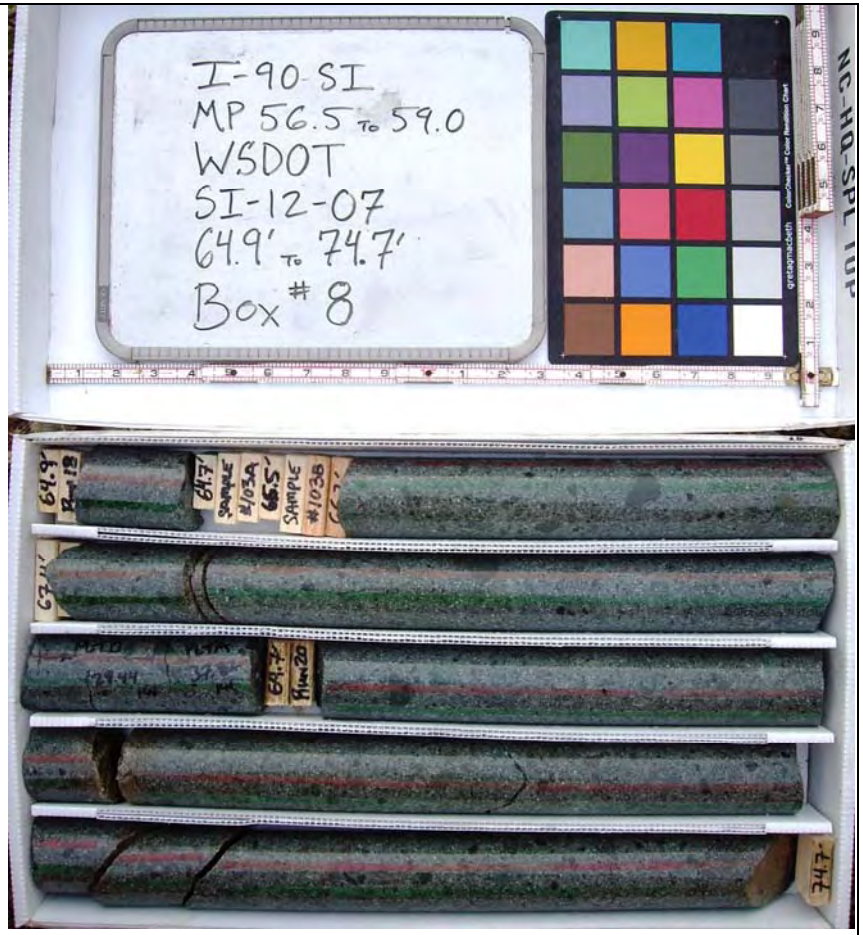
Box #4: 29.0 to 37.8 feet bgs



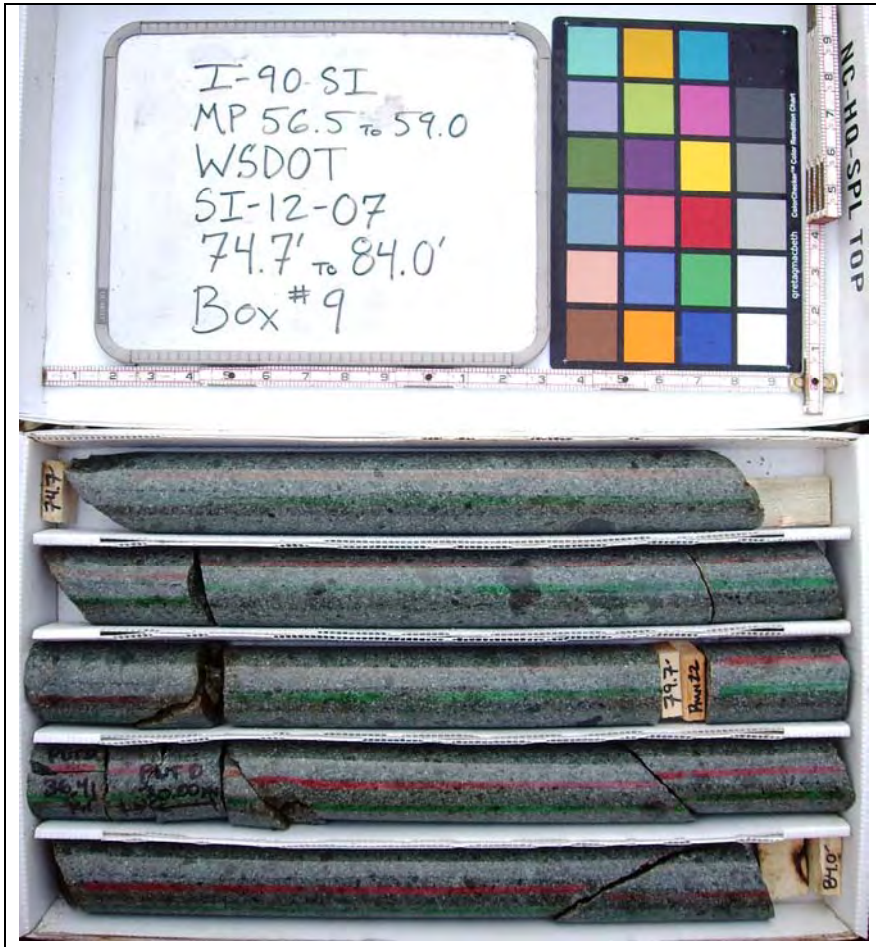
Box #5: 37.8 to 47.1 feet bgs

Box #6: 47.1 to 55.2 feet bgs

Box #7: 55.2 to 64.9 feet bgs



Box #8: 64.9 to 74.7 feet bgs



Box #9: 74.7 to 84.0 feet bgs

Box #10: 84.0 to 92.7 feet bgs

Box #11: 92.7 to 99.7 feet bgs

Appendix D

Downhole Televiewer (COBL) Surveys

All boreholes drilled at Slide Curve upslope from I-90 in 2006 and 2007 were surveyed using downhole optical and acoustical televiewer methods. CRUX Optical Borehole Logging (COBL), a division of CRUX Subsurface Inc (CRUX), provided all necessary equipment and staff to complete the downhole surveys and process the data. The Wyllie & Norrish team reviewed the preliminary data before COBL issued their final report. The televiewer logs and various summary tables of the orientation data are provided in this Appendix.

The downhole optical televiewer generates a continuous 360 degree image of the borehole wall. The image is oriented using a magnetometer and accelerometer to correct for borehole deviation and to provide corrected structural data for all visible linear features. In addition to structural data the optical image provides additional information to assist with lithologic characterization. The acoustical televiewer generates a digital image of the borehole by transmitting ultrasound pulses from a rotating sensor and recording the amplitude and travel time of the reflected signal. The amplitude of the returning signal is representative of the acoustic (elastic) properties of the surrounding material while the travel time log provides borehole diameter data. The logs are displayed by relative difference in a grading color scale.

The downhole image instrumentation used on the project are listed below. Summary data sheets for these instruments are included in this Appendix.

Optical Televiewer:
OBI 40 (Mark 4) – Manufactured by Advanced Logic Technology

Acoustical Televiewer:
ABI 40 – Manufactured by Advanced Logic Technology

Summary of Figures and Tables:

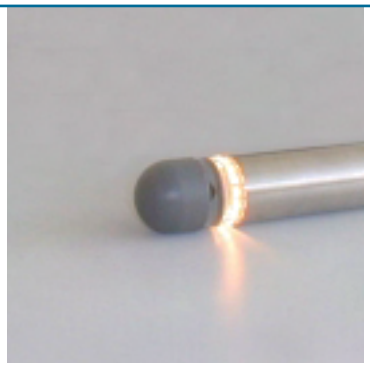
Downhole COBL logs from 2007 are provided for each borehole in sequential order. Following the logs are Tables for each borehole which include all data collected from the OBI and ABI tools with an average value provided. The average value is shown by number on the COBL logs. COBL data from 2006 was provided in *Rock Cut Feasibility Investigation – Slide Curve I-90 MP 59* (Wyllie & Norrish, 2007a).

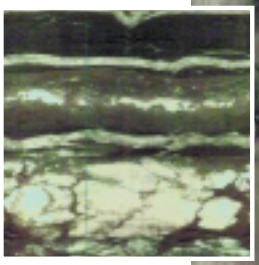
DISCLAIMER:

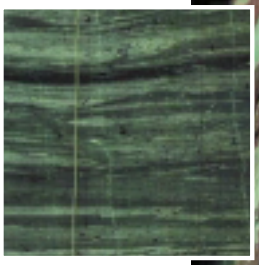
Data represented on the COBL logs includes all identifiable features that appear to have an orientation. This includes but was not limited to joints, faults, shears, bedding, healed joints or fractures and lineated or foliated structure. No attempt was made by COBL personnel to screen the data for a specific type of discontinuity or orientation on the feature. The purpose was to consistently mark all identifiable features. The attached tables provide a reduction of all marked features to those that W&N interpreted to be of engineering significance.

OBI 40

slimhole optical televiewer







The tool generates a continuous oriented 360° image of the borehole wall using an optical imaging system. (downhole CCD camera which views a image of the borehole wall in a prism). The tool includes a orientation device consisting of a precision 3 axis magnetometer and 3 accelerometers thus allowing accurate borehole deviation data to be obtained during the same logging run (accurate and precise orientation of the image).

Optical and acoustic televiewer data are complimentary tools especially when the purpose of the survey is structural analysis.

A common data display option is the projection on a virtual core that can be rotated and viewed from any orientation. Actually, an optical televiewer image will complement and even replace coring survey and its associated problem of core recovery and orientation.

The optical televiewer is fully downhole digital and can be run on any standard wireline (mono, four-conductor, seven-conductor). Resolution is user definable (up to 0.5mm vertical resolution and 720 pixels azimuthal resolution)

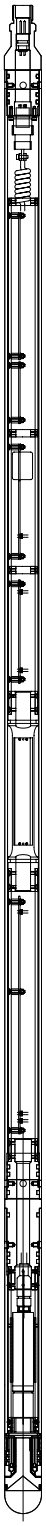
Advanced Logic Technology

Bâtiment A, Route de Niederpallen,
L-8506 Redange-sur-Attert.
Grand-Duché de Luxembourg

T:(352) 23 649 289 • F:(352) 23 649 364
e-mail: sales@alt.lu www.alt.lu

OBI 40

slimhole optical televiewer



Applications:

The purpose of the optical imaging tool is to provide detailed, oriented, structural information. Possible applications are :

- fracture detection and evaluation
- detection of thin beds
- bedding dip
- lithological characterization
- casing inspection

Technical specifications

Diameter	40mm
Length	approx. 1.7m
Weight	approx 7 kgs
Max temp	50°C
Max pressure	200 bars
Borehole diameter	1 3/4" to 24" depending on borehole conditions
Logging speed	variable function of resolution and wireline

Cable:

Cable type	mono, four-conductor, seven-conductor
Digital data transmission	up to 500 Kbps depending on wireline, realtime compressed
Compatibility	ALTlogger- ALT-Abox- Mount Sopris MgXII (limited to 41 Kbps)

sensor:

Sensor type	downhole DSP based digital CCD camera
Optics	plain polycarbonate conic prism system
Azimuthal resolution	user definable 90/180/360 or 720 pixels /360°
Vertical resolution	user definable, depth or time sampling rate
Color resolution	24 bit RGB value
White balance:	automatic or user adjustable
Aperture & Shutter	automatic or user adjustable
Special functions	User configurable real time digital edge enhancing User configurable ultra low light condition mode
Orientation	3 axis magnetometer and 3 accelerometers.
Inclination accuracy	0.5 degree
Azimuth accuracy:	1.0 degree

Logging parameters:

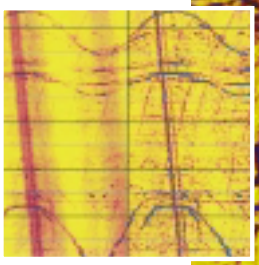
- 360° RGB orientated optical image
- Borehole azimuth and dip
- Tool internal Temperature

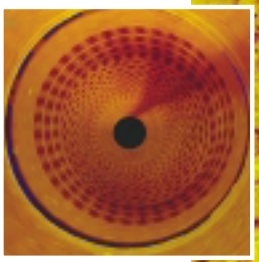
The specifications are not contractual and are subject to modification without notice.

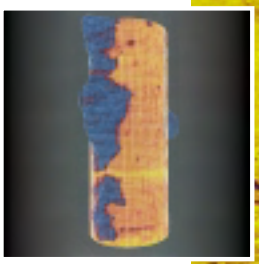
Advanced Logic Technology

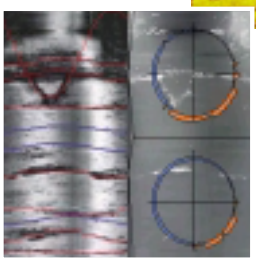
ABI 40

slimhole acoustic televiewer

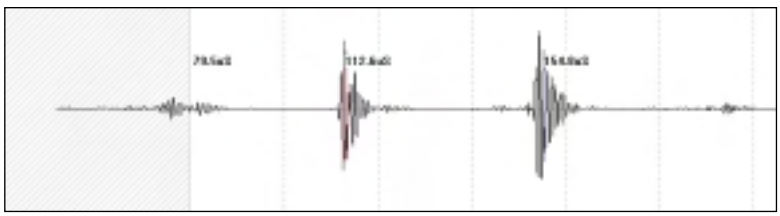


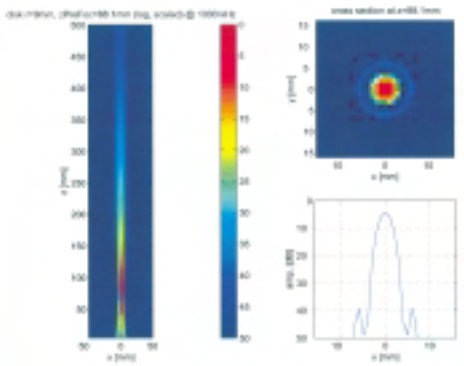


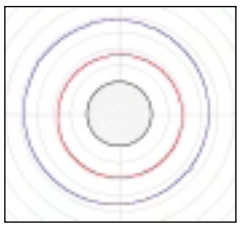




The ABI40 is the latest generation of the FAC40. Based on 8 years of experience and market leadership with BHTV technology, the new system consists of industry standard focused acoustic head with completely new deviation subsystem and redesigned electronics. The new electronic architecture uses a A/D converter 14 Bit directly coupled to a super FAST 75Mops DSP processor. The DSP is performing complex data processing operations in real time on each individual ultrasonic wave train enabling higher dynamic range of signal detection and easy field operation in a wide variety of logging applications.







Advanced Logic Technology

Bâtiment A, Route de Niederpallen,
L-8506 Redange-sur-Attert.
Grand-Duché de Luxembourg

T:(352)23 649 289 • F:(352)23 649 364
e-mail: sales@alt.lu www.alt.lu

ABI 40

slimhole acoustic televiewer

- Direct linear 14 Bit,10mhz A/D conversion (automatic gain settings)
- Dynamic range of amplitude measurement is 84dB
- Caliper resolution is better than 0.1mm
- New orientation sensor (3 accelerometers and 3 axis magnetometer)
- New orientation sensor (3 accelerometers and 3 axis magnetometer) which does not require field calibration
- Increased telemetry bandwidth (data transmission rate up to 500 Kbits depending on wireline), 166 kbps typical on 3000m four-conductor.
- Full wave form recording and real time display for quality control
- Multiecho mode to realize acoustic measurements through plastic pipes (require the plastic pipe to be centralized inside the borehole.
- Pipe-inspection mode to detect inner corrosion, outer corrosion, and wall thickness
- Automatic measurement window definition to gain optimum performance and variable borehole conditions

Tool design philosophy :

Acoustic borehole scanner tools generates an image of the borehole wall by transmitting ultrasound pulses from a rotating sensor and recording the amplitude and travel time of the signals reflected at the interface between mud and formation (borehole wall). Compared to the FAC40, which measures one echo (one amplitude and one travel time), the ABI is a multi-echo system. This is achieved by digital recording of the reflected acoustic wave train. On line analysis of the acoustic data is made by a DSP (digital Signal Processor). Sophisticated algorithms allow the system to detect the reflection from the acoustic window and to separate/classify all subsequent echoes. Minimum input of the operator is needed to enable:

- Automatic optimisation of measurement window under all borehole conditions
- Automatic adaptation to variable borehole conditions
- Improvement of dynamic range of signal detection
- Very high travel time resolution
- Implementation of different operating modes.

E.g. when run inside plastic casing, the tool can record both the echo of the casing and of the borehole wall. Tool upgrades and implementations of customised operating modes can be simply made by downloading new firmware into the tool from the surface computer.

Technical specifications

Diameter:	40mm
Length:	1.6 m
Weight:	6kgs
Max temp:	70°C
Max pressure:	200 bar
Borehole diameter:	2" to 21" depending on mud conditions
Logging speed:	variable function of resolution and wireline. i.e 2.0 m/min at 144x3mm

Cable:

Cable type:	mono, four-conductor, seven-conductor
digital data transmission:	up to 500 Kbits per second depending on wireline.
compatibility:	ALTlogger - ALTboxOX - Mount Sopris MgxII (limited to 41 Kbps)

sensor:

acoustic sensor:	fixed transducer and rotating focusing mirror
focusing:	3" or 6"
frequency:	1.2 MHz
acoustic beam width:	1.5 mm (-3db) focal distance
rotation speed:	up to 10 revolutions per second - automatic
samples per revolution:	72, 144, 288 user defined
caliper resolution:	0.08mm
orientation:	3 axis magnetometer, 3 accelerometers
Inclination accuracy:	+/- 0.5 degree
Azimuth accuracy:	+/- 1.0 degree

The specifications are not contractual and are subject to modification without notice.

Applications:

The purpose of the acoustic borehole imaging tool is to provide detailed, oriented caliper and structural information on the basis of high resolution, ultrasonic travel time and amplitude images. The travel time is used to determine exceptionally accurate borehole diameter data, which makes the tool ideal for borehole deformation description (stress field analysis) and casing inspection. Travel time is also used for quality control of the amplitude measurement. The amplitude of the reflection from the borehole wall is representative of the acoustic (elastic) properties of the surrounding rock. Therefore, the tool is ideal for fracture detection and geotechnical rock classification. Cement bond quality can be checked if the reflection signal from behind casing is analyzed.

Most common applications are:

- fracture detection and evaluation
- detection of thin beds
- determination of bedding dip
- lithological characterization
- breakout analysis
- monitoring of earth stress field
- casing inspection
- high resolution caliper measurements

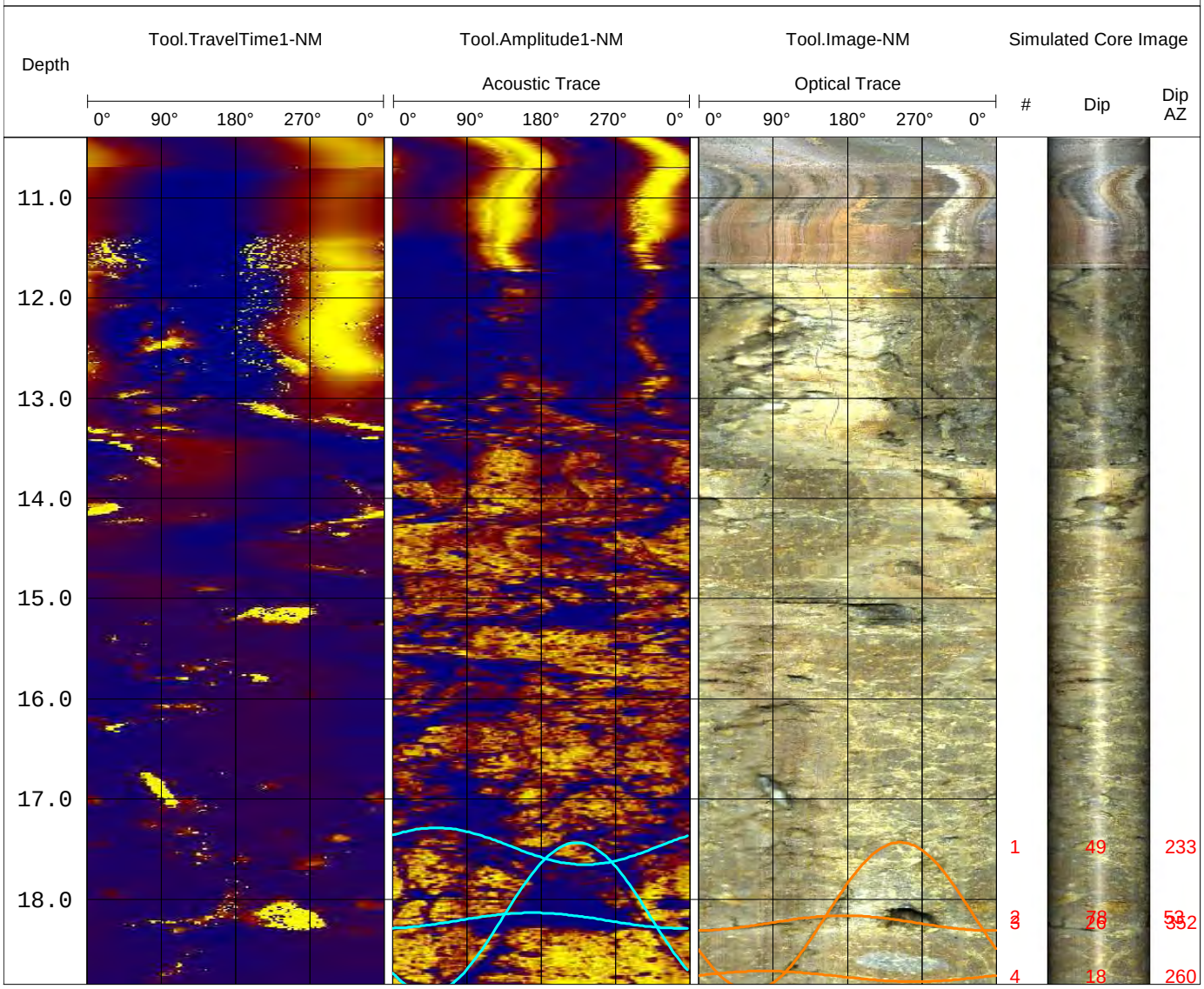
Advanced Logic Technology

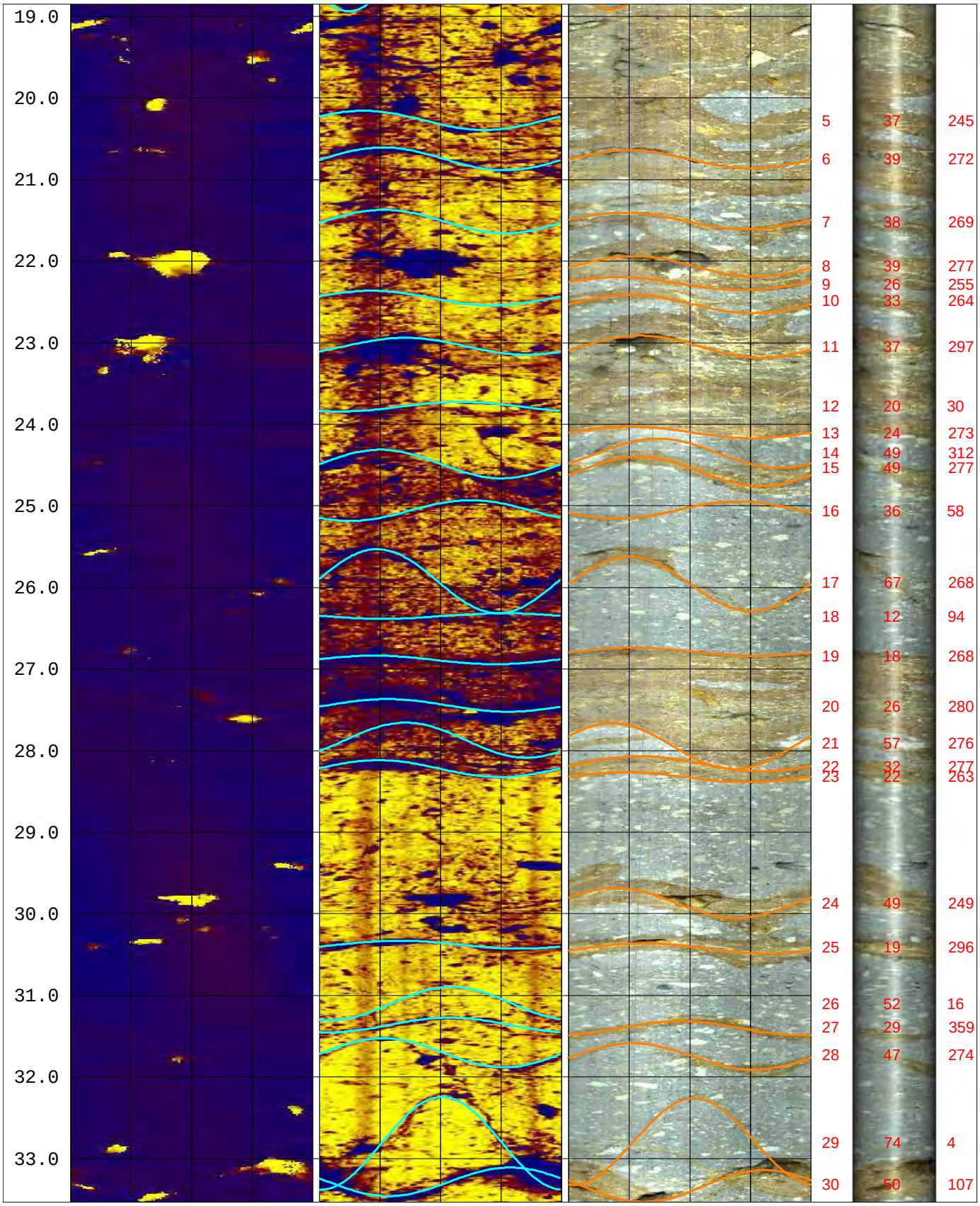
* released in 2002

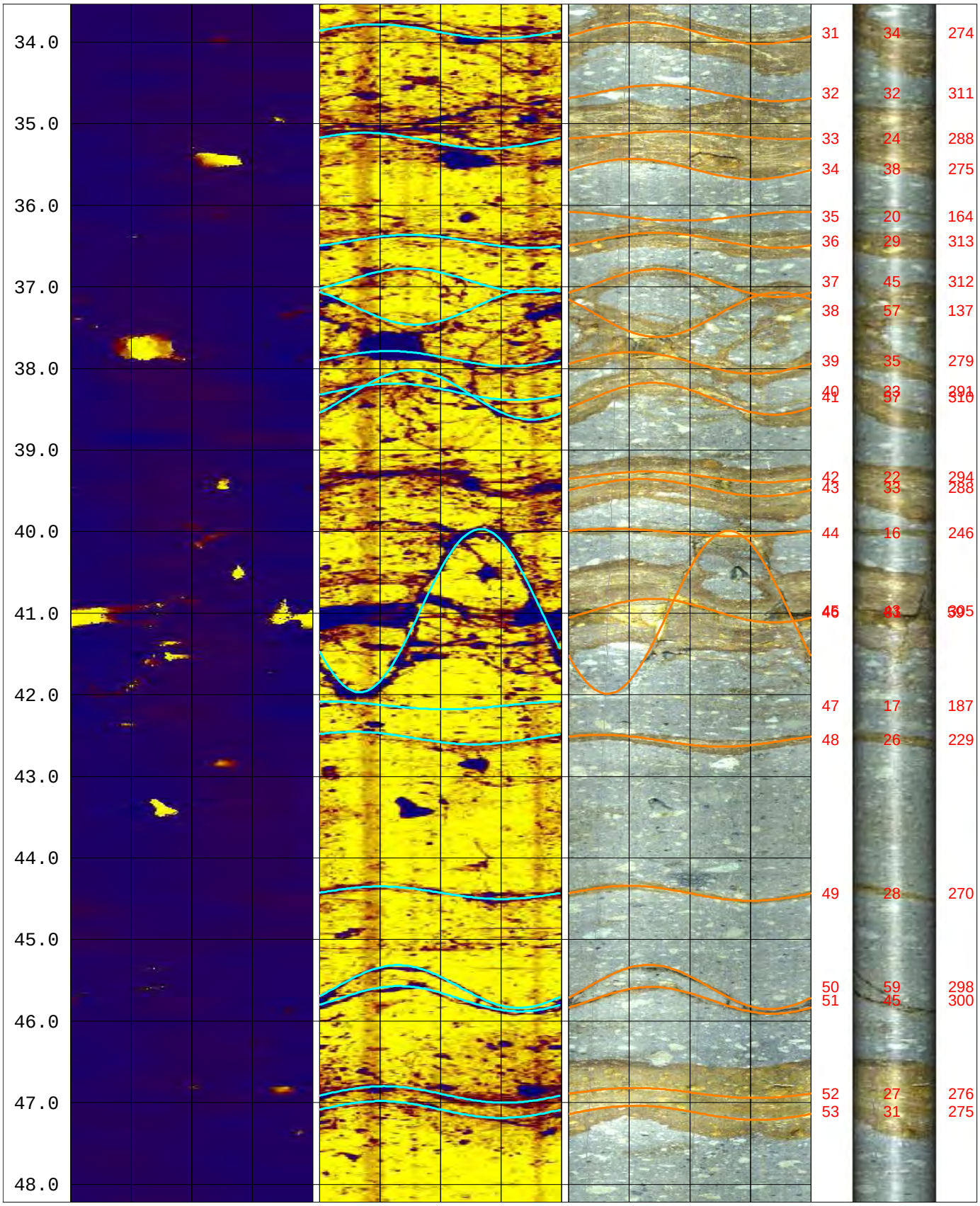
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program
Date Logged:	September 21, 2007	Borehole ID: RKS-19-07
File Name:	RKS1907-1M.wcl	Logged By: F G Kruger

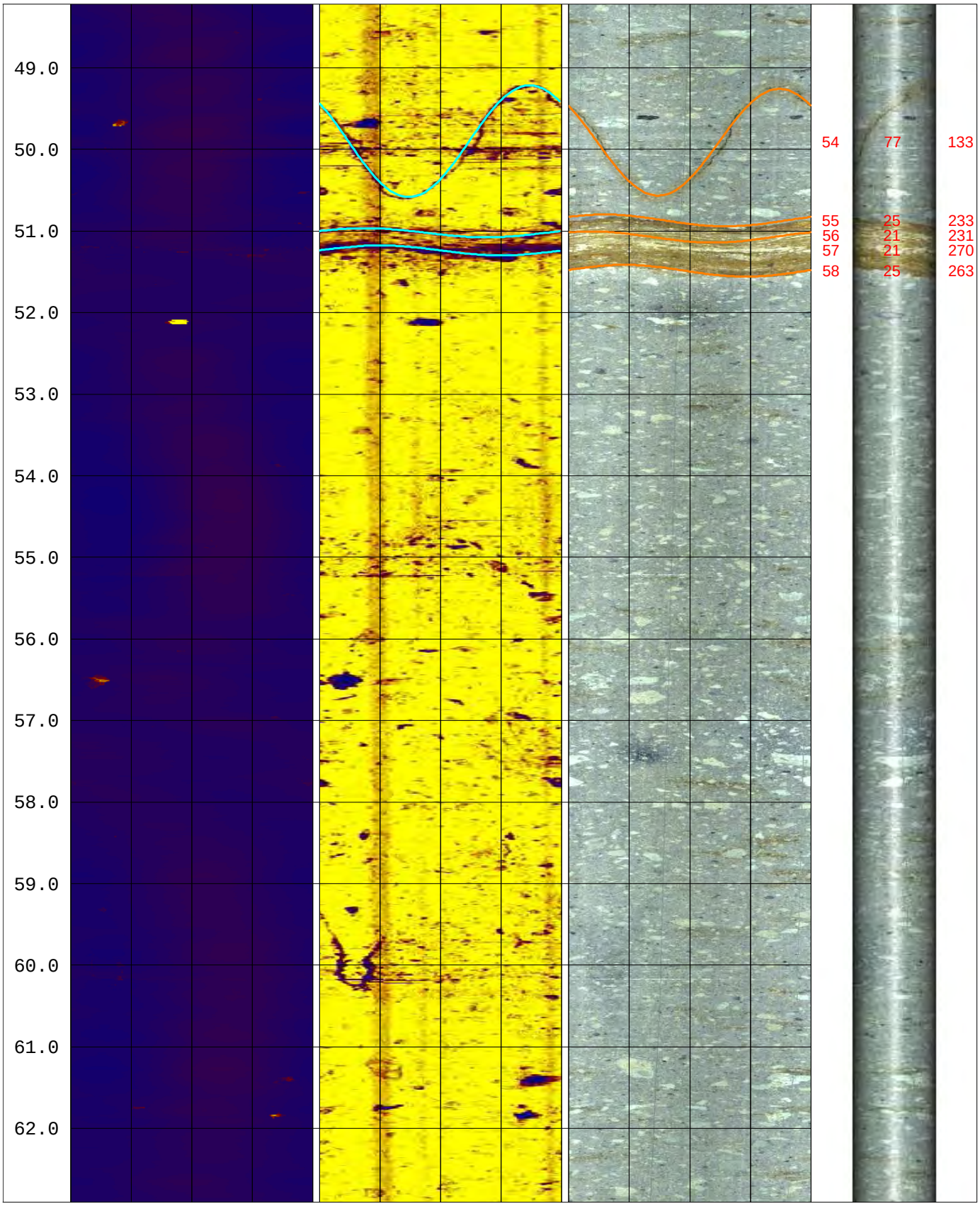
Notes:

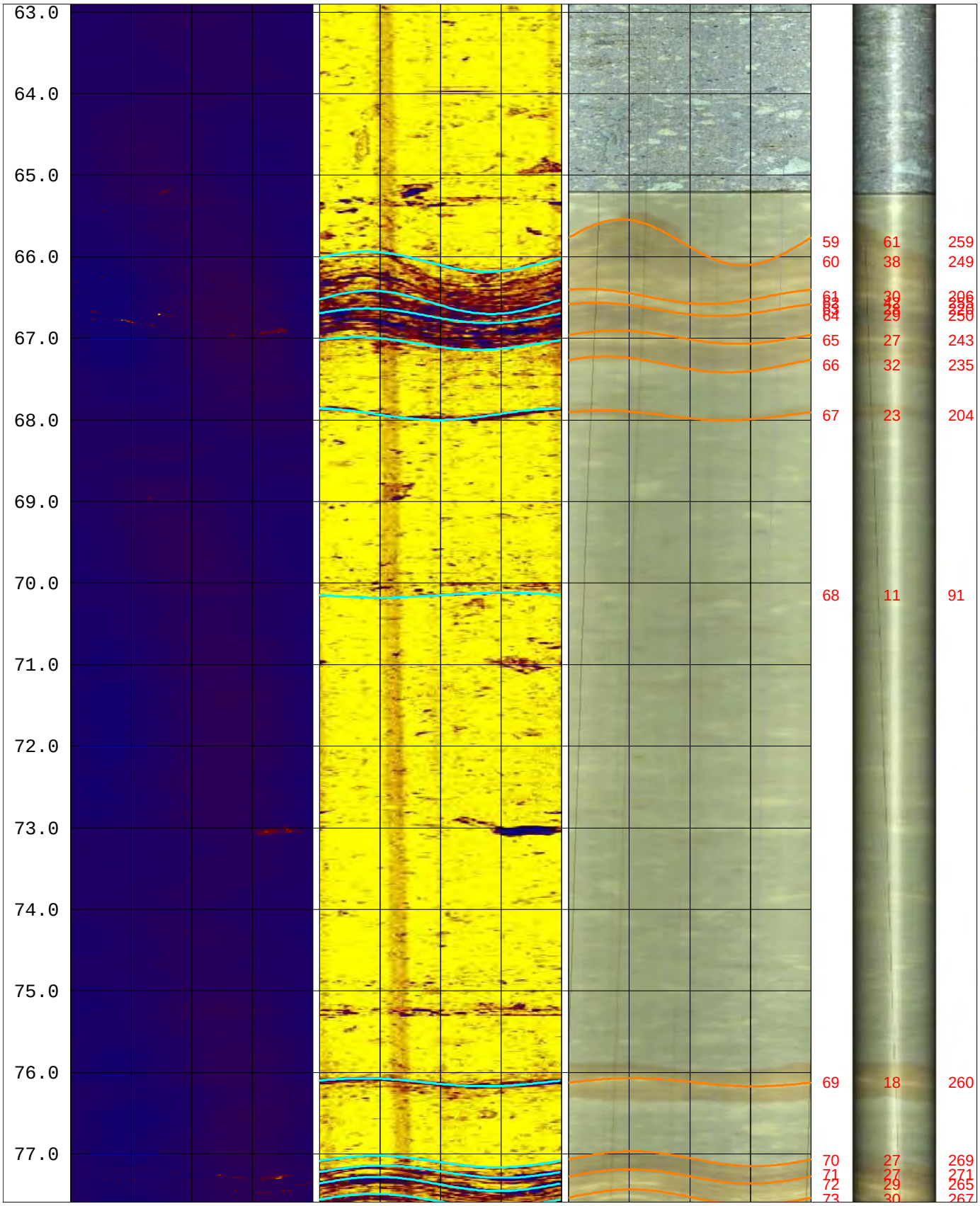
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

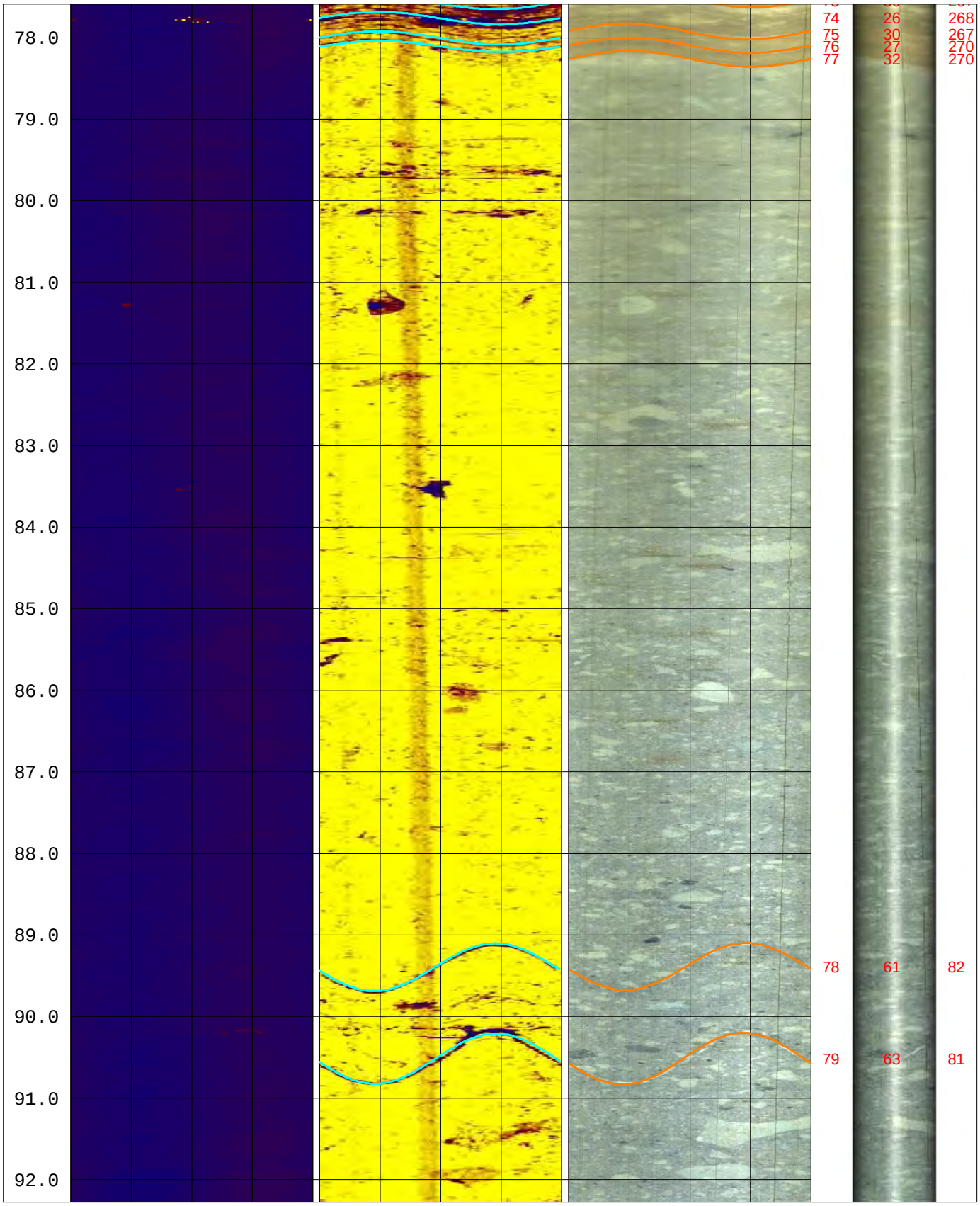


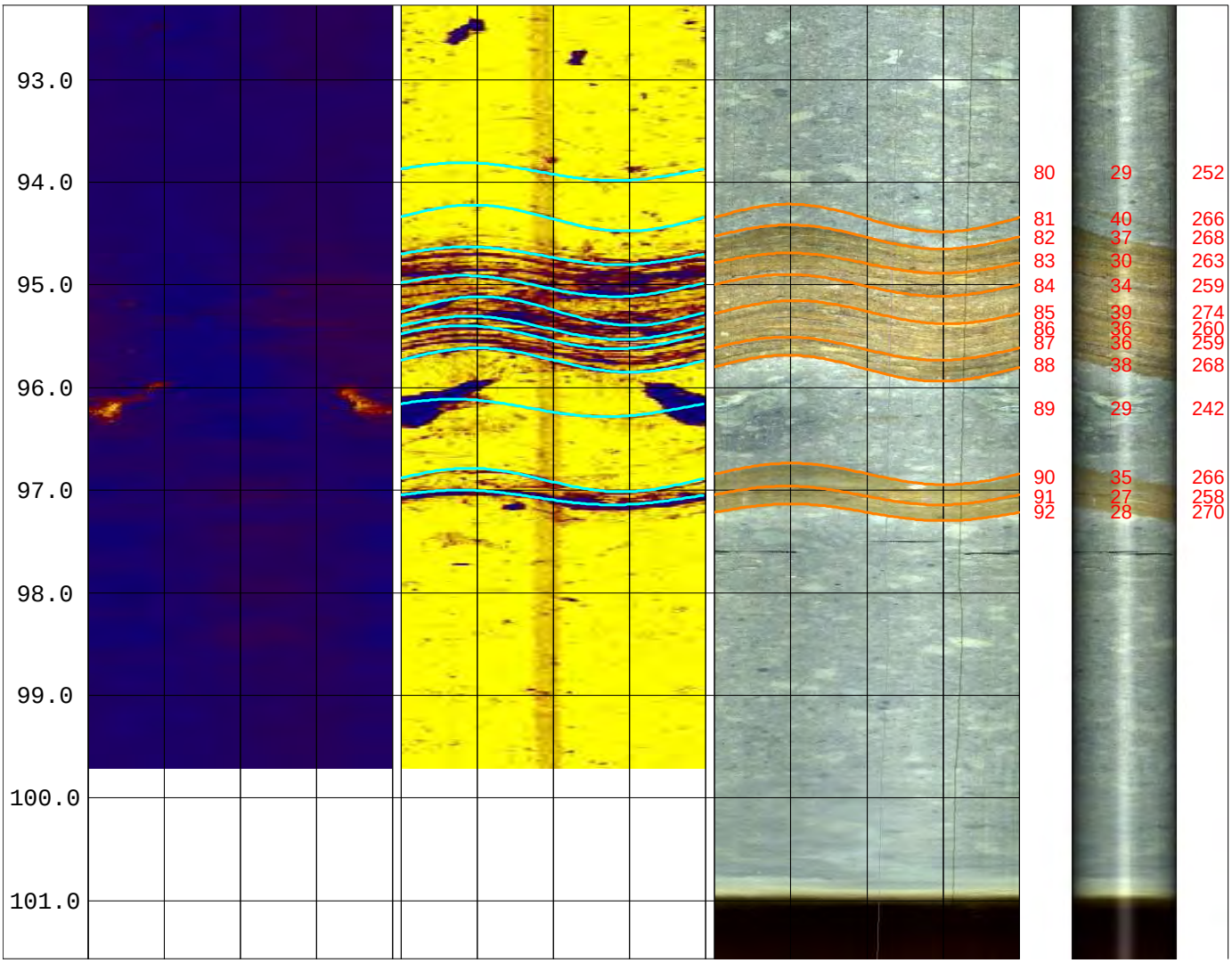

19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
5 37 245
6 39 272
7 38 269
8 39 277
9 26 255
10 33 264
11 37 297
12 20 30
13 24 273
14 49 312
15 49 277
16 36 58
17 67 268
18 12 94
19 18 268
20 26 280
21 57 276
22 32 277
23 22 263
24 49 249
25 19 296
26 52 16
27 29 359
28 47 274
29 74 4
30 50 107


34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
31 34 274
32 32 311
33 24 288
34 38 275
35 20 164
36 29 313
37 45 312
38 57 137
39 35 279
40 33 291
41 57 310
42 22 294
43 33 288
44 16 246
45 61 305
46 59
47 17 187
48 26 229
49 28 270
50 59 298
51 45 300
52 27 276
53 31 275


49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
62.0
54 77 133
55 25 233
56 21 231
57 21 270
58 25 263


63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
73.0
74.0
75.0
76.0
77.0
59 61 259
60 38 249
61 30 206
64 29 250
65 27 243
66 32 235
67 23 204
68 11 91
69 18 260
70 27 269
71 27 271
72 29 265
73 30 267


78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
74 26 268
75 30 267
76 27 270
77 32 270
78 61 82
79 63 81

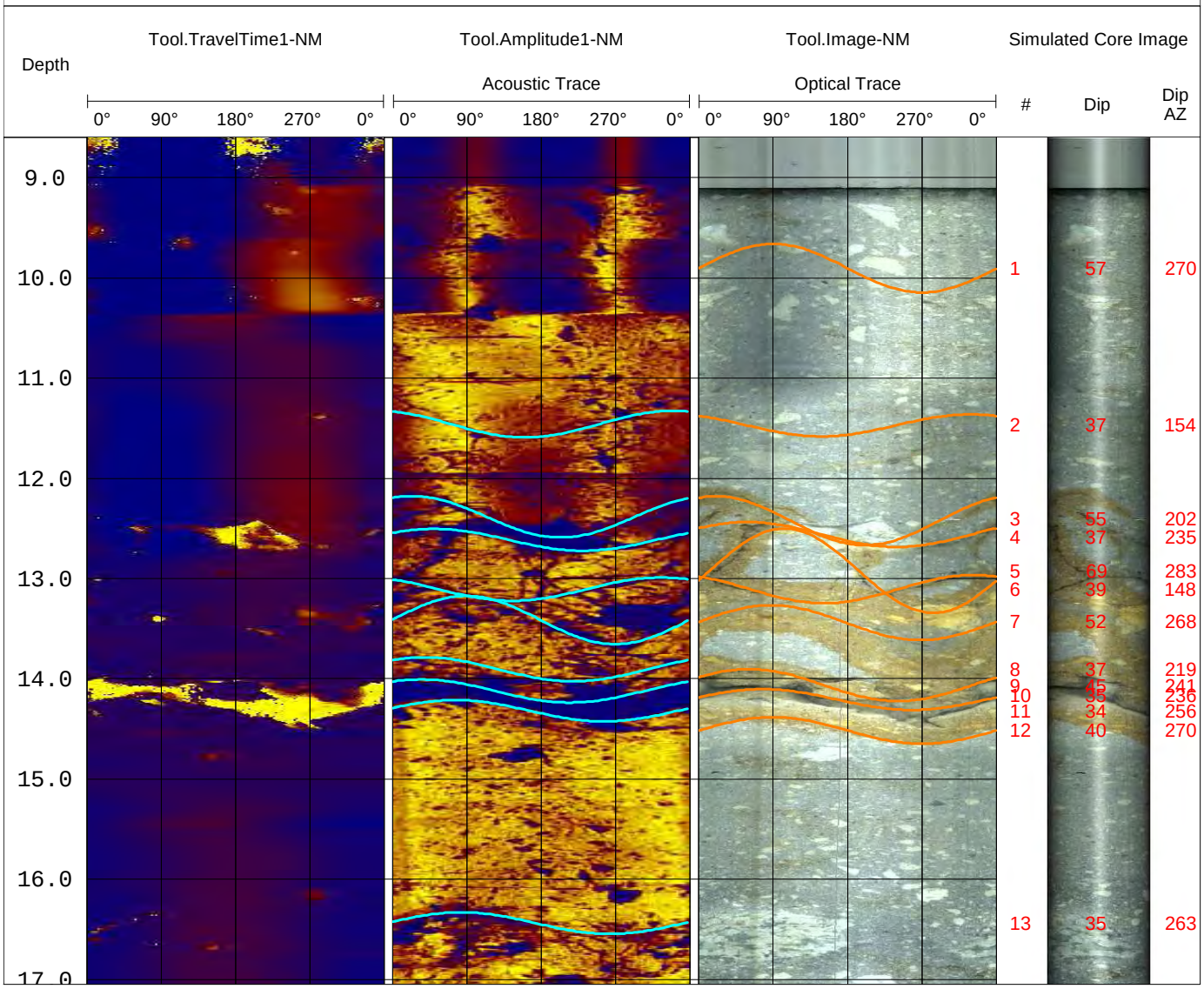

93.0
94.0
95.0
96.0
97.0
98.0
99.0
100.0
101.0
80 29 252
81 40 266
82 37 268
83 30 263
84 34 259
85 39 274
86 36 260
87 36 259
88 38 268
89 29 242
90 35 266
91 27 258
92 28 270

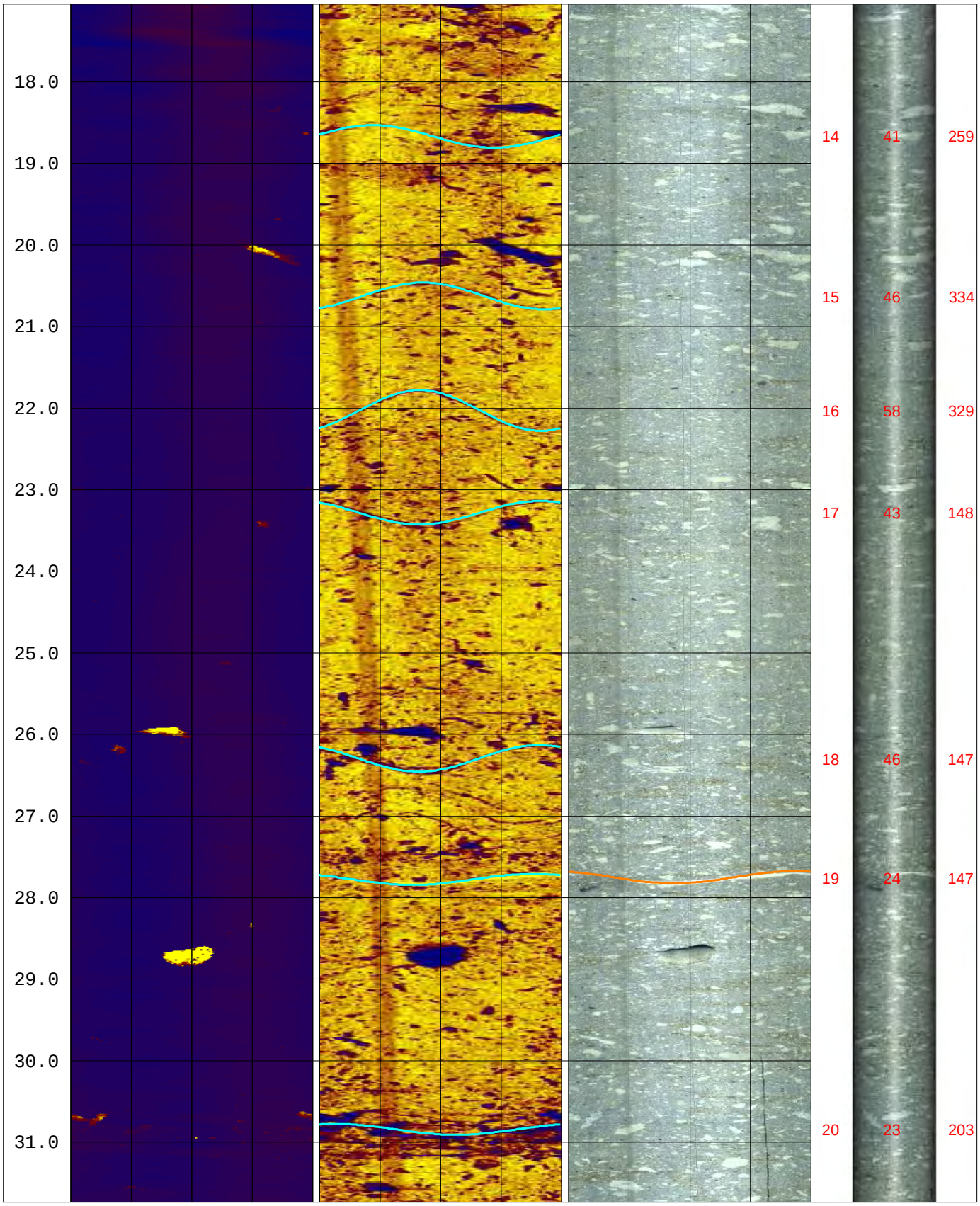
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

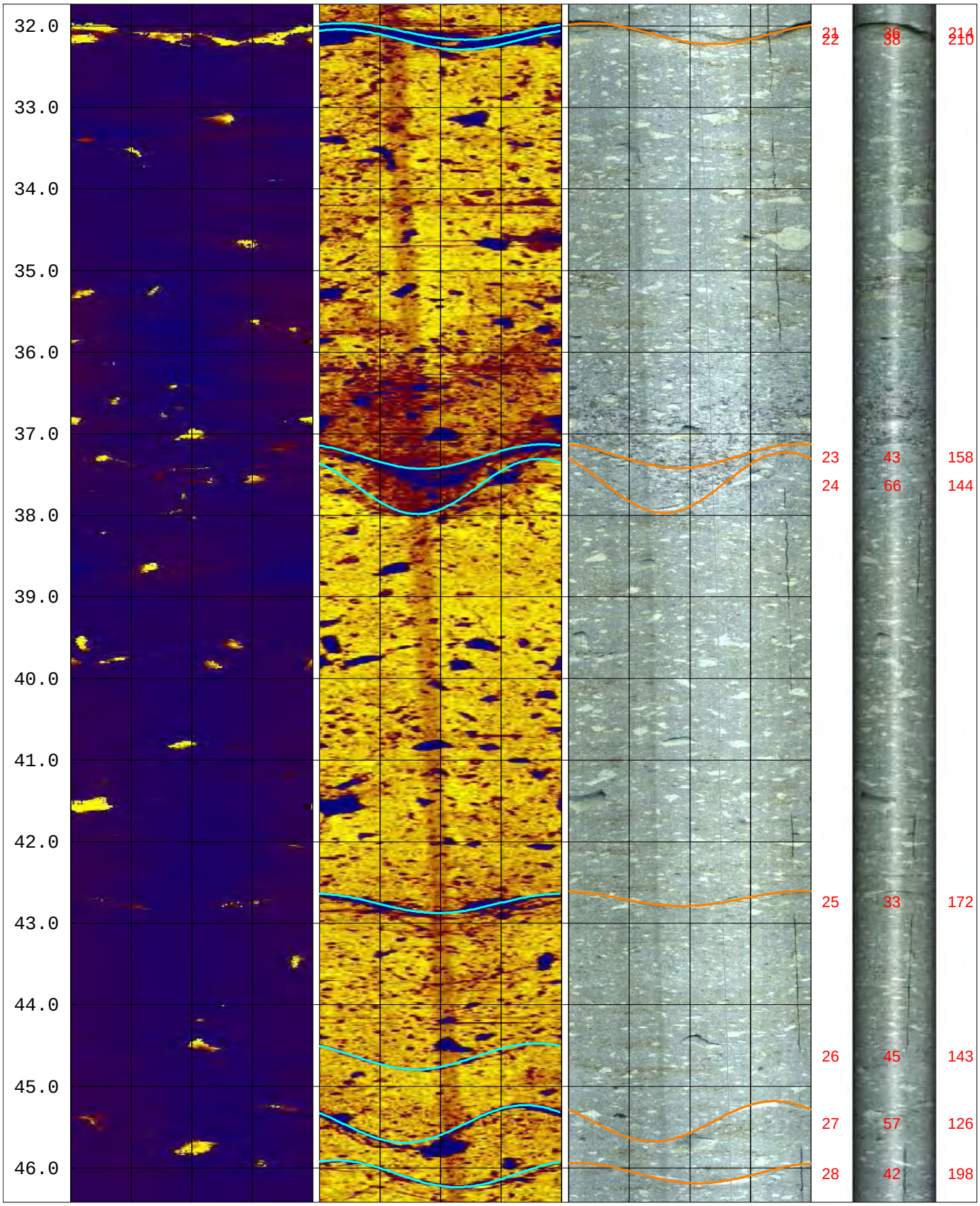
Date Logged:	October 3, 2007	Borehole ID:	RKS-20-07
File Name:	RKS2007-1M.wcl	Logged By:	F G Kruger

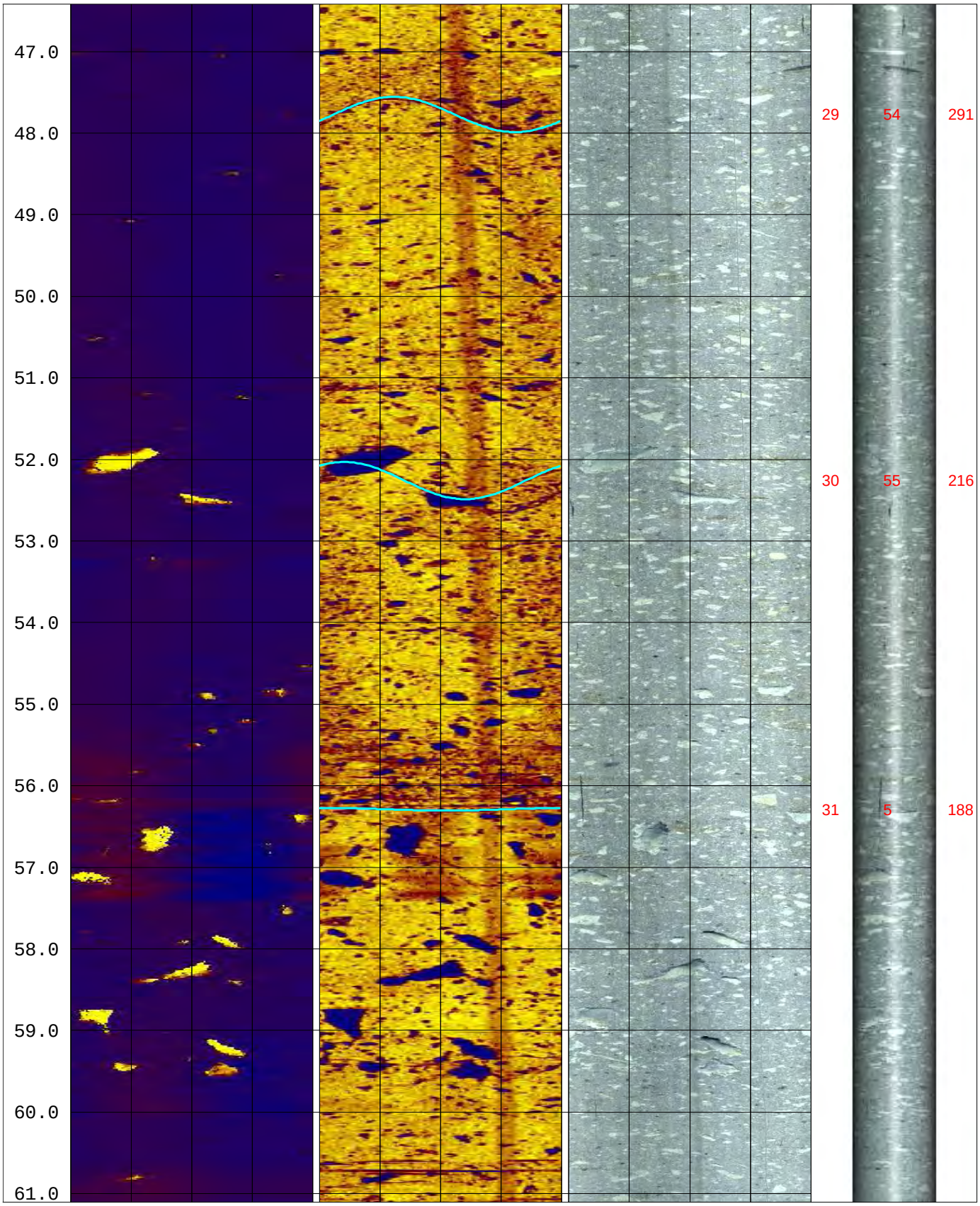
Notes:

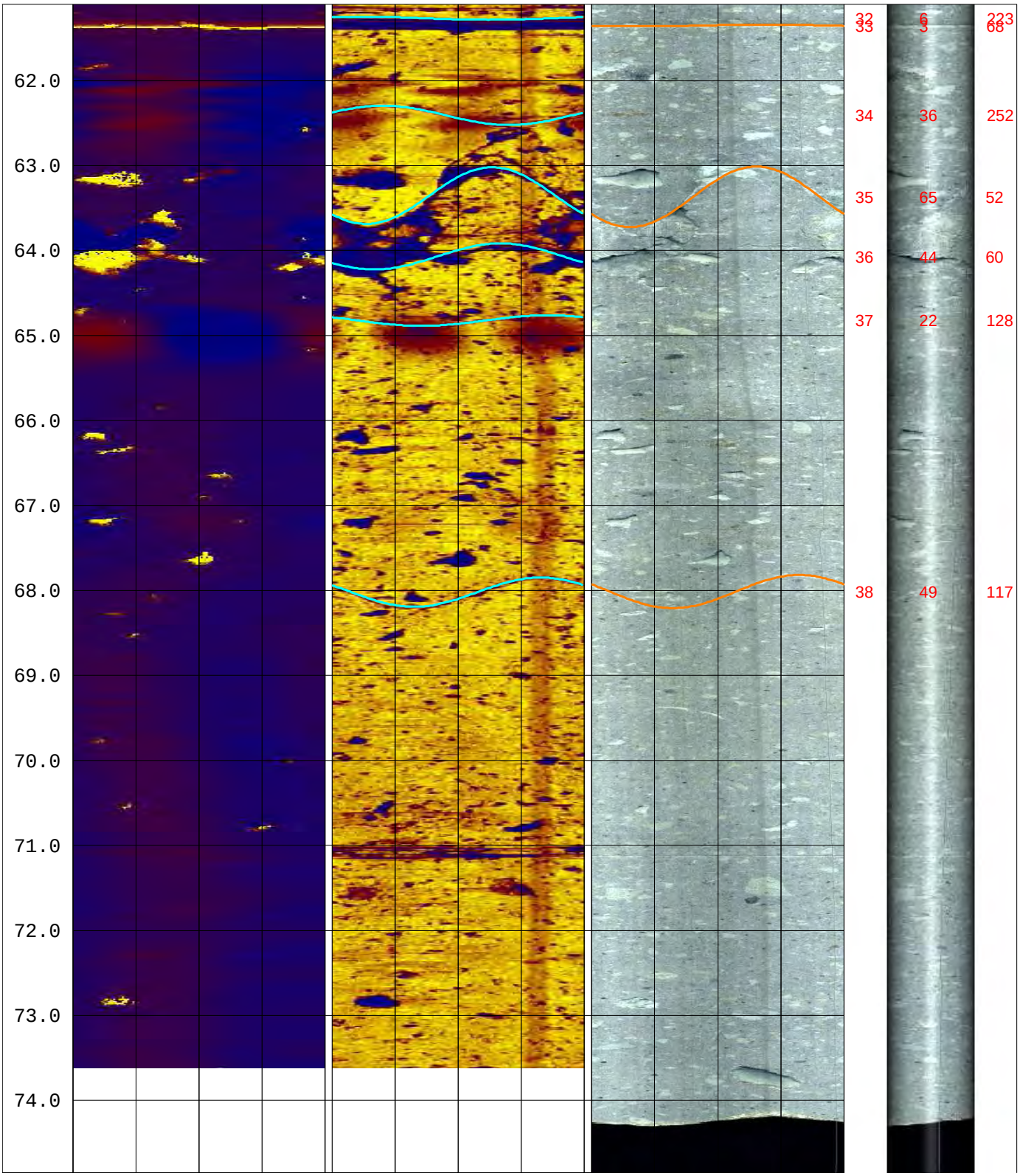
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.




18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
14 41 259
15 46 334
16 58 329
17 43 148
18 46 147
19 24 147
20 23 203


32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
21 36 214
22 38 210
23 43 158
24 66 144
25 33 172
26 45 143
27 57 126
28 42 198


47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
29 54 291
30 55 216
31 5 188

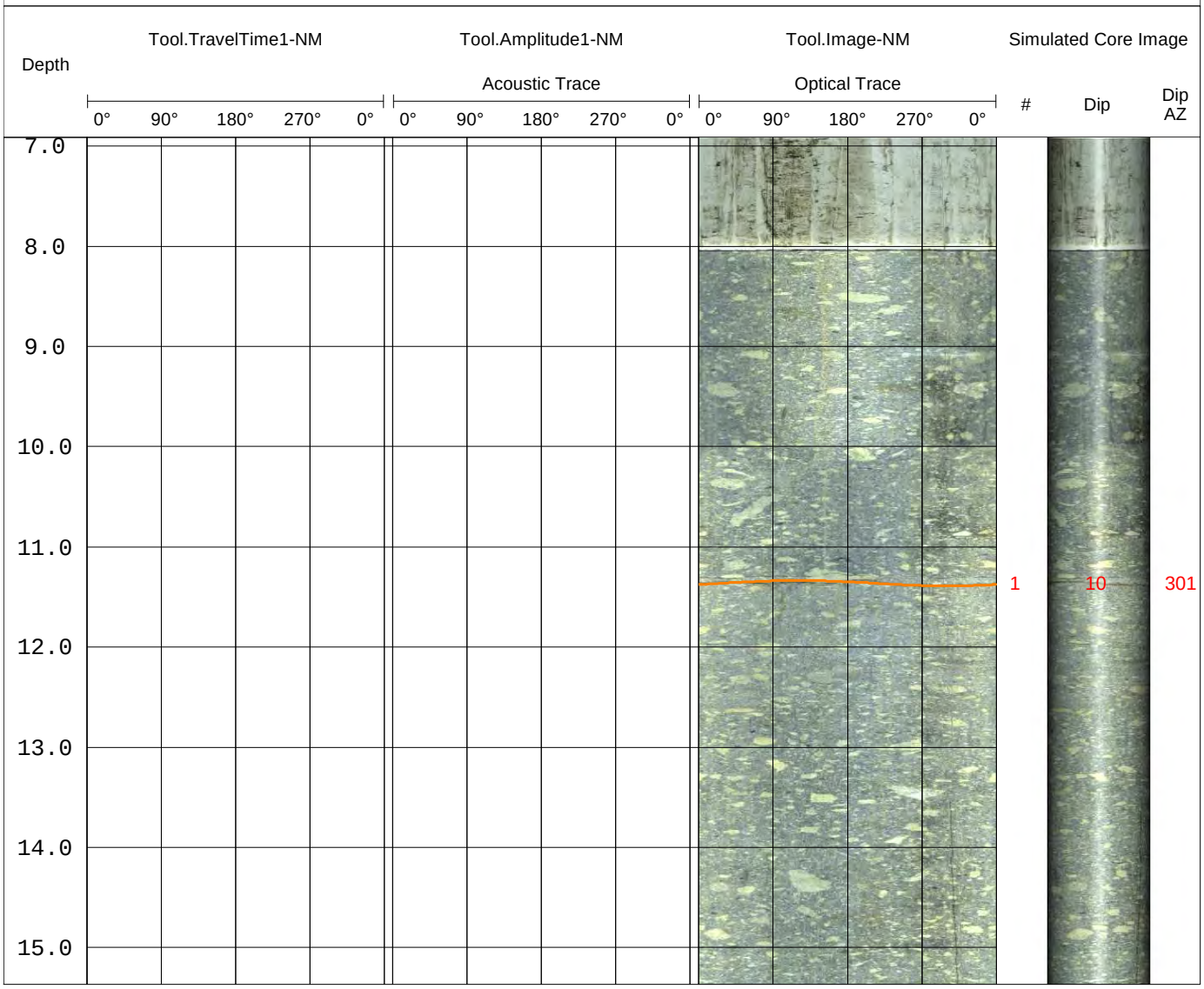

62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
73.0
74.0
32
33
34
35
36
37
38
6
3
36
65
44
22
49
223
68
252
52
60
128
117

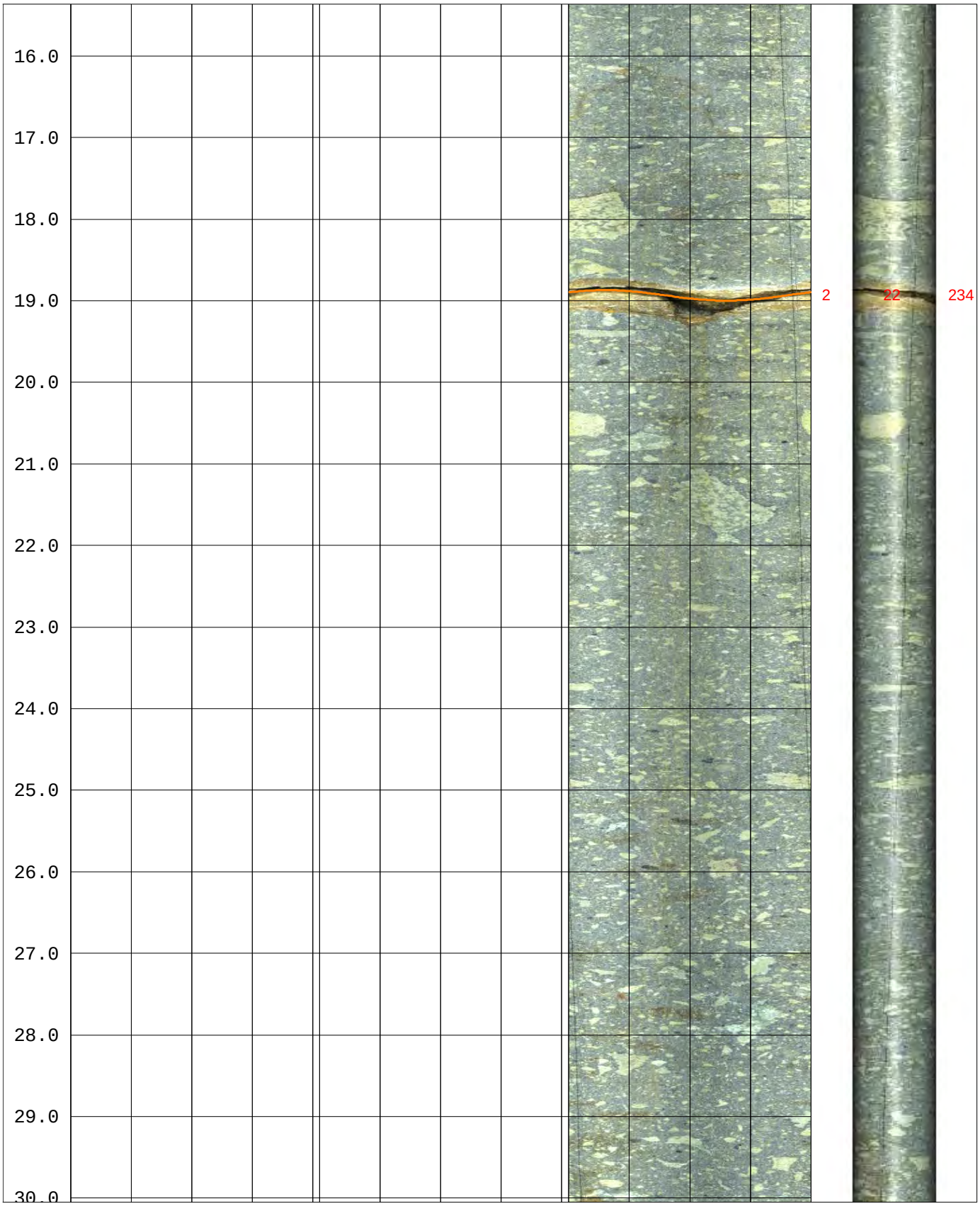
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

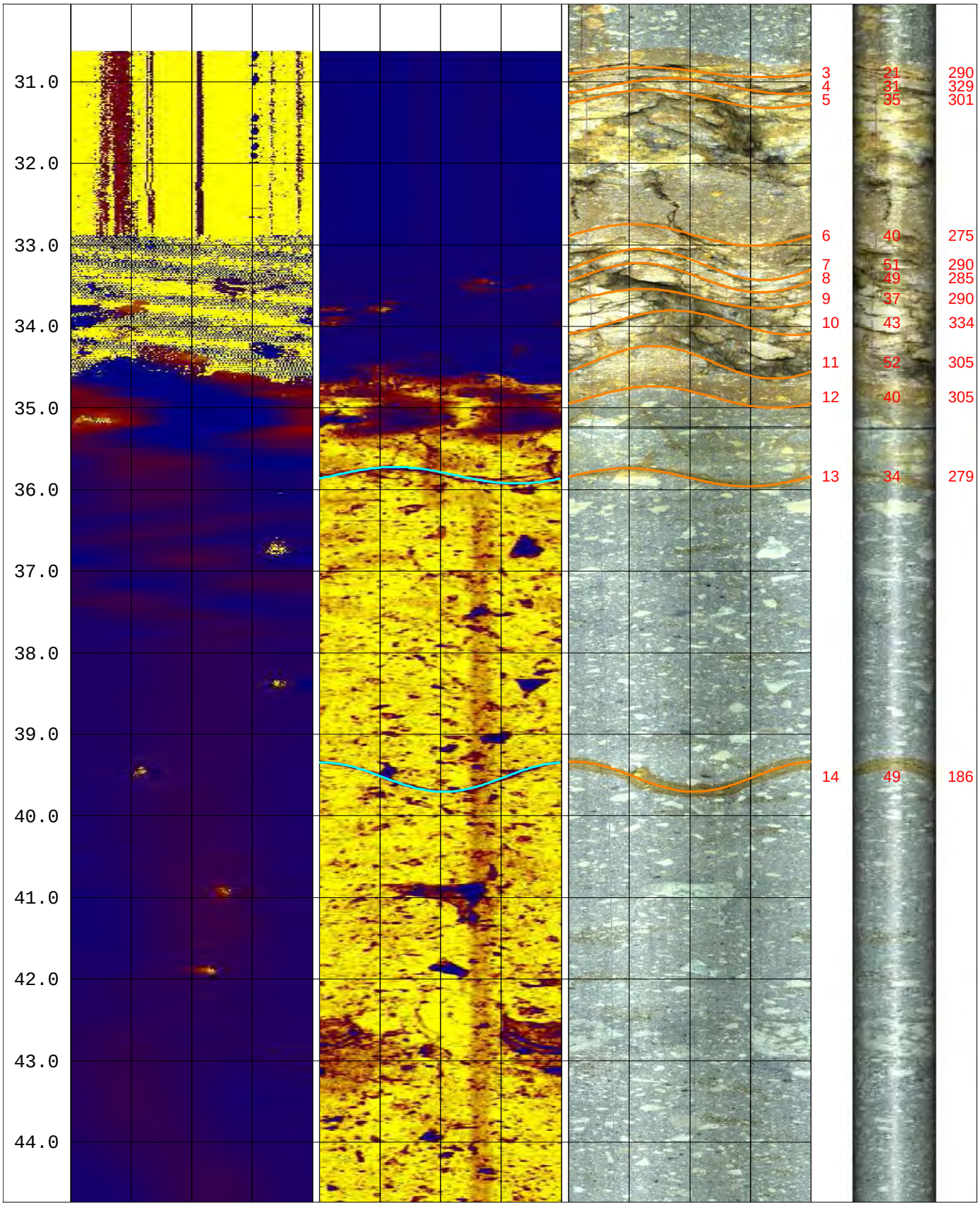
Date Logged:	October 18, 2007	Borehole ID:	RKS-21-07
File Name:	RKS2107-1M.wcl	Logged By:	F G Kruger

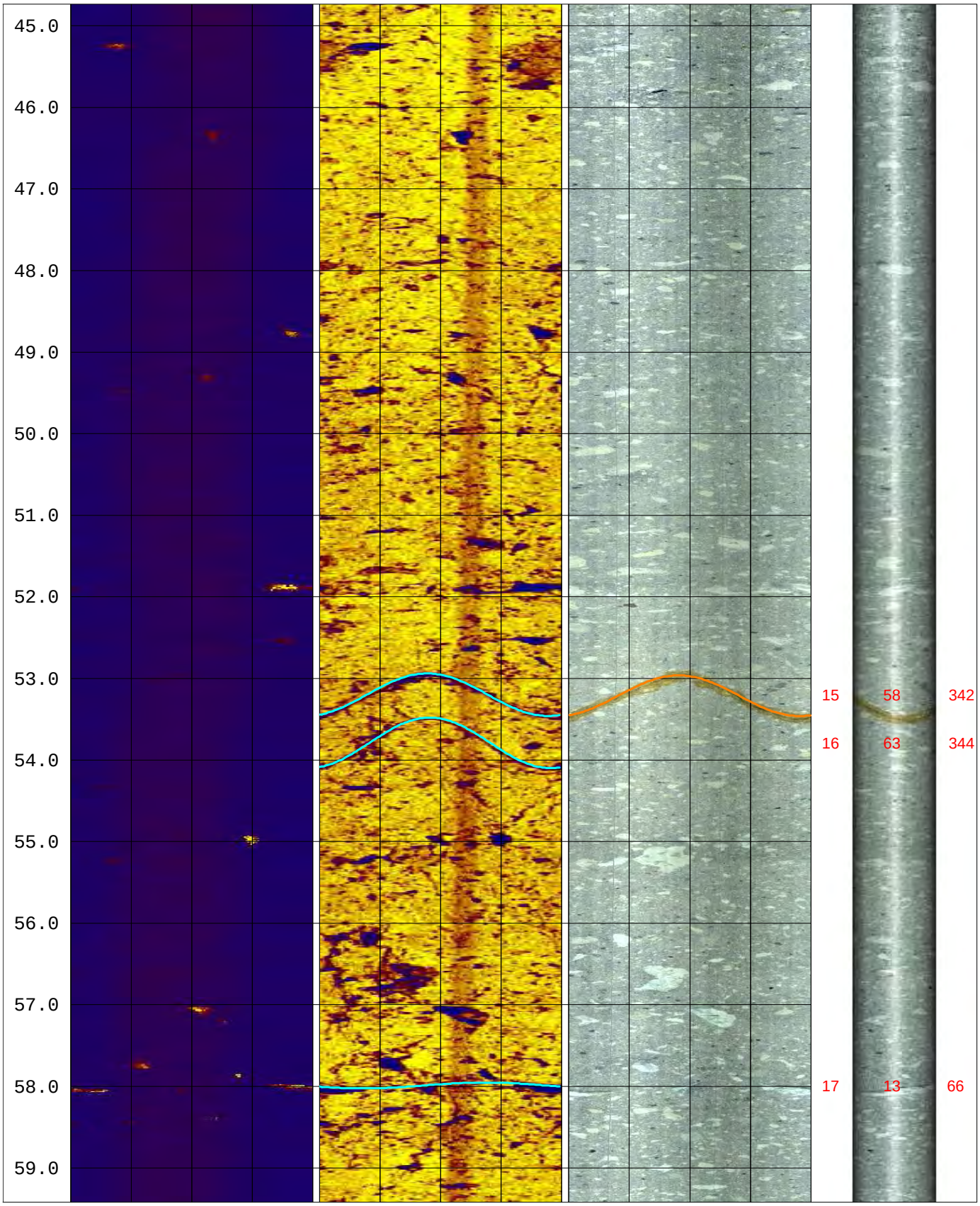
Notes:

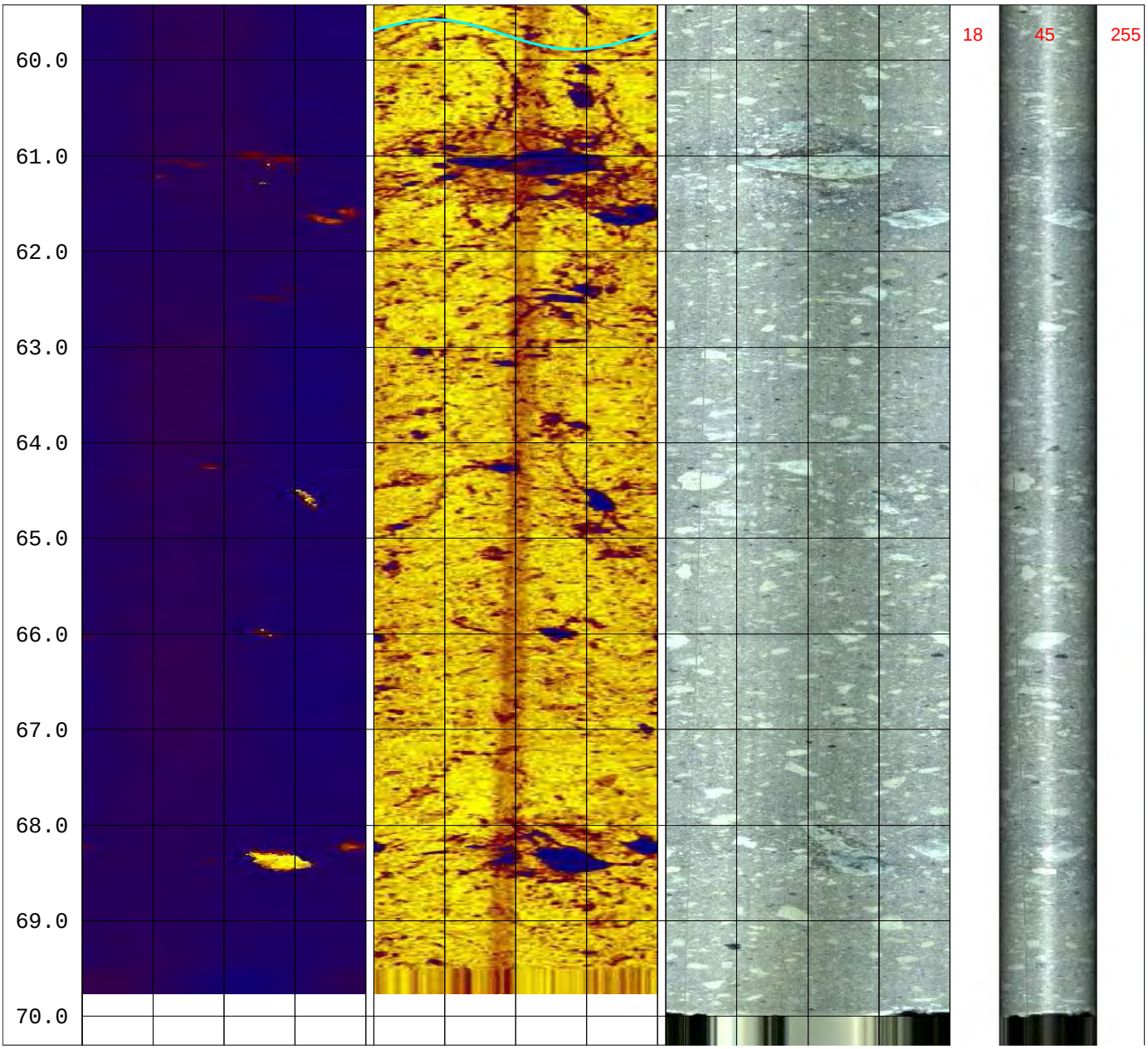
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.




16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
2
22
234


31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
3 21 290
4 31 329
5 35 301
6 40 275
7 51 290
8 49 285
9 37 290
10 43 334
11 52 305
12 40 305
13 34 279
14 49 186


45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
15 58 342
16 63 344
17 13 66

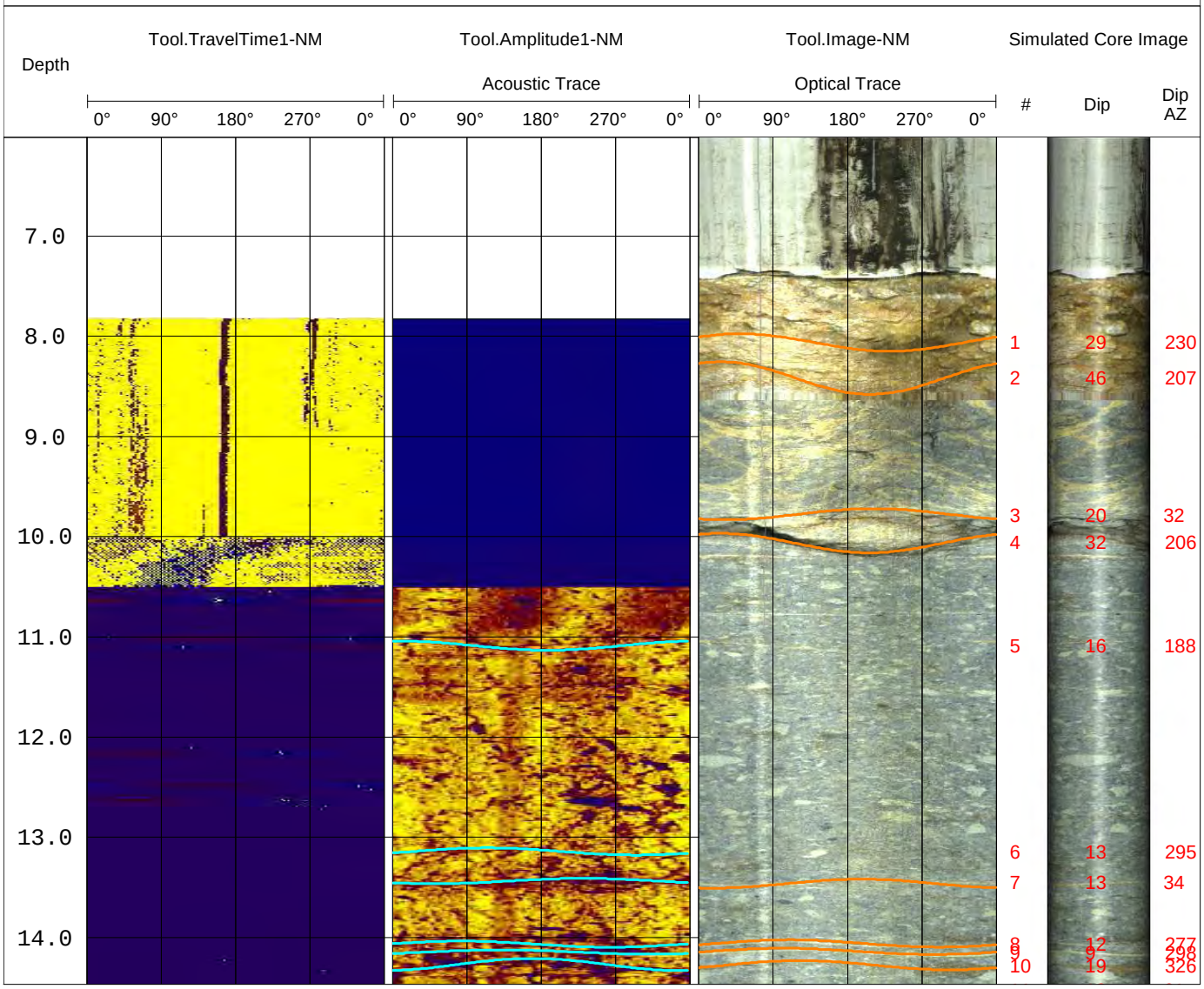

60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
18
45
255

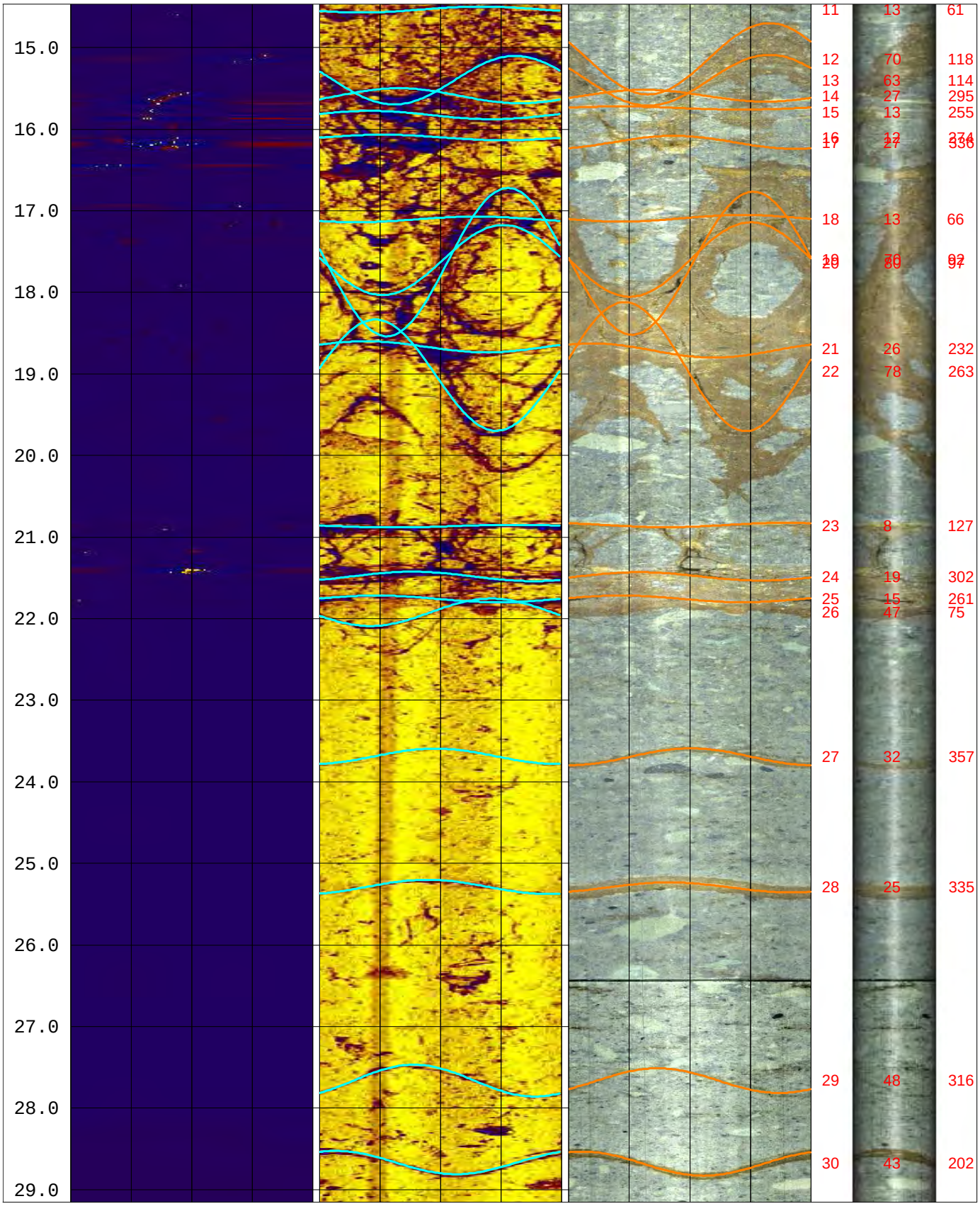
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

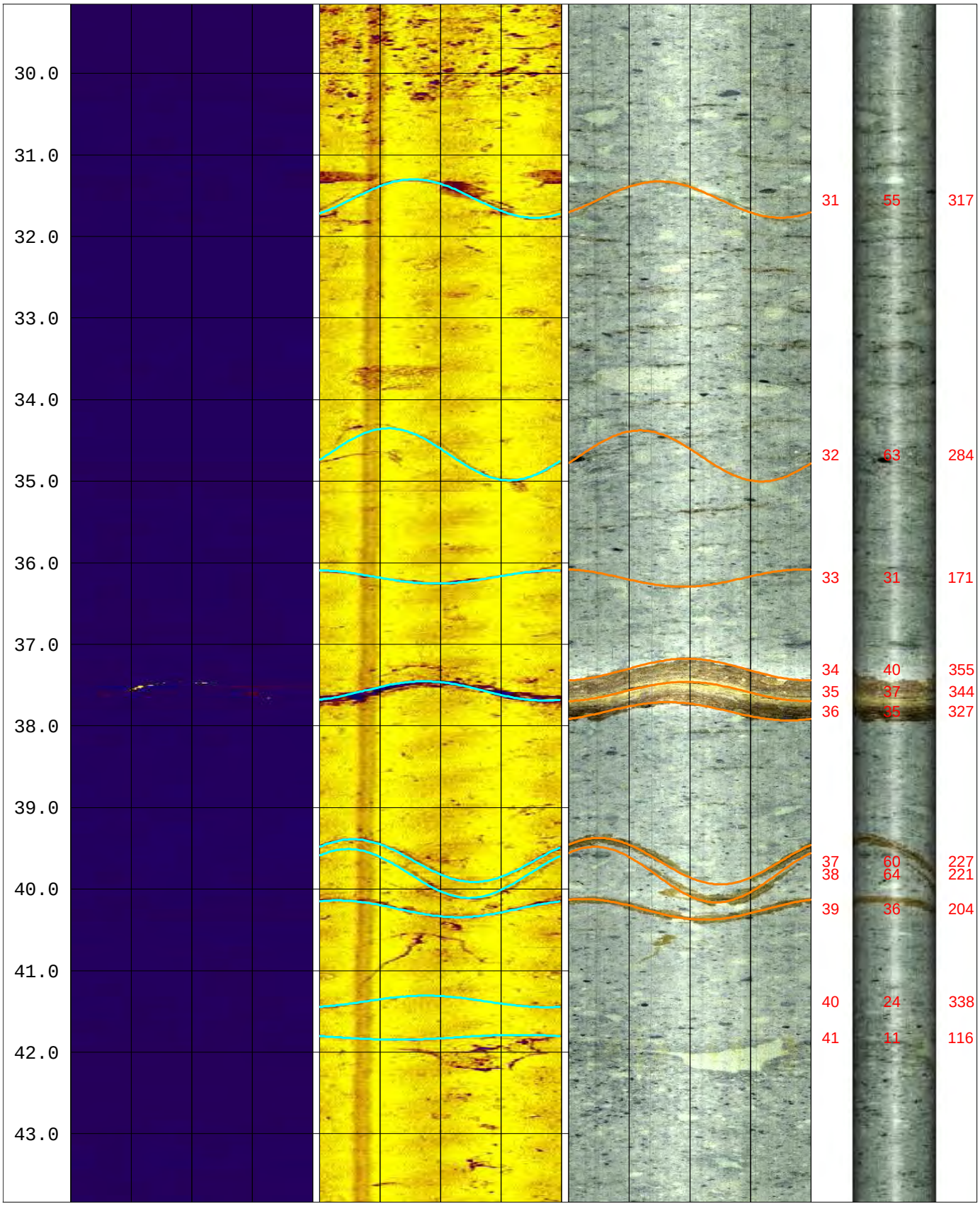
Date Logged:	October 18, 2007	Borehole ID:	RKS-22-07
File Name:	RKS2207-1M.wcl	Logged By:	F G Kruger

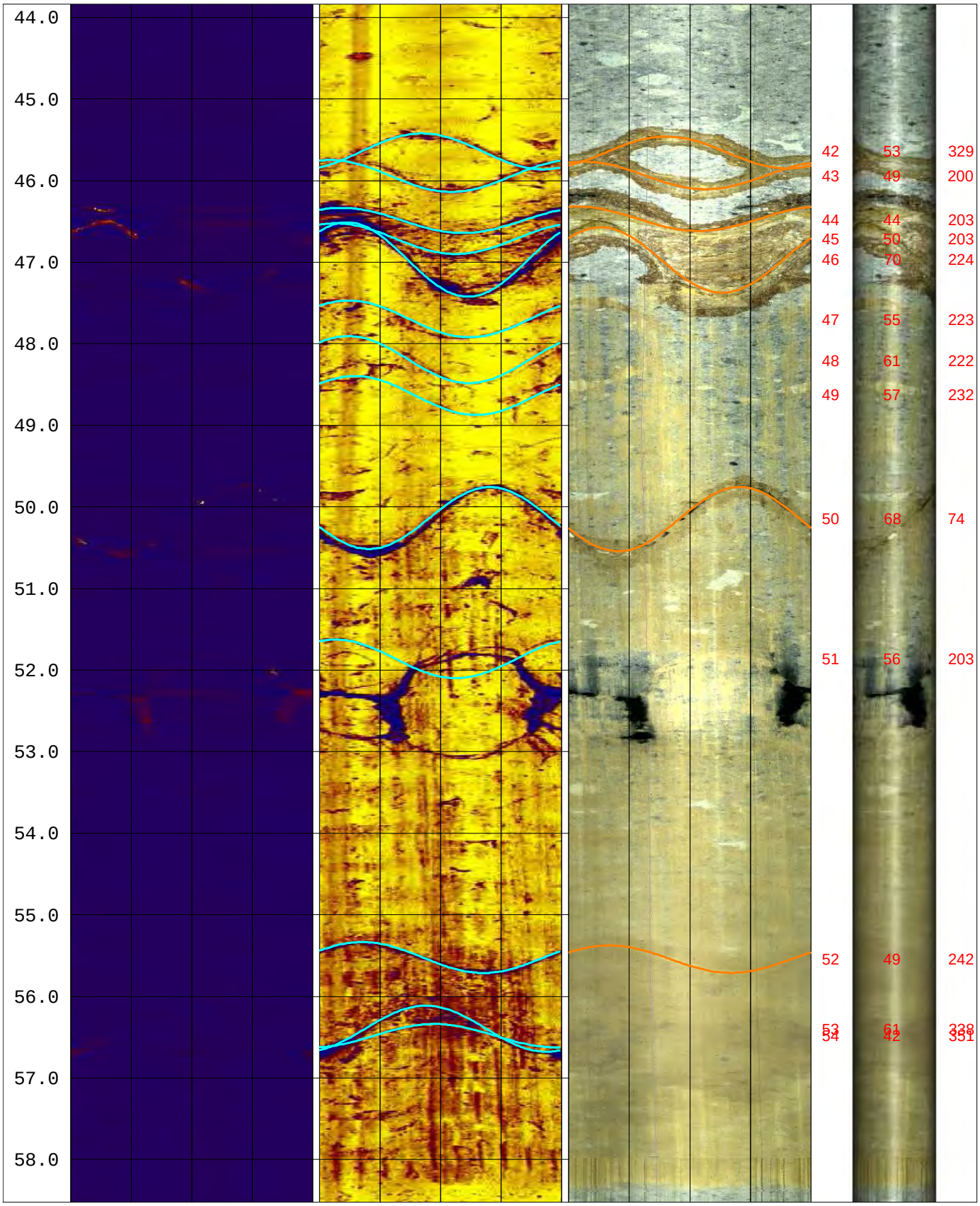
Notes:

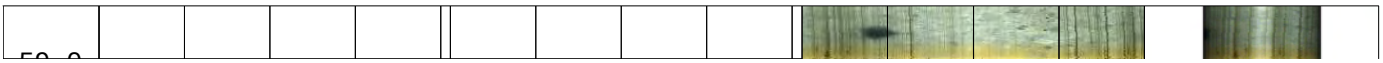
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.




15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
11 13 61
12 70 118
13 63 114
14 27 295
15 13 255
16 12 274
17 27 336
18 13 66
19 70 92
20 80 97
21 26 232
22 78 263
23 8 127
24 19 302
25 15 261
26 47 75
27 32 357
28 25 335
29 48 316
30 43 202


30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
31 55 317
32 63 284
33 31 171
34 40 355
35 37 344
36 35 327
37 60 227
38 64 221
39 36 204
40 24 338
41 11 116


44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
42 53 329
43 49 200
44 44 203
45 50 203
46 70 224
47 55 223
48 61 222
49 57 232
50 68 74
51 56 203
52 49 242
53 61 338
54 42 351

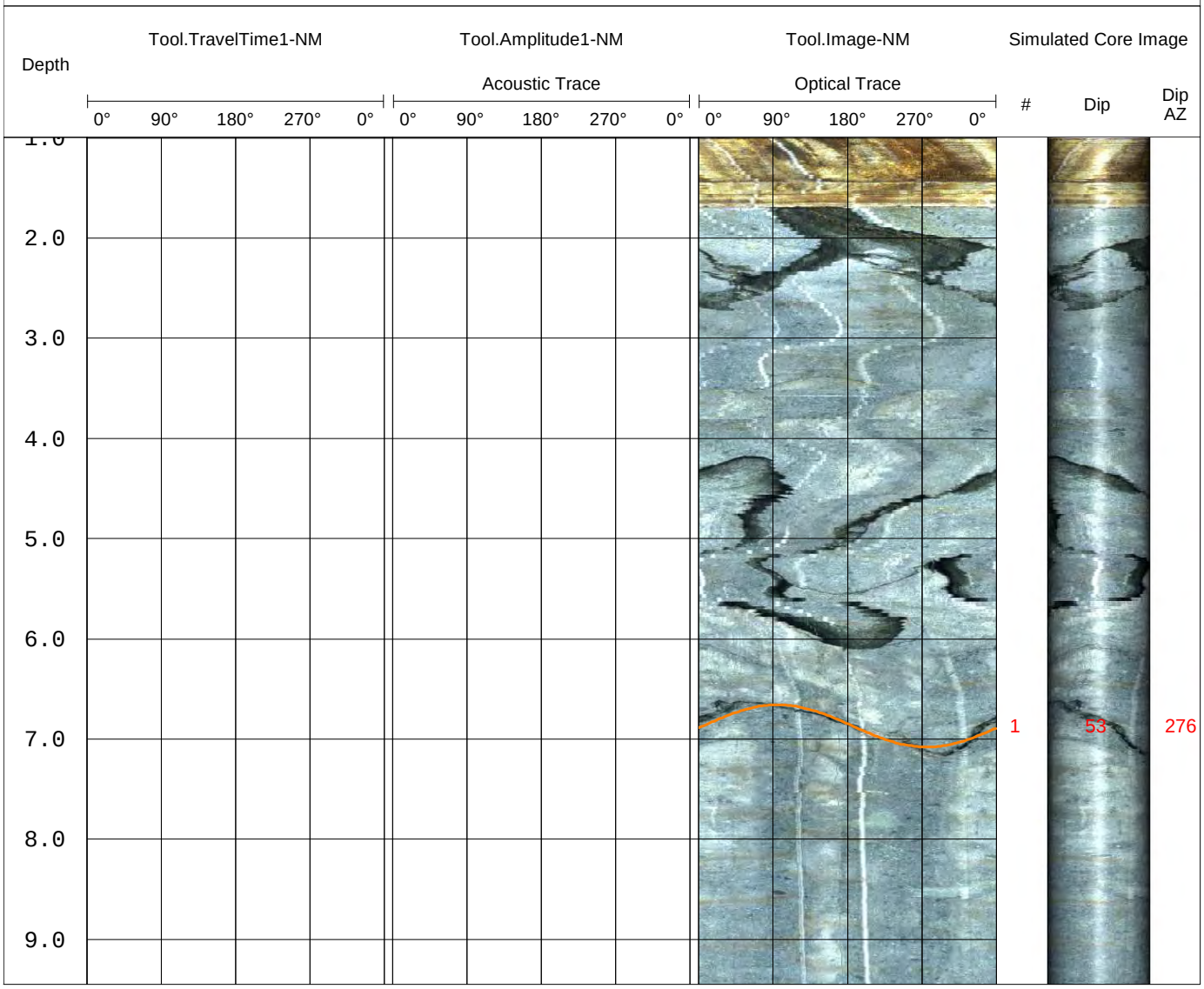


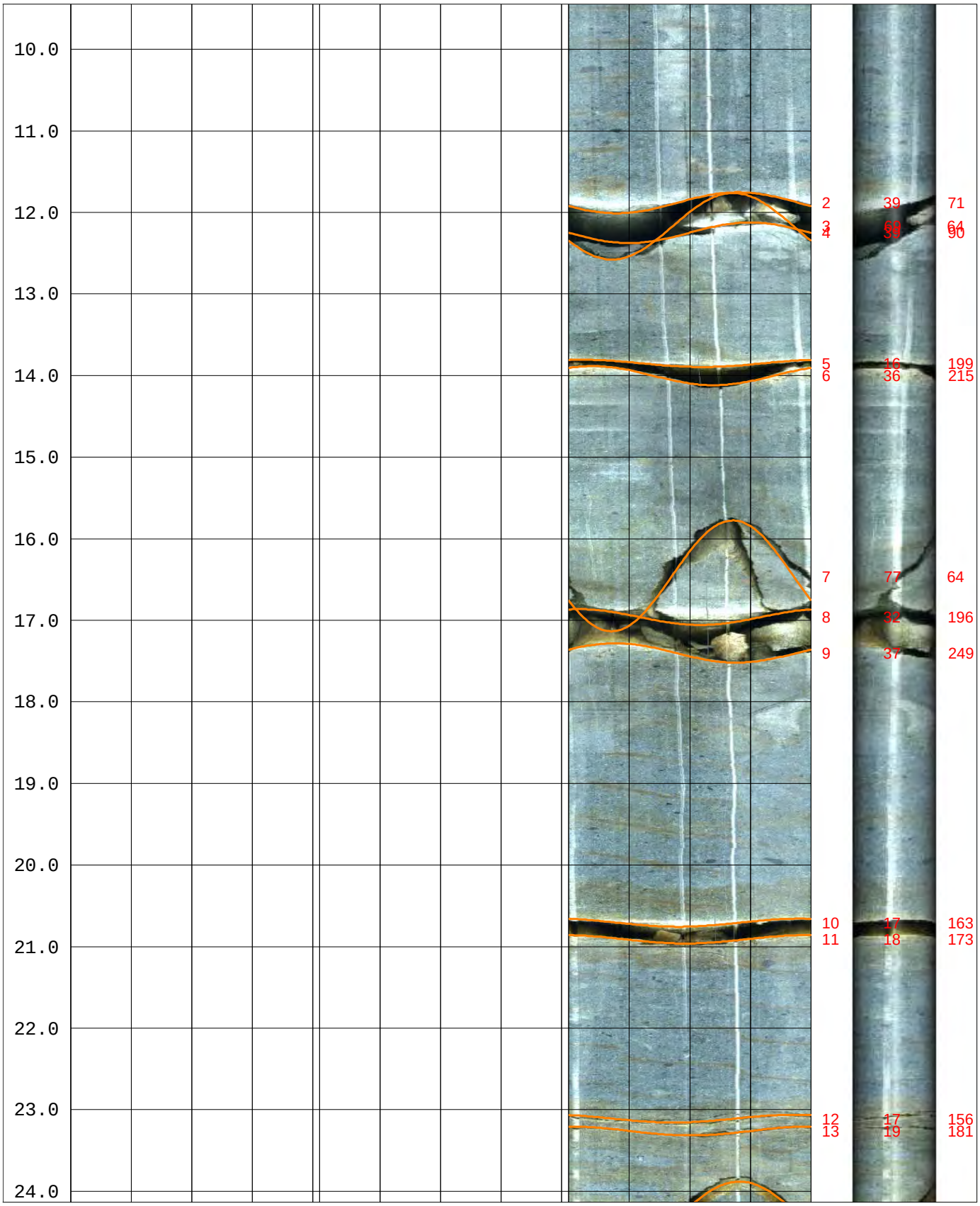
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

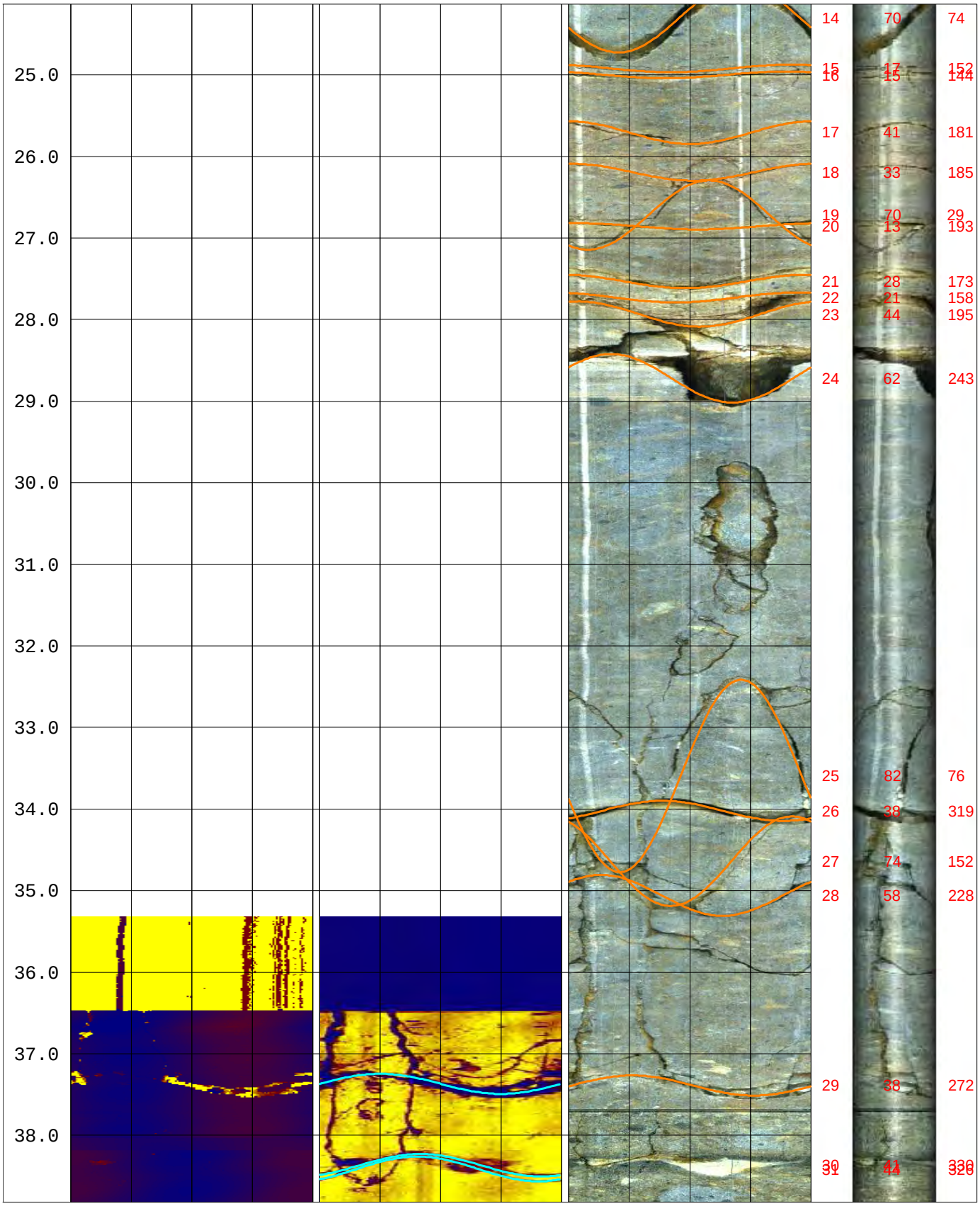
Date Logged:	October 19, 2007	Borehole ID:	RKS-23-07
File Name:	RKS2307M-1.wcl	Logged By:	F G Kruger

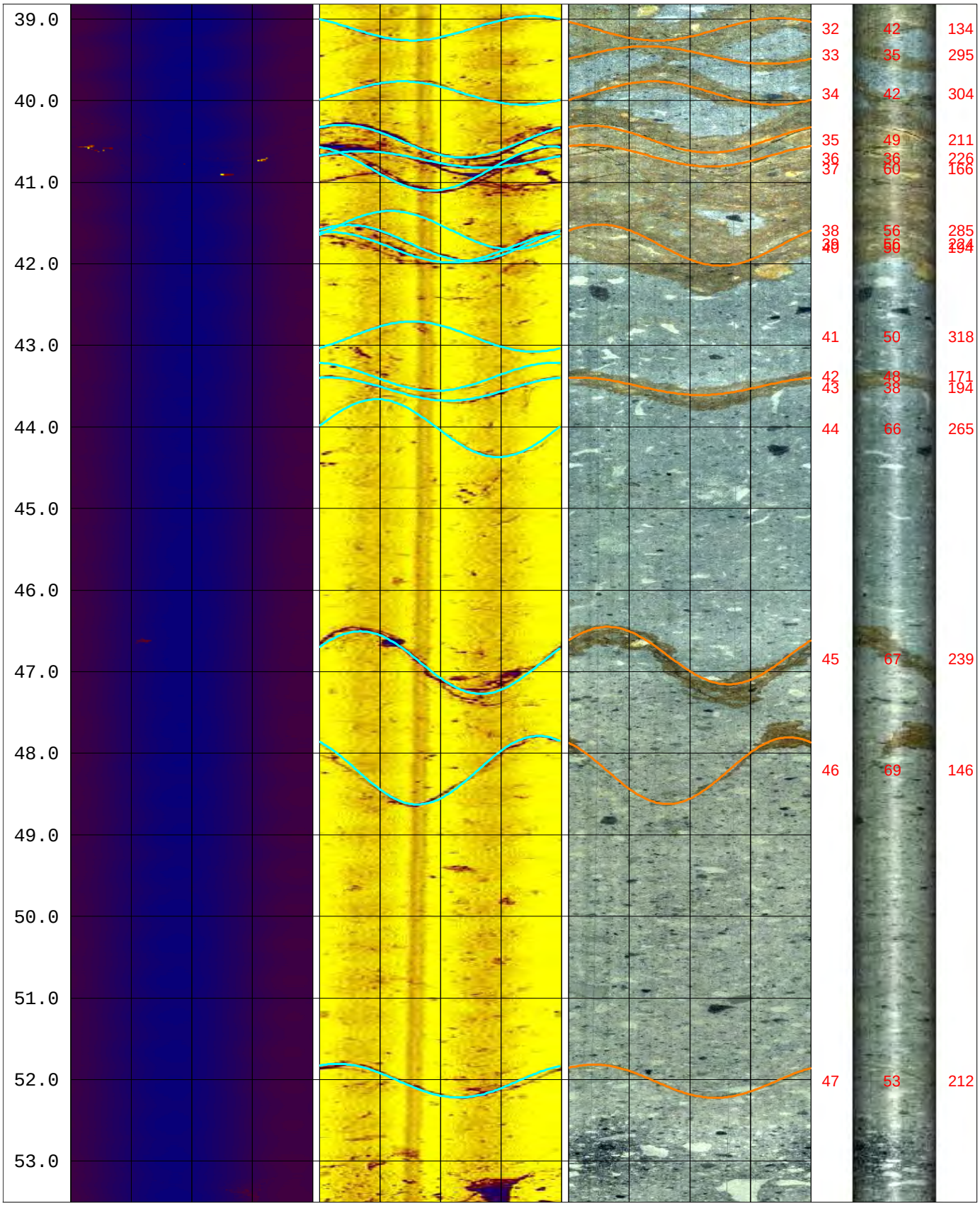
Notes:

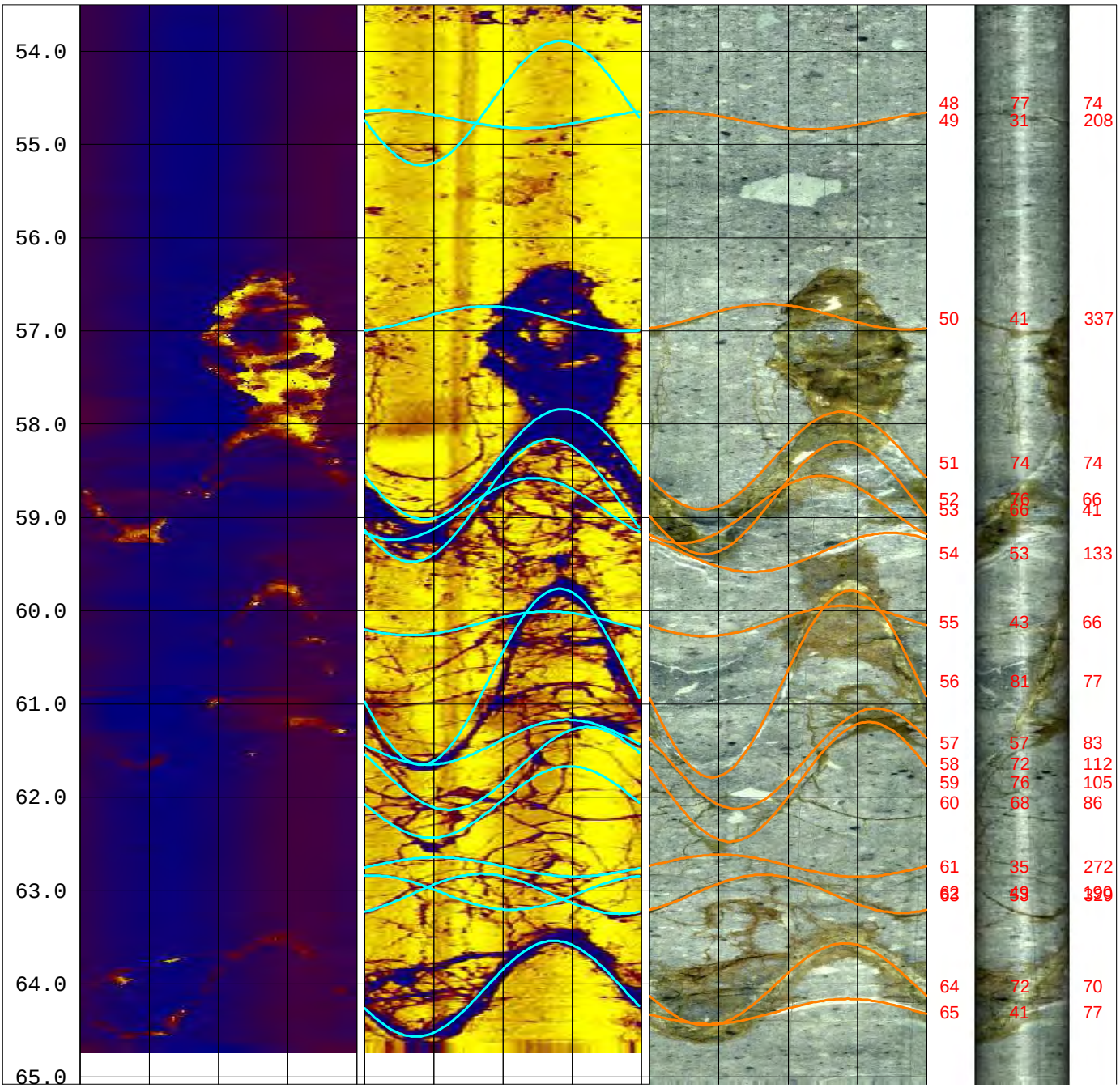
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.




10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
2 39 71
3 60 64
4 31 90
5 16 199
6 36 215
7 77 64
8 32 196
9 37 249
10 17 163
11 18 173
12 17 156
13 19 181


25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
14 70 74
15 17 152
16 15 144
17 41 181
18 33 185
19 70 29
20 13 193
21 28 173
22 21 158
23 44 195
24 62 243
25 82 76
26 38 319
27 74 152
28 58 228
29 38 272
30 41 330
31 44 326


39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
32 42 134
33 35 295
34 42 304
35 49 211
36 36 226
37 60 166
38 56 285
39 56 224
40 50 194
41 50 318
42 48 171
43 38 194
44 66 265
45 67 239
46 69 146
47 53 212

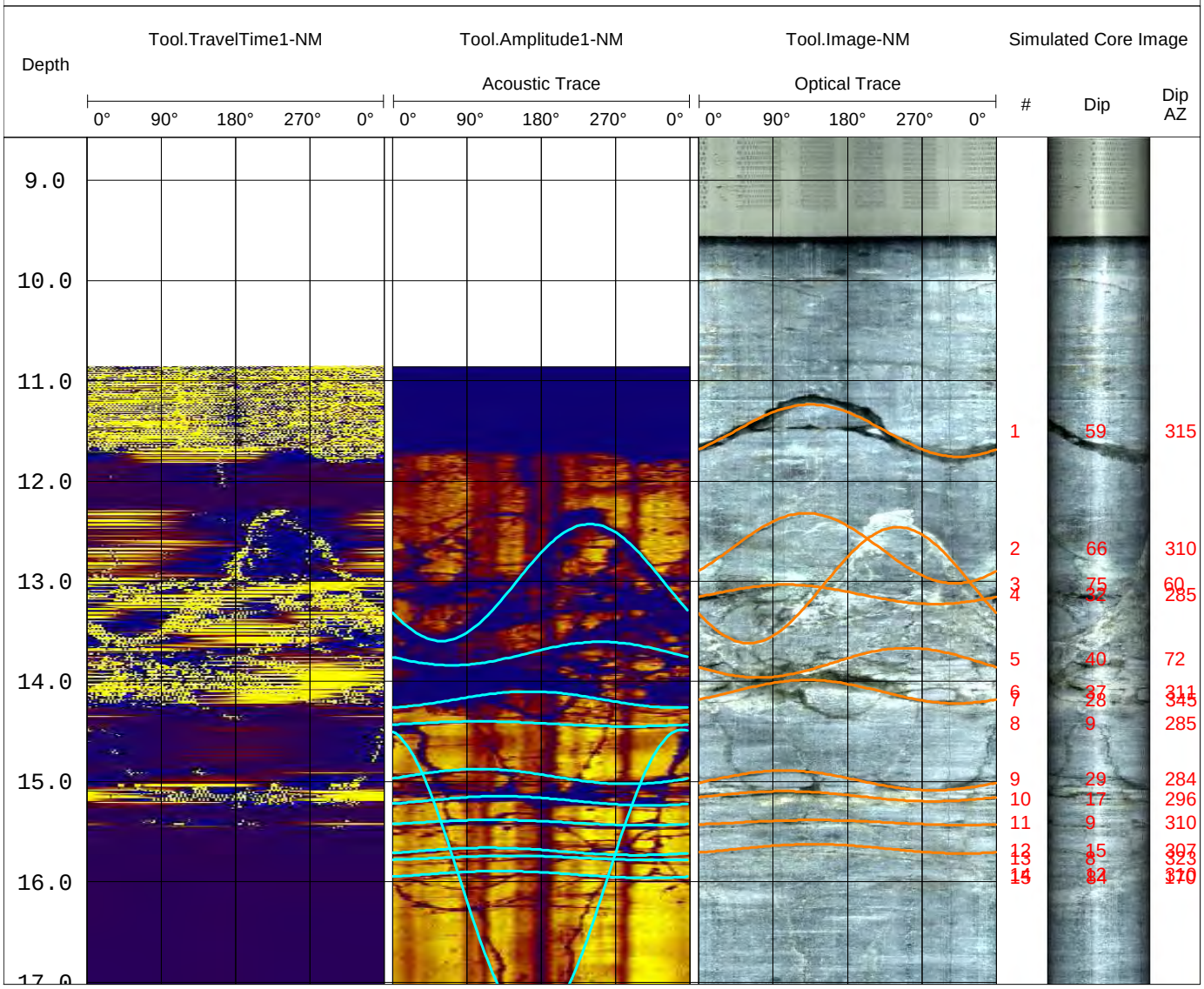

54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
48 77 74
49 31 208
50 41 337
51 74 74
52 76 66
53 66 41
54 53 133
55 43 66
56 81 77
57 57 83
58 72 112
59 76 105
60 68 86
61 35 272
64 72 70
65 41 77

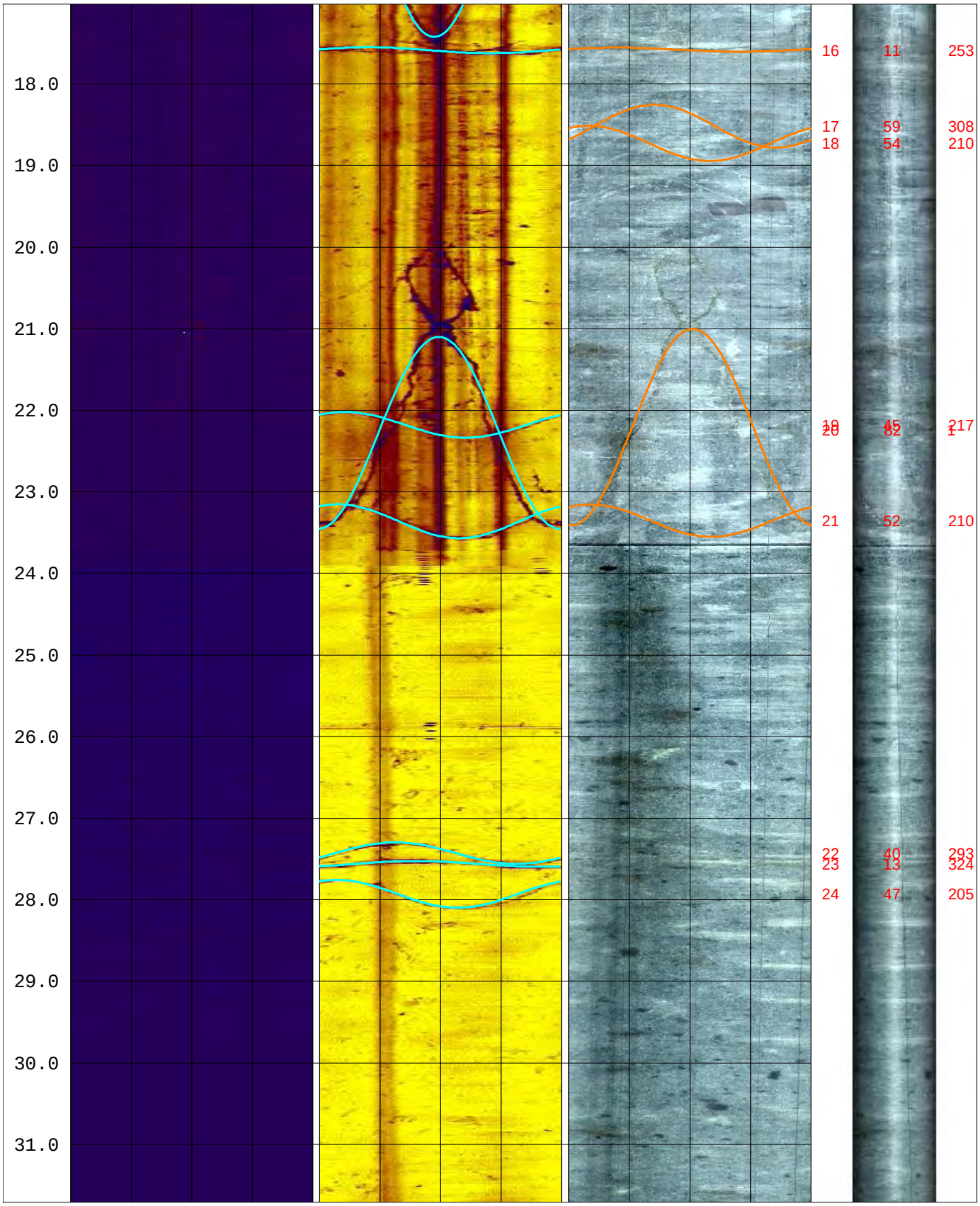
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

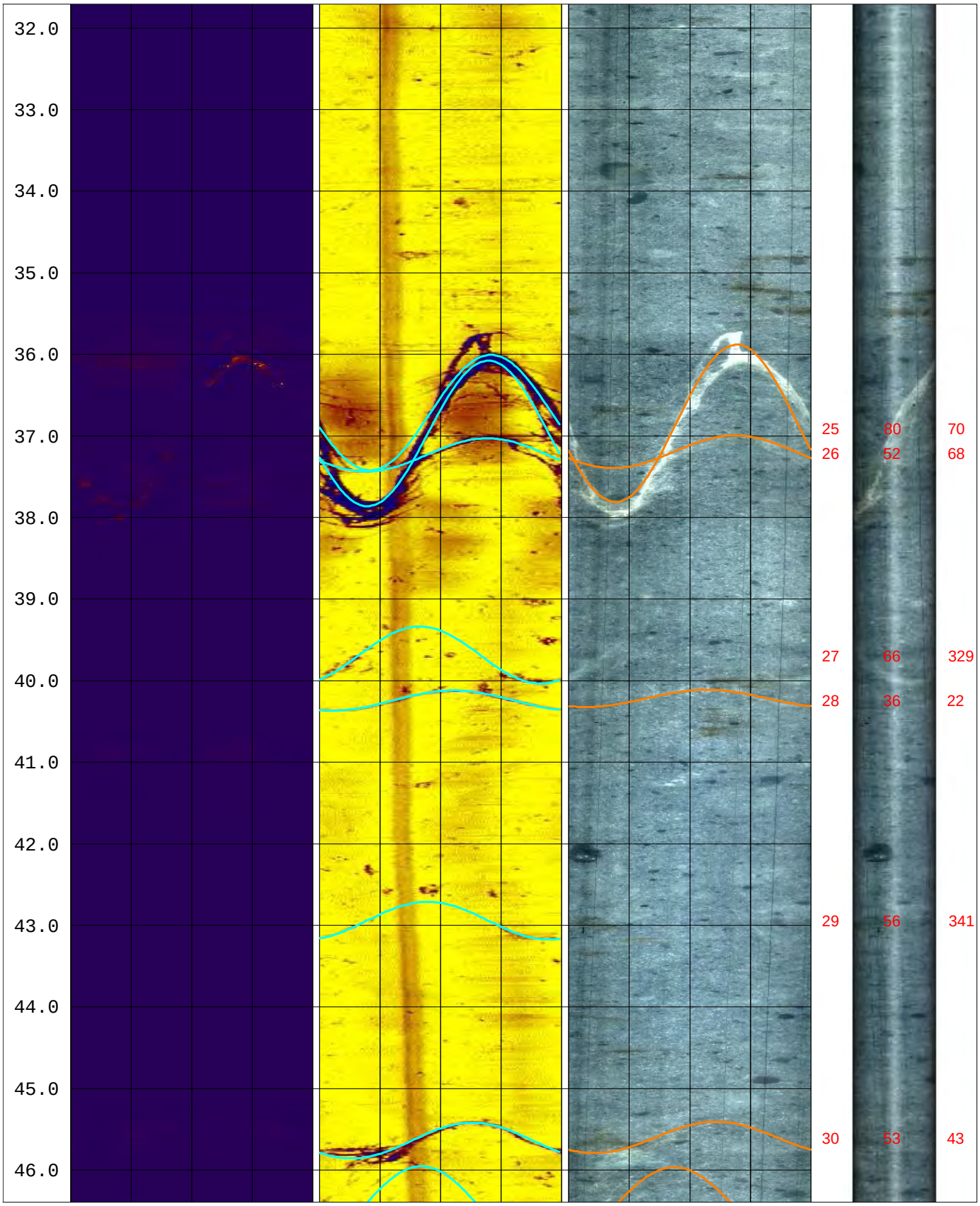
Date Logged:	November 3, 2007	Borehole ID:	RKS-24-07
File Name:	RKS2407-1M.wcl	Logged By:	F G Kruger

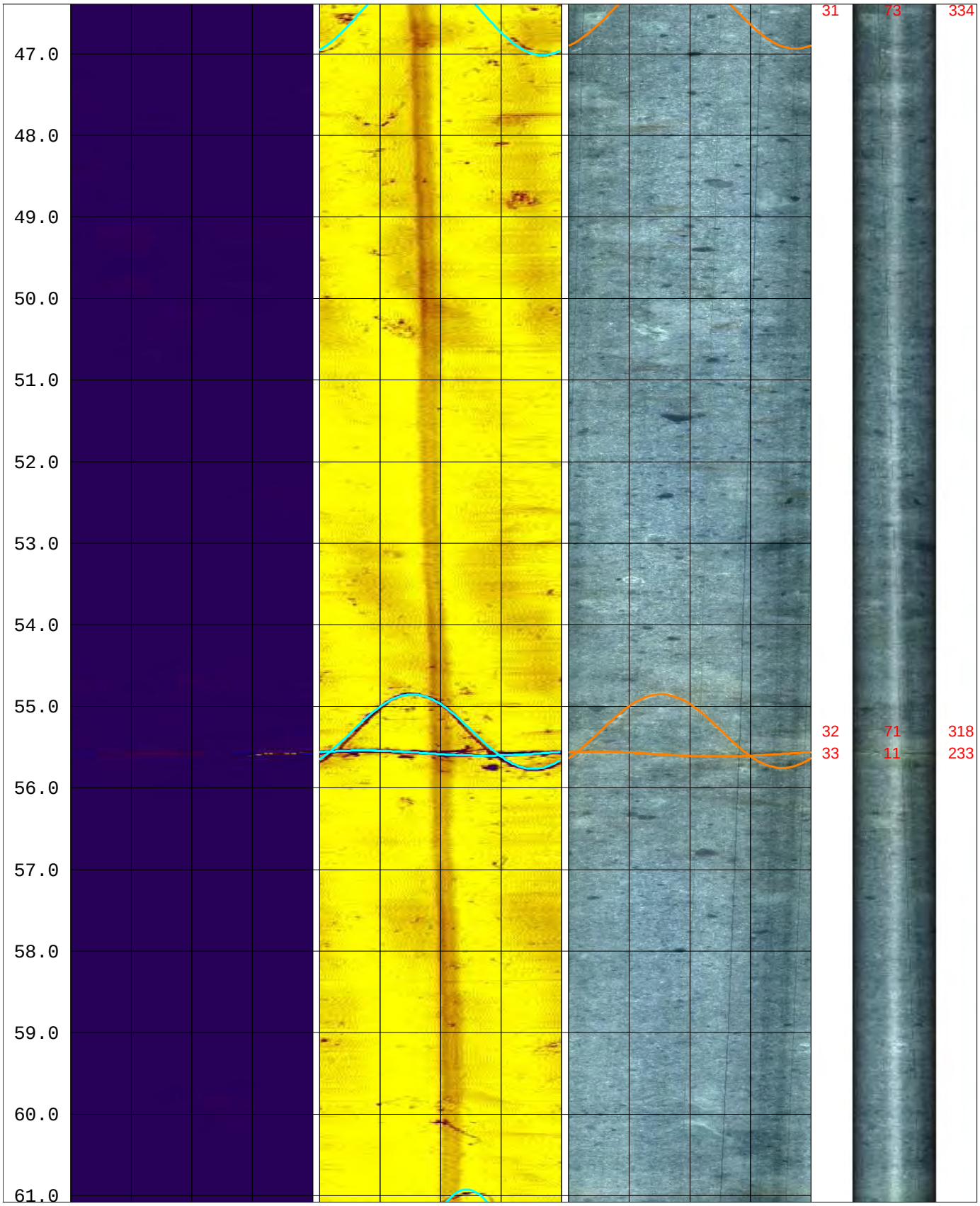
Notes:

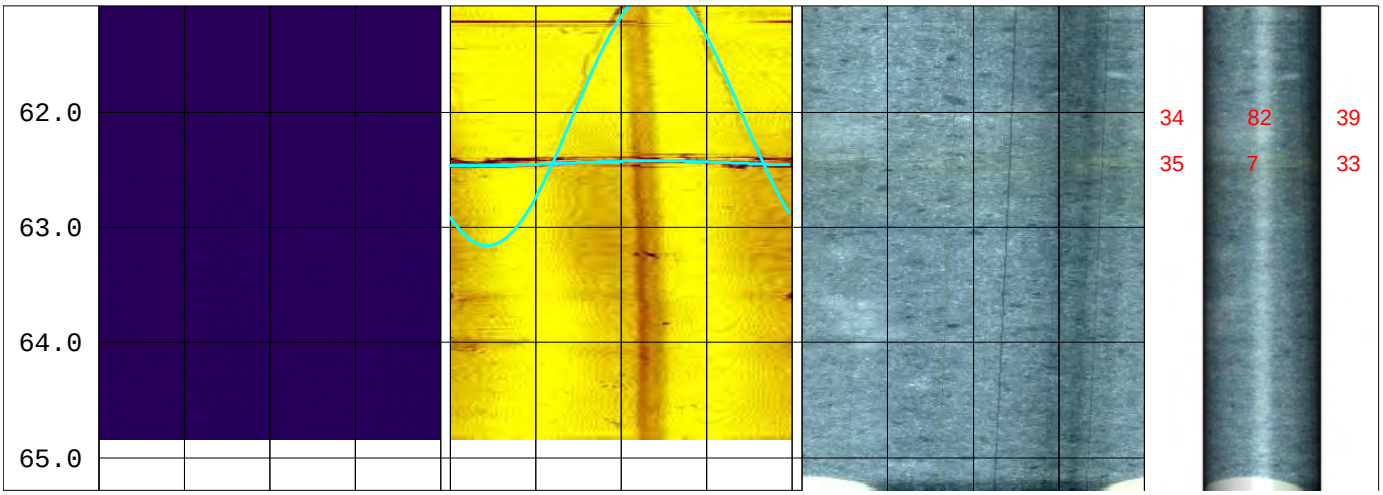
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.




18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
16 11 253
17 59 308
18 54 210
19 45 217
20 82 1
21 52 210
22 40 293
23 13 324
24 47 205


32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
25 80 70
26 52 68
27 66 329
28 36 22
29 56 341
30 53 43

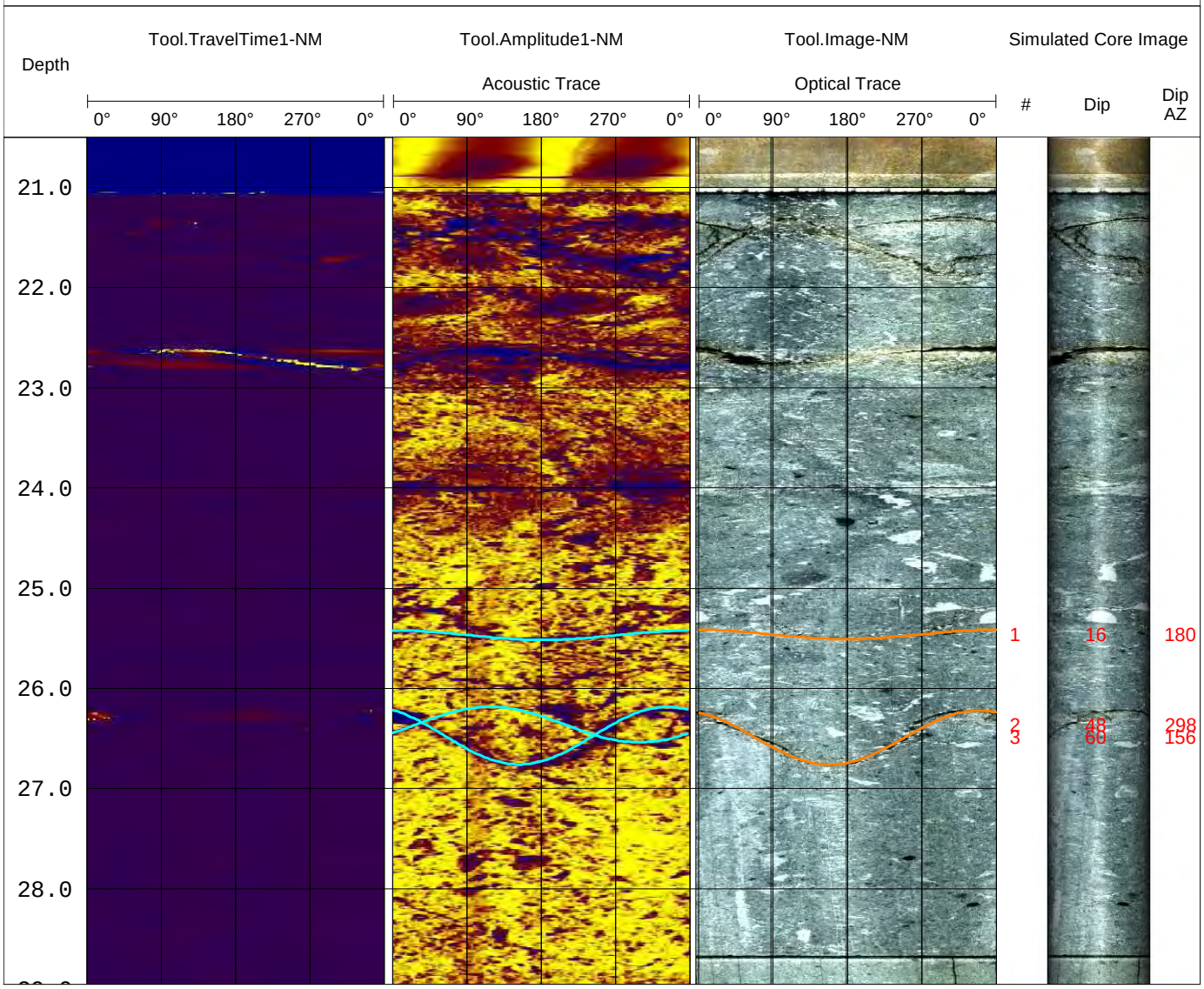

47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
31
73
334
32
71
318
33
11
233

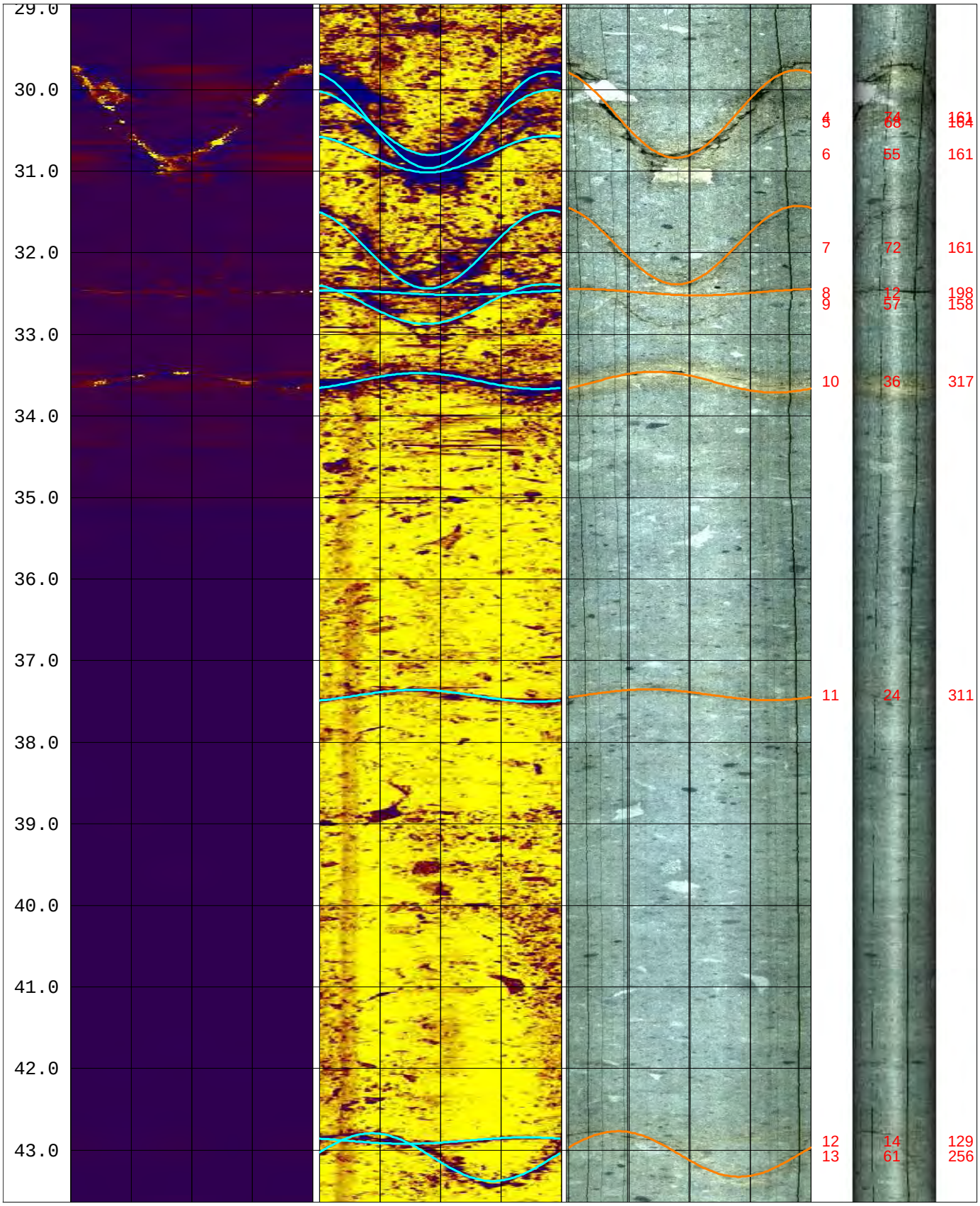

62.0
63.0
64.0
65.0
34
35
82
7
39
33

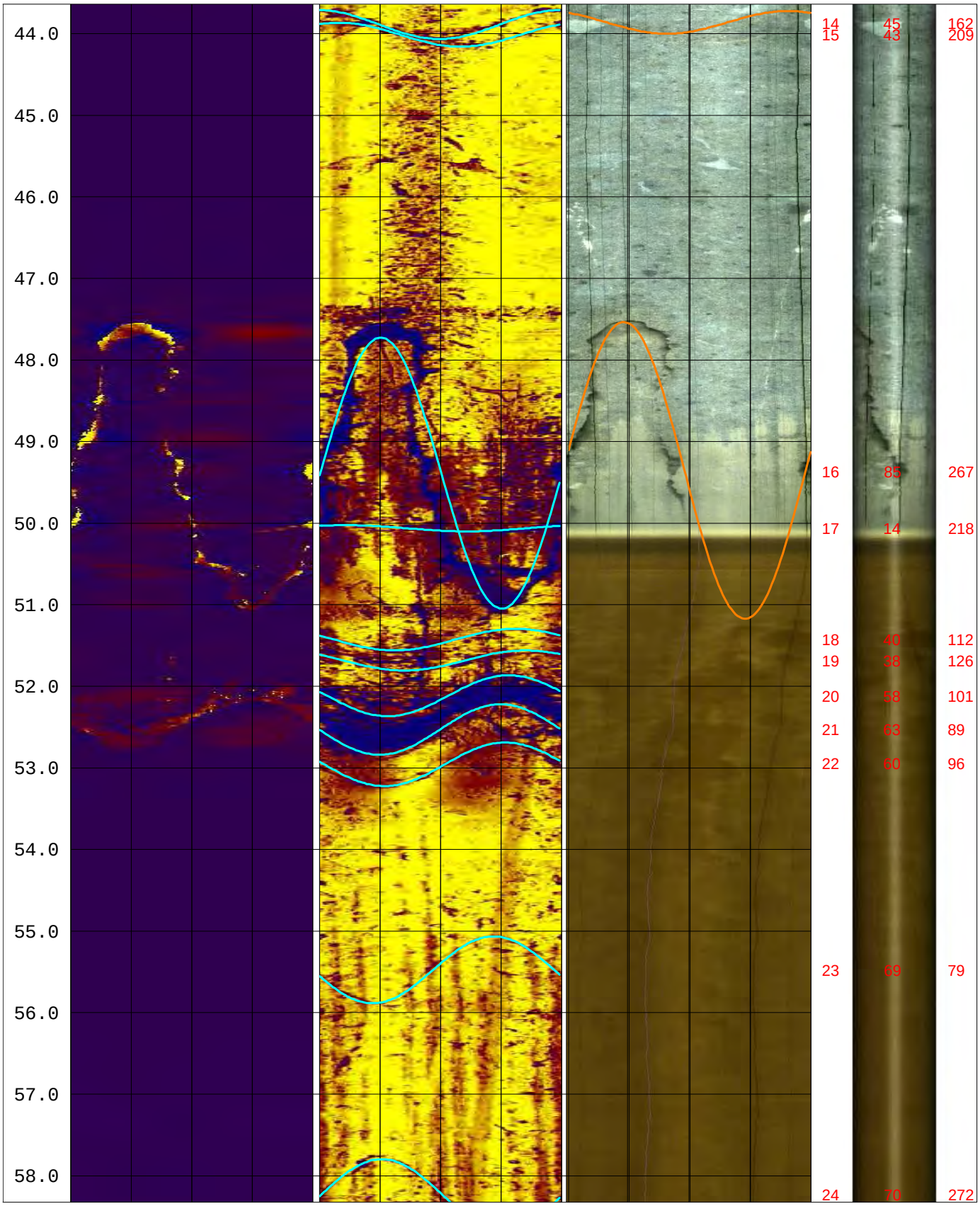
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program
Date Logged:	November 8, 2007	Borehole ID: RKS-25-07
File Name:	RKS2507-1M.wcl	Logged By: F G Kruger

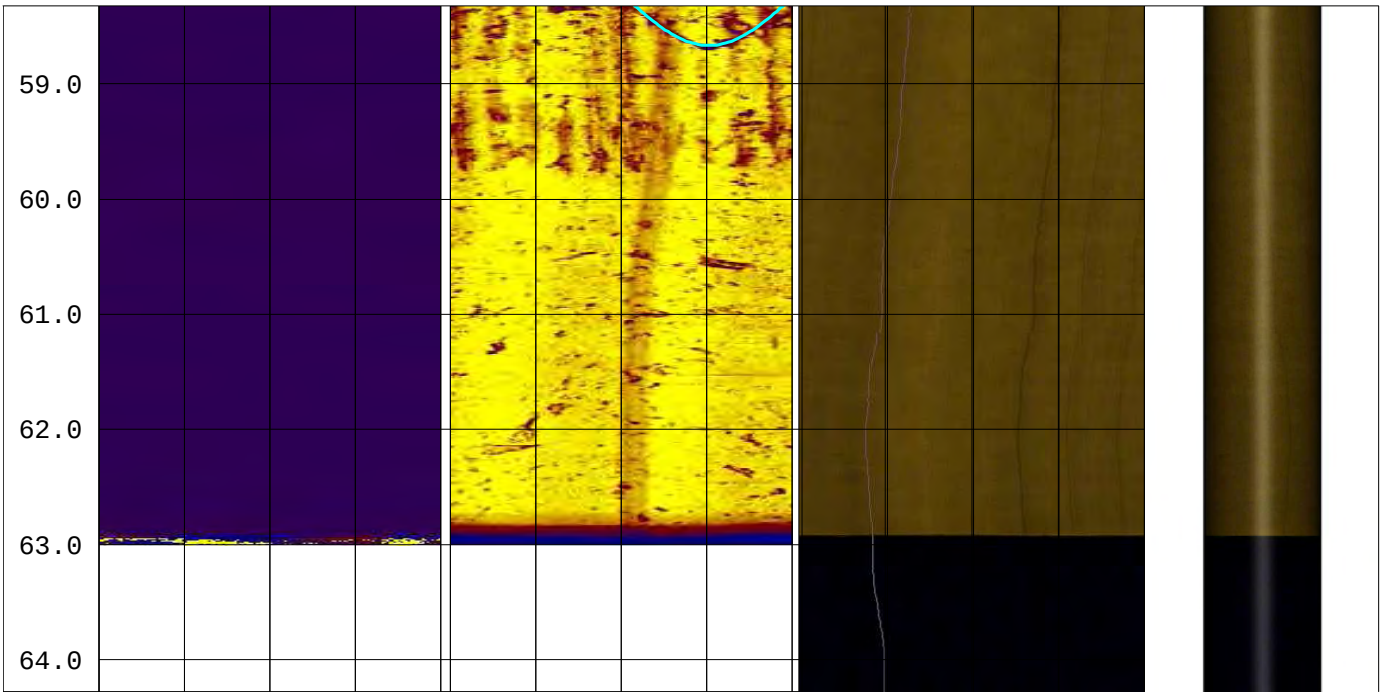
Notes:

1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.




29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
4 74 161
5 68 164
6 55 161
7 72 161
8 12 198
9 57 158
10 36 317
11 24 311
12 14 129
13 61 256


44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
14 45 162
15 43 209
16 85 267
17 14 218
18 40 112
19 38 126
20 58 101
21 63 89
22 60 96
23 69 79
24 70 272

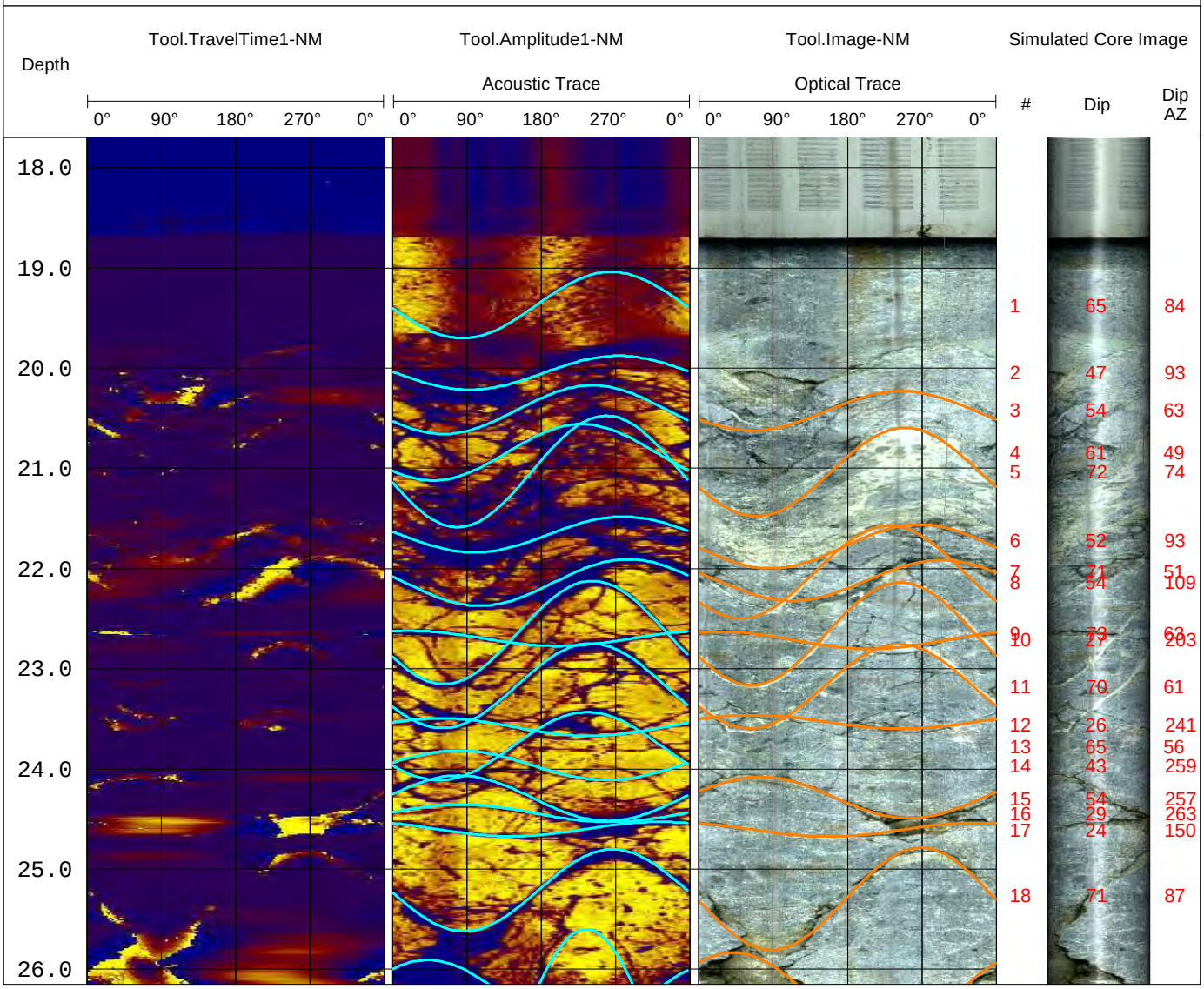

59.0
60.0
61.0
62.0
63.0
64.0

COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

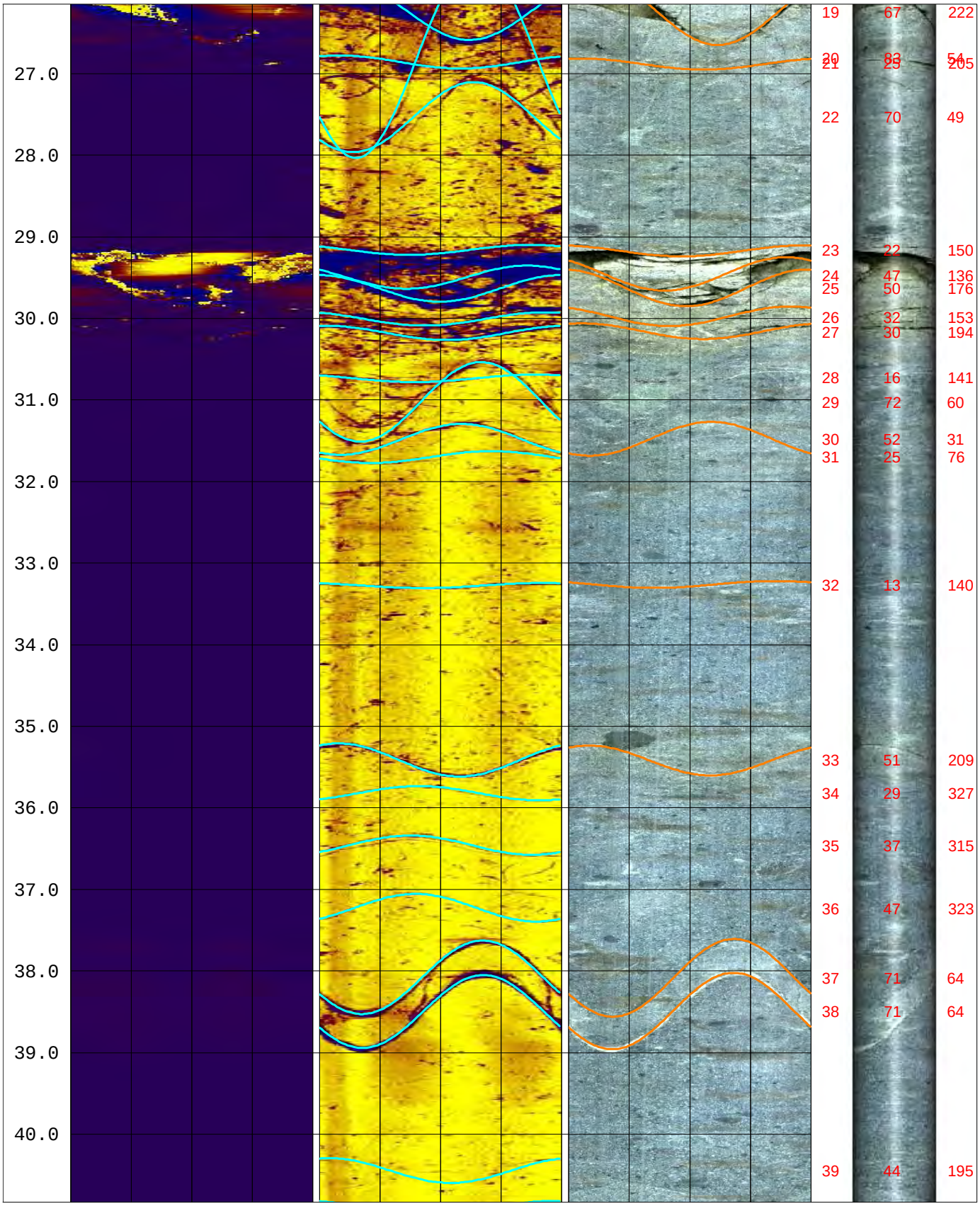
Date Logged:	November 7, 2007	Borehole ID:	RKS-26-07
File Name:	RKS2607-1M.wcl	Logged By:	F G Kruger

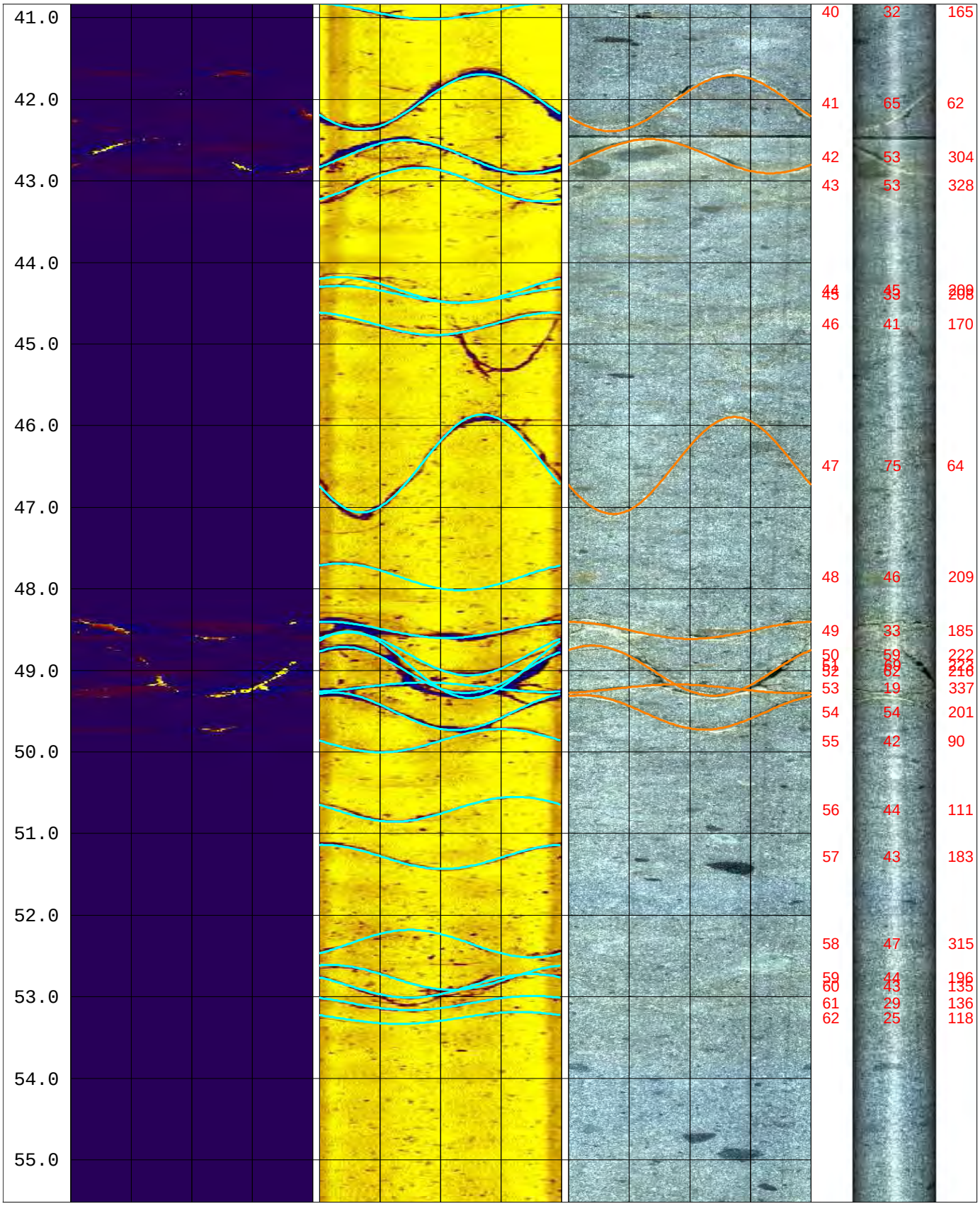
Notes:

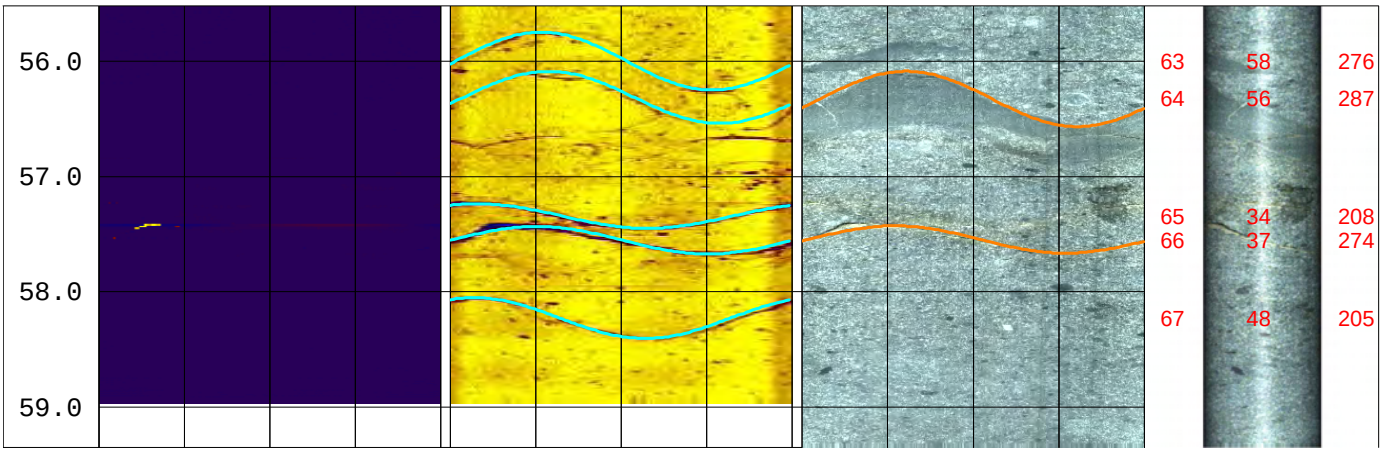
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.



#	Dip	Dip AZ
1	65	84
2	47	93
3	54	63
4	61	49
5	72	74
6	52	93
7	71	51
8	54	109
9	73	63
10	27	203
11	70	61
12	26	241
13	65	56
14	43	259
15	54	257
16	29	263
17	24	150
18	71	87


27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
19 67 222
20 83 54
21 85 205
22 70 49
23 22 150
24 47 136
25 50 176
26 32 153
27 30 194
28 16 141
29 72 60
30 52 31
31 25 76
32 13 140
33 51 209
34 29 327
35 37 315
36 47 323
37 71 64
38 71 64
39 44 195


41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
40 32 165
41 65 62
42 53 304
43 53 328
44 45 209
45 33 208
46 41 170
47 75 64
48 46 209
49 33 185
50 59 222
51 59 216
52 62 216
53 19 337
54 54 201
55 42 90
56 44 111
57 43 183
58 47 315
59 44 196
60 43 135
61 29 136
62 25 118

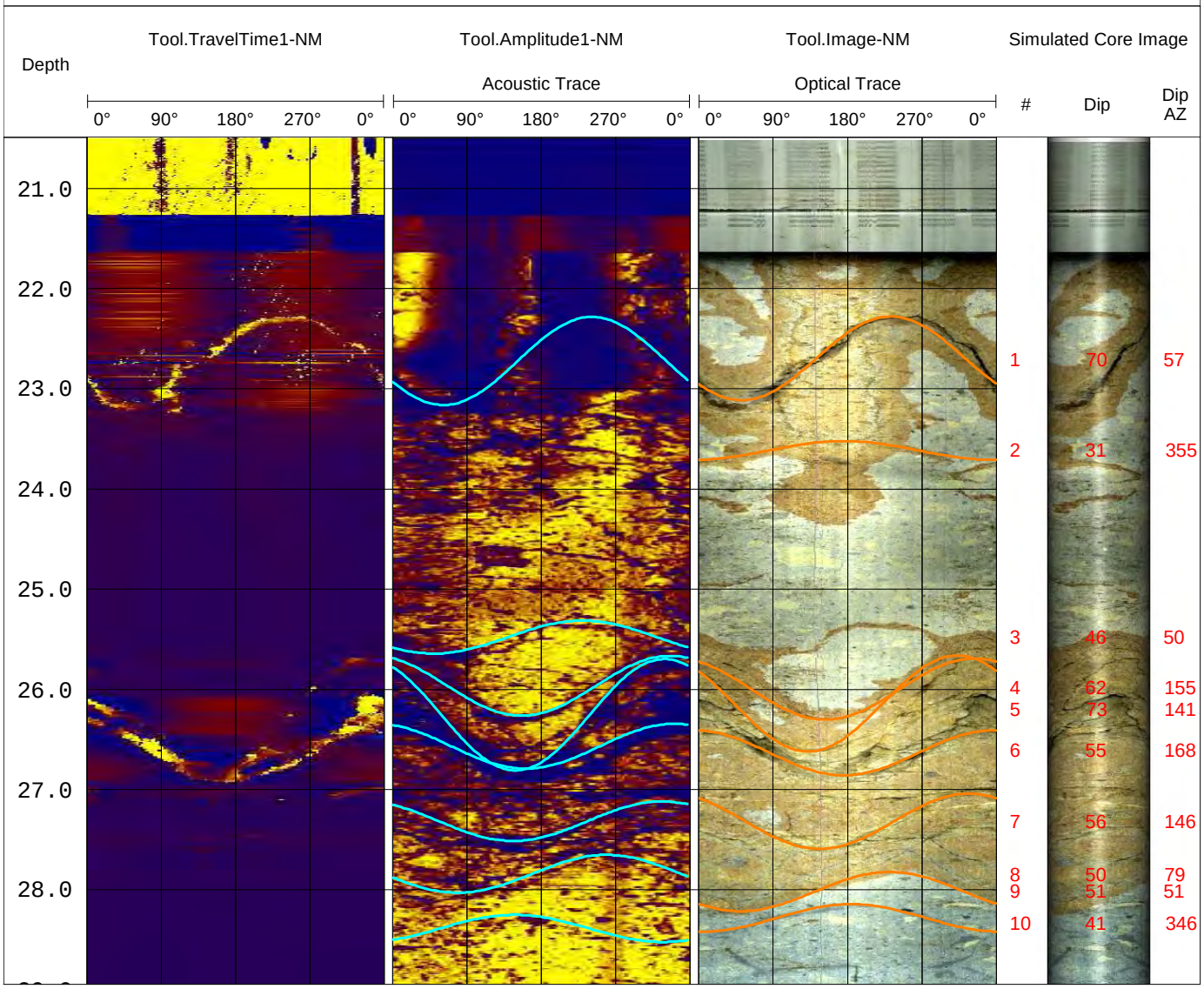

56.0
57.0
58.0
59.0
63
64
65
66
67
58
56
34
37
48
276
287
208
274
205

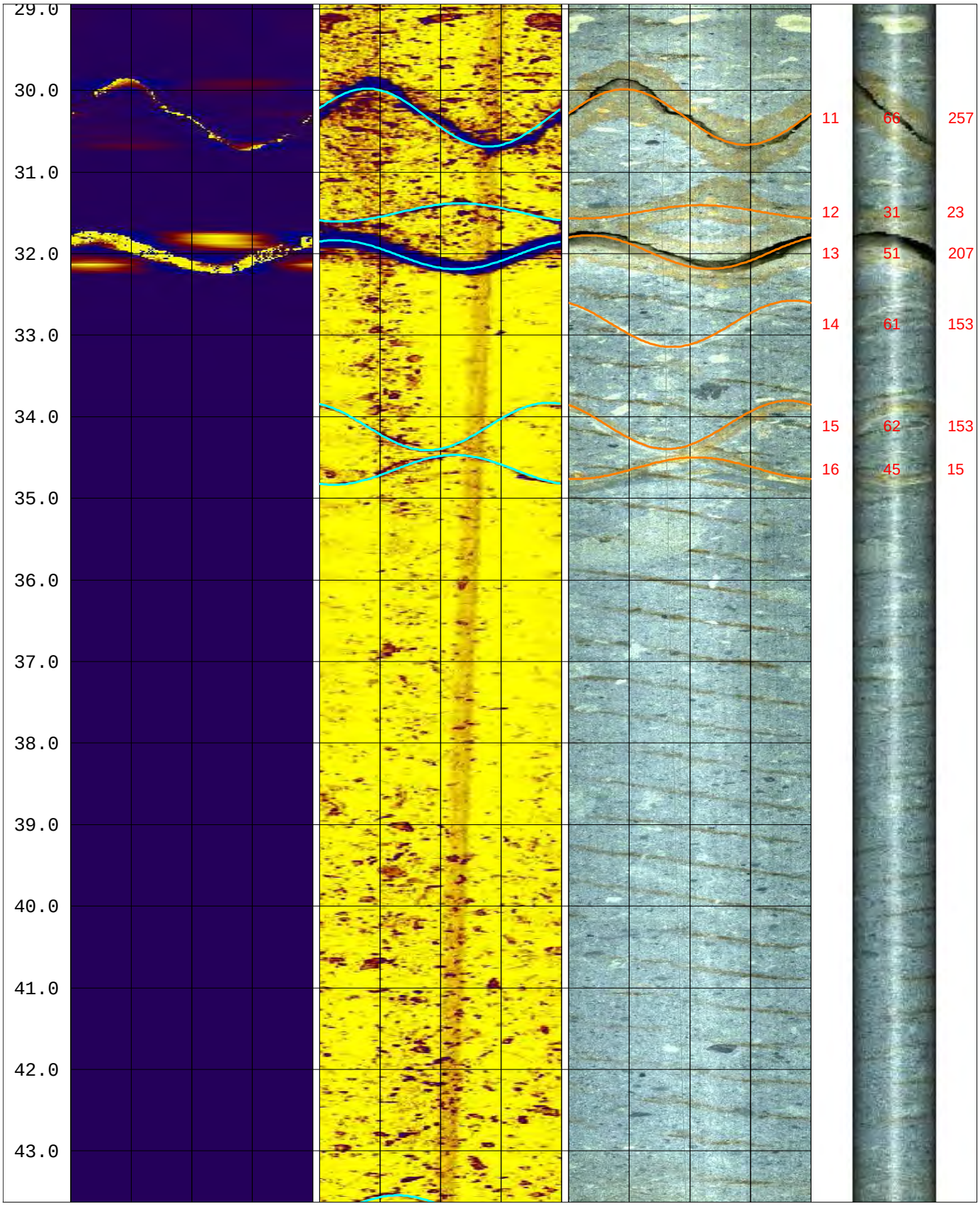
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

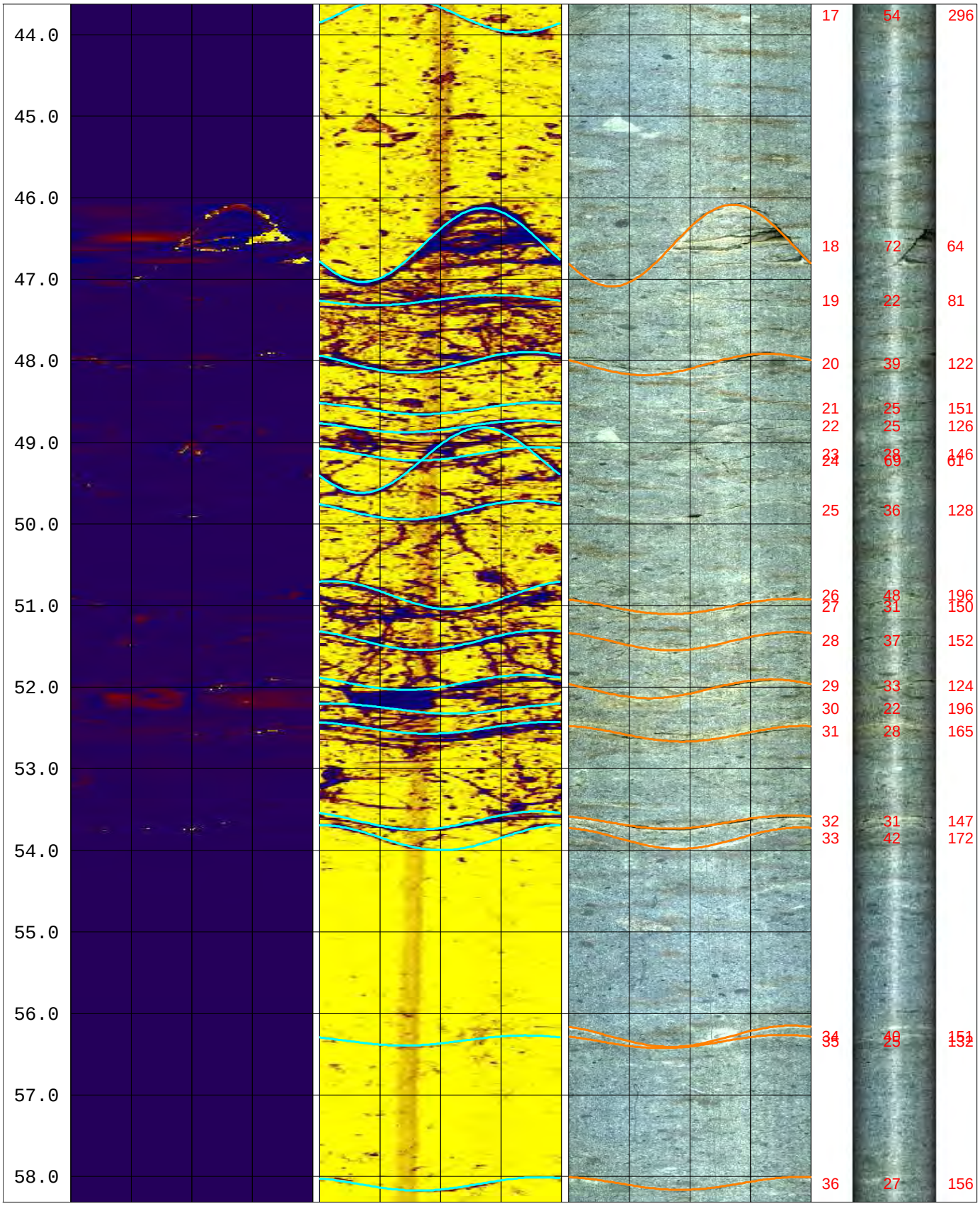
Date Logged:	November 3, 2007	Borehole ID:	RKS-27-07
File Name:	RKS2707-1.wcl	Logged By:	F G Kruger

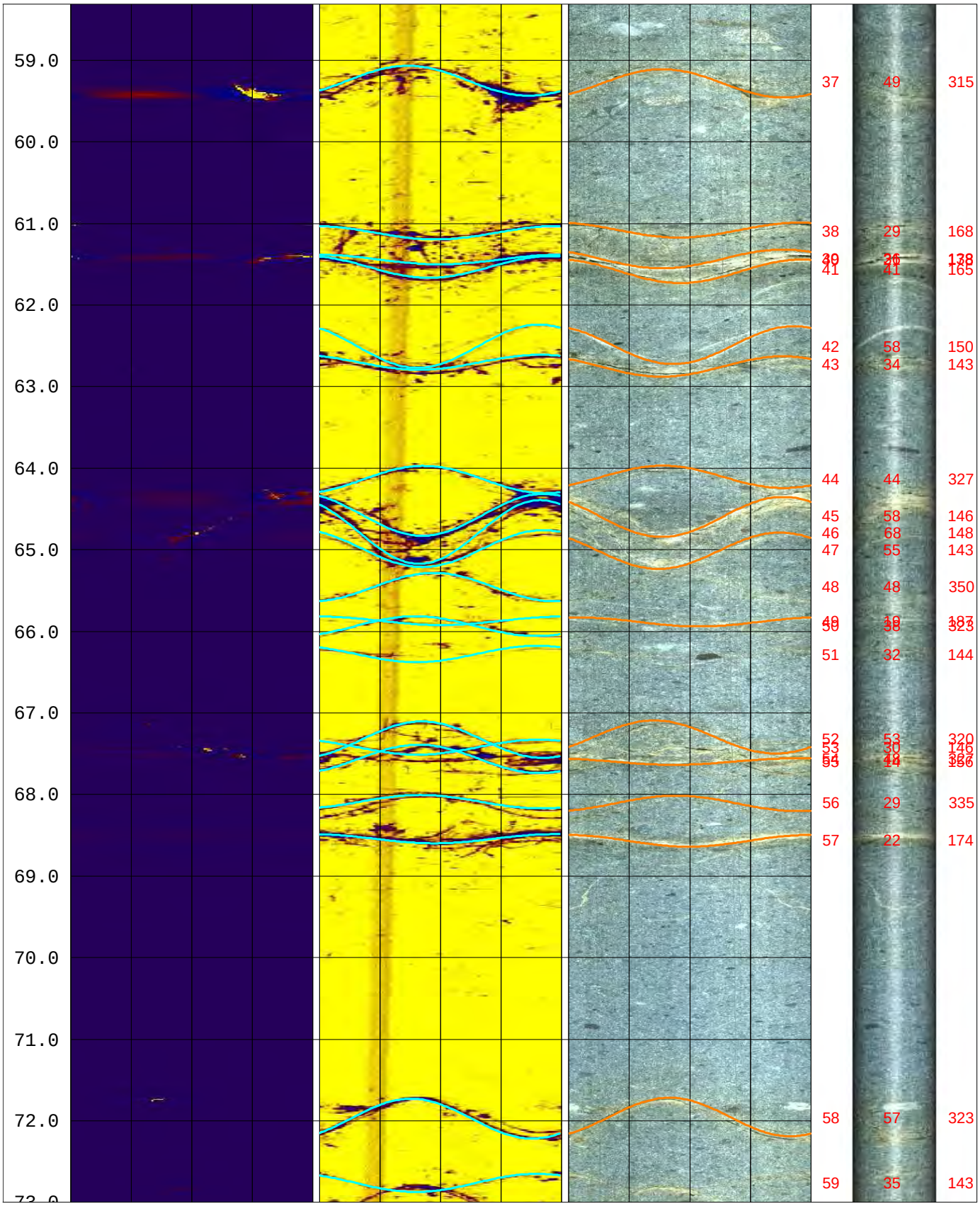
Notes:

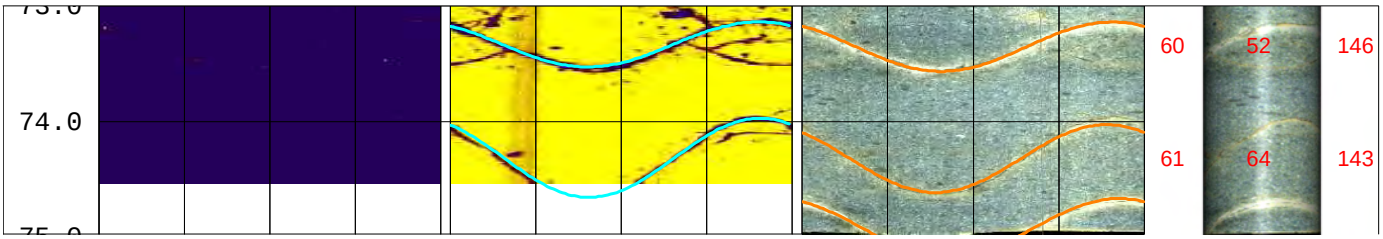
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.




