

1 APPENDIX F

2 **Hylebos Bridge DAHP Eligibility**

3 **Concurrence Letter**

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Highways & Local Programs  
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OLYMPIA, WA



STATE OF WASHINGTON

**DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION**

1063 S. Capitol Way, Suite 106 • Olympia, Washington 98501  
Mailing address: PO Box 48343 • Olympia, Washington 98504-8343  
(360) 586-3065 • Fax Number (360) 586-3067 • Website: [www.dahp.wa.gov](http://www.dahp.wa.gov)

March 5, 2008

Mr. Trevin Taylor  
Environmental Engineer  
Washington Department of Transportation  
310 Maple Park Ave. SE  
P.O. Box 47390  
Olympia, Washington 98504-7300

In future correspondence please refer to:

Log: 020306-27-FHWA  
Property: Hylebos Waterway Bridge  
Re: Archaeology - No Historic Properties

Dear Mr. Taylor:

Thank you for contacting our office and providing a copy of the cultural resources survey report completed by HRA Associates. We concur with their professional recommendations and your finding of No Historic Properties Effected.

We would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer in conformance with Section 106 of the National Historic Preservation Act and its implementing regulations 36CFR800.

Should additional information become available, our assessment may be revised. In the event that archaeological or historic materials are discovered during project activities, work in the immediate vicinity must stop, the area secured, and this office and the concerned tribes notified.

Sincerely,

Matthew Sterner, M.A., RPA  
Transportation Archaeologist  
(360) 586-3082  
[matthew.sterner@dahp.wa.gov](mailto:matthew.sterner@dahp.wa.gov)



**DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION**

*Protect the Past. Shape the Future*



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March 5, 2008

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Environmental Engineer  
Washington Department of Transportation  
310 Maple Park Ave. SE  
P.O. Box 47390  
Olympia, Washington 98504-7300

In future correspondence please refer to:

Log: 020306-27-FHWA  
Property: Hylebos Waterway Bridge  
Re: NOT Eligible

Dear Mr. Taylor:

Thank you for contacting the Washington State Department of Archaeology and Historic Preservation (DAHP). The Hylebos Waterway Bridge has been reviewed on behalf of the State Historic Preservation Officer under provisions of Section 106 of the National Historic Preservation Act of 1966 (as amended) and 36 CFR Part 800.

Research indicates that the Hylebos Waterway Bridge is not currently listed in the Washington Heritage Register or National Register of Historic Places. The Hylebos Waterway Bridge is NOT ELIGIBLE for the National Register of Historic Places. As a result of this finding, further contact with DAHP is not necessary. However, if additional information on the property becomes available, or if any archaeological resources are uncovered during construction, please halt work in the area of discovery and contact the appropriate Native American Tribes and DAHP for further consultation.

Please note that DAHP requires that all historic property inventory and archaeological site forms be provided to our office electronically. Thank you for the opportunity to review and comment. If you have any questions, please contact me.

Sincerely,

Matthew Sterner, M.A., RPA  
Transportation Archaeologist  
(360) 586-3082  
[matthew.sterner@dahp.wa.gov](mailto:matthew.sterner@dahp.wa.gov)



**DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION**

*Protect the Past, Shape the Future*

1 APPENDIX G

2 **Archaeological Trench Data**

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3

REDACTED

1 APPENDIX H

2 **Results from Beta Analytic**

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*Consistent Accuracy . . .  
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Beta Analytic Inc.  
4985 SW 74 Court  
Miami, Florida 33155 USA  
Tel: 305 667 5167  
Fax: 305 663 0964  
Beta@radiocarbon.com  
www.radiocarbon.com

Darden Hood  
President

Ronald Hatfield  
Christopher Patrick  
Deputy Directors

November 19, 2009

Mr. Kurt Perkins  
ICF Jones & Stokes  
317 SW Alder Street  
Suite 800  
Portland, OR 97204-2583

RE: Radiocarbon Dating Results For Samples [REDACTED]

Dear Mr. Perkins:

Enclosed are the radiocarbon dating results for 34 samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. The report sheet contains the dating result, method used, material type, applied pretreatment and two-sigma calendar calibration result (where applicable) for each sample.

This report has been both mailed and sent electronically, along with a separate publication quality calendar calibration page. This is useful for incorporating directly into your reports. It is also digitally available in Windows metafile (.wmf) format upon request. Calibrations are calculated using the newest (2004) calibration database. References are quoted on the bottom of each calibration page. Multiple probability ranges may appear in some cases, due to short-term variations in the atmospheric  $^{14}\text{C}$  contents at certain time periods. Examining the calibration graphs will help you understand this phenomenon. Calibrations may not be included with all analyses. The upper limit is about 20,000 years, the lower limit is about 250 years and some material types are not suitable for calibration (e.g. water).

We analyzed these samples on a sole priority basis. No students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

Information pages are enclosed with the mailed copy of this report. They should answer most of questions you may have. If they do not, or if you have specific questions about the analyses, please do not hesitate to contact us. Someone is always available to answer your questions.

Thank you for prepaying the analyses. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Digital signature on file





## REPORT OF RADIOCARBON DATING ANALYSES

Mr. Kurt Perkins

Report Date: 11/19/2009

ICF Jones & Stokes

Material Received: 11/3/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 267595 SAMPLE : ██████████ ANALYSIS : Radiometric-Advance delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1270 to 1400 (Cal BP 680 to 550)	680 +/- 40 BP	-26.1 o/oo	660 +/- 40 BP
Beta - 267596 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1540 to 1540 (Cal BP 420 to 400) AND Cal AD 1630 to 1680 (Cal BP 320 to 270) Cal AD 1740 to 1810 (Cal BP 210 to 140) AND Cal AD 1930 to 1950 (Cal BP 20 to 0)	250 +/- 40 BP	-26.1 o/oo	230 +/- 40 BP
Beta - 267597 SAMPLE : ██████████ ANALYSIS : Radiometric-Advance delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1410 to 1460 (Cal BP 540 to 490)	460 +/- 40 BP	-24.5 o/oo	470 +/- 40 BP
Beta - 267598 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (twigs): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1030 to 1230 (Cal BP 920 to 720)	920 +/- 40 BP	-26.6 o/oo	890 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by \*\*\*. The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.



## REPORT OF RADIOCARBON DATING ANALYSES

Mr. Kurt Perkins

Report Date: 11/19/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 267599 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1490 to 1670 (Cal BP 460 to 280) AND Cal AD 1780 to 1790 (Cal BP 160 to 160)	290 +/- 40 BP	-25.7 o/oo	280 +/- 40 BP
Beta - 267600 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (shell): acid etch Comment: The result is outside of calibration range.	470 +/- 40 BP	-5.1 o/oo	800 +/- 40 BP
Beta - 267601 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal BC 50 to Cal AD 120 (Cal BP 2000 to 1830)	1970 +/- 40 BP	-25.1 o/oo	1970 +/- 40 BP
Beta - 267602 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (shell): acid etch Comment: The result is outside of calibration range.	360 +/- 40 BP	-4.6 o/oo	690 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "??". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.



## REPORT OF RADIOCARBON DATING ANALYSES

Mr. Kurt Perkins

Report Date: 11/19/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 267603 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (bark): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1420 to 1490 (Cal BP 530 to 460)	440 +/- 40 BP	-25.3 o/oo	440 +/- 40 BP
Beta - 267604 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1290 to 1420 (Cal BP 660 to 530)	580 +/- 40 BP	-24.2 o/oo	590 +/- 40 BP
Beta - 267605 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1320 to 1350 (Cal BP 630 to 600) AND Cal AD 1390 to 1440 (Cal BP 560 to 510)	520 +/- 40 BP	-24.8 o/oo	520 +/- 40 BP
Beta - 267606 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1210 to 1290 (Cal BP 740 to 660)	720 +/- 40 BP	-22.1 o/oo	770 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "\*\*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.



## REPORT OF RADIOCARBON DATING ANALYSES

Mr. Kurt Perkins

Report Date: 11/19/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 267607 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1290 to 1420 (Cal BP 660 to 540)	540 +/- 40 BP	-21.0 o/oo	610 +/- 40 BP
Beta - 267608 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1030 to 1220 (Cal BP 920 to 730)	880 +/- 40 BP	-23.3 o/oo	910 +/- 40 BP
Beta - 267609 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1290 to 1420 (Cal BP 660 to 530)	580 +/- 40 BP	-23.9 o/oo	600 +/- 40 BP
Beta - 267610 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1320 to 1350 (Cal BP 630 to 600) AND Cal AD 1390 to 1440 (Cal BP 560 to 510)	510 +/- 40 BP	-23.9 o/oo	530 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "\*\*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.



# REPORT OF RADIOCARBON DATING ANALYSES

Mr. Kurt Perkins

Report Date: 11/19/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 267611 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (brak): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1640 to 1690 (Cal BP 310 to 260) AND Cal AD 1730 to 1810 (Cal BP 220 to 140) Cal AD 1930 to 1950 (Cal BP 20 to 0)	230 +/- 40 BP	-25.9 o/oo	220 +/- 40 BP
Beta - 267612 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1020 to 1200 (Cal BP 930 to 750)	880 +/- 40 BP	-21.6 o/oo	940 +/- 40 BP
Beta - 267613 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1040 to 1240 (Cal BP 920 to 700)	920 +/- 40 BP	-27.5 o/oo	880 +/- 40 BP
Beta - 267614 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1210 to 1290 (Cal BP 740 to 660)	710 +/- 40 BP	-21.9 o/oo	760 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "\*\*\*\*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.



# REPORT OF RADIOCARBON DATING ANALYSES

Mr. Kurt Perkins

Report Date: 11/19/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 267615 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 890 to 1020 (Cal BP 1060 to 930)	1030 +/- 40 BP	-21.9 o/oo	1080 +/- 40 BP
Beta - 267616 SAMPLE : ██████████ ANALYSIS : Radiometric-Advance delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1000 to 1160 (Cal BP 950 to 790)	940 +/- 40 BP	-22.9 o/oo	970 +/- 40 BP
Beta - 267617 SAMPLE : ██████████ ANALYSIS : Radiometric-Advance delivery MATERIAL/PRETREATMENT : (bark): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1040 to 1270 (Cal BP 910 to 680)	850 +/- 50 BP	-24.9 o/oo	850 +/- 50 BP
Beta - 267618 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (bark): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1050 to 1090 (Cal BP 900 to 860) AND Cal AD 1130 to 1140 (Cal BP 820 to 810) Cal AD 1140 to 1260 (Cal BP 810 to 690)	850 +/- 40 BP	-25.2 o/oo	850 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "\*\*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.



## REPORT OF RADIOCARBON DATING ANALYSES

Mr. Kurt Perkins

Report Date: 11/19/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 267619 SAMPLE : ██████████ ANALYSIS : Radiometric-Advance delivery MATERIAL/PRETREATMENT : (wood); acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 680 to 890 (Cal BP 1270 to 1060)	1170 +/- 40 BP	-22.2 o/oo	1220 +/- 40 BP
Beta - 267620 SAMPLE : ██████████ ANALYSIS : Radiometric-Advance delivery MATERIAL/PRETREATMENT : (wood); acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1260 to 1320 (Cal BP 690 to 630) AND Cal AD 1350 to 1390 (Cal BP 600 to 560)	760 +/- 40 BP	-29.7 o/oo	690 +/- 40 BP
Beta - 267621 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood); acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1010 to 1170 (Cal BP 940 to 780)	940 +/- 40 BP	-23.5 o/oo	960 +/- 40 BP
Beta - 267622 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood); acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 900 to 920 (Cal BP 1050 to 1030) AND Cal AD 950 to 1040 (Cal BP 1000 to 920)	980 +/- 40 BP	-21.6 o/oo	1040 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

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# REPORT OF RADIOCARBON DATING ANALYSES

Mr. Kurt Perkins

Report Date: 11/19/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 267623 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1160 to 1270 (Cal BP 790 to 680)	810 +/- 40 BP	-24.5 o/oo	820 +/- 40 BP
Beta - 267624 SAMPLE : ██████████ ANALYSIS : Radiometric-Advance delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 890 to 1020 (Cal BP 1060 to 930)	1040 +/- 40 BP	-22.9 o/oo	1080 +/- 40 BP
Beta - 267625 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1020 to 1210 (Cal BP 930 to 740)	860 +/- 40 BP	-21.2 o/oo	920 +/- 40 BP
Beta - 267626 SAMPLE : ██████████ ANALYSIS : Radiometric-Advance delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 810 to 1010 (Cal BP 1140 to 940)	1120 +/- 40 BP	-25.0 o/oo	1120 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "\*\*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.



## REPORT OF RADIOCARBON DATING ANALYSES

Mr. Kurt Perkins

Report Date: 11/19/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 267627 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal BC 340 to 320 (Cal BP 2290 to 2270) AND Cal BC 210 to 40 (Cal BP 2160 to 1990)	2120 +/- 40 BP	-25.5 o/oo	2110 +/- 40 BP
Beta - 267628 SAMPLE : ██████████ ANALYSIS : AMS-ADVANCE delivery MATERIAL/PRETREATMENT : (shell): acid etch 2 SIGMA CALIBRATION : Cal AD 1310 to 1460 (Cal BP 640 to 490)	990 +/- 40 BP	-3.1 o/oo	1350 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.1:lab. mult=1)

Laboratory number: **Beta-267595**

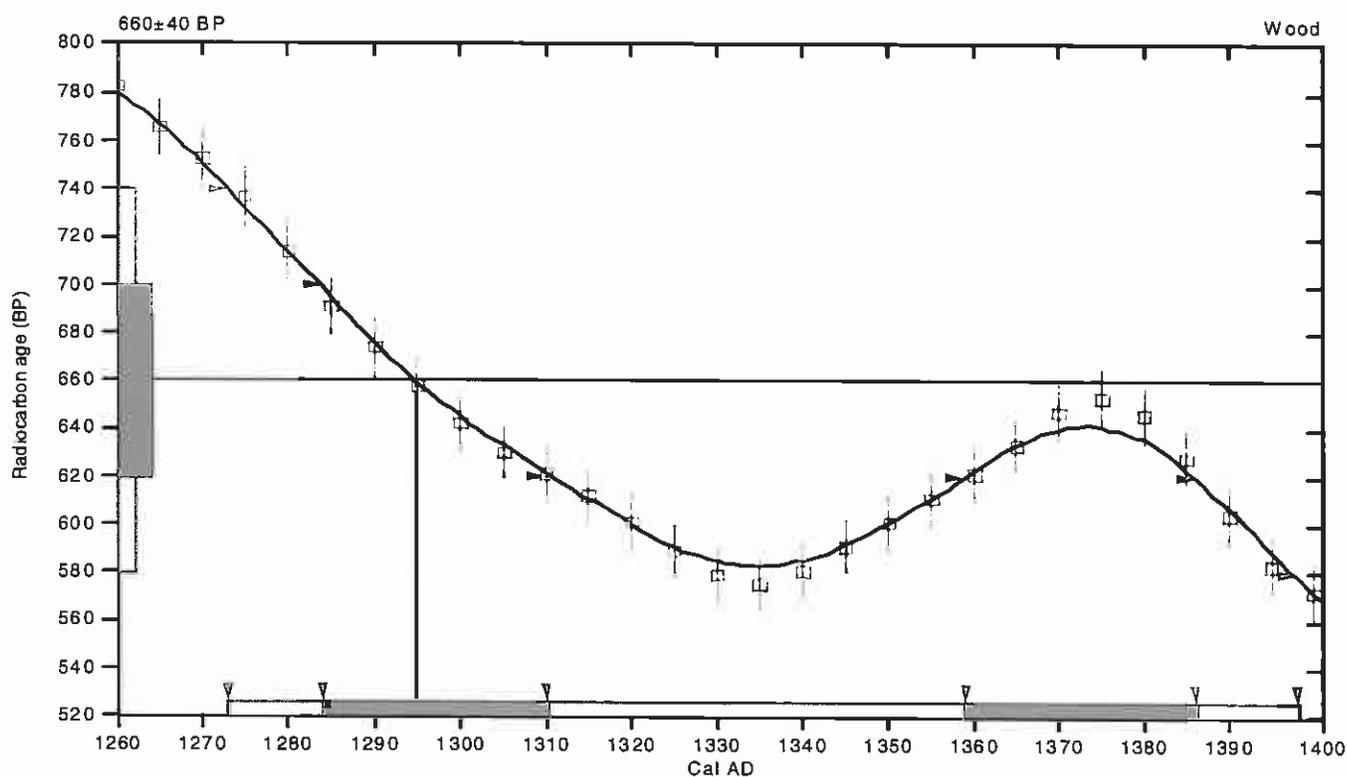
Conventional radiocarbon age: **660±40 BP**

**2 Sigma calibrated result: Cal AD 1270 to 1400 (Cal BP 680 to 550)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1300 (Cal BP 660)**

**1 Sigma calibrated results: Cal AD 1280 to 1310 (Cal BP 670 to 640) and**  
(68 % probability) **Cal AD 1360 to 1390 (Cal BP 590 to 560)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

## Beta Analytic Radiocarbon Dating Laboratory

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.1:lab. mult=1)