29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
11 66 257
12 31 23
13 51 207
14 61 153
15 62 153
16 45 15


44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
17 54 296
18 72 64
19 22 81
20 39 122
21 25 151
22 25 126
23 28 146
24 69 61
25 36 128
26 48 196
27 31 150
28 37 152
29 33 124
30 22 196
31 28 165
32 31 147
33 42 172
34 40 151
35 25 132
36 27 156


59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
37 49 315
38 29 168
41 165
42 58 150
43 34 143
44 44 327
45 58 146
46 68 148
47 55 143
48 48 350
51 32 144
52 53 320
53 30 146
56 29 335
57 22 174
58 57 323
59 35 143

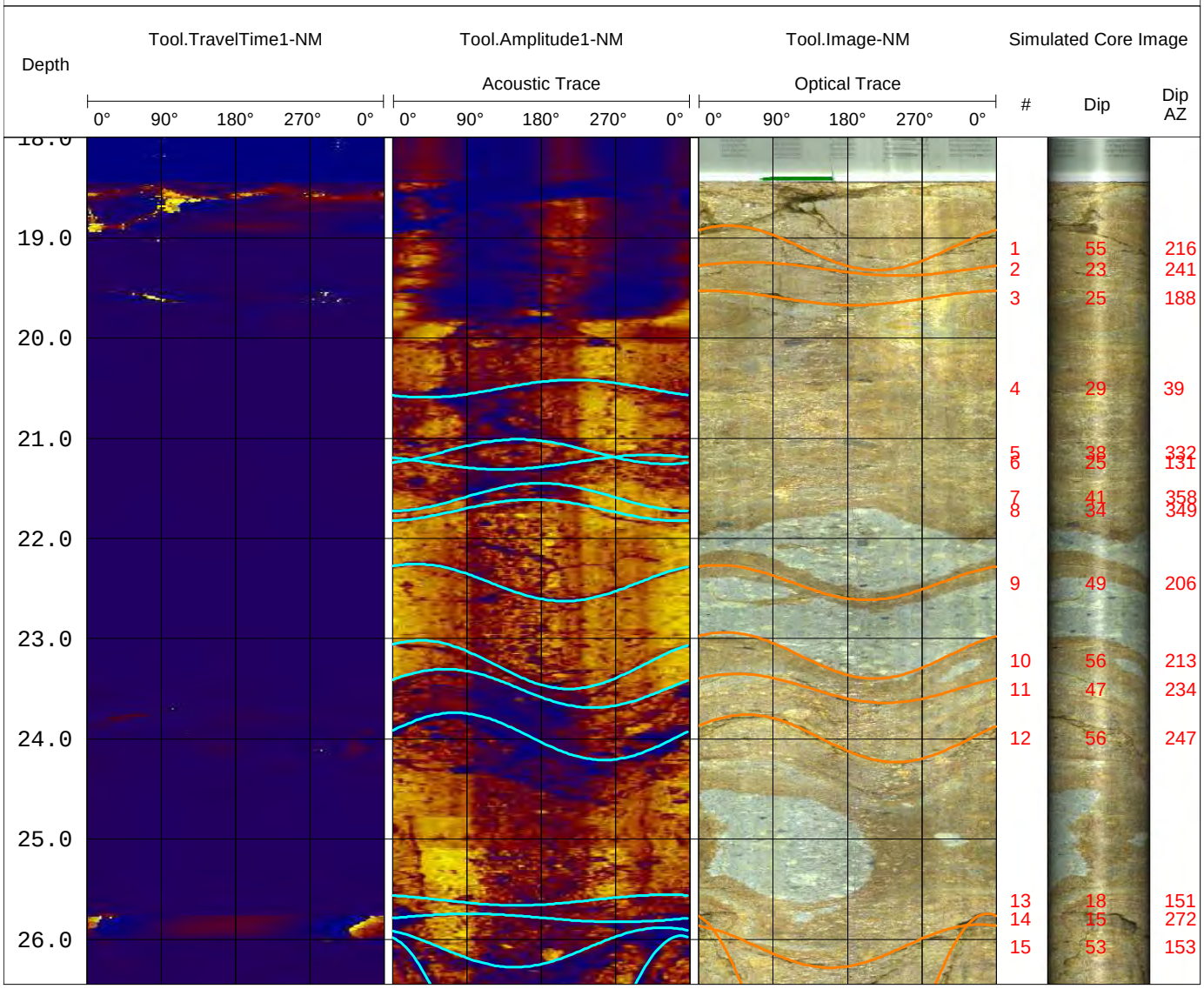

74.0
60
52
146
61
64
143

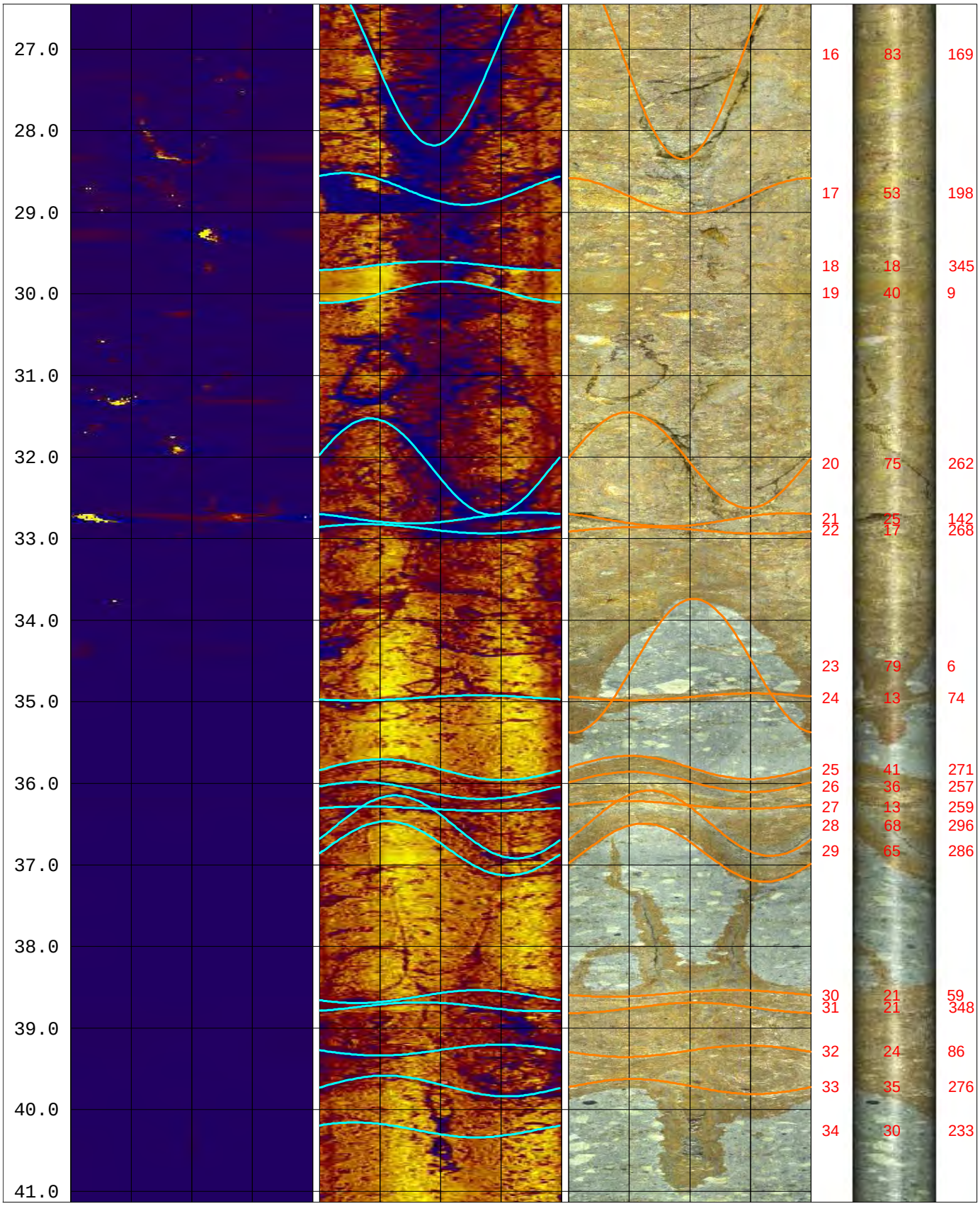
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

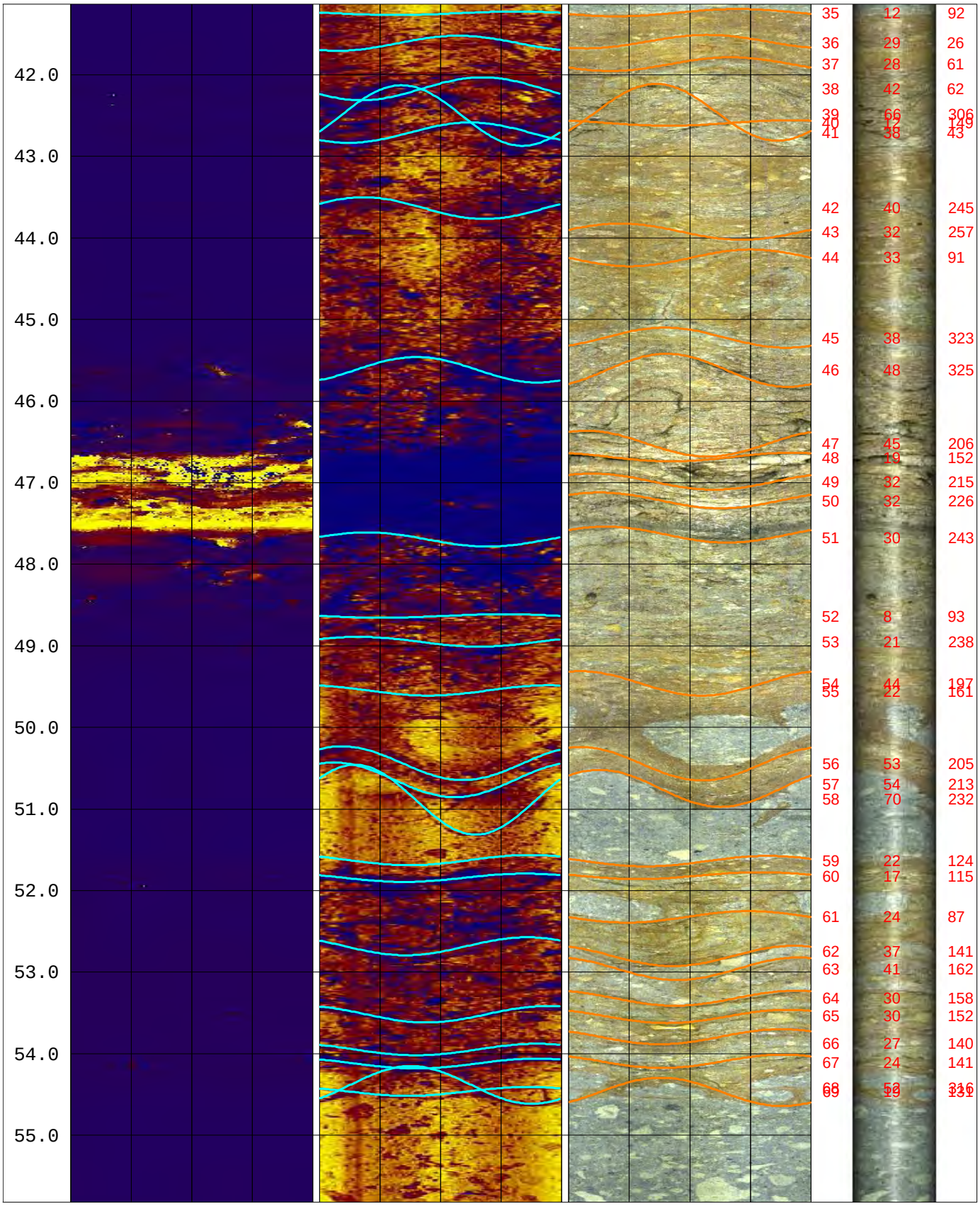
Date Logged:	October 31, 2007	Borehole ID:	RKS-28-07
File Name:	RKS2807-1M.wcl	Logged By:	F G Kruger

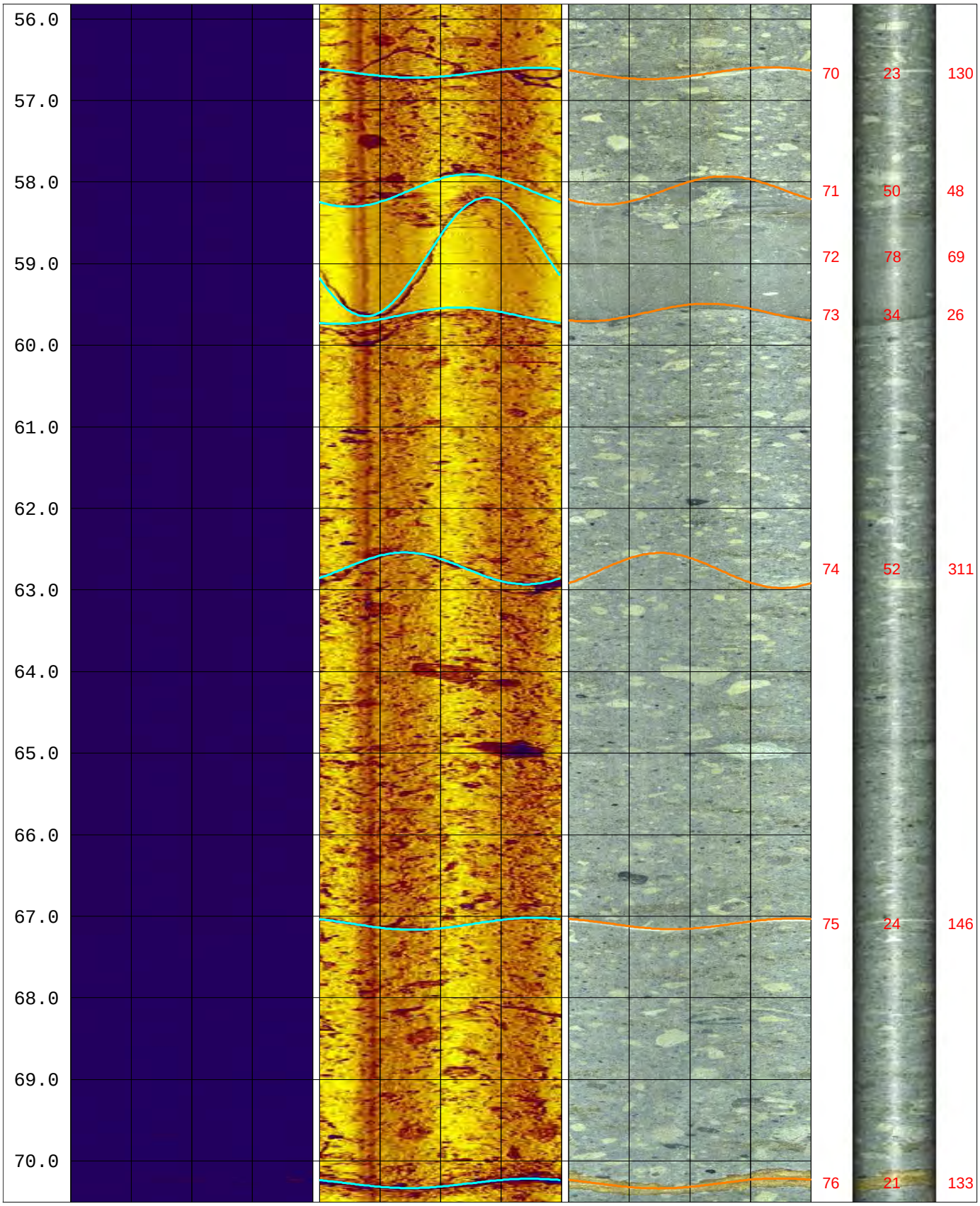
Notes:

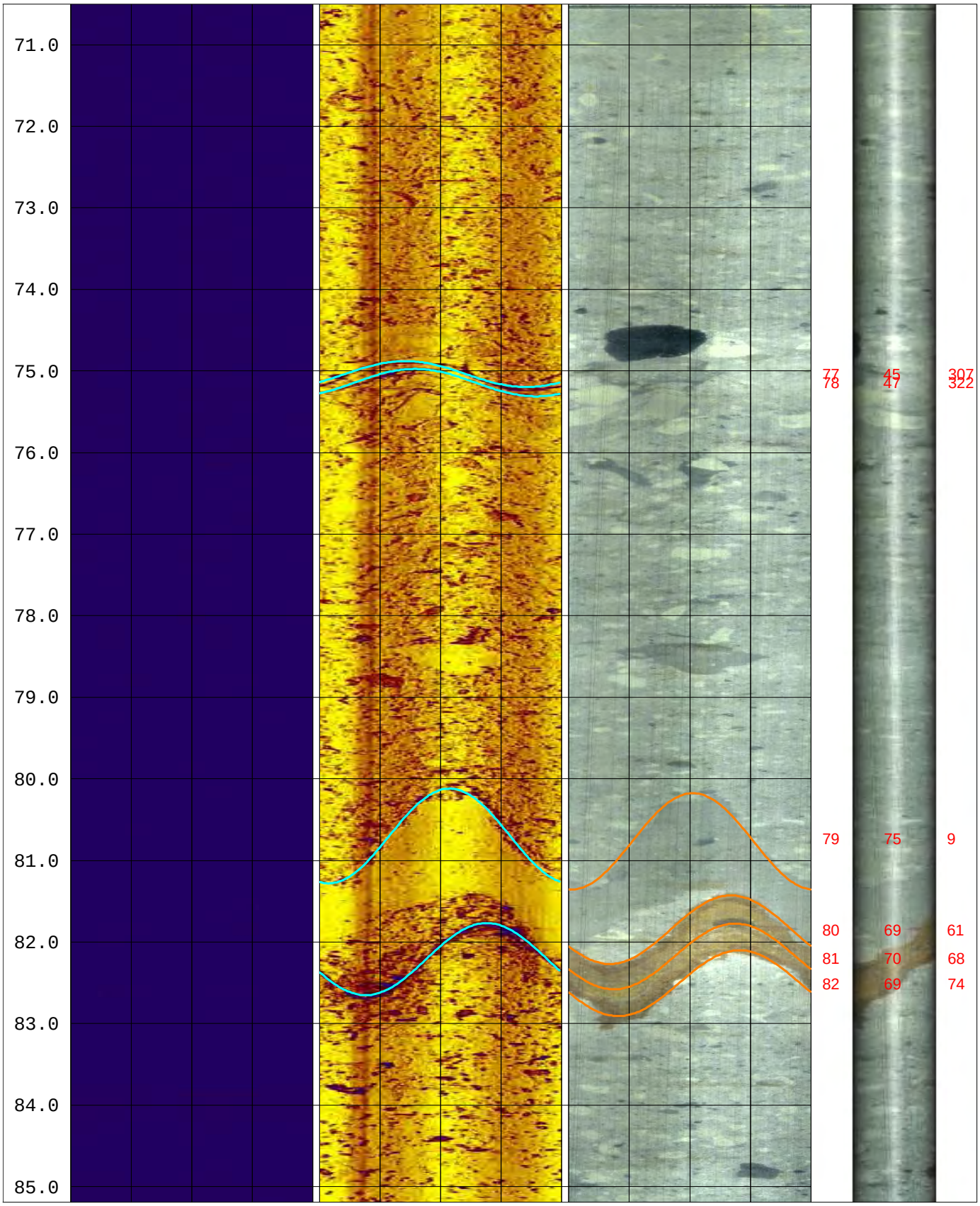
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

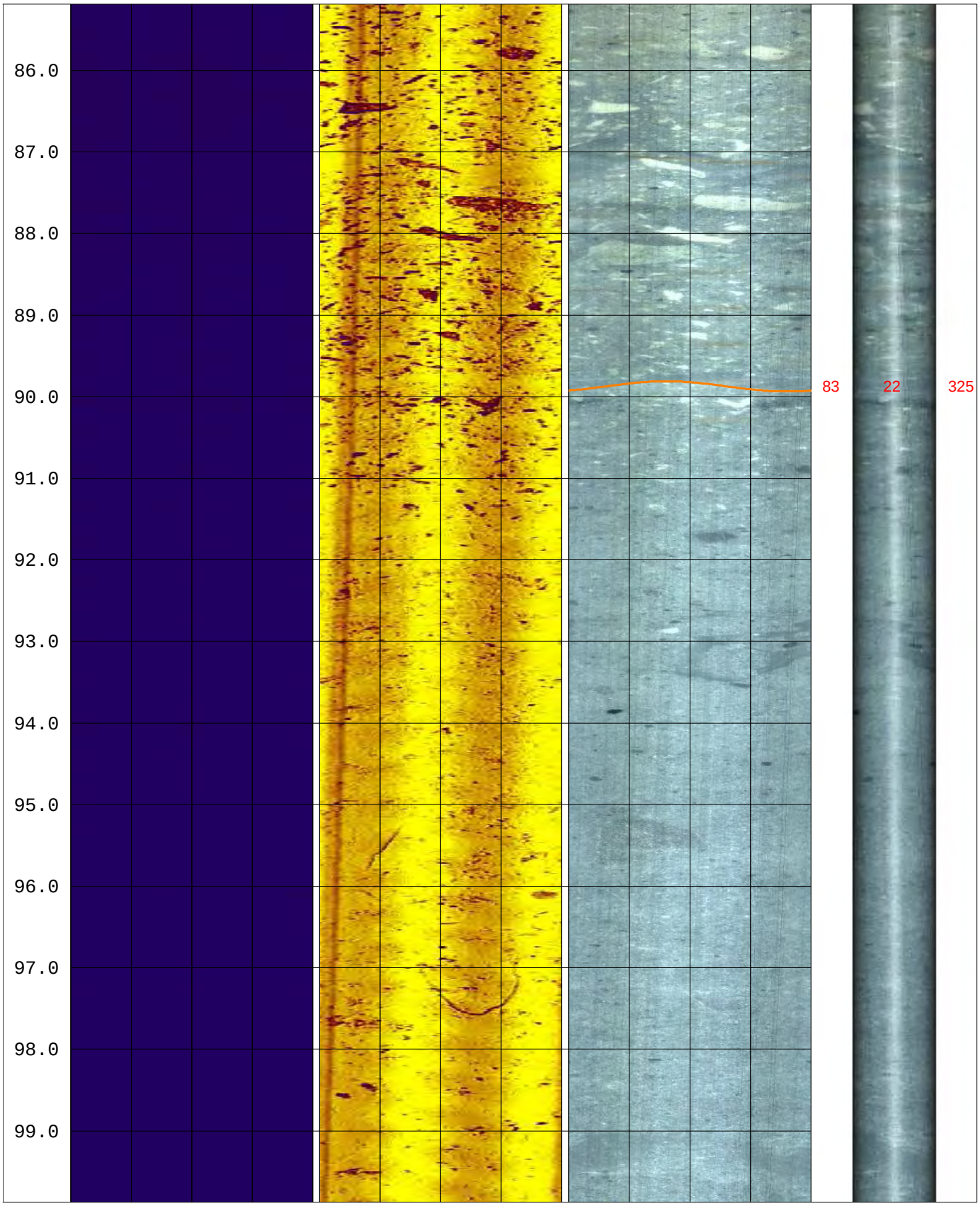


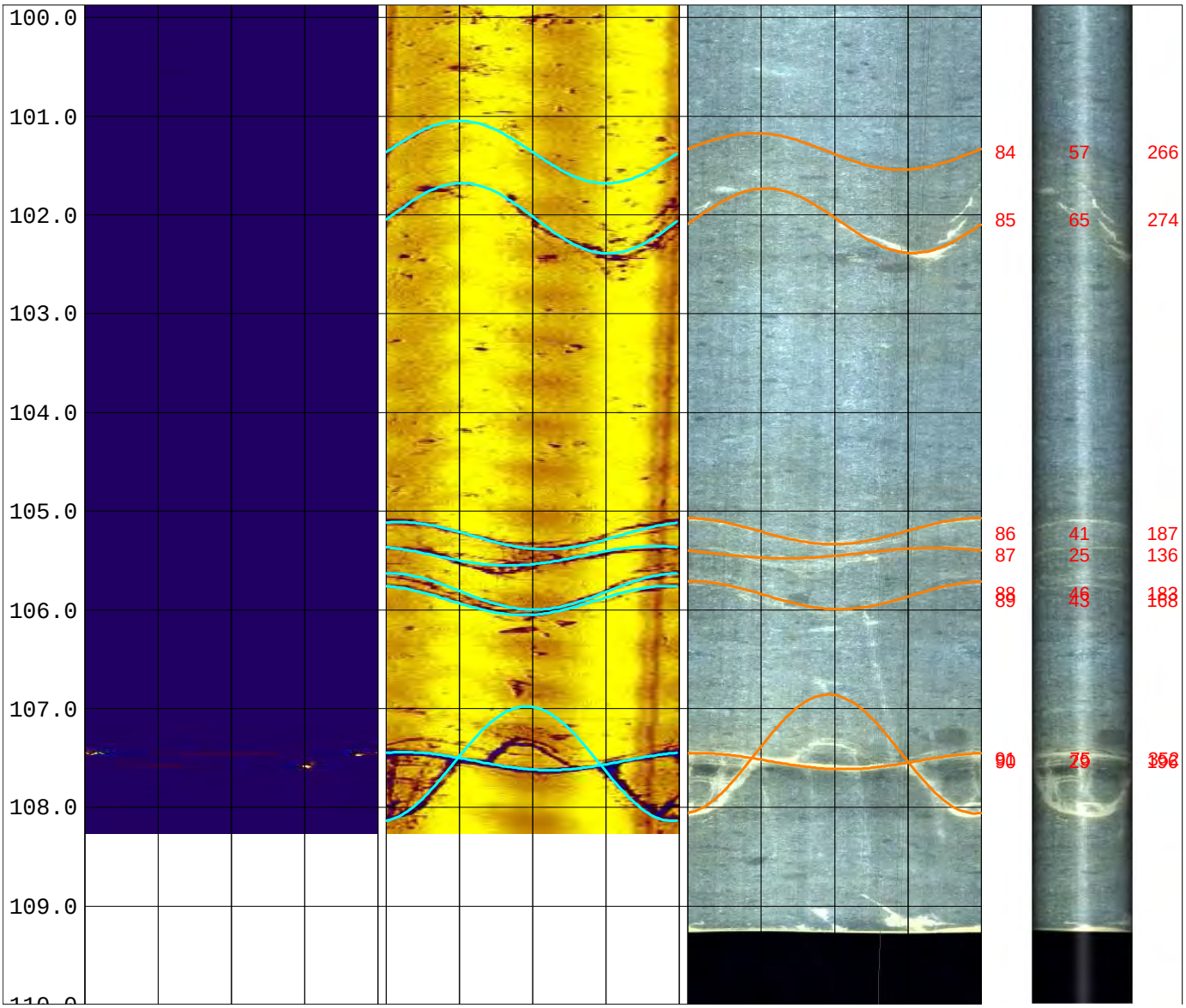

27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
16 83 169
17 53 198
18 18 345
19 40 9
20 75 262
21 25 142
22 17 268
23 79 6
24 13 74
25 41 271
26 36 257
27 13 259
28 68 296
29 65 286
30 21 59
31 21 348
32 24 86
33 35 276
34 30 233


42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
35 12 92
36 29 26
37 28 61
38 42 62
39 66 306
40 19 149
41 38 43
42 40 245
43 32 257
44 33 91
45 38 323
46 48 325
47 45 206
48 19 152
49 32 215
50 32 226
51 30 243
52 8 93
53 21 238
54 44 197
55 22 161
56 53 205
57 54 213
58 70 232
59 22 124
60 17 115
61 24 87
62 37 141
63 41 162
64 30 158
65 30 152
66 27 140
67 24 141
68 53 316
69 29 131


56.0
57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
70 23 130
71 50 48
72 78 69
73 34 26
74 52 311
75 24 146
76 21 133


71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
77 45 307
78 47 322
79 75 9
80 69 61
81 70 68
82 69 74


86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
96.0
97.0
98.0
99.0
83
22
325

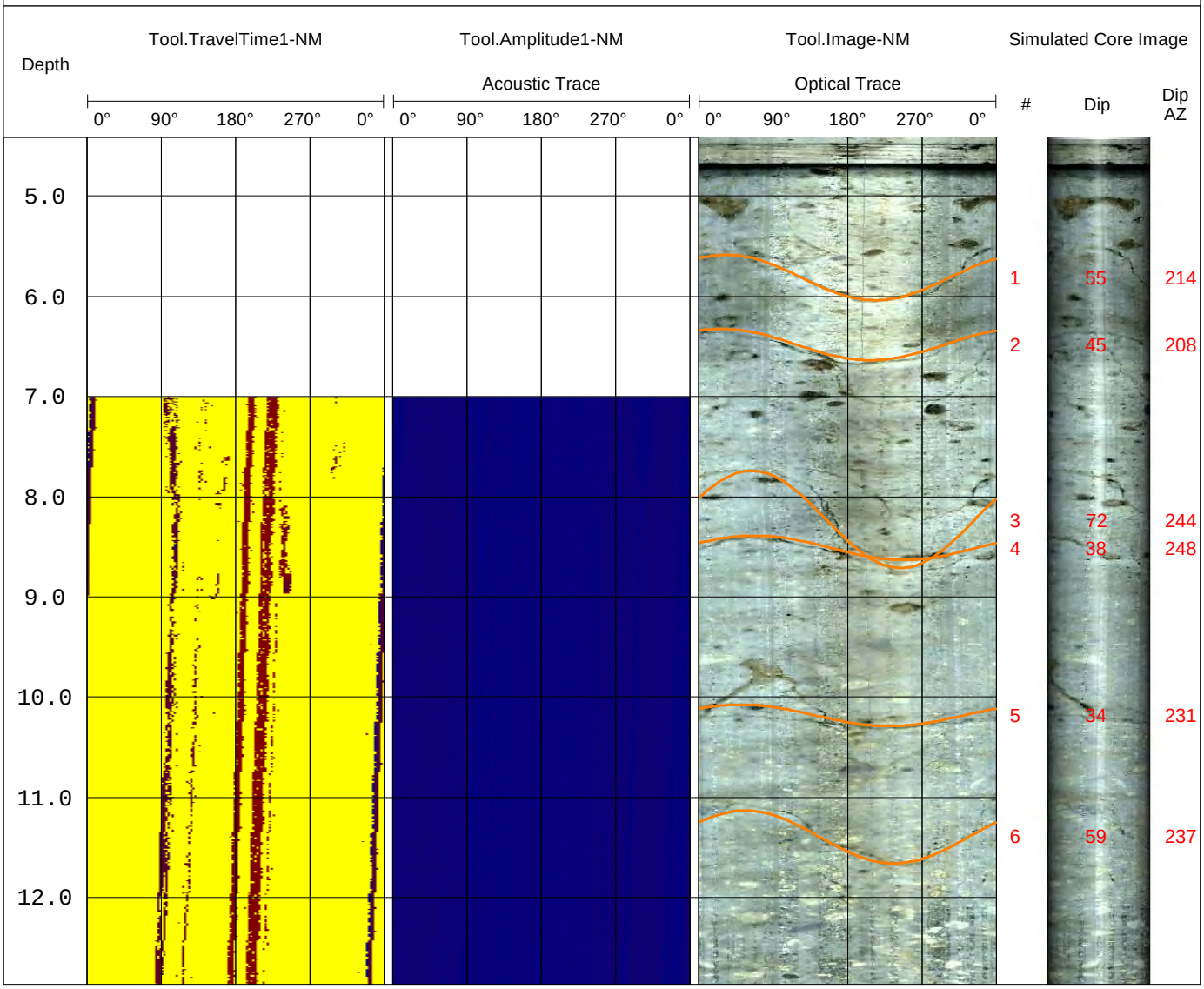

100.0
101.0
102.0
103.0
104.0
105.0
106.0
107.0
108.0
109.0
84 57 266
85 65 274
86 41 187
87 25 136
88 46 183
89 43 168
91 75 352
90 76 356

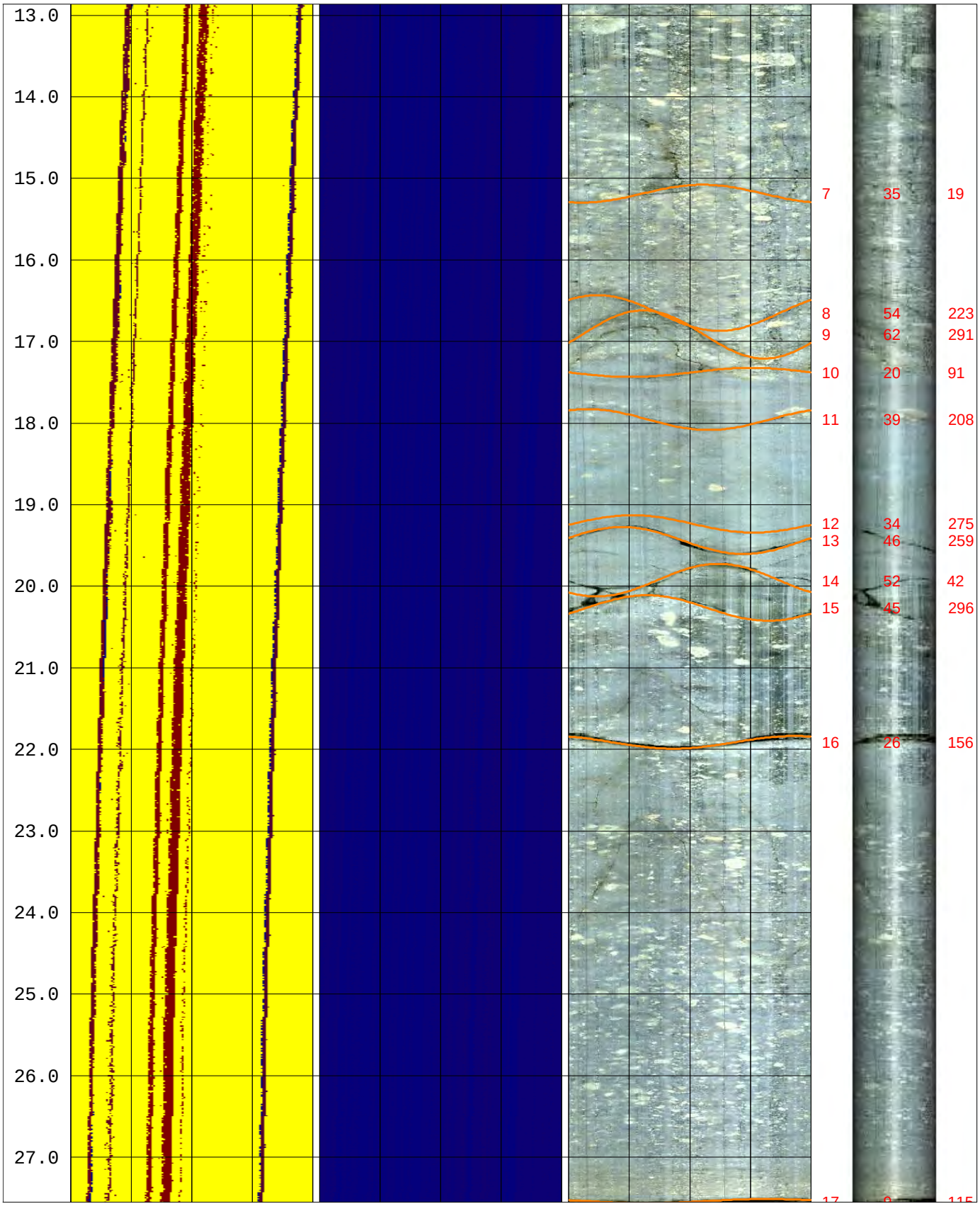
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

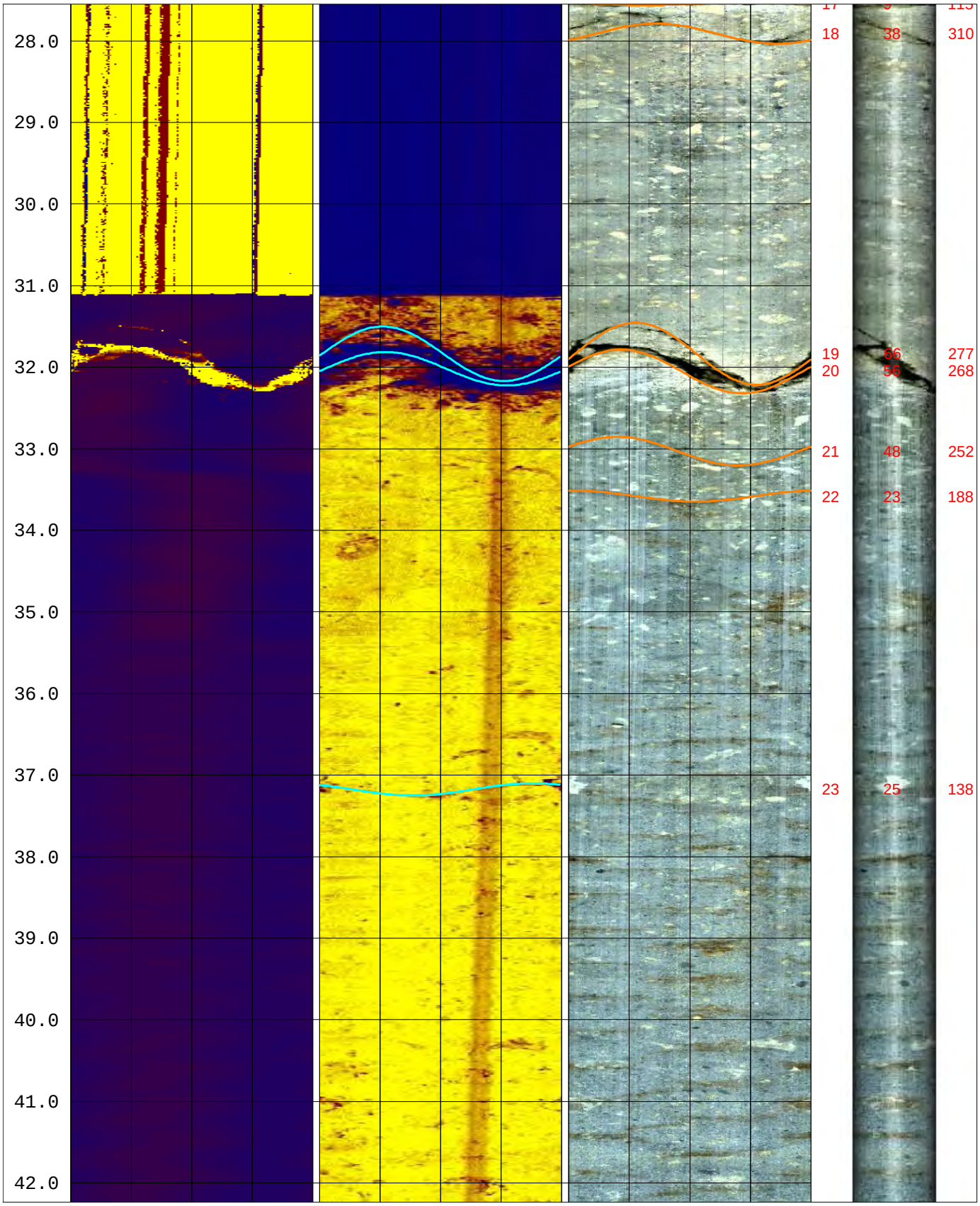
Date Logged:	October 30, 2007	Borehole ID:	RKS-29-07
File Name:	RKS2907-1M.wcl	Logged By:	F G Kruger

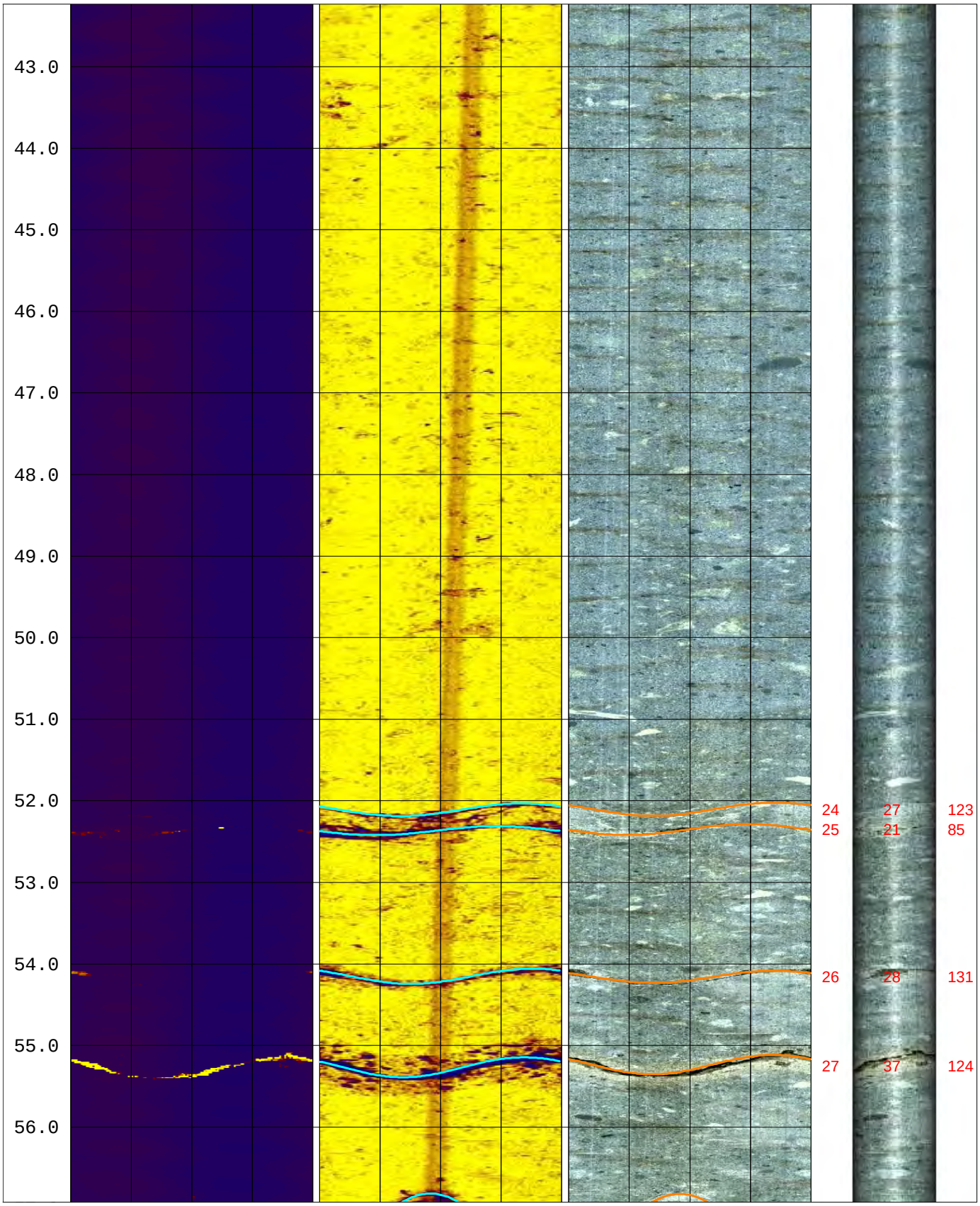
Notes:

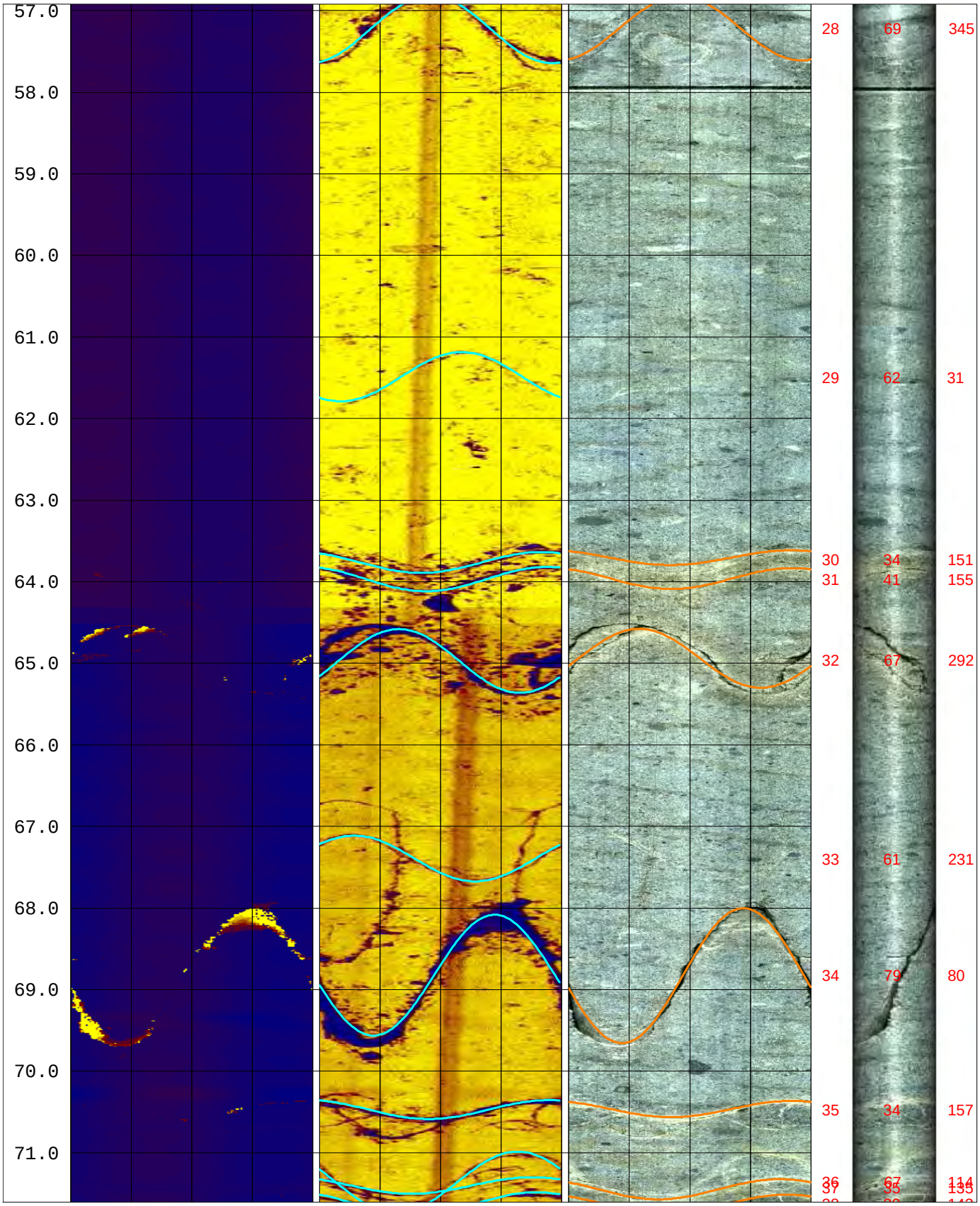
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

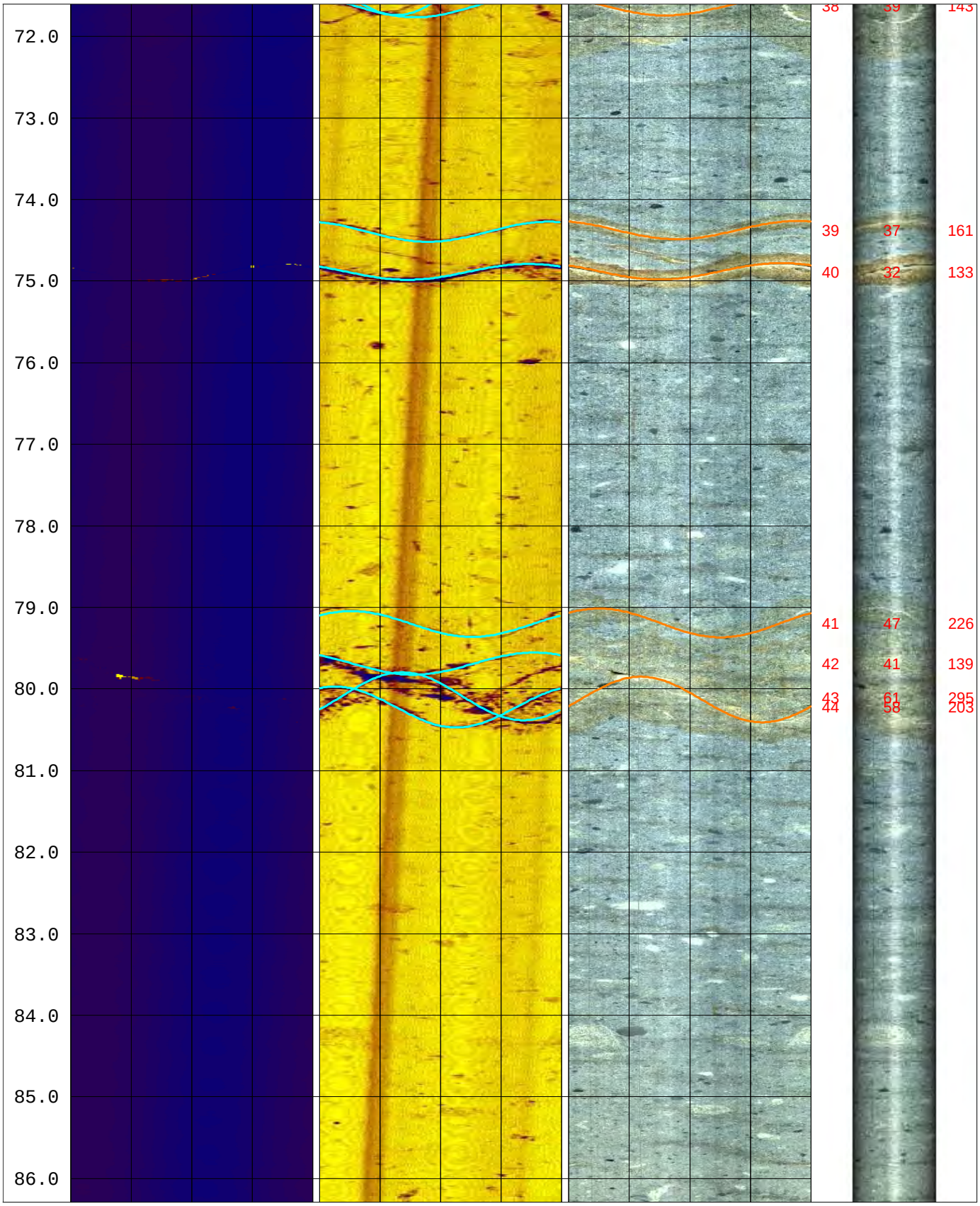


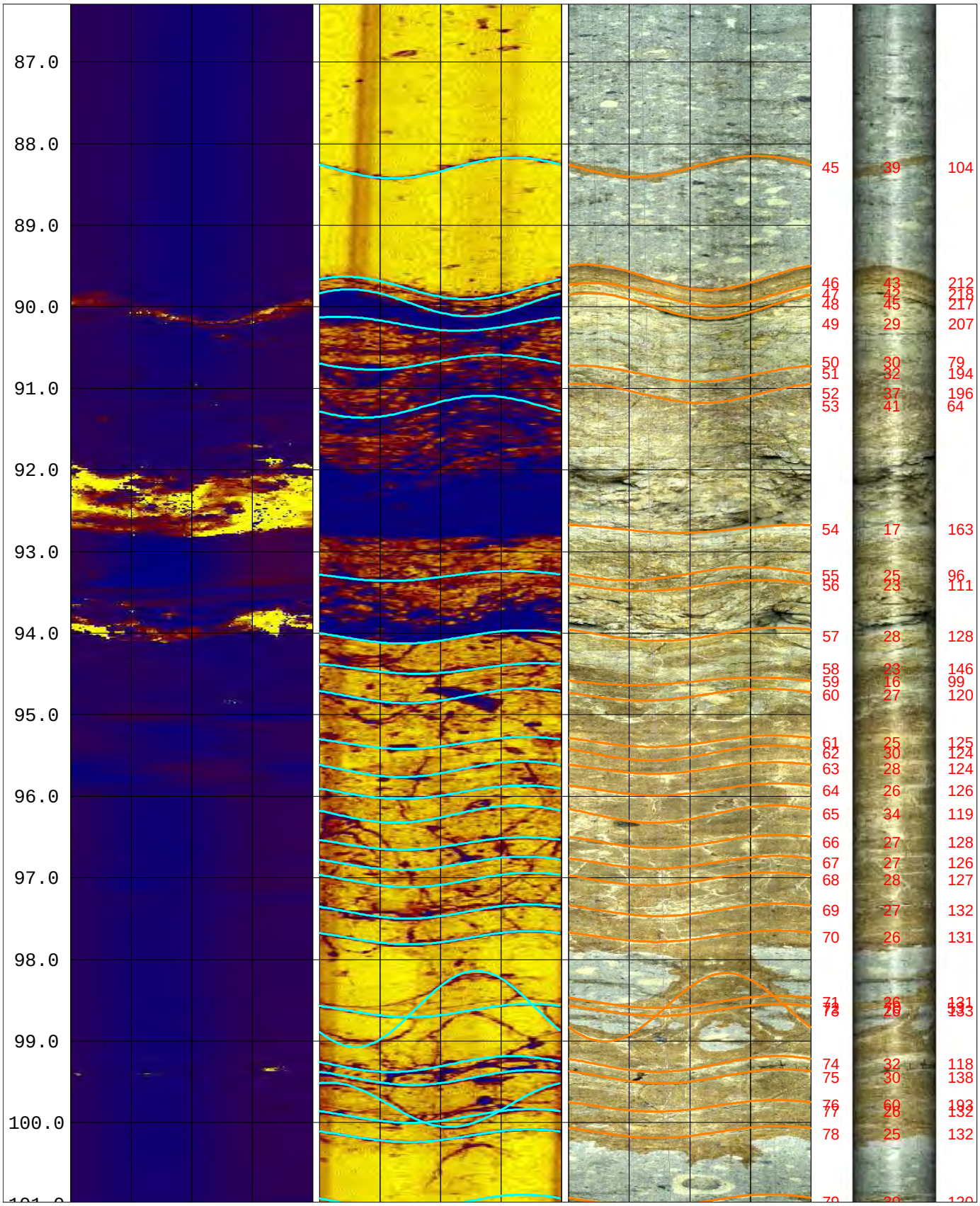

13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
7 35 19
8 54 223
9 62 291
10 20 91
11 39 208
12 34 275
13 46 259
14 52 42
15 45 296
16 26 156

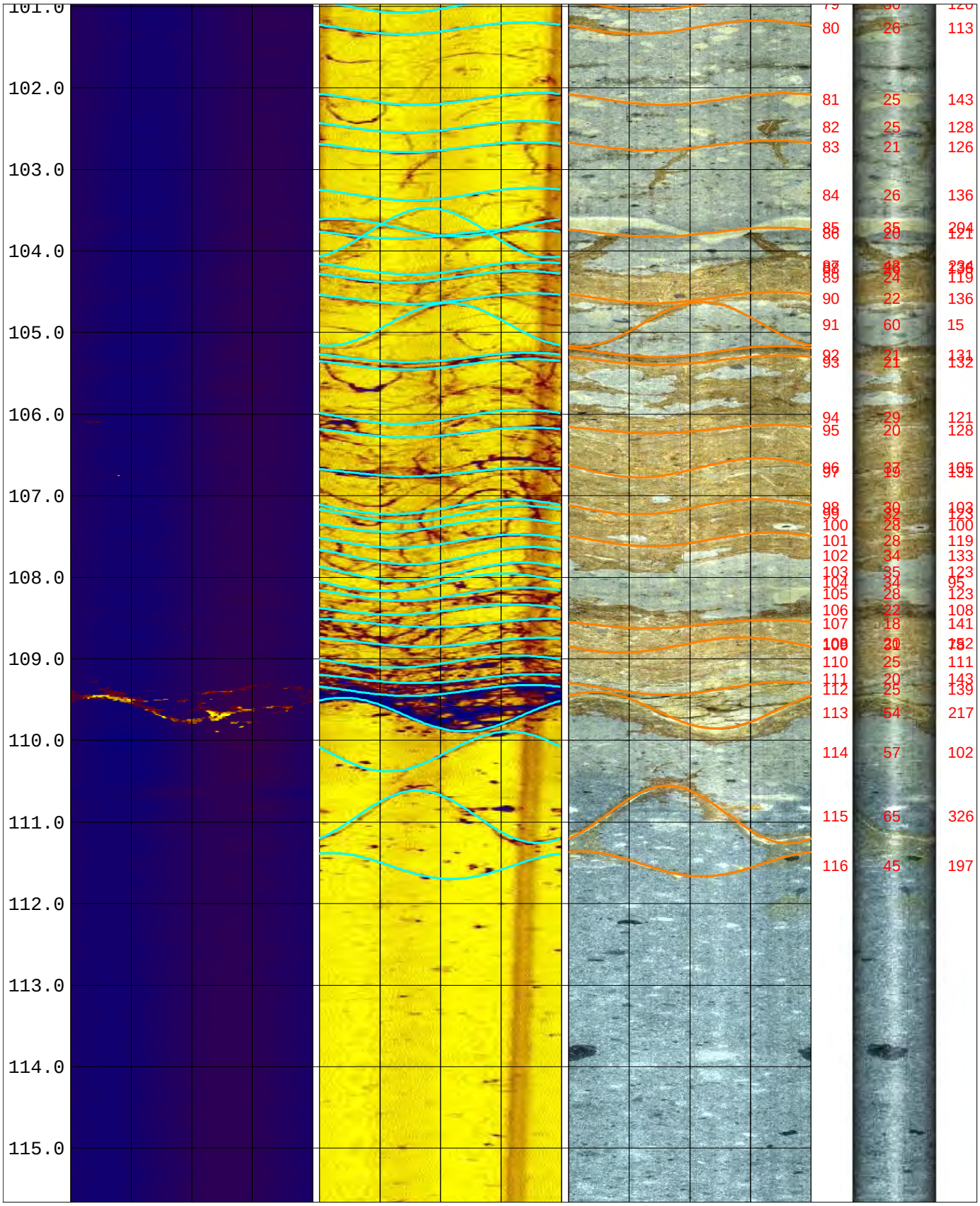

28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
18 38 310
19 66 277
20 56 268
21 48 252
22 23 188
23 25 138

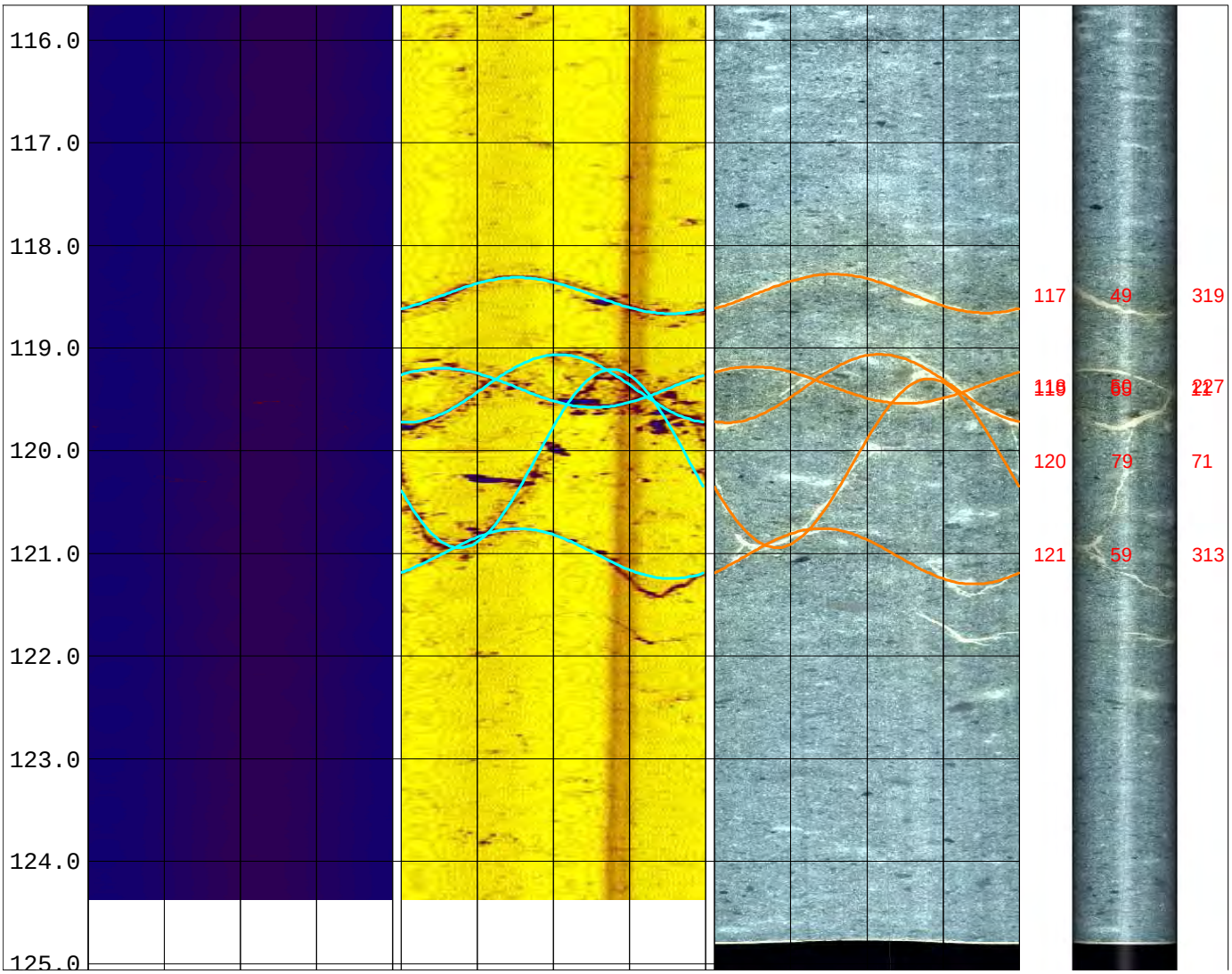

43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
24
25
26
27
27
21
28
37
123
85
131
124


57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
28 69 345
29 62 31
30 34 151
31 41 155
32 67 292
33 61 231
34 79 80
35 34 157
36 67 114


72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
86.0
38
39
143
39
37
161
40
32
133
41
47
226
42
41
139
43
61
295
44
58
203


87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
96.0
97.0
98.0
99.0
100.0
45 39 104
46 43 212
47 42 218
48 45 217
49 29 207
50 30 79
51 32 194
52 37 196
53 41 64
54 17 163
55 25 96
56 23 111
57 28 128
58 23 146
59 16 99
60 27 120
61 25 125
62 30 124
63 28 124
64 26 126
65 34 119
66 27 128
67 27 126
68 28 127
69 27 132
70 26 131
71 26 131
74 32 118
75 30 138
76 60 193
77 28 132
78 25 132


101.0
102.0
103.0
104.0
105.0
106.0
107.0
108.0
109.0
110.0
111.0
112.0
113.0
114.0
115.0
80 26 113
81 25 143
82 25 128
83 21 126
84 26 136
90 22 136
91 60 15
94 29 121
95 20 128
100 28 100
101 28 119
102 34 133
105 28 123
106 22 108
107 18 141
110 25 111
111 20 143
112 25 139
113 54 217
114 57 102
115 65 326
116 45 197

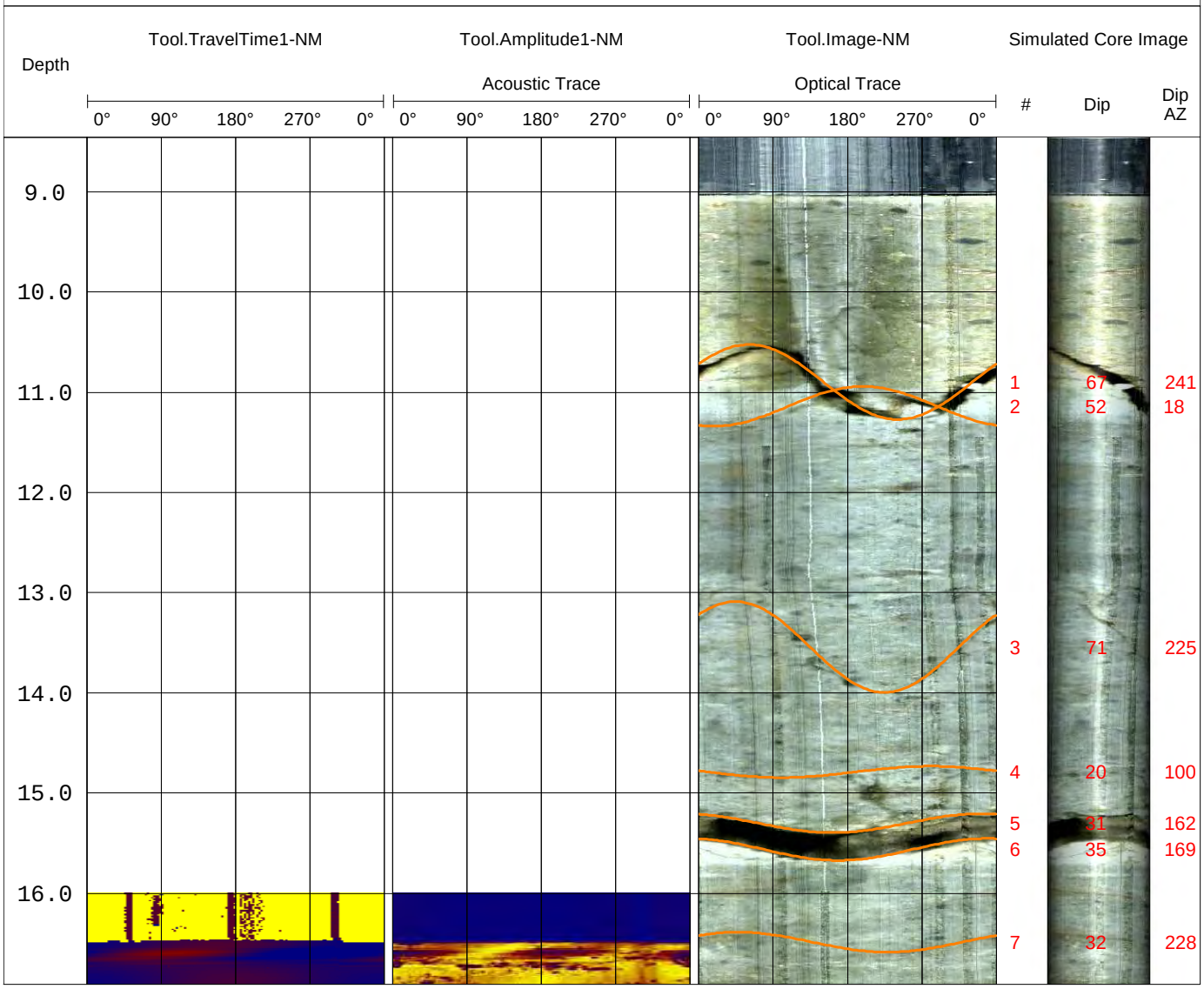

116.0
117.0
118.0
119.0
120.0
121.0
122.0
123.0
124.0
125.0
117
49
319
120
79
71
121
59
313

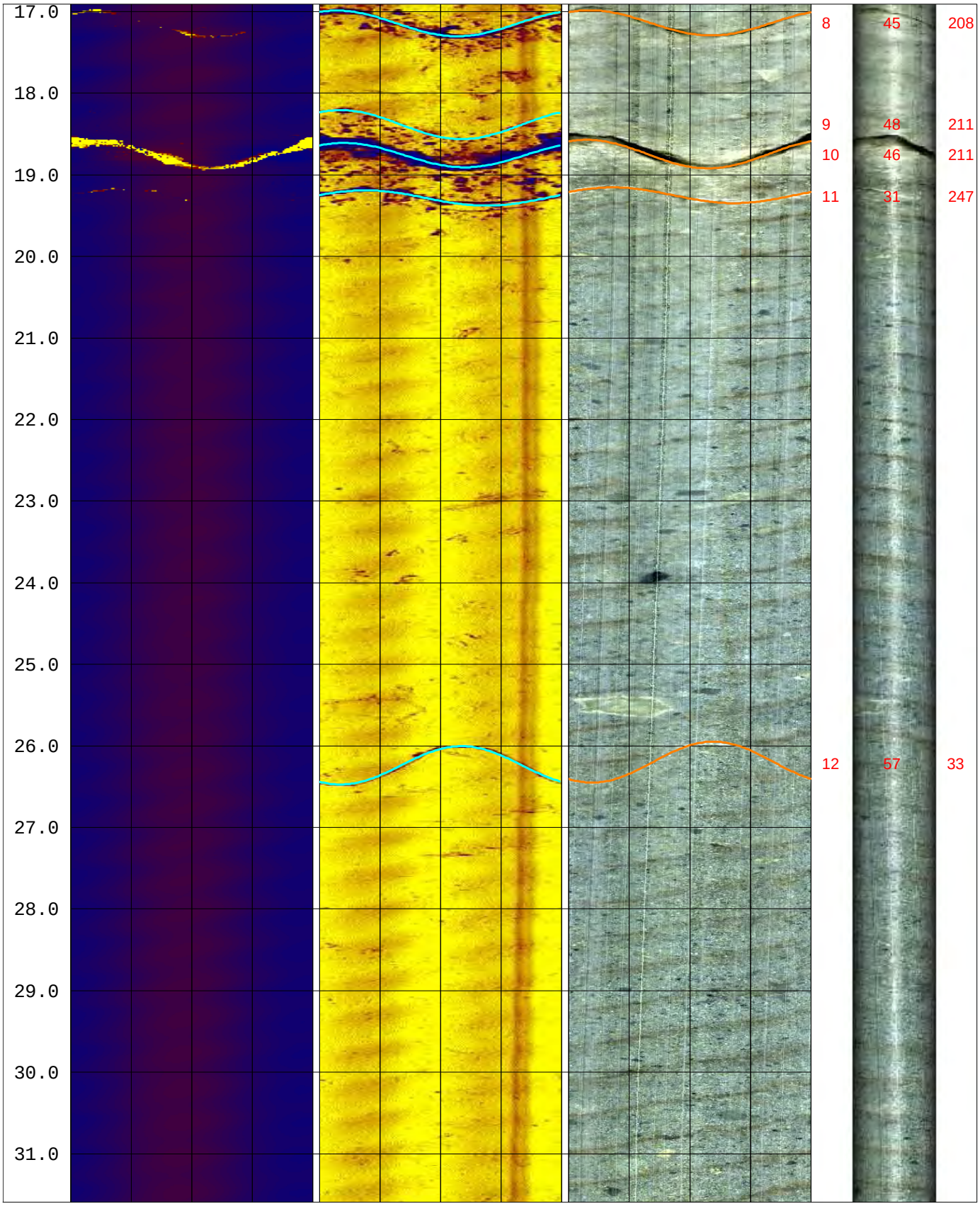
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

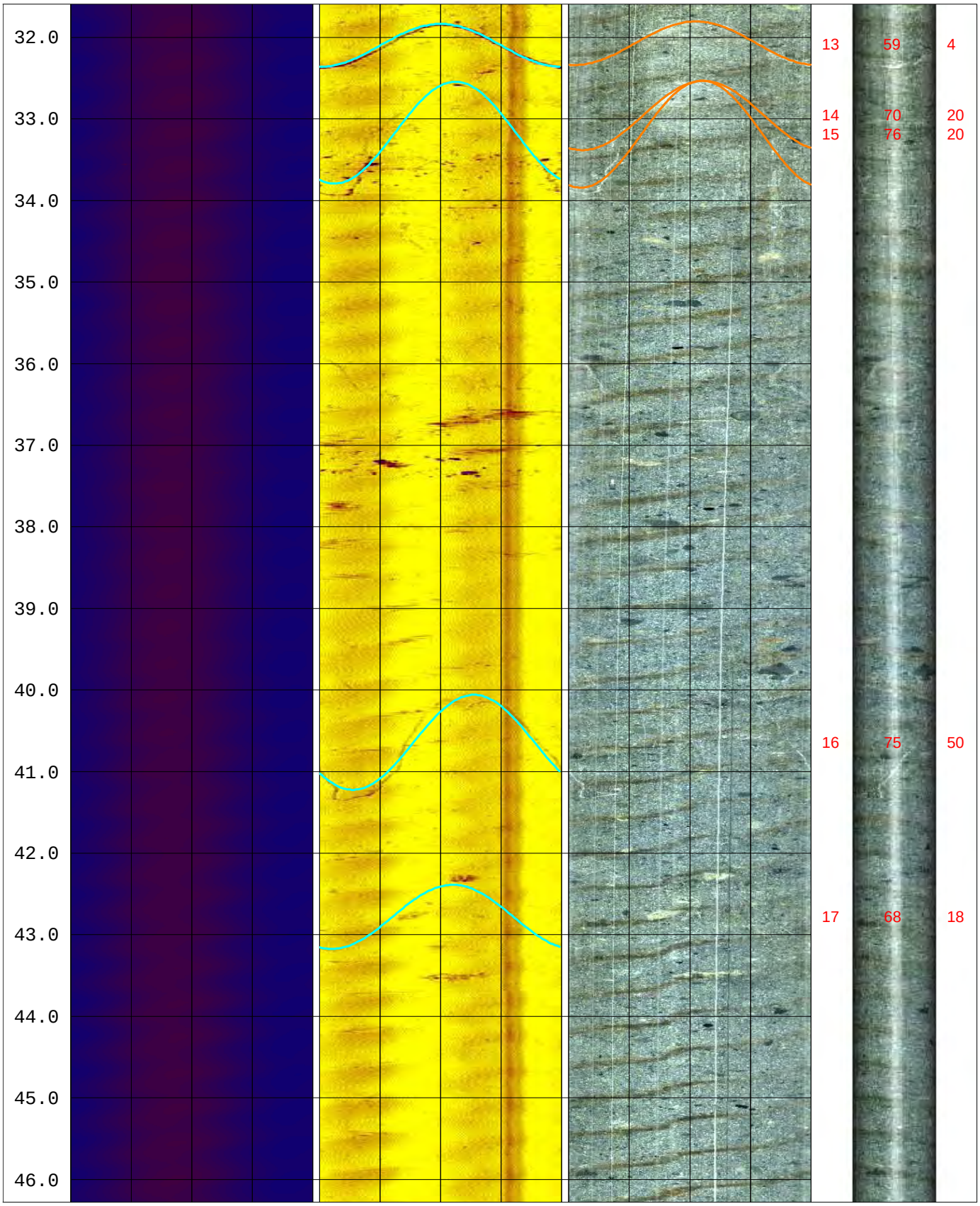
Date Logged:	October 3, 2007	Borehole ID:	RKS-30-07
File Name:	RKS3007-1M.wcl	Logged By:	F G Kruger

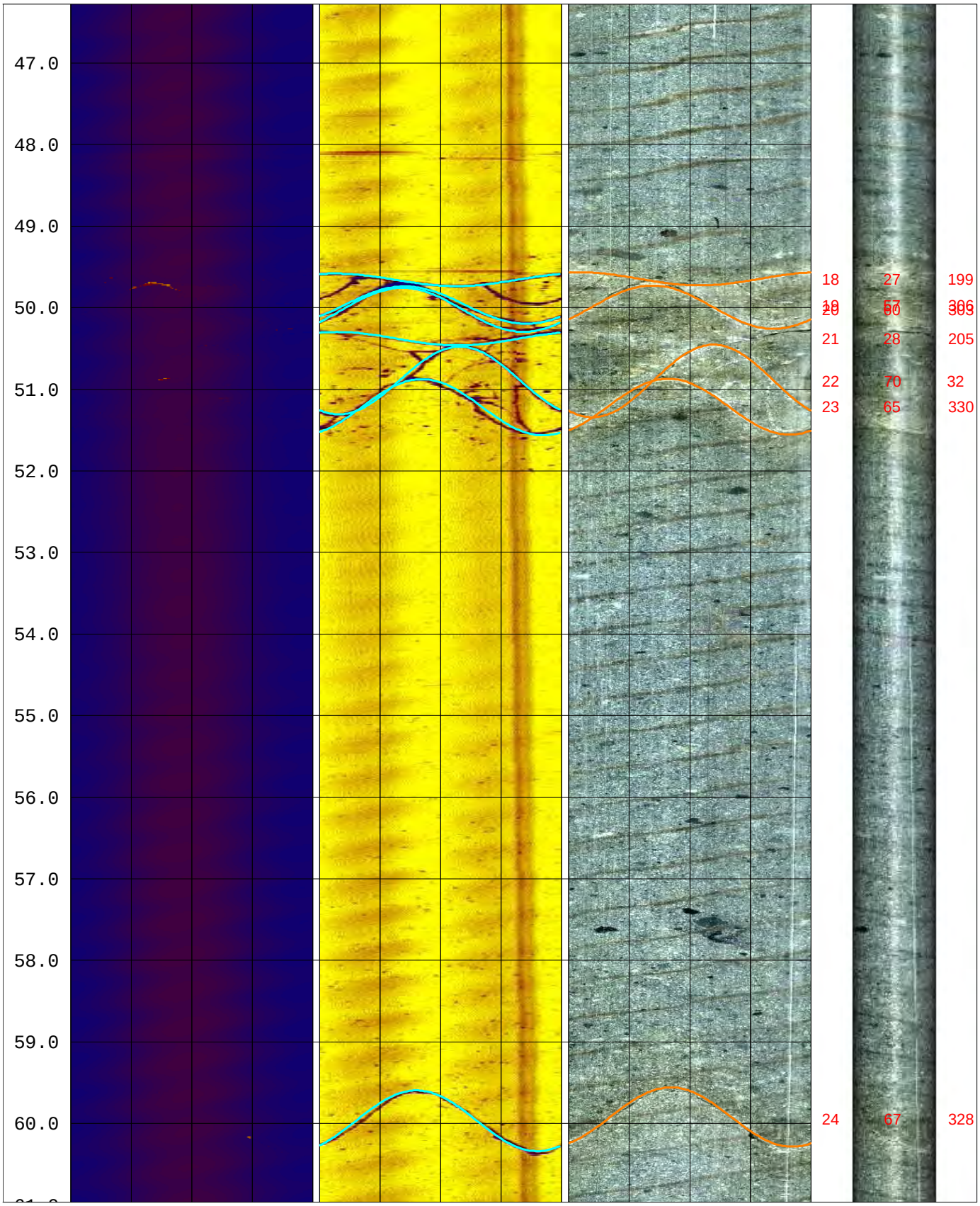
Notes:

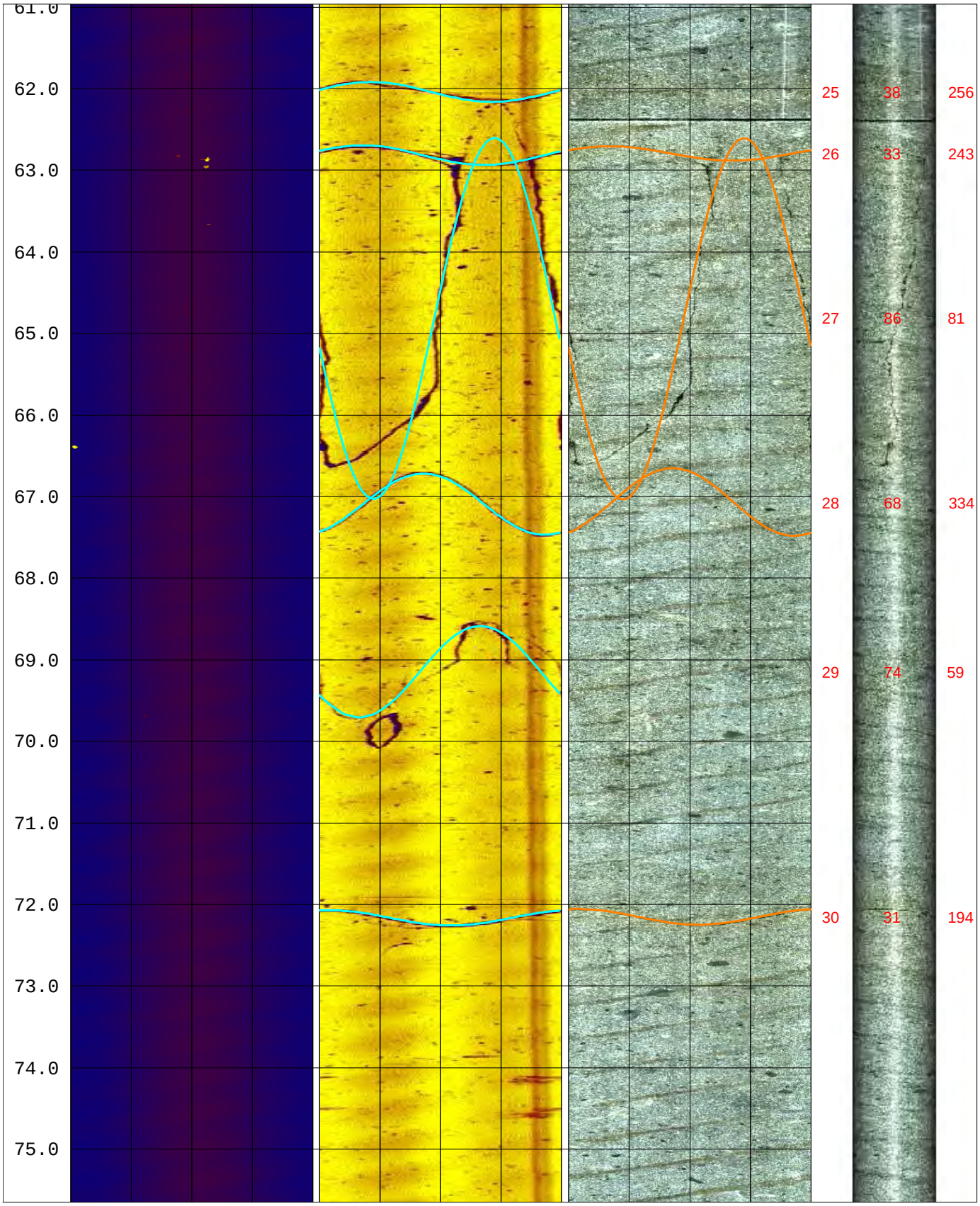
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

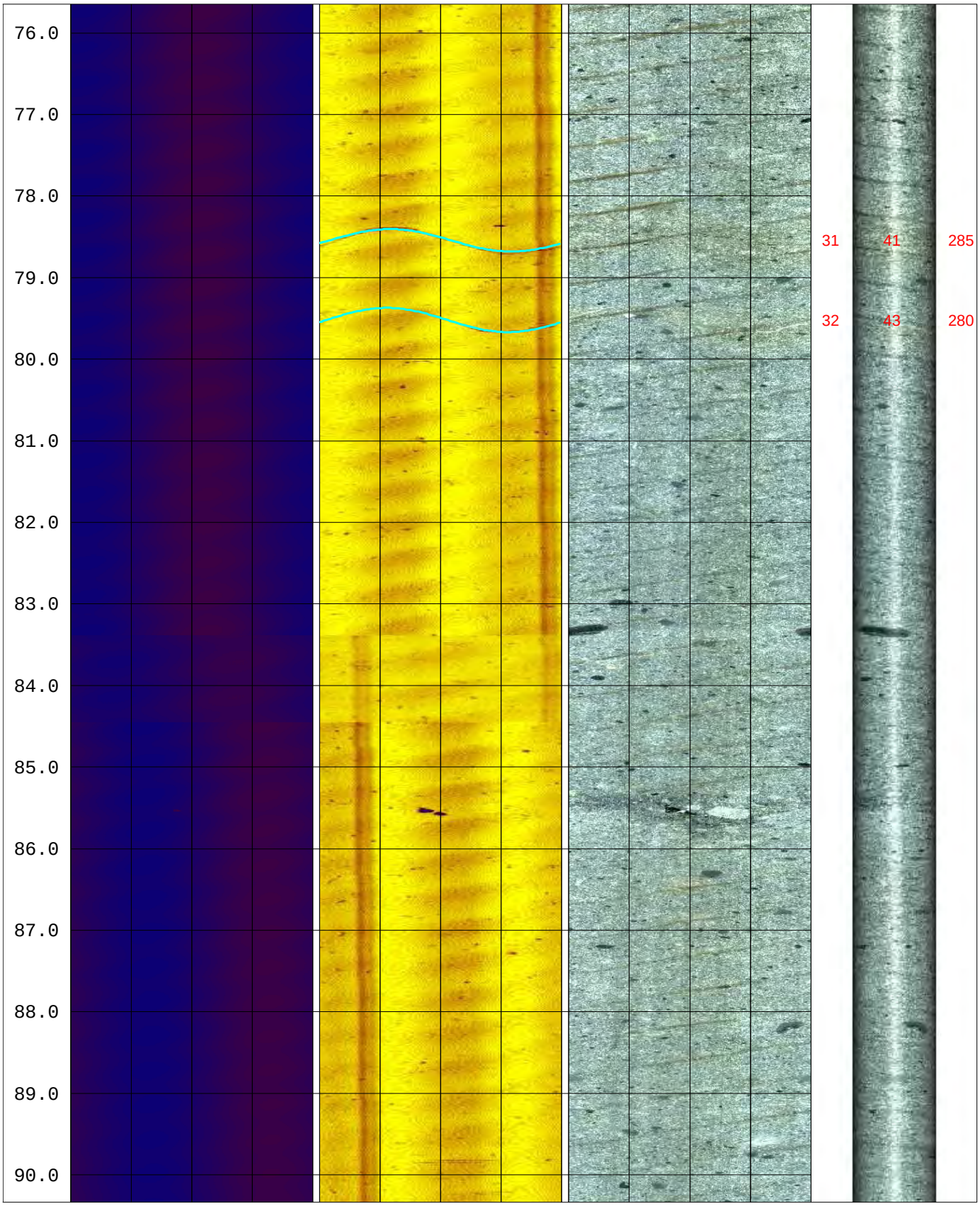


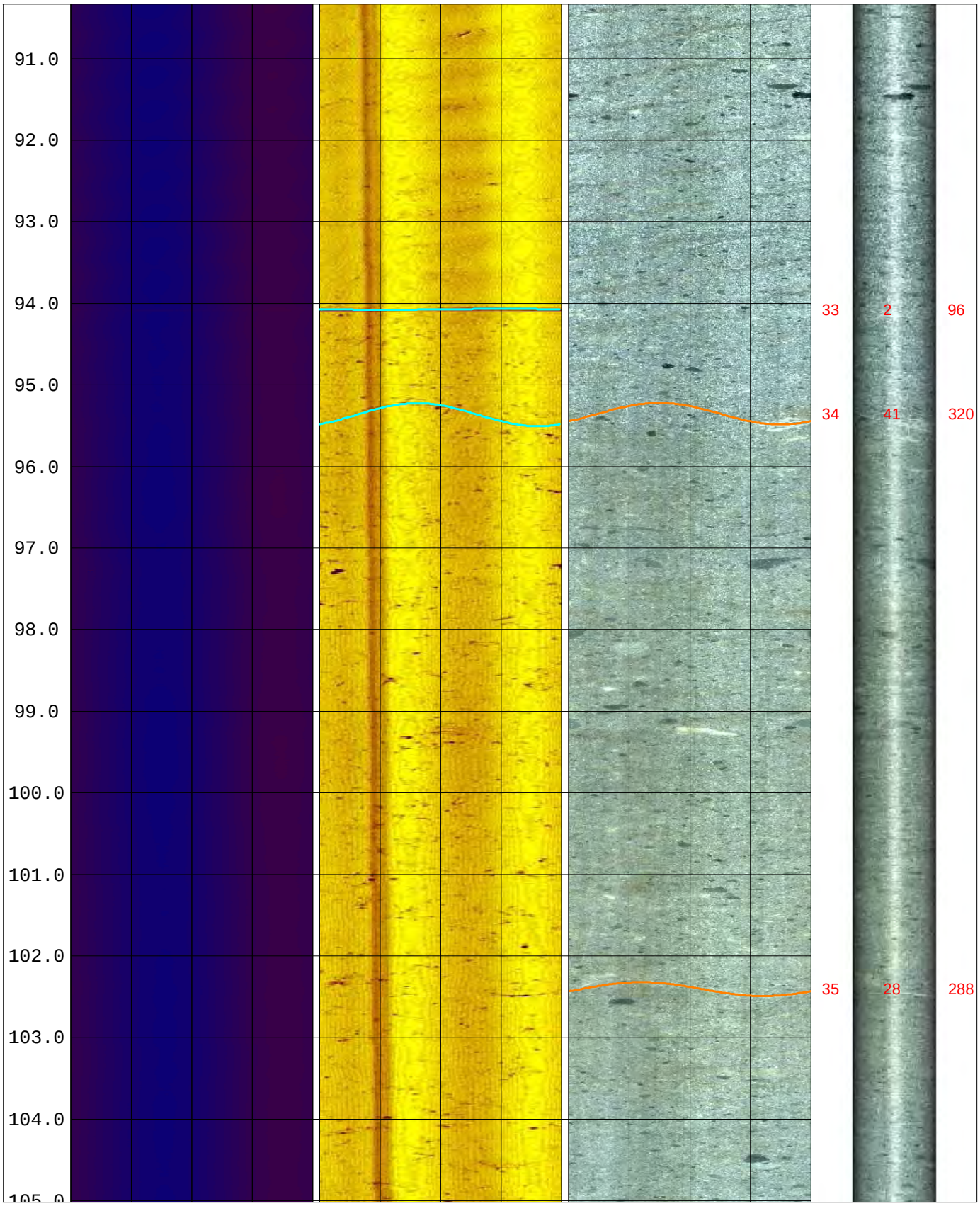

17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
8 45 208
9 48 211
10 46 211
11 31 247
12 57 33

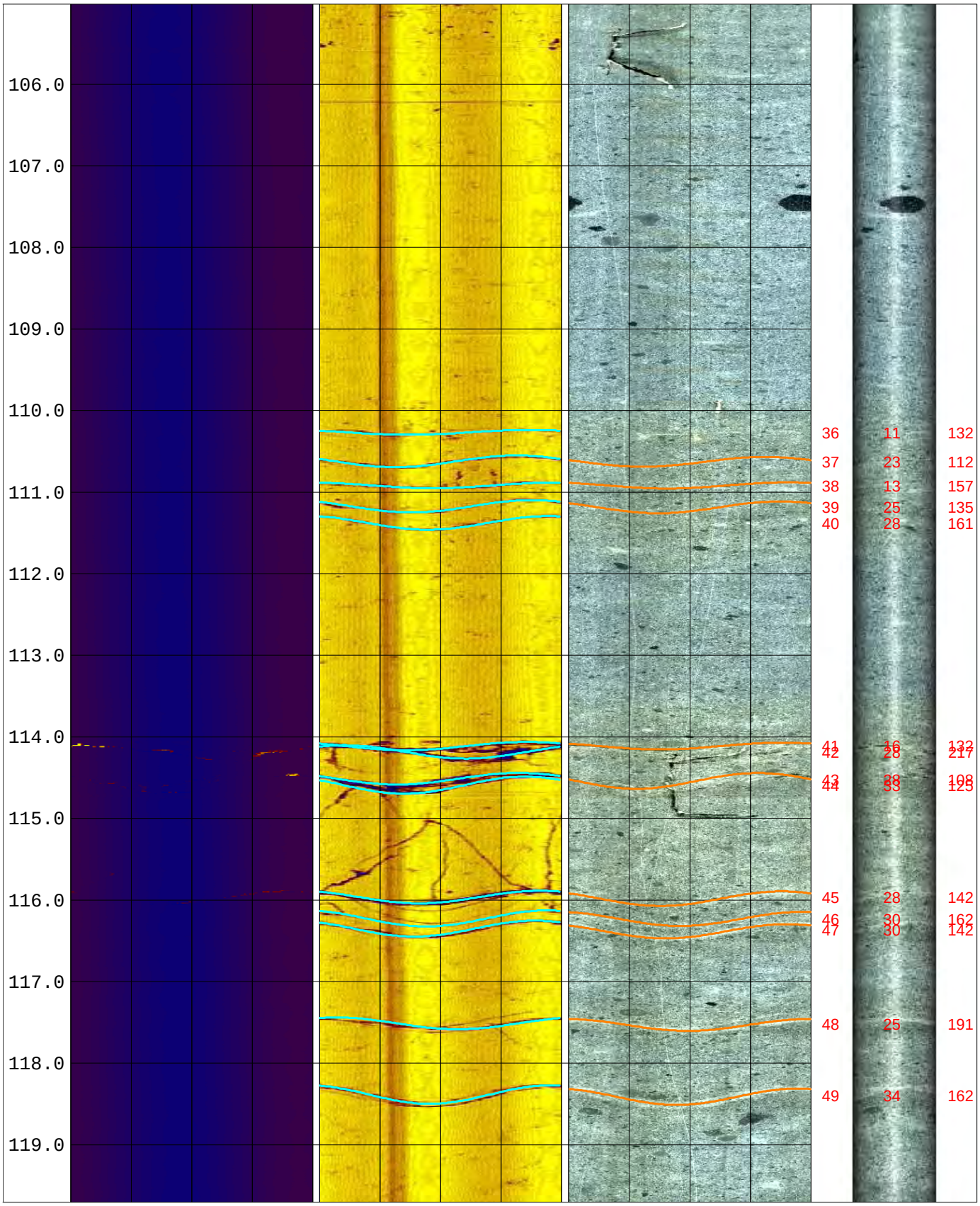

32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
13 59 4
14 70 20
15 76 20
16 75 50
17 68 18

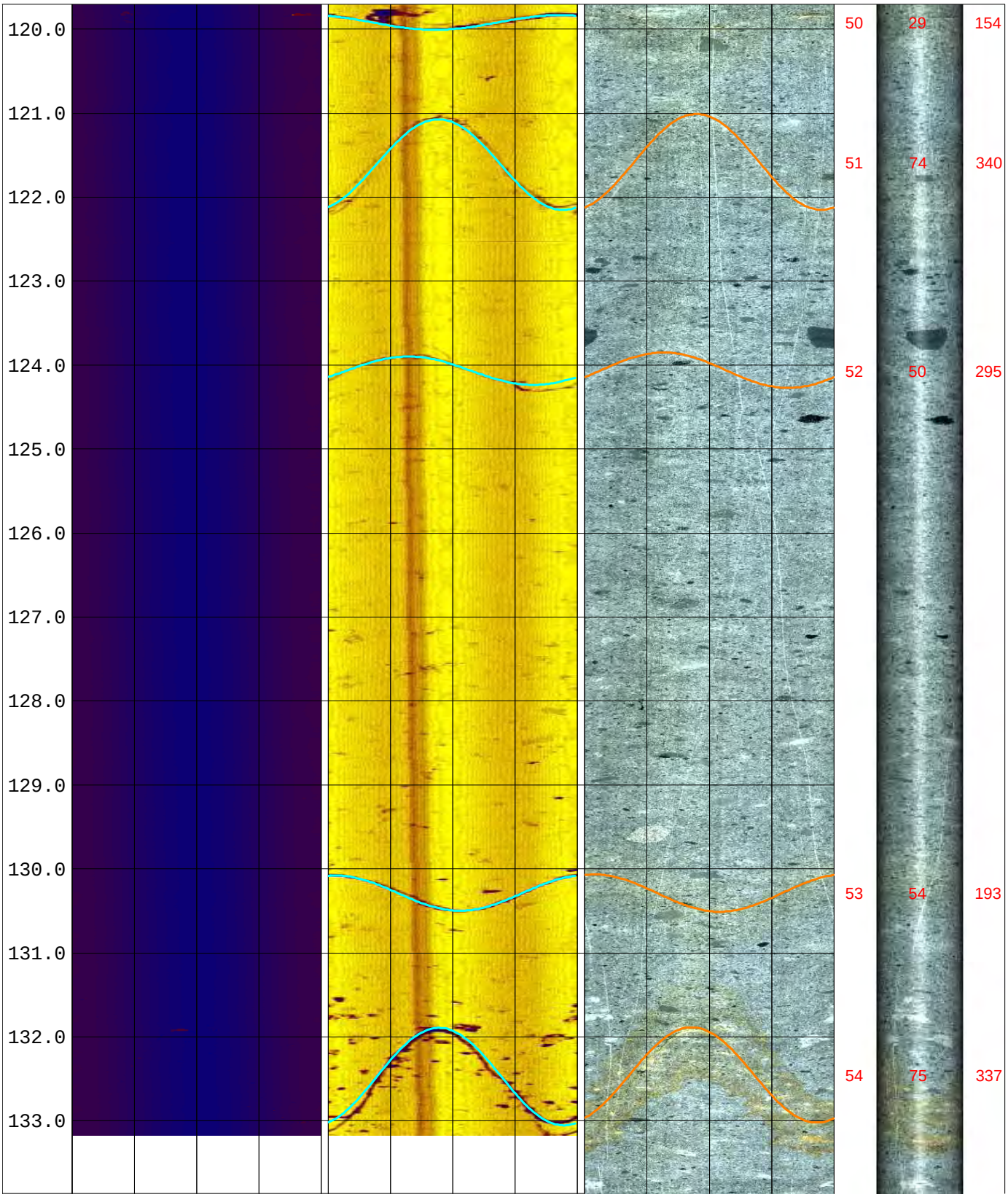

47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
18 27 199
19 57 306
20 60 305
21 28 205
22 70 32
23 65 330
24 67 328


61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
73.0
74.0
75.0
25 38 256
26 33 243
27 86 81
28 68 334
29 74 59
30 31 194


76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
31
41
285
32
43
280


91.0
92.0
93.0
94.0
95.0
96.0
97.0
98.0
99.0
100.0
101.0
102.0
103.0
104.0
33 2 96
34 41 320
35 28 288


106.0
107.0
108.0
109.0
110.0
111.0
112.0
113.0
114.0
115.0
116.0
117.0
118.0
119.0
36 11 132
37 23 112
38 13 157
39 25 135
40 28 161
41 16 132
42 28 217
43 28 108
44 55 125
45 28 142
46 30 162
47 30 142
48 25 191
49 34 162

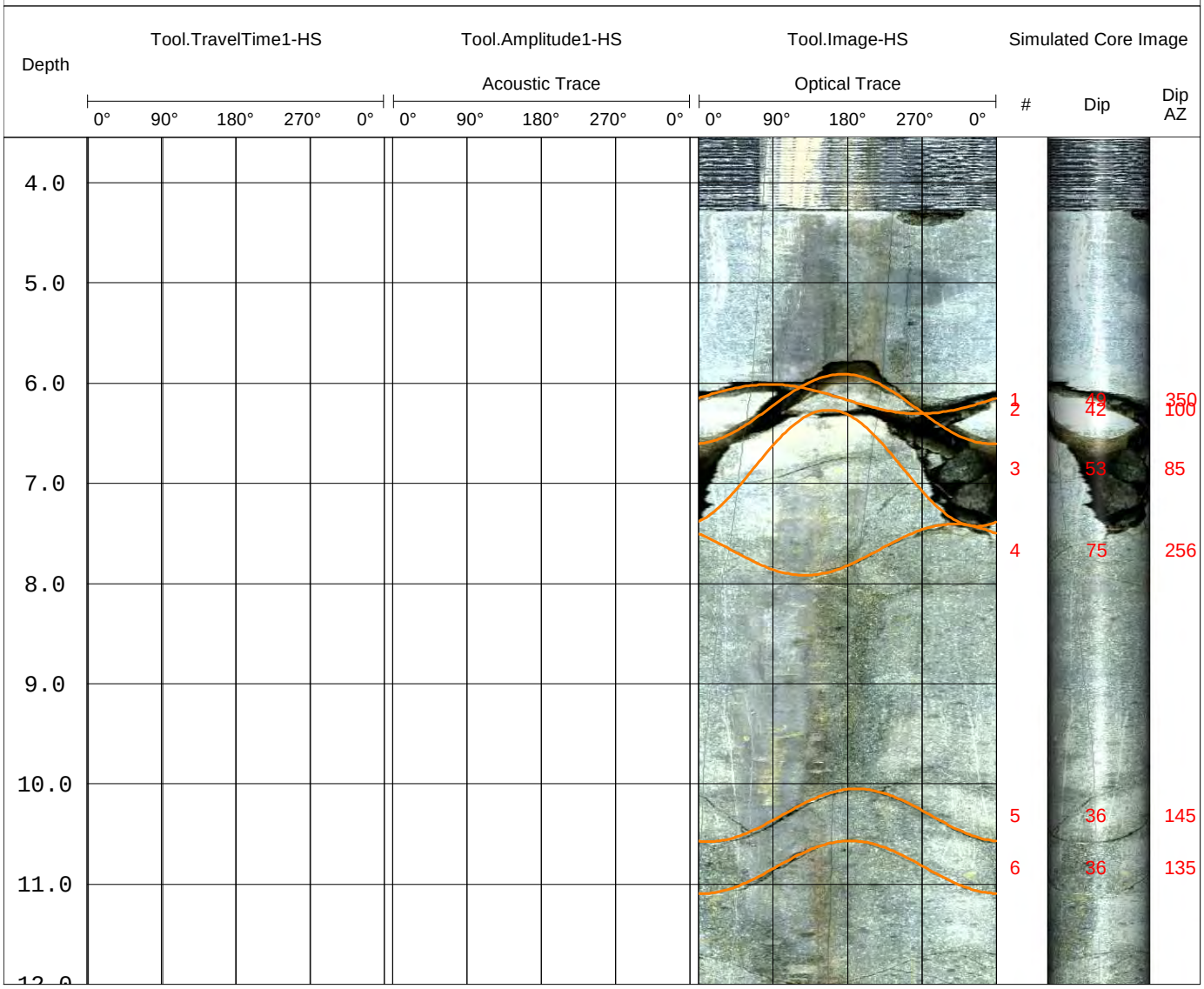

120.0
121.0
122.0
123.0
124.0
125.0
126.0
127.0
128.0
129.0
130.0
131.0
132.0
133.0
50 29 154
51 74 340
52 50 295
53 54 193
54 75 337

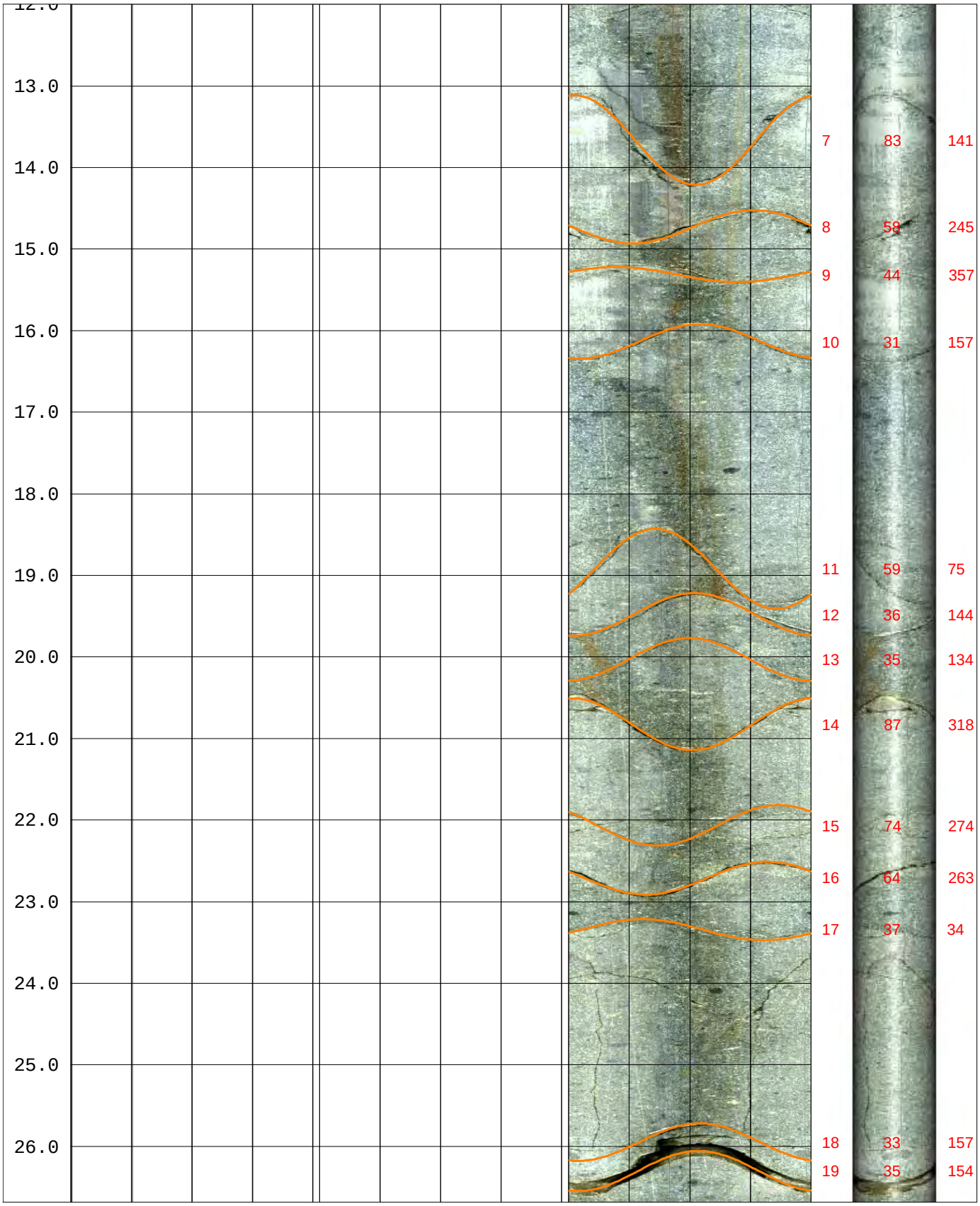
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

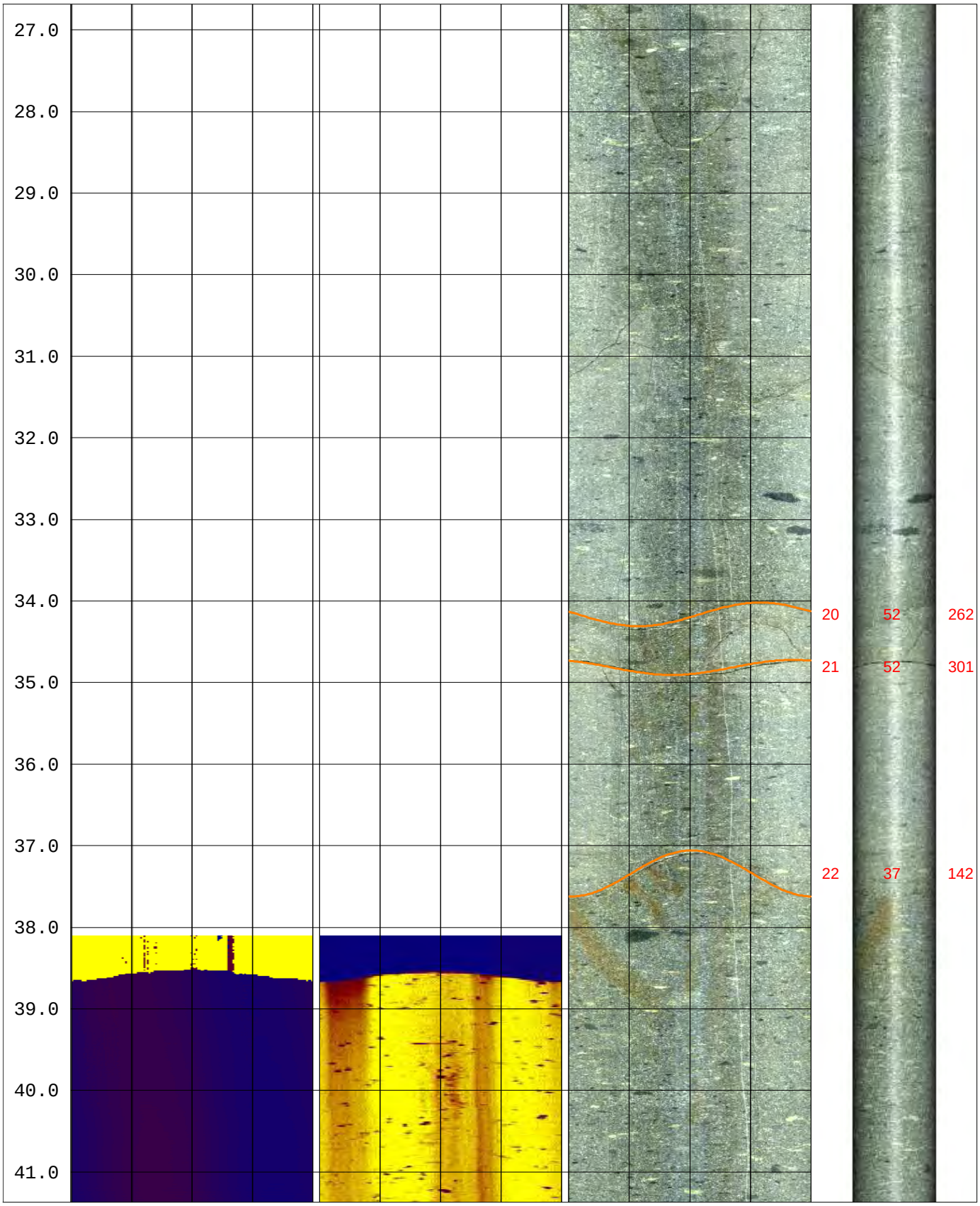
Date Logged:	September 21, 2007	Borehole ID:	RKS-31-07
File Name:	RKS3107-1HS.wcl	Logged By:	F G Kruger

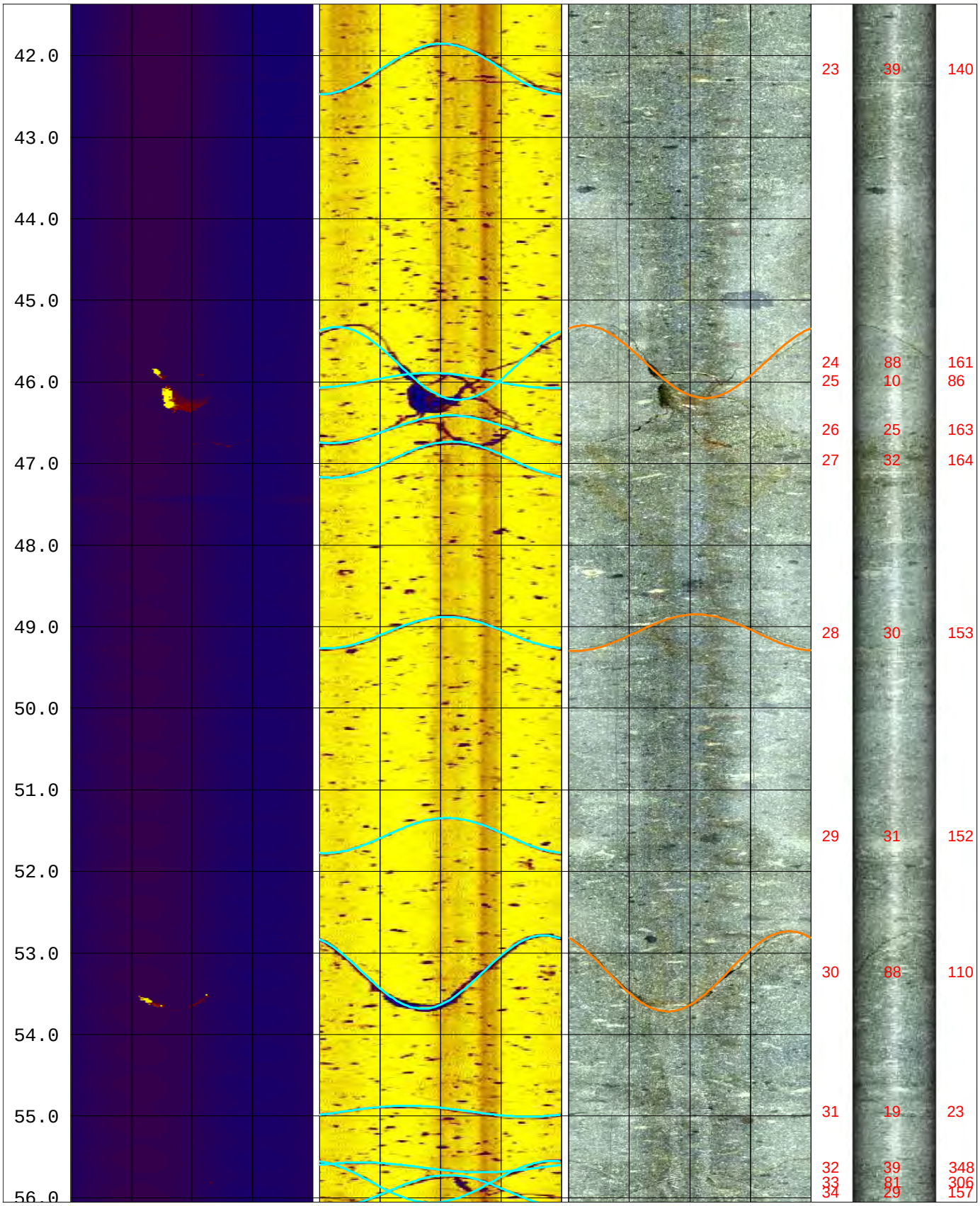
Notes:

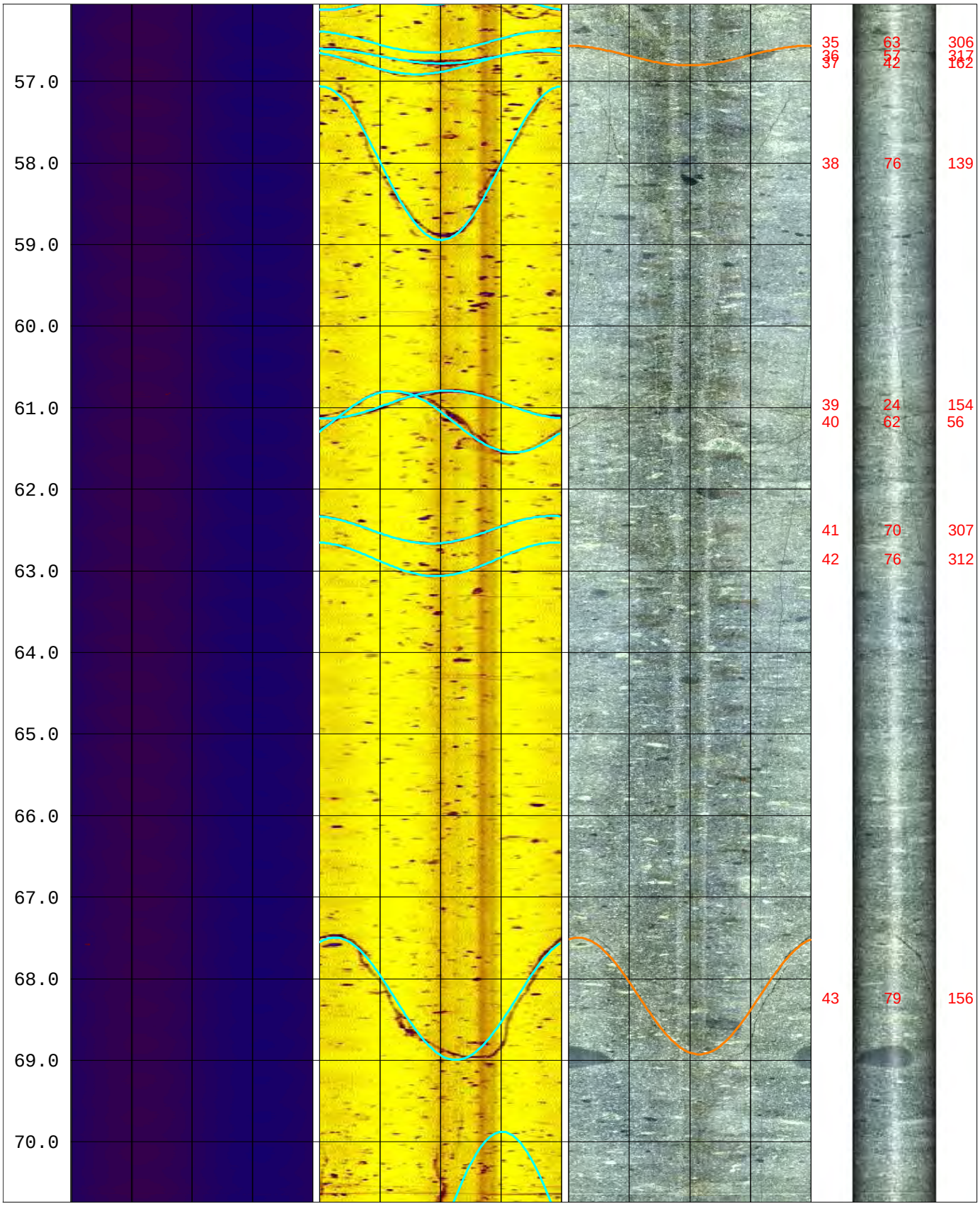
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.
6) Median orientation of borehole is Dip of 66.4 degrees, Dip AZ is 137.1 degrees.

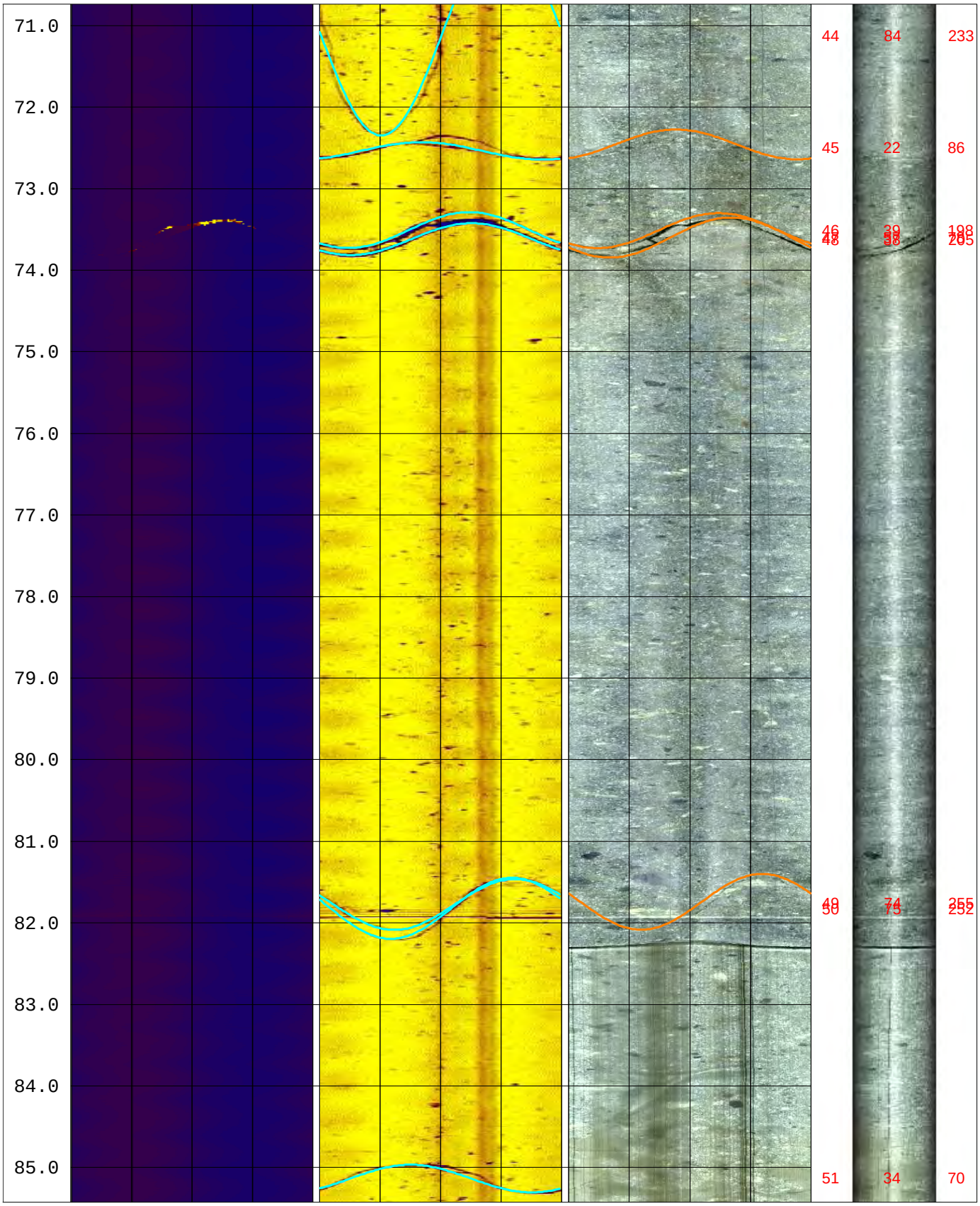


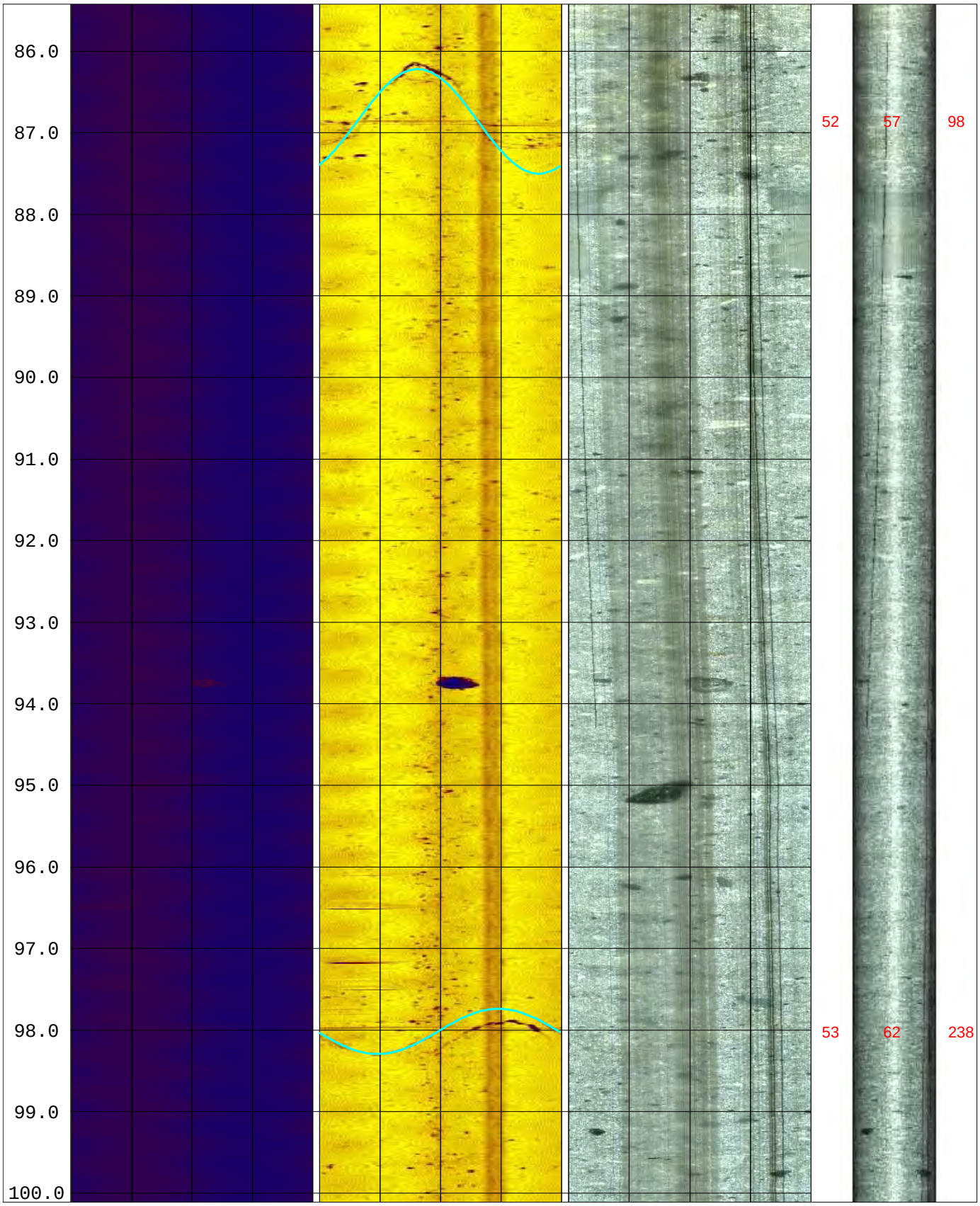

12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
7 83 141
8 58 245
9 44 357
10 31 157
11 59 75
12 36 144
13 35 134
14 87 318
15 74 274
16 64 263
17 37 34
18 33 157
19 35 154

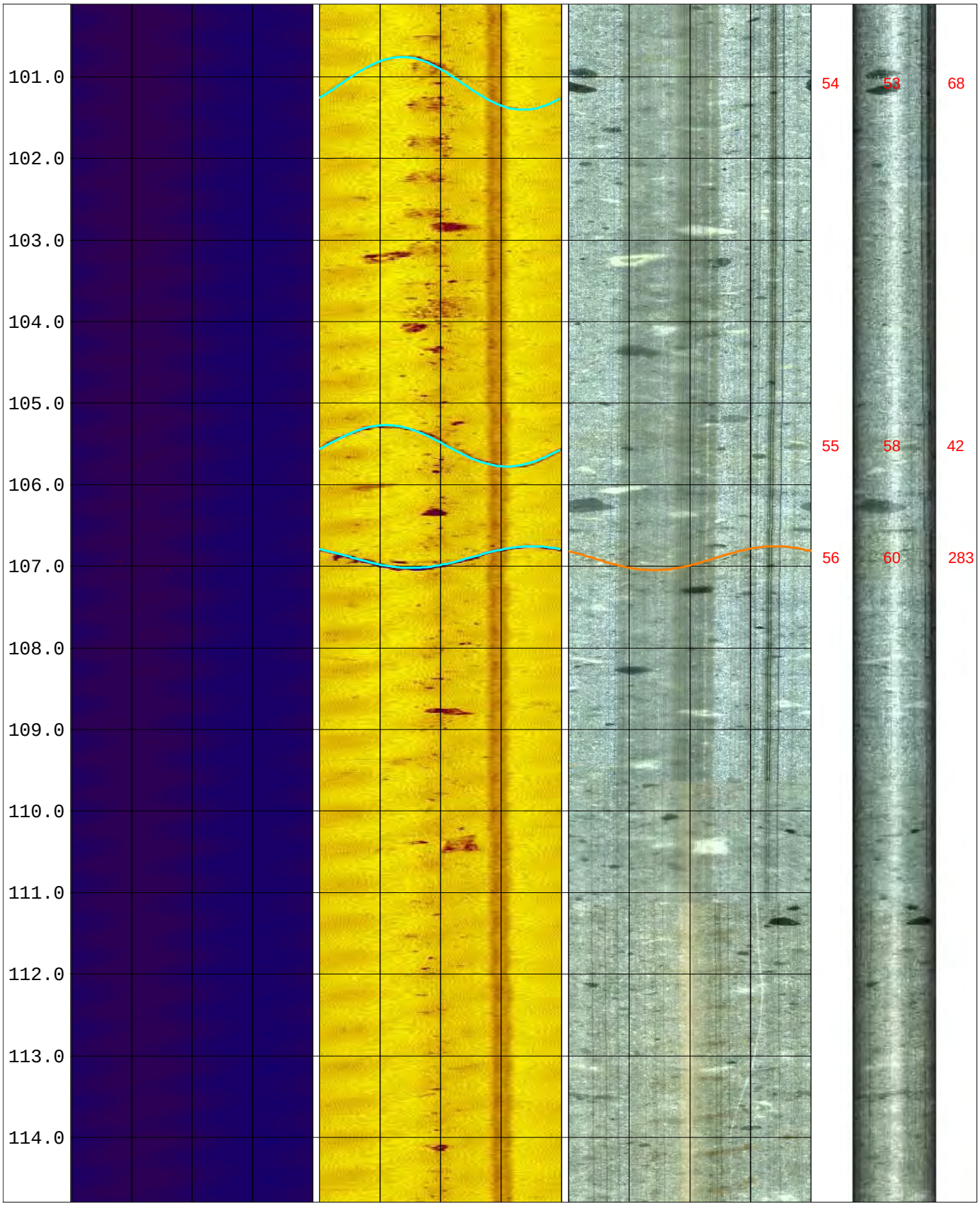

27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
20 52 262
21 52 301
22 37 142

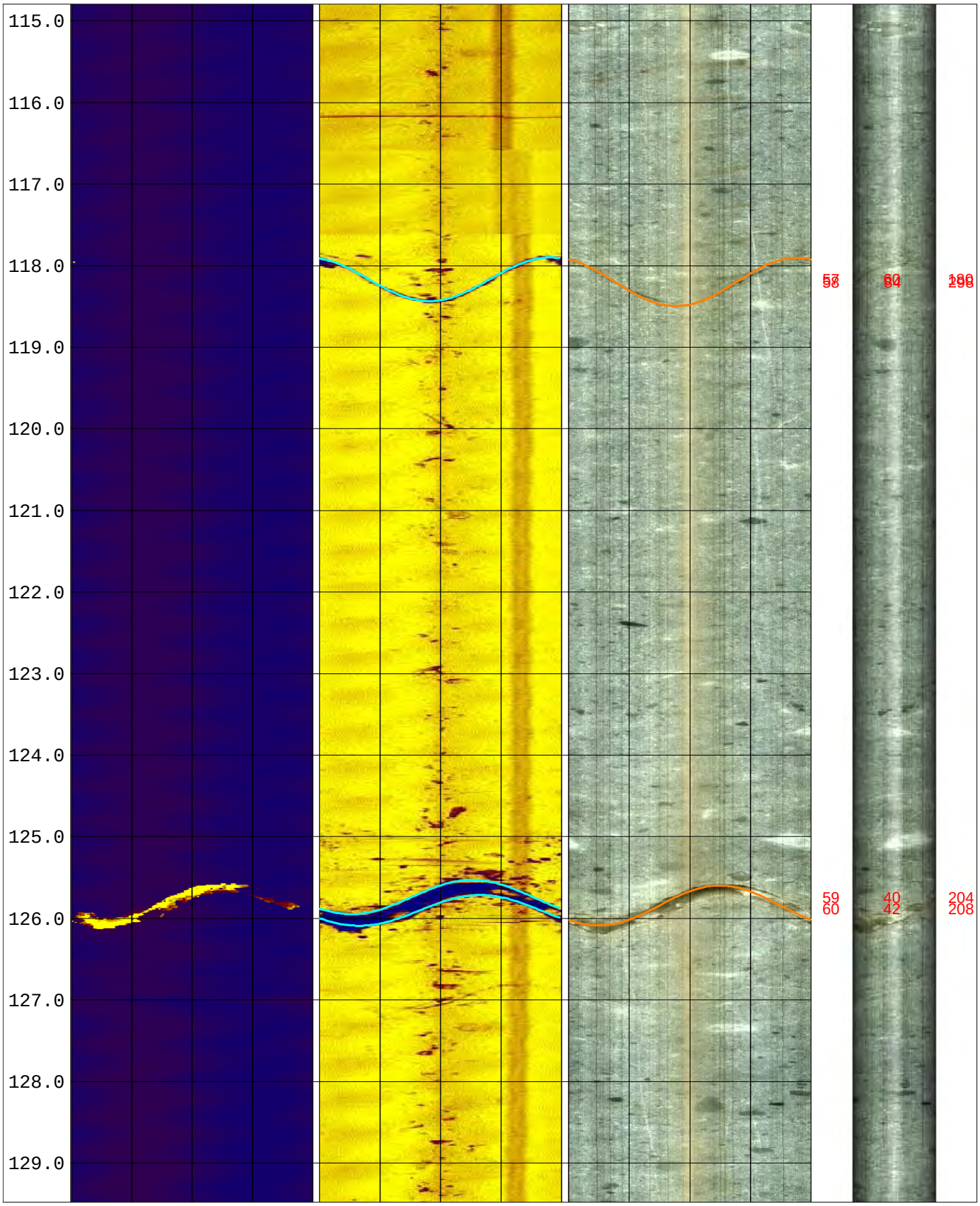

42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
23 39 140
24 88 161
25 10 86
26 25 163
27 32 164
28 30 153
29 31 152
30 88 110
31 19 23
32 39 348
33 81 306
34 29 157

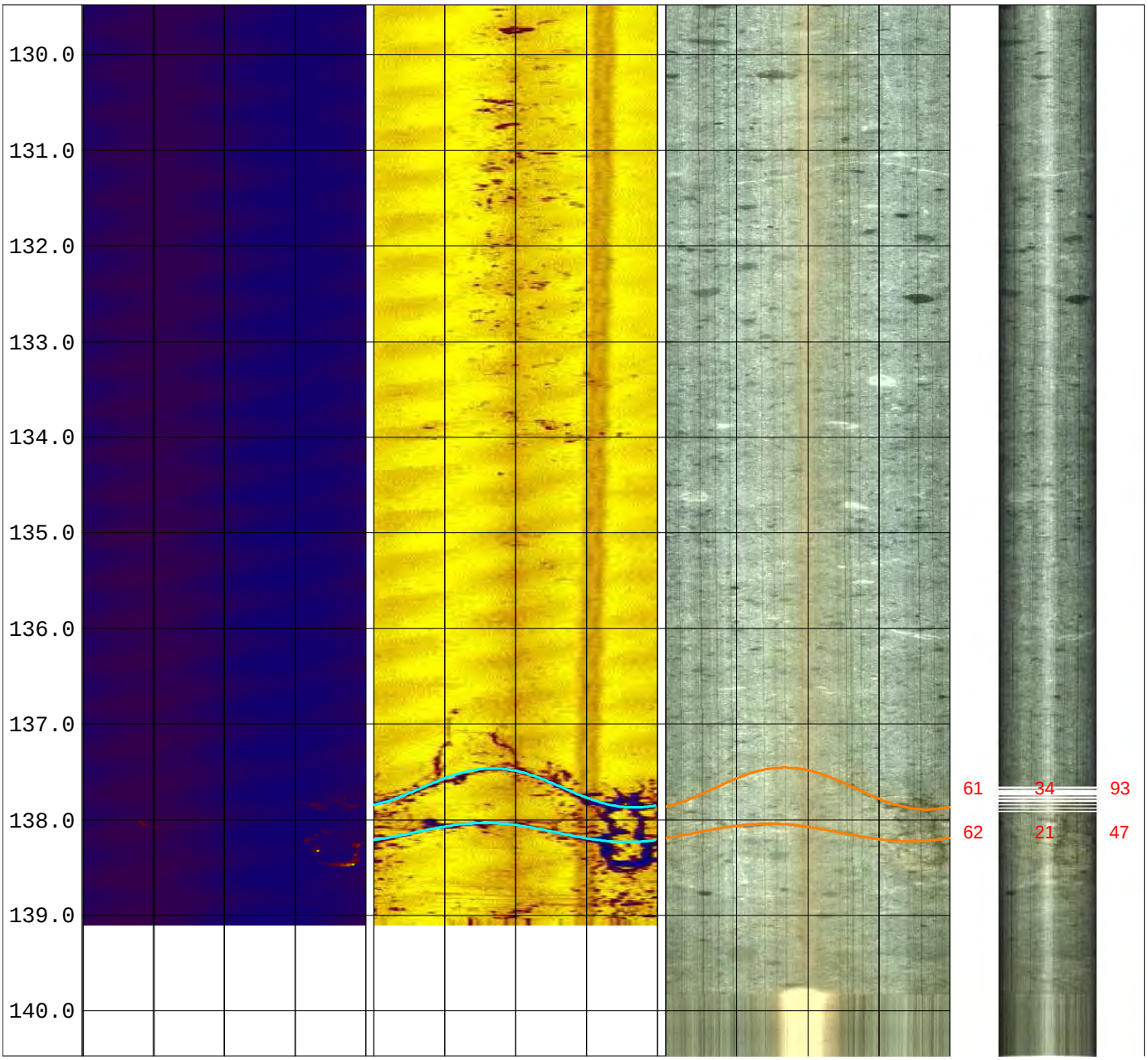

57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
35 63 306
36 57 317
37 42 162
38 76 139
39 24 154
40 62 56
41 70 307
42 76 312
43 79 156


71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
44
84
233
45
22
86
46
29
198
48
38
205
49
74
255
50
75
252
51
34
70


86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
96.0
97.0
98.0
99.0
100.0
52
57
98
53
62
238


101.0
102.0
103.0
104.0
105.0
106.0
107.0
108.0
109.0
110.0
111.0
112.0
113.0
114.0
54
53
68
55
58
42
56
60
283


115.0
116.0
117.0
118.0
119.0
120.0
121.0
122.0
123.0
124.0
125.0
126.0
127.0
128.0
129.0
57
58
60
64
196
200
59
60
40
42
204
208

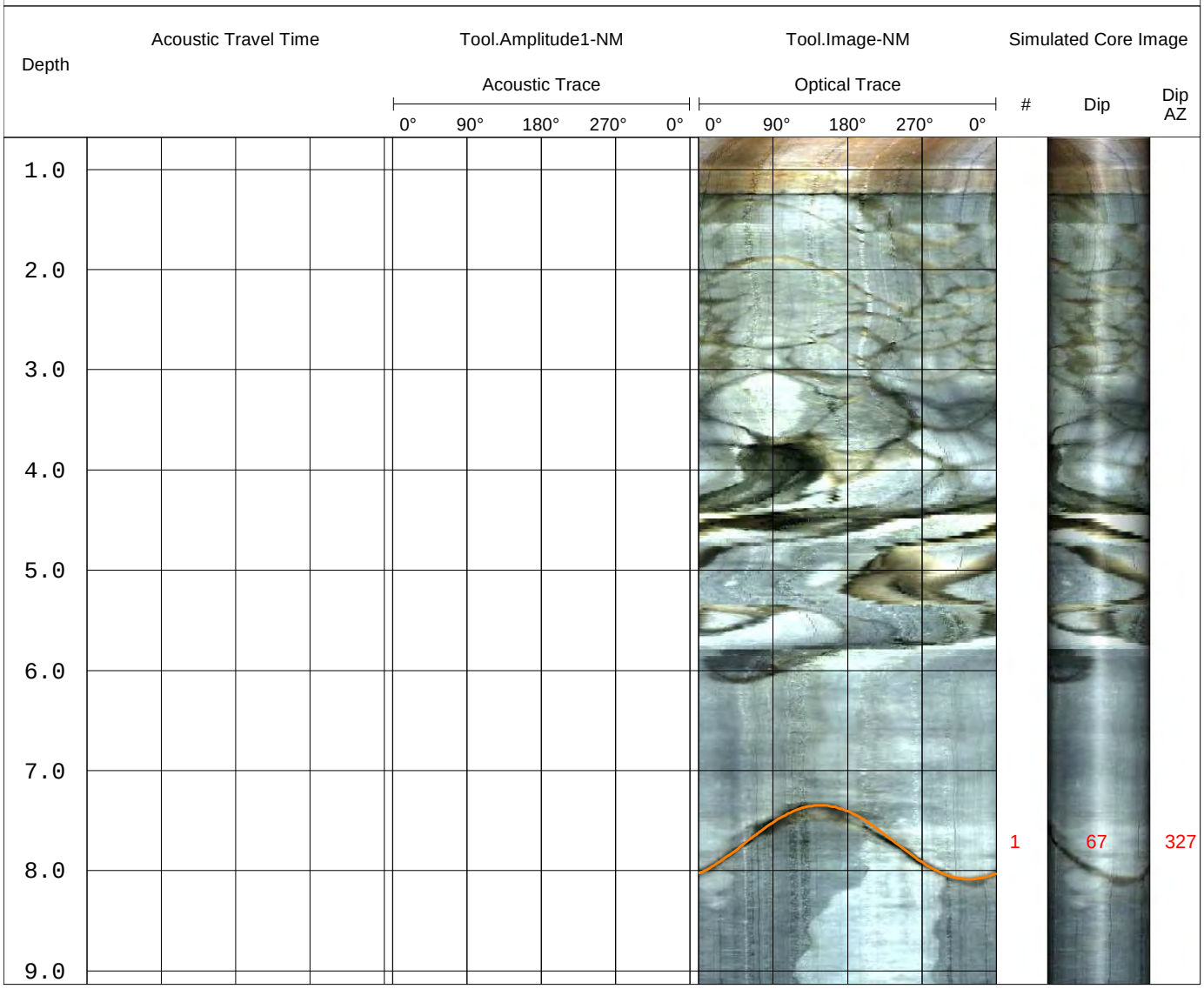

130.0
131.0
132.0
133.0
134.0
135.0
136.0
137.0
138.0
139.0
140.0
61
34
93
62
21
47

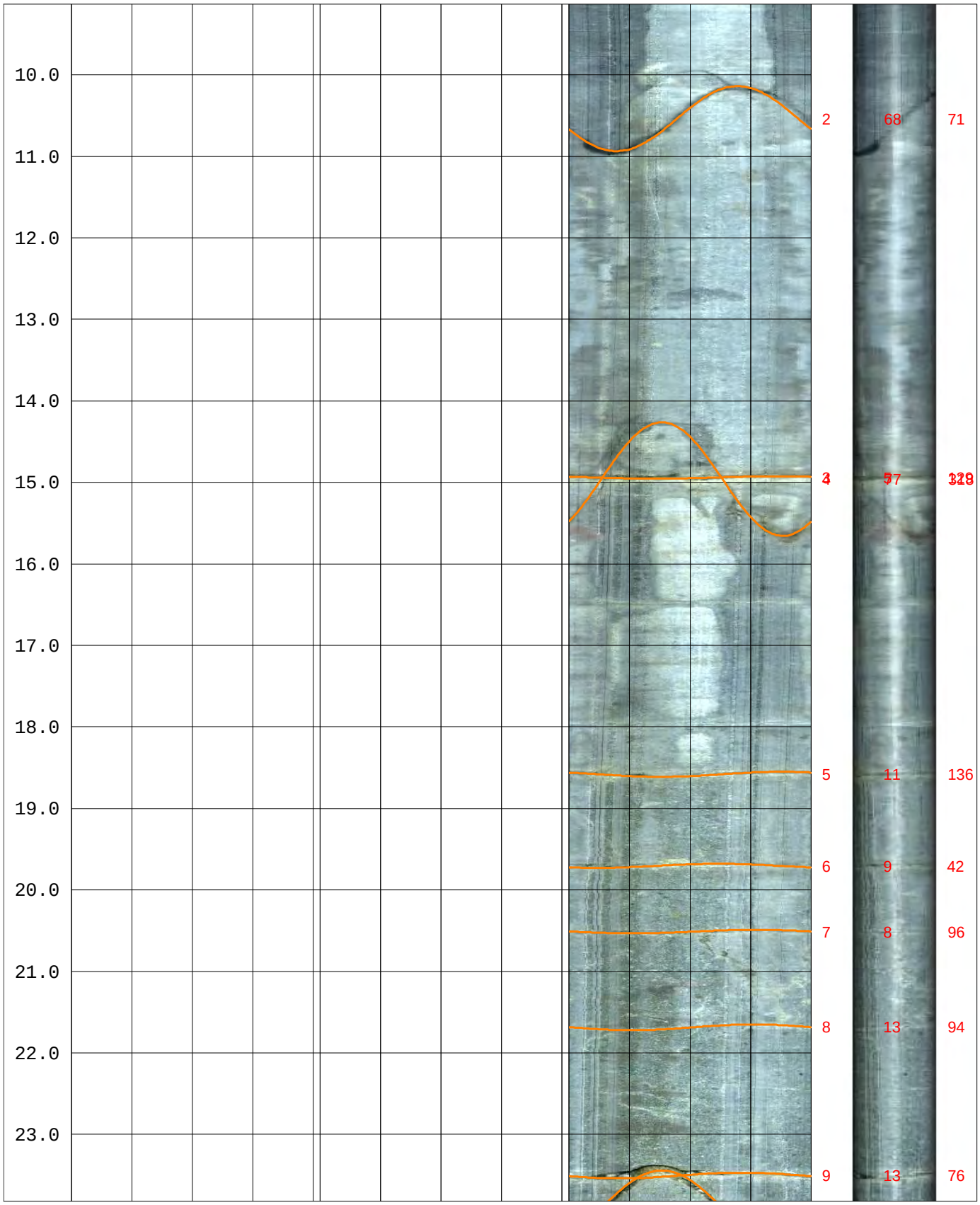
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

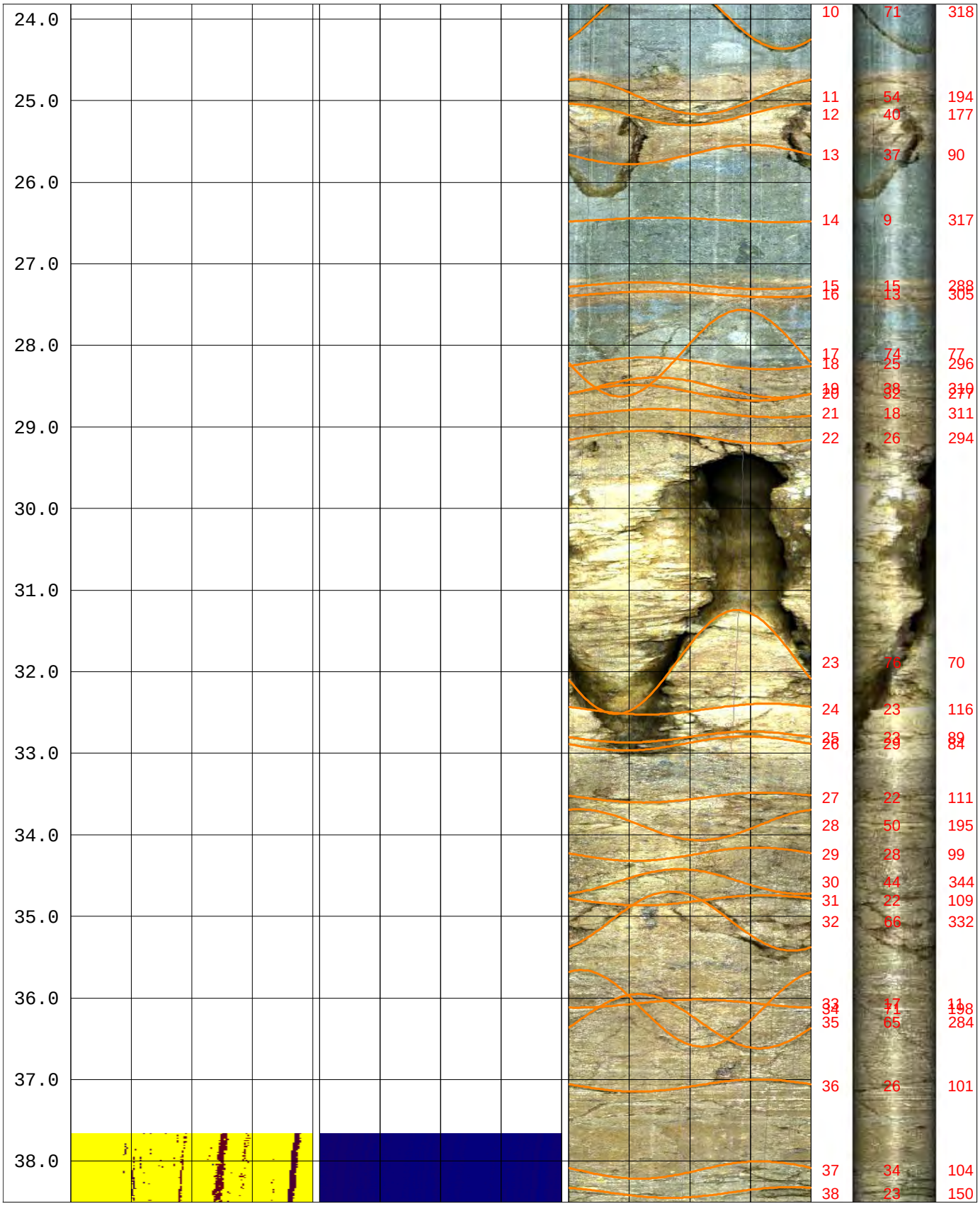
Date Logged:	September 27, 2007	Borehole ID:	SI-01-07
File Name:	SI0107-2M.wcl	Logged By:	F G Kruger

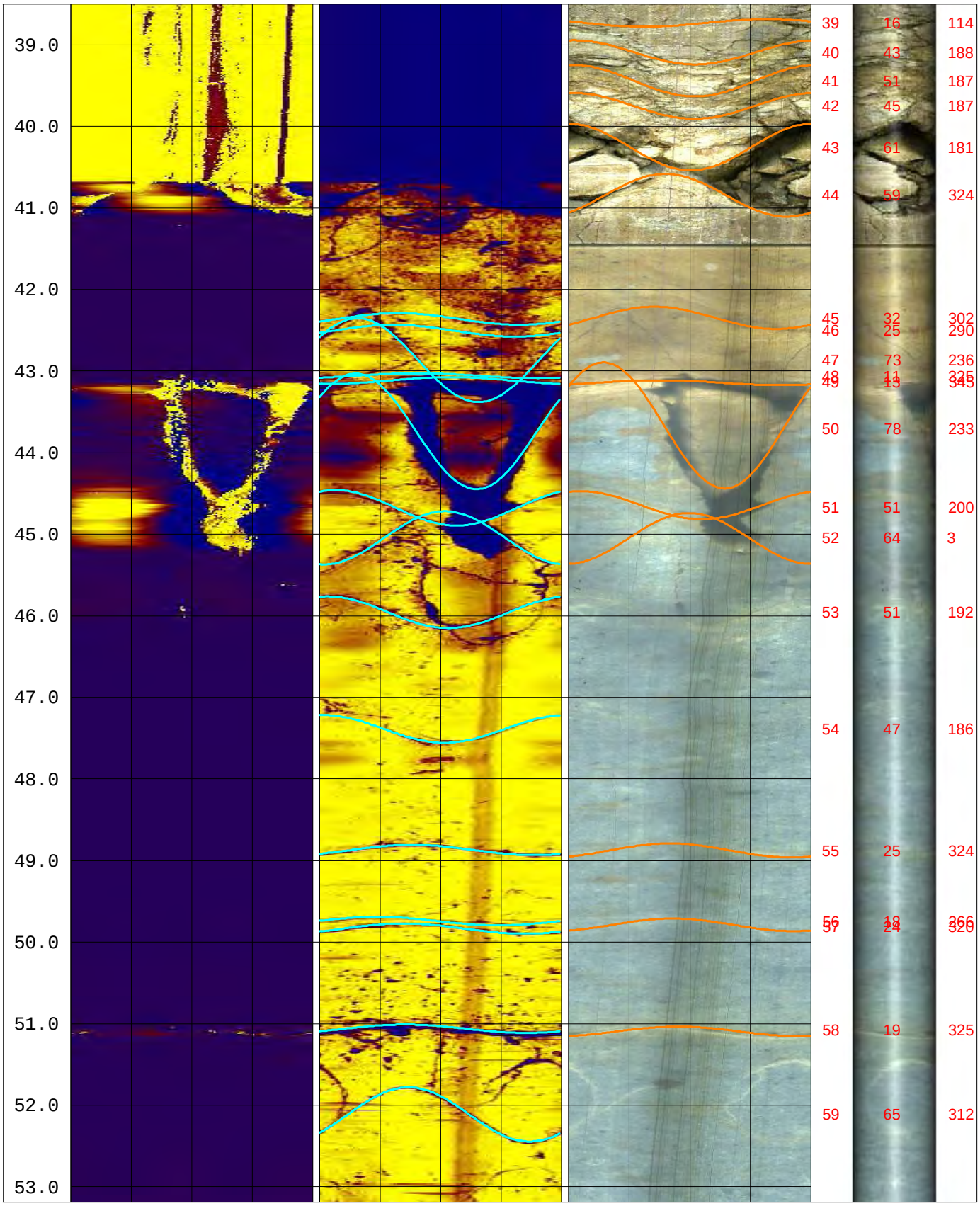
Notes:

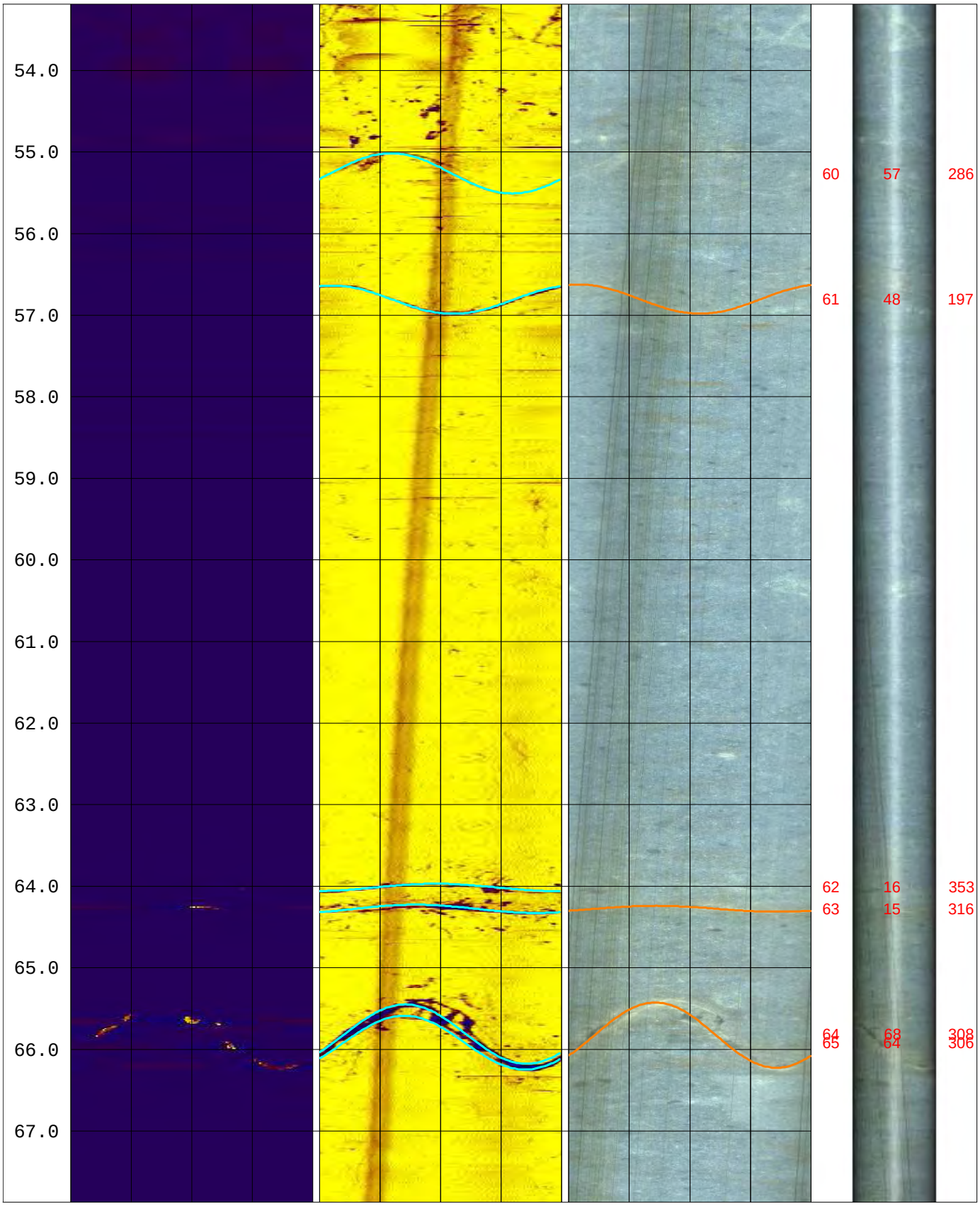
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

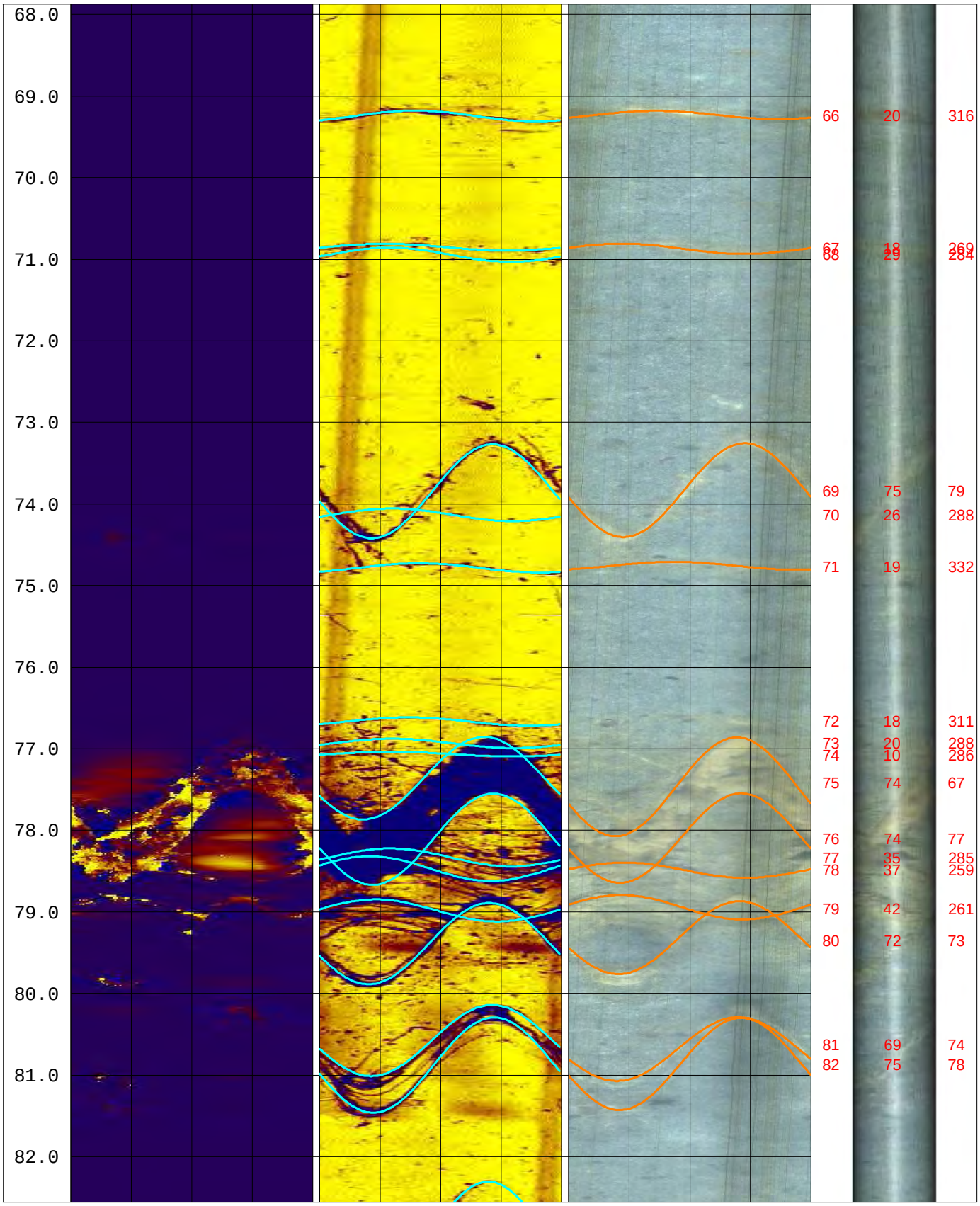


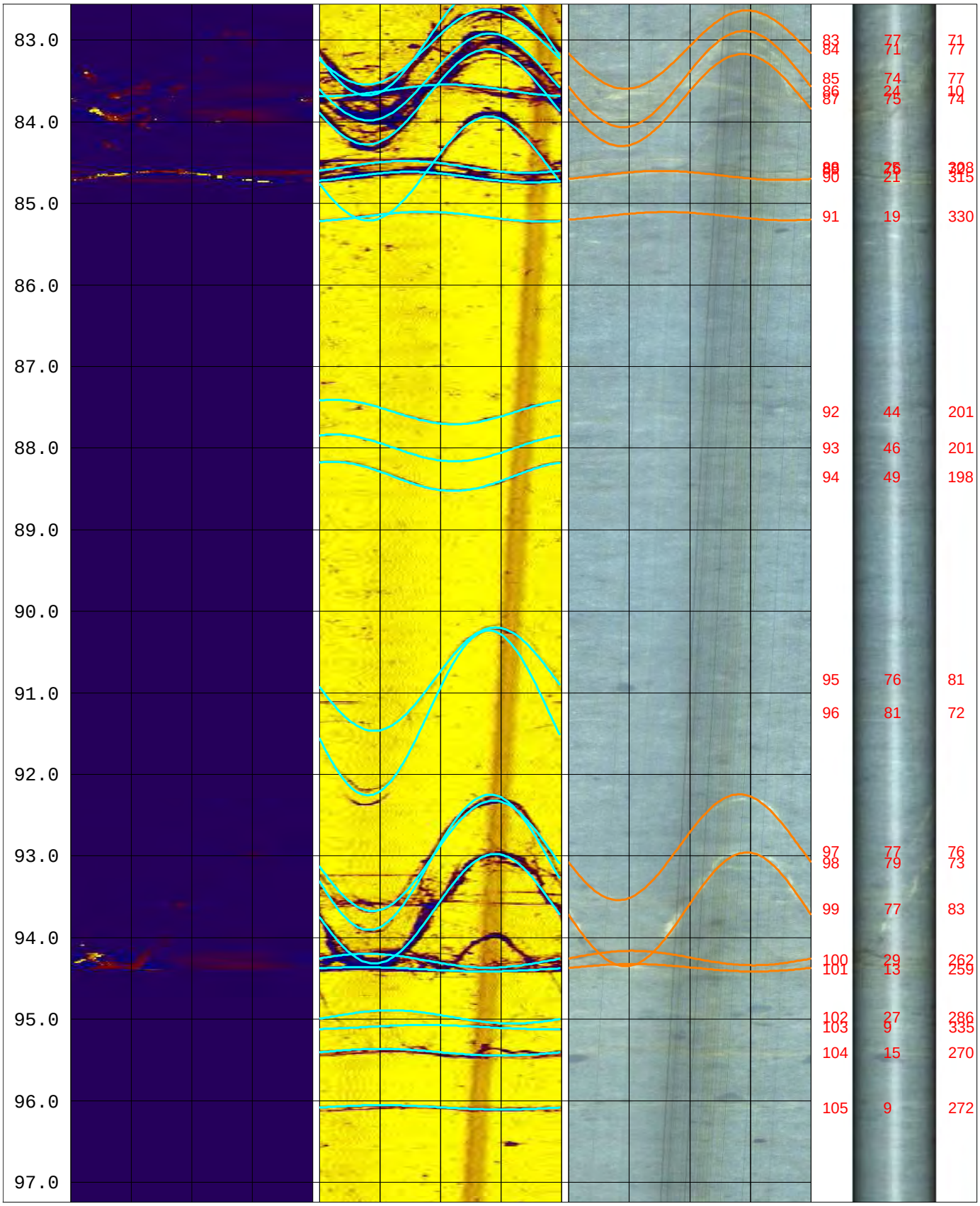

10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
2
68
71
3
57
4
5
11
136
6
9
42
7
8
96
8
13
94
9
13
76

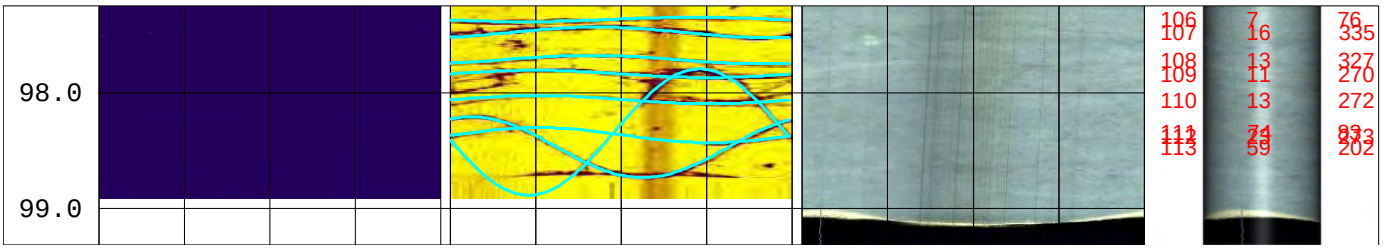

24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
10 71 318
11 54 194
12 40 177
13 37 90
14 9 317
15 15 288
16 13 305
17 74 77
18 25 296
19 38 310
20 32 277
21 18 311
22 26 294
23 76 70
24 23 116
25 23 89
26 29 84
27 22 111
28 50 195
29 28 99
30 44 344
31 22 109
32 66 332
33 17 11
34 71 198
35 65 284
36 26 101
37 34 104
38 23 150


39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
39 16 114
40 43 188
41 51 187
42 45 187
43 61 181
44 59 324
45 32 302
46 25 290
47 73 236
48 11 325
49 13 345
50 78 233
51 51 200
52 64 3
53 51 192
54 47 186
55 25 324
56 18 366
57 24 320
58 19 325
59 65 312


54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
60 57 286
61 48 197
62 16 353
63 15 316
64 68 308
65 64 306


68.0
69.0
70.0
71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
66 20 316
67 18 269
68 29 284
69 75 79
70 26 288
71 19 332
72 18 311
73 20 288
74 10 286
75 74 67
76 74 77
77 35 285
78 37 259
79 42 261
80 72 73
81 69 74
82 75 78


83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
96.0
97.0
83 77 71
84 71 77
85 74 77
86 24 10
87 75 74
88 25 308
89 42 326
90 21 315
91 19 330
92 44 201
93 46 201
94 49 198
95 76 81
96 81 72
97 77 76
98 79 73
99 77 83
100 29 262
101 13 259
102 27 286
103 6 335
104 15 270
105 9 272

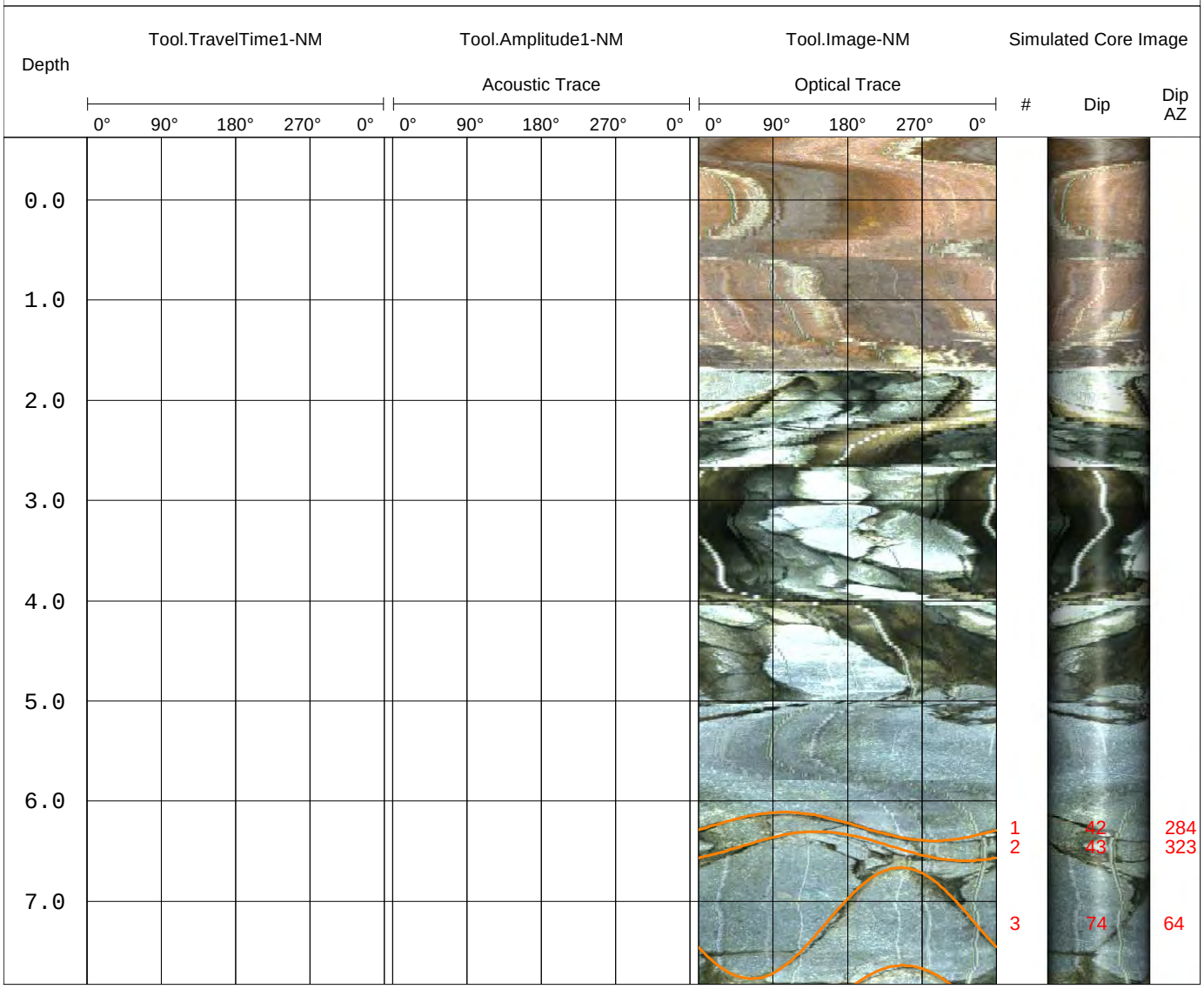

98.0
99.0
106
107
108
109
110
113
7
16
13
11
13
59
76
335
327
270
272
202

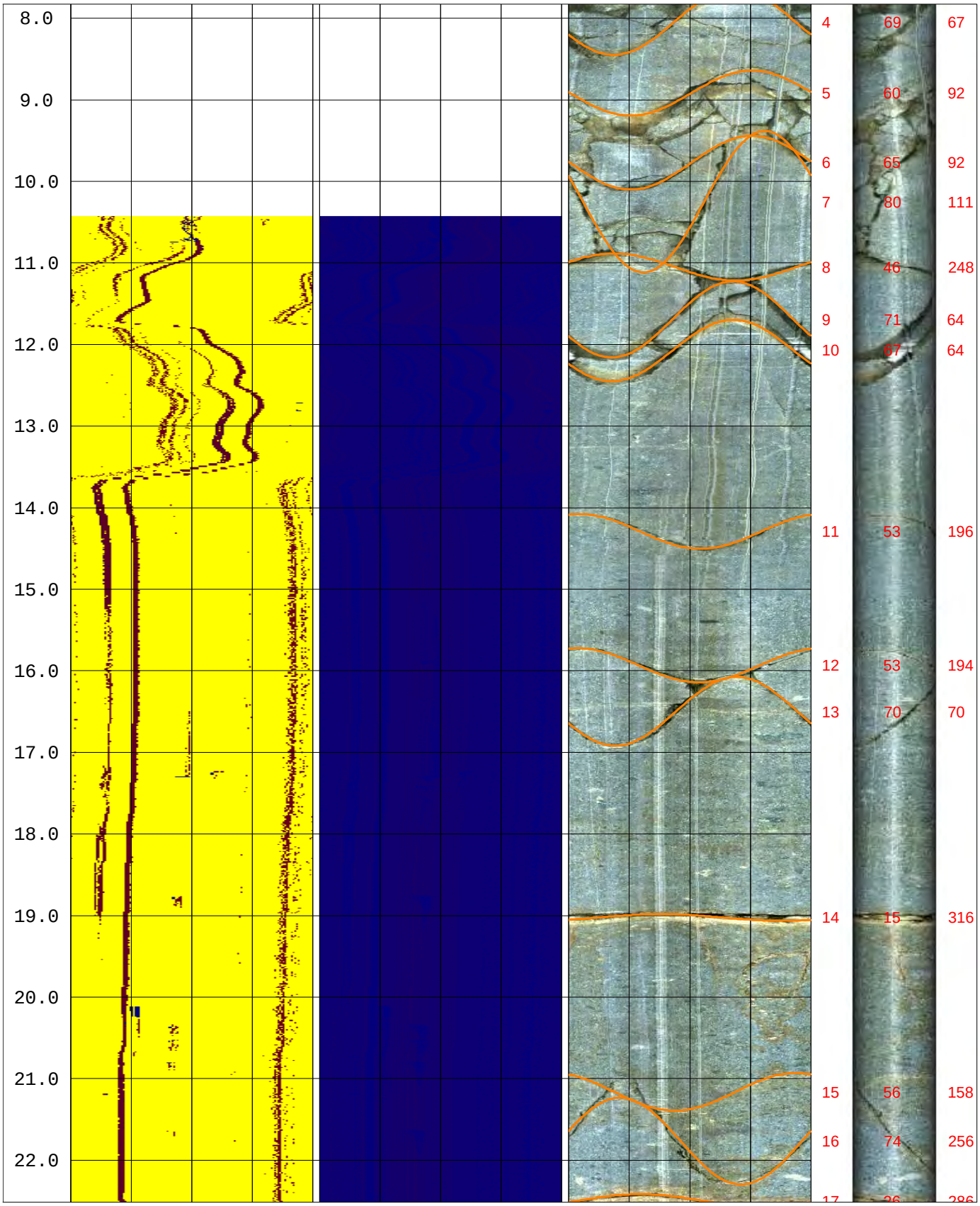
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

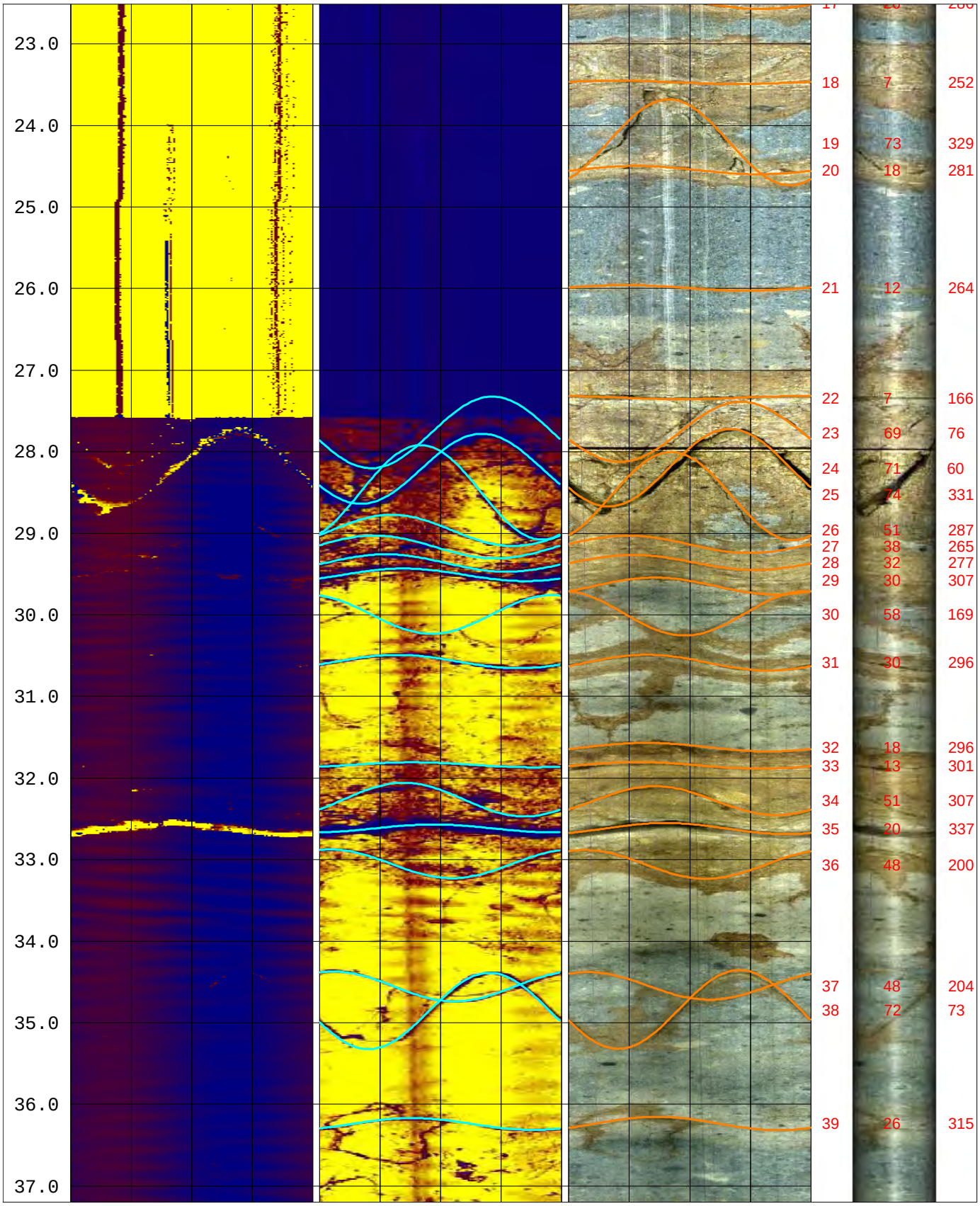
Date Logged:	October 4, 2007	Borehole ID:	SI-02-07
File Name:	SI0207-2M.wcl	Logged By:	F G Kruger

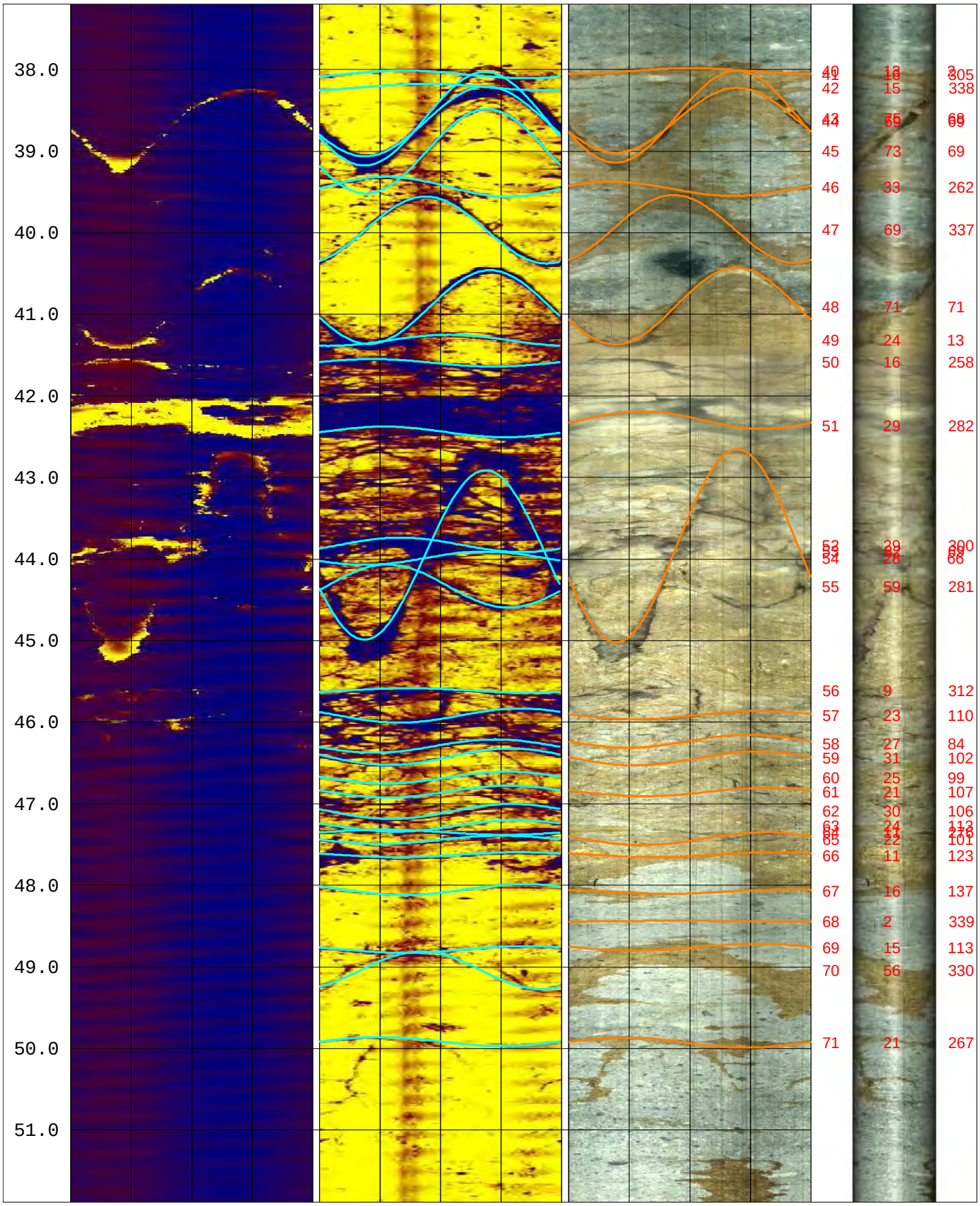
Notes:

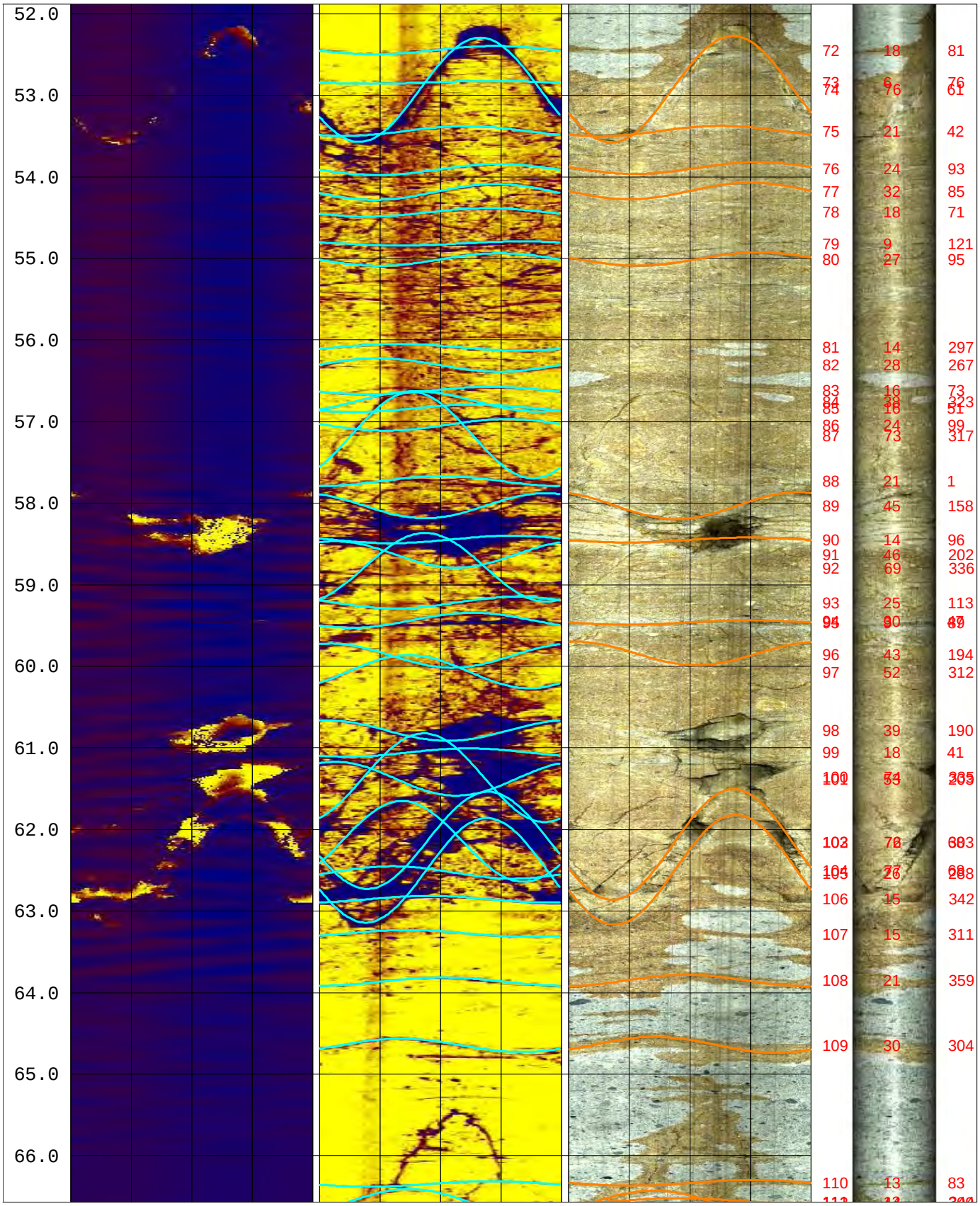
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

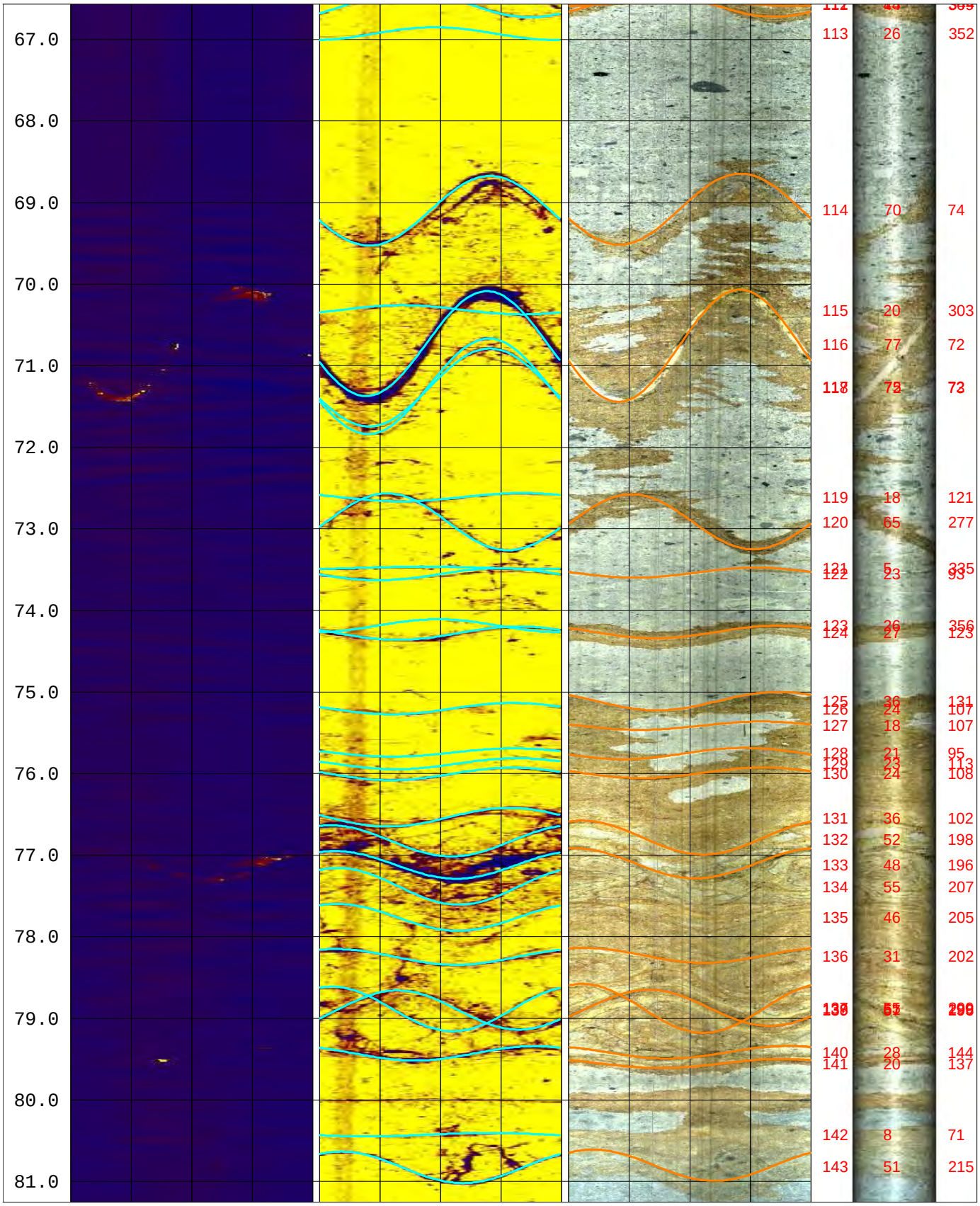


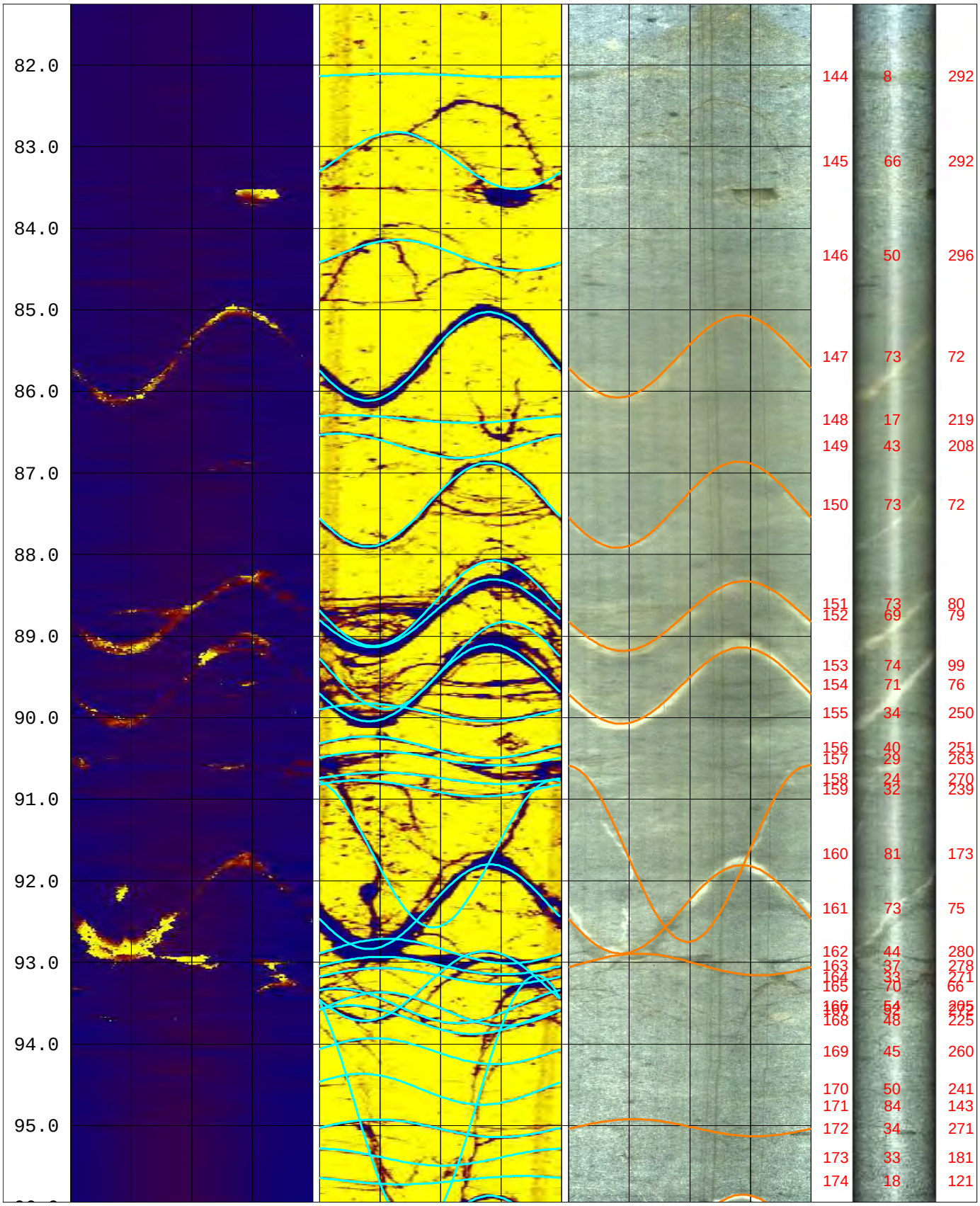

8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
4 69 67
5 60 92
6 65 92
7 80 111
8 46 248
9 71 64
10 67 64
11 53 196
12 53 194
13 70 70
14 15 316
15 56 158
16 74 256

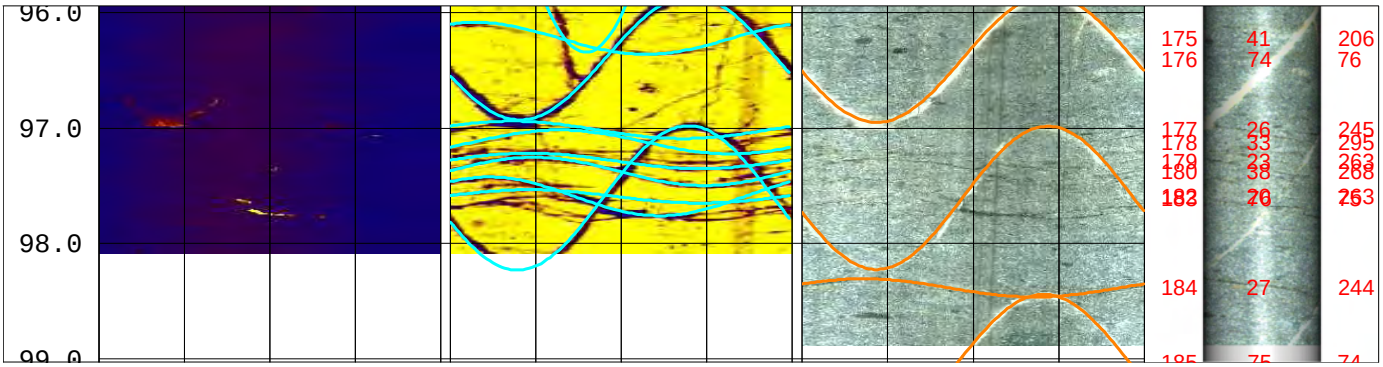

23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
18 7 252
19 73 329
20 18 281
21 12 264
22 7 166
23 69 76
24 71 60
25 74 331
26 51 287
27 38 265
28 32 277
29 30 307
30 58 169
31 30 296
32 18 296
33 13 301
34 51 307
35 20 337
36 48 200
37 48 204
38 72 73
39 26 315


38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
40 13 3
41 16 305
42 15 338
43 75 68
44 65 69
45 73 69
46 33 262
47 69 337
48 71 71
49 24 13
50 16 258
51 29 282
52 29 200
53 29 69
54 28 66
55 59 281
56 9 312
57 23 110
58 27 84
59 31 102
60 25 99
61 21 107
62 30 106
63 24 113
64 22 106
65 22 101
66 11 123
67 16 137
68 2 339
69 15 113
70 56 330
71 21 267


52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
72 18 81
73 6 76
74 76 61
75 21 42
76 24 93
77 32 85
78 18 71
79 9 121
80 27 95
81 14 297
82 28 267
83 16 73
84 38 323
85 18 51
86 24 99
87 73 317
88 21 1
89 45 158
90 14 96
91 46 202
92 69 336
93 25 113
94 30 47
95 69
96 43 194
97 52 312
98 39 190
99 18 41
100 74 305
101 53 203
102 78 603
103 68
104 77 68
105 26 288
106 15 342
107 15 311
108 21 359
109 30 304
110 13 83
111 13 344


67.0
68.0
69.0
70.0
71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
80.0
81.0
113 26 352
114 70 74
115 20 303
116 77 72
119 18 121
120 65 277
127 18 107
128 21 95
130 24 108
131 36 102
132 52 198
133 48 196
134 55 207
135 46 205
136 31 202
140 28 144
141 20 137
142 8 71
143 51 215


82.0
83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
144 8 292
145 66 292
146 50 296
147 73 72
148 17 219
149 43 208
150 73 72
151 73 80
152 69 79
153 74 99
154 71 76
155 34 250
156 40 251
157 29 263
158 24 270
159 32 239
160 81 173
161 73 75
162 44 280
163 37 278
164 33 271
165 70 66
166 54 205
167 46 225
168 48 225
169 45 260
170 50 241
171 84 143
172 34 271
173 33 181
174 18 121

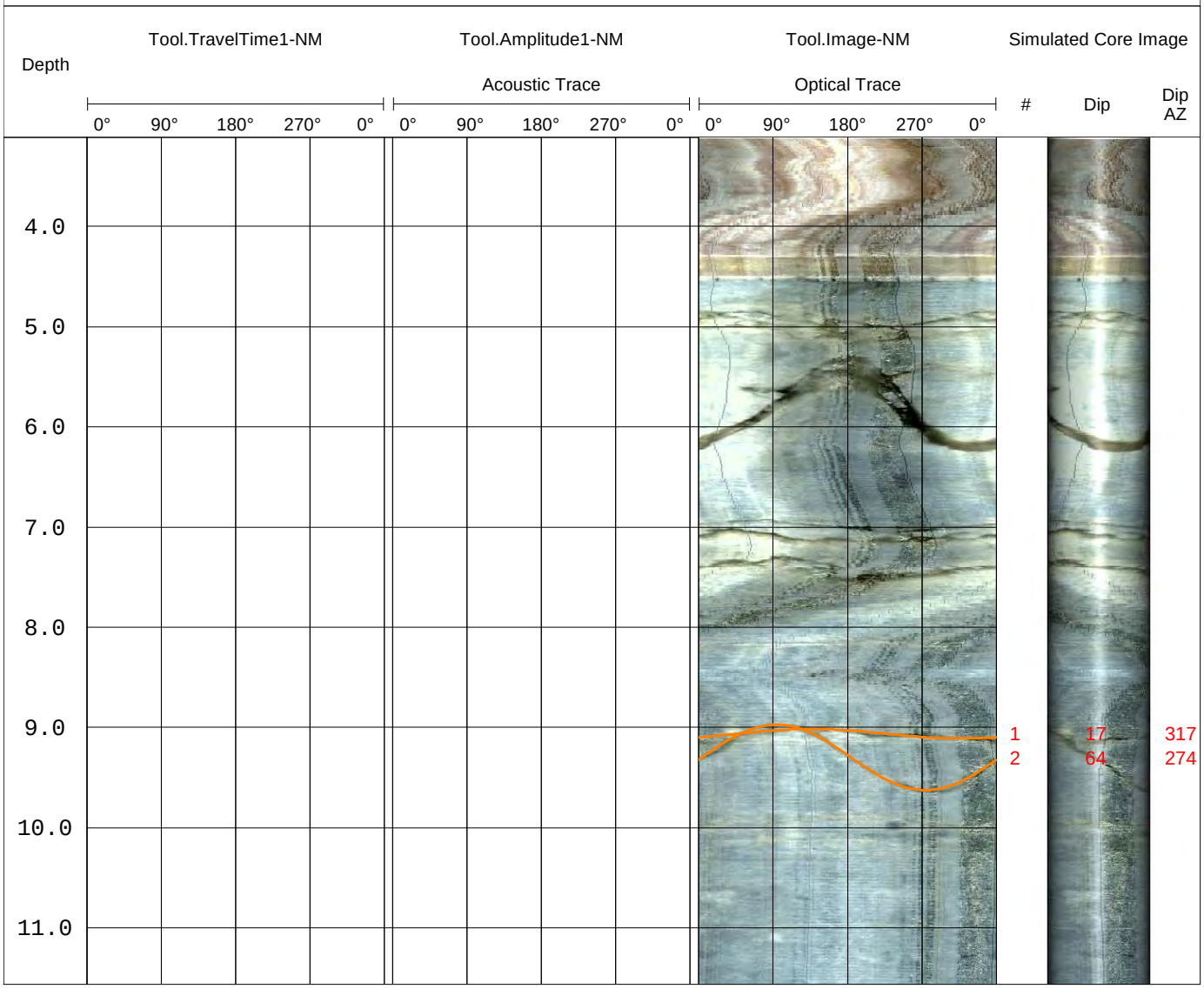

96.0
97.0
98.0
175 41 206
176 74 76
177 26 245
178 33 295
179 23 263
180 38 268
184 27 244

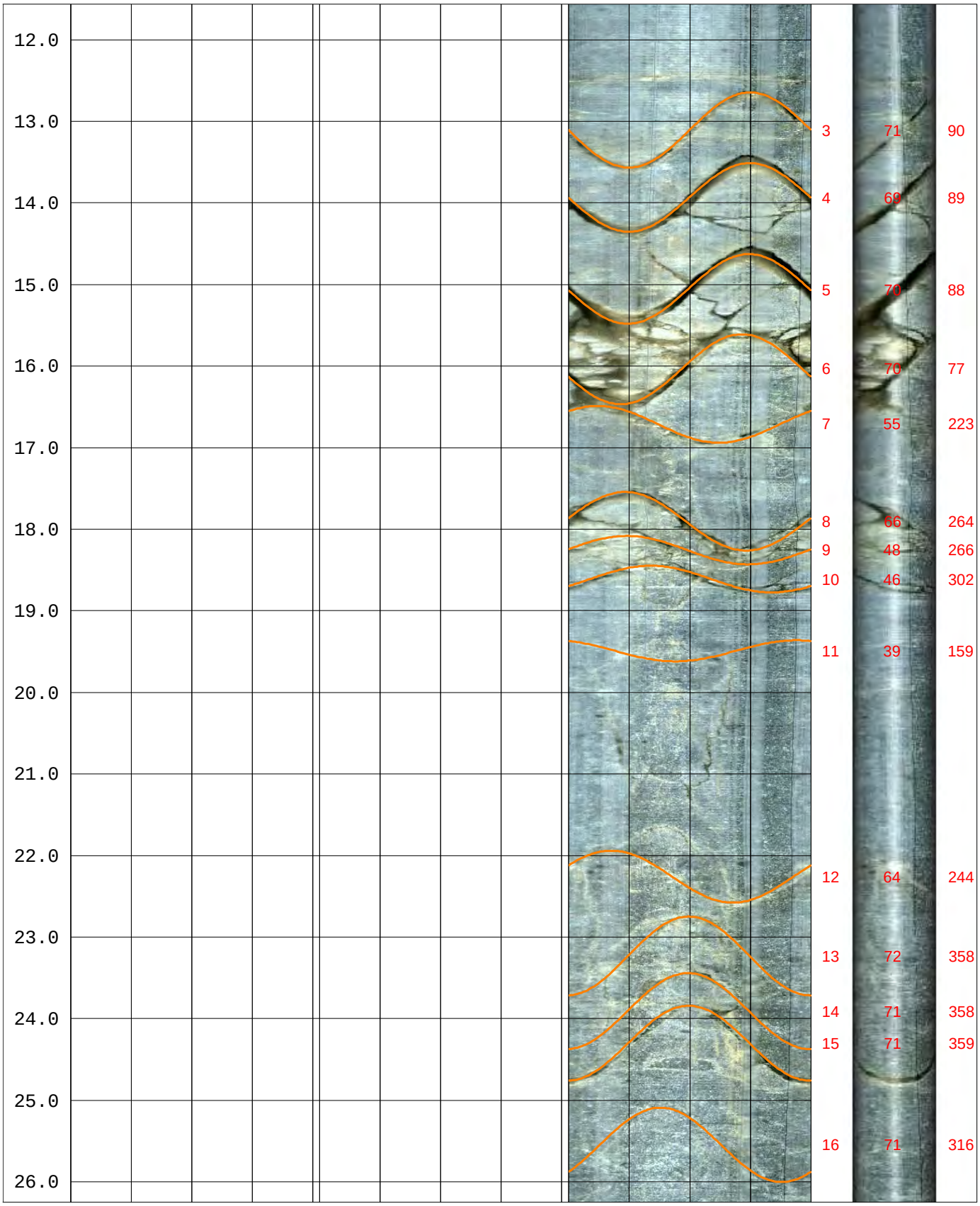
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

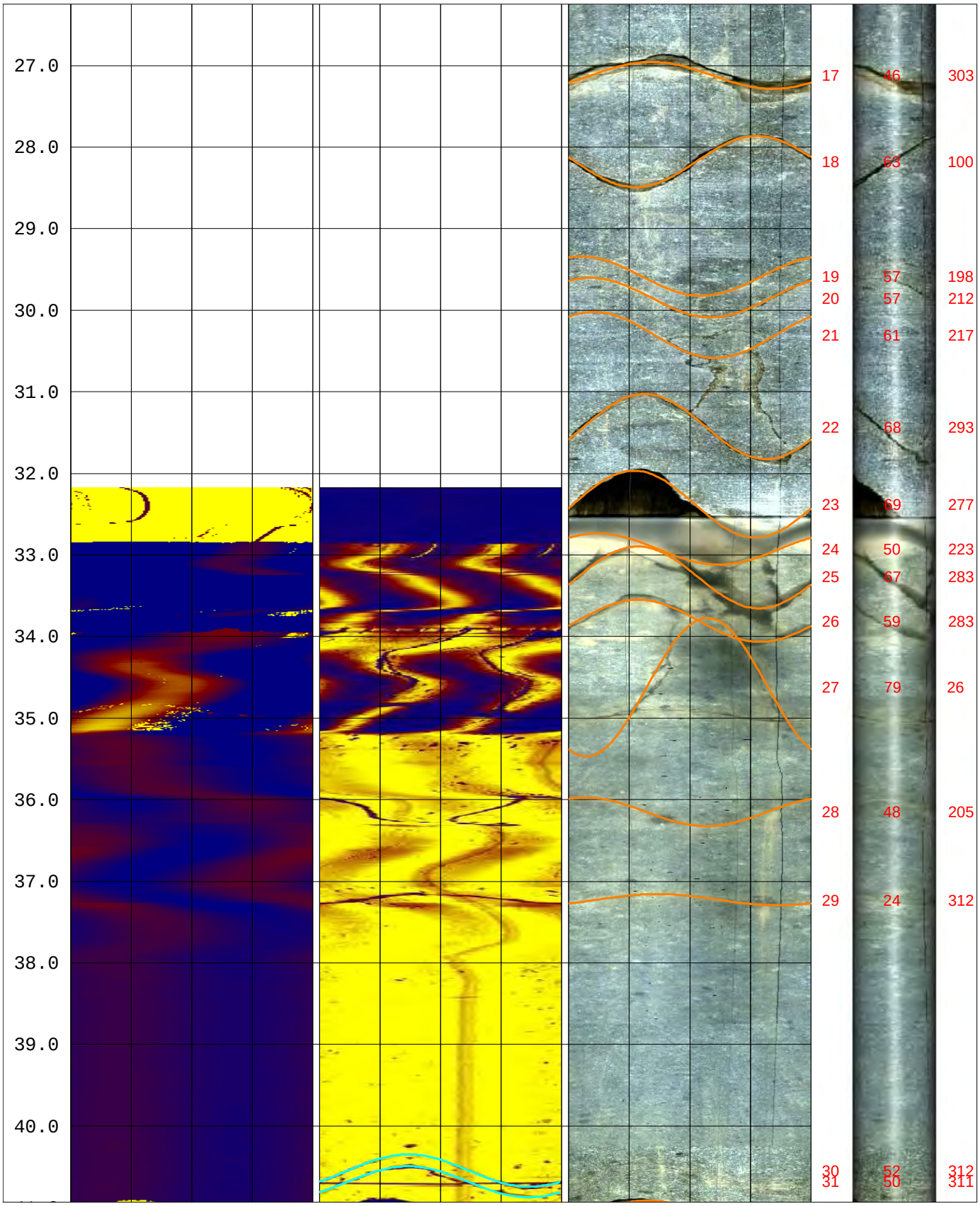
Date Logged:	October 5, 2007	Borehole ID:	SI-03-07
File Name:	SI0307-2M.wcl	Logged By:	F G Kruger

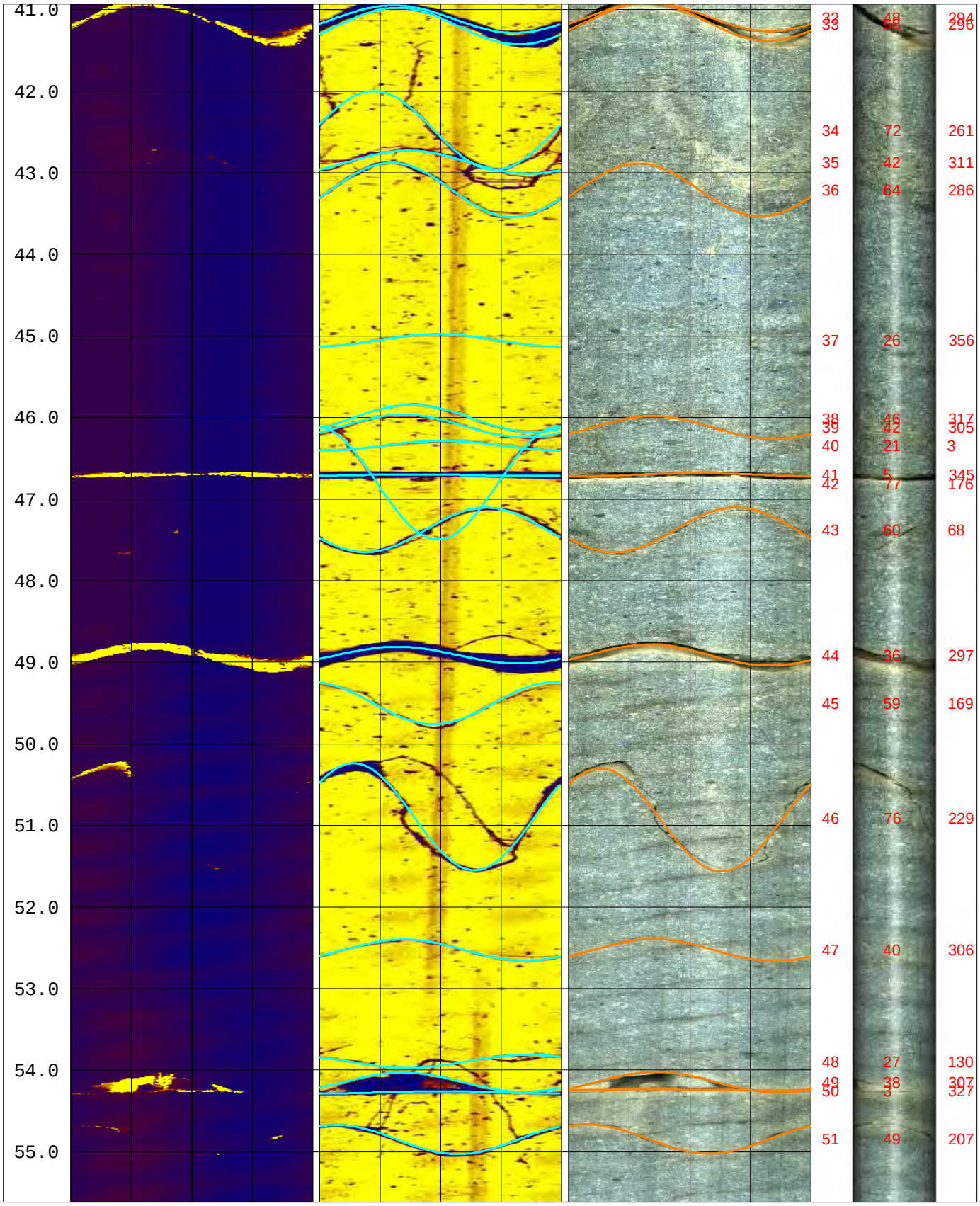
Notes:

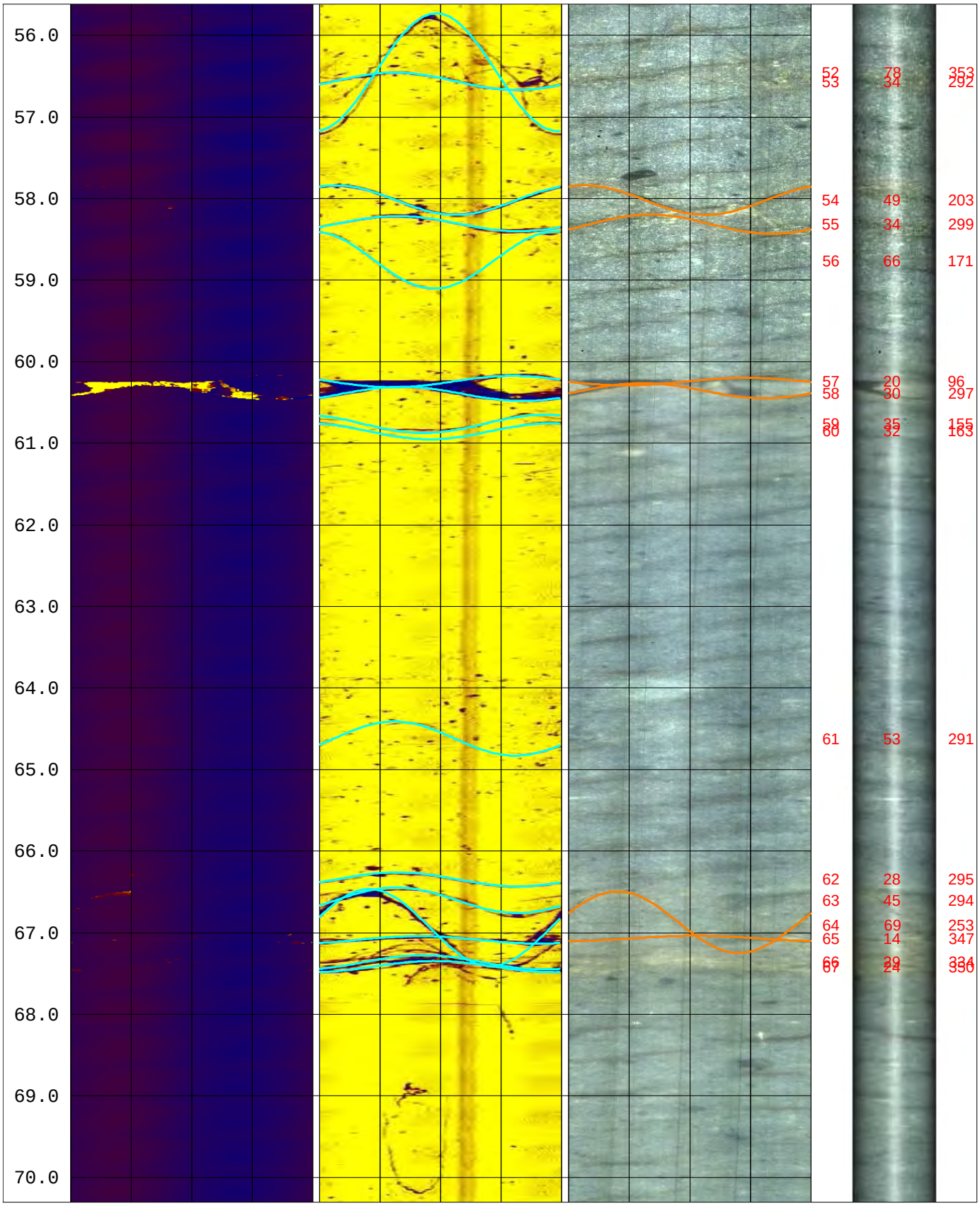
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

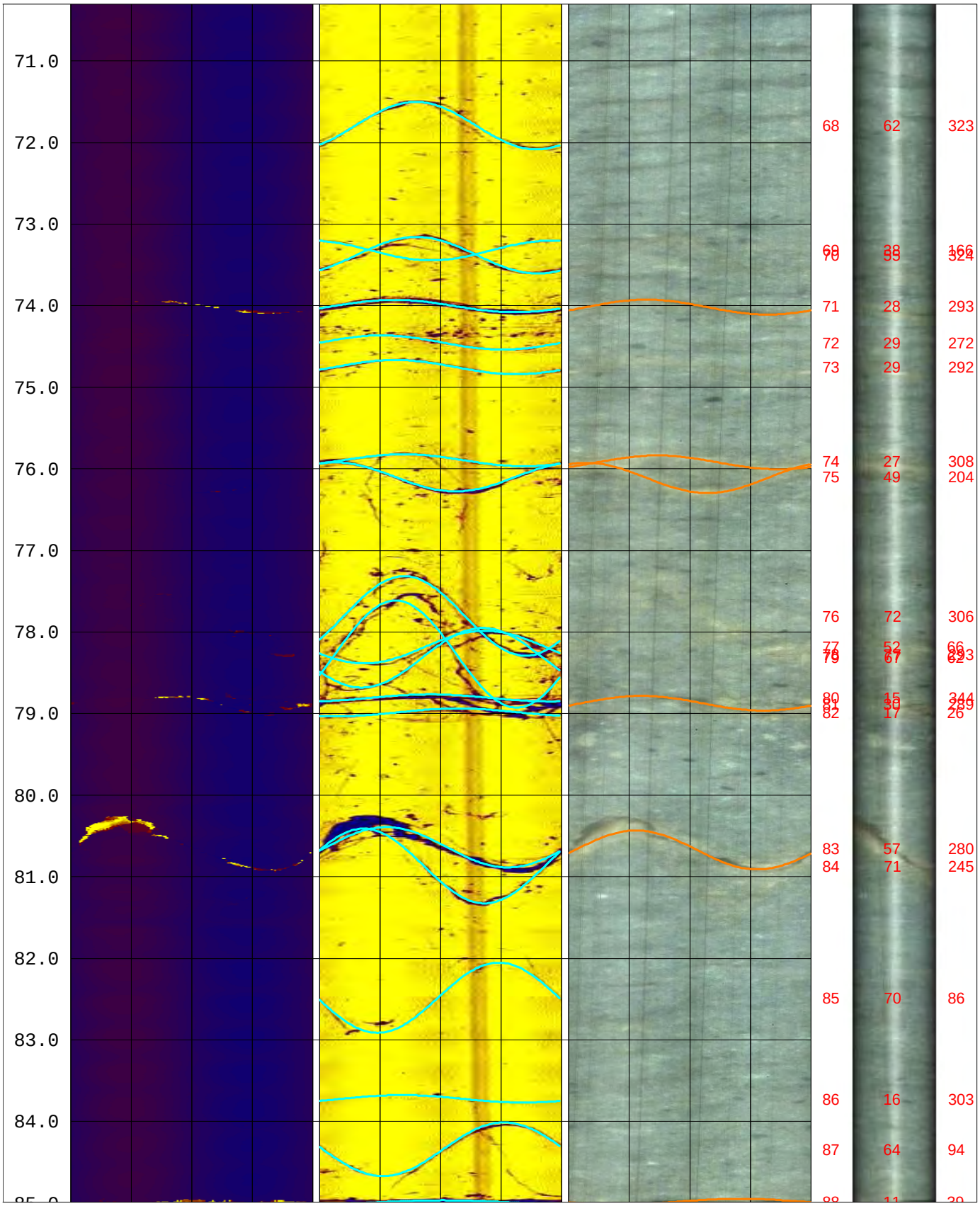


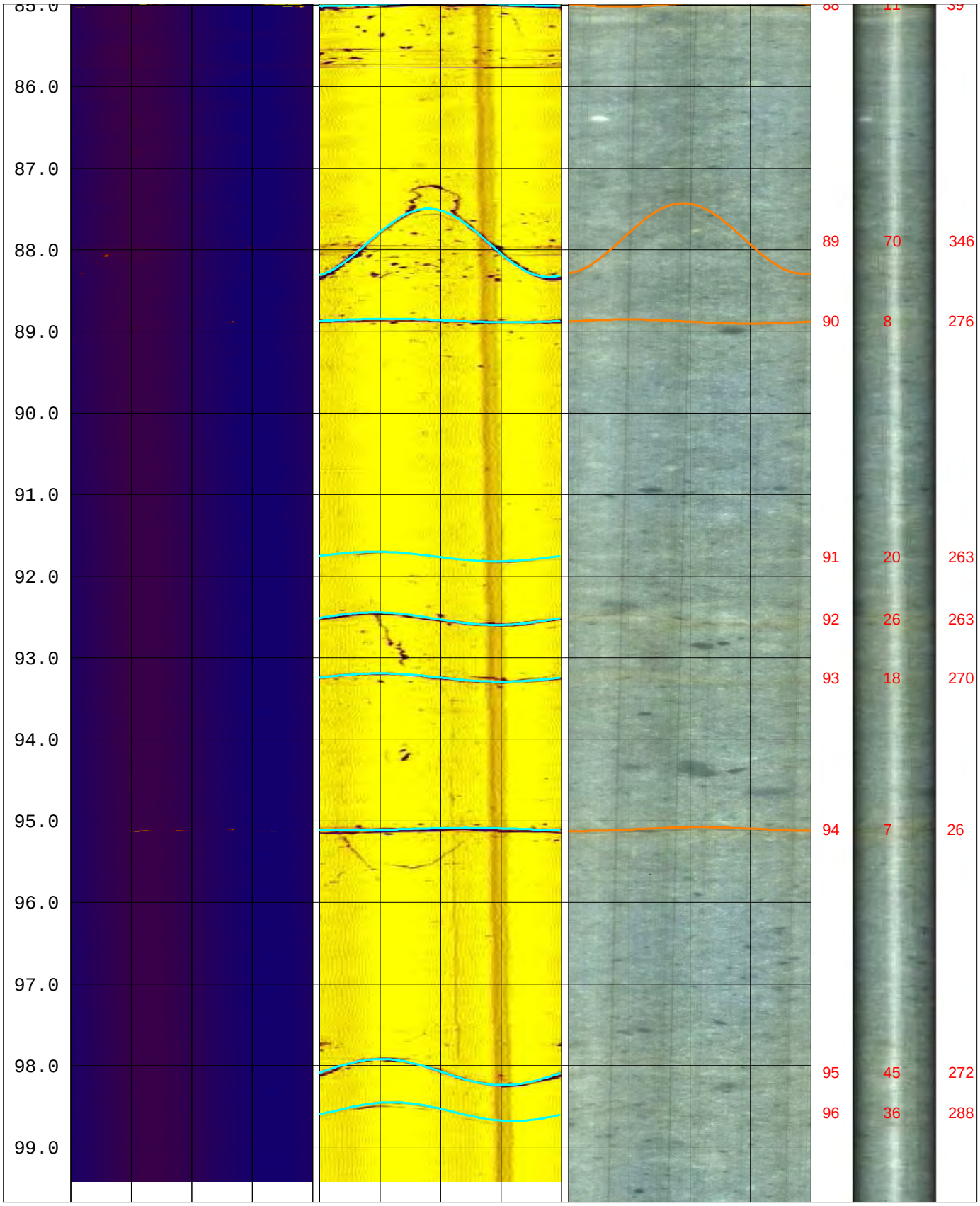

12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
3 71 90
4 69 89
5 70 88
6 70 77
7 55 223
8 66 264
9 48 266
10 46 302
11 39 159
12 64 244
13 72 358
14 71 358
15 71 359
16 71 316


27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
17 46 303
18 63 100
19 57 198
20 57 212
21 61 217
22 68 293
23 69 277
24 50 223
25 67 283
26 59 283
27 79 26
28 48 205
29 24 312
30 52 312
31 50 311


41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
32 48 294
33 296
34 72 261
35 42 311
36 64 286
37 26 356
38 46 317
39 42 305
40 21 3
41 5 345
42 77 176
43 60 68
44 36 297
45 59 169
46 76 229
47 40 306
48 27 130
49 38 307
50 3 327
51 49 207


56.0
57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
52 78 353
53 34 292
54 49 203
55 34 299
56 66 171
57 20 96
58 30 297
59 35 155
60 32 183
61 53 291
62 28 295
63 45 294
64 69 253
65 14 347
66 29 334
67 24 330


71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
68 62 323
69 38 166
70 55 324
71 28 293
72 29 272
73 29 292
74 27 308
75 49 204
76 72 306
77 52 66
78 67 323
79 62
80 15 344
81 30 289
82 17 26
83 57 280
84 71 245
85 70 86
86 16 303
87 64 94


85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
96.0
97.0
98.0
99.0
89 70 346
90 8 276
91 20 263
92 26 263
93 18 270
94 7 26
95 45 272
96 36 288

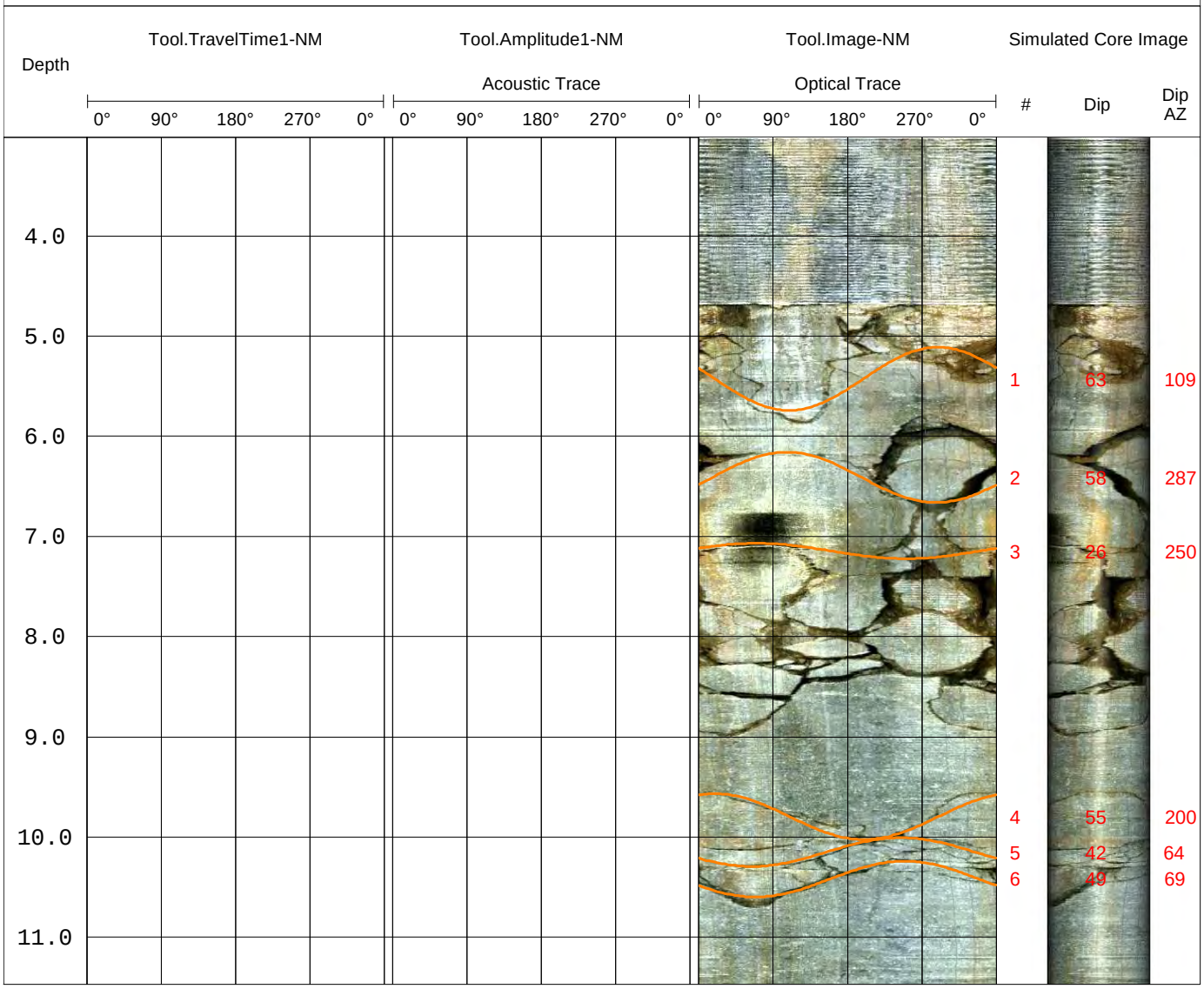
100.0														

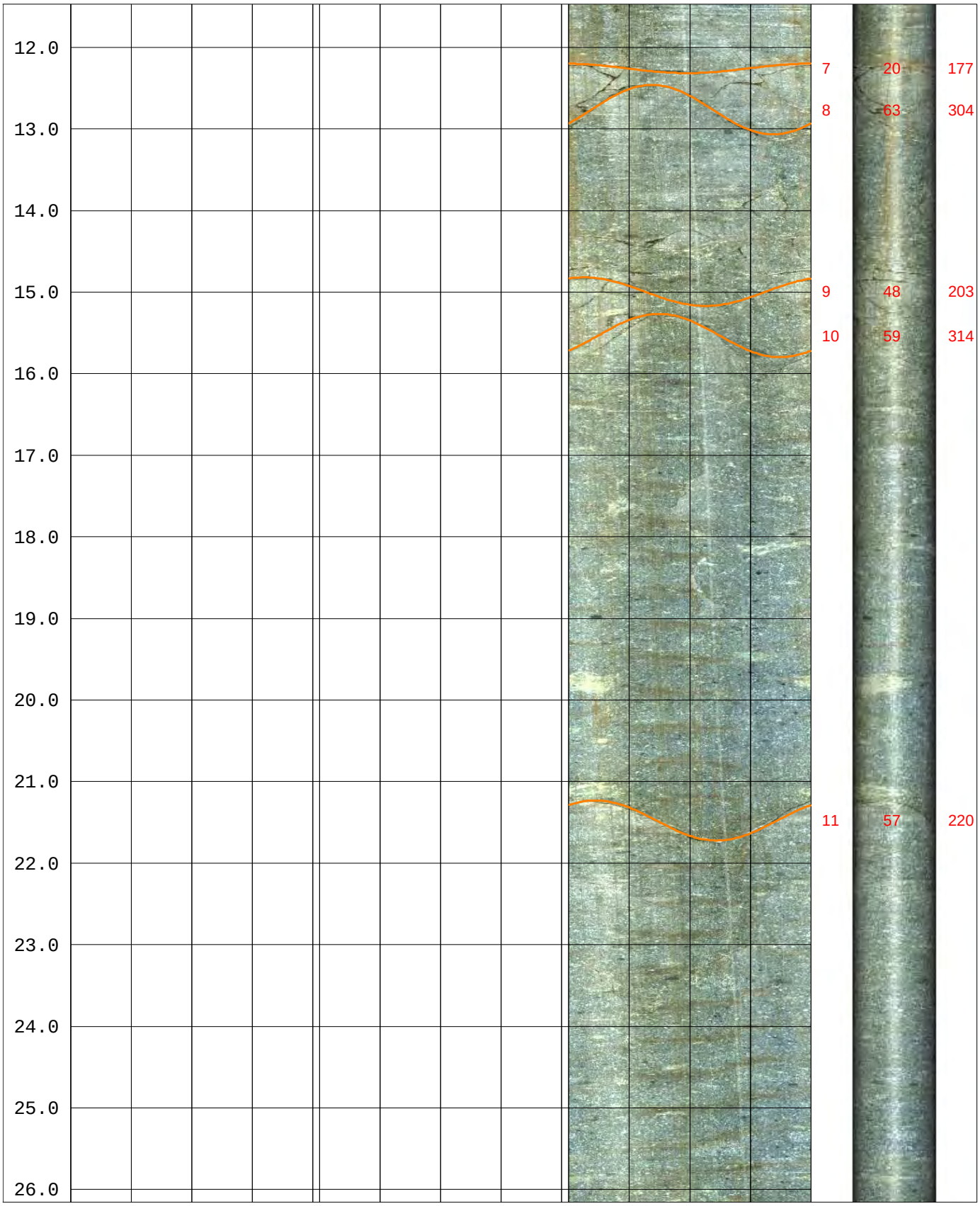
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

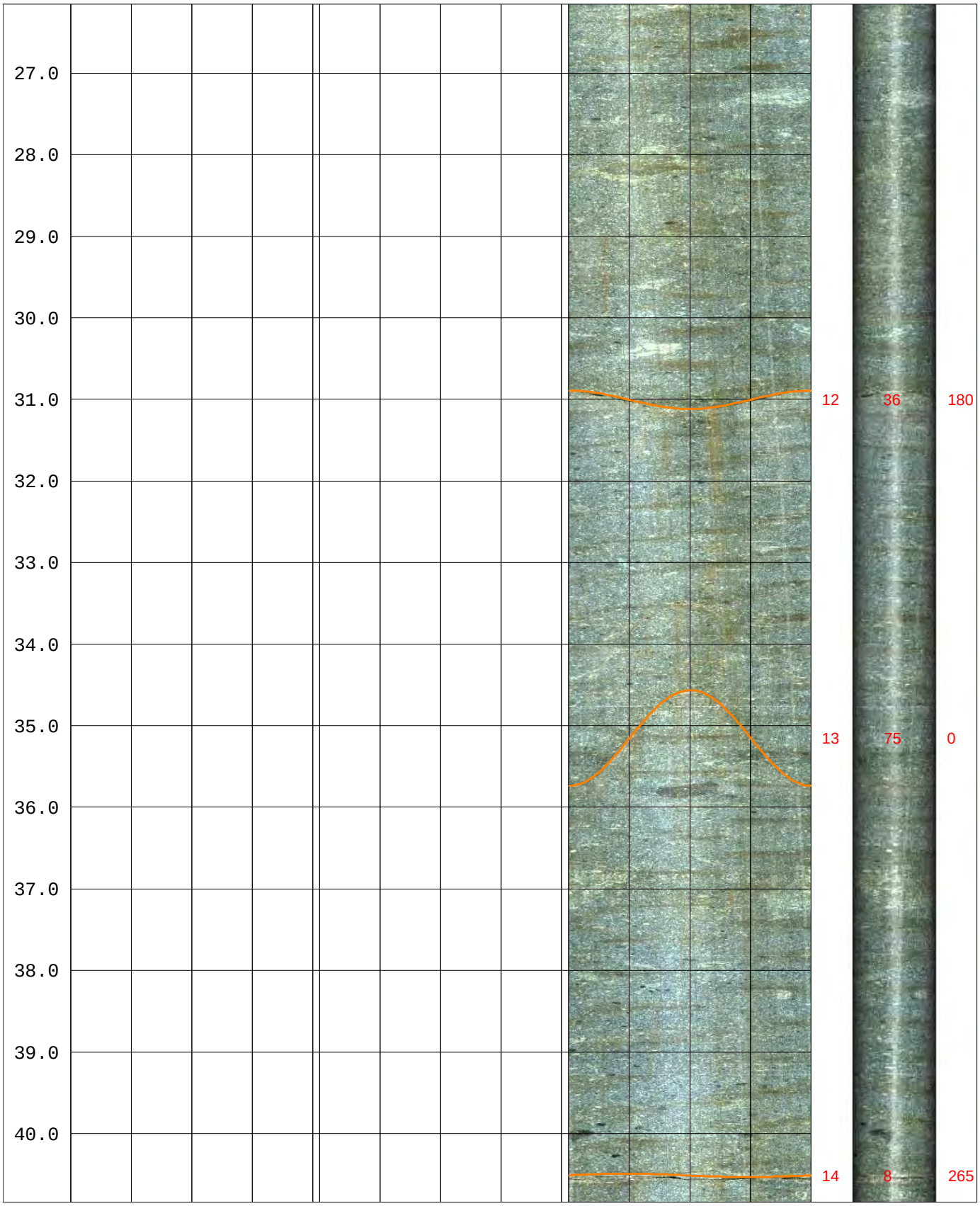
Date Logged:	October 10, 2007	Borehole ID:	SI-04-07
File Name:	SI0407-2M.wcl	Logged By:	F G Kruger

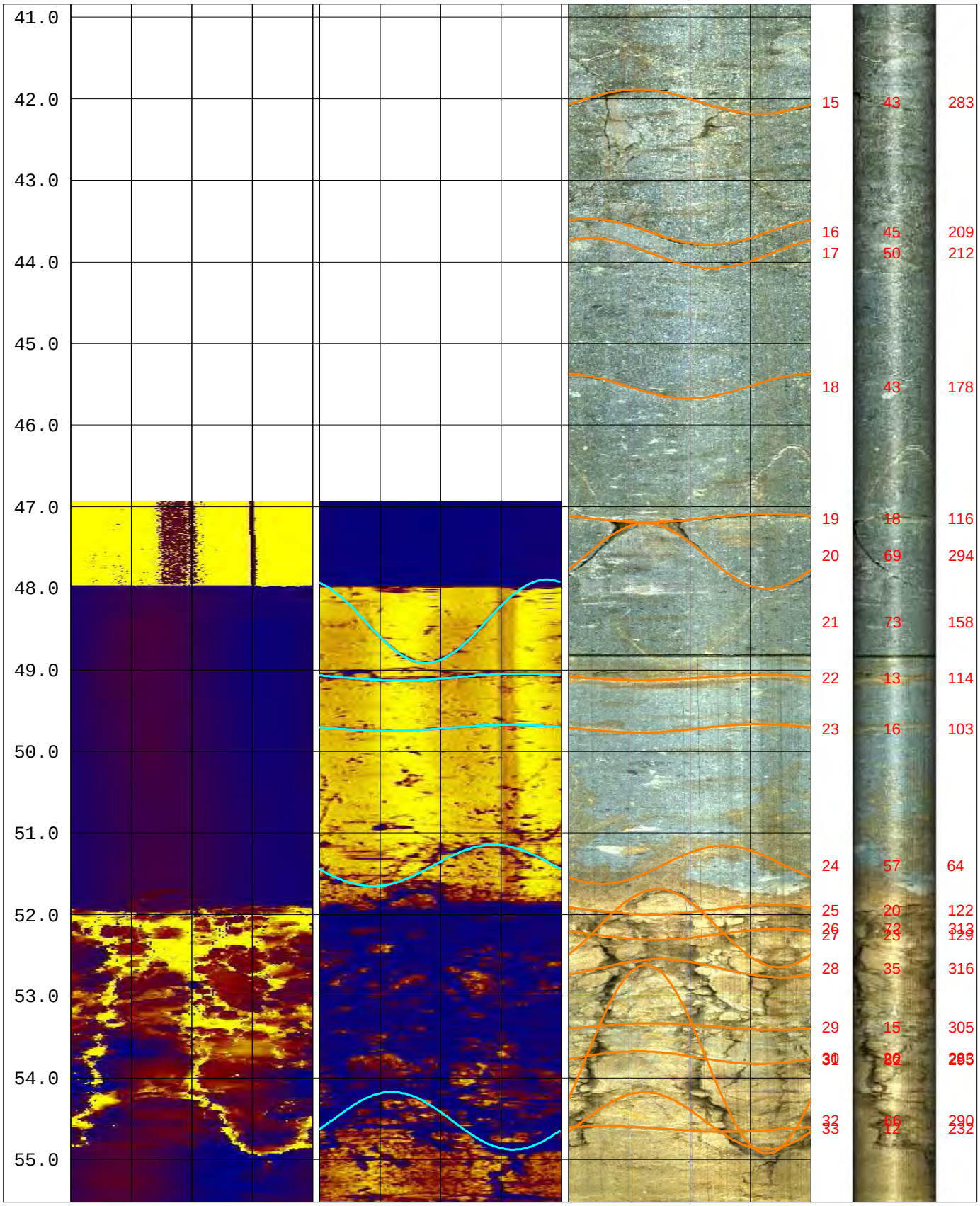
Notes:

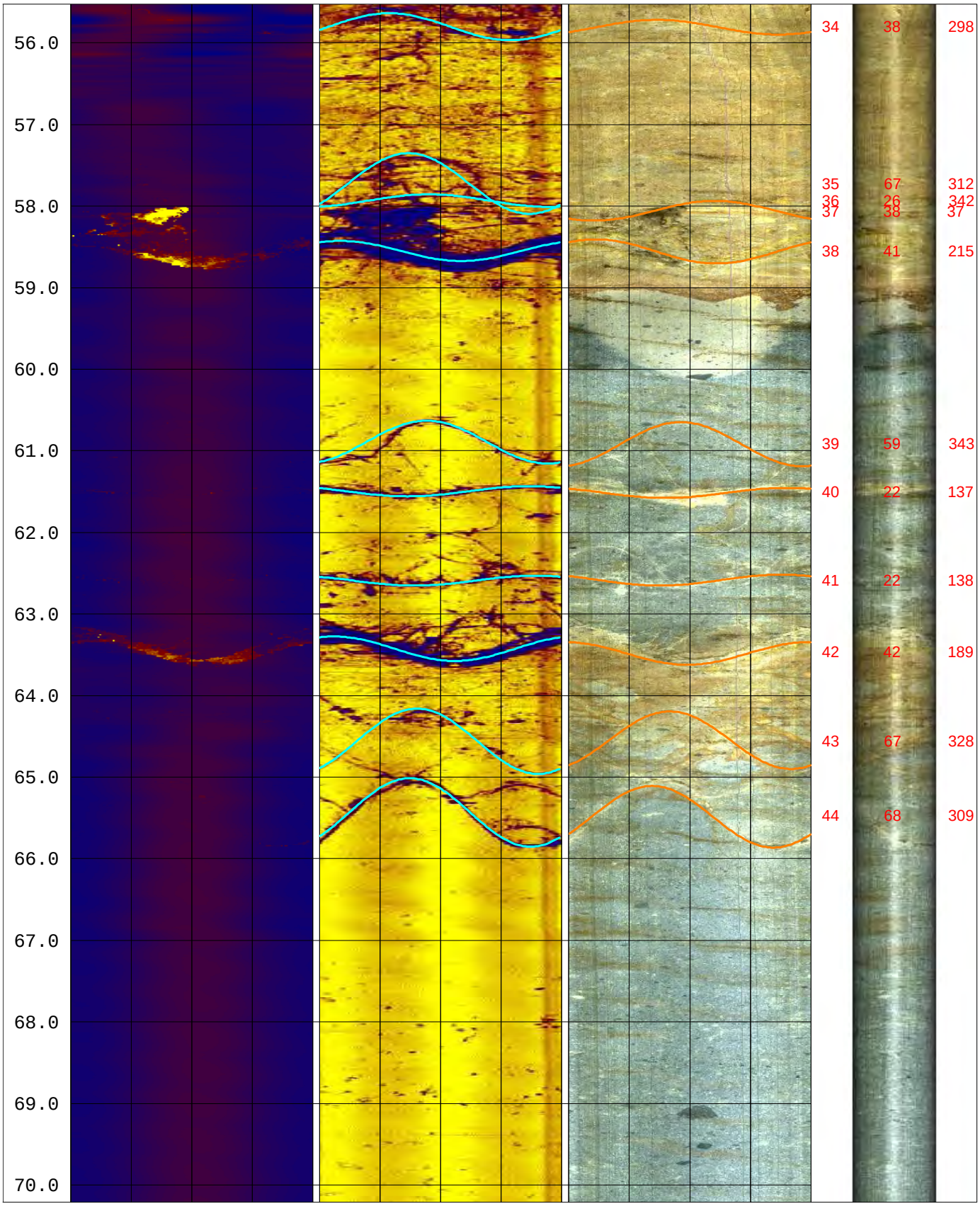
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

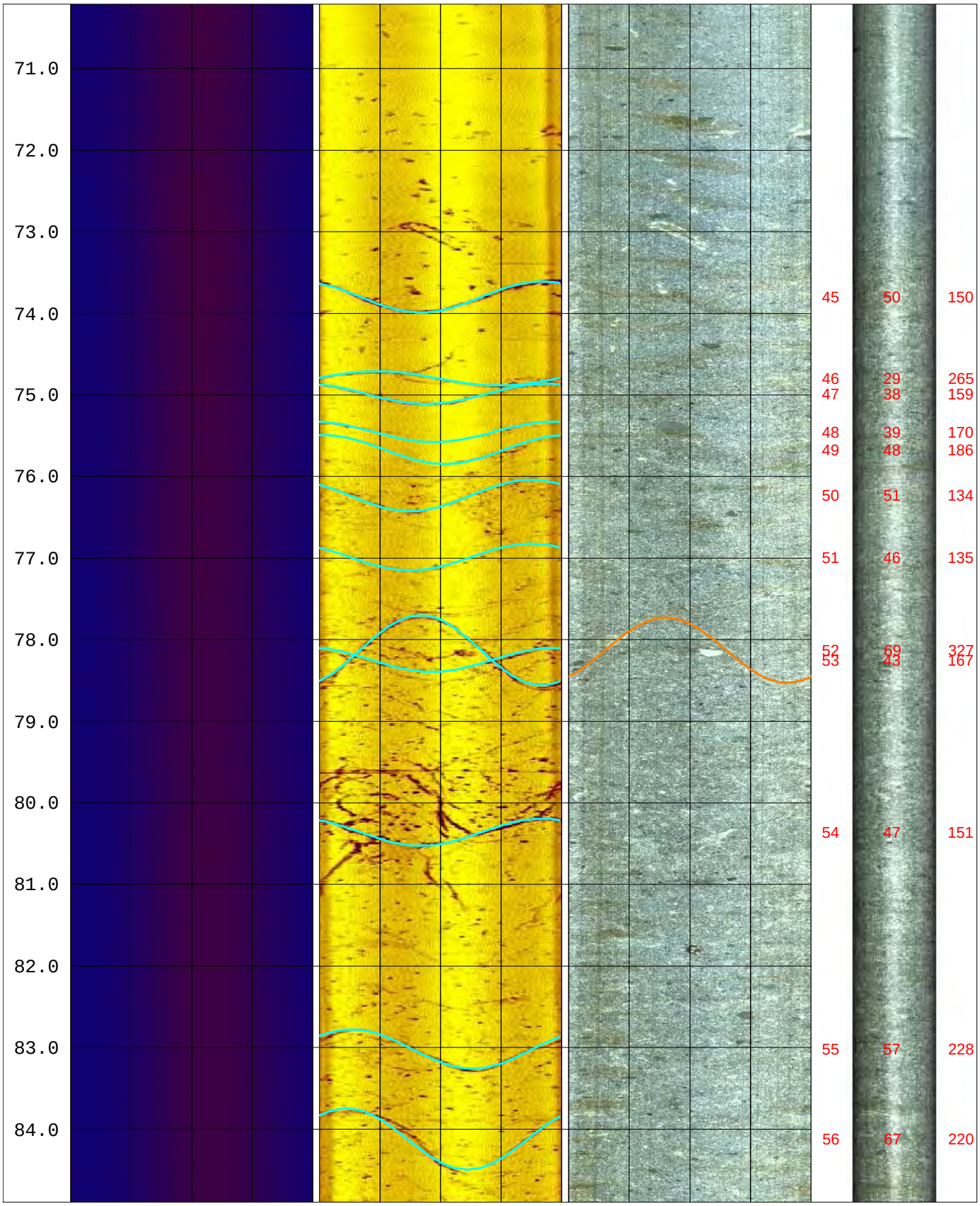


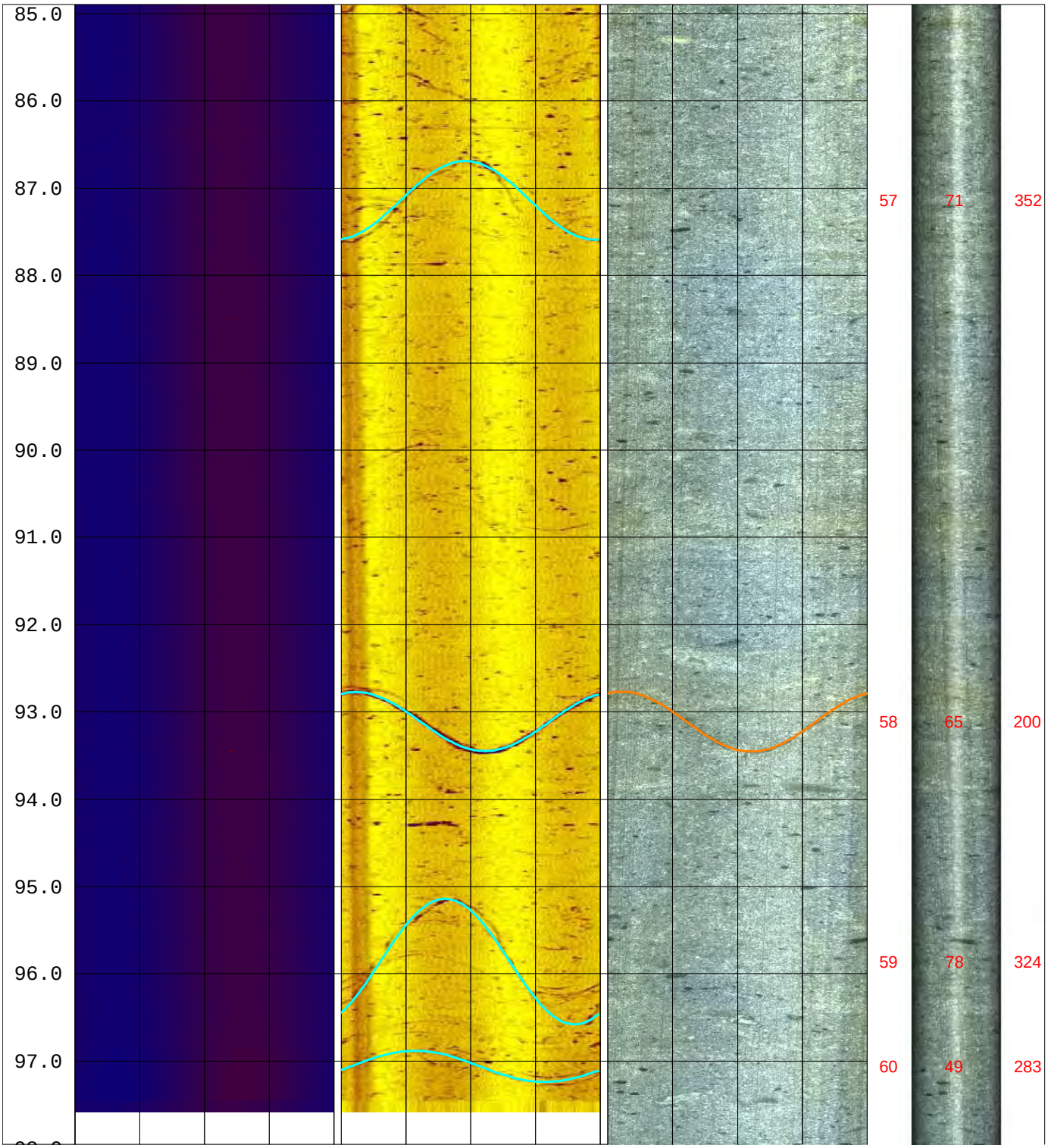

12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
7 20 177
8 63 304
9 48 203
10 59 314
11 57 220


27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
12
36
180
13
75
0
14
8
265


41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
15 43 283
16 45 209
17 50 212
18 43 178
19 18 116
20 69 294
21 73 158
22 13 114
23 16 103
24 57 64
25 20 122
26 72 313
27 23 129
28 35 316
29 15 305
30 80 295
31
32 66 290
33 12 232


56.0
57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
34 38 298
35 67 312
36 26 342
37 38 37
38 41 215
39 59 343
40 22 137
41 22 138
42 42 189
43 67 328
44 68 309


71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
45 50 150
46 29 265
47 38 159
48 39 170
49 48 186
50 51 134
51 46 135
52 69 327
53 43 167
54 47 151
55 57 228
56 67 220

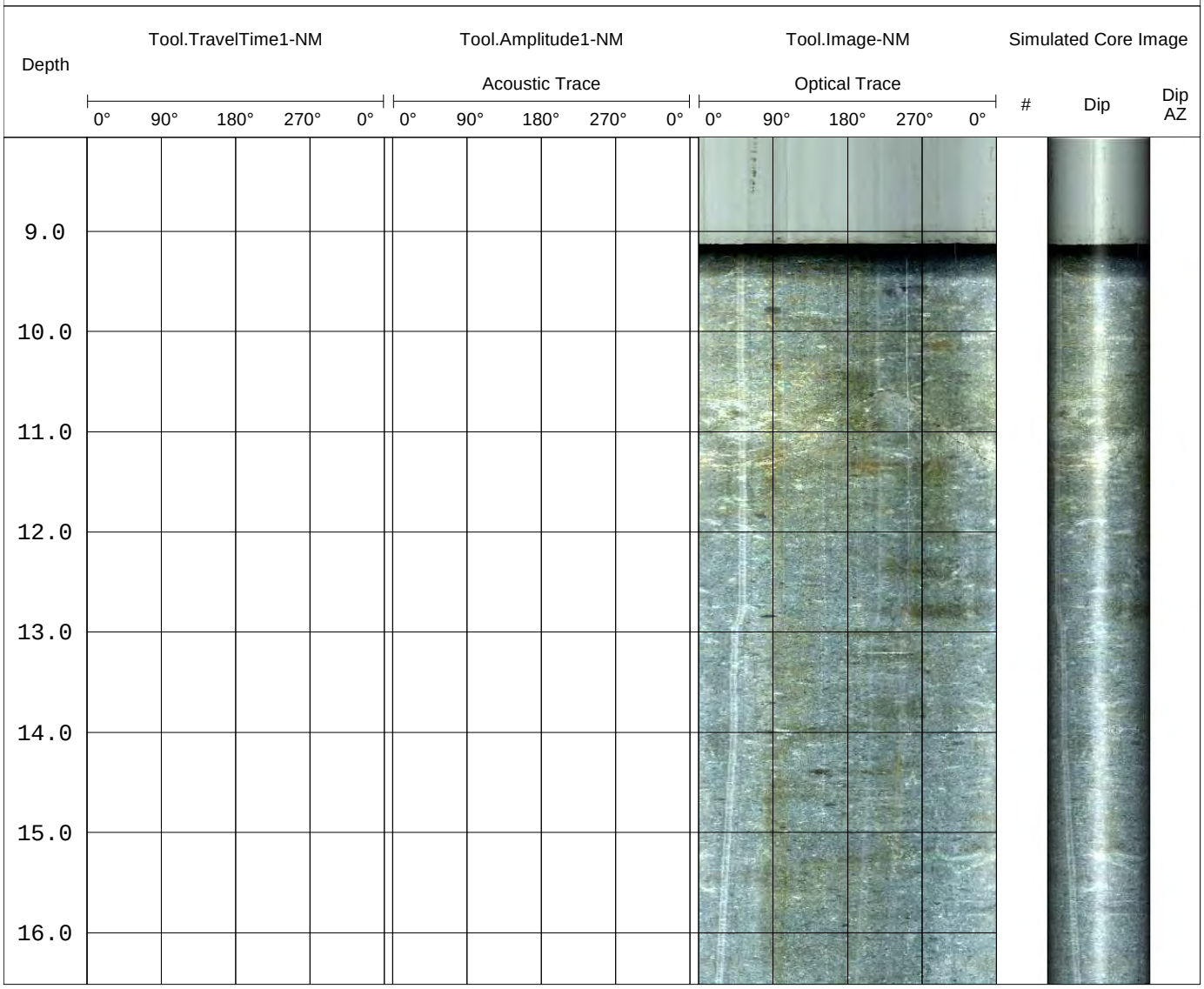

85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
96.0
97.0
57 71 352
58 65 200
59 78 324
60 49 283

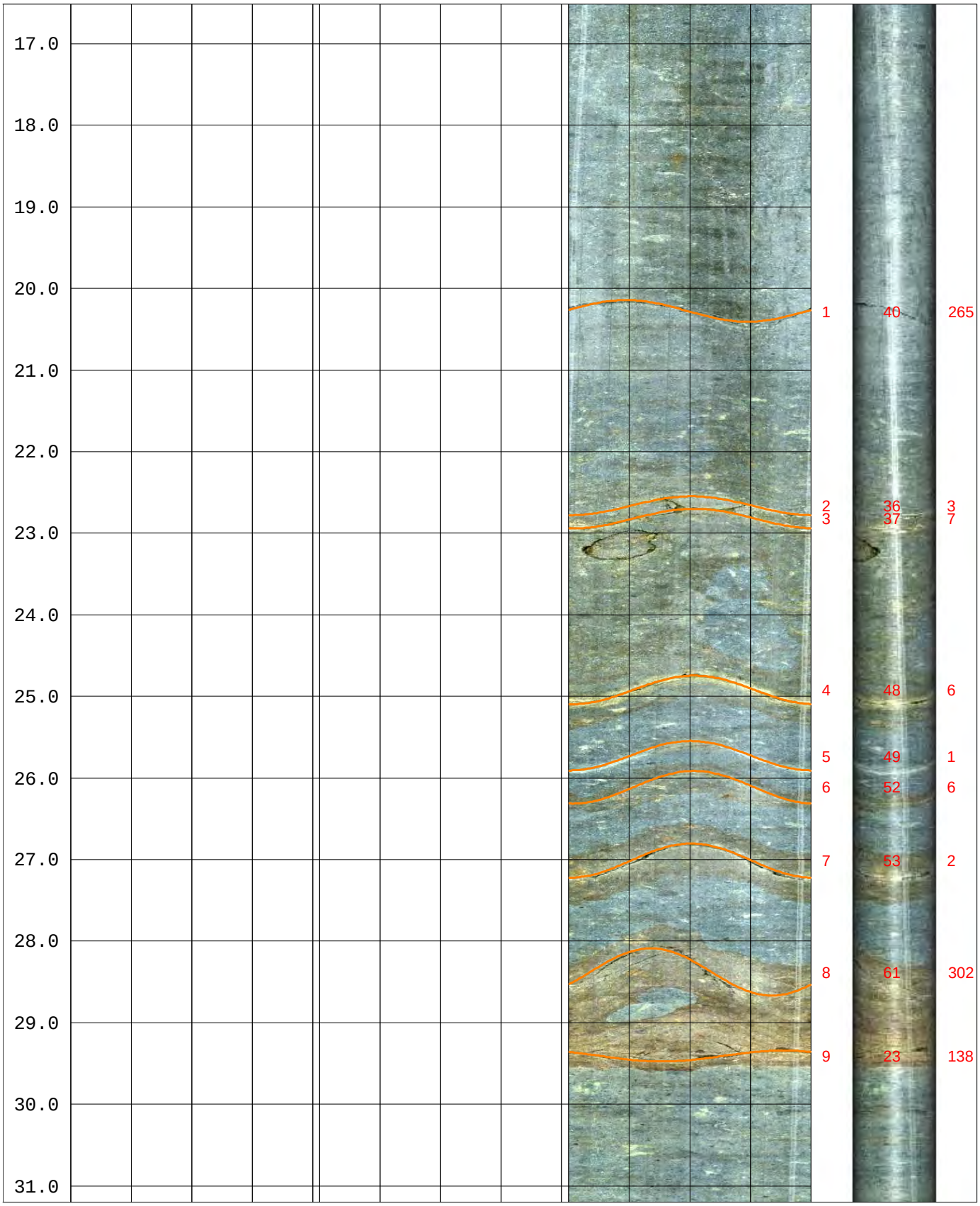
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

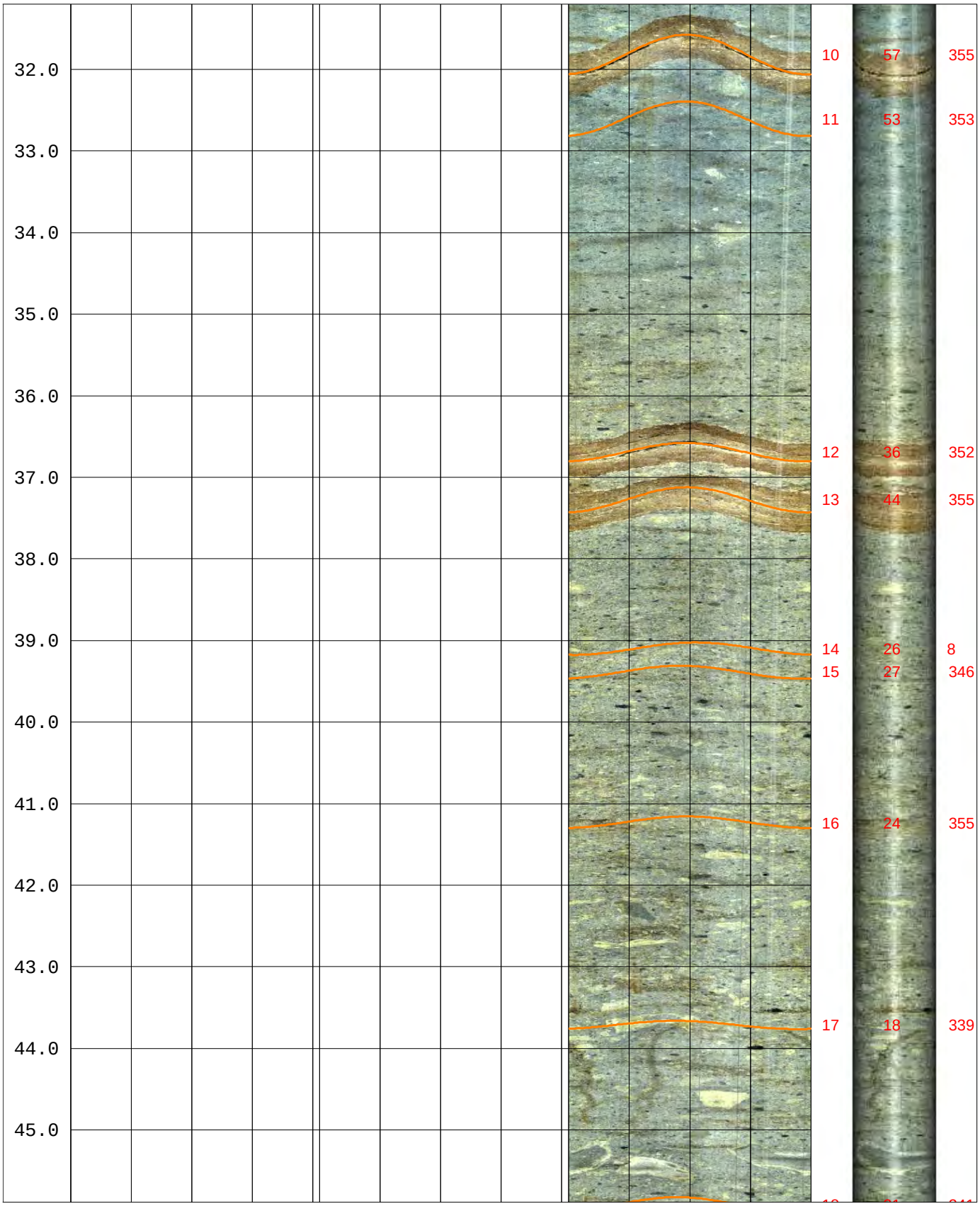
Date Logged:	October 10, 2007	Borehole ID:	SI-05-07
File Name:	SI0507-2M.wcl	Logged By:	F G Kruger

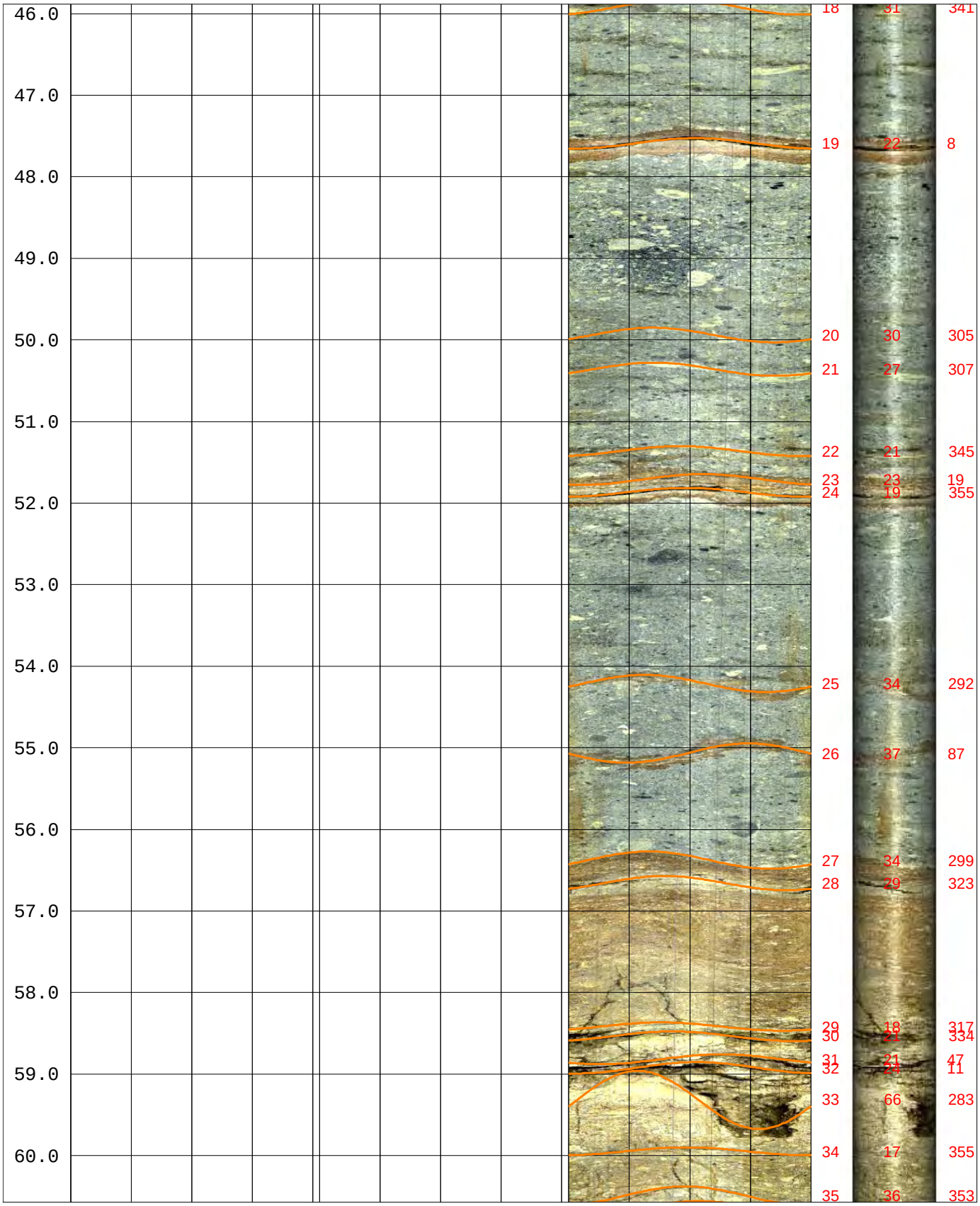
Notes:

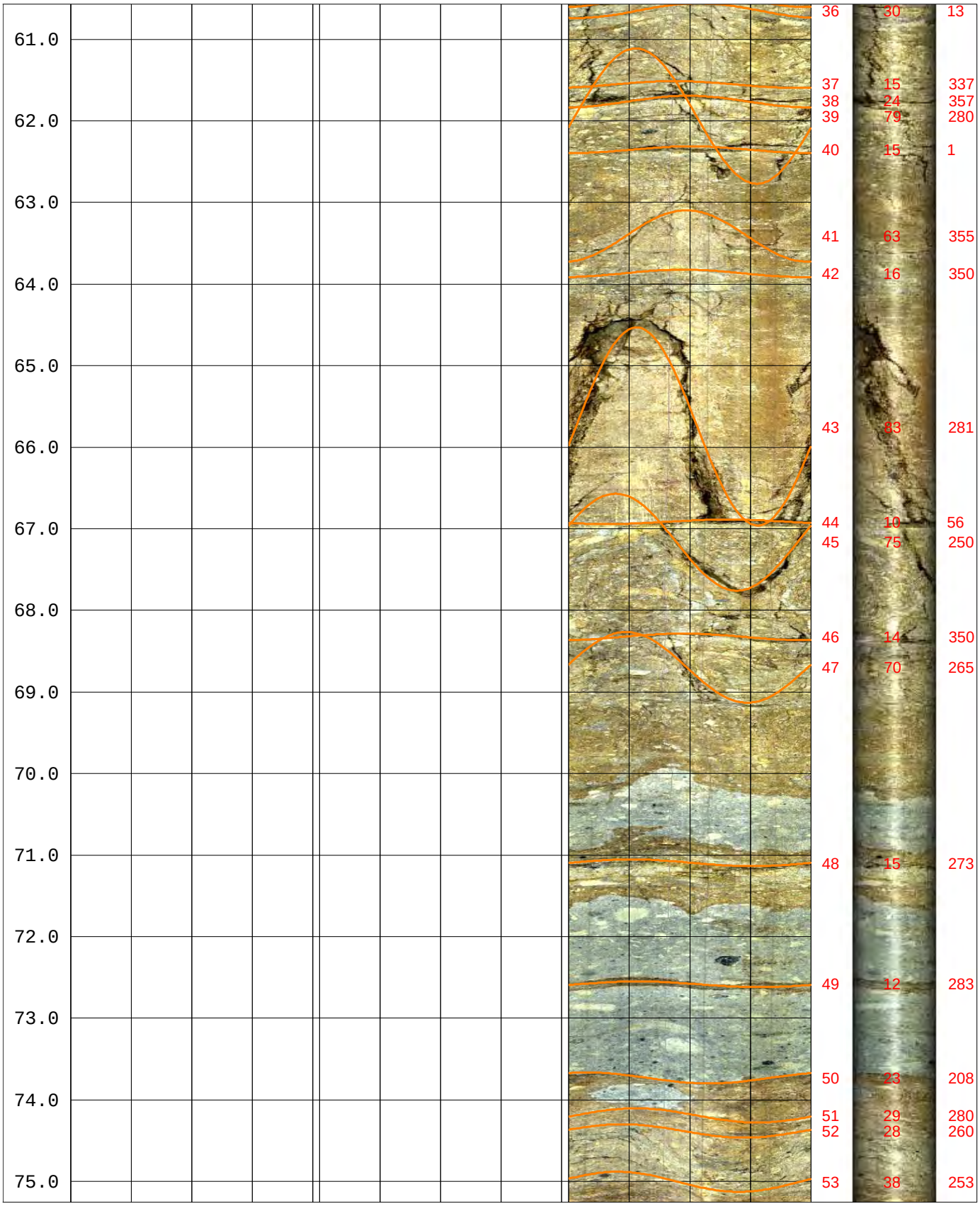
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

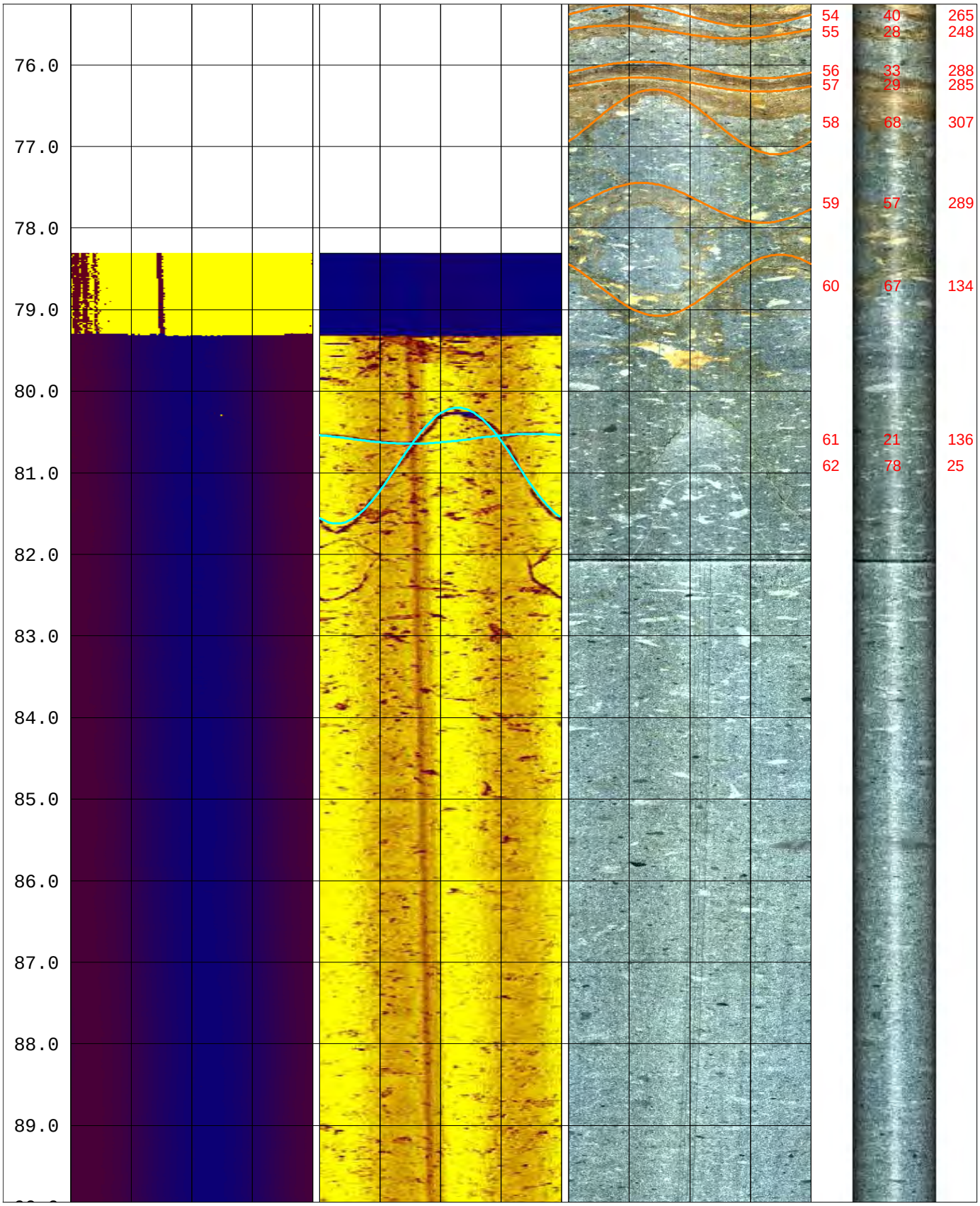


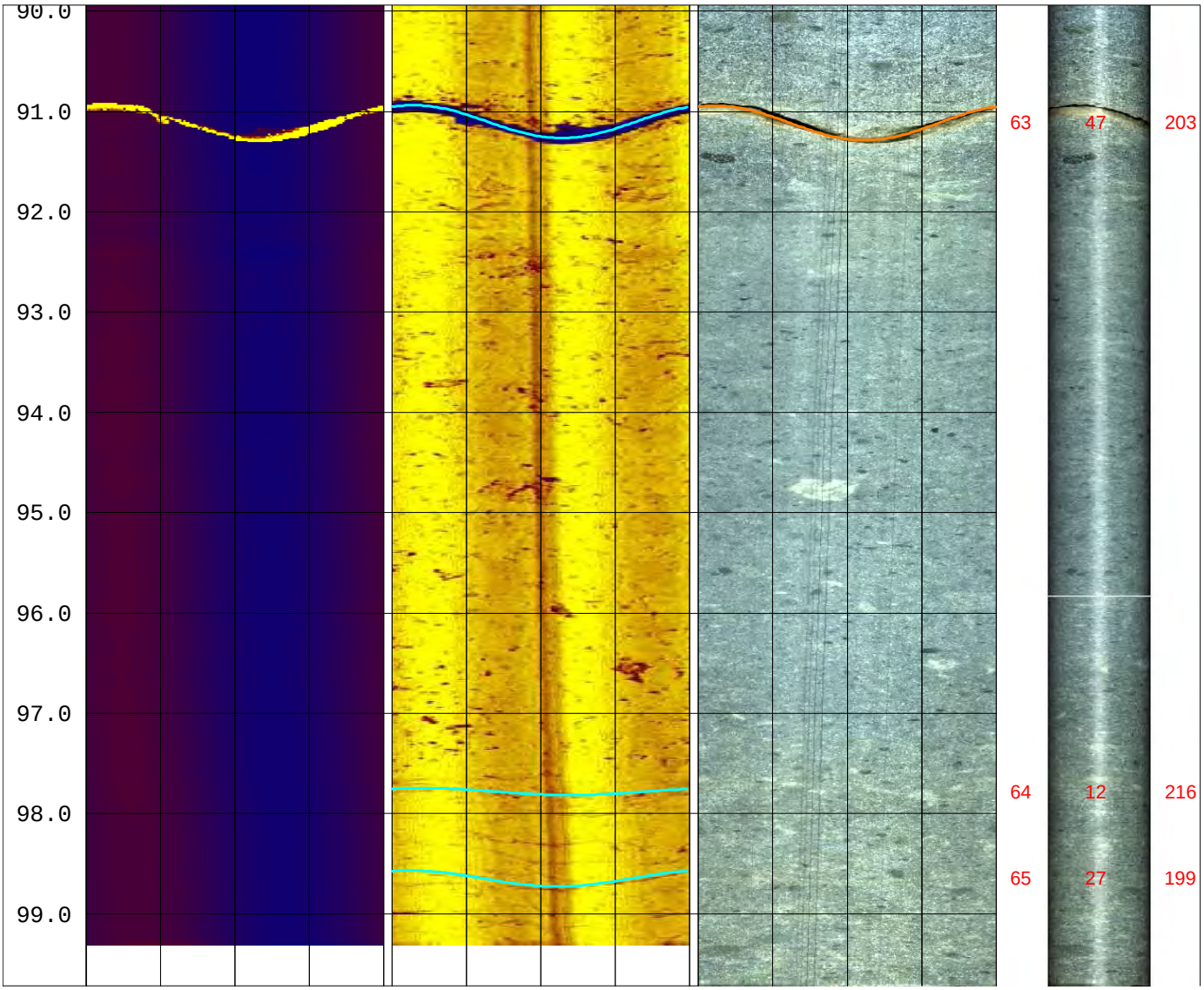

17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
1 40 265
2 36 3
3 37 7
4 48 6
5 49 1
6 52 6
7 53 2
8 61 302
9 23 138


32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
10 57 355
11 53 353
12 36 352
13 44 355
14 26 8
15 27 346
16 24 355
17 18 339


46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
18 31 341
19 22 8
20 30 305
21 27 307
22 21 345
23 23 19
24 19 355
25 34 292
26 37 87
27 34 299
28 29 323
29 18 317
30 22 334
31 21 47
32 24 11
33 66 283
34 17 355
35 36 353


61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
73.0
74.0
75.0
36 30 13
37 15 337
38 24 357
39 79 280
40 15 1
41 63 355
42 16 350
43 83 281
44 10 56
45 75 250
46 14 350
47 70 265
48 15 273
49 12 283
50 23 208
51 29 280
52 28 260
53 38 253


76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
89.0
54 40 265
55 28 248
56 33 288
57 29 285
58 68 307
59 57 289
60 67 134
61 21 136
62 78 25

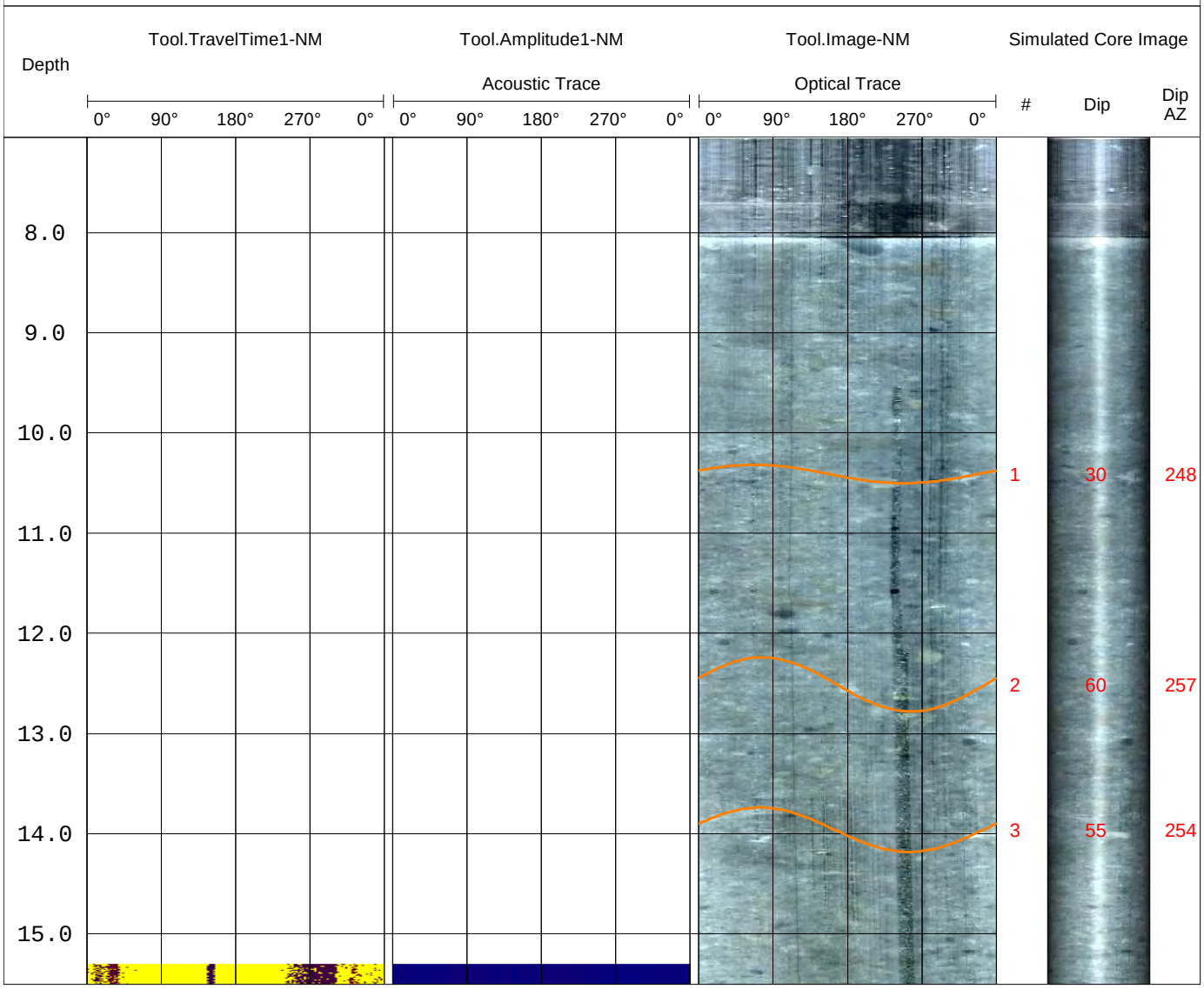

90.0
91.0
92.0
93.0
94.0
95.0
96.0
97.0
98.0
99.0
63
47
203
64
12
216
65
27
199

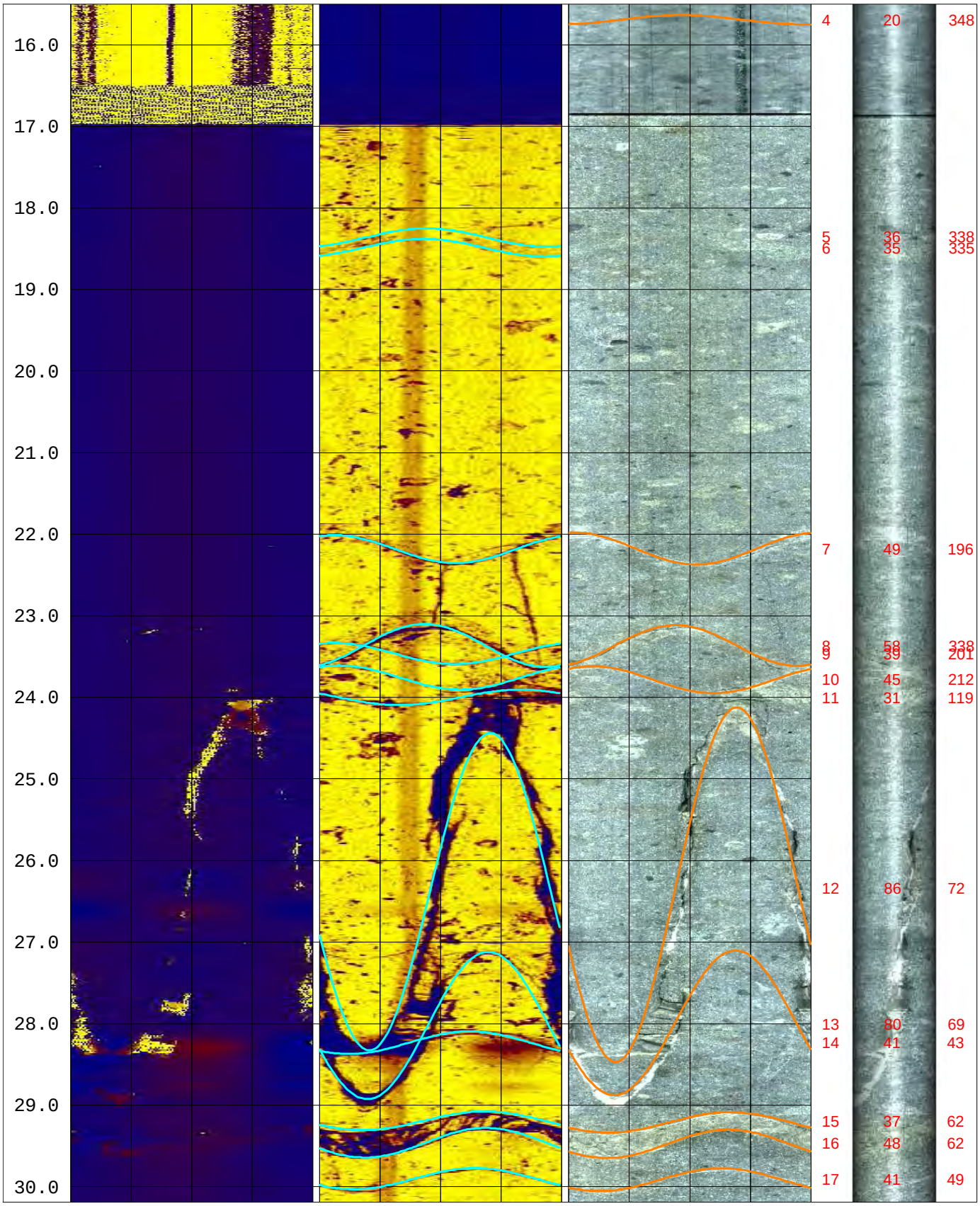
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

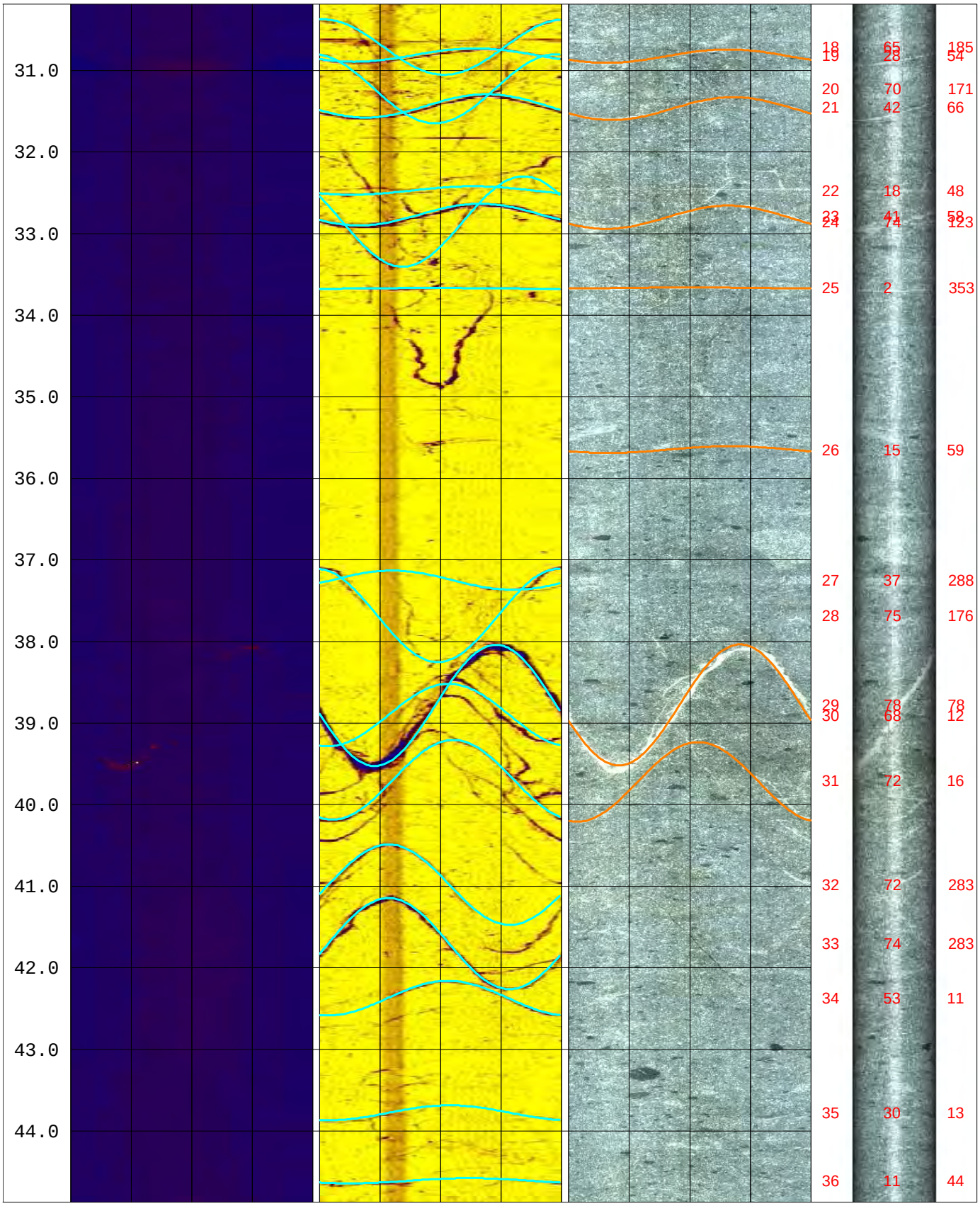
Date Logged:	October 11, 2007	Borehole ID:	SI-06-07
File Name:	SI0607-2M.wcl	Logged By:	F G Kruger

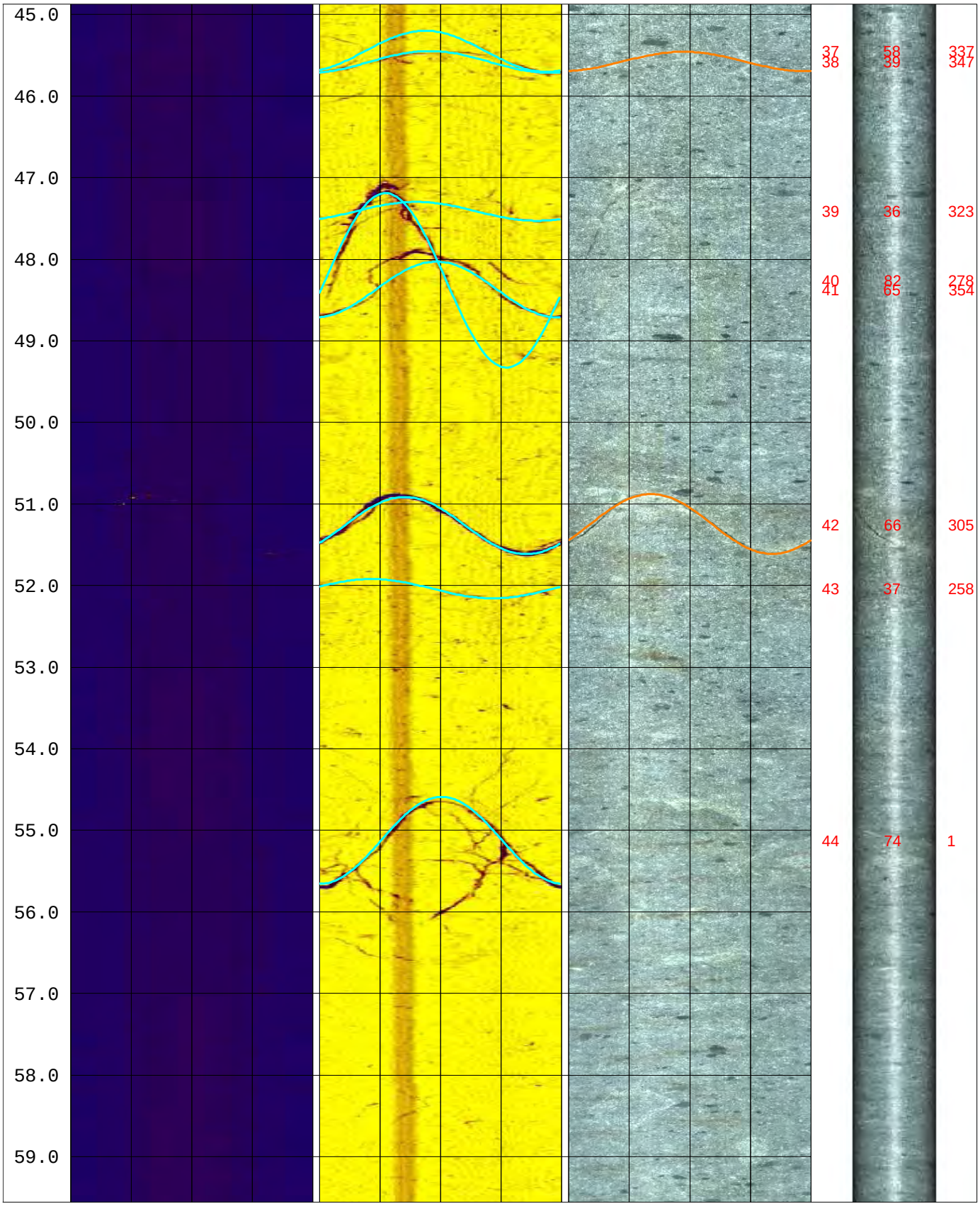
Notes:

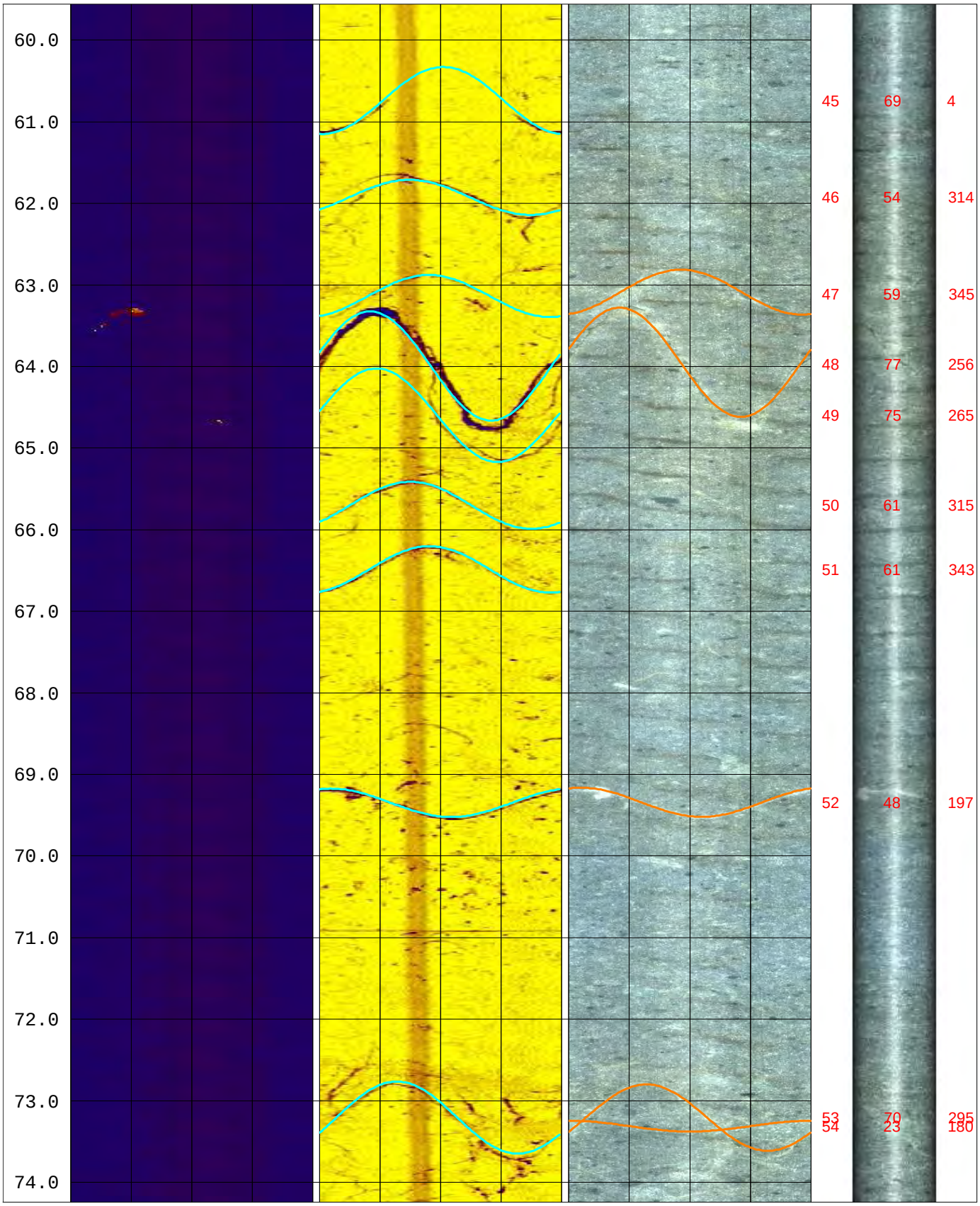
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

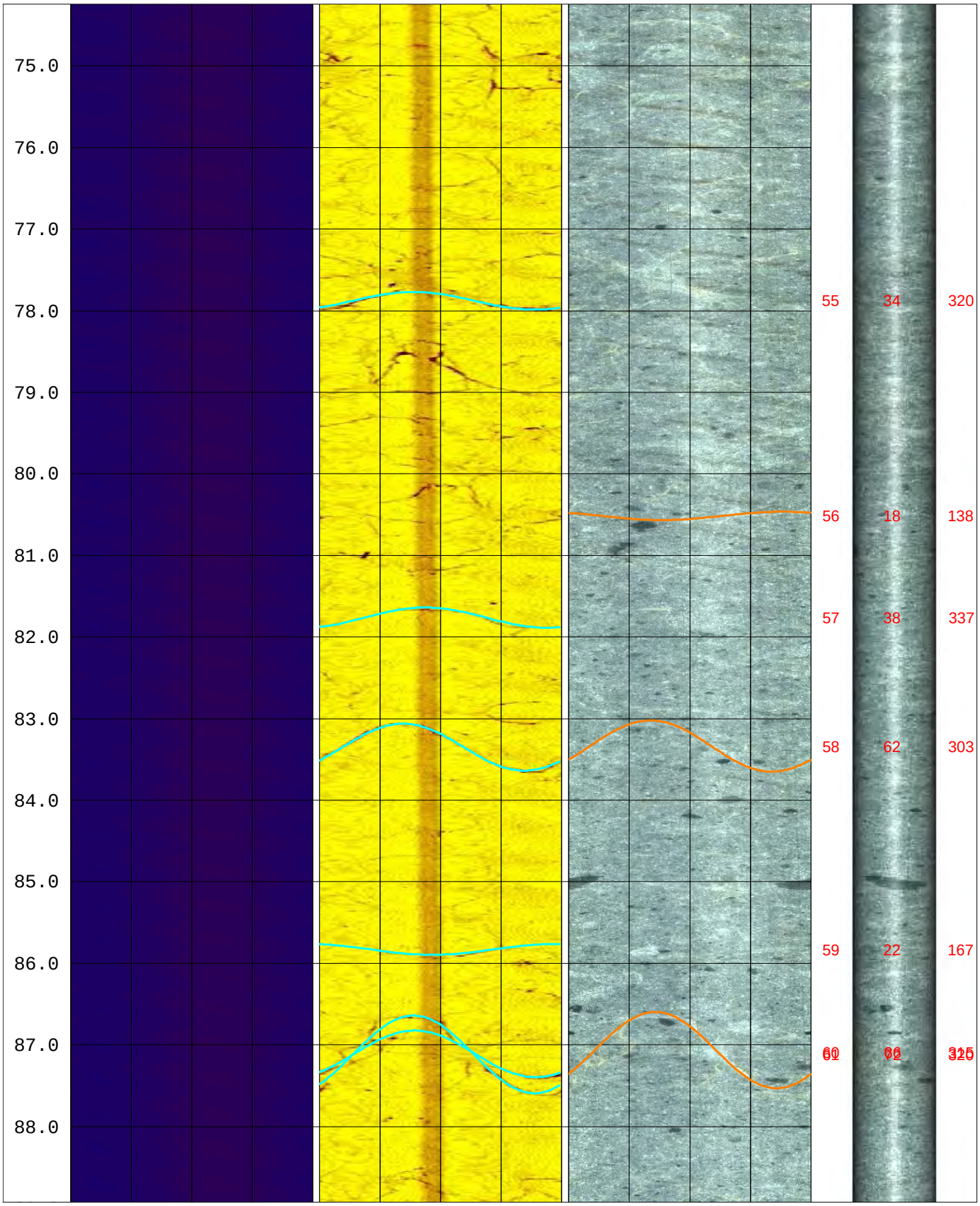


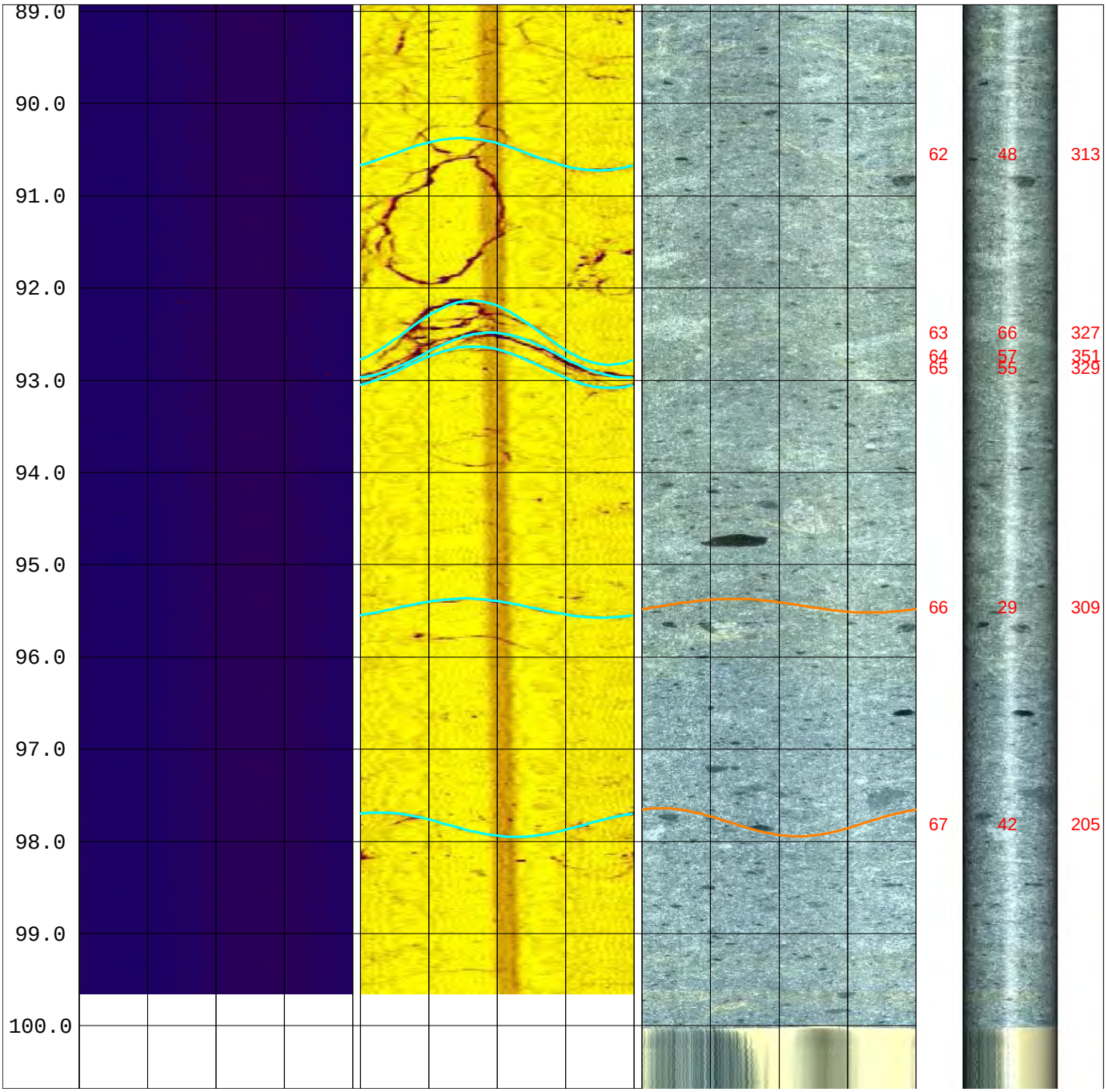

16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
4 20 348
5 36 338
6 35 335
7 49 196
8 58 338
9 39 201
10 45 212
11 31 119
12 86 72
13 80 69
14 41 43
15 37 62
16 48 62
17 41 49


31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
18 65 185
19 28 54
20 70 171
21 42 66
22 18 48
23 41 58
24 74 123
25 2 353
26 15 59
27 37 288
28 75 176
29 78 78
30 68 12
31 72 16
32 72 283
33 74 283
34 53 11
35 30 13
36 11 44


45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
37 58 337
38 39 347
39 36 323
40 82 278
41 65 354
42 66 305
43 37 258
44 74 1


60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
73.0
74.0
45 69 4
46 54 314
47 59 345
48 77 256
49 75 265
50 61 315
51 61 343
52 48 197
53 70 295
54 23 180


75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
55 34 320
56 18 138
57 38 337
58 62 303
59 22 167

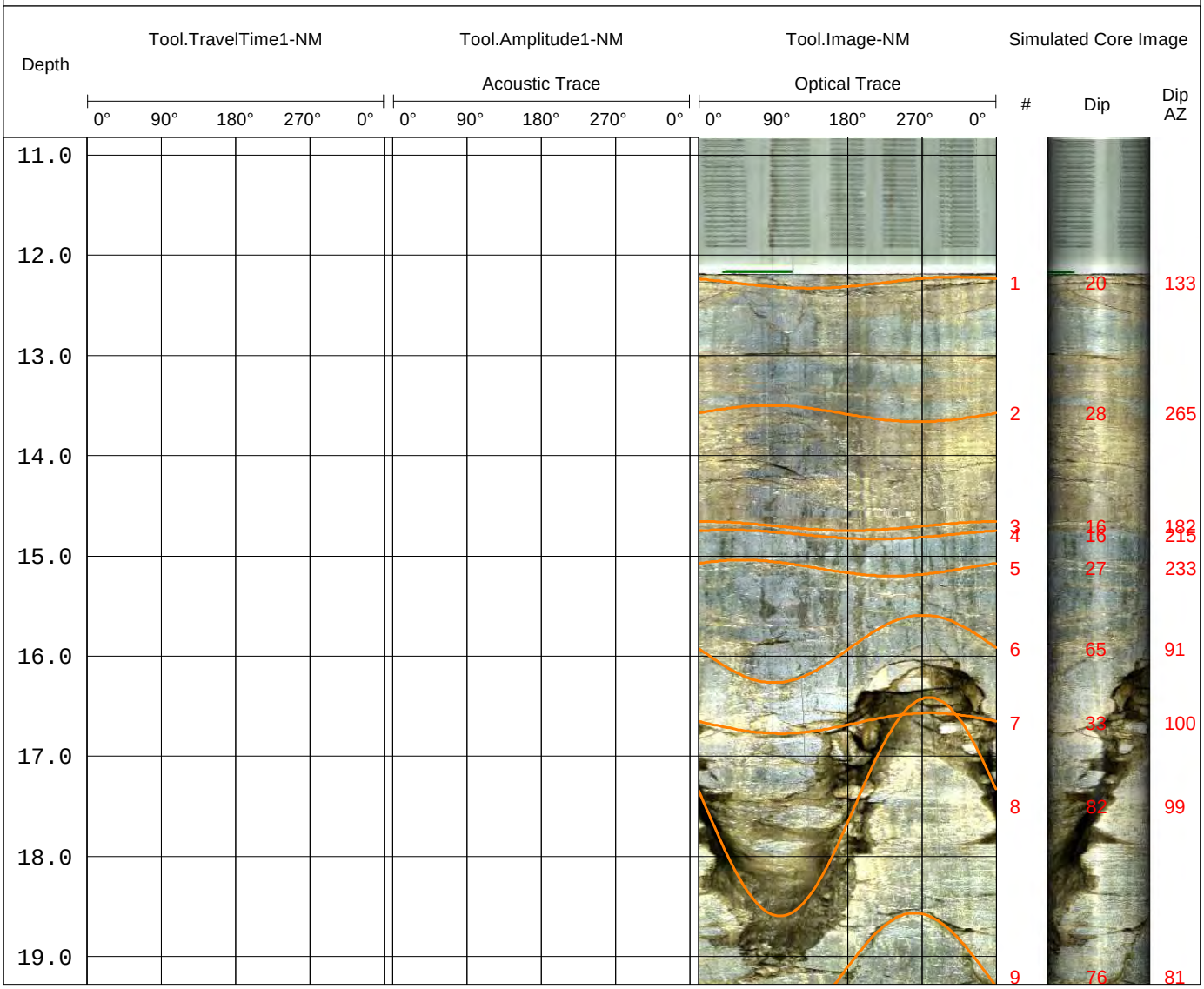

89.0
90.0
91.0
92.0
93.0
94.0
95.0
96.0
97.0
98.0
99.0
100.0
62 48 313
63 66 327
64 57 351
65 55 329
66 29 309
67 42 205

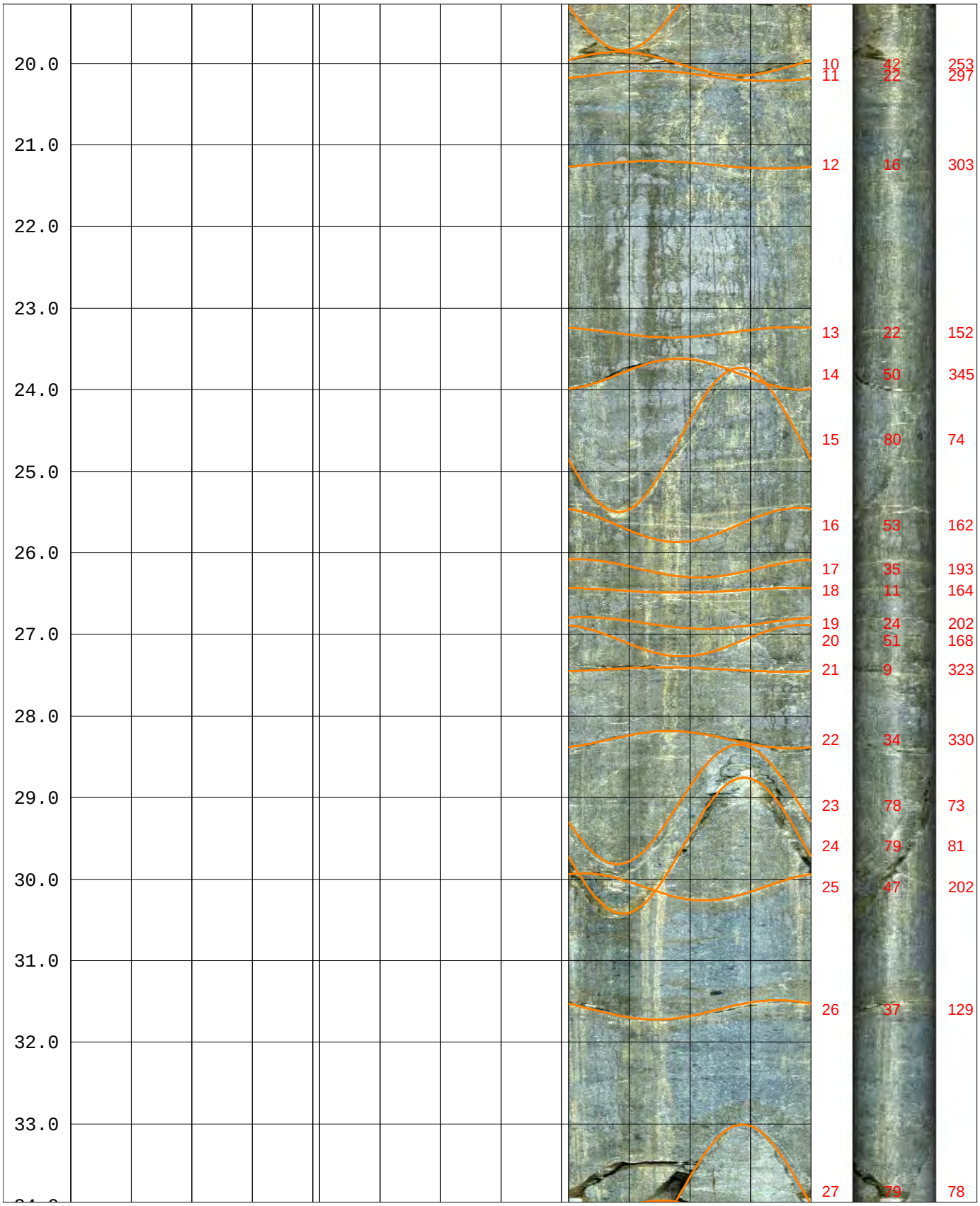
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

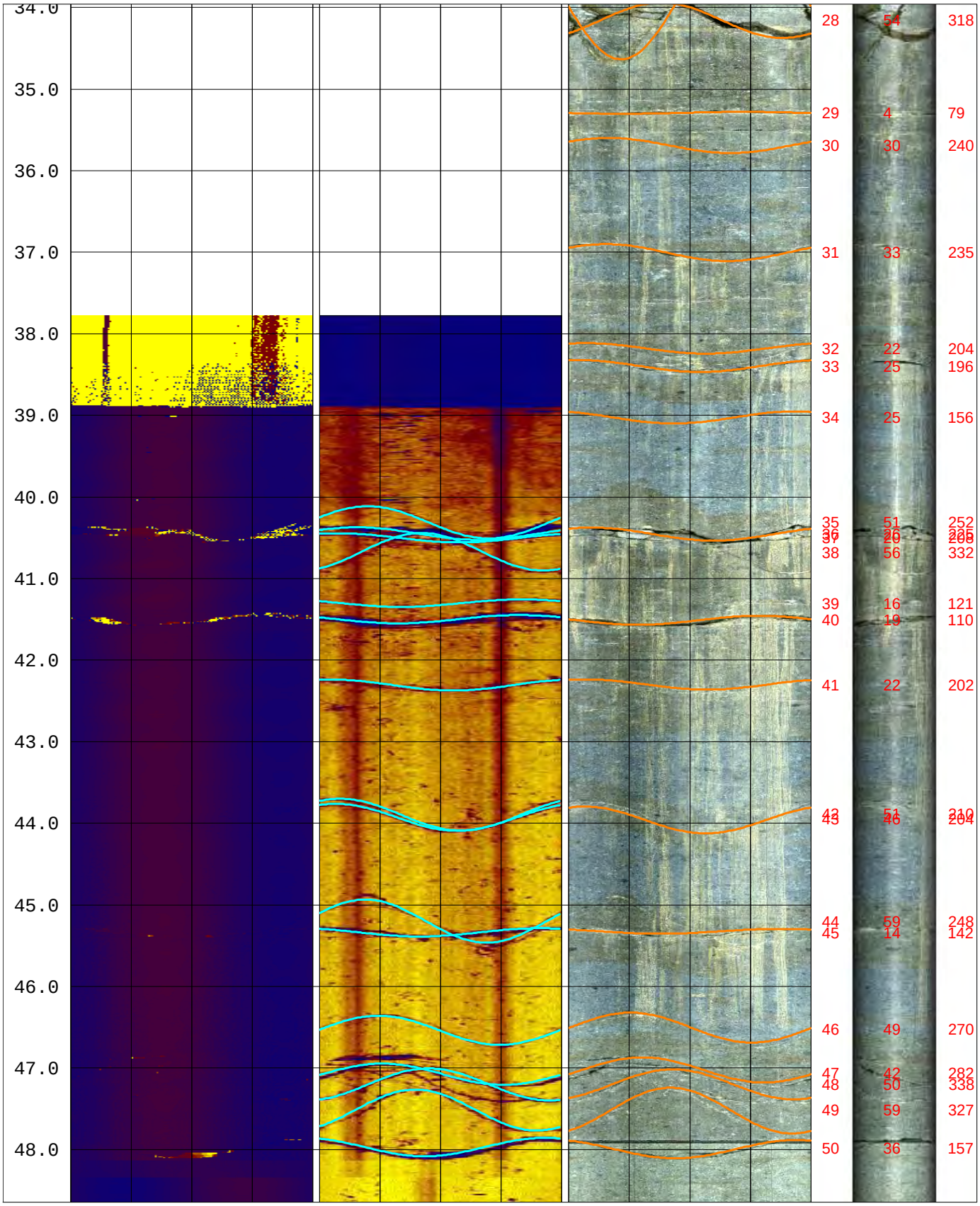
Date Logged:	October 19, 2007	Borehole ID:	SI-07-07
File Name:	SI0707-2M.wcl	Logged By:	F G Kruger

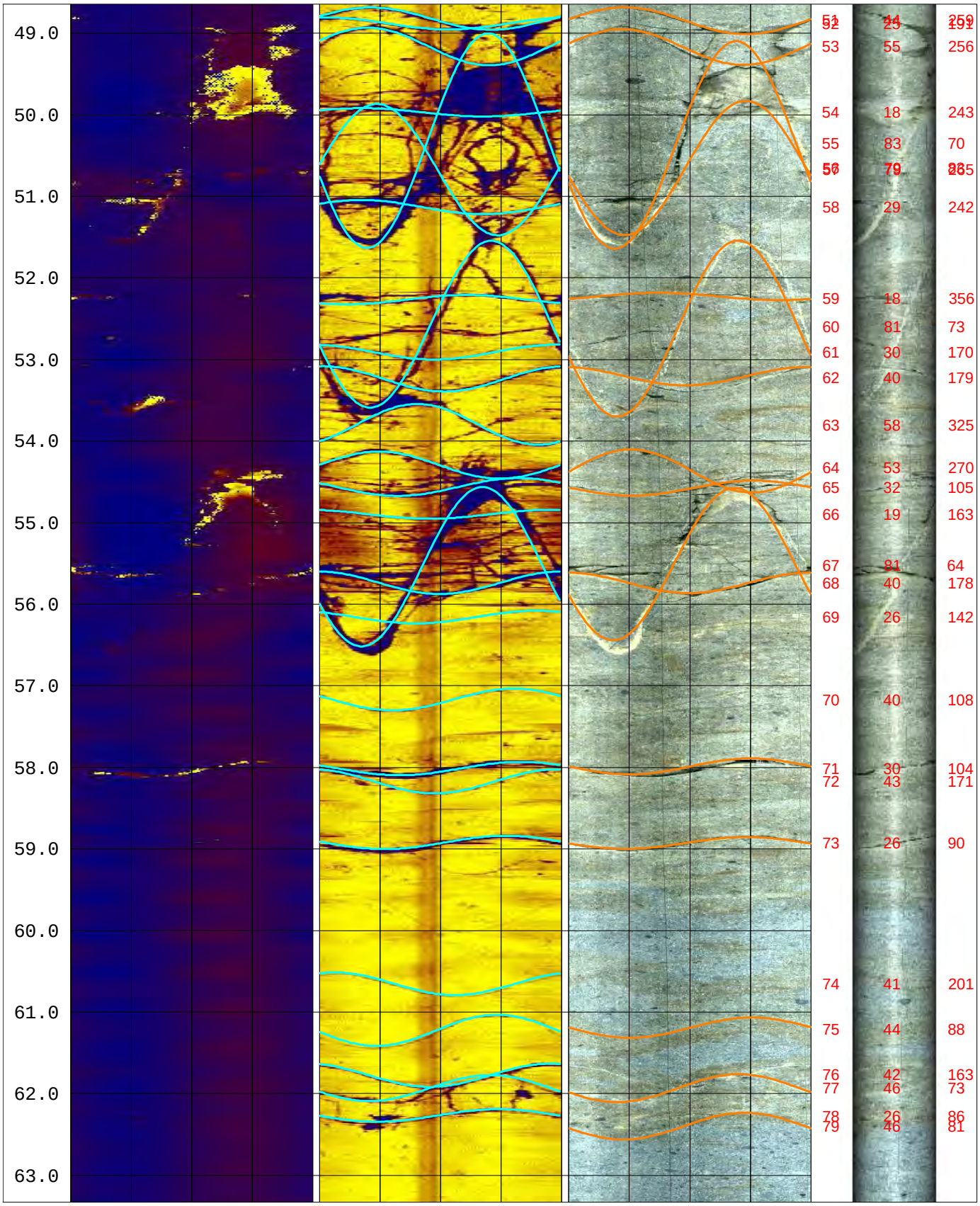
Notes:

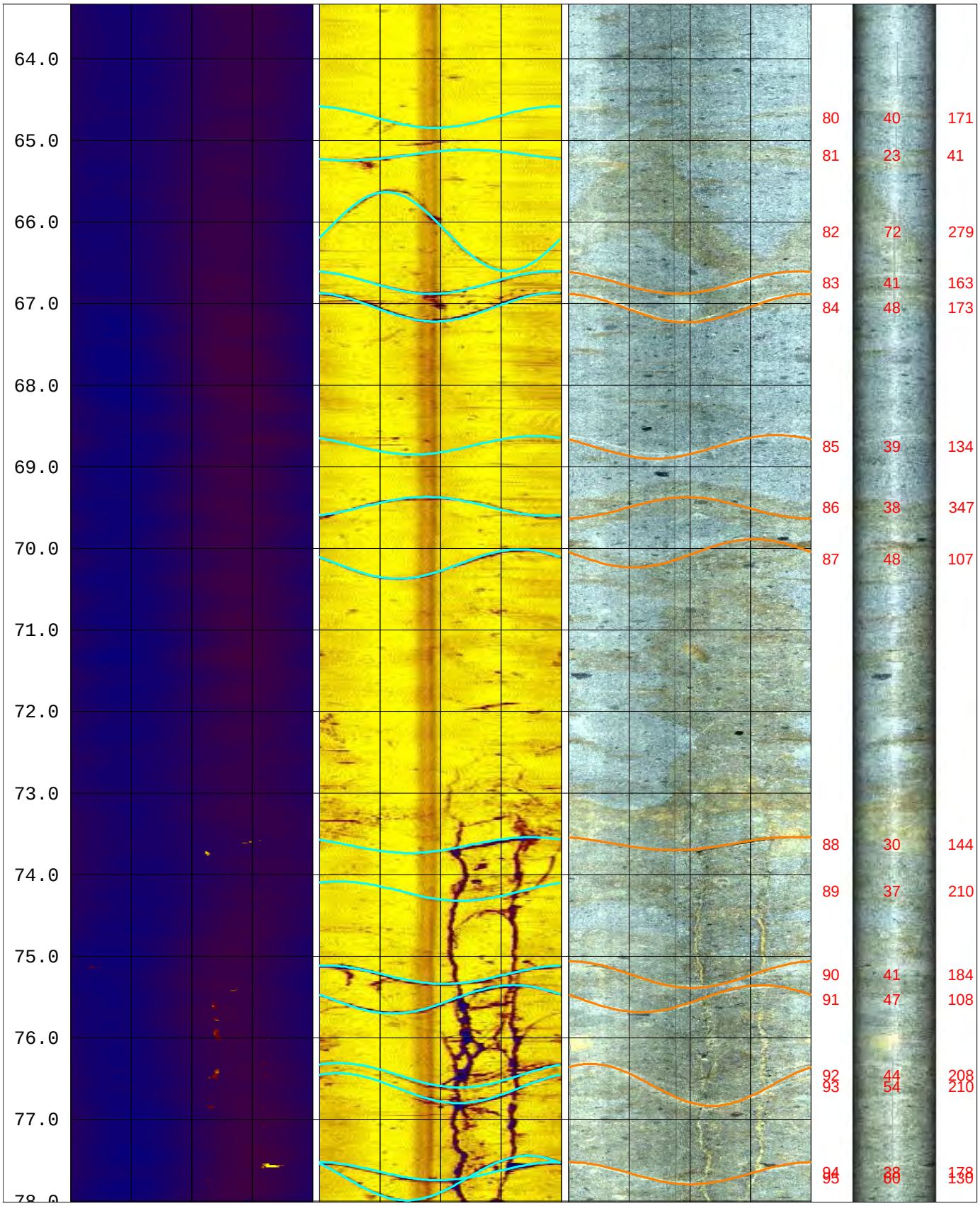
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

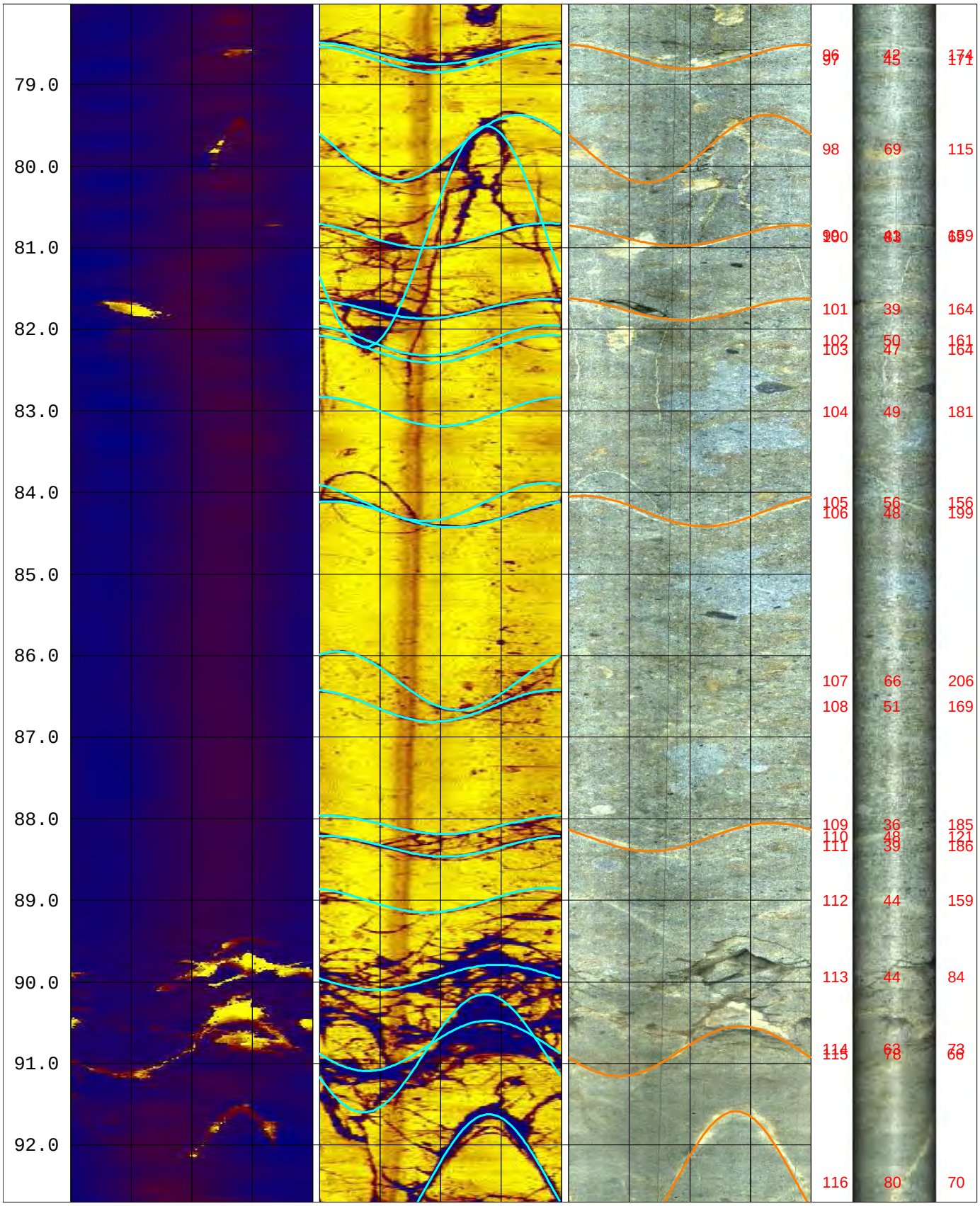


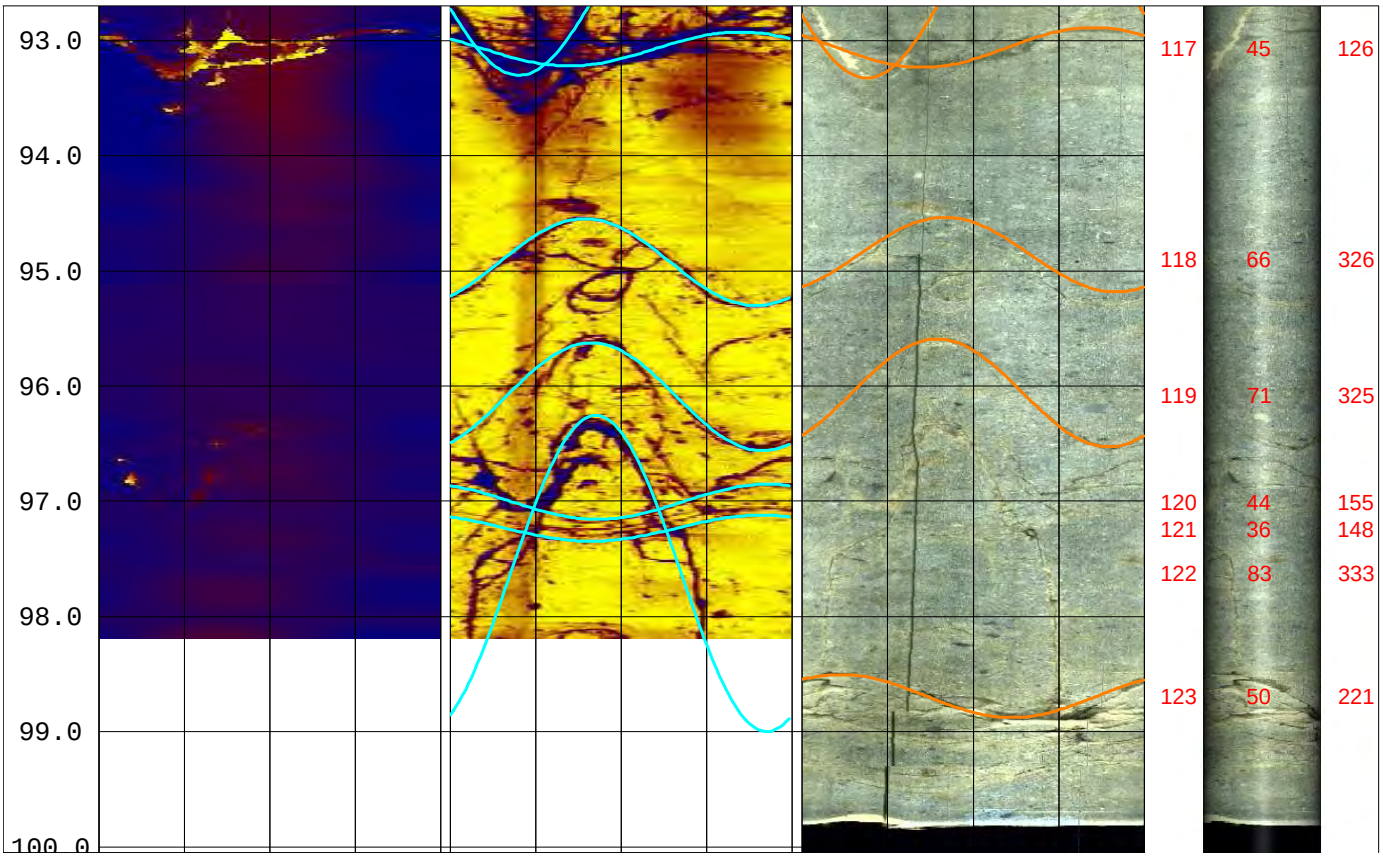

20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
10 42 253
11 22 297
12 16 303
13 22 152
14 50 345
15 80 74
16 53 162
17 35 193
18 11 164
19 24 202
20 51 168
21 9 323
22 34 330
23 78 73
24 79 81
25 47 202
26 37 129
27 79 78


34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
28 54 318
29 4 79
30 30 240
31 33 235
32 22 204
33 25 196
34 25 156
35 51 252
38 56 332
39 16 121
40 19 110
41 22 202
44 59 248
45 14 142
46 49 270
47 42 282
48 50 338
49 59 327
50 36 157


49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
62.0
63.0
51 14 259
52 25 191
53 55 256
54 18 243
55 83 70
56 79 285
57
58 29 242
59 18 356
60 81 73
61 30 170
62 40 179
63 58 325
64 53 270
65 32 105
66 19 163
67 81 64
68 40 178
69 26 142
70 40 108
71 30 104
72 43 171
73 26 90
74 41 201
75 44 88
76 42 163
77 46 73
78 26 86
79 46 81


64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
80 40 171
81 23 41
82 72 279
83 41 163
84 48 173
85 39 134
86 38 347
87 48 107
88 30 144
89 37 210
90 41 184
91 47 108
92 44 208
93 54 210
94 28 178
95 60 130


79.0
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
96 42 174
97 45 171
98 69 115
100 83 159
101 39 164
102 50 161
103 47 164
104 49 181
105 56 156
106 48 199
107 66 206
108 51 169
109 36 185
110 48 121
111 39 186
112 44 159
113 44 84
114 63 73
115 78 66
116 80 70

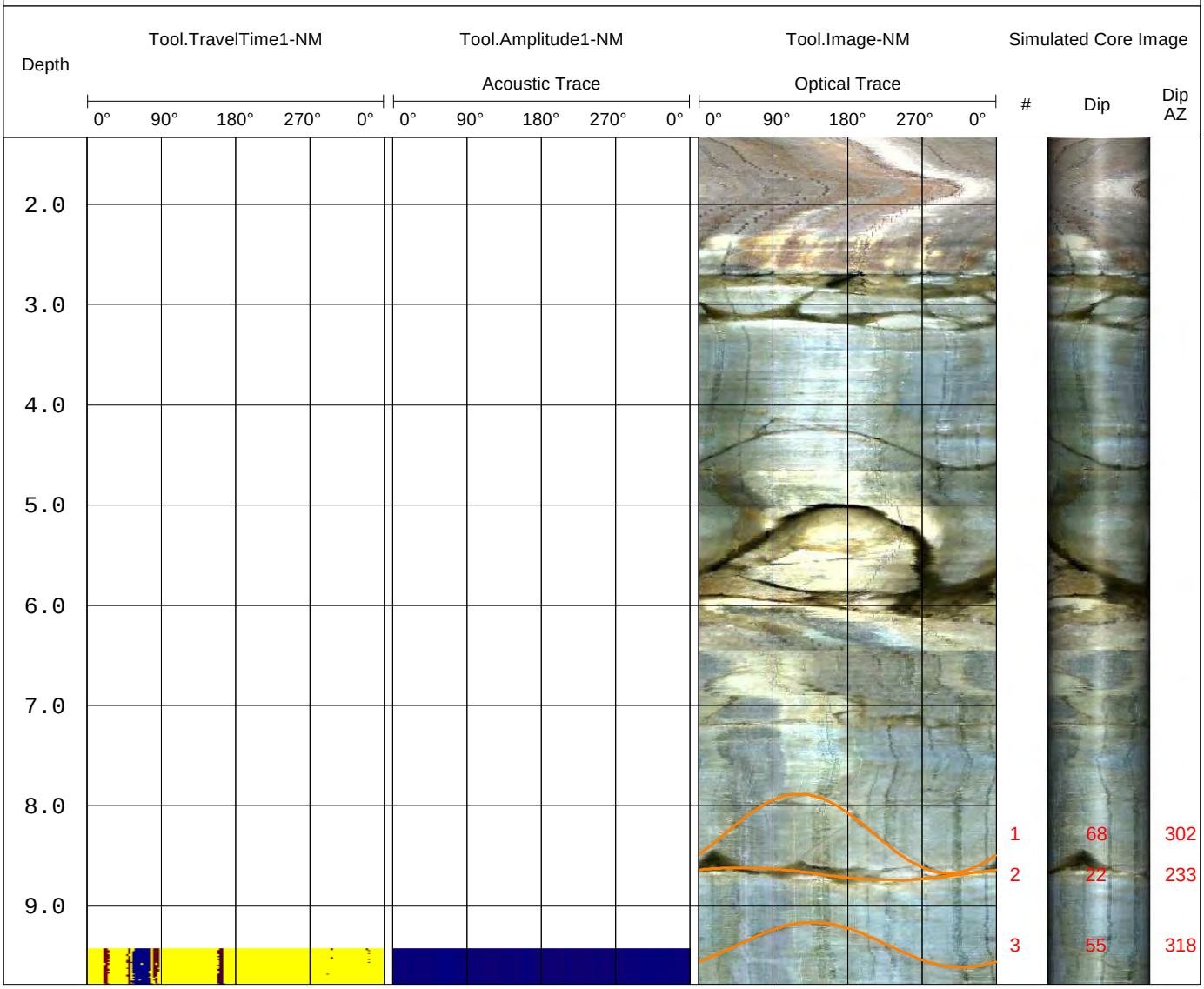

93.0
94.0
95.0
96.0
97.0
98.0
99.0
100.0
117 45 126
118 66 326
119 71 325
120 44 155
121 36 148
122 83 333
123 50 221

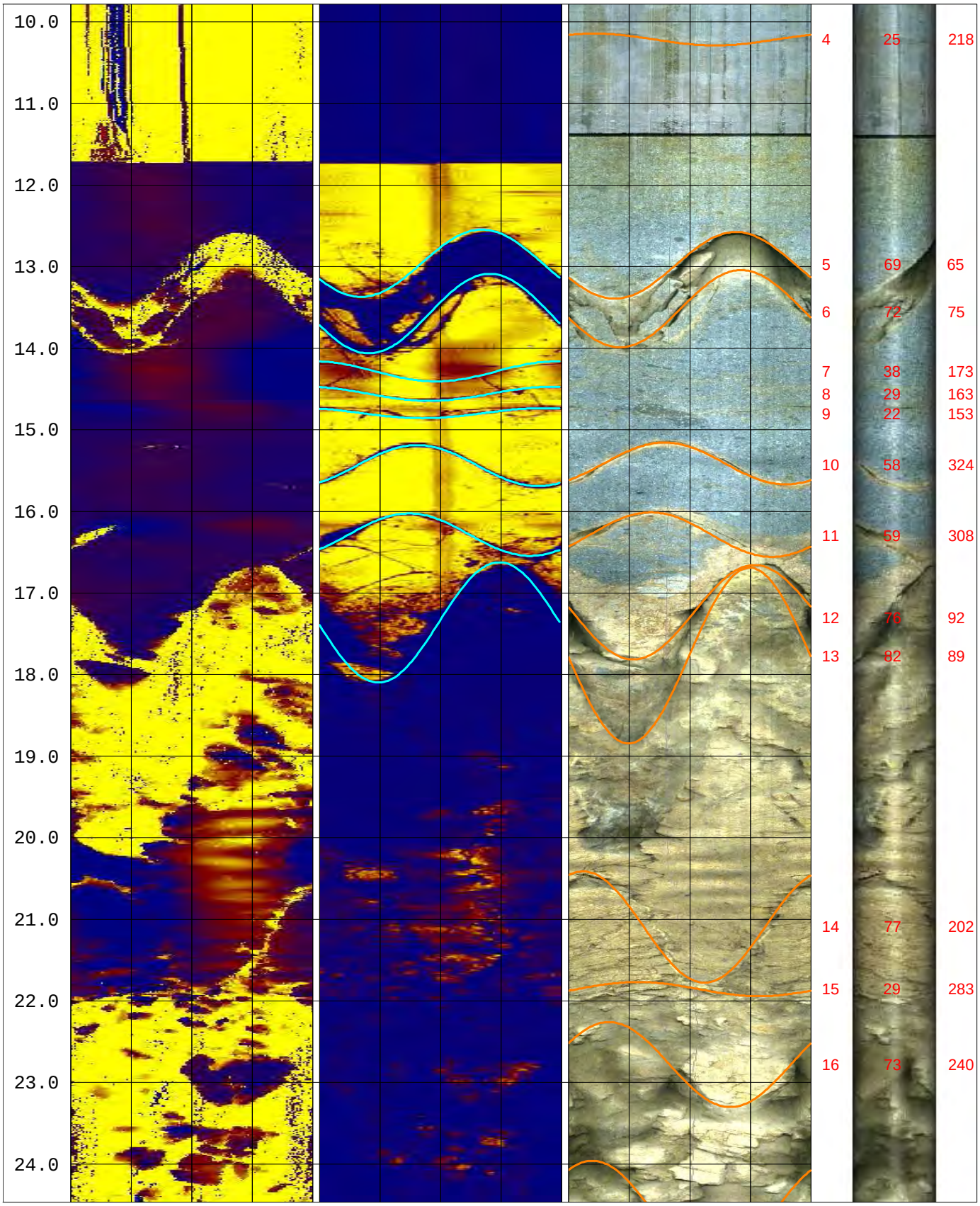
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

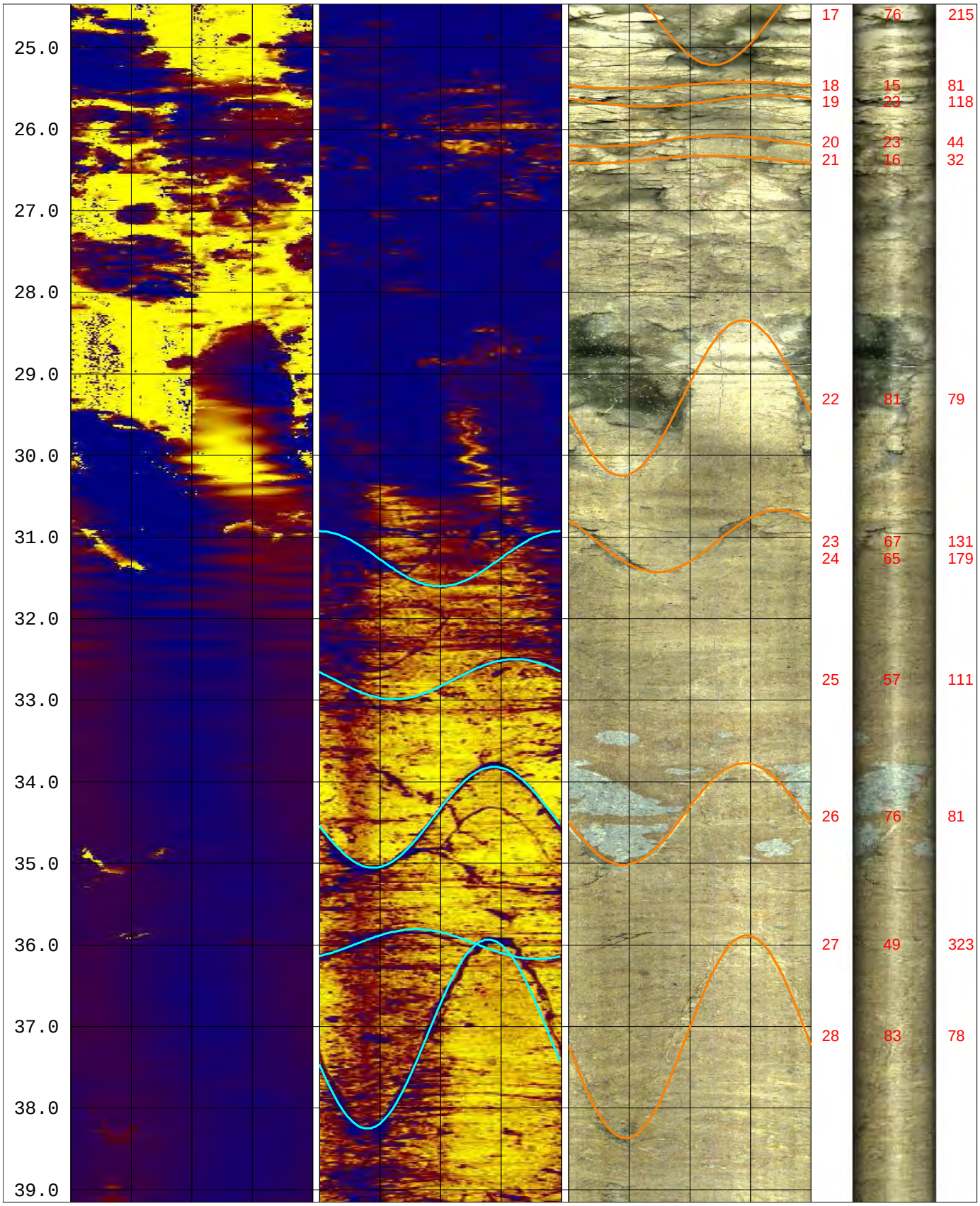
Date Logged:	October 21, 2007	Borehole ID:	SI-08-07
File Name:	SI0807-2M.wcl	Logged By:	F G Kruger

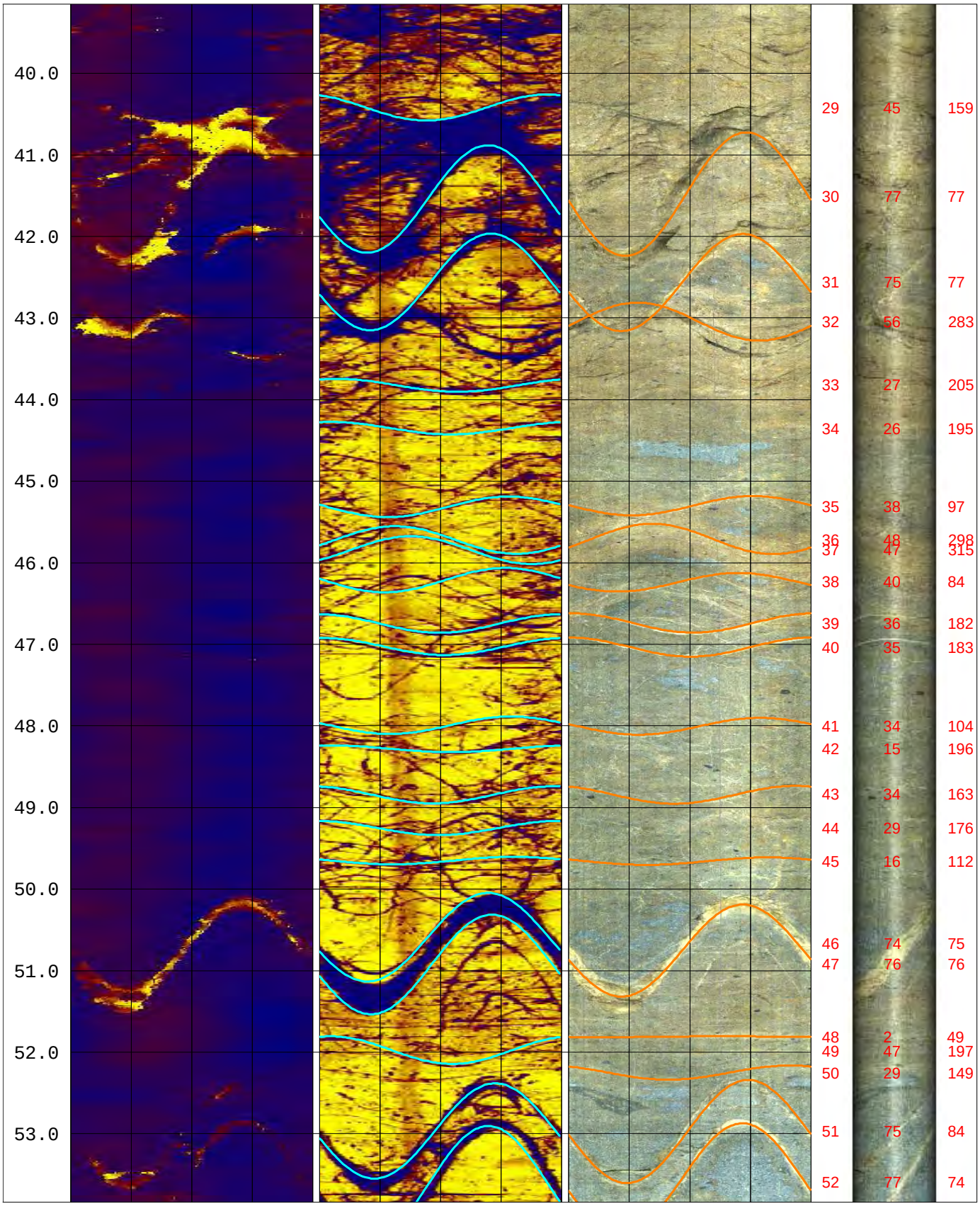
Notes:

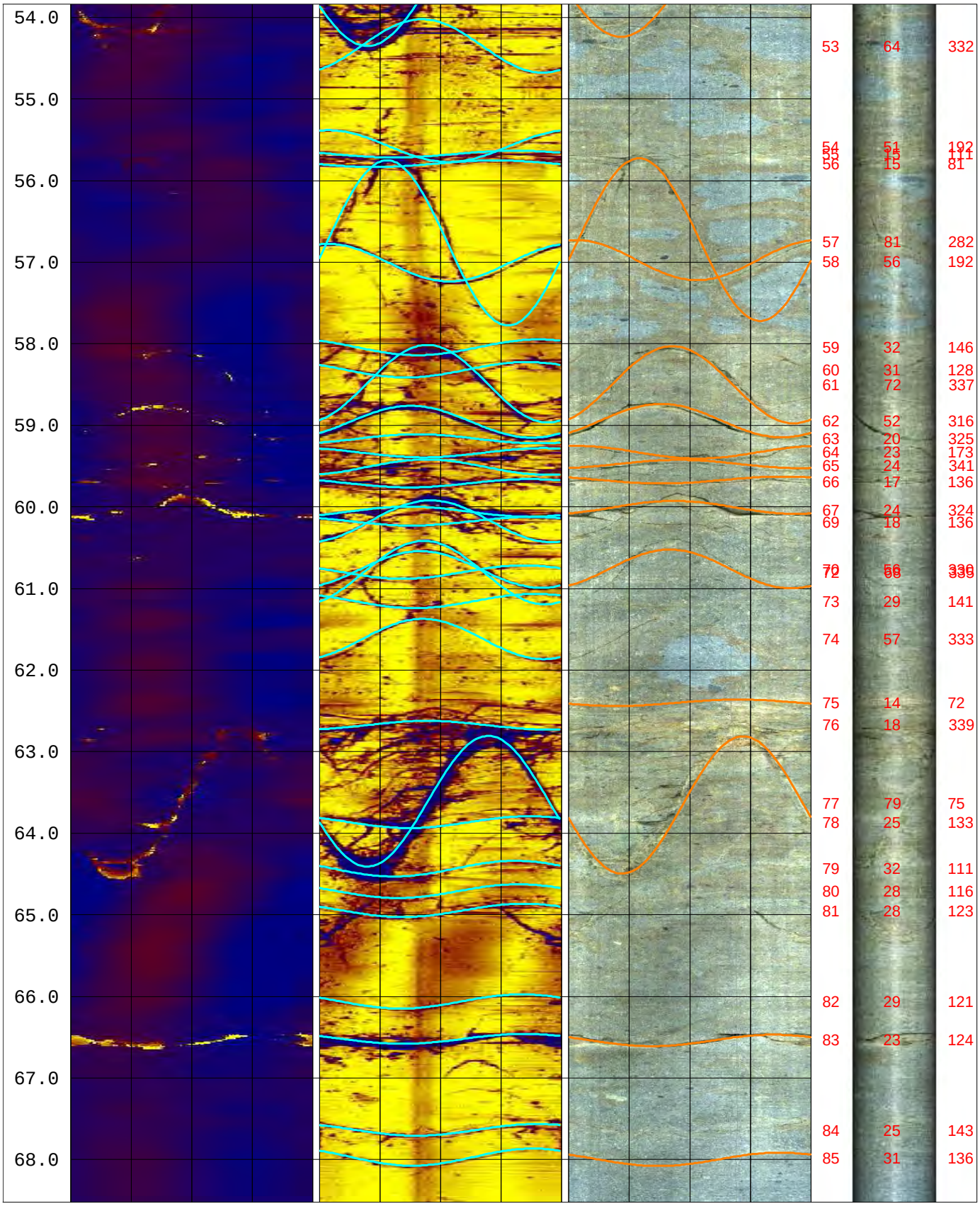
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

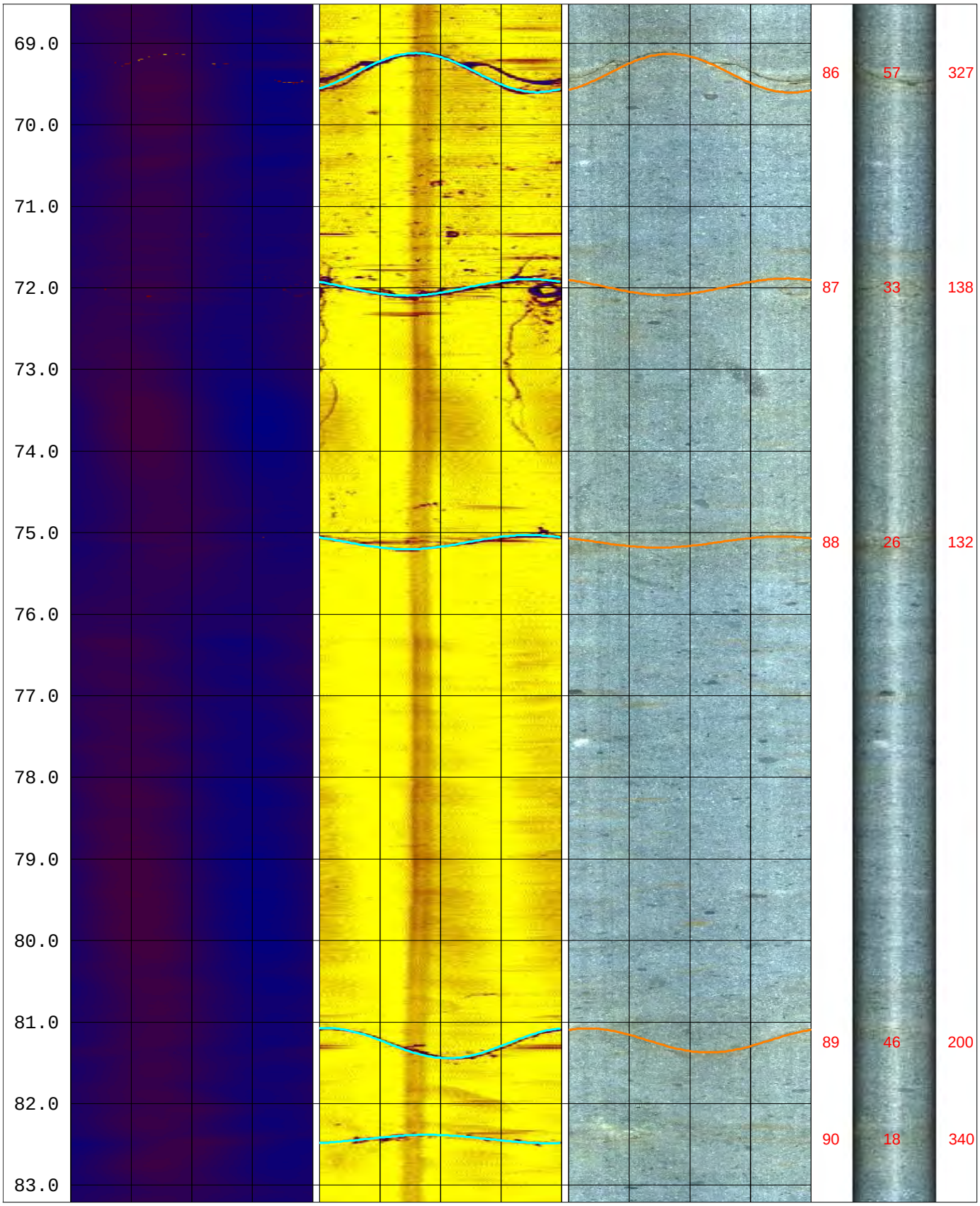


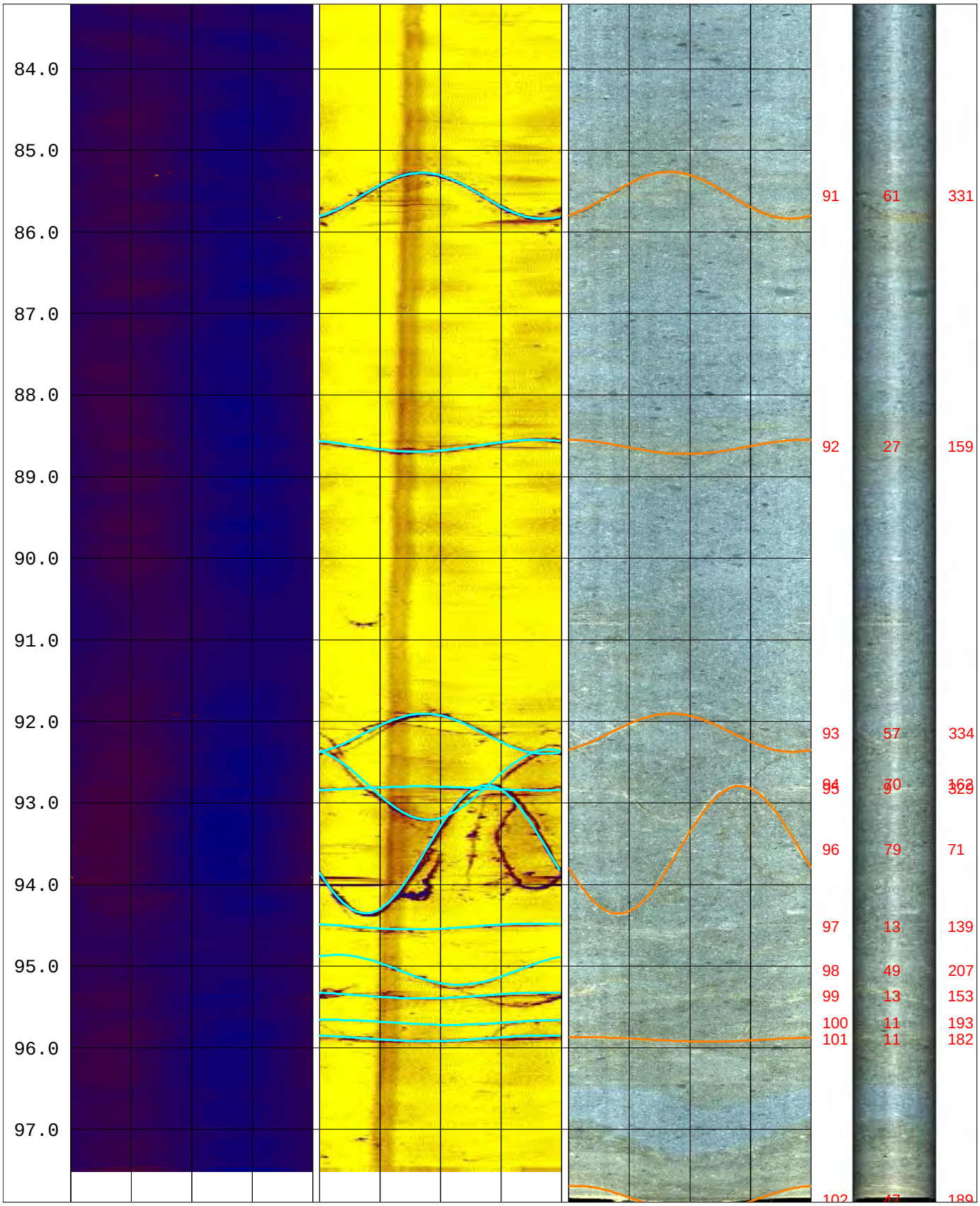

10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
4 25 218
5 69 65
6 72 75
7 38 173
8 29 163
9 22 153
10 58 324
11 59 308
12 76 92
13 82 89
14 77 202
15 29 283
16 73 240


25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
17 76 215
18 15 81
19 23 118
20 23 44
21 16 32
22 81 79
23 67 131
24 65 179
25 57 111
26 76 81
27 49 323
28 83 78


40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
29 45 159
30 77 77
31 75 77
32 56 283
33 27 205
34 26 195
35 38 97
36 48 298
37 47 315
38 40 84
39 36 182
40 35 183
41 34 104
42 15 196
43 34 163
44 29 176
45 16 112
46 74 75
47 76 76
48 2 49
49 47 197
50 29 149
51 75 84
52 77 74


54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
53 64 332
54 51 192
55 34 111
56 15 81
57 81 282
58 56 192
59 32 146
60 31 128
61 72 337
62 52 316
63 20 325
64 23 173
65 24 341
66 17 136
67 24 324
69 18 136
70 56 330
72 60 339
73 29 141
74 57 333
75 14 72
76 18 339
77 79 75
78 25 133
79 32 111
80 28 116
81 28 123
82 29 121
83 23 124
84 25 143
85 31 136


69.0
70.0
71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
86 57 327
87 33 138
88 26 132
89 46 200
90 18 340


84.0
85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
96.0
97.0
91 61 331
92 27 159
93 57 334
94 70 162
95 9 329
96 79 71
97 13 139
98 49 207
99 13 153
100 11 193
101 11 182
102 47 189

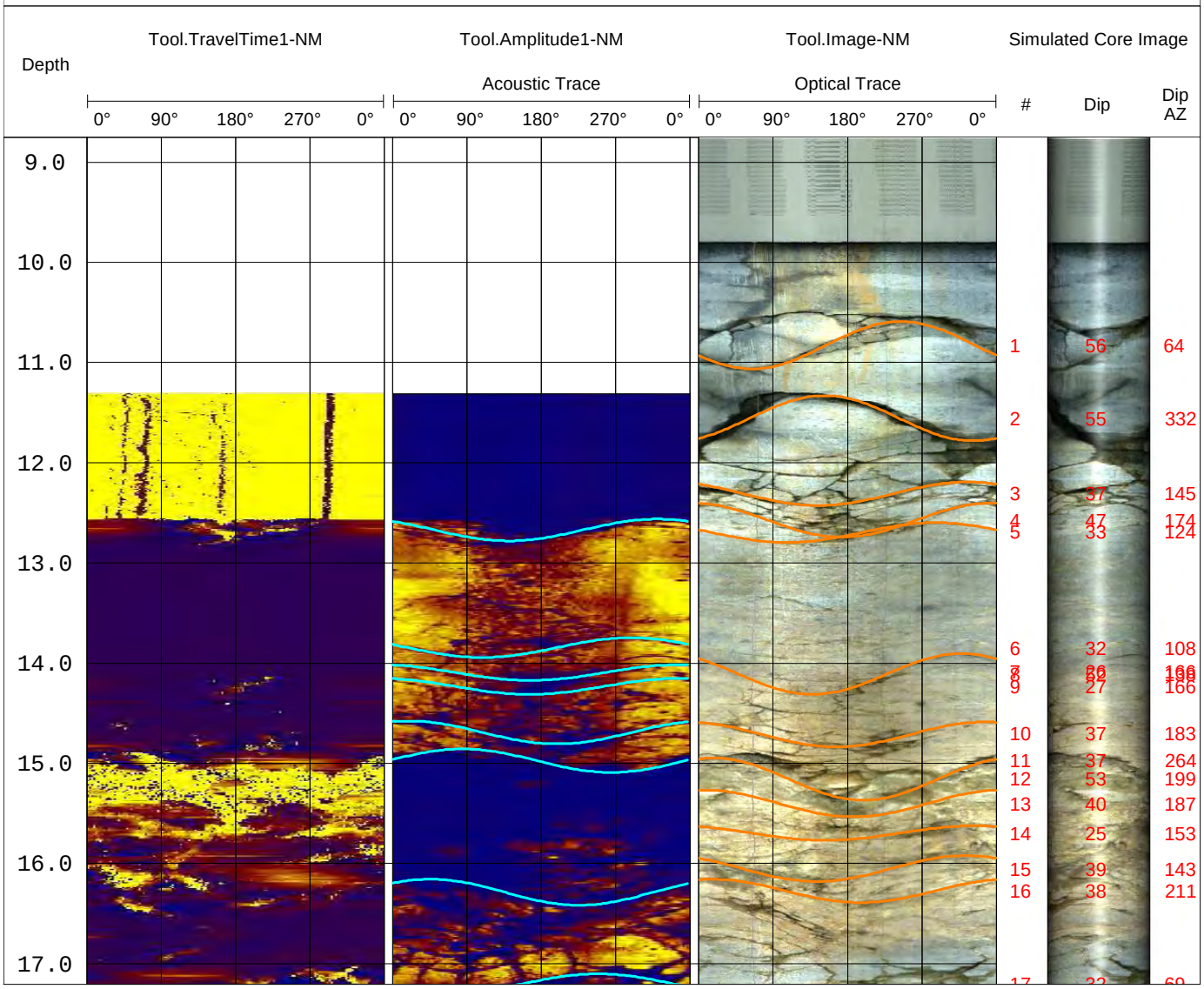
98	0											

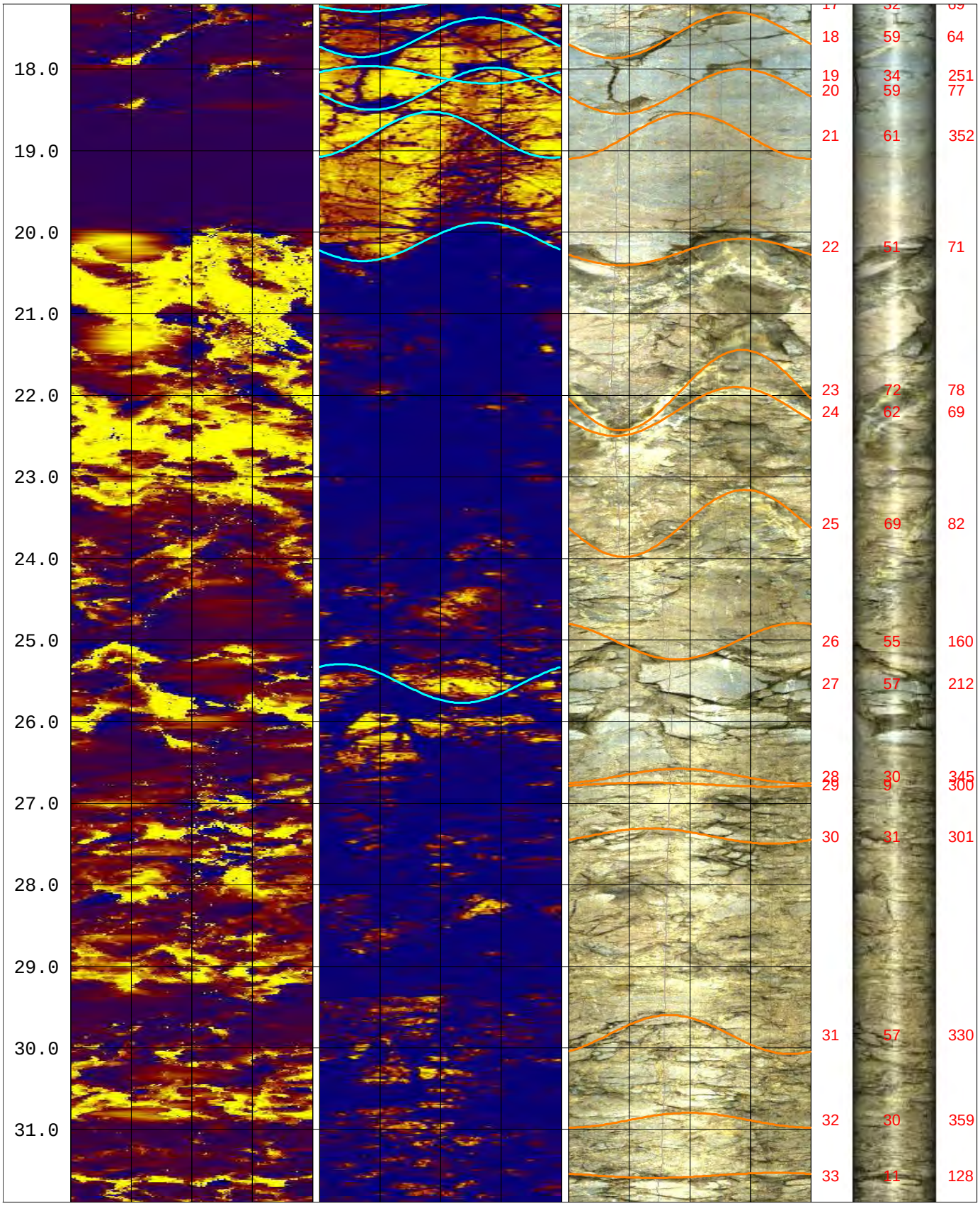
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