Laboratory number: Beta-267596

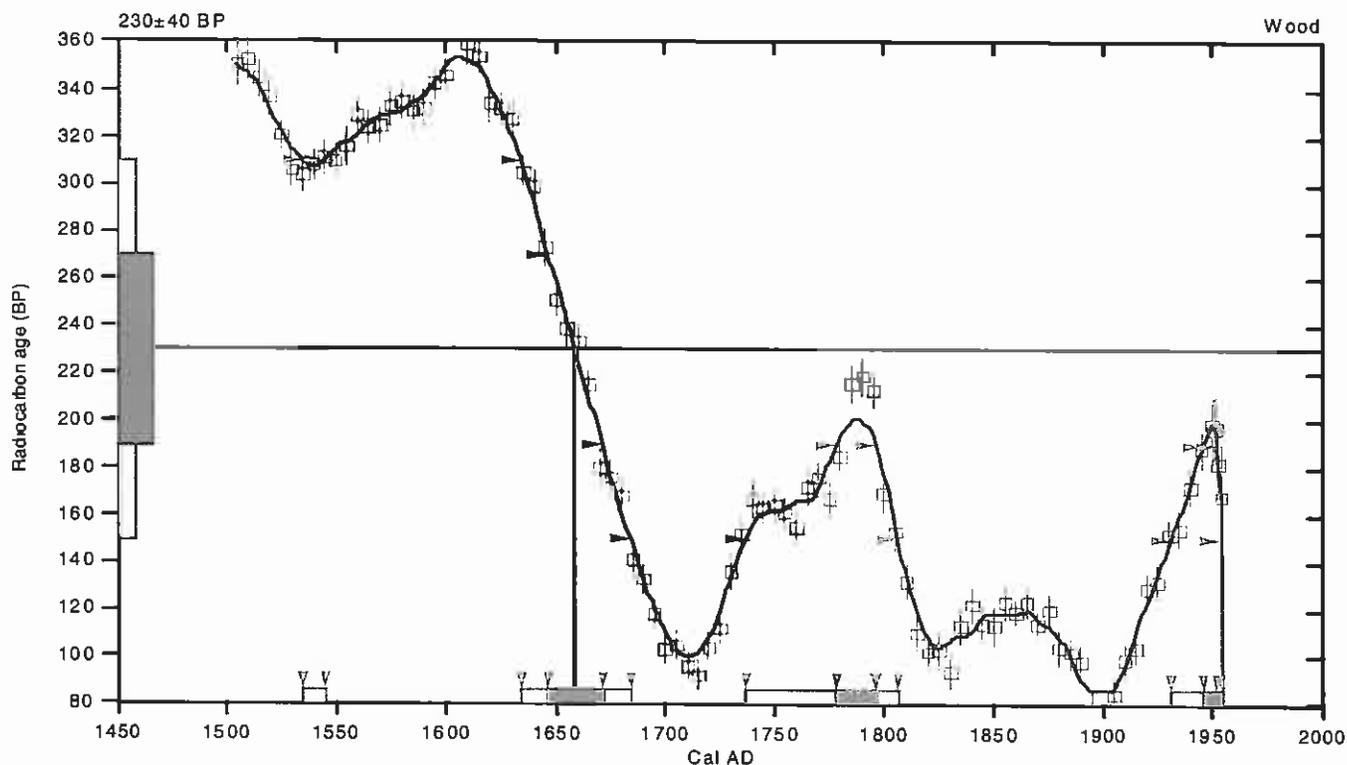
Conventional radiocarbon age: 230±40 BP

2 Sigma calibrated results: Cal AD 1540 to 1540 (Cal BP 420 to 400) and  
(95 % probability) Cal AD 1630 to 1680 (Cal BP 320 to 270) and  
Cal AD 1740 to 1810 (Cal BP 210 to 140) and  
Cal AD 1930 to 1950 (Cal BP 20 to 0)

Intercept data

Intercept of radiocarbon age  
with calibration curve: Cal AD 1660 (Cal BP 290)

1 Sigma calibrated results: Cal AD 1650 to 1670 (Cal BP 300 to 280) and  
(68 % probability) Cal AD 1780 to 1800 (Cal BP 170 to 150) and  
Cal AD 1950 to 1950 (Cal BP 0 to 0)



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.5:lab. mult=1)

Laboratory number: **Beta-267597**

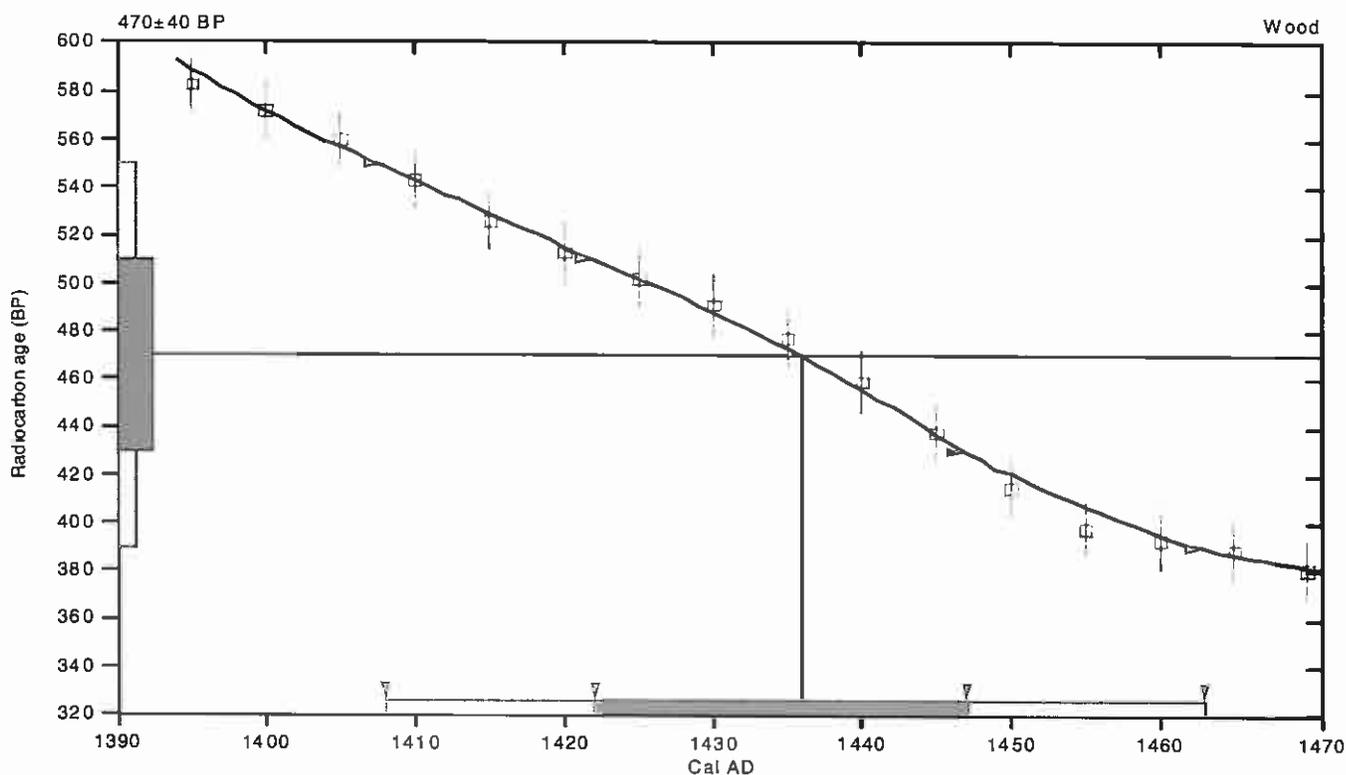
Conventional radiocarbon age: **470±40 BP**

2 Sigma calibrated result: **Cal AD 1410 to 1460 (Cal BP 540 to 490)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1440 (Cal BP 510)**

1 Sigma calibrated result: **Cal AD 1420 to 1450 (Cal BP 530 to 500)**  
(68 % probability)



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.6:lab. mult=1)

Laboratory number: **Beta-267598**

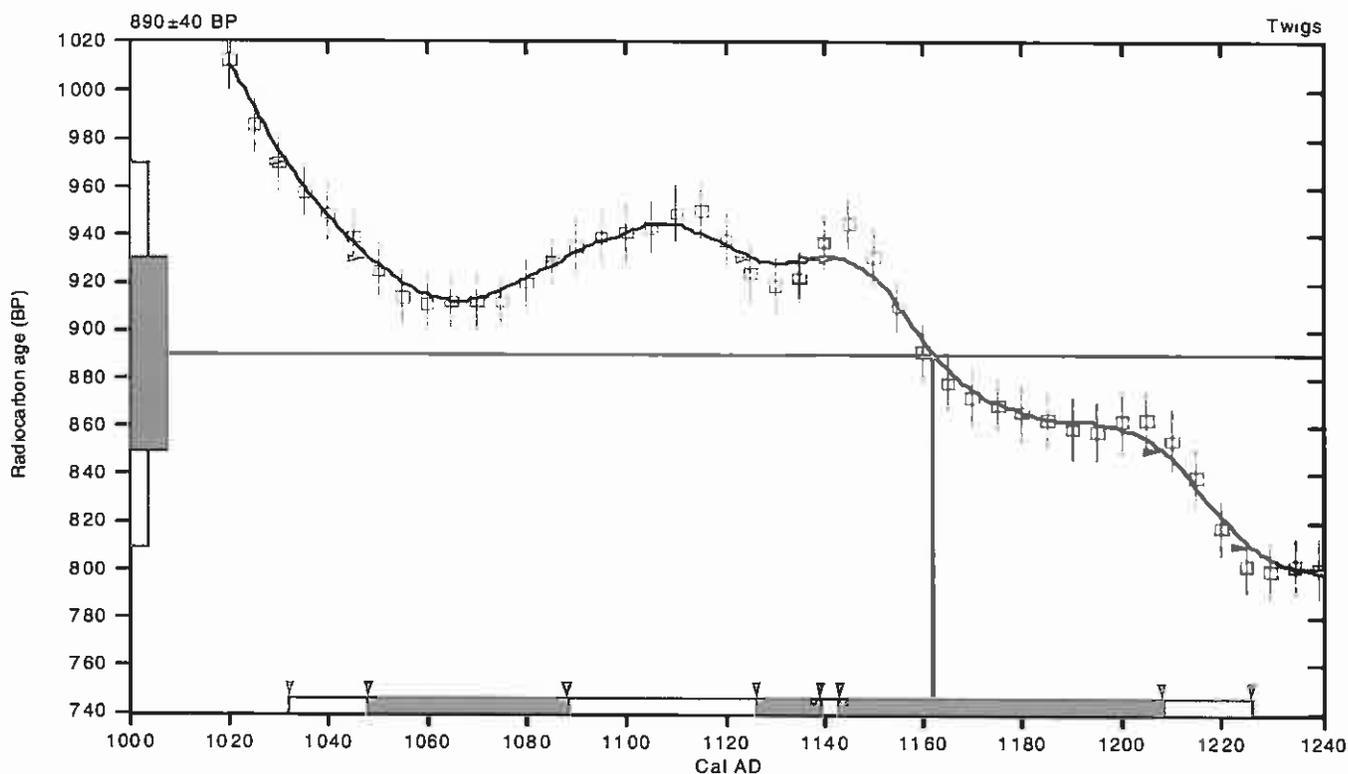
Conventional radiocarbon age: **890±40 BP**

2 Sigma calibrated result: **Cal AD 1030 to 1230 (Cal BP 920 to 720)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1160 (Cal BP 790)**

1 Sigma calibrated results: **Cal AD 1050 to 1090 (Cal BP 900 to 860) and**  
(68 % probability) **Cal AD 1130 to 1140 (Cal BP 820 to 810) and**  
**Cal AD 1140 to 1210 (Cal BP 810 to 740)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.7:lab. mult=1)

Laboratory number: **Beta-267599**

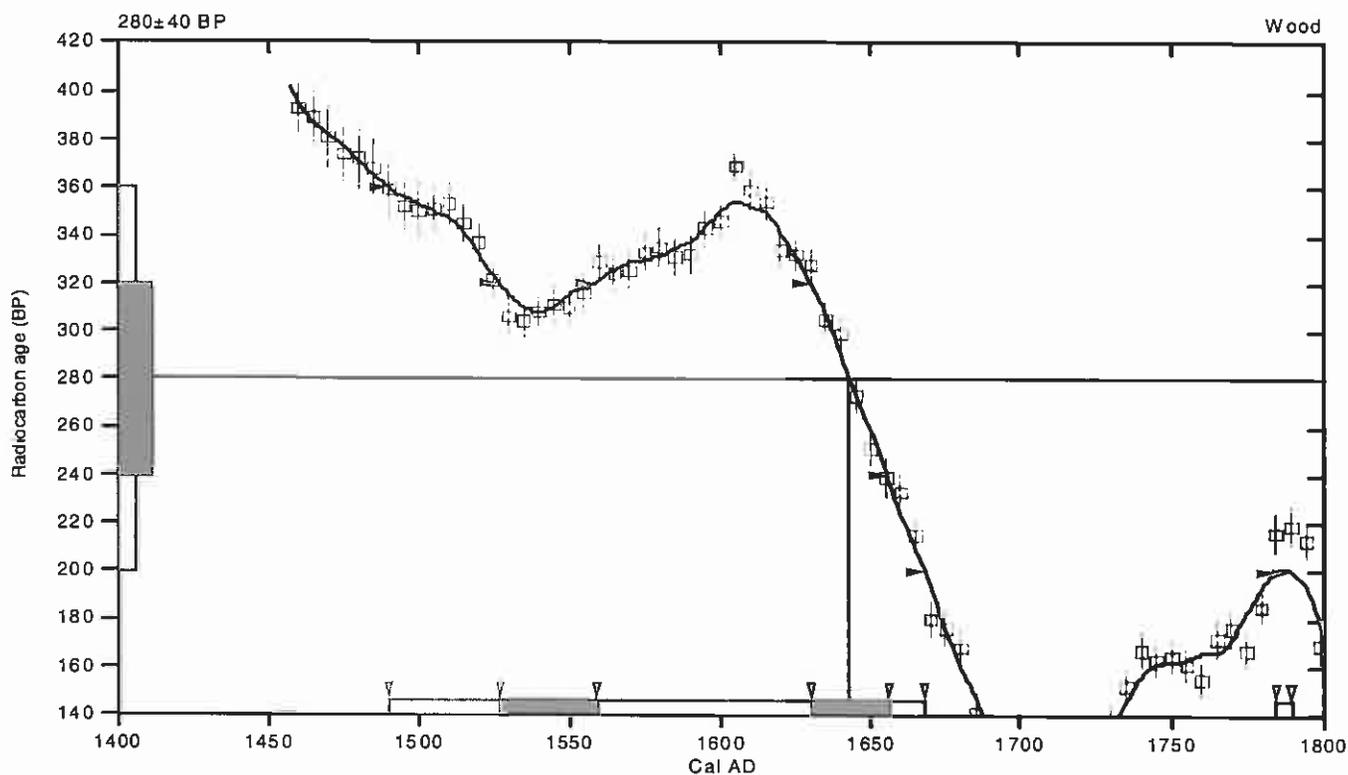
Conventional radiocarbon age: **280±40 BP**

2 Sigma calibrated results: **Cal AD 1490 to 1670 (Cal BP 460 to 280) and  
(95 % probability) Cal AD 1780 to 1790 (Cal BP 160 to 160)**

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1640 (Cal BP 310)**

1 Sigma calibrated results: **Cal AD 1530 to 1560 (Cal BP 420 to 390) and  
(68 % probability) Cal AD 1630 to 1660 (Cal BP 320 to 290)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.1:lab. mult=1)

Laboratory number: Beta-267601

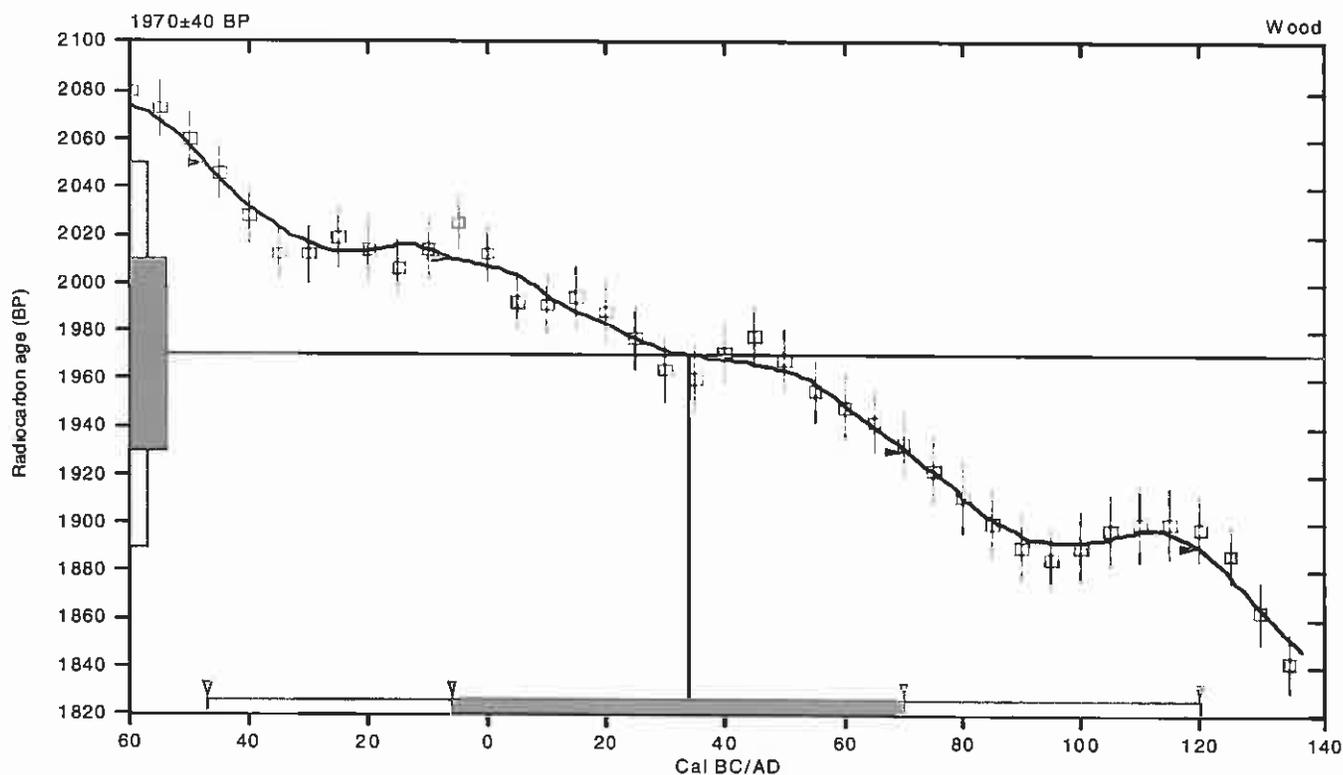
Conventional radiocarbon age: 1970±40 BP

2 Sigma calibrated result: Cal BC 50 to Cal AD 120 (Cal BP 2000 to 1830)  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: Cal AD 30 (Cal BP 1920)

1 Sigma calibrated result: Cal BC 10 to Cal AD 70 (Cal BP 1960 to 1880)  
(68 % probability)



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.3:lab. mult=1)