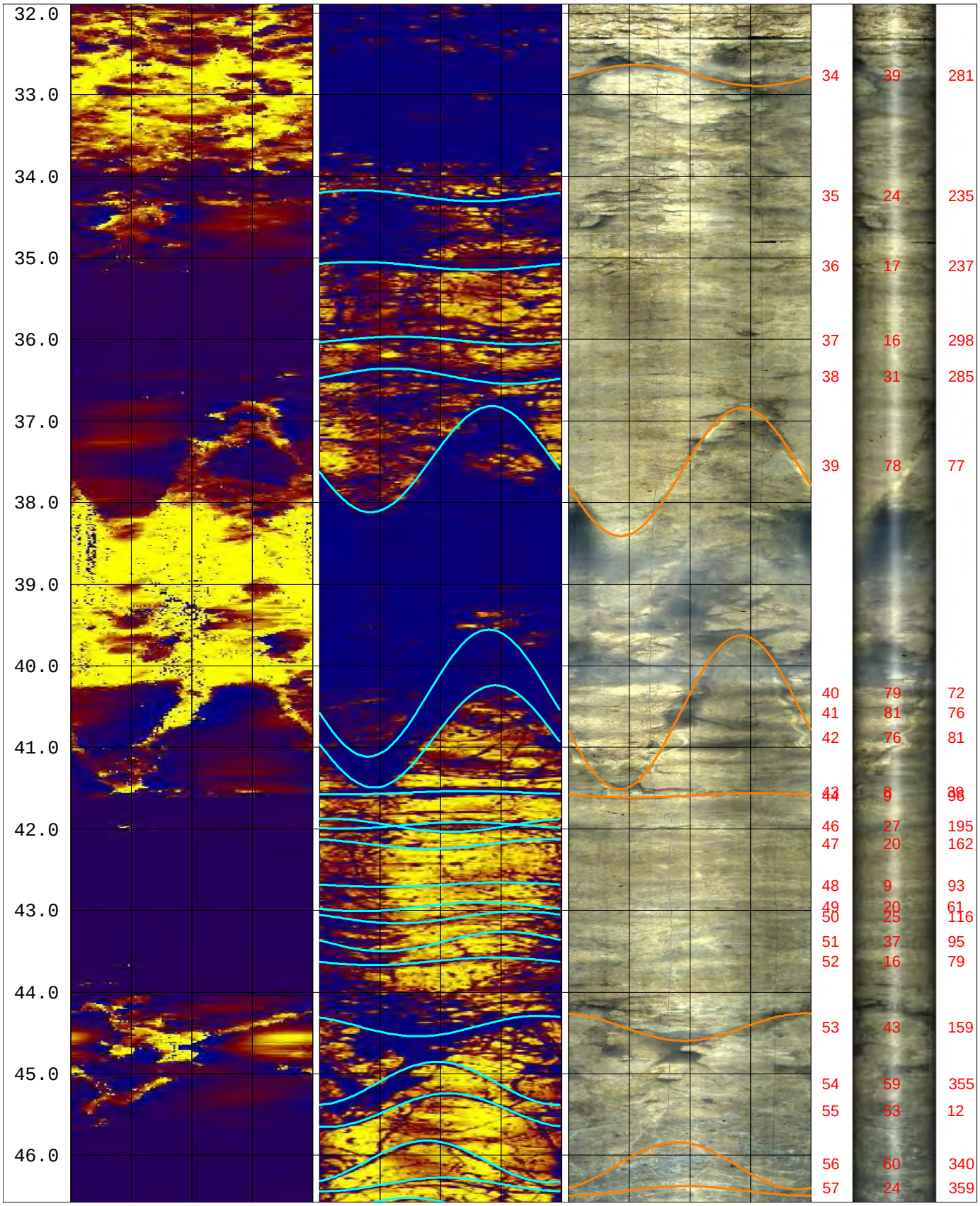
Date Logged:	November 1, 2007	Borehole ID:	SI-09-07
File Name:	SI0907-2M.wcl	Logged By:	F G Kruger

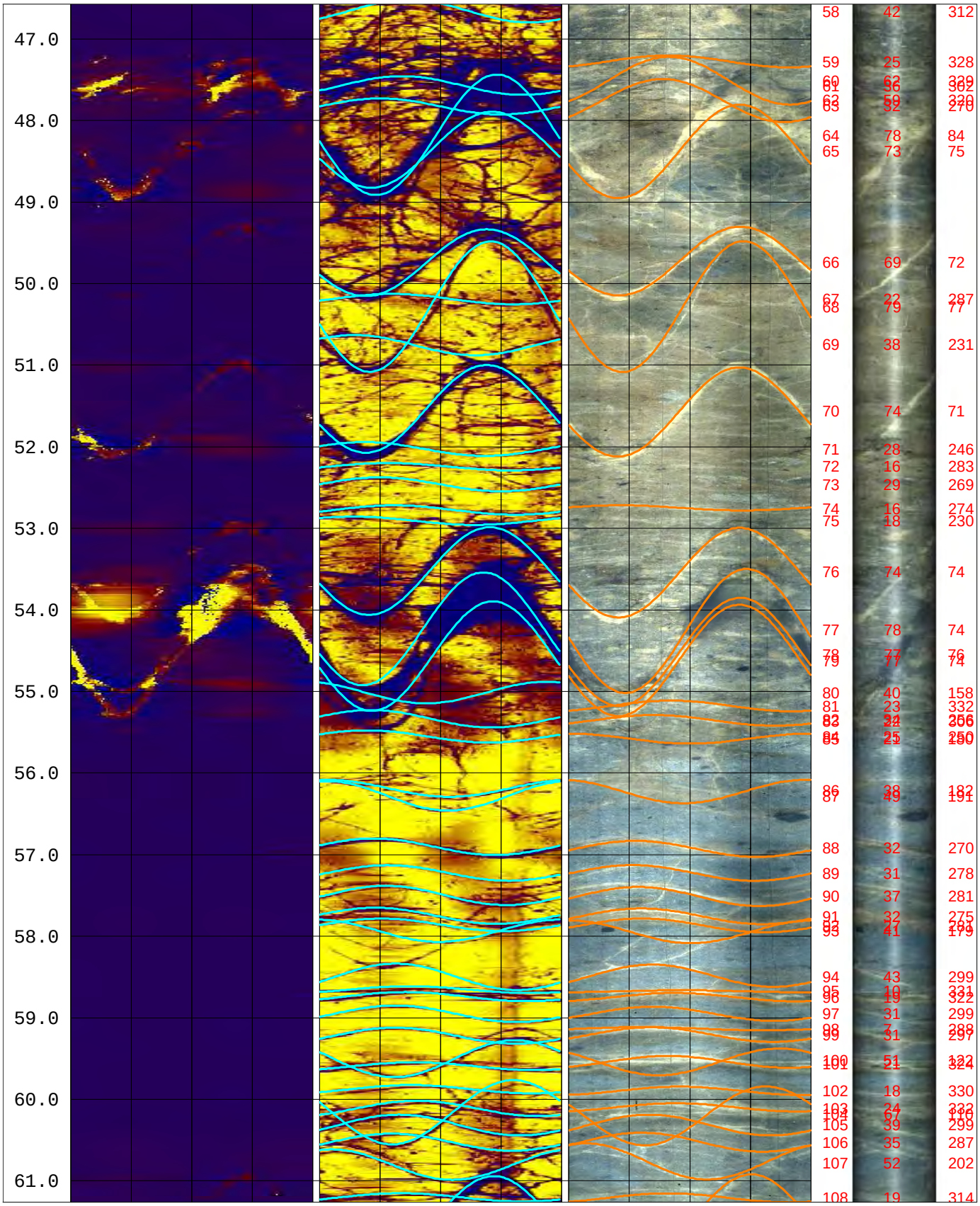
Notes:

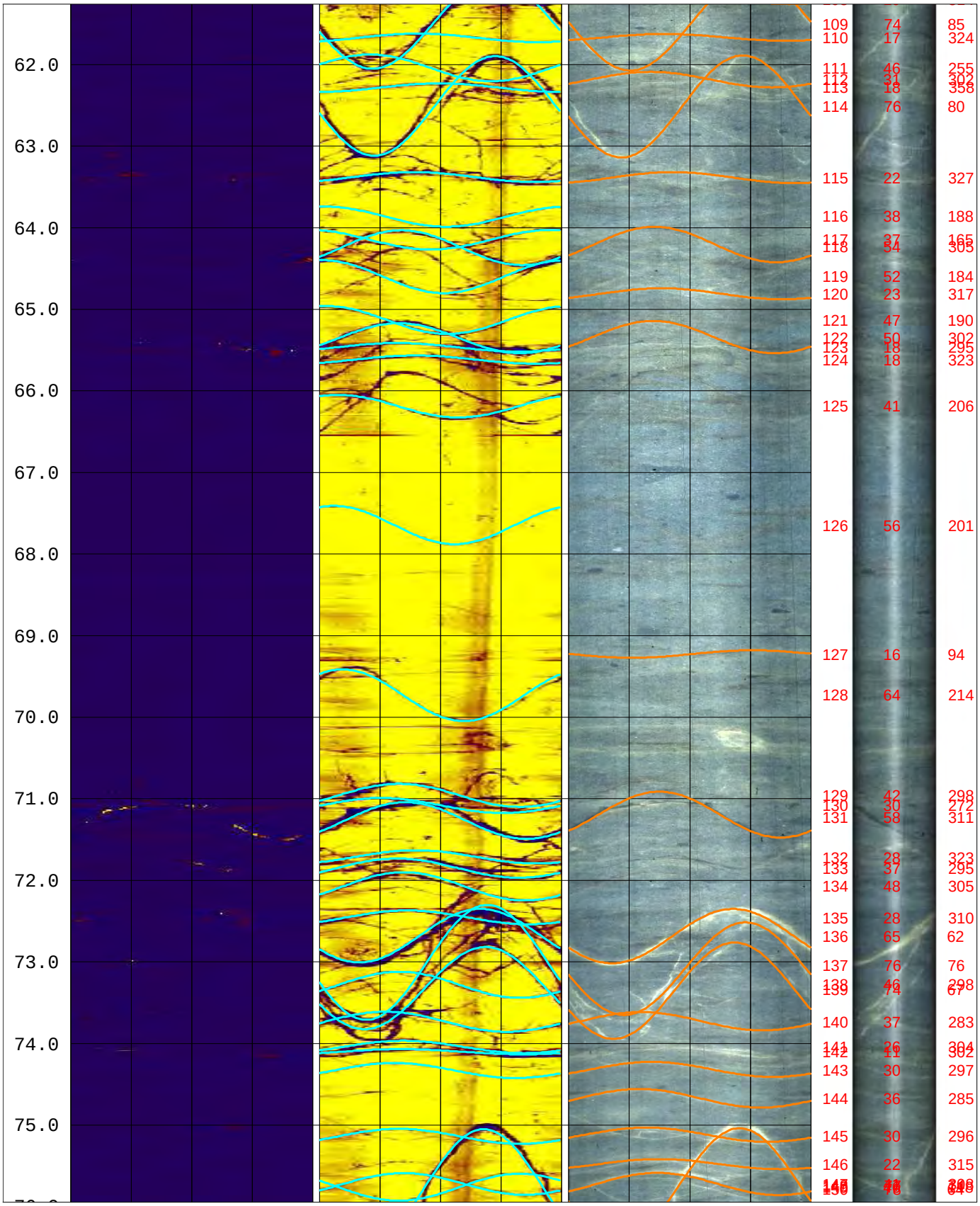
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

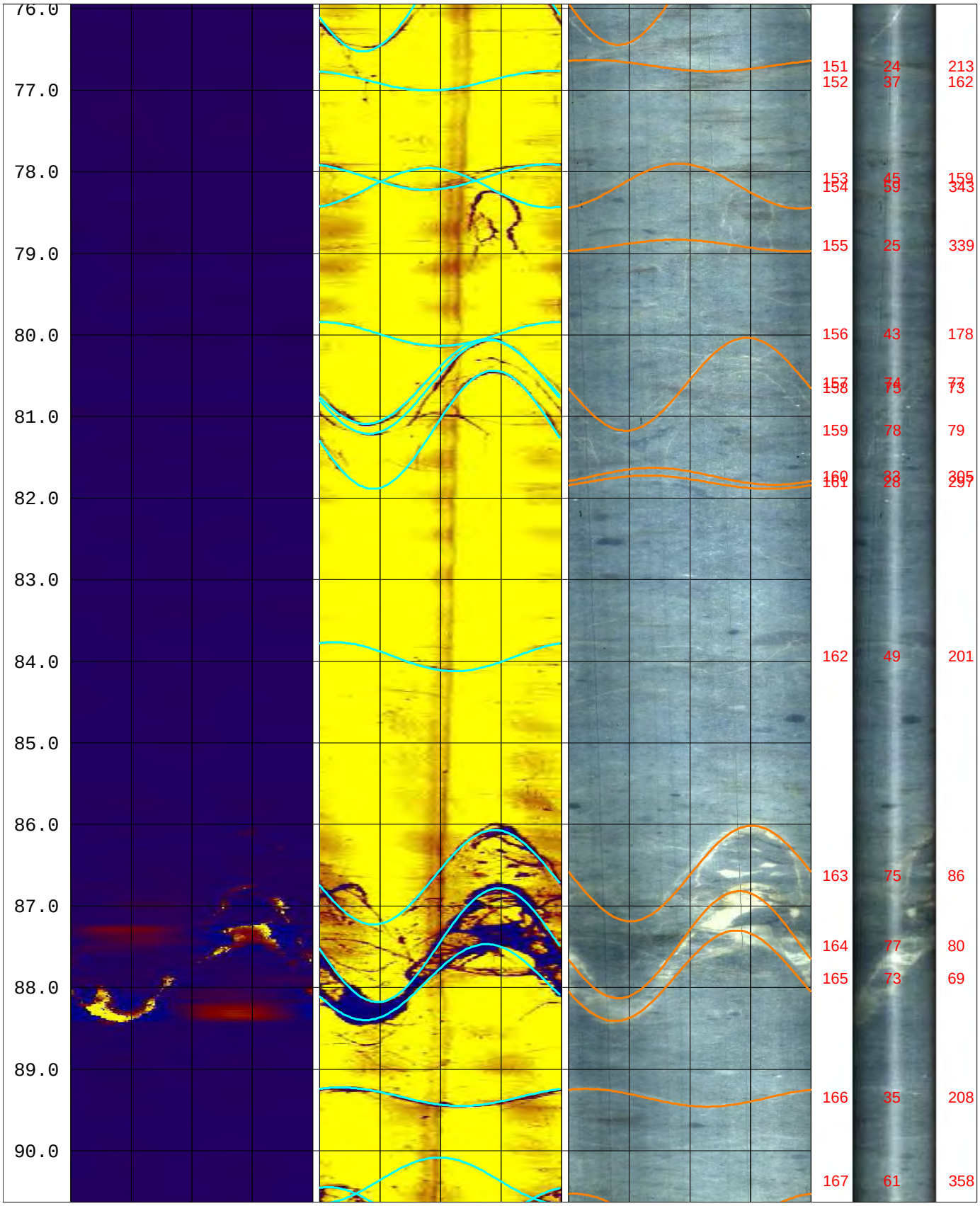


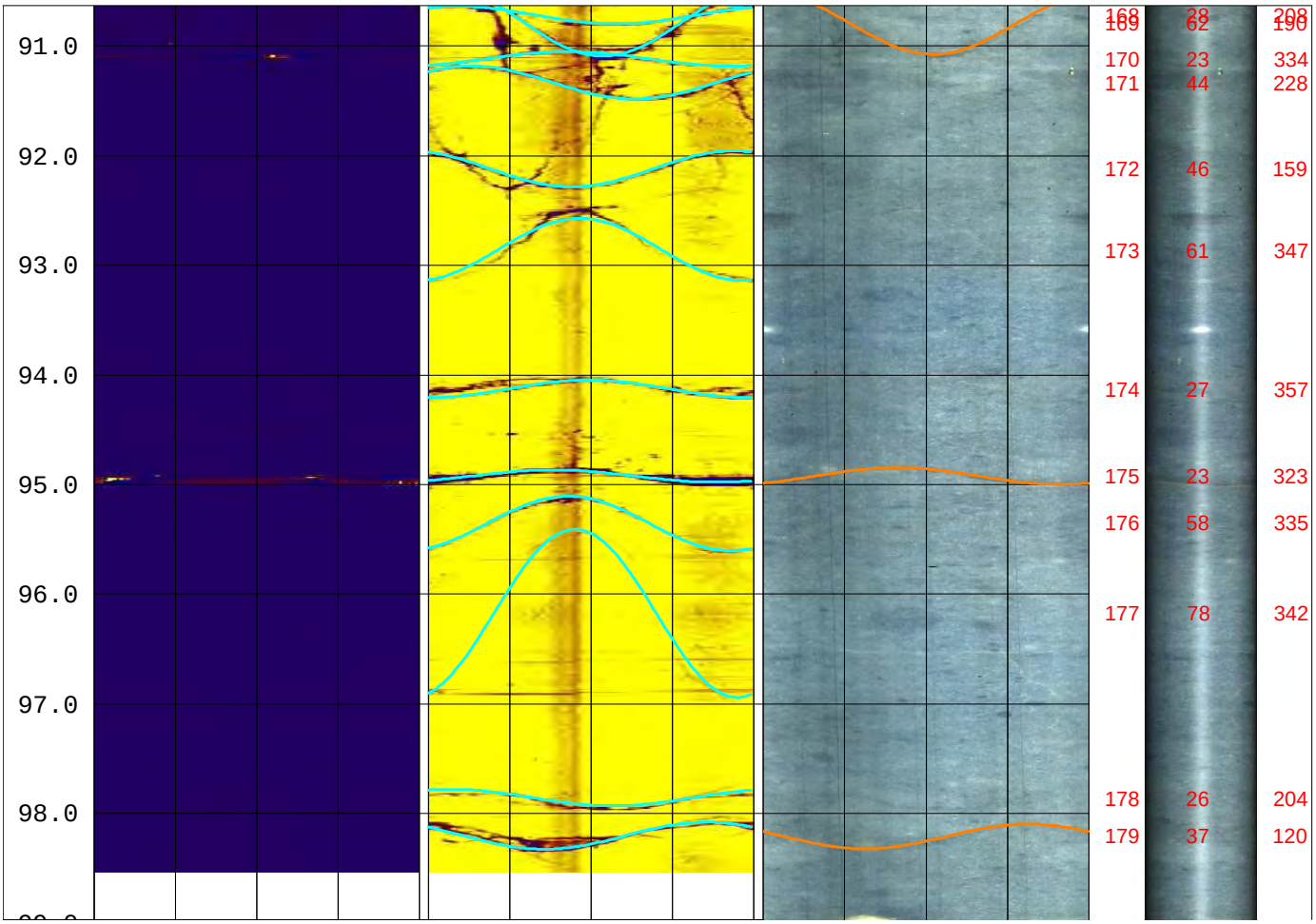

18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
18 59 64
19 34 251
20 59 77
21 61 352
22 51 71
23 72 78
24 62 69
25 69 82
26 55 160
27 57 212
28 30 345
29 9 300
30 31 301
31 57 330
32 30 359
33 11 128


32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
34 39 281
35 24 235
36 17 237
37 16 298
38 31 285
39 78 77
40 79 72
41 81 76
42 76 81
46 27 195
47 20 162
48 9 93
49 20 61
50 25 116
51 37 95
52 16 79
53 43 159
54 59 355
55 53 12
56 60 340
57 24 359


47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
58 42 312
59 25 328
64 78 84
65 73 75
66 69 72
69 38 231
70 74 71
71 28 246
72 16 283
73 29 269
74 16 274
75 18 230
76 74 74
77 78 74
80 40 158
81 23 332
88 32 270
89 31 278
90 37 281
91 32 275
94 43 299
97 31 299
102 18 330
105 39 299
106 35 287
107 52 202
108 19 314


62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
73.0
74.0
75.0
109 74 85
110 17 324
111 46 255
113 18 358
114 76 80
115 22 327
116 38 188
118 54 305
119 52 184
120 23 317
121 47 190
123 18 295
124 18 323
125 41 206
126 56 201
127 16 94
128 64 214
129 42 298
130 30 272
131 58 311
132 28 323
133 37 295
134 48 305
135 28 310
136 65 62
137 76 76
140 37 283
143 30 297
144 36 285
145 30 296
146 22 315


76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
151 24 213
152 37 162
153 45 159
154 59 343
155 25 339
156 43 178
157 74 77
158 75 73
159 78 79
160 33 205
161 28 297
162 49 201
163 75 86
164 77 80
165 73 69
166 35 208
167 61 358

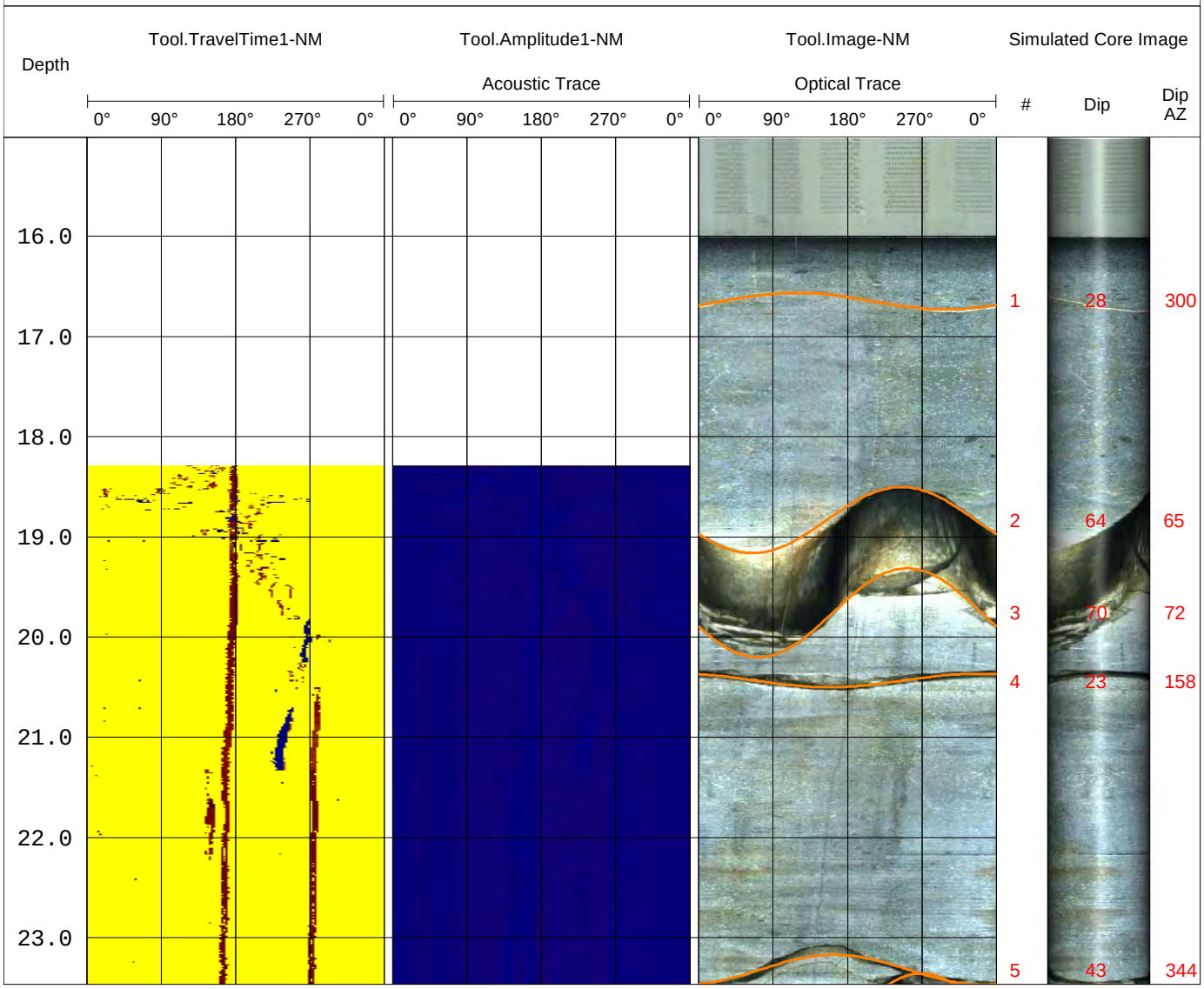

91.0
92.0
93.0
94.0
95.0
96.0
97.0
98.0
168 28 208
169 62 190
170 23 334
171 44 228
172 46 159
173 61 347
174 27 357
175 23 323
176 58 335
177 78 342
178 26 204
179 37 120

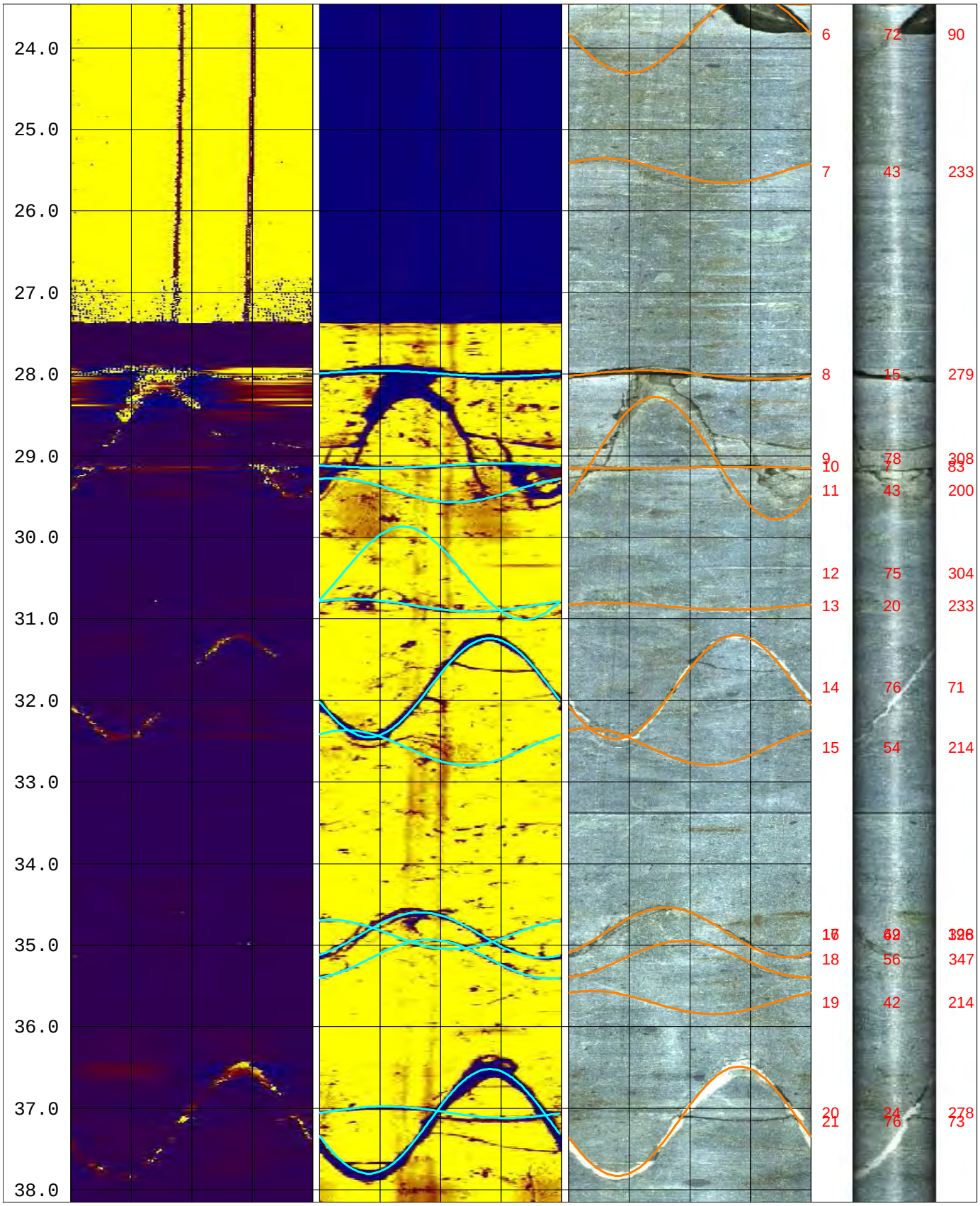
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

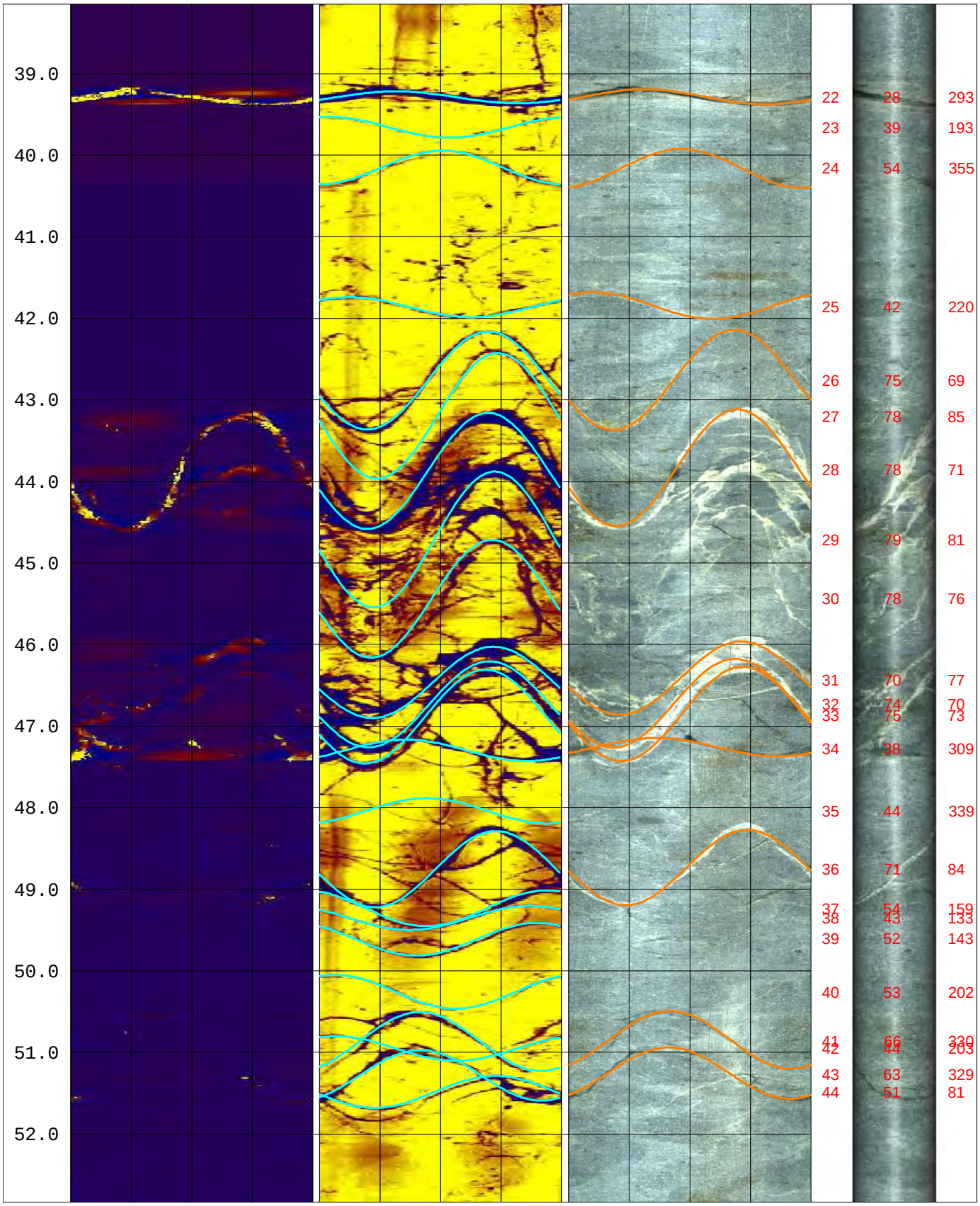
Date Logged:	November 1, 2007	Borehole ID:	SI-10-07
File Name:	SI1007-2M.wcl	Logged By:	F G Kruger

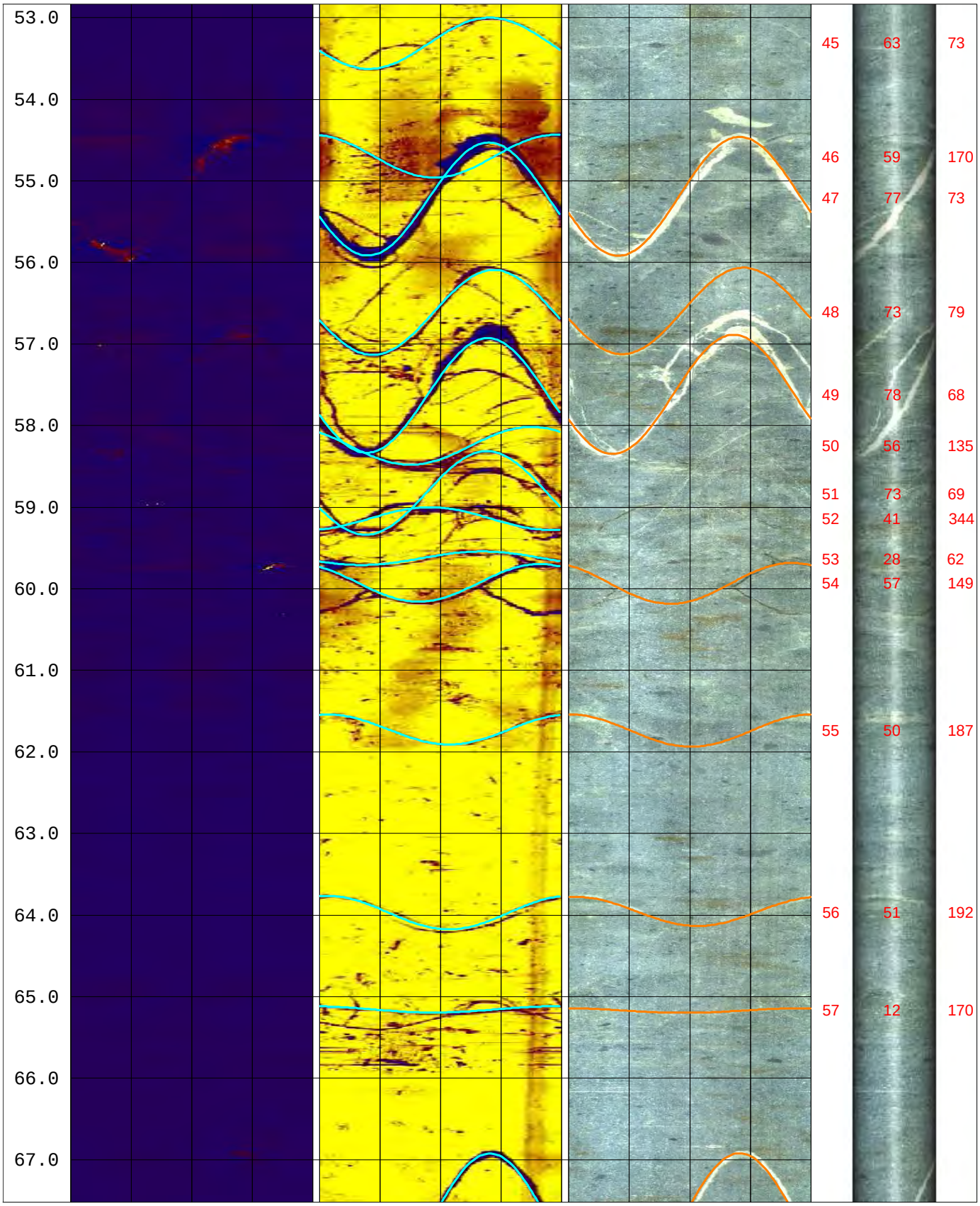
Notes:

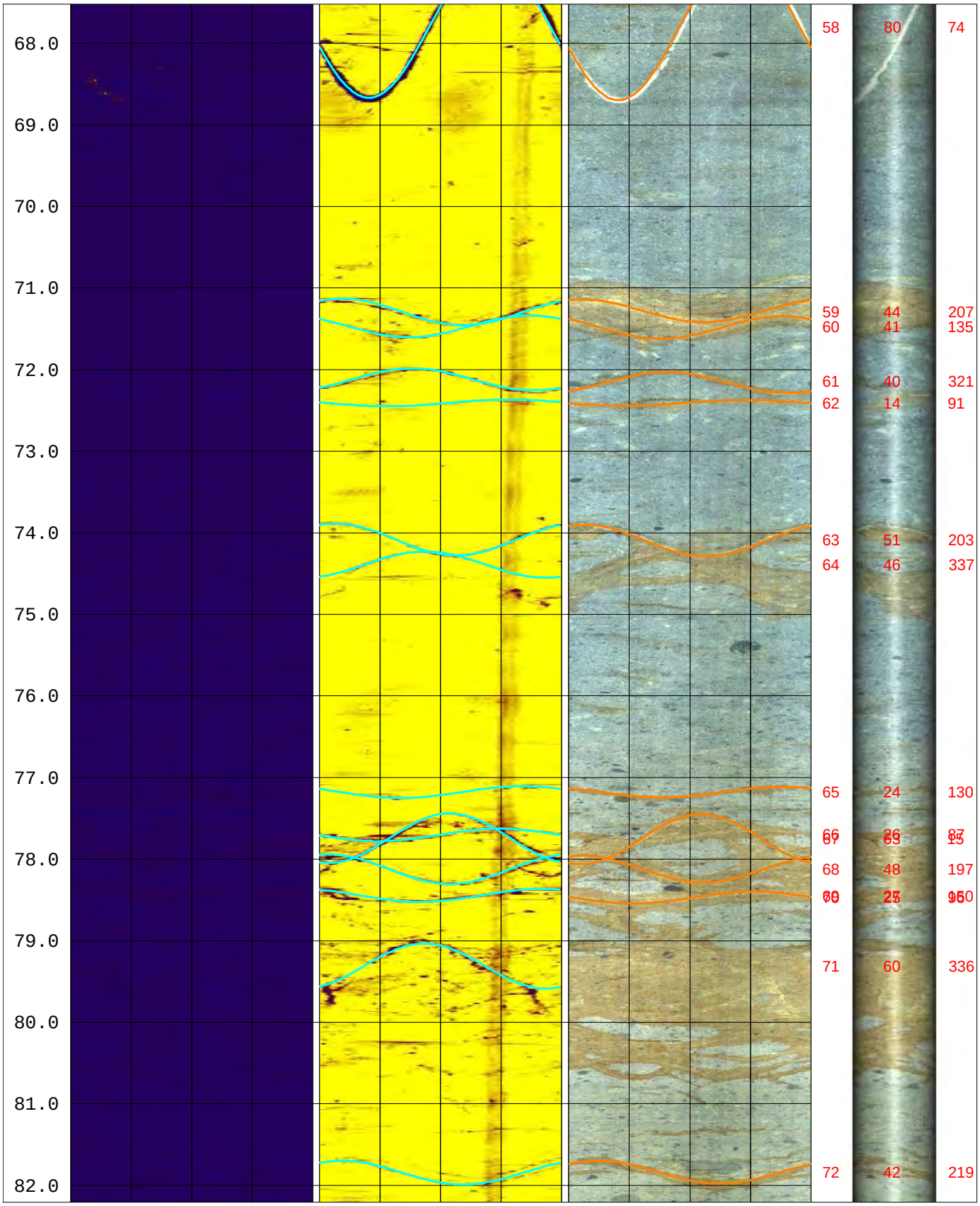
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

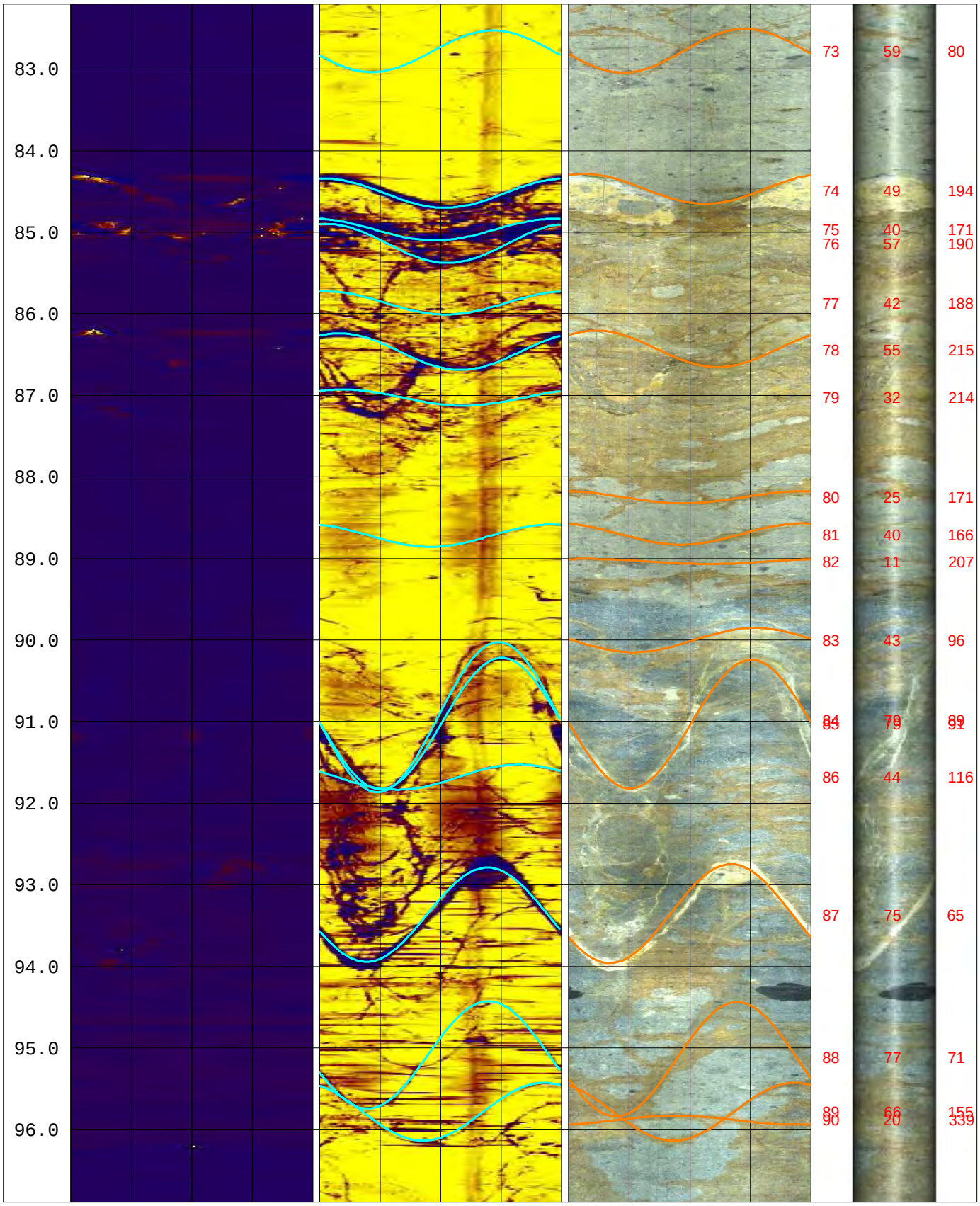


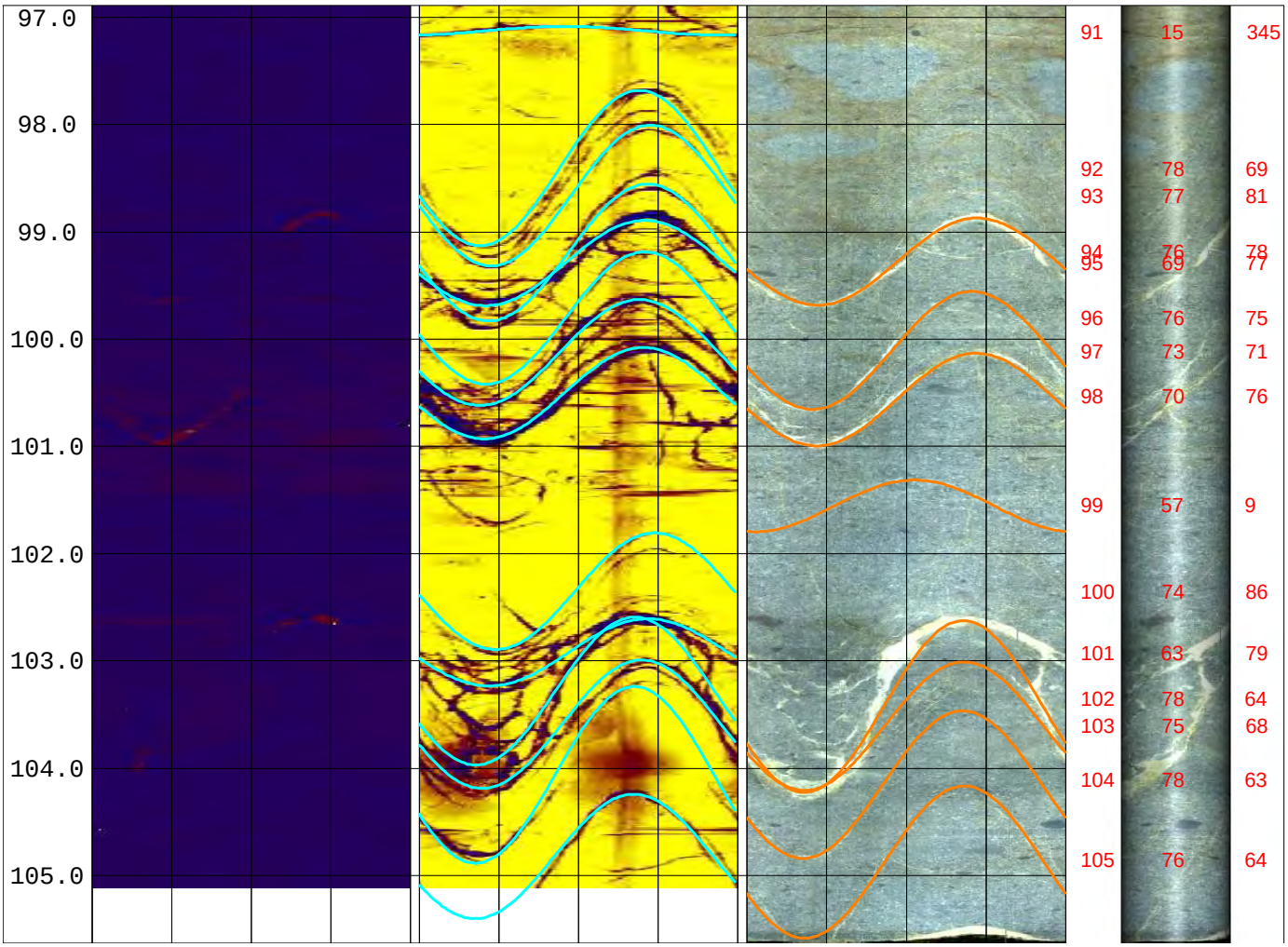

24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
6 72 90
7 43 233
8 15 279
9 78 308
10 7 83
11 43 200
12 75 304
13 20 233
14 76 71
15 54 214
16 69 326
17 92 126
18 56 347
19 42 214
20 24 278
21 76 73


39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
22 28 293
23 39 193
24 54 355
25 42 220
26 75 69
27 78 85
28 78 71
29 79 81
30 78 76
31 70 77
32 74 70
33 75 73
34 38 309
35 44 339
36 71 84
37 54 159
38 43 133
39 52 143
40 53 202
41 66 330
42 44 203
43 63 329
44 51 81


53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
45 63 73
46 59 170
47 77 73
48 73 79
49 78 68
50 56 135
51 73 69
52 41 344
53 28 62
54 57 149
55 50 187
56 51 192
57 12 170


68.0
69.0
70.0
71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
58 80 74
59 44 207
60 41 135
61 40 321
62 14 91
63 51 203
64 46 337
65 24 130
66 26 87
67 63 15
68 48 197
69 25 150
70 95
71 60 336
72 42 219


83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
96.0
73 59 80
74 49 194
75 40 171
76 57 190
77 42 188
78 55 215
79 32 214
80 25 171
81 40 166
82 11 207
83 43 96
84 79 89
85 91
86 44 116
87 75 65
88 77 71
89 66 155
90 20 339

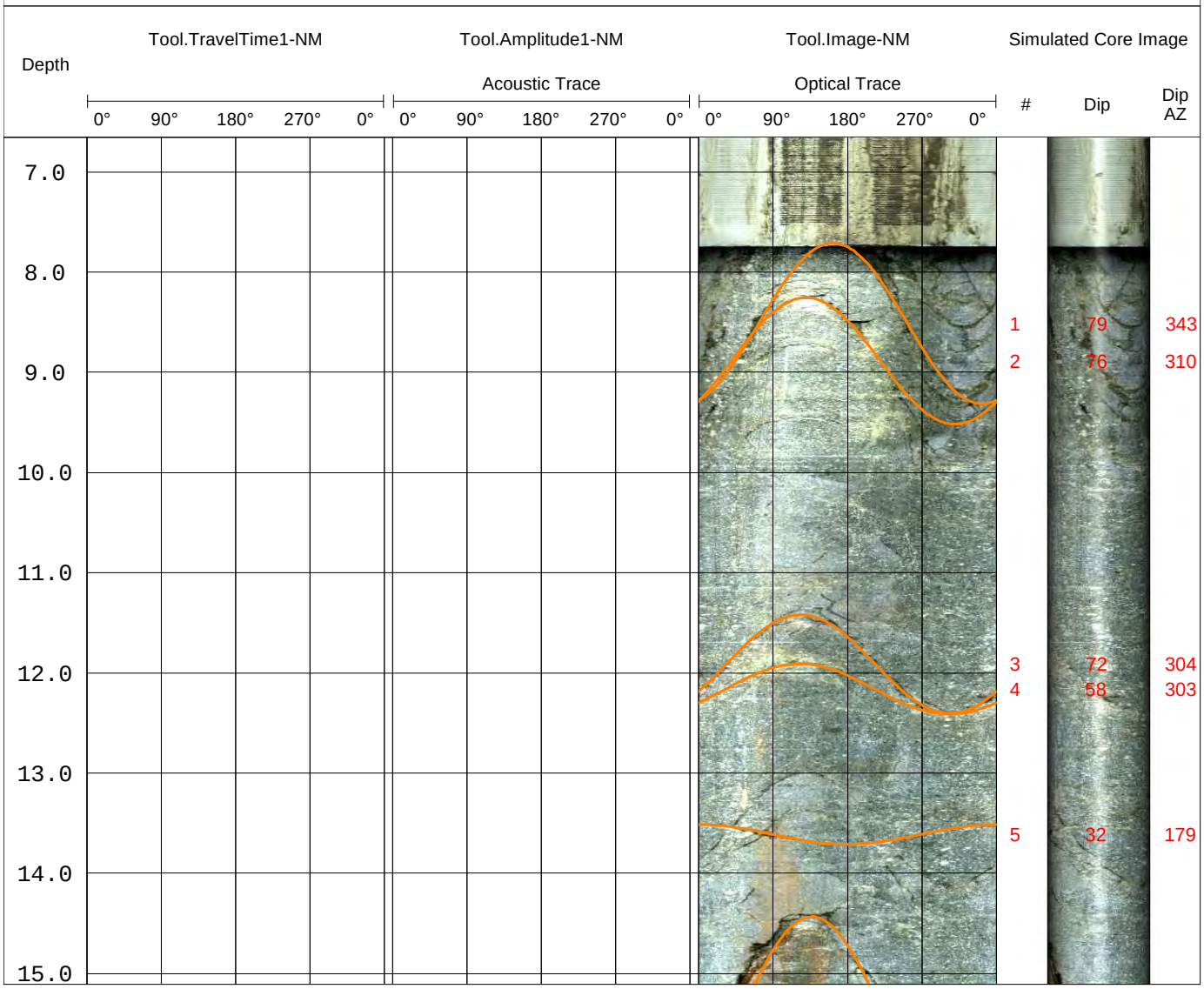

97.0
98.0
99.0
100.0
101.0
102.0
103.0
104.0
105.0
91 15 345
92 78 69
93 77 81
94 76 78
95 69 77
96 76 75
97 73 71
98 70 76
99 57 9
100 74 86
101 63 79
102 78 64
103 75 68
104 78 63
105 76 64

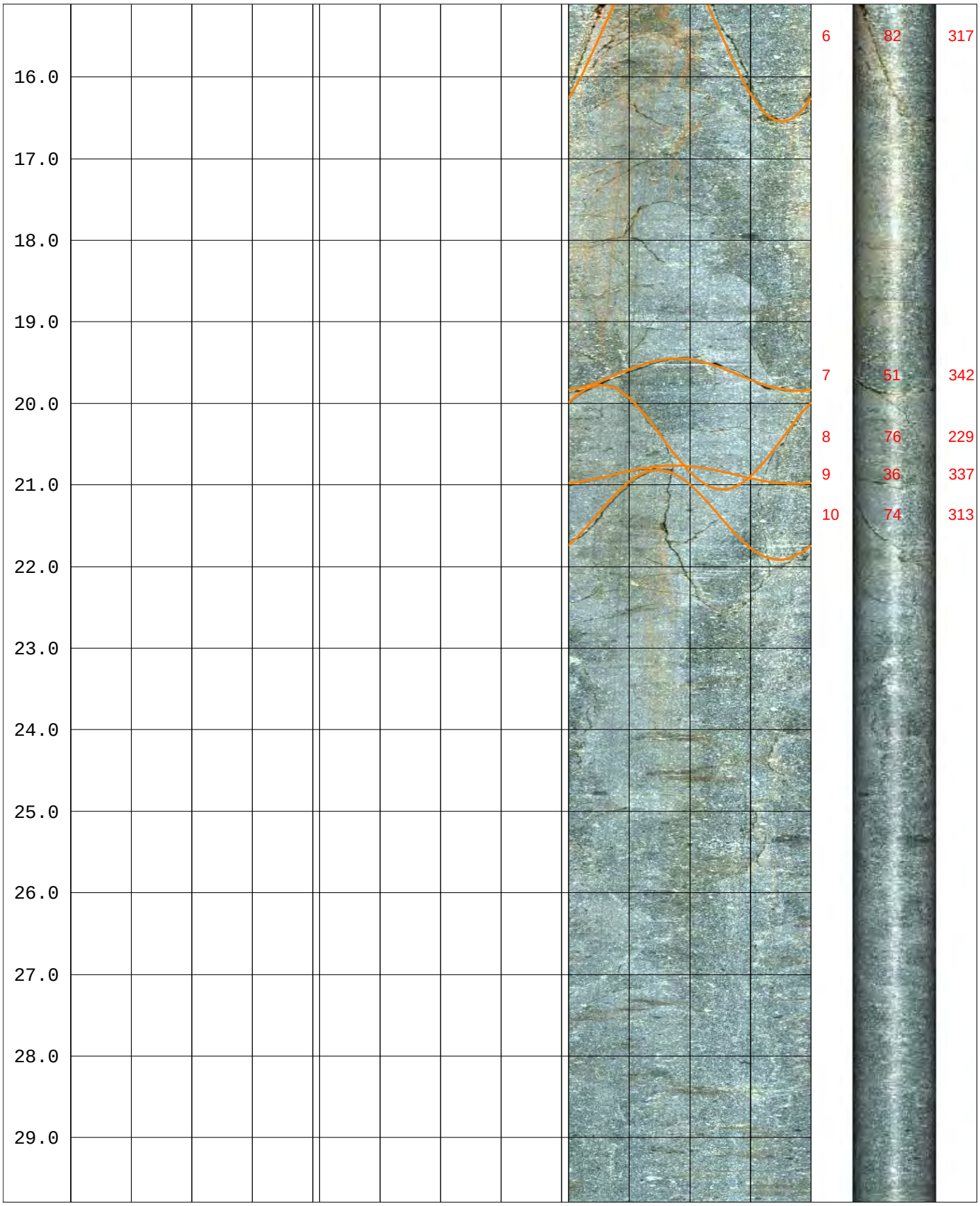
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

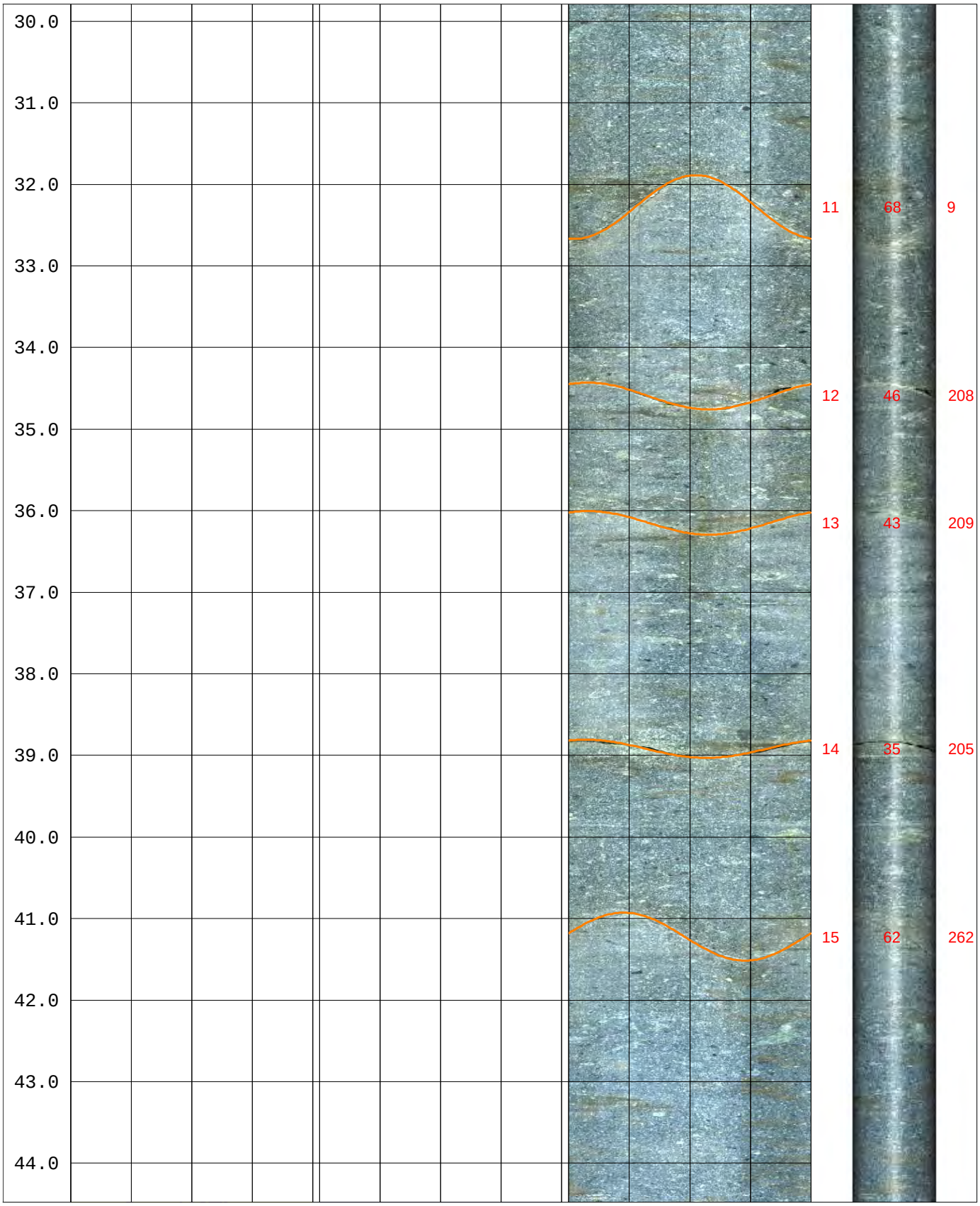
Date Logged:	November 7, 2007	Borehole ID:	SI-11-07
File Name:	SI1107-2M.wcl	Logged By:	F G Kruger

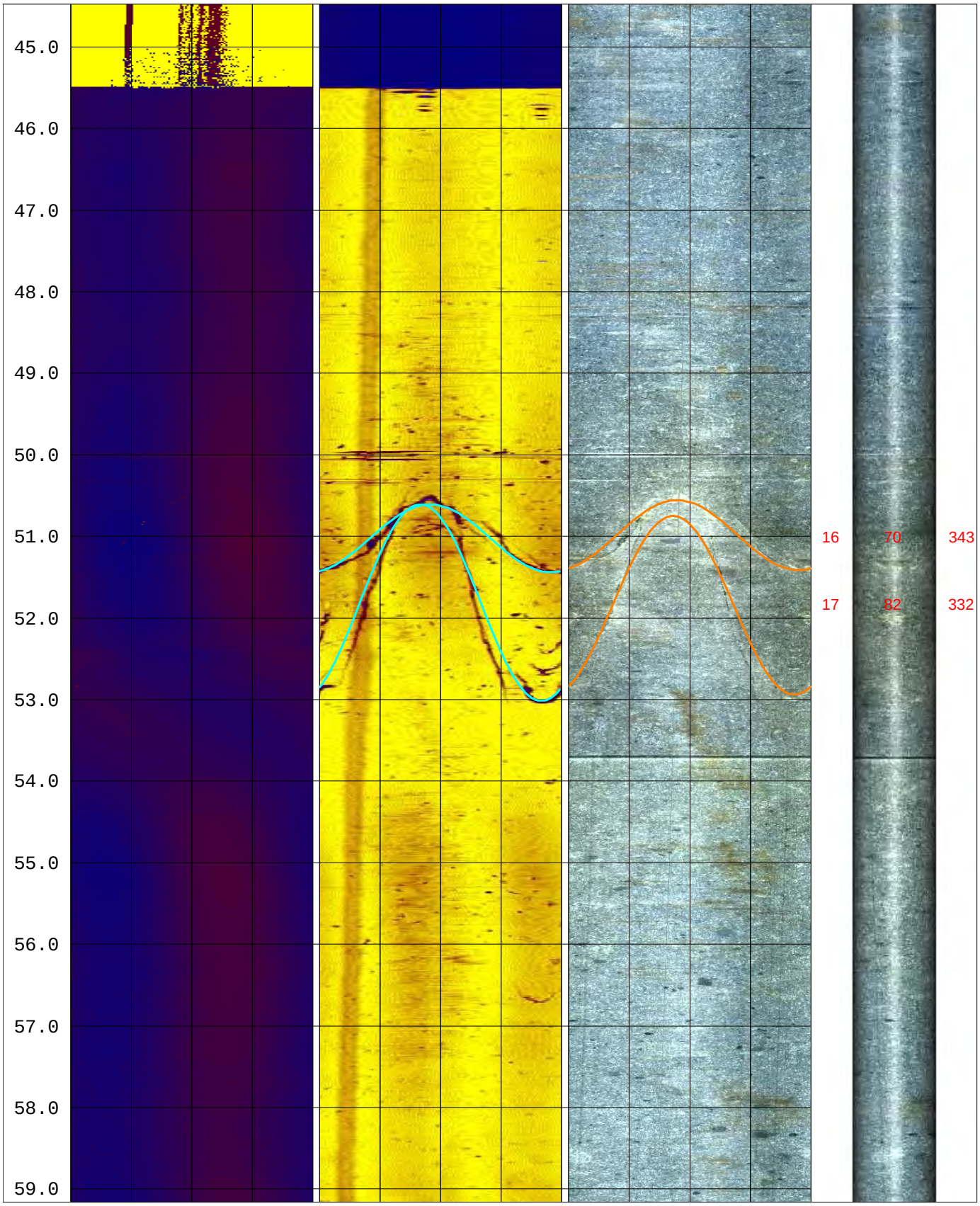
Notes:

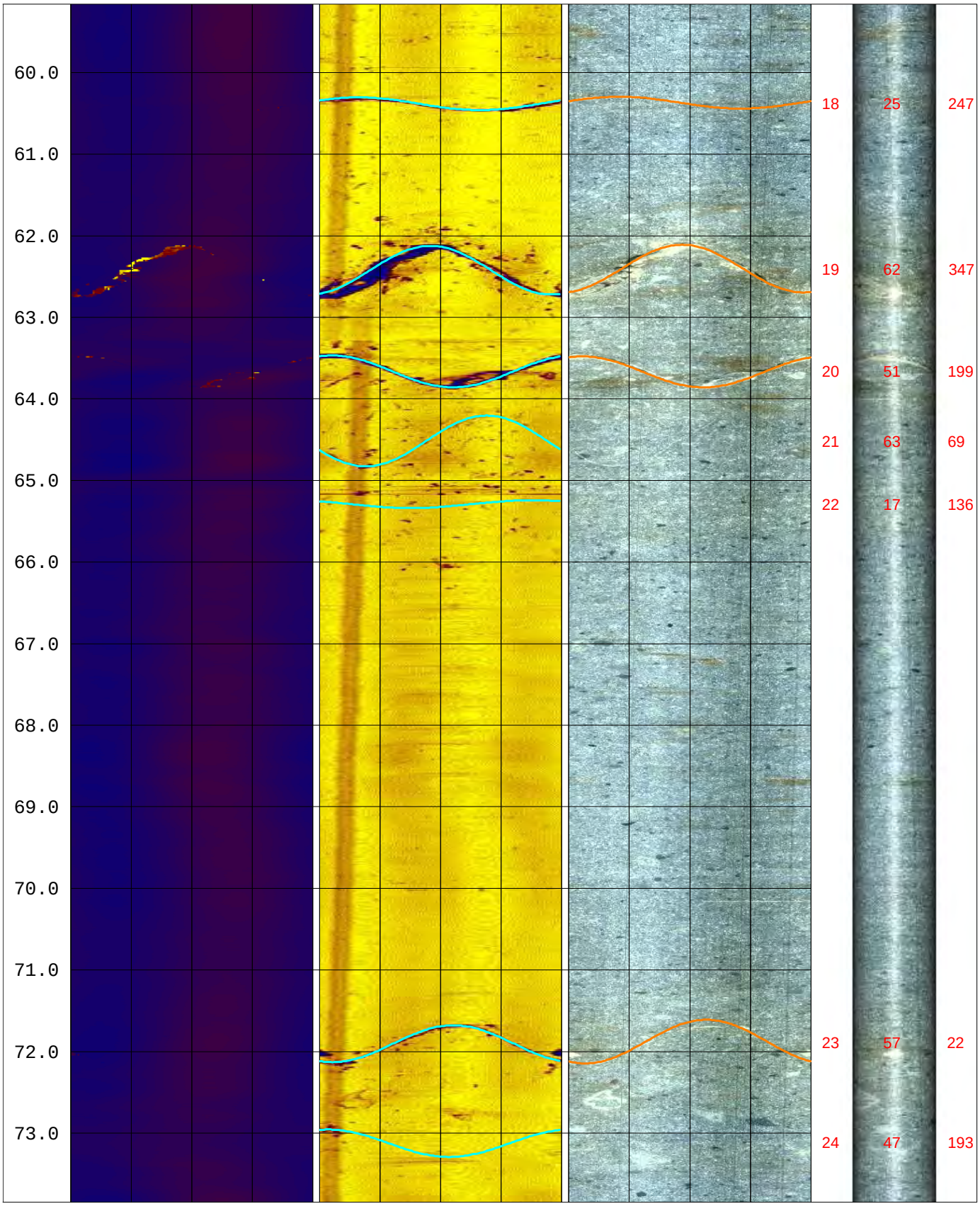
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

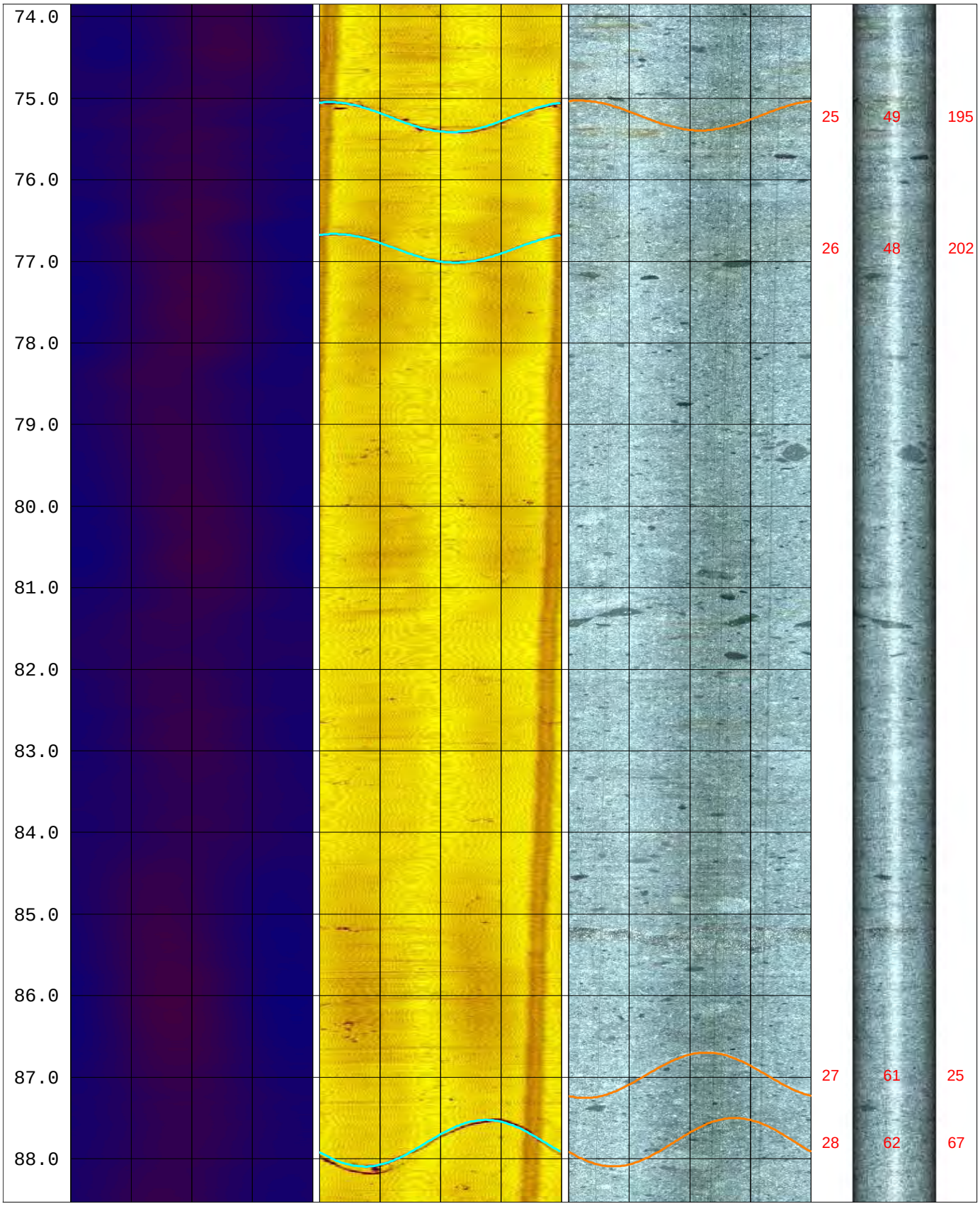


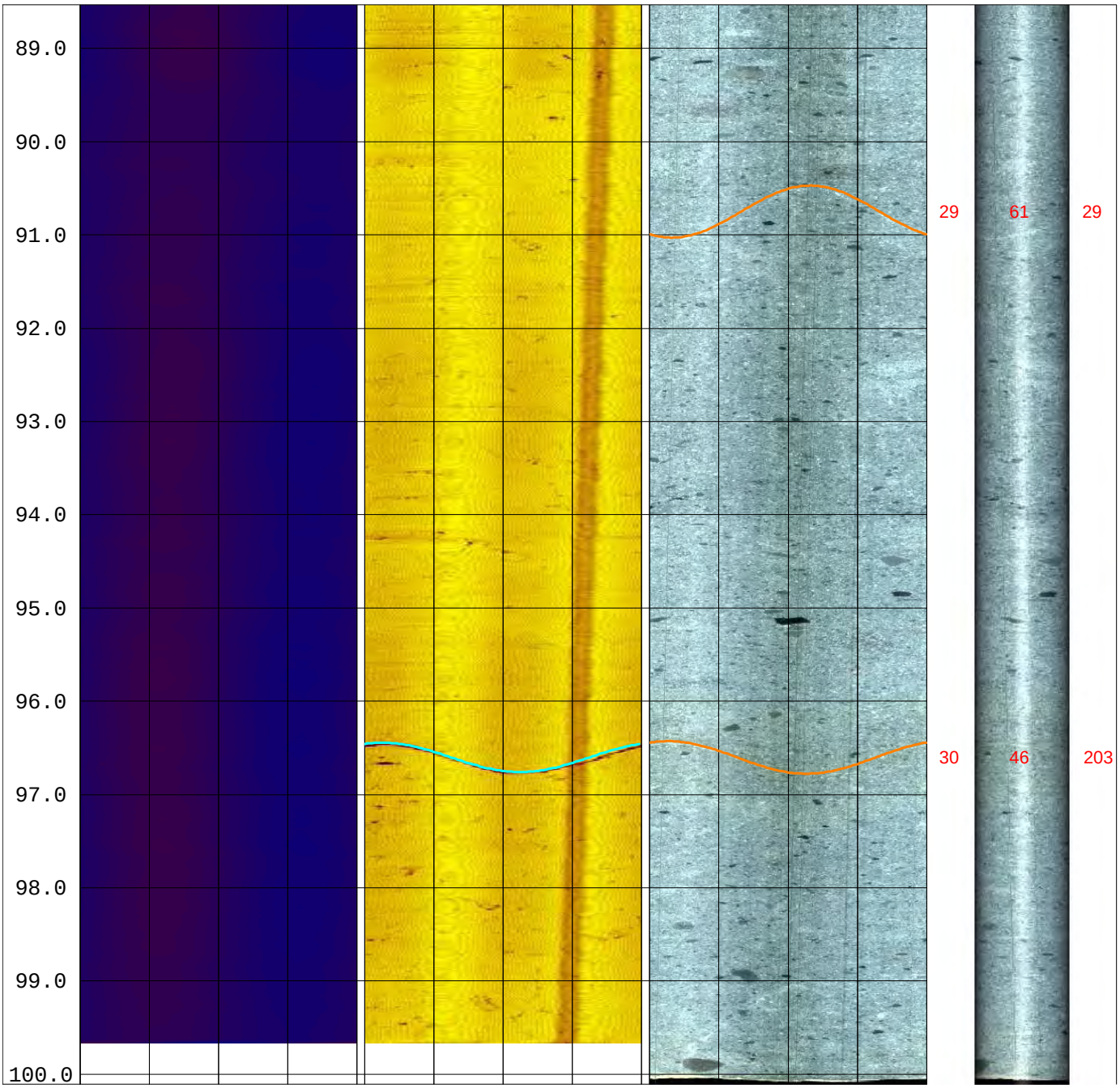

16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
6 82 317
7 51 342
8 76 229
9 36 337
10 74 313


30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
11 68 9
12 46 208
13 43 209
14 35 205
15 62 262


45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
16 70 343
17 82 332


60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
73.0
18 25 247
19 62 347
20 51 199
21 63 69
22 17 136
23 57 22
24 47 193


74.0
75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
25 49 195
26 48 202
27 61 25
28 62 67

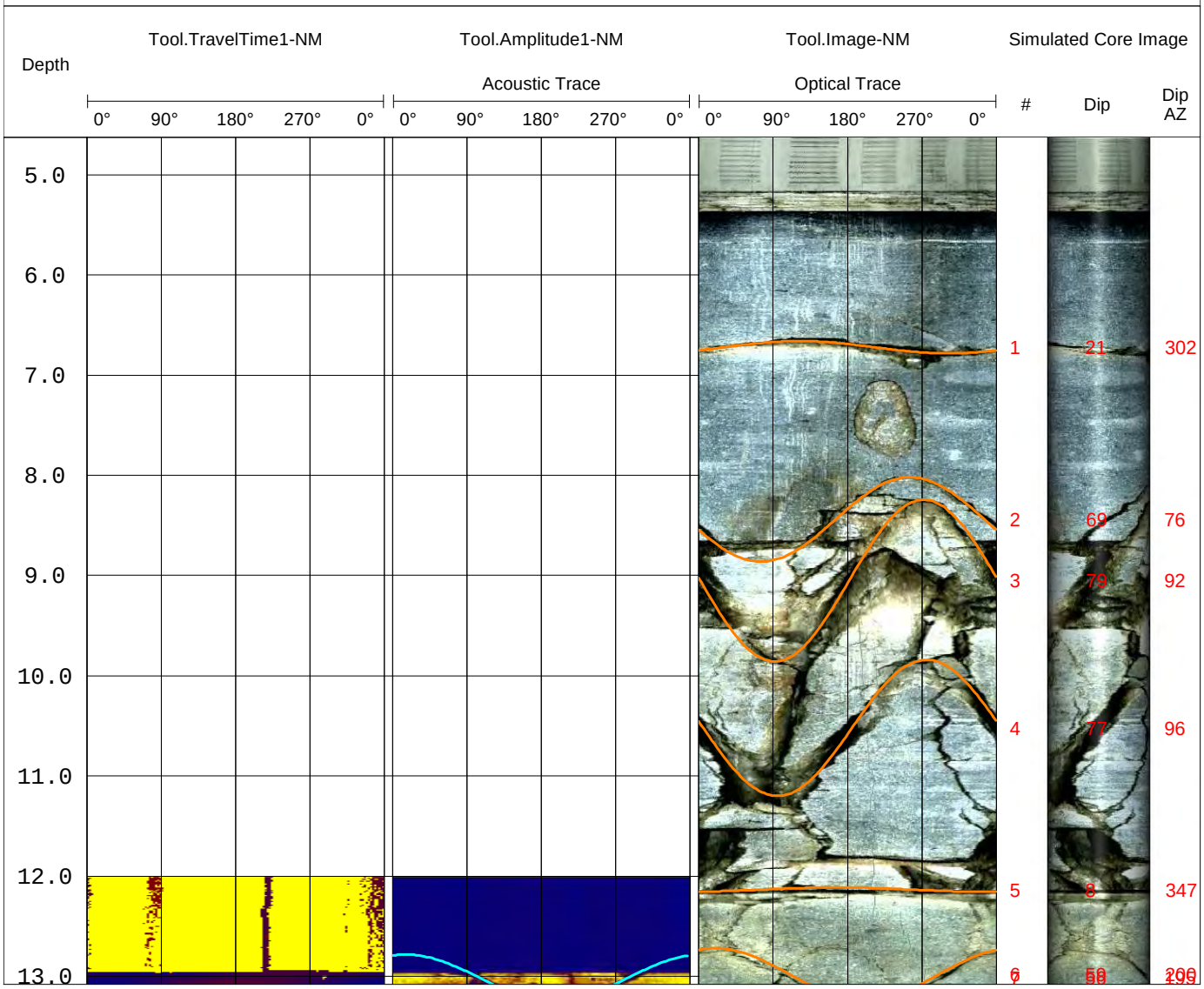

89.0
90.0
91.0
92.0
93.0
94.0
95.0
96.0
97.0
98.0
99.0
100.0
29
61
29
30
46
203

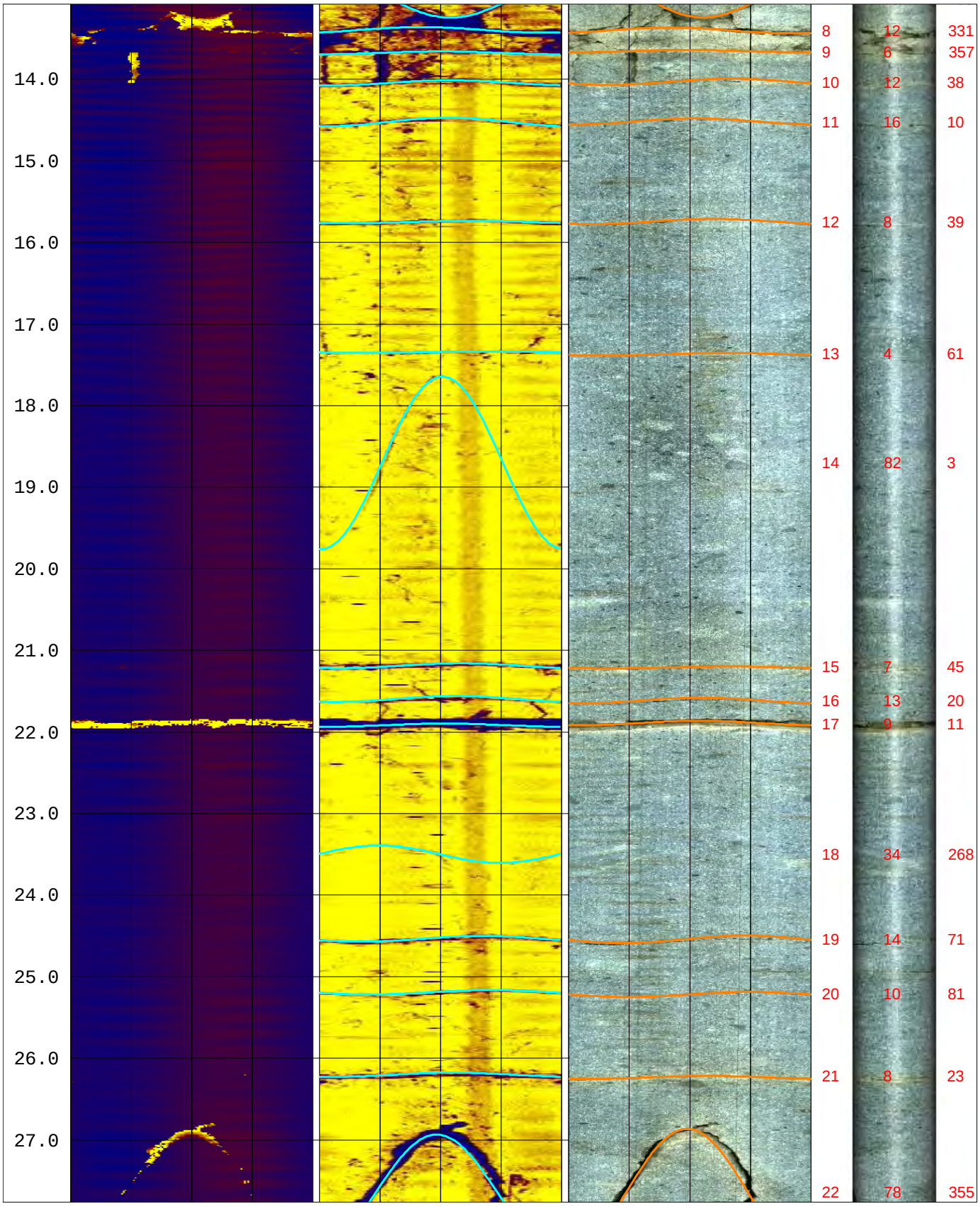
COBL CRUX Oriented Borehole Logging	Company	Washington State Dept. of Transportation
	Location:	Interstate 90 - Snoqualmie Pass
	Project:	2007 Geotechnical Program

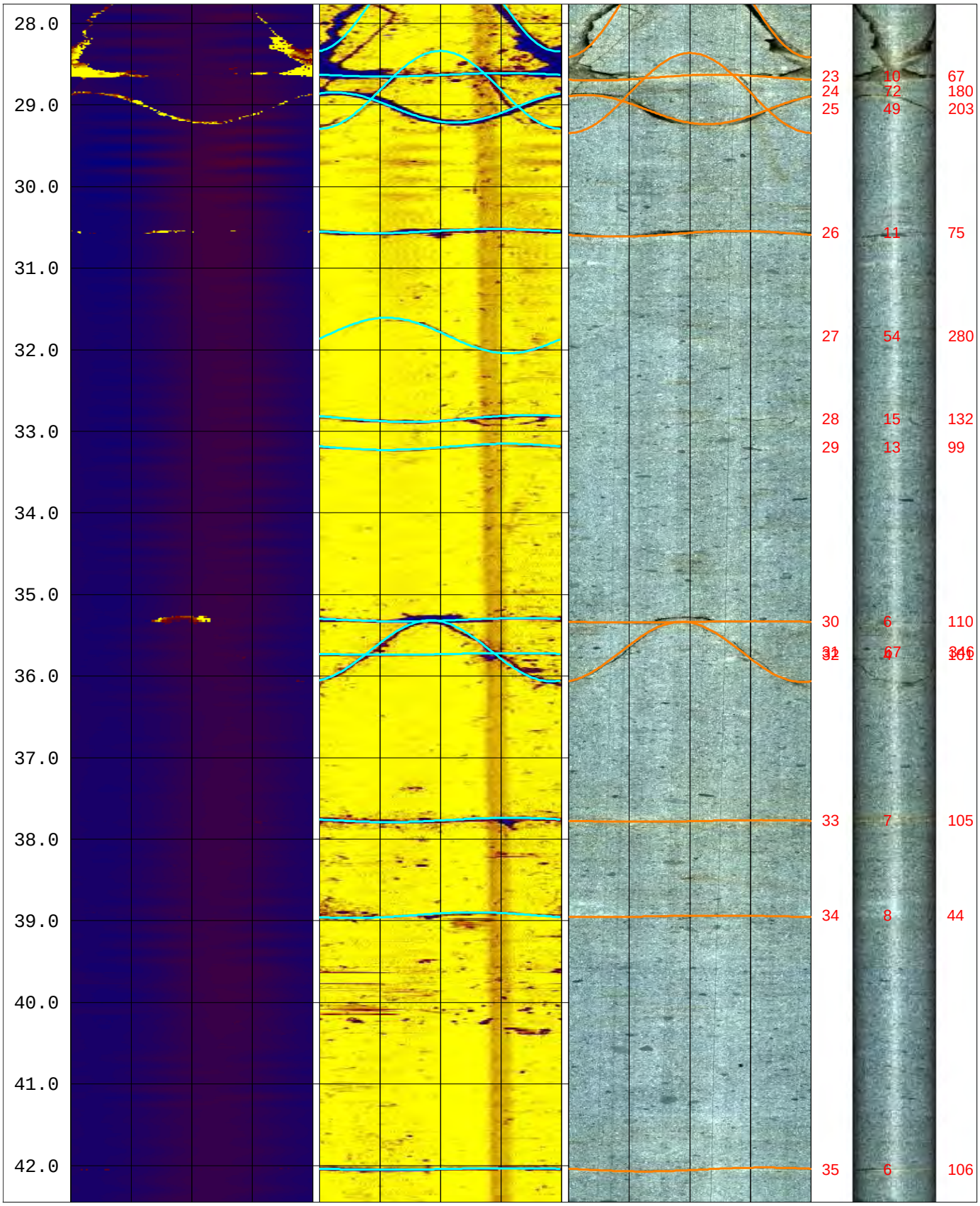
Date Logged:	November 8, 2007	Borehole ID:	SI-12-07
File Name:	SI1207-2M.wcl	Logged By:	F G Kruger

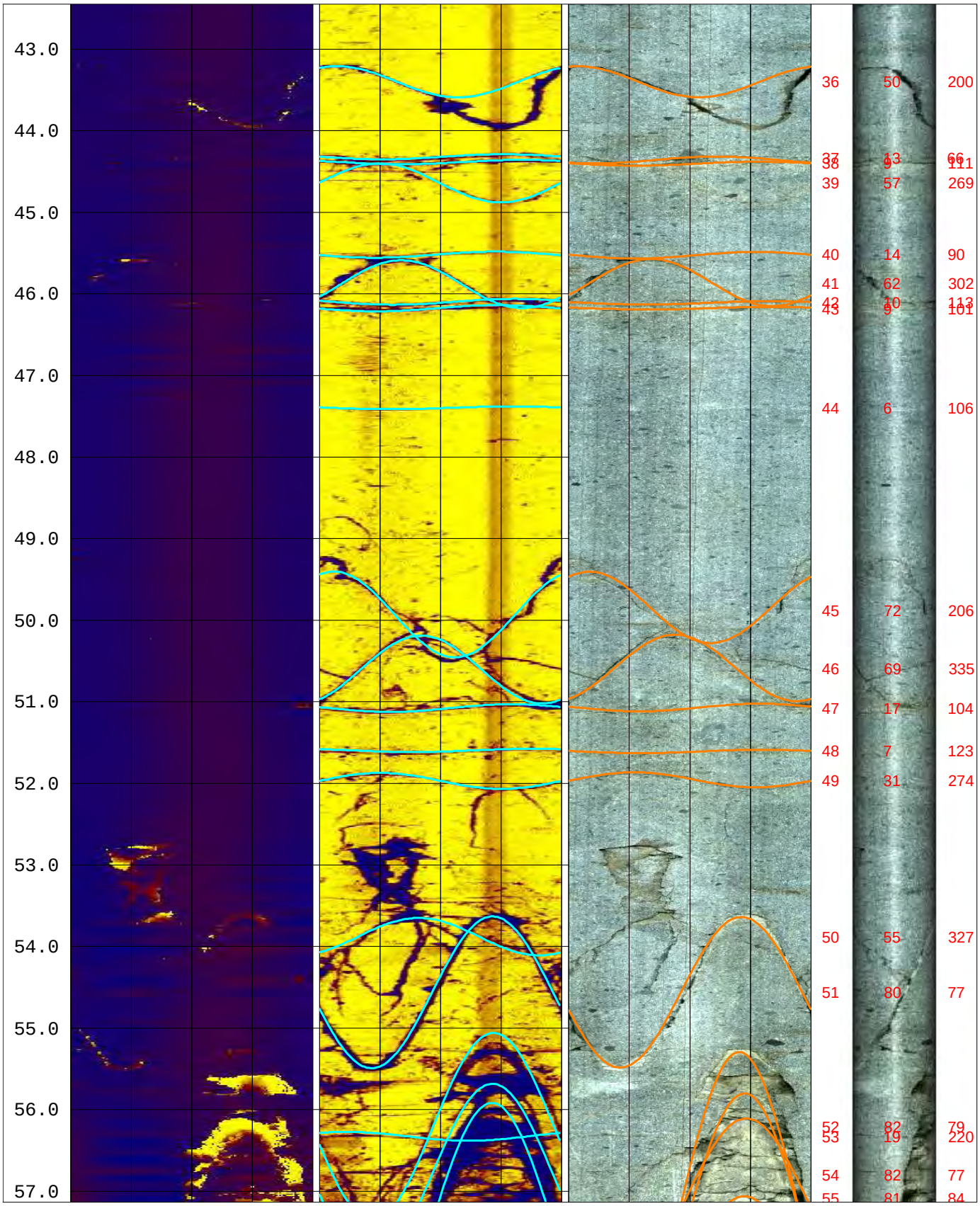
Notes:

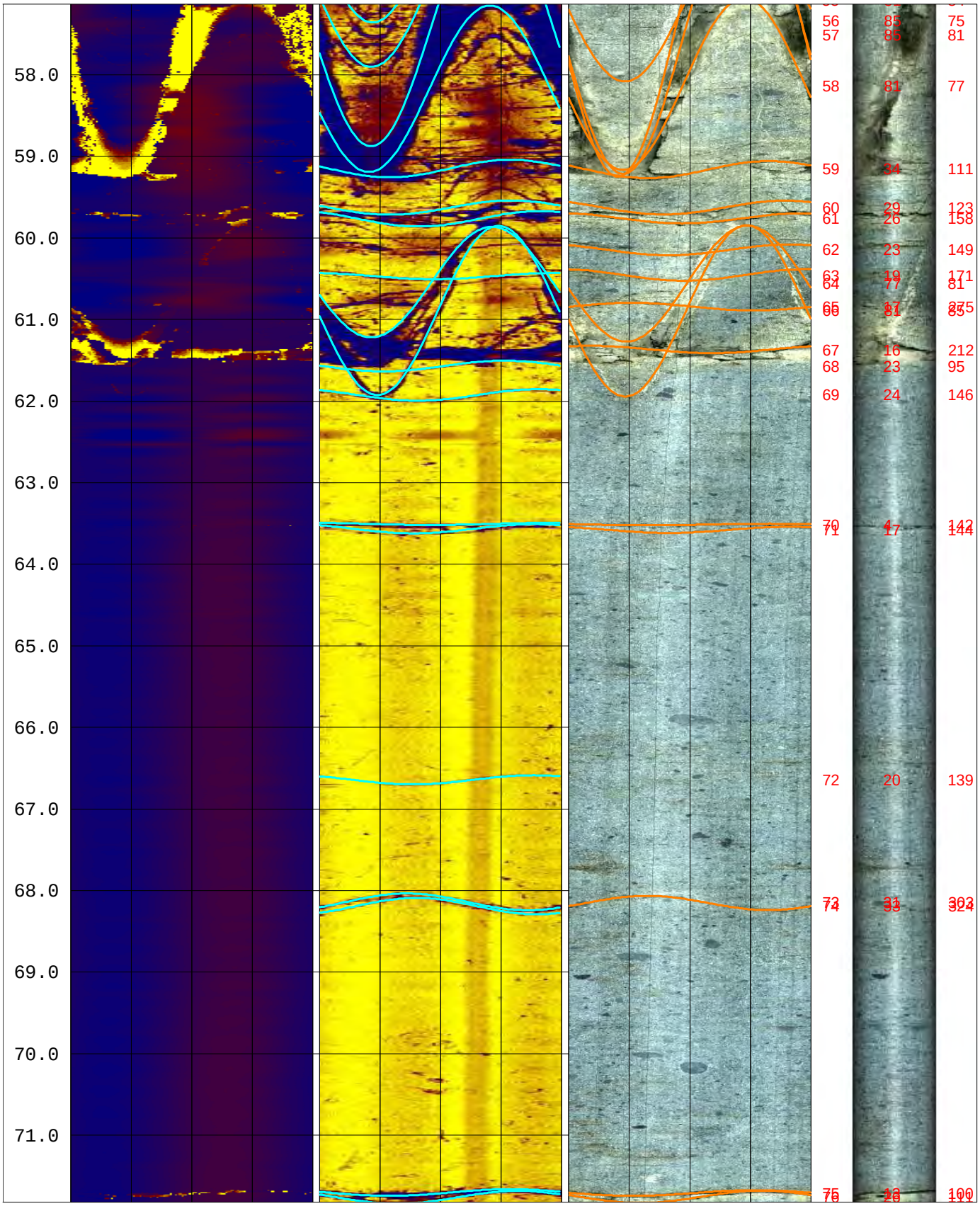
1) Azimuths reference True North. Magnetic declination of +17 degrees applied.
2) 3x Horizontal Exaggeration on Televiewer Images.
3) Dip values presented in degrees from horizontal.
4) Dip direction presented in degrees of azimuth.
5) Simulated Core Image is viewed from north, east on left, west on right.

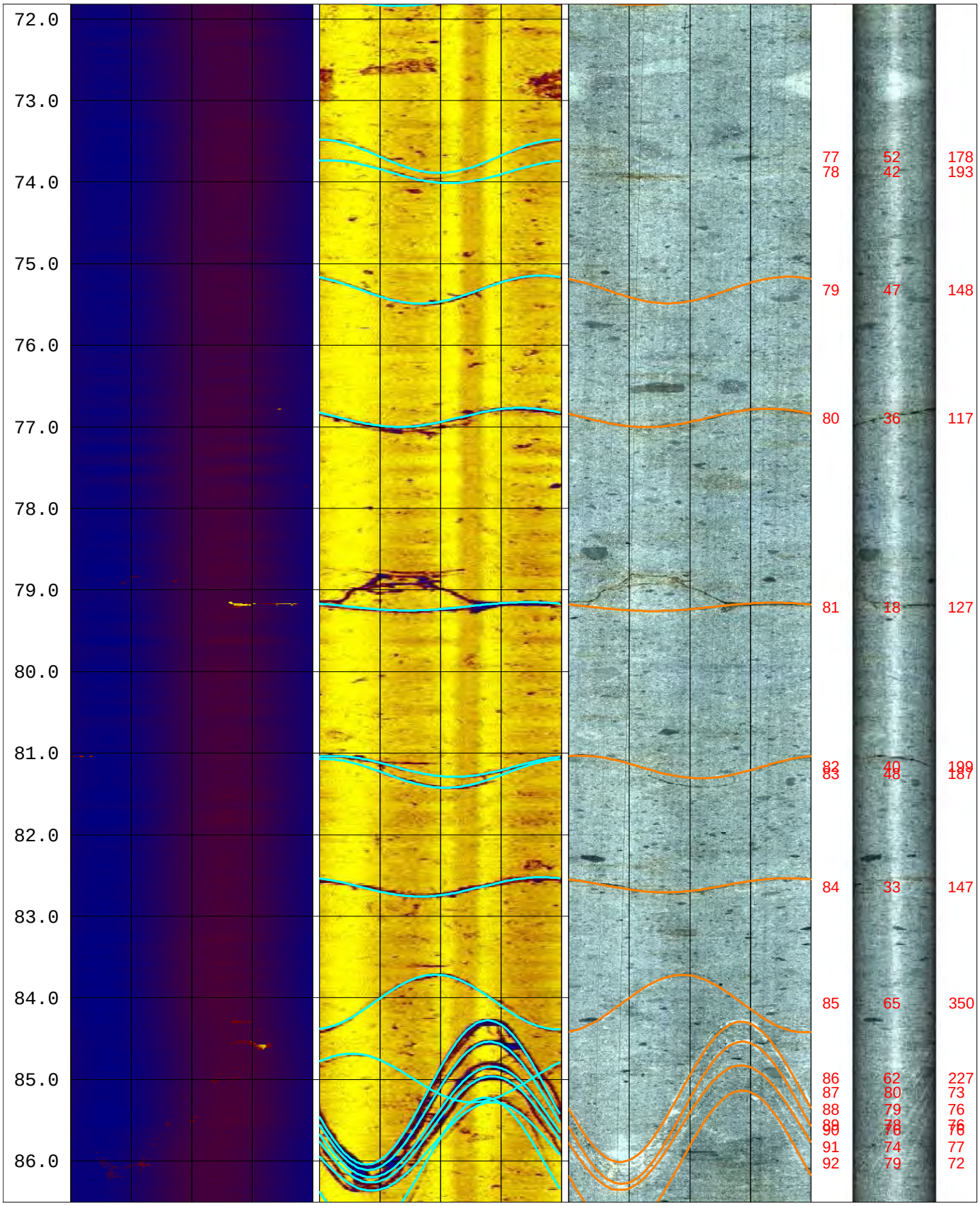


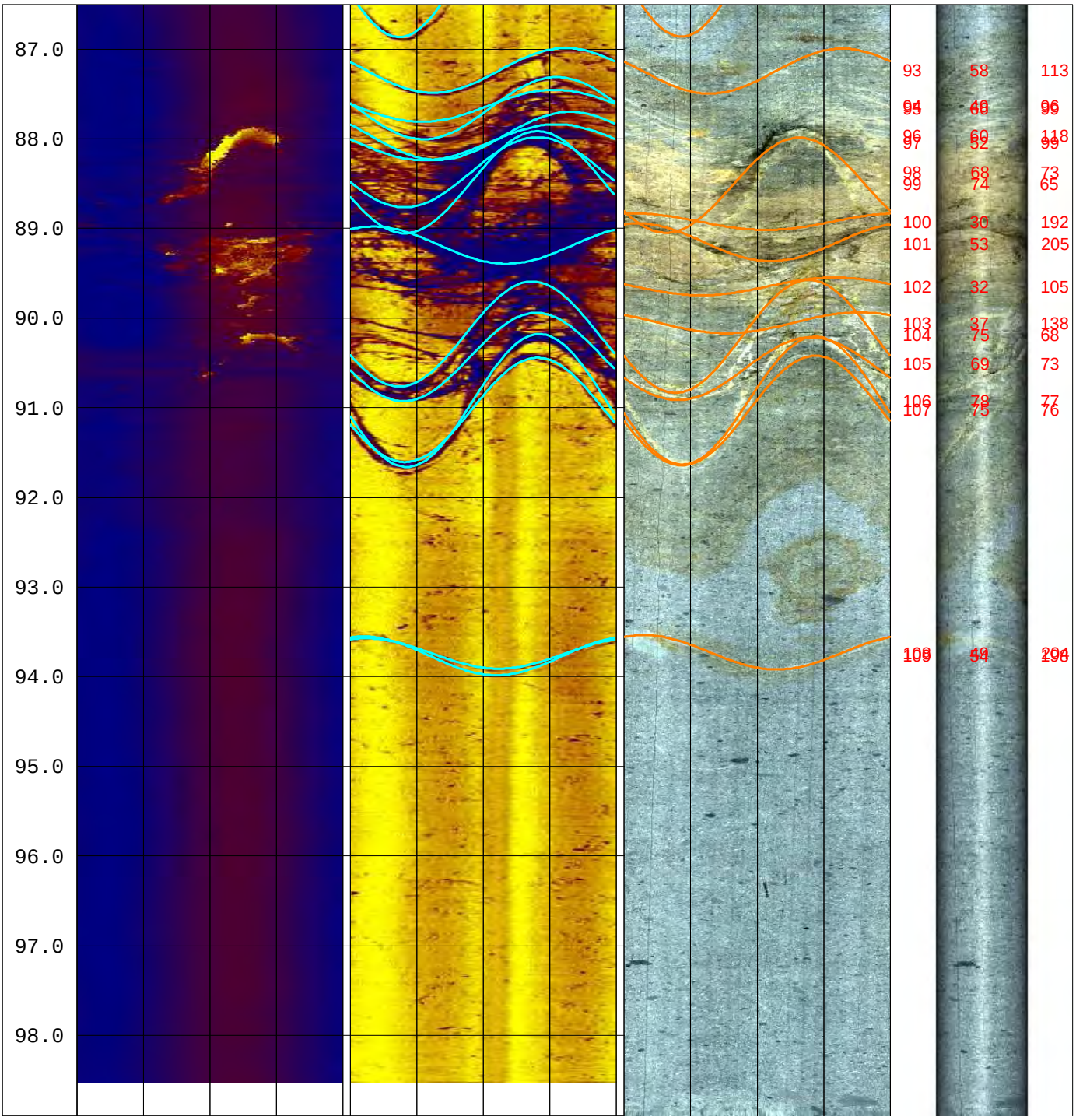

14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
8 12 331
9 6 357
10 12 38
11 16 10
12 8 39
13 4 61
14 82 3
15 7 45
16 13 20
17 9 11
18 34 268
19 14 71
20 10 81
21 8 23
22 78 355


28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
23 10 67
24 72 180
25 49 203
26 11 75
27 54 280
28 15 132
29 13 99
30 6 110
31 67 346
32 101
33 7 105
34 8 44
35 6 106


43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
36 50 200
37 13 66
38 9 111
39 57 269
40 14 90
41 62 302
42 10 113
43 9 101
44 6 106
45 72 206
46 69 335
47 17 104
48 7 123
49 31 274
50 55 327
51 80 77
52 82 79
53 19 220
54 82 77
55 81 84


58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
56 85 75
57 85 81
58 81 77
59 34 111
60 29 123
61 26 158
62 23 149
63 19 171
64 77 81
67 16 212
68 23 95
69 24 146
70 4 142
71 17 144
72 20 139
73 31 303
74 33 324
75 28 100


72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
86.0
77 52 178
78 42 193
79 47 148
80 36 117
81 18 127
82 40 199
83 48 187
84 33 147
85 65 350
86 62 227
87 80 73
88 79 76
89 78 76
90 78 76
91 74 77
92 79 72


87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
96.0
97.0
98.0
93 58 113
94 48 96
95 60 99
96 69 118
97 52 99
98 68 73
99 74 65
100 30 192
101 53 205
102 32 105
103 37 138
104 75 68
105 69 73
106 78 77
107 75 76
108 49 204
109 54 206

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-19-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
			17.47	49	233	1	17.47	49	233
18.17	78	063	18.19	78	043	2	18.18	78	053
18.24	25	355	18.22	26	349	3	18.23	26	352
18.77	18	260				4	18.77	18	260
			20.27	37	245	5	20.27	37	245
20.75	35	270	20.74	42	275	6	20.75	39	272
21.51	33	263	21.52	42	275	7	21.52	38	269
22.06	39	277				8	22.06	39	277
22.28	26	255				9	22.28	26	255
22.52	36	273	22.45	30	256	10	22.49	33	264
23.05	41	287	23.04	33	307	11	23.05	37	297
			23.78	20	030	12	23.78	20	030
24.10	24	273				13	24.10	24	273
24.35	49	312				14	24.35	49	312
24.58	49	284	24.49	48	270	15	24.54	49	277
25.05	34	072	25.06	39	045	16	25.06	36	058
25.95	65	270	25.92	68	265	17	25.94	67	268
			26.35	12	094	18	26.35	12	094
26.79	18	275	26.88	19	261	19	26.84	18	268
			27.45	26	280	20	27.45	26	280
27.94	61	245	27.87	54	308	21	27.91	57	276
28.16	30	287	28.22	33	268	22	28.19	32	277
28.32	22	263				23	28.32	22	263
29.87	49	249				24	29.87	49	249
30.43	22	293	30.38	17	298	25	30.41	19	296
			31.10	52	016	26	31.10	52	016
31.40	28	345	31.37	30	013	27	31.39	29	359
31.75	46	275	31.70	49	274	28	31.73	47	274
32.79	73	006	32.81	75	002	29	32.80	74	004
33.34	51	111	33.29	48	103	30	33.32	50	107
33.89	40	285	33.87	29	263	31	33.88	34	274
34.62	32	311				32	34.62	32	311
35.14	16	327	35.21	32	248	33	35.18	24	288
35.55	38	275				34	35.55	38	275
36.13	20	164				35	36.13	20	164
36.43	31	312	36.44	27	314	36	36.44	29	313
36.95	47	313	36.92	43	312	37	36.94	45	312
37.34	60	132	37.24	55	143	38	37.29	57	137
37.93	40	275	37.88	30	283	39	37.91	35	279
			38.28	33	291	40	38.28	33	291
38.37	51	304	38.32	62	315	41	38.35	57	310
39.33	22	294				42	39.33	22	294
39.46	33	288				43	39.46	33	288
40.01	16	246				44	40.01	16	246
40.97	43	305				45	40.97	43	305
40.99	81	058	40.97	81	060	46	40.98	81	059
			42.13	17	187	47	42.13	17	187
42.57	25	228	42.53	26	230	48	42.55	26	229

44.43	30	270		44.43	26	270		49	44.43	28	270
45.58	60	299		45.57	59	296		50	45.58	59	298
45.75	46	303		45.73	45	298		51	45.74	45	300
46.88	22	277		46.90	33	276		52	46.89	27	276
47.12	29	280		47.09	33	270		53	47.11	31	275
49.91	76	133		49.90	77	133		54	49.91	77	133
50.87	25	233						55	50.87	25	233
51.07	23	214		51.02	20	248		56	51.05	21	231
				51.24	21	270		57	51.24	21	270
51.49	25	263						58	51.49	25	263
65.82	61	259						59	65.82	61	259
				66.06	38	249		60	66.06	38	249
66.48	30	206						61	66.48	30	206
				66.56	42	255		62	66.56	42	255
66.64	28	220						63	66.64	28	220
				66.72	29	250		64	66.72	29	250
66.99	28	250		67.06	26	236		65	67.03	27	243
67.32	32	235						66	67.32	32	235
67.94	21	233		67.93	24	175		67	67.94	23	204
				70.15	11	091		68	70.15	11	091
76.12	18	275		76.12	17	245		69	76.12	18	260
77.05	30	275		77.09	25	263		70	77.07	27	269
77.28	29	270		77.22	26	272		71	77.25	27	271
				77.37	29	265		72	77.37	29	265
77.53	32	273		77.57	28	260		73	77.55	30	267
				77.76	26	268		74	77.76	26	268
77.92	32	265		78.00	28	268		75	77.96	30	267
78.09	30	270		78.11	23	270		76	78.10	27	270
78.26	32	270						77	78.26	32	270
89.39	61	084		89.39	62	081		78	89.39	61	082
90.51	63	080		90.52	63	082		79	90.52	63	081
				93.90	29	252		80	93.90	29	252
94.35	41	268		94.35	39	265		81	94.35	40	266
94.53	37	268						82	94.53	37	268
94.79	32	268		94.72	29	258		83	94.76	30	263
95.00	34	265		95.01	33	252		84	95.01	34	259
95.27	36	275		95.25	42	274		85	95.26	39	274
				95.42	36	260		86	95.42	36	260
95.62	36	265		95.51	36	252		87	95.57	36	259
95.81	39	265		95.73	37	270		88	95.77	38	268
				96.20	29	242		89	96.20	29	242
96.84	34	271		96.90	36	260		90	96.87	35	266
97.05	30	265		97.07	25	250		91	97.06	27	258
97.21	28	270						92	97.21	28	270

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-20-08

Optical Televiewer Data				Acoustic Televiewer Data				Average Data Set			
Depth	Dip	Dip AZ		Depth	Dip	Dip AZ		#	Depth	Dip	Dip AZ
9.90	57	270						1	9.90	57	270
11.47	35	149		11.46	40	160		2	11.47	37	154
12.42	57	201		12.39	53	203		3	12.41	55	202
12.56	38	239		12.61	35	230		4	12.59	37	235
12.92	69	283						5	12.92	69	283
13.11	42	152		13.10	36	145		6	13.11	39	148
13.44	48	268		13.41	57	269		7	13.43	52	268
				13.90	37	219		8	13.90	37	219
14.06	45	241						9	14.06	45	241
14.21	33	257		14.12	36	214		10	14.17	35	236
				14.32	34	256		11	14.32	34	256
14.51	40	270						12	14.51	40	270
				16.44	35	263		13	16.44	35	263
				18.67	41	259		14	18.67	41	259
				20.63	46	334		15	20.63	46	334
				22.03	58	329		16	22.03	58	329
				23.28	43	148		17	23.28	43	148
				26.30	46	147		18	26.30	46	147
27.75	25	156		27.78	23	139		19	27.77	24	147
				30.84	23	203		20	30.84	23	203
32.09	39	213		32.07	33	215		21	32.08	36	214
				32.16	38	210		22	32.16	38	210
37.27	43	163		37.28	44	153		23	37.28	43	158
37.60	67	142		37.65	65	146		24	37.63	66	144
42.70	30	168		42.76	37	176		25	42.73	33	172
				44.63	45	143		26	44.63	45	143
45.43	58	126		45.46	56	126		27	45.45	57	126
46.07	38	192		46.07	46	204		28	46.07	42	198
				47.77	54	291		29	47.77	54	291
				52.26	55	216		30	52.26	55	216
				56.29	05	188		31	56.29	05	188
				61.27	06	223		32	61.27	06	223
61.35	03	068						33	61.35	03	068
				62.41	36	252		34	62.41	36	252
63.37	66	055		63.36	65	049		35	63.37	65	052
				64.07	44	060		36	64.07	44	060
				64.82	22	128		37	64.82	22	128
68.01	51	116		68.02	48	117		38	68.02	49	117

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-21-08

Optical Televiewer Data				Acoustic Televiewer Data				Average Data Set			
Depth	Dip	Dip AZ		Depth	Dip	Dip AZ		#	Depth	Dip	Dip AZ
11.36	10	301						1	11.36	10	301
18.93	22	234						2	18.93	22	234
30.88	21	290						3	30.88	21	290
31.05	31	329						4	31.05	31	329
31.21	35	301						5	31.21	35	301
32.88	40	275						6	32.88	40	275
33.24	51	290						7	33.24	51	290
33.40	49	285						8	33.40	49	285
33.66	37	290						9	33.66	37	290
33.95	43	334						10	33.95	43	334
34.44	52	305						11	34.44	52	305
34.86	40	305						12	34.86	40	305
35.85	35	266		35.83	33	292		13	35.84	34	279
39.52	50	187		39.52	49	184		14	39.52	49	186
53.21	58	343		53.20	59	340		15	53.21	58	342
				53.79	63	344		16	53.79	63	344
				57.99	13	066		17	57.99	13	066
				59.73	45	255		18	59.73	45	255

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-22-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
8.06	29	230				1	8.06	29	230
8.42	46	207				2	8.42	46	207
9.78	20	032				3	9.78	20	032
10.06	32	206				4	10.06	32	206
			11.09	16	188	5	11.09	16	188
			13.14	13	295	6	13.14	13	295
13.46	16	017	13.43	09	051	7	13.45	13	034
14.06	13	290	14.07	11	263	8	14.07	12	277
14.14	11	283	14.15	08	312	9	14.15	09	298
14.28	16	303	14.27	21	349	10	14.28	19	326
			14.53	13	061	11	14.53	13	061
15.14	70	118				12	15.14	70	118
15.40	63	118	15.40	62	111	13	15.40	63	114
15.59	25	292	15.59	30	298	14	15.59	27	295
15.74	07	255	15.83	18	255	15	15.79	13	255
			16.10	12	274	16	16.10	12	274
16.16	27	336				17	16.16	27	336
17.09	15	079	17.11	12	053	18	17.10	13	066
17.60	71	091	17.60	70	093	19	17.60	70	092
17.64	80	094	17.63	80	100	20	17.64	80	097
18.71	29	215	18.67	23	248	21	18.69	26	232
18.91	79	263	19.01	77	263	22	18.96	78	263
20.85	09	144	20.87	06	111	23	20.86	08	127
21.48	18	285	21.48	20	318	24	21.48	19	302
21.76	15	257	21.76	15	265	25	21.76	15	261
			21.92	47	075	26	21.92	47	075
23.69	33	001	23.69	31	352	27	23.69	32	357
25.29	21	330	25.29	29	340	28	25.29	25	335
27.66	44	313	27.66	51	320	29	27.66	48	316
28.68	43	200	28.67	42	203	30	28.68	43	202
31.55	55	315	31.54	56	320	31	31.55	55	317
34.69	63	286	34.67	64	282	32	34.68	63	284
36.19	34	170	36.17	28	173	33	36.18	31	171
37.31	40	355				34	37.31	40	355
37.58	37	354	37.57	37	335	35	37.58	37	344
37.82	35	327				36	37.82	35	327
39.66	61	225	39.65	59	229	37	39.66	60	227
39.82	65	219	39.81	62	223	38	39.82	64	221
40.25	39	202	40.24	33	206	39	40.25	36	204
			41.38	24	338	40	41.38	24	338
			41.82	11	116	41	41.82	11	116
45.65	51	325	45.64	54	332	42	45.65	53	329
45.94	47	203	45.94	51	196	43	45.94	49	200
46.47	43	193	46.49	44	213	44	46.48	44	203
			46.71	50	203	45	46.71	50	203
46.98	69	228	46.96	71	221	46	46.97	70	224
			47.70	55	223	47	47.70	55	223
			48.20	61	222	48	48.20	61	222

				48.63	57	232		49	48.63	57	232
50.15	68	074		50.14	67	073		50	50.15	68	074
				51.86	56	203		51	51.86	56	203
55.55	47	241		55.53	50	244		52	55.54	49	242
				56.40	61	338		53	56.40	61	338
				56.48	42	351		54	56.48	42	351

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-23-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
6.87	53	276				1	6.87	53	276
11.88	39	071				2	11.88	39	071
12.17	69	064				3	12.17	69	064
12.25	39	090				4	12.25	39	090
13.85	16	199				5	13.85	16	199
14.00	36	215				6	14.00	36	215
16.46	77	064				7	16.46	77	064
16.96	32	196				8	16.96	32	196
17.40	37	249				9	17.40	37	249
20.71	17	163				10	20.71	17	163
20.91	18	173				11	20.91	18	173
23.11	17	156				12	23.11	17	156
23.26	19	181				13	23.26	19	181
24.30	70	074				14	24.30	70	074
24.92	17	152				15	24.92	17	152
25.00	15	144				16	25.00	15	144
25.70	41	181				17	25.70	41	181
26.19	33	185				18	26.19	33	185
26.71	70	029				19	26.71	70	029
26.85	13	193				20	26.85	13	193
27.53	28	173				21	27.53	28	173
27.73	21	158				22	27.73	21	158
27.93	44	195				23	27.93	44	195
28.72	62	243				24	28.72	62	243
33.59	82	076				25	33.59	82	076
34.02	38	319				26	34.02	38	319
34.64	74	152				27	34.64	74	152
35.06	58	228				28	35.06	58	228
37.39	38	275	37.37	38	270	29	37.38	38	272
			38.36	41	330	30	38.36	41	330
			38.41	44	326	31	38.41	44	326
39.12	41	131	39.11	43	138	32	39.12	42	134
39.44	35	295				33	39.44	35	295
39.91	42	305	39.91	42	303	34	39.91	42	304
40.47	47	210	40.49	52	212	35	40.48	49	211
40.68	40	209	40.72	33	243	36	40.70	36	226
			40.83	60	166	37	40.83	60	166
			41.59	56	285	38	41.59	56	285
41.77	58	226	41.74	54	223	39	41.76	56	224
			41.80	50	194	40	41.80	50	194
			42.89	50	318	41	42.89	50	318
			43.38	48	171	42	43.38	48	171
43.50	34	196	43.53	42	192	43	43.52	38	194
			44.01	66	265	44	44.01	66	265
46.80	66	238	46.89	68	240	45	46.85	67	239
48.21	69	147	48.21	69	145	46	48.21	69	146
52.02	52	218	52.01	53	206	47	52.02	53	212
			54.56	77	074	48	54.56	77	074

54.74	31	209		54.73	31	208		49	54.74	31	208
56.85	41	334		56.87	40	340		50	56.86	41	337
58.39	73	069		58.43	75	078		51	58.41	74	074
58.79	75	072		58.81	77	061		52	58.80	76	066
58.91	66	042		58.91	65	040		53	58.91	66	041
59.38	53	133						54	59.38	53	133
60.11	46	073		60.14	39	059		55	60.13	43	066
60.79	81	082		60.71	81	073		56	60.75	81	077
				61.41	57	083		57	61.41	57	083
61.59	74	114		61.69	70	110		58	61.64	72	112
61.84	76	105						59	61.84	76	105
				62.05	68	086		60	62.05	68	086
62.74	37	271		62.74	33	273		61	62.74	35	272
				63.02	49	190		62	63.02	49	190
63.04	52	327		63.04	54	332		63	63.04	53	329
64.01	70	074		64.05	73	066		64	64.03	72	070
64.30	41	077						65	64.30	41	077

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-24-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
11.50	59	315				1	11.50	59	315
12.67	66	310				2	12.67	66	310
13.04	75	061	13.01	75	059	3	13.03	75	060
13.13	32	285				4	13.13	32	285
13.82	43	072	13.72	37	072	5	13.77	40	072
14.10	37	311				6	14.10	37	311
			14.18	28	345	7	14.18	28	345
			14.42	09	285	8	14.42	09	285
14.99	32	284	14.95	26	285	9	14.97	29	284
15.15	18	283	15.19	16	310	10	15.17	17	296
15.41	09	319	15.41	10	301	11	15.41	09	310
15.67	16	319	15.70	13	296	12	15.69	15	307
			15.76	08	323	13	15.76	08	323
			15.92	12	310	14	15.92	12	310
			15.95	84	170	15	15.95	84	170
17.58	09	253	17.59	13	253	16	17.59	11	253
18.52	59	308				17	18.52	59	308
18.73	54	210				18	18.73	54	210
			22.18	45	217	19	22.18	45	217
22.20	83	004	22.28	82	357	20	22.24	82	001
23.35	51	212	23.36	53	207	21	23.36	52	210
			27.43	40	293	22	27.43	40	293
			27.56	13	324	23	27.56	13	324
			27.93	47	205	24	27.93	47	205
36.85	81	070	36.97	80	071	25	36.91	80	070
37.19	52	067	37.23	52	069	26	37.21	52	068
			39.69	66	329	27	39.69	66	329
40.22	34	025	40.25	38	019	28	40.24	36	022
			42.94	56	341	29	42.94	56	341
45.59	51	039	45.63	54	047	30	45.61	53	043
46.45	72	337	46.48	74	331	31	46.47	73	334
55.30	71	317	55.31	71	318	32	55.31	71	318
55.58	11	220	55.57	11	245	33	55.58	11	233
			62.04	82	039	34	62.04	82	039
			62.44	07	033	35	62.44	07	033

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-25-08

Optical Televiewer Data				Acoustic Televiewer Data				Average Data Set			
Depth	Dip	Dip AZ		Depth	Dip	Dip AZ		#	Depth	Dip	Dip AZ
25.46	16	178		25.47	17	182		1	25.47	16	180
				26.36	48	298		2	26.36	48	298
26.49	60	159		26.47	61	153		3	26.48	60	156
30.30	74	160		30.37	75	163		4	30.34	74	161
				30.40	68	164		5	30.40	68	164
				30.79	55	161		6	30.79	55	161
31.90	72	161		31.96	72	161		7	31.93	72	161
32.49	14	193		32.49	10	203		8	32.49	12	198
				32.63	57	158		9	32.63	57	158
33.58	39	308		33.57	32	327		10	33.58	36	317
37.42	23	299		37.43	25	323		11	37.43	24	311
				42.89	14	129		12	42.89	14	129
43.05	61	253		43.09	62	258		13	43.07	61	256
43.86	42	146		43.89	48	178		14	43.88	45	162
				44.01	43	209		15	44.01	43	209
49.36	85	262		49.38	85	271		16	49.37	85	267
				50.06	14	218		17	50.06	14	218
				51.43	40	112		18	51.43	40	112
				51.68	38	126		19	51.68	38	126
				52.12	58	101		20	52.12	58	101
				52.53	63	089		21	52.53	63	089
				52.95	60	096		22	52.95	60	096
				55.48	69	079		23	55.48	69	079
				58.23	70	272		24	58.23	70	272

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-26-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
			19.37	65	084	1	19.37	65	084
			20.04	47	093	2	20.04	47	093
20.43	51	065	20.41	57	062	3	20.42	54	063
			20.84	61	049	4	20.84	61	049
21.03	70	070	21.03	74	078	5	21.03	72	074
21.77	54	087	21.66	49	099	6	21.72	52	093
22.03	71	051				7	22.03	71	051
22.12	52	113	22.14	56	105	8	22.13	54	109
22.65	73	064	22.64	73	062	9	22.65	73	063
22.71	28	206	22.70	26	200	10	22.71	27	203
23.18	69	062	23.17	70	060	11	23.18	70	061
23.53	23	244	23.58	29	238	12	23.56	26	241
			23.77	65	056	13	23.77	65	056
			23.97	43	259	14	23.97	43	259
24.29	53	254	24.29	55	260	15	24.29	54	257
			24.44	29	263	16	24.44	29	263
24.61	24	156	24.60	25	143	17	24.61	24	150
25.30	73	088	25.21	69	086	18	25.26	71	087
26.24	69	222	26.25	65	223	19	26.25	67	222
			26.81	83	054	20	26.81	83	054
26.88	23	200	26.86	27	210	21	26.87	25	205
			27.53	70	049	22	27.53	70	049
29.17	23	168	29.16	21	133	23	29.17	22	150
29.46	52	143	29.49	42	129	24	29.48	47	136
29.63	55	174	29.63	46	178	25	29.63	50	176
29.98	37	149	30.00	28	156	26	29.99	32	153
30.16	31	200	30.18	29	189	27	30.17	30	194
			30.73	16	141	28	30.73	16	141
			31.03	72	060	29	31.03	72	060
31.48	53	032	31.48	50	031	30	31.48	52	031
			31.70	25	076	31	31.70	25	076
33.26	15	127	33.27	11	153	32	33.27	13	140
35.42	49	211	35.41	52	208	33	35.42	51	209
			35.82	29	327	34	35.82	29	327
			36.46	37	315	35	36.46	37	315
			37.23	47	323	36	37.23	47	323
38.09	72	066	38.08	71	062	37	38.09	71	064
38.49	71	065	38.50	71	064	38	38.50	71	064
			40.45	44	195	39	40.45	44	195
			40.92	32	165	40	40.92	32	165
42.05	65	062	42.03	65	061	41	42.04	65	062
42.70	53	300	42.70	52	307	42	42.70	53	304
			43.05	53	328	43	43.05	53	328
			44.33	45	209	44	44.33	45	209
			44.39	33	208	45	44.39	33	208
			44.75	41	170	46	44.75	41	170
46.49	75	066	46.47	75	062	47	46.48	75	064
			47.85	46	209	48	47.85	46	209

48.51	33	182		48.51	32	188		49	48.51	33	185
				48.80	59	222		50	48.80	59	222
				48.93	69	223		51	48.93	69	223
49.00	63	215		49.00	61	216		52	49.00	62	216
49.22	19	339		49.20	20	336		53	49.21	19	337
49.51	53	202		49.50	56	200		54	49.51	54	201
				49.86	42	090		55	49.86	42	090
				50.70	44	111		56	50.70	44	111
				51.28	43	183		57	51.28	43	183
				52.35	47	315		58	52.35	47	315
				52.76	44	196		59	52.76	44	196
				52.87	43	135		60	52.87	43	135
				53.08	29	136		61	53.08	29	136
				53.26	25	118		62	53.26	25	118
				56.00	58	276		63	56.00	58	276
56.33	57	290		56.31	55	284		64	56.32	56	287
				57.34	34	208		65	57.34	34	208
57.55	37	277		57.55	37	271		66	57.55	37	274
				58.23	48	205		67	58.23	48	205

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-27-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
22.70	69	052	22.72	70	061	1	22.71	70	057
23.61	31	355				2	23.61	31	355
			25.48	46	050	3	25.48	46	050
25.99	63	153	25.96	62	156	4	25.98	62	155
26.14	72	133	26.25	74	149	5	26.20	73	141
26.63	55	176	26.57	55	161	6	26.60	55	168
27.32	60	146	27.31	51	146	7	27.32	56	146
			27.84	50	079	8	27.84	50	079
28.01	51	051				9	28.01	51	051
28.28	41	004	28.38	41	328	10	28.33	41	346
30.33	65	263	30.33	66	251	11	30.33	66	257
31.49	28	017	31.49	35	029	12	31.49	31	023
31.98	53	210	32.01	49	205	13	32.00	51	207
32.86	61	153				14	32.86	61	153
34.10	62	146	34.12	62	161	15	34.11	62	153
34.63	40	009	34.65	49	021	16	34.64	45	015
			43.76	54	296	17	43.76	54	296
46.59	73	064	46.58	71	064	18	46.59	72	064
			47.26	22	081	19	47.26	22	081
48.04	40	114	48.02	39	130	20	48.03	39	122
			48.58	25	151	21	48.58	25	151
			48.80	25	126	22	48.80	25	126
			49.14	28	146	23	49.14	28	146
			49.22	69	061	24	49.22	69	061
			49.83	36	128	25	49.83	36	128
			50.87	48	196	26	50.87	48	196
51.01	31	150				27	51.01	31	150
51.44	36	153	51.42	38	151	28	51.43	37	152
52.02	36	120	51.94	30	128	29	51.98	33	124
			52.26	22	196	30	52.26	22	196
52.57	31	169	52.50	25	161	31	52.54	28	165
53.65	28	149	53.63	35	145	32	53.64	31	147
53.85	40	164	53.85	44	181	33	53.85	42	172
56.28	40	151				34	56.28	40	151
56.34	28	138	56.33	22	126	35	56.34	25	132
58.08	27	166	58.09	27	147	36	58.09	27	156
59.28	48	319	59.25	49	311	37	59.27	49	315
61.08	30	164	61.11	28	173	38	61.10	29	168
61.43	36	138				39	61.43	36	138
			61.44	21	178	40	61.44	21	178
61.59	43	166	61.53	40	163	41	61.56	41	165
62.50	56	155	62.51	59	146	42	62.51	58	150
62.75	38	138	62.70	30	148	43	62.73	34	143
64.11	41	319	64.14	47	334	44	64.13	44	327
64.60	57	138	64.57	59	153	45	64.59	58	146
			64.79	68	148	46	64.79	68	148
65.01	55	134	64.99	55	153	47	65.00	55	143
			65.45	48	350	48	65.45	48	350

65.88	20	193		65.87	18	180		49	65.88	19	187
				65.93	38	323		50	65.93	38	323
				66.28	32	144		51	66.28	32	144
67.30	52	307		67.33	55	332		52	67.32	53	320
				67.42	30	146		53	67.42	30	146
				67.56	48	327		54	67.56	48	327
67.60	14	156						55	67.60	14	156
68.11	31	339		68.09	28	330		56	68.10	29	335
68.57	25	178		68.54	20	170		57	68.56	22	174
71.95	56	330		71.97	57	316		58	71.96	57	323
				72.76	35	143		59	72.76	35	143
73.35	54	146		73.33	51	145		60	73.34	52	146
74.33	62	140		74.32	65	146		61	74.33	64	143
74.93	58	154						62	74.93	58	154

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-28-08

Optical Televiewer Data				Acoustic Televiewer Data				Average Data Set			
Depth	Dip	Dip AZ		Depth	Dip	Dip AZ		#	Depth	Dip	Dip AZ
19.10	55	216						1	19.10	55	216
19.31	23	241						2	19.31	23	241
19.60	25	188						3	19.60	25	188
				20.50	29	039		4	20.50	29	039
				21.14	38	332		5	21.14	38	332
				21.24	25	131		6	21.24	25	131
				21.59	41	358		7	21.59	41	358
				21.72	34	349		8	21.72	34	349
22.44	48	203		22.44	50	208		9	22.44	49	206
23.17	56	213		23.26	57	214		10	23.22	56	213
23.50	43	226		23.50	51	243		11	23.50	47	234
24.00	56	238		23.98	56	256		12	23.99	56	247
				25.61	18	151		13	25.61	18	151
				25.79	15	272		14	25.79	15	272
26.07	54	160		26.08	51	147		15	26.08	53	153
27.05	83	169		27.07	82	170		16	27.06	83	169
28.80	54	178		28.72	51	217		17	28.76	53	198
				29.66	18	345		18	29.66	18	345
				29.98	40	009		19	29.98	40	009
32.04	75	267		32.12	75	256		20	32.08	75	262
32.76	28	149		32.75	23	136		21	32.76	25	142
32.90	15	288		32.88	20	248		22	32.89	17	268
34.56	79	006						23	34.56	79	006
34.94	15	094		34.96	12	054		24	34.95	13	074
35.81	42	270		35.84	39	272		25	35.83	41	271
35.98	38	273		36.09	33	241		26	36.04	36	257
36.26	17	265		36.31	09	252		27	36.29	13	259
36.49	69	300		36.53	68	292		28	36.51	68	296
36.85	66	292		36.80	65	280		29	36.83	65	286
38.58	15	061		38.61	27	056		30	38.60	21	059
38.75	22	007		38.74	20	330		31	38.75	21	348
39.29	24	084		39.27	23	088		32	39.28	24	086
39.72	30	275		39.71	39	278		33	39.72	35	276
				40.25	30	233		34	40.25	30	233
41.24	16	071		41.24	08	113		35	41.24	12	092
41.59	28	026		41.61	30	026		36	41.60	29	026
41.87	28	061						37	41.87	28	061
				42.17	42	062		38	42.17	42	062
42.46	66	310		42.50	67	302		39	42.48	66	306
42.59	12	149						40	42.59	12	149
				42.71	38	043		41	42.71	38	043
				43.63	40	245		42	43.63	40	245
43.92	32	257						43	43.92	32	257
44.24	33	091						44	44.24	33	091
45.22	38	323						45	45.22	38	323
45.62	52	326		45.61	45	324		46	45.62	48	325
46.52	45	206						47	46.52	45	206
46.69	19	152						48	46.69	19	152

46.99	32	215						49	46.99	32	215
47.22	32	226						50	47.22	32	226
47.64	32	235		47.70	29	250		51	47.67	30	243
				48.64	08	093		52	48.64	08	093
				48.95	21	238		53	48.95	21	238
49.46	44	197						54	49.46	44	197
				49.55	22	161		55	49.55	22	161
50.45	52	198		50.44	53	213		56	50.45	53	205
50.75	55	226		50.64	53	201		57	50.70	54	213
				50.88	70	232		58	50.88	70	232
51.64	22	115		51.63	22	133		59	51.64	22	124
51.81	15	104		51.84	18	126		60	51.83	17	115
52.32	24	087						61	52.32	24	087
52.80	38	155		52.68	35	128		62	52.74	37	141
52.96	41	162						63	52.96	41	162
53.32	30	158						64	53.32	30	158
53.54	28	146		53.52	33	158		65	53.53	30	152
53.79	30	136		53.95	24	143		66	53.87	27	140
54.09	28	138		54.12	21	143		67	54.11	24	141
54.47	48	317		54.38	56	315		68	54.43	52	316
				54.46	19	131		69	54.46	19	131
56.67	25	118		56.66	21	141		70	56.67	23	130
58.10	48	052		58.10	52	044		71	58.10	50	048
				58.91	78	069		72	58.91	78	069
59.60	34	026		59.64	33	027		73	59.62	34	026
62.76	54	316		62.73	51	307		74	62.75	52	311
67.09	23	154		67.09	25	139		75	67.09	24	146
70.27	22	134		70.27	20	133		76	70.27	21	133
				75.04	45	307		77	75.04	45	307
				75.14	47	322		78	75.14	47	322
80.77	75	005		80.70	75	013		79	80.74	75	009
81.85	69	061						80	81.85	69	061
82.18	69	067		82.21	70	069		81	82.20	70	068
82.51	69	074						82	82.51	69	074
89.87	22	325						83	89.87	22	325
101.36	50	262		101.36	63	270		84	101.36	57	266
102.06	64	276		102.03	66	273		85	102.05	65	274
105.20	40	178		105.25	41	196		86	105.23	41	187
105.43	18	121		105.45	32	151		87	105.44	25	136
105.85	42	185		105.81	50	182		88	105.83	46	183
				105.90	43	168		89	105.90	43	168
107.53	28	191		107.53	30	201		90	107.53	29	196
107.46	75	353		107.56	75	352		91	107.51	75	352

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-29-08

Optical Televiewer Data				Acoustic Televiewer Data				Average Data Set			
Depth	Dip	Dip AZ		Depth	Dip	Dip AZ		#	Depth	Dip	Dip AZ
5.81	55	214						1	5.81	55	214
6.48	45	208						2	6.48	45	208
8.23	72	244						3	8.23	72	244
8.51	38	248						4	8.51	38	248
10.18	34	231						5	10.18	34	231
11.39	59	237						6	11.39	59	237
15.18	35	019						7	15.18	35	019
16.65	54	223						8	16.65	54	223
16.91	62	291						9	16.91	62	291
17.38	20	091						10	17.38	20	091
17.95	39	208						11	17.95	39	208
19.23	34	275						12	19.23	34	275
19.44	46	259						13	19.44	46	259
19.93	52	042						14	19.93	52	042
20.26	45	296						15	20.26	45	296
21.91	26	156						16	21.91	26	156
27.54	09	115						17	27.54	09	115
27.91	38	310						18	27.91	38	310
31.83	67	280		31.83	65	274		19	31.83	66	277
32.05	60	258		32.02	52	278		20	32.04	56	268
33.03	48	252						21	33.03	48	252
33.58	23	188						22	33.58	23	188
				37.17	25	138		23	37.17	25	138
52.10	28	126		52.11	26	120		24	52.11	27	123
52.35	23	087		52.36	20	084		25	52.36	21	085
54.15	26	126		54.15	31	136		26	54.15	28	131
55.23	37	124		55.26	38	124		27	55.25	37	124
57.21	68	345		57.23	69	345		28	57.22	69	345
				61.49	62	031		29	61.49	62	031
63.70	30	151		63.76	39	151		30	63.73	34	151
63.96	39	152		63.97	43	159		31	63.97	41	155
64.94	66	285		64.97	68	298		32	64.96	67	292
				67.40	61	231		33	67.40	61	231
68.83	79	080		68.82	78	080		34	68.83	79	080
70.47	32	152		70.47	36	162		35	70.47	34	157
				71.36	67	114		36	71.36	67	114
71.45	38	134		71.40	33	136		37	71.43	35	135
71.63	37	144		71.62	42	142		38	71.63	39	143
74.37	35	161		74.39	38	161		39	74.38	37	161
74.88	33	135		74.89	32	131		40	74.89	32	133
79.19	48	226		79.20	45	227		41	79.20	47	226
				79.69	41	139		42	79.69	41	139
80.13	61	287		80.09	62	303		43	80.11	61	295
				80.22	58	203		44	80.22	58	203
88.28	39	099		88.30	39	108		45	88.29	39	104
89.64	45	206		89.76	41	218		46	89.70	43	212
89.84	42	218						47	89.84	42	218
89.98	44	211		89.95	46	224		48	89.97	45	217

				90.21	29	207		49	90.21	29	207
				90.68	30	079		50	90.68	30	079
90.82	32	194						51	90.82	32	194
91.06	37	196						52	91.06	37	196
				91.22	41	064		53	91.22	41	064
92.72	17	163						54	92.72	17	163
93.27	28	089		93.30	22	104		55	93.29	25	096
93.41	23	111						56	93.41	23	111
94.02	28	134		94.05	28	123		57	94.04	28	128
				94.43	23	146		58	94.43	23	146
94.59	16	099						59	94.59	16	099
94.75	25	111		94.77	30	130		60	94.76	27	120
95.33	24	124		95.35	25	126		61	95.34	25	125
95.47	30	124						62	95.47	30	124
95.65	24	126		95.67	32	121		63	95.66	28	124
95.91	25	131		95.95	28	121		64	95.93	26	126
96.22	34	126		96.22	34	113		65	96.22	34	119
96.55	27	133		96.58	26	123		66	96.57	27	128
96.81	26	129		96.82	28	123		67	96.82	27	126
97.01	28	121		97.02	29	133		68	97.02	28	127
97.39	26	134		97.41	29	131		69	97.40	27	132
97.71	24	130		97.73	28	133		70	97.72	26	131
98.52	26	131						71	98.52	26	131
98.59	69	054		98.60	71	053		72	98.60	70	053
98.62	25	133		98.63	28	133		73	98.63	26	133
99.28	32	131		99.28	32	106		74	99.28	32	118
99.43	29	138		99.45	30	139		75	99.44	30	138
				99.78	60	193		76	99.78	60	193
99.80	25	129		99.92	28	134		77	99.86	26	132
100.12	25	131		100.16	26	133		78	100.14	25	132
100.96	28	118		100.98	32	122		79	100.97	30	120
101.26	28	102		101.27	25	123		80	101.27	26	113
102.13	24	141		102.14	26	145		81	102.14	25	143
				102.48	25	128		82	102.48	25	128
102.71	21	124		102.73	22	128		83	102.72	21	126
				103.31	26	136		84	103.31	26	136
				103.71	35	204		85	103.71	35	204
103.77	20	126		103.79	20	116		86	103.78	20	121
104.57	24	127		103.78	63	342		87	104.18	43	234
				104.21	26	136		88	104.21	26	136
				104.32	24	119		89	104.32	24	119
				104.58	22	136		90	104.58	22	136
104.90	60	018		104.90	59	012		91	104.90	60	015
105.24	23	131		105.31	20	131		92	105.28	21	131
105.34	20	135		105.39	23	128		93	105.37	21	132
				106.04	29	121		94	106.04	29	121
106.18	18	125		106.22	22	131		95	106.20	20	128
106.65	37	105						96	106.65	37	105
				106.71	19	131		97	106.71	19	131
107.14	30	101		107.13	30	106		98	107.14	30	103
				107.22	32	123		99	107.22	32	123
				107.36	28	100		100	107.36	28	100
107.54	28	122		107.56	28	116		101	107.55	28	119
				107.73	34	133		102	107.73	34	133
				107.93	35	123		103	107.93	35	123

				108.06	34	095		104	108.06	34	095
				108.20	28	123		105	108.20	28	123
				108.40	22	108		106	108.40	22	108
108.57	18	118		108.56	18	163		107	108.57	18	141
				108.80	20	152		108	108.80	20	152
108.83	31	078						109	108.83	31	078
				109.03	25	111		110	109.03	25	111
				109.24	20	143		111	109.24	20	143
109.36	27	144		109.39	23	133		112	109.38	25	139
109.63	55	219		109.68	53	214		113	109.66	54	217
				110.14	57	102		114	110.14	57	102
110.91	66	327		110.93	64	325		115	110.92	65	326
111.52	44	198		111.54	45	196		116	111.53	45	197
118.47	50	321		118.49	48	318		117	118.48	49	319
119.36	49	225		119.38	50	228		118	119.37	50	227
119.40	65	015		119.39	64	006		119	119.40	65	011
120.12	79	074		120.07	80	069		120	120.10	79	071
121.03	60	306		121.00	57	319		121	121.02	59	313

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-30-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
10.90	67	241				1	10.90	67	241
11.14	52	018				2	11.14	52	018
13.54	71	225				3	13.54	71	225
14.79	20	100				4	14.79	20	100
15.30	31	162				5	15.30	31	162
15.56	35	169				6	15.56	35	169
16.49	32	228				7	16.49	32	228
17.14	44	212	17.14	45	205	8	17.14	45	208
			18.38	48	211	9	18.38	48	211
18.74	48	207	18.76	43	216	10	18.75	46	211
19.25	32	246	19.28	31	248	11	19.27	31	247
26.20	58	035	26.24	56	031	12	26.22	57	033
32.07	59	009	32.09	59	000	13	32.08	59	004
32.95	70	020				14	32.95	70	020
33.19	76	018	33.17	76	022	15	33.18	76	020
			40.64	75	050	16	40.64	75	050
			42.78	68	018	17	42.78	68	018
49.64	27	195	49.66	26	203	18	49.65	27	199
49.99	59	304	49.96	55	307	19	49.98	57	306
			50.02	60	303	20	50.02	60	303
			50.38	28	205	21	50.38	28	205
50.90	71	035	50.89	69	028	22	50.90	70	032
51.21	65	328	51.22	65	332	23	51.22	65	330
59.92	67	332	59.97	67	324	24	59.95	67	328
			62.04	38	256	25	62.04	38	256
62.79	29	242	62.81	37	244	26	62.80	33	243
64.82	86	081	64.81	86	080	27	64.82	86	081
67.07	69	335	67.09	67	334	28	67.08	68	334
			69.15	74	059	29	69.15	74	059
72.15	31	193	72.17	31	195	30	72.16	31	194
			78.54	41	285	31	78.54	41	285
			79.52	43	280	32	79.52	43	280
			94.07	02	096	33	94.07	02	096
95.35	40	314	95.36	42	325	34	95.36	41	320
102.40	28	288				35	102.40	28	288
			110.27	11	132	36	110.27	11	132
110.63	21	111	110.62	25	113	37	110.63	23	112
110.92	13	146	110.92	12	168	38	110.92	13	157
111.19	25	134	111.18	26	136	39	111.19	25	135
			111.38	28	161	40	111.38	28	161
114.11	15	136	114.11	18	128	41	114.11	16	132
			114.19	28	217	42	114.19	28	217
114.54	32	101	114.51	24	116	43	114.53	28	108
			114.59	33	125	44	114.59	33	125
115.98	30	136	115.96	26	148	45	115.97	28	142
116.23	29	165	116.23	32	159	46	116.23	30	162
116.38	29	144	116.35	32	140	47	116.37	30	142
117.53	25	177	117.51	25	205	48	117.52	25	191

118.41	32	161		118.39	36	163		49	118.40	34	162
				119.92	29	154		50	119.92	29	154
121.58	75	342		121.61	74	339		51	121.60	74	340
124.06	53	294		124.07	47	296		52	124.07	50	295
130.29	55	195		130.29	53	190		53	130.29	54	193
132.45	74	335		132.47	75	340		54	132.46	75	337

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: RKS-31-08

Optical Televiewer Data				Acoustic Televiewer Data				Average Data Set			
Depth	Dip	Dip AZ		Depth	Dip	Dip AZ		#	Depth	Dip	Dip AZ
6.16	49	350						1	6.16	49	350
6.26	42	100						2	6.26	42	100
6.85	53	085						3	6.85	53	085
7.66	75	256						4	7.66	75	256
10.31	36	145						5	10.31	36	145
10.83	36	135						6	10.83	36	135
13.67	83	141						7	13.67	83	141
14.73	58	245						8	14.73	58	245
15.31	44	357						9	15.31	44	357
16.14	31	157						10	16.14	31	157
18.92	59	075						11	18.92	59	075
19.48	36	144						12	19.48	36	144
20.03	35	134						13	20.03	35	134
20.83	87	318						14	20.83	87	318
22.07	74	274						15	22.07	74	274
22.71	64	263						16	22.71	64	263
23.34	37	034						17	23.34	37	034
25.95	33	157						18	25.95	33	157
26.30	35	154						19	26.30	35	154
34.16	52	262						20	34.16	52	262
34.81	52	301						21	34.81	52	301
37.34	37	142						22	37.34	37	142
				42.16	39	140		23	42.16	39	140
45.75	88	160		45.77	88	163		24	45.76	88	161
				45.98	10	086		25	45.98	10	086
				46.58	25	163		26	46.58	25	163
				46.95	32	164		27	46.95	32	164
49.07	32	153		49.07	28	153		28	49.07	30	153
				51.56	31	152		29	51.56	31	152
53.22	88	107		53.23	88	113		30	53.23	88	110
				54.94	19	023		31	54.94	19	023
				55.63	39	348		32	55.63	39	348
				55.81	81	306		33	55.81	81	306
				55.93	29	157		34	55.93	29	157
				56.51	63	306		35	56.51	63	306
56.68	61	317		56.69	53	317		36	56.69	57	317
				56.77	42	162		37	56.77	42	162
				58.00	76	139		38	58.00	76	139
				60.96	24	154		39	60.96	24	154
				61.17	62	056		40	61.17	62	056
				62.50	70	307		41	62.50	70	307
				62.86	76	312		42	62.86	76	312
68.21	79	151		68.25	80	161		43	68.23	79	156
				71.12	84	233		44	71.12	84	233
72.46	27	101		72.54	17	071		45	72.50	22	086
73.51	38	199		73.50	39	198		46	73.51	39	198
73.60	57	078						47	73.60	57	078
				73.62	38	205		48	73.62	38	205

81.74	74	253		81.77	73	258		49	81.76	74	255
				81.82	75	252		50	81.82	75	252
				85.13	34	070		51	85.13	34	070
				86.86	57	098		52	86.86	57	098
				98.02	62	238		53	98.02	62	238
				101.08	53	068		54	101.08	53	068
				105.52	58	042		55	105.52	58	042
106.90	60	279		106.89	59	287		56	106.90	60	283
				118.16	60	180		57	118.16	60	180
118.20	84	298						58	118.20	84	298
				125.74	40	204		59	125.74	40	204
125.85	43	197		125.90	42	219		60	125.88	42	208
137.67	35	093		137.66	33	093		61	137.67	34	093
138.13	23	039		138.13	19	056		62	138.13	21	047

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: SI-01-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
7.71	67	327				1	7.71	67	327
10.54	68	071				2	10.54	68	071
14.94	05	129				3	14.94	05	129
14.96	77	318				4	14.96	77	318
18.58	11	136				5	18.58	11	136
19.71	09	042				6	19.71	09	042
20.51	08	096				7	20.51	08	096
21.68	13	094				8	21.68	13	094
23.50	13	076				9	23.50	13	076
23.90	71	318				10	23.90	71	318
24.95	54	194				11	24.95	54	194
25.17	40	177				12	25.17	40	177
25.66	37	090				13	25.66	37	090
26.46	09	317				14	26.46	09	317
27.27	15	288				15	27.27	15	288
27.37	13	305				16	27.37	13	305
28.10	74	077				17	28.10	74	077
28.22	25	296				18	28.22	25	296
28.52	38	310				19	28.52	38	310
28.58	32	277				20	28.58	32	277
28.83	18	311				21	28.83	18	311
29.13	26	294				22	29.13	26	294
31.88	76	070				23	31.88	76	070
32.46	23	116				24	32.46	23	116
32.80	23	089				25	32.80	23	089
32.88	29	084				26	32.88	29	084
33.54	22	111				27	33.54	22	111
33.88	50	195				28	33.88	50	195
34.24	28	099				29	34.24	28	099
34.57	44	344				30	34.57	44	344
34.80	22	109				31	34.80	22	109
35.06	66	332				32	35.06	66	332
36.07	17	011				33	36.07	17	011
36.13	71	198				34	36.13	71	198
36.29	65	284				35	36.29	65	284
37.07	26	101				36	37.07	26	101
38.11	34	104				37	38.11	34	104
38.39	23	150				38	38.39	23	150
38.73	16	114				39	38.73	16	114
39.09	43	188				40	39.09	43	188
39.44	51	187				41	39.44	51	187
39.75	45	187				42	39.75	45	187
40.26	61	181				43	40.26	61	181
40.84	59	324				44	40.84	59	324
42.35	41	308	42.36	24	297	45	42.36	32	302
			42.50	25	290	46	42.50	25	290
			42.86	73	236	47	42.86	73	236
			43.06	11	325	48	43.06	11	325

43.14	11	315		43.12	15	015		49	43.13	13	345
43.67	78	232		43.74	77	234		50	43.71	78	233
44.65	47	197		44.68	54	203		51	44.67	51	200
45.05	63	359		45.04	64	006		52	45.05	64	003
				45.95	51	192		53	45.95	51	192
				47.39	47	186		54	47.39	47	186
48.88	28	331		48.87	22	318		55	48.88	25	324
				49.74	18	266		56	49.74	18	266
49.79	26	335		49.83	22	305		57	49.81	24	320
51.09	21	342		51.06	18	307		58	51.08	19	325
				52.11	65	312		59	52.11	65	312
				55.26	57	286		60	55.26	57	286
56.80	49	196		56.81	48	198		61	56.81	48	197
				64.01	16	353		62	64.01	16	353
64.27	13	310		64.28	18	323		63	64.28	15	316
65.82	69	309		65.81	67	307		64	65.82	68	308
				65.92	64	306		65	65.92	64	306
69.23	18	310		69.24	23	322		66	69.24	20	316
70.87	22	260		70.85	15	278		67	70.86	18	269
				70.94	29	284		68	70.94	29	284
73.83	75	081		73.84	75	077		69	73.84	75	079
				74.13	26	288		70	74.13	26	288
74.76	17	336		74.78	20	327		71	74.77	19	332
				76.66	18	311		72	76.66	18	311
				76.93	20	288		73	76.93	20	288
				77.07	10	286		74	77.07	10	286
77.47	75	070		77.36	73	065		75	77.42	74	067
78.10	74	076		78.11	74	079		76	78.11	74	077
				78.33	35	285		77	78.33	35	285
78.49	31	263		78.47	44	255		78	78.48	37	259
78.94	44	258		78.98	41	264		79	78.96	42	261
79.31	71	074		79.39	72	073		80	79.35	72	073
80.68	68	072		80.57	70	076		81	80.63	69	074
80.86	74	076		80.88	75	079		82	80.87	75	078
				82.99	77	071		83	82.99	77	071
83.12	72	085		83.08	71	070		84	83.10	71	077
83.48	75	081		83.45	74	073		85	83.47	74	077
				83.62	24	010		86	83.62	24	010
83.73	74	079		83.69	75	070		87	83.71	75	074
				84.55	25	308		88	84.55	25	308
				84.57	76	072		89	84.57	76	072
84.66	20	317		84.68	22	314		90	84.67	21	315
85.15	18	325		85.16	21	334		91	85.16	19	330
				87.55	44	201		92	87.55	44	201
				87.99	46	201		93	87.99	46	201
				88.35	49	198		94	88.35	49	198
				90.83	76	081		95	90.83	76	081
				91.24	81	072		96	91.24	81	072
92.89	76	074		93.00	77	079		97	92.95	77	076
				93.08	79	073		98	93.08	79	073
93.65	77	085		93.65	77	081		99	93.65	77	083
94.25	29	274		94.29	28	251		100	94.27	29	262
94.37	16	275		94.39	09	243		101	94.38	13	259
				94.97	27	286		102	94.97	27	286
				95.09	09	335		103	95.09	09	335

		95.41	15	270		104	95.41	15	270
		96.08	09	272		105	96.08	09	272
		97.36	07	076		106	97.36	07	076
		97.47	16	335		107	97.47	16	335
		97.71	13	327		108	97.71	13	327
		97.83	11	270		109	97.83	11	270
		98.06	13	272		110	98.06	13	272
		98.34	74	083		111	98.34	74	083
		98.37	23	273		112	98.37	23	273
		98.47	59	202		113	98.47	59	202

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: SI-02-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
6.26	42	284				1	6.26	42	284
6.45	43	323				2	6.45	43	323
7.22	74	064				3	7.22	74	064
8.05	69	067				4	8.05	69	067
8.92	60	092				5	8.92	60	092
9.77	65	092				6	9.77	65	092
10.25	80	111				7	10.25	80	111
11.05	46	248				8	11.05	46	248
11.69	71	064				9	11.69	71	064
12.07	67	064				10	12.07	67	064
14.29	53	196				11	14.29	53	196
15.93	53	194				12	15.93	53	194
16.50	70	070				13	16.50	70	070
19.02	15	316				14	19.02	15	316
21.16	56	158				15	21.16	56	158
21.76	74	256				16	21.76	74	256
22.50	26	286				17	22.50	26	286
23.47	07	252				18	23.47	07	252
24.21	73	329				19	24.21	73	329
24.55	18	281				20	24.55	18	281
25.99	12	264				21	25.99	12	264
27.34	07	166				22	27.34	07	166
27.76	67	076	27.76	70	077	23	27.76	69	076
28.20	72	059	28.21	70	061	24	28.21	71	060
28.55	74	332	28.50	75	330	25	28.53	74	331
			28.96	51	287	26	28.96	51	287
29.14	34	268	29.17	42	261	27	29.16	38	265
29.36	30	276	29.36	34	278	28	29.36	32	277
29.64	33	308	29.51	26	305	29	29.58	30	307
29.98	60	172	30.00	56	166	30	29.99	58	169
30.58	32	296	30.57	28	295	31	30.58	30	296
31.62	18	296				32	31.62	18	296
31.85	14	283	31.84	11	318	33	31.85	13	301
32.27	48	308	32.27	53	305	34	32.27	51	307
32.62	23	324	32.62	17	349	35	32.62	20	337
33.06	48	204	33.05	48	196	36	33.06	48	200
34.55	47	209	34.55	49	200	37	34.55	48	204
34.84	72	074	34.85	71	073	38	34.85	72	073
36.23	28	311	36.24	25	318	39	36.24	26	315
38.02	13	002				40	38.02	13	002
			38.06	16	305	41	38.06	16	305
			38.22	15	338	42	38.22	15	338
38.58	74	070	38.61	75	066	43	38.60	75	068
38.63	68	070	38.63	70	067	44	38.63	69	069
			39.00	73	069	45	39.00	73	069
39.46	29	244	39.43	38	280	46	39.45	33	262
39.95	69	336	39.97	69	338	47	39.96	69	337
40.90	72	069	40.91	71	073	48	40.91	71	071

				41.32	24	013		49	41.32	24	013
				41.59	16	258		50	41.59	16	258
42.30	35	288		42.44	23	276		51	42.37	29	282
				43.83	29	300		52	43.83	29	300
43.84	82	071		43.95	81	067		53	43.90	82	069
				43.99	28	066		54	43.99	28	066
				44.33	59	281		55	44.33	59	281
				45.61	09	312		56	45.61	09	312
45.91	18	102		45.92	29	119		57	45.92	23	110
46.23	27	087		46.30	28	081		58	46.27	27	084
46.44	29	100		46.43	33	104		59	46.44	31	102
				46.68	25	099		60	46.68	25	099
46.86	18	112		46.85	25	101		61	46.86	21	107
				47.09	30	106		62	47.09	30	106
				47.27	24	113		63	47.27	24	113
				47.35	11	276		64	47.35	11	276
47.43	26	111		47.44	18	091		65	47.44	22	101
47.63	11	129		47.63	11	116		66	47.63	11	123
48.08	09	149		48.05	23	126		67	48.07	16	137
48.44	02	339						68	48.44	02	339
48.76	15	099		48.78	15	126		69	48.77	15	113
				49.04	56	330		70	49.04	56	330
49.93	22	264		49.92	20	270		71	49.93	21	267
				52.45	18	081		72	52.45	18	081
				52.84	06	076		73	52.84	06	076
52.93	76	064		52.93	76	059		74	52.93	76	061
53.44	22	046		53.44	21	037		75	53.44	21	042
53.89	25	100		53.91	23	086		76	53.90	24	093
54.17	33	090		54.19	32	081		77	54.18	32	085
				54.43	18	071		78	54.43	18	071
				54.82	09	121		79	54.82	09	121
55.01	28	102		55.02	26	088		80	55.02	27	095
				56.09	14	297		81	56.09	14	297
				56.30	28	267		82	56.30	28	267
				56.62	16	073		83	56.62	16	073
				56.75	38	323		84	56.75	38	323
				56.84	16	051		85	56.84	16	051
				57.04	24	099		86	57.04	24	099
				57.17	73	317		87	57.17	73	317
				57.73	21	001		88	57.73	21	001
58.03	46	160		58.03	44	157		89	58.03	45	158
58.45	11	087		58.45	16	106		90	58.45	14	096
				58.63	46	202		91	58.63	46	202
				58.79	69	336		92	58.79	69	336
				59.22	25	113		93	59.22	25	113
				59.44	30	047		94	59.44	30	047
59.46	09	089						95	59.46	09	089
59.84	42	190		59.87	43	197		96	59.86	43	194
				60.07	52	312		97	60.07	52	312
				60.79	39	190		98	60.79	39	190
				61.06	18	041		99	61.06	18	041
				61.36	74	335		100	61.36	74	335
				61.38	53	203		101	61.38	53	203
62.19	77	065		62.13	75	071		102	62.16	76	068
				62.15	72	303		103	62.15	72	303

62.50	77	068		62.50	76	069		104	62.50	77	068
				62.53	26	288		105	62.53	26	288
				62.85	15	342		106	62.85	15	342
				63.28	15	311		107	63.28	15	311
63.85	24	354		63.86	18	003		108	63.86	21	359
64.64	32	308		64.65	28	300		109	64.65	30	304
66.33	13	092		66.34	12	073		110	66.34	13	083
66.56	13	344						111	66.56	13	344
66.58	43	306		66.57	46	313		112	66.58	44	309
				66.93	26	352		113	66.93	26	352
69.08	70	075		69.10	70	074		114	69.09	70	074
				70.32	20	303		115	70.32	20	303
70.76	77	074		70.73	76	069		116	70.75	77	072
				71.26	75	072		117	71.26	75	072
				71.27	72	073		118	71.27	72	073
				72.61	18	121		119	72.61	18	121
72.91	65	274		72.92	66	280		120	72.92	65	277
				73.48	05	335		121	73.48	05	335
73.54	21	098		73.56	25	088		122	73.55	23	093
				74.18	26	356		123	74.18	26	356
74.27	26	129		74.28	28	116		124	74.28	27	123
75.11	36	131						125	75.11	36	131
				75.21	24	107		126	75.21	24	107
75.41	18	107						127	75.41	18	107
75.76	24	081		75.74	18	108		128	75.75	21	095
				75.88	23	113		129	75.88	23	113
75.99	23	109		76.00	26	106		130	76.00	24	108
				76.54	36	102		131	76.54	36	102
76.79	53	200		76.82	50	196		132	76.81	52	198
77.10	49	189		77.12	47	203		133	77.11	48	196
				77.38	55	207		134	77.38	55	207
				77.76	46	205		135	77.76	46	205
78.23	30	202		78.25	32	203		136	78.24	31	202
78.87	55	299						137	78.87	55	299
78.88	62	200		78.89	60	198		138	78.89	61	199
				78.90	57	296		139	78.90	57	296
79.41	26	147		79.43	29	141		140	79.42	28	144
79.56	20	137						141	79.56	20	137
				80.43	08	071		142	80.43	08	071
80.80	51	217		80.83	51	213		143	80.82	51	215
				82.13	08	292		144	82.13	08	292
				83.17	66	292		145	83.17	66	292
				84.33	50	296		146	84.33	50	296
85.57	73	073		85.57	74	071		147	85.57	73	072
				86.34	17	219		148	86.34	17	219
				86.67	43	208		149	86.67	43	208
87.39	73	072		87.39	73	071		150	87.39	73	072
				88.60	73	080		151	88.60	73	080
88.75	70	081		88.72	69	078		152	88.74	69	079
				89.36	74	099		153	89.36	74	099
89.61	71	077		89.57	72	074		154	89.59	71	076
				89.94	34	250		155	89.94	34	250
				90.36	40	251		156	90.36	40	251
				90.50	29	263		157	90.50	29	263
				90.74	24	270		158	90.74	24	270

				90.87	32	239		159	90.87	32	239
91.67	82	177		91.67	80	169		160	91.67	81	173
92.35	74	078		92.31	73	073		161	92.33	73	075
				92.86	44	280		162	92.86	44	280
93.02	40	284		93.04	35	272		163	93.03	37	278
				93.17	33	271		164	93.17	33	271
				93.29	70	066		165	93.29	70	066
				93.53	54	205		166	93.53	54	205
				93.57	52	272		167	93.57	52	272
				93.70	48	225		168	93.70	48	225
				94.09	45	260		169	94.09	45	260
				94.55	50	241		170	94.55	50	241
				94.75	84	143		171	94.75	84	143
95.03	34	277		95.03	35	265		172	95.03	34	271
				95.39	33	181		173	95.39	33	181
				95.67	18	121		174	95.67	18	121
				96.22	41	206		175	96.22	41	206
96.40	74	079		96.39	74	073		176	96.40	74	076
				97.01	26	245		177	97.01	26	245
				97.12	33	295		178	97.12	33	295
				97.29	23	263		179	97.29	23	263
				97.37	38	268		180	97.37	38	268
				97.59	47	220		181	97.59	47	220
				97.59	20	263		182	97.59	20	263
97.61	76	079		97.61	76	071		183	97.61	76	075
98.38	27	244						184	98.38	27	244
99.03	75	074						185	99.03	75	074

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: SI-03-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
9.06	17	317				1	9.06	17	317
9.30	64	274				2	9.30	64	274
13.11	71	090				3	13.11	71	090
13.93	69	089				4	13.93	69	089
15.06	70	088				5	15.06	70	088
16.03	70	077				6	16.03	70	077
16.71	55	223				7	16.71	55	223
17.90	66	264				8	17.90	66	264
18.25	48	266				9	18.25	48	266
18.61	46	302				10	18.61	46	302
19.49	39	159				11	19.49	39	159
22.26	64	244				12	22.26	64	244
23.23	72	358				13	23.23	72	358
23.91	71	358				14	23.91	71	358
24.30	71	359				15	24.30	71	359
25.54	71	316				16	25.54	71	316
27.12	46	303				17	27.12	46	303
28.18	63	100				18	28.18	63	100
29.58	57	198				19	29.58	57	198
29.85	57	212				20	29.85	57	212
30.30	61	217				21	30.30	61	217
31.43	68	293				22	31.43	68	293
32.38	69	277				23	32.38	69	277
32.93	50	223				24	32.93	50	223
33.27	67	283				25	33.27	67	283
33.81	59	283				26	33.81	59	283
34.62	79	026				27	34.62	79	026
36.15	48	205				28	36.15	48	205
37.23	24	312				29	37.23	24	312
			40.55	52	312	30	40.55	52	312
			40.68	50	311	31	40.68	50	311
41.09	48	299	41.12	47	290	32	41.11	48	294
41.15	56	296	41.20	55	296	33	41.18	56	296
			42.48	72	261	34	42.48	72	261
			42.87	42	311	35	42.87	42	311
43.21	64	284	43.21	65	287	36	43.21	64	286
			45.05	26	356	37	45.05	26	356
			46.01	46	317	38	46.01	46	317
46.12	42	305	46.11	42	305	39	46.12	42	305
			46.34	21	003	40	46.34	21	003
46.70	07	012	46.70	04	318	41	46.70	05	345
			46.81	77	176	42	46.81	77	176
47.38	60	069	47.37	60	068	43	47.38	60	068
48.92	39	299	48.91	33	295	44	48.92	36	297
			49.50	59	169	45	49.50	59	169
50.93	76	227	50.89	77	230	46	50.91	76	229
52.53	41	306	52.53	39	305	47	52.53	40	306
			53.89	27	130	48	53.89	27	130

54.15	39	310		54.15	37	304		49	54.15	38	307
54.24	02	294		54.27	05	001		50	54.26	03	327
54.84	49	209		54.85	49	206		51	54.85	49	207
				56.45	78	353		52	56.45	78	353
				56.56	34	292		53	56.56	34	292
58.02	49	203		58.02	49	203		54	58.02	49	203
58.31	37	301		58.31	30	297		55	58.31	34	299
				58.76	66	171		56	58.76	66	171
60.24	16	084		60.24	24	108		57	60.24	20	096
60.36	30	291		60.40	29	303		58	60.38	30	297
				60.76	35	155		59	60.76	35	155
				60.85	32	163		60	60.85	32	163
				64.62	53	291		61	64.62	53	291
				66.34	28	295		62	66.34	28	295
				66.60	45	294		63	66.60	45	294
66.87	67	253		66.94	72	254		64	66.91	69	253
67.07	11	007		67.08	16	327		65	67.08	14	347
				67.36	29	334		66	67.36	29	334
				67.42	24	350		67	67.42	24	350
				71.79	62	323		68	71.79	62	323
				73.32	38	166		69	73.32	38	166
				73.38	55	324		70	73.38	55	324
74.01	30	296		74.00	26	291		71	74.01	28	293
				74.45	29	272		72	74.45	29	272
				74.75	29	292		73	74.75	29	292
75.92	28	312		75.89	25	305		74	75.91	27	308
76.11	50	206		76.09	49	202		75	76.10	49	204
				77.80	72	306		76	77.80	72	306
				78.18	52	066		77	78.18	52	066
				78.27	77	293		78	78.27	77	293
				78.31	67	062		79	78.31	67	062
				78.81	15	344		80	78.81	15	344
78.88	30	289						81	78.88	30	289
				78.99	17	026		82	78.99	17	026
80.67	57	280		80.64	58	279		83	80.66	57	280
				80.87	71	245		84	80.87	71	245
				82.48	70	086		85	82.48	70	086
				83.73	16	303		86	83.73	16	303
				84.34	64	094		87	84.34	64	094
84.98	13	075		84.99	08	003		88	84.99	11	039
87.86	70	350		87.92	69	341		89	87.89	70	346
88.88	09	268		88.86	08	283		90	88.87	08	276
				91.76	20	263		91	91.76	20	263
				92.52	26	263		92	92.52	26	263
				93.24	18	270		93	93.24	18	270
95.10	09	015		95.10	06	037		94	95.10	07	026
				98.08	45	272		95	98.08	45	272
				98.57	36	288		96	98.57	36	288

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: SI-04-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
5.43	63	109				1	5.43	63	109
6.41	58	287				2	6.41	58	287
7.15	26	250				3	7.15	26	250
9.80	55	200				4	9.80	55	200
10.15	42	064				5	10.15	42	064
10.42	49	069				6	10.42	49	069
12.25	20	177				7	12.25	20	177
12.76	63	304				8	12.76	63	304
14.99	48	203				9	14.99	48	203
15.53	59	314				10	15.53	59	314
21.47	57	220				11	21.47	57	220
31.00	36	180				12	31.00	36	180
35.15	75	000				13	35.15	75	000
40.51	08	265				14	40.51	08	265
42.04	43	283				15	42.04	43	283
43.63	45	209				16	43.63	45	209
43.89	50	212				17	43.89	50	212
45.53	43	178				18	45.53	43	178
47.14	18	116				19	47.14	18	116
47.60	69	294				20	47.60	69	294
			48.41	73	158	21	48.41	73	158
49.10	11	109	49.09	15	119	22	49.10	13	114
49.72	18	104	49.71	13	102	23	49.72	16	103
51.39	56	050	51.40	58	079	24	51.40	57	064
51.94	20	122				25	51.94	20	122
52.17	72	313				26	52.17	72	313
52.25	23	129				27	52.25	23	129
52.66	35	316				28	52.66	35	316
53.37	15	305				29	53.37	15	305
53.76	26	283				30	53.76	26	283
53.77	82	295				31	53.77	82	295
54.53	66	292	54.53	66	288	32	54.53	66	290
54.62	12	232				33	54.62	12	232
55.80	30	312	55.80	46	284	34	55.80	38	298
			57.72	67	312	35	57.72	67	312
			57.93	26	342	36	57.93	26	342
58.06	38	037				37	58.06	38	037
58.55	43	220	58.55	38	210	38	58.55	41	215
60.92	60	347	60.89	59	339	39	60.91	59	343
61.51	22	144	61.49	22	131	40	61.50	22	137
62.58	23	136	62.59	21	141	41	62.59	22	138
63.48	41	176	63.43	44	201	42	63.46	42	189
64.55	66	330	64.56	68	325	43	64.56	67	328
65.49	67	304	65.44	69	314	44	65.47	68	309
			73.80	50	150	45	73.80	50	150
			74.80	29	265	46	74.80	29	265
			74.99	38	159	47	74.99	38	159
			75.45	39	170	48	75.45	39	170

				75.67	48	186		49	75.67	48	186
				76.23	51	134		50	76.23	51	134
				76.99	46	135		51	76.99	46	135
78.13	68	324		78.13	70	330		52	78.13	69	327
				78.25	43	167		53	78.25	43	167
				80.36	47	151		54	80.36	47	151
				83.02	57	228		55	83.02	57	228
				84.12	67	220		56	84.12	67	220
				87.14	71	352		57	87.14	71	352
93.11	65	199		93.11	65	200		58	93.11	65	200
				95.86	78	324		59	95.86	78	324
				97.06	49	283		60	97.06	49	283

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: SI-05-08

Optical Televiewer Data				Acoustic Televiewer Data				Average Data Set			
Depth	Dip	Dip AZ		Depth	Dip	Dip AZ		#	Depth	Dip	Dip AZ
20.28	40	265						1	20.28	40	265
22.66	36	003						2	22.66	36	003
22.82	37	007						3	22.82	37	007
24.92	48	006						4	24.92	48	006
25.73	49	001						5	25.73	49	001
26.11	52	006						6	26.11	52	006
27.01	53	002						7	27.01	53	002
28.38	61	302						8	28.38	61	302
29.41	23	138						9	29.41	23	138
31.82	57	355						10	31.82	57	355
32.61	53	353						11	32.61	53	353
36.69	36	352						12	36.69	36	352
37.27	44	355						13	37.27	44	355
39.10	26	008						14	39.10	26	008
39.38	27	346						15	39.38	27	346
41.23	24	355						16	41.23	24	355
43.71	18	339						17	43.71	18	339
45.92	31	341						18	45.92	31	341
47.59	22	008						19	47.59	22	008
49.94	30	305						20	49.94	30	305
50.36	27	307						21	50.36	27	307
51.36	21	345						22	51.36	21	345
51.71	23	019						23	51.71	23	019
51.87	19	355						24	51.87	19	355
54.21	34	292						25	54.21	34	292
55.07	37	087						26	55.07	37	087
56.38	34	299						27	56.38	34	299
56.66	29	323						28	56.66	29	323
58.42	18	317						29	58.42	18	317
58.53	21	334						30	58.53	21	334
58.82	21	047						31	58.82	21	047
58.92	24	011						32	58.92	24	011
59.31	66	283						33	59.31	66	283
59.95	17	355						34	59.95	17	355
60.49	36	353						35	60.49	36	353
60.65	30	013						36	60.65	30	013
61.55	15	337						37	61.55	15	337
61.76	24	357						38	61.76	24	357
61.94	79	280						39	61.94	79	280
62.35	15	001						40	62.35	15	001
63.41	63	355						41	63.41	63	355
63.87	16	350						42	63.87	16	350
65.75	83	281						43	65.75	83	281
66.92	10	056						44	66.92	10	056
67.16	75	250						45	67.16	75	250
68.32	14	350						46	68.32	14	350
68.70	70	265						47	68.70	70	265
71.10	15	273						48	71.10	15	273

72.58	12	283						49	72.58	12	283
73.73	23	208						50	73.73	23	208
74.19	29	280						51	74.19	29	280
74.38	28	260						52	74.38	28	260
75.01	38	253						53	75.01	38	253
75.39	40	265						54	75.39	40	265
75.59	28	248						55	75.59	28	248
76.06	33	288						56	76.06	33	288
76.24	29	285						57	76.24	29	285
76.70	68	307						58	76.70	68	307
77.69	57	289						59	77.69	57	289
78.70	67	134						60	78.70	67	134
				80.58	21	136		61	80.58	21	136
				80.91	78	025		62	80.91	78	025
91.11	48	201		91.10	46	205		63	91.11	47	203
				97.78	12	216		64	97.78	12	216
				98.64	27	199		65	98.64	27	199

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: SI-06-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
10.41	30	248				1	10.41	30	248
12.51	60	257				2	12.51	60	257
13.96	55	254				3	13.96	55	254
15.69	20	348				4	15.69	20	348
			18.36	36	338	5	18.36	36	338
			18.49	35	335	6	18.49	35	335
22.18	51	190	22.18	47	202	7	22.18	49	196
23.37	58	339	23.37	59	336	8	23.37	58	338
			23.46	39	201	9	23.46	39	201
23.79	46	215	23.76	43	209	10	23.78	45	212
			24.00	31	119	11	24.00	31	119
26.30	86	070	26.39	85	074	12	26.35	86	072
27.99	80	068	28.02	80	071	13	28.01	80	069
			28.23	41	043	14	28.23	41	043
29.21	38	059	29.19	36	065	15	29.20	37	062
29.47	48	057	29.46	49	067	16	29.47	48	062
29.91	42	046	29.90	39	051	17	29.91	41	049
			30.71	65	185	18	30.71	65	185
30.83	28	056	30.81	28	051	19	30.82	28	054
			31.22	70	171	20	31.22	70	171
31.47	42	064	31.43	42	069	21	31.45	42	066
			32.47	18	048	22	32.47	18	048
32.80	42	056	32.77	40	059	23	32.79	41	058
			32.85	74	123	24	32.85	74	123
33.66	02	001	33.67	02	345	25	33.67	02	353
35.65	15	059				26	35.65	15	059
			37.25	37	288	27	37.25	37	288
			37.68	75	176	28	37.68	75	176
38.77	78	075	38.78	78	082	29	38.78	78	078
			38.90	68	012	30	38.90	68	012
39.72	72	013	39.70	72	019	31	39.71	72	016
			40.98	72	283	32	40.98	72	283
			41.70	74	283	33	41.70	74	283
			42.37	53	011	34	42.37	53	011
			43.78	30	013	35	43.78	30	013
			44.61	11	044	36	44.61	11	044
			45.45	58	337	37	45.45	58	337
45.57	37	351	45.58	40	343	38	45.58	39	347
			47.41	36	323	39	47.41	36	323
			48.26	82	278	40	48.26	82	278
			48.37	65	354	41	48.37	65	354
51.25	67	303	51.26	66	307	42	51.26	66	305
			52.04	37	258	43	52.04	37	258
			55.12	74	001	44	55.12	74	001
			60.74	69	004	45	60.74	69	004
			61.92	54	314	46	61.92	54	314
63.09	60	347	63.14	59	342	47	63.12	59	345
63.95	77	256	63.99	77	255	48	63.97	77	256

				64.60	75	265		49	64.60	75	265
				65.70	61	315		50	65.70	61	315
				66.49	61	343		51	66.49	61	343
69.34	49	198		69.35	48	196		52	69.35	48	197
73.20	69	296		73.21	70	295		53	73.21	70	295
73.31	23	180						54	73.31	23	180
				77.88	34	320		55	77.88	34	320
80.51	18	138						56	80.51	18	138
				81.76	38	337		57	81.76	38	337
83.34	63	302		83.35	61	304		58	83.35	62	303
				85.83	22	167		59	85.83	22	167
87.07	71	309		87.11	61	321		60	87.09	66	315
				87.12	72	320		61	87.12	72	320
				90.55	48	313		62	90.55	48	313
				92.48	66	327		63	92.48	66	327
				92.73	57	351		64	92.73	57	351
				92.86	55	329		65	92.86	55	329
95.45	25	300		95.47	33	318		66	95.46	29	309
97.79	44	205		97.82	40	205		67	97.81	42	205

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: SI-07-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
12.27	20	133				1	12.27	20	133
13.58	28	265				2	13.58	28	265
14.70	16	182				3	14.70	16	182
14.79	16	215				4	14.79	16	215
15.12	27	233				5	15.12	27	233
15.93	65	091				6	15.93	65	091
16.67	33	100				7	16.67	33	100
17.50	82	099				8	17.50	82	099
19.20	76	081				9	19.20	76	081
20.00	42	253				10	20.00	42	253
20.15	22	297				11	20.15	22	297
21.24	16	303				12	21.24	16	303
23.30	22	152				13	23.30	22	152
23.81	50	345				14	23.81	50	345
24.61	80	074				15	24.61	80	074
25.66	53	162				16	25.66	53	162
26.19	35	193				17	26.19	35	193
26.46	11	164				18	26.46	11	164
26.86	24	202				19	26.86	24	202
27.07	51	168				20	27.07	51	168
27.43	09	323				21	27.43	09	323
28.29	34	330				22	28.29	34	330
29.09	78	073				23	29.09	78	073
29.59	79	081				24	29.59	79	081
30.09	47	202				25	30.09	47	202
31.60	37	129				26	31.60	37	129
33.82	79	078				27	33.82	79	078
34.15	54	318				28	34.15	54	318
35.29	04	079				29	35.29	04	079
35.69	30	240				30	35.69	30	240
37.00	33	235				31	37.00	33	235
38.18	22	204				32	38.18	22	204
38.40	25	196				33	38.40	25	196
39.02	25	156				34	39.02	25	156
			40.31	51	252	35	40.31	51	252
40.46	27	215	40.45	26	236	36	40.46	26	225
			40.50	20	208	37	40.50	20	208
			40.68	56	332	38	40.68	56	332
			41.30	16	121	39	41.30	16	121
41.51	19	103	41.50	18	116	40	41.51	19	110
42.30	22	206	42.31	23	198	41	42.31	22	202
			43.89	51	210	42	43.89	51	210
43.96	46	203	43.93	46	204	43	43.95	46	204
			45.20	59	248	44	45.20	59	248
45.33	11	136	45.34	18	148	45	45.34	14	142
46.51	49	272	46.54	49	268	46	46.53	49	270
47.03	44	290	47.08	40	273	47	47.06	42	282
47.20	49	335	47.20	51	342	48	47.20	50	338

47.52	61	331		47.51	58	323		49	47.52	59	327
48.00	35	158		47.97	36	156		50	47.99	36	157
48.85	46	263		48.82	41	256		51	48.84	44	259
				48.88	25	191		52	48.88	25	191
49.17	54	259		49.16	56	252		53	49.17	55	256
				49.97	18	243		54	49.97	18	243
50.37	83	069		50.32	83	071		55	50.35	83	070
50.65	79	083						56	50.65	79	083
				50.67	79	265		57	50.67	79	265
				51.13	29	242		58	51.13	29	242
52.23	16	313		52.26	20	039		59	52.25	18	356
52.62	82	072		52.57	81	075		60	52.60	81	073
				52.91	30	170		61	52.91	30	170
53.21	35	173		53.24	44	185		62	53.23	40	179
				53.80	58	325		63	53.80	58	325
54.37	59	272		54.29	46	268		64	54.33	53	270
54.58	30	094		54.56	35	116		65	54.57	32	105
				54.90	19	163		66	54.90	19	163
55.50	80	066		55.54	81	062		67	55.52	81	064
55.74	38	178		55.74	41	178		68	55.74	40	178
				56.16	26	142		69	56.16	26	142
				57.17	40	108		70	57.17	40	108
57.99	32	090		58.02	28	119		71	58.01	30	104
				58.17	43	171		72	58.17	43	171
58.93	25	084		58.92	28	096		73	58.93	26	090
				60.65	41	201		74	60.65	41	201
61.19	38	091		61.22	50	084		75	61.21	44	088
				61.77	42	163		76	61.77	42	163
61.93	47	073		61.93	45	074		77	61.93	46	073
				62.27	26	086		78	62.27	26	086
62.40	46	081						79	62.40	46	081
				64.72	40	171		80	64.72	40	171
				65.18	23	041		81	65.18	23	041
				66.12	72	279		82	66.12	72	279
66.74	41	161		66.74	42	166		83	66.74	41	163
67.06	48	176		67.04	48	171		84	67.05	48	173
68.76	43	129		68.74	36	140		85	68.75	39	134
69.50	40	357		69.48	36	338		86	69.49	38	347
70.06	48	096		70.19	49	117		87	70.13	48	107
73.62	28	156		73.64	32	133		88	73.63	30	144
				74.20	37	210		89	74.20	37	210
75.23	46	183		75.22	36	186		90	75.23	41	184
75.52	46	107		75.53	48	108		91	75.53	47	108
				76.46	44	208		92	76.46	44	208
76.58	59	213		76.62	49	206		93	76.60	54	210
77.66	41	181		77.64	35	176		94	77.65	38	178
				77.72	60	130		95	77.72	60	130
78.66	43	175		78.62	40	173		96	78.64	42	174
				78.69	45	171		97	78.69	45	171
79.79	69	115		79.78	69	115		98	79.79	69	115
80.85	39	161		80.85	44	157		99	80.85	41	159
				80.86	83	069		100	80.86	83	069
81.75	40	171		81.75	37	156		101	81.75	39	164
				82.13	50	161		102	82.13	50	161
				82.24	47	164		103	82.24	47	164

				83.01	49	181		104	83.01	49	181
				84.12	56	156		105	84.12	56	156
84.23	50	202		84.27	45	196		106	84.25	48	199
				86.31	66	206		107	86.31	66	206
				86.62	51	169		108	86.62	51	169
				88.07	36	185		109	88.07	36	185
88.22	48	121						110	88.22	48	121
				88.33	39	186		111	88.33	39	186
				89.00	44	159		112	89.00	44	159
				89.94	44	084		113	89.94	44	084
90.85	63	075		90.79	63	071		114	90.82	63	073
				90.88	78	066		115	90.88	78	066
92.46	80	068		92.46	79	072		116	92.46	80	070
93.06	48	126		93.07	43	125		117	93.07	45	126
94.86	64	330		94.93	67	322		118	94.90	66	326
96.06	71	322		96.10	71	328		119	96.08	71	325
				97.01	44	155		120	97.01	44	155
				97.24	36	148		121	97.24	36	148
				97.63	83	333		122	97.63	83	333
98.69	50	221						123	98.69	50	221

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination

Average data set used for analysis and presented on COBL logs

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: SI-08-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
8.28	68	302				1	8.28	68	302
8.68	22	233				2	8.68	22	233
9.39	55	318				3	9.39	55	318
10.21	25	218				4	10.21	25	218
12.98	69	069	12.96	69	061	5	12.97	69	065
13.52	72	076	13.58	72	073	6	13.55	72	075
			14.28	38	173	7	14.28	38	173
			14.56	29	163	8	14.56	29	163
			14.80	22	153	9	14.80	22	153
15.41	58	322	15.44	58	325	10	15.43	58	324
16.29	60	302	16.29	59	313	11	16.29	59	308
17.24	75	096	17.36	78	087	12	17.30	76	092
17.77	82	089				13	17.77	82	089
21.09	77	202				14	21.09	77	202
21.85	29	283				15	21.85	29	283
22.78	73	240				16	22.78	73	240
24.59	76	215				17	24.59	76	215
25.46	15	081				18	25.46	15	081
25.66	23	118				19	25.66	23	118
26.15	23	044				20	26.15	23	044
26.37	16	032				21	26.37	16	032
29.30	81	079				22	29.30	81	079
31.05	67	131				23	31.05	67	131
			31.26	65	179	24	31.26	65	179
			32.74	57	111	25	32.74	57	111
34.40	76	082	34.44	76	080	26	34.42	76	081
			35.99	49	323	27	35.99	49	323
37.13	83	085	37.09	82	071	28	37.11	83	078
			40.42	45	159	29	40.42	45	159
41.48	78	084	41.54	77	071	30	41.51	77	077
42.56	75	078	42.56	75	075	31	42.56	75	077
43.04	56	283				32	43.04	56	283
			43.82	27	205	33	43.82	27	205
			44.35	26	195	34	44.35	26	195
45.30	37	094	45.31	39	101	35	45.31	38	097
45.71	50	304	45.72	47	292	36	45.72	48	298
			45.84	47	315	37	45.84	47	315
46.24	36	072	46.21	43	096	38	46.23	40	084
46.73	37	185	46.74	36	178	39	46.74	36	182
47.03	37	181	47.03	33	185	40	47.03	35	183
48.00	33	104	47.99	34	104	41	48.00	34	104
			48.28	15	196	42	48.28	15	196
48.84	35	157	48.84	33	168	43	48.84	34	163
			49.25	29	176	44	49.25	29	176
49.66	16	116	49.65	16	108	45	49.66	16	112
50.75	74	079	50.59	74	071	46	50.67	74	075
			50.92	76	076	47	50.92	76	076
51.81	02	049				48	51.81	02	049

				51.98	47	197		49	51.98	47	197
52.25	29	149						50	52.25	29	149
52.97	76	087		52.96	75	081		51	52.97	75	084
53.55	77	078		53.63	78	071		52	53.59	77	074
				54.35	64	332		53	54.35	64	332
				55.58	51	192		54	55.58	51	192
				55.67	15	111		55	55.67	15	111
				55.79	15	081		56	55.79	15	081
56.72	81	284		56.77	81	280		57	56.75	81	282
56.97	57	191		57.01	56	193		58	56.99	56	192
				58.04	32	146		59	58.04	32	146
				58.32	31	128		60	58.32	31	128
58.51	72	334		58.49	72	340		61	58.50	72	337
58.94	52	317		58.95	51	315		62	58.95	52	316
				59.16	20	325		63	59.16	20	325
59.33	26	192		59.33	20	154		64	59.33	23	173
59.47	18	343		59.51	31	339		65	59.49	24	341
59.67	15	138		59.71	18	133		66	59.69	17	136
60.01	27	337		60.06	22	312		67	60.04	24	324
				60.18	58	345		68	60.18	58	345
				60.18	18	136		69	60.18	18	136
60.76	56	330		60.77	55	330		70	60.77	56	330
				60.80	28	123		71	60.80	28	123
				60.80	68	335		72	60.80	68	335
				61.15	29	141		73	61.15	29	141
				61.62	57	333		74	61.62	57	333
62.40	14	072						75	62.40	14	072
				62.67	18	339		76	62.67	18	339
63.66	79	079		63.61	79	071		77	63.64	79	075
				63.86	25	133		78	63.86	25	133
				64.43	32	111		79	64.43	32	111
				64.71	28	116		80	64.71	28	116
				64.95	28	123		81	64.95	28	123
				66.06	29	121		82	66.06	29	121
66.54	24	124		66.52	21	123		83	66.53	23	124
				67.64	25	143		84	67.64	25	143
67.99	28	134		67.97	34	138		85	67.98	31	136
69.37	57	330		69.36	57	323		86	69.37	57	327
71.99	33	144		71.99	33	131		87	71.99	33	138
75.11	23	134		75.11	29	131		88	75.11	26	132
81.23	43	208		81.26	50	191		89	81.25	46	200
				82.43	18	340		90	82.43	18	340
85.55	61	330		85.55	61	332		91	85.55	61	331
88.63	29	174		88.62	25	143		92	88.63	27	159
92.14	56	332		92.15	57	335		93	92.15	57	334
				92.77	70	162		94	92.77	70	162
				92.82	09	329		95	92.82	09	329
93.57	79	074		93.57	79	069		96	93.57	79	071
				94.51	13	139		97	94.51	13	139
				95.05	49	207		98	95.05	49	207
				95.36	13	153		99	95.36	13	153
				95.69	11	193		100	95.69	11	193
95.90	09	206		95.88	13	159		101	95.89	11	182
97.86	47	189						102	97.86	47	189

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: SI-09-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
10.83	56	064				1	10.83	56	064
11.56	55	332				2	11.56	55	332
12.31	37	145				3	12.31	37	145
12.57	47	174				4	12.57	47	174
12.70	32	106	12.67	35	141	5	12.69	33	124
			13.85	32	108	6	13.85	32	108
			14.09	26	166	7	14.09	26	166
14.11	52	138				8	14.11	52	138
			14.23	27	166	9	14.23	27	166
14.71	38	166	14.69	36	199	10	14.70	37	183
			14.97	37	264	11	14.97	37	264
15.16	53	199				12	15.16	53	199
15.40	40	187				13	15.40	40	187
15.70	25	153				14	15.70	25	153
16.05	39	143				15	16.05	39	143
16.27	36	196	16.28	39	226	16	16.28	38	211
			17.20	32	069	17	17.20	32	069
17.59	61	067	17.61	57	061	18	17.60	59	064
			18.07	34	251	19	18.07	34	251
18.27	60	077	18.24	59	077	20	18.26	59	077
18.82	61	357	18.81	61	346	21	18.82	61	352
20.24	46	078	20.12	56	063	22	20.18	51	071
21.93	72	078				23	21.93	72	078
22.20	62	069				24	22.20	62	069
23.57	69	082				25	23.57	69	082
25.01	55	160				26	25.01	55	160
			25.53	57	212	27	25.53	57	212
26.67	30	345				28	26.67	30	345
26.77	09	300				29	26.77	09	300
27.40	31	301				30	27.40	31	301
29.84	57	330				31	29.84	57	330
30.88	30	359				32	30.88	30	359
31.56	11	128				33	31.56	11	128
32.76	39	281				34	32.76	39	281
			34.24	24	235	35	34.24	24	235
			35.10	17	237	36	35.10	17	237
			36.01	16	298	37	36.01	16	298
			36.45	31	285	38	36.45	31	285
37.62	79	077	37.47	76	076	39	37.55	78	077
			40.33	79	072	40	40.33	79	072
40.57	81	076				41	40.57	81	076
			40.87	76	081	42	40.87	76	081
			41.55	08	039	43	41.55	08	039
41.59	09	096				44	41.59	09	096
			41.96	14	035	45	41.96	14	035
			41.96	27	195	46	41.96	27	195
			42.18	20	162	47	42.18	20	162
			42.69	09	093	48	42.69	09	093

				42.95	20	061		49	42.95	20	061
				43.08	25	116		50	43.08	25	116
				43.38	37	095		51	43.38	37	095
				43.62	16	079		52	43.62	16	079
44.43	47	171		44.42	39	146		53	44.43	43	159
				45.12	59	355		54	45.12	59	355
				45.45	53	012		55	45.45	53	012
46.13	61	340		46.08	58	340		56	46.11	60	340
46.43	20	354		46.36	28	004		57	46.40	24	359
				46.66	42	312		58	46.66	42	312
47.28	25	328						59	47.28	25	328
47.51	62	329						60	47.51	62	329
				47.58	36	302		61	47.58	36	302
47.75	59	320						62	47.75	59	320
				47.82	32	270		63	47.82	32	270
				48.18	78	084		64	48.18	78	084
48.38	75	074		48.36	71	076		65	48.37	73	075
49.73	70	075		49.74	69	069		66	49.74	69	072
				50.19	22	287		67	50.19	22	287
50.28	79	080		50.28	79	074		68	50.28	79	077
				50.75	38	231		69	50.75	38	231
51.57	74	073		51.54	74	069		70	51.56	74	071
				52.03	28	246		71	52.03	28	246
				52.24	16	283		72	52.24	16	283
				52.46	29	269		73	52.46	29	269
52.75	11	257		52.77	20	290		74	52.76	16	274
				52.91	18	230		75	52.91	18	230
53.54	74	074		53.52	74	073		76	53.53	74	074
54.26	78	084		54.23	77	064		77	54.25	78	074
54.52	77	075		54.57	77	078		78	54.55	77	076
54.62	77	074						79	54.62	77	074
				55.01	40	158		80	55.01	40	158
55.18	23	332						81	55.18	23	332
				55.34	34	256		82	55.34	34	256
55.36	22	306						83	55.36	22	306
				55.55	25	250		84	55.55	25	250
55.58	21	180						85	55.58	21	180
56.23	42	171		56.19	33	193		86	56.21	38	182
				56.28	49	191		87	56.28	49	191
56.93	32	280		56.90	33	260		88	56.92	32	270
57.23	32	275		57.22	31	281		89	57.23	31	278
57.51	37	283		57.50	37	278		90	57.51	37	281
57.76	31	288		57.75	32	263		91	57.76	32	275
57.87	28	289		57.86	26	272		92	57.87	27	281
57.94	41	181		57.93	41	177		93	57.94	41	179
58.48	41	304		58.50	46	293		94	58.49	43	299
58.68	04	348		58.66	15	313		95	58.67	10	331
58.75	18	337		58.74	20	307		96	58.75	19	322
58.95	29	305		58.95	33	292		97	58.95	31	299
59.14	07	288						98	59.14	07	288
59.21	30	303		59.22	32	292		99	59.22	31	297
59.54	46	134		59.50	55	111		100	59.52	51	122
59.54	25	328		59.59	17	320		101	59.57	21	324
59.90	18	345		59.88	18	315		102	59.89	18	330
60.10	18	339		60.11	31	324		103	60.11	24	332

60.20	66	113		60.16	68	108		104	60.18	67	110
60.31	39	300		60.31	39	298		105	60.31	39	299
60.53	36	288		60.53	34	286		106	60.53	35	287
60.76	55	206		60.80	50	198		107	60.78	52	202
61.20	20	327		61.20	18	300		108	61.20	19	314
61.50	75	092		61.50	74	079		109	61.50	74	085
61.67	15	323		61.67	18	325		110	61.67	17	324
				62.04	46	255		111	62.04	46	255
62.18	31	302						112	62.18	31	302
				62.28	18	358		113	62.28	18	358
62.51	76	079		62.51	76	081		114	62.51	76	080
63.39	23	335		63.38	21	320		115	63.39	22	327
				63.86	38	188		116	63.86	38	188
				64.15	37	165		117	64.15	37	165
64.21	54	308		64.24	54	301		118	64.23	54	305
				64.60	52	184		119	64.60	52	184
64.81	23	317						120	64.81	23	317
				65.13	47	190		121	65.13	47	190
65.34	51	306		65.36	49	298		122	65.35	50	302
				65.46	18	295		123	65.46	18	295
				65.62	18	323		124	65.62	18	323
				66.18	41	206		125	66.18	41	206
				67.65	56	201		126	67.65	56	201
69.23	16	094						127	69.23	16	094
				69.73	64	214		128	69.73	64	214
				70.96	42	298		129	70.96	42	298
				71.08	30	272		130	71.08	30	272
71.19	61	315		71.27	55	307		131	71.23	58	311
				71.72	28	323		132	71.72	28	323
				71.85	37	295		133	71.85	37	295
				72.07	48	305		134	72.07	48	305
				72.46	28	310		135	72.46	28	310
72.69	65	064		72.68	64	059		136	72.69	65	062
73.08	75	083		73.01	77	069		137	73.05	76	076
				73.28	46	298		138	73.28	46	298
73.35	75	067		73.32	73	067		139	73.34	74	067
73.73	35	288		73.74	38	278		140	73.74	37	283
				74.04	26	304		141	74.04	26	304
				74.10	11	302		142	74.10	11	302
74.32	30	303		74.33	30	290		143	74.33	30	297
74.67	36	285						144	74.67	36	285
75.12	29	295		75.14	30	298		145	75.13	30	296
75.48	22	315						146	75.48	22	315
75.72	41	312		75.72	40	305		147	75.72	41	308
75.74	77	074						148	75.74	77	074
				75.76	46	118		149	75.76	46	118
				75.79	78	064		150	75.79	78	064
76.70	24	213						151	76.70	24	213
				76.89	37	162		152	76.89	37	162
				78.07	45	159		153	78.07	45	159
78.17	60	344		78.19	57	343		154	78.18	59	343
78.90	25	339						155	78.90	25	339
				79.99	43	178		156	79.99	43	178
80.60	75	085		80.57	73	069		157	80.59	74	077
				80.64	75	073		158	80.64	75	073

				81.16	78	079		159	81.16	78	079
81.73	33	305						160	81.73	33	305
81.80	28	297						161	81.80	28	297
				83.94	49	201		162	83.94	49	201
86.60	75	092		86.65	75	080		163	86.63	75	086
87.48	77	074		87.48	77	086		164	87.48	77	080
87.85	74	069		87.93	71	068		165	87.89	73	069
89.35	35	205		89.34	36	210		166	89.35	35	208
				90.37	61	358		167	90.37	61	358
				90.72	28	208		168	90.72	28	208
90.80	60	188		90.77	64	193		169	90.79	62	190
				91.12	23	334		170	91.12	23	334
				91.33	44	228		171	91.33	44	228
				92.12	46	159		172	92.12	46	159
				92.86	61	347		173	92.86	61	347
				94.13	27	357		174	94.13	27	357
94.92	26	328		94.92	20	318		175	94.92	23	323
				95.35	58	335		176	95.35	58	335
				96.17	78	342		177	96.17	78	342
				97.86	26	204		178	97.86	26	204
98.21	35	113		98.20	38	128		179	98.21	37	120

Dip is measured from horizontal

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: SI-10-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
16.64	28	300				1	16.64	28	300
18.83	64	065				2	18.83	64	065
19.76	70	072				3	19.76	70	072
20.44	23	158				4	20.44	23	158
23.32	43	344				5	23.32	43	344
23.83	72	090				6	23.83	72	090
25.51	43	233				7	25.51	43	233
28.01	18	290	27.99	12	268	8	28.00	15	279
29.03	78	308				9	29.03	78	308
29.14	04	074	29.12	10	093	10	29.13	07	083
			29.42	43	200	11	29.42	43	200
			30.44	75	304	12	30.44	75	304
30.85	15	237	30.83	26	229	13	30.84	20	233
31.84	76	069	31.84	75	073	14	31.84	76	071
32.57	55	208	32.58	54	220	15	32.58	54	214
			34.87	49	196	16	34.87	49	196
34.84	63	325	34.88	61	330	17	34.86	62	328
35.17	55	350	35.17	57	343	18	35.17	56	347
35.70	42	214				19	35.70	42	214
			37.05	24	278	20	37.05	24	278
37.16	77	073	37.16	76	073	21	37.16	76	073
39.29	30	292	39.29	25	294	22	39.29	28	293
			39.66	39	193	23	39.66	39	193
40.16	57	347	40.15	52	002	24	40.16	54	355
41.85	46	215	41.86	38	225	25	41.86	42	220
42.76	76	066	42.76	75	071	26	42.76	75	069
			43.20	78	085	27	43.20	78	085
43.83	78	070	43.87	78	071	28	43.85	78	071
			44.71	79	081	29	44.71	79	081
			45.44	78	076	30	45.44	78	076
46.41	71	076	46.47	70	078	31	46.44	70	077
46.72	74	067	46.73	73	073	32	46.73	74	070
46.85	75	078	46.88	75	067	33	46.87	75	073
47.26	35	310	47.30	40	308	34	47.28	38	309
			48.04	44	339	35	48.04	44	339
48.74	71	085	48.75	71	082	36	48.75	71	084
			49.24	54	159	37	49.24	54	159
			49.35	43	133	38	49.35	43	133
			49.61	52	143	39	49.61	52	143
			50.26	53	202	40	50.26	53	202
50.85	66	330	50.87	66	329	41	50.86	66	330
			50.95	44	203	42	50.95	44	203
51.26	63	328	51.28	63	330	43	51.27	63	329
			51.49	51	081	44	51.49	51	081
			53.31	63	073	45	53.31	63	073
			54.70	59	170	46	54.70	59	170
55.19	78	074	55.22	77	072	47	55.21	77	073
56.60	73	080	56.61	73	079	48	56.61	73	079

57.62	78	065		57.63	77	070		49	57.63	78	068
				58.25	56	135		50	58.25	56	135
				58.83	73	069		51	58.83	73	069
				59.14	41	344		52	59.14	41	344
				59.63	28	062		53	59.63	28	062
59.93	58	151		59.93	56	147		54	59.93	57	149
61.74	52	182		61.72	49	192		55	61.73	50	187
63.96	49	191		63.97	53	192		56	63.97	51	192
65.17	11	171		65.16	14	170		57	65.17	12	170
67.81	80	074		67.80	80	073		58	67.81	80	074
71.28	41	200		71.30	46	213		59	71.29	44	207
71.48	41	138		71.47	40	133		60	71.48	41	135
72.16	39	325		72.12	41	318		61	72.14	40	321
72.41	13	081		72.41	15	101		62	72.41	14	091
74.09	51	203		74.08	51	203		63	74.09	51	203
				74.39	46	337		64	74.39	46	337
77.18	23	138		77.18	25	121		65	77.18	24	130
				77.70	26	087		66	77.70	26	087
77.76	63	017		77.74	63	014		67	77.75	63	015
78.12	46	200		78.13	49	193		68	78.13	48	197
				78.45	27	150		69	78.45	27	150
78.47	25	096						70	78.47	25	096
				79.31	60	336		71	79.31	60	336
81.84	42	224		81.84	43	213		72	81.84	42	219
82.78	60	081		82.79	58	078		73	82.79	59	080
84.47	49	202		84.52	49	186		74	84.50	49	194
				84.97	40	171		75	84.97	40	171
				85.14	57	190		76	85.14	57	190
				85.87	42	188		77	85.87	42	188
86.43	55	221		86.46	55	209		78	86.45	55	215
				87.03	32	214		79	87.03	32	214
88.25	25	171						80	88.25	25	171
88.70	39	166		88.72	41	165		81	88.71	40	166
89.04	11	207						82	89.04	11	207
90.00	43	096						83	90.00	43	096
91.03	79	091		90.94	80	086		84	90.99	79	089
				91.03	79	091		85	91.03	79	091
				91.68	44	116		86	91.68	44	116
93.36	75	061		93.37	75	069		87	93.37	75	065
95.14	77	070		95.08	77	071		88	95.11	77	071
95.78	66	156		95.78	66	154		89	95.78	66	155
95.88	20	339						90	95.88	20	339
				97.13	15	345		91	97.13	15	345
				98.41	78	069		92	98.41	78	069
				98.66	77	081		93	98.66	77	081
				99.19	76	078		94	99.19	76	078
99.28	69	080		99.29	68	075		95	99.29	69	077
				99.80	76	075		96	99.80	76	075
100.11	74	074		100.12	72	069		97	100.12	73	071
100.56	70	079		100.51	70	073		98	100.54	70	076
101.55	57	009						99	101.55	57	009
				102.35	74	086		100	102.35	74	086
				102.92	63	079		101	102.92	63	079
103.43	79	064		103.28	77	064		102	103.36	78	064
103.61	75	065		103.59	75	071		103	103.60	75	068

104.15	77	063		104.06	79	063		104	104.11	78	063
104.88	77	065		104.82	75	063		105	104.85	76	064

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: SI-11-08

Optical Televiewer Data				Acoustic Televiewer Data				Average Data Set			
Depth	Dip	Dip AZ		Depth	Dip	Dip AZ		#	Depth	Dip	Dip AZ
8.51	79	343						1	8.51	79	343
8.89	76	310						2	8.89	76	310
11.91	72	304						3	11.91	72	304
12.16	58	303						4	12.16	58	303
13.61	32	179						5	13.61	32	179
15.49	82	317						6	15.49	82	317
19.65	51	342						7	19.65	51	342
20.41	76	229						8	20.41	76	229
20.87	36	337						9	20.87	36	337
21.36	74	313						10	21.36	74	313
32.28	68	009						11	32.28	68	009
34.59	46	208						12	34.59	46	208
36.15	43	209						13	36.15	43	209
38.92	35	205						14	38.92	35	205
41.22	62	262						15	41.22	62	262
50.99	70	341		51.02	69	344		16	51.01	70	343
51.84	82	335		51.82	83	330		17	51.83	82	332
60.37	25	255		60.38	26	238		18	60.38	25	247
62.40	62	349		62.42	62	345		19	62.41	62	347
63.67	50	201		63.66	51	198		20	63.67	51	199
				64.52	63	069		21	64.52	63	069
				65.29	17	136		22	65.29	17	136
71.88	60	025		71.90	55	019		23	71.89	57	022
				73.12	47	193		24	73.12	47	193
75.21	49	195		75.23	49	195		25	75.22	49	195
				76.84	48	202		26	76.84	48	202
86.98	61	025						27	86.98	61	025
87.80	62	067		87.81	61	067		28	87.81	62	067
90.75	61	029						29	90.75	61	029
96.60	48	204		96.60	45	202		30	96.60	46	203

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

I-90 Eask Hyak Realignment Project
Summary of COBL Discontinuity Data
Borehole #: SI-12-08

Optical Televiewer Data			Acoustic Televiewer Data			Average Data Set			
Depth	Dip	Dip AZ	Depth	Dip	Dip AZ	#	Depth	Dip	Dip AZ
6.72	21	302				1	6.72	21	302
8.44	69	076				2	8.44	69	076
9.05	79	092				3	9.05	79	092
10.52	77	096				4	10.52	77	096
12.14	08	347				5	12.14	08	347
12.98	59	200				6	12.98	59	200
			13.01	56	195	7	13.01	56	195
13.40	12	330	13.40	12	332	8	13.40	12	331
13.66	05	355	13.67	06	359	9	13.67	06	357
14.03	14	061	14.04	11	015	10	14.04	12	038
14.52	13	008	14.52	18	012	11	14.52	16	010
15.74	11	034	15.75	05	044	12	15.75	08	039
17.37	05	052	17.34	04	071	13	17.36	04	061
			18.70	82	003	14	18.70	82	003
21.21	04	061	21.19	11	029	15	21.20	07	045
21.62	13	017	21.60	13	022	16	21.61	13	020
21.89	10	015	21.92	07	007	17	21.91	09	011
			23.50	34	268	18	23.50	34	268
24.55	16	081	24.53	13	061	19	24.54	14	071
25.22	11	089	25.19	10	074	20	25.21	10	081
26.23	07	027	26.20	09	018	21	26.22	08	023
27.64	78	356	27.64	77	354	22	27.64	78	355
28.66	13	039	28.63	07	095	23	28.65	10	067
28.85	72	001	28.81	72	360	24	28.83	72	180
29.06	49	206	29.03	50	201	25	29.05	49	203
30.58	13	069	30.54	09	081	26	30.56	11	075
			31.83	54	280	27	31.83	54	280
			32.84	15	132	28	32.84	15	132
			33.19	13	099	29	33.19	13	099
35.34	04	096	35.31	07	123	30	35.33	06	110
35.70	67	347	35.69	67	345	31	35.70	67	346
			35.73	04	101	32	35.73	04	101
37.78	04	106	37.76	09	104	33	37.77	07	105
38.94	04	039	38.93	13	049	34	38.94	08	044
42.05	09	111	42.04	04	101	35	42.05	06	106
43.40	50	194	43.40	50	205	36	43.40	50	200
44.36	15	040	44.32	11	093	37	44.34	13	066
44.41	09	101	44.38	09	121	38	44.40	09	111
			44.64	57	269	39	44.64	57	269
45.52	15	099	45.52	13	081	40	45.52	14	090
45.86	61	302	45.88	62	302	41	45.87	62	302
46.11	07	116	46.10	13	110	42	46.11	10	113
46.18	05	118	46.18	14	084	43	46.18	09	101
			47.40	06	106	44	47.40	06	106
49.84	70	211	49.93	73	201	45	49.89	72	206
50.58	69	338	50.61	69	331	46	50.60	69	335
51.07	16	103	51.08	17	105	47	51.08	17	104
51.61	08	106	51.60	07	139	48	51.61	07	123

51.96	30	277		51.97	32	270		49	51.97	31	274
				53.88	55	327		50	53.88	55	327
54.56	80	077		54.56	80	077		51	54.56	80	077
				56.21	82	079		52	56.21	82	079
				56.33	19	220		53	56.33	19	220
				56.80	82	077		54	56.80	82	077
57.09	81	084						55	57.09	81	084
57.27	85	073		57.40	84	077		56	57.34	85	075
57.51	85	081						57	57.51	85	081
58.11	81	081		58.17	81	073		58	58.14	81	077
59.16	34	118		59.15	34	104		59	59.16	34	111
59.63	28	141		59.63	29	104		60	59.63	29	123
59.76	22	168		59.76	31	148		61	59.76	26	158
60.14	23	149						62	60.14	23	149
60.45	24	171		60.47	13	170		63	60.46	19	171
60.56	78	085		60.54	77	076		64	60.55	77	081
60.84	17	275						65	60.84	17	275
60.89	81	084		60.89	81	086		66	60.89	81	085
61.37	16	212						67	61.37	16	212
				61.57	23	095		68	61.57	23	095
				61.92	24	146		69	61.92	24	146
63.51	04	118		63.51	05	165		70	63.51	04	142
63.58	13	149		63.57	20	140		71	63.58	17	144
				66.64	20	139		72	66.64	20	139
68.15	29	297		68.14	33	310		73	68.15	31	303
				68.19	33	324		74	68.19	33	324
71.71	12	096		71.70	15	104		75	71.71	13	100
71.75	26	106		71.76	27	115		76	71.76	26	111
				73.68	52	178		77	73.68	52	178
				73.87	42	193		78	73.87	42	193
75.32	46	147		75.32	47	149		79	75.32	47	148
76.89	36	116		76.89	36	119		80	76.89	36	117
79.21	18	124		79.20	18	131		81	79.21	18	127
81.17	41	197		81.16	39	201		82	81.17	40	199
				81.25	48	187		83	81.25	48	187
82.62	29	144		82.64	37	151		84	82.63	33	147
84.07	66	349		84.05	65	352		85	84.06	65	350
				84.98	62	227		86	84.98	62	227
85.15	80	076		85.16	80	070		87	85.16	80	073
85.41	80	079		85.32	79	073		88	85.37	79	076
85.59	78	076		85.52	77	076		89	85.56	78	076
				85.61	76	076		90	85.61	76	076
				85.82	74	077		91	85.82	74	077
86.00	80	078		86.04	79	066		92	86.02	79	072
87.24	58	115		87.24	58	112		93	87.24	58	113
				87.63	49	096		94	87.63	49	096
				87.66	66	099		95	87.66	66	099
				87.97	60	118		96	87.97	60	118
				88.04	52	099		97	88.04	52	099
				88.37	68	073		98	88.37	68	073
88.52	73	057		88.49	75	073		99	88.51	74	065
88.93	30	192						100	88.93	30	192
89.15	53	198		89.19	53	211		101	89.17	53	205
89.65	32	105						102	89.65	32	105
90.06	37	138						103	90.06	37	138

90.20	76	070		90.18	75	066		104	90.19	75	068
90.57	66	073		90.44	72	072		105	90.51	69	073
90.92	78	079		90.92	78	076		106	90.92	78	077
91.03	76	079		91.02	75	074		107	91.03	75	076
93.73	51	207		93.74	47	201		108	93.74	49	204
				93.76	54	198		109	93.76	54	198

Notes:
Depth measured from ground surface to center of selected discontinuity
Azimuth corrected for 17 degrees East declination
Dip is measured from horizontal
Average data set used for analysis and presented on COBL logs
# of Average value corresponds to COBL log data presentation on simulated core image
Duplicate discontinuities selected based on geologic review of COBL log and borehole log

Appendix E

Downhole Instrumentation

VWP and Slope Displacement Instrumentation Installation

Vibrating Wire Piezometers

This installation procedure for the Vibrating Wire Piezometer (VWP) instruments was developed in cooperation with Slope Indicator's VWP consultant, experienced CRUX project managers and drillers and WNROCK personnel.

1. Advance the borehole to the total depth by HQ triple-tube wire line coring technology.
2. Flush hole with clean water for 15 minutes.
3. Remove HQ rods and replace diamond bit with a casing shoe and reinstall rods to total depth to verify that no slough remains in the bottom of the boring.
4. Flush hole with clean water for a minimum of 15 minutes or until surfacing fluid is visually free of cuttings.
5. Complete any downhole survey required for the borehole (ie: optical televiewer survey).
6. Place 10-20 silica sand from total depth of borehole to elevation of first VWP instrument by slowly pouring the sand in from the surface and frequently "tagging" the bottom of the hole to confirm the sand elevation and ensure that no bridging occurs. Add clean water at the top of the borehole into the stickup of the drill rods to assist in "flushing" the sand down the rods.
7. Assemble the PVC grout tube and VWP instrument package as follows:
   a. Glued-together ½ inch PVC is used with an end cap to seal the bottom. The first grout hole (drilled into the side of PVC) is located at approximately 2 feet above the top of filter pack elevation. Either ½ diameter flexible polyethylene pipe are attached to the PVC to various depths or a removable tremie pipe is constructed to allow for secondary and tertiary grouting of the borehole.
   b. VWPs are attached to the PVC grout tremie tube. The VWPs are inverted, hydrated and placed in 18-inch long "socks" filled with sand and attached to the PVC casing using drywall tape to reduce the potential for settling of the sand and "mushrooming" of the sock. Electrical tape should be used every six inches over the drywall tape. The sand within the sock is hydrated by the water remaining within the borehole during installation. The wires from each VWP and the secondary grout tubes are taped to the PVC approximately every 5 feet to reduce the potential for "snagging" during casing removal.
8. Due to limited annulus space, once the PVC and instruments are installed to the designed elevation and no sloughing has been observed in the borehole the HQ drill rods can be removed from the hole to allow for the silica sand to be placed to the designed top of filter pack elevation. Prior to removing the rods the instruments should be tested to ensure proper operation. The height above ground of the PVC grout tube should be measured to the nearest 0.1 foot regularly to ensure that the instrument string has not been snagged or pulled up during rod removal.

9. Grouting should be completed in a continuous operation using the following mix proportions:
    a. 94 lbs Portland Cement
    b. 30 gallons of water
    c. 25 to 50 pounds (as necessary) of **pure** bentonite powder. The bentonite is added until the mix is sufficiently thick to reduce the potential for separation once in the boring (marsh funnel value of 50 to 60 seconds).
10. The cement and water are mixed first and the bentonite powder added afterwards. The grout mix is pumped through the primary grout tube until visually observed at the surface. The secondary and tertiary grout tubes are also pumped to ensure a continuous grout column.
11. The total grout volume that is pumped into the borehole is compared to the calculated net volume of the borehole to independently verify a continuous grout column.
12. A stickup monument is installed as the surface completion for the well with sand used as backfill inside the stickup to bring the wires to an elevation that is accessible for data acquisition. An $^{1}/_{8}$ inch diameter hole should be drilled approximately 6 inches above the ground surface in the stickup monument to allow for drainage of water that collects on the interior of the monument.

The calibration sheets for the vibrating wire piezometers installed in 2007 are provided within this appendix. A summary of the VWP locations by borehole with serial number and depth interval is provided within the main report. Calibration sheets for VWP's installed in 2006 are provided in the Rock Cut Feasibility Investigation - Slide Curve I-90 MP 59 (Wyllie & Norrish, 2007a).

Time Domain Reflectometer Cable

When installing TDR cable adjacent to the VWP instruments the TDR cable can be attached to the PVC instrument string using electrical tape. The grout mix for backfilling the borehole should be amended to match as closely as reasonable the subsurface soil or rock strength. Both ends of the TDR cable must be sealed using electrical tape coated with electrical tape glue to ensure no moisture enters the cable. TDR cable was installed as part of the 2006 Feasibility Investigation (Wyllie & Norrish, 2007a) and is referenced by table in the main report.

Slope Inclinometer Casing

Installation of the slope inclinometer casing was completed as part of slope stability monitoring program for the scarps identified mid-slope along Slide Curve. The 2.75" diameter casing was installed through the drill rods into a flushed and reamed borehole. The casing was grouted in place using tremie grout methods. Grout mix on this project comprised:

1. 94 lbs Portland Cement
2. 30 gallons of water

3. 25 to 35 pounds of bentonite powder is added until the mix is sufficiently thick (marsh funnel value of 55 to 60 seconds). It is necessary to mix the cement and water first, then add the bentonite.

In-place inclinometer instruments (little dippers) were installed into the grooved inclinometer casing by WSDOT for continuous remote monitoring of the slope stability. The calibration sheets for the 'little dippers' are provided within this appendix. A summary of the locations, elevations and serial numbers are provided within the main report.

The following pages provide the information listed below:

1. Vibrating Wire Piezometer Calibration Sheets
2. In-Place Inclinometer Calibration Sheets
3. Vibrating Wire Piezometer Summary Graphs by Instrument
4. Time Domain Reflectometer Graphs
5. In-Place Inclinometer Graphs

SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 92270
Range : 100 psi
Cable Length: 60 m
Date of Calibration: 8/14/2007

Part #: 52611035
Cable Part # : 50613524
Calibrated by: KB
Note

ABC Calibration Factors

	A	B	C
kPa	-1.659516E-4	5.500690E-2	1.245891E+3
psi	-2.406925E-5	7.978076E-3	1 807012E+2

Pressure in kPa/psi = $(A \times Hz^2) + (B \times Hz) + C$, where Hz is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.244429E+3	5.429432E-2	1.575923E-1	-1.658574E-4	2.005573E-5	-2.013164E-3
psi	1.804828E+2	7.874448E-3	2.285602E-2	-2.405473E-5	2.908736E-6	-2.919745E-4

Pressure in kPa/psi = $C0 + (C1 \times Hz) + (C2 \times T) + (C3 \times Hz^2) + (C4 \times Hz \times T) + (C5 \times T^2)$

Where Hz is the frequency reading in Hertz and T is the Thermistor reading in degrees C.
TI factors are calculated from temperatures at 5.0, 15.0 and 25.0 degrees C
Applied pressure and temperature are NIST traceable.

Summary of Test Results at 15°C

Thermistor reading is 15.0 °C.

Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (psi)	Equivalent (kPa)	Frequency (Hz)	Calculated (psi)	Calculated (kPa)	Error (%FS)
0.00	0 0	2910.8	-0 01	-0 1	0.01
10 00	68.9	2834.0	10 00	68.9	0.00
20.00	137.9	2754.7	20.03	138.1	-0.03
30.00	206 8	2673.5	29 99	206.8	0.01
40 00	275.8	2589.3	39 99	275.7	0.01
50.00	344.7	2502.0	49.99	344.7	0.01
60.00	413.7	2411.3	59 99	413.6	0.01
70.00	482.6	2316.8	69.99	482.6	0.01
80.00	551.6	2217.8	80 01	551.6	-0.01
90.00	620.5	2114.0	90.00	620.5	0.00
100.00	689.5	2004 3	100.00	689.5	0.00

SLOPE INDICATOR

VW Piezometer Calibration Report

Customer	Washington DOT	Serial No.	92089 T
Cust. No.	20383	Part No.	52611024
Order No.	28080	Range	0-50 PSI
Date	31-Jul-07	Cable	50613524
Cal. By.	kb	Length	30 m
Note			

Conversion Factors for Serial No. 92089 T

Referenced To Standard Atmosphere*

	ABC Factors			IDA ABC Factors		
Units	A	B	C	A	B	C
psi	-0.000014097	-0.0056312	131.21	-25.061	-7.5083	131.21
ft H2O	-0.000032517	-0.012989	302.66	-57.807	-17 319	302.66
kN/m² (kPa)	-0.000097195	-0.038826	904.67	-172.79	-51.768	904.67
m H2O	-0 0000099111	-0 0039591	92 251	-17.620	-5.2788	92.251
bar	-0.00000097195	-0.00038826	9.0467	-1.7279	-0.51768	9.0467
kg/cm²	-0.00000099111	-0.00039591	9.2251	-1.7620	-0.52788	9.2251
				IF Factor = T		

Temp. Coefficients (m = 0.0134 PSI/°C, b = -0.331 PSI) TempOffset: -0.1 °C

Test Data

Referenced To Standard Atmosphere*

PSI	Frequency	% FS Error
-5.000	2915.07	0.01
0.000	2857.63	0.00
5.000	2799.12	-0.01
10.000	2739.52	-0.03
15.000	2678.55	-0.03
20.000	2616.10	0.00
25.000	2552.24	0.02
30.000	2487.15	0.00
35.000	2420.33	0.00
40.000	2351.77	0.00
45.000	2281.32	-0.01
50.000	2208.81	-0.01

Calibrated at = 24.7 °C Thermistor Reading = 24.6 °C

*Standard Atmosphere = 14.696 psi, 1013 millibar.

SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 92946
Range : 50 psi
Cable Length: 30 m
Date of Calibration: 9/28/2007

Part #: 52611024
Cable Part # : 50613524
Calibrated by: KB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.074027E-4	-1.445098E-3	8.762498E+2
psi	-1.557745E-5	-2.095938E-4	1.270893E+2

Pressure in kPa/psi = $(A \times Hz^2) + (B \times Hz) + C$, where Hz is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	8.752651E+2	-1.906789E-3	1.028388E-1	-1.074797E-4	5.126708E-5	-3.591352E-3
psi	1.269420E+2	-2.765467E-4	1.491498E-2	-1.558807E-5	7.435400E-6	-5.208633E-4

Pressure in kPa/psi = $C0 + (C1 \times Hz) + (C2 \times T) + (C3 \times Hz^2) + (C4 \times Hz \times T) + (C5 \times T^2)$

Where Hz is the frequency reading in Hertz and T is the Thermistor reading in degrees C.
TI factors are calculated from temperatures at 5.0, 15.0 and 25.0 degrees C
Applied pressure and temperature are NIST traceable.

Summary of Test Results at 15°C

Thermistor reading is 14.8 °C

Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (psi)	Equivalent (kPa)	Frequency (Hz)	Calculated (psi)	Calculated (kPa)	Error (%FS)
0.00	0.0	2849.6	0.00	0.0	0.00
5.00	34.5	2792.8	5.00	34.5	-0.01
10.00	68.9	2735.1	9.98	68.8	0.03
15.00	103.4	2675.7	15.00	103.4	-0.01
20.00	137.9	2615.2	20.00	137.9	0.00
25.00	172.4	2553.3	25.00	172.4	0.00
30.00	206.8	2489.8	30.00	206.8	0.00
35.00	241.3	2424.7	35.00	241.3	0.00
40.00	275.8	2357.8	40.00	275.8	0.01
45.00	310.3	2288.9	45.00	310.3	0.00
50.00	344.7	2217.9	50.00	344.7	0.00

SLOPE INDICATOR

VW Piezometer Calibration Report

Customer	Washington DOT	Serial No.	92060 T
Cust. No.	20383	Part No.	52611024
Order No.	28080	Range	0-50 PSI
Date	30-Jul-07	Cable	50613524
Cal. By.	kb	Length	30 m
Note			

Conversion Factors for Serial No. 92060 T

Referenced To Standard Atmosphere*

	ABC Factors			IDA ABC Factors		
Units	A	B	C	A	B	C
psi	-0.000011765	-0.0025919	107.76	-20.915	-3.4558	107.76
ft H2O	-0.000027138	-0.0059786	248.57	-48.245	-7.9714	248.57
kN/m² (kPa)	-0.000081116	-0.017870	743.00	-144.21	-23.827	743.00
m H2O	-0.0000082715	-0.0018223	75.765	-14.705	-2.4297	75.765
bar	-0.00000081116	-0.00017870	7.4300	-1.4421	-0.23827	7.4300
kg/cm²	-0.00000082715	-0.00018223	7.5765	-1.4705	-0.24297	7.5765

IF Factor = T

Temp. Coefficients (m = 0.0135 PSI/°C, b = -0.307 PSI) TempOffset: -0.1 °C

Test Data

Referenced To Standard Atmosphere*

PSI	Frequency	% FS Error
-5.000	2987.79	-0.02
0.000	2918.36	-0.01
5.000	2847.30	0.00
10.000	2774.58	0.00
15.000	2700.00	-0.01
20.000	2623.36	-0.01
25.000	2544.50	-0.01
30.000	2463.13	-0.01
35.000	2379.20	-0.01
40.000	2292.38	-0.01
45.000	2202.26	-0.01
50.000	2108.33	0.00

Calibrated at = 23.0 °C Thermistor Reading = 22.9 °C

*Standard Atmosphere = 14.696 psi, 1013 millibar.

SLOPE INDICATOR

VW Piezometer Calibration Report

Customer	Washington DOT	Serial No.	92083 T
Cust. No.	20383	Part No.	52611035
Order No.	28080	Range	0-100 PSI
Date	26-Jul-07	Cable	50613524
Cal. By.	kb	Length	60 m
Note			

Conversion Factors for Serial No. 92083 T

Referenced To Standard Atmosphere*

	ABC Factors			IDA ABC Factors		
Units	A	B	C	A	B	C
psi	-0.000027580	0.0079665	193.53	-49.030	10.622	193.53
ft H2O	-0.000063617	0.018376	446.42	-113.10	24.501	446.42
kN/m² (kPa)	-0.00019015	0.054927	1334.4	-338.05	73.236	1334.4
m H2O	-0.000019390	0.0056010	136.07	-34 472	7.4680	136.07
bar	-0.0000019015	0.00054927	13.344	-3.3805	0.73236	13.344
kg/cm²	-0.0000019390	0 00056010	13.607	-3.4472	0.74680	13.607

IF Factor = T

Temp. Coefficients (m = 0.0322 PSI/°C, b = -0.767 PSI) TempOffset: -0.2 °C

Test Data

Referenced To Standard Atmosphere*

PSI	Frequency	% FS Error
0.000	2797.26	0.01
10.000	2728.25	-0.02
20.000	2657.06	-0.02
30.000	2583.71	0.00
40.000	2508.31	-0.01
50.000	2430.36	-0.01
60.000	2349.64	-0.02
70.000	2265.66	0.01
80.000	2178.39	0.01
90.000	2087.25	0.00
100.000	1991.81	-0.02

Calibrated at = 23.5 °C Thermistor Reading = 23.3 °C

*Standard Atmosphere = 14.696 psi, 1013 millibar.

SLOPE INDICATOR

VW Piezometer Calibration Report

Customer	Washington DOT	Serial No.	92082 T
Cust. No.	20383	Part No.	52611035
Order No.	28080	Range	0-100 PSI
Date	26-Jul-07	Cable	50613524
Cal. By.	kb	Length	60 m
Note			

Conversion Factors for Serial No. 92082 T

Referenced To Standard Atmosphere*

	ABC Factors			IDA ABC Factors		
Units	A	B	C	A	B	C
psi	-0.000025394	-0.0016948	213.63	-45.144	-2.2597	213.63
ft H2O	-0.000058575	-0.0039093	492.77	-104.13	-5.2123	492.77
kN/m² (kPa)	-0.00017508	-0.011685	1472.9	-311.26	-15.580	1472.9
m H2O	-0.000017854	-0.0011915	150.20	-31.740	-1.5887	150.20
bar	-0.0000017508	-0.00011685	14.729	-3.1126	-0.15580	14.729
kg/cm²	-0.0000017854	-0.00011915	15.020	-3.1740	-0.15887	15.020

IF Factor = T

Temp. Coefficients (m = 0.0294 PSI/°C, b = -0.671 PSI) TempOffset: -0.3 °C

Test Data

Referenced To Standard Atmosphere*

PSI	Frequency	% FS Error
0.000	2867.42	-0.02
10.000	2798.84	-0.04
20.000	2728.25	-0.01
30.000	2655.33	0.08
40.000	2581.06	0.08
50.000	2505.53	-0.03
60.000	2426.94	-0.05
70.000	2345.52	-0.05
80.000	2260.96	-0.01
90.000	2173.28	0.01
100.000	2081.99	0.03

Calibrated at = 23.5 °C Thermistor Reading = 23.2 °C

*Standard Atmosphere = 14.696 psi, 1013 millibar.

SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 92274
Range : 100 psi
Cable Length: 60 m
Date of Calibration: 8/14/2007

Part #: 52611035
Cable Part # : 50613524
Calibrated by: KB
Note.

ABC Calibration Factors

	A	B	C
kPa	-1.819808E-4	5.792804E-2	1.336344E+3
psi	-2.639409E-5	8.401752E-3	1.938203E+2

Pressure in kPa/psi = $(A \times Hz^2) + (B \times Hz) + C$, where Hz is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.334348E+3	5.761694E-2	1.559468E-1	-1.820034E-4	3.193164E-5	-2.519277E-3
psi	1.935240E+2	8.356336E-3	2.261738E-2	-2.639643E-5	4.631130E-6	-3.653774E-4

Pressure in kPa/psi = $C0 + (C1 \times Hz) + (C2 \times T) + (C3 \times Hz^2) + (C4 \times Hz \times T) + (C5 \times T^2)$

Where Hz is the frequency reading in Hertz and T is the Thermistor reading in degrees C.
TI factors are calculated from temperatures at 5.0, 15.0 and 25.0 degrees C
Applied pressure and temperature are NIST traceable.

Summary of Test Results at 15°C

Thermistor reading is 14.7 °C.

Applied Pressure is referenced to 1 atm Calculated Pressure uses ABC Calibration factors.

Applied (psi)	Equivalent (kPa)	Frequency (Hz)	Calculated (psi)	Calculated (kPa)	Error (%FS)
0.00	0.0	2873.6	0.01	0.1	-0.01
10.00	68.9	2803.1	9.98	68.8	0.02
20.00	137.9	2730.3	20.00	137.9	0.00
30.00	206.8	2655.5	30.01	206.9	-0.01
40.00	275.8	2578.5	40.00	275.8	0.00
50.00	344.7	2498.9	50.00	344.7	0.00
60.00	413.7	2416.5	60.00	413.7	0.00
70.00	482.6	2330.9	70.00	482.6	0.00
80.00	551.6	2241.8	80.01	551.6	-0.01
90.00	620.5	2148.8	90.00	620.5	0.00
100.00	689.5	2051.3	99.99	689.4	0.01

SLOPE INDICATOR

VW Piezometer Calibration Report

Customer	Washington DOT	Serial No.	92081 T
Cust. No.	20383	Part No.	52611035
Order No.	28080	Range	0-100 PSI
Date	26-Jul-07	Cable	50613524
Cal. By.	kb	Length	60 m
Note			

Conversion Factors for Serial No. 92081 T

Referenced To Standard Atmosphere*

	ABC Factors			IDA ABC Factors		
Units	A	B	C	A	B	C
psi	-0 000024507	-0.0012350	196.46	-43.569	-1.6467	196.46
ft H2O	-0.000056530	-0 0028488	453.18	-100.50	-3 7984	453.18
kN/m² (kPa)	-0.00016897	-0.0085153	1354 6	-300.40	-11.354	1354.6
m H2O	-0 000017230	-0 00086832	138 13	-30.632	-1 1578	138.13
bar	-0.0000016897	-0.000085153	13 546	-3 0040	-0.11354	13 546
kg/cm²	-0.0000017230	-0.000086832	13.813	-3.0632	-0.11578	13 813

IF Factor = T

Temp. Coefficients (m = 0.0139 PSI/°C, b = -0.295 PSI) TempOffset: -0.3 °C

Test Data

Referenced To Standard Atmosphere*

PSI	Frequency	% FS Error
0.000	2806.49	-0.03
10.000	2733.54	-0.04
20.000	2658.18	0.01
30.000	2580.84	0.04
40.000	2501.16	0.06
50.000	2418.95	0.07
60.000	2334.65	0.00
70.000	2247.40	-0.10
80.000	2155.70	-0.09
90.000	2059.57	-0.04
100.000	1957.99	0.09

Calibrated at = 23.5 °C Thermistor Reading = 23.2 °C

*Standard Atmosphere = 14.696 psi, 1013 millibar.

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3493
Date 9/12/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-9.7042	-2.2638	0.3128
-8.7070	-2.0264	0.3103
-7.7070	-1.7904	0.3078
-6.7097	-1.5558	0.3033
-5.7015	-1.3204	0.2973
-4.6987	-1.0851	0.2919
-3.7070	-0.8542	0.2872
-2.7015	-0.6233	0.2823
-1.7042	-0.3933	0.2782
-0.7015	-0.1615	0.2751
0.2903	0.0682	0.2681
1.2930	0.2961	0.2636
2.3013	0.5287	0.2581
3.2958	0.7596	0.2559
4.2958	0.9920	0.2541
5.2903	1.2259	0.2509
6.2985	1.4603	0.2456
7.3013	1.6930	0.2414
8.2930	1.9243	0.2375
9.2875	2.1596	0.2322
10.2958	2.4001	0.2287
11.2930	2.6395	0.2243
12.2985	2.8833	0.2216
13.2958	3.1292	0.2177
14.2930	3.3731	0.2127

Y-Axis Calibration

Theta	X-Output	Y-Output
-9.6384	0.2491	-2.2566
-8.6384	0.2521	-2.0176
-7.6411	0.2561	-1.7796
-6.6439	0.2588	-1.5425
-5.6356	0.2634	-1.3058
-4.6356	0.2646	-1.0722
-3.6356	0.2682	-0.8389
-2.6411	0.2721	-0.6087
-1.6384	0.2773	-0.3761
-0.6384	0.2833	-0.1470
0.3561	0.2871	0.0816
1.3589	0.2918	0.3111
2.3644	0.2945	0.5428
3.3671	0.2995	0.7763
4.3616	0.3065	1.0046
5.3561	0.3132	1.2364
6.3644	0.3184	1.4710
7.3644	0.3222	1.7041
8.3616	0.3275	1.9372
9.3534	0.3332	2.1697
10.3616	0.3391	2.4083
11.3589	0.3466	2.6442
12.3616	0.3542	2.8892
13.3616	0.3621	3.1327
14.3616	0.3674	3.3794

Theta = 0 is defined as the angle for which voltage = 0 in the table above. To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 22.0 deg. C
Y-Axis calibration temperature = 22.0 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.284 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.255

Y-Axis scale factor = 4.288 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.220

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.3376	0.0005	-0.0087	0.0003	-0.0001
Y-Axis	-0.0000	4.3409	0.0055	-0.0092	0.0006	-0.0002

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3494
Date 9/12/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-9.8405	-2.3617	0.9178
-8.8432	-2.1178	0.9171
-7.8432	-1.8745	0.9160
-6.8459	-1.6314	0.9139
-5.8377	-1.3889	0.9147
-4.8350	-1.1463	0.9132
-3.8432	-0.9090	0.9107
-2.8377	-0.6714	0.9098
-1.8405	-0.4349	0.9072
-0.8377	-0.1994	0.9063
0.1541	0.0369	0.9025
1.1568	0.2725	0.8996
2.1650	0.5086	0.8995
3.1595	0.7439	0.8970
4.1595	0.9791	0.8979
5.1541	1.2148	0.8989
6.1623	1.4543	0.8967
7.1650	1.6897	0.8989
8.1595	1.9257	0.9004
9.1513	2.1633	0.9001
10.1595	2.4115	0.9012
11.1568	2.6520	0.9025
12.1623	2.8978	0.9051
13.1623	3.1479	0.9063
14.1541	3.3961	0.9083

Y-Axis Calibration

Theta	X-Output	Y-Output
-6.9124	0.4034	-1.6569
-5.9124	0.4019	-1.4106
-4.9152	0.4001	-1.1692
-3.9179	0.4001	-0.9281
-2.9097	0.3986	-0.6880
-1.9097	0.3992	-0.4520
-0.9097	0.3996	-0.2148
0.0848	0.4012	0.0212
1.0876	0.4019	0.2557
2.0903	0.4022	0.4911
3.0821	0.4021	0.7227
4.0848	0.4021	0.9579
5.0903	0.4018	1.1923
6.0931	0.4004	1.4295
7.0876	0.4009	1.6630
8.0821	0.4006	1.8974
9.0903	0.4021	2.1349
10.0903	0.4026	2.3720
11.0876	0.4049	2.6078
12.0794	0.4066	2.8452
13.0876	0.4065	3.0889
14.0848	0.4099	3.3301
15.0876	0.4131	3.5763
16.0876	0.4164	3.8228
17.0876	0.4172	4.0719

Theta = 0 is defined as the angle for which voltage = 0 in the table above.
To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 22.0 deg. C
Y-Axis calibration temperature = 22.0 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.196 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.259

Y-Axis scale factor = 4.218 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.231

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	0.0000	4.2427	0.0157	-0.0095	-0.0008	0.0001
Y-Axis	0.0000	4.2507	0.0236	-0.0114	0.0014	-0.0002

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3497
Date 9/12/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-9.7043	-2.2326	-0.2194
-8.7043	-1.9966	-0.2072
-7.7098	-1.7625	-0.1971
-6.7070	-1.5268	-0.1850
-5.7015	-1.2937	-0.1742
-4.7015	-1.0637	-0.1652
-3.7043	-0.8356	-0.1562
-2.7043	-0.6116	-0.1455
-1.7043	-0.3853	-0.1331
-0.7043	-0.1605	-0.1234
0.2902	0.0653	-0.1115
1.2957	0.2922	-0.1008
2.2985	0.5182	-0.0906
3.2957	0.7421	-0.0792
4.2957	0.9670	-0.0691
5.2930	1.1938	-0.0587
6.2985	1.4215	-0.0479
7.2985	1.6498	-0.0385
8.2930	1.8767	-0.0287
9.2930	2.1081	-0.0178
10.2930	2.3386	-0.0075
11.2957	2.5733	0.0041
12.2957	2.8089	0.0156
13.2957	3.0471	0.0278
14.2957	3.2865	0.0374

Y-Axis Calibration

Theta	X-Output	Y-Output
-11.2394	0.3696	-2.5705
-10.2421	0.3618	-2.3347
-9.2421	0.3581	-2.1031
-8.2449	0.3547	-1.8705
-7.2366	0.3487	-1.6390
-6.2339	0.3442	-1.4117
-5.2394	0.3374	-1.1851
-4.2421	0.3340	-0.9585
-3.2394	0.3287	-0.7300
-2.2394	0.3252	-0.5042
-1.2449	0.3198	-0.2803
-0.2394	0.3165	-0.0531
0.7606	0.3118	0.1715
1.7661	0.3098	0.3988
2.7579	0.3064	0.6234
3.7579	0.3029	0.8485
4.7634	0.2977	1.0776
5.7634	0.2924	1.3083
6.7606	0.2888	1.5359
7.7551	0.2841	1.7668
8.7606	0.2802	2.0020
9.7579	0.2763	2.2354
10.7606	0.2732	2.4743
11.7634	0.2680	2.7133
12.7579	0.2644	2.9536

Theta = 0 is defined as the angle for which voltage = 0 in the table above.
To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 23.0 deg. C
Y-Axis calibration temperature = 23.0 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.381 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.266

Y-Axis scale factor = 4.375 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.295

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.4411	0.0103	-0.0131	0.0006	-0.0001
Y-Axis	-0.0000	4.4366	-0.0054	-0.0125	-0.0000	0.0001

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3501
Date 9/27/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-9.6971	-2.4050	0.1220
-8.6971	-2.1547	0.1247
-7.6944	-1.9022	0.1241
-6.6971	-1.6511	0.1248
-5.6916	-1.3995	0.1288
-4.6916	-1.1485	0.1353
-3.6971	-0.8990	0.1428
-2.6944	-0.6538	0.1505
-1.6944	-0.4136	0.1553
-0.6944	-0.1740	0.1565
0.3029	0.0691	0.1583
1.3056	0.3149	0.1616
2.3056	0.5608	0.1629
3.3084	0.8060	0.1642
4.3056	1.0453	0.1688
5.3002	1.2855	0.1726
6.3084	1.5348	0.1707
7.3139	1.7761	0.1705
8.3029	2.0186	0.1716
9.3084	2.2734	0.1752
10.3441	2.5334	0.1824
11.3441	2.7849	0.1891
12.2947	3.0254	0.1919
13.3056	3.2830	0.1943
14.3194	3.5465	0.1998

Y-Axis Calibration

Theta	X-Output	Y-Output
-10.0797	0.3682	-2.5009
-9.0769	0.3669	-2.2440
-8.0824	0.3642	-1.9939
-7.0769	0.3635	-1.7419
-6.0742	0.3602	-1.4920
-5.0742	0.3588	-1.2440
-4.0797	0.3528	-0.9956
-3.0769	0.3482	-0.7481
-2.0742	0.3469	-0.5047
-1.0769	0.3438	-0.2659
-0.0797	0.3395	-0.0228
0.9231	0.3362	0.2255
1.9231	0.3334	0.4674
2.9286	0.3276	0.7099
3.9258	0.3257	0.9504
4.9148	0.3241	1.1910
5.9286	0.3196	1.4339
6.9423	0.3159	1.6781
7.9945	0.3132	1.9325
8.9231	0.3100	2.1634
9.9203	0.3085	2.4081
10.9231	0.3083	2.6553
11.9231	0.3087	2.9092
12.9231	0.3086	3.1634
13.9176	0.3033	3.4165

| Theta = 0 is defined as the angle for which voltage = 0 in the table above.
| To measure and remove bias (zero offset) in your tiltmeter, ask for our
| technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 21.0 deg. C
Y-Axis calibration temperature = 21.0 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.063 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.318

Y-Axis scale factor = 4.084 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.398

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.1171	0.0209	-0.0121	-0.0014	0.0004
Y-Axis	0.0000	4.1186	0.0224	-0.0064	-0.0008	-0.0001

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3502
Date 9/27/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-11.0851	-2.5556	0.1755
-10.0851	-2.3179	0.1707
-9.0824	-2.0824	0.1656
-8.0851	-1.8495	0.1627
-7.0796	-1.6173	0.1584
-6.0796	-1.3881	0.1558
-5.0851	-1.1601	0.1530
-4.0824	-0.9301	0.1486
-3.0796	-0.7007	0.1436
-2.0824	-0.4727	0.1407
-1.0851	-0.2450	0.1393
-0.0824	-0.0174	0.1370
0.9176	0.2082	0.1353
1.9204	0.4365	0.1321
2.9176	0.6630	0.1280
3.9121	0.8907	0.1246
4.9204	1.1222	0.1215
5.9259	1.3553	0.1194
6.9149	1.5831	0.1162
7.9204	1.8146	0.1116
8.9561	2.0598	0.1057
9.9561	2.2951	0.0995
10.9066	2.5211	0.0945
11.9176	2.7621	0.0896
12.9314	3.0105	0.0876

Y-Axis Calibration

Theta	X-Output	Y-Output
-10.1329	-0.0638	-2.3379
-9.1301	-0.0581	-2.0986
-8.1356	-0.0530	-1.8643
-7.1301	-0.0493	-1.6314
-6.1274	-0.0460	-1.3993
-5.1274	-0.0412	-1.1688
-4.1329	-0.0353	-0.9417
-3.1301	-0.0281	-0.7132
-2.1274	-0.0223	-0.4848
-1.1301	-0.0164	-0.2560
-0.1329	-0.0095	-0.0290
0.8699	-0.0023	0.1984
1.8699	0.0033	0.4242
2.8754	0.0087	0.6527
3.8726	0.0148	0.8807
4.8616	0.0192	1.1076
5.8754	0.0245	1.3386
6.8891	0.0321	1.5691
7.9413	0.0378	1.8113
8.8699	0.0417	2.0269
9.8671	0.0460	2.2564
10.8699	0.0492	2.4916
11.8699	0.0546	2.7293
12.8699	0.0596	2.9647
13.8644	0.0645	3.2029

Theta = 0 is defined as the angle for which voltage = 0 in the table above. To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 21.0 deg. C
Y-Axis calibration temperature = 21.0 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.345 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.248

Y-Axis scale factor = 4.358 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.217

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.3986	-0.0027	-0.0098	0.0000	-0.0001
Y-Axis	-0.0000	4.4004	0.0024	-0.0072	0.0008	-0.0003

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3503
Date 9/27/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-11.7517	-2.7458	0.4154
-10.7517	-2.5014	0.4086
-9.7489	-2.2666	0.4033
-8.7517	-2.0314	0.4033
-7.7462	-1.7970	0.4032
-6.7462	-1.5614	0.4054
-5.7517	-1.3310	0.4041
-4.7489	-1.0965	0.4037
-3.7462	-0.8598	0.3983
-2.7489	-0.6262	0.3933
-1.7517	-0.3977	0.3882
-0.7489	-0.1703	0.3820
0.2511	0.0541	0.3780
1.2538	0.2854	0.3801
2.2511	0.5122	0.3799
3.2456	0.7410	0.3796
4.2538	0.9748	0.3761
5.2566	1.2082	0.3683
6.2483	1.4403	0.3614
7.2538	1.6739	0.3571
8.2895	1.9136	0.3618
9.2895	2.1456	0.3611
10.2401	2.3702	0.3563
11.2511	2.6117	0.3532
12.2648	2.8612	0.3533

Y-Axis Calibration

Theta	X-Output	Y-Output
-9.0373	-0.1735	-2.1144
-8.0373	-0.1753	-1.8732
-7.0428	-0.1763	-1.6387
-6.0373	-0.1726	-1.4048
-5.0346	-0.1674	-1.1672
-4.0346	-0.1620	-0.9309
-3.0401	-0.1633	-0.6987
-2.0373	-0.1636	-0.4648
-1.0346	-0.1585	-0.2317
-0.0373	-0.1554	-0.0039
0.9599	-0.1517	0.2185
1.9627	-0.1546	0.4417
2.9627	-0.1524	0.6709
3.9682	-0.1515	0.9058
4.9654	-0.1514	1.1343
5.9544	-0.1518	1.3650
6.9682	-0.1525	1.5986
7.9819	-0.1511	1.8331
9.0341	-0.1457	2.0761
9.9627	-0.1421	2.2906
10.9599	-0.1384	2.5236
11.9627	-0.1379	2.7562
12.9627	-0.1362	2.9925
13.9627	-0.1361	3.2344
14.9572	-0.1309	3.4706

Theta = 0 is defined as the angle for which voltage = 0 in the table above. To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 21.0 deg. C
Y-Axis calibration temperature = 21.0 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.312 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.314

Y-Axis scale factor = 4.322 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.295

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.3614	0.0095	-0.0112	-0.0009	0.0002
Y-Axis	-0.0000	4.3643	0.0224	-0.0128	-0.0007	0.0004

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3504
Date 9/27/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-10.4256	-2.4580	-0.0554
-9.4256	-2.2150	-0.0560
-8.4229	-1.9755	-0.0553
-7.4256	-1.7359	-0.0567
-6.4201	-1.4974	-0.0567
-5.4201	-1.2615	-0.0559
-4.4256	-1.0288	-0.0558
-3.4229	-0.7940	-0.0553
-2.4201	-0.5629	-0.0531
-1.4229	-0.3293	-0.0518
-0.4256	-0.0967	-0.0480
0.5771	0.1360	-0.0450
1.5771	0.3649	-0.0431
2.5799	0.5953	-0.0377
3.5771	0.8261	-0.0347
4.5716	1.0565	-0.0326
5.5799	1.2902	-0.0328
6.5854	1.5286	-0.0317
7.5744	1.7637	-0.0318
8.5799	2.0015	-0.0341
9.6156	2.2518	-0.0397
10.6156	2.4952	-0.0412
11.5661	2.7315	-0.0397
12.5771	2.9832	-0.0360
13.5909	3.2378	-0.0337

Y-Axis Calibration

Theta	X-Output	Y-Output
-10.9501	0.1297	-2.5682
-9.9474	0.1281	-2.3252
-8.9529	0.1273	-2.0855
-7.9474	0.1262	-1.8459
-6.9446	0.1271	-1.6075
-5.9446	0.1285	-1.3725
-4.9501	0.1299	-1.1409
-3.9474	0.1326	-0.9094
-2.9446	0.1359	-0.6779
-1.9474	0.1419	-0.4479
-0.9501	0.1518	-0.2194
0.0526	0.1541	0.0117
1.0526	0.1556	0.2422
2.0581	0.1590	0.4769
3.0554	0.1590	0.7074
4.0444	0.1577	0.9359
5.0581	0.1557	1.1707
6.0719	0.1540	1.4096
7.1240	0.1565	1.6617
8.0499	0.1589	1.8857
9.0499	0.1574	2.1290
10.0526	0.1572	2.3709
11.0526	0.1587	2.6129
12.0526	0.1638	2.8565
13.0471	0.1691	3.1057

Theta = 0 is defined as the angle for which voltage = 0 in the table above. To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 21.0 deg. C
Y-Axis calibration temperature = 21.0 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.254 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.394

Y-Axis scale factor = 4.264 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.411

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.3320	0.0111	-0.0161	-0.0014	0.0004
Y-Axis	-0.0000	4.3485	-0.0115	-0.0189	0.0008	0.0005

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3505
Date 9/27/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-9.9430	-2.4390	-0.2778
-8.9430	-2.1832	-0.2724
-7.9402	-1.9291	-0.2646
-6.9430	-1.6810	-0.2577
-5.9375	-1.4338	-0.2511
-4.9375	-1.1885	-0.2456
-3.9430	-0.9431	-0.2412
-2.9402	-0.7044	-0.2359
-1.9375	-0.4647	-0.2317
-0.9402	-0.2270	-0.2283
0.0570	0.0119	-0.2212
1.0598	0.2546	-0.2134
2.0598	0.4931	-0.2080
3.0625	0.7345	-0.2045
4.0598	0.9753	-0.2007
5.0543	1.2177	-0.1955
6.0625	1.4651	-0.1881
7.0680	1.7080	-0.1822
8.0570	1.9458	-0.1794
9.0625	2.1890	-0.1755
10.0982	2.4459	-0.1695
11.0982	2.6910	-0.1648
12.0488	2.9246	-0.1595
13.0598	3.1746	-0.1524
14.0735	3.4310	-0.1477

Y-Axis Calibration

Theta	X-Output	Y-Output
-11.6355	0.3086	-2.8282
-10.6355	0.3065	-2.5710
-9.6410	0.3070	-2.3242
-8.6355	0.3050	-2.0782
-7.6328	0.3052	-1.8333
-6.6328	0.3026	-1.5903
-5.6383	0.2981	-1.3483
-4.6355	0.2938	-1.1083
-3.6328	0.2862	-0.8713
-2.6355	0.2828	-0.6319
-1.6383	0.2781	-0.3913
-0.6355	0.2792	-0.1503
0.3645	0.2758	0.0864
1.3700	0.2738	0.3271
2.3672	0.2708	0.5671
3.3562	0.2711	0.8085
4.3700	0.2734	1.0534
5.3837	0.2695	1.2998
6.4359	0.2644	1.5552
7.3645	0.2623	1.7826
8.3617	0.2627	2.0284
9.3645	0.2576	2.2726
10.3645	0.2546	2.5227
11.3645	0.2497	2.7746
12.3590	0.2442	3.0261

Theta = 0 is defined as the angle for which voltage = 0 in the table above.
To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 21.0 deg. C
Y-Axis calibration temperature = 21.0 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.119 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.393

Y-Axis scale factor = 4.128 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.261

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	0.0000	4.1661	-0.0039	-0.0084	0.0026	-0.0004
Y-Axis	-0.0000	4.1698	-0.0140	-0.0050	0.0013	-0.0004

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3506
Date 9/27/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-11.6690	-2.7406	0.2602
-10.6690	-2.4947	0.2620
-9.6663	-2.2552	0.2621
-8.6690	-2.0181	0.2662
-7.6636	-1.7811	0.2689
-6.6636	-1.5477	0.2687
-5.6690	-1.3158	0.2721
-4.6663	-1.0824	0.2785
-3.6636	-0.8478	0.2800
-2.6663	-0.6157	0.2794
-1.6690	-0.3849	0.2794
-0.6663	-0.1540	0.2791
0.3337	0.0759	0.2826
1.3364	0.3100	0.2861
2.3337	0.5409	0.2907
3.3282	0.7752	0.2931
4.3364	1.0103	0.2925
5.3419	1.2469	0.2949
6.3310	1.4824	0.2974
7.3364	1.7190	0.3007
8.3722	1.9681	0.3042
9.3722	2.2099	0.3075
10.3227	2.4411	0.3088
11.3337	2.6893	0.3099
12.3474	2.9419	0.3108

Y-Axis Calibration

Theta	X-Output	Y-Output
-9.5038	-0.1381	-2.2244
-8.5010	-0.1386	-1.9858
-7.5065	-0.1386	-1.7488
-6.5010	-0.1389	-1.5103
-5.4983	-0.1377	-1.2766
-4.4983	-0.1384	-1.0424
-3.5038	-0.1383	-0.8105
-2.5010	-0.1381	-0.5759
-1.4983	-0.1379	-0.3431
-0.5010	-0.1391	-0.1151
0.4962	-0.1401	0.1136
1.4990	-0.1427	0.3422
2.4990	-0.1435	0.5738
3.5045	-0.1438	0.8091
4.5017	-0.1473	1.0409
5.4908	-0.1502	1.2696
6.5045	-0.1482	1.5050
7.5182	-0.1484	1.7406
8.5704	-0.1506	1.9864
9.4962	-0.1508	2.2062
10.4962	-0.1511	2.4431
11.4990	-0.1516	2.6809
12.4990	-0.1549	2.9229
13.4990	-0.1579	3.1683
14.4935	-0.1597	3.4141

Theta = 0 is defined as the angle for which voltage = 0 in the table above.
To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 21.0 deg. C
Y-Axis calibration temperature = 21.0 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.259 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.280

Y-Axis scale factor = 4.284 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.241

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.3133	-0.0130	-0.0091	0.0005	-0.0002
Y-Axis	0.0000	4.3338	0.0065	-0.0084	0.0003	-0.0002

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3508
Date 10/16/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-8.9828	-2.1304	-0.0840
-7.9828	-1.8885	-0.0828
-6.9856	-1.6469	-0.0809
-5.9856	-1.4063	-0.0786
-4.9801	-1.1674	-0.0749
-3.9773	-0.9323	-0.0690
-2.9856	-0.6974	-0.0668
-1.9828	-0.4611	-0.0657
-0.9828	-0.2278	-0.0655
0.0172	0.0035	-0.0624
1.0144	0.2346	-0.0599
2.0172	0.4677	-0.0587
3.0172	0.6989	-0.0568
4.0172	0.9291	-0.0572
5.0172	1.1605	-0.0580
6.0144	1.3947	-0.0590
7.0199	1.6305	-0.0576
8.0199	1.8658	-0.0553
9.0144	2.0976	-0.0533
10.0281	2.3385	-0.0507
11.0034	2.5740	-0.0490
12.0254	2.8246	-0.0494
13.0089	3.0680	-0.0506
14.0199	3.3165	-0.0499
15.0556	3.5727	-0.0478

Y-Axis Calibration

Theta	X-Output	Y-Output
-9.9070	0.2669	-2.3410
-8.9097	0.2642	-2.0992
-7.9097	0.2634	-1.8600
-6.9097	0.2586	-1.6179
-5.9015	0.2557	-1.3776
-4.9042	0.2527	-1.1419
-3.9070	0.2479	-0.9057
-2.9070	0.2430	-0.6732
-1.9070	0.2401	-0.4420
-0.9097	0.2357	-0.2110
0.0875	0.2322	0.0209
1.0958	0.2287	0.2514
2.0958	0.2254	0.4827
3.0930	0.2191	0.7130
4.0930	0.2168	0.9437
5.0930	0.2124	1.1740
6.0958	0.2086	1.4055
7.0985	0.2052	1.6423
8.1260	0.2029	1.8849
9.1452	0.1989	2.1268
10.0848	0.1960	2.3515
11.0958	0.1944	2.5944
12.0903	0.1903	2.8380
13.0958	0.1880	3.0846
14.0875	0.1861	3.3275

Theta = 0 is defined as the angle for which voltage = 0 in the table above. To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 20.9 deg. C
Y-Axis calibration temperature = 20.5 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.249 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.325

Y-Axis scale factor = 4.266 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.335

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.3100	0.0260	-0.0142	-0.0018	0.0004
Y-Axis	0.0000	4.3391	0.0209	-0.0180	-0.0016	0.0007

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3510
Date 10/16/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-8.3566	-1.9944	0.1324
-7.3566	-1.7527	0.1379
-6.3594	-1.5119	0.1419
-5.3594	-1.2721	0.1486
-4.3539	-1.0302	0.1528
-3.3511	-0.7892	0.1613
-2.3594	-0.5566	0.1723
-1.3566	-0.3201	0.1778
-0.3566	-0.0857	0.1848
0.6434	0.1521	0.1893
1.6406	0.3859	0.1925
2.6434	0.6204	0.1960
3.6434	0.8540	0.2014
4.6434	1.0887	0.2062
5.6434	1.3242	0.2150
6.6406	1.5620	0.2200
7.6461	1.8016	0.2253
8.6461	2.0425	0.2299
9.6406	2.2835	0.2364
10.6544	2.5314	0.2419
11.6296	2.7733	0.2441
12.6516	3.0257	0.2493
13.6351	3.2733	0.2509
14.6461	3.5301	0.2543
15.6818	3.7932	0.2619

Y-Axis Calibration

Theta	X-Output	Y-Output
-8.7627	0.4410	-2.0951
-7.7655	0.4337	-1.8518
-6.7655	0.4285	-1.6107
-5.7655	0.4238	-1.3677
-4.7572	0.4185	-1.1269
-3.7600	0.4117	-0.8882
-2.7627	0.4056	-0.6510
-1.7627	0.3976	-0.4136
-0.7627	0.3924	-0.1779
0.2345	0.3859	0.0555
1.2318	0.3784	0.2881
2.2400	0.3689	0.5238
3.2400	0.3618	0.7579
4.2373	0.3550	0.9922
5.2373	0.3501	1.2280
6.2373	0.3458	1.4643
7.2400	0.3401	1.7023
8.2428	0.3333	1.9415
9.2702	0.3293	2.1899
10.2895	0.3227	2.4372
11.2290	0.3156	2.6662
12.2400	0.3107	2.9145
13.2345	0.3053	3.1621
14.2400	0.2979	3.4142
15.2318	0.2900	3.6643

Theta = 0 is defined as the angle for which voltage = 0 in the table above.
To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 20.9 deg. C
Y-Axis calibration temperature = 20.6 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.185 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.414

Y-Axis scale factor = 4.197 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.340

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.2586	0.0210	-0.0139	-0.0024	0.0006
Y-Axis	-0.0000	4.2628	0.0210	-0.0141	-0.0017	0.0005

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3511
Date 10/16/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-10.7194	-2.6337	0.1011
-9.7194	-2.3826	0.1049
-8.7222	-2.1328	0.1065
-7.7222	-1.8831	0.1085
-6.7167	-1.6358	0.1080
-5.7139	-1.3901	0.1077
-4.7222	-1.1483	0.1093
-3.7194	-0.9035	0.1132
-2.7194	-0.6596	0.1159
-1.7194	-0.4178	0.1172
-0.7249	-0.1739	0.1226
0.2806	0.0687	0.1249
1.2833	0.3107	0.1274
2.2806	0.5538	0.1272
3.2806	0.8000	0.1265
4.2778	1.0465	0.1249
5.2833	1.2948	0.1274
6.2833	1.5456	0.1286
7.2778	1.7940	0.1327
8.2915	2.0508	0.1342
9.2668	2.2970	0.1320
10.2888	2.5577	0.1313
11.2723	2.8136	0.1323
12.2833	3.0796	0.1349
13.3190	3.3548	0.1356

Y-Axis Calibration

Theta	X-Output	Y-Output
-9.1569	-0.1590	-2.2572
-8.1597	-0.1625	-2.0073
-7.1597	-0.1656	-1.7583
-6.1597	-0.1644	-1.5083
-5.1514	-0.1656	-1.2593
-4.1542	-0.1689	-1.0146
-3.1569	-0.1749	-0.7701
-2.1569	-0.1793	-0.5240
-1.1569	-0.1807	-0.2801
-0.1597	-0.1809	-0.0388
0.8376	-0.1797	0.2049
1.8458	-0.1827	0.4472
2.8458	-0.1860	0.6924
3.8431	-0.1889	0.9345
4.8431	-0.1893	1.1755
5.8431	-0.1919	1.4228
6.8458	-0.1958	1.6696
7.8486	-0.1985	1.9223
8.8761	-0.1996	2.1825
9.8953	-0.2019	2.4387
10.8348	-0.2076	2.6757
11.8458	-0.2133	2.9335
12.8403	-0.2169	3.1933
13.8458	-0.2196	3.4561
14.8376	-0.2220	3.7209

Theta = 0 is defined as the angle for which voltage = 0 in the table above. To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 20.9 deg. C
Y-Axis calibration temperature = 21.1 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.045 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.382

Y-Axis scale factor = 4.044 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.429

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.1129	-0.0136	-0.0101	0.0005	-0.0000
Y-Axis	-0.0000	4.1174	0.0081	-0.0122	-0.0010	0.0003

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3513
Date 10/16/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-10.4582	-2.6421	0.1099
-9.4554	-2.3801	0.1157
-8.4582	-2.1242	0.1220
-7.4582	-1.8727	0.1263
-6.4527	-1.6172	0.1258
-5.4500	-1.3643	0.1240
-4.4582	-1.1090	0.1256
-3.4554	-0.8548	0.1226
-2.4554	-0.6082	0.1169
-1.4554	-0.3588	0.1143
-0.4609	-0.1113	0.1119
0.5446	0.1329	0.1085
1.5473	0.3794	0.1167
2.5446	0.6262	0.1239
3.5446	0.8738	0.1300
4.5418	1.1264	0.1287
5.5473	1.3813	0.1237
6.5473	1.6317	0.1227
7.5418	1.8823	0.1280
8.5583	2.1385	0.1359
9.5308	2.3875	0.1419
10.5528	2.6506	0.1481
11.5363	2.9100	0.1498
12.5473	3.1797	0.1492
13.5830	3.4568	0.1496

Y-Axis Calibration

Theta	X-Output	Y-Output
-9.1984	-0.1011	-2.3208
-8.2011	-0.1005	-2.0624
-7.2011	-0.0986	-1.8041
-6.2011	-0.0975	-1.5505
-5.1929	-0.0963	-1.2943
-4.1956	-0.0980	-1.0383
-3.1984	-0.0995	-0.7873
-2.1984	-0.1034	-0.5426
-1.1984	-0.1060	-0.3002
-0.2011	-0.1059	-0.0540
0.7961	-0.1113	0.1934
1.8044	-0.1202	0.4446
2.8044	-0.1232	0.6997
3.8016	-0.1272	0.9549
4.8016	-0.1320	1.2081
5.8016	-0.1345	1.4618
6.8044	-0.1379	1.7165
7.8071	-0.1411	1.9689
8.8346	-0.1422	2.2260
9.8538	-0.1430	2.4818
10.7934	-0.1446	2.7231
11.8044	-0.1445	2.9882
12.7989	-0.1469	3.2512
13.8044	-0.1458	3.5126
14.7961	-0.1496	3.7732

| Theta = 0 is defined as the angle for which voltage = 0 in the table above.
| To measure and remove bias (zero offset) in your tiltmeter, ask for our
| technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 20.9 deg. C
Y-Axis calibration temperature = 20.7 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 3.974 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.293

Y-Axis scale factor = 3.960 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.276

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.0380	0.0100	-0.0118	-0.0009	0.0003
Y-Axis	0.0000	4.0105	-0.0196	-0.0051	0.0039	-0.0008

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3514
Date 10/16/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-10.4690	-2.5464	-0.2515
-9.4690	-2.3003	-0.2496
-8.4662	-2.0552	-0.2444
-7.4745	-1.8095	-0.2349
-6.4635	-1.5619	-0.2262
-5.4607	-1.3156	-0.2183
-4.4690	-1.0705	-0.2086
-3.4635	-0.8284	-0.1953
-2.4690	-0.5872	-0.1849
-1.4662	-0.3460	-0.1813
-0.4690	-0.1125	-0.1759
0.5338	0.1257	-0.1717
1.5338	0.3635	-0.1668
2.5365	0.5990	-0.1645
3.5310	0.8334	-0.1595
4.5338	1.0760	-0.1514
5.5365	1.3109	-0.1470
6.5365	1.5498	-0.1412
7.5365	1.7923	-0.1351
8.5283	2.0389	-0.1247
9.5310	2.2883	-0.1105
10.5365	2.5414	-0.1002
11.5338	2.7859	-0.0968
12.5365	3.0335	-0.0957
13.5338	3.2908	-0.0919

Y-Axis Calibration

Theta	X-Output	Y-Output
-10.4022	-0.0601	-2.5068
-9.3995	-0.0663	-2.2608
-8.4050	-0.0741	-2.0142
-7.4022	-0.0806	-1.7708
-6.3940	-0.0839	-1.5279
-5.3940	-0.0879	-1.2873
-4.4022	-0.0928	-1.0495
-3.3995	-0.0938	-0.8070
-2.3995	-0.0999	-0.5672
-1.3995	-0.1079	-0.3301
-0.4050	-0.1167	-0.0960
0.6033	-0.1252	0.1430
1.6005	-0.1338	0.3804
2.6033	-0.1418	0.6155
3.5978	-0.1489	0.8494
4.6005	-0.1544	1.0905
5.6033	-0.1627	1.3322
6.6527	-0.1730	1.5838
7.5511	-0.1815	1.8009
8.6747	-0.1873	2.0766
9.5868	-0.1921	2.3044
10.6060	-0.1991	2.5601
11.5895	-0.2078	2.8063
12.6170	-0.2157	3.0653
13.5950	-0.2201	3.3133

Theta = 0 is defined as the angle for which voltage = 0 in the table above. To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 21.1 deg. C
Y-Axis calibration temperature = 20.8 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.142 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.377

Y-Axis scale factor = 4.153 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.349

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.2243	0.0303	-0.0234	-0.0035	0.0014
Y-Axis	-0.0000	4.2313	0.0085	-0.0174	-0.0014	0.0007

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3515
Date 10/16/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-9.2638	-2.1930	-0.2527
-8.2638	-1.9546	-0.2461
-7.2611	-1.7139	-0.2407
-6.2693	-1.4751	-0.2354
-5.2583	-1.2372	-0.2323
-4.2556	-1.0061	-0.2288
-3.2638	-0.7720	-0.2228
-2.2583	-0.5284	-0.2141
-1.2638	-0.2916	-0.2084
-0.2611	-0.0561	-0.2074
0.7362	0.1765	-0.2026
1.7389	0.4055	-0.1950
2.7389	0.6355	-0.1899
3.7417	0.8686	-0.1900
4.7362	1.1029	-0.1882
5.7389	1.3411	-0.1840
6.7417	1.5805	-0.1779
7.7417	1.8192	-0.1711
8.7417	2.0582	-0.1672
9.7334	2.2955	-0.1625
10.7362	2.5392	-0.1574
11.7417	2.7868	-0.1520
12.7389	3.0371	-0.1476
13.7417	3.2906	-0.1451
14.7389	3.5467	-0.1408

Y-Axis Calibration

Theta	X-Output	Y-Output
-10.5398	0.2090	-2.4909
-9.5370	0.2031	-2.2450
-8.5425	0.1997	-2.0038
-7.5398	0.1966	-1.7685
-6.5316	0.1907	-1.5336
-5.5316	0.1836	-1.2966
-4.5398	0.1812	-1.0579
-3.5370	0.1797	-0.8208
-2.5370	0.1791	-0.5852
-1.5370	0.1774	-0.3565
-0.5425	0.1752	-0.1280
0.4657	0.1687	0.1046
1.4630	0.1621	0.3382
2.4657	0.1556	0.5722
3.4602	0.1486	0.8083
4.4630	0.1462	1.0482
5.4657	0.1434	1.2853
6.5151	0.1394	1.5335
7.4135	0.1336	1.7473
8.5371	0.1275	2.0175
9.4492	0.1210	2.2379
10.4684	0.1163	2.4850
11.4520	0.1178	2.7307
12.4794	0.1155	2.9911
13.4575	0.1148	3.2394

Theta = 0 is defined as the angle for which voltage = 0 in the table above. To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 21.1 deg. C
Y-Axis calibration temperature = 20.8 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.214 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.375

Y-Axis scale factor = 4.222 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.331

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.2799	0.0172	-0.0116	-0.0026	0.0005
Y-Axis	-0.0000	4.2876	-0.0075	-0.0099	0.0004	-0.0002

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3517
Date 10/16/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-8.7713	-2.0770	-0.1913
-7.7686	-1.8366	-0.1860
-6.7713	-1.5956	-0.1843
-5.7713	-1.3594	-0.1796
-4.7658	-1.1188	-0.1760
-3.7631	-0.8813	-0.1712
-2.7713	-0.6488	-0.1661
-1.7686	-0.4145	-0.1608
-0.7686	-0.1780	-0.1556
0.2314	0.0566	-0.1516
1.2287	0.2871	-0.1467
2.2287	0.5196	-0.1420
3.2342	0.7539	-0.1391
4.2314	0.9853	-0.1353
5.2314	1.2218	-0.1336
6.2287	1.4587	-0.1347
7.2342	1.6971	-0.1337
8.2342	1.9344	-0.1321
9.2451	2.1779	-0.1301
10.2259	2.4153	-0.1246
11.2232	2.6588	-0.1173
12.2479	2.9049	-0.1127
13.2122	3.1435	-0.1115
14.2369	3.3989	-0.1102
15.2287	3.6505	-0.1077

Y-Axis Calibration

Theta	X-Output	Y-Output
-10.2950	0.3174	-2.4287
-9.2977	0.3155	-2.1866
-8.2977	0.3133	-1.9496
-7.2977	0.3098	-1.7110
-6.2895	0.3069	-1.4730
-5.2922	0.3037	-1.2366
-4.2977	0.2965	-1.0007
-3.2950	0.2928	-0.7659
-2.2950	0.2903	-0.5325
-1.2922	0.2876	-0.2995
-0.3032	0.2874	-0.0704
0.7105	0.2832	0.1639
1.7270	0.2815	0.3987
2.7215	0.2807	0.6339
3.6721	0.2767	0.8563
4.6995	0.2728	1.0980
5.7188	0.2678	1.3407
6.7792	0.2664	1.5955
7.7078	0.2663	1.8170
8.7078	0.2639	2.0599
9.6995	0.2596	2.3015
10.7105	0.2562	2.5552
11.7023	0.2539	2.8048
12.7105	0.2542	3.0597
13.6913	0.2515	3.3090

Theta = 0 is defined as the angle for which voltage = 0 in the table above. To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 21.2 deg. C
Y-Axis calibration temperature = 20.9 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.219 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.326

Y-Axis scale factor = 4.215 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.445

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	0.0000	4.2841	0.0097	-0.0122	-0.0006	0.0003
Y-Axis	-0.0000	4.3036	-0.0021	-0.0174	-0.0010	0.0006

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3518
Date 10/16/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-9.3465	-2.2261	-0.2885
-8.3438	-1.9828	-0.2856
-7.3465	-1.7439	-0.2824
-6.3465	-1.5021	-0.2790
-5.3410	-1.2628	-0.2774
-4.3383	-1.0222	-0.2743
-3.3465	-0.7857	-0.2711
-2.3438	-0.5484	-0.2691
-1.3438	-0.3172	-0.2677
-0.3438	-0.0832	-0.2642
0.6535	0.1513	-0.2604
1.6535	0.3866	-0.2574
2.6590	0.6269	-0.2534
3.6562	0.8683	-0.2521
4.6562	1.1055	-0.2503
5.6535	1.3433	-0.2467
6.6590	1.5830	-0.2456
7.6590	1.8295	-0.2441
8.6699	2.0744	-0.2446
9.6507	2.3166	-0.2439
10.6480	2.5690	-0.2435
11.6727	2.8267	-0.2386
12.6370	3.0706	-0.2363
13.6617	3.3314	-0.2345
14.6535	3.5901	-0.2348

Y-Axis Calibration

Theta	X-Output	Y-Output
-10.8100	0.1849	-2.5832
-9.8127	0.1801	-2.3354
-8.8127	0.1755	-2.0944
-7.8127	0.1731	-1.8536
-6.8045	0.1715	-1.6123
-5.8072	0.1715	-1.3729
-4.8127	0.1705	-1.1353
-3.8100	0.1655	-0.8989
-2.8100	0.1603	-0.6633
-1.8072	0.1565	-0.4256
-0.8182	0.1543	-0.1922
0.1955	0.1539	0.0454
1.2120	0.1545	0.2872
2.2065	0.1515	0.5221
3.1570	0.1481	0.7460
4.1845	0.1441	0.9901
5.2037	0.1406	1.2346
6.2642	0.1368	1.4912
7.1928	0.1359	1.7160
8.1928	0.1339	1.9596
9.1845	0.1316	2.2029
10.1955	0.1279	2.4545
11.1873	0.1222	2.7004
12.1955	0.1173	2.9541
13.1763	0.1126	3.2055

Theta = 0 is defined as the angle for which voltage = 0 in the table above. To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 21.2 deg. C
Y-Axis calibration temperature = 20.9 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.157 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.484

Y-Axis scale factor = 4.174 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.352

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.2460	-0.0076	-0.0138	0.0002	0.0002
Y-Axis	0.0000	4.2403	-0.0089	-0.0117	0.0002	0.0001

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3519
Date 10/16/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-8.5721	-1.9821	0.3266
-7.5694	-1.7461	0.3341
-6.5721	-1.5134	0.3389
-5.5721	-1.2822	0.3434
-4.5666	-1.0511	0.3461
-3.5639	-0.8203	0.3499
-2.5721	-0.5883	0.3559
-1.5694	-0.3598	0.3636
-0.5694	-0.1295	0.3697
0.4306	0.0999	0.3753
1.4279	0.3267	0.3821
2.4279	0.5528	0.3869
3.4334	0.7803	0.3922
4.4306	1.0060	0.3981
5.4306	1.2334	0.4041
6.4279	1.4609	0.4101
7.4334	1.6930	0.4156
8.4334	1.9247	0.4222
9.4444	2.1590	0.4286
10.4252	2.3892	0.4344
11.4224	2.6237	0.4432
12.4471	2.8667	0.4514
13.4114	3.0977	0.4586
14.4361	3.3437	0.4637
15.4279	3.5842	0.4675

Y-Axis Calibration

Theta	X-Output	Y-Output
-8.0158	0.3727	-1.8491
-7.0186	0.3659	-1.6156
-6.0186	0.3593	-1.3832
-5.0186	0.3531	-1.1522
-4.0104	0.3460	-0.9193
-3.0131	0.3398	-0.6886
-2.0186	0.3341	-0.4595
-1.0158	0.3312	-0.2326
-0.0158	0.3269	-0.0036
0.9869	0.3229	0.2249
1.9759	0.3175	0.4509
2.9896	0.3123	0.6802
4.0061	0.3038	0.9124
5.0006	0.2981	1.1384
5.9512	0.2944	1.3536
6.9787	0.2879	1.5929
7.9979	0.2800	1.8276
9.0583	0.2754	2.0719
9.9869	0.2720	2.2872
10.9869	0.2670	2.5232
11.9787	0.2627	2.7575
12.9896	0.2606	2.9959
13.9814	0.2565	3.2351
14.9896	0.2511	3.4798
15.9704	0.2446	3.7222

Theta = 0 is defined as the angle for which voltage = 0 in the table above.
To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 21.2 deg. C
Y-Axis calibration temperature = 20.9 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.338 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.303

Y-Axis scale factor = 4.334 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.317

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	0.0000	4.3873	0.0271	-0.0113	-0.0035	0.0008
Y-Axis	-0.0000	4.3867	0.0149	-0.0092	-0.0009	0.0001

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3520
Date 10/16/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-10.1566	-2.4038	-0.2109
-9.1539	-2.1624	-0.1996
-8.1566	-1.9211	-0.1926
-7.1566	-1.6816	-0.1892
-6.1511	-1.4435	-0.1860
-5.1484	-1.2072	-0.1826
-4.1566	-0.9767	-0.1787
-3.1539	-0.7416	-0.1743
-2.1539	-0.5048	-0.1671
-1.1539	-0.2680	-0.1600
-0.1566	-0.0369	-0.1553
0.8434	0.1974	-0.1515
1.8489	0.4346	-0.1481
2.8461	0.6726	-0.1429
3.8461	0.9052	-0.1391
4.8434	1.1382	-0.1321
5.8489	1.3786	-0.1294
6.8489	1.6189	-0.1279
7.8599	1.8655	-0.1249
8.8406	2.1061	-0.1262
9.8379	2.3515	-0.1224
10.8626	2.6061	-0.1162
11.8269	2.8473	-0.1109
12.8516	3.1072	-0.1070
13.8434	3.3608	-0.1032

Y-Axis Calibration

Theta	X-Output	Y-Output
-10.3366	0.0039	-2.4557
-9.3393	-0.0020	-2.2097
-8.3393	-0.0072	-1.9674
-7.3393	-0.0101	-1.7268
-6.3311	-0.0150	-1.4875
-5.3339	-0.0228	-1.2547
-4.3393	-0.0273	-1.0206
-3.3366	-0.0302	-0.7856
-2.3366	-0.0313	-0.5488
-1.3339	-0.0349	-0.3122
-0.3448	-0.0406	-0.0805
0.6689	-0.0447	0.1564
1.6854	-0.0501	0.3977
2.6799	-0.0520	0.6327
3.6304	-0.0576	0.8577
4.6579	-0.0647	1.0997
5.6771	-0.0705	1.3373
6.7376	-0.0769	1.5892
7.6661	-0.0814	1.8157
8.6661	-0.0835	2.0608
9.6552	-0.0875	2.3082
10.6689	-0.0908	2.5601
11.6607	-0.0936	2.8118
12.6689	-0.0997	3.0700
13.6497	-0.1077	3.3239

Theta = 0 is defined as the angle for which voltage = 0 in the table above.
To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 21.2 deg. C
Y-Axis calibration temperature = 20.9 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

X-Axis scale factor = 4.194 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.458

Y-Axis scale factor = 4.188 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.496

Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

	a	b	c	d	e	f
X-Axis	-0.0000	4.2714	-0.0083	-0.0128	-0.0001	0.0002
Y-Axis	-0.0000	4.2654	-0.0072	-0.0108	0.0000	-0.0002

APPLIED GEOMECHANICS INC.
CALIBRATION CERTIFICATE
906V-H, Serial Number 3523
Date 10/17/2007
Calibrated by: W.Hinz

X-Axis Calibration

Theta	X-Output	Y-Output
-10.0739	-2.4535	0.2504
-9.0739	-2.2023	0.2506
-8.0712	-1.9537	0.2541
-7.0767	-1.7080	0.2563
-6.0657	-1.4625	0.2589
-5.0685	-1.2196	0.2613
-4.0739	-0.9778	0.2624
-3.0685	-0.7363	0.2655
-2.0712	-0.4956	0.2681
-1.0712	-0.2554	0.2742
-0.0739	-0.0172	0.2759
0.9261	0.2211	0.2791
1.9343	0.4641	0.2815
2.9288	0.7032	0.2838
3.9261	0.9412	0.2895
4.9261	1.1861	0.2920
5.9343	1.4306	0.2966
6.9480	1.6814	0.2991
7.9590	1.9302	0.3015
8.9068	2.1676	0.3037
9.9370	2.4232	0.3042
10.9288	2.6730	0.3071
11.9151	2.9248	0.3079
12.9370	3.1870	0.3078
13.9013	3.4358	0.3073

Y-Axis Calibration

Theta	X-Output	Y-Output
-8.4601	0.0013	-2.0627
-7.4629	-0.0018	-1.8147
-6.4629	-0.0058	-1.5687
-5.4629	-0.0092	-1.3234
-4.4546	-0.0114	-1.0757
-3.4601	-0.0162	-0.8312
-2.4574	-0.0168	-0.5903
-1.4629	-0.0157	-0.3526
-0.4601	-0.0174	-0.1095
0.5426	-0.0192	0.1318
1.5344	-0.0218	0.3682
2.5399	-0.0247	0.6087
3.6003	-0.0269	0.8622
4.5206	-0.0313	1.0853
5.5069	-0.0336	1.3243
6.5399	-0.0361	1.5781
7.5454	-0.0388	1.8220
8.6250	-0.0406	2.0888
9.5371	-0.0407	2.3113
10.5426	-0.0430	2.5590
11.5316	-0.0456	2.8067
12.5426	-0.0468	3.0627
13.5371	-0.0502	3.3152
14.5454	-0.0548	3.5731
15.5261	-0.0593	3.8273

Theta = 0 is defined as the angle for which voltage = 0 in the table above. To measure and remove bias (zero offset) in your tiltmeter, ask for our technical note: "Removing Tiltmeter Bias."

Theta is reported in: Degrees of Arc
X and Y outputs are reported in Volts.
X-Axis calibration temperature = 20.7 deg. C
Y-Axis calibration temperature = 20.5 deg. C

Scale Factors are determined by linear regression of all data points for each axis of calibration.

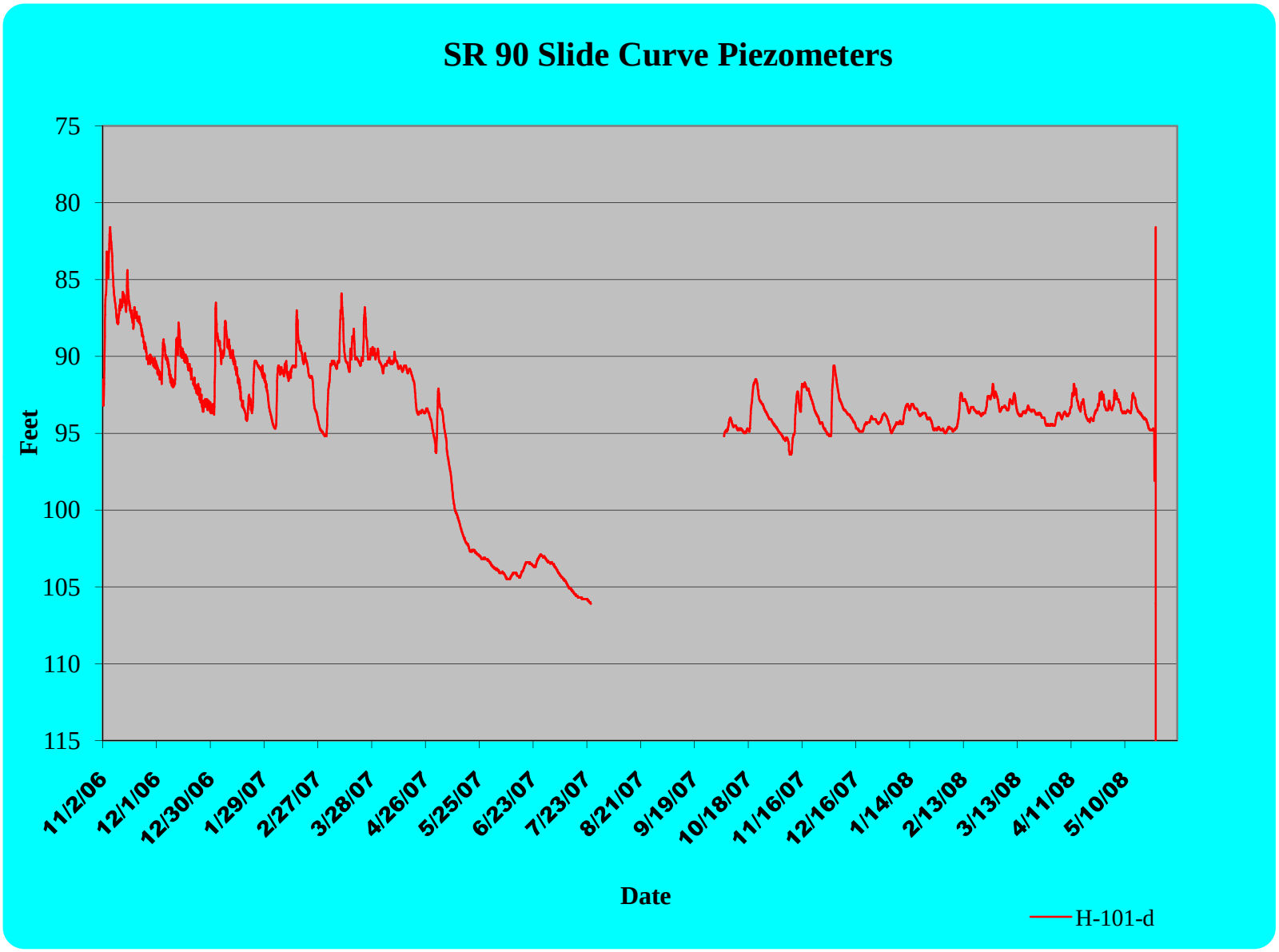
X-Axis scale factor = 4.101 Arc Degrees/V
Maximum nonlinearity (% of full span), X-axis = 0.369

Y-Axis scale factor = 4.100 Arc Degrees/V
Maximum nonlinearity (% of full span), Y-axis = 0.318

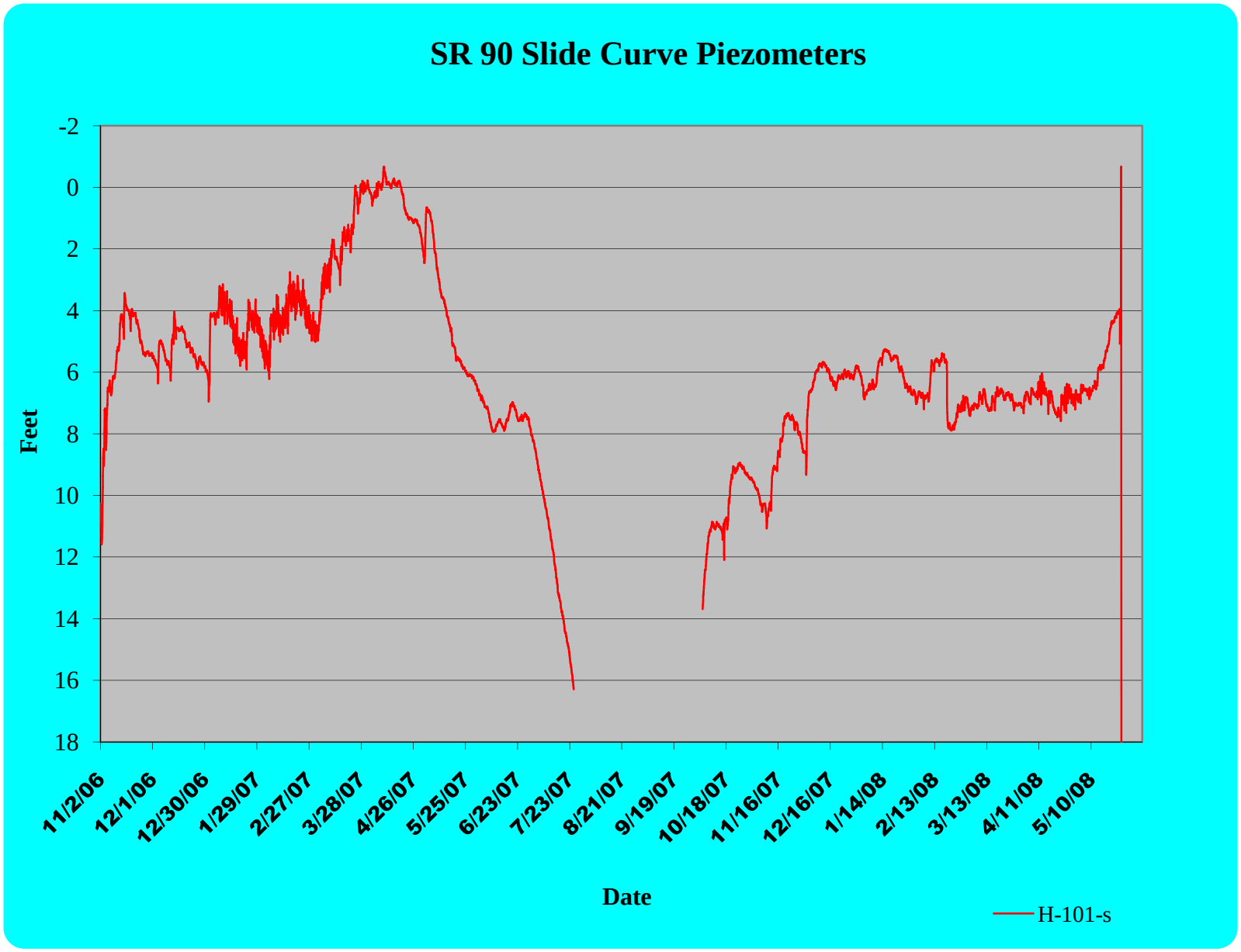
Calibration curves fit a polynomial of form:
Theta = a + bV + cV**2 + dV**3 + eV**4 + fV**5 where V = X or Y output

POLYNOMIAL FIT COEFFICIENTS

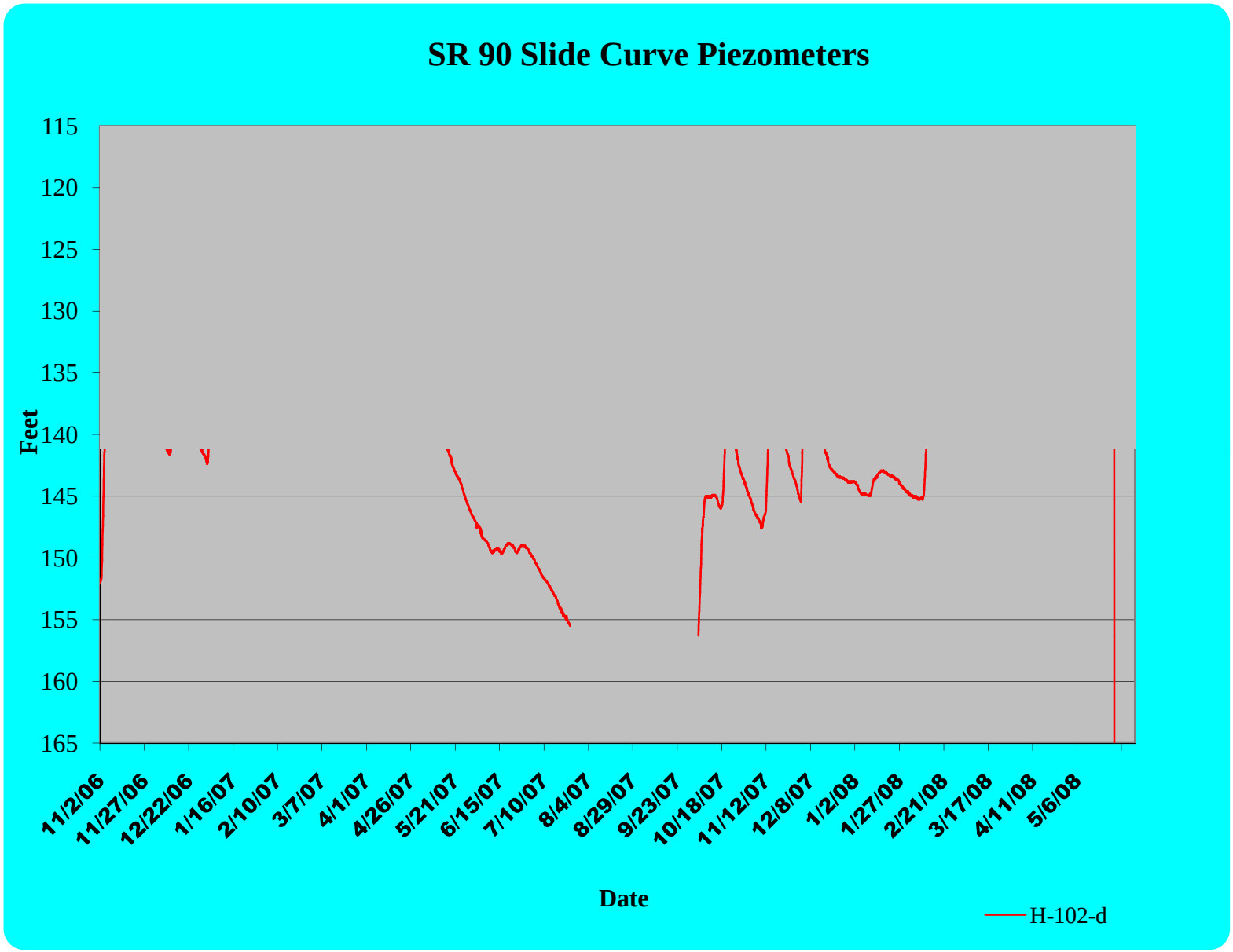
	a	b	c	d	e	f
X-Axis	0.0000	4.1753	-0.0027	-0.0135	0.0002	0.0002
Y-Axis	-0.0000	4.1640	0.0080	-0.0112	0.0002	0.0001



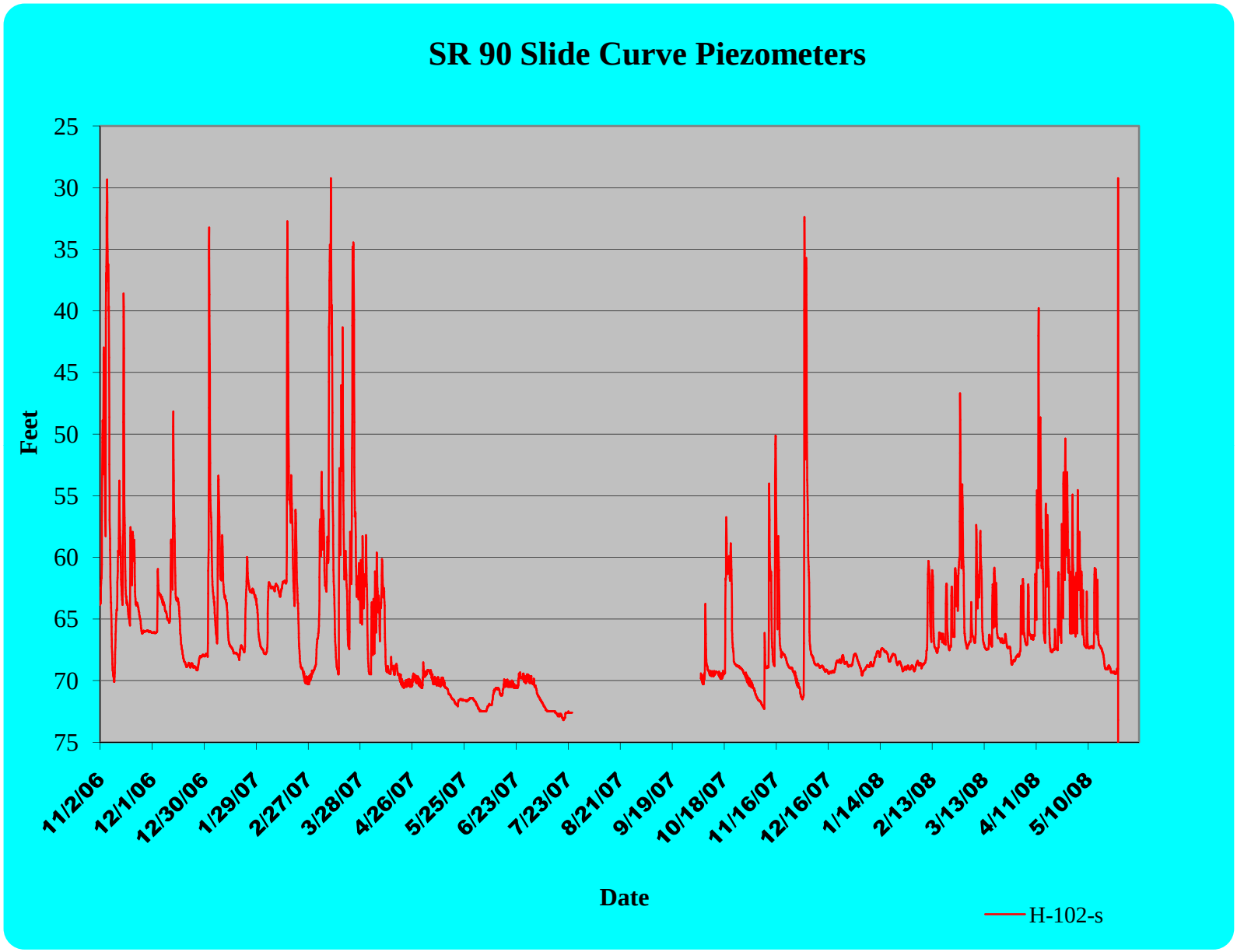
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



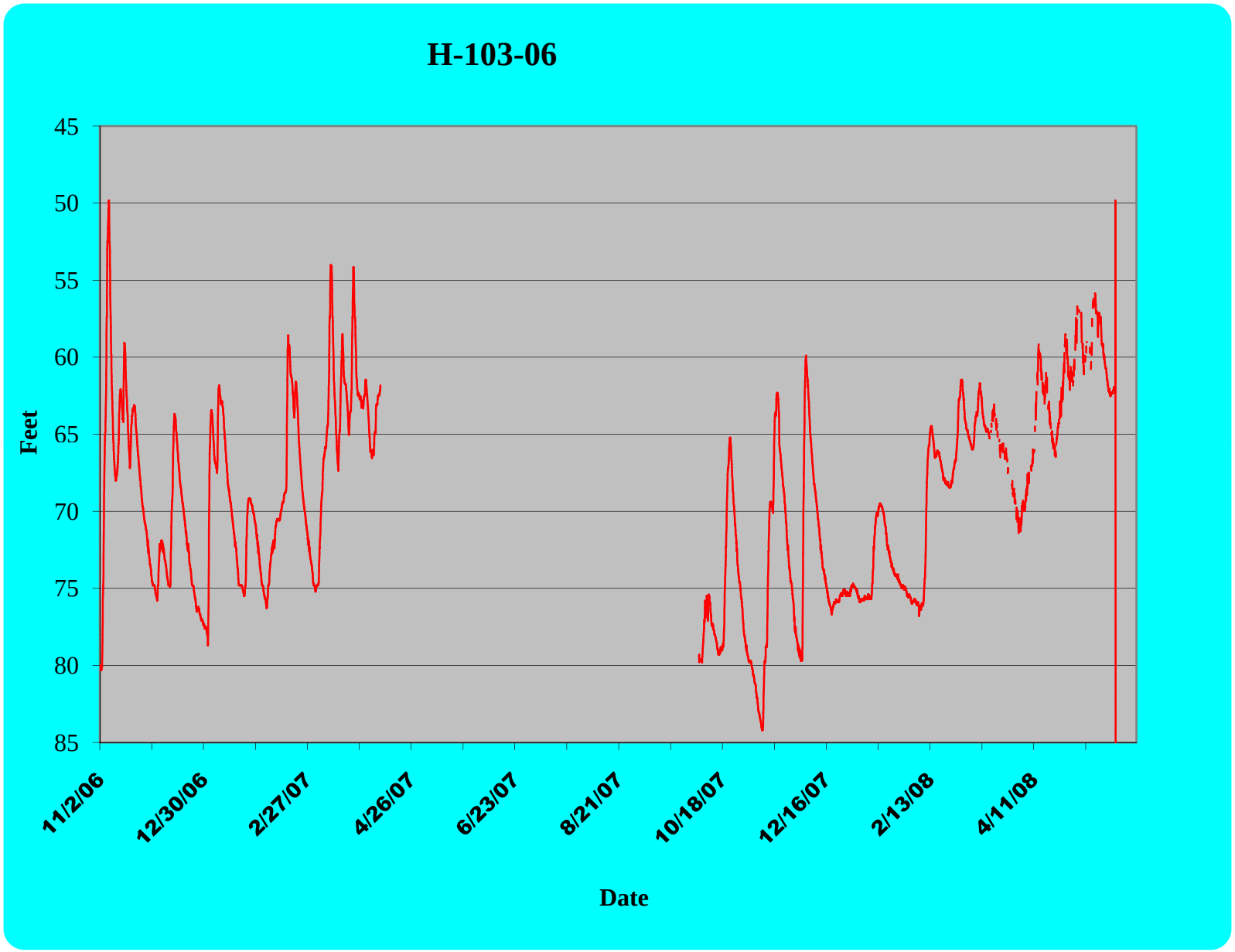
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



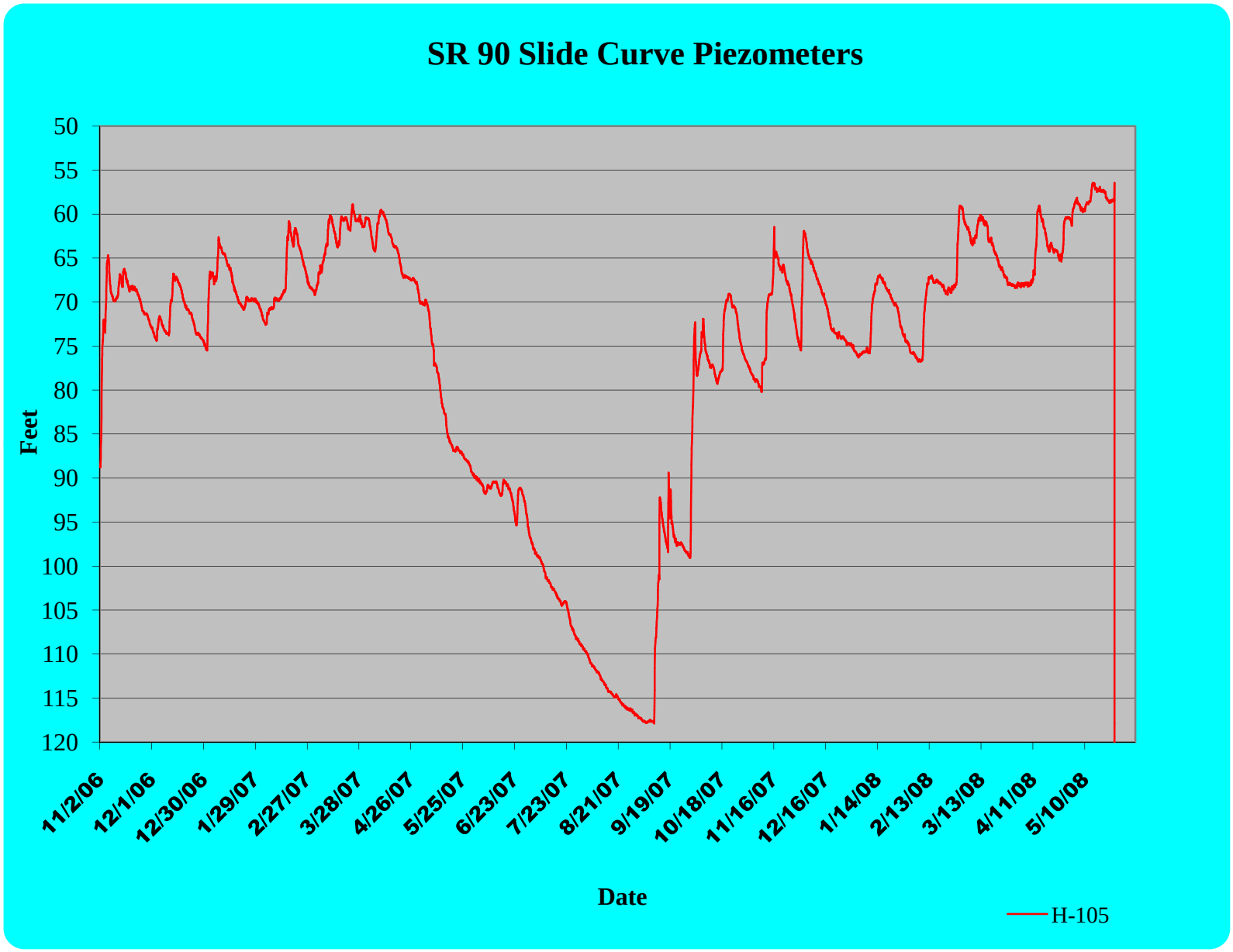
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



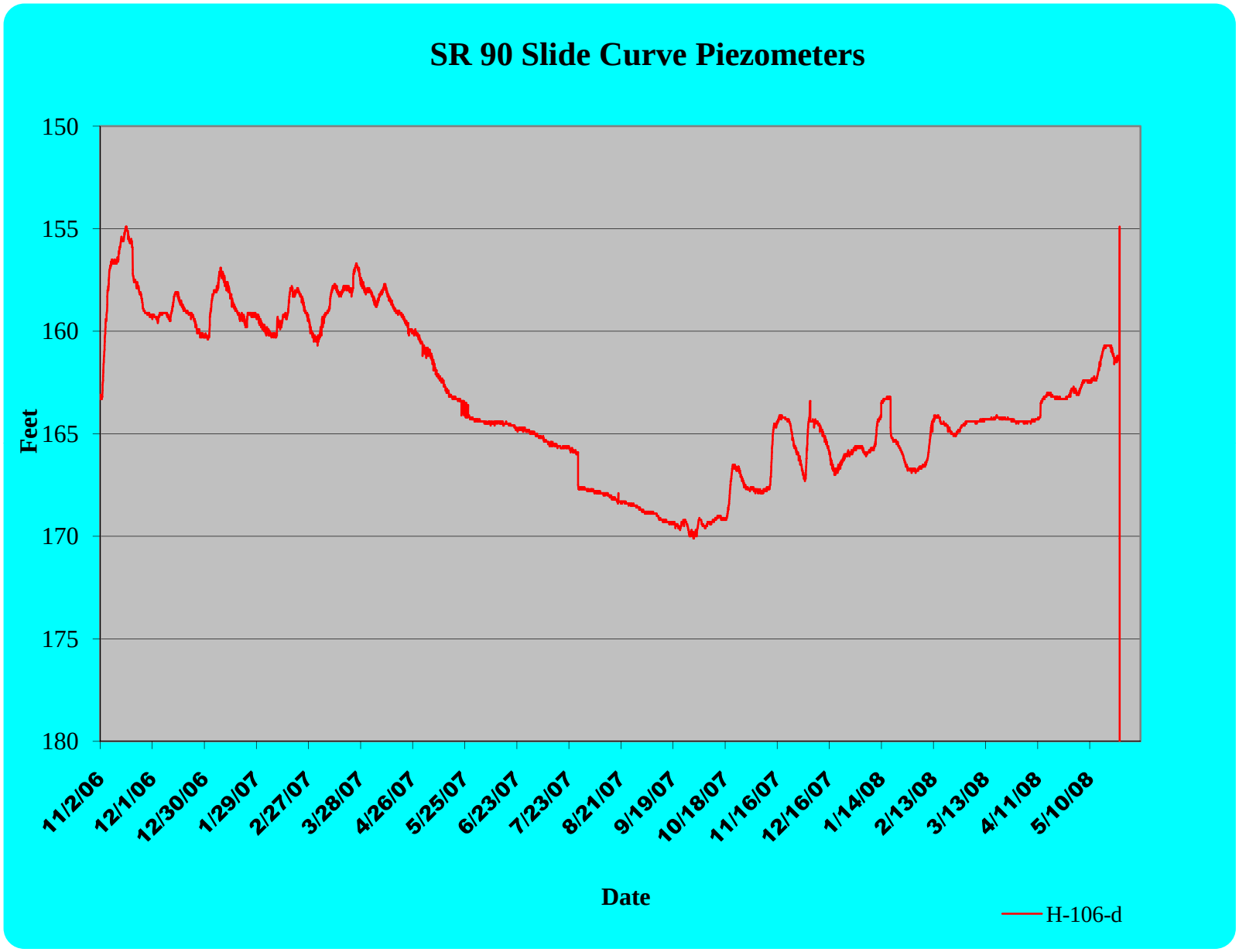
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



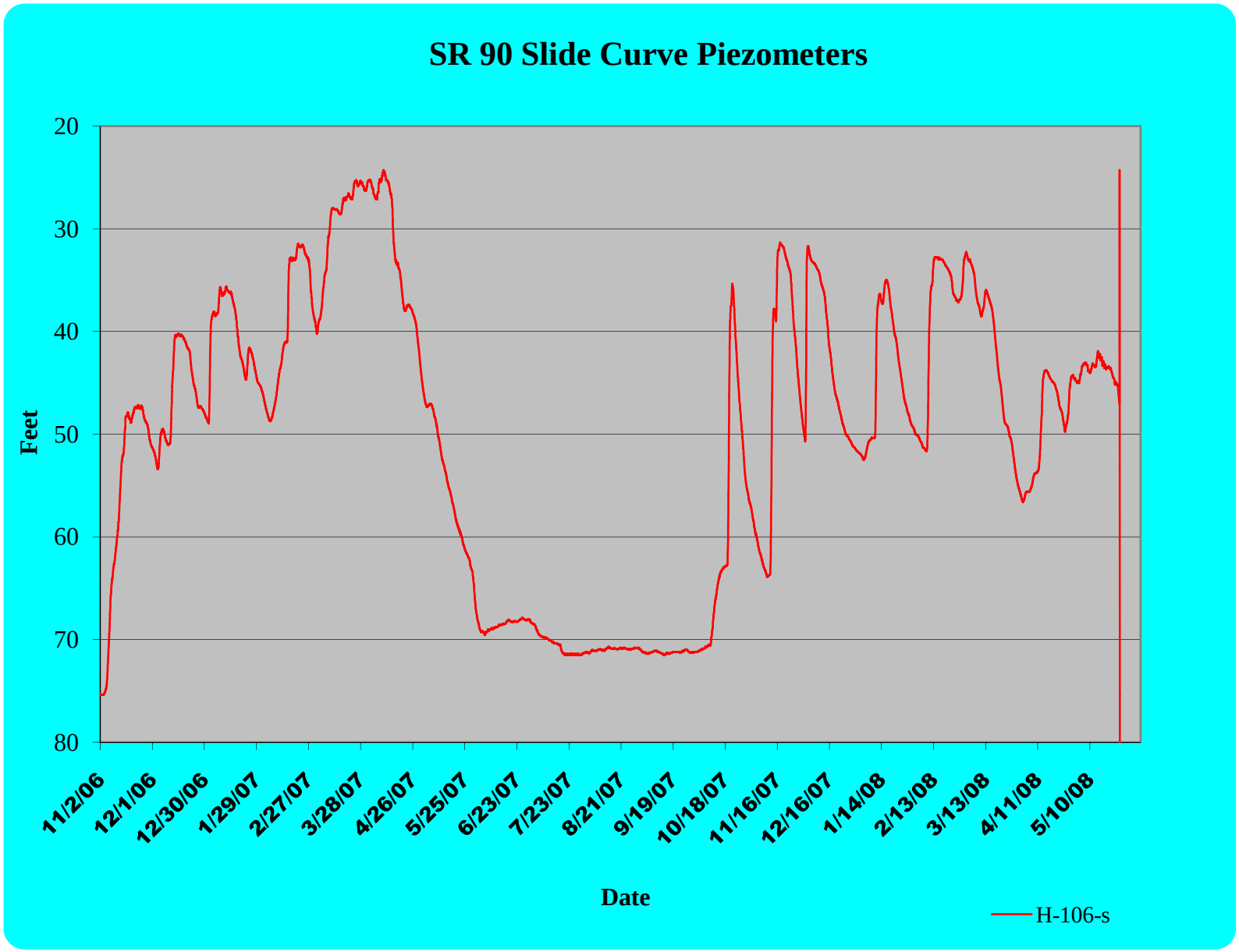
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



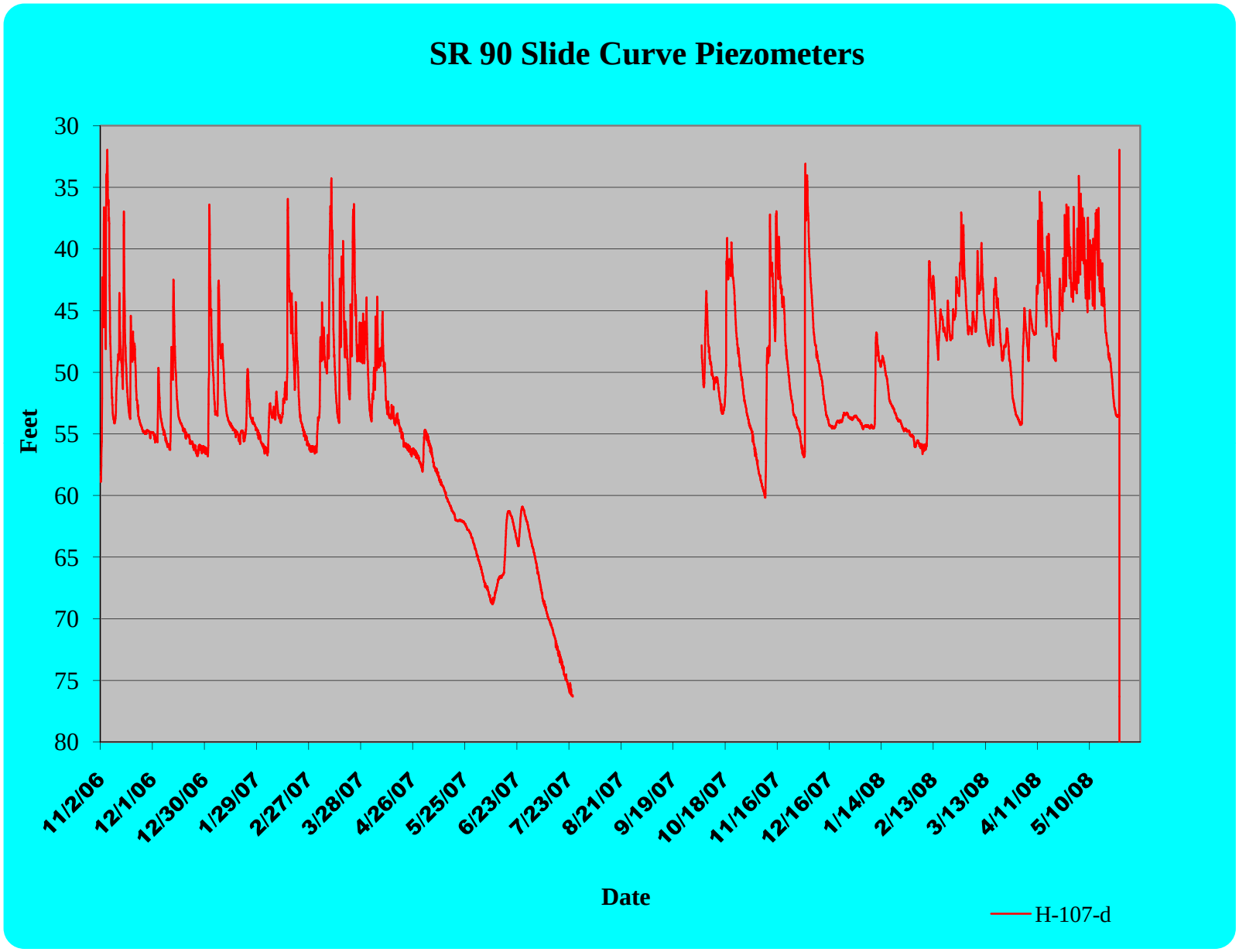
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



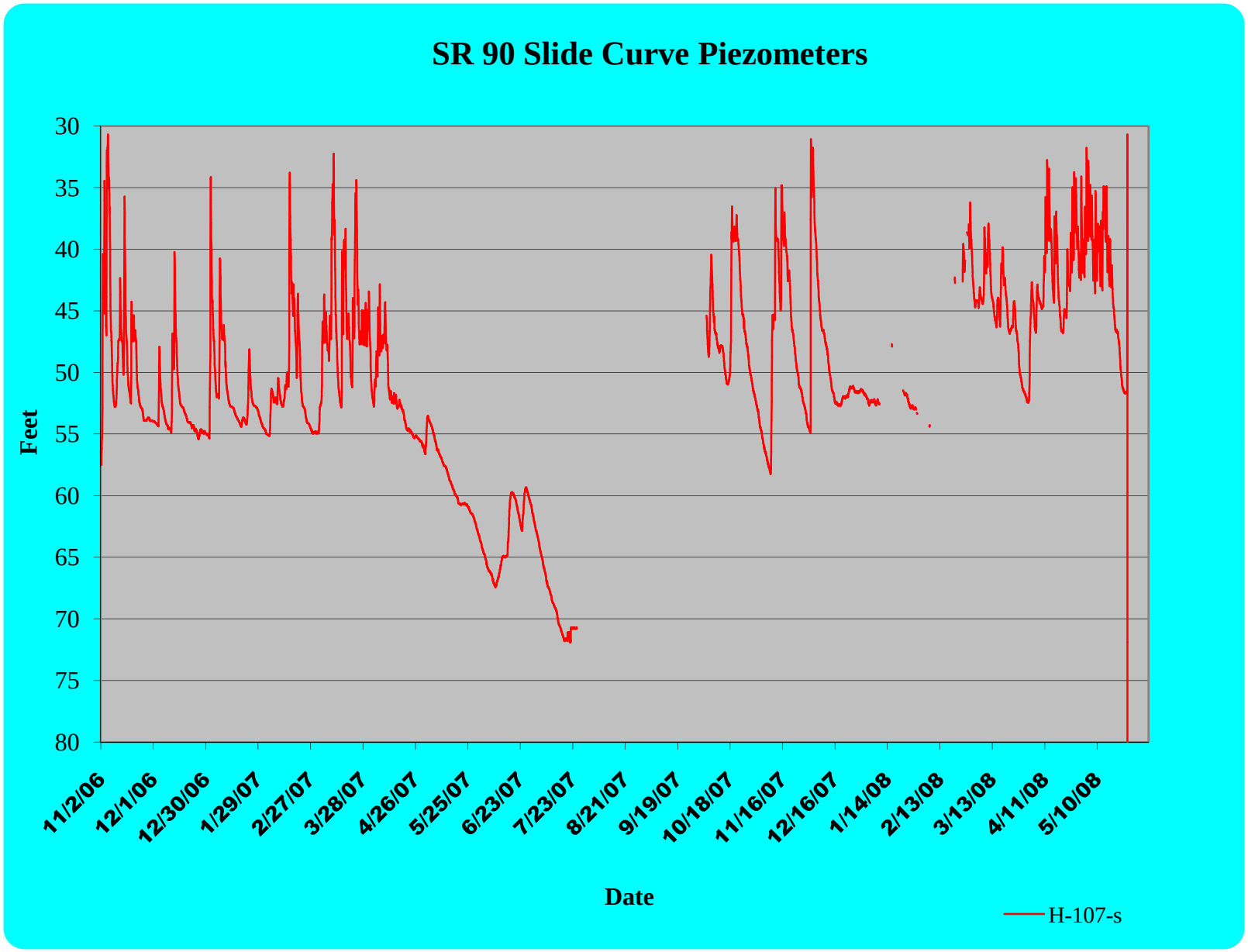
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



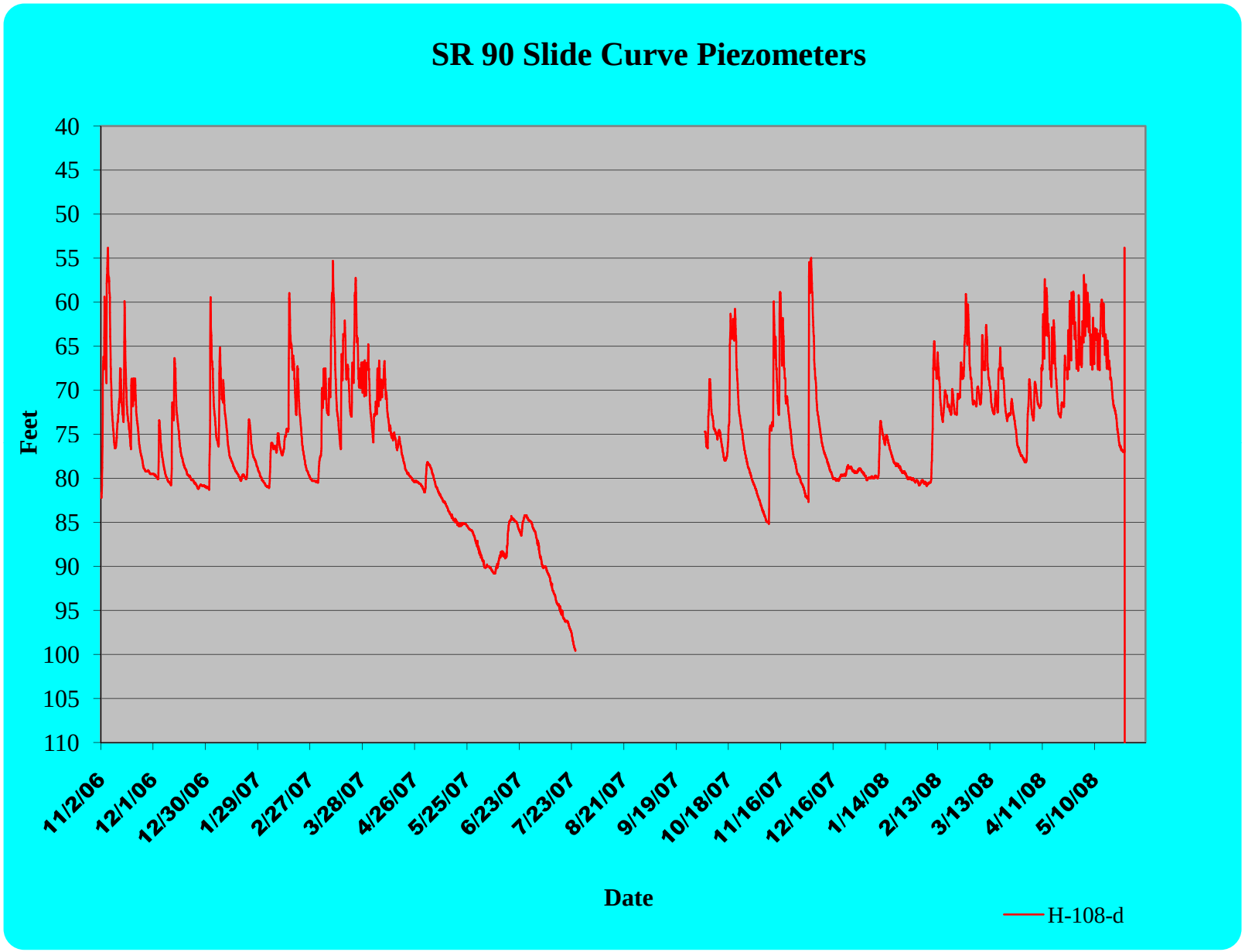
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



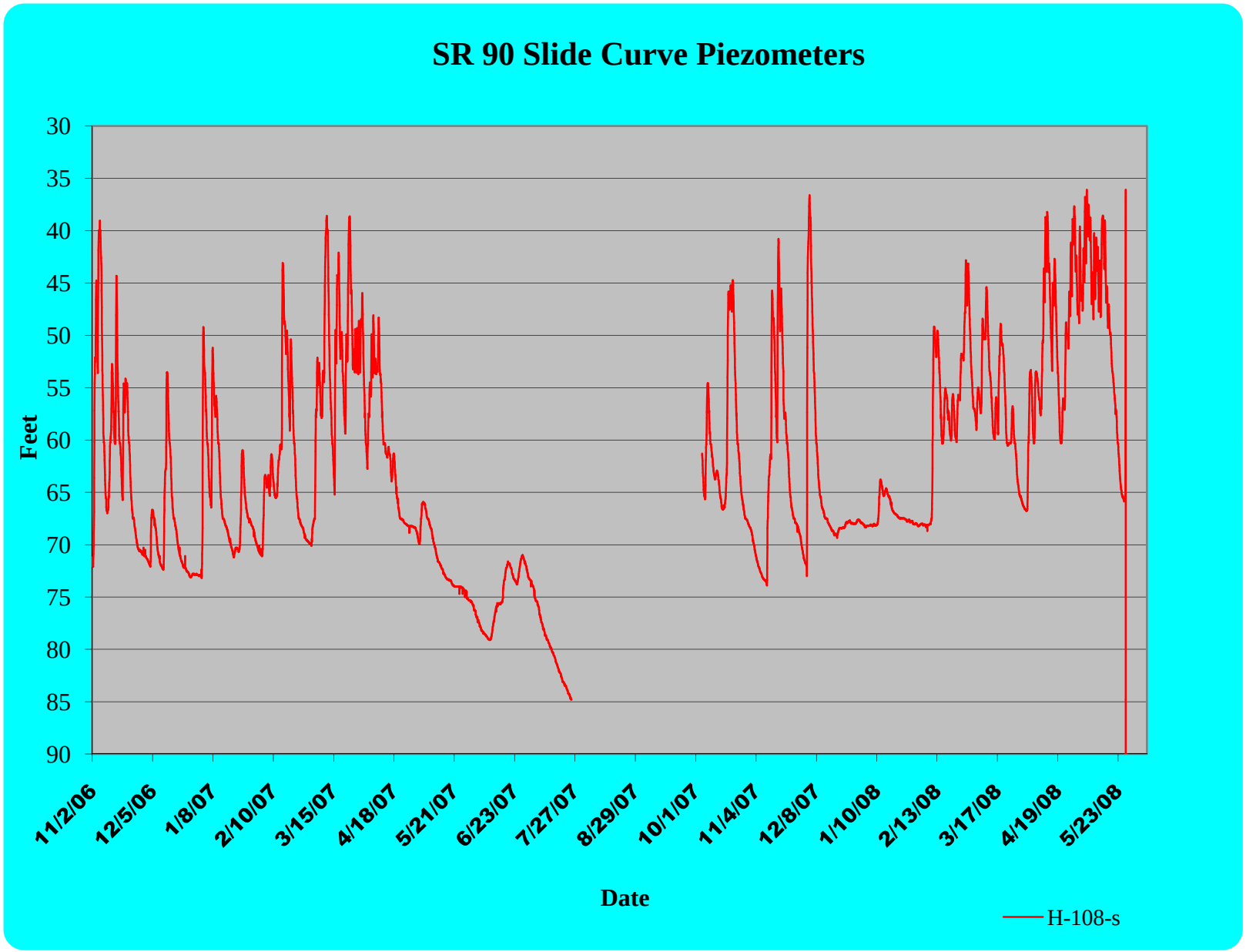
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



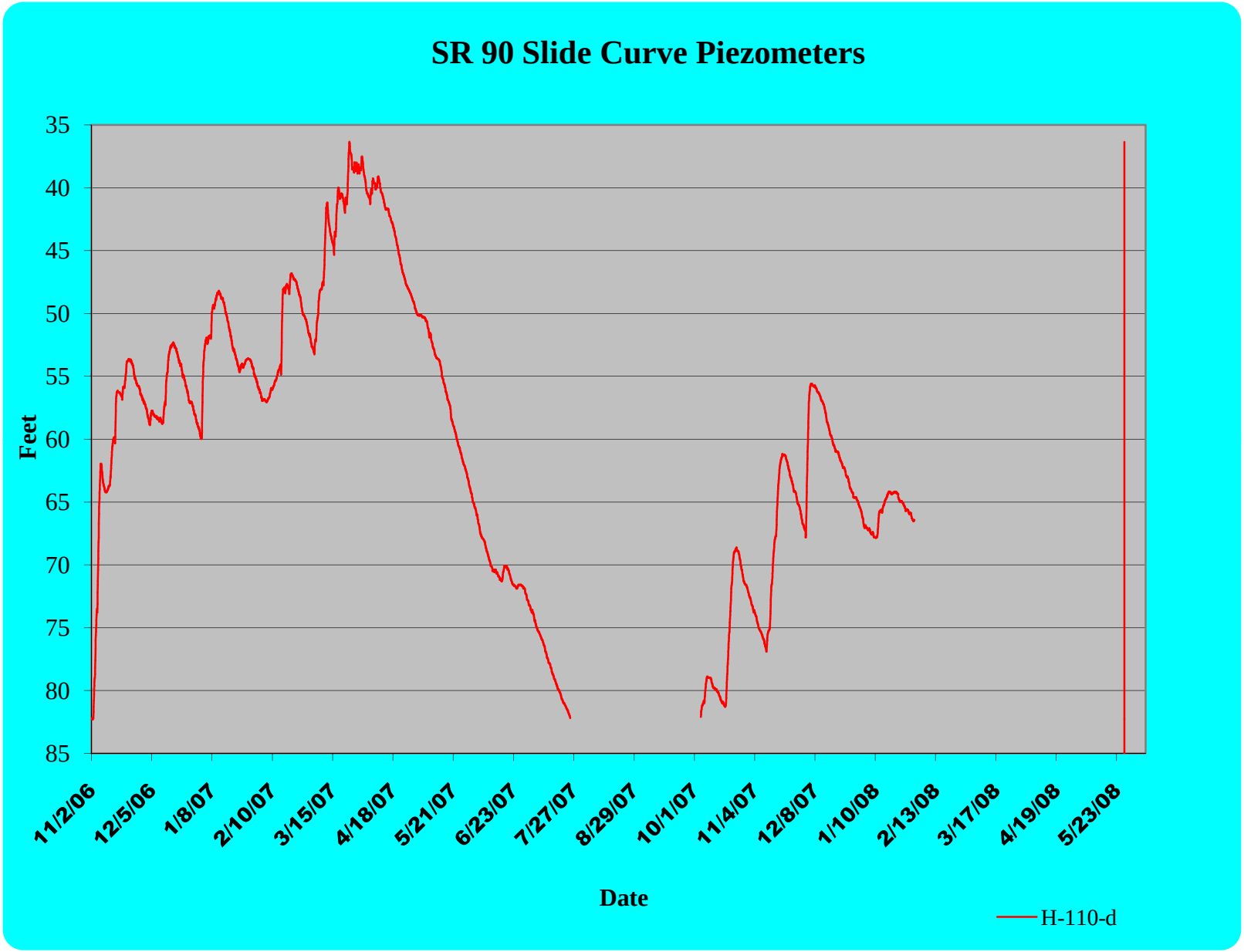
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



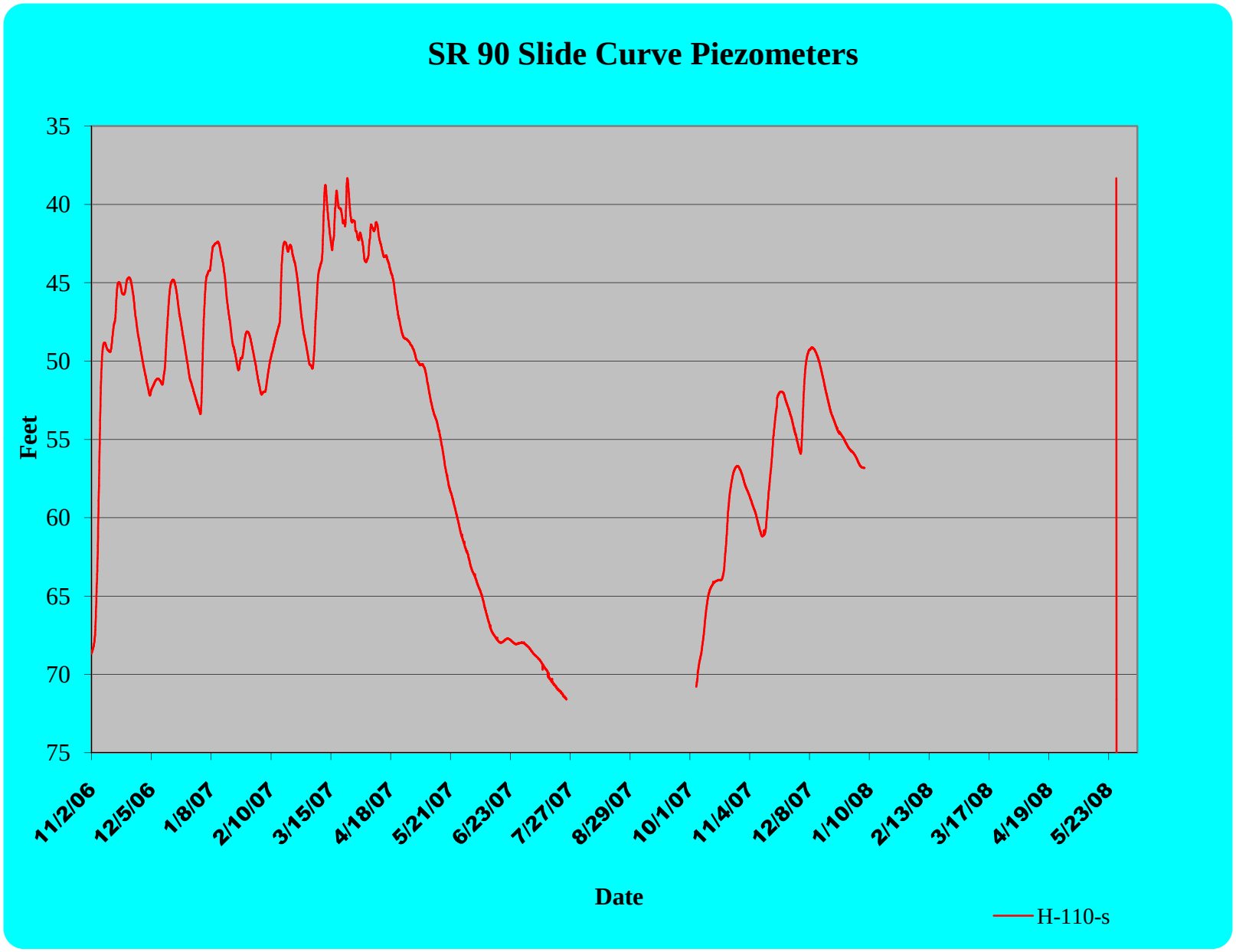
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



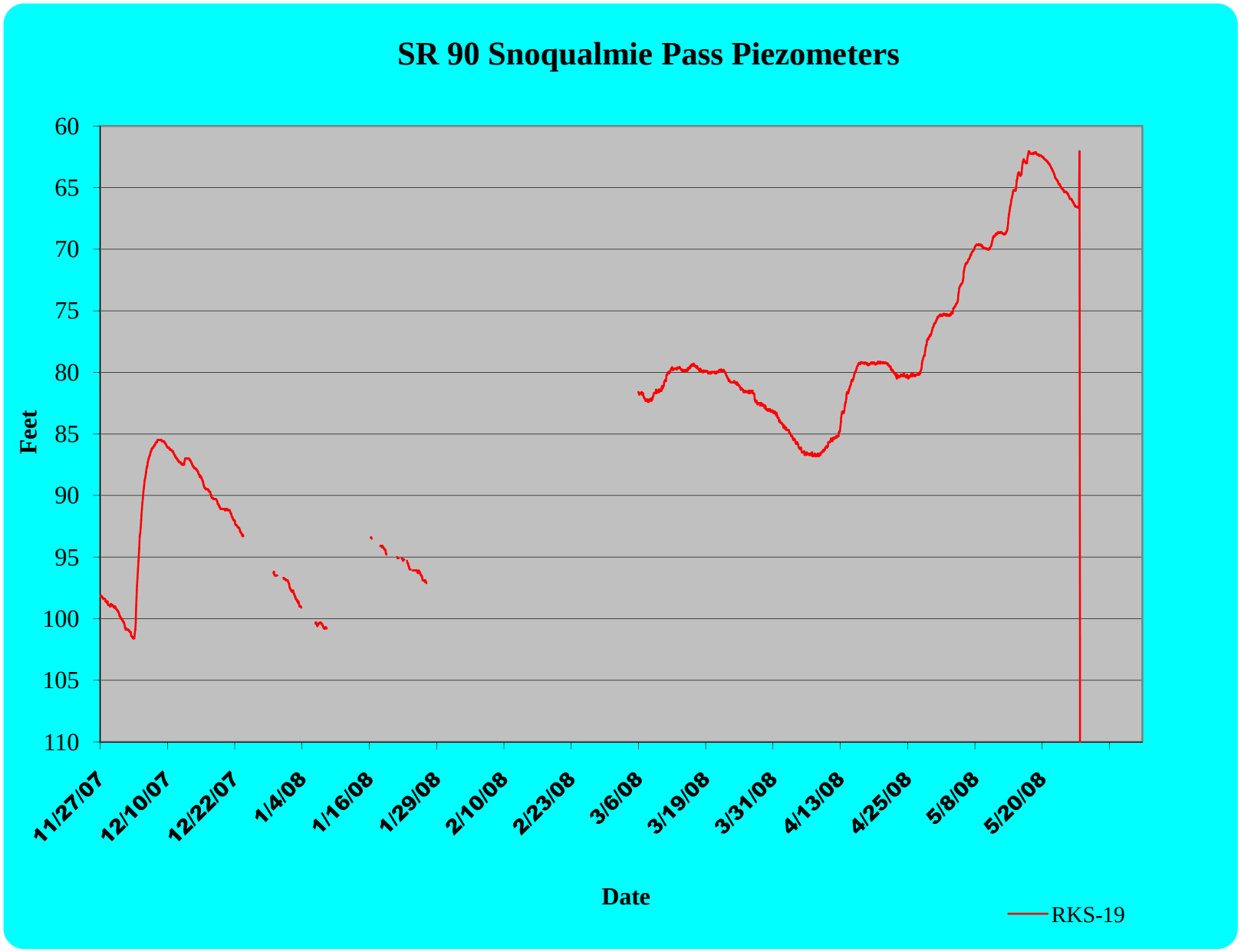
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



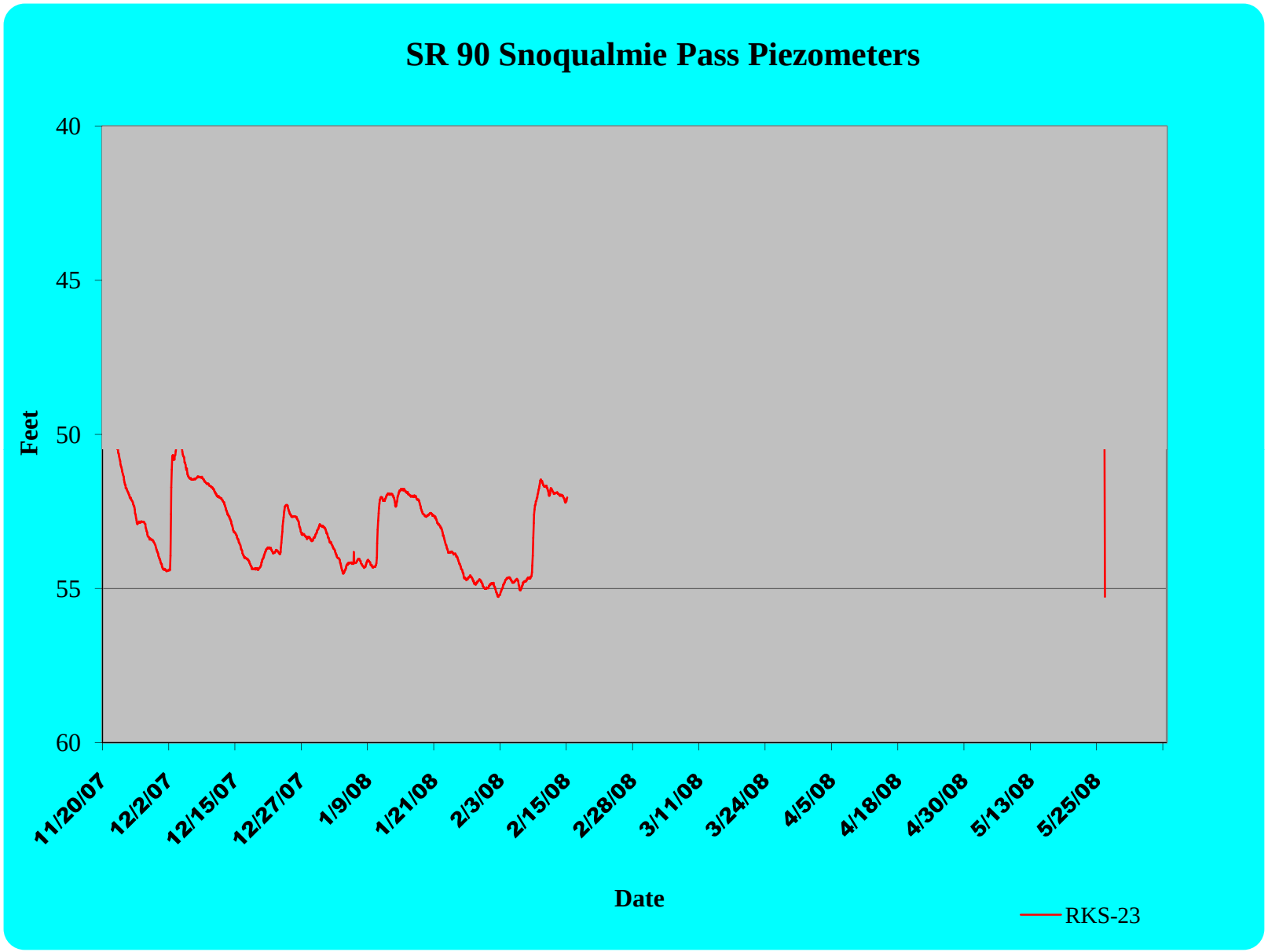
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



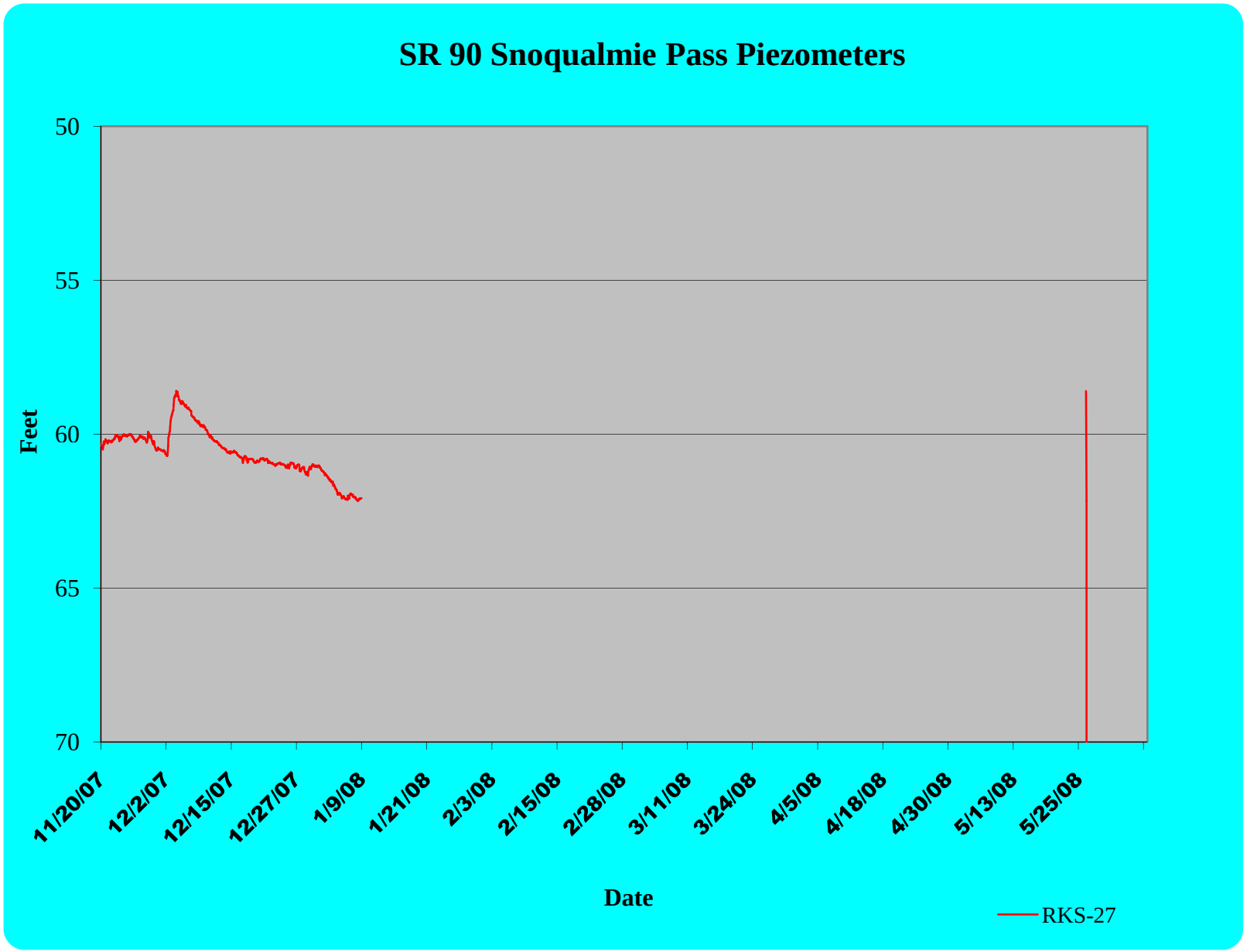
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



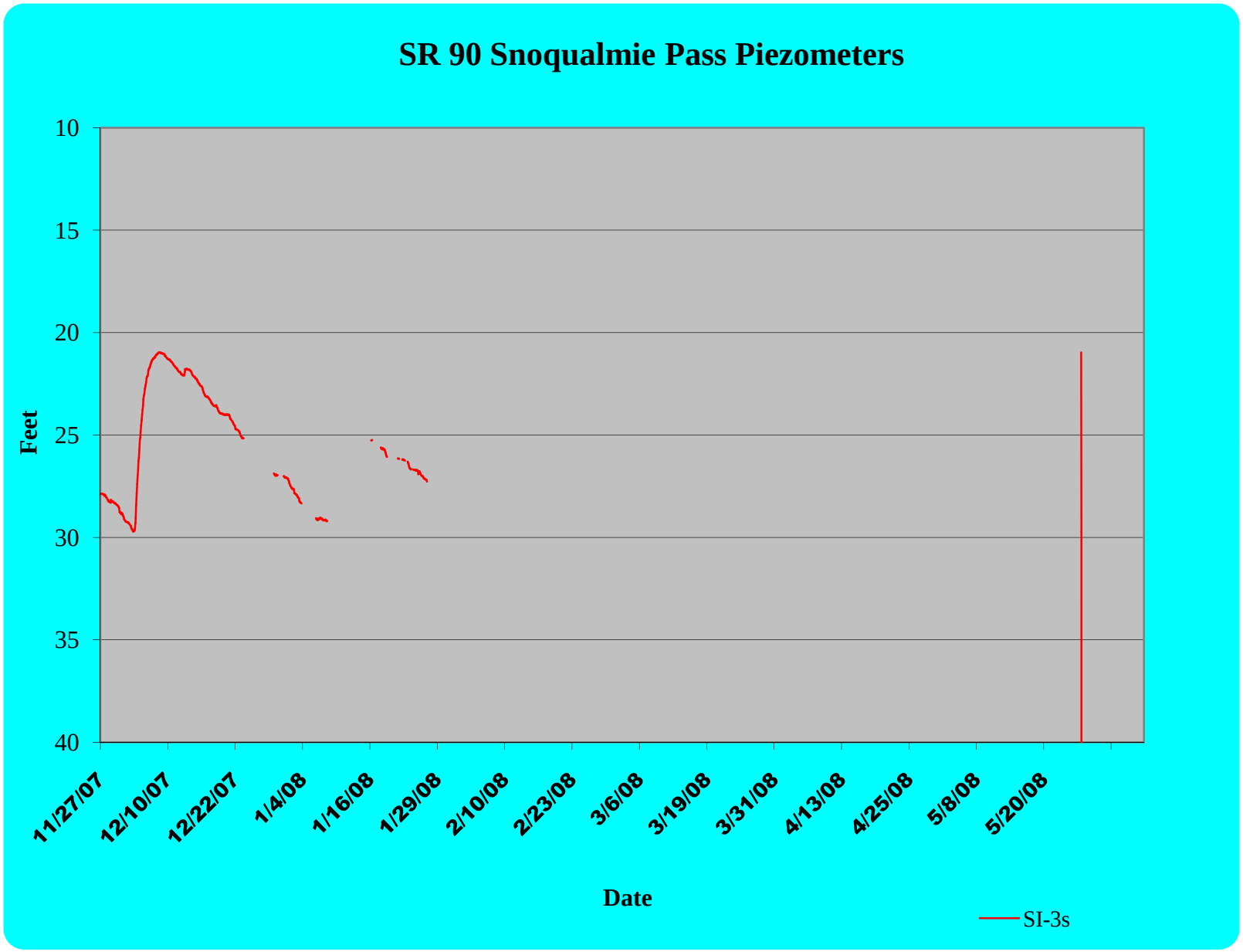
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



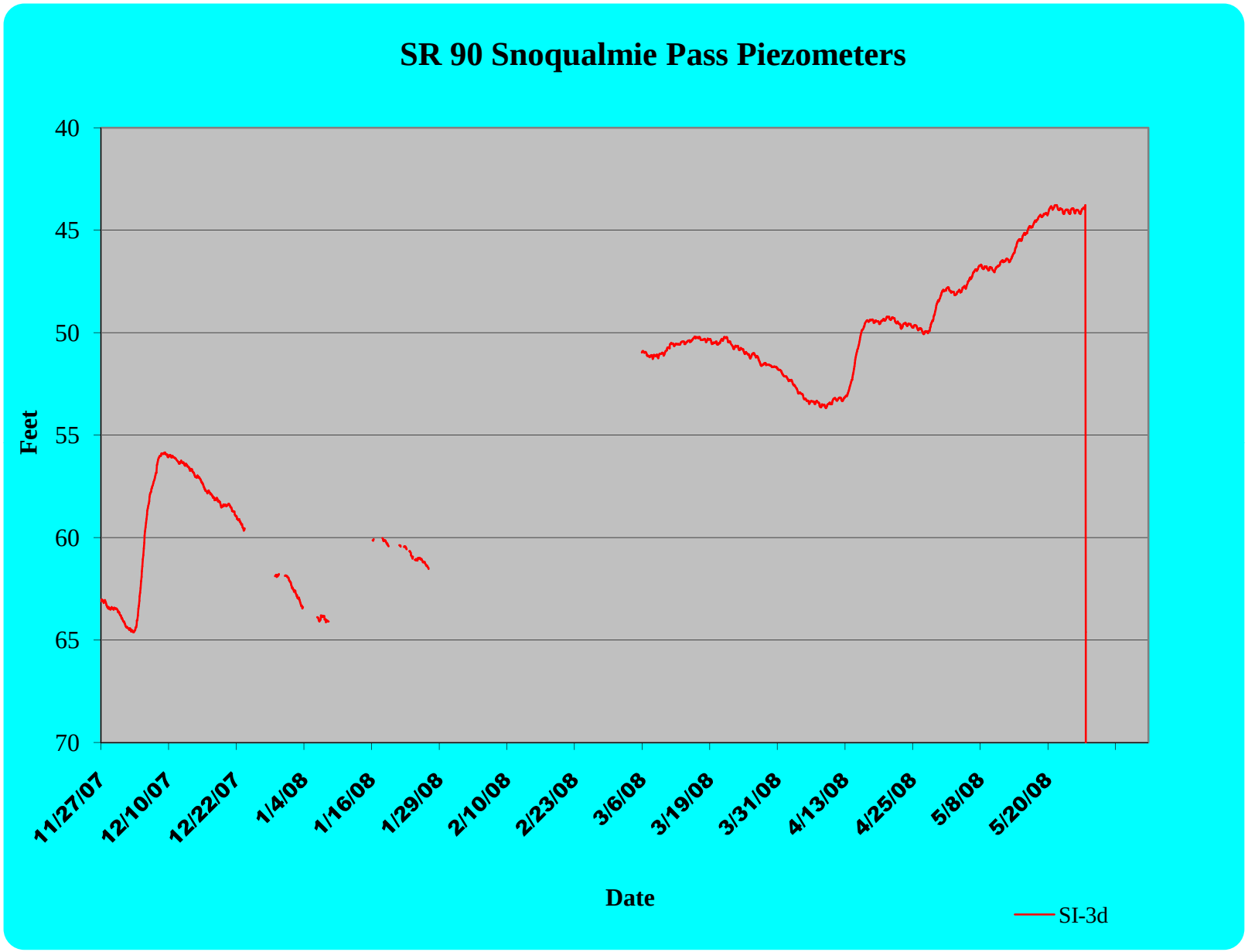
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



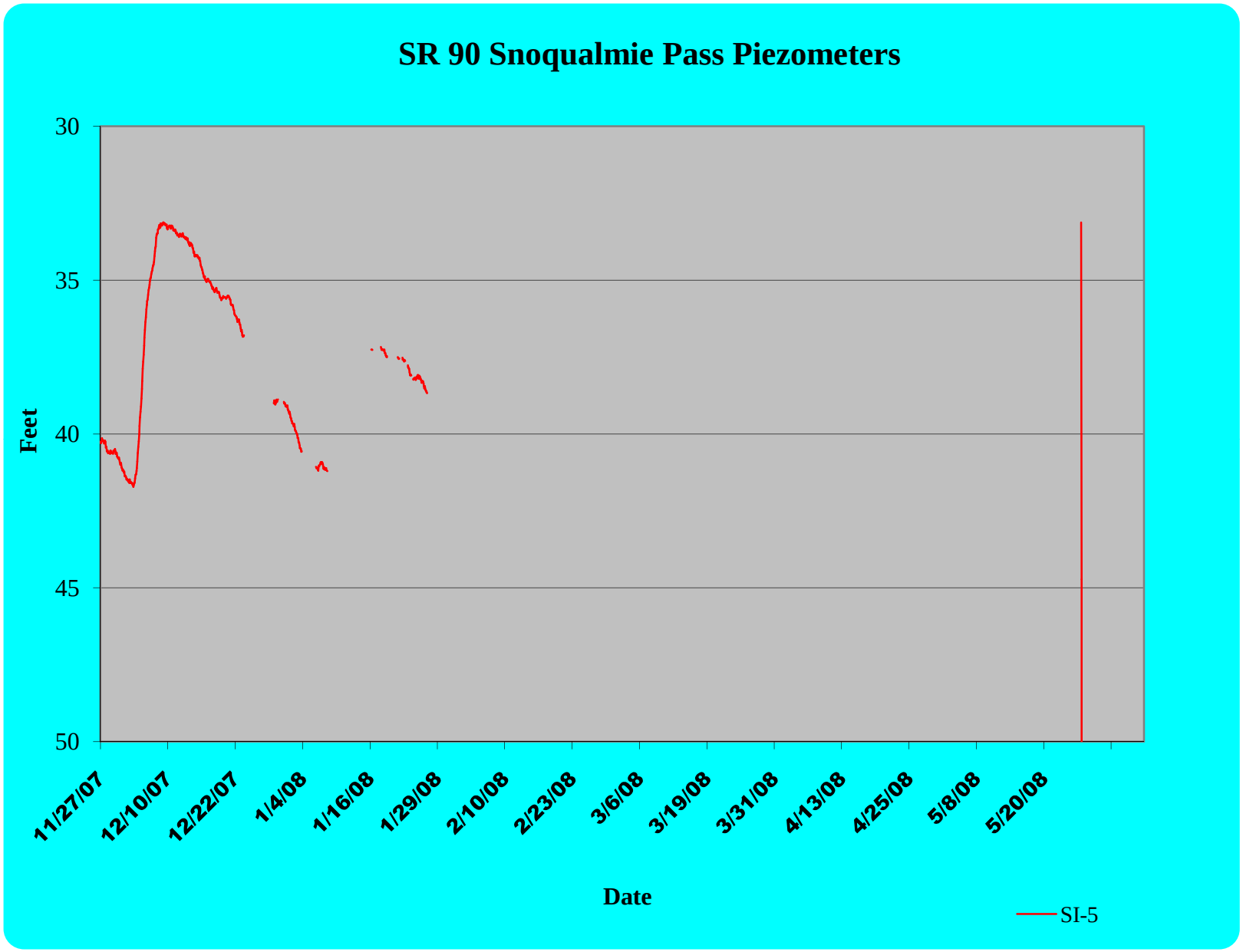
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



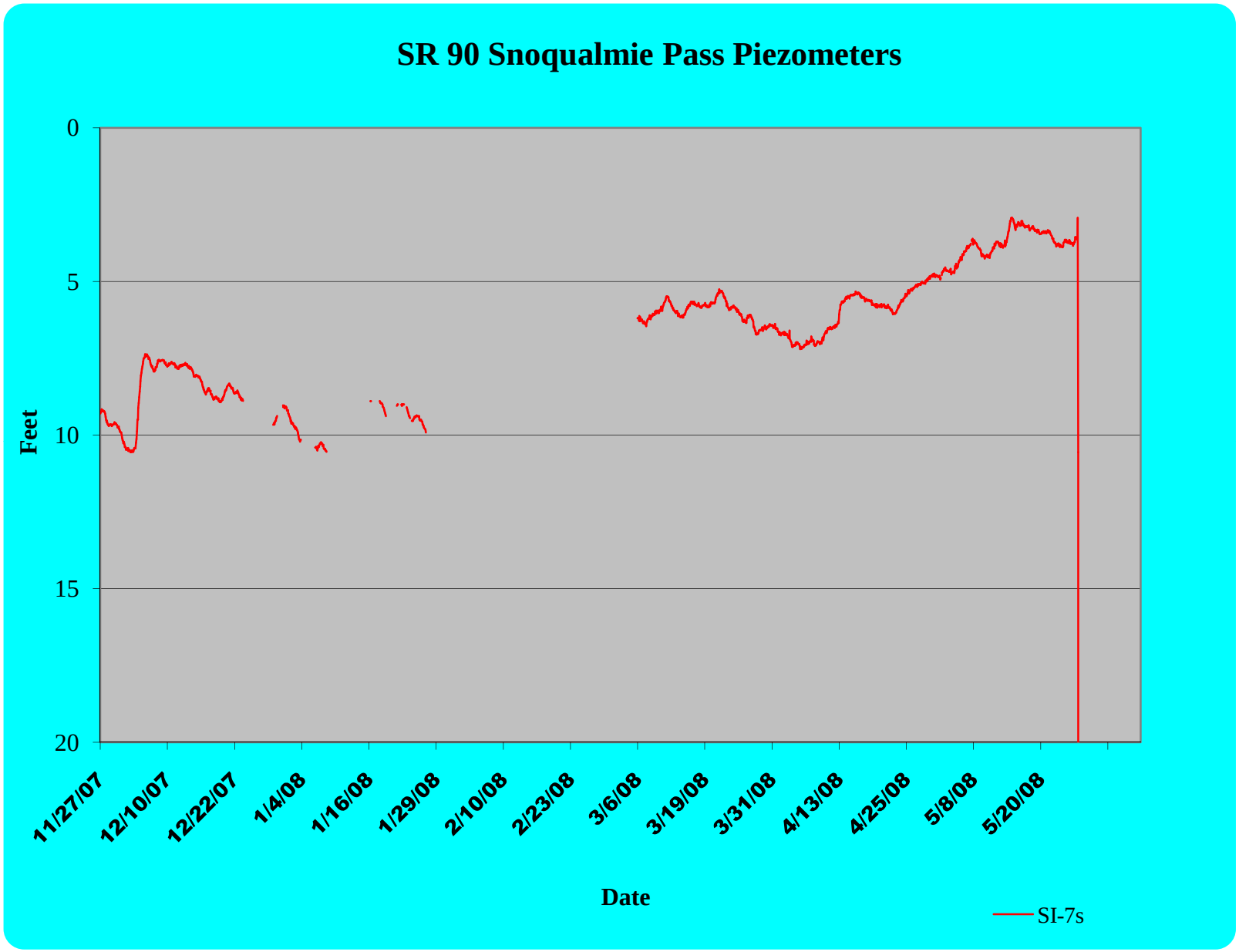
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



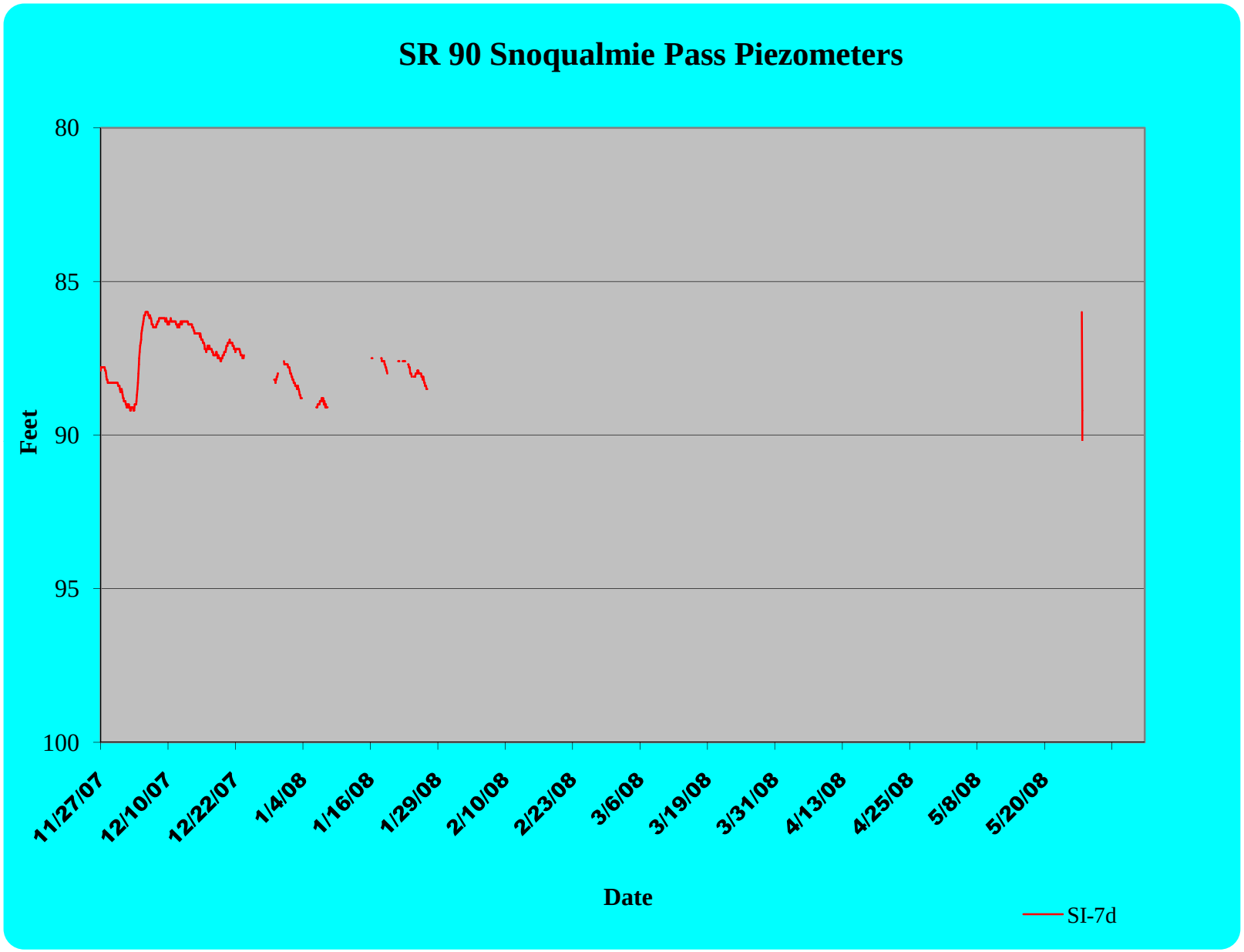
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation



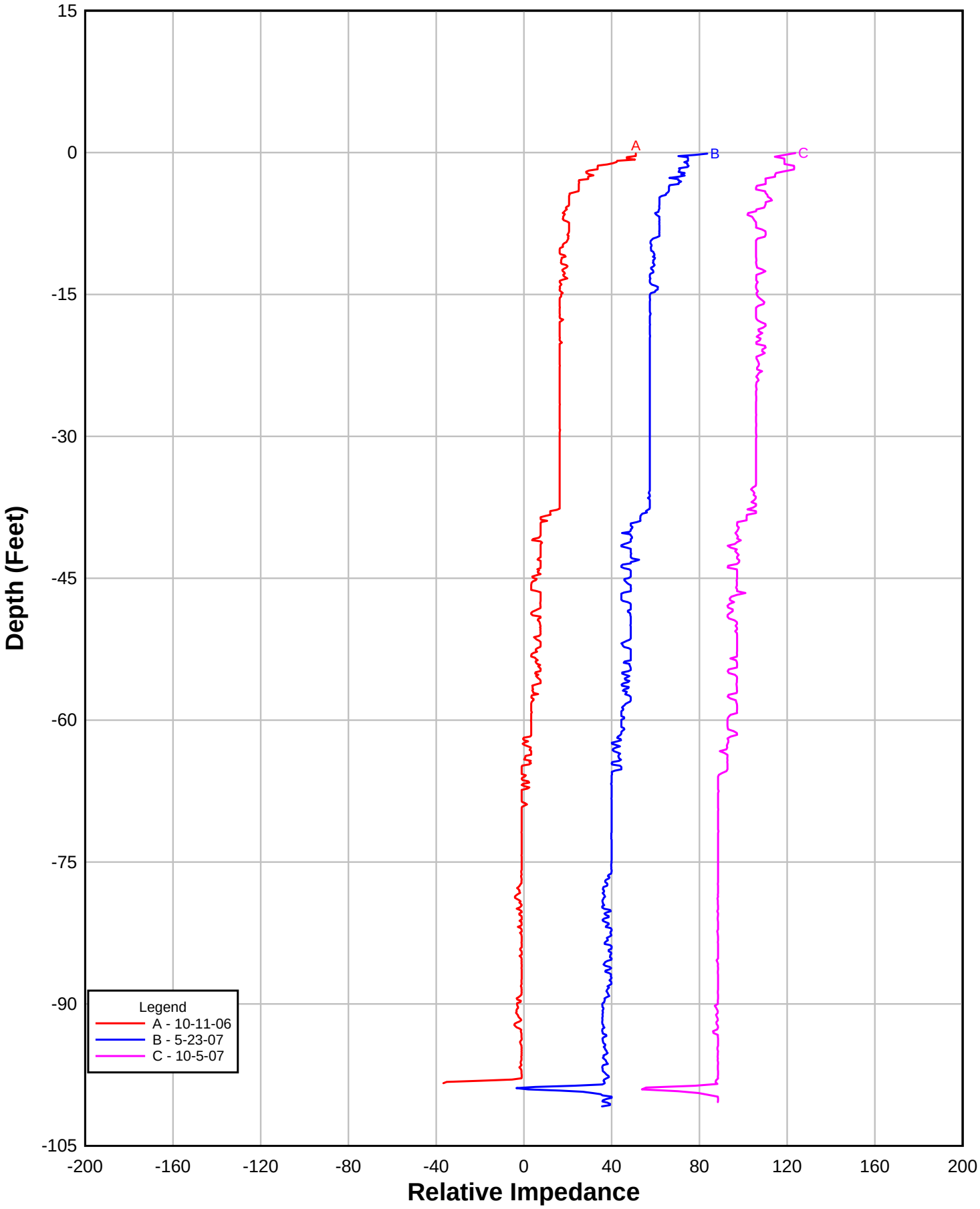
Feet expressed in below ground surface
Vibrating wire location noted in lower right corner of graph
d - deeper instrument if dual stage installation
s - shallow instrument if dual stage installation