Laboratory number: Beta-267603

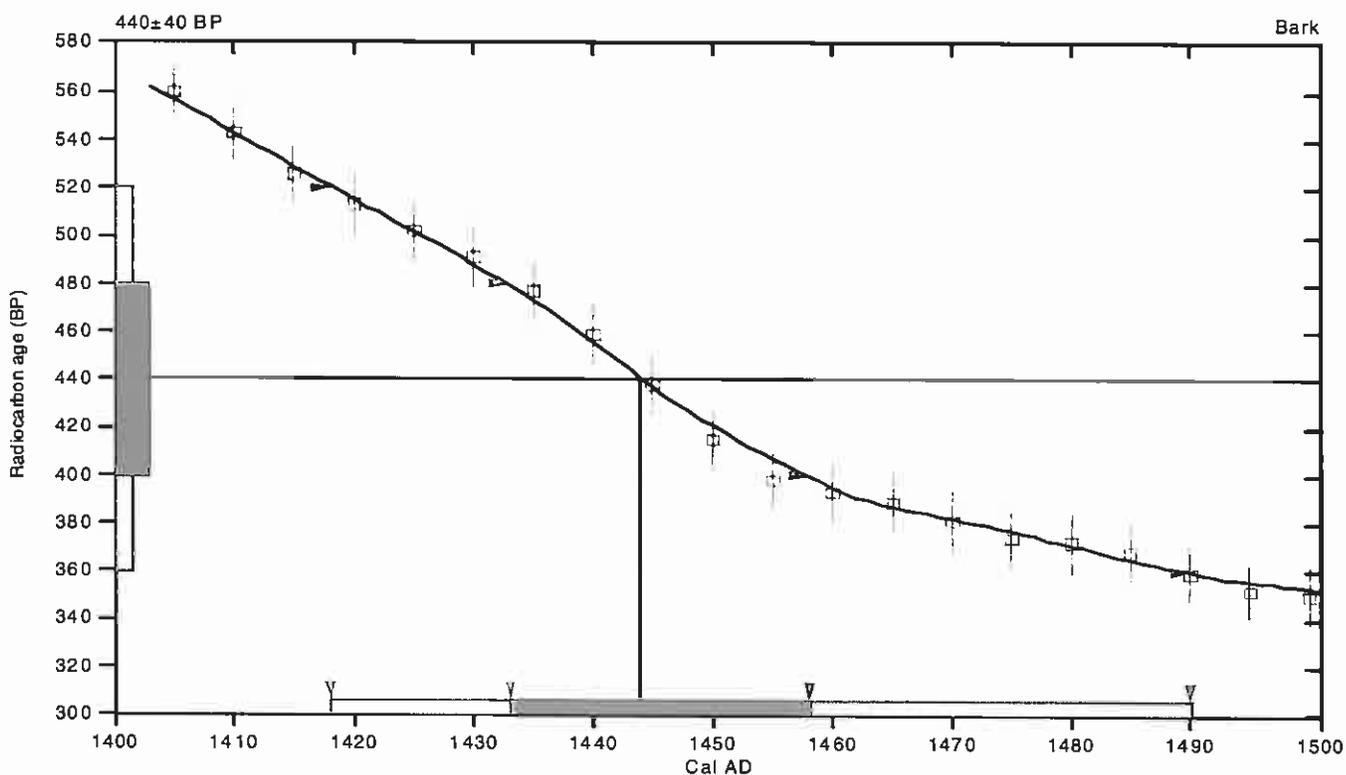
Conventional radiocarbon age:  $440 \pm 40$  BP

2 Sigma calibrated result: Cal AD 1420 to 1490 (Cal BP 530 to 460)  
(95% probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: Cal AD 1440 (Cal BP 510)

1 Sigma calibrated result: Cal AD 1430 to 1460 (Cal BP 520 to 490)  
(68% probability)



## References:

*Database used*

INTCAL04

*Calibration Database*

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

*Mathematics*

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.2:lab. mult=1)

Laboratory number: **Beta-267604**

Conventional radiocarbon age: **590±40 BP**

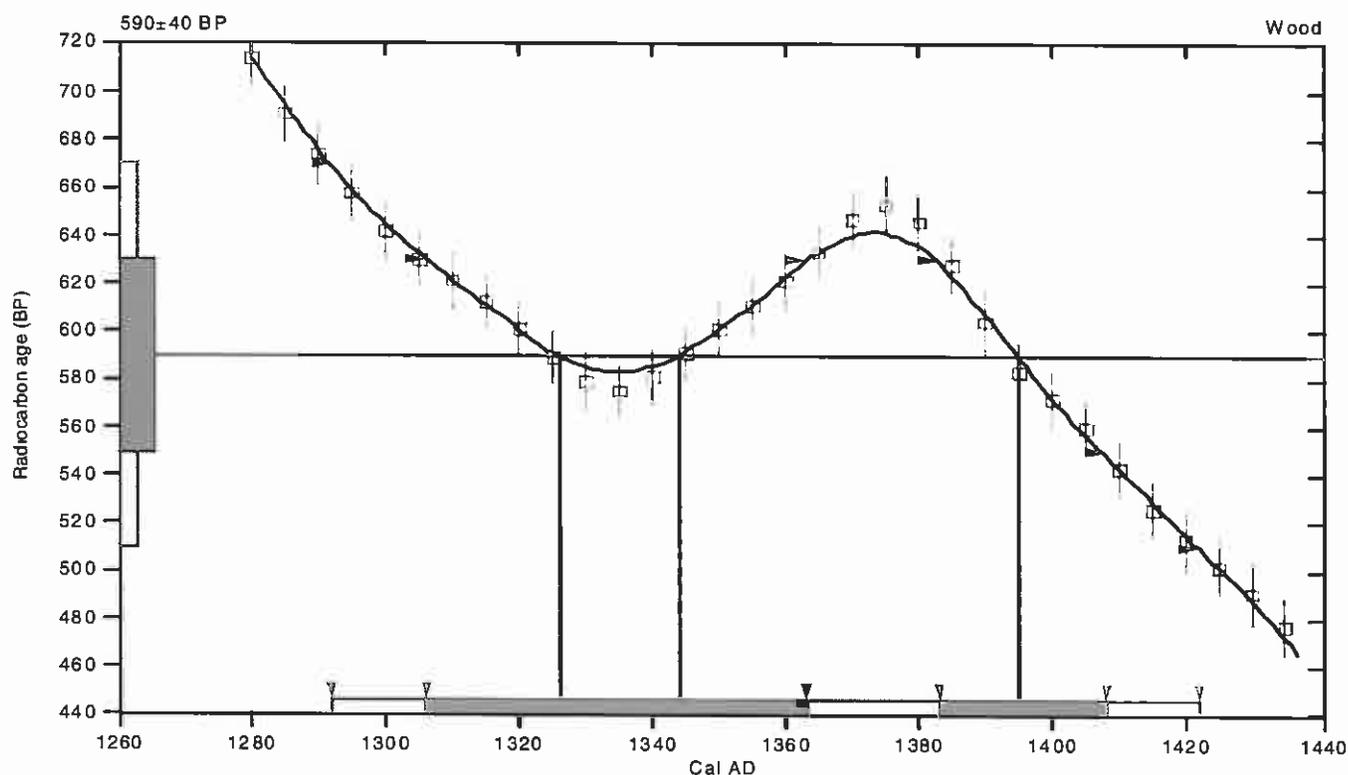
2 Sigma calibrated result: **Cal AD 1290 to 1420 (Cal BP 660 to 530)**  
(95 % probability)

Intercept data

Intercepts of radiocarbon age  
with calibration curve:

Cal AD 1330 (Cal BP 620) and  
Cal AD 1340 (Cal BP 610) and  
Cal AD 1400 (Cal BP 560)

1 Sigma calibrated results: **Cal AD 1310 to 1360 (Cal BP 640 to 590) and**  
(68 % probability) **Cal AD 1380 to 1410 (Cal BP 570 to 540)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.8:lab. mult=1)

Laboratory number: **Beta-267605**

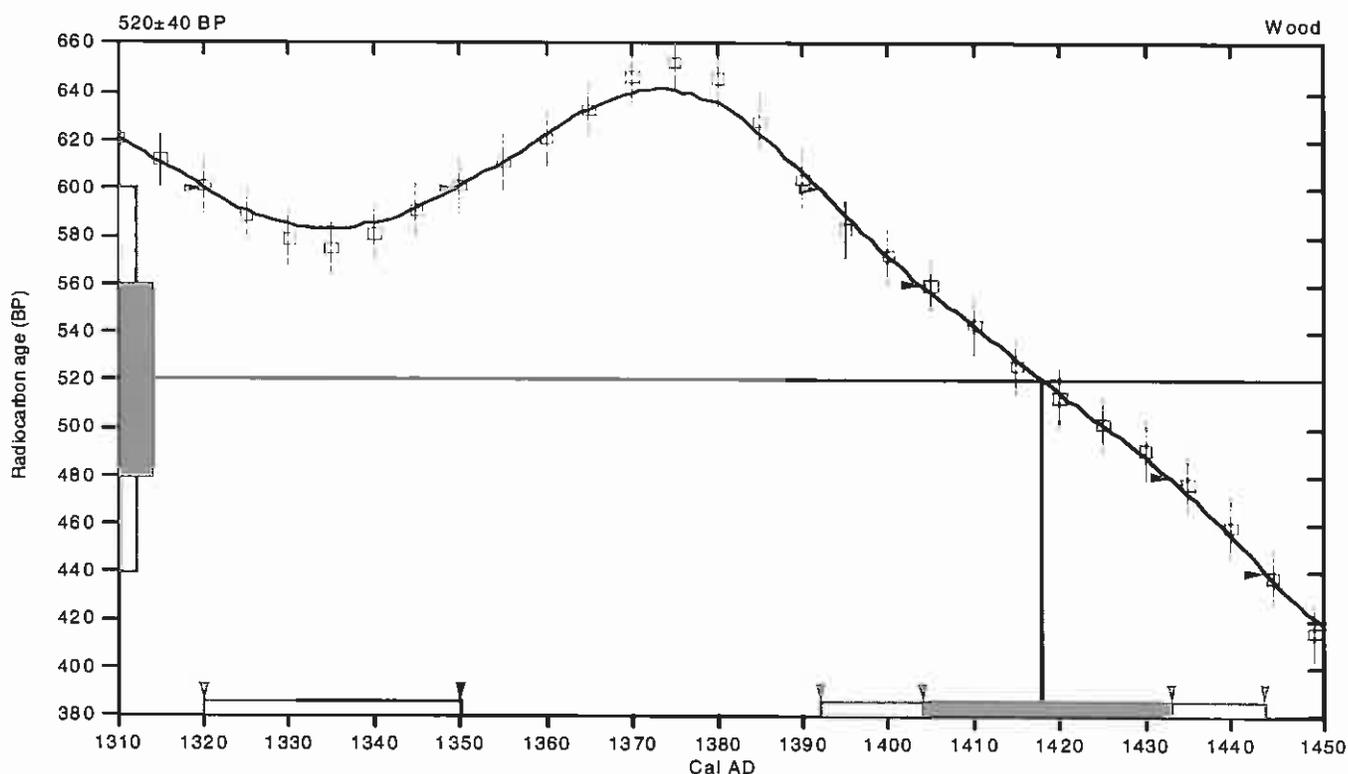
Conventional radiocarbon age: **520±40 BP**

2 Sigma calibrated results: **Cal AD 1320 to 1350 (Cal BP 630 to 600) and**  
**(95 % probability) Cal AD 1390 to 1440 (Cal BP 560 to 510)**

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1420 (Cal BP 530)**

1 Sigma calibrated result: **Cal AD 1400 to 1430 (Cal BP 550 to 520)**  
**(68 % probability)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.1:lab. mult=1)

Laboratory number: **Beta-267606**

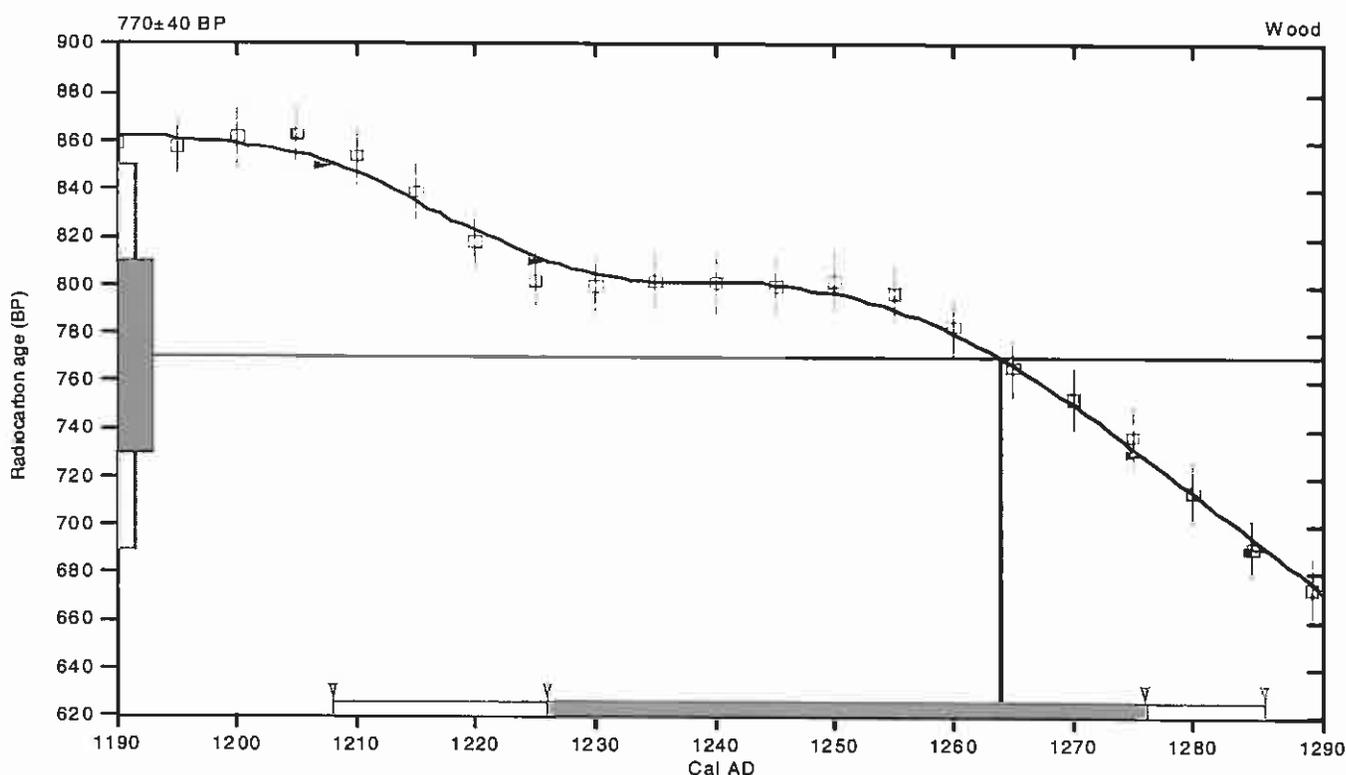
Conventional radiocarbon age: **770±40 BP**

2 Sigma calibrated result: **Cal AD 1210 to 1290 (Cal BP 740 to 660)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1260 (Cal BP 690)**

1 Sigma calibrated result: **Cal AD 1230 to 1280 (Cal BP 720 to 670)**  
(68 % probability)



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21;lab. mult=1)

Laboratory number: **Beta-267607**

Conventional radiocarbon age: **610±40 BP**

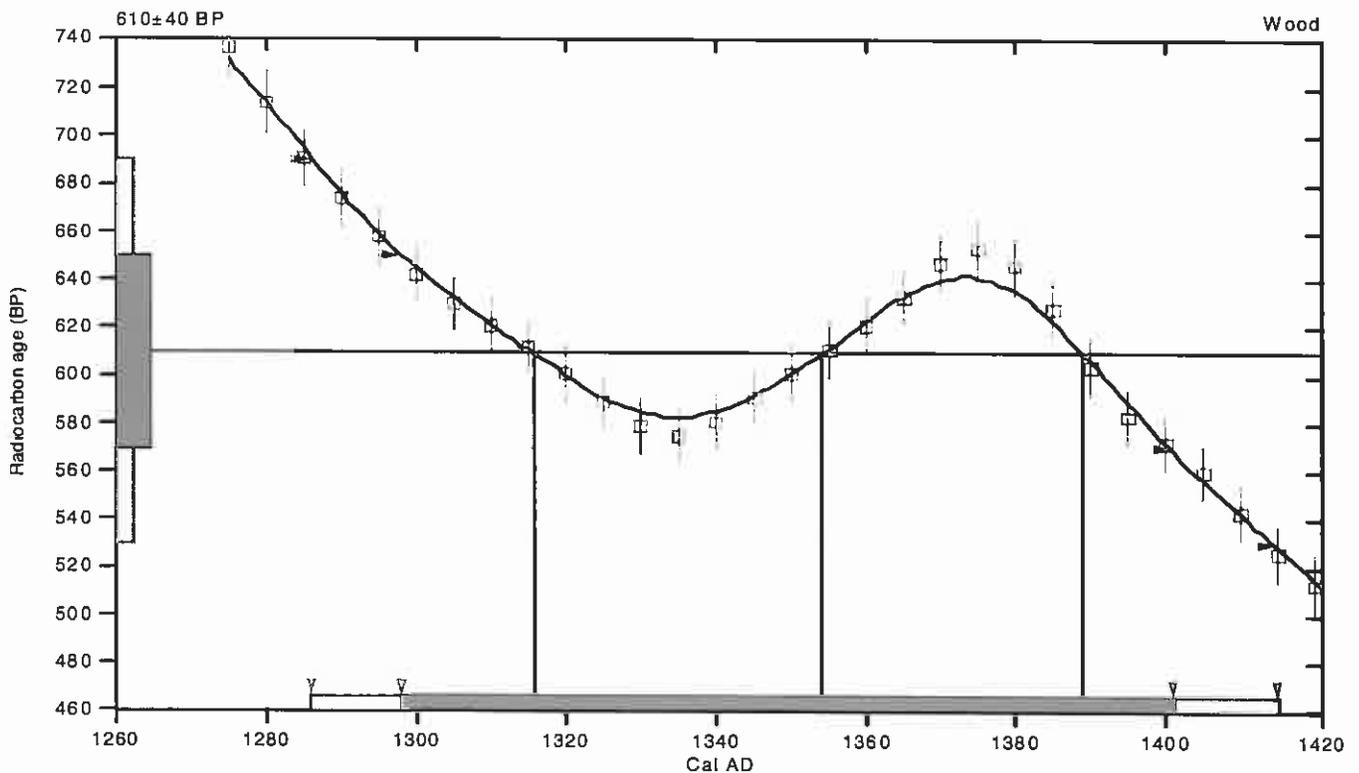
2 Sigma calibrated result: **Cal AD 1290 to 1420 (Cal BP 660 to 540)**  
(95% probability)