2/11/2008

WSDOT Geotech Division

SR 90 Slide Curve TDR Graphs

H-101-06-TDR

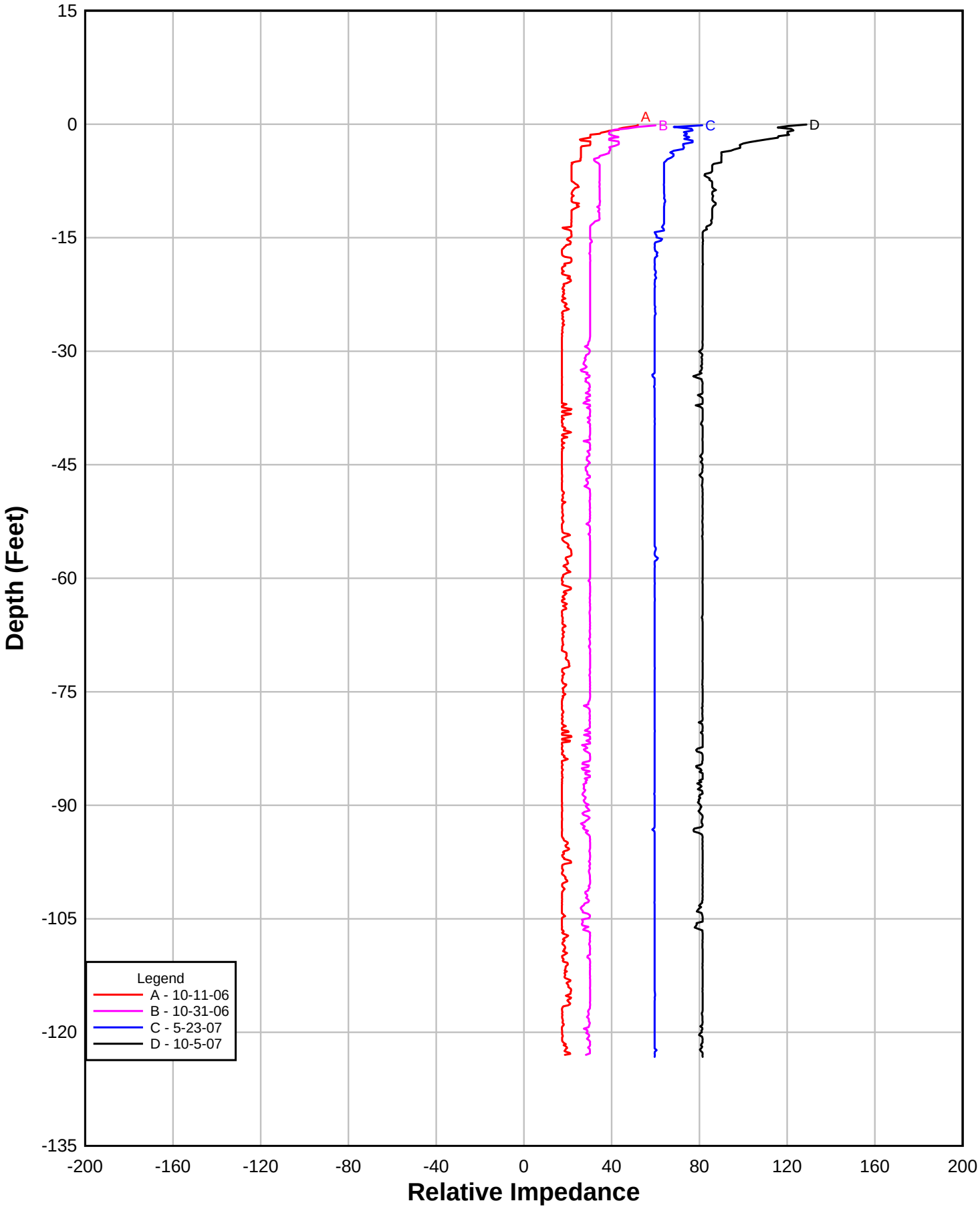


2/11/2008

WSDOT Geotech Division

SR 90 Slide Curve TDR Graphs

H-107-06

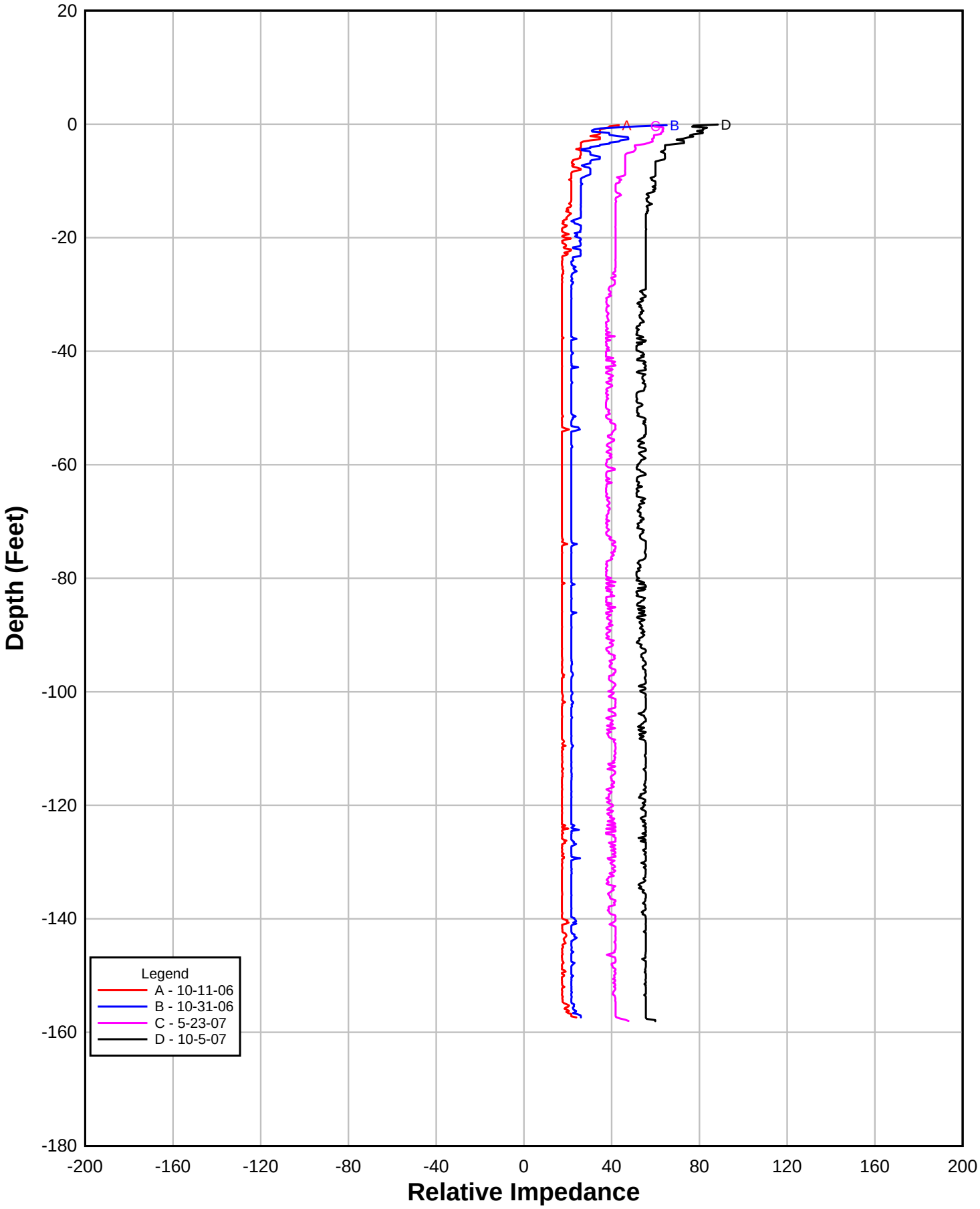


2/11/2008

WSDOT Geotech Division

SR 90 Slide Curve TDR Graphs

H-108-06

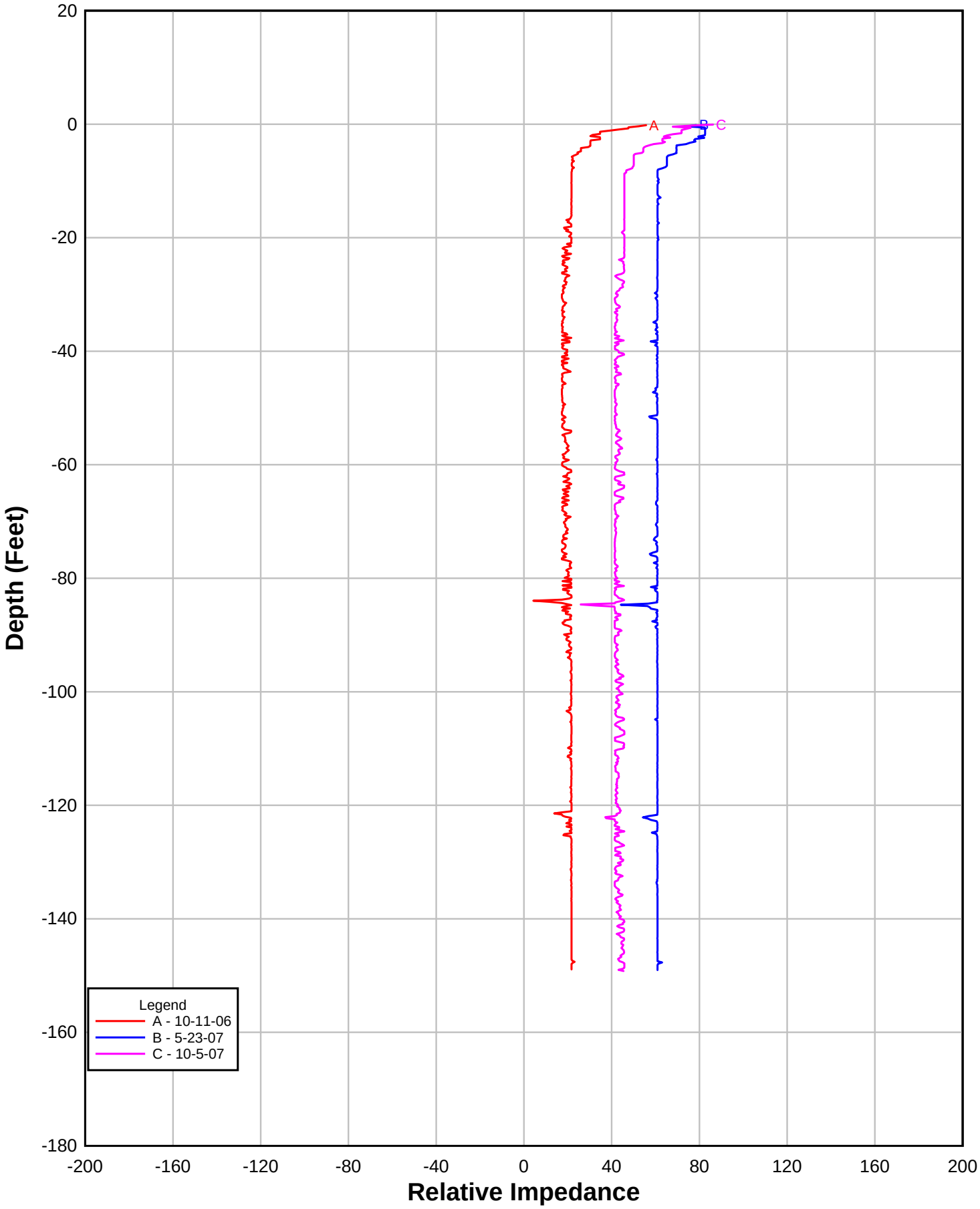


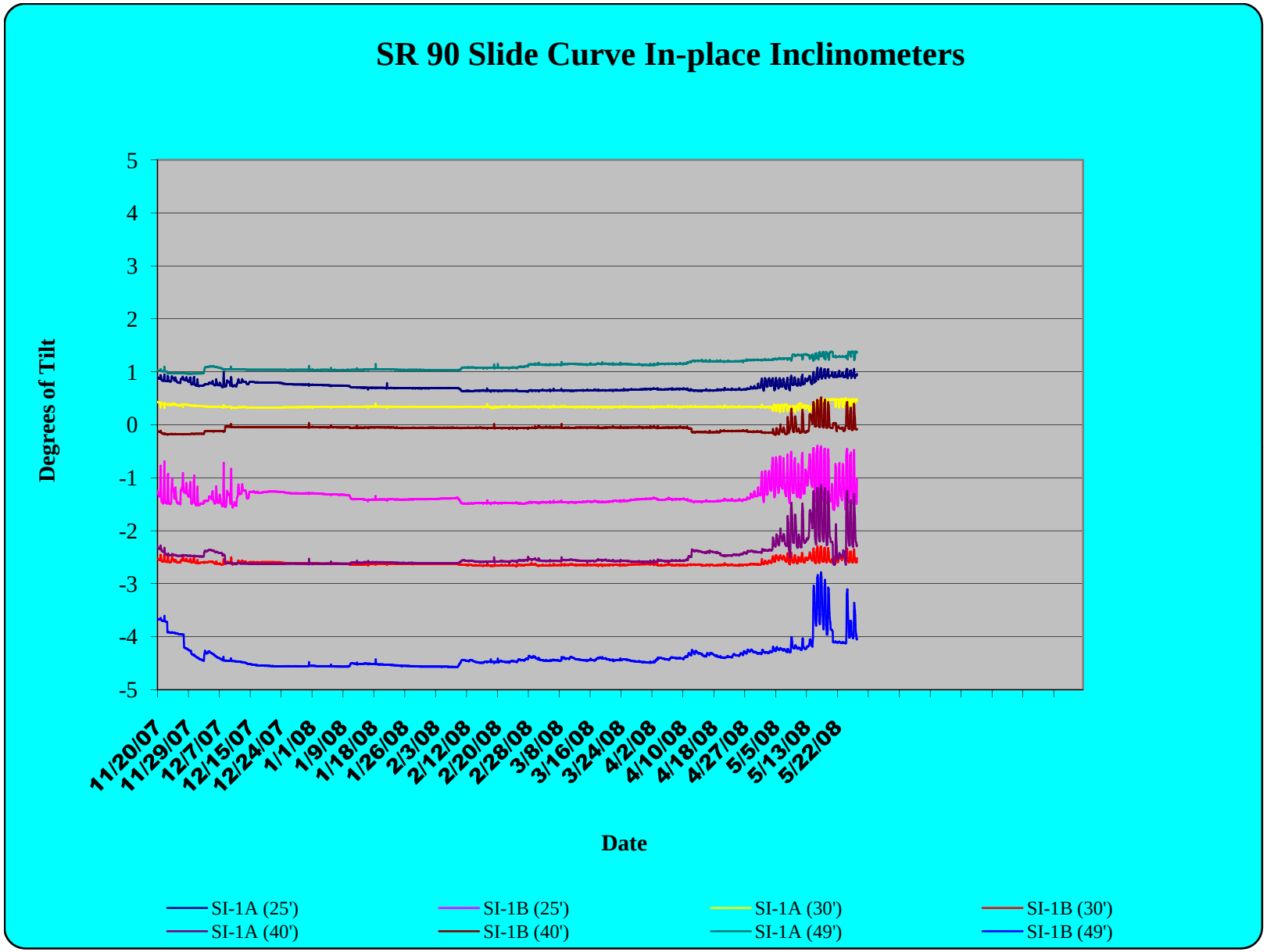
2/11/2008

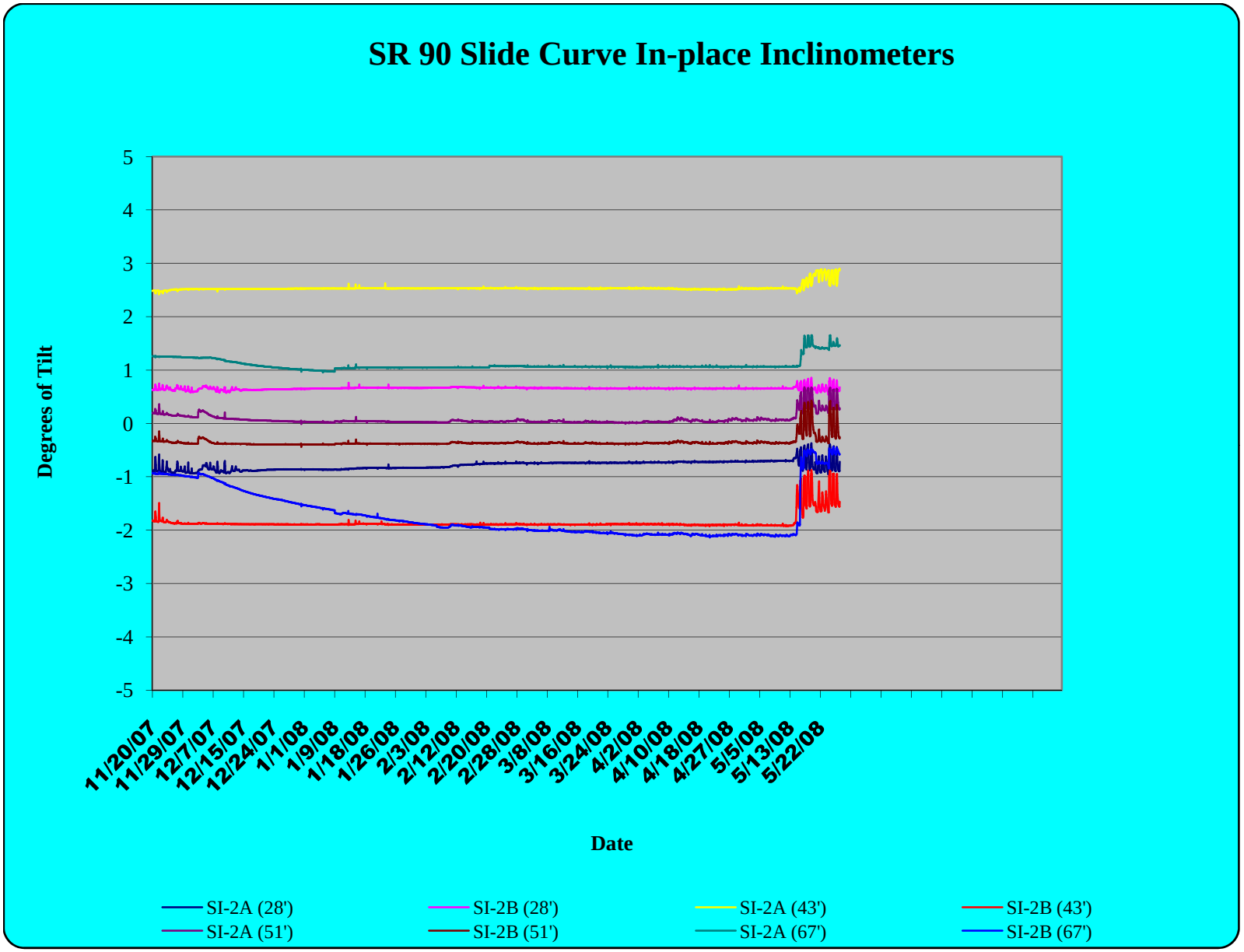
WSDOT Geotech Division

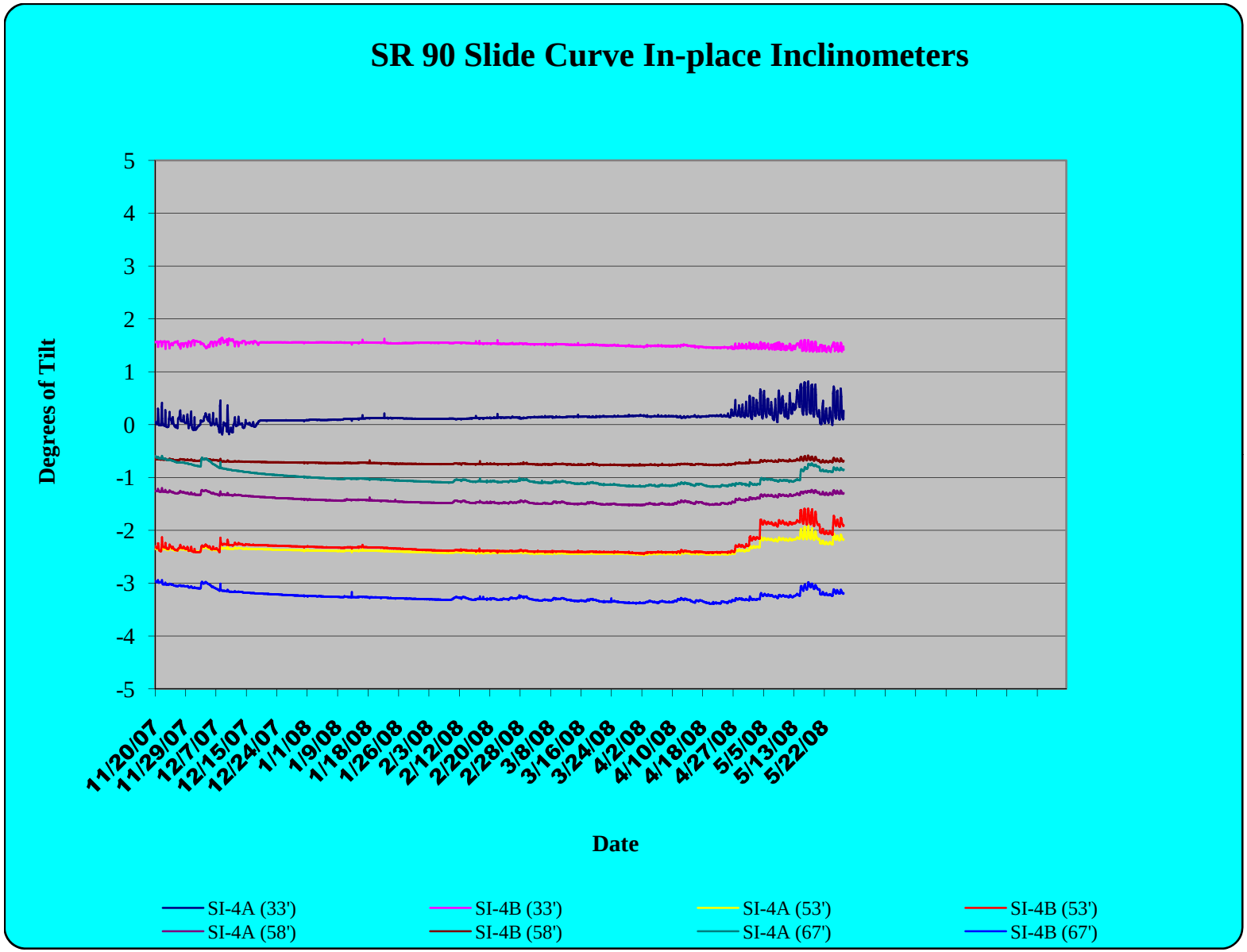
SR 90 Slide Curve TDR Graphs

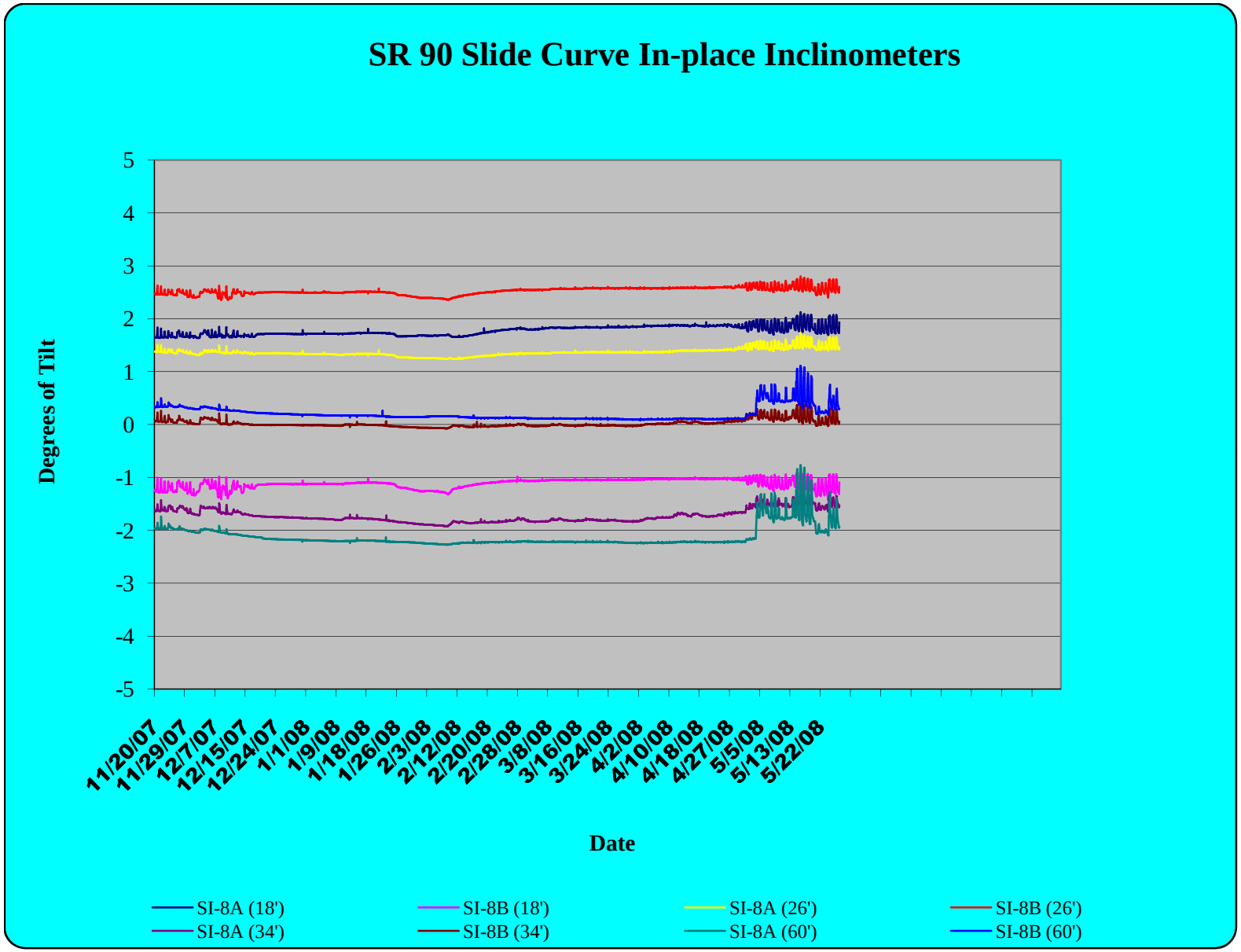
H-110-06

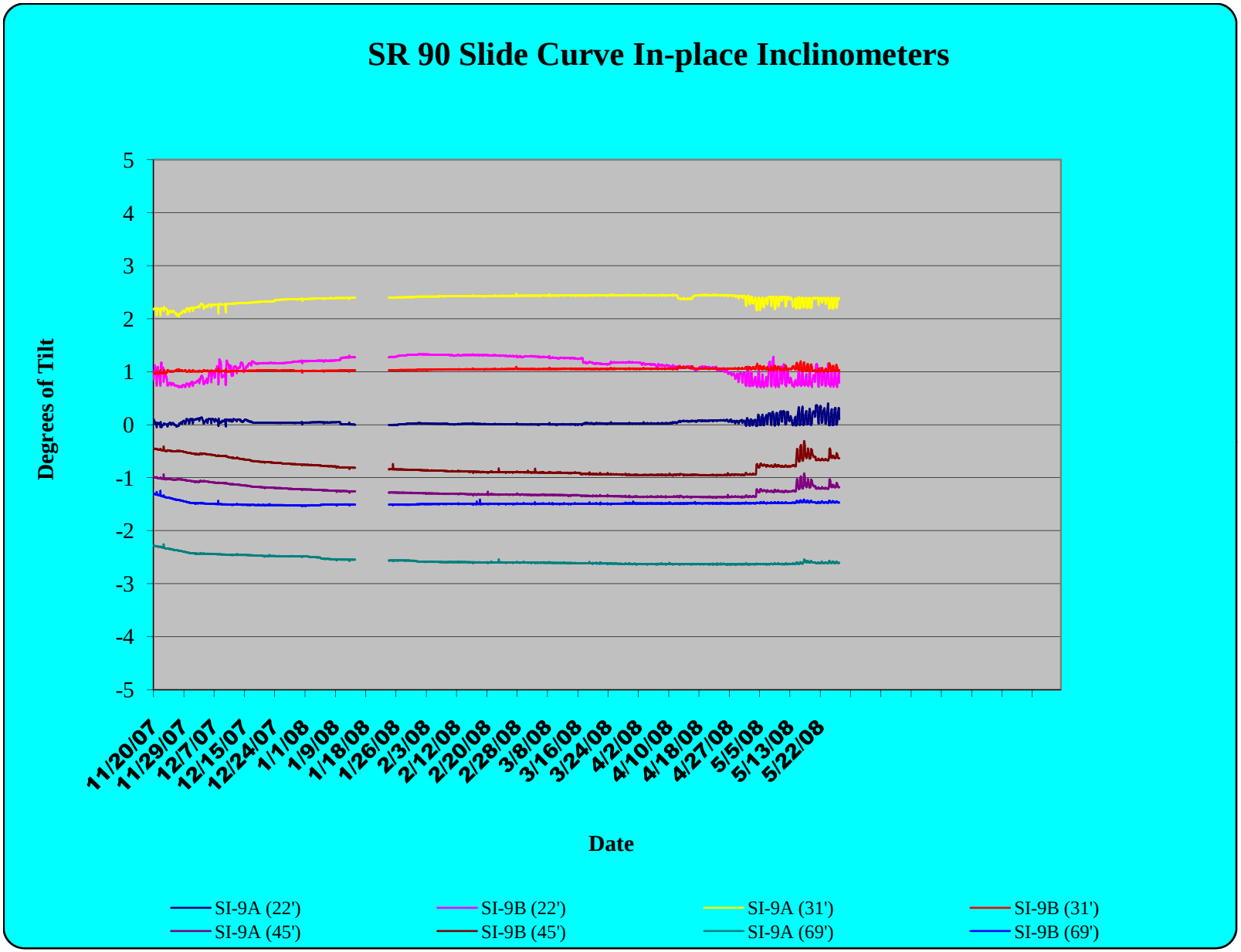



SR 90 Slide Curve In-place Inclinometers
Degrees of Tilt
5
4
3
2
1
0
-1
-2
-3
-4
-5
11/20/07
11/29/07
12/7/07
12/15/07
12/24/07
1/1/08
1/9/08
1/18/08
1/26/08
2/3/08
2/12/08
2/20/08
2/28/08
3/8/08
3/16/08
3/24/08
4/2/08
4/10/08
4/18/08
4/27/08
5/5/08
5/13/08
5/22/08
Date
SI-1A (25')
SI-1B (25')
SI-1A (30')
SI-1B (30')
SI-1A (40')
SI-1B (40')
SI-1A (49')
SI-1B (49')


SR 90 Slide Curve In-place Inclinometers
Degrees of Tilt
5
4
3
2
1
0
-1
-2
-3
-4
-5
11/20/07
11/29/07
12/7/07
12/15/07
12/24/07
1/1/08
1/9/08
1/18/08
1/26/08
2/3/08
2/12/08
2/20/08
2/28/08
3/8/08
3/16/08
3/24/08
4/2/08
4/10/08
4/18/08
4/27/08
5/5/08
5/13/08
5/22/08
Date
SI-2A (28')
SI-2B (28')
SI-2A (43')
SI-2B (43')
SI-2A (51')
SI-2B (51')
SI-2A (67')
SI-2B (67')


SR 90 Slide Curve In-place Inclinometers
Degrees of Tilt
5
4
3
2
1
0
-1
-2
-3
-4
-5
11/20/07
11/29/07
12/7/07
12/15/07
12/24/07
1/1/08
1/9/08
1/18/08
1/26/08
2/3/08
2/12/08
2/20/08
2/28/08
3/8/08
3/16/08
3/24/08
4/2/08
4/10/08
4/18/08
4/27/08
5/5/08
5/13/08
5/22/08
Date
SI-4A (33')
SI-4B (33')
SI-4A (53')
SI-4B (53')
SI-4A (58')
SI-4B (58')
SI-4A (67')
SI-4B (67')


SR 90 Slide Curve In-place Inclinometers
Degrees of Tilt
5
4
3
2
1
0
-1
-2
-3
-4
-5
11/20/07
11/29/07
12/7/07
12/15/07
12/24/07
1/1/08
1/9/08
1/18/08
1/26/08
2/3/08
2/12/08
2/20/08
2/28/08
3/8/08
3/16/08
3/24/08
4/2/08
4/10/08
4/18/08
4/27/08
5/5/08
5/13/08
5/22/08
Date
SI-8A (18')
SI-8B (18')
SI-8A (26')
SI-8B (26')
SI-8A (34')
SI-8B (34')
SI-8A (60')
SI-8B (60')


SR 90 Slide Curve In-place Inclinometers
Degrees of Tilt
5
4
3
2
1
0
-1
-2
-3
-4
-5
11/20/07
11/29/07
12/7/07
12/15/07
12/24/07
1/1/08
1/9/08
1/18/08
1/26/08
2/3/08
2/12/08
2/20/08
2/28/08
3/8/08
3/16/08
3/24/08
4/2/08
4/10/08
4/18/08
4/27/08
5/5/08
5/13/08
5/22/08
Date
SI-9A (22')
SI-9B (22')
SI-9A (31')
SI-9B (31')
SI-9A (45')
SI-9B (45')
SI-9A (69')
SI-9B (69')

Appendix F

Laboratory Analytical Reports

Strength and Direct Shear Testing Results

GeoTest Unlimited

Geo Test Unlimited

Test Equipment Design & Fabrication
Laboratory & Field Testing
Consulting Services

Dr. Anders Bro

October 15, 2007

Rock Testing
I90 Hyak Extension

Wyllie & Norrish Rock Engineers
17918 NE 27th St.
Redmond, WA 98052

Dear Norm,

This letter report summarizes the unconfined compression, point load, and direct shear tests performed on the samples that you had sent to my lab a number of weeks ago. The report summarizes the test results along with some comments about the testing program that you might find helpful in interpreting the results. The standard test procedures used for these tests are appended to this letter, along with a compact disk containing the data files and photographs of the pre-and post-test samples.

Of the 23 samples sent to me, three filled interfaces were slated for direct shear testing. In addition, ten were slated for unconfined compression tests along with companion axial and diametral point load tests using the remaining 10 samples.

Unconfined Compression and Point Load Testing

The objective of this testing program was to perform a set of unconfined compression tests along with companion axial and diametral point load tests so that a reasonable correlation between the test values could be developed. For each pair of samples (labeled –A and –B) the least fractured samples were chosen for the unconfined compression tests. An effort was also made to cut unfractured samples for the axial point load tests. It was felt that it should be possible to find a suitable diametral point load sample from the remaining core.

The samples did not appear to be particularly hard when cut with the diamond saw. In a few cases, the samples appeared to be slightly friable, the edges of the cut sample being easily fractured during sawing. In one case, Sample 03-102B, the medium grained greenish gray material appeared to be quite weak and was relatively easily rubbed from the sample. In retrospect, this material may have been slightly altered compared to the dark gray fine grained material.

The materials were generally metamorphosed and were of volcanic origin. Some of the medium gray lapilli tuffs were not very dense (154.6-158.1 pcf) and I wonder if these may not have been metamorphosed. Perhaps if they have, they have been subjected to only a very low grade of metamorphism. These low densities are unusual for a metamorphic rock. On the other hand, their relatively high strength might argue the case that they have been metamorphosed.

The test results are tabulated as follows:

27069 N. Bloomfield Rd. Nevada City, CA 95959 Tel/Fax (530)470-0583 email: abro@saber.net

Unconfined Compressive Strength and Point Load Test Results

Boring/ Sample #	Depth (ft.)	Description	Density (pcf)	Corrected Point Load (psi)	UC Strength (psi)
RKS-01-07 01-102A	44.3-44.8	Dark gray meta-andesite with a healed calcite vein and calcite inclusions.		974/757[di]	
RKS-01-07 01-102B	44.8-45.5	Dark gray meta-andesite with a healed calcite vein and calcite inclusions.	171.6	553[a]	12,380
RKS-03-07 03-102B	71.6-72.3	Dark gray fine grained and dark greenish gray medium grained meta-lapilli tuff.	165.1	195[a] 370[d]	5113
RKS-04-07 04-101A	24.3-25.2	Medium gray meta-welded lapilli tuff with no apparent planes of weakness.		569[a]	
RKS-04-07 04-101B	25.2-26.0	Medium gray meta-welded lapilli tuff with no apparent planes of weakness.	160.2	774[d]	16,725
RKS-05-07 05-101A	15.1-15.7	Dark purplish gray meta-basalt with no apparent planes of weakness.		192[a] 288[d]	
RKS-05-07 05-101B	15.7-16.4	Dark purplish gray meta-basalt with no apparent planes of weakness.	156.7		10,599
RKS-05-07 05-103A	59.5-60.1	Dark purplish gray and dark greenish gray breciated andesite with no apparent planes of weakness.	165.6		13,961
RKS-05-07 05-103B	60.1-60.7	Dark purplish gray and dark greenish gray breciated andesite with no apparent planes of weakness.		562[a] 424[d]	
RKS-06-07 06-101A	35.1-35.8	Dark gray meta-andesite with quartz healed fractures and tight fractures.	174.6	611[a]	10,946
RKS-06-07 06-101B	35.8-36.5	Dark gray meta-andesite with quartz healed fractures and tight fractures.		518[d]	
RKS-08-07 08-101A	10.0-10.7	Medium gray meta-welded lapilli tuff with no apparent planes of weakness.	158.1	364[a]	9795
RKS-08-07 08-101B	10.7-11.3	Medium gray meta-welded lapilli tuff with no apparent planes of weakness.		321[d]	

Unconfined Compressive Strength and Point Load Test Results (cont.)

RKS-09-07 09-102A	41.3-41.9	Medium gray meta-welded lapilli tuff with no apparent planes of weakness.		262[a] 234[d]	
RKS-09-07 09-102B	41.9-42.6	Medium gray meta-welded lapilli tuff with no apparent planes of weakness.	156.6		10,040
RKS-10-07 10-2A	74.1-74.8	Medium gray meta-welded lapilli tuff with no apparent planes of weakness.	154.6	279[a]	10,674
RKS-10-07 10-2B	74.8-75.4	Medium gray meta-welded lapilli tuff with no apparent planes of weakness.		128/206[a]	
RHS-11-07 11-101A	64.1-64.8	Medium gray meta-welded lapilli tuff with a few tight fractures.	161.3		11,100
RHS-11-07 11-101B	64.8-65.4	Medium gray meta-welded lapilli tuff with a few tight fractures.		254[a] 429[d]	

Notes: a. Axial Point Loading
d. Diametral Point Loading
i. Invalid – failure did not pass through both points of loading.

With the exception of Sample 03-102B, the unconfined samples were quite competent with strengths generally above 10,000 psi, ranging from 9795 to 16,725 psi. Excluding the two extreme strengths (5113 psi and 16,725 psi), the average strength was 11,187 psi and the strengths ranged from 9795 to 13,961 psi. This tight band of strengths was quite unusual considering the variety of materials. Unlike other rock testing programs, there did not appear to be a clear correlation between rock density and rock strength.

With regard to the point load tests, a few tests were repeated due to the unusual test results. In the case of Sample 01-102A, the sample appeared to be quite hard and the loading points slipped off the sample before the sample could break properly, resulting in a chip created on the side of the sample. This sample was retested in another location, resulting in the same invalid mode of failure. Two tests were also performed on Sample 10-2B as the first result seemed to be unusually low. I believe that the second result is more representative of this rock. All of the sample failed through intact rock and the strengths did not appear to be influenced by discontinuities.

Direct Shear Testing

Three samples were slated for direct shear testing. One consisted of a highly fractured rock interface with a clay filling. The second one consisted of a single clay-filled discontinuity, and the third consisted of a thick clay layer bearing against an undulating rock contact. The first sample, Sample 06-104, posed no problem in that the sample was undisturbed and did not appear to be disturbed during sample preparation. The second sample, Sample 11-102, was greatly disturbed during sample preparation. When cutting the very hard parent rock, the clay filling became moist, one of the sample halves fractured along weak discontinuities, and the sample came apart. After cutting, the sample was carefully reassembled and successfully tested. The third sample, Sample 02-201, was unsuitable for testing in my rock shear testing apparatus. The rock-clay contact was greatly disturbed and the two sample halves did not conform to each other. On viewing the sample, particularly in light of the level of stress to which the sample

would be subjected and the resultant squeezing and deformation of the clay portion of the sample, I felt the results would not properly represent the in-situ interface, and so did not recommend testing this sample.

The remains (the cuttings and the tested portions) of these three samples were sent to Sunland Analytical Lab in Rancho Cordova for corrosivity testing. It should be noted that they require a minimum sample weight for their tests and there may be some problems with obtaining good test results with the limited volume of clay material from these samples.

The following table summarizes the direct shear test results:

Direct Shear Test Results

Boring/ Sample #	Depth (ft.)	Description	Shear Intercept (psi)	Friction Angle (deg.)
RKS-06-07 06-104	80.9-81.6	Breciated shear zone with hard broken meta-andesite interspersed in tannish gray clay.	1.3[i] 2.3[f]	23.2[i] 23.0[f]
RKS-11-07 11-102	107.3-107.8	Planar joint with firm brown clay filling in meta-welded lapilli tuff.	4.1[i] 4.1[f]	10.1[i] 12.3[f]

Notes: i. Initial strength parameter
f. Final strength parameter

Both of these direct shear samples resulted in some quite interesting test results that required some thought when it comes to reducing the test measurements.

Sample 06-104 consisted of a shear zone consisting of broken rock, appearing as slabs parallel to the main shear plane, with clay separating the rock pieces. Unlike a typical filled discontinuity, the broken rock pieces could rotate and modify the interface strength as shear displacements developed. This interaction was evident during the initial second and third stages and well as the final third stage. During the initial second stage, the strength appeared to be quite low. This low strength was either due to error on my part, by not allowing the test to proceed to a large enough shear displacement (although the shear strength did start to drop just before stopping this second stage) or it did represent the shear strength of the clay without the rock blocks bridging the two sides of the shear zone. I expect that the high initial third stage strength represented a rock-to-rock contact strength that was modified by the presence of the clay. I have chosen, somewhat arbitrarily, to simply use the linear approximation of these three measured strengths to represent the failure envelope of the initial shear of the interface. This representation may be incorrect and it may be more proper to use the first and second stage initial strengths to represent the clay strength without the rock-to-rock interaction.

During the final stages, quite regular first and second stage strengths developed. However something occurred during this final third stage, possibly a major rotation of one of the rock blocks, that significantly weakened the interface. This occurrence was also accompanied by a much more extreme irregularity in the stress-displacement trace, something that would be characteristic of a rolling block within the interface. I expect that for the purposes of creating a failure envelope that this lower strength should not be used. For the purposes of constructing the final failure envelope, the third stage strength of the initial set of loadings was used. Despite the nice alignment of the failure points, it should be recognized that there is a distinct possibility that the hard rock blocks could act in the manner of ball bearings, and allow the shear interface to be quite a bit weaker than has been expressed by this failure envelope.

Sample 11-102 behaved a bit more normally than Sample 06-104. The initial strengths were quite regular, however the final third stage strength did become a bit irregular. I expect that this irregularity might have been due to sample rotation, and

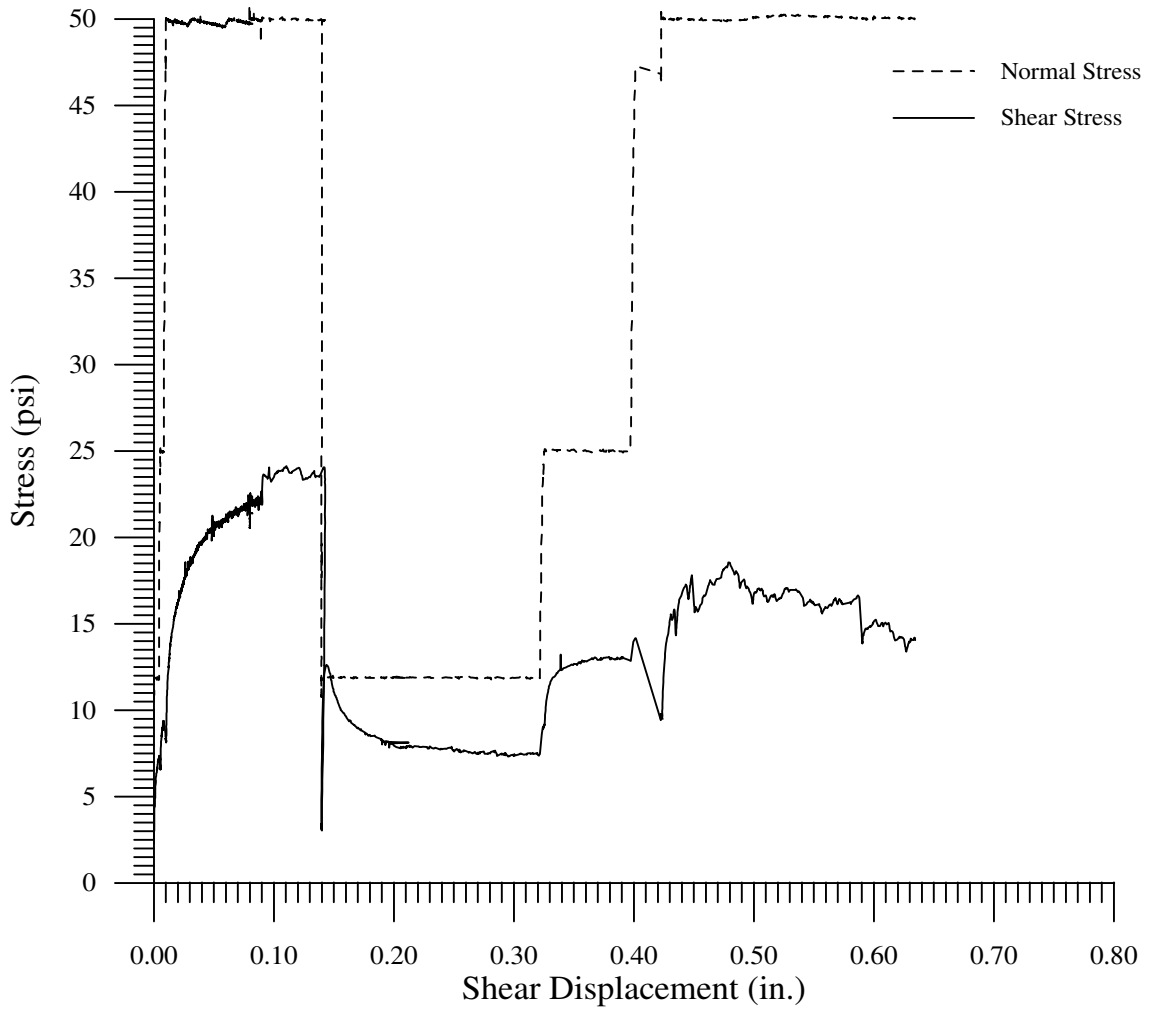
perhaps the development of a rock-to-rock contact. The peak strength was discounted in the development of the final failure envelope. It was interesting to note that by the end of the test, the clay layer had developed quite distinct slickensides. Such slickensides are quite unusual as the shearing process typically disrupts the slickensides rather than developing them. I expect their development was due to the quite hard nature of the clay that filled the discontinuity.

If you have any questions regarding these test results or the test procedures, please feel free to contact me so that we can discuss any of your concerns.

for GeoTest Unlimited

_____

Dr. Anders Bro



DIRECT SHEAR TEST
Shear and Normal Stress vs. Shear Displacement

Sample: 06-104
Boring: RKS-06-07
Depth: 80.9-81.6'

DESCRIPTION

Breciated shear zone with hard broken meta-andesite interspersed in tannish gray clay.

	Normal Stress (psi)	Shear Strength (psi)
Initial	11.8	7.4
	25	9.4
	50	22.2(?)
Final	11.8	7.4
	25	12.8
	50	23.6

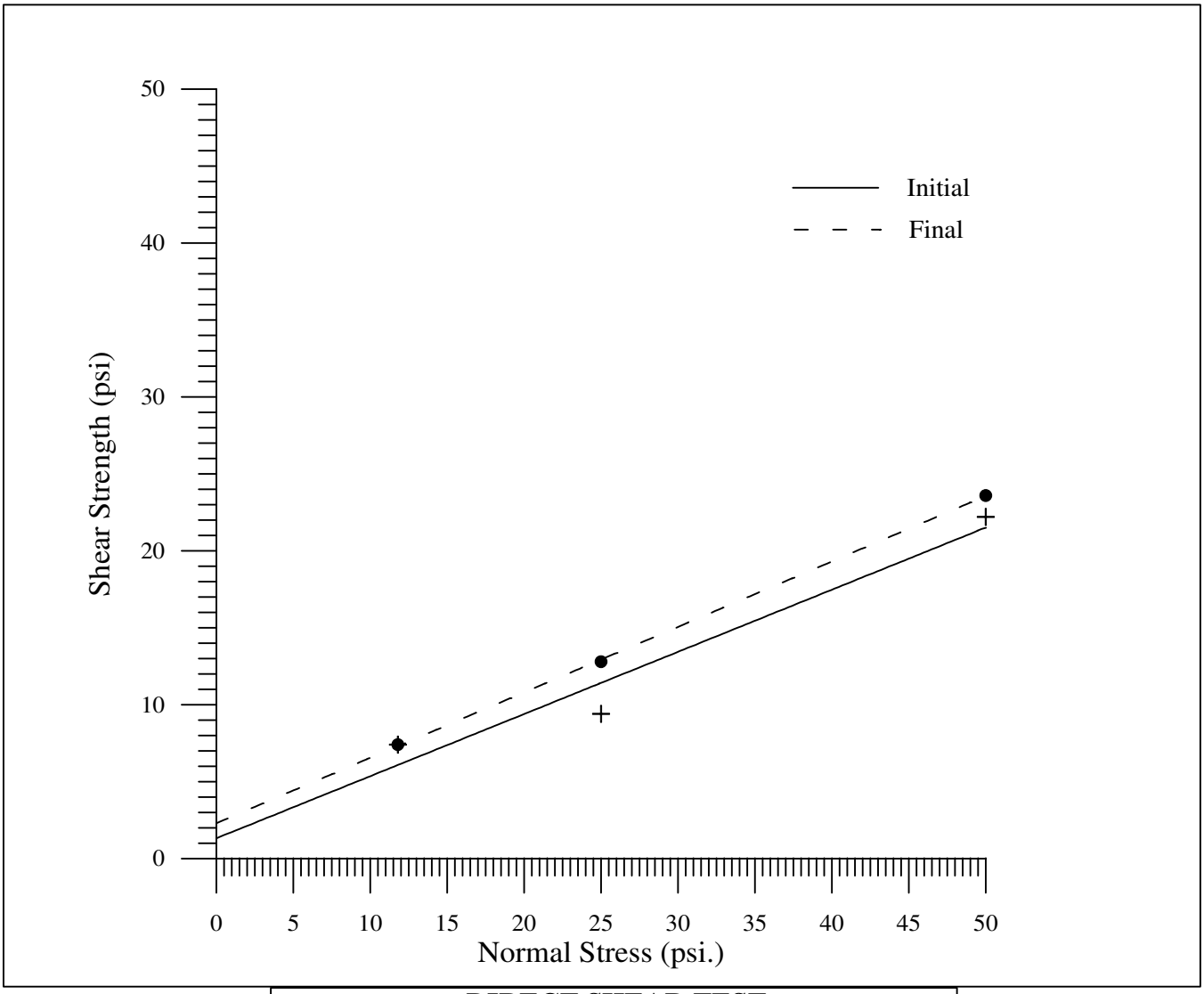
Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **October 11, 2007**



DIRECT SHEAR TEST
Failure Envelope Normal Stress vs. Shear Strength

Sample: 06-104
Boring: RKS-06-07
Depth: 80.9-81.6'

DESCRIPTION

Breciated shear zone with hard broken meta-andesite interspersed in tannish gray clay.

	Shear Intercept (psi)	Friction Angle (degrees)
Initial	1.3	23.2
Final	2.3	23.0

Geo Test Unlimited GTU

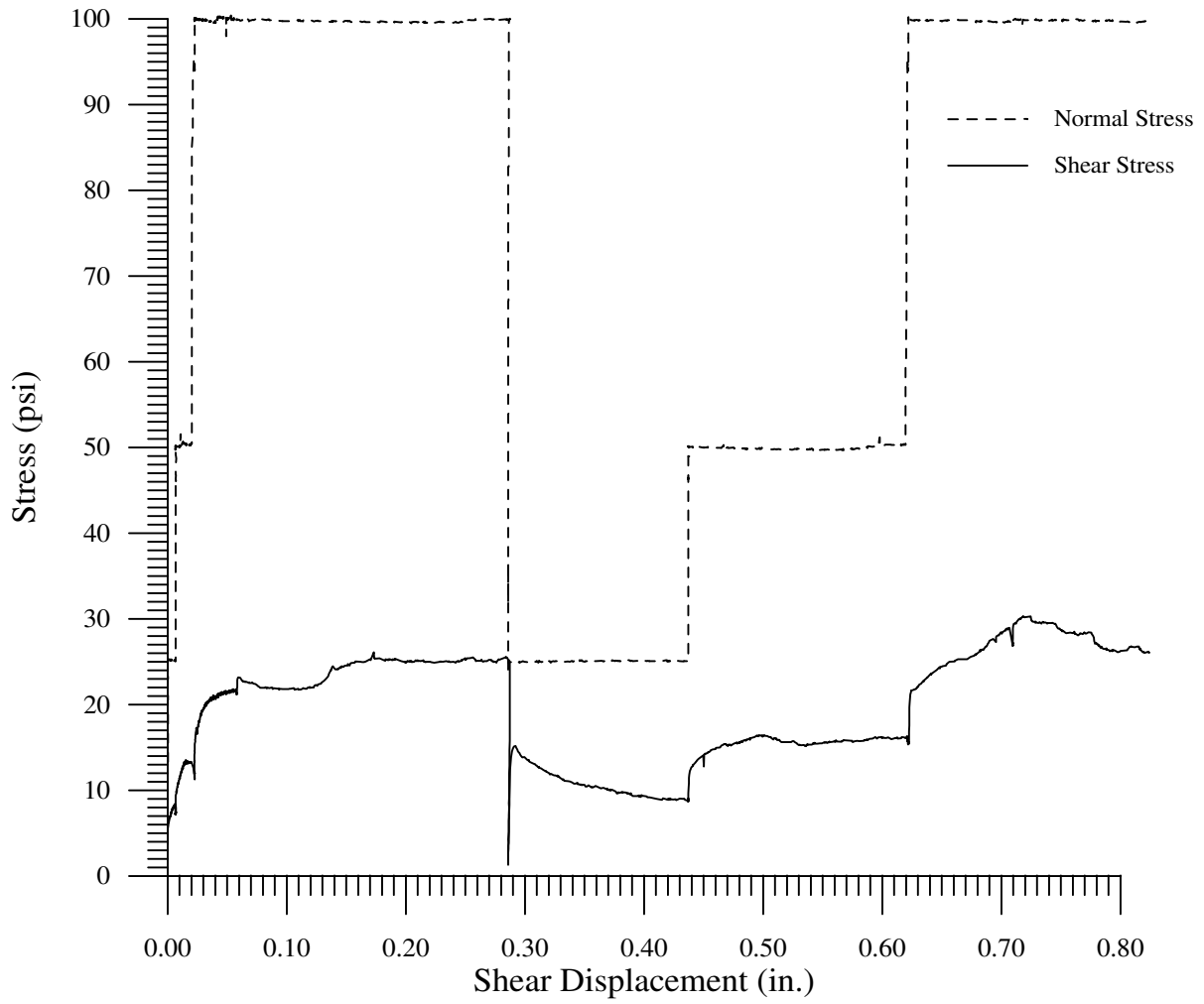
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **October 11, 2007**



DIRECT SHEAR TEST
Shear and Normal Stress vs. Shear Displacement

Sample: 11-102
Boring: RKS-11-07
Depth: 107.3-107.8'

DESCRIPTION

Planar joint with firm brown clay filling in meta-welded lapilli tuff.

	Normal Stress (psi)	Shear Strength (psi)
Initial	25	8.1
	50.3	13.6
	100	21.6
Final	25	8.8
	49.6	16
	99.6	25.4

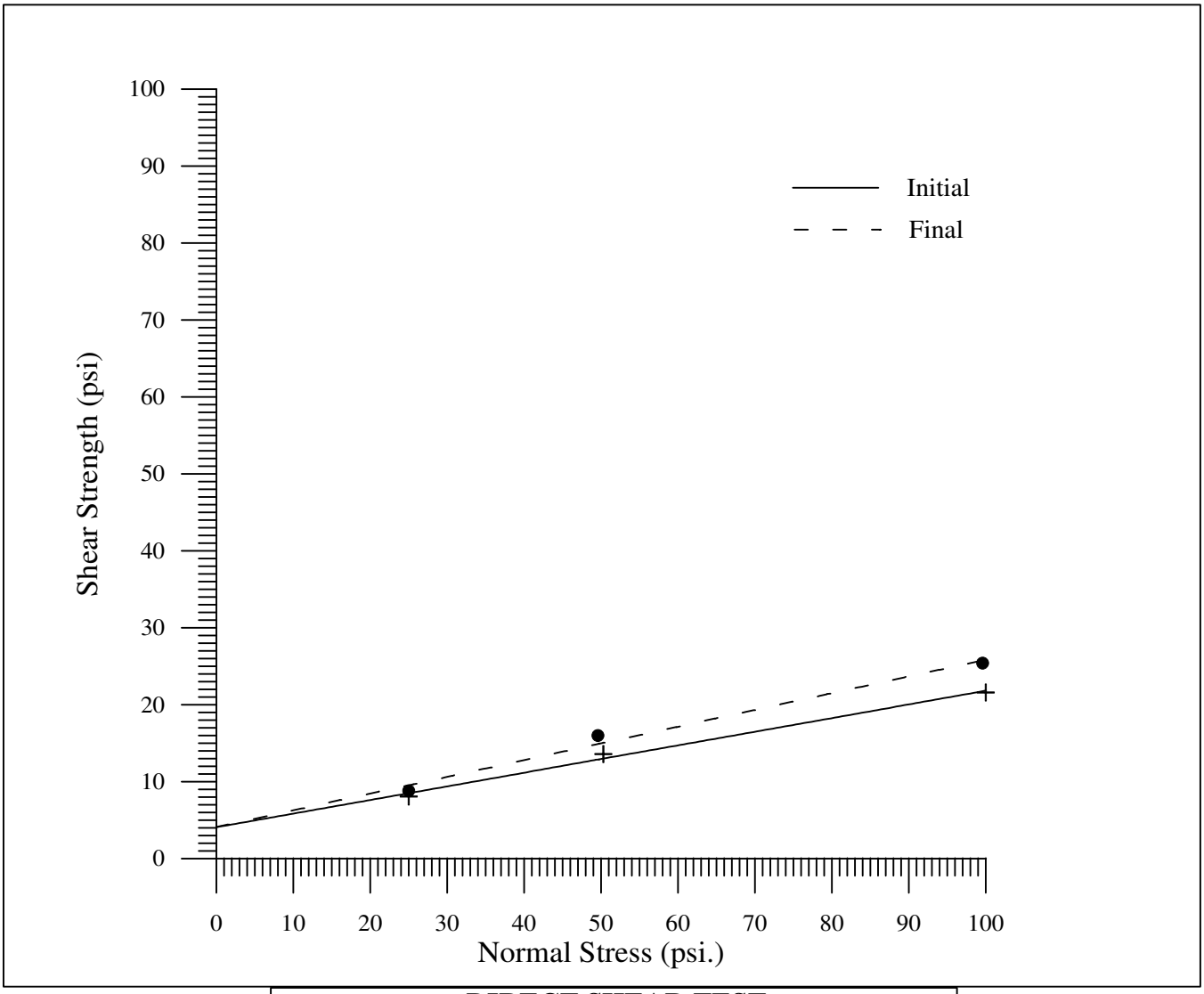
Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **October 11, 2007**



DIRECT SHEAR TEST
Failure Envelope Normal Stress vs. Shear Strength

Sample: 11-102
Boring: RKS-11-07
Depth: 107.3-107.8'

DESCRIPTION

Planar joint with firm brown clay filling in meta-welded lapilli tuff.

	Shear Intercept (psi)	Friction Angle (degrees)
Initial	4.1	10.1
Final	4.1	12.3

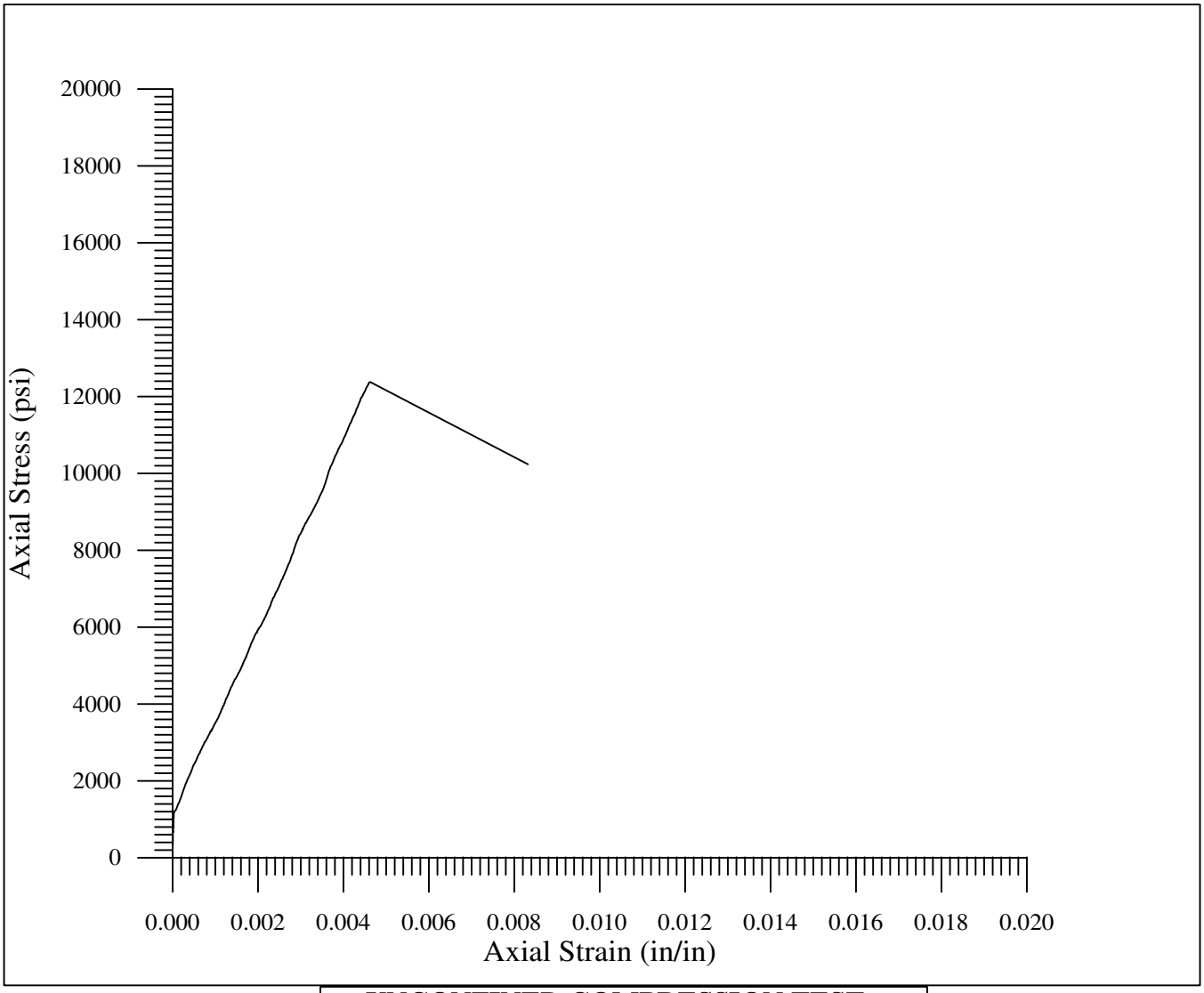
Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **October 11, 2007**



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 01-102B
Boring: RKS-01-07
Depth: 44.8-45.5'

DESCRIPTION

Dark gray meta-andesite with a healed calcite vein and calcite inclusions.

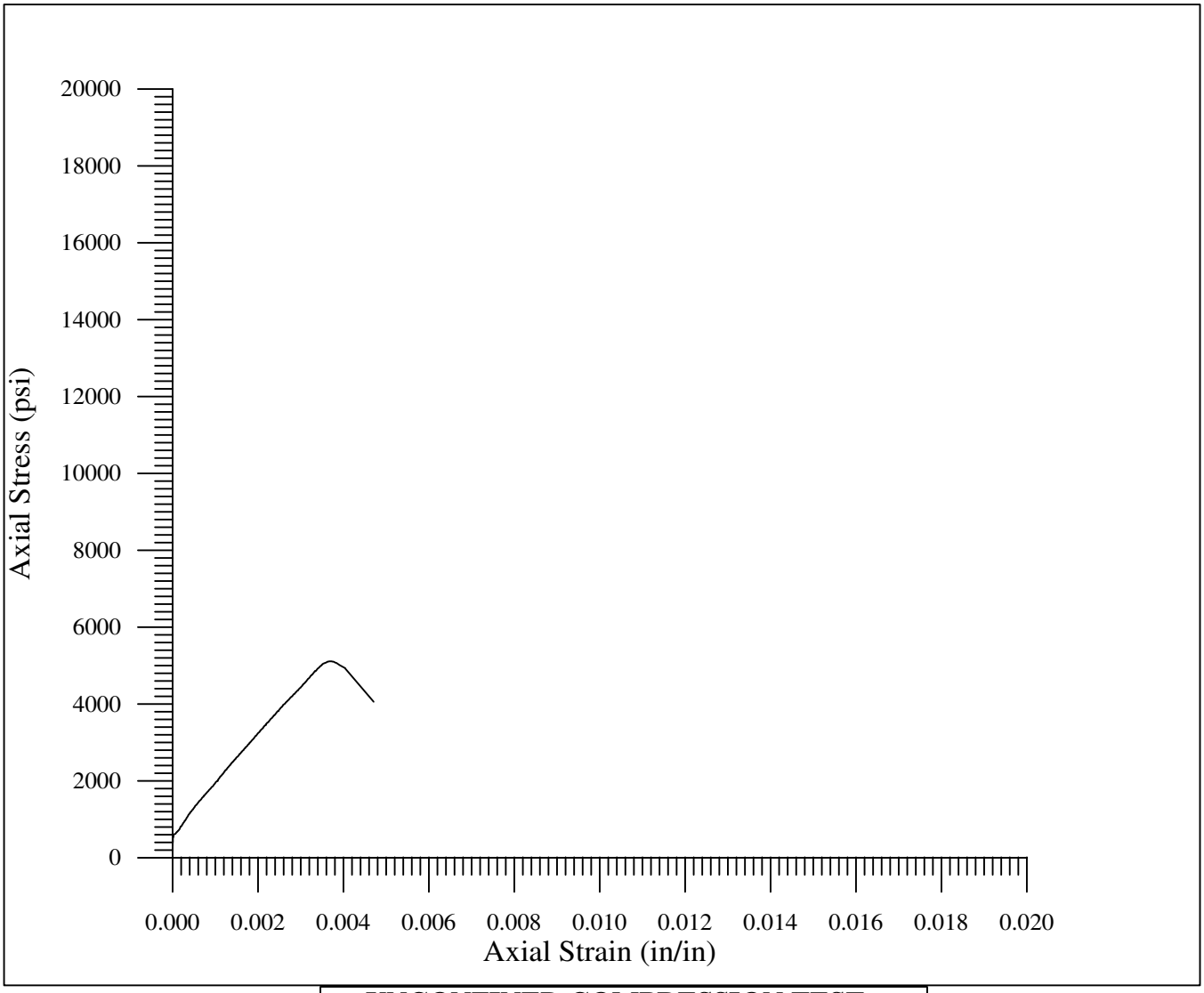
Density: 171.6 pcf
Strength: 12,380 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: I-90 Hyak Realignment
Project Number: 03-2007

Test Date: October 10, 2007



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 03-102B
Boring: RKS-03-07
Depth: 71.6-72.3'

DESCRIPTION

Dark gray fine grained and dark greenish gray medium grained meta-lapilli tuff.

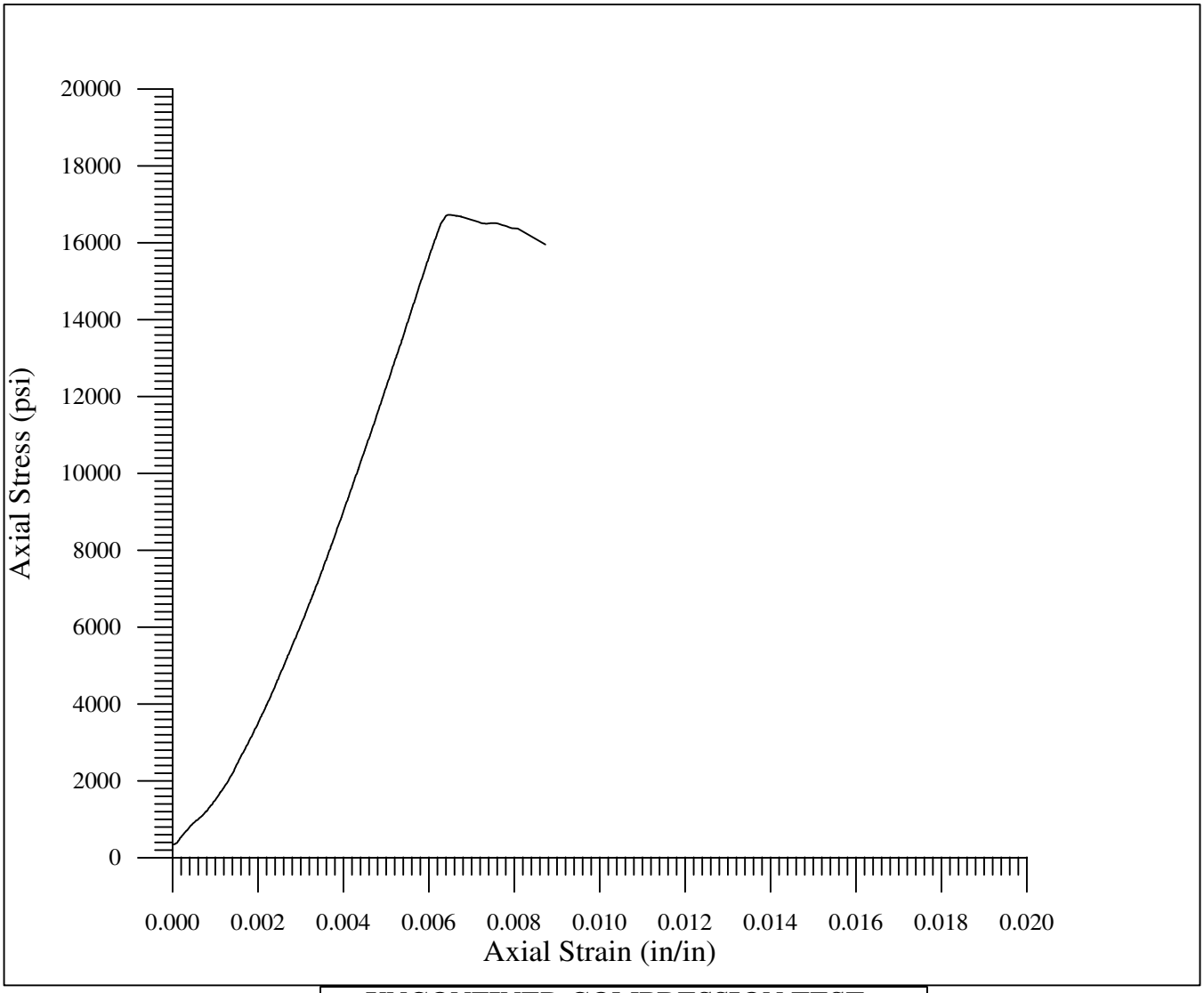
Density: 165.1 pcf
Strength: 5113 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: I-90 Hyak Realignment
Project Number: 03-2007

Test Date: October 10, 2007



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 04-101B
Boring: RKS-04-07
Depth: 25.2-26.0'

DESCRIPTION

Medium gray meta-welded lapilli tuff with no apparent planes of weakness.

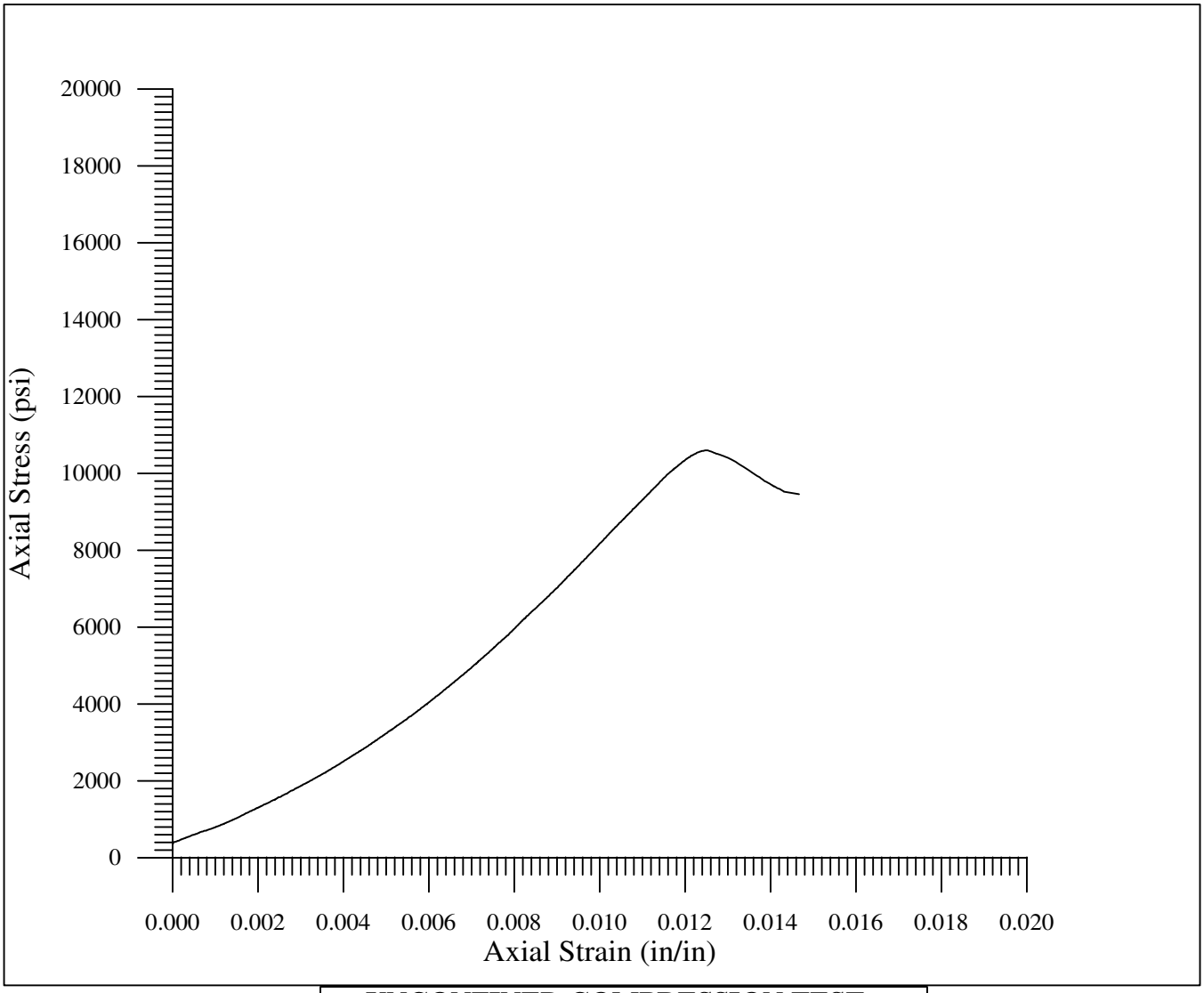
Density: 160.2 pcf
Strength: 16,725 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: I-90 Hyak Realignment
Project Number: 03-2007

Test Date: October 10, 2007



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 05-101B
Boring: RKS-05-07
Depth: 15.7-16.4'

DESCRIPTION

Dark purplish gray meta-basalt
with no apparent planes of weakness.

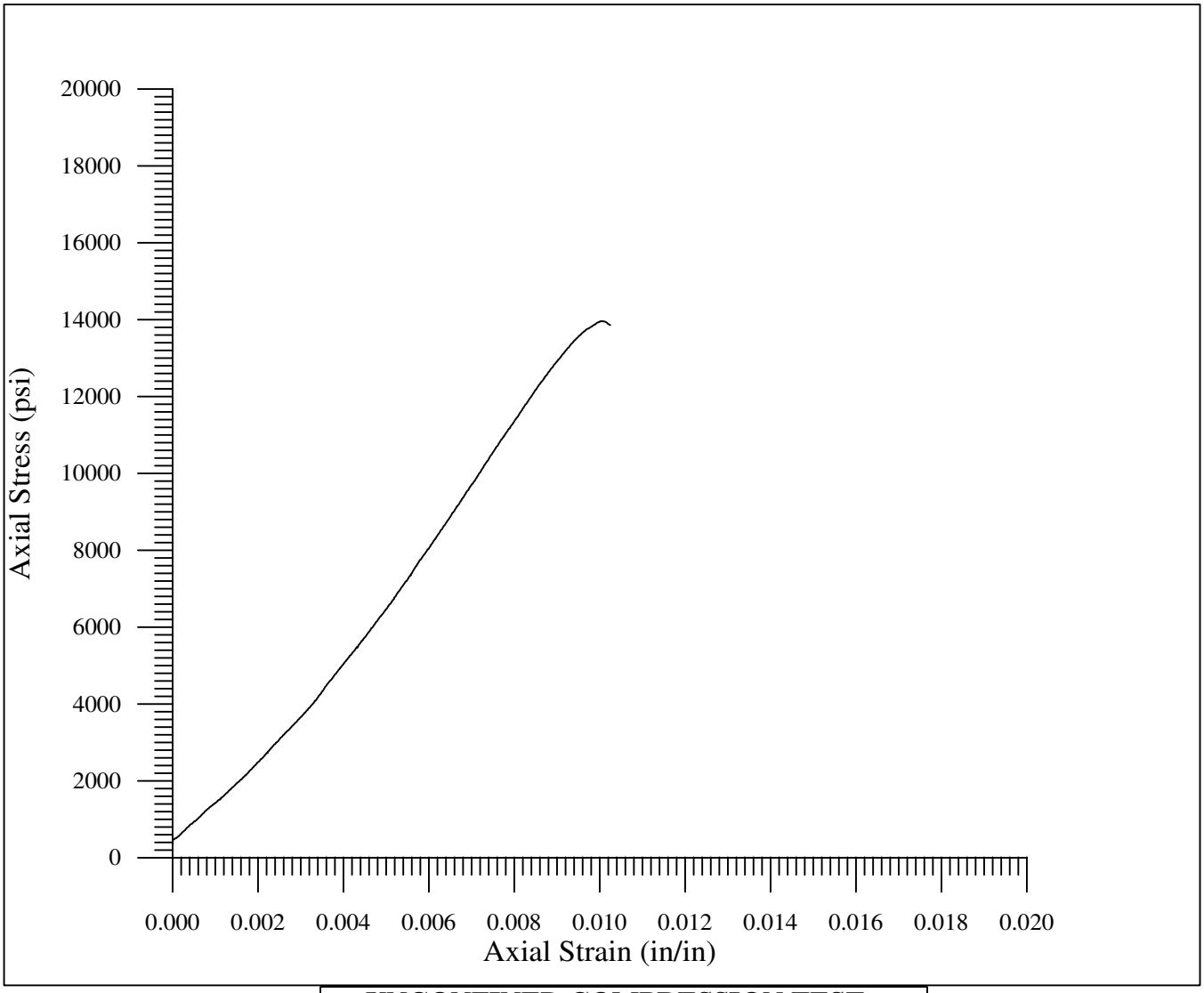
Density: 156.7 pcf
Strength: 10,599 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: I-90 Hyak Realignment
Project Number: 03-2007

Test Date: October 10, 2007



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 05-103A
Boring: RKS-05-07
Depth: 59.5-60.1'

DESCRIPTION

Dark purplish gray and dark greenish gray breciated andesite with no apparent planes of weakness.

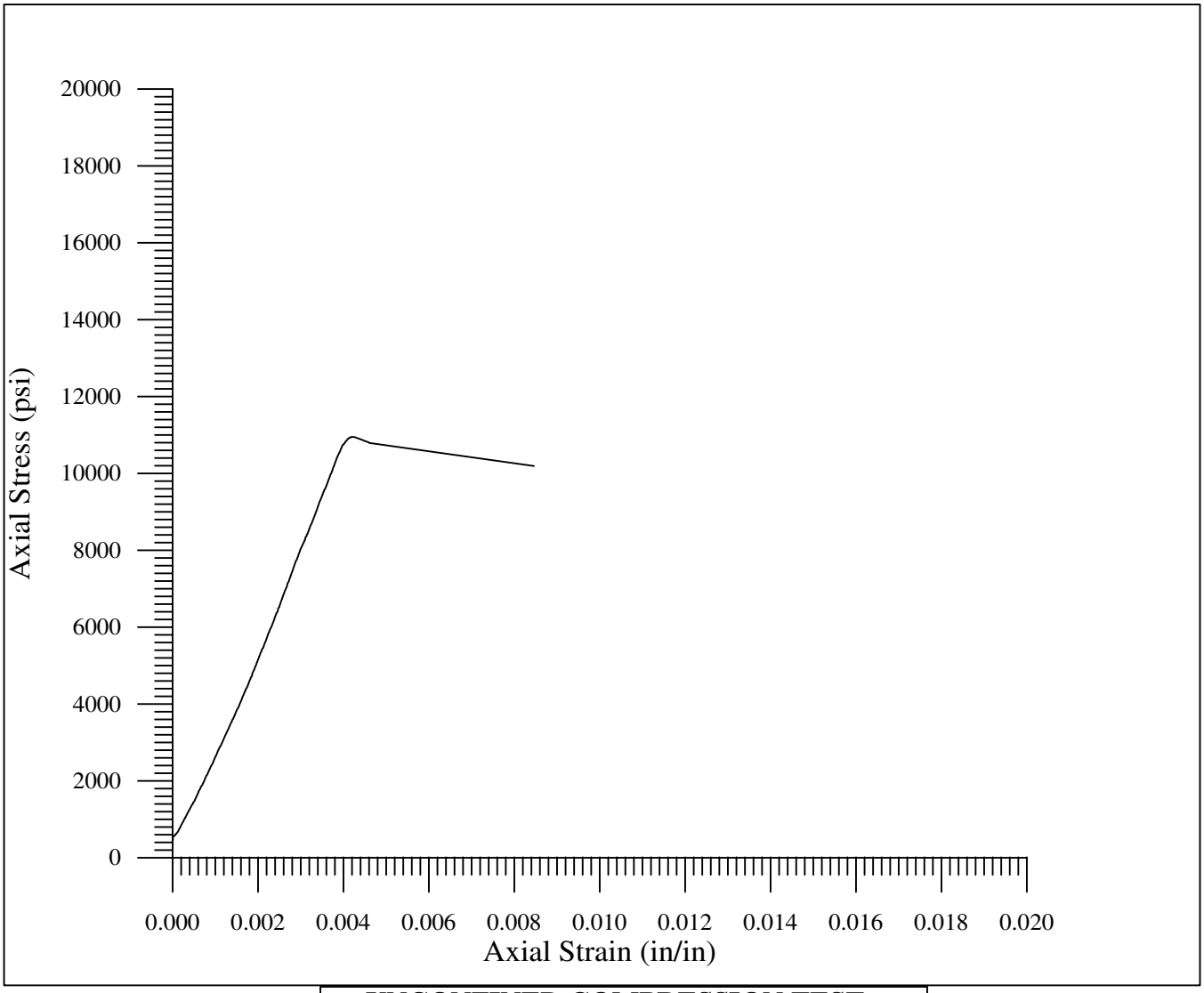
Density: 165.6 pcf
Strength: 13,961 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: I-90 Hyak Realignment
Project Number: 03-2007

Test Date: October 10, 2007



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 06-101A
Boring: RKS-06-07
Depth: 35.1-35.8'

DESCRIPTION

Dark gray meta-andesite with
quartz healed fractures and tight fractures.

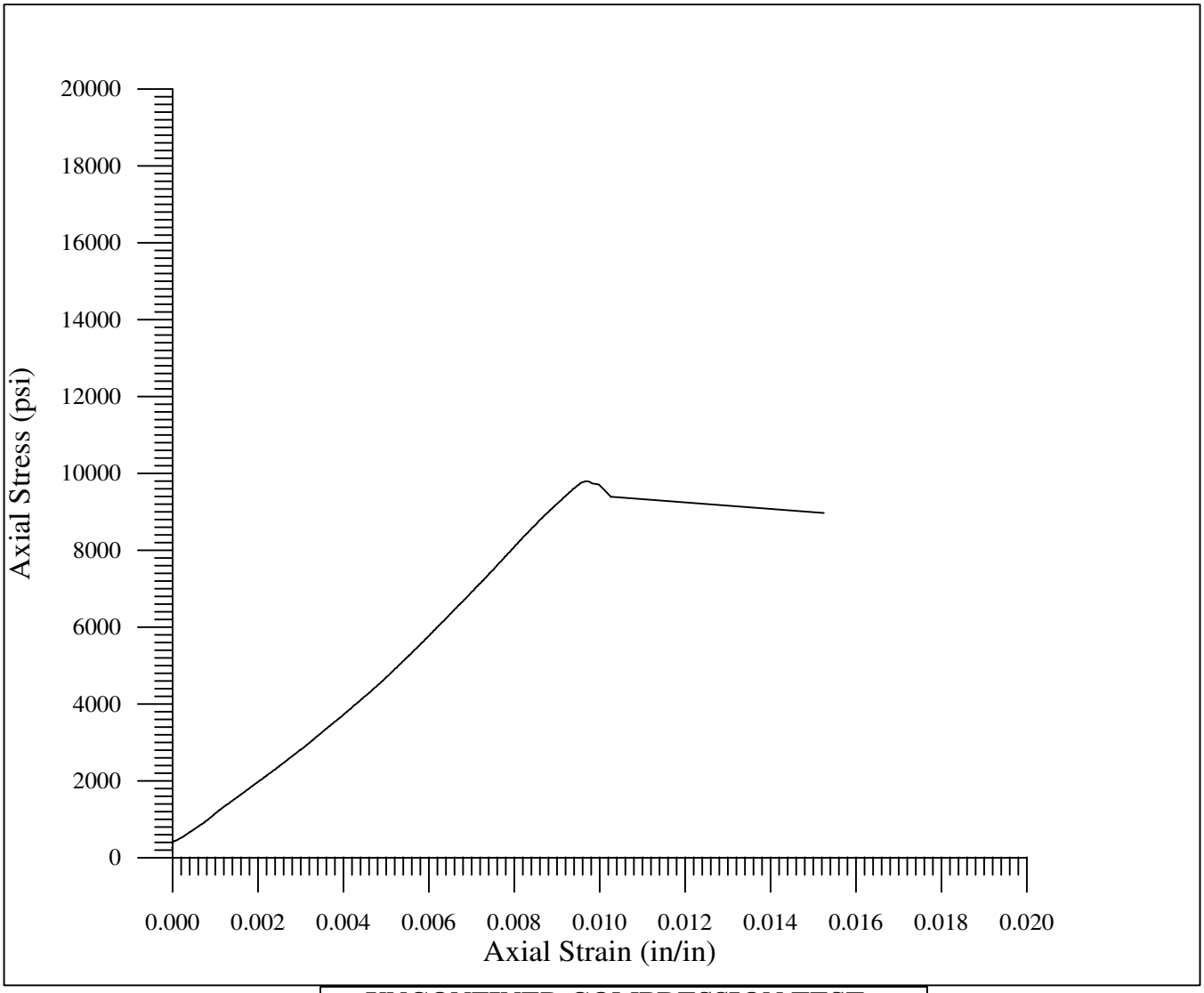
Density: 174.6 pcf
Strength: 10,946 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: I-90 Hyak Realignment
Project Number: 03-2007

Test Date: October 10, 2007



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 08-101A
Boring: RKS-08-07
Depth: 10.0-10.7'

DESCRIPTION

Medium gray meta-welded lapilli tuff with no apparent planes of weakness.

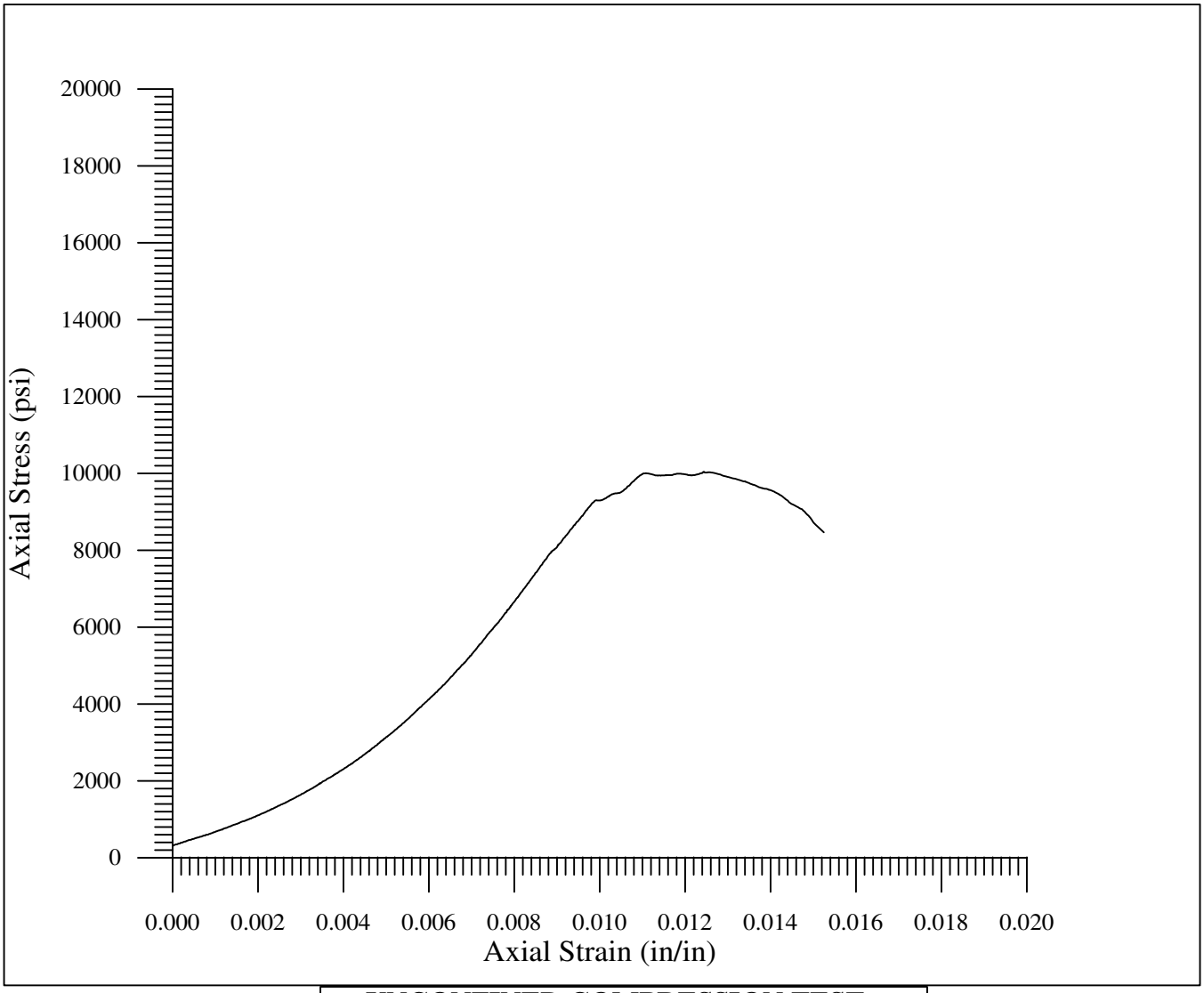
Density: 158.1 pcf
Strength: 9795 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: I-90 Hyak Realignment
Project Number: 03-2007

Test Date: October 10, 2007



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 09-102B
Boring: RKS-09-07
Depth: 41.9-42.6'

DESCRIPTION

Medium gray meta-welded lapilli tuff with no apparent planes of weakness.

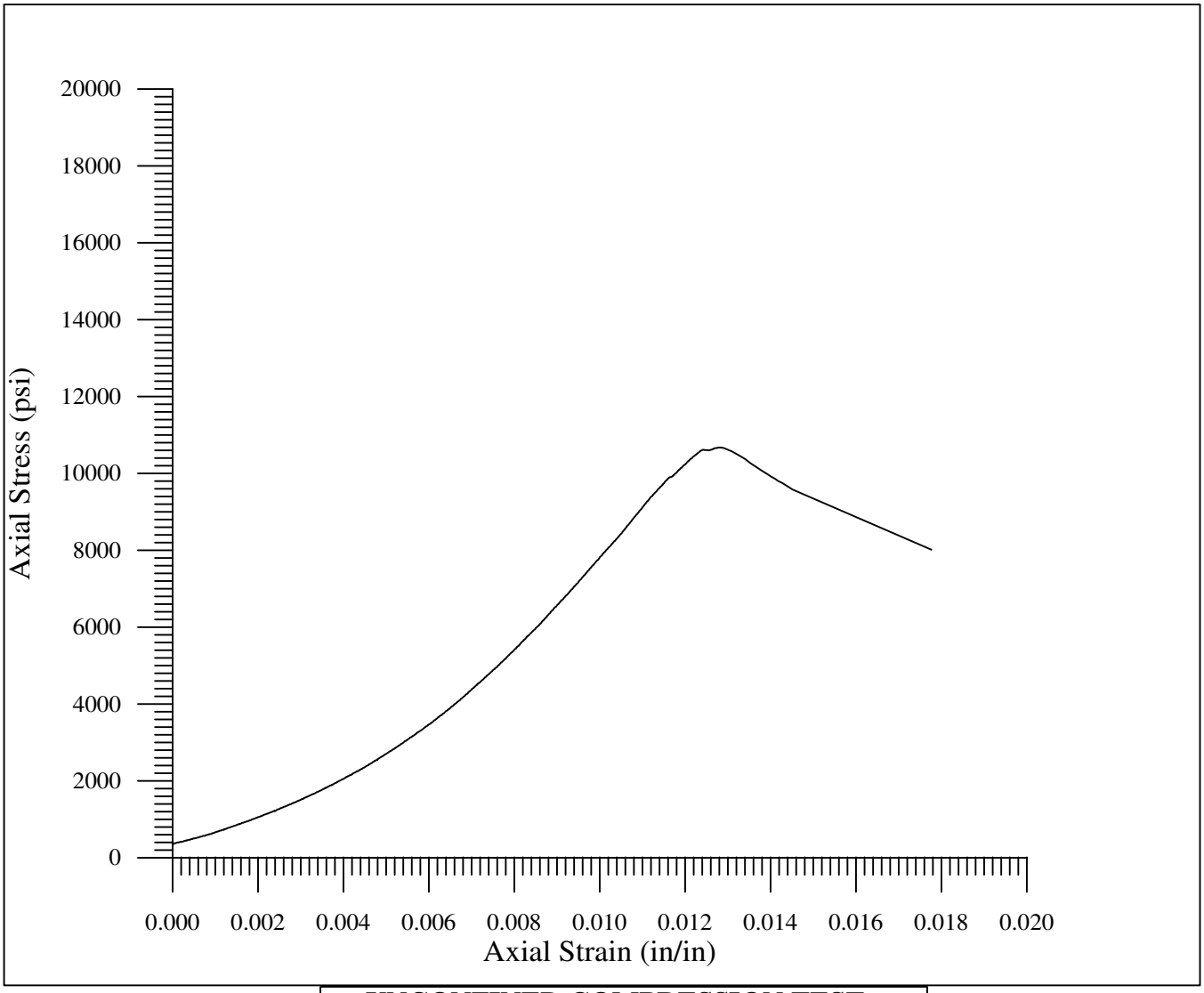
Density: 156.6 pcf
Strength: 10,040 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: I-90 Hyak Realignment
Project Number: 03-2007

Test Date: October 10, 2007



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 10-2A
Boring: RKS-10-07
Depth: 74.1-74.8'

DESCRIPTION

Medium gray meta-welded lapilli tuff with no apparent planes of weakness.

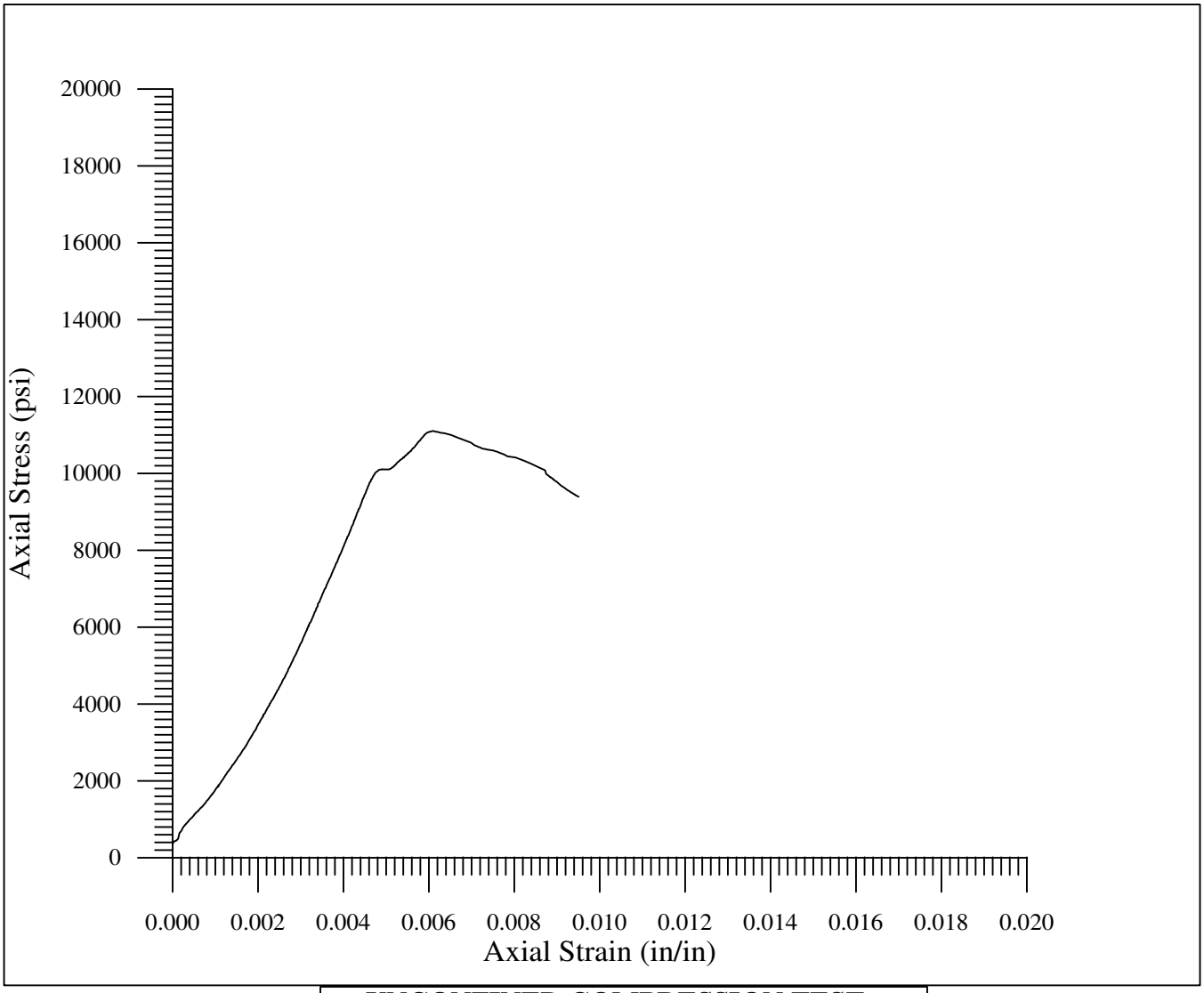
Density: 154.6 pcf
Strength: 10,674 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: I-90 Hyak Realignment
Project Number: 03-2007

Test Date: October 10, 2007



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 11-101A
Boring: RKS-11-07
Depth: 64.1-64.8'

DESCRIPTION

Medium gray meta-welded lapilli tuff with a few tight fractures.

Density: 161.3 pcf
Strength: 11,100 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: I-90 Hyak Realignment
Project Number: 03-2007

Test Date: October 10, 2007

Geo Test Unlimited

Test Equipment Design & Fabrication
Laboratory & Field Testing
Consulting Services

Dr. Anders Bro

January 24, 2008

Rock Testing
East I90 Hyak Extension

Wyllie & Norrish Rock Engineers
17918 NE 27th St.
Redmond, WA 98052

Dear Norm,

This letter report summarizes the unconfined compression, point load, and direct shear tests performed on the samples that you had sent to my lab last month. The report summarizes the test results along with some comments about the testing program that you might find helpful in interpreting the results. The standard test procedures used for these tests are appended to this letter, along with a compact disk containing the data files and photographs of the pre-and post-test samples.

Of the all the samples sent to me, I ended up performing 31 unconfined compression tests, 52 point load tests, and 10 direct shear tests. All of the rock consisted of a meta welded lapilli tuff, with varying degrees of alteration. The hardest rock consisted of a medium blue gray rock. The intermediate strength rock appeared to be a lighter gray, with no blue cast to it. The weakest rock was brown oxide stained rock, clearly weakened by alteration. When cutting the samples with the continuous diamond rimmed rock saw blade, the blue-gray and medium gray rock behaved in a peculiar manner. Even though the rock appeared to cut relatively quickly, it tended to load up the blade and stall the saw. When the length of the cut was short, the saw cut very quickly, however when the length of cut extended (ie half way through the sample), the saw bogged down. I assume it was due to the rock flour that bore against the saw blade increasing the friction and preventing the diamonds from bearing against the virgin rock. The lighter gray rock was significantly easier to cut than the medium blue-gray rock.

Some of the samples contained large clasts of either heavily altered material or they were naturally weak. These light gray materials looked as if they had been a tuff that was either quite weak as deposited, or had partially altered to clay. These inclusions had little cohesion and were either clay-like or silt-like.

The desire was to perform two point load tests (one axial and one diametral test) on the companion samples to the unconfined compression tests. For a few of the samples, no companion samples were available and I tested what I could of the sample cut-off pieces. Four of the direct shear tests were performed on saw-cut interfaces. These samples were extracted from the hard parent rock and were ground flat with a diamond surfacing plate. The remaining six direct shear sample consisted of fairly planar filled joints, typically dipping at high angles. (See the raw data sheets for the measured dip angles.)

Unconfined Compression and Point Load Testing

The objective of this testing program was to perform a set of unconfined compression tests along with companion axial and diametral point load tests so that a reasonable correlation between the test values could be developed. For each pair of samples (labeled –A and –B) the least fractured samples were chosen for the unconfined compression tests. An effort was also made to cut unfractured samples for the axial point

27069 N. Bloomfield Rd. Nevada City, CA 95959 Tel/Fax (530)470-0583 email: abro@saber.net

load tests. It was felt that it should be possible to find a suitable diametral point load sample from the remaining core.

The tests were performed according to the appended test procedures and the test results are tabulated as follows:

Unconfined Compressive Strength and Point Load Test Results

Boring/ Sample #	Depth (ft.)	Description	Density (pcf)	Corrected Point Load (psi)	UC Strength (psi)
SI-1-07 #101	32.0-32.7	Medium brown meta welded lapilli tuff, altered and friable with an open oxide coated fracture.	155.1		4680
SI-2-07 #103A	53.4-54.0	Medium brown meta welded lapilli tuff, altered with several oxide healed joints.	160.5	203[1.2.d.]	2901
SI-4-07 #101A	23.6-24.5	Medium blue gray meta welded lapilli tuff with a glued fracture at one end.	162.9		23,469
SI-4-07 #101B	24.5-25.3	Medium blue gray meta welded lapilli tuff.		1531[d] 993[a]	
SI-5-07 #102A	33.9-34.8	Light greenish gray meta welded lapilli tuff with no apparent planes of weakness.	165.0		29,523
SI-5-07 #102B	34.8-35.7	Light greenish gray meta welded lapilli tuff.		1170[d] 1043[a]	
SI-5-07 #103	56.9-57.6	Medium brown meta welded lapilli tuff, slightly altered with two minor oxide stained non-through-going joints.	158.6	95[2.d.]	3782
SI-7-07 #101A	35.6-36.3	Medium blue gray meta welded lapilli tuff.		993[1.d.] 774[a]	
SI-7-07 #101B	36.9-37.4	Medium gray meta welded lapilli tuff with slight oxide staining but no apparent planes of weakness.	163.5		26,444
SI-9-07 #201	42.4-43.1	Light to medium brown meta welded lapilli tuff, somewhat friable with several oxide stained joints.	158.9	72[2.d.]	3348
SI-10-07 #101A	24.7-25.4	Medium blue gray meta welded lapilli tuff with no apparent planes of weakness.	163.5		21,770
SI-10-07 #101B	26.8-27.6	Medium blue gray meta welded lapilli tuff.		1464[d] 934[a]	

Unconfined Compressive Strength and Point Load Test Results (cont.)

RKS-12-07 #101A	28.9-29.5	Medium gray meta welded lapilli tuff.		1365[d] 1235[a]	
RKS-12-07 #101B	29.5-30.3	Medium blue gray meta welded lapilli tuff with a few light green zones of matrix, with no apparent planes of weakness.	164.0		31,257
RKS-12-07 #103A	124.0-124.6	Medium gray meta welded lapilli tuff.		848[d] 288[2.a.]	
RKS-12-07 #103B	124.6-125.3	Medium blue gray meta welded lapilli tuff with an axial healed hairline joint.	164.3		23,952
RKS-13-07 #102	19.0-19.7	Medium brown meta welded lapilli tuff, somewhat altered with zones of lighter brown, more severely altered matrix.	155.7	91[2.d.]	4120
RKS-13-07 #104A	44.1-44.6	Light greenish gray meta welded lapilli tuff, slightly altered with light green, more altered inclusions with no apparent planes of weakness.	162.6		8184
RKS-13-07 #104B	44.6-45.1	Light greenish gray meta welded lapilli tuff.		425[d] 801[a]	
RKS-14-07 #103A	78.2-78.8	Light greenish gray meta welded lapilli tuff.		259[d] 222[a]	
RKS-14-07 #103B	78.8-79.4	Light greenish gray meta welded lapilli tuff, slightly altered with light green, more altered inclusions with one minor end fracture.	159.0		5805
RKS-15-07 #102A	20.5-21.1	Brown fractured and altered meta welded lapilli tuff.		121[d] 37[a]	
RKS-15-07 #102B	21.1-21.8	Medium brown meta welded lapilli tuff, altered with weak end fractures that have been glued.	151.6		3250
RKS-15-07 #105A	120.0-120.5	Medium brown meta welded lapilli tuff, altered with a few thin planar zones of weakness.	159.6		8287
RKS-15-07 #105B	120.5-121.1	Light brownish gray fractured and altered meta welded lapilli tuff.		366[d] 148[a]	
RKS-16-07 #101A	47.0-47.6	Light brownish gray fractured and altered meta welded lapilli tuff.		397[d] 277[a]	
RKS-16-07 #101B	47.6-48.2	Medium brown meta welded lapilli tuff, oxide stained with a small light gray clay(?) zone and one non-through-going fracture.	159.3		6408

Unconfined Compressive Strength and Point Load Test Results (cont.)

RKS-17-07 #102	53.3-54.0	Meta welded lapilli tuff, medium brown and blue gray clasts in a light gray matrix, with a few non-through-going fractures.	156.2	430[d]	7767
RKS-18-07 #102A	72.0-72.5	Dark gray fractured meta welded lapilli tuff.		317[d] 193[a]	
RKS-18-07 #102B	72.5-72.9	Dark gray heavily fractured meta welded lapilli tuff.	159.4		6005
RKS-19-07 #102	30.4-31.4	Light gray meta welded lapilli tuff with several light blue inclusions altered to clay(?) with a glued end fracture.	156.4	259[d]	5959
RKS-19-07 #103A	55.6-56.3	Light gray meta welded lapilli tuff with light green clasts.		342[d] 405[a]	
RKS-19-07 #103B	56.3-57.0	Light gray meta welded lapilli tuff, with light blue inclusions altered to clay(?).	160.9		9148
RKS-20-07 #102A	64.8-65.4	Light gray meta welded lapilli tuff, with light blue inclusions altered to clay(?).	160.4		8358
RKS-20-07 #102B	65.4-66.1	Light gray meta welded lapilli tuff with light green clasts.		282[d] 230[a]	
RKS-22-07 #101A	11.7-12.5	Medium gray meta welded lapilli tuff with a tight end fracture.	166.0		9327
RKS-22-07 #101B	12.5-13.4	Light gray meta welded lapilli tuff with light green clasts (less altered).		645[d] 495[a]	
RKS-23-07 #101A	10.3-11.0	Medium blue gray meta welded lapilli tuff with no apparent planes of weakness.	163.2		23,917
RKS-23-07 #101B	11.0-11.7	Medium blue gray meta welded lapilli tuff.		996[d] 1097[a]	
RKS-26-07 #101A	28.2-28.8	Medium greenish gray meta welded lapilli tuff.		974[d] 852[1.a.]	
RKS-26-07 #101B	32.1-32.8	Medium blue gray meta welded lapilli tuff with no apparent planes of weakness.	163.9		16,267
RKS-27-07 #102A	28.5-29.2	Light to medium gray meta welded lapilli tuff with a few altered clasts.	164.6		18,597
RKS-27-07 #102B	29.2-29.9	Medium greenish gray meta welded lapilli tuff.		1197[d] 1061[a]	

Unconfined Compressive Strength and Point Load Test Results (cont.)

RKS-28-07 #102A	65.4-66.0	Light gray meta welded lapilli tuff with no apparent planes of weakness.	164.0		10,535
RKS-28-07 #102B	66.0-66.6	Light gray meta welded lapilli tuff.		468[d] 1286[a]	
RKS-28-07 #201	33.0-33.8	Medium brown meta welded lapilli tuff with a tight axial non-through-going fracture..	158.3	128[1.2.d.]	3588
RKS-28-07 #202	27.8-28.5	Medium brown meta welded lapilli tuff with two major axial fractures.	156.2	85[d]	1970
RKS-29-07 #102A	18.8-19.5	Medium gray meta welded lapilli tuff with no apparent planes of weakness. (finer clasts than the other samples)	159.4		14,605
RKS-29-07 #102B	20.6-21.2	Medium gray meta welded lapilli tuff.		602[d] 384[a]	
RKS-30-07 #103A	55.1-55.8	Medium blue gray meta welded lapilli tuff with no apparent planes of weakness.	161.7		43,320
RKS-30-07 #103B	55.8-56.4	Medium blue gray meta welded lapilli tuff.		1280[d] 1134[a]	
RKS-31-07 #103A	84.8-85.6	Medium blue gray meta welded lapilli tuff.		1580[d] 1403[a]	
RKS-31-07 #103B	83.5-84.3	Medium gray meta welded lapilli tuff with no apparent planes of weakness.	162.4		38,505

Notes: a. Axial Point Loading
d. Diametral Point Loading
1. Invalid – failure did not pass through both points of loading.
2. Failed along existing planes of weakness.

The most unique sample of this group were the samples from Boring RKS-18-07 from 72.0-72.9'. This rock looked a little more like basalt and was highly fractured with little if any cohesion. It was interesting to note that despite the high degree of fracturing, it still had a respectable strength (6005 psi). This sample failed in a somewhat ductile manner that I attribute to the interlocking of the short-length, non-through-going fractures.

Most of the rock appeared to characterized by a low grade of metamorphism in which the rock had been subjected to high temperature, but not necessarily elevated pressure. The rock had clearly been altered to varying degrees and some of the clasts were quite porous, a characteristic that I attribute to the clasts, as-placed. Some of these clasts had likely altered a bit to clay, but their texture was not particularly plastic, indicating a limited alteration.

The medium blue gray colored rock was clearly the strongest material, with strengths ranging from 21,770 psi to an extremely high strength of 43,320 psi. It may be that this rock is characterized by a higher grade of metamorphism and it clearly was not appreciably altered.

The brown altered rock was the weakest with strengths generally below 5000 psi. The weak brown colored rock was typically altered and jointed and the weakness seemed to be associated with failure along existing planes of weakness. These materials were also quite weak in the point load tests in which failures more often than not developed along pre-existing fractures.

The intermediate strength rocks generally consisted of the lighter creamy gray materials and seemed to fall in the 5000-10,000 psi range. Failures of these samples typically developed through the intact material.

Direct Shear Testing

Four tests were performed on saw-cut and ground interfaces created from strong sections of the intact rock. The other six samples consisted of clay filled discontinuities. Six additional direct shear samples were supplied for possible testing, but these were deemed of poorer quality or duplicated the samples that were selected for testing. The target normal stresses for these multistage tests were 10, 20, and 40 psi. They were tested according to the appended test procedures.

The saw-cut interfaces were created by cutting the intact core normal to the core axis and then grinding the resulting flat surfaces with a 120 grit diamond disk such as is used for creating thin sections. The purpose of the diamond grinding was to eliminate any ridges that might have developed during the sample cutting operation and to create a flat planar surface.

Before cutting the filled joint samples, the core was wrapped with heat-shrink plastic wrap. The purpose of this wrap was to reduce wash-out of the weak and erodible joint filling while cutting the samples to length. The heat-shrink wrap also helped hold the two sample halves together, reducing sample disturbance. The results were quite satisfactory, particularly in light of earlier experiences with trying to cut similar filled joints when not so confined.

The following table summarizes the direct shear test results:

Direct Shear Test Results

Boring/ Sample #	Depth (ft.)	Description	Shear Intercept (psi)	Friction Angle (deg.)
SI-2-07 #102A	40.4-41.4	Planar clay filled joint in medium gray and brown gray meta welded lapilli tuff. Light yellowish brown filling about 1/8” thick.	1.1^{i} 1.7^{f}	15.7^{i} 11.1^{f}
SI-2-07 #105	84.6-86.0	Planar clay filled joint in blue gray meta welded lapilli tuff. White filling with light brown interlacings about 1/8-3/8” thick.	6.6^{i} 1.2^{f}	16.7^{i} 13.0^{f}
SI-10-07 #104	43.4-44.0	Planar clay filled joint in fractured blue gray meta welded lapilli tuff. Light bluish white filling 1/4-5/8” thick with rock fragments.	3.2^{i} 1.9^{f}	16.9^{i} 15.7^{f}
RKS-13-07 #103	39.0-39.5	Wavy filled joint in medium brownish gray meta welded lapilli tuff. Light yellowish brown filling <1/8” thick.	4.6^{i} 1.7^{f}	18.07^{i} 18.5^{f}
RKS-19-07 #101	33.0-33.7	Planar filled joint in light gray meta welded lapilli tuff. Thick light bluish white filling.	0.6^{i} 3.3^{f}	19.9^{i} 15.9^{f}

Direct Shear Test Results (cont.)

RKS-19-07 #103B	56.3-57.0	Saw-cut and ground interface in light gray meta welded lapilli tuff with a few light bluish white friable clasts.	0.2[i] 1.7[f]	27.6[i] 31.5[f]
RKS-22-07 #101A	11.7-12.5	Saw-cut and ground interface in light gray meta welded lapilli tuff.	na(-0.6)[i] 0.8[f]	28.1[i] 33.3[f]
RKS-24-07 #102	36.3-36.9	Filled shear zone in blue gray meta welded lapilli tuff. Light bluish white filling in 5/8-1” wide shear zone with rock flakes.	3.7[i] na[1]	14.5[i] na[1]
RKS-29-07 #102A	18.8-19.5	Saw-cut and ground interface in medium greenish gray meta welded lapilli tuff, fine grained with clasts <1/8”.	na(-0.4)[i] 0.6[f]	26.7[i] 31.1[f]
RKS-30-07 #103A	55.1-55.6	Saw-cut and ground interface in medium blue gray meta welded lapilli tuff.	0.1[i] 0.8[f]	33.4[i] 39.2[f]

Notes: i. Initial strength parameter
f. Final strength parameter
na. The shear intercept is negative and not applicable
1. The shear box rotated and developed box-to-box contact preventing the evaluation of final values.

The saw-cut sample tests resulted in low shear intercepts of between –0.6 and 1.7. The negative intercepts are clearly inapplicable and are likely due to the strengthening of the interface as it incurred a shear displacement, thus effectively rotating the initial shear envelope in a counterclockwise manner, driving the intercept in a more negative direction. I have often encountered such negative intercepts for saw-cut interfaces and think that it is appropriate to simply ignore them and assume a zero intercept.

The saw-cut sample initial friction angles ranged from 26.7 to 33.4^{o}, with the three more altered materials resulting in a spread of 26.7-28.1^{o}. The least altered material, the blue gray rock, resulted in the highest friction angle, 33.4^{o}. An interesting aspect of these saw-cut tests was that all of the samples exhibited displacement hardening, and the final friction angles were on the order of 4-5° greater than the initial values. On post-test inspection, the interfaces were found to have been polished as a result of the testing. Patches of the interface were polished to the extent that they would readily reflect light. I tried to photograph this reflectivity, but could not capture the reflections in a convincing manner. It appears that this more polished surface is slightly more frictional than the slightly rougher ground interface. I am not sure which strength parameter would be more appropriate for characterizing the basic friction angle.

It should be noted that, as with all saw-cut and ground samples that I have tested, the interfaces exhibited a marked stick-slip behavior. The slip-action was accompanied by an audible “chunk” sound and was decidedly a dynamic event. As such, the stick-slip minima are a consequence of the dynamic overshoot of the slip event. The static friction angles are represented by the stick-slip peaks (used in this report to evaluate the failure envelopes) and the mid-points of the slip events likely represent the dynamic friction angles for this interface.

The filled joint tests were quite interesting. With the exception of Sample #102 from Boring RKS-24-07, in which the box rotated too much to obtain a set of final strength values, the remaining tests were of high quality, and at the normal stresses used, did not squeeze any appreciable amount of filling from the filled joints. For these samples, the initial shear intercepts were generally on the order of 3 psi whereas the final intercepts were a bit lower, typically on the order of 1 psi or so. The initial friction angles were quite low, in the mid-teens, whereas the final values were about 3-5 degrees lower. These low values are characteristic of clay fillings.

One of the most interesting aspects of these clay filled joint tests was the location of the shear plane. Often testing of such filled interfaces is precluded due to squeezing of the filling out of the joint. In instances where the filling is quite thick, another approach is taken of simply testing the filling material in a soil direct shear apparatus. Based on the behavior of these samples, I am starting to doubt the applicability of such a testing approach. That which was unique about these tests was that the fillings were strong enough to withstand the normal stresses without squeezing out of the joints. Thus good quality tests could be performed on these samples. A telling observation was that the samples generally sheared along the clay-rock interface. Clearly this interface was the weakest link in the samples. It would be very useful to know how strong the filling is in comparison to this rock-clay interface. Only then could one know how unconservative one might be in testing just the clay fillings.

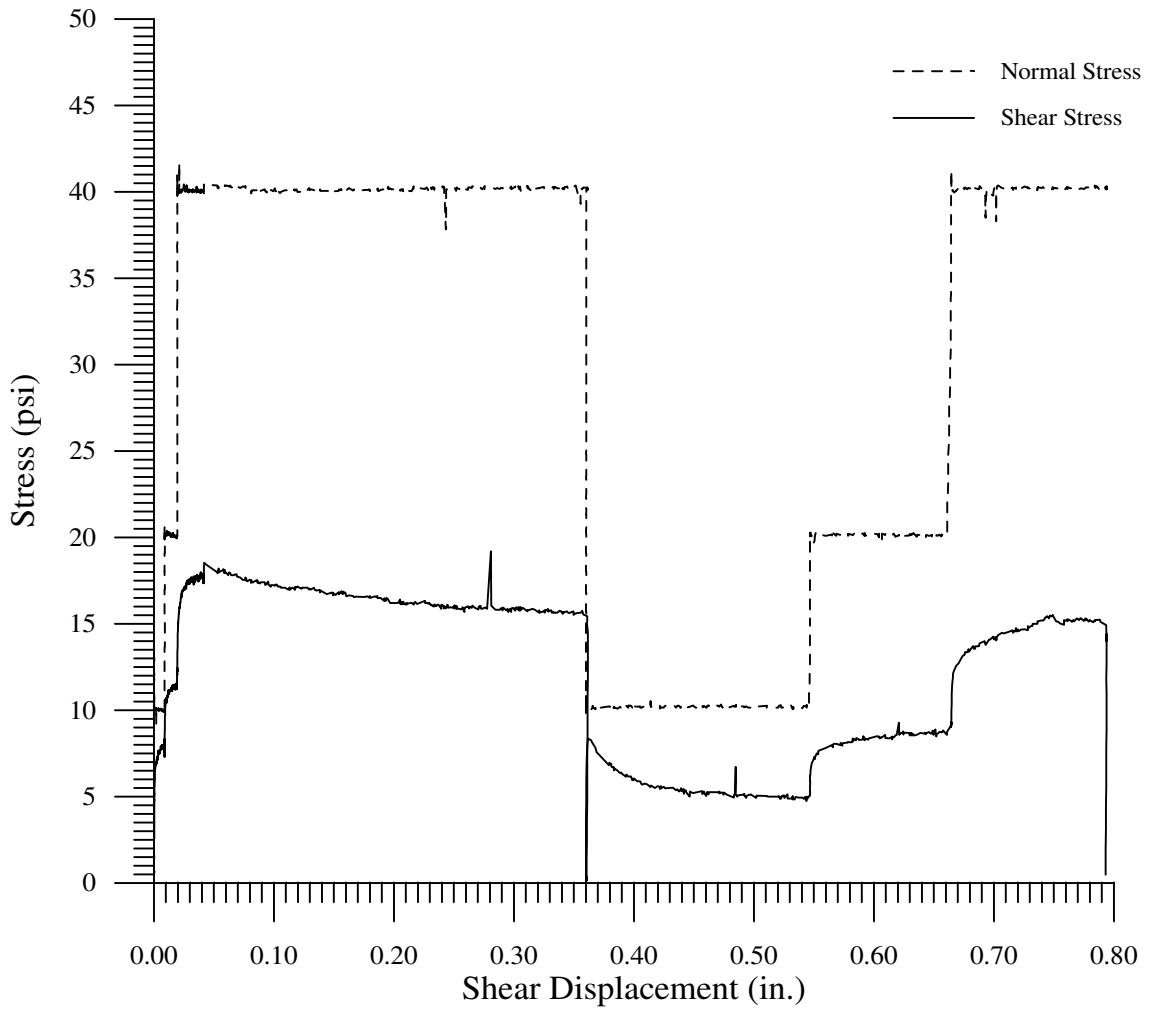
Sample #101 from Boring RKS-19-07 was somewhat problematic in the data reduction. It appeared that some of the altered parent rock penetrated through the filling and developed a rock-to-rock contact, significantly strengthening the interface. This strengthening can be seen at shear displacements of between 0.15 and 0.2 inches. I have done my best to choose the initial strengths (Expanding the displacement axis helps greatly.), but as with all of these test results, the engineer should evaluate the chosen strengths and assess the suitability of these choices for the design goals. It should also be noted that quite large shear displacements were required to reach final strength values. By the end of the test there was not a sufficient stroke remaining to measure the third final stage. Thus the final strength parameters for this sample are based on only two stages.

If you have any questions regarding these test results or the test procedures, please feel free to contact me so that we can discuss any of your concerns.

for GeoTest Unlimited

_____

Dr. Anders Bro



DIRECT SHEAR TEST
Shear and Normal Stress vs. Shear Displacement

Sample: 103
Boring: RKS-13-07
Depth: 39.0-39.5'

DESCRIPTION

Wavy filled joint in medium brownish gray meta welded lapilli tuff. Light yellowish brown filling <1/8" thick.

	Normal Stress (psi)	Shear Strength (psi)
Initial	10.0	7.8
	20.1	11.3
	40.0	17.6
Final	10.0	4.9
	20.0	8.7
	40.2	15.1

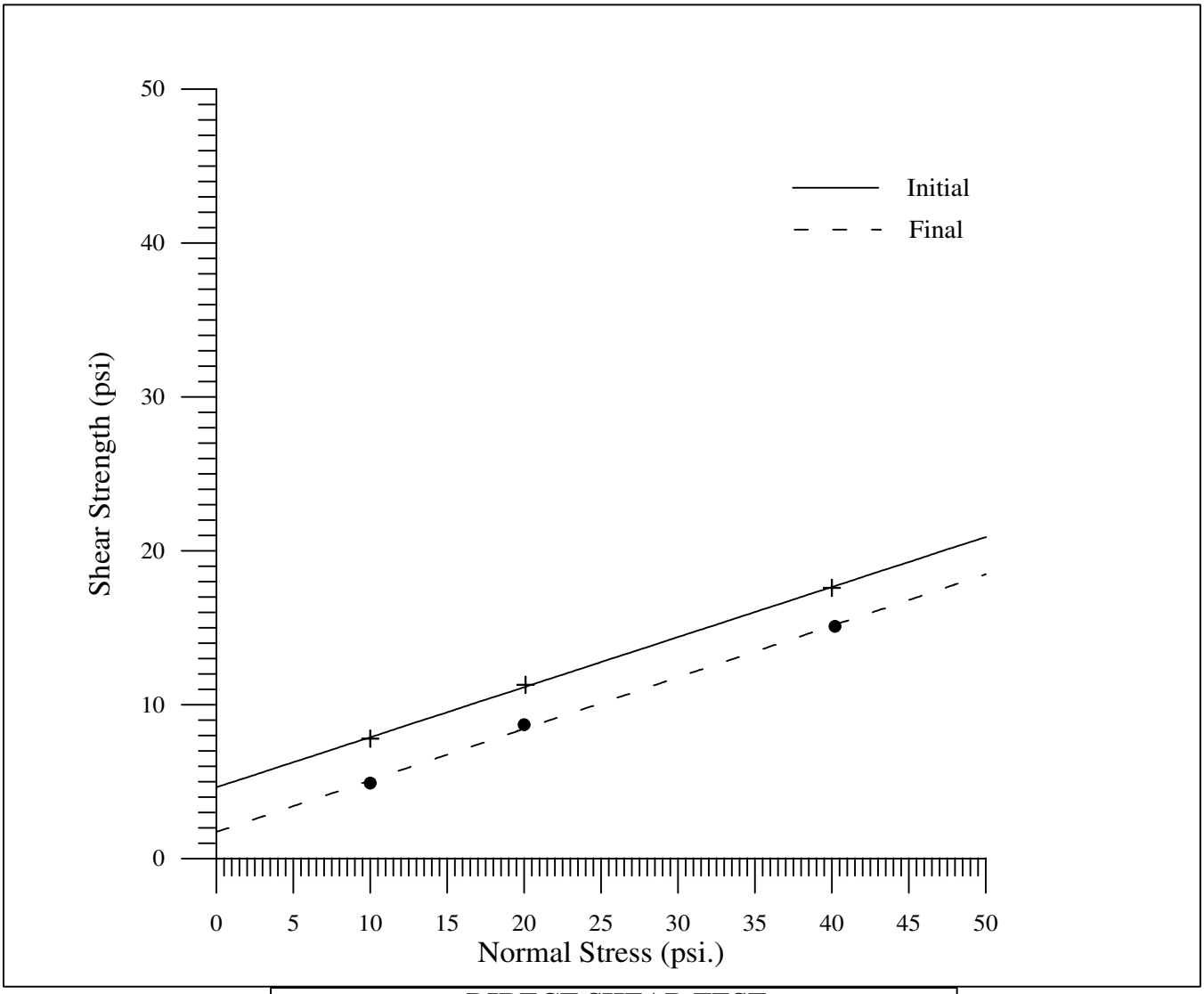
Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 22, 2008**



DIRECT SHEAR TEST
Failure Envelope Normal Stress vs. Shear Strength

Sample: 103
Boring: RKS-13-07
Depth: 39.0-39.5'

DESCRIPTION

Wavy filled joint in medium brownish gray meta welded lapilli tuff. Light yellowish brown filling <1/8" thick.

	Shear Intercept (psi)	Friction Angle (degrees)
Initial	4.6	18.0
Final	1.7	18.5

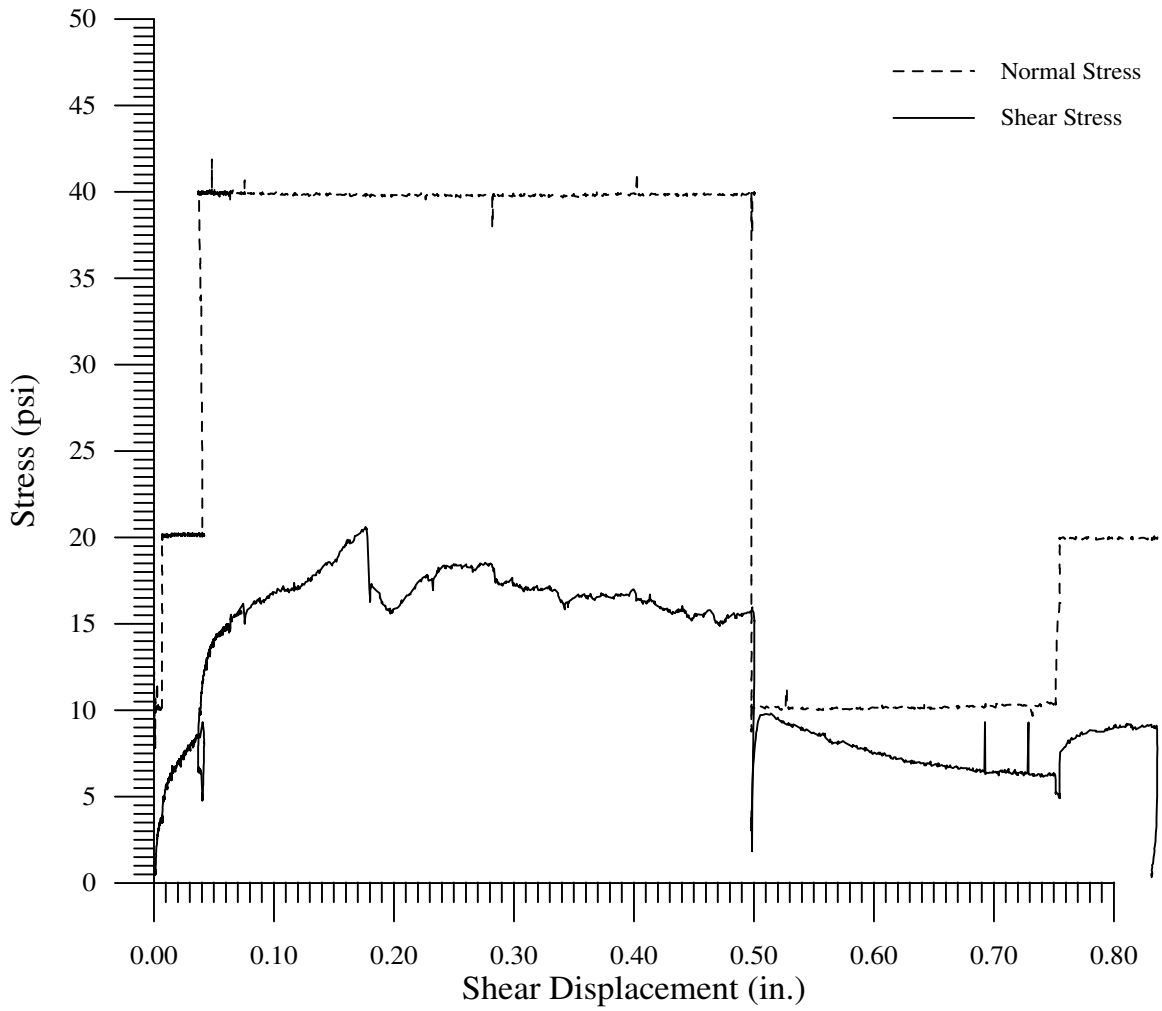
Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 22, 2008**



DIRECT SHEAR TEST
Shear and Normal Stress vs. Shear Displacement

Sample: 101
Boring: RKS-19-07
Depth: 33.0-33.7'

DESCRIPTION

Planar filled joint in light gray meta welded lapilli tuff. Thick light bluish white filling.

	Normal Stress (psi)	Shear Strength (psi)
Initial	10.0	3.8
	20.1	8.5
	39.9	14.8
Final	10.2	6.2
	20.0	9.0

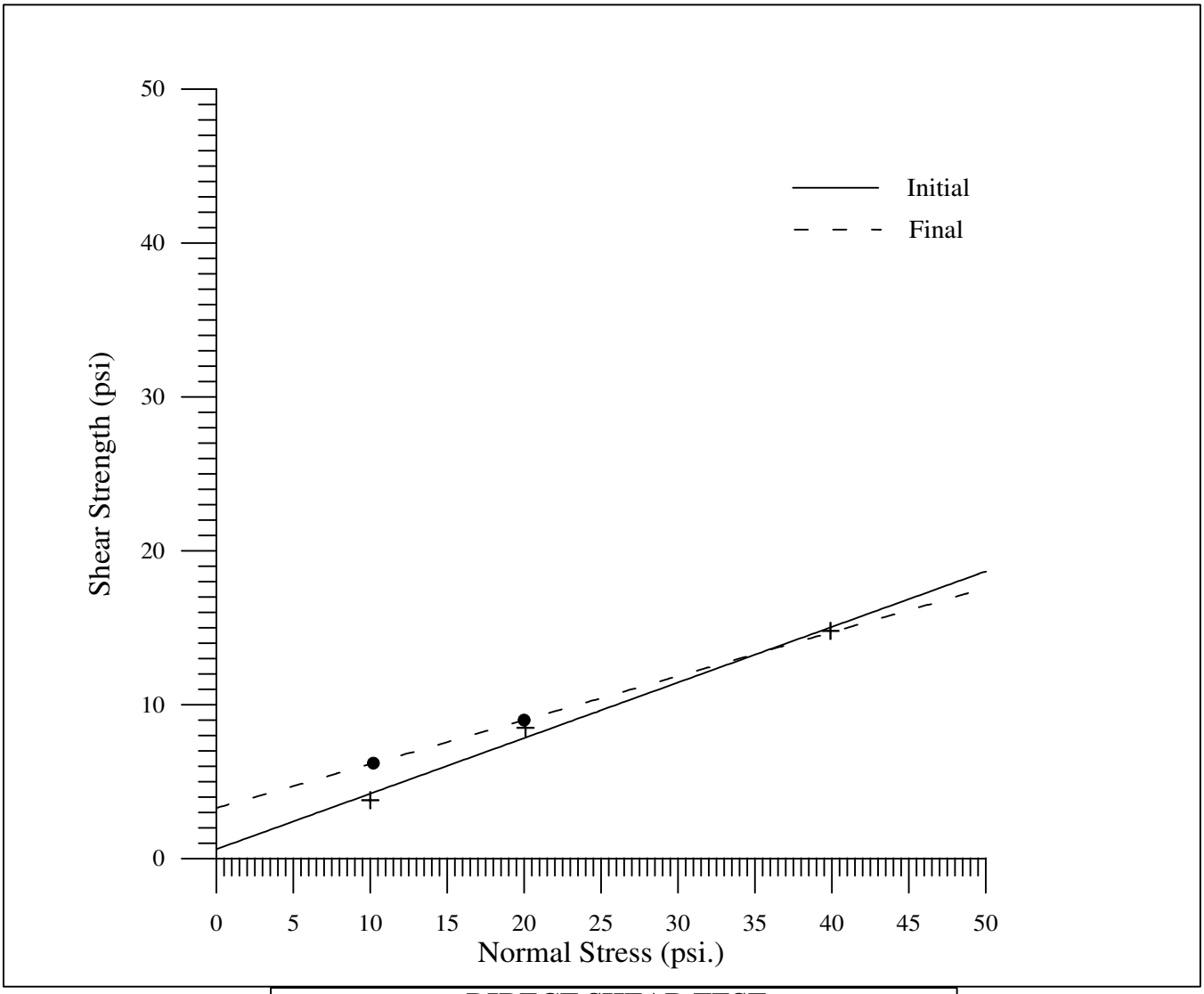
Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 23, 2008**



DIRECT SHEAR TEST
Failure Envelope Normal Stress vs. Shear Strength

Sample: 101
Boring: RKS-19-07
Depth: 33.0-33.7'

DESCRIPTION

Planar filled joint in light gray meta welded lapilli tuff. Thick light bluish white filling.

	Shear Intercept (psi)	Friction Angle (degrees)
Initial	0.6	19.9
Final	3.3	15.9

Geo Test Unlimited GTU

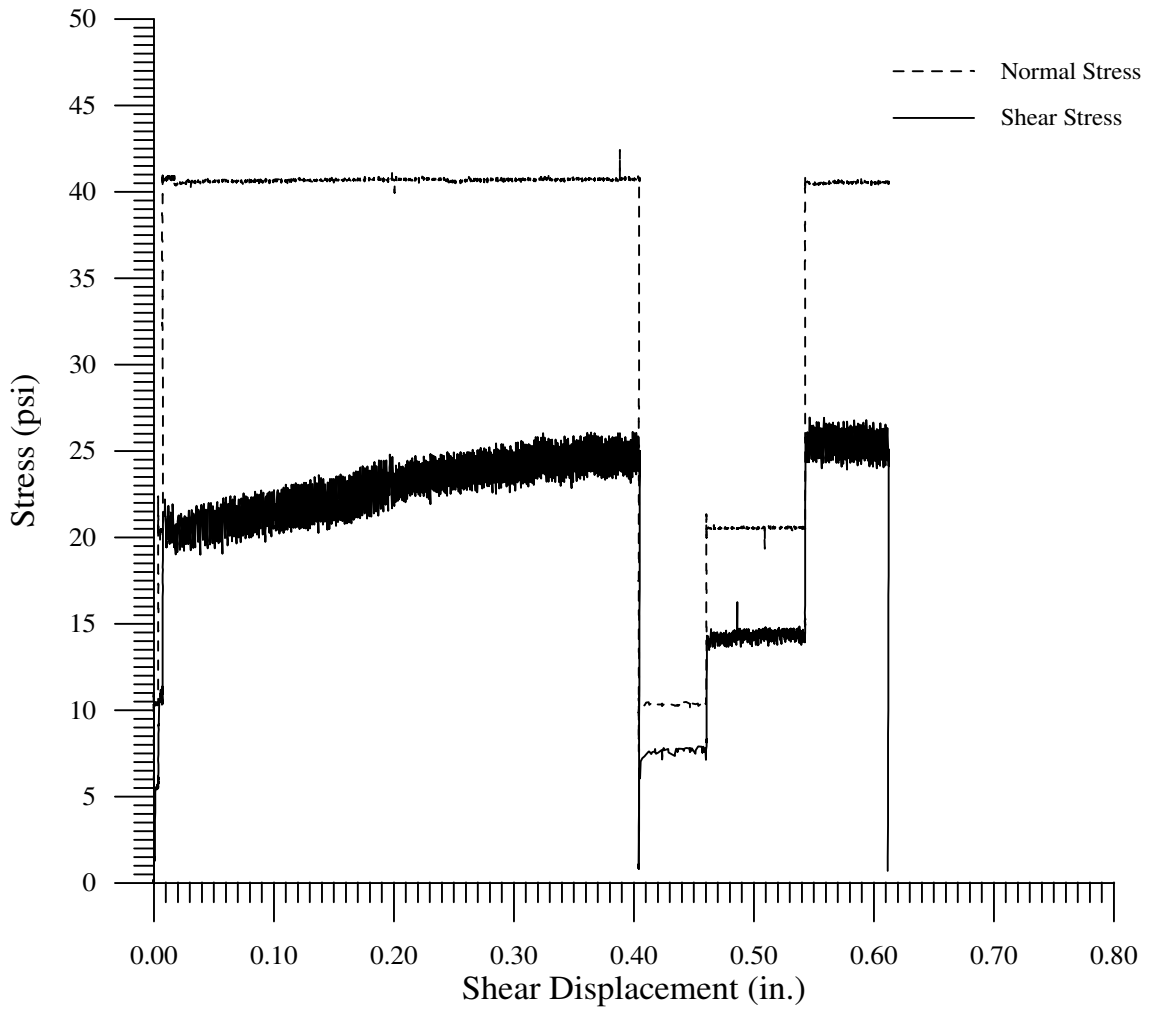
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 23, 2008**



DIRECT SHEAR TEST
Shear and Normal Stress vs. Shear Displacement

Sample: 103B
Boring: RKS-19-07
Depth: 56.3-57.0'

DESCRIPTION

Saw-cut interface in light gray meta welded lapilli tuff with a few large light bluish white friable clasts.

	Normal Stress (psi)	Shear Strength (psi)
Initial	10.3	5.6
	20.5	10.9
	40.7	21.5
Final	10.3	7.7
	20.5	14.6
	40.5	26.3

Geo Test Unlimited GTU

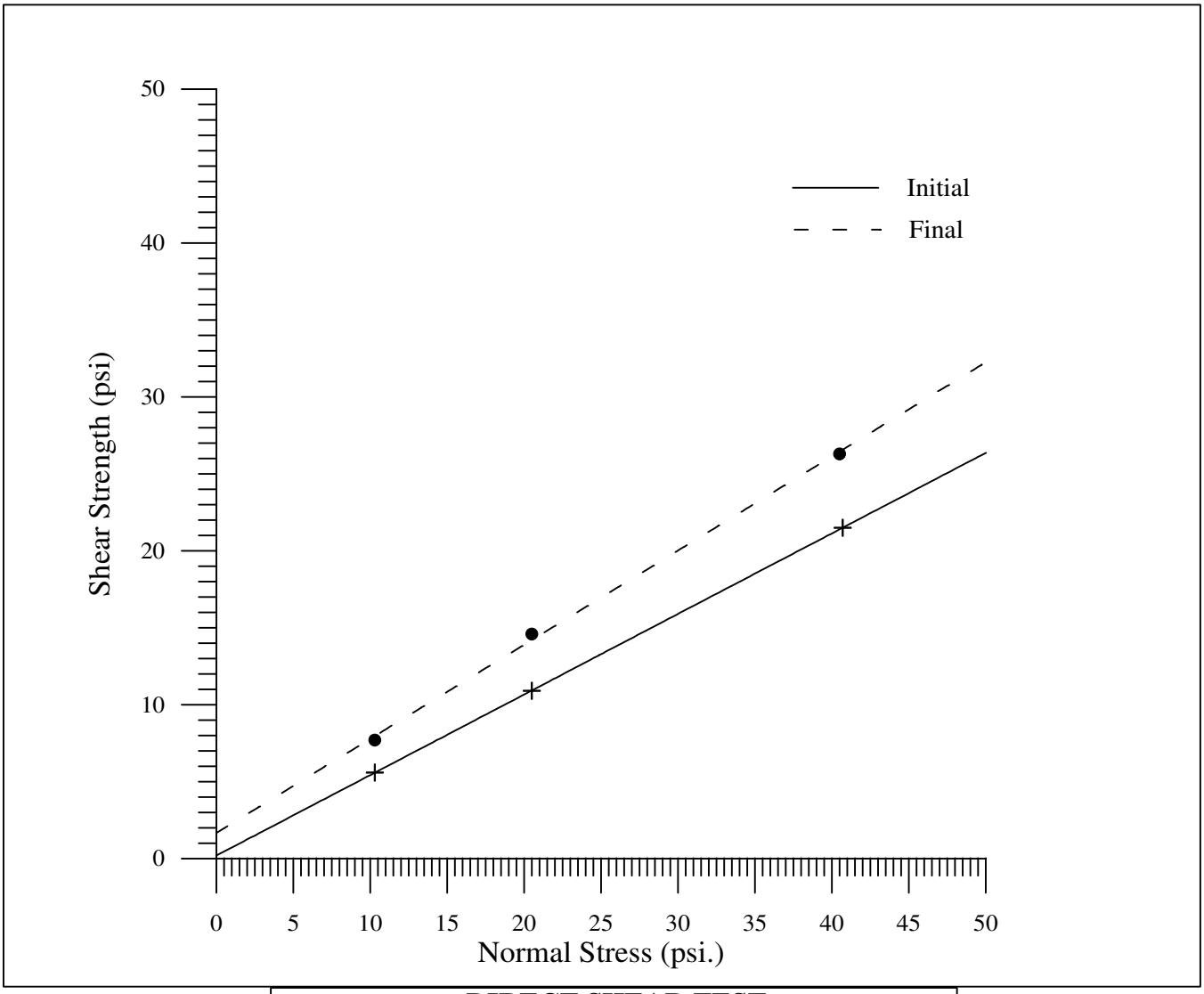
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 21, 2008**



DIRECT SHEAR TEST
Failure Envelope Normal Stress vs. Shear Strength

Sample: 103B
Boring: RKS-19-07
Depth: 56.3-57.0'

DESCRIPTION

Saw-cut interface in light gray meta welded lapilli tuff with a few large light bluish white friable clasts.

	Shear Intercept (psi)	Friction Angle (degrees)
Initial	0.2	27.6
Final	1.7	31.5

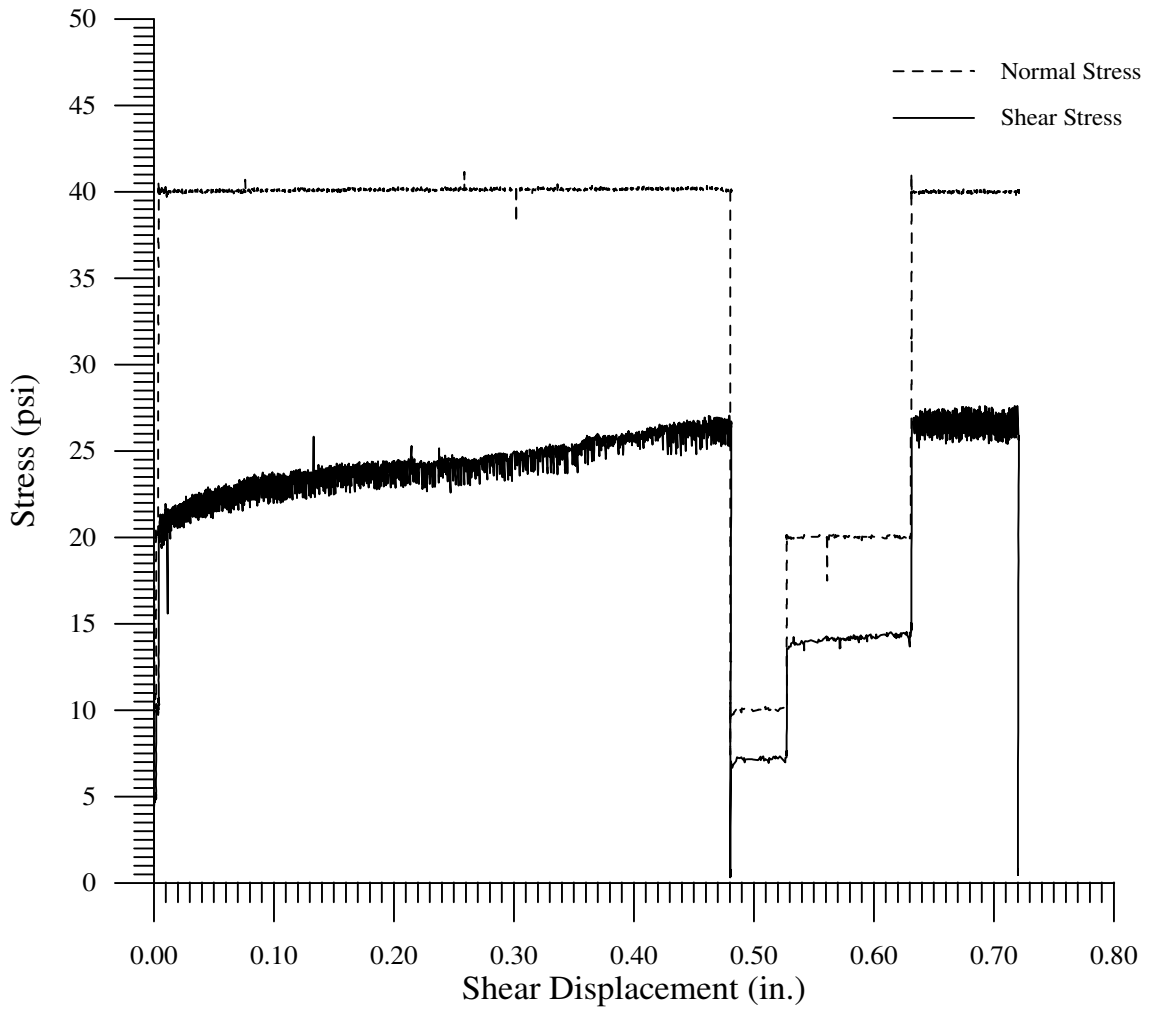
Geo Test Unlimited
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 21, 2008**



DIRECT SHEAR TEST
Shear and Normal Stress vs. Shear Displacement

Sample: 101A
Boring: RKS-22-07
Depth: 11.7-12.5'

DESCRIPTION

Saw-cut interface in light gray meta welded lapilli tuff.

	Normal Stress (psi)	Shear Strength (psi)
Initial	10.1	5.0
	20.2	10.0
	40.0	20.9
Final	9.9	7.1
	19.9	14.3
	40.0	27.0

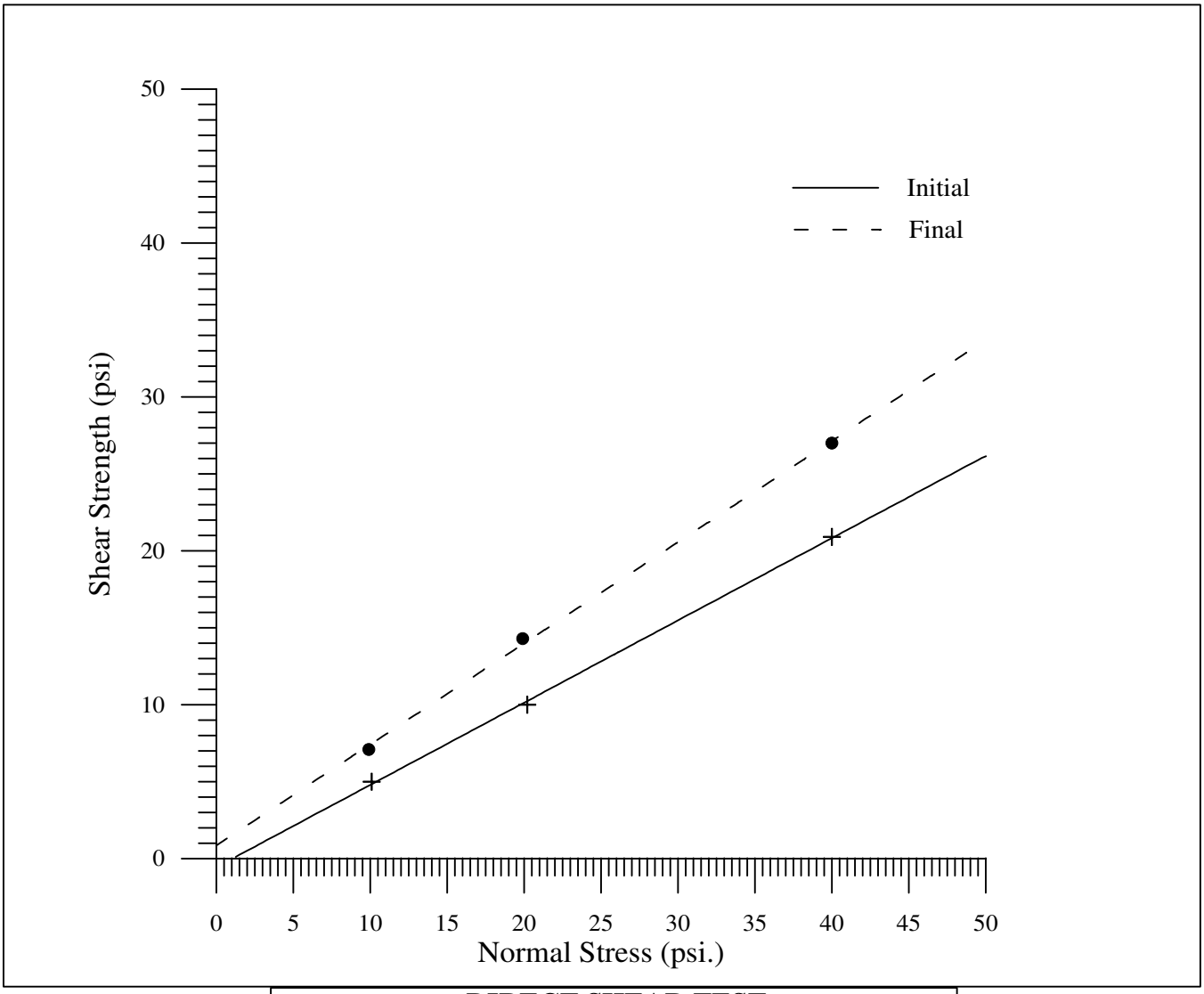
Geo Test Unlimited
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 21, 2008**



DIRECT SHEAR TEST
Failure Envelope Normal Stress vs. Shear Strength

Sample: 101A
Boring: RKS-22-07
Depth: 11.7-12.5'

DESCRIPTION
Saw-cut interface in light gray meta welded lapilli tuff.

	Shear Intercept (psi)	Friction Angle (degrees)
Initial	na(-0.6)	28.1
Final	0.8	33.3

Geo Test Unlimited

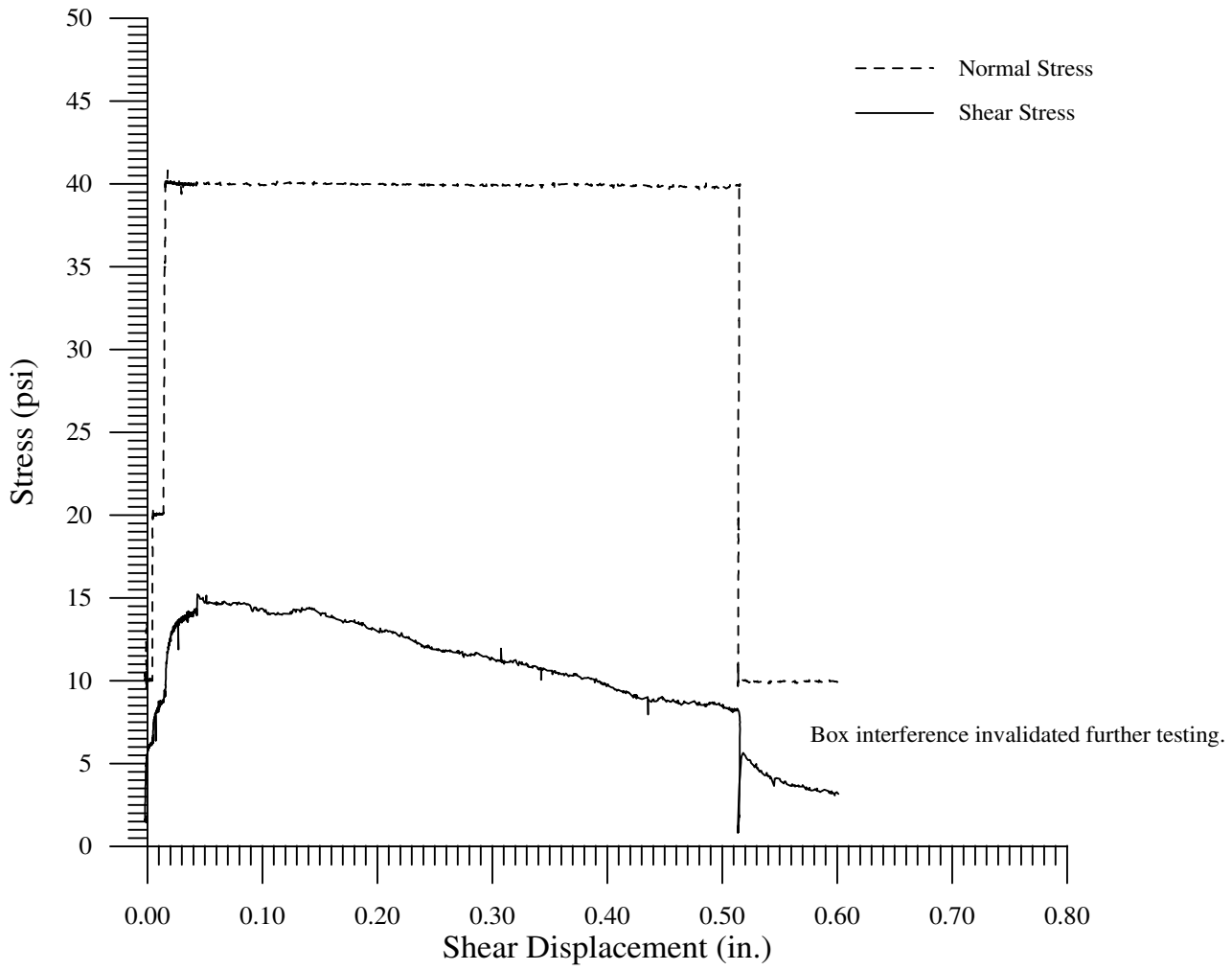
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 21, 2008**



DIRECT SHEAR TEST
Shear and Normal Stress vs. Shear Displacement

Sample: 102
Boring: RKS-24-07
Depth: 36.3-36.9'

DESCRIPTION

Filled shear zone in blue gray meta welded lapilli tuff. Light bluish white filling in 5/8-1" wide shear zone with rock flakes.

	Normal Stress (psi)	Shear Strength (psi)
Initial	10.0	6.2
	20.0	8.9
	40.0	14.0
Final	na	na

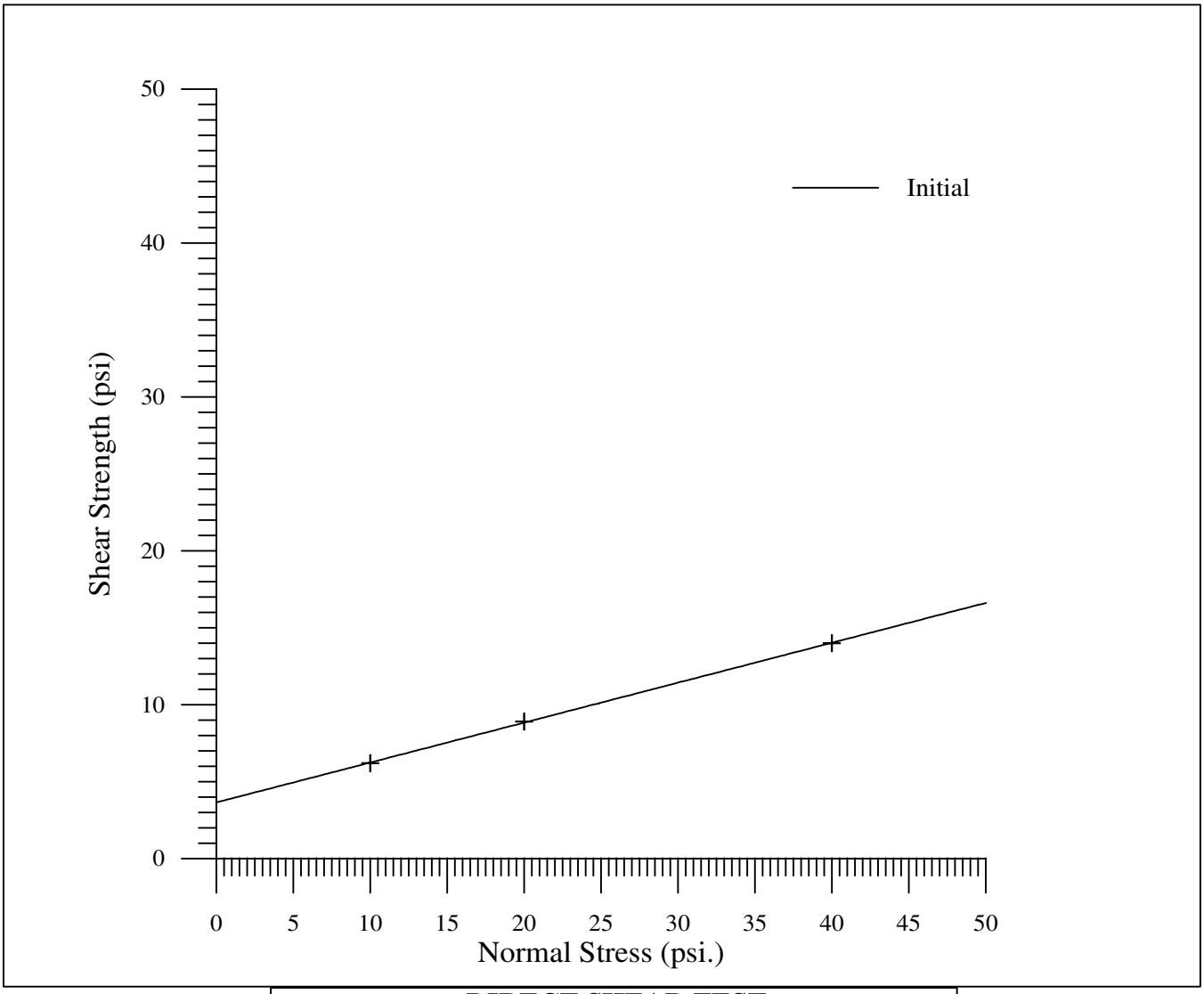
Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 23, 2008**



DIRECT SHEAR TEST
Failure Envelope Normal Stress vs. Shear Strength

Sample: 102
Boring: RKS-24-07
Depth: 36.3-36.9'

DESCRIPTION

Filled shear zone in blue gray meta welded lapilli tuff. Light bluish white filling in 5/8-1" wide shear zone with rock flakes.

	Shear Intercept (psi)	Friction Angle (degrees)
Initial	3.7	14.5
Final	na	na

Geo Test Unlimited GTU

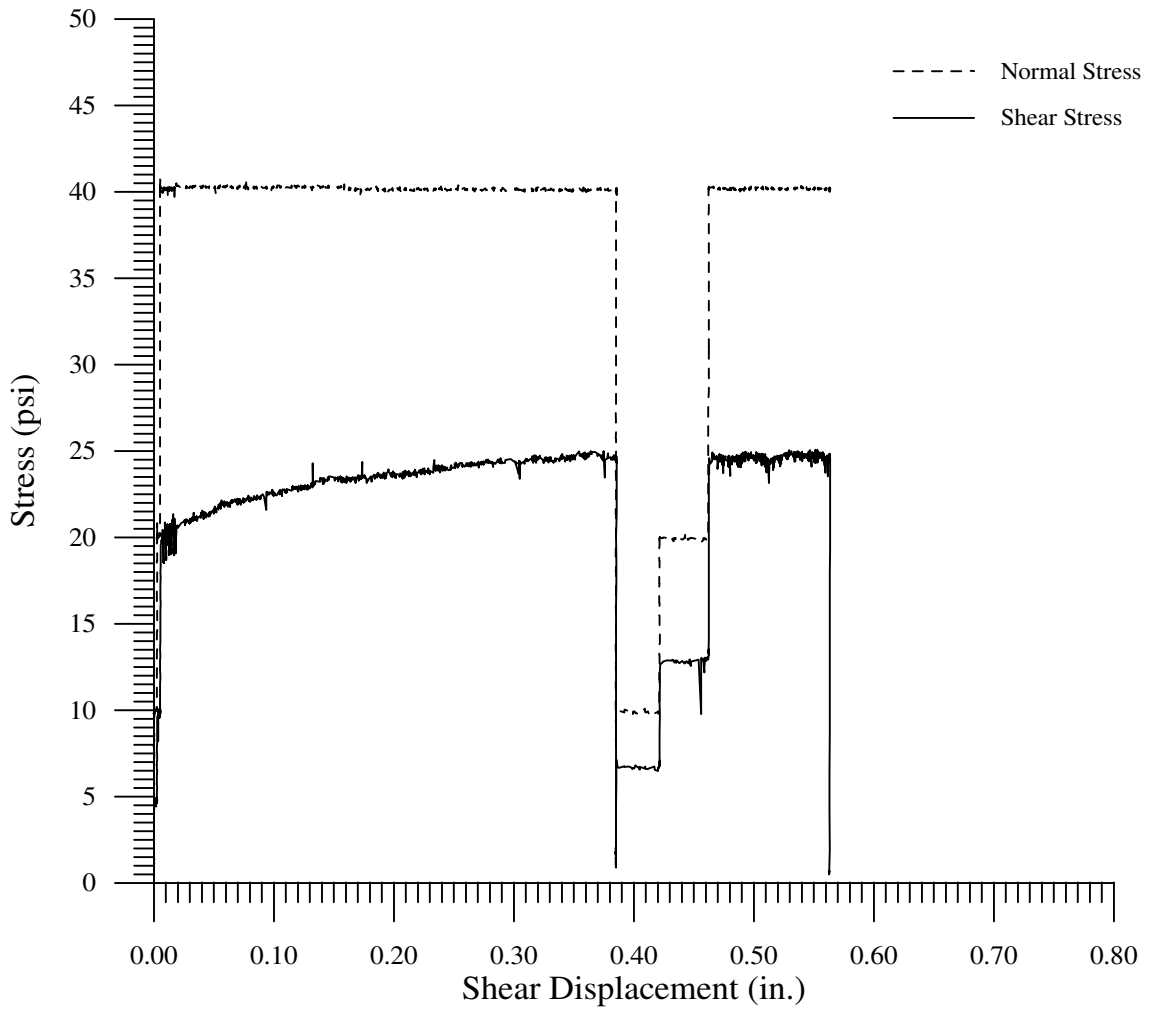
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 23, 2008**



DIRECT SHEAR TEST
Shear and Normal Stress vs. Shear Displacement

Sample: 102A
Boring: RKS-29-07
Depth: 18.8-19.5'

DESCRIPTION

Saw-cut interface in medium greenish gray meta welded lapilli tuff, fine grained with clasts <1/8".

	Normal Stress (psi)	Shear Strength (psi)
Initial	10.0	4.7
	20.2	9.8
	40.0	19.8
Final	9.9	6.5
	19.9	12.8
	40.2	24.8

Geo Test Unlimited GTU

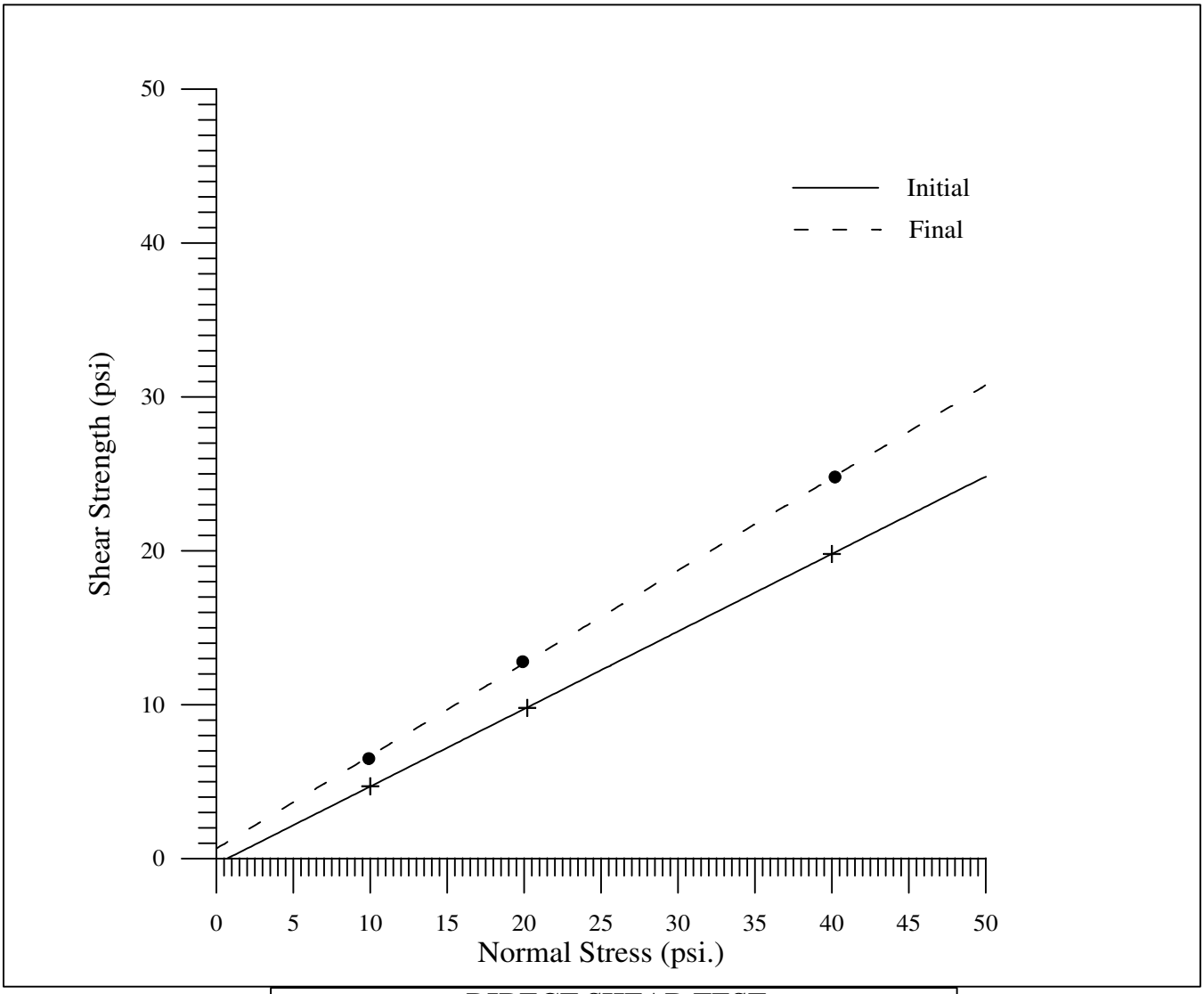
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 21, 2008**



DIRECT SHEAR TEST
Failure Envelope Normal Stress vs. Shear Strength

Sample: 102A
Boring: RKS-29-07
Depth: 18.8-19.5'

DESCRIPTION

Saw-cut interface in medium greenish gray meta welded lapilli tuff, fine grained with clasts< 1/8".

	Shear Intercept (psi)	Friction Angle (degrees)
Initial	na(-0.4)	26.7
Final	0.6	31.1

Geo Test Unlimited GTU

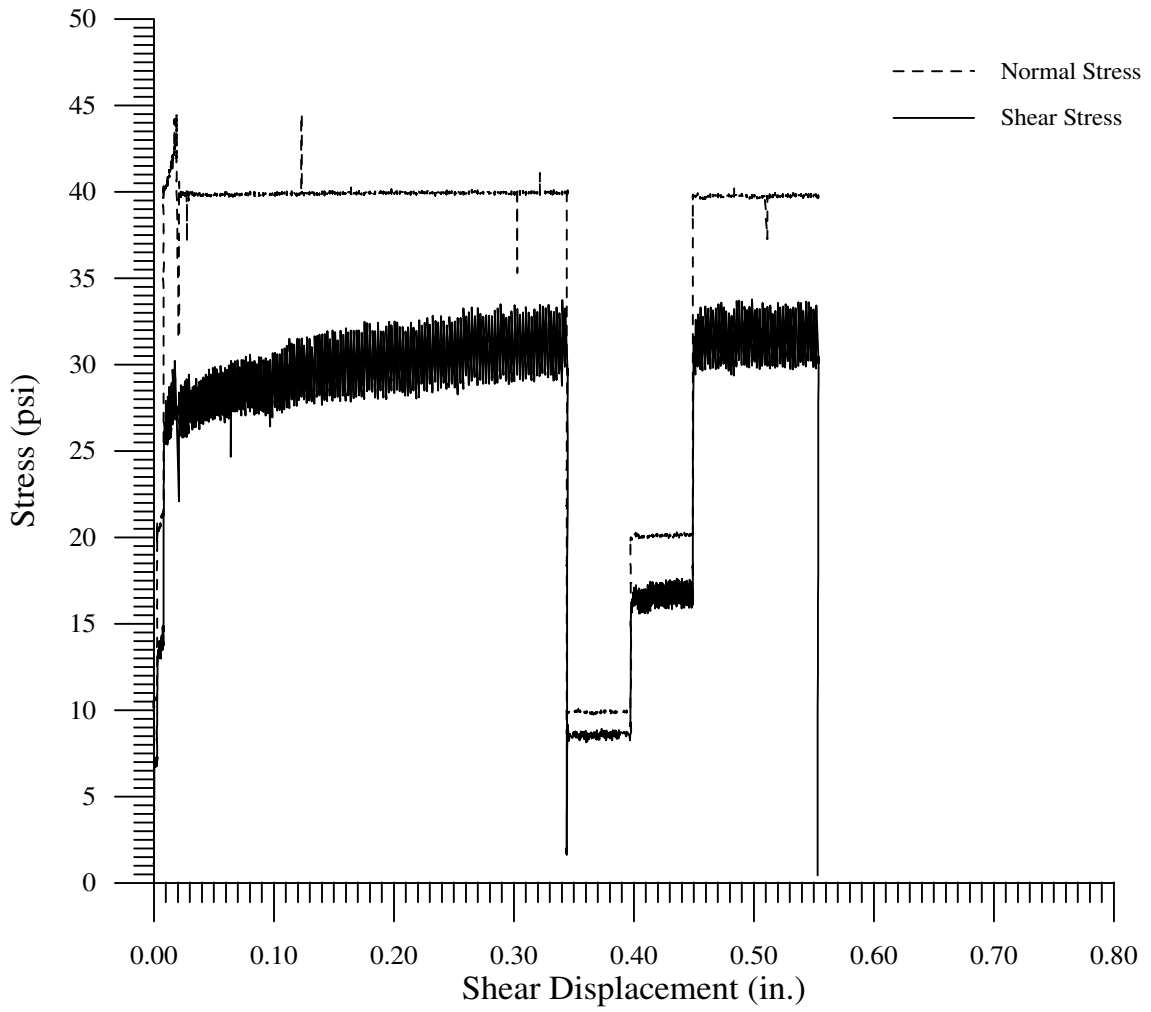
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 21, 2008**



DIRECT SHEAR TEST
Shear and Normal Stress vs. Shear Displacement

Sample: 103A
Boring: RKS-30-07
Depth: 55.1-55.6'

DESCRIPTION

Saw-cut interface in medium blue gray meta welded lapilli tuff.

	Normal Stress (psi)	Shear Strength (psi)
Initial	10.6	7.0
	20.5	13.7
	40.1	26.5
Final	10.0	8.8
	20.2	17.5
	39.8	33.2

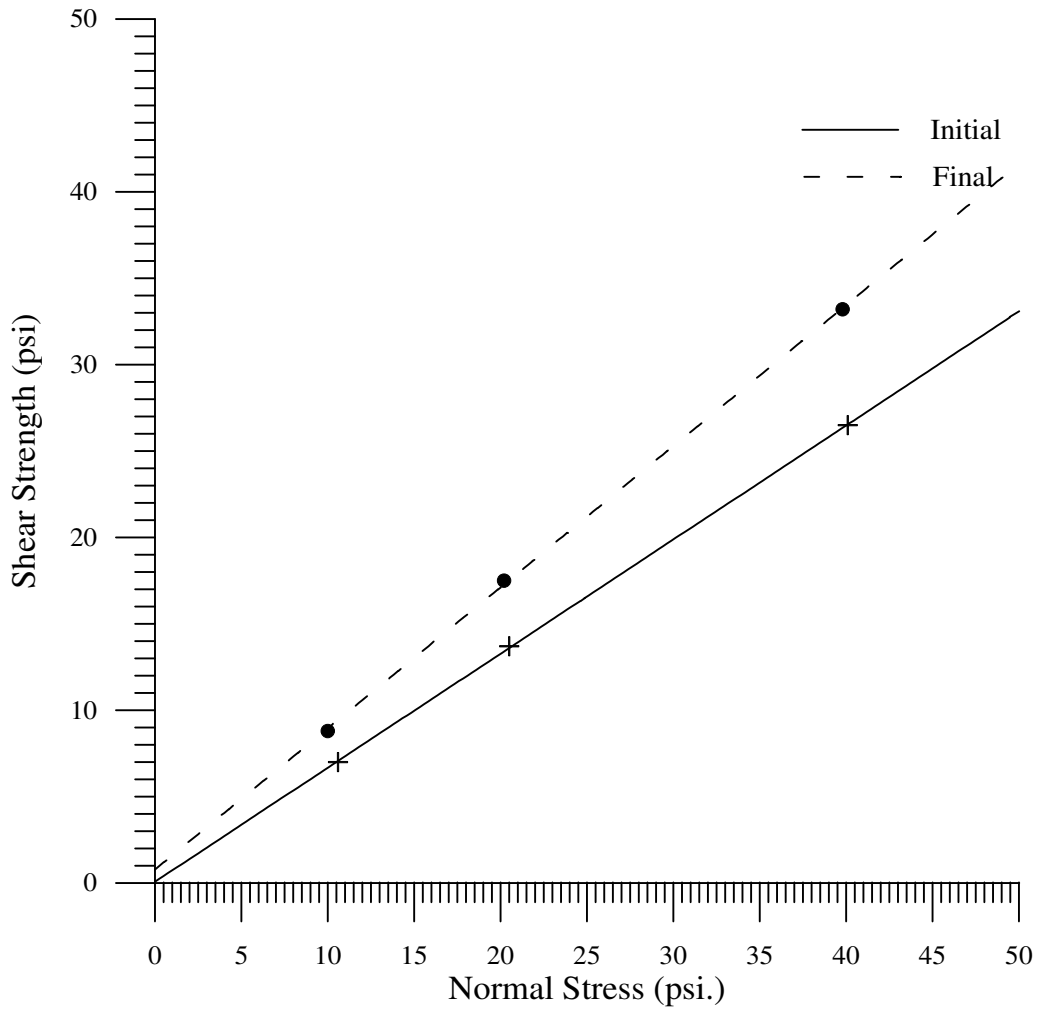
Geo Test Unlimited
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 21, 2008**



DIRECT SHEAR TEST
Failure Envelope Normal Stress vs. Shear Strength

Sample: 103A
Boring: RKS-30-07
Depth: 55.1-55.6'

DESCRIPTION

Saw-cut interface in medium blue gray meta welded lapilli tuff.

	Shear Intercept (psi)	Friction Angle (degrees)
Initial	0.1	33.4
Final	0.8	39.2

Geo Test Unlimited

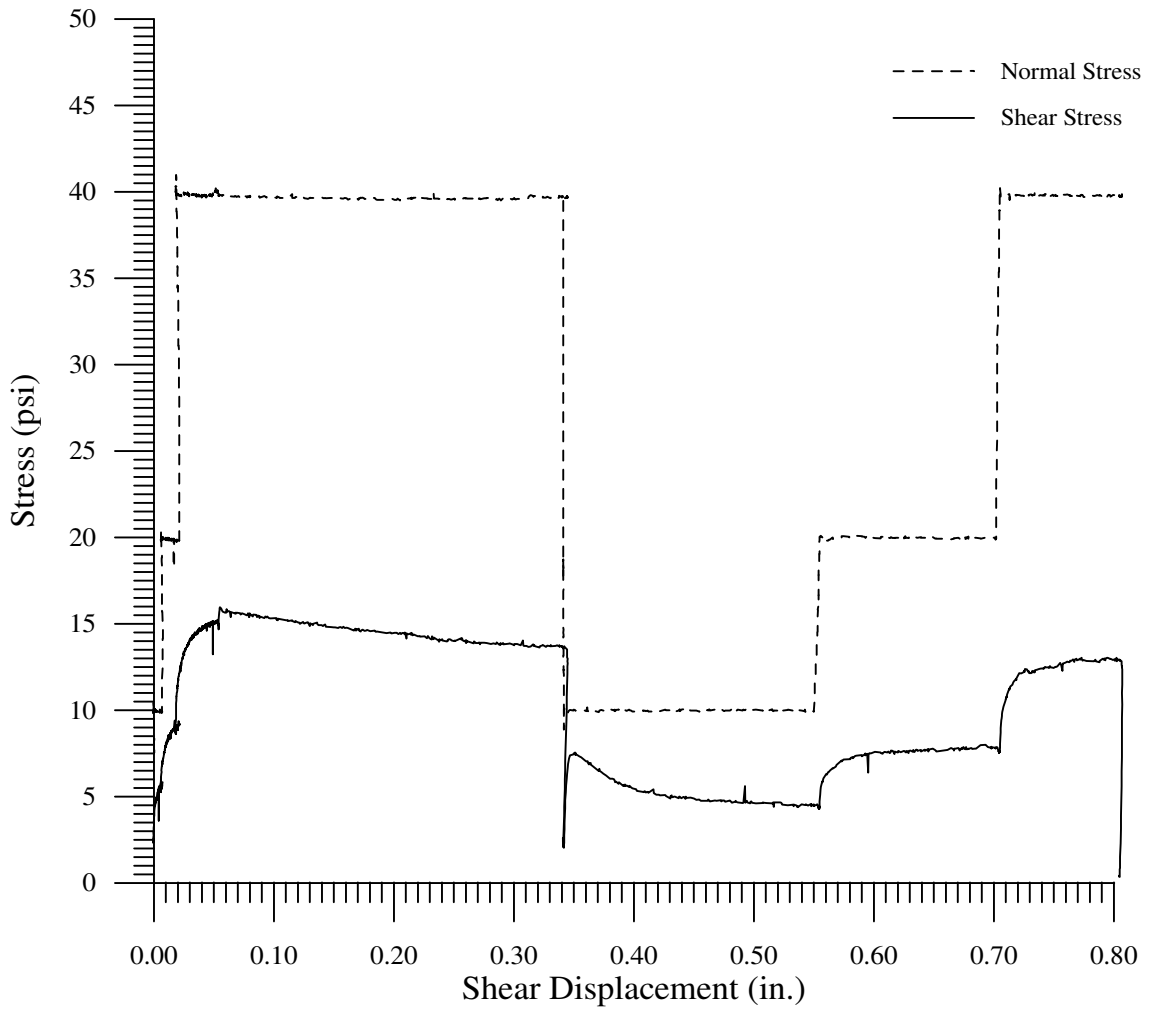
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 21, 2008**



DIRECT SHEAR TEST
Shear and Normal Stress vs. Shear Displacement

Sample: 104
Boring: SI-10-07
Depth: 43.4-44.0'

DESCRIPTION

Planar clay filled joint in fractured blue gray meta welded lapilli tuff. Light bluish white filling 1/4-5/8" thick with rock fragments.

	Normal Stress (psi)	Shear Strength (psi)
Initial	9.8	6.0
	19.8	9.5
	39.8	15.2
Final	10.0	4.5
	19.8	7.8
	39.8	13.0

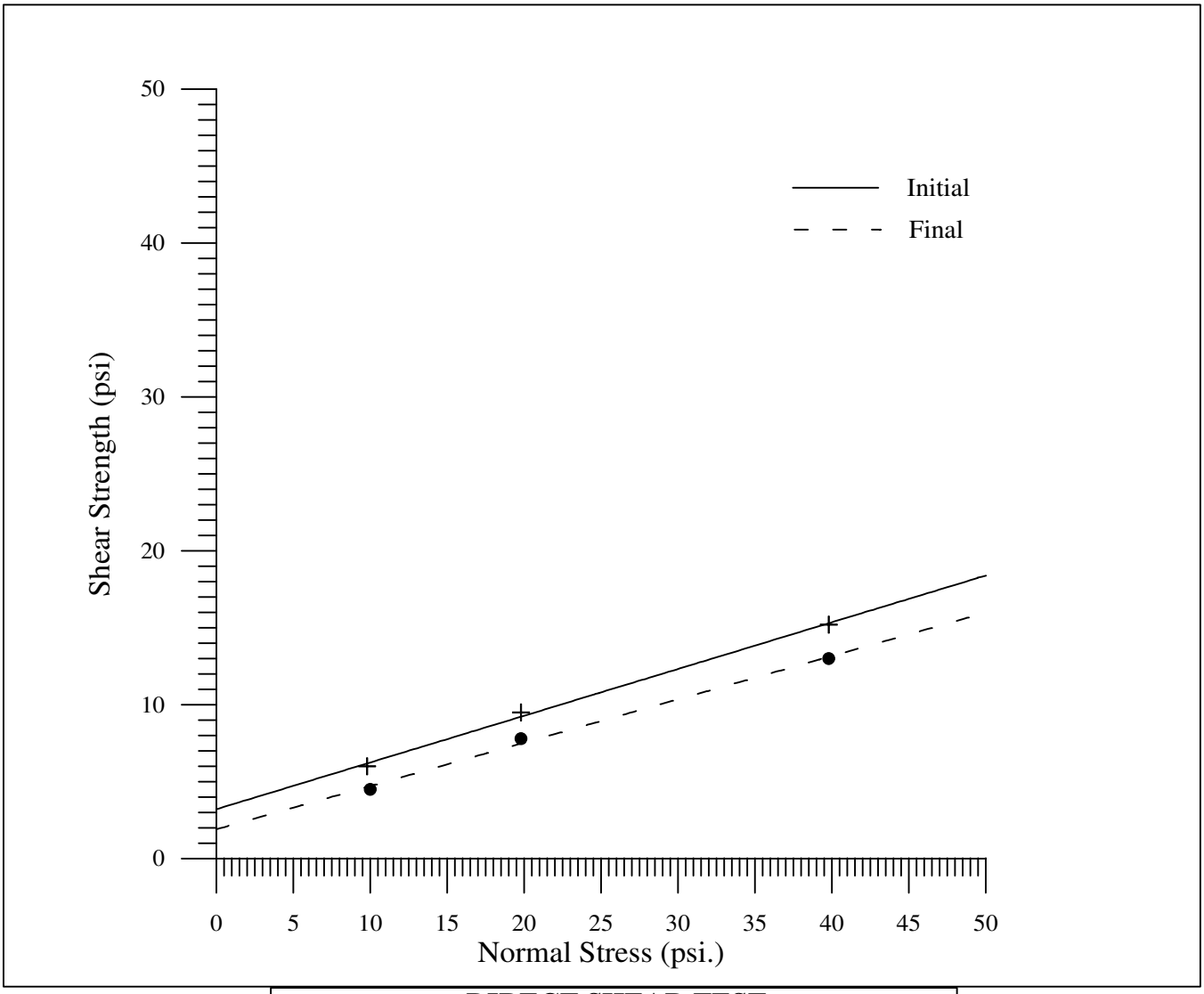
Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 22, 2008**



DIRECT SHEAR TEST
Failure Envelope Normal Stress vs. Shear Strength

Sample: 104
Boring: SI-10-07
Depth: 43.4-44.0'

DESCRIPTION

Planar clay filled joint in fractured blue gray meta welded lapilli tuff. Light bluish white filling 1/4-5/8" thick with rock fragments.

	Shear Intercept (psi)	Friction Angle (degrees)
Initial	3.2	16.9
Final	1.9	15.7

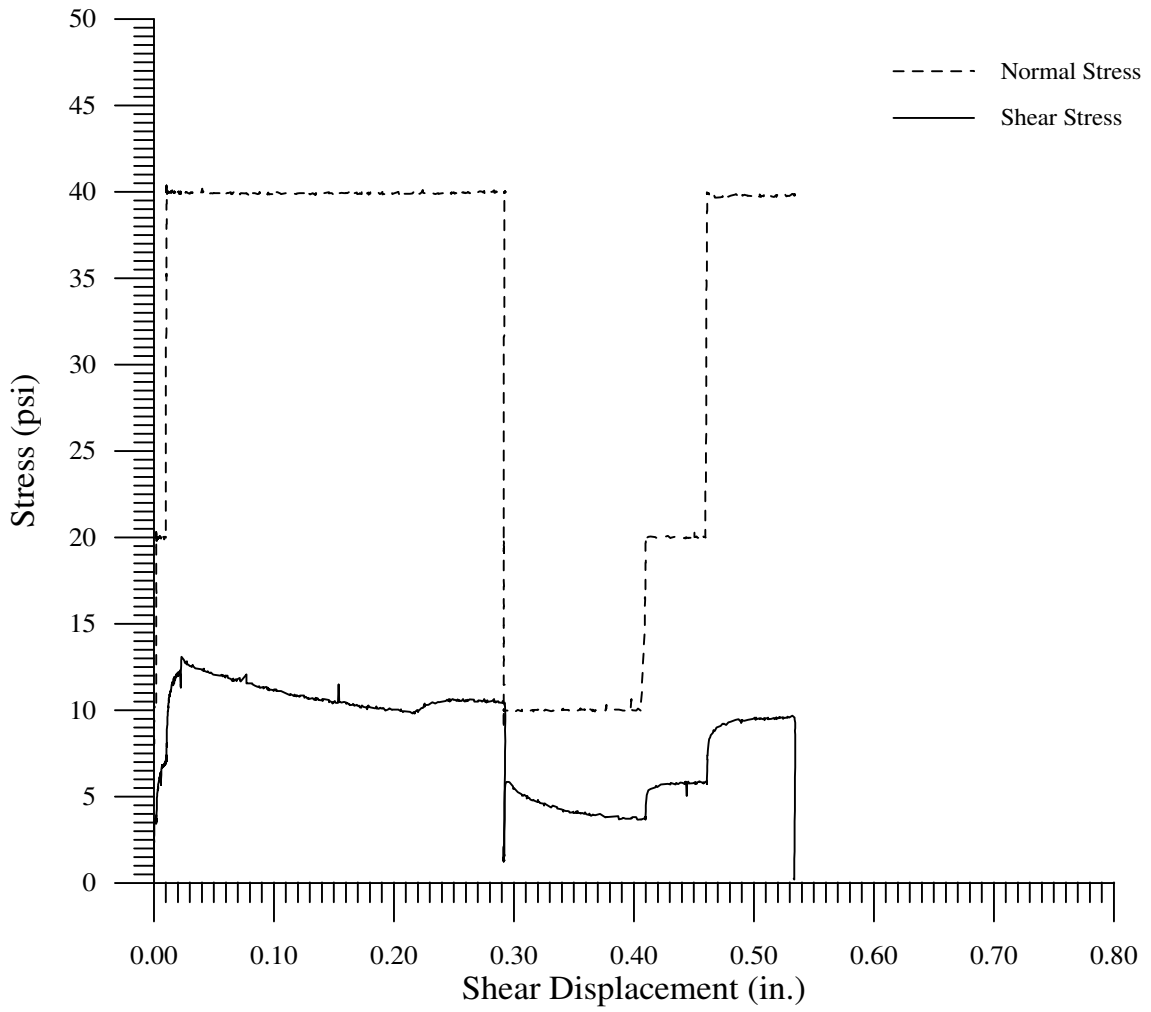
Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 22, 2008**



DIRECT SHEAR TEST
Shear and Normal Stress vs. Shear Displacement

Sample: 102A
Boring: SI-2-07
Depth: 40.4-41.4'

DESCRIPTION

Fairly planar clay filled joint in medium gray and brownish gray meta welded lapilli tuff. Light yellowish brown filling about 1/8" thick.

	Normal Stress (psi)	Shear Strength (psi)
Initial	10.1	3.7
	20.0	7.0
	40.0	12.2
Final	10.0	3.6
	20.0	5.8
	39.8	9.5

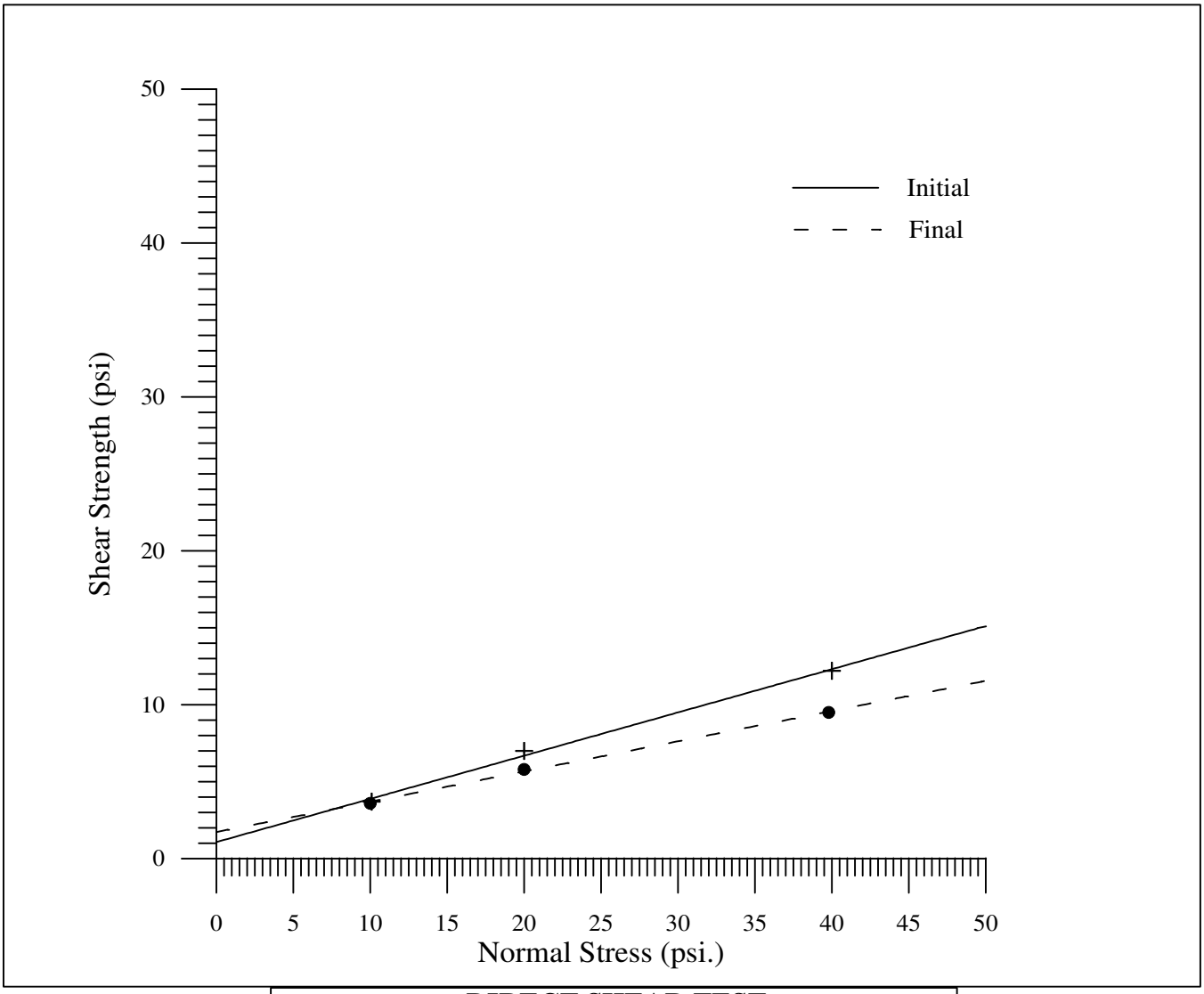
Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 22, 2008**



DIRECT SHEAR TEST
Failure Envelope Normal Stress vs. Shear Strength

Sample: 102A
Boring: SI-2-07
Depth: 40.4-41.4'

DESCRIPTION

Fairly planar clay filled joint in medium gray and brownish gray meta welded lapilli tuff. Light yellowish brown filling about 1/8" thick.

	Shear Intercept (psi)	Friction Angle (degrees)
Initial	1.1	15.7
Final	1.7	11.1

Geo Test Unlimited GTU

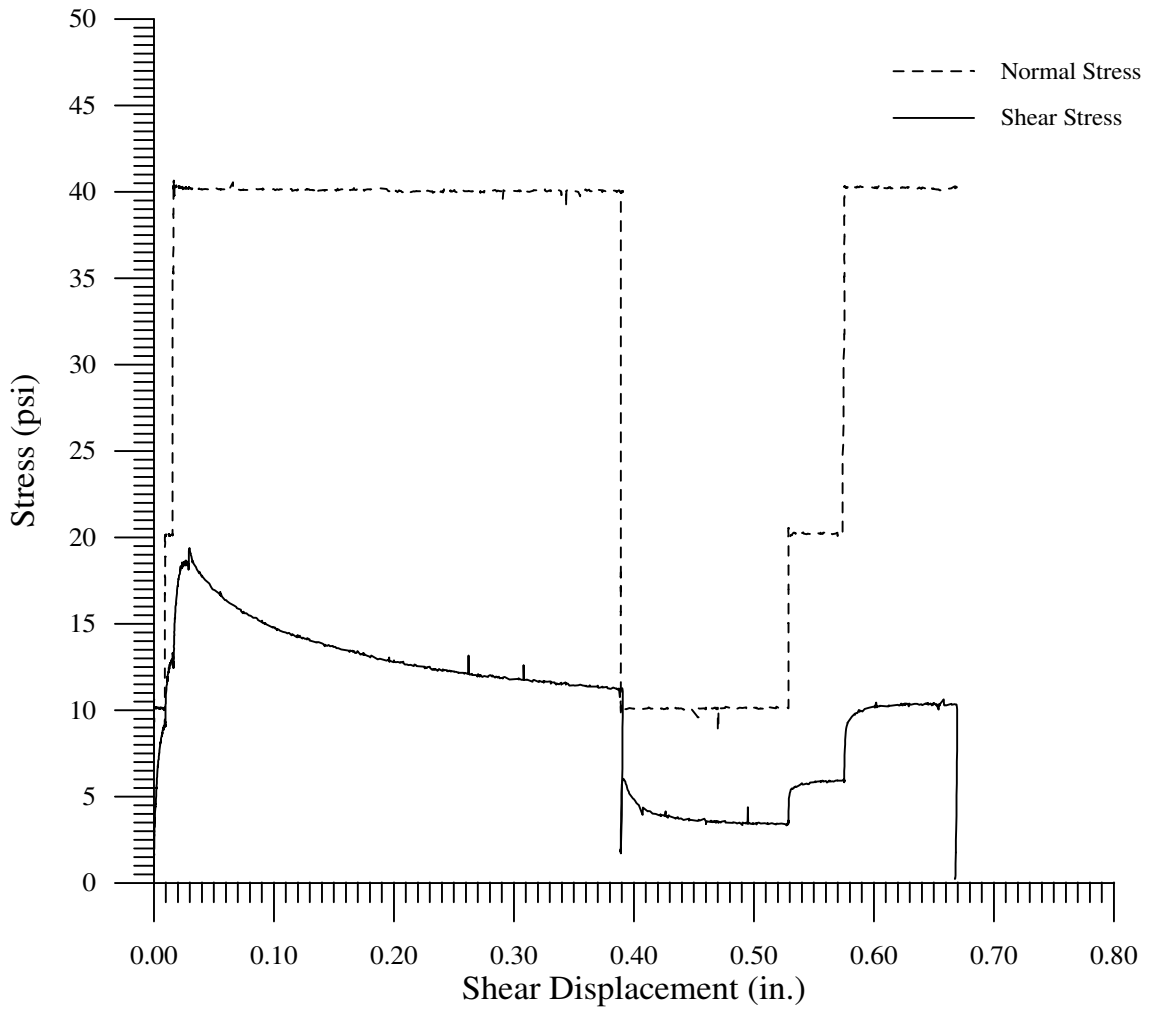
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 22, 2008**



DIRECT SHEAR TEST
Shear and Normal Stress vs. Shear Displacement

Sample: 105
Boring: SI-2-07
Depth: 84.6-86.0'

DESCRIPTION

Planar clay filled joint in blue gray meta welded lapilli tuff. White filling with light brown interlacings about 1/8-3/8" thick.

	Normal Stress (psi)	Shear Strength (psi)
Initial	10.1	9.4
	20.1	13.0
	40.1	18.5
Final	10.1	3.4
	20.2	6.0
	40.2	10.4

Geo Test Unlimited GTU

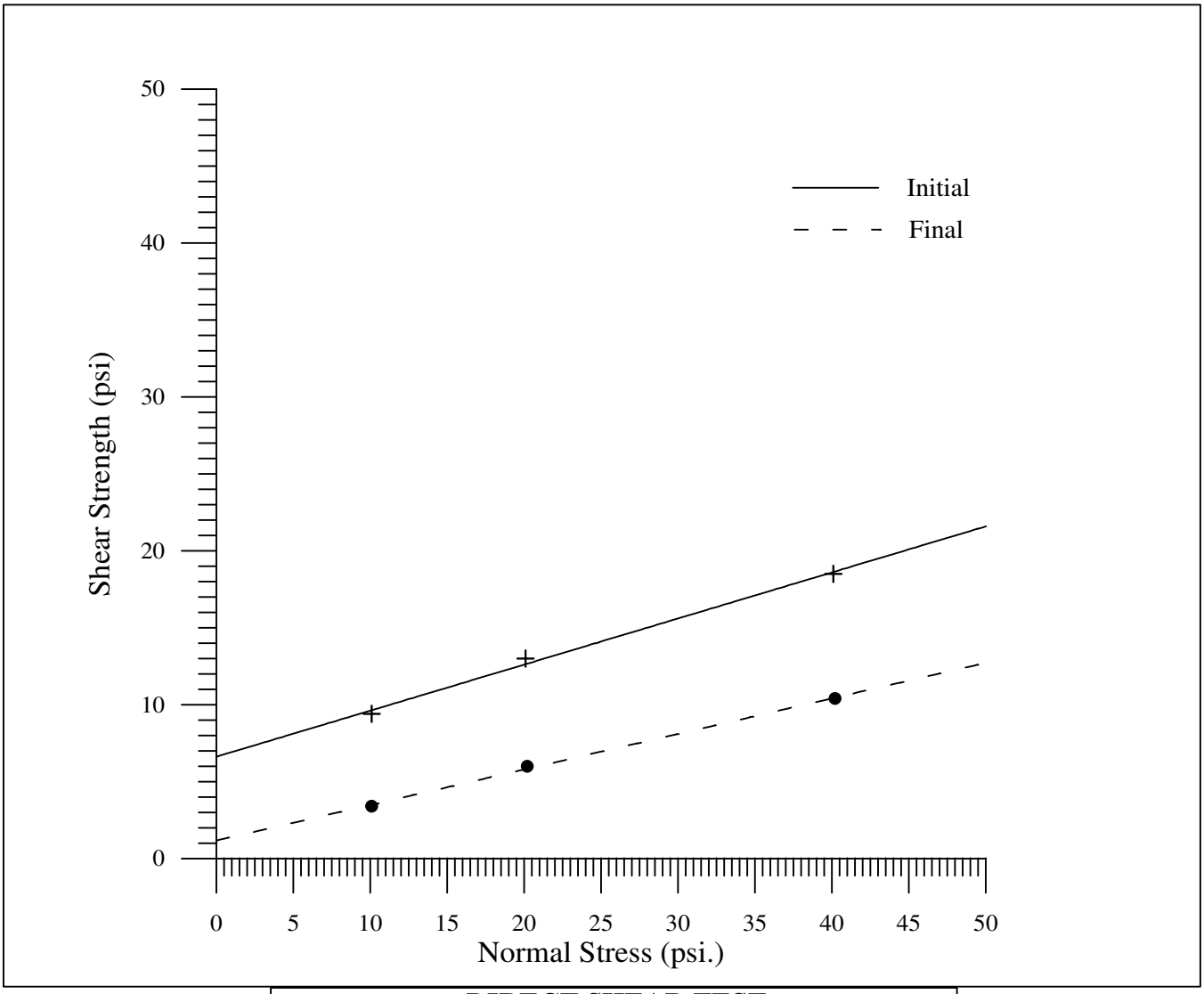
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 22, 2008**



DIRECT SHEAR TEST
Failure Envelope Normal Stress vs. Shear Strength

Sample: 105
Boring: SI-2-07
Depth: 84.6-86.0'

DESCRIPTION

Planar clay filled joint in blue gray meta welded lapilli tuff. White filling with light brown interlacings about 1/8-3/8" thick.

	Shear Intercept (psi)	Friction Angle (degrees)
Initial	6.6	16.7
Final	1.2	13.0

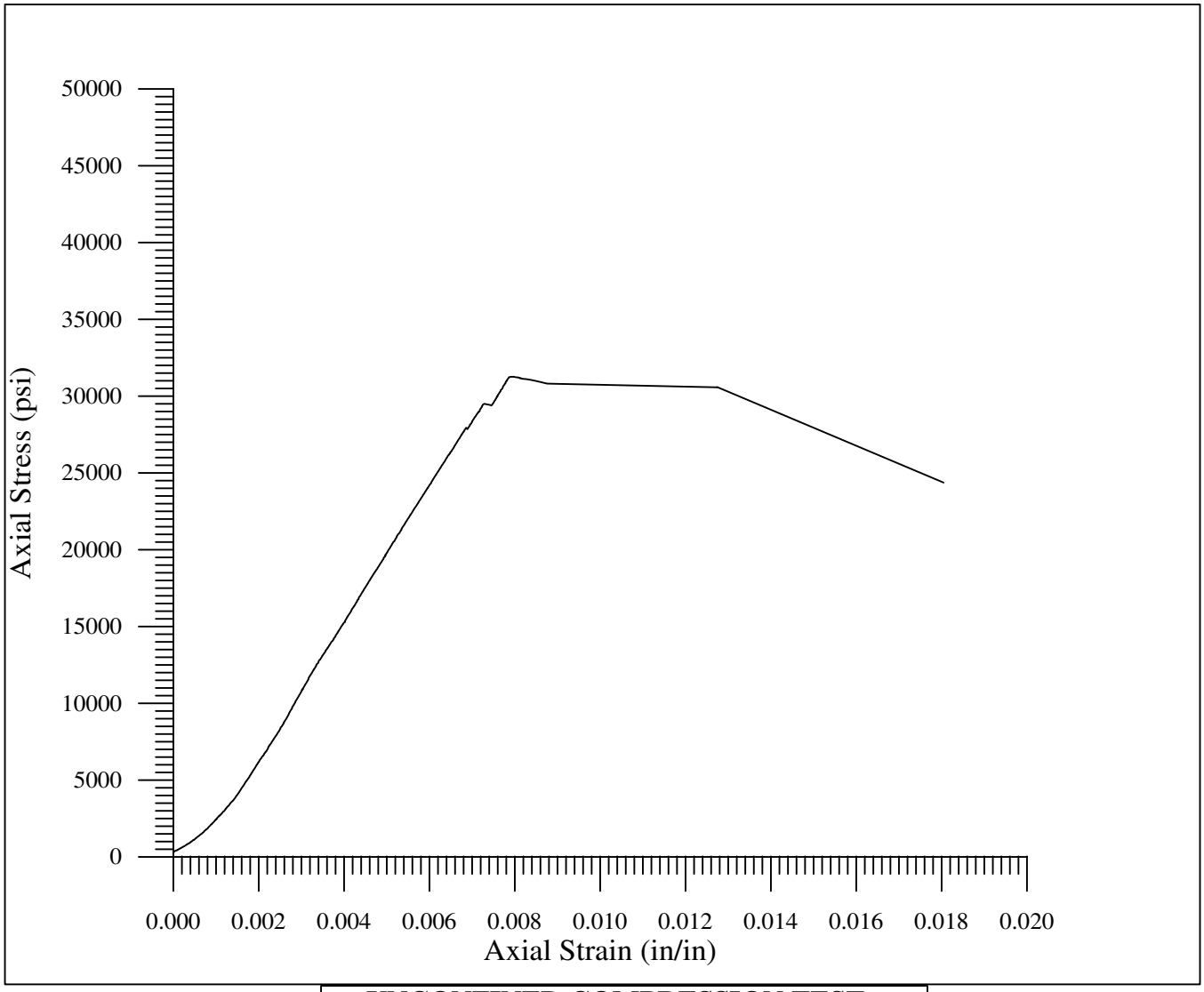
Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: **East I-90 Hyak Realignment**

Project Number: 03-2007

Test Date: **January 22, 2008**



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 101B
Boring: RKS-12-07
Depth: 29.5-30.3'

DESCRIPTION

Medium blue gray meta welded lapilli tuff, with a few light green zones in the matrix, with no apparent planes of weakness.

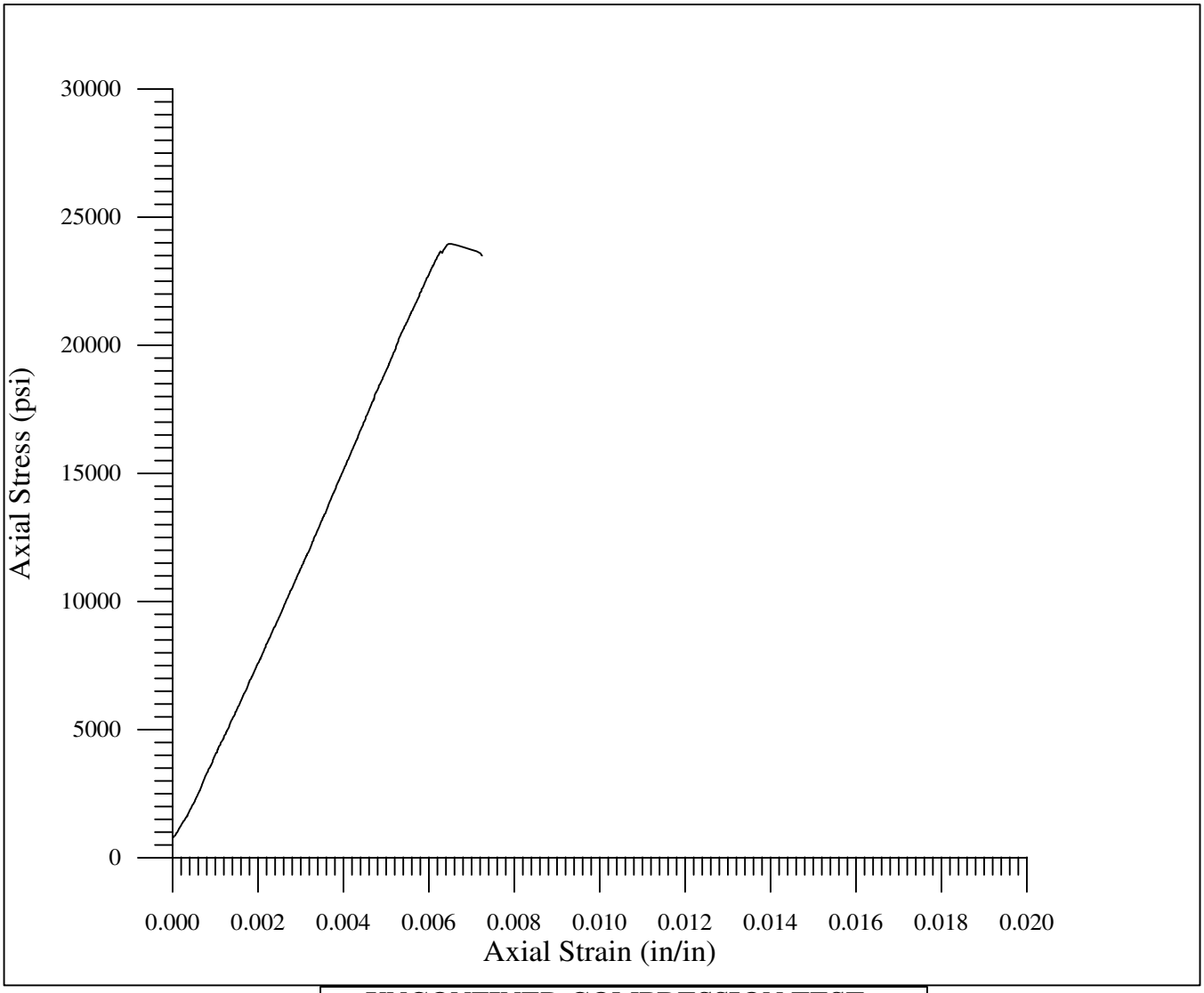
Density: 164.0 pcf
Strength: 31,257 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 14, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 103B
Boring: RKS-12-07
Depth: 124.6-125.3'

DESCRIPTION

Medium blue gray meta welded lapilli tuff, with an axial healed hairline joint.

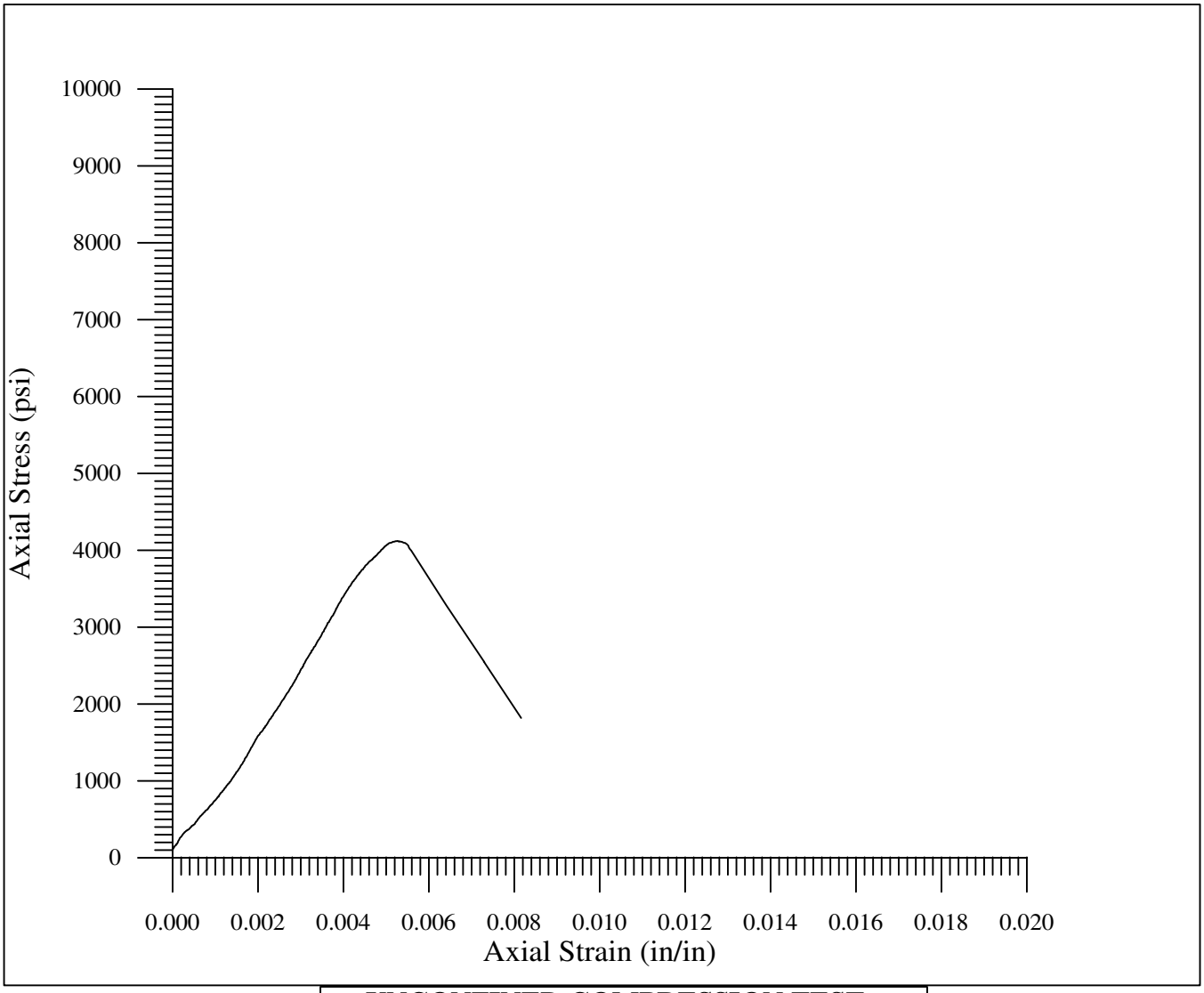
Density: 164.3 pcf
Strength: 23,952 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 102
Boring: RKS-13-07
Depth: 19.0-19.7'

DESCRIPTION

Medium brown meta welded lapilli tuff, somewhat altered with zones of lighter brown more severely altered matrix.

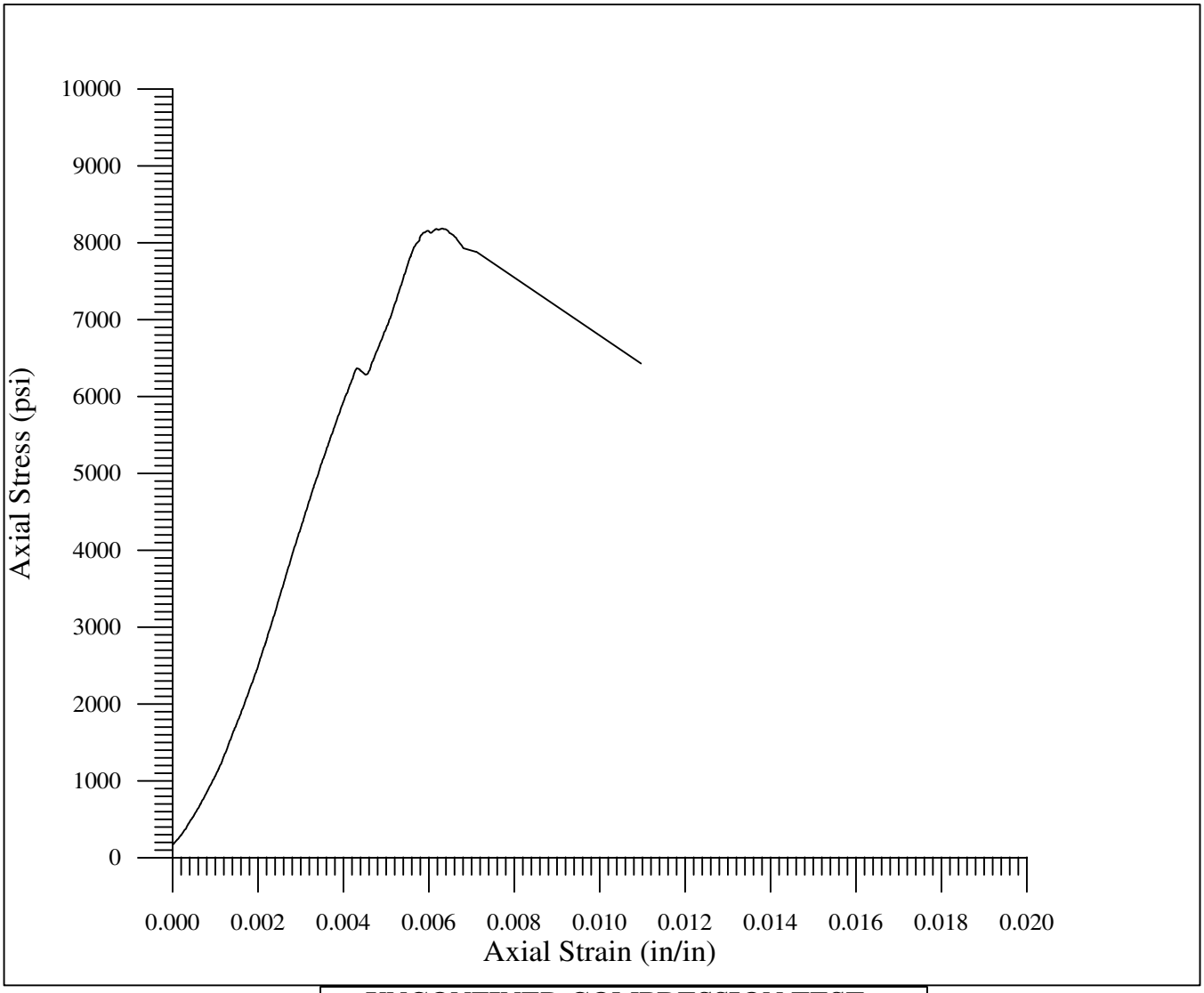
Density: 155.7 pcf
Strength: 4120 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 104A
Boring: RKS-13-07
Depth: 44.1-44.6'

DESCRIPTION

Light greenish gray meta welded lapilli tuff, slightly altered with light green more altered inclusions with no apparent planes of weakness.

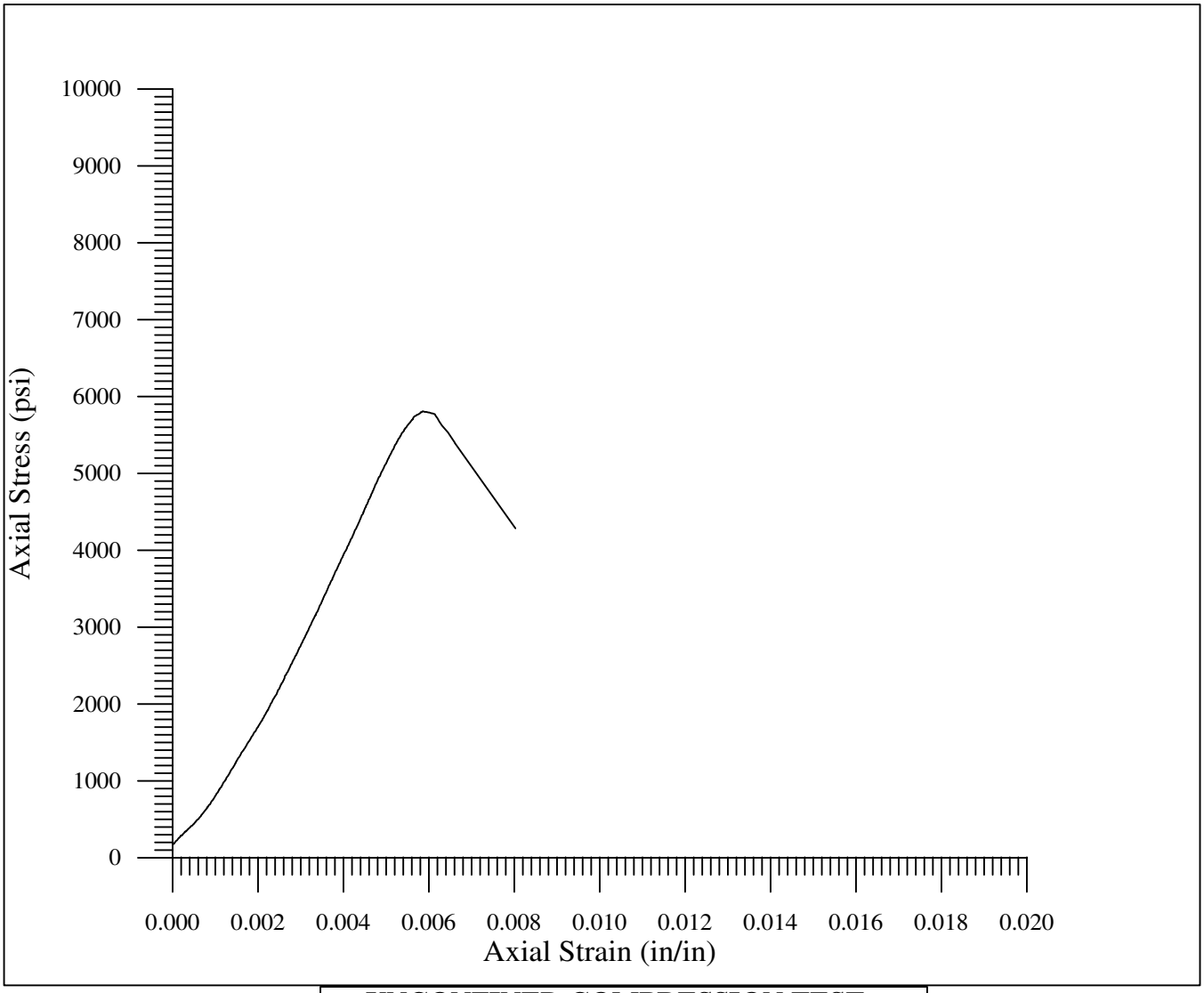
Density: 162.6 pcf
Strength: 8184 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 103B
Boring: RKS-14-07
Depth: 78.8-79.4'

DESCRIPTION

Light greenish gray meta welded lapilli tuff, slightly altered with light green more altered inclusions with one minor end fracture.

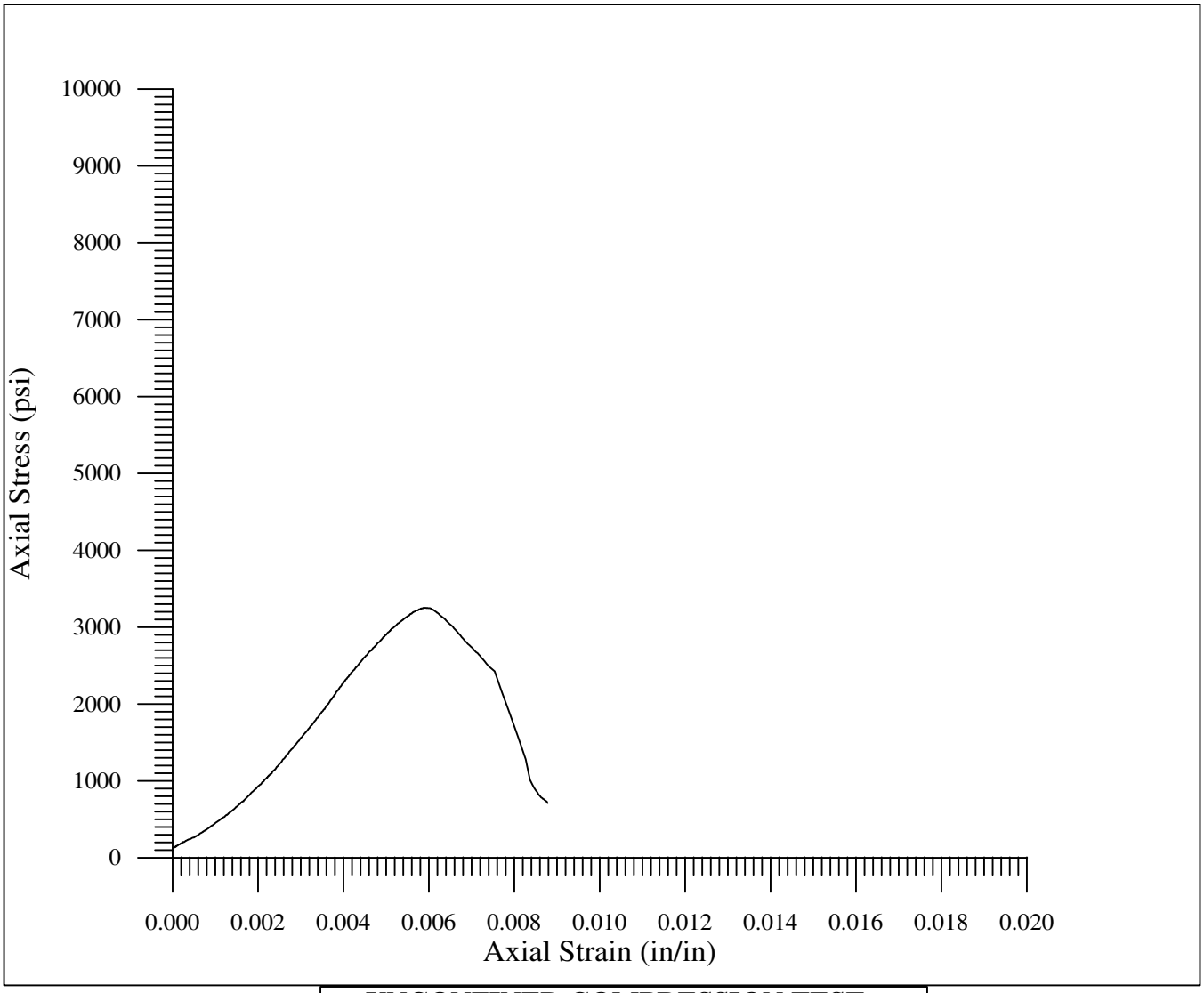
Density: 159.0 pcf
Strength: 5805 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 102B
Boring: RKS-15-07
Depth: 21.1-21.8'

DESCRIPTION

Medium brown meta welded lapilli tuff, altered with weak end fractures that have been glued.

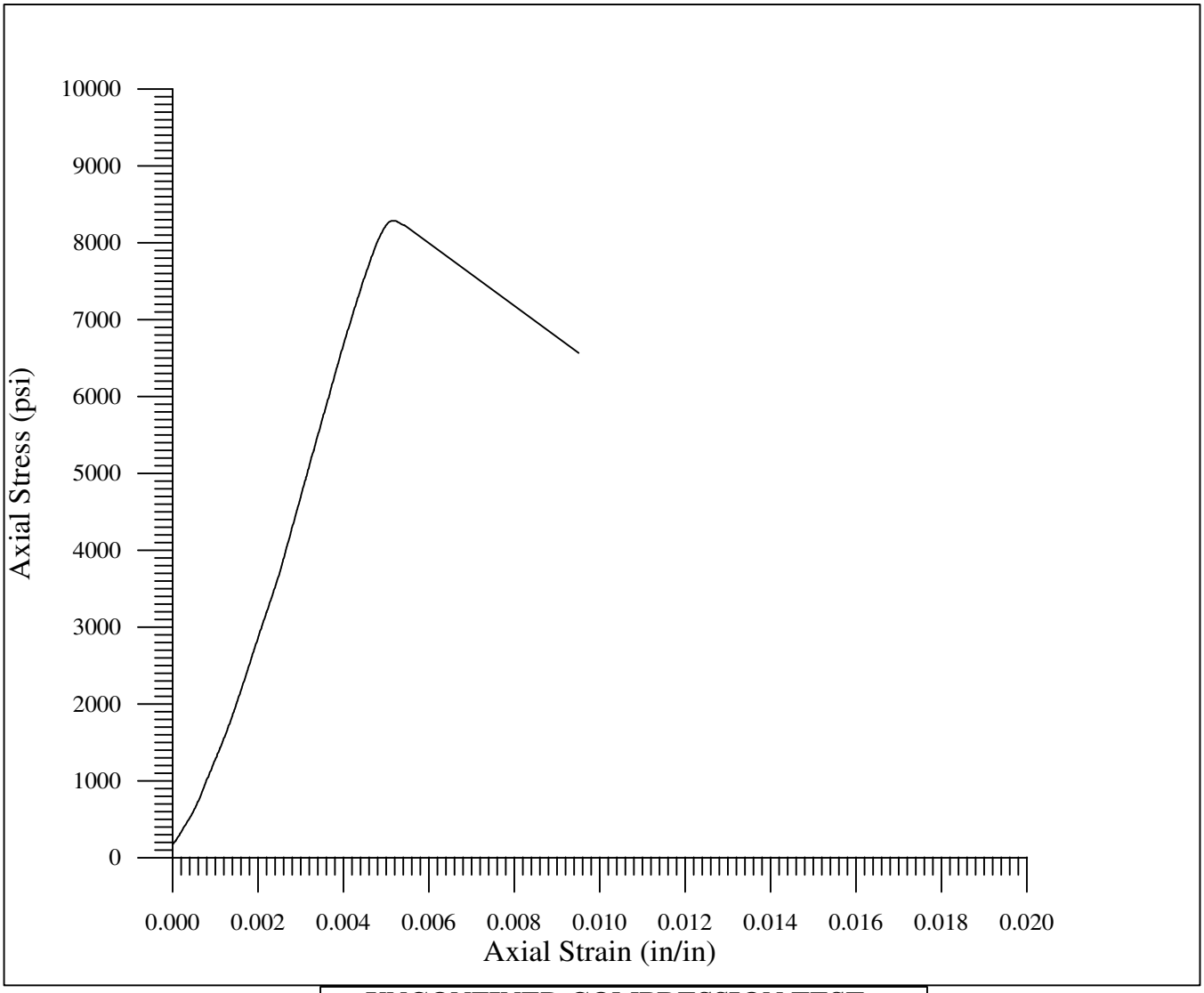
Density: 151.6 pcf
Strength: 3250 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 105A
Boring: RKS-15-07
Depth: 120.0-120.5'

DESCRIPTION

Medium brown meta welded lapilli tuff, altered with a few thin planar zones of weakness.

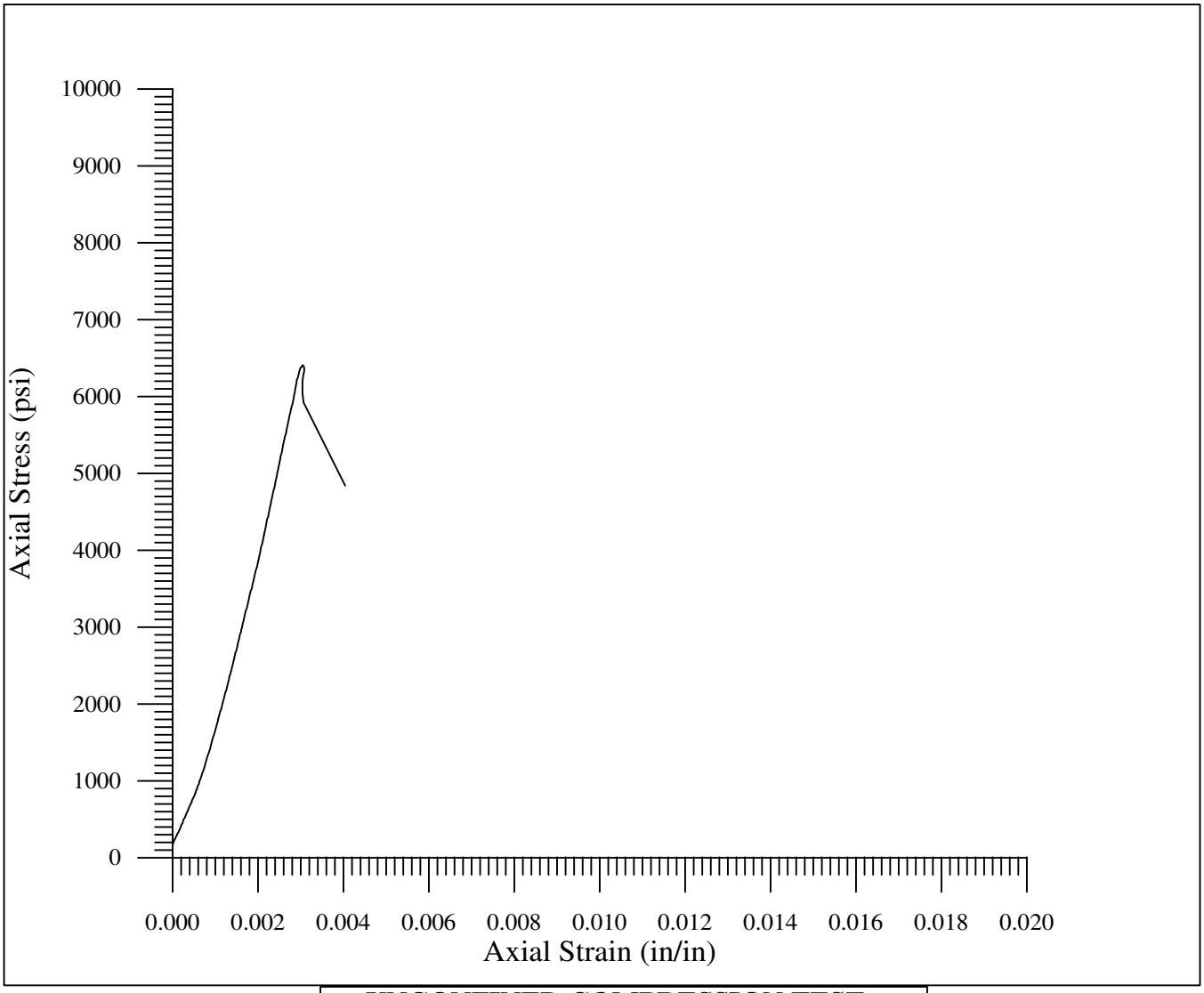
Density: 159.6 pcf
Strength: 8287 psi

Geo Test Unlimited
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 101B
Boring: RKS-16-07
Depth: 47.6-48.2'

DESCRIPTION

Medium brown meta welded lapilli tuff, oxide stained with a small light gray clay(?) zone and one non-through-going fracture.

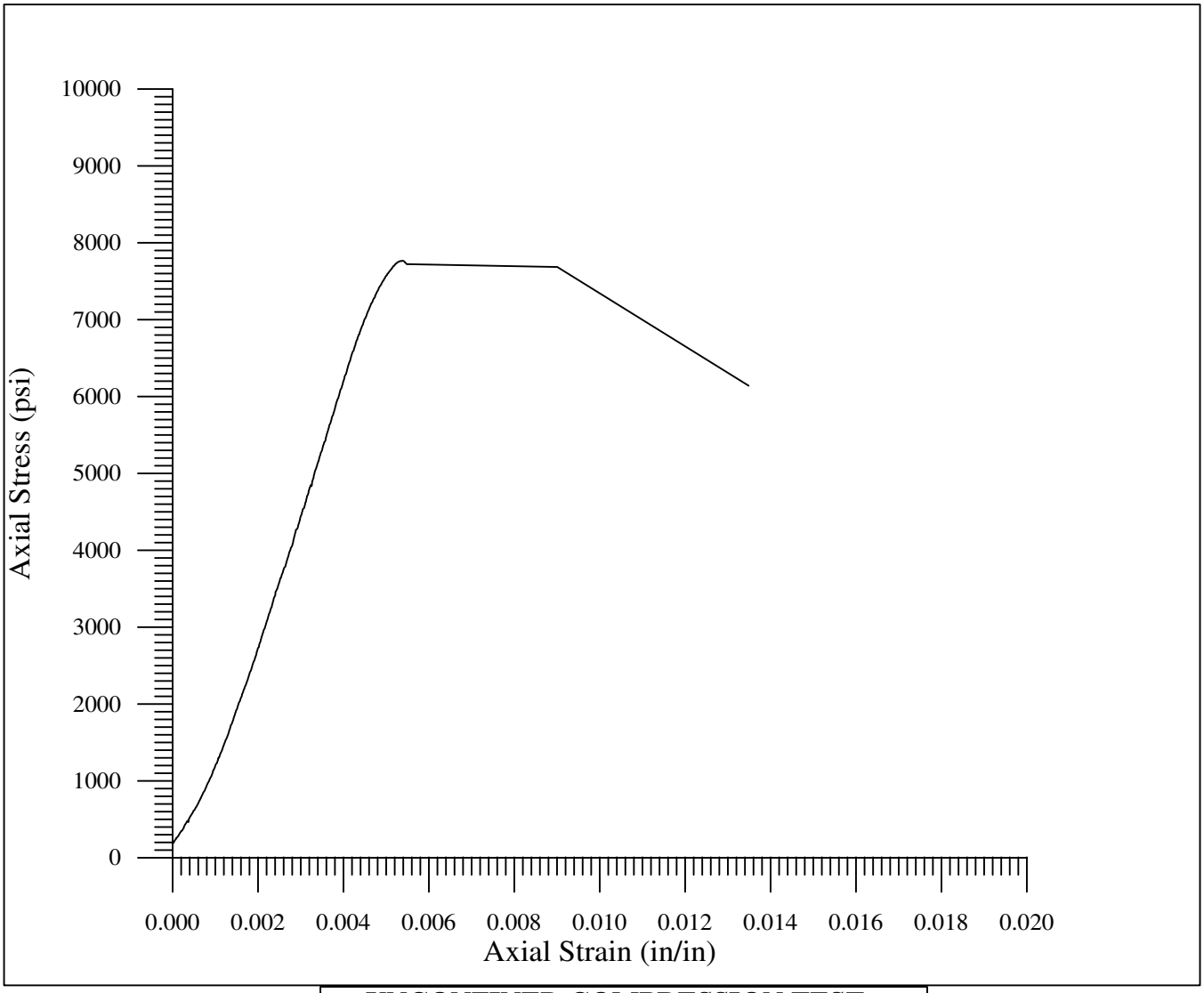
Density: 159.3 pcf
Strength: 6408 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 102
Boring: RKS-17-07
Depth: 53.3-54.0'

DESCRIPTION

Meta welded lapilli tuff, medium brown and blue gray clasts in a light gray matrix, with a few non-through-going fractures.

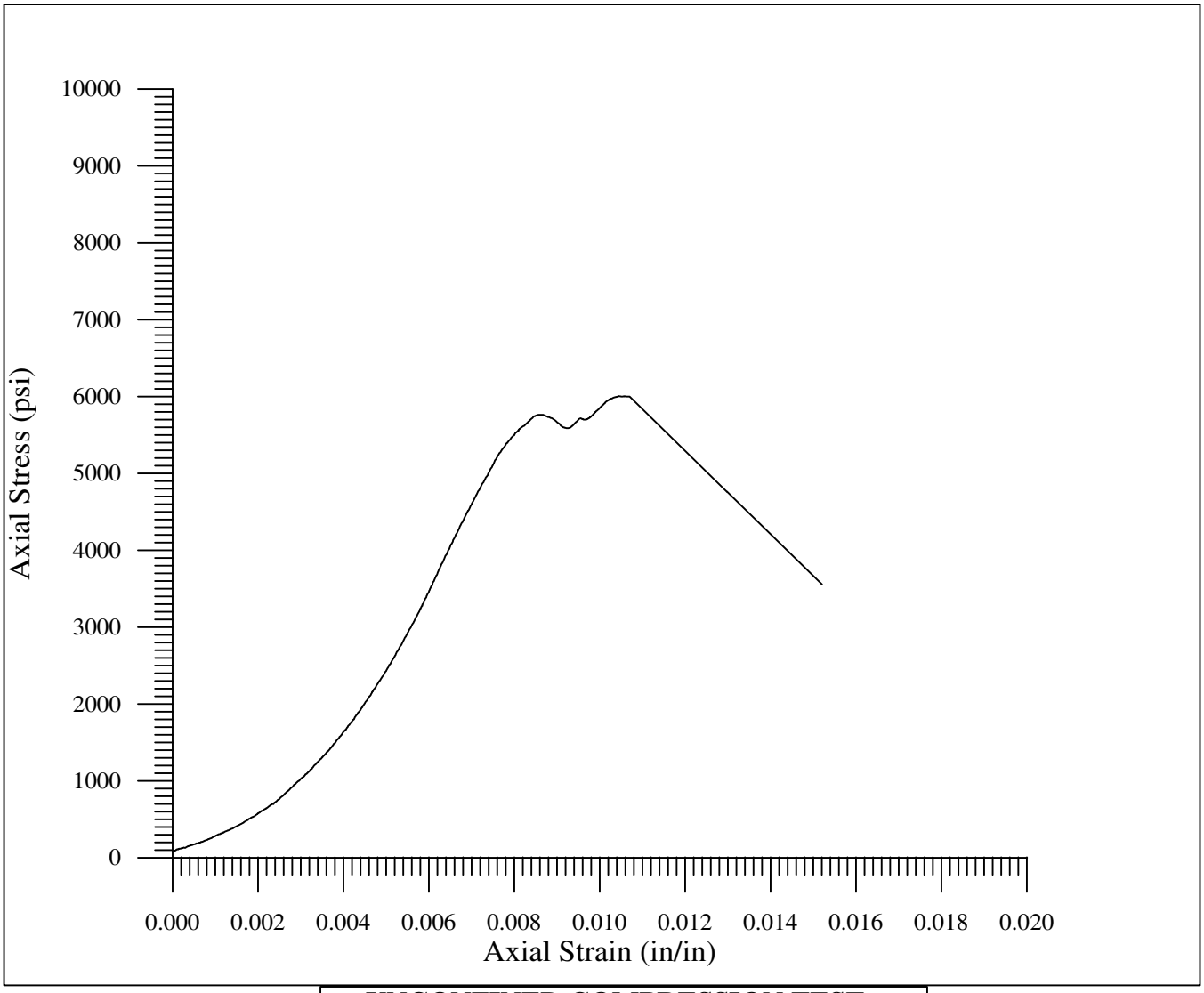
Density: 156.2 pcf
Strength: 7767 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 102B
Boring: RKS-18-07
Depth: 72.5-72.9'

DESCRIPTION

Dark gray meta welded lapilli tuff, heavily fractured.

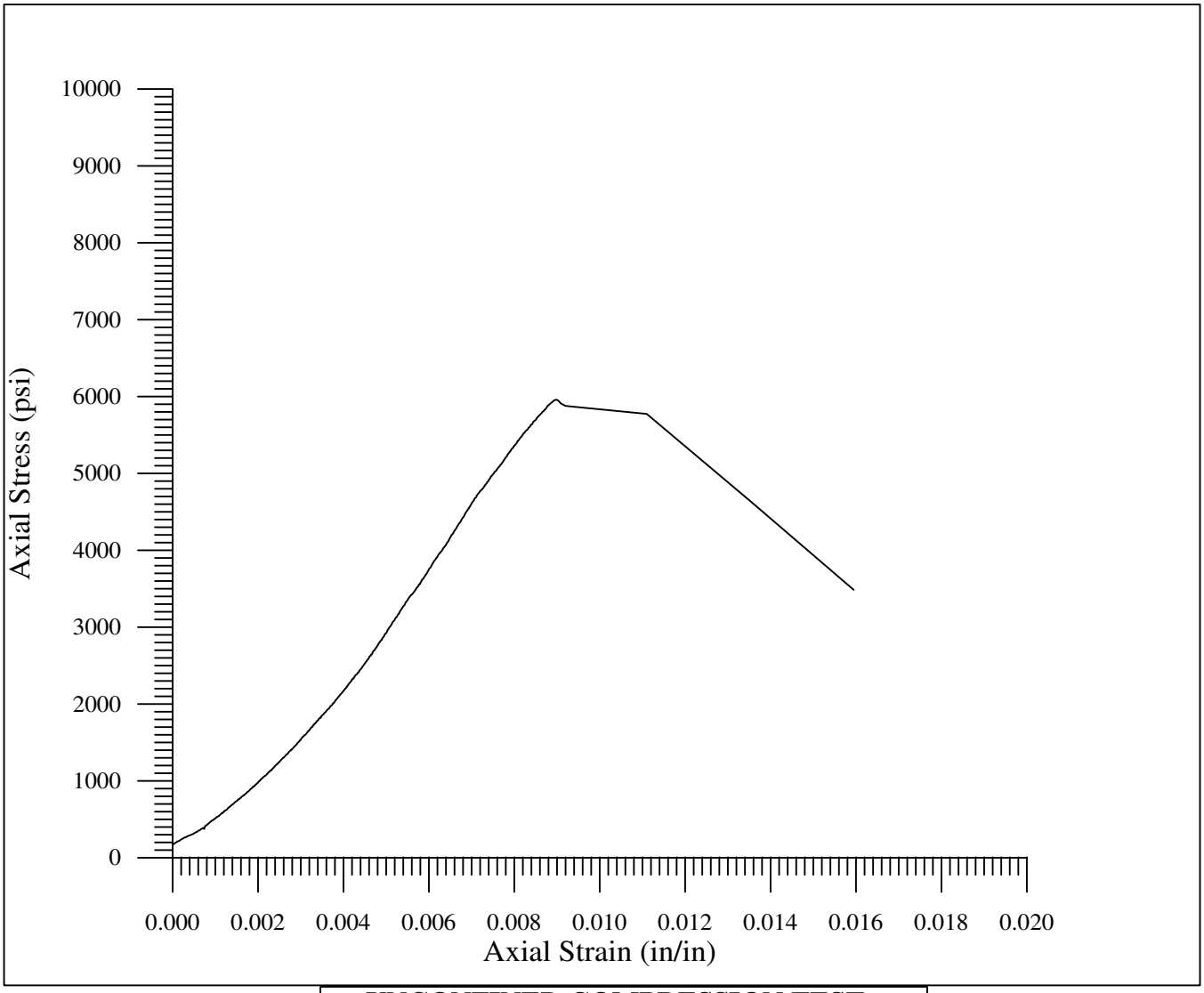
Density: 159.4 pcf
Strength: 6005 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 102
Boring: RKS-19-07
Depth: 30.4-31.4'

DESCRIPTION

Light gray meta welded lapilli tuff,
with several light blue inclusions
altered to clay(?), with a glued end fracture.

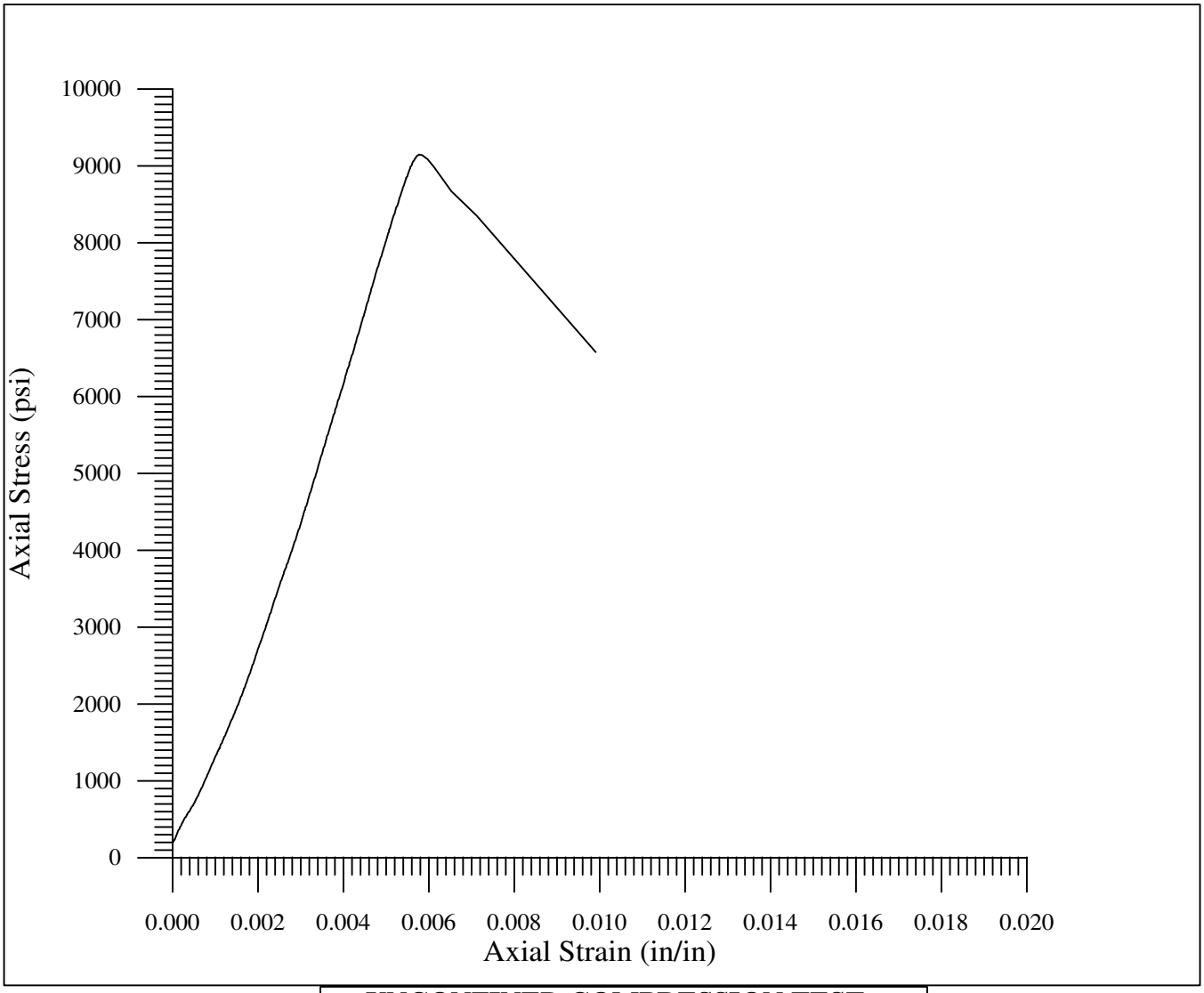
Density: 156.4 pcf
Strength: 5959 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 103B
Boring: RKS-19-07
Depth: 56.3-57.0'

DESCRIPTION

Light gray meta welded lapilli tuff,
with light blue inclusions altered to clay(?).

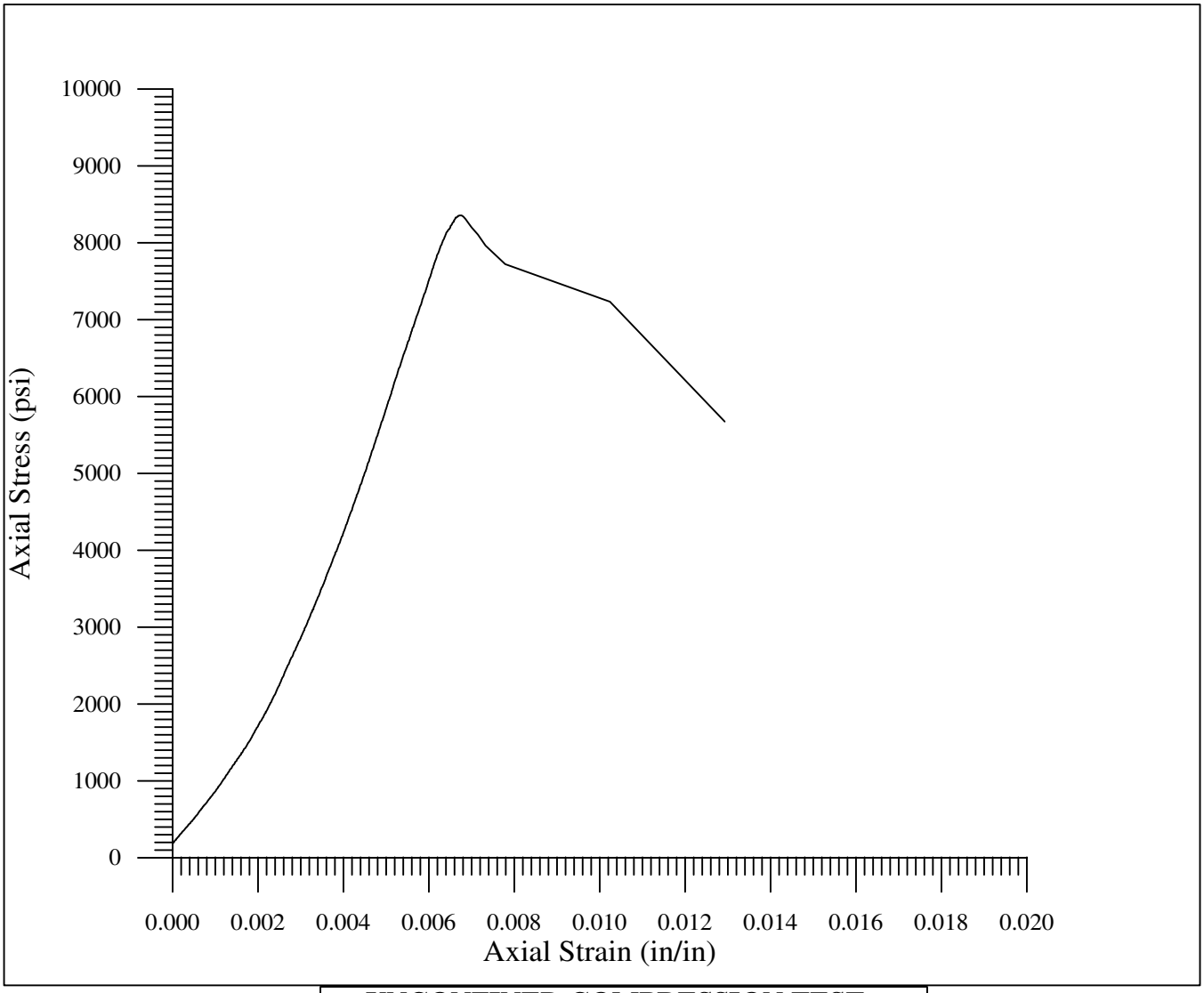
Density: 160.9 pcf
Strength: 9148 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 102A
Boring: RKS-20-07
Depth: 64.8-65.4'

DESCRIPTION

Light gray meta welded lapilli tuff,
with light blue inclusions altered to clay(?).

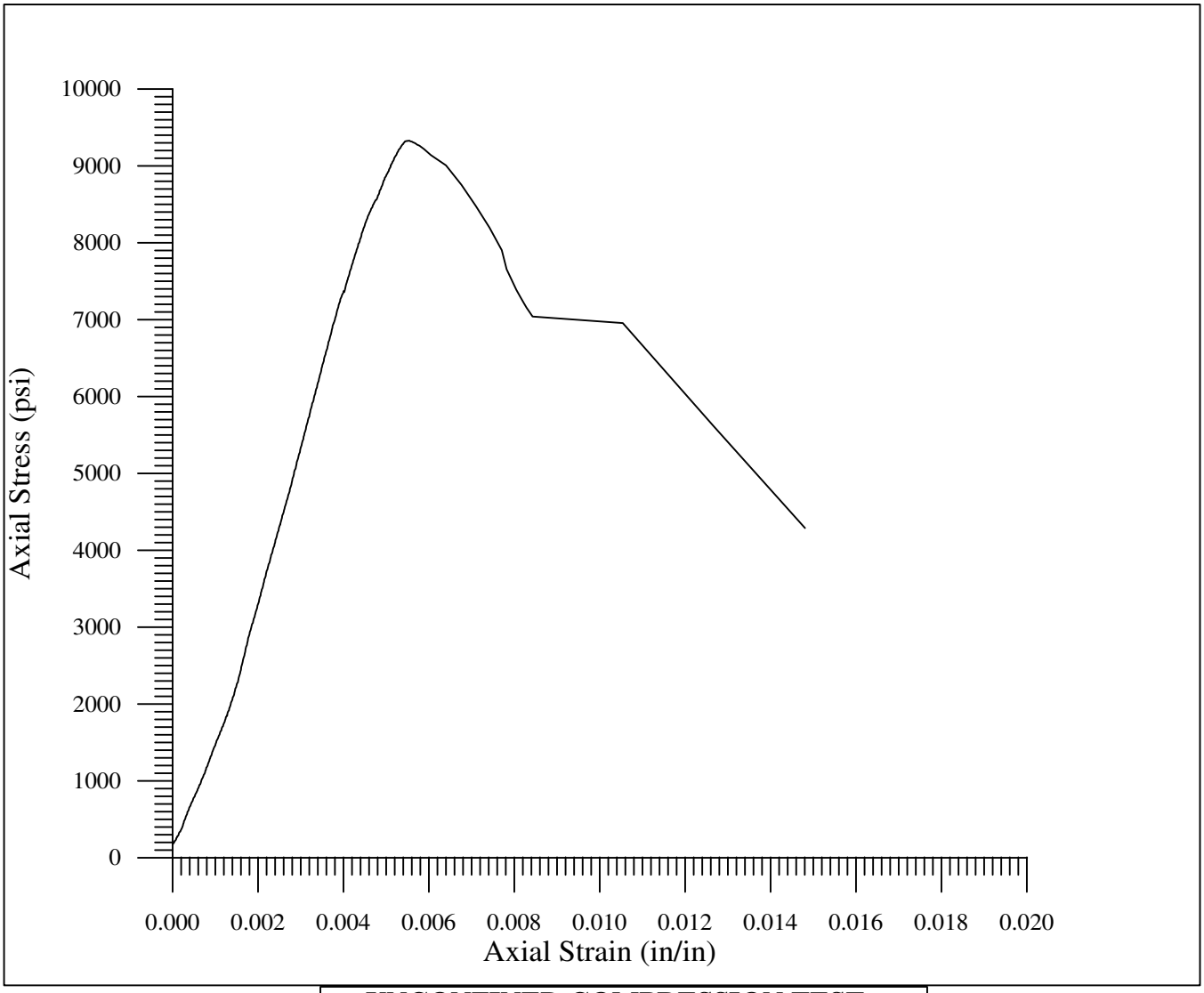
Density: 160.4 pcf
Strength: 8358 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 101A
Boring: RKS-22-07
Depth: 11.7-12.5'

DESCRIPTION

Medium gray meta welded lapilli tuff, with a tight end fracture.

Density: 166.0 pcf
Strength: 9327 psi

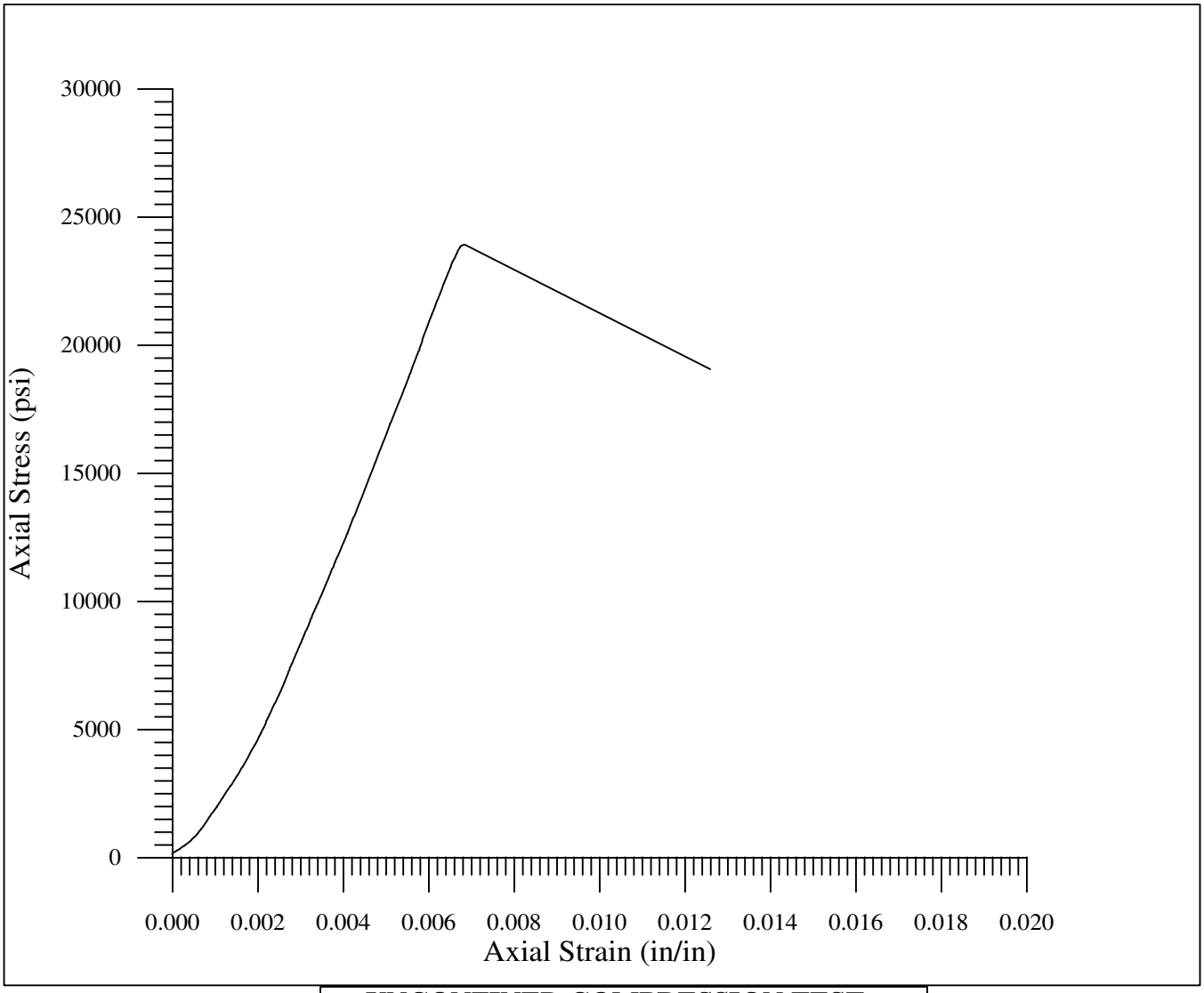
Geo Test Unlimited GTU

27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Wyllie & Norrish Engineers
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 101A
Boring: RKS-23-07
Depth: 10.3-11.0'

DESCRIPTION

Medium blue gray meta welded lapilli tuff, with no apparent planes of weakness

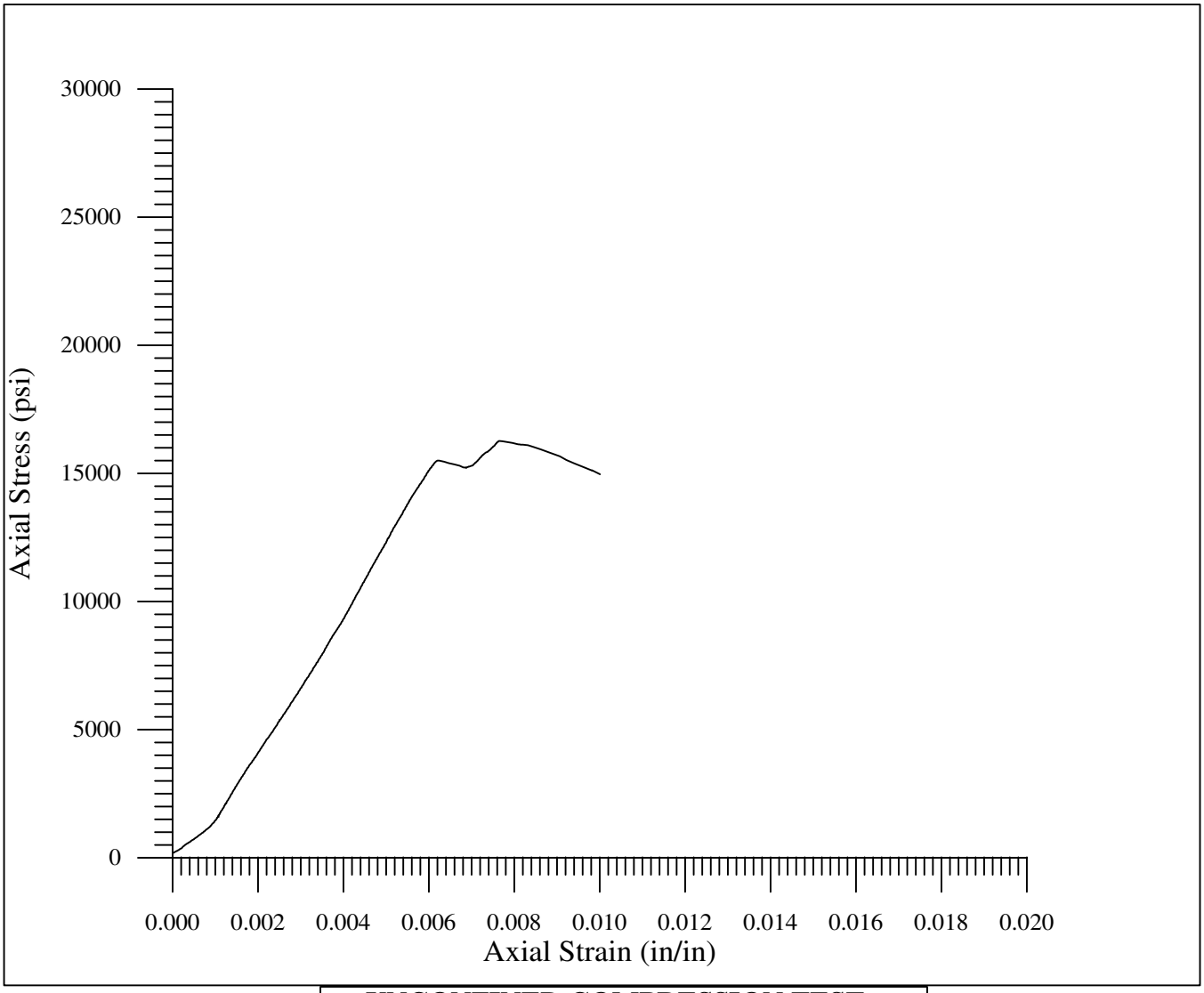
Density: 163.2 pcf
Strength: 23,917 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 101B
Boring: RKS-26-07
Depth: 32.1-32.8'

DESCRIPTION

Medium blue gray meta welded lapilli tuff, with no apparent planes of weakness

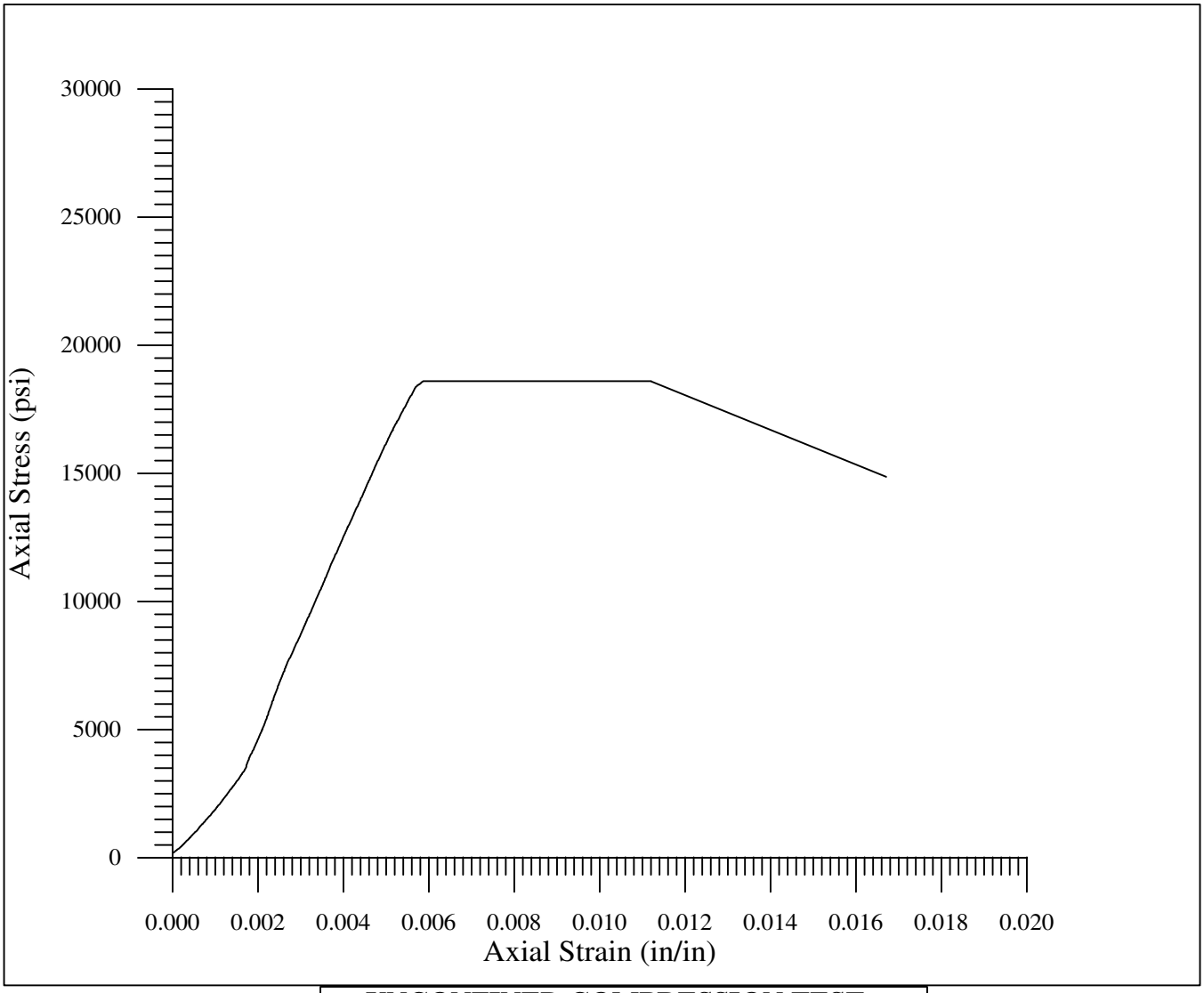
Density: 163.9 pcf
Strength: 16,267 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 102A
Boring: RKS-27-07
Depth: 28.5-29.2'

DESCRIPTION

Light to medium gray meta welded lapilli tuff, with a few altered clasts.

Density: 164.6 pcf
Strength: 18,597 psi

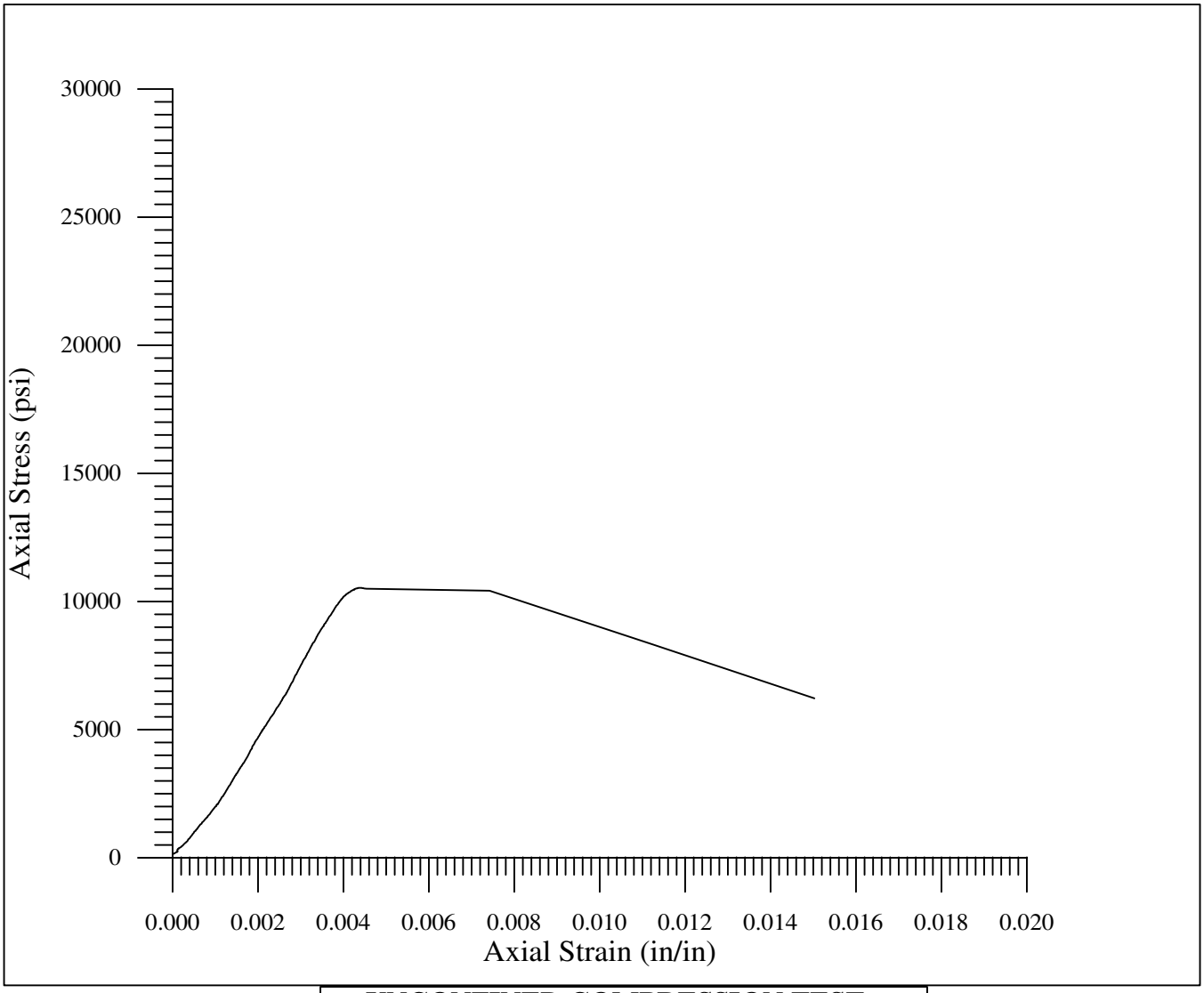
Geo Test Unlimited GTU

27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Wyllie & Norrish Engineers
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 102A
Boring: RKS-28-07
Depth: 65.4-66.0'

DESCRIPTION

Light gray meta welded lapilli tuff,
with no apparent planes of weakness.

Density: 164.0 pcf
Strength: 10,535 psi

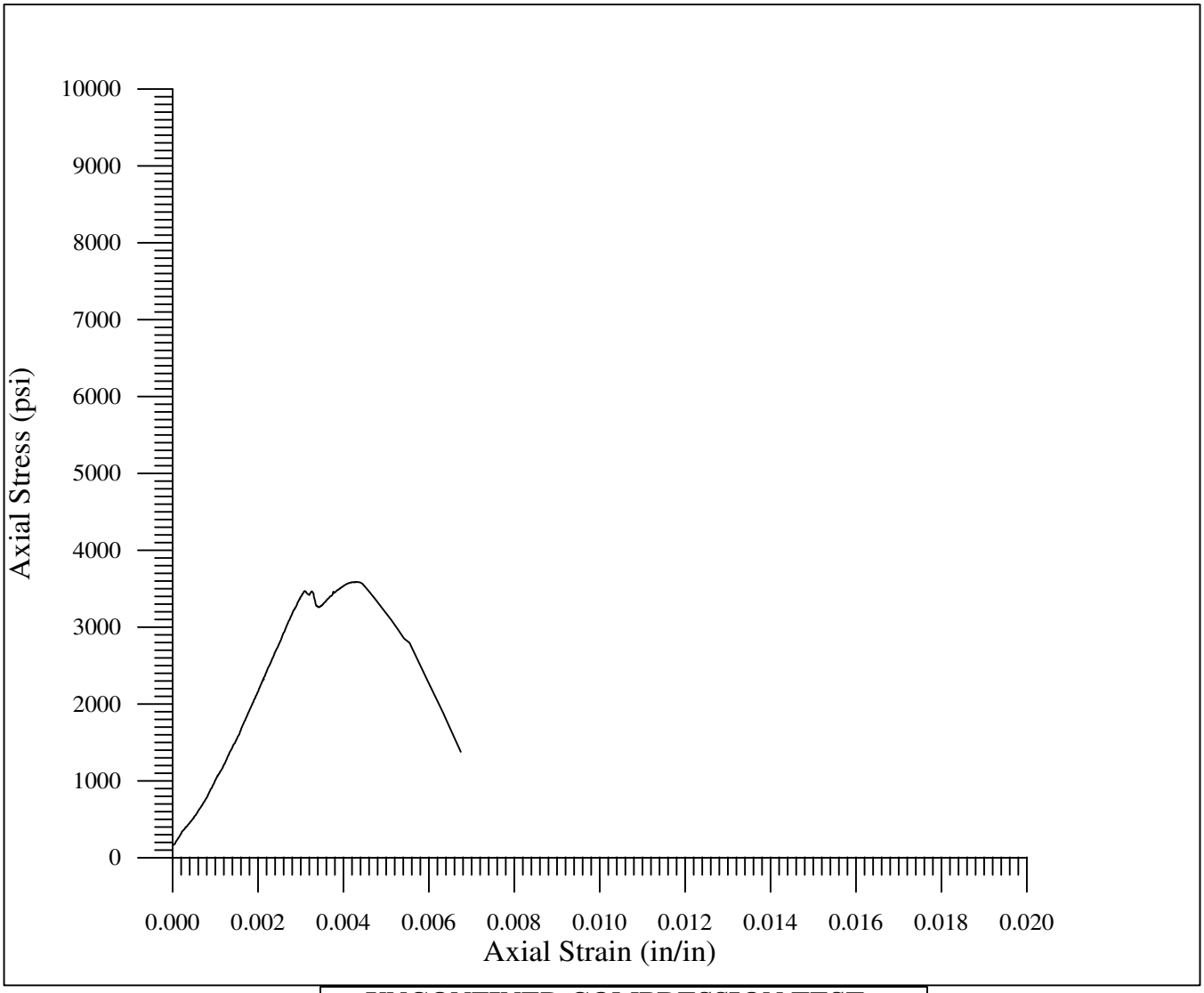
Geo Test Unlimited GTU

27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Wyllie & Norrish Engineers
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 201
Boring: RKS-28-07
Depth: 33.0-33.8'

DESCRIPTION

Medium brown meta welded lapilli tuff, with a tight axial non-through-going fracture.

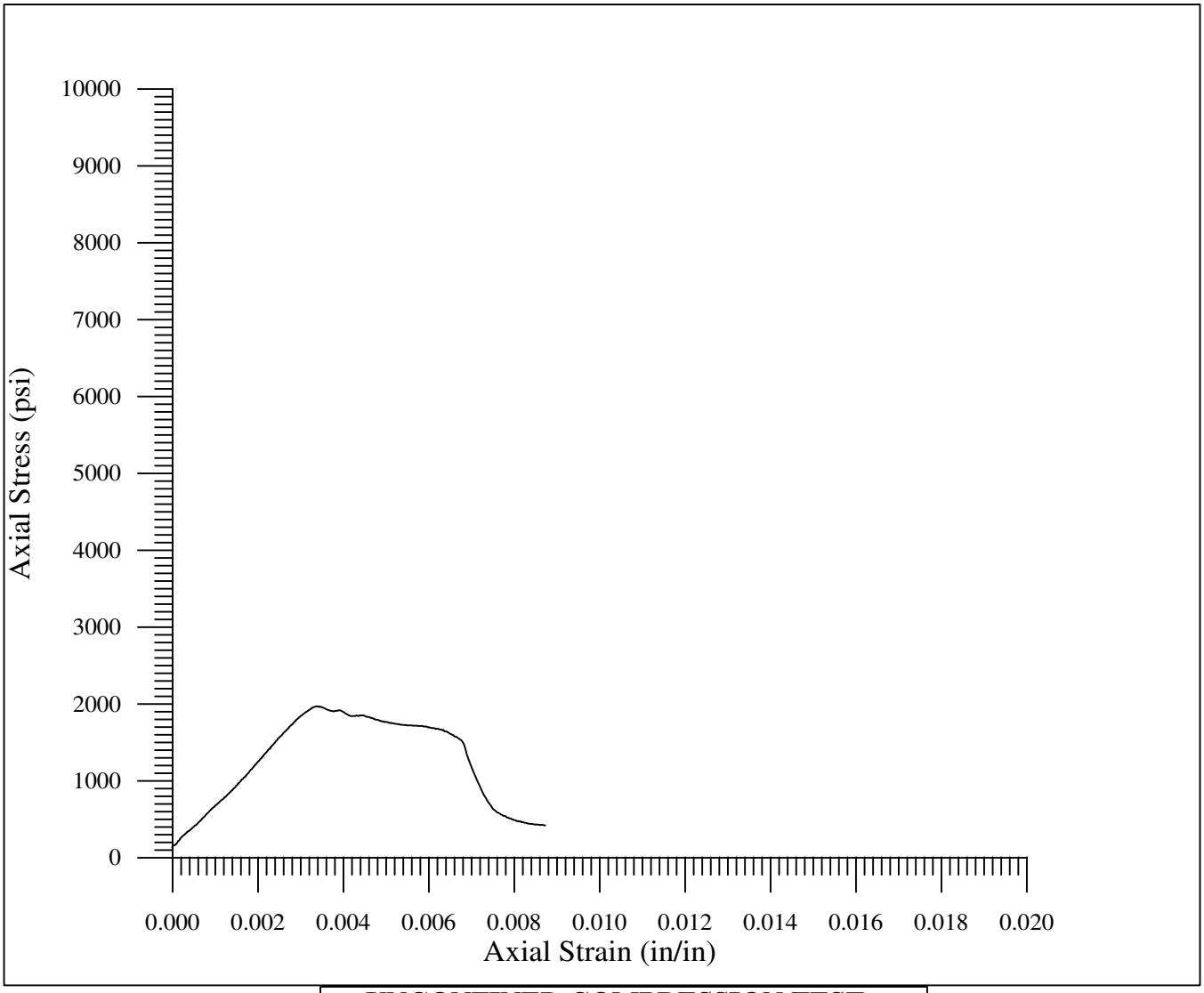
Density: 158.3 pcf
Strength: 3588 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 202
Boring: RKS-28-07
Depth: 27.8-28.5'

DESCRIPTION

Medium brown meta welded lapilli tuff, with two major axial fractures.

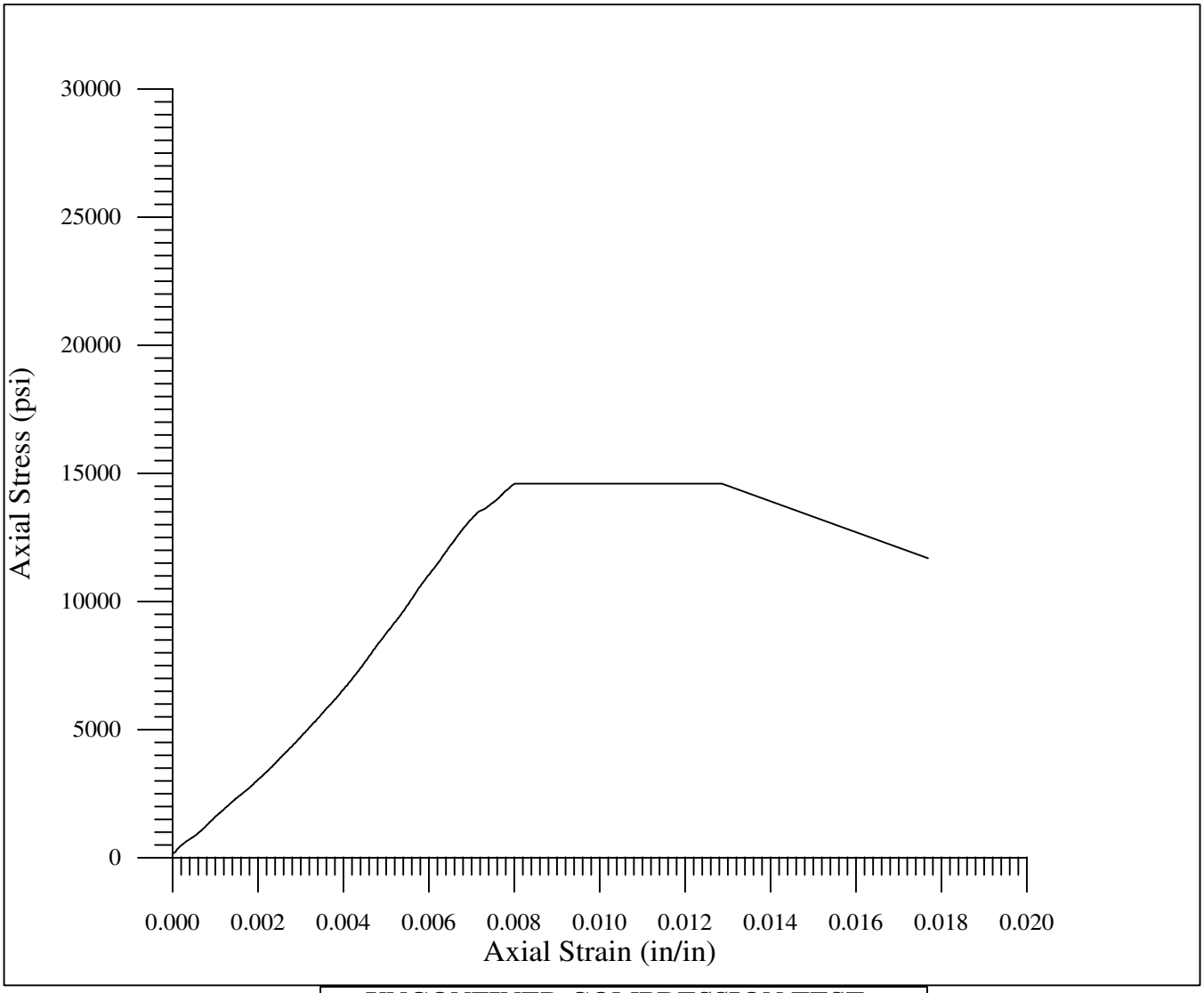
Density: 156.2 pcf
Strength: 1970 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 102A
Boring: RKS-29-07
Depth: 18.8-19.5'

DESCRIPTION

Medium gray meta welded lapilli tuff, with no apparent planes of weakness (finer clasts than other samples).

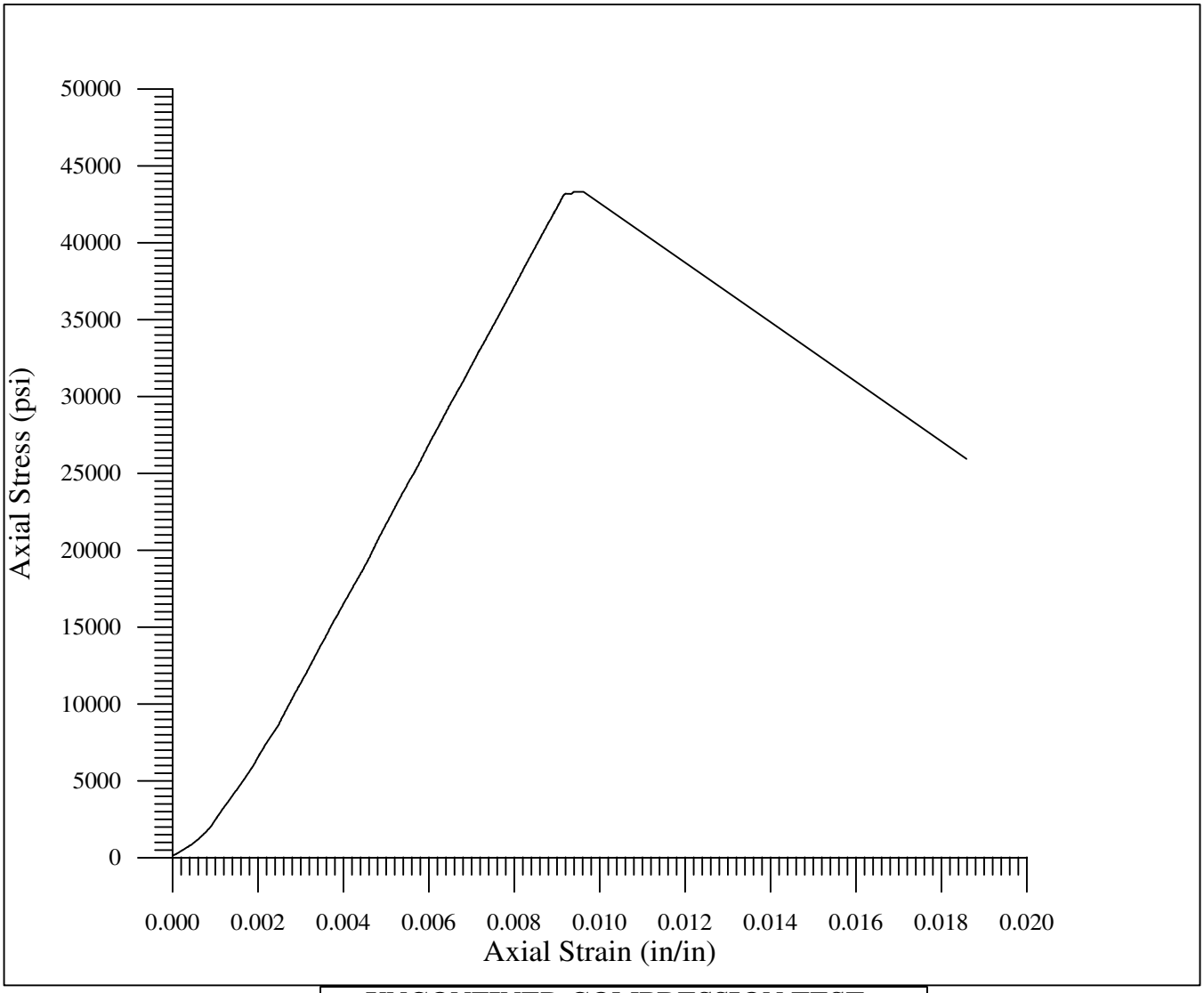
Density: 159.4 pcf
Strength: 14,605 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 103A
Boring: RKS-30-07
Depth: 55.1-55.8'

DESCRIPTION

Medium blue gray meta welded lapilli tuff, with no apparent planes of weakness.

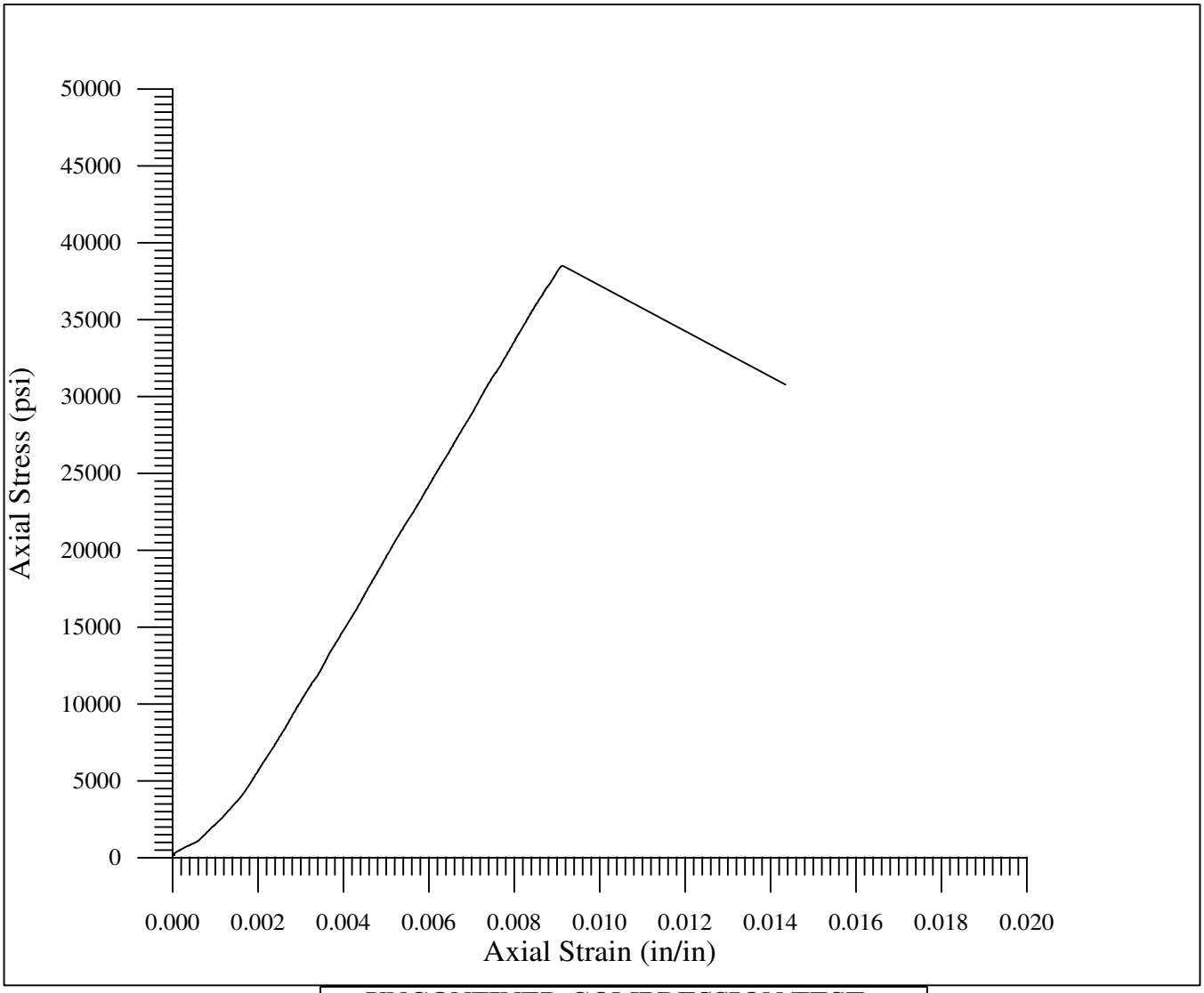
Density: 161.7 pcf
Strength: 43,320 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 103B
Boring: RKS-31-07
Depth: 83.5-84.3'

DESCRIPTION

Medium gray meta welded lapilli tuff, with no apparent planes of weakness.

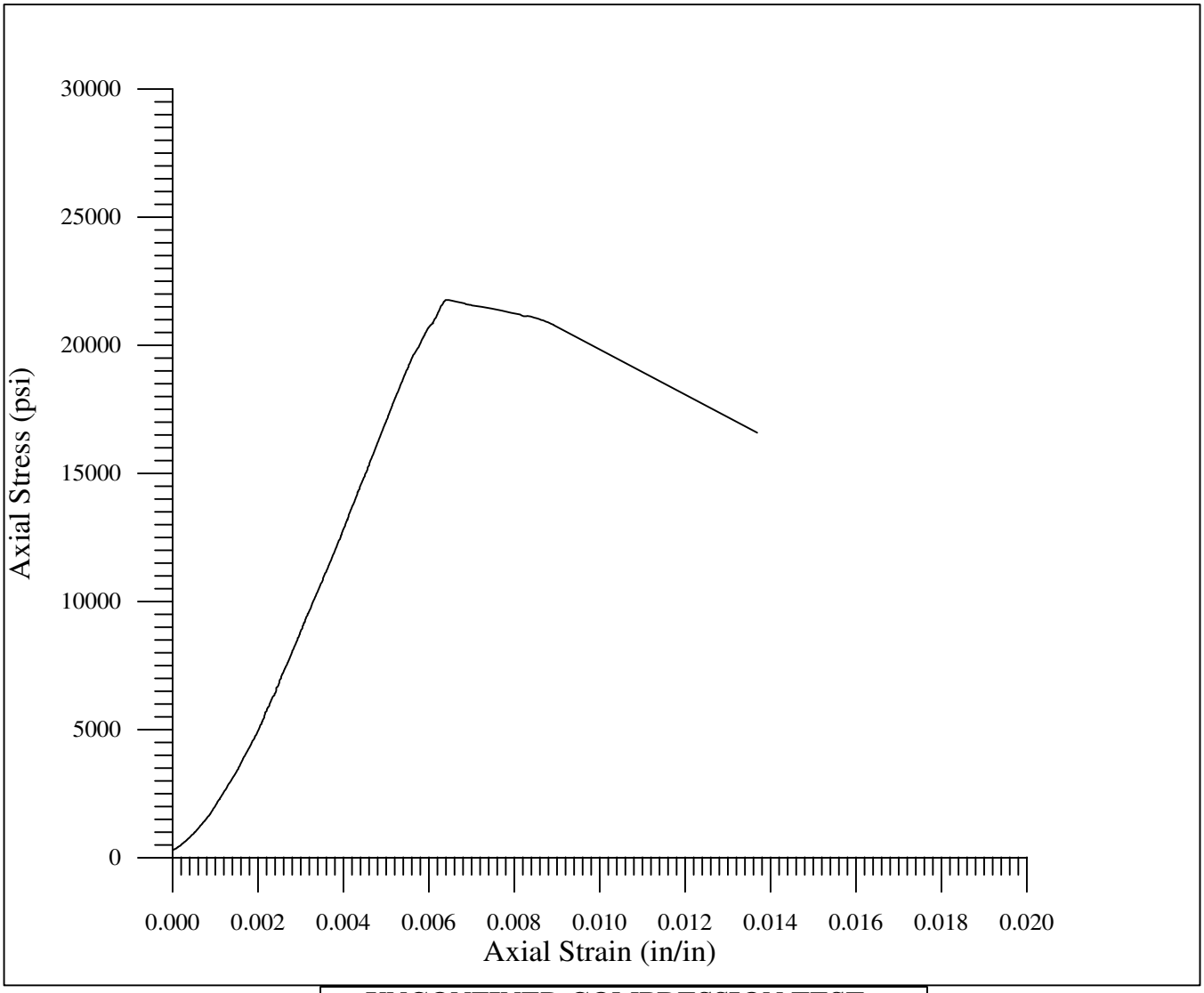
Density: 162.4 pcf
Strength: 38,505 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 16, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 101A
Boring: SI-10-07
Depth: 24.7-25.4'

DESCRIPTION

Medium blue gray meta welded lapilli tuff, with no apparent planes of weakness.

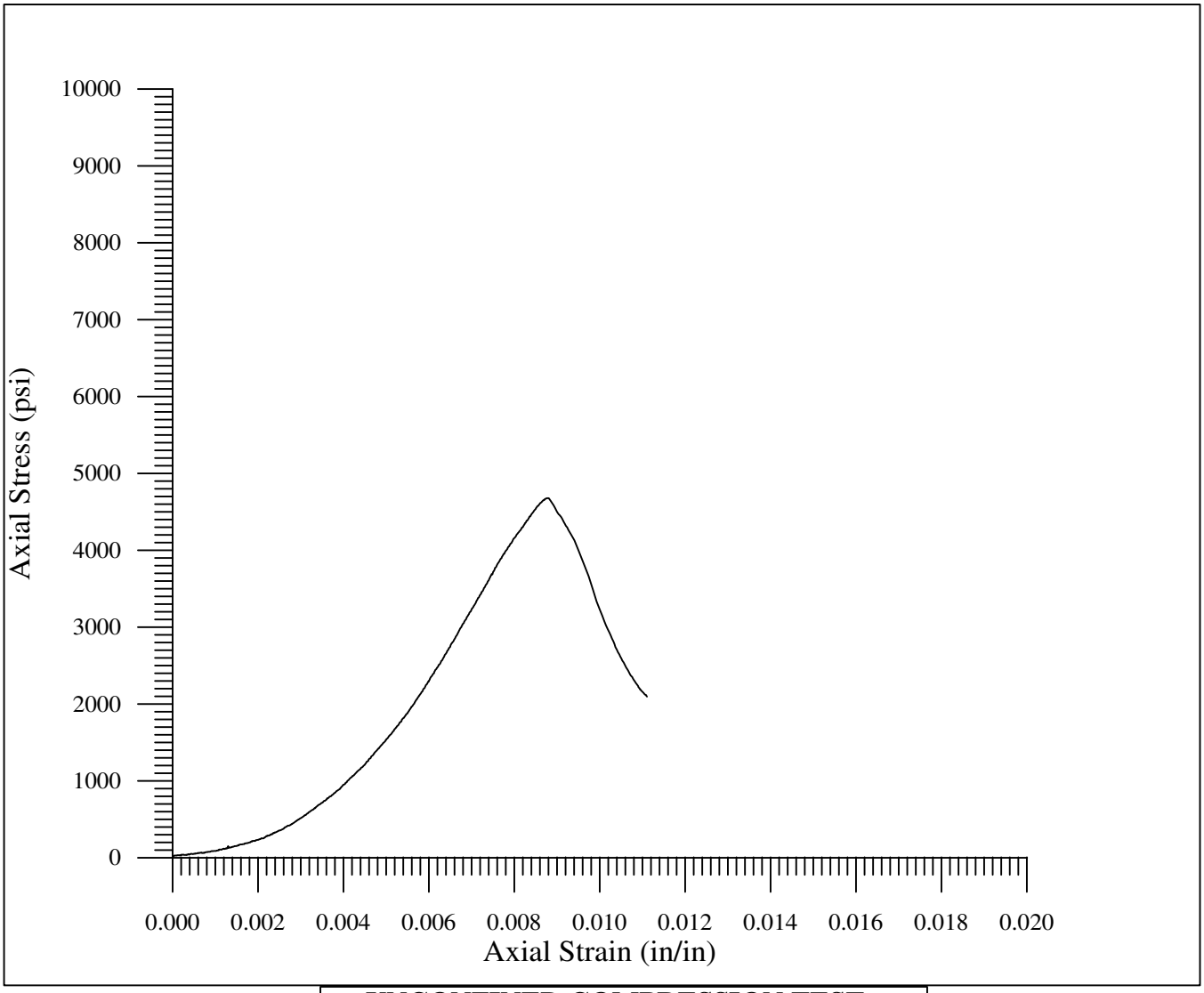
Density: 163.5 pcf
Strength: 21,770 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 14, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 101
Boring: SI-1-07
Depth: 32.0-32.7'

DESCRIPTION

Medium brown meta welded lapilli tuff, altered and friable with an open oxide coated fracture.

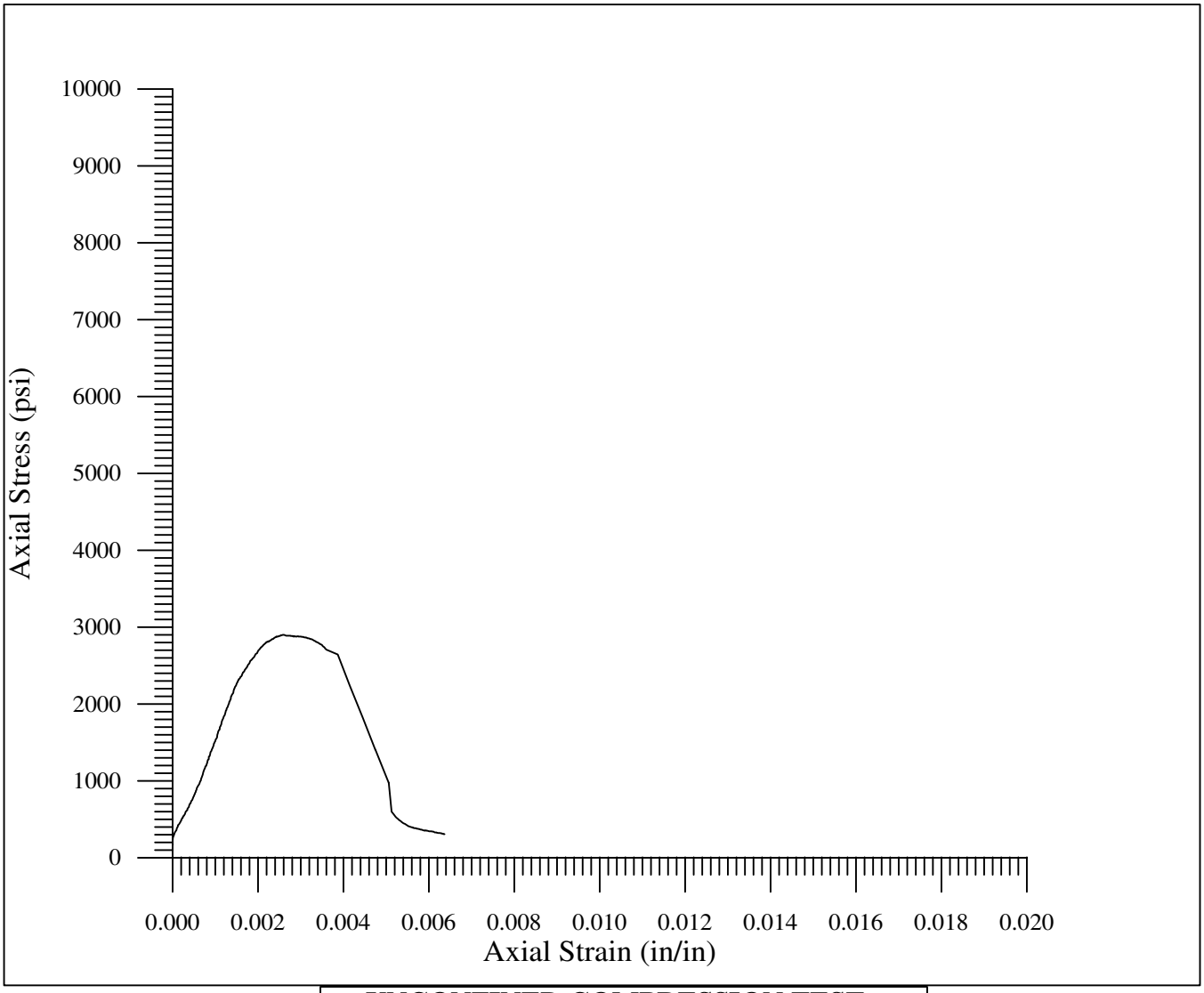
Density: 155.1 pcf
Strength: 4680 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 14, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 103A
Boring: SI-2-07
Depth: 53.4-54.0'

DESCRIPTION

Medium brown meta welded lapilli tuff, altered with several oxide healed joints.

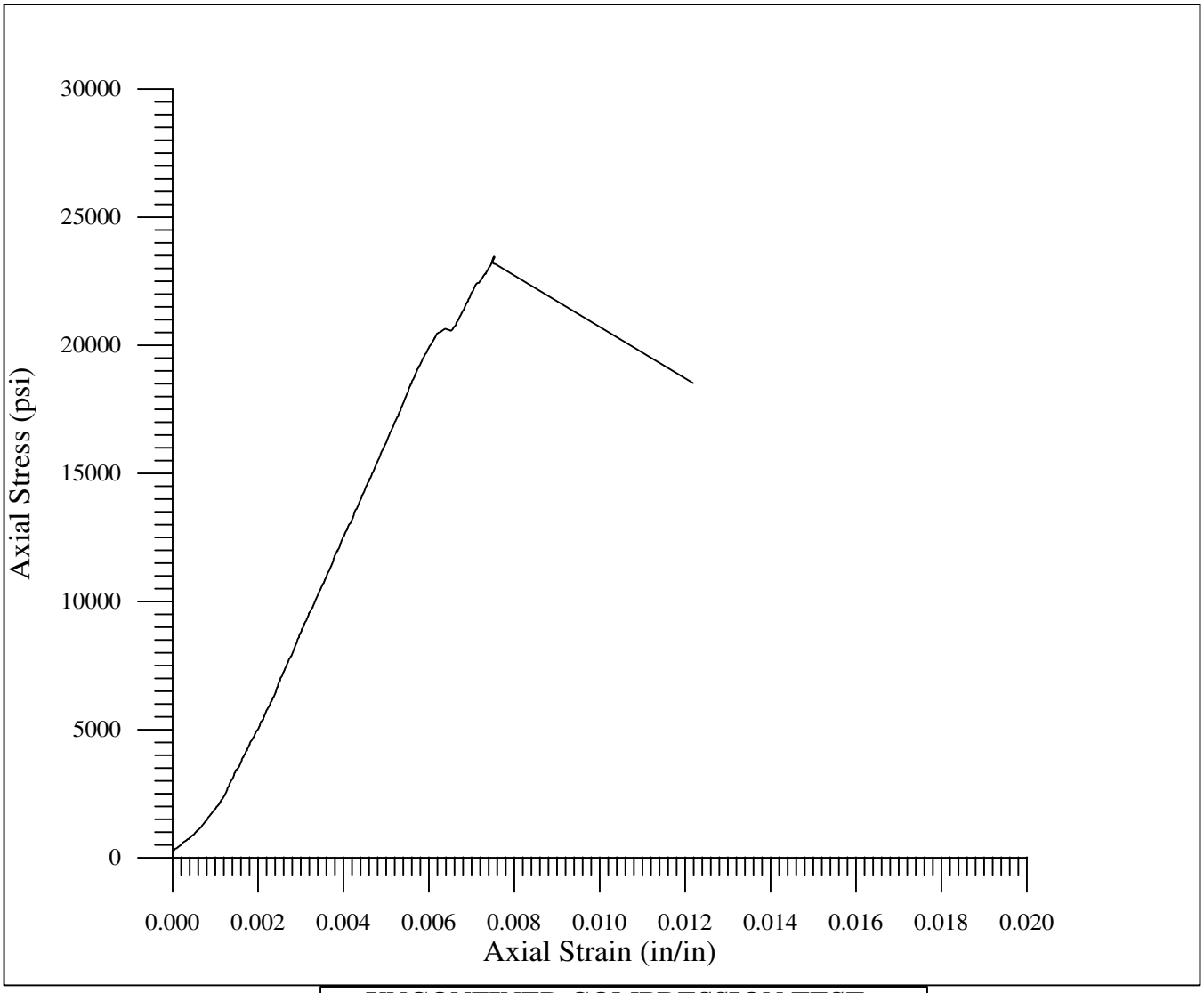
Density: 160.5 pcf
Strength: 2901 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 14, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 101A
Boring: SI-4-07
Depth: 23.6-24.5'

DESCRIPTION

Medium blue gray meta welded lapilli tuff, with a glued fracture at one end.

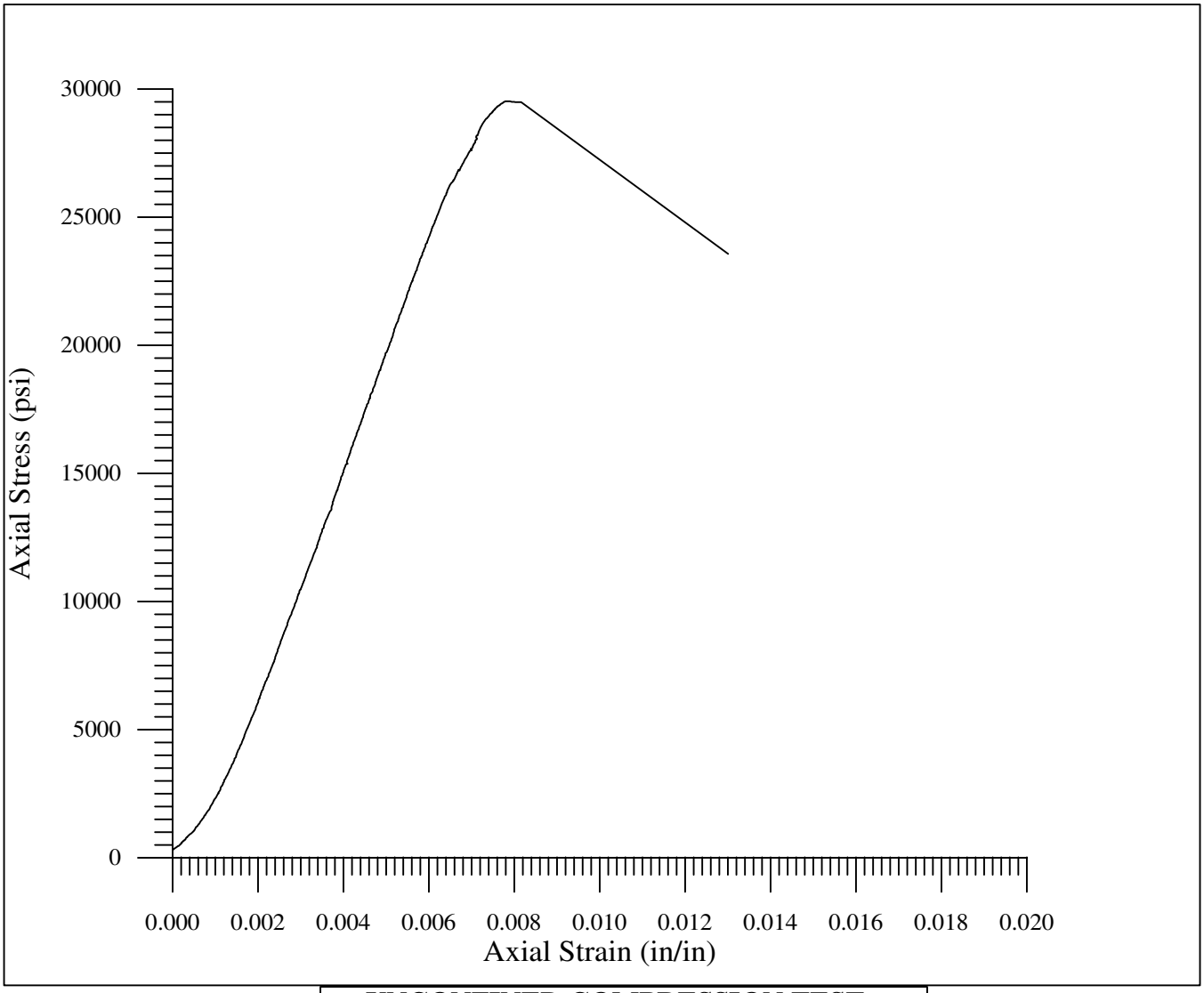
Density: 162.9 pcf
Strength: 23,469 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 14, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 102A
Boring: SI-5-07
Depth: 33.9-34.8'

DESCRIPTION

Light greenish gray meta welded lapilli tuff, with no apparent planes of weakness.

Density: 165.0 pcf
Strength: 29,523 psi

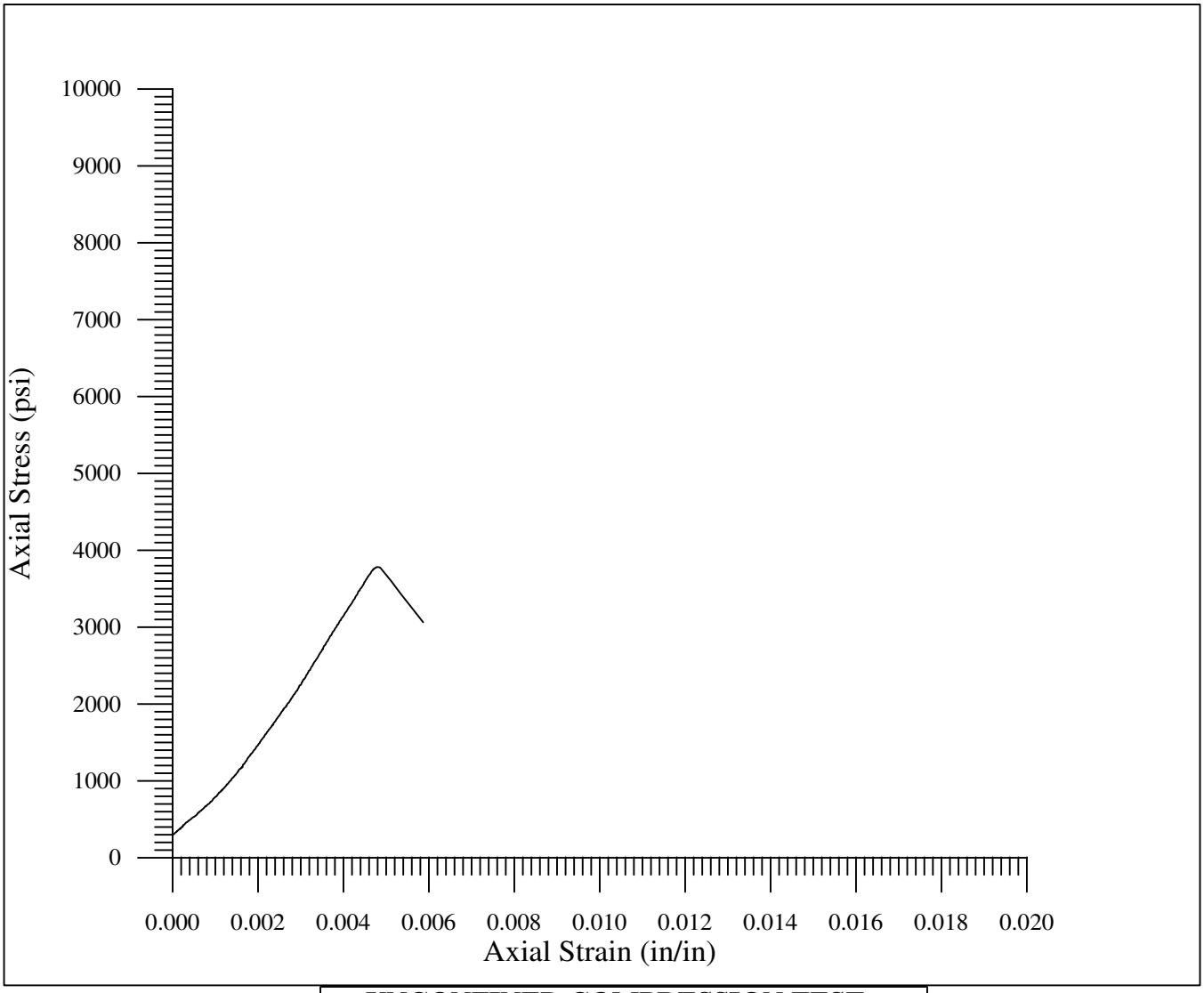
Geo Test Unlimited GTU

27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Wyllie & Norrish Engineers
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 14, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 103
Boring: SI-5-07
Depth: 56.9-57.6'

DESCRIPTION

Medium brown meta welded lapilli tuff, slightly altered with two minor oxide stained non-through-going joints.

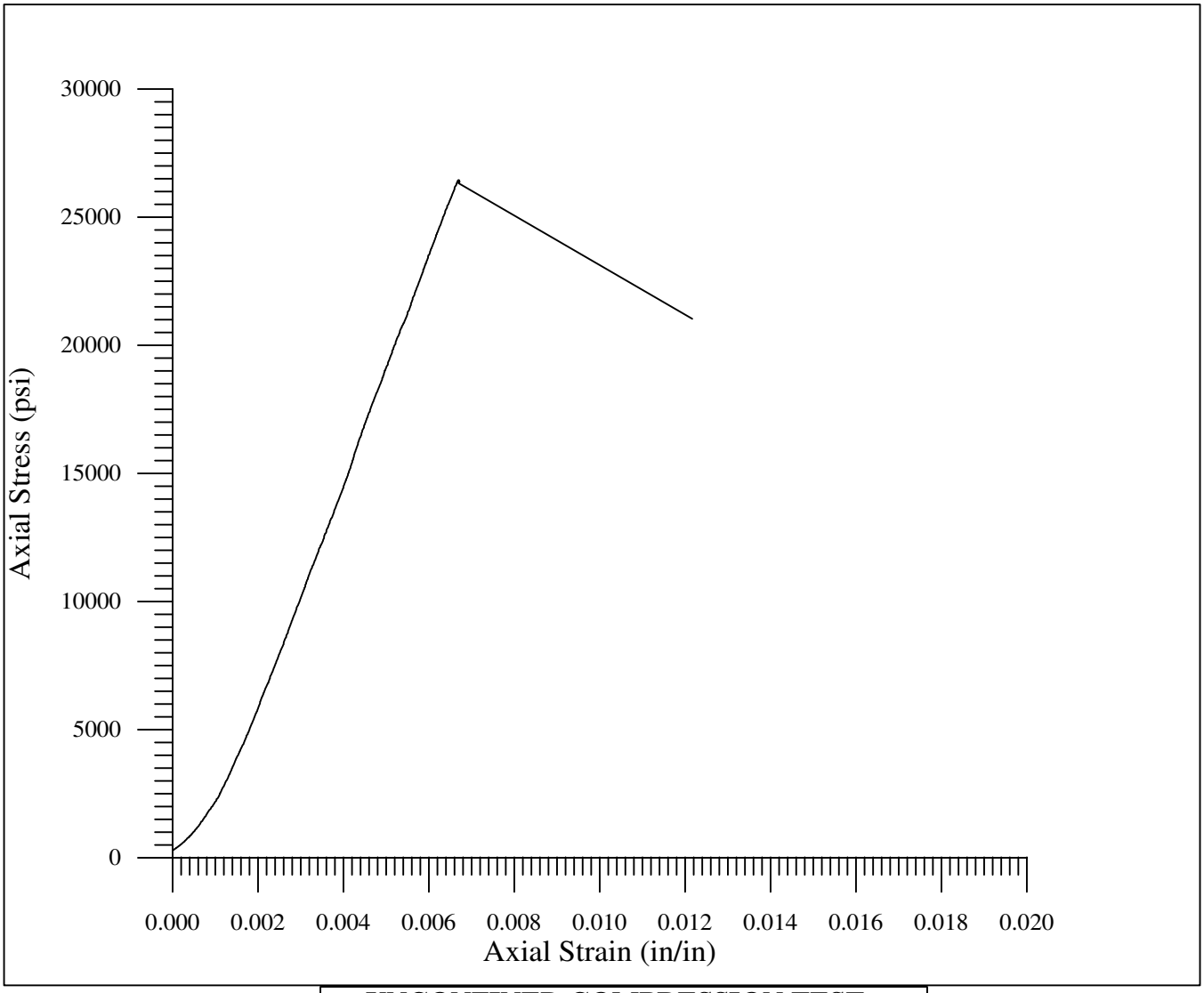
Density: 158.6 pcf
Strength: 3782 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 14, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 101B
Boring: SI-7-07
Depth: 36.9-37.4'

DESCRIPTION

Medium gray meta welded lapilli tuff, with slight oxide staining, but no apparent planes of weakness.

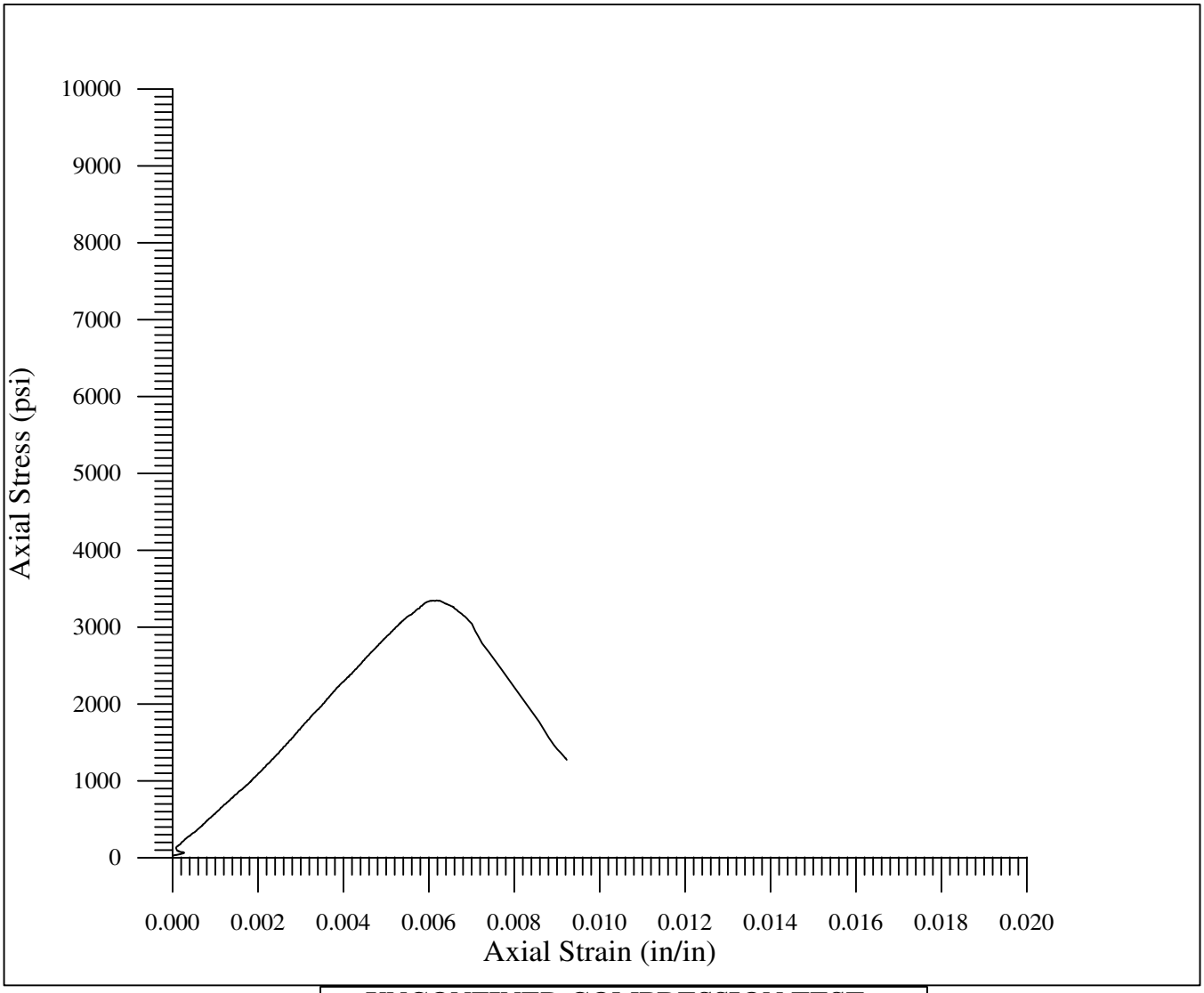
Density: 163.5 pcf
Strength: 26,444 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

Test Date: January 14, 2008



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: 201
Boring: SI-9-07
Depth: 42.4-43.1'

DESCRIPTION

Medium brown meta welded lapilli tuff, somewhat friable with several oxide stained joints.

Density: 158.9 pcf
Strength: 3348 psi

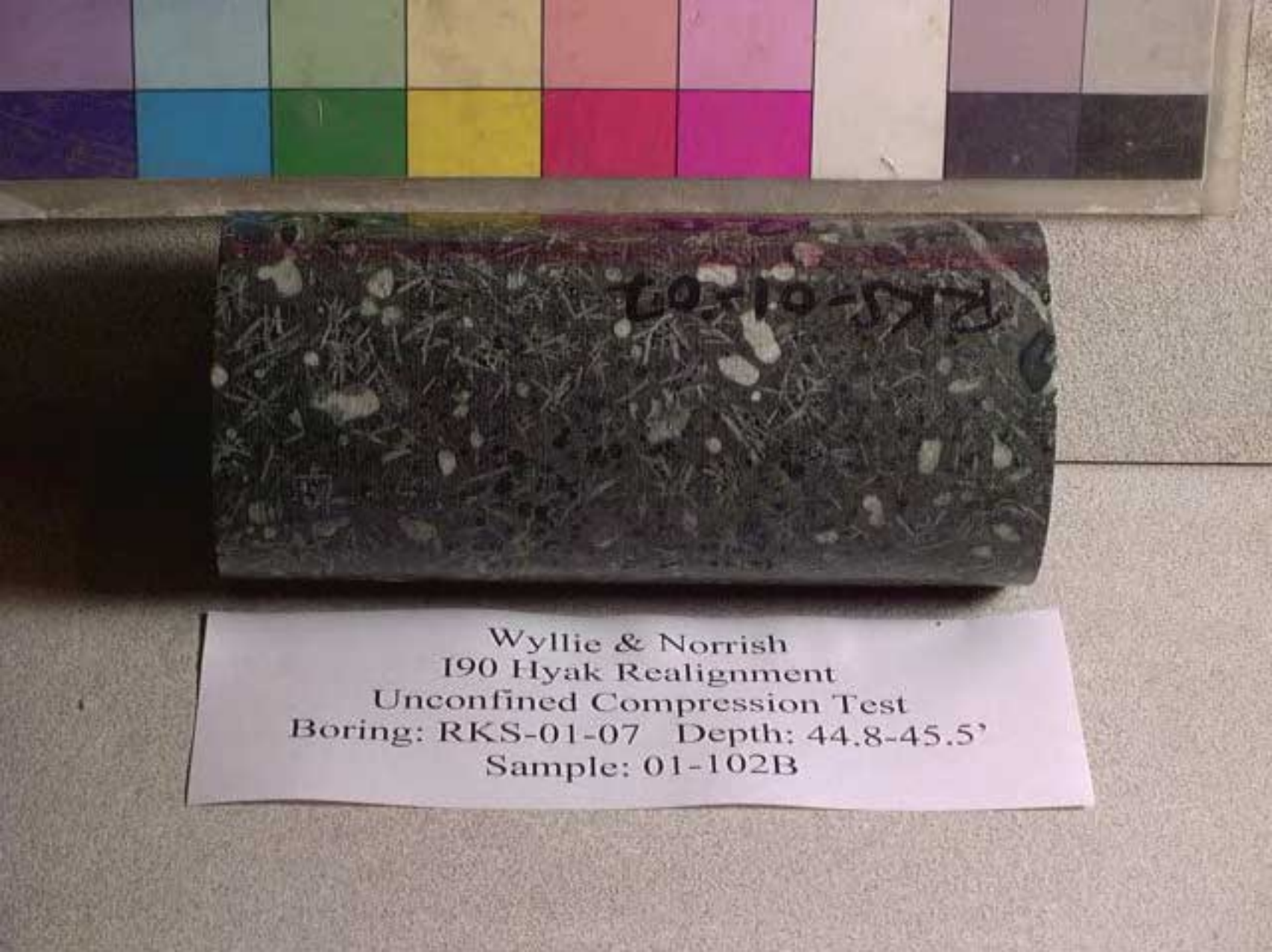
Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

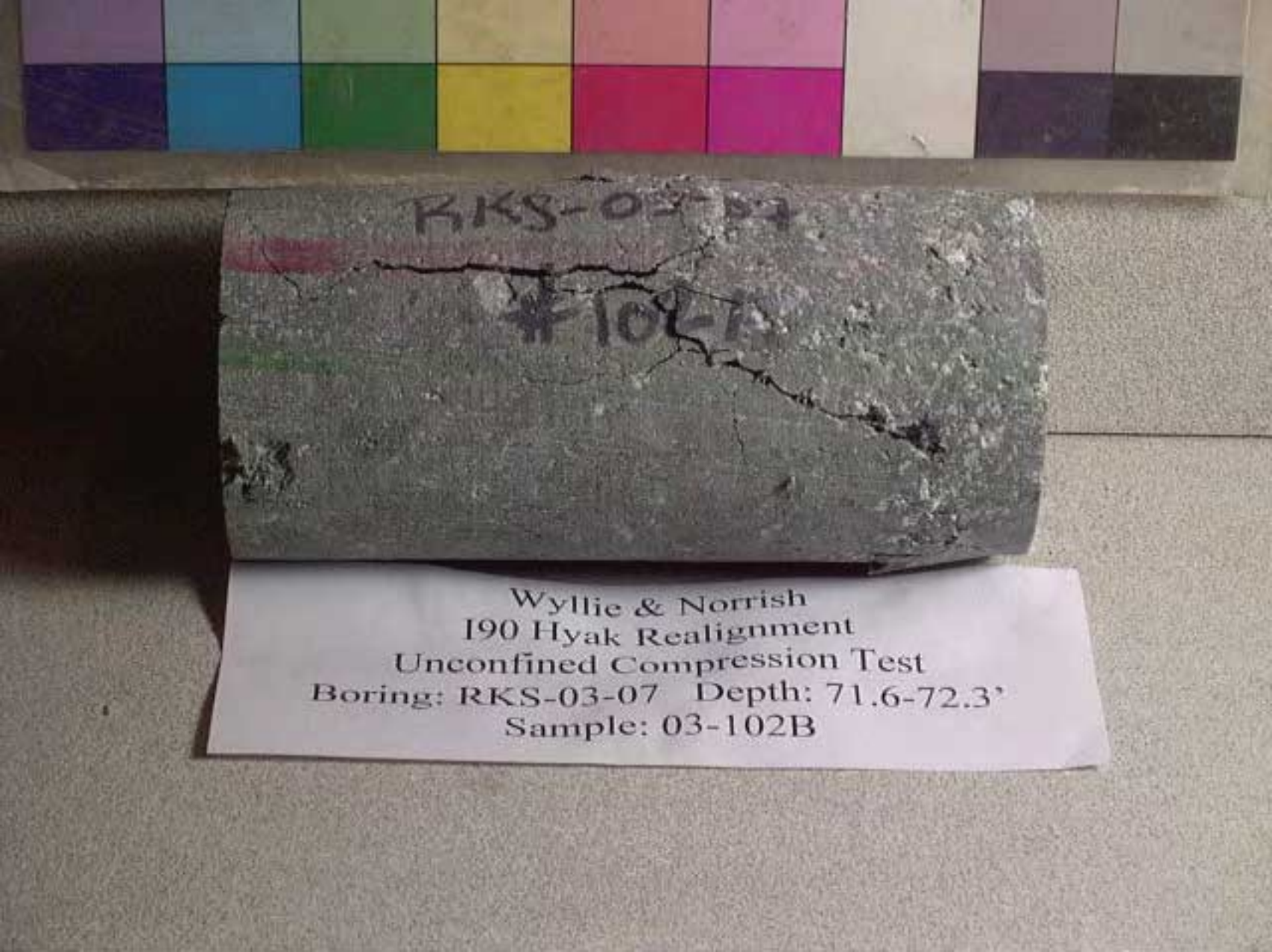
Client: **Wyllie & Norrish Engineers**
17918 NE 27th St.
Redmond, WA 98052

Project: East I-90 Hyak Realignment
Project Number: none

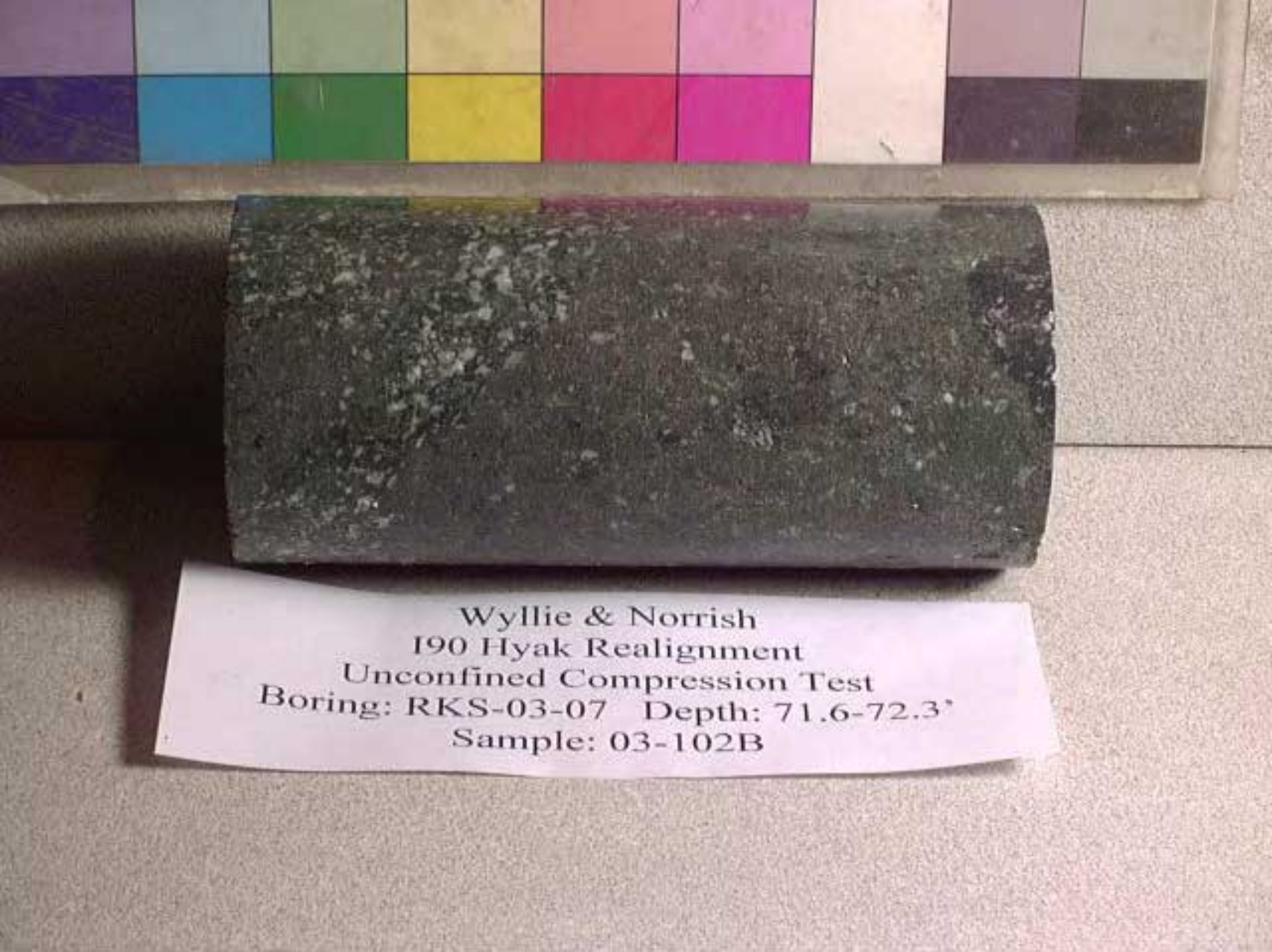
Test Date: January 14, 2008

Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-01-07 Depth: 44.8-45.5'
Sample: 01-102B


Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-01-07 Depth: 44.8-45.5'
Sample: 01-102B

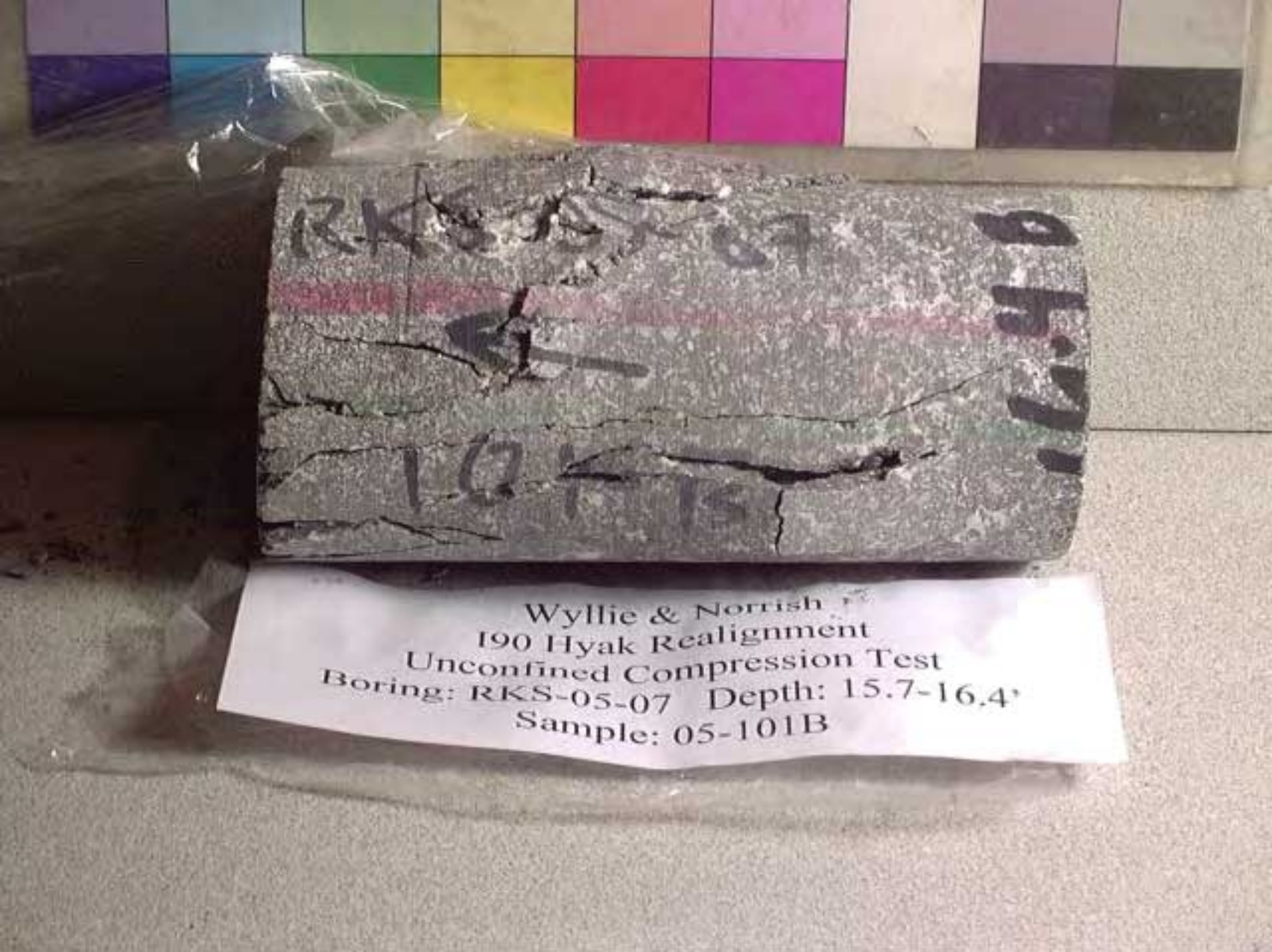


Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-03-07 Depth: 71.6-72.3'
Sample: 03-102B


Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-03-07 Depth: 71.6-72.3'
Sample: 03-102B

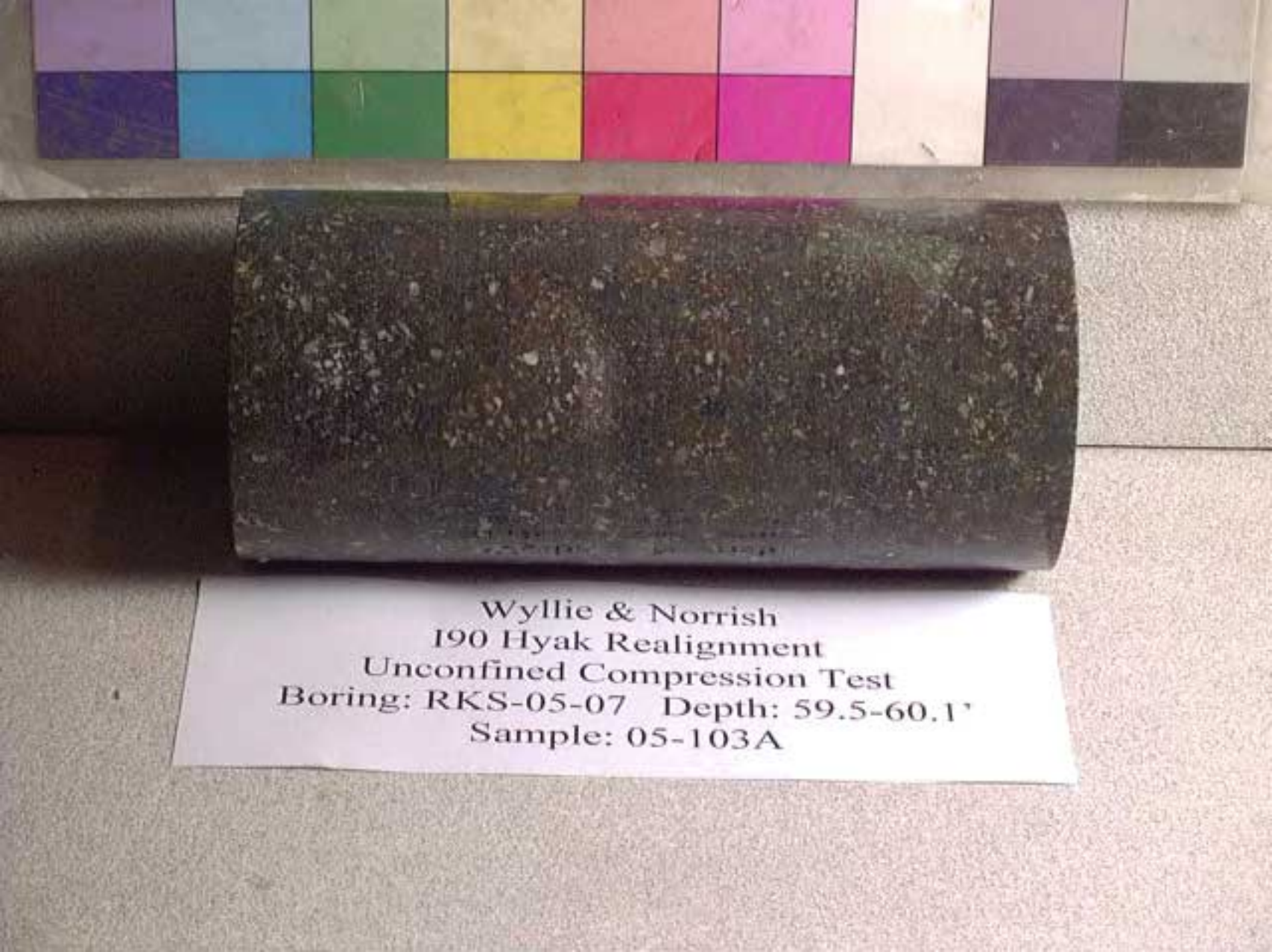
Wyllie & Norrish
190 Hyak Realignment
Unconfined Compression Test
Boring: RKS-04-07 Depth: 25.2-26.0'
Sample: 04-101B

Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-04-07 Depth: 25.2-26.0'
Sample: 04-101B

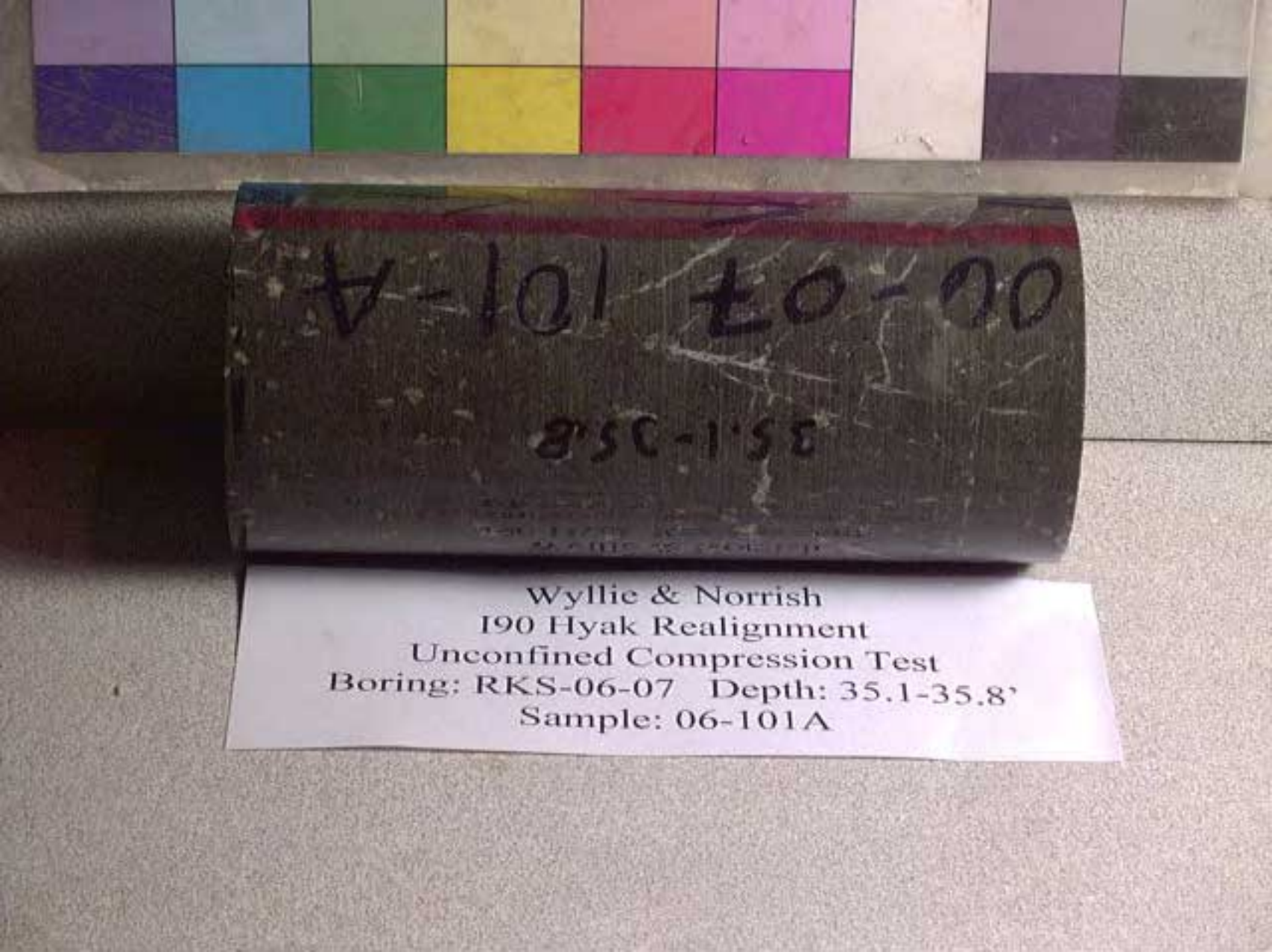

Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-05-07 Depth: 15.7-16.4'
Sample: 05-101B

Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-05-07 Depth: 15.7-16.4'
Sample: 05-101B

RKS-05-07
59.5-60.1'
Wyllie & Norrish
190 Hyak Realignment
Unconfined Compression Test
Boring: RKS-05-07 Depth: 59.5-60.1'
Sample: 05-103A


Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-05-07 Depth: 59.5-60.1'
Sample: 05-103A

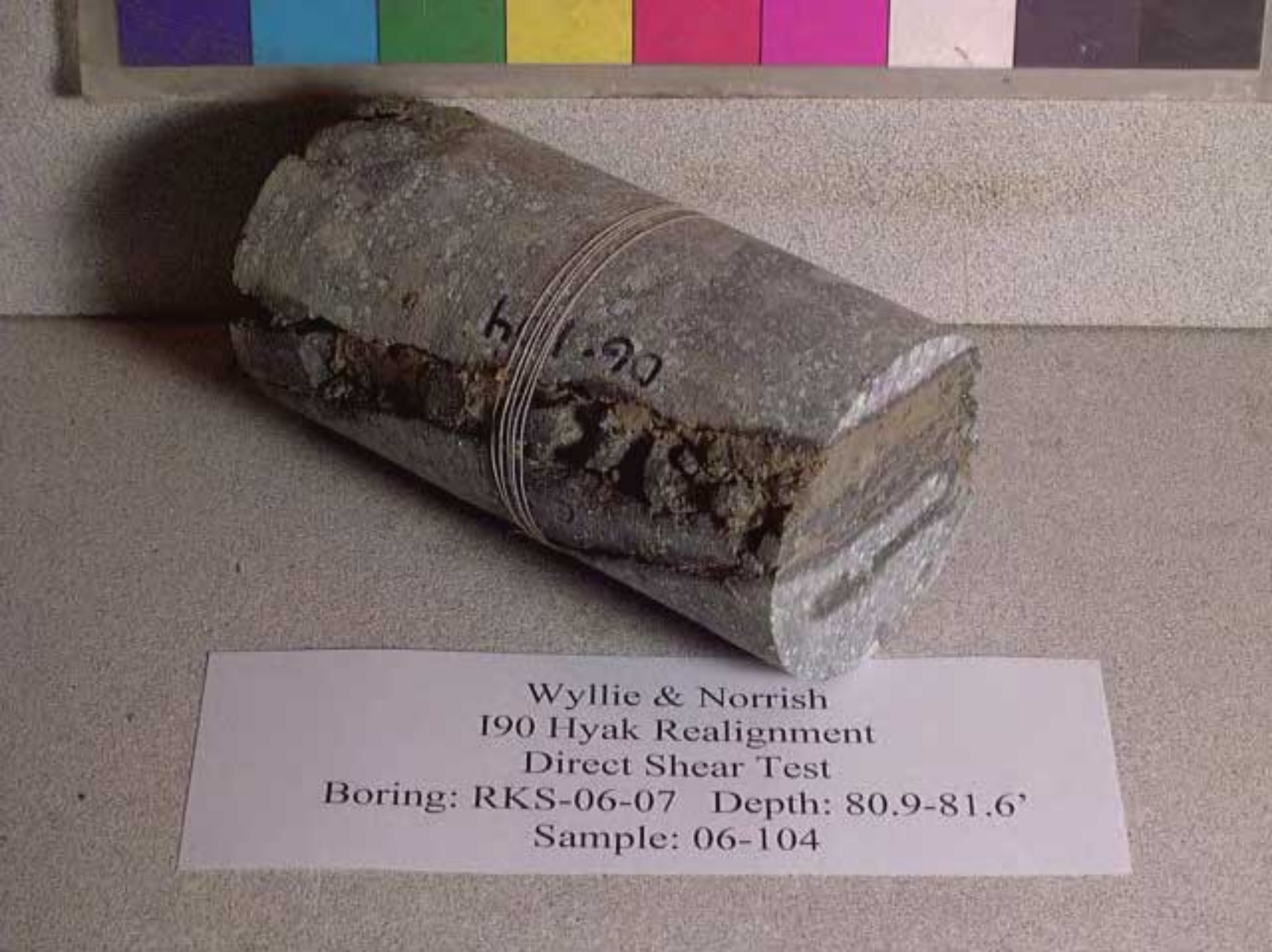
Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-06-07 Depth: 35.1-35.8'
Sample: 06-101A



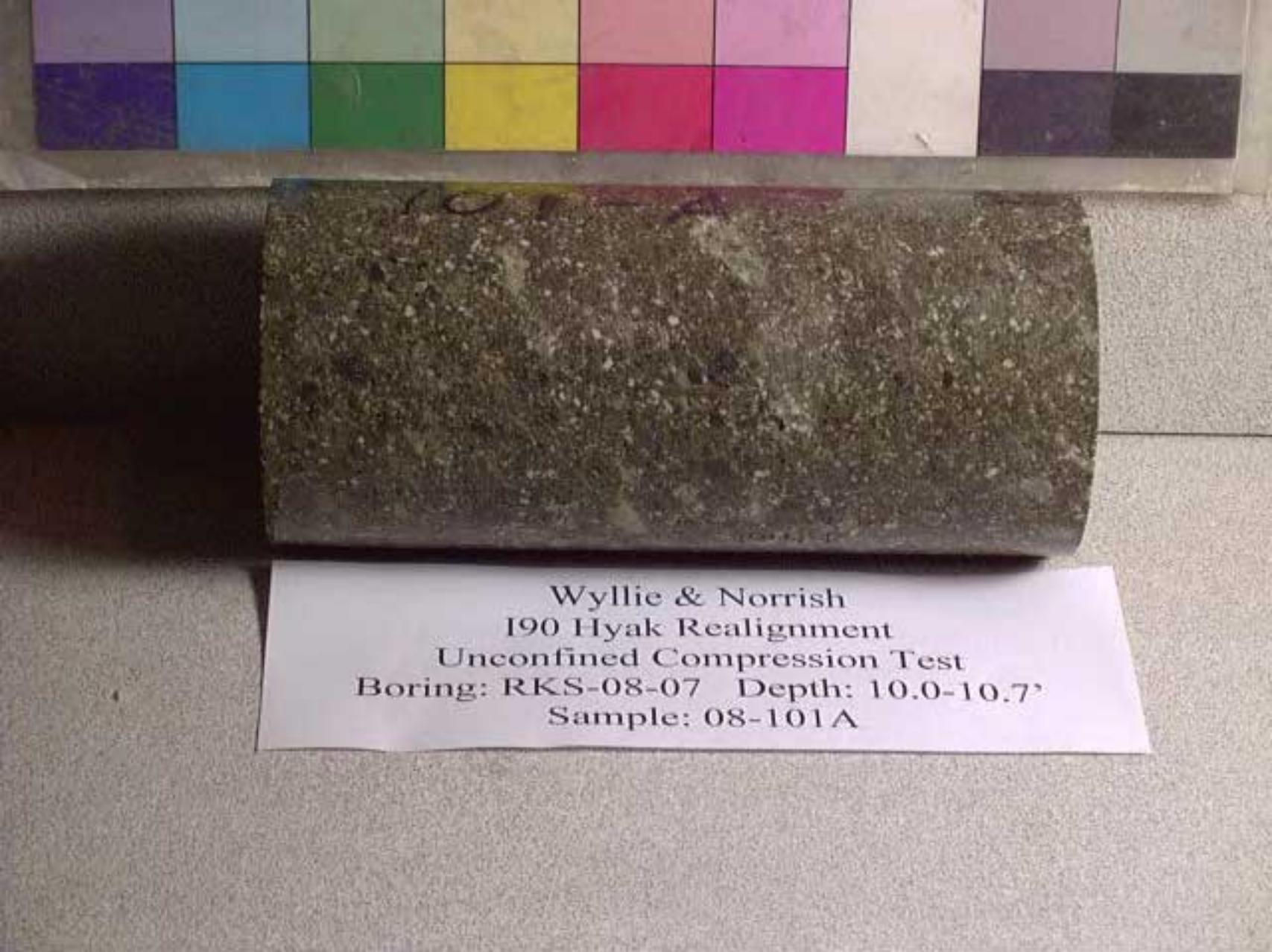
Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-06-07 Depth: 35.1-35.8'
Sample: 06-101A

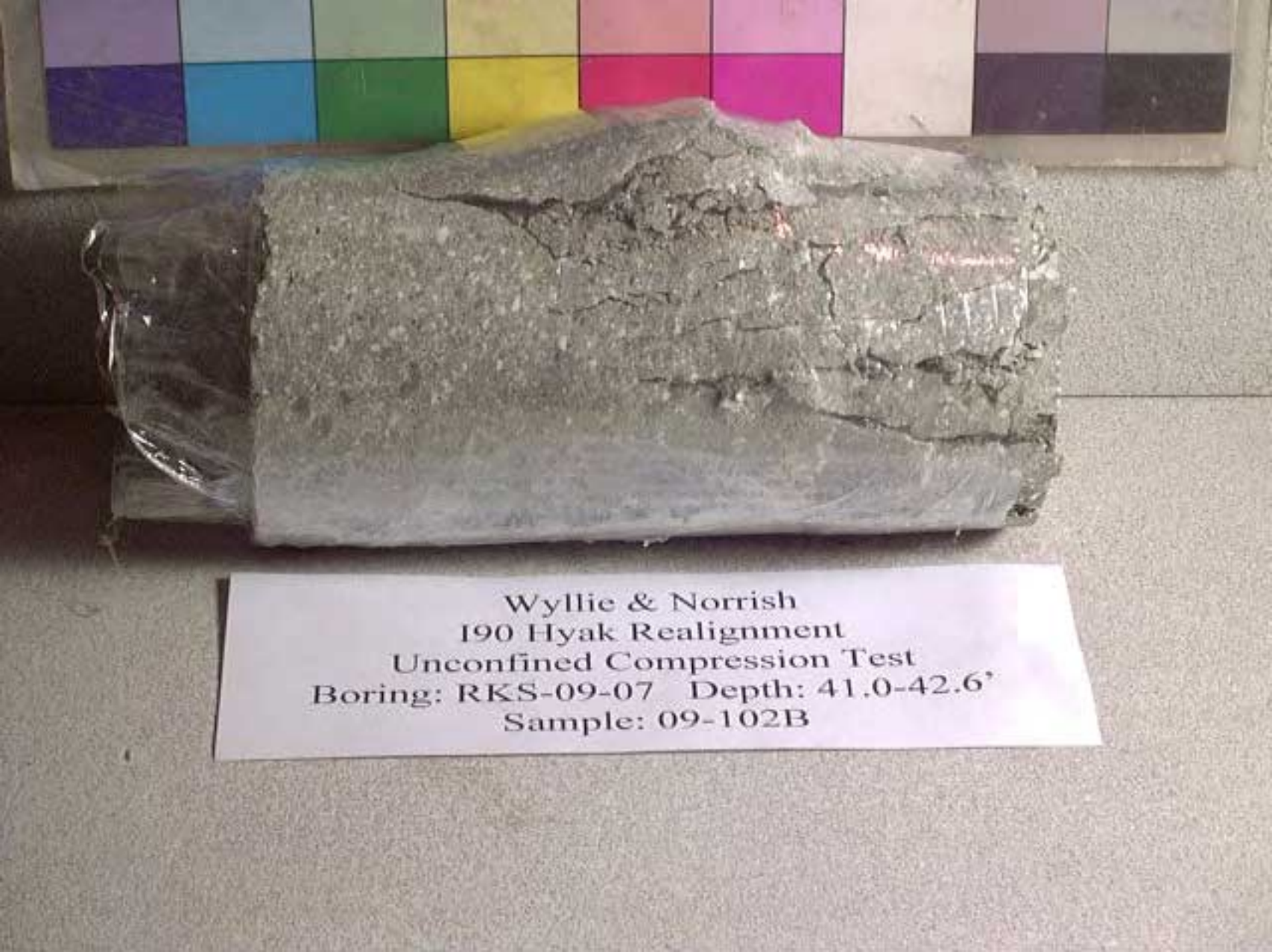
Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-06-07 Depth: 35.1-35.8'
Sample: 06-101A

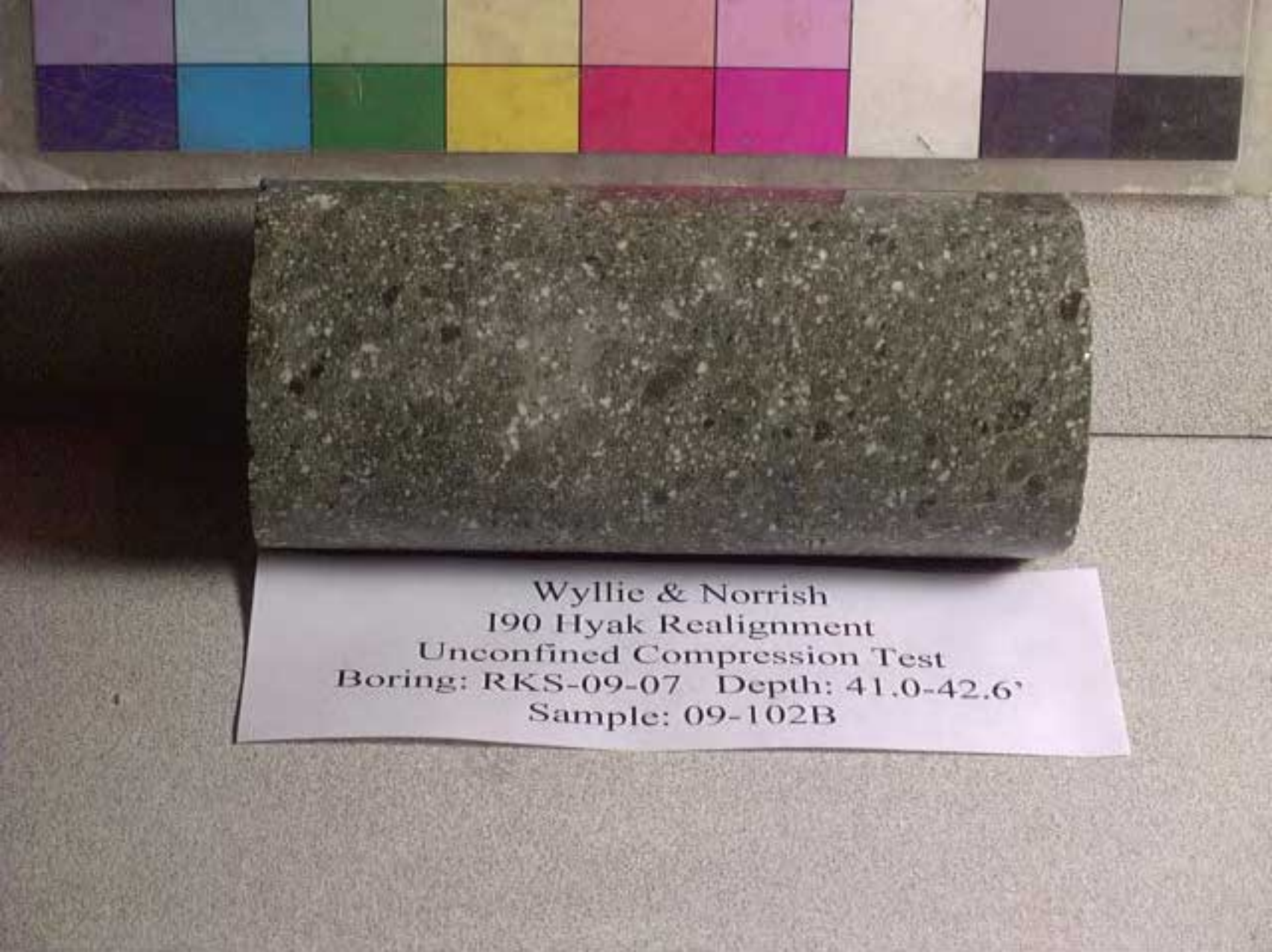
Wyllie & Norrish
I90 Hyak Realignment
Direct Shear Test
Boring: RKS-06-07 Depth: 80.9-81.6'
Sample: 06-104