Intercept data

Intercepts of radiocarbon age

with calibration curve: **Cal AD 1320 (Cal BP 630) and**  
**Cal AD 1350 (Cal BP 600) and**  
**Cal AD 1390 (Cal BP 560)**

1 Sigma calibrated result: **Cal AD 1300 to 1400 (Cal BP 650 to 550)**  
(68% probability)



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.3:lab. mult=1)

Laboratory number: **Beta-267608**

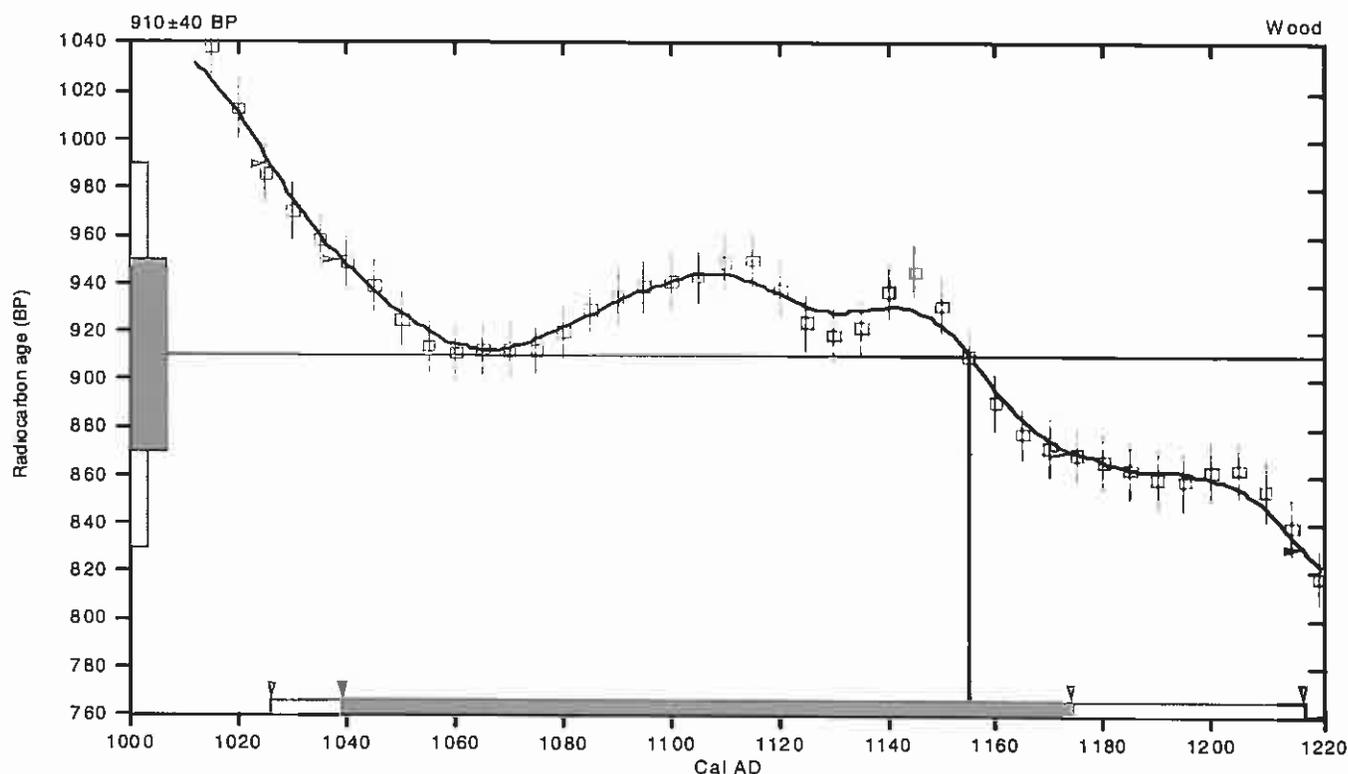
Conventional radiocarbon age: **910±40 BP**

**2 Sigma calibrated result: Cal AD 1030 to 1220 (Cal BP 920 to 730)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1160 (Cal BP 800)**

**1 Sigma calibrated result: Cal AD 1040 to 1170 (Cal BP 910 to 780)**  
(68 % probability)



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.9:lab. mult=1)

Laboratory number: **Beta-267609**

Conventional radiocarbon age: **600±40 BP**

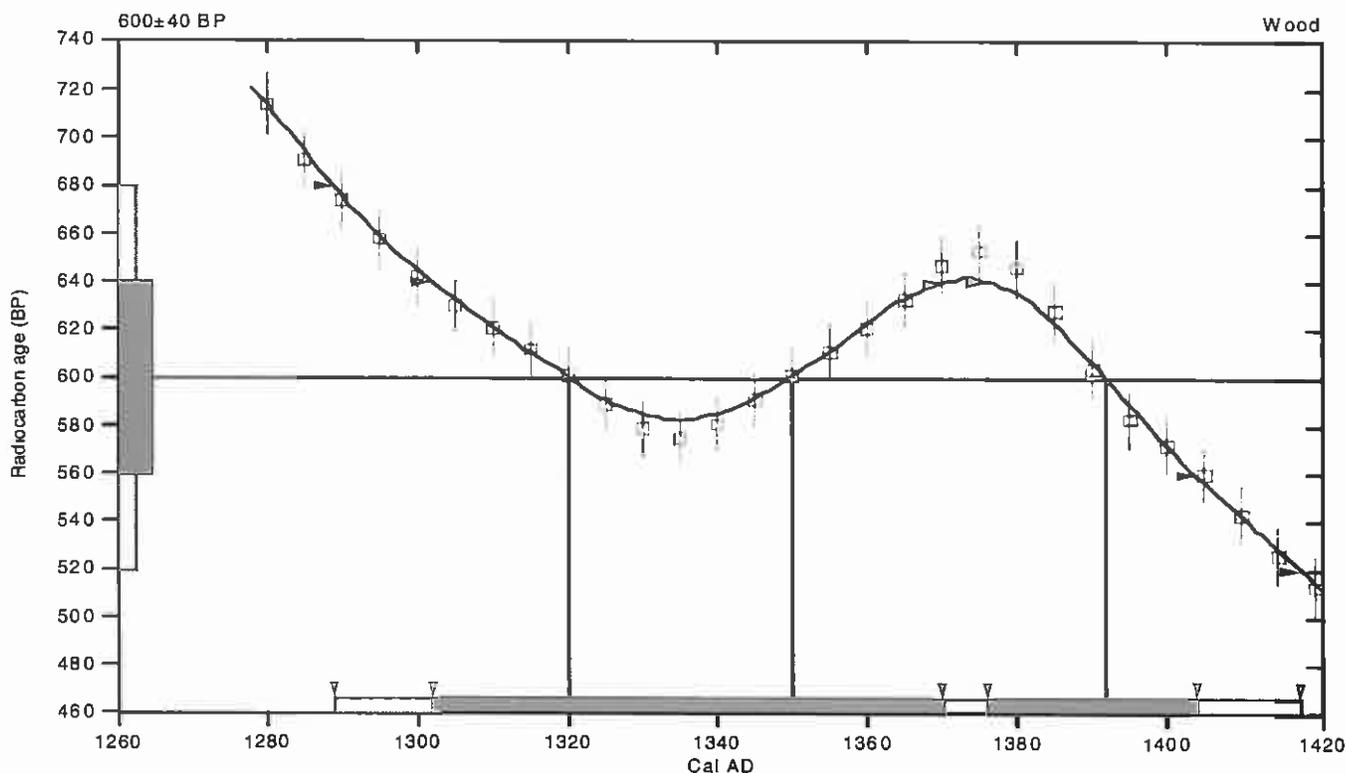
**2 Sigma calibrated result: Cal AD 1290 to 1420 (Cal BP 660 to 530)**  
(95 % probability)

Intercept data

Intercepts of radiocarbon age

with calibration curve: Cal AD 1320 (Cal BP 630) and  
Cal AD 1350 (Cal BP 600) and  
Cal AD 1390 (Cal BP 560)

**1 Sigma calibrated results: Cal AD 1300 to 1370 (Cal BP 650 to 580) and**  
(68 % probability) **Cal AD 1380 to 1400 (Cal BP 570 to 550)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.9:lab. mult=1)

Laboratory number: **Beta-267610**

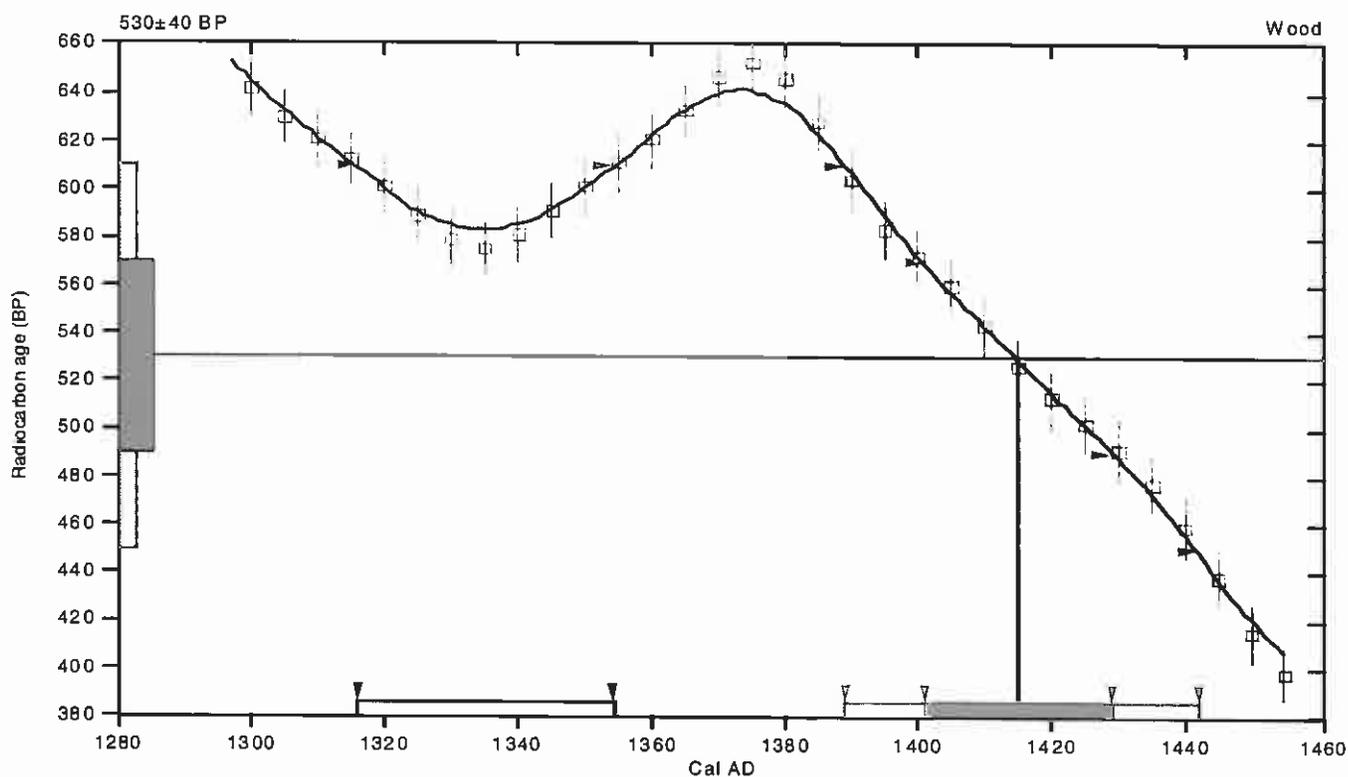
Conventional radiocarbon age: **530±40 BP**

2 Sigma calibrated results: **Cal AD 1320 to 1350 (Cal BP 630 to 600) and**  
**(95 % probability) Cal AD 1390 to 1440 (Cal BP 560 to 510)**

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1420 (Cal BP 540)**

1 Sigma calibrated result: **Cal AD 1400 to 1430 (Cal BP 550 to 520)**  
**(68 % probability)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.9;lab. mult=1)

Laboratory number: **Beta-267611**

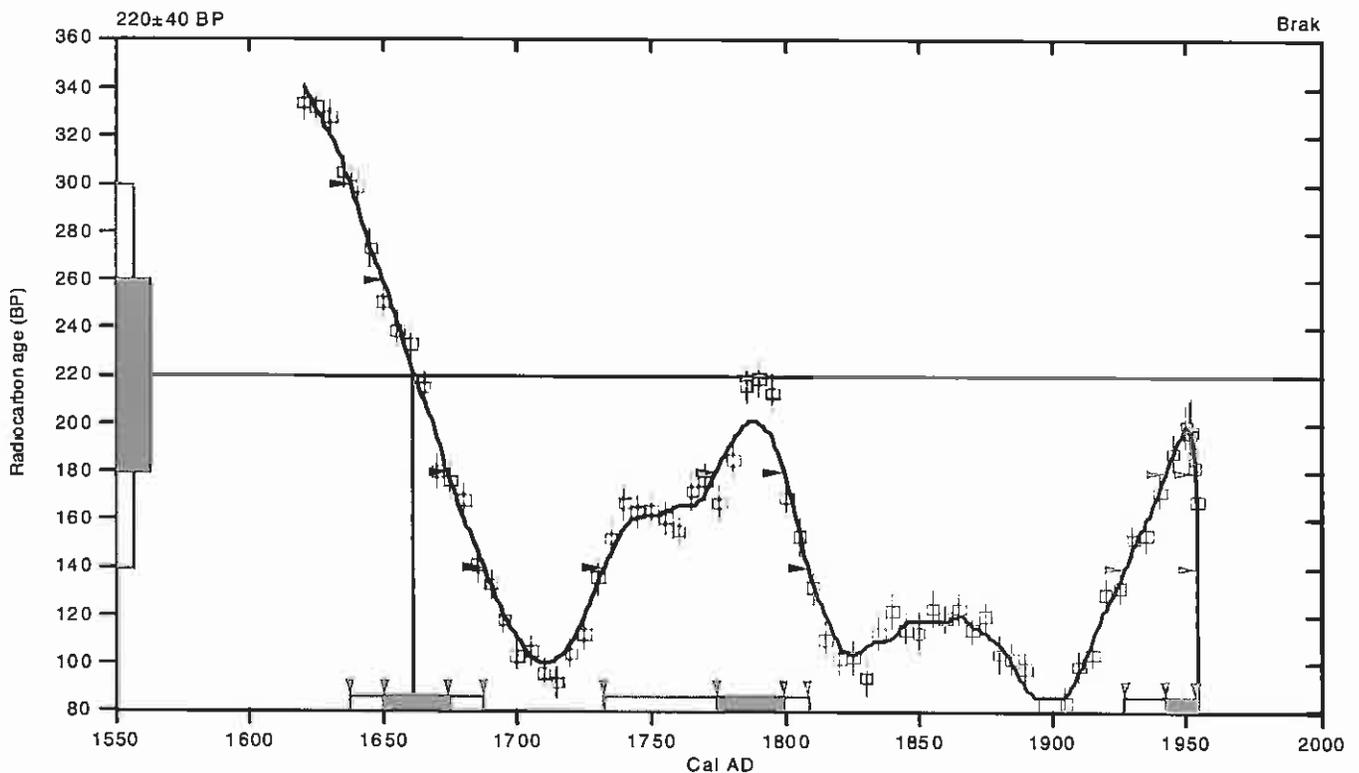
Conventional radiocarbon age: **220±40 BP**

**2 Sigma calibrated results:** Cal AD 1640 to 1690 (Cal BP 310 to 260) and  
(95 % probability) Cal AD 1730 to 1810 (Cal BP 220 to 140) and  
Cal AD 1930 to 1950 (Cal BP 20 to 0)

Intercept data

Intercept of radiocarbon age  
with calibration curve: Cal AD 1660 (Cal BP 290)

**1 Sigma calibrated results:** Cal AD 1650 to 1670 (Cal BP 300 to 280) and  
(68 % probability) Cal AD 1770 to 1800 (Cal BP 180 to 150) and  
Cal AD 1940 to 1950 (Cal BP 10 to 0)



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21.6:lab. mult=1)

Laboratory number: Beta-267612

Conventional radiocarbon age: 940±40 BP

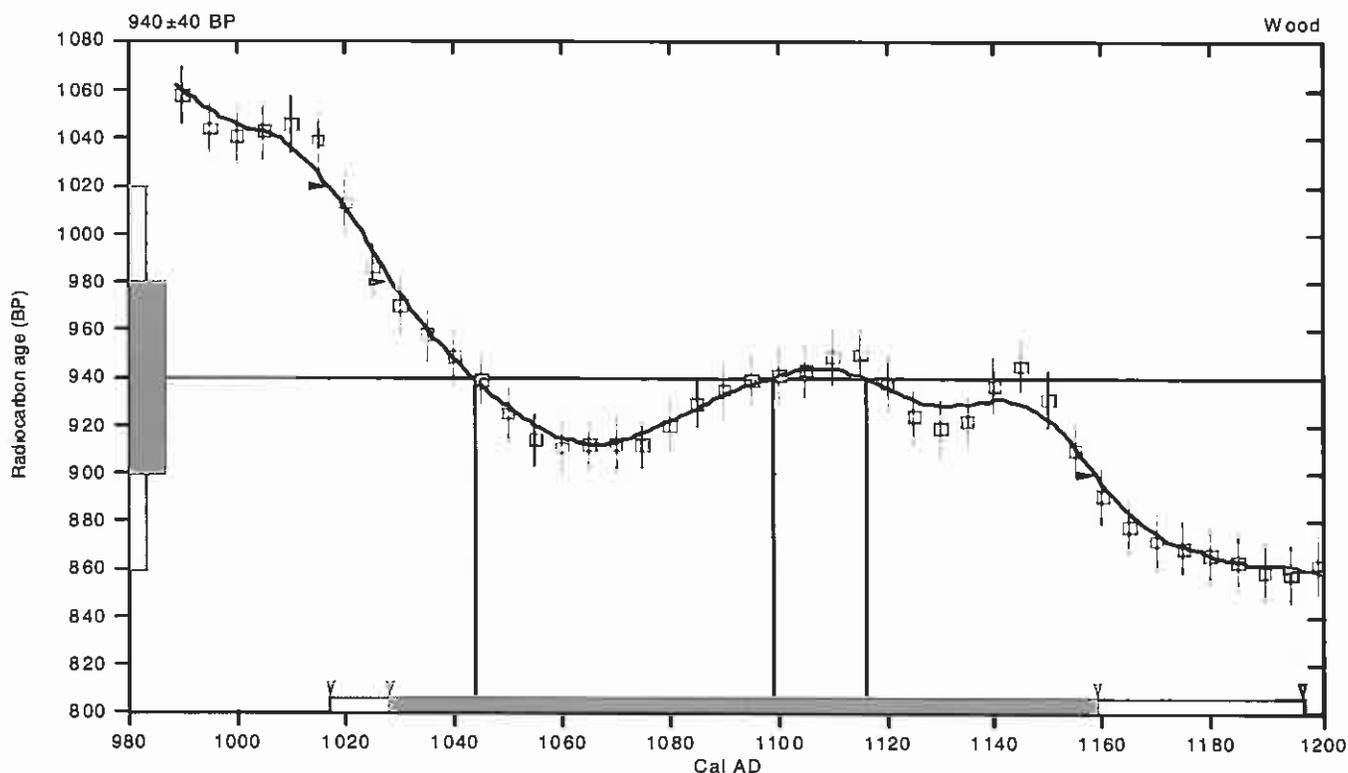
2 Sigma calibrated result: Cal AD 1020 to 1200 (Cal BP 930 to 750)  
(95 % probability)

Intercept data

Intercepts of radiocarbon age  
with calibration curve:

Cal AD 1040 (Cal BP 910) and  
Cal AD 1100 (Cal BP 850) and  
Cal AD 1120 (Cal BP 830)

1 Sigma calibrated result: Cal AD 1030 to 1160 (Cal BP 920 to 790)  
(68 % probability)



## References:

*Database used*

INTCAL04

*Calibration Database*

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

*Mathematics*

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.5:lab. mult=1)

Laboratory number: **Beta-267613**

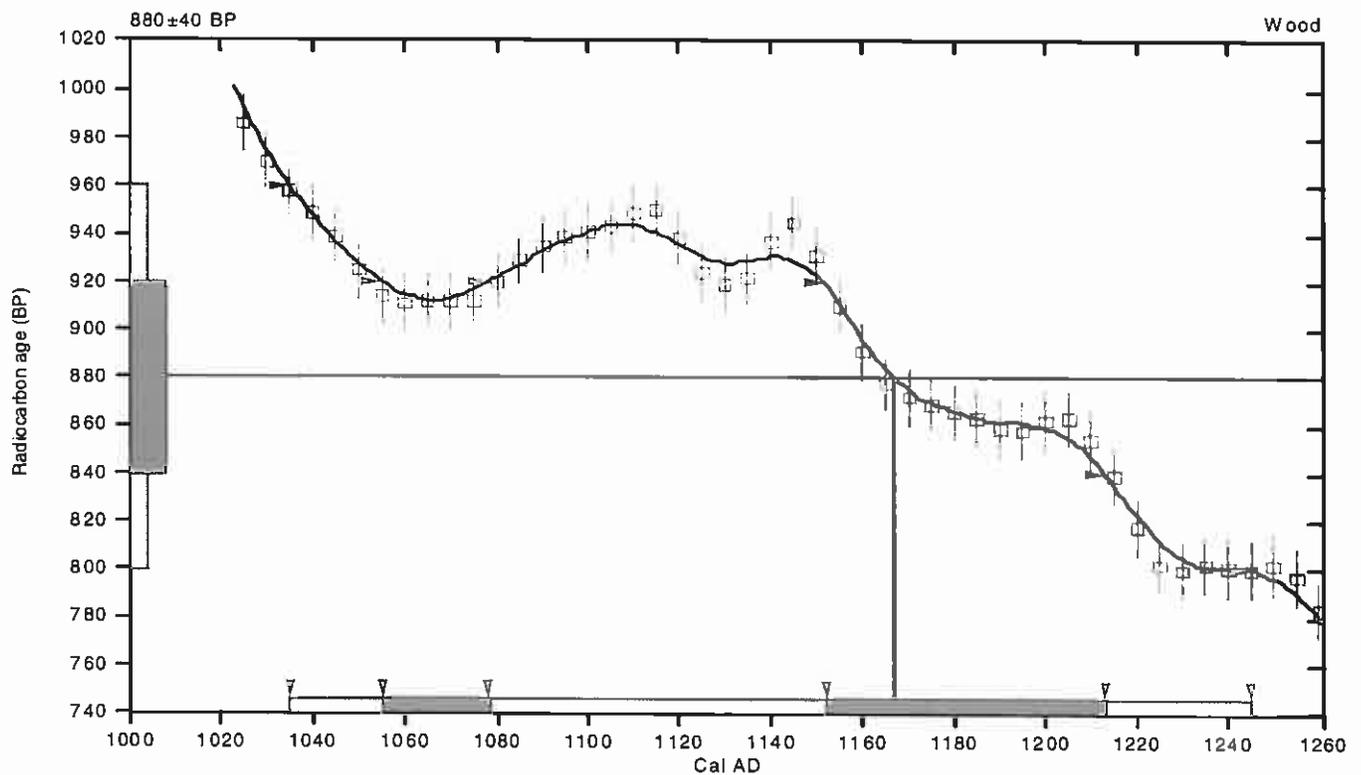
Conventional radiocarbon age: **880±40 BP**

**2 Sigma calibrated result: Cal AD 1040 to 1240 (Cal BP 920 to 700)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1170 (Cal BP 780)**

**1 Sigma calibrated results: Cal AD 1060 to 1080 (Cal BP 900 to 870) and**  
(68 % probability) **Cal AD 1150 to 1210 (Cal BP 800 to 740)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21.9;lab. mult=1)

Laboratory number: Beta-267614

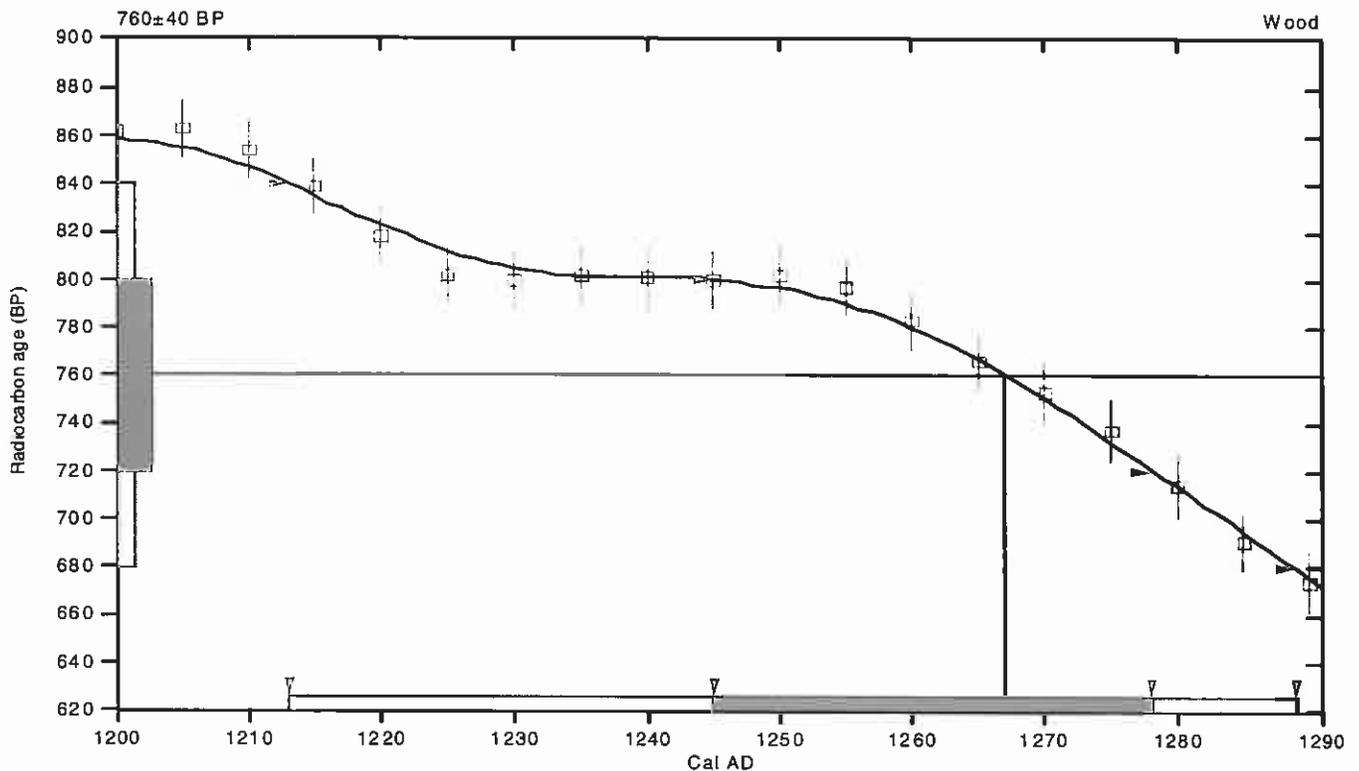
Conventional radiocarbon age:  $760 \pm 40$  BP

2 Sigma calibrated result: Cal AD 1210 to 1290 (Cal BP 740 to 660)  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: Cal AD 1270 (Cal BP 680)

1 Sigma calibrated result: Cal AD 1240 to 1280 (Cal BP 700 to 670)  
(68 % probability)



## References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21.9:lab. mult=1)

Laboratory number: **Beta-267615**

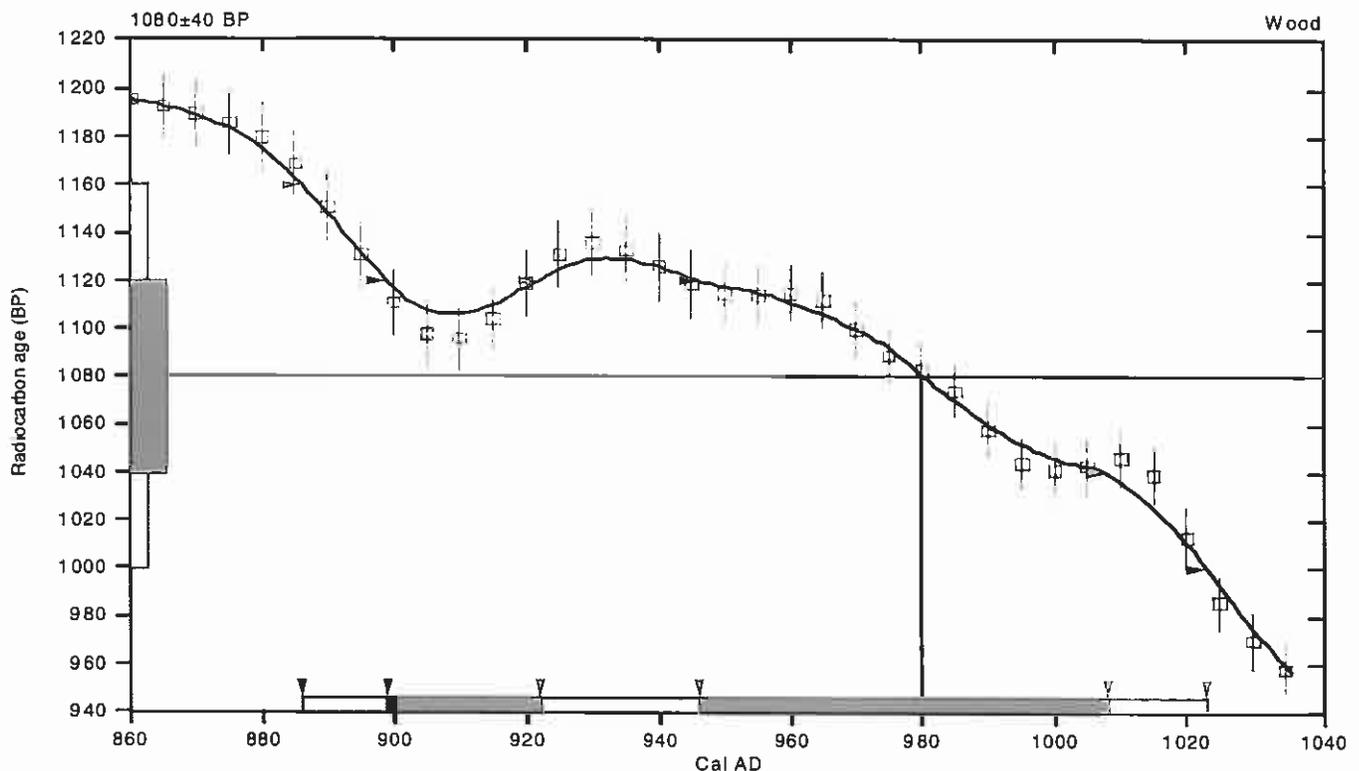
Conventional radiocarbon age: **1080±40 BP**

2 Sigma calibrated result: **Cal AD 890 to 1020 (Cal BP 1060 to 930)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 980 (Cal BP 970)**

1 Sigma calibrated results: **Cal AD 900 to 920 (Cal BP 1050 to 1030) and**  
(68 % probability) **Cal AD 950 to 1010 (Cal BP 1000 to 940)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.9:lab. mult=1)

Laboratory number: **Beta-267616**

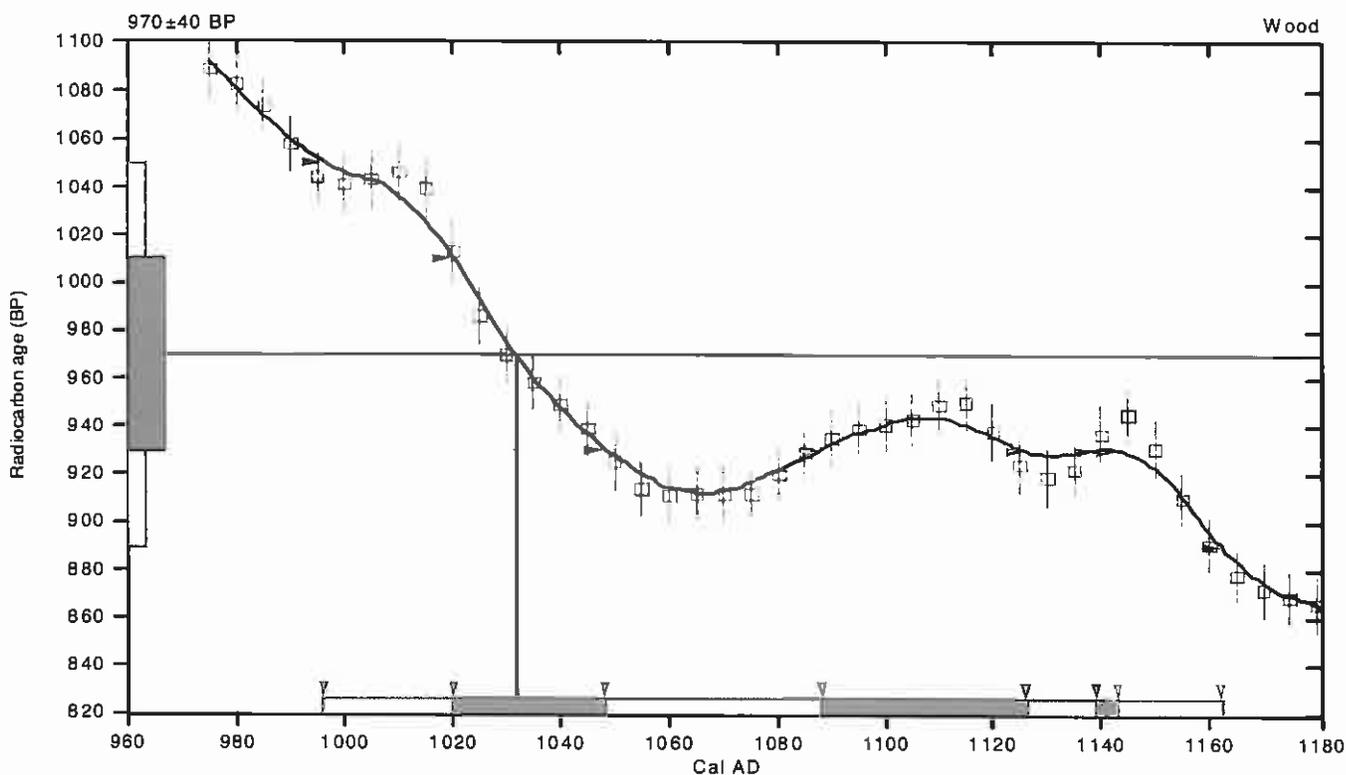
Conventional radiocarbon age: **970±40 BP**

2 Sigma calibrated result: **Cal AD 1000 to 1160 (Cal BP 950 to 790)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1030 (Cal BP 920)**

1 Sigma calibrated results: **Cal AD 1020 to 1050 (Cal BP 930 to 900) and**  
(68 % probability) **Cal AD 1090 to 1130 (Cal BP 860 to 820) and**  
**Cal AD 1140 to 1140 (Cal BP 810 to 810)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.9:lab. mult=1)