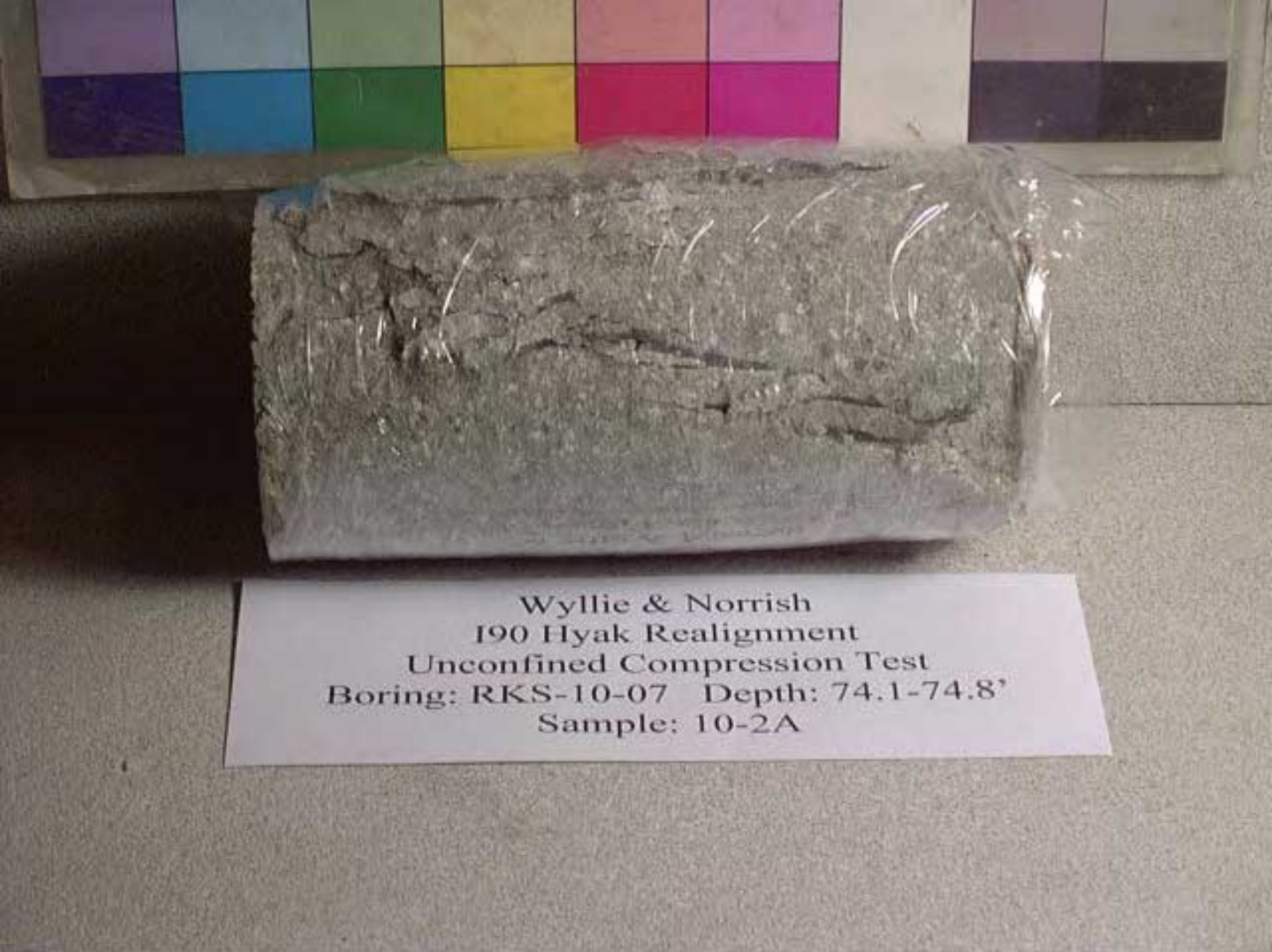

Wyllie & Norrish
I90 Hyak Realignment
Direct Shear Test
Boring: RKS-06-07 Depth: 80.9-81.6'
Sample: 06-104

Wyllie & Norrish
190 Hyak Realignment
Unconfined Compression Test
Boring: RKS-08-07 Depth: 10.0-10.7'
Sample: 08-101A


Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-08-07 Depth: 10.0-10.7'
Sample: 08-101A

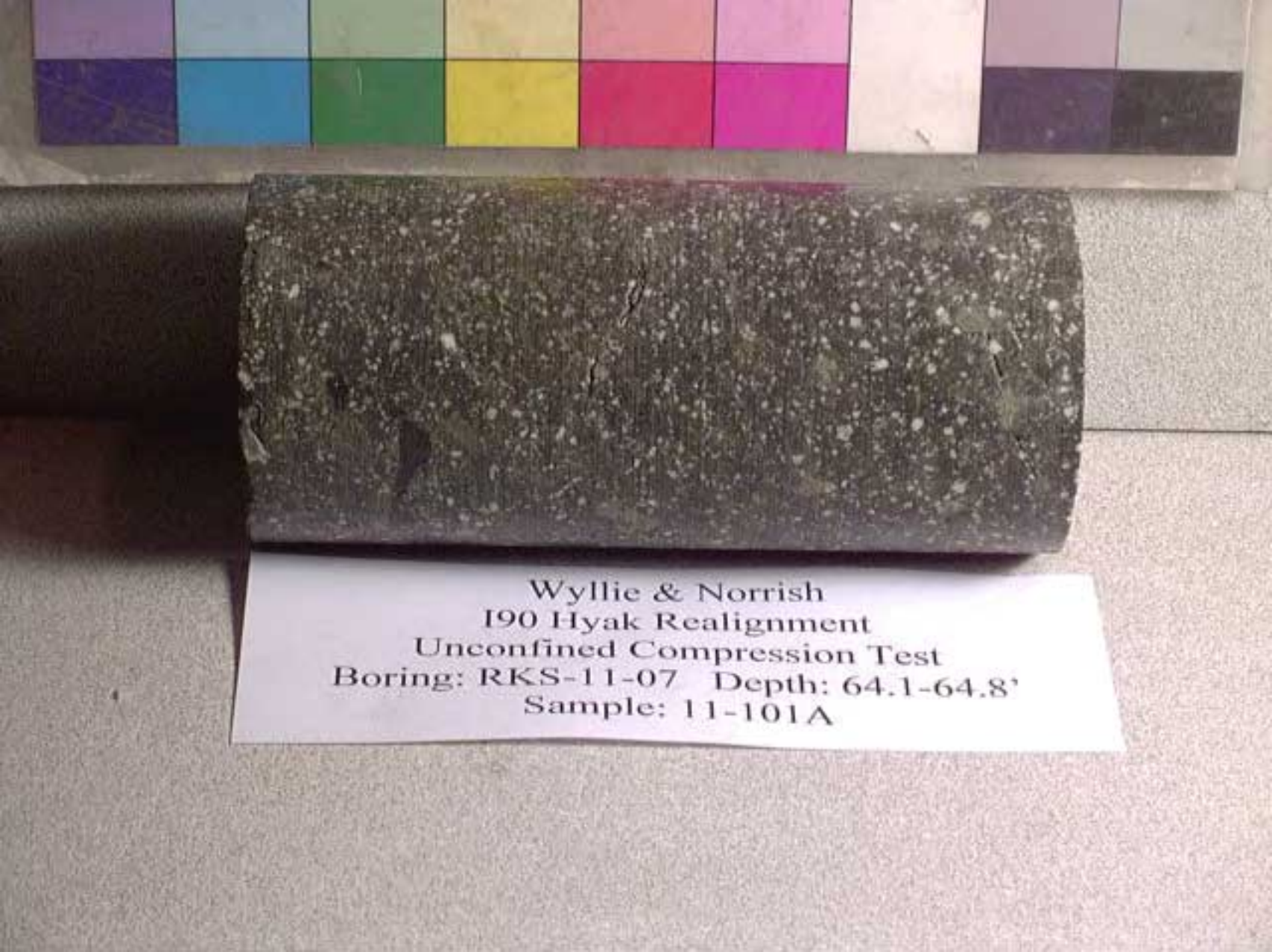

Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-09-07 Depth: 41.0-42.6'
Sample: 09-102B


Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-09-07 Depth: 41.0-42.6'
Sample: 09-102B


Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-10-07 Depth: 74.1-74.8'
Sample: 10-2A

Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-10-07 Depth: 74.1-74.8'
Sample: 10-2A

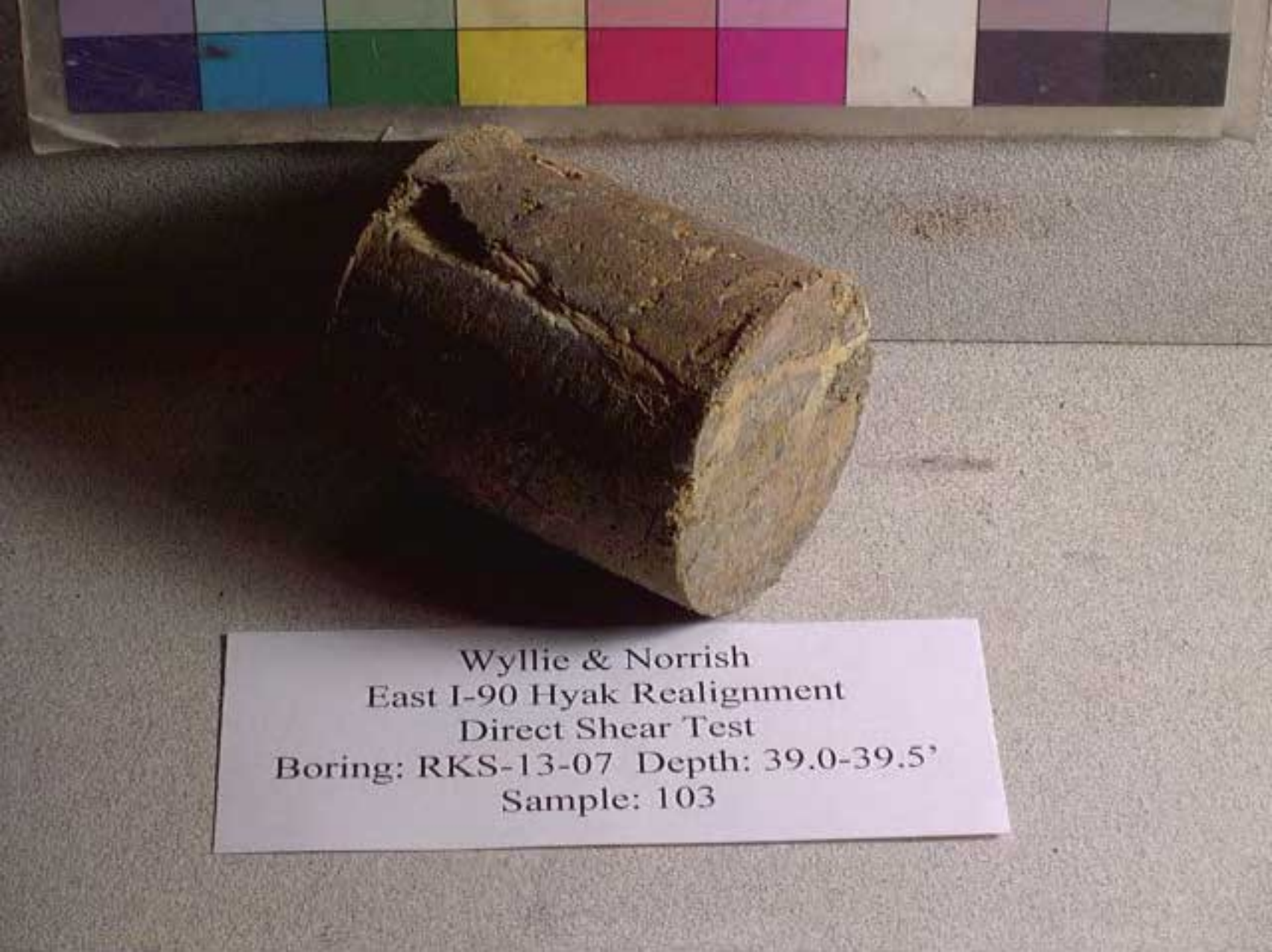
Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-11-07 Depth: 64.1-64.8'
Sample: 11-101A


Wyllie & Norrish
I90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-11-07 Depth: 64.1-64.8'
Sample: 11-101A

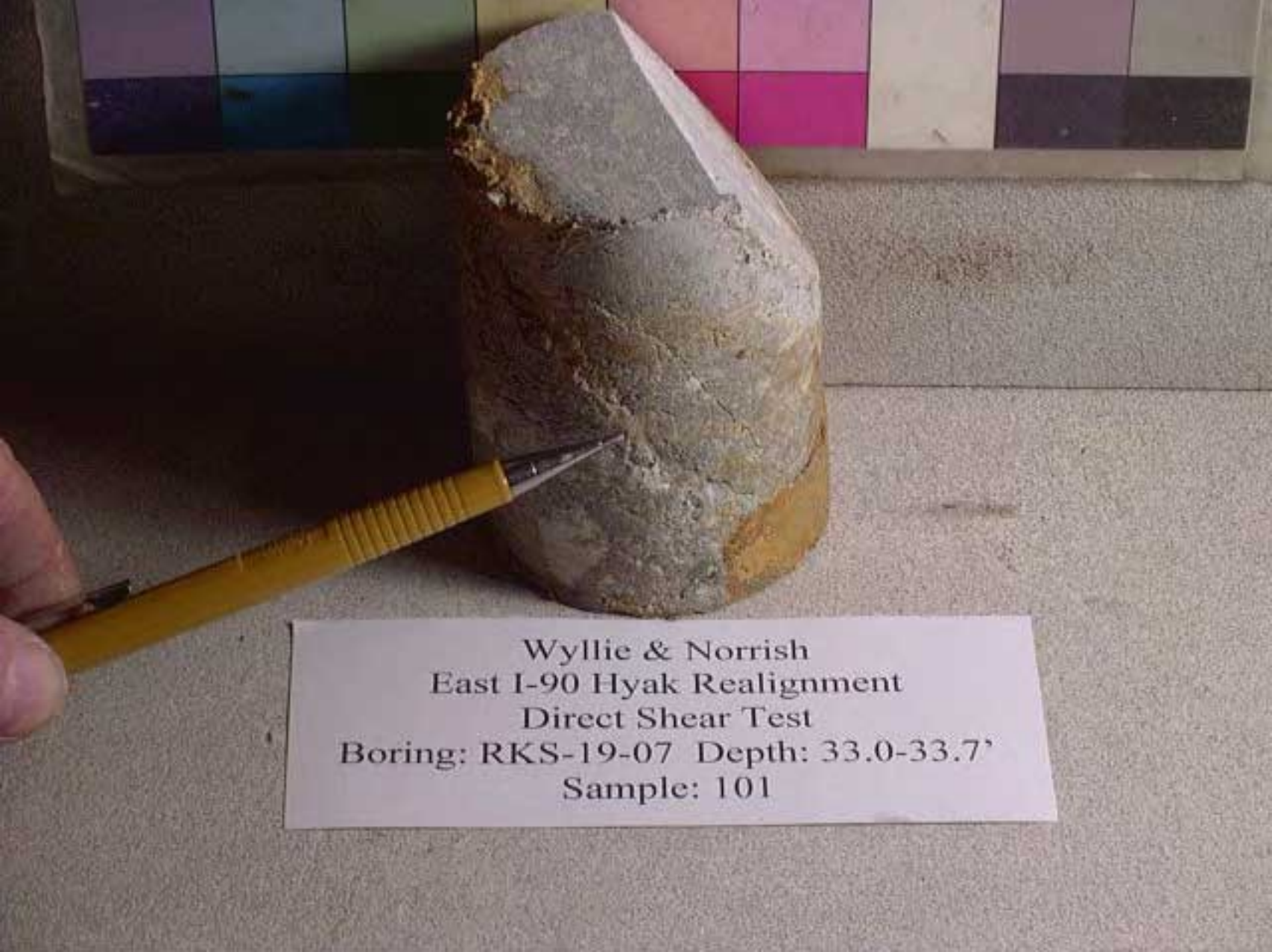
Wyllie & Norrish
I90 Hyak Realignment
Direct Shear Test
Boring: RKS-11-07 Depth: 107.3-107.8'
Sample: 11-102

Wyllie & Norrish
I90 Hyak Realignment
Direct Shear Test
Boring: RKS-11-07 Depth: 107.3-107.8'
Sample: 11-102

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-13-07 Depth: 39.0-39.5'
Sample: 103


Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-13-07 Depth: 39.0-39.5'
Sample: 103

Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-19-07 Depth: 33.0-33.7'
Sample: 101


Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-19-07 Depth: 33.0-33.7'
Sample: 101

Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-19-07 Depth: 56.3-57.0'
Sample: 103B

Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-19-07 Depth: 56.3-57.0'
Sample: 103B

Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-22-07 Depth: 11.7-12.5'
Sample: 101A

Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-22-07 Depth: 11.7-12.5'
Sample: 101A

Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-24-07 Depth: 36.3-36.9'
Sample: 102

Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-24-07 Depth: 36.3-36.9'
Sample: 102

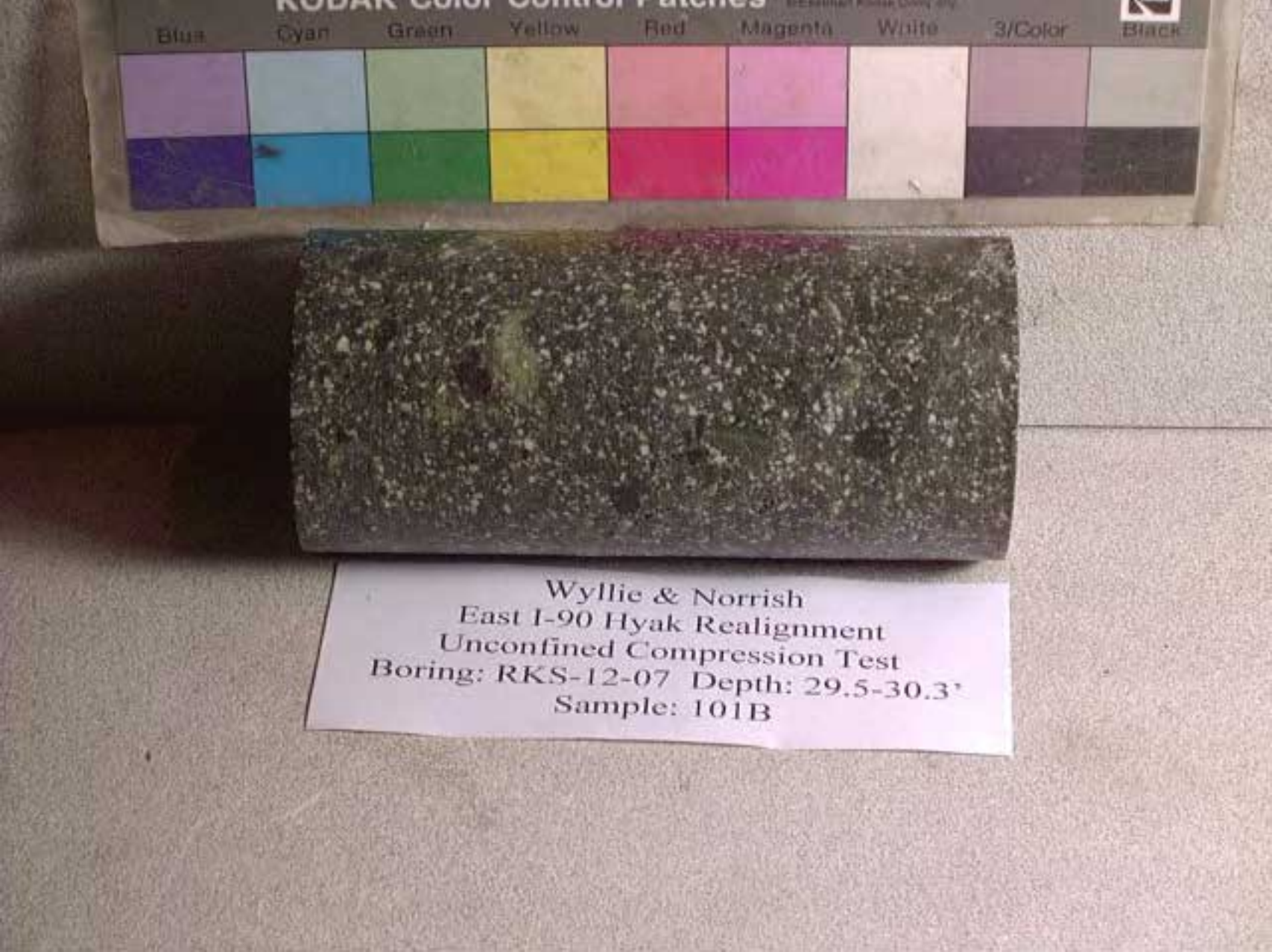
KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-29-07 Depth: 18.8-19.5'
Sample: 102A

Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-29-07 Depth: 18.8-19.5'
Sample: 102A

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-30-07 Depth: 55.1-55.6'
Sample: 103A

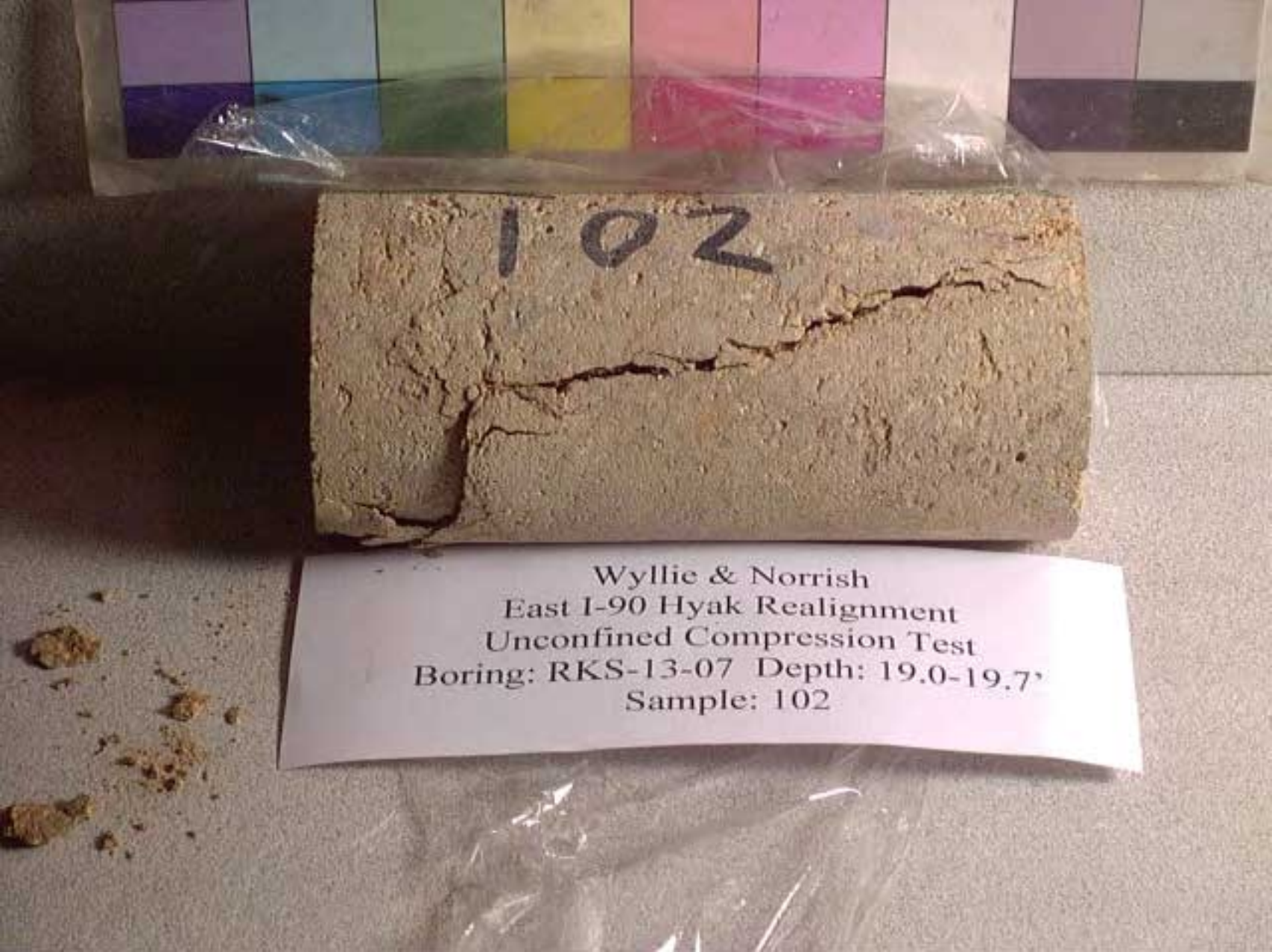
Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: RKS-30-07 Depth: 55.1-55.6'
Sample: 103A

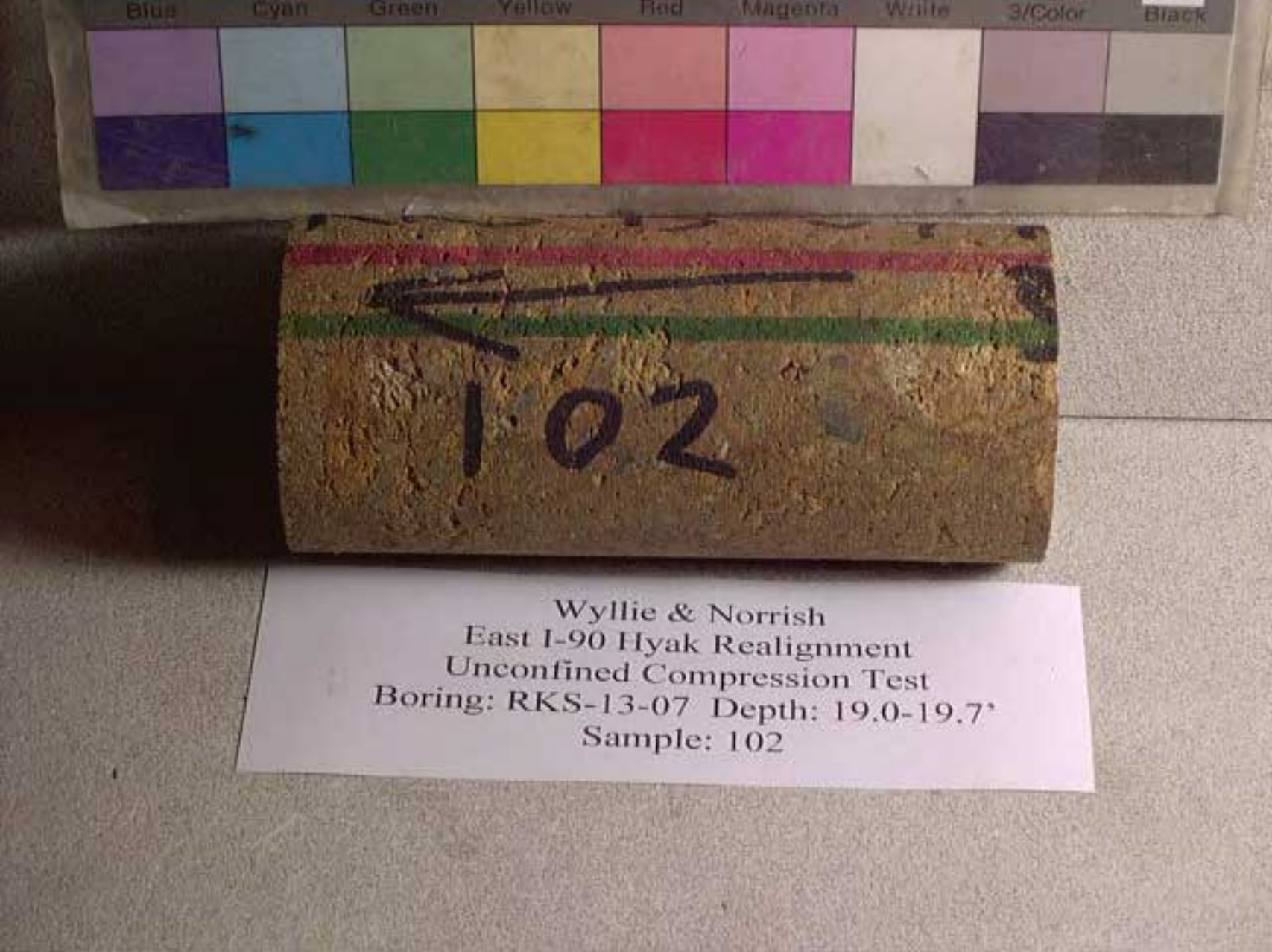
KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-12-07 Depth: 29.5-30.3'
Sample: 101B

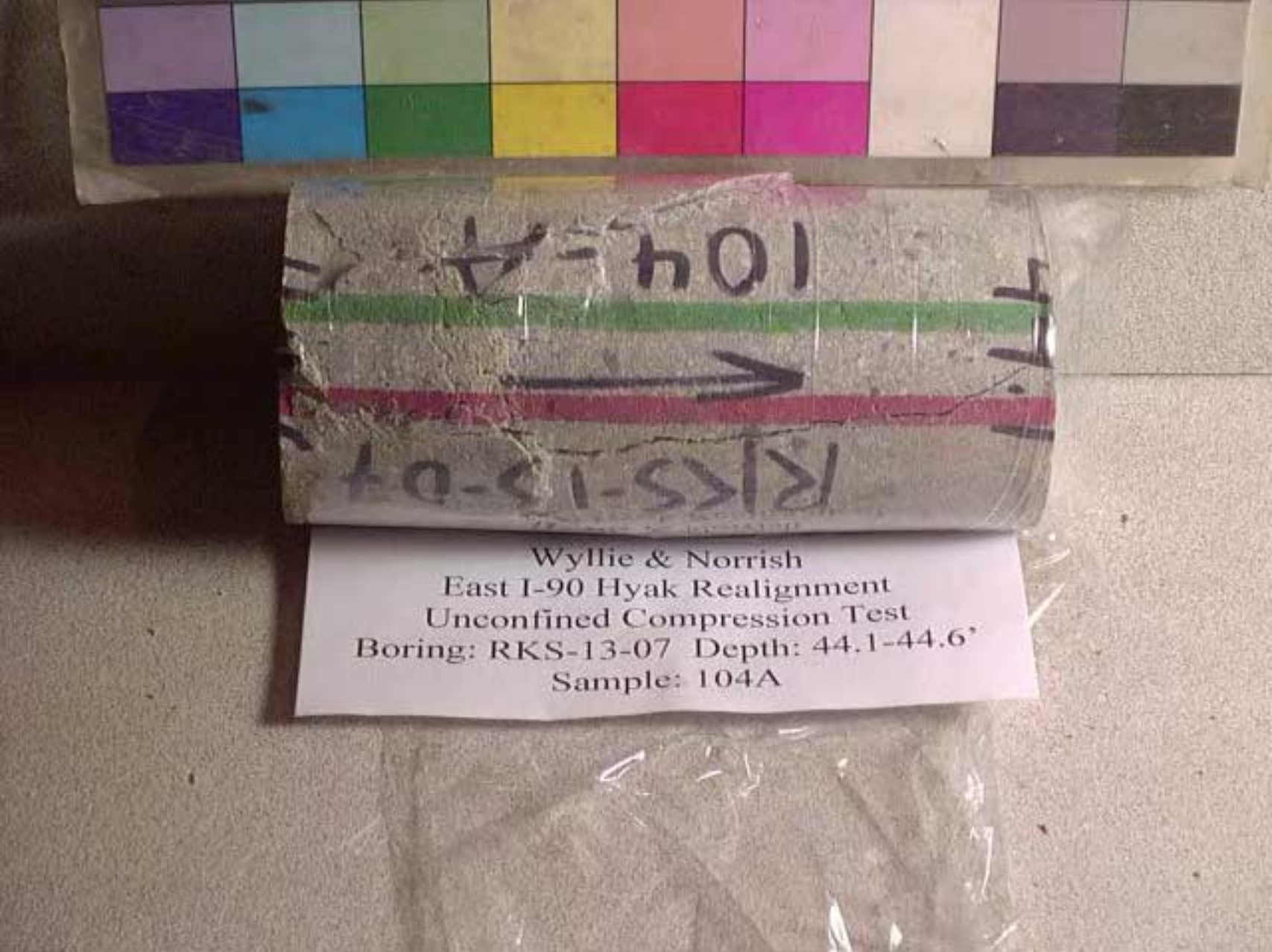

KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-12-07 Depth: 29.5-30.3'
Sample: 101B

KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-12-07 Depth: 124.6-125.3'
Sample: 103B

KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-12-07 Depth: 124.6-125.3'
Sample: 103B


102
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-13-07 Depth: 19.0-19.7'
Sample: 102

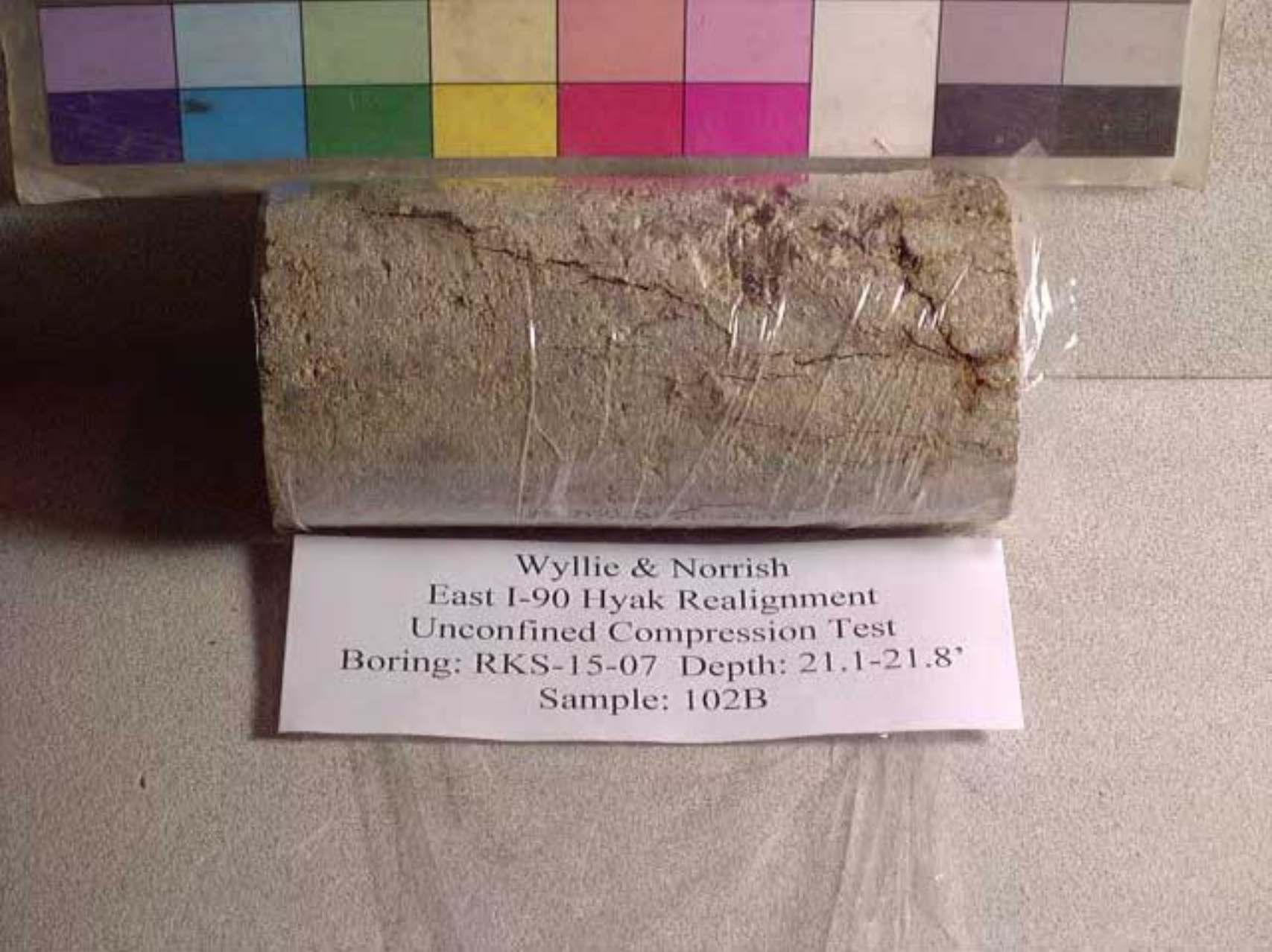

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
102
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-13-07 Depth: 19.0-19.7'
Sample: 102


Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-13-07 Depth: 44.1-44.6'
Sample: 104A

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-13-07 Depth: 44.1-44.6'
Sample: 104A

103-B
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-14-07 Depth: 78.8-79.4'
Sample: 103B

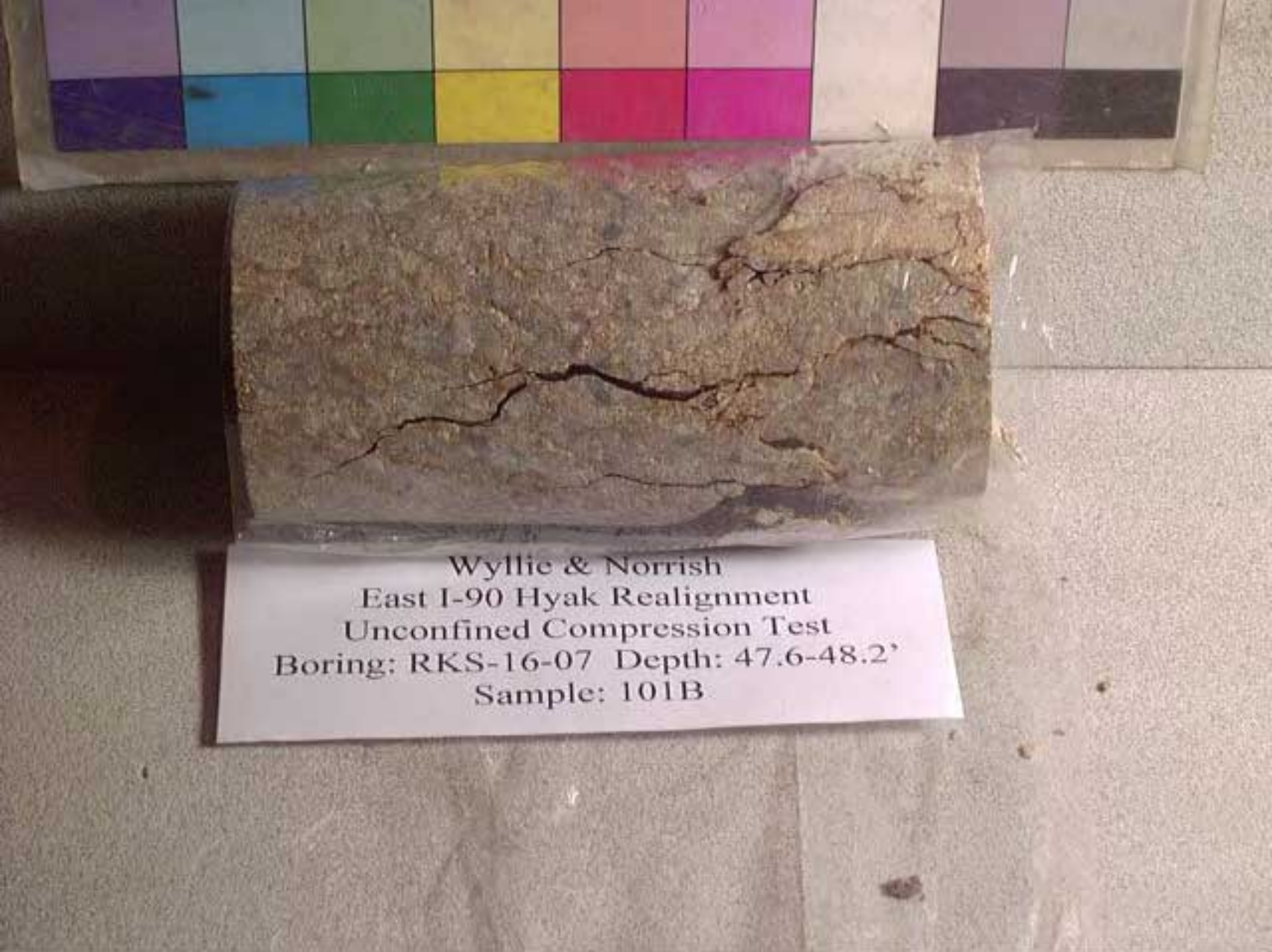
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-14-07 Depth: 78.8-79.4'
Sample: 103B


Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-15-07 Depth: 21.1-21.8'
Sample: 102B

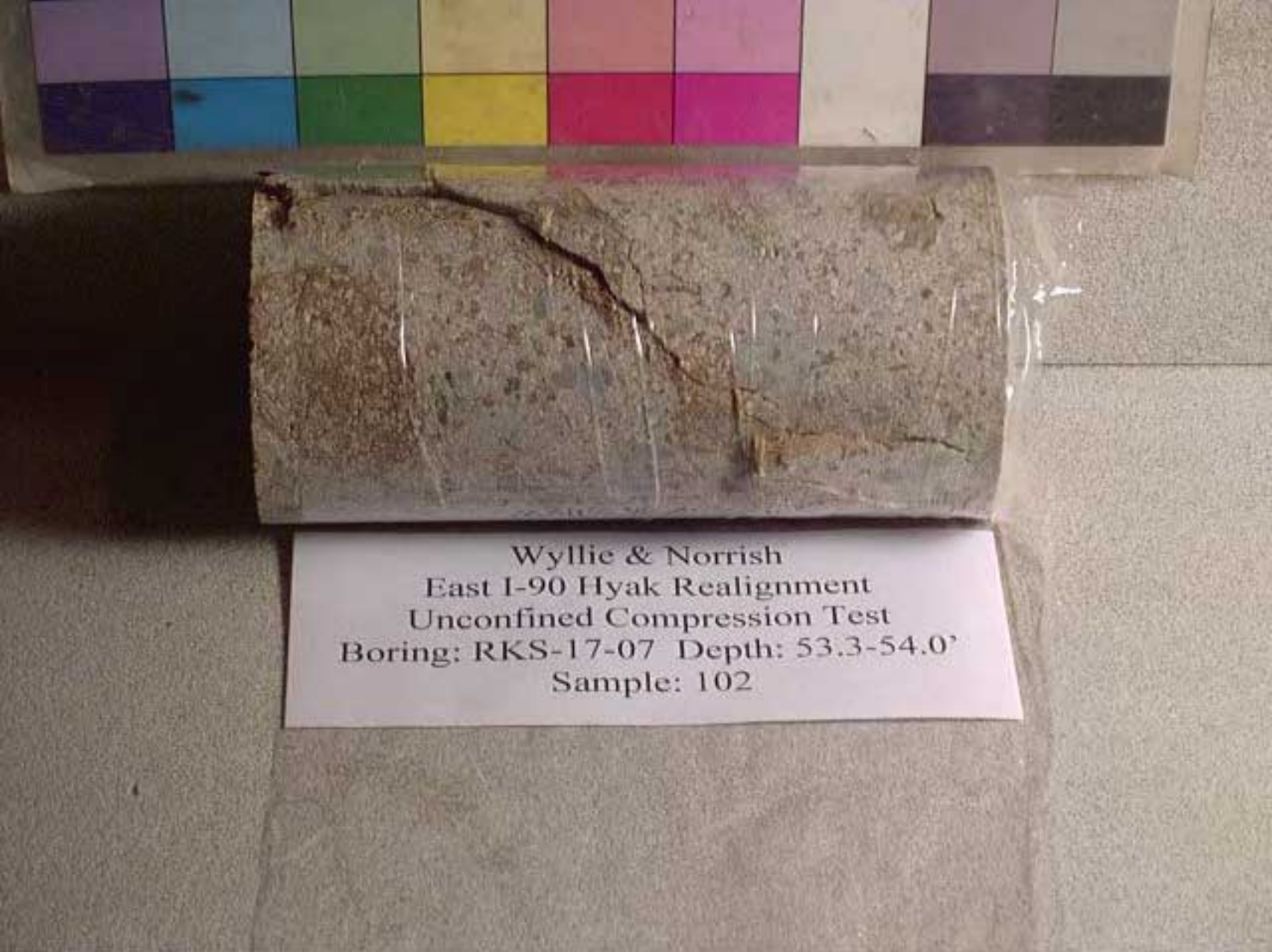
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-15-07 Depth: 21.1-21.8'
Sample: 102B

120.5'
RKS-15-07
#105A
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-15-07 Depth: 120.0-120.5'
Sample: 105A

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-15-07 Depth: 120.0-120.5'
Sample: 105[redacted]A

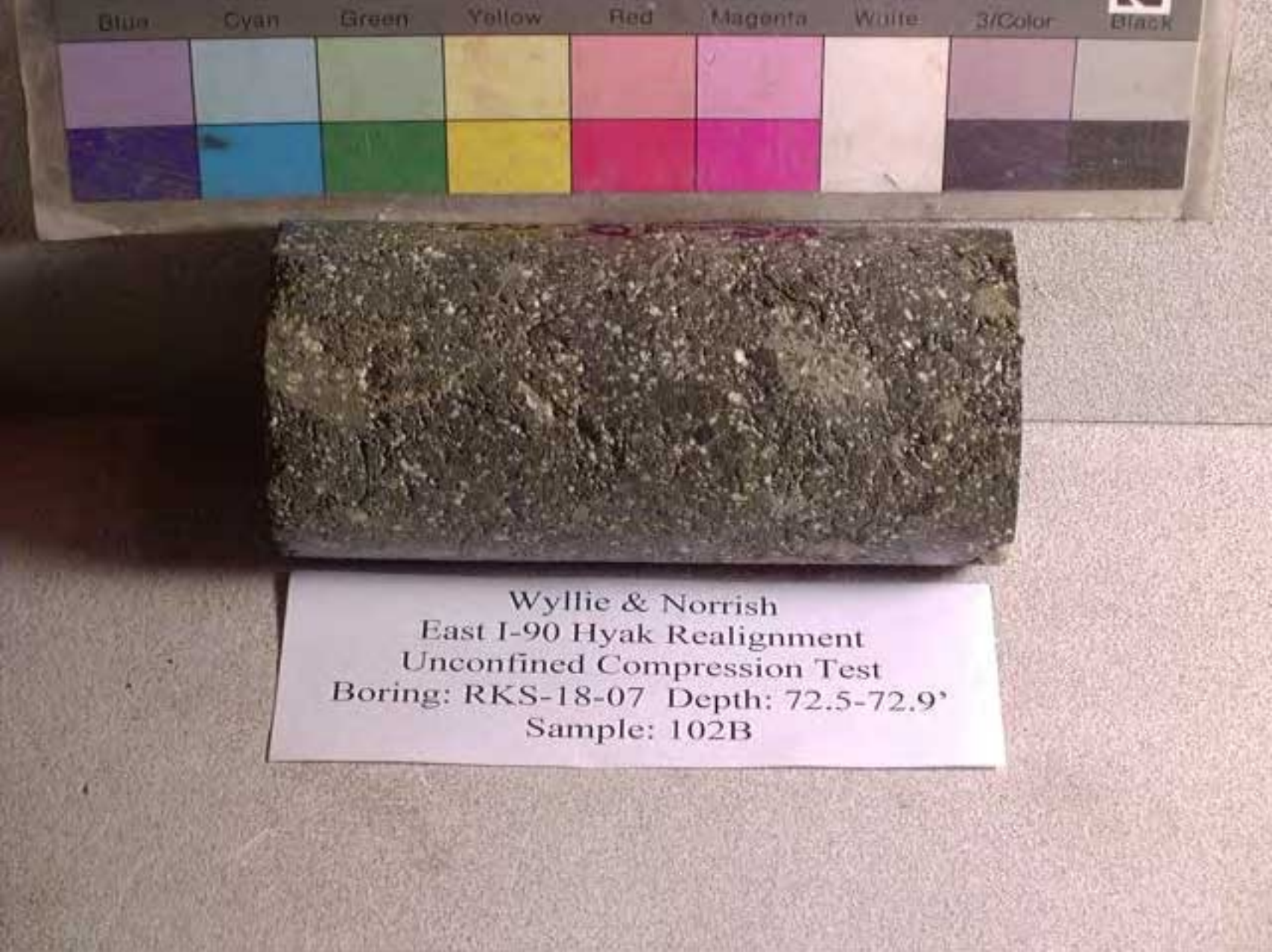

Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-16-07 Depth: 47.6-48.2'
Sample: 101B

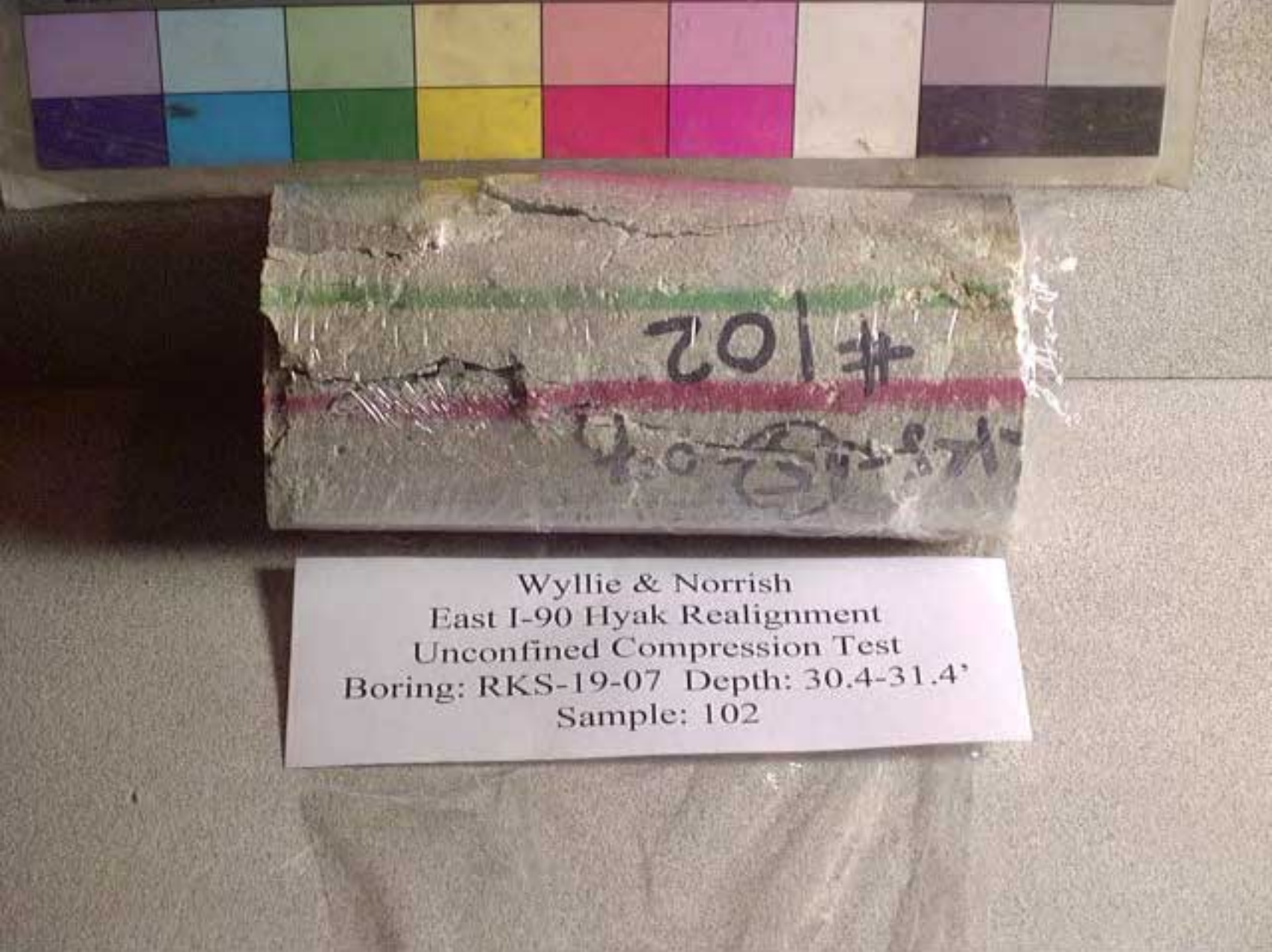
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-16-07 Depth: 47.6-48.2'
Sample: 101B

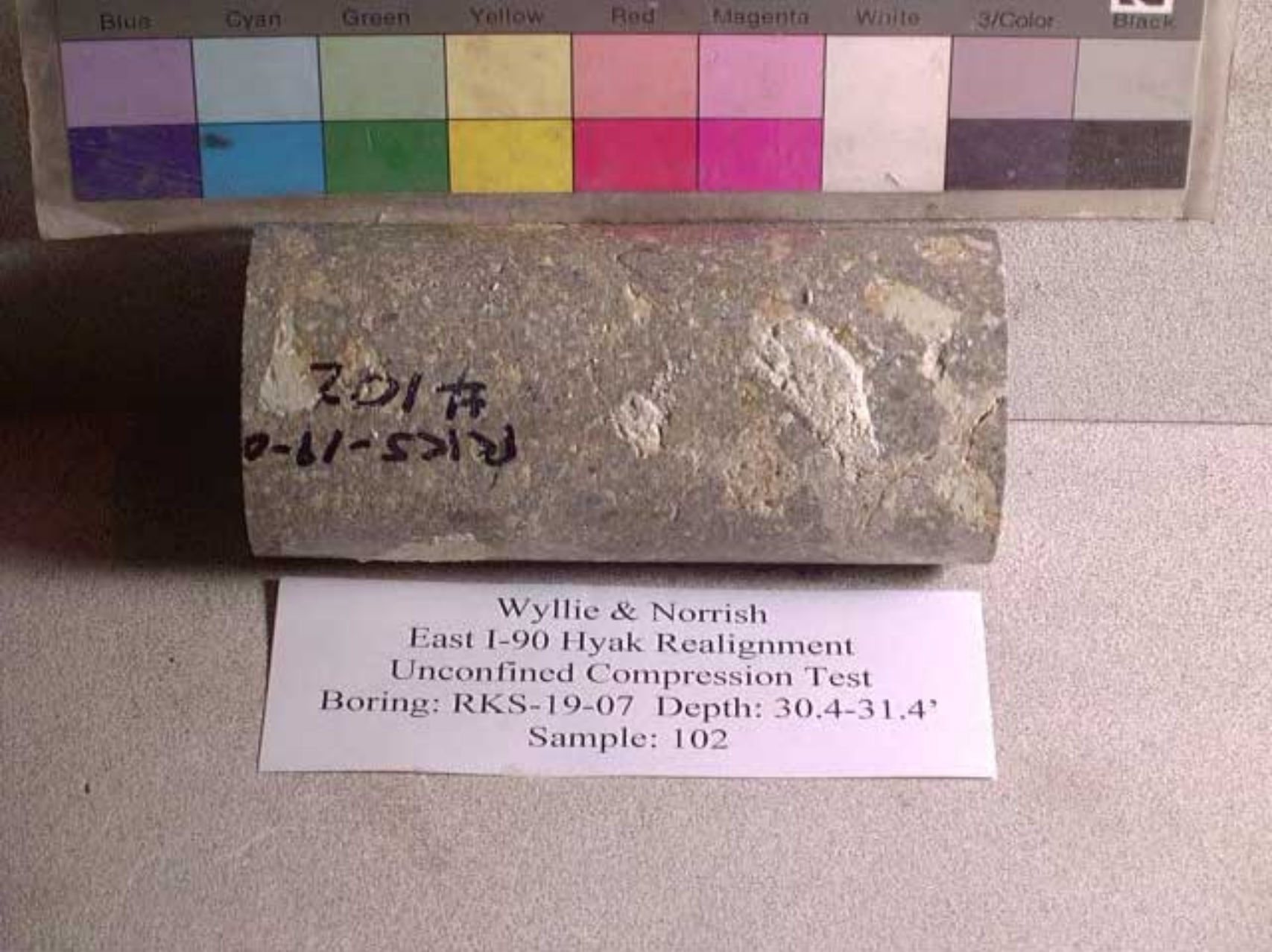

Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-17-07 Depth: 53.3-54.0'
Sample: 102

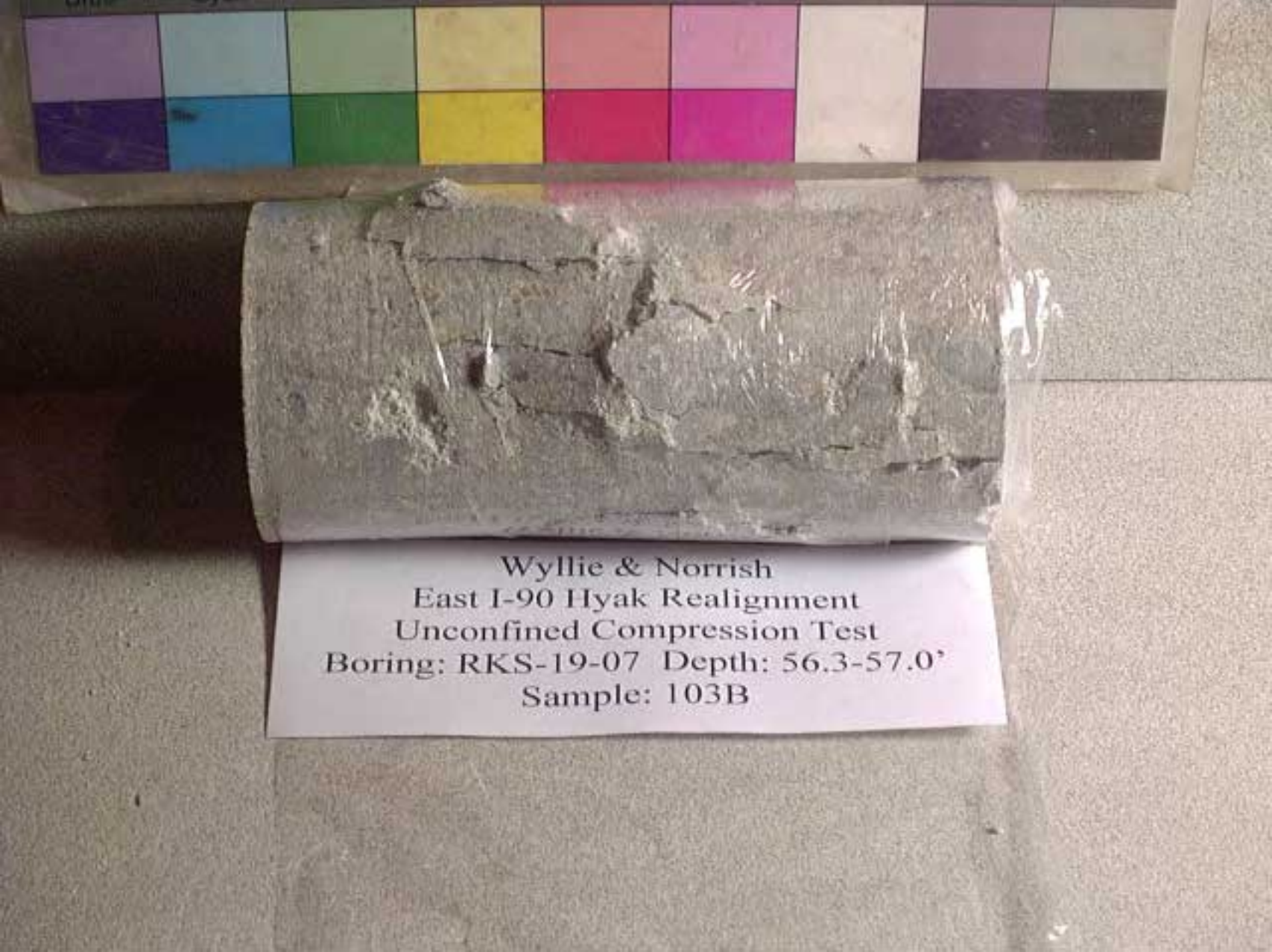
Blue
Cyan
Green
Yellow
Red
Magenta
White
2/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-17-07 Depth: 53.3-54.0'
Sample: 102

Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-18-07 Depth: 72.5-72.9'
Sample: 102B

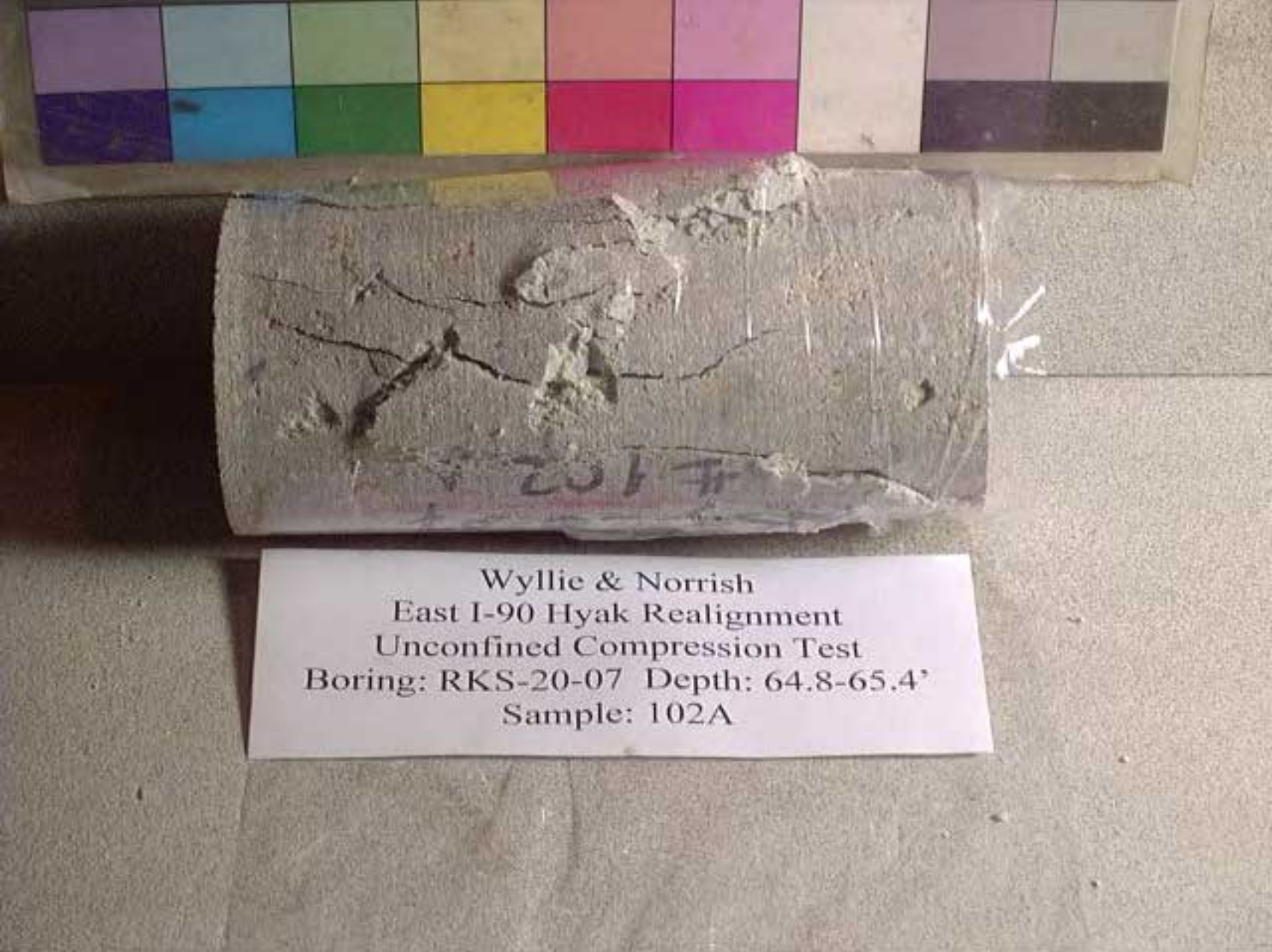

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-18-07 Depth: 72.5-72.9'
Sample: 102B

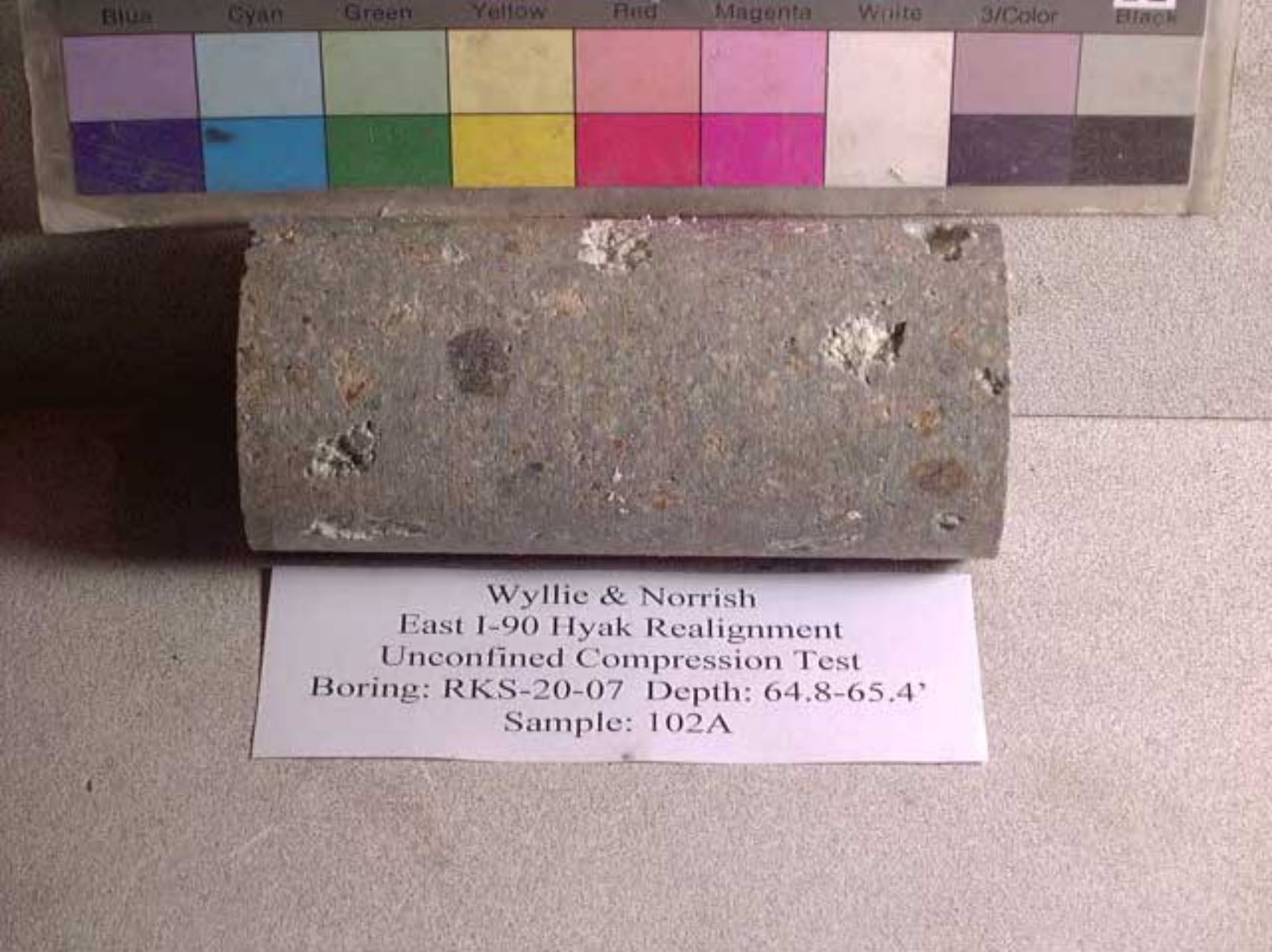

#102
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-19-07 Depth: 30.4-31.4'
Sample: 102


Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-19-07 Depth: 30.4-31.4'
Sample: 102


Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-19-07 Depth: 56.3-57.0'
Sample: 103B

Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-19-07 Depth: 56.3-57.0'
Sample: 103B


Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-20-07 Depth: 64.8-65.4'
Sample: 102A

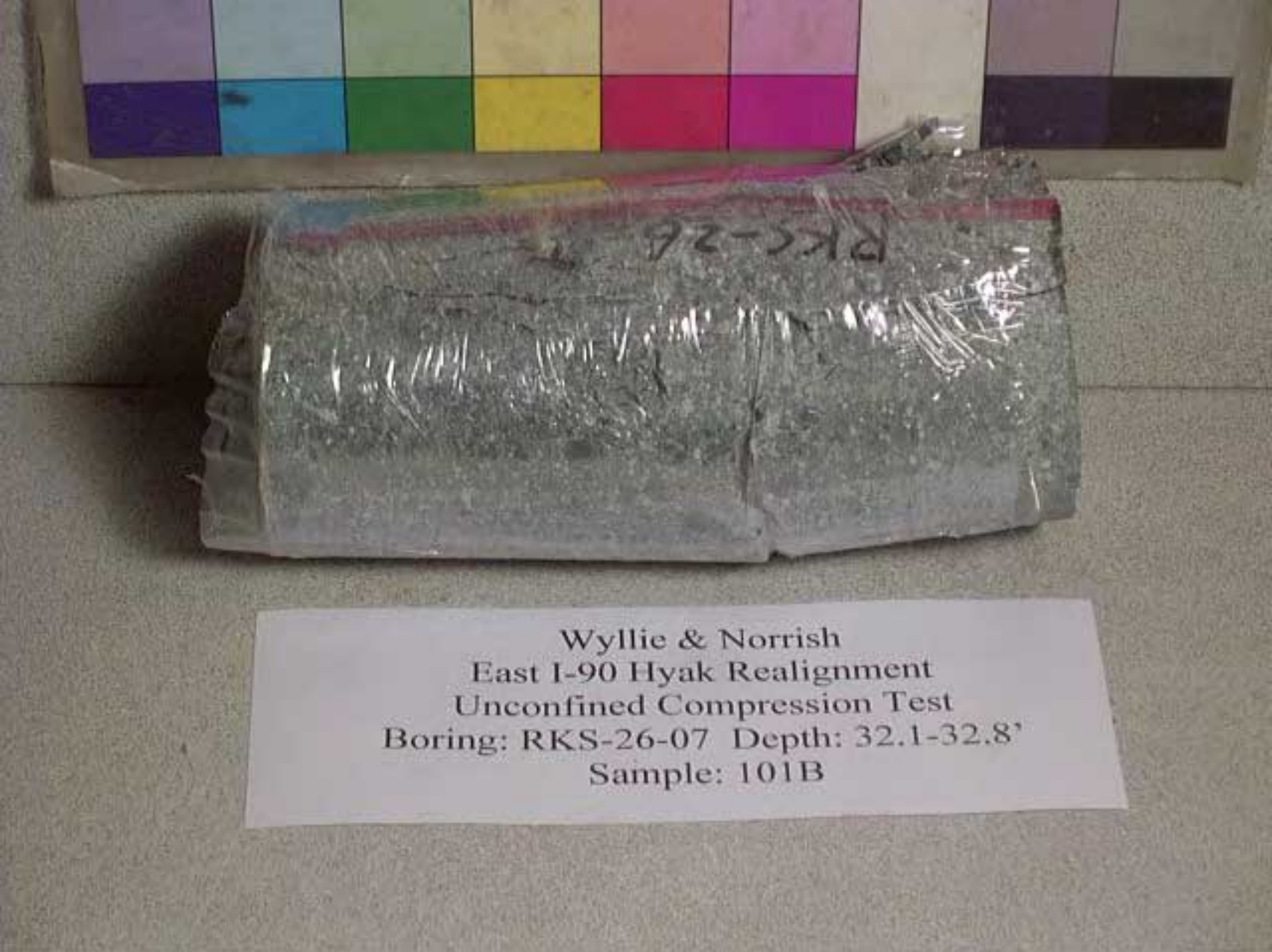

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-20-07 Depth: 64.8-65.4'
Sample: 102A

Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-22-07 Depth: 11.7-12.5'
Sample: 101A

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
101-A
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-22-07 Depth: 11.7-12.5'
Sample: 101A

KODAK Col ontrol Patches
Cyan
Green
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-23-07 Depth: 10.3-11.0'
Sample: 101A

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-23-07 Depth: 10.3-11.0'
Sample: 101A


RKS-26
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-26-07 Depth: 32.1-32.8'
Sample: 101B

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-26-07 Depth: 32.1-32.8'
Sample: 101B

102-A
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-27-07 Depth: 28.5-29.2'
Sample: 102A

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-27-07 Depth: 28.5-29.2'
Sample: 102A

Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-28-07 Depth: 65.4-66.0'
Sample: 102A

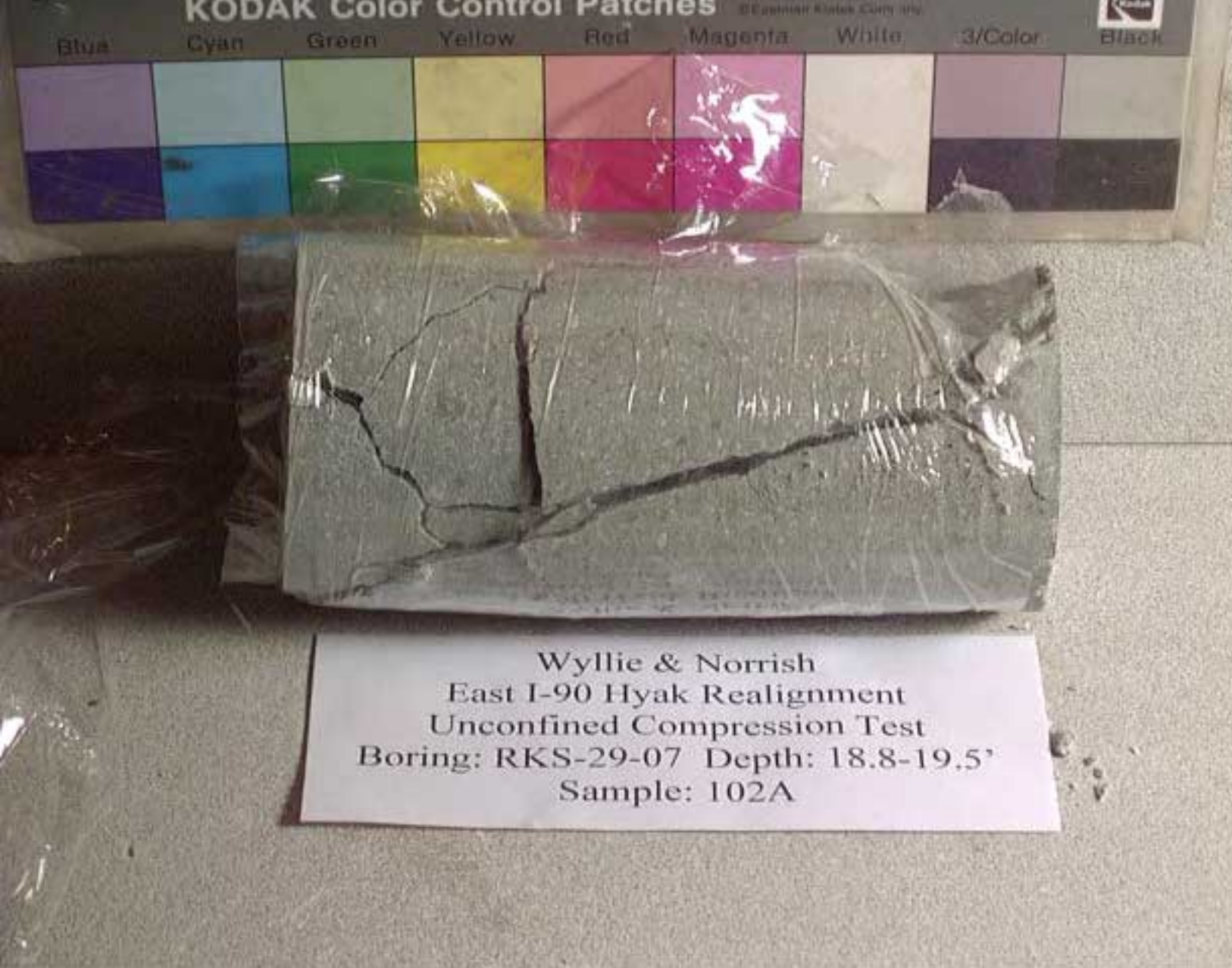
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-28-07 Depth: 65.4-66.0'
Sample: 102A

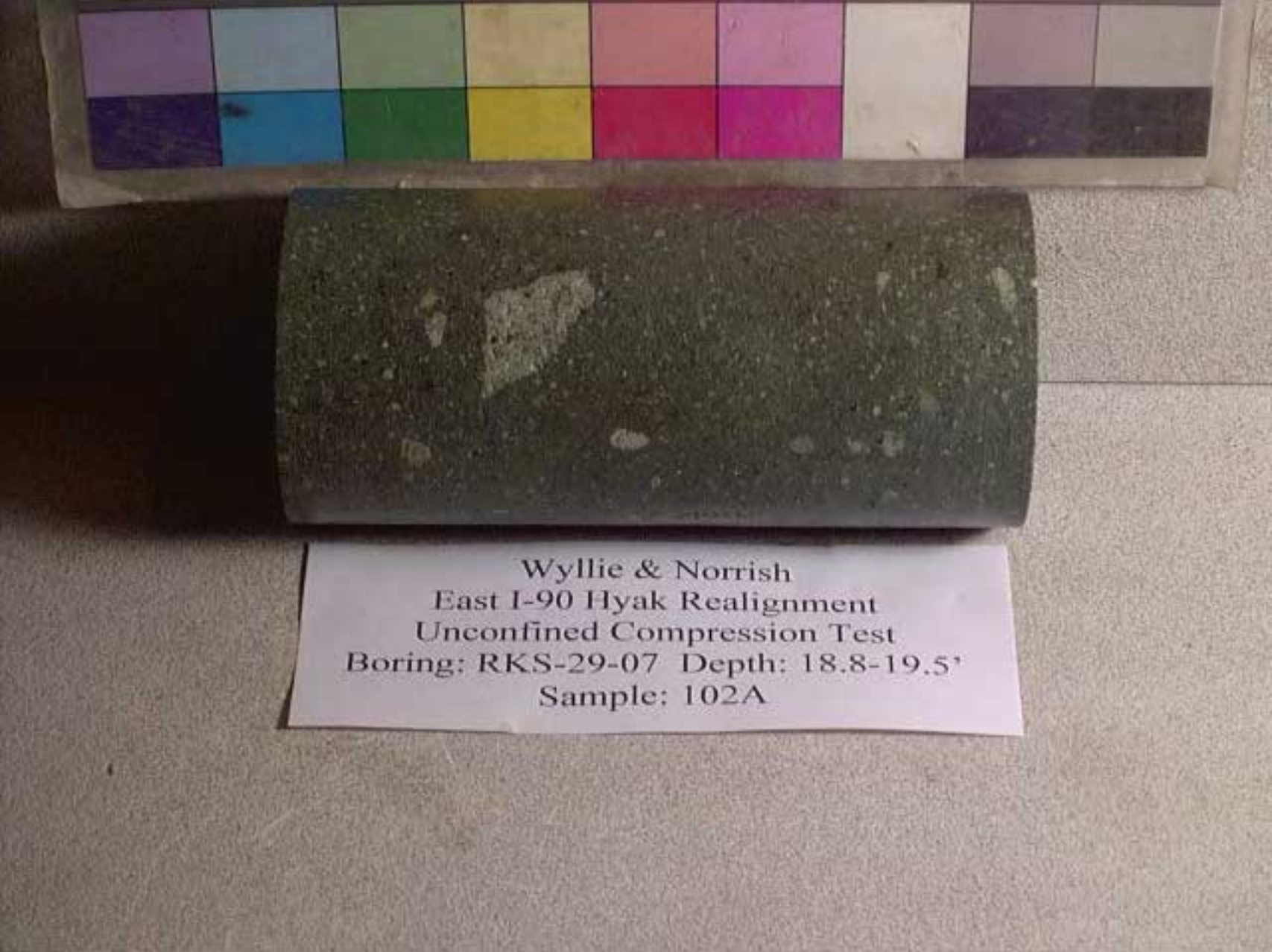
KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-28-07 Depth: 33.0-33.8'
Sample: 201

Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-28-07 Depth: 33.0-33.8'
Sample: 201

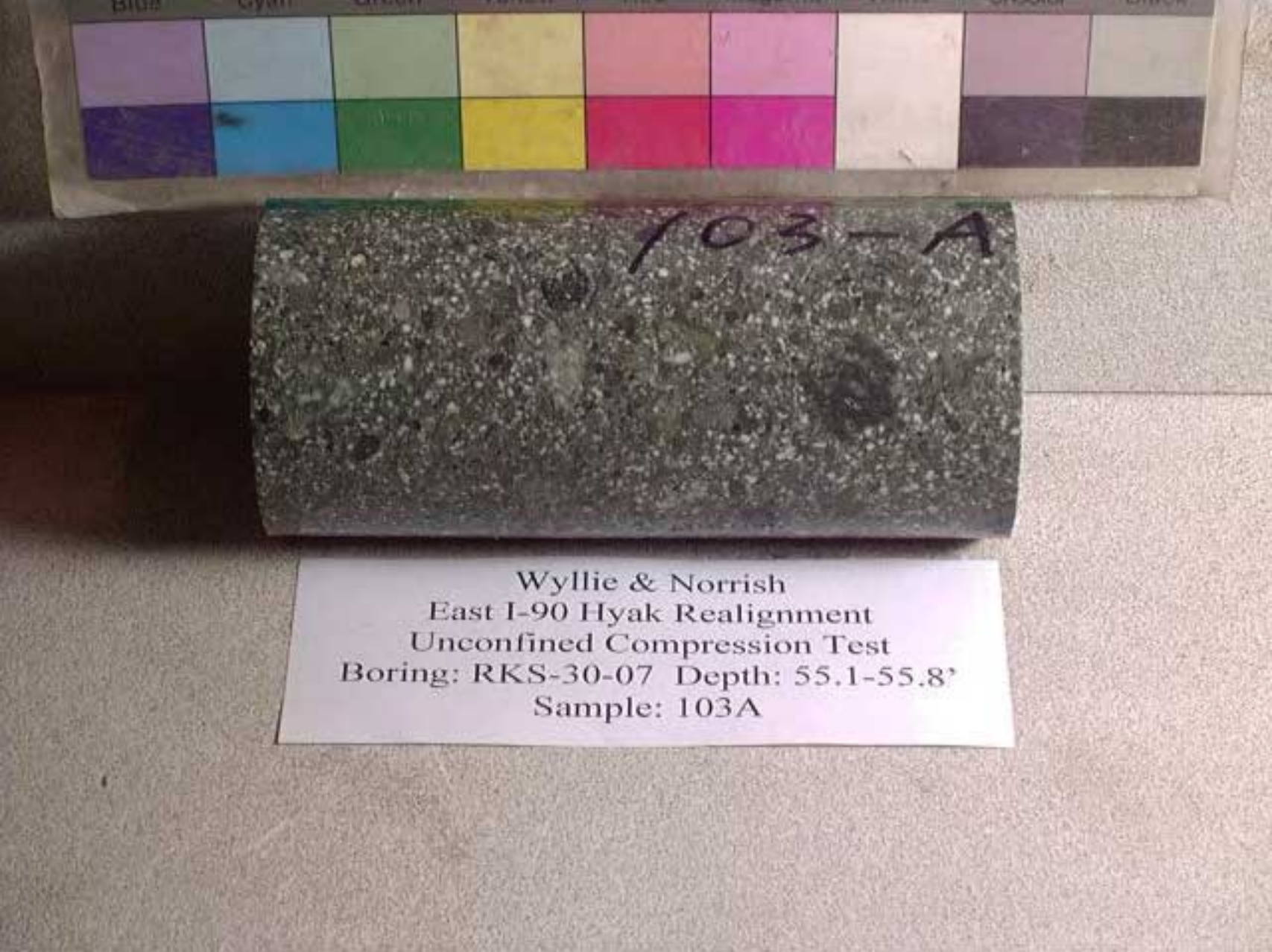
KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-28-07 Depth: 27.8-28.5'
Sample: 202

Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-28-07 Depth: 27.8-28.5'
Sample: 202


KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-29-07 Depth: 18.8-19.5'
Sample: 102A

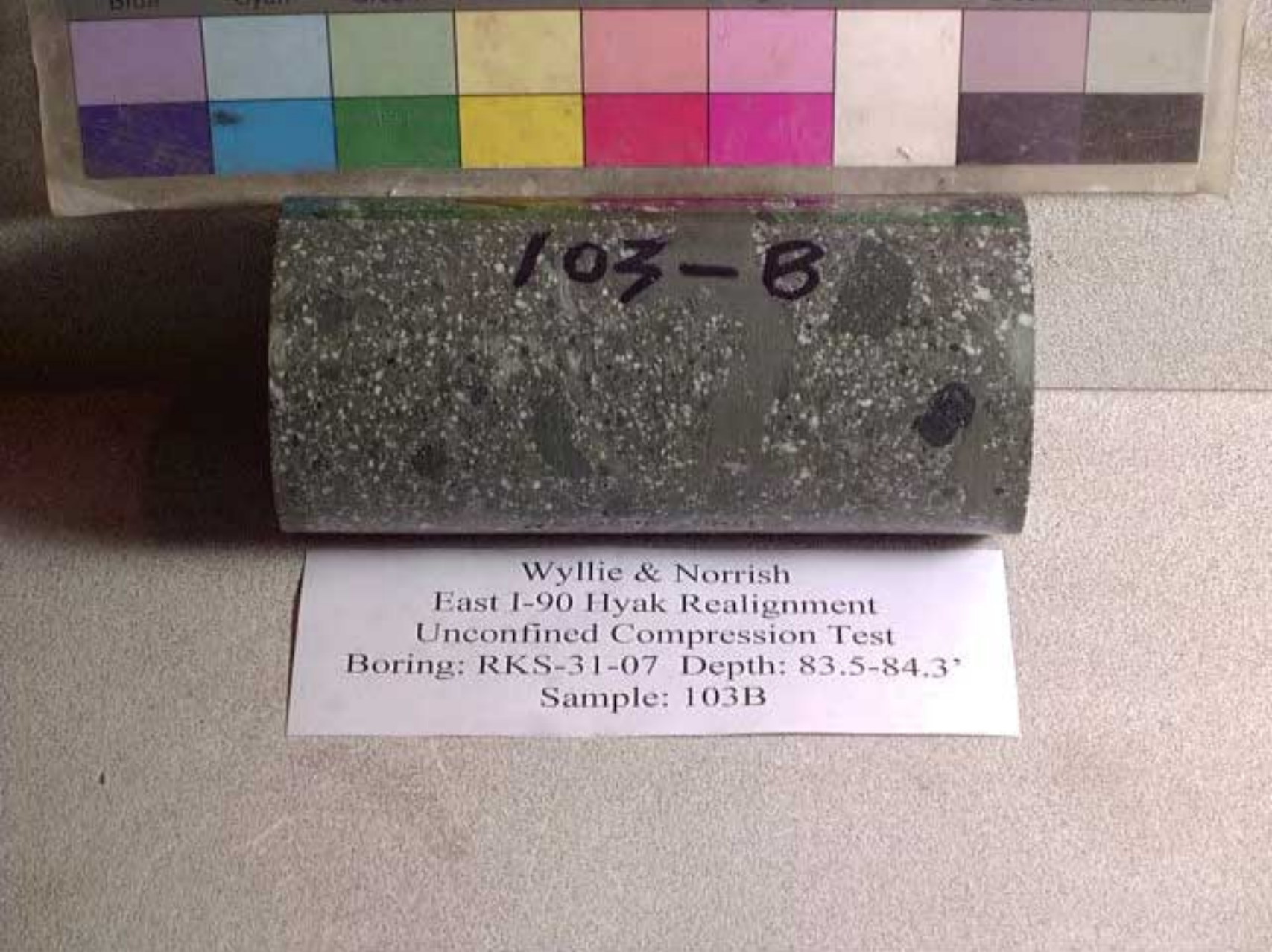

Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-29-07 Depth: 18.8-19.5'
Sample: 102A

KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-30-07 Depth: 55.1-55.8'
Sample: 103A

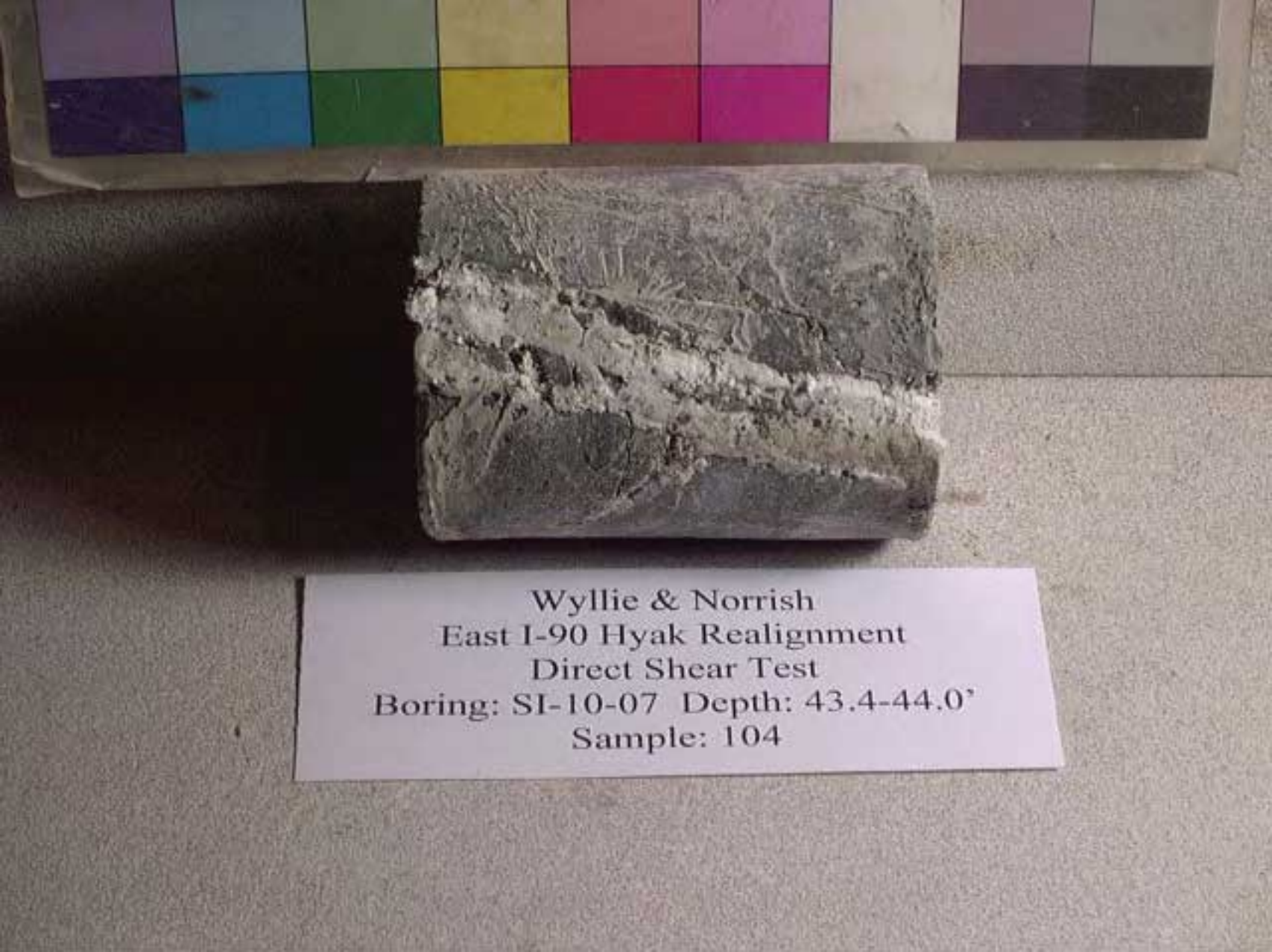


Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-30-07 Depth: 55.1-55.8'
Sample: 103A

KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-31-07 Depth: 83.5-84.3'
Sample: 103B


103-B
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: RKS-31-07 Depth: 83.5-84.3'
Sample: 103B

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: SI-10-07 Depth: 43.4-44.0'
Sample: 104


Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: SI-10-07 Depth: 43.4-44.0'
Sample: 104

Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: SI-2-07 Depth: 40.4-41.4'
Sample: 102A

Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: SI-2-07 Depth: 40.4-41.4'
Sample: 102A

Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: SI-2-07 Depth: 84.6-86.0'
Sample: 105

Wyllie & Norrish
East I-90 Hyak Realignment
Direct Shear Test
Boring: SI-2-07 Depth: 84.6-86.0'
Sample: 105

Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-10-07 Depth: 24.7-25.4'
Sample: 101A

KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-10-07 Depth: 24.7-25.4'
Sample: 101A

KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-1-07 Depth: 32.0-32.7'
Sample: 101

Centimetres
KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-1-07 Depth: 32.0-32.7'
Sample: 101

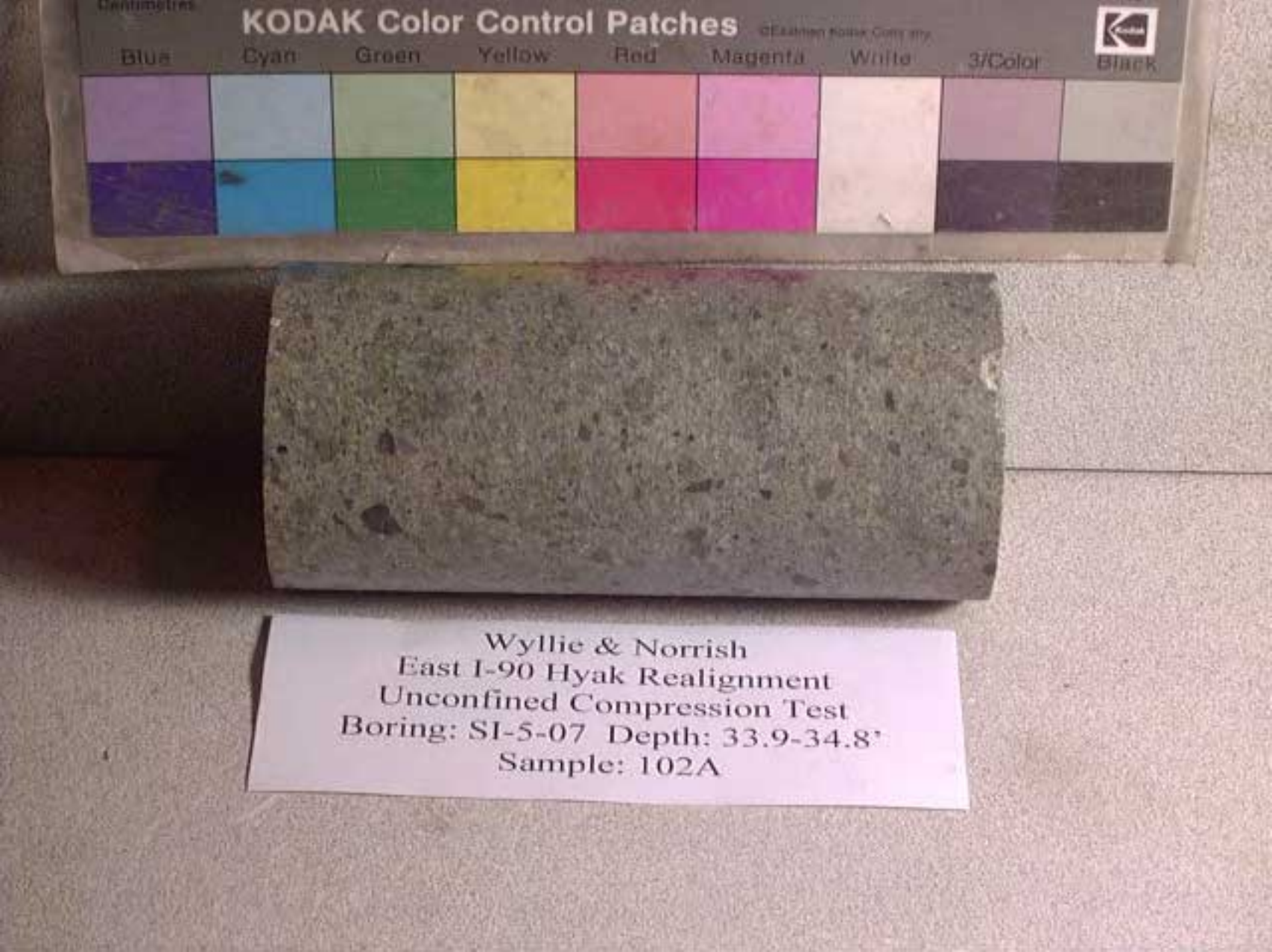
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-2-07 Depth: 53.4-54.0'
Sample: 103A

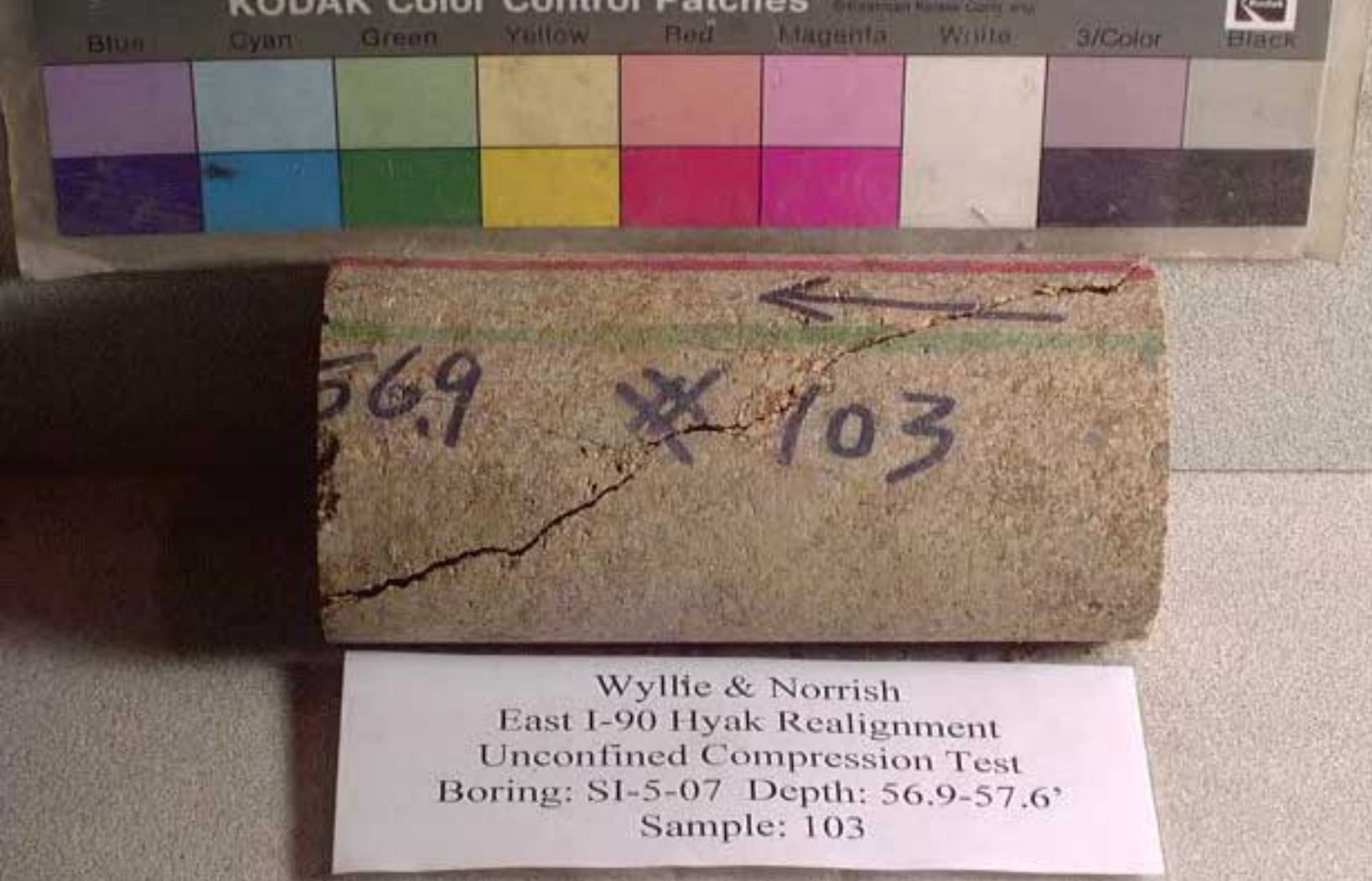
KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
103-A
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-2-07 Depth: 53.4-54.0'
Sample: 103A

Wyllie & Norris
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-4-07 Depth: 23.6-24.5'
Sample: 101A

Centimetres
KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-4-07 Depth: 23.6-24.5'
Sample: 101A

KODAK Color Control Patches
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-5-07 Depth: 33.9-34.8'
Sample: 102A


Centimetres
KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-5-07 Depth: 33.9-34.8'
Sample: 102A



Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-5-07 Depth: 56.9-57.6'
Sample: 103

Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-5-07 Depth: 56.9-57.6'
Sample: 103

KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-7-07 Depth: 36.9-37.4'
Sample: 101B

KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-7-07 Depth: 36.9-37.4'
Sample: 101B

Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-9-07 Depth: 42.4-43.1'
Sample: 201

KODAK Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
Wyllie & Norrish
East I-90 Hyak Realignment
Unconfined Compression Test
Boring: SI-9-07 Depth: 42.4-43.1'
Sample: 201

Corrosion Testing Results

Sunland Analytical

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 10/31/2007
Date Submitted 10/24/2007

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : RKS-02-07 Site ID : 201/61-61.3'.
Thank you for your business.

* For future reference to this analysis please use SUN # 51984-103885.

EVALUATION FOR SOIL CORROSION

Soil pH	7.61	
Minimum Resistivity	1.34 ohm-cm (x1000)	
Chloride	14.9 ppm	00.00149 %
Sulfate	2.2 ppm	00.00022 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 10/31/2007
Date Submitted 10/24/2007

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : RKS-06-07/RKS-11-07 Site ID : 104/102 COMPOS..
Thank you for your business.

* For future reference to this analysis please use SUN # 51984-103886.

EVALUATION FOR SOIL CORROSION

Soil pH	7.65	
Minimum Resistivity	0.64 ohm-cm (x1000)	
Chloride	12.8 ppm	00.00128 %
Sulfate	332.2 ppm	00.03322 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : RKS 13-07 Site ID : 101.
Thank you for your business.

* For future reference to this analysis please use SUN # 52506-104990.

EVALUATION FOR SOIL CORROSION

Soil pH	6.88	
Minimum Resistivity	4.29 ohm-cm (x1000)	
Chloride	6.2 ppm	00.00062 %
Sulfate	1.5 ppm	00.00015 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : RKS 13-07 Site ID : 103.
Thank you for your business.

* For future reference to this analysis please use SUN # 52506-104991.

EVALUATION FOR SOIL CORROSION

Soil pH	7.65	
Minimum Resistivity	1.37 ohm-cm (x1000)	
Chloride	6.5 ppm	00.00065 %
Sulfate	162.3 ppm	00.01623 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : RKS 15-07 Site ID : 101.
Thank you for your business.

* For future reference to this analysis please use SUN # 52506-104992.

EVALUATION FOR SOIL CORROSION

Soil pH	5.91	
Minimum Resistivity	7.77 ohm-cm (x1000)	
Chloride	14.9 ppm	00.00149 %
Sulfate	1.3 ppm	00.00013 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : RKS 19-07 Site ID : 101.
Thank you for your business.

* For future reference to this analysis please use SUN # 52506-104993.

EVALUATION FOR SOIL CORROSION

Soil pH	7.86	
Minimum Resistivity	0.51 ohm-cm (x1000)	
Chloride	46.2 ppm	00.00462 %
Sulfate	1105.1 ppm	00.11051 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney RA
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : RKS 23-07 Site ID : 104.
Thank you for your business.

* For future reference to this analysis please use SUN # 52506-104995.

EVALUATION FOR SOIL CORROSION

Soil pH	8.54	
Minimum Resistivity	3.48 ohm-cm (x1000)	
Chloride	6.0 ppm	00.00060 %
Sulfate	10.4 ppm	00.00104 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : RKS 24-07 Site ID : 102.
Thank you for your business.

* For future reference to this analysis please use SUN # 52506-104996.

EVALUATION FOR SOIL CORROSION

Soil pH	8.18	
Minimum Resistivity	0.64 ohm-cm (x1000)	
Chloride	28.3 ppm	00.00283 %
Sulfate	293.5 ppm	00.02935 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : RKS 27-07 Site ID : 101.
Thank you for your business.

* For future reference to this analysis please use SUN # 52506-104997.

EVALUATION FOR SOIL CORROSION

Soil pH	8.13	
Minimum Resistivity	4.56 ohm-cm (x1000)	
Chloride	5.7 ppm	00.00057 %
Sulfate	2.6 ppm	00.00026 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : SI 2-07 Site ID : 102A.
Thank you for your business.

* For future reference to this analysis please use SUN # 52507-104998.

EVALUATION FOR SOIL CORROSION

Soil pH	7.98		
Minimum Resistivity	0.72 ohm-cm (x1000)		
Chloride	43.3 ppm	00.00433	%
Sulfate	315.0 ppm	00.03150	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : SI 2-07 Site ID : 105.
Thank you for your business.

* For future reference to this analysis please use SUN # 52507-104999.

EVALUATION FOR SOIL CORROSION

Soil pH	7.90	
Minimum Resistivity	0.86 ohm-cm (x1000)	
Chloride	11.2 ppm	00.00112 %
Sulfate	252.0 ppm	00.02520 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : SI-5-07 Site ID : 104.
Thank you for your business.

* For future reference to this analysis please use SUN # 52507-105000.

EVALUATION FOR SOIL CORROSION

Soil pH	7.70	
Minimum Resistivity	4.29 ohm-cm (x1000)	
Chloride	8.3 ppm	00.00083 %
Sulfate	20.1 ppm	00.00201 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : SI-9-07 Site ID : 203.
Thank you for your business.

* For future reference to this analysis please use SUN # 52507-105001.

EVALUATION FOR SOIL CORROSION

Soil pH	7.24	
Minimum Resistivity	4.56 ohm-cm (x1000)	
Chloride	13.9 ppm	00.00139 %
Sulfate	2.2 ppm	00.00022 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : SI-10-07 Site ID : 104.
Thank you for your business.

* For future reference to this analysis please use SUN # 52507-105002.

EVALUATION FOR SOIL CORROSION

Soil pH	8.10	
Minimum Resistivity	0.70 ohm-cm (x1000)	
Chloride	27.0 ppm	00.00270 %
Sulfate	271.9 ppm	00.02719 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 02/08/2008
Date Submitted 02/05/2008

To: Norm Norrish
Wyllie & Norrish Rock Eng.
17918 NE 27th St.
Redmond, WA 98052

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : SI 12-07 Site ID : 102.
Thank you for your business.

* For future reference to this analysis please use SUN # 52507-105003.

EVALUATION FOR SOIL CORROSION

Soil pH	7.72		
Minimum Resistivity	3.48 ohm-cm (x1000)		
Chloride	8.1 ppm	00.00081	%
Sulfate	10.1 ppm	00.00101	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Appendix G

Petrographic Analyses Report

Key to Petrographic and Photomicrographic Descriptions

Clay minerals common in altered rocks must often be identified by X-ray diffraction either because their optic properties are not diagnostic or because they are too fine grained to be reliably identified by optical methods. The term "clay" is used herein to denote fine grained phyllosilicates in general. Under ideal conditions, it is often possible to optically discriminate between 4 major groups: kaolinite, smectite, mica (including illite), and chlorite. This is done whenever conditions permit.

The term "sericite" is applied to fine grained colorless phyllosilicates that show upper 2nd order maximum interference colors. These could include muscovite, illite, paragonite, lepidolite, margarite, clintonite, pyrophyllite, and talc. The term "intermediate clay" is applied to fine grained very pale or colorless phyllosilicates that show upper 1st order maximum interference colors. These are probably dominated by chlorite, smectite, and mixed-layer illite/smectite.

The term "opaques" is used to refer to all materials opaque (and sometimes semi-opaque) to transmitted light. The term "FEOH" is herein used to indicate fine grained, yellowish to reddish brown, earthy materials of varying opacity in transmitted light. FEOH is probably mostly Fe oxyhydroxides but may sometimes include sphalerite, realgar, orpiment, jarosite, a number of Mn oxyhydroxides, and organic matter.

A question mark after a rock or mineral name in a petrographic description means that there is uncertainty about the identification of that rock or mineral.

Particle size distributions are given as (A-B m), where A and B are the median and largest particle sizes, respectively, in microns. A question mark (?) in the position of A or B indicates that the value of A or B was indeterminate, probably because of excessively large or small particle size or statistically insignificant numbers of particles.

Mineral abundances are visual estimates for an entire slide. For multi-lithologic materials (cuttings, etc...), mineralogy, textures, and alteration are described only for the dominant lithology.

Section preparation codes are as follows: (1) Format: 27 x 46 mm, 51 x 76 mm, or 1" round; (2) Finish: standard lapping (STD) or polished (POL); (3) Stains: sodium cobaltinitrite (SCN), alizarin red S (ARS), potassium ferricyanide (PF), and barium chloride + potassium rhodizonate (BCPR); and (4) Cover: none, permanent Loctite acrylic (PLA), or removable Canada Balsam (RCB).

Photomicrograph captions/labels contain the following items of information in consecutive order separated by forward slashes: (1) sample identification; (2) film roll number; (3) frame number; (4) illumination; (5) field of view (FOV); and (6) the job identification number. "PPL" indicates plane-polarized light; "XPL indicates cross-polarized light; "R" indicates reflected light. "550" means that a 550 nanometer wavelength plate was inserted in the light path. "C" indicates that the substage condenser was in (sometimes used for Fe-oxides). "O" indicates substage condenser in an oblique position. These various illuminations can be combined. "CON" indicates conoscopic illumination. POL means that a polarizing filter was used with the lens, and DAY means the sample was photographed in diffused daylight.

Features on photomicrographs are indicated by the number of the feature in the ALTERATION section of the text or by a mineral name abbreviation: **Q**uartz, **P**lagioclase, **K**feldspar,**ser**icite, **b**io**t**ite, **fe**rroan **c**al**c**ite, **act**inolite.

Thin section descriptions are based on work by Spectrum Petrographics and Burk GeoConsult, with review by Dr. Ray Ingersoll, UCLA.

SAMPLE # **MRE-SI6A**

ROCK NAME ALTERED DACITE ASH-FLOW TUFF -- probably formed by devitrification and alteration (secondary quartz + sericite + ferroan calcite + chlorite + opaques) of a devitrified welded dacite ash-flow tuff protolith.

MINERALS Plagioclase (35%) + cryptocrystalline devitrified K-glass (33%) + quartz (20%) + sericite (5%) + ferroan calcite (3%) + chlorite (3%) + opaques (1%) + apatite (<1%).

TEXTURES Pyroclastic, devitrified hypocrystalline. Weak welding has produced a weakly directed fabric.

Framework Components (50%) are 1-9 mm, angular to subangular. Contacts between framework components are floating to tangential.

Phenocryst Fragments (35%) are composed of subhedral to euhedral, whole to broken, isolated [plagioclase (25%) + quartz (10%)].

Lithic Fragments (15%) are composed of basalt and dacite

Pumice Fragments (0%) were not observed.

Matrix/Cement (50%) is composed of moderately welded devitrified K-glass

ALTERATION The following alteration features are also present but of indeterminate relative ages: (1) K-glass moderately devitrified to quartz; (2) plagioclase weakly altered to sericite + ferroan calcite; and (3) veins of quartz + ferroan calcite.

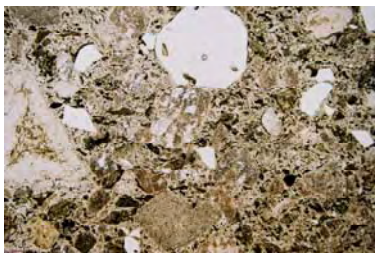
SECTIONING Format: 27 x 46 mm Finish: STD Stains: SCN (top 1/2) + [ARS + PF] (right 1/2) Cover: PLA

PHOTOGRAPHS MRE-SI6A 07044/16/DAY/3X/UNN

ALTERED DACITE ASH-FLOW TUFF showing typical appearance of hand specimen.

MRE-SI6A 07051/20/PPL/28X/UNN

ALTERED DACITE ASH-FLOW TUFF showing typical appearance of phenocrysts and lithic fragments in a groundmass of moderately welded devitrified glass shards.



SAMPLE # **MRE-SI6B**

ROCK NAME ALTERED DACITE ASH-FLOW TUFF -- probably formed by devitrification and alteration (secondary quartz + sericite + chlorite + opaques) of a welded dacite ash-flow tuff protolith.

MINERALS Plagioclase (48%) + cryptocrystalline K-glass (25%) + quartz (15%) + sericite (5%) + chlorite (5%) + opaques (2%).

TEXTURES Pyroclastic, devitrified hypocrystalline. Weak welding has produced a weakly directed fabric.

Framework Components (70%) are 1-20 mm, angular to subangular. Contacts between framework components are floating to tangential.

Phenocryst Fragments (25%) are composed of subhedral to euhedral, whole to broken, isolated [plagioclase (25%) + quartz (10%)].

Lithic Fragments (45%) are composed of basalt and dacite vitrophyre.

Pumice Fragments (0%) were not observed.

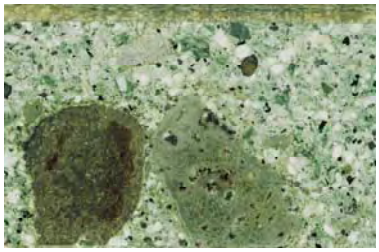
Matrix/Cement (30%) is composed of moderately welded K-glass moderately devitrified to quartz.

ALTERATION The following alteration features are also present but of indeterminate relative ages: (1) Devitrified K-glass; and (2) plagioclase weakly altered to sericite.

SECTIONING Format: 27 x 46 mm Finish: STD Stains: SCN (top 1/2) + [ARS + PF] (right 1/2) Cover: PLA

PHOTOGRAPHS MRE-SI6B 07044/17/DAY/3X/UNN

ALTERED DACITE ASH-FLOW TUFF showing typical appearance of hand specimen.



MRE-SI6B 07051/21/PPL/28X/UNN

ALTERED DACITE ASH-FLOW TUFF showing typical appearance of phenocrysts and lithic fragments in a groundmass of moderately welded devitrified glass shards.

SAMPLE # **MRE-SI6C**

ROCK NAME ALTERED DACITE ASH-FLOW TUFF -- probably formed by devitrification and alteration (secondary quartz + clay + ferroan calcite + chlorite + opaques) of a welded dacite ash-flow tuff protolith.

MINERALS Cryptocrystalline devitrified K-glass (40%) + plagioclase (25%) + quartz (15%) + clay (10%) + ferroan calcite (5%) + chlorite (3%) + opaques (2%).

TEXTURES Pyroclastic, devitrified hypocrystalline. Weak welding has produced a weakly directed fabric.

Framework Components (50%) are 1-12 mm, angular to subangular. Contacts between framework components are floating to tangential.

Phenocryst Fragments (25%) are composed of subhedral to euhedral, whole to broken, isolated [plagioclase (18%) + quartz (7%)].

Lithic Fragments (25%) are composed of basalt and dacite

Pumice Fragments (0%) were not observed.

Matrix/Cement (50%) is composed of moderately welded K-glass weakly devitrified to quartz.

ALTERATION The following alteration features are also present but of indeterminate relative ages: (1) Devitrified K-glass; and (2) plagioclase weakly altered to clay.

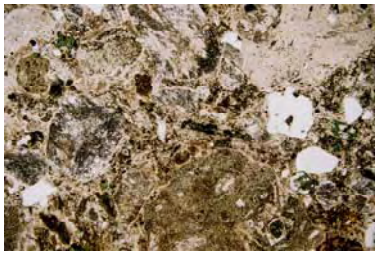
SECTIONING Format: 27 x 46 mm Finish: STD Stains: SCN (top 1/2) + [ARS + PF] (right 1/2) Cover: PLA

PHOTOGRAPHS MRE-SI6C 07044/18/DAY/3X/UNN

ALTERED DACITE ASH-FLOW TUFF showing typical appearance of hand specimen.

MRE-SI6C 07051/22/PPL/28X/UNN

ALTERED DACITE ASH-FLOW TUFF showing typical appearance of phenocrysts and lithic fragments in a groundmass of moderately welded devitrified glass shards.



Appendix H

Mathematica 3-D Model

(Attached as compact disc)

Appendix H

A three-dimensional model was developed by Haneberg Geoscience to assist with geologic interpretation of the slide mass in Design Sector XIII of this Report. Still images of the model have been included as Figures 25 and 26. The complete model is viewable utilizing either WOLFRAM RESEARCH – Mathematica 7 software or their free reader program.

The two electronically attached files include:

1. Borehole_model_final.nbp - This requires the professional version of the software which can be purchased at the following link.

   http://www.wolfram.com/products/mathematica/index.html

2. Borehole_model_final.nb - This requires the viewer version (Mathematica Player 7) of the software and can be downloaded at the link provided below. This viewer will allow for zooming and rotation of the model along with adjustment of the various borehole specific mapping parameters.

   http://www.wolfram.com/products/player/

Appendix I

Point Load Strength Data

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-19-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1481	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:	
De	Equivalent Core Diameter
Is	Uncorrected Point Load Index
Fs	Size Correction Factor
Is50	Corrected Point Load Index
UCS	Unconfined Compressive Strength
UCS/Is50	**22.0**

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:
1 = Diametral normal failure
2 = Axial normal failure
3 = Block normal failure
4 = Diametral chipped failure
5 = Axial sheared failure
6 = Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
22.7	3	II	D	61	4	3			75.00	0.17	3.9	3.8	V1481	845	1	3477	59	157	1.08	169	3716	**2**
30.0	2	I	D	61	2	3			75.00	0.07	6.0	5.9	V1481	1324	1	3599	60	237	1.09	258	5668	**2**
38.9	2	I	D	61	2	3			75.00	0.06	5.8	5.7	V1481	1286	1	3599	60	231	1.09	250	5504	**2**
44.8	2	I	D	61	2	3			75.00	-0.05	12.8	12.9	V1481	2889	1	3599	60	518	1.09	562	12366	**3**
49.0	2	I	A	61		3	80	86	56.20	-0.05	10.6	10.7	V1481	2394	2	4354	66	355	1.13	402	8843	**3**
50.5	2	I	D	61	3	3			75.00	-0.07	10.7	10.8	V1481	2417	1	3538	59	441	1.08	476	10483	**3**
52.0	2	I	D	61	5	3			75.00	0.04	13.6	13.5	V1481	3039	1	3416	58	574	1.07	616	13547	**3**
52.2	2	I	A	61		3	82	95	54.20	-0.06	16.6	16.6	V1481	3734	2	4199	65	574	1.12	645	14184	**3**
60.6	2	I	A	61		3	84	90	52.20	-0.01	16.2	16.2	V1481	3641	2	4044	64	581	1.11	647	14239	**3**
71.5	2	I	A	61		3	80	89	56.20	-0.09	13.1	13.2	V1481	2956	2	4354	66	438	1.13	496	10918	**3**
82.3	2	I	D	61	4	3			75.00	-0.10	9.2	9.3	V1481	2084	1	3477	59	387	1.08	416	9162	**3**
91.8	2	I	A	61		3	82	93	54.20	0.08	10.0	10.0	V1481	2237	2	4199	65	344	1.12	386	8497	**3**
100.5	2	I	A	61		3	87	108	49.20	-0.10	7.6	7.7	V1481	1720	2	3812	62	291	1.10	320	7041	**2**

Notes:

1 Ft = Feet
2 WSDOT = Washington State Department of Transportation
3 A = Axial
4 D = Diametral
5 L = Lump
6 Diam = Diameter
7 mm = millimeter
8 kN = Kilo Newtons
9 lbs = pounds
10 psi = pounds per square inch
11 Indentation based on geologist's field measurement.
12 Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
13 Failure code based on ISRM methodology.
14 Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-20-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1481	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:	De	Equivalent Core Diameter
	Is	Uncorrected Point Load Index
	Fs	Size Correction Factor
	Is50	Corrected Point Load Index
	UCS	Unconfined Compressive Strength

UCS/Is50
22.0

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:

		UCS (psi)	WSDOT **R Index**	Is 50
1 =	Diametral normal failure			
2 =	Axial normal failure	40	**0**	2
3 =	Block normal failure	150	**1**	7
4 =	Diametral chipped failure	3600	**2**	164
5 =	Axial sheared failure	7300	**3**	332
6 =	Diametral failure along healed joint	15000	**4**	682
		29000	**5**	1318
		72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
16.0	2	I	A	61		3	68	84	68.20	0.00	11.8	11.8	V1481	2641	2	5283	73	323	1.18	382	8397	**3**
34.7	2	I	A	61		3	96	98	40.20	-0.01	2.5	2.5	V1481	569	2	3114	56	118	1.05	124	2723	**1**
44.8	2	I	D	61	4	3			75.00	-0.06	11.3	11.4	V1481	2558	1	3477	59	475	1.08	511	11248	**3**
58.5	2	I	D	61	3	3			75.00	0.04	4.7	4.6	V1481	1039	1	3538	59	189	1.08	205	4505	**2**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-21-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:		
	UCS/Is50	
	22.0	
Rock Types:		

De	Equivalent Core Diameter	
Is	Uncorrected Point Load Index	
Fs	Size Correction Factor	
Is50	Corrected Point Load Index	
UCS	Unconfined Compressive Strength	
1 = Meta-Welded Lapilli Tuff (Domain #1)		
2 = Meta-Welded Lapilli Tuff (Domain #2)		
3 = Meta-Welded Lapilli Tuff (Domain #3)		

Types of failures:				
	UCS	WSDOT	Is 50	
	(psi)	**R Index**		
1 = Diametral normal failure	40	**0**	2	
2 = Axial normal failure	150	**1**	7	
3 = Block normal failure	3600	**2**	164	
4 = Diametral chipped failure	7300	**3**	332	
5 = Axial sheared failure	15000	**4**	682	
6 = Diametral failure along healed joint	29000	**5**	1318	
	72500	**5**	3295	

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
5.1	3	II	D	61	5	3			75.00	0.23	4.6	4.3	V1484	971	1	3416	58	183	1.07	197	4329	**2**
14.1	2	I	A	61		4	79	92	82.60	0.29	14.9	14.6	V1484	3273	2	6399	80	330	1.24	408	8970	**3**
24.9	2	I	D	61	3	3			75.00	0.28	12.5	12.3	V1484	2754	1	3538	59	502	1.08	543	11945	**3**
25.2	2	I	A	61		4	102	112	59.60	0.27	12.2	12.0	V1484	2686	2	4617	68	375	1.15	431	9480	**3**
35.5	2	I	D	61	4	3			75.00	0.24	16.3	16.0	V1484	3599	1	3477	59	668	1.08	719	15824	**4**
39.8	2	I	A	61		3	71	86	65.20	0.24	5.5	5.2	V1484	1171	2	5051	71	150	1.17	175	3855	**2**
40.1	2	I	D	61	4	3			75.00	0.24	2.4	2.2	V1484	495	1	3477	59	92	1.08	99	2174	**1**
43.7	2	I	A	61		4	84	97	77.60	0.20	17.2	17.0	V1484	3826	2	6012	78	411	1.22	500	11005	**3**
44.1	2	I	D	61	4	3			75.00	0.20	13.4	13.2	V1484	2965	1	3477	59	550	1.08	593	13037	**3**
68.5	2	I	D	61	5	3			75.00	0.21	10.1	9.9	V1484	2217	1	3416	58	419	1.07	449	9880	**3**
68.9	2	I	D	61	4	3			75.00	0.21	6.1	5.9	V1484	1324	1	3477	59	246	1.08	265	5821	**2**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-22-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

	UCS/Is50		
	22.0		

General Notes:

De	Equivalent Core Diameter
Is	Uncorrected Point Load Index
Fs	Size Correction Factor
Is50	Corrected Point Load Index
UCS	Unconfined Compressive Strength

Rock Types:

1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:

1 =	Diametral normal failure
2 =	Axial normal failure
3 =	Block normal failure
4 =	Diametral chipped failure
5 =	Axial sheared failure
6 =	Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50 psi
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
6.2	3	III	D	61	3	3			75.00	0.21	4.4	4.2	V1484	940	1	3538	59	171	1.08	185	4076	**2**
9.5	2	I	D	61	2	3			75.00	0.17	0.8	0.6	V1484	137	1	3599	60	25	1.09	27	587	**1**
15.2	2	I	D	61	3	3			75.00	0.19	4.3	4.1	V1484	931	1	3538	59	170	1.08	184	4037	**2**
16.0	2	II	D	61	2	3			75.00	0.17	1.2	1.1	V1484	238	1	3599	60	43	1.09	46	1020	**1**
34.5	2	I	D	61	4	3			75.00	0.15	23.3	23.1	V1484	5195	1	3477	59	964	1.08	1038	22841	**4**
45.2	2	I	D	61	5	2			75.00	0.15	56.8	56.6	V1484	12728	1	3416	58	2404	1.07	2579	56734	**5**
56.1	2	II	D	61	2	2			75.00	0.17	17.1	16.9	V1484	3797	1	3599	60	681	1.09	739	16253	**4**
57.5	2	I	D	61	3	2			75.00	0.11	25.3	25.2	V1484	5654	1	3538	59	1031	1.08	1115	24525	**4**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-23-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:	
UCS/Is50	**22.0**
Rock Types:	
De	Equivalent Core Diameter
Is	Uncorrected Point Load Index
Fs	Size Correction Factor
Is50	Corrected Point Load Index
UCS	Unconfined Compressive Strength
1 =	Meta-Welded Lapilli Tuff (Domain #1)
2 =	Meta-Welded Lapilli Tuff (Domain #2)
3 =	Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:	
1 =	Diametral normal failure
2 =	Axial normal failure
3 =	Block normal failure
4 =	Diametral chipped failure
5 =	Axial sheared failure
6 =	Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
3.5	1	I	A	61		4	79	93	82.60	0.10	29.8	29.7	V1484	6672	2	6399	80	673	1.24	831	18284	**4**
7.8	1	I	D	61	4	2			75.00	0.70	30.7	30.0	V1484	6753	1	3477	59	1253	1.08	1350	29690	**5**
18.4	1	I	D	61	4	2			75.00	-0.03	35.5	35.5	V1484	7980	1	3477	59	1481	1.08	1595	35087	**5**
25.3	1	II	D	61	5	2			75.00	-0.05	27.9	28.0	V1484	6288	1	3416	58	1188	1.07	1274	28026	**4**
25.7	1	II	A	61		4	88	98	73.60	-0.05	20.1	20.2	V1484	4534	2	5702	76	513	1.20	618	13588	**3**
38.9	2	II	D	61	4	2			75.00	-0.05	23.7	23.7	V1484	5335	1	3477	59	990	1.08	1066	23454	**4**
47.3	2	I	D	61	5	3			75.00	-0.04	9.7	9.7	V1484	2181	1	3416	58	412	1.07	442	9720	**3**
51.2	2	I	A	61		3	97	110	39.20	-0.07	26.1	26.2	V1484	5888	2	3037	55	1251	1.04	1307	28748	**4**
58.7	2	I	D	61	4	3			75.00	-0.07	23.1	23.2	V1484	5209	1	3477	59	966	1.08	1041	22900	**4**
63.4	2	II	D	61	4	3			75.00	-0.13	11.2	11.4	V1484	2554	1	3477	59	474	1.08	510	11228	**3**
65.3	2	I	D	61	4	3			75.00	-0.10	17.1	17.2	V1484	3862	1	3477	59	717	1.08	772	16980	**4**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-24-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1481	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:		
	UCS/Is50	**22.0**
De	Equivalent Core Diameter	
Is	Uncorrected Point Load Index	
Fs	Size Correction Factor	
Is50	Corrected Point Load Index	
UCS	Unconfined Compressive Strength	

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:
1 = Diametral normal failure
2 = Axial normal failure
3 = Block normal failure
4 = Diametral chipped failure
5 = Axial sheared failure
6 = Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
10.6	1	I	D	61	1	3			75.00	-0.19	23.7	23.8	V1481	5359	1	3660	60	945	1.09	1029	22644	**4**
17.7	1	I	D	61	2	3			75.00	-0.24	37.6	37.8	V1481	8504	1	3599	60	1524	1.09	1655	36404	**5**
29.3	1	I	D	61	1	3			75.00	-0.26	32.9	33.2	V1481	7452	1	3660	60	1314	1.09	1431	31487	**5**
29.5	1	I	A	61		3	83	92	53.20	-0.27	41.5	41.7	V1481	9379	2	4121	64	1468	1.12	1643	36144	**5**
40.8	1	I	D	61	5	3			75.00	-0.27	26.4	26.7	V1481	6004	1	3416	58	1134	1.07	1217	26764	**4**
41.0	1	I	A	61		3	63	77	73.20	-0.27	47.5	47.7	V1481	10730	2	5671	75	1221	1.20	1468	32290	**5**
42.3	1	I	D	61	3	3			75.00	-0.25	37.6	37.9	V1481	8509	1	3538	59	1552	1.08	1678	36909	**5**
50.0	1	I	A	61		3	80	100	56.20	-0.26	45.7	45.9	V1481	10321	2	4354	66	1529	1.13	1733	38118	**5**
50.2	1	I	D	61	4	3			75.00	-0.27	53.8	54.0	V1481	12148	1	3477	59	2254	1.08	2428	53411	**5**
58.9	1	I	A	61		3	60	70	76.20	-0.32	32.4	32.7	V1481	7353	2	5903	77	804	1.21	975	21450	**4**
60.1	1	I	A	61		3	63	72	73.20	-0.29	39.8	40.1	V1481	9012	2	5671	75	1025	1.20	1233	27121	**4**
60.3	1	I	D	61	2	3			75.00	0.26	30.6	30.3	V1481	6820	1	3599	60	1223	1.09	1327	29196	**5**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-25-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:		
UCS/Is50	De	Equivalent Core Diameter
22.0	Is	Uncorrected Point Load Index
	Fs	Size Correction Factor
	Is50	Corrected Point Load Index
	UCS	Unconfined Compressive Strength

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:	
1 =	Diametral normal failure
2 =	Axial normal failure
3 =	Block normal failure
4 =	Diametral chipped failure
5 =	Axial sheared failure
6 =	Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
15.1	1	I,II	D	61	3	3			75.00	-0.43	16.6	17.1	V1484	3835	1	3538	59	699	1.08	756	16636	**4**
16.2	1	I,II	D	61	3	3			75.00	-0.42	2.5	3.0	V1484	663	1	3538	59	121	1.08	131	2877	**1**
28.6	1	I	D	61	4	3			75.00	-0.37	15.5	15.9	V1484	3570	1	3477	59	662	1.08	713	15695	**4**
29.7	1	I	A	61		4	71	90	90.60	-0.32	18.5	18.8	V1484	4235	2	7019	84	389	1.26	491	10804	**3**
38.2	1	I	D	61	3	3			75.00	-0.36	12.1	12.5	V1484	2808	1	3538	59	512	1.08	554	12179	**3**
38.4	1	I	A	61		4	72	85	89.60	-0.35	21.4	21.8	V1484	4892	2	6941	83	455	1.26	572	12586	**3**
46.5	1	I,II	D	61	3	3			75.00	-0.36	15.9	16.2	V1484	3651	1	3538	59	666	1.08	720	15836	**4**
59.4	1	I	D	61	4	3			75.00	-0.38	27.7	28.1	V1484	6306	1	3477	59	1170	1.08	1260	27724	**4**
59.7	1	I	A	61		4	78	106	83.60	-0.42	24.3	24.7	V1484	5548	2	6476	80	553	1.24	685	15063	**4**
62.5	1	I	D	61	3	3			75.00	-0.39	30.9	31.3	V1484	7041	1	3538	59	1284	1.08	1388	30541	**5**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-26-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:	De	Equivalent Core Diameter	
	Is	Uncorrected Point Load Index	
	Fs	Size Correction Factor	
UCS/Is50	Is50	Corrected Point Load Index	
22.0	UCS	Unconfined Compressive Strength	

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:		
1 =	Diametral normal failure	
2 =	Axial normal failure	
3 =	Block normal failure	
4 =	Diametral chipped failure	
5 =	Axial sheared failure	
6 =	Diametral failure along healed joint	

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
18.0	1	I	D	61	3	3			75.00	-0.29	20.0	20.3	V1484	4561	1	3538	59	832	1.08	899	19785	**4**
28.3	1	I	D	61	2	3			75.00	-0.25	12.1	12.3	V1484	2774	1	3599	60	497	1.09	540	11875	**3**
31.9	1	I	D	61	2	3			75.00	-0.27	27.9	28.2	V1484	6342	1	3599	60	1137	1.09	1234	27146	**4**
33.6	1	I	A	61		4	78	95	83.60	-0.30	39.8	40.1	V1484	9017	2	6476	80	898	1.24	1113	24480	**4**
41.2	1	I	D	61	4	3			75.00	-0.47	25.4	25.9	V1484	5813	1	3477	59	1079	1.08	1162	25559	**4**
41.3	1	I	A	61		3	80	95	56.20	-0.25	43.3	43.5	V1484	9786	2	4354	66	1450	1.13	1643	36142	**5**
53.6	1	I	D	61	4	3			75.00	-0.42	36.6	37.0	V1484	8322	1	3477	59	1544	1.08	1663	36589	**5**
53.9	1	I	A	61		3	77	96	59.20	-0.42	34.2	34.6	V1484	7771	2	4586	68	1093	1.15	1253	27569	**4**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-27-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:	De	Equivalent Core Diameter	
	Is	Uncorrected Point Load Index	
	Fs	Size Correction Factor	
UCS/Is50	Is50	Corrected Point Load Index	
22.0	UCS	Unconfined Compressive Strength	

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:
1 = Diametral normal failure
2 = Axial normal failure
3 = Block normal failure
4 = Diametral chipped failure
5 = Axial sheared failure
6 = Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
22.0	2	II	D	61	2	3			75.00	-0.41	10.1	10.5	V1484	2367	1	3599	60	424	1.09	461	10133	**3**
25.8	2	II	D	61	2	3			75.00	-0.49	9.9	10.4	V1484	2329	1	3599	60	417	1.09	453	9969	**3**
28.3	2	I	D	61	4	3			75.00	-0.40	18.7	19.1	V1484	4296	1	3477	59	797	1.08	859	18888	**4**
33.8	2	I	D	61	3	3			75.00	-0.40	28.2	28.6	V1484	6425	1	3538	59	1172	1.08	1267	27869	**4**
37.7	1	I	A	61		3	71	91	65.20	-0.42	33.3	33.7	V1484	7574	2	5051	71	967	1.17	1133	24930	**4**
43.1	1	I	D	61	3	3			75.00	-0.45	17.4	17.9	V1484	4013	1	3538	59	732	1.08	791	17406	**4**
53.0	1	I	D	61	4	3			75.00	-0.40	46.8	47.2	V1484	10608	1	3477	59	1968	1.08	2120	46641	**5**
54.5	1	I	A	61		3	71	88	65.20	-0.43	47.4	47.9	V1484	10761	2	5051	71	1375	1.17	1610	35424	**5**
60.0	1	I	A	61		3	68	84	68.20	-0.51	29.1	29.6	V1484	6645	2	5283	73	811	1.18	960	21125	**4**
62.0	1	I	D	61	2	3			75.00	-0.48	7.7	8.2	V1484	1839	1	3599	60	330	1.09	358	7872	**3**
62.2	1	I	D	61	4	3			75.00	-0.49	37.7	38.2	V1484	8585	1	3477	59	1593	1.08	1716	37746	**5**
72.2	1	I	A	61		3	64	78	72.20	-0.36	41.5	41.8	V1484	9401	2	5593	75	1084	1.20	1300	28595	**4**
73.0	1	I	D	61	3	3			75.00	-0.41	31.1	31.5	V1484	7077	1	3538	59	1290	1.08	1395	30697	**5**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-28-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:	
De	Equivalent Core Diameter
Is	Uncorrected Point Load Index
Fs	Size Correction Factor
Is50	Corrected Point Load Index
UCS	Unconfined Compressive Strength

UCS/Is50
22.0

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:
1 = Diametral normal failure
2 = Axial normal failure
3 = Block normal failure
4 = Diametral chipped failure
5 = Axial sheared failure
6 = Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
21.9	2	I	D	61	1.5	3			75.00	-0.08	11.5	11.5	V1484	2592	1	3630	60	461	1.09	501	11023	**3**
25.0	2	I	A	61		3	73	88	63.20	-0.06	16.4	16.4	V1484	3691	2	4896	70	486	1.16	566	12448	**3**
29.3	3	II	A	61		3	61	74	75.20	-0.05	5.0	5.0	V1484	1133	2	5826	76	125	1.21	152	3339	**1**
29.8	3	II	D	61	2.5	3			75.00	-0.06	7.1	7.2	V1484	1607	1	3569	60	291	1.08	315	6926	**2**
39.9	2	I	D	61	1.5	3			75.00	-0.15	18.0	18.2	V1484	4080	1	3630	60	725	1.09	789	17352	**4**
44.9	3	II,III	D	61	2.5	3			75.00	-0.16	7.4	7.5	V1484	1688	1	3569	60	305	1.08	331	7275	**2**
55.3	2	I	D	61	1.5	3			75.00	-0.23	17.3	17.5	V1484	3936	1	3630	60	700	1.09	761	16740	**4**
64.2	2	I	A	61		3	73	90	63.20	-0.24	19.6	19.8	V1484	4458	2	4896	70	587	1.16	683	15033	**4**
65.1	2	I	D	61	1.5	3			75.00	-0.26	14.8	15.1	V1484	3394	1	3630	60	603	1.09	656	14436	**3**
70.7	2	I	D	61	2	3			75.00	-0.24	24.3	24.6	V1484	5519	1	3599	60	989	1.09	1074	23624	**4**
77.4	2	I	D	61	1.5	3			75.00	-0.27	24.6	24.8	V1484	5584	1	3630	60	993	1.09	1079	23748	**4**
79.1	2	I	A	61		3	76	91	60.20	-0.26	20.8	21.0	V1484	4723	2	4664	68	653	1.15	752	16539	**4**
88.6	1	I	D	61	1.5	3			75.00	-0.27	22.2	22.4	V1484	5045	1	3630	60	897	1.09	975	21453	**4**
90.3	1	I	A	61		3	72	85	64.20	-0.27	21.4	21.7	V1484	4880	2	4974	71	633	1.17	739	16259	**4**
98.7	1	I	D	61	1.5	3			75.00	-0.28	34.0	34.2	V1484	7695	1	3630	60	1368	1.09	1487	32725	**5**
99.0	1	I	A	61		3	70	83	66.20	-0.29	28.9	29.2	V1484	6571	2	5129	72	827	1.18	972	21376	**4**
106.4	1	I	D	61	1.5	3			75.00	-0.32	29.6	29.9	V1484	6731	1	3630	60	1196	1.09	1301	28623	**4**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-29-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:	
De	Equivalent Core Diameter
Is	Uncorrected Point Load Index
Fs	Size Correction Factor
Is50	Corrected Point Load Index
UCS	Unconfined Compressive Strength

UCS/Is50 **22.0**

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:

1 =	Diametral normal failure
2 =	Axial normal failure
3 =	Block normal failure
4 =	Diametral chipped failure
5 =	Axial sheared failure
6 =	Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
4.9	2	I,II	A	61	3	3			75.00	-0.05	9.6	9.7	V1484	2178	1	5578	75	252	1.20	302	6640	**2**
11.1	2	I	D	61	4	3			75.00	-0.09	12.4	12.5	V1484	2808	1	3477	59	521	1.08	561	12345	**3**
26.4	2	I	D	61	4	3			75.00	-0.19	19.8	20.0	V1484	4494	1	3477	59	834	1.08	898	19757	**4**
34.9	2	I	A	61	4	3			75.00	-0.20	19.1	19.3	V1484	4341	1	5500	74	509	1.19	608	13376	**3**
45.2	1	I	D	61	3	3			75.00	-0.19	22.0	22.2	V1484	4991	1	3538	59	910	1.08	984	21648	**4**
53.9	1	I	D	61	4	3			75.00	-0.20	22.1	22.3	V1484	5011	1	3477	59	930	1.08	1001	22031	**4**
59.6	1	I	A	61		4	97	108	64.60	-0.23	29.6	29.8	V1484	6706	2	5005	71	864	1.17	1011	22233	**4**
66.5	1	I	D	61	4	3			75.00	-0.24	44.3	44.5	V1484	10010	1	3477	59	1857	1.08	2001	44012	**5**
70.3	1	I,II	D	61	4	3			75.00	-0.23	28.2	28.4	V1484	6393	1	3477	59	1186	1.08	1278	28109	**4**
73.7	1	I	A	61		4	81	101	80.60	-0.41	42.8	43.2	V1484	9711	2	6244	79	1003	1.23	1233	27123	**4**
83.7	1	I	D	61	4	3			75.00	-0.25	37.2	37.4	V1484	8410	1	3477	59	1560	1.08	1681	36975	**5**
83.9	1	I	A	61		4	83	99	78.60	-0.50	39.8	40.3	V1484	9057	2	6089	78	960	1.22	1172	25794	**4**
95.0	2	II,III	D	61	3	3			75.00	-0.25	9.2	9.5	V1484	2131	1	3538	59	389	1.08	420	9244	**3**
98.0	2	I,II	D	61	4	3			75.00	-0.29	30.9	31.2	V1484	7005	1	3477	59	1300	1.08	1400	30797	**5**
102.3	2	I	D	61	5	3			75.00	-0.26	37.3	37.5	V1484	8437	1	3416	58	1593	1.07	1709	37606	**5**
116.3	1	I	D	61	5	3			75.00	-0.29	23.4	23.6	V1484	5314	1	3416	58	1004	1.07	1077	23688	**4**
116.7	1	I	A	61		3	61	78	75.20	-0.09	14.9	15.0	V1484	3379	2	5826	76	374	1.21	453	9958	**3**
121.9	1	I	A	61		4	78	91	83.60	-0.28	31.7	32.0	V1484	7191	2	6476	80	716	1.24	887	19524	**4**
122.4	1	I	D	61	4	3			75.00	-0.29	42.1	42.4	V1484	9529	1	3477	59	1768	1.08	1904	41897	**5**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-30-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:		
UCS/Is50	De	Equivalent Core Diameter
22.0	Is	Uncorrected Point Load Index
	Fs	Size Correction Factor
	Is50	Corrected Point Load Index
	UCS	Unconfined Compressive Strength

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:
1 = Diametral normal failure
2 = Axial normal failure
3 = Block normal failure
4 = Diametral chipped failure
5 = Axial sheared failure
6 = Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
4.0	2	II,III	D	61	2	3			75.00	0.05	1.0	0.9	V1484	205	1	3599	60	37	1.09	40	876	**1**
6.1	2	II,III	D	61	4	3			75.00	0.07	22.9	22.9	V1484	5137	1	3477	59	953	1.08	1027	22584	**4**
38.7	1	I	A	61		4	84	100	77.60	0.09	40.3	40.2	V1484	9035	2	6012	78	970	1.22	1181	25986	**4**
39.1	1	I	D	61	5	2			75.00	0.10	15.9	15.8	V1484	3545	1	3416	58	670	1.07	718	15802	**4**
48.4	1	I	A	61		4	82	94	79.60	0.01	46.4	46.3	V1484	10417	2	6167	79	1090	1.23	1335	29378	**5**
51.3	2	I	D	61	5	3			75.00	0.12	20.6	20.5	V1484	4613	1	3416	58	871	1.07	935	20561	**4**
54.5	1	I	A	61		4	76	74	85.60	0.04	42.3	42.3	V1484	9498	2	6631	81	924	1.25	1151	25318	**4**
54.9	1	I	D	61	4	3			75.00	0.03	40.6	40.6	V1484	9118	1	3477	59	1692	1.08	1822	40088	**5**
64.7	1	I,II	A	61		4	72	86	89.60	0.04	27.8	27.8	V1484	6249	2	6941	83	581	1.26	731	16080	**4**
74.0	1	I	D	61	4	3			75.00	0.06	30.2	30.2	V1484	6778	1	3477	59	1258	1.08	1355	29799	**5**
74.4	1	I	A	61		5	83	100	104.00	0.01	46.4	46.4	V1484	10435	2	8057	90	836	1.30	1087	23921	**4**
83.3	1	I	A	61		4	81	95	80.60	0.22	44.2	44.0	V1484	9896	2	6244	79	1022	1.23	1256	27638	**4**
83.6	1	I	D	61	4	3			75.00	0.26	35.2	35.0	V1484	7857	1	3477	59	1458	1.08	1570	34543	**5**
94.6	1	I	D	61	5	3			75.00	0.09	27.5	27.4	V1484	6160	1	3416	58	1163	1.07	1248	27455	**4**
108.5	1	I	D	61	5	3			75.00	0.09	30.9	30.8	V1484	6915	1	3416	58	1306	1.07	1401	30822	**5**
115.2	1	I	D	61	5	3			75.00	0.07	13.6	13.5	V1484	3037	1	3416	58	574	1.07	615	13537	**3**
118.3	1	I	D	61	4	3			75.00	0.09	26.7	26.7	V1484	5991	1	3477	59	1112	1.08	1197	26340	**4**
129.9	1	I	A	61		4	81	96	80.60	0.12	33.4	33.3	V1484	7477	2	6244	79	773	1.23	949	20883	**4**
134.3	1	I	A	61		4	68	94	93.60	0.08	42.3	42.2	V1484	9487	2	7251	85	844	1.27	1073	23596	**4**
134.9	1	I	D	61	4	3			75.00	0.09	23.5	23.4	V1484	5265	1	3477	59	977	1.08	1052	23147	**4**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: RKS-31-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:

UCS/Is50
22.0

Rock Types:

De	Equivalent Core Diameter
Is	Uncorrected Point Load Index
Fs	Size Correction Factor
Is50	Corrected Point Load Index
UCS	Unconfined Compressive Strength

1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:

1 =	Diametral normal failure
2 =	Axial normal failure
3 =	Block normal failure
4 =	Diametral chipped failure
5 =	Axial sheared failure
6 =	Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
4.4	1	I	D	61	4	3			75.00	0.20	31.7	31.5	V1484	7083	1	3477	59	1314	1.08	1416	31143	**5**
4.9	1	I	A	61		3	61	74	75.20	0.05	40.3	40.3	V1484	9057	2	5826	76	1003	1.21	1213	26693	**4**
17.6	1	I	A	61		4	70	86	91.60	0.04	69.4	69.4	V1484	15590	2	7096	84	1417	1.26	1792	39432	**5**
19.6	1	I	D	61	4	3			75.00	0.04	35.1	35.0	V1484	7870	3	3477	59	1460	1.08	1573	34603	**5**
29.4	1	I	A	61		4	85	98	76.60	0.16	39.5	39.4	V1484	8846	2	5934	77	962	1.21	1168	25700	**4**
34.7	1	II	D	61	4	3			75.00	0.07	28.1	28.1	V1484	6308	1	3477	59	1170	1.08	1261	27733	**4**
35.1	1	I,II	A	61		3	69	82	67.20	0.05	32.7	32.7	V1484	7342	2	5206	72	910	1.18	1073	23609	**4**
35.5	1	I,II	D	61	3	3			75.00	0.06	32.8	32.7	V1484	7358	1	3538	59	1342	1.08	1451	31916	**5**
43.8	1	I	D	61	5	3			75.00	0.22	33.3	33.1	V1484	7439	1	3416	58	1405	1.07	1507	33157	**5**
51.8	1	I	A	61		3	86	99	50.20	0.19	43.8	43.6	V1484	9810	2	3889	62	1627	1.10	1798	39547	**5**
64.9	1	I	D	61	5	3			75.00	0.01	42.8	42.8	V1484	9621	1	3416	58	1817	1.07	1949	42886	**5**
65.2	1	I	A	61		4	76	89	85.60	0.04	36.2	36.2	V1484	8138	2	6631	81	792	1.25	986	21693	**4**
75.7	1	I	A	61		4	69	85	92.60	0.16	42.6	42.5	V1484	9550	2	7174	85	859	1.27	1089	23951	**4**
84.5	1	I	D	61	5	3			75.00	0.16	29.6	29.4	V1484	6614	1	3416	58	1249	1.07	1340	29479	**5**
86.4	1	I	A	61		4	67	81	94.60	0.13	28.1	28.0	V1484	6294	2	7329	86	554	1.27	706	15528	**4**
93.0	1	I	A	61		4	69	82	92.60	0.17	49.1	48.9	V1484	10997	2	7174	85	989	1.27	1254	27583	**4**
102.6	1	I	A	61		3	61	72	75.20	0.08	23.6	23.5	V1484	5285	2	5826	76	585	1.21	708	15576	**4**
103.0	1	I	D	61	5	3			75.00	0.11	32.7	32.6	V1484	7317	1	3416	58	1382	1.07	1483	32616	**5**
112.9	1	I	A	61		4	62	76	99.60	0.15	28.6	28.5	V1484	6405	2	7716	88	536	1.29	690	15181	**4**
114.6	1	I	D	61	5	3			75.00	0.16	35.7	35.6	V1484	7994	1	3416	58	1510	1.07	1620	35632	**5**
120.5	1	I	D	61	4	3			75.00	0.28	35.3	35.1	V1484	7881	1	3477	59	1462	1.08	1575	34652	**5**
132.6	1	I	A	61		4	82	94	79.60	0.23	35.8	35.6	V1484	8001	2	6167	79	837	1.23	1026	22563	**4**
133.0	1	I	D	61	2	3			75.00	0.23	37.1	36.9	V1484	8286	1	3599	60	1485	1.09	1612	35470	**5**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: SI-01-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1481	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:		
UCS/Is50	De	Equivalent Core Diameter
22.0	Is	Uncorrected Point Load Index
	Fs	Size Correction Factor
	Is50	Corrected Point Load Index
	UCS	Unconfined Compressive Strength

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:	
1 =	Diametral normal failure
2 =	Axial normal failure
3 =	Block normal failure
4 =	Diametral chipped failure
5 =	Axial sheared failure
6 =	Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
8.5	1	I	A	61		3	62	70	74.20	0.11	50.2	50.0	V1481	11249	2	5748	76	1263	1.21	1523	33499	**5**
8.7	1	I	D	61	3	3			75.00	0.15	38.4	38.3	V1481	8599	1	3538	59	1568	1.08	1695	37299	**5**
16.3	1	I	A	61		3	67	72	69.20	0.17	25.0	24.8	V1481	5577	2	5361	73	671	1.19	797	17531	**4**
16.7	1	I	D	61	5	3			75.00	0.18	35.5	35.4	V1481	7949	1	3416	58	1501	1.07	1611	35431	**5**
21.9	1	I,II	A	61		3	77	83	59.20	0.20	35.7	35.5	V1481	7976	2	4586	68	1122	1.15	1286	28295	**4**
22.1	1	I,II	D	61	4	3			75.00	0.15	39.9	39.7	V1481	8927	1	3477	59	1656	1.08	1784	39248	**5**
27.5	2	I,II	D	61	5	3			75.00	0.19	41.0	40.9	V1481	9183	1	3416	58	1734	1.07	1861	40932	**5**
41.2	2	II,III	D	61	8	3			75.00	0.12	23.1	23.0	V1481	5168	1	3233	57	1031	1.06	1093	24041	**4**
49.4	1	I	A	61		3	68	74	68.20	0.17	59.5	59.4	V1481	13342	2	5283	73	1629	1.18	1928	42414	**5**
49.8	1	I	D	61	3	3			75.00	0.16	25.0	24.9	V1481	5589	1	3538	59	1019	1.08	1102	24242	**4**
62.0	1	I	D	61	3	3			75.00	0.18	25.9	25.7	V1481	5784	1	3538	59	1055	1.08	1140	25090	**4**
62.8	1	I	A	61		3	84	89	52.20	0.14	28.3	28.2	V1481	6337	2	4044	64	1011	1.11	1127	24784	**4**
69.9	1	I	A	61		3	63	69	73.20	0.27	52.3	52.1	V1481	11705	2	5671	75	1332	1.20	1601	35226	**5**
72.2	1	I	D	61	3	3			75.00	-0.09	31.2	31.3	V1481	7032	1	3538	59	1282	1.08	1386	30502	**5**
83.3	1	I	D	61	2	3			75.00	0.32	28.9	28.6	V1481	6427	1	3599	60	1152	1.09	1251	27512	**4**
87.3	1	I	D	61	4	3			75.00	0.31	37.8	37.5	V1481	8434	1	3477	59	1565	1.08	1686	37083	**5**
88.7	1	I	A	61		3	64	70	72.20	0.32	44.8	44.5	V1481	10001	2	5593	75	1154	1.20	1383	30421	**5**
96.9	1	I	A	61		3	67	80	69.20	0.24	41.1	40.9	V1481	9185	2	5361	73	1105	1.19	1312	28873	**4**
97.2	1	I	D	61	7	3			75.00	0.24	48.6	48.3	V1481	10865	1	3294	57	2128	1.06	2264	49812	**5**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: SI-02-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:	De	Equivalent Core Diameter	
	Is	Uncorrected Point Load Index	
	Fs	Size Correction Factor	
UCS/Is50	Is50	Corrected Point Load Index	
22.0	UCS	Unconfined Compressive Strength	

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:
1 = Diametral normal failure
2 = Axial normal failure
3 = Block normal failure
4 = Diametral chipped failure
5 = Axial sheared failure
6 = Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
15.7	1	I	A	61		4	74	86	87.60	0.58	42.0	41.5	V1484	9320	2	6786	82	886	1.25	1109	24404	**4**
16.4	1	I	D	61	4	3			75.00	0.60	42.1	41.5	V1484	9338	1	3477	59	1733	1.08	1866	41057	**5**
23.9	1	II	D	61	5	3			75.00	0.01	26.6	26.6	V1484	5971	1	3416	58	1128	1.07	1210	26613	**4**
25.4	1	I	D	61	4	3			75.00	0.01	29.9	29.9	V1484	6719	1	3477	59	1247	1.08	1343	29542	**5**
29.1	2	II	D	61	3	3			75.00	0.02	18.8	18.8	V1484	4228	1	3538	59	771	1.08	834	18342	**4**
37.7	2	I	D	61	4	3			75.00	0.12	39.6	39.5	V1484	8873	1	3477	59	1646	1.08	1773	39011	**5**
48.2	2	I	D	61	4	3			75.00	0.16	20.4	20.3	V1484	4559	1	3477	59	846	1.08	911	20044	**4**
56.4	2	II	D	61	3	3			75.00	0.08	15.4	15.3	V1484	3439	1	3538	59	627	1.08	678	14919	**3**
56.8	2	II	D	61	2	3			75.00	0.09	1.7	1.7	V1484	371	1	3599	60	66	1.09	72	1588	**1**
65.1	2	II	D	61	4	3			75.00	0.03	40.2	40.1	V1484	9023	1	3477	59	1674	1.08	1803	39673	**5**
76.1	2	II,III	D	61	4	3			75.00	0.08	16.4	16.3	V1484	3673	1	3477	59	682	1.08	734	16150	**4**
80.9	2	II	D	61	5	3			75.00	0.17	23.0	22.8	V1484	5121	1	3416	58	967	1.07	1038	22826	**4**
96.8	1	I	D	61	4	3			75.00	0.17	21.6	21.4	V1484	4817	1	3477	59	894	1.08	963	21181	**4**
98.1	1	I	D	61	4	3			75.00	0.17	27.0	26.8	V1484	6020	1	3477	59	1117	1.08	1203	26468	**4**

Notes:

1 Ft = Feet
2 WSDOT = Washington State Department of Transportation
3 A = Axial
4 D = Diametral
5 L = Lump
6 Diam = Diameter
7 mm = millimeter
8 kN = Kilo Newtons
9 lbs = pounds
10 psi = pounds per square inch
11 Indentation based on geologist's field measurement.
12 Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
13 Failure code based on ISRM methodology.
14 Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: SI-03-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1481	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:		
	De	Equivalent Core Diameter
	Is	Uncorrected Point Load Index
	Fs	Size Correction Factor
UCS/Is50	Is50	Corrected Point Load Index
22.0	UCS	Unconfined Compressive Strength

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:
1 = Diametral normal failure
2 = Axial normal failure
3 = Block normal failure
4 = Diametral chipped failure
5 = Axial sheared failure
6 = Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
10.9	1	I	A	61		3	63	68	73.20	0.18	29.1	28.9	V1481	6492	2	5671	75	739	1.20	888	19538	**4**
11.1	1	I	D	61	3	3			75.00	0.16	32.8	32.6	V1481	7331	1	3538	59	1337	1.08	1445	31799	**5**
19.0	1	I	D	61	3	3			75.00	0.18	31.8	31.6	V1481	7110	1	3538	59	1297	1.08	1402	30843	**5**
27.3	1	I	D	61	5	3			75.00	0.17	50.8	50.7	V1481	11388	1	3416	58	2151	1.07	2307	50762	**5**
35.4	1	I	A	61		4	77	83	84.60	0.15	49.2	49.1	V1481	11031	2	6554	81	1086	1.24	1349	29674	**5**
38.0	1	I	D	61	2	3			75.00	0.11	28.5	28.4	V1481	6375	1	3599	60	1143	1.09	1240	27291	**4**
48.1	1	I	A	61		4	70	78	91.60	0.04	56.4	56.3	V1481	12665	2	7096	84	1151	1.26	1456	32035	**5**
48.3	1	I	D	61	5	3			75.00	0.04	63.6	63.5	V1481	14284	1	3416	58	2698	1.07	2894	63668	**5**
59.5	1	I	A	61		3	61	70	75.20	0.15	57.6	57.4	V1481	12906	2	5826	76	1429	1.21	1729	38036	**5**
68.8	1	I	D	61	5	3			75.00	0.20	42.7	42.5	V1481	9558	1	3416	58	1805	1.07	1937	42606	**5**
69.3	1	I	A	61		3	61	65	75.20	0.16	51.6	51.4	V1481	11557	2	5826	76	1280	1.21	1548	34060	**5**
77.4	1	I	D	61	4	3			75.00	0.13	28.4	28.3	V1481	6351	1	3477	59	1178	1.08	1269	27921	**4**
79.9	1	I	A	61		4	78	85	83.60	0.14	45.4	45.3	V1481	10177	2	6476	80	1014	1.24	1256	27629	**4**
90.0	1	I	D	61	3	3			75.00	0.11	33.7	33.6	V1481	7560	1	3538	59	1379	1.08	1491	32794	**5**
90.2	1	I	A	61		3	63	73	73.20	0.11	48.4	48.3	V1481	10865	2	5671	75	1236	1.20	1486	32696	**5**
97.3	1	I	A	61		3	64	76	72.20	0.11	47.3	47.1	V1481	10597	2	5593	75	1222	1.20	1465	32233	**5**
97.6	1	I	D	61	4	3			75.00	0.14	55.5	55.4	V1481	12443	1	3477	59	2309	1.08	2487	54706	**5**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: SI-04-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1481	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:		
UCS/Is50	De	Equivalent Core Diameter
22.0	Is	Uncorrected Point Load Index
	Fs	Size Correction Factor
	Is50	Corrected Point Load Index
	UCS	Unconfined Compressive Strength

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:
1 = Diametral normal failure
2 = Axial normal failure
3 = Block normal failure
4 = Diametral chipped failure
5 = Axial sheared failure
6 = Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
7.8	1	I	A	61		3	80	90	56.20	0.10	43.2	43.1	V1481	9689	2	4354	66	1436	1.13	1627	35785	**5**
25.8	1	I	A	61		3	83	100	53.20	0.09	58.5	58.4	V1481	13124	2	4121	64	2054	1.12	2299	50577	**5**
39.4	1	I	A	61		4	88	105	73.60	0.13	46.7	46.6	V1481	10469	2	5702	76	1185	1.20	1426	31372	**5**
39.9	1	I	D	61	2	4			75.00	0.09	24.7	24.6	V1481	5535	1	3599	60	992	1.09	1077	23692	**4**
56.2	2,3	II,III	A	61		4	105	115	56.60	0.14	17.9	17.7	V1481	3983	2	4385	66	586	1.13	665	14632	**3**
75.3	1	I	D	61	5	4			75.00	0.09	43.6	43.5	V1481	9783	1	3416	58	1848	1.07	1982	43608	**5**
88.9	1	I	D	61	3	4			75.00	0.10	28.7	28.6	V1481	6432	1	3538	59	1173	1.08	1268	27898	**4**
89.2	1	I	A	61		4	88	97	73.60	0.04	40.3	40.3	V1481	9048	2	5702	76	1024	1.20	1232	27115	**4**
94.0	1	I	D	61	5	3			75.00	0.18	39.8	39.7	V1481	8913	1	3416	58	1683	1.07	1806	39730	**5**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: SI-05-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

		General Notes:	De	Equivalent Core Diameter
			Is	Uncorrected Point Load Index
			Fs	Size Correction Factor
		UCS/Is50	Is50	Corrected Point Load Index
		22.0	UCS	Unconfined Compressive Strength
		Rock Types:	1 = Meta-Welded Lapilli Tuff (Domain #1)
			2 = Meta-Welded Lapilli Tuff (Domain #2)
			3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:

		UCS	WSDOT	Is 50
1 =	Diametral normal failure	(psi)	**R Index**	
2 =	Axial normal failure	40	**0**	2
3 =	Block normal failure	150	**1**	7
4 =	Diametral chipped failure	3600	**2**	164
5 =	Axial sheared failure	7300	**3**	332
6 =	Diametral failure along healed joint	15000	**4**	682
		29000	**5**	1318
		72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
5.5	1	II	D	61	3	3			75.00	-0.18	4.1	4.3	V1484	958	1	3538	59	175	1.08	189	4154	**2**
7.6	1	I	D	61	4	3			75.00	-0.19	17.1	17.2	V1484	3876	1	3477	59	719	1.08	775	17039	**4**
15.7	1	I	A	61		4	63	77	98.60	-0.18	31.1	31.3	V1484	7027	2	7639	87	594	1.29	763	16788	**4**
16.1	1	I	D	61	4	3			75.00	-0.22	36.8	37.0	V1484	8311	1	3477	59	1542	1.08	1661	36540	**5**
24.3	1,2	II	D	61	4	3			75.00	-0.04	30.6	30.7	V1484	6895	1	3477	59	1279	1.08	1378	30313	**5**
25.1	1,2	I	D	61	5	3			75.00	0.07	34.9	34.8	V1484	7819	1	3416	58	1477	1.07	1584	34850	**5**
36.1	2	I	D	61	4	3			75.00	0.03	34.5	34.5	V1484	7747	1	3477	59	1437	1.08	1548	34059	**5**
41.7	2	I	A	61		3	66	82	70.20	0.06	35.3	35.3	V1484	7931	2	5438	74	941	1.19	1121	24654	**4**
42.1	2	I	D	61	4	3			75.00	0.03	36.4	36.3	V1484	8169	1	3477	59	1516	1.08	1633	35917	**5**
55.1	2	I	D	61	4	3			75.00	0.03	36.3	36.3	V1484	8158	1	3477	59	1514	1.08	1630	35868	**5**
55.5	2	I	A	61		4	67	88	94.60	0.07	36.9	36.8	V1484	8268	2	7329	86	728	1.27	927	20397	**4**
62.4	2	II	D	61	5	3			75.00	0.07	7.7	7.6	V1484	1715	1	3416	58	324	1.07	348	7645	**3**
72.9	2	I	D	61	4	3			75.00	0.05	23.1	23.1	V1484	5191	1	3477	59	963	1.08	1037	22821	**4**
85.6	1	I	D	61	4	3			75.00	0.04	29.2	29.2	V1484	6557	1	3477	59	1217	1.08	1310	28831	**4**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: SI-06-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1484	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:		
UCS/Is50	De	Equivalent Core Diameter
22.0	Is	Uncorrected Point Load Index
	Fs	Size Correction Factor
	Is50	Corrected Point Load Index
	UCS	Unconfined Compressive Strength

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:
1 = Diametral normal failure
2 = Axial normal failure
3 = Block normal failure
4 = Diametral chipped failure
5 = Axial sheared failure
6 = Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
6.3	1	I	A	61		3	84	102	52.20	0.24	32.2	31.9	V1484	7178	2	4044	64	1145	1.11	1276	28072	**4**
6.9	1	I	D	61	5	3			75.00	0.23	29.4	29.1	V1484	6551	1	3416	58	1237	1.07	1327	29199	**5**
12.1	1	I	A	61		3	60	71	76.20	0.31	35.0	34.7	V1484	7792	2	5903	77	852	1.21	1033	22729	**4**
14.4	1	I	D	61	6	3			75.00	0.29	26.9	26.6	V1484	5982	1	3355	58	1150	1.07	1229	27039	**4**
23.6	1	I	D	61	4	3			75.00	0.20	24.4	24.2	V1484	5440	1	3477	59	1009	1.08	1087	23918	**4**
31.7	1	I	D	61	3	3			75.00	0.21	19.5	19.3	V1484	4334	1	3538	59	790	1.08	855	18801	**4**
32.1	1	I	A	61		3	74	88	62.20	0.21	8.2	8.0	V1484	1794	2	4819	69	240	1.16	278	6125	**2**
33.2	1	I	A	61		4	83	102	78.60	0.25	26.7	26.4	V1484	5937	2	6089	78	629	1.22	769	16908	**4**
42.6	1	I	D	61	3	3			75.00	0.21	23.5	23.3	V1484	5245	1	3538	59	956	1.08	1034	22750	**4**
46.1	1	I	A	61		4	71	86	90.60	0.23	40.8	40.5	V1484	9111	2	7019	84	837	1.26	1056	23242	**4**
52.0	1	I	A	61		4	84	101	77.60	0.27	17.9	17.6	V1484	3961	2	6012	78	425	1.22	518	11393	**3**
52.4	1	I	D	61	4	4			75.00	0.21	32.4	32.2	V1484	7243	1	3477	59	1344	1.08	1448	31845	**5**
67.6	1	I	D	61	4	3			75.00	0.31	24.4	24.1	V1484	5413	1	3477	59	1004	1.08	1082	23800	**4**
68.1	1	I	D	61	4	3			75.00	0.33	28.5	28.2	V1484	6339	1	3477	59	1176	1.08	1267	27872	**4**
76.5	1	I	D	61	4	3			75.00	0.31	24.7	24.3	V1484	5472	1	3477	59	1015	1.08	1093	24057	**4**
77.0	1	I	D	61	2	3			75.00	0.30	14.1	13.8	V1484	3098	1	3599	60	555	1.09	603	13260	**3**
84.5	1	I	A	61		4	65	84	96.60	0.20	25.6	25.4	V1484	5717	2	7484	87	493	1.28	631	13876	**3**
85.1	1	I	D	61	3	3			75.00	0.27	20.0	19.8	V1484	4440	1	3538	59	810	1.08	631	13876	**3**
93.2	1	I	D	61	4	3			75.00	0.31	31.5	31.2	V1484	7009	1	3477	59	1301	1.08	875	19259	**4**

Notes:

1. Ft = Feet
2. WSDOT = Washington State Department of Transportation
3. A = Axial
4. D = Diametral
5. L = Lump
6. Diam = Diameter
7. mm = millimeter
8. kN = Kilo Newtons
9. lbs = pounds
10. psi = pounds per square inch
11. Indentation based on geologist's field measurement.
12. Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
13. Failure code based on ISRM methodology.
14. Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: SI-07-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1481	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:	De	Equivalent Core Diameter	
	Is	Uncorrected Point Load Index	
	Fs	Size Correction Factor	
UCS/Is50	Is50	Corrected Point Load Index	
22.0	UCS	Unconfined Compressive Strength	

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:
1 = Diametral normal failure
2 = Axial normal failure
3 = Block normal failure
4 = Diametral chipped failure
5 = Axial sheared failure
6 = Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
21.8	1	I	D	61	5	3			75.00	-0.06	35.5	35.6	V1481	7996	1	3416	58	1510	1.07	1620	35642	**5**
22.0	1	I	A	61		3	66	80	70.20	-0.06	45.0	45.1	V1481	10129	2	5438	74	1202	1.19	1431	31488	**5**
31.7	1	I	A	61		3	67	77	69.20	-0.10	33.9	34.0	V1481	7652	2	5361	73	921	1.19	1093	24054	**4**
32.0	1	I	D	61	4	3			75.00	0.08	32.7	32.6	V1481	7331	1	3477	59	1360	1.08	1465	32231	**5**
42.7	1	I,II	A	61		3	89	96	47.20	0.10	29.3	29.2	V1481	6562	2	3657	60	1158	1.09	1261	27746	**4**
43.3	1	I	D	61	3	3			75.00	0.10	21.7	21.6	V1481	4853	1	3538	59	885	1.08	957	21053	**4**
48.2	1	I,II	D	61	3	3			75.00	-0.10	32.6	32.7	V1481	7355	1	3538	59	1341	1.08	1450	31906	**5**
68.3	1	I	D	61	3	3			75.00	-0.11	31.6	31.7	V1481	7126	1	3538	59	1299	1.08	1405	30912	**5**

Notes:

1 Ft = Feet
2 WSDOT = Washington State Department of Transportation
3 A = Axial
4 D = Diametral
5 L = Lump
6 Diam = Diameter
7 mm = millimeter
8 kN = Kilo Newtons
9 lbs = pounds
10 psi = pounds per square inch
11 Indentation based on geologist's field measurement.
12 Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
13 Failure code based on ISRM methodology.
14 Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: SI-08-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1481	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:		
UCS/Is50	De	Equivalent Core Diameter
22.0	Is	Uncorrected Point Load Index
	Fs	Size Correction Factor
	Is50	Corrected Point Load Index
	UCS	Unconfined Compressive Strength

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:	
1 =	Diametral normal failure
2 =	Axial normal failure
3 =	Block normal failure
4 =	Diametral chipped failure
5 =	Axial sheared failure
6 =	Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
20.1	3	II,III	D	61	2	3			75.00	-0.14	5.8	5.9	V1481	1331	1	3599	60	239	1.09	259	5697	**2**
70.3	1	I	A	61		3	74	85	62.20	-0.25	40.6	40.8	V1481	9172	2	4819	69	1228	1.16	1423	31314	**5**
70.6	1	I	D	61	5	3			75.00	-0.24	40.5	40.7	V1481	9156	1	3416	58	1729	1.07	1855	40812	**5**
78.5	1	I	D	61	5	3			75.00	-0.31	44.0	44.3	V1481	9952	1	3416	58	1880	1.07	2016	44359	**5**
78.7	1	I	A	61		3	63	77	73.20	-0.28	33.7	34.0	V1481	7648	2	5671	75	870	1.20	1046	23015	**4**
88.0	1	I	A	61		3	62	71	74.20	-0.33	43.1	43.5	V1481	9768	2	5748	76	1096	1.21	1322	29087	**5**
88.3	1	I	D	61	3	3			75.00	-0.31	45.0	45.3	V1481	10177	1	3538	59	1856	1.08	2007	44144	**5**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: SI-09-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1481	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:	De	Equivalent Core Diameter	
	Is	Uncorrected Point Load Index	
	Fs	Size Correction Factor	
UCS/Is50	Is50	Corrected Point Load Index	
22.0	UCS	Unconfined Compressive Strength	

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:
1 = Diametral normal failure
2 = Axial normal failure
3 = Block normal failure
4 = Diametral chipped failure
5 = Axial sheared failure
6 = Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
10.7	1	I	D	61	4	3			75.00	-0.44	38.0	38.5	V1481	8646	1	3477	59	1604	1.08	1728	38012	**5**
57.6	2	I,II	D	61	2	3			75.00	-0.71	27.1	27.8	V1481	6247	1	3599	60	1120	1.09	1216	26742	**4**
68.0	1	I,II	D	61	2	3			75.00	-0.55	31.8	32.3	V1481	7270	1	3599	60	1303	1.09	1415	31121	**5**
78.0	1	I,II	D	61	2	3			75.00	-0.76	25.2	26.0	V1481	5845	1	3599	60	1048	1.09	1137	25020	**4**
94.2	1	I	D	61	2	3			75.00	-0.58	32.28	32.9	V1481	7387	1	3599	60	1324	1.09	1437	31621	**5**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: SI-10-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1481	100kN	224.8	0

Gauge calibrations set to convert kN to lb

		UCS/Is50	
		22.0	

General Notes:

De	Equivalent Core Diameter
Is	Uncorrected Point Load Index
Fs	Size Correction Factor
Is50	Corrected Point Load Index
UCS	Unconfined Compressive Strength

Rock Types:

1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:

1 =	Diametral normal failure
2 =	Axial normal failure
3 =	Block normal failure
4 =	Diametral chipped failure
5 =	Axial sheared failure
6 =	Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
15.1	1	I	D	61	4	3			75.00	-0.76	47.8	48.5	V1481	10912	1	3477	59	2025	1.08	2181	47975	**5**
15.4	1	I	A	61		4	80	95	81.60	-0.73	43.9	44.6	V1481	10028	2	6322	80	1023	1.23	1261	27742	**4**
25.4	1	I	A	61		3	68	88	68.20	0.00	42.3	42.3	V1481	9514	2	5283	73	1162	1.18	1375	30244	**5**
34.0	1	I	A	61		3	67	82	69.20	0.11	48.6	48.5	V1481	10898	2	5361	73	1312	1.19	1557	34257	**5**
34.3	1	I	D	61	2	3			75.00	-0.09	28.9	29.0	V1481	6512	1	3599	60	1167	1.09	1267	27878	**4**
41.7	1	I	D	61	3	3			75.00	-0.07	22.8	22.9	V1481	5137	1	3538	59	937	1.08	1013	22282	**4**
53.7	1	I	D	61	3	3			75.00	-0.06	29.0	29.1	V1481	6530	1	3538	59	1191	1.08	1288	28328	**4**
60.8	1	I	D	61	3	3			75.00	-0.09	32.7	32.8	V1481	7380	1	3538	59	1346	1.08	1455	32014	**5**
76.1	2	I	A	61		3	60	73	76.20	-0.11	48.3	48.4	V1481	10880	2	5903	77	1189	1.21	1443	31740	**5**
76.4	2	I	D	61	4	3			75.00	-0.13	28.8	28.9	V1481	6506	1	3477	59	1207	1.08	1300	28603	**4**
105.8	1	I,II	D	61	2	3			75.00	-0.19	35.5	35.7	V1481	8028	1	3599	60	1439	1.09	1562	34364	**5**

Notes:

1	Ft = Feet
2	WSDOT = Washington State Department of Transportation
3	A = Axial
4	D = Diametral
5	L = Lump
6	Diam = Diameter
7	mm = millimeter
8	kN = Kilo Newtons
9	lbs = pounds
10	psi = pounds per square inch
11	Indentation based on geologist's field measurement.
12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
13	Failure code based on ISRM methodology.
14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: SI-11-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1481	100kN	224.8	0

Gauge calibrations set to convert kN to lb

UCS/Is50: **22.0**

General Notes:

De	Equivalent Core Diameter
Is	Uncorrected Point Load Index
Fs	Size Correction Factor
Is50	Corrected Point Load Index
UCS	Unconfined Compressive Strength

Rock Types:

1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:

1 =	Diametral normal failure
2 =	Axial normal failure
3 =	Block normal failure
4 =	Diametral chipped failure
5 =	Axial sheared failure
6 =	Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
14.0	1	I	D	61	2	3			75.00	0.03	31.5	31.4	V1481	7068	1	3599	60	1267	1.09	1375	30255	**5**
30.7	1	I	D	61	1	3			75.00	-0.06	32.0	32.0	V1481	7196	1	3660	60	1268	1.09	1382	30404	**5**
31.0	1	I	A	61		3	64	74	72.20	-0.04	42.7	42.8	V1481	9615	2	5593	75	1109	1.20	1329	29245	**5**
42.4	1	I	A	61		3	74	84	62.20	-0.09	48.1	48.2	V1481	10840	2	4819	69	1451	1.16	1682	37009	**5**
42.6	1	I	D	61		3			75.00	0.02	29.0	29.0	V1481	6517	1	3721	61	1130	1.09	1236	27185	**4**
50.4	1	I	D	61	2	3			75.00	-0.09	42.1	42.1	V1481	9473	1	3599	60	1698	1.09	1843	40551	**5**
53.1	1	I	A	61		3	71	81	65.20	-0.09	41.9	42.0	V1481	9437	2	5051	71	1205	1.17	1412	31065	**5**
53.4	1	I	D	61		3			75.00	-0.11	37.9	38.1	V1481	8554	1	3721	61	1483	1.09	1622	35682	**5**
60.2	1	I	A	61		3	60	68	76.20	-0.11	43.6	43.7	V1481	9817	2	5903	77	1073	1.21	1302	28638	**4**
61.7	1	I	D	61	4	3			75.00	-0.10	23.7	23.8	V1481	5355	1	3477	59	994	1.08	1070	23543	**4**
64.2	1	I	D	61	3	3			75.00	-0.09	29.1	29.2	V1481	6564	1	3538	59	1197	1.08	1294	28474	**4**
71.9	1	I	D	61	2	3			75.00	-0.14	38.1	38.2	V1481	8596	1	3599	60	1541	1.09	1673	36798	**5**
72.1	1	I	A	61		3	59	68	77.20	-0.16	49.5	49.7	V1481	11170	2	5981	77	1205	1.22	1466	32258	**5**
80.2	1	I	D	61	2	3			75.00	-0.33	28.0	28.4	V1481	6375	1	3599	60	1143	1.09	1240	27291	**4**
80.5	1	I	A	61		3	59	65	77.20	0.36	14.8	14.5	V1481	3251	2	5981	77	351	1.22	427	9387	**3**
91.0	1	I	D	61	6	3			75.00	-0.25	48.4	48.6	V1481	10932	1	3355	58	2102	1.07	2246	49413	**5**
99.8	1	I	D	61	2	3			75.00	-0.25	27.3	27.6	V1481	6195	1	3599	60	1111	1.09	1205	26521	**4**
100.0	1	I	A	61		3	74	85	62.20	-0.24	28.4	28.6	V1481	6432	2	4819	69	861	1.16	998	21958	**4**

Notes:

1	Ft = Feet
2	WSDOT = Washington State Department of Transportation
3	A = Axial
4	D = Diametral
5	L = Lump
6	Diam = Diameter
7	mm = millimeter
8	kN = Kilo Newtons
9	lbs = pounds
10	psi = pounds per square inch
11	Indentation based on geologist's field measurement.
12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
13	Failure code based on ISRM methodology.
14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.

I-90 East Hyak Realignment Project

Job Number: 03-2007

Borehole #: SI-12-07

Point Load Tester Type: GCTS-PLT110

Gauge Calibrations			
Gauge #	Value	m	b
V1481	100kN	224.8	0

Gauge calibrations set to convert kN to lb

General Notes:	
De	Equivalent Core Diameter
Is	Uncorrected Point Load Index
Fs	Size Correction Factor
Is50	Corrected Point Load Index
UCS	Unconfined Compressive Strength

UCS/Is50
22.0

Rock Types:
1 = Meta-Welded Lapilli Tuff (Domain #1)
2 = Meta-Welded Lapilli Tuff (Domain #2)
3 = Meta-Welded Lapilli Tuff (Domain #3)

Types of failures:
1 = Diametral normal failure
2 = Axial normal failure
3 = Block normal failure
4 = Diametral chipped failure
5 = Axial sheared failure
6 = Diametral failure along healed joint

UCS (psi)	WSDOT **R Index**	Is 50
40	**0**	2
150	**1**	7
3600	**2**	164
7300	**3**	332
15000	**4**	682
29000	**5**	1318
72500	**5**	3295

Depth (ft)	Rock Type	Weathering (WSDOT)	Test Type (A, D, or L)	Core Diam (mm)	Indentation (mm)	Pin	Ruler (i) mm	Ruler (f) mm	Length (mm)	Gauge Tare (kN)	Guage Reading (kN)	Failure Value (kN)	Guage	Calibrated Load (lbs)	Failure Code	De**2 (mm^2)	De (mm)	Is psi	Fs	Is50 psi	UCS psi	**WSDOT R Index**
11.9	1	I,II	A	61		3	67	76	69.20	-0.34	41.5	41.8	V1481	9394	2	5361	73	1131	1.19	1342	29530	**5**
12.1	1	I,II	D	61	4	3			75.00	-0.33	37.0	37.3	V1481	8385	1	3477	59	1556	1.08	1676	36866	**5**
19.1	1	I	A	61		3	69	80	67.20	-0.18	53.0	53.2	V1481	11955	2	5206	72	1482	1.18	1747	38442	**5**
19.8	1	I	D	61	1	3			75.00	-0.11	31.7	31.9	V1481	7160	1	3660	60	1262	1.09	1375	30253	**5**
29.7	1	I	D	61	2	3			75.00	-0.07	33.5	33.6	V1481	7556	1	3599	60	1354	1.09	1470	32343	**5**
30.0	1	I	A	61		3	81	92	55.20	-0.12	37.3	37.4	V1481	8403	2	4276	65	1268	1.13	1430	31471	**5**
38.6	1	I	A	61		3	73	80	63.20	-0.18	33.0	33.2	V1481	7463	2	4896	70	983	1.16	1144	25168	**4**
39.0	1	I	D	61	3	3			75.00	-0.14	38.8	39.0	V1481	8760	1	3538	59	1597	1.08	1727	38001	**5**
50.8	1	I	D	61	3	3			75.00	-0.16	29.9	30.1	V1481	6757	1	3538	59	1232	1.08	1332	29312	**5**
52.0	1	I	A	61		3	85	91	51.20	-0.16	21.4	21.6	V1481	4847	2	3966	63	788	1.11	875	19241	**4**
55.1	1	I,II	D	61	1	3			75.00	-0.18	12.1	12.2	V1481	2752	1	3660	60	485	1.09	528	11626	**3**
61.9	1	I	D	61	3	3			75.00	-0.19	28.5	28.6	V1481	6438	1	3538	59	1174	1.08	1269	27928	**4**
69.2	1	I	A	61		3	76	84	60.20	-0.18	37.8	38.0	V1481	8542	2	4664	68	1182	1.15	1360	29914	**5**
69.5	1	I	D	61	3	3			75.00	-0.16	29.4	29.6	V1481	6655	1	3538	59	1214	1.08	1312	28868	**4**
80.1	1	I	A	61		3	84	95	52.20	-0.22	36.4	36.6	V1481	8234	2	4044	64	1314	1.11	1464	32204	**5**
86.2	1	I	D	61	4	3			75.00	-0.21	29.0	29.2	V1481	6564	1	3477	59	1218	1.08	1312	28860	**4**
96.5	1	I	A	61		3	67	77	69.20	-0.24	38.2	38.4	V1481	8639	2	5361	73	1040	1.19	1234	27156	**4**

Notes:

1	Ft = Feet	8	kN = Kilo Newtons
2	WSDOT = Washington State Department of Transportation	9	lbs = pounds
3	A = Axial	10	psi = pounds per square inch
4	D = Diametral	11	Indentation based on geologist's field measurement.
5	L = Lump	12	Calculations for R value utilized indentation when available. Otherwise initial ruler measurement utilized for axial testing.
6	Diam = Diameter	13	Failure code based on ISRM methodology.
7	mm = millimeter	14	Axial and Diametral testing completed on 5 to 10 foot intervals. Only valid failures have been reported.