Laboratory number: **Beta-267617**

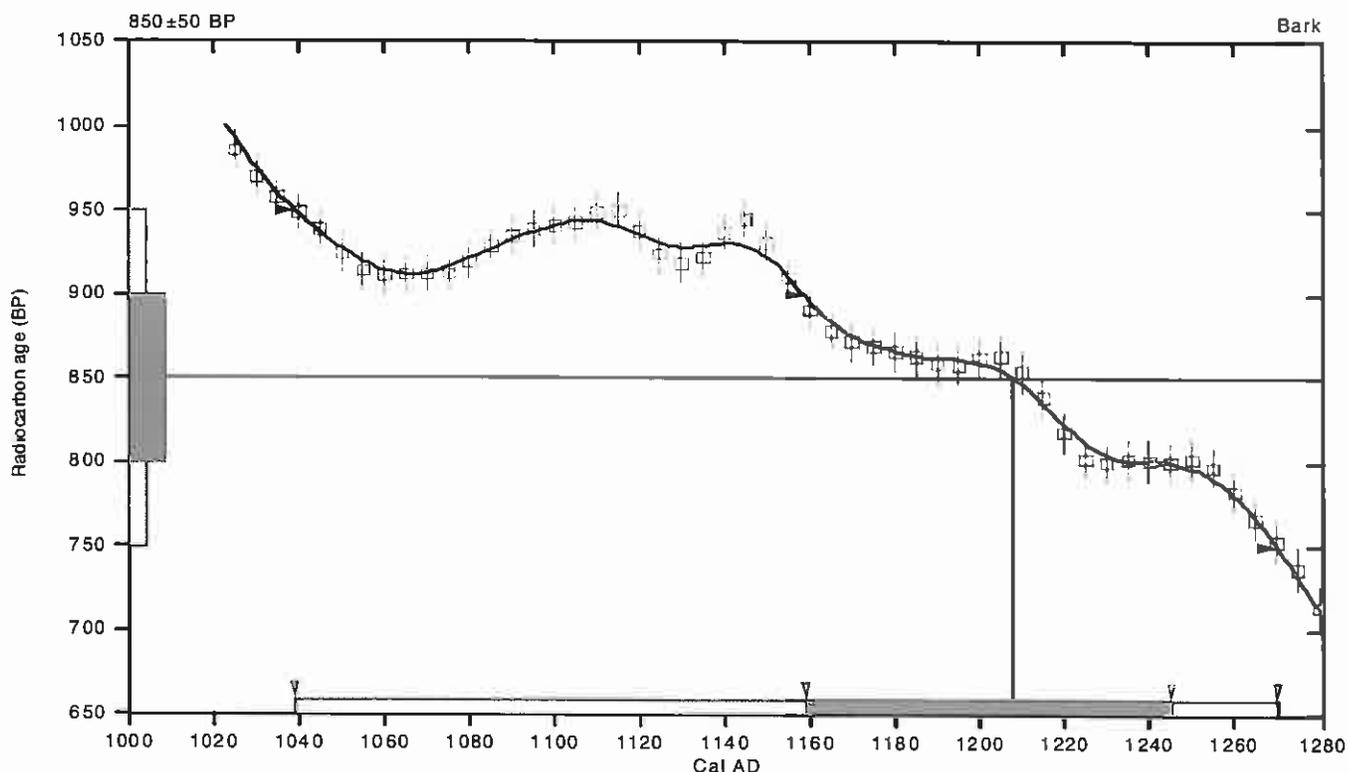
Conventional radiocarbon age: **850±50 BP**

2 Sigma calibrated result: **Cal AD 1040 to 1270 (Cal BP 910 to 680)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1210 (Cal BP 740)**

1 Sigma calibrated result: **Cal AD 1160 to 1240 (Cal BP 790 to 700)**  
(68 % probability)



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.2:lab. mult=1)

Laboratory number: **Beta-267618**

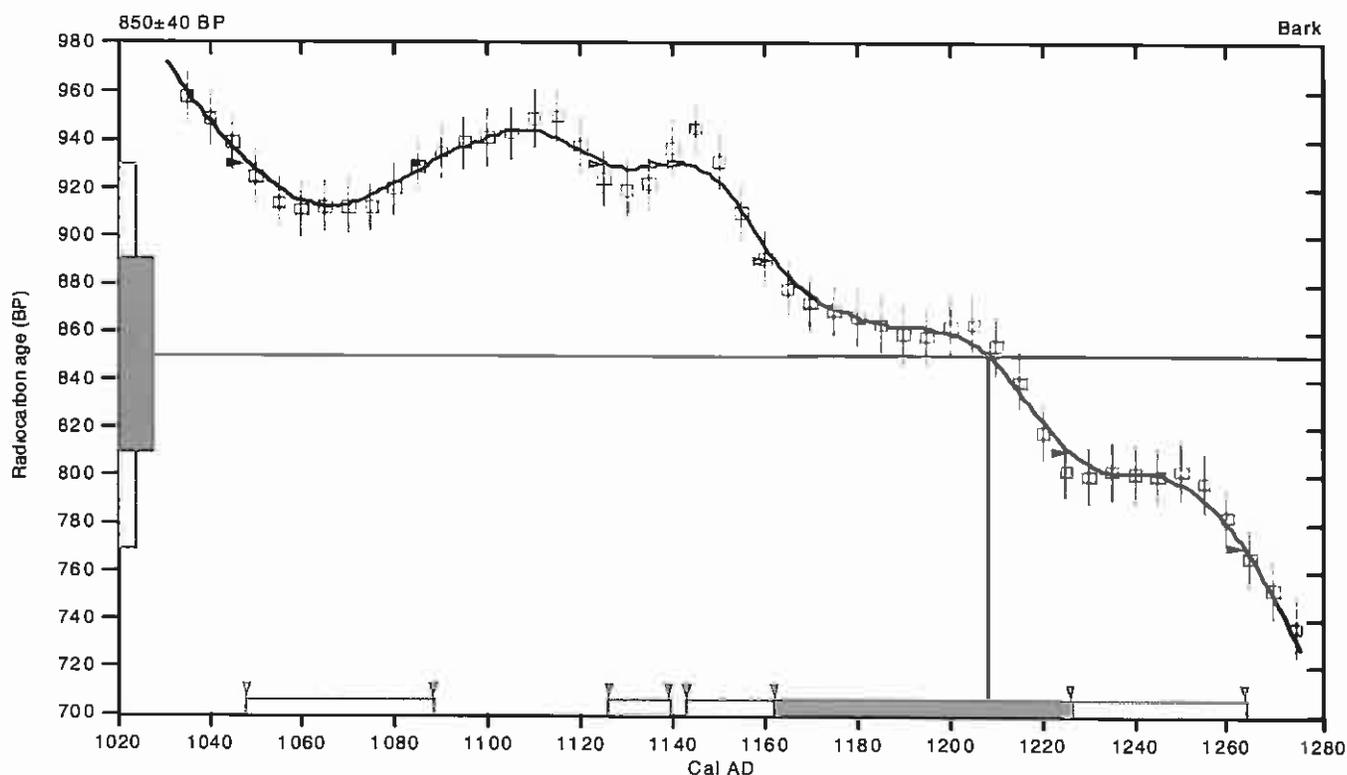
Conventional radiocarbon age: **850±40 BP**

2 Sigma calibrated results: **Cal AD 1050 to 1090 (Cal BP 900 to 860) and  
(95 % probability) Cal AD 1130 to 1140 (Cal BP 820 to 810) and  
Cal AD 1140 to 1260 (Cal BP 810 to 690)**

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1210 (Cal BP 740)**

1 Sigma calibrated result: **Cal AD 1160 to 1230 (Cal BP 790 to 720)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.2:lab. mult=1)

Laboratory number: **Beta-267619**

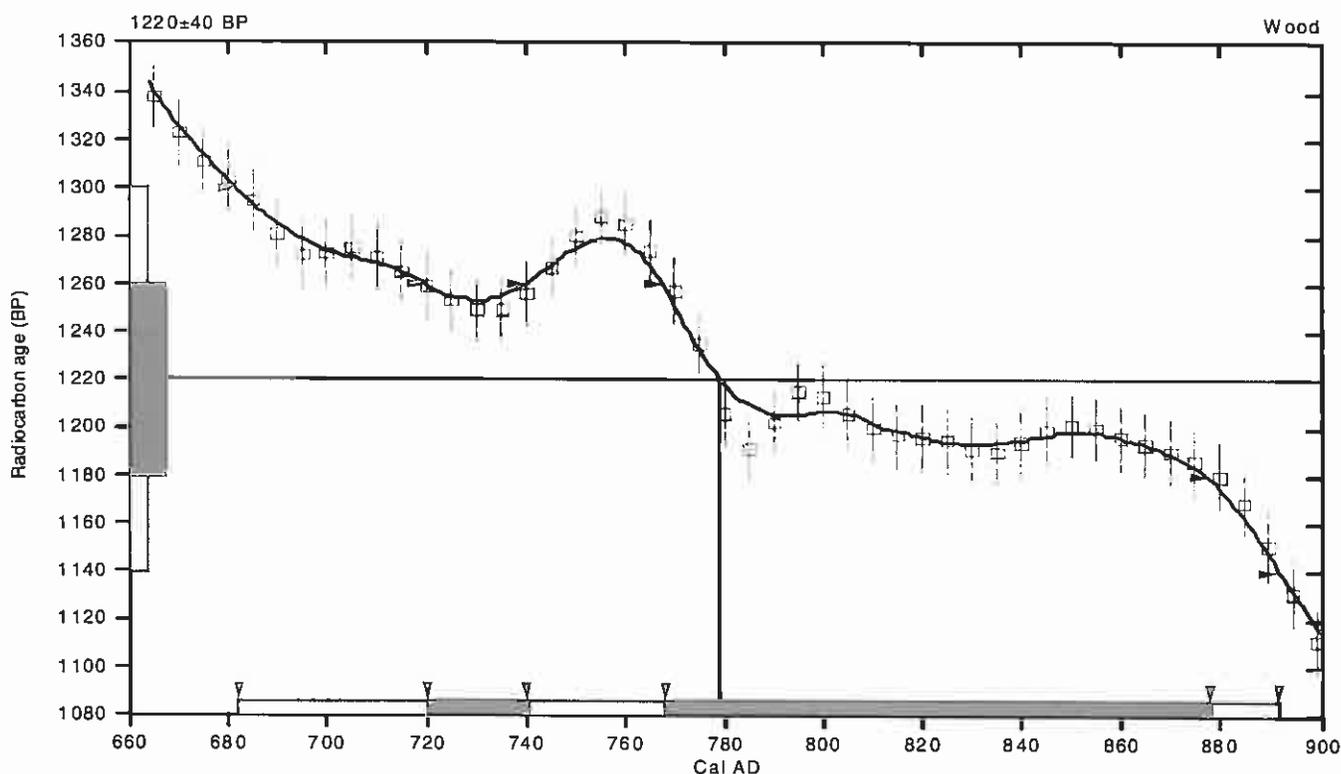
Conventional radiocarbon age: **1220±40 BP**

**2 Sigma calibrated result: Cal AD 680 to 890 (Cal BP 1270 to 1060)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 780 (Cal BP 1170)**

**1 Sigma calibrated results: Cal AD 720 to 740 (Cal BP 1230 to 1210) and**  
(68 % probability) **Cal AD 770 to 880 (Cal BP 1180 to 1070)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-29.7:lab. mult=1)

Laboratory number: Beta-267620

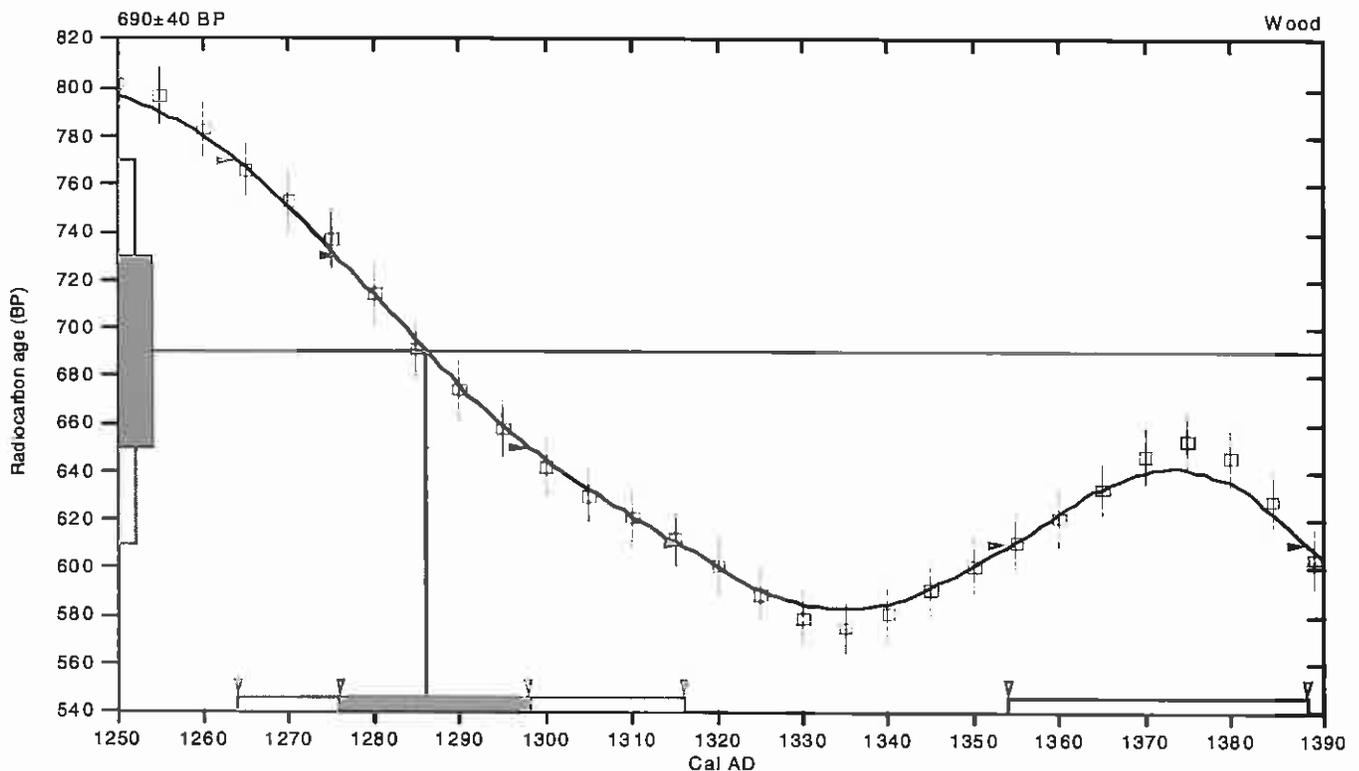
Conventional radiocarbon age:  $690 \pm 40$  BP

2 Sigma calibrated results: Cal AD 1260 to 1320 (Cal BP 690 to 630) and  
(95 % probability) Cal AD 1350 to 1390 (Cal BP 600 to 560)

Intercept data

Intercept of radiocarbon age  
with calibration curve: Cal AD 1290 (Cal BP 660)

1 Sigma calibrated result: Cal AD 1280 to 1300 (Cal BP 670 to 650)  
(68 % probability)



## References:

*Database used*

INTCAL04

*Calibration Database*

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

*Mathematics*

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.5:lab. mult=1)

Laboratory number: **Beta-267621**

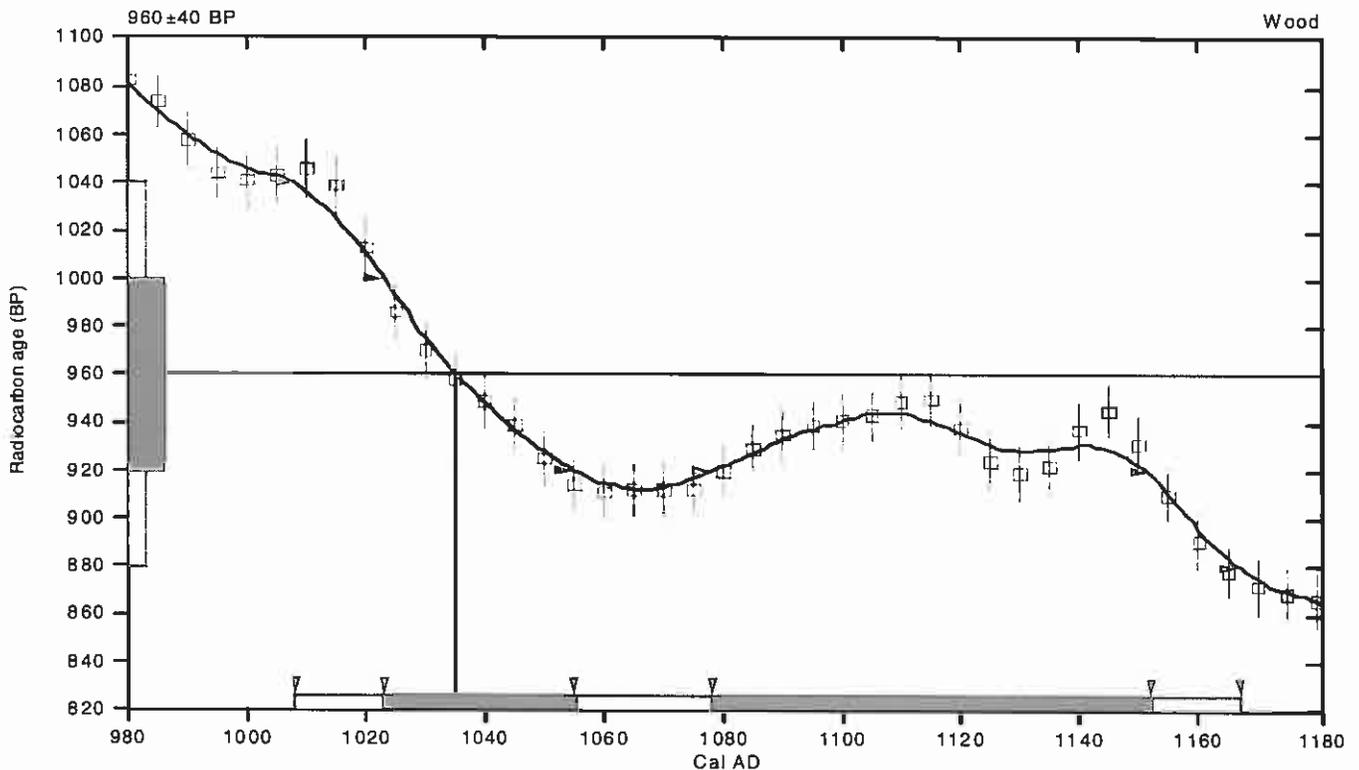
Conventional radiocarbon age: **960±40 BP**

2 Sigma calibrated result: **Cal AD 1010 to 1170 (Cal BP 940 to 780)**  
(95% probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1040 (Cal BP 920)**

1 Sigma calibrated results: **Cal AD 1020 to 1060 (Cal BP 930 to 900) and**  
**Cal AD 1080 to 1150 (Cal BP 870 to 800)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21.6:lab. mult=1)

Laboratory number: **Beta-267622**

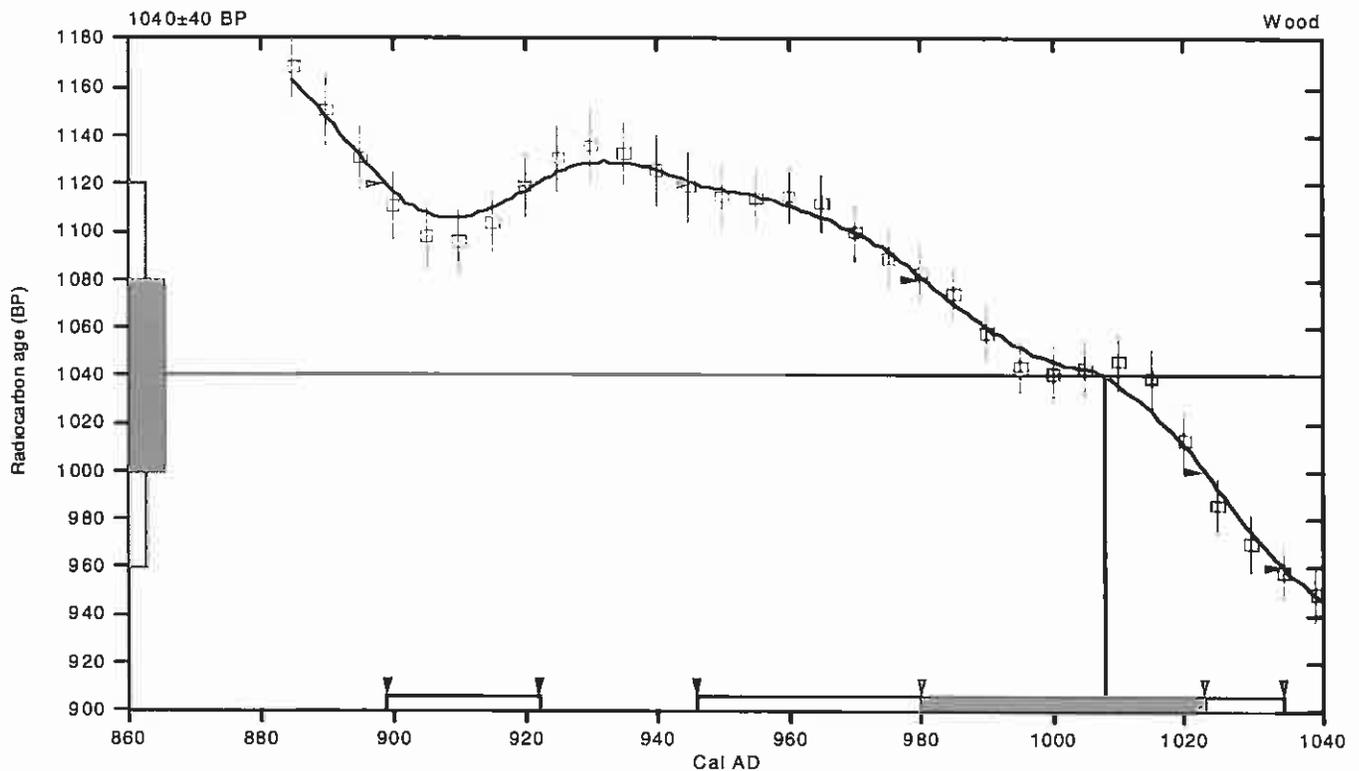
Conventional radiocarbon age: **1040±40 BP**

2 Sigma calibrated results: **Cal AD 900 to 920 (Cal BP 1050 to 1030) and  
(95 % probability) Cal AD 950 to 1040 (Cal BP 1000 to 920)**

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1010 (Cal BP 940)**

1 Sigma calibrated result: **Cal AD 980 to 1020 (Cal BP 970 to 930)**  
(68 % probability)



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.5:lab. mult=1)

Laboratory number: **Beta-267623**

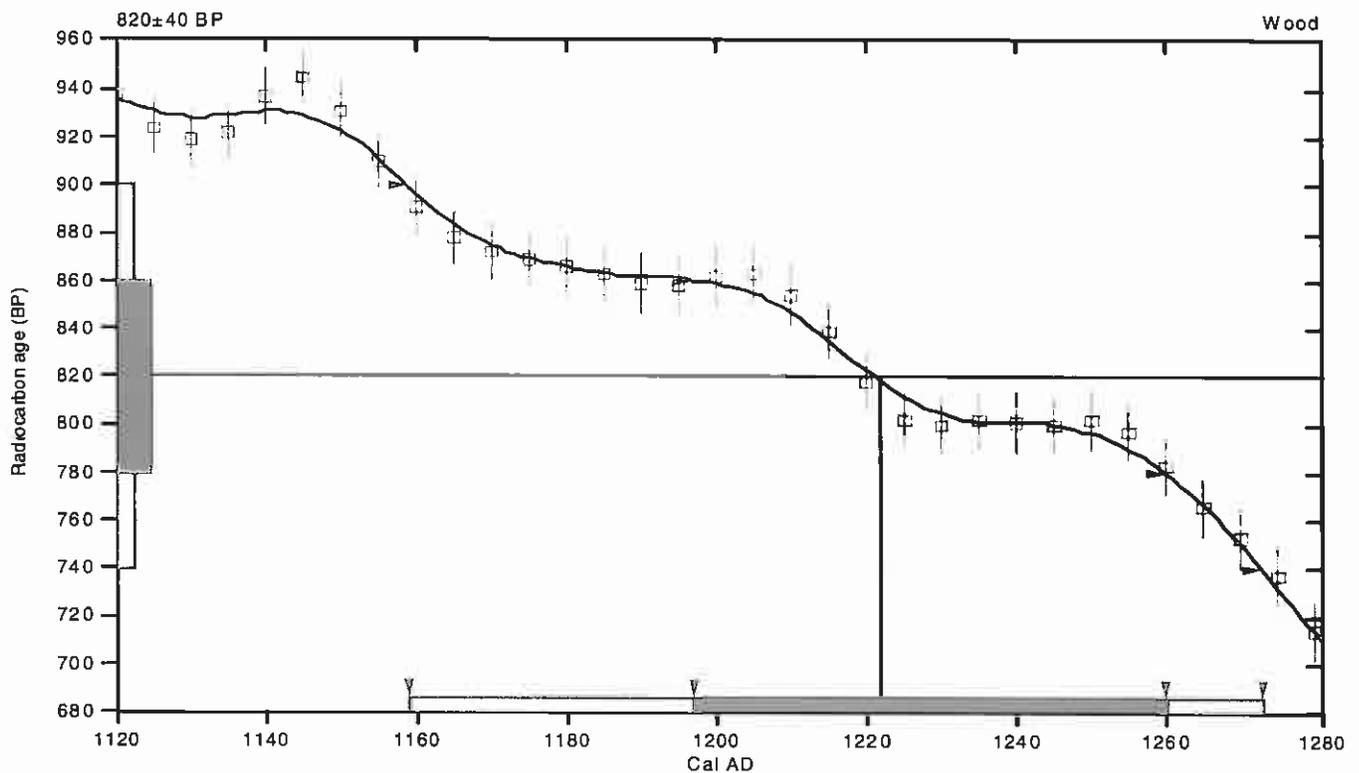
Conventional radiocarbon age: **820±40 BP**

**2 Sigma calibrated result: Cal AD 1160 to 1270 (Cal BP 790 to 680)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 1220 (Cal BP 730)**

**1 Sigma calibrated result: Cal AD 1200 to 1260 (Cal BP 750 to 690)**  
(68 % probability)



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.9:lab. mult=1)

Laboratory number: **Beta-267624**

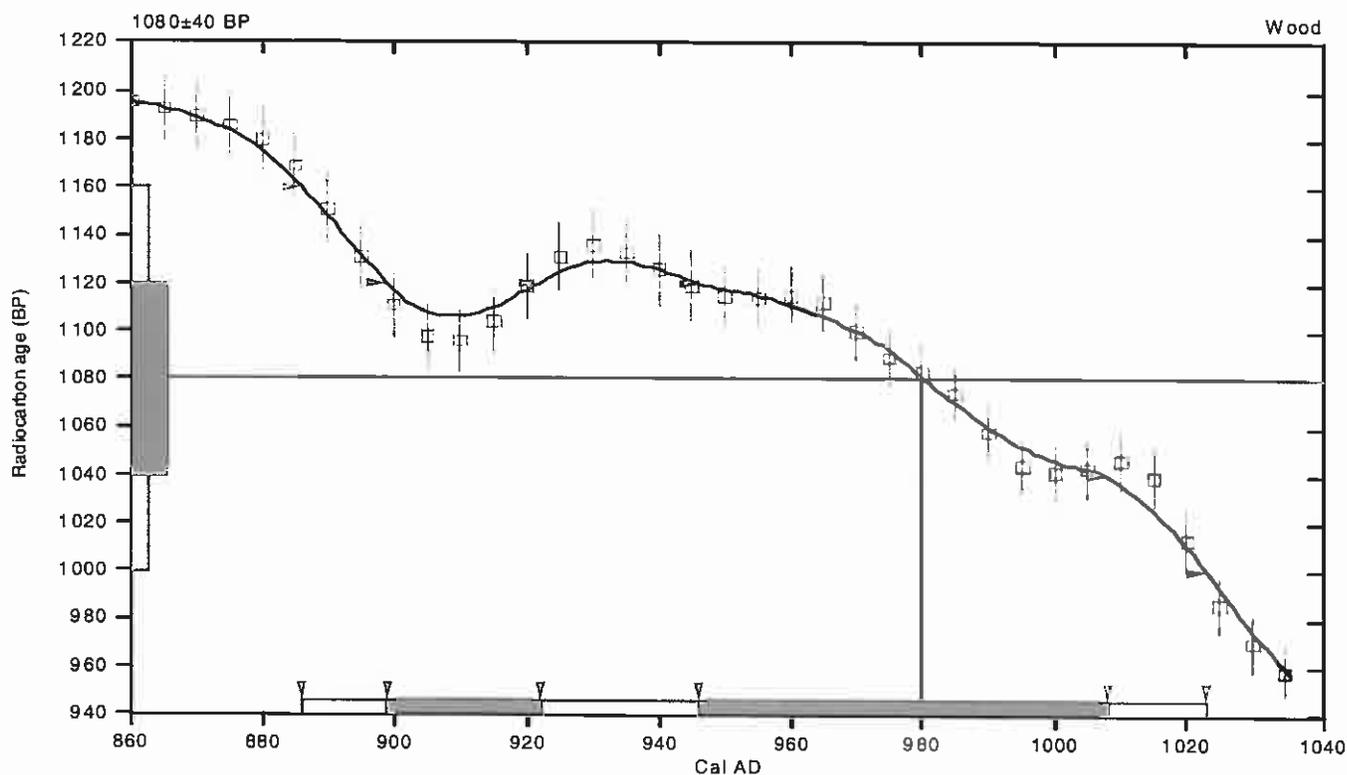
Conventional radiocarbon age: **1080±40 BP**

2 Sigma calibrated result: **Cal AD 890 to 1020 (Cal BP 1060 to 930)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: **Cal AD 980 (Cal BP 970)**

1 Sigma calibrated results: **Cal AD 900 to 920 (Cal BP 1050 to 1030) and**  
**Cal AD 950 to 1010 (Cal BP 1000 to 940)**



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21.2:lab. mult=1)

Laboratory number: **Beta-267625**

Conventional radiocarbon age: **920±40 BP**

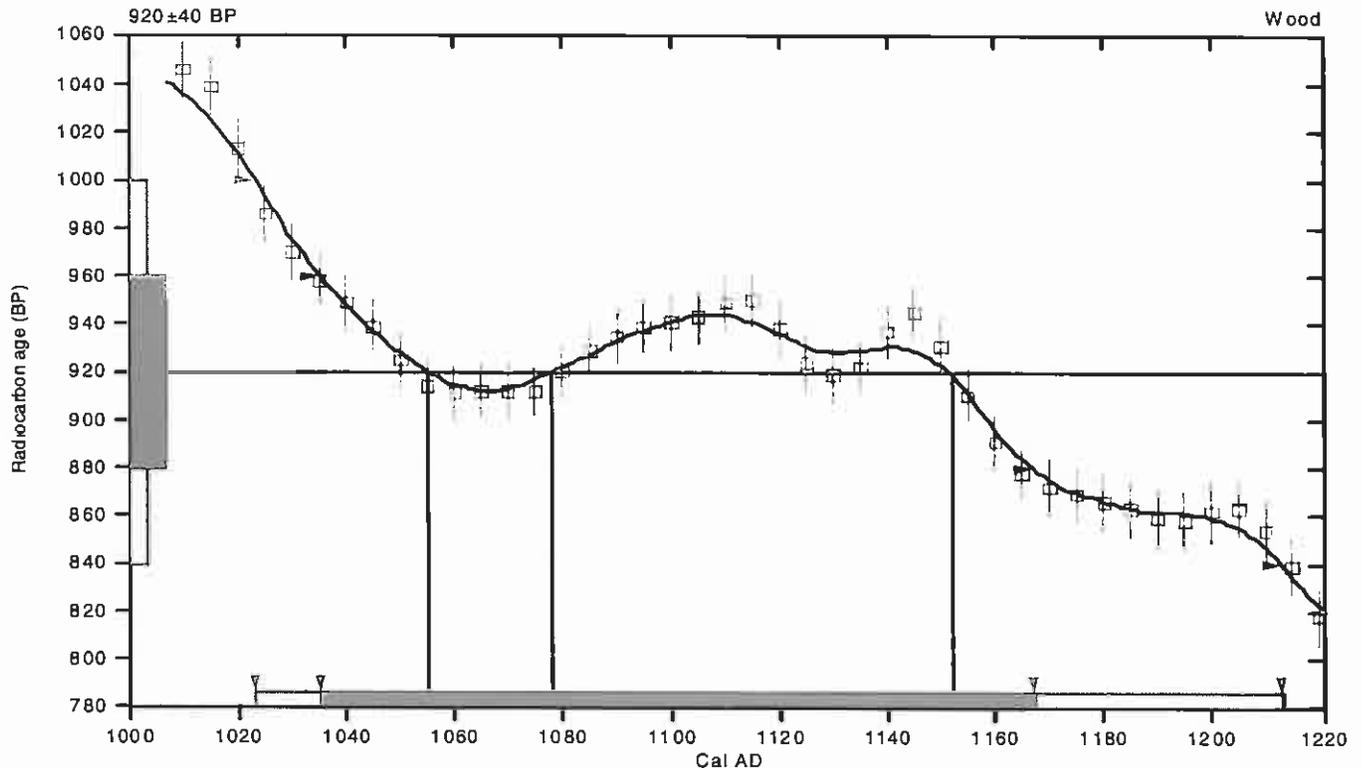
2 Sigma calibrated result: **Cal AD 1020 to 1210 (Cal BP 930 to 740)**  
(95 % probability)

Intercept data

Intercepts of radiocarbon age  
with calibration curve:

Cal AD 1060 (Cal BP 900) and  
Cal AD 1080 (Cal BP 870) and  
Cal AD 1150 (Cal BP 800)

1 Sigma calibrated result: **Cal AD 1040 to 1170 (Cal BP 920 to 780)**  
(68 % probability)



## References:

*Database used*

INTCAL04

*Calibration Database*

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

*Mathematics*

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25;lab. mult=1)

Laboratory number: **Beta-267626**

Conventional radiocarbon age: **1120±40 BP**

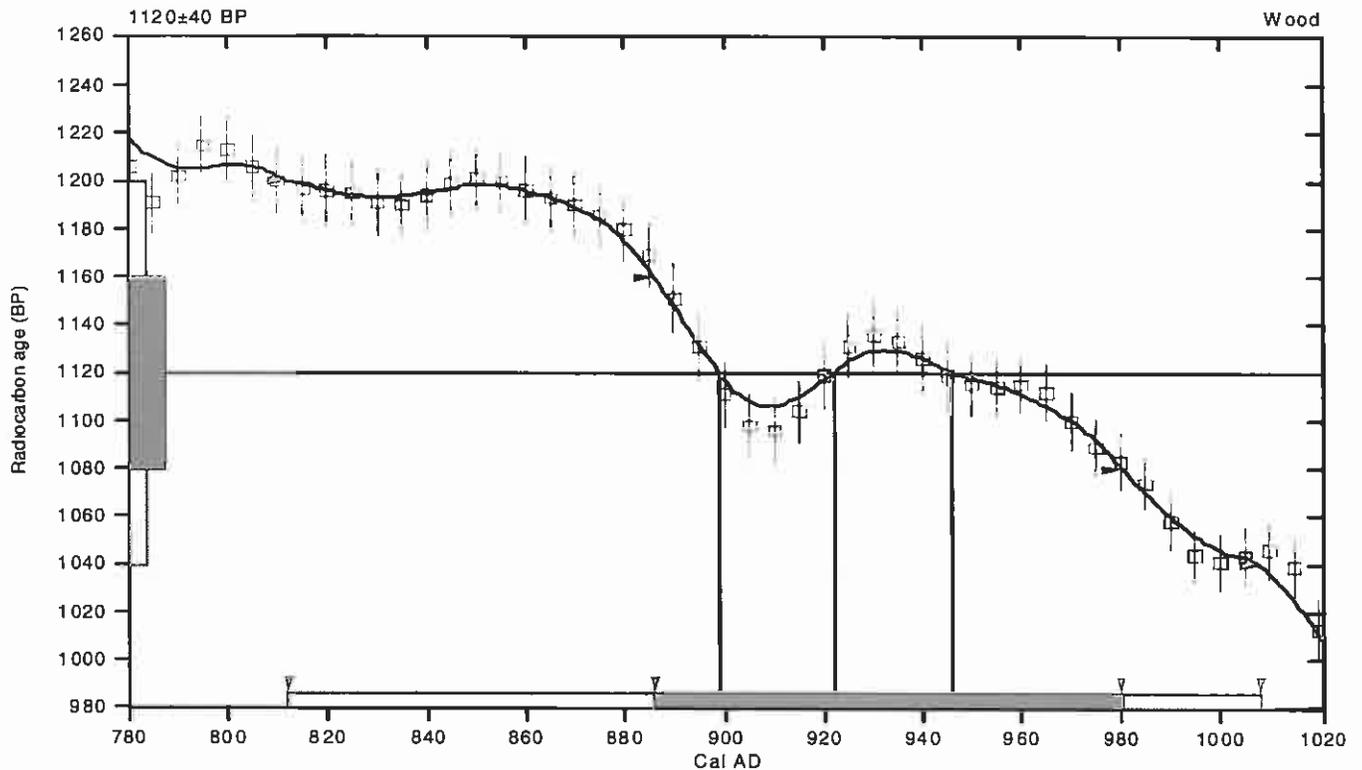
**2 Sigma calibrated result: Cal AD 810 to 1010 (Cal BP 1140 to 940)**  
(95 % probability)

Intercept data

Intercepts of radiocarbon age  
with calibration curve:

Cal AD 900 (Cal BP 1050) and  
Cal AD 920 (Cal BP 1030) and  
Cal AD 950 (Cal BP 1000)

**1 Sigma calibrated result: Cal AD 890 to 980 (Cal BP 1060 to 970)**  
(68 % probability)



## References:

*Database used*

*INTCAL04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

*A Simplified Approach to Calibrating C14 Dates*

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.5:lab. mult=1)

Laboratory number: Beta-267627

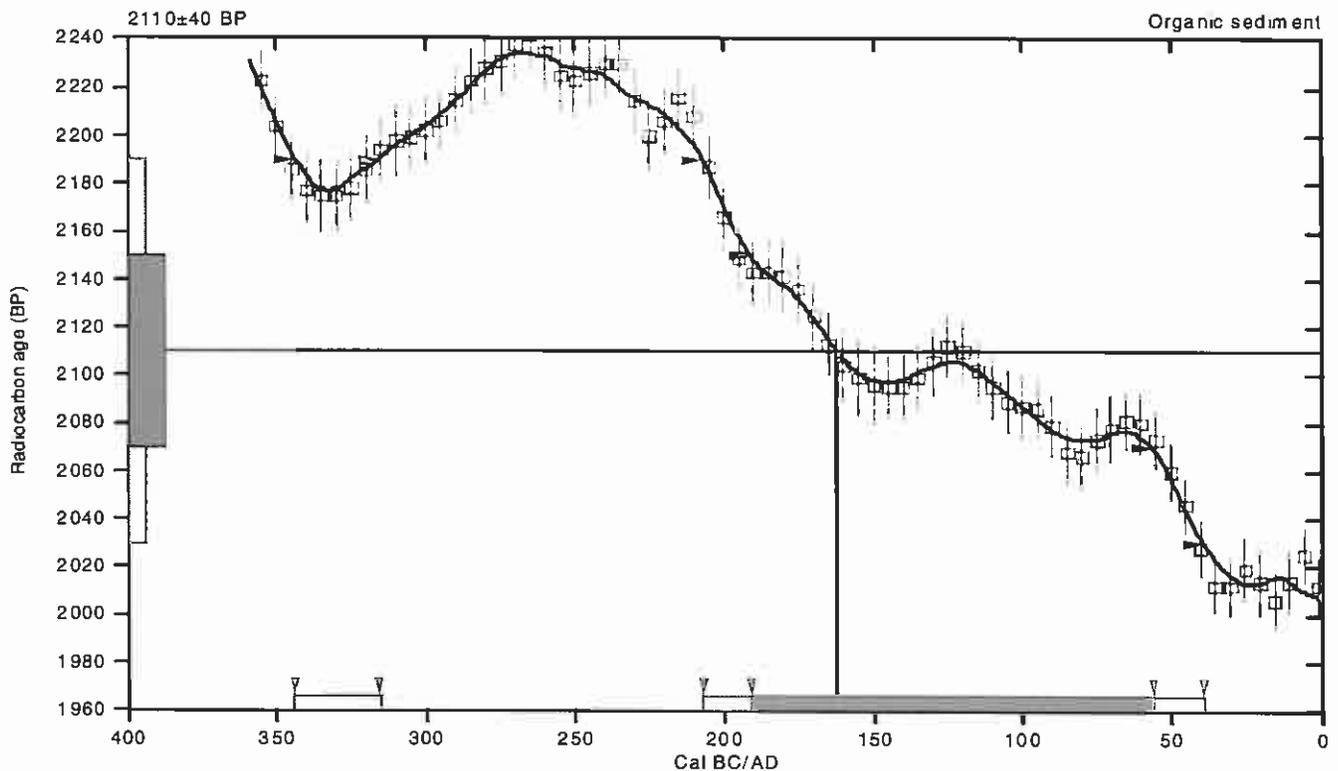
Conventional radiocarbon age: 2110±40 BP

2 Sigma calibrated results: Cal BC 340 to 320 (Cal BP 2290 to 2270) and  
(95 % probability) Cal BC 210 to 40 (Cal BP 2160 to 1990)

Intercept data

Intercept of radiocarbon age  
with calibration curve: Cal BC 160 (Cal BP 2110)

1 Sigma calibrated result: Cal BC 190 to 60 (Cal BP 2140 to 2010)  
(68 % probability)



## References:

*Database used*

INTCAL04

*Calibration Database*

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

*Mathematics*

A Simplified Approach to Calibrating C14 Dates

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# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-3.1:Delta-R=390±25:Glob res=-200 to 500:lab. mult=1)

Laboratory number: **Beta-267628**

Conventional radiocarbon age: **1350±40 BP**

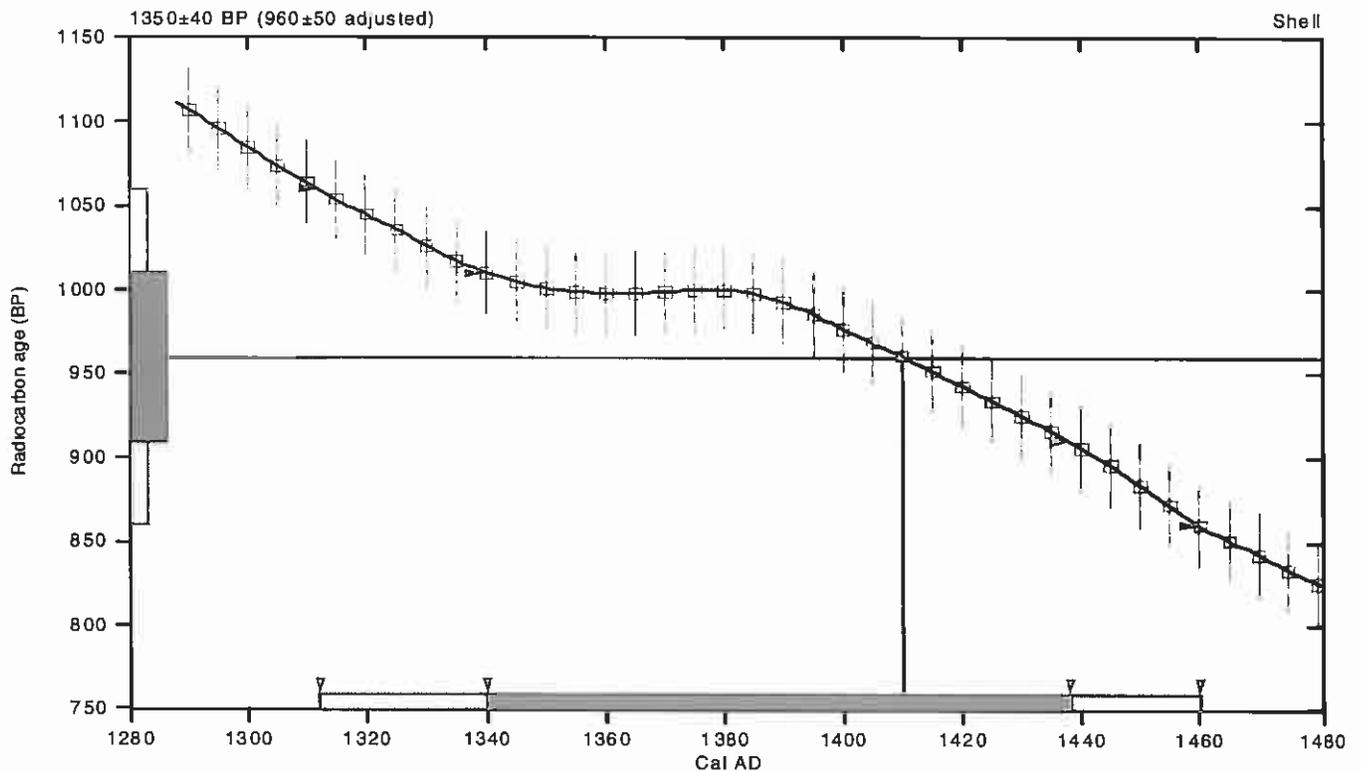
(960±50 adjusted for local reservoir correction)

**2 Sigma calibrated result: Cal AD 1310 to 1460 (Cal BP 640 to 490)**  
(95 % probability)

Intercept data

Intercept of radiocarbon age  
with calibration curve: Cal AD 1410 (Cal BP 540)

**1 Sigma calibrated result: Cal AD 1340 to 1440 (Cal BP 610 to 510)**  
(68 % probability)



## References:

*Database used*

*MARINE04*

*Calibration Database*

*INTCAL04 Radiocarbon Age Calibration*

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

*Mathematics*

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**Mr. Darden Hood**  
President

**Mr. Ronald Hatfield**  
**Mr. Christopher Patrick**  
Deputy Directors

*The Radiocarbon Laboratory Accredited to ISO-17025 Testing Standards (PJLA Accreditation #59423)*

## **Final Report**

The final report package includes the final date report, a statement outlining our analytical procedures, a glossary of pretreatment terms, calendar calibration information, billing documents (containing balance/credit information and the number of samples submitted within the yearly discount period), and peripheral items to use with future submittals. The final report includes the individual analysis method, the delivery basis, the material type and the individual pretreatments applied. The final report has been sent by mail and e-mail (where available).

## **Pretreatment**

Pretreatment methods are reported along with each result. All necessary chemical and mechanical pretreatments of the submitted material were applied at the laboratory to isolate the carbon, which may best represent the time event of interest. When interpreting the results, it is important to consider the pretreatments. Some samples cannot be fully pretreated, making their  $^{14}\text{C}$  ages more subjective than samples, which can be fully pretreated. Some materials receive no pretreatments. Please look at the pretreatment indicated for each sample and read the pretreatment glossary to understand the implications.

## **Analysis**

Materials measured by the radiometric technique were analyzed by synthesizing sample carbon to benzene (92% C), measuring for  $^{14}\text{C}$  content in one of 53 scintillation spectrometers, and then calculating for radiocarbon age. If the Extended Counting Service was used, the  $^{14}\text{C}$  content was measured for a greatly extended period of time. AMS results were derived from reduction of sample carbon to graphite (100 %C), along with standards and backgrounds. The graphite was then detected for  $^{14}\text{C}$  content in one of 9 accelerator-mass-spectrometers (AMS).

## **The Radiocarbon Age and Calendar Calibration**

The "Conventional  $^{14}\text{C}$  Age (\*)" is the result after applying  $^{13}\text{C}/^{12}\text{C}$  corrections to the measured age and is the most appropriate radiocarbon age. If an "\*" is attached to this date, it means the  $^{13}\text{C}/^{12}\text{C}$  was estimated rather than measured (The ratio is an option for radiometric analysis, but included on all AMS analyses.) Ages are reported with the units "BP" (Before Present). "Present" is defined as AD 1950 for the purposes of radiocarbon dating.

Results for samples containing more  $^{14}\text{C}$  than the modern reference standard are reported as "percent modern carbon" (pMC). These results indicate the material was respiring carbon after the advent of thermo-nuclear weapons testing and is less than ~ 50 years old.

Applicable calendar calibrations are included for materials between about 100 and 19,000 BP. If calibrations are not included with a report, those results were too young, too old, or inappropriate for calibration. Please read the enclosed page discussing calibration.

## **PRETREATMENT GLOSSARY**

### **Standard Pretreatment Protocols at Beta Analytic**

Unless otherwise requested by a submitter or discussed in a final date report, the following procedures apply to pretreatment of samples submitted for analysis. This glossary defines the pretreatment methods applied to each result listed on the date report form (e.g. you will see the designation "acid/alkali/acid" listed along with the result for a charcoal sample receiving such pretreatment).

Pretreatment of submitted materials is required to eliminate secondary carbon components. These components, if not eliminated, could result in a radiocarbon date, which is too young or too old. Pretreatment does not ensure that the radiocarbon date will represent the time event of interest. This is determined by the sample integrity. Effects such as the old wood effect, burned intrusive roots, bioturbation, secondary deposition, secondary biogenic activity incorporating recent carbon (bacteria) and the analysis of multiple components of differing age are just some examples of potential problems. The pretreatment philosophy is to reduce the sample to a single component, where possible, to minimize the added subjectivity associated with these types of problems. If you suspect your sample requires special pretreatment considerations be sure to tell the laboratory prior to analysis.

#### **"acid/alkali/acid"**

The sample was first gently crushed/dispersed in deionized water. It was then given hot HCl acid washes to eliminate carbonates and alkali washes (NaOH) to remove secondary organic acids. The alkali washes were followed by a final acid rinse to neutralize the solution prior to drying. Chemical concentrations, temperatures, exposure times, and number of repetitions, were applied accordingly with the uniqueness of the sample. Each chemical solution was neutralized prior to application of the next. During these serial rinses, mechanical contaminants such as associated sediments and rootlets were eliminated. This type of pretreatment is considered a "full pretreatment". On occasion the report will list the pretreatment as "acid/alkali/acid - insolubles" to specify which fraction of the sample was analyzed. This is done on occasion with sediments (See "acid/alkali/acid - solubles")

Typically applied to: charcoal, wood, some peats, some sediments, and textiles "acid/alkali/acid - solubles"

On occasion the alkali soluble fraction will be analyzed. This is a special case where soil conditions imply that the soluble fraction will provide a more accurate date. It is also used on some occasions to verify the present/absence or degree of contamination present from secondary organic acids. The sample was first pretreated with acid to remove any carbonates and to weaken organic bonds. After the alkali washes (as discussed above) are used, the solution containing the alkali soluble fraction is isolated/filtered and combined with acid. The soluble fraction, which precipitates, is rinsed and dried prior to combustion.

#### **"acid/alkali/acid/cellulose extraction"**

Following full acid/alkali/acid pretreatments, the sample is bathed in (sodium chlorite)  $\text{NaClO}_2$  under very controlled conditions (Ph = 3, temperature = 70 degrees C). This eliminates all components except wood cellulose. It is useful for woods that are either very old or highly contaminated.

Applied to: wood

#### **"acid washes"**

Surface area was increased as much as possible. Solid chunks were crushed, fibrous materials were shredded, and sediments were dispersed. Acid (HCl) was applied repeatedly to ensure the absence of carbonates. Chemical concentrations, temperatures, exposure times, and number of repetitions, were applied accordingly with the uniqueness of each sample. The sample was not be subjected to alkali washes to ensure the absence of secondary organic acids for intentional reasons. The most common reason is that the primary carbon is soluble in the alkali. Dating results reflect the total organic content of the analyzed material. Their accuracy depends on the researcher's ability to subjectively eliminate potential contaminants based on contextual facts.

Typically applied to: organic sediments, some peats, small wood or charcoal, special cases



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**Mr. Christopher Patrick**  
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*The Radiocarbon Laboratory Accredited to ISO-17025 Testing Standards (PJLA Accreditation #59423)*

## Calendar Calibration at Beta Analytic

Calibrations of radiocarbon age determinations are applied to convert BP results to calendar years. The short-term difference between the two is caused by fluctuations in the heliomagnetic modulation of the galactic cosmic radiation and, recently, large scale burning of fossil fuels and nuclear devices testing. Geomagnetic variations are the probable cause of longer-term differences.

The parameters used for the corrections have been obtained through precise analyses of hundreds of samples taken from known-age tree rings of oak, sequoia, and fir up to about 10,000 BP. Calibration using tree-rings to about 12,000 BP is still being researched and provides somewhat less precise correlation. Beyond that, up to about 20,000 BP, correlation using a modeled curve determined from U/Th measurements on corals is used. This data is still highly subjective. Calibrations are provided up to about 19,000 years BP using the most recent calibration data available.

The Pretoria Calibration Procedure (Radiocarbon, Vol 35, No.1, 1993, pg 317) program has been chosen for these calendar calibrations. It uses splines through the tree-ring data as calibration curves, which eliminates a large part of the statistical scatter of the actual data points. The spline calibration allows adjustment of the average curve by a quantified closeness-of-fit parameter to the measured data points. A single spline is used for the precise correlation data available back to 9900 BP for terrestrial samples and about 6900 BP for marine samples. Beyond that, splines are taken on the error limits of the correlation curve to account for the lack of precision in the data points.

In describing our calibration curves, the solid bars represent one sigma statistics (68% probability) and the hollow bars represent two sigma statistics (95% probability). Marine carbonate samples that have been corrected for  $^{13}\text{C}/^{12}\text{C}$ , have also been corrected for both global and local geographic reservoir effects (as published in Radiocarbon, Volume 35, Number 1, 1993) prior to the calibration. Marine carbonates that have not been corrected for  $^{13}\text{C}/^{12}\text{C}$  are adjusted by an assumed value of 0 ‰ in addition to the reservoir corrections. Reservoir corrections for fresh water carbonates are usually unknown and are generally not accounted for in those calibrations. In the absence of measured  $^{13}\text{C}/^{12}\text{C}$  ratios, a typical value of -5 ‰ is assumed for freshwater carbonates.

(Caveat: the correlation curve for organic materials assume that the material dated was living for exactly ten years (e.g. a collection of 10 individual tree rings taken from the outer portion of a tree that was cut down to produce the sample in the feature dated). For other materials, the maximum and minimum calibrated age ranges given by the computer program are uncertain. The possibility of an "old wood effect" must also be considered, as well as the potential inclusion of younger or older material in matrix samples. Since these factors are in determinant error in most cases, these calendar calibration results should be used only for illustrative purposes. In the case of carbonates, reservoir correction is theoretical and the local variations are real, highly variable and dependent on provenience. Since imprecision in the correlation data beyond 10,000 years is high, calibrations in this range are likely to change in the future with refinement in the correlation curve. The age ranges and especially the intercept ages generated by the program must be considered as approximations.)