



Beta Analytic
RADIOCARBON DATING

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Mr. Darden Hood
President

Mr. Ronald Hatfield
Mr. Christopher Patrick
Deputy Directors

ISO/IEC 17025:2005 Accredited Test Results: Testing results recognized by all Signatories to the ILAC Mutual Recognition Arrangement

July 10, 2018

Mr. Vadim Adel
Pirkanmaa Provincial Museum
P.O. Box 487
Tampere, FIN-33101
Finland

RE: Radiocarbon Dating Results

Dear Mr. Adel,

Enclosed are the radiocarbon dating results for three samples recently sent to us. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable. The Conventional Radiocarbon Ages have all been corrected for total fractionation effects and where applicable, calibration was performed using 2013 calibration databases (cited on the graph pages).

The web directory containing the table of results and PDF download also contains pictures, a cvs spreadsheet download option and a quality assurance report containing expected vs. measured values for 3-5 working standards analyzed simultaneously with your samples.

Reported results are accredited to ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators here. Since Beta is not a teaching laboratory, only graduates trained to strict protocols of the ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 program participated in the analyses.

As always Conventional Radiocarbon Ages and sigmas are rounded to the nearest 10 years per the conventions of the 1977 International Radiocarbon Conference. When counting statistics produce sigmas lower than +/- 30 years, a conservative +/- 30 BP is cited for the result. The reported $\delta^{13}C$ values were measured separately in an IRMS (isotope ratio mass spectrometer). They are NOT the AMS $\delta^{13}C$ which would include fractionation effects from natural, chemistry and AMS induced sources.

When interpreting the results, please consider any communications you may have had with us regarding the samples.

The cost of analysis was previously invoiced. As always, if you have any questions or would like to discuss the results, don't hesitate to contact us.

Sincerely ,

Darden Hood
Digital signature on file



REPORT OF RADIOCARBON DATING ANALYSES

Vadim Adel

Report Date: July 10, 2018

Pirkanmaa Provincial Museum

Material Received: June 19, 2018

Laboratory Number

Sample Code Number

Conventional Radiocarbon Age (BP) or
Percent Modern Carbon (pMC) & Stable Isotopes

Calendar Calibrated Results: 95.4 % Probability
High Probability Density Range Method (HPD)

Beta - 497221

TURSIA2012-5

1180 +/- 30 BP

IRMS δ13C: -26.9 o/oo

(87.5%)
(7.2%)
(0.7%)

768 - 900 cal AD
920 - 951 cal AD
730 - 736 cal AD

(1182 - 1050 cal BP)
(1030 - 999 cal BP)
(1220 - 1214 cal BP)

Submitter Material: Woody Material
Pretreatment: (wood) acid/alkali/acid
Analyzed Material: Wood

Analysis Service: RadiometricPLUS-Standard delivery
Percent Modern Carbon: 86.34 +/- 0.32 pMC
Fraction Modern Carbon: 0.8634 +/- 0.0032

D14C: -136.62 +/- 3.22 o/oo
Δ14C: -143.69 +/- 3.22 o/oo(1950:2,018.00)

Measured Radiocarbon Age: (without d13C correction): 1210 +/- 30 BP
Calibration: BetaCal3.21: HPD method: INTCAL13

Results are ISO/IEC-17025:2005 accredited. No sub-contracting or student labor was used in the analyses. All work was done at Beta in 4 in-house NEC accelerator mass spectrometers and 4 Thermo IRMSs. The "Conventional Radiocarbon Age" was calculated using the Libby half-life (5568 years), is corrected for total isotopic fraction and was used for calendar calibration where applicable. The Age is rounded to the nearest 10 years and is reported as radiocarbon years before present (BP), "present" = AD 1950. Results greater than the modern reference are reported as percent modern carbon (pMC). The modern reference standard was 95% the 14C signature of NIST SRM-4990C (oxalic acid). Quoted errors are 1 sigma counting statistics. Calculated sigmas less than 30 BP on the Conventional Radiocarbon Age are conservatively rounded up to 30. d13C values are on the material itself (not the AMS d13C). d13C and d15N values are relative to VPDB-1. References for calendar calibrations are cited at the bottom of calibration graph pages.



REPORT OF RADIOCARBON DATING ANALYSES

Vadim Adel

Report Date: July 10, 2018

Pirkanmaa Provincial Museum

Material Received: June 19, 2018

Laboratory Number

Sample Code Number

Conventional Radiocarbon Age (BP) or
Percent Modern Carbon (pMC) & Stable Isotopes

Calendar Calibrated Results: 95.4 % Probability
High Probability Density Range Method (HPD)

Beta - 497222

TURSIA2012-10

1020 +/- 30 BP

IRMS δ13C: -25.0 o/oo

(90.3%)	968 - 1046 cal AD	(982 - 904 cal BP)
(4.1%)	1094 - 1120 cal AD	(856 - 830 cal BP)
(0.7%)	1141 - 1147 cal AD	(809 - 803 cal BP)
(0.3%)	908 - 912 cal AD	(1042 - 1038 cal BP)

Submitter Material: Woody Material
Pretreatment: (wood) acid/alkali/acid
Analyzed Material: Wood
Analysis Service: AMS-Standard delivery

Percent Modern Carbon: 88.08 +/- 0.33 pMC

Fraction Modern Carbon: 0.8808 +/- 0.0033

D14C: -119.25 +/- 3.29 o/oo

Δ14C: -126.46 +/- 3.29 o/oo(1950:2,018.00)

Measured Radiocarbon Age: (without d13C correction): 1020 +/- 30 BP

Calibration: BetaCal3.21: HPD method: INTCAL13

Results are ISO/IEC-17025:2005 accredited. No sub-contracting or student labor was used in the analyses. All work was done at Beta in 4 in-house NEC accelerator mass spectrometers and 4 Thermo IRMSs. The "Conventional Radiocarbon Age" was calculated using the Libby half-life (5568 years), is corrected for total isotopic fraction and was used for calendar calibration where applicable. The Age is rounded to the nearest 10 years and is reported as radiocarbon years before present (BP), "present" = AD 1950. Results greater than the modern reference are reported as percent modern carbon (pMC). The modern reference standard was 95% the 14C signature of NIST SRM-4990C (oxalic acid). Quoted errors are 1 sigma counting statistics. Calculated sigmas less than 30 BP on the Conventional Radiocarbon Age are conservatively rounded up to 30. d13C values are on the material itself (not the AMS d13C). d13C and d15N values are relative to VPDB-1. References for calendar calibrations are cited at the bottom of calibration graph pages.



REPORT OF RADIOCARBON DATING ANALYSES

Vadim Adel

Report Date: July 10, 2018

Pirkanmaa Provincial Museum

Material Received: June 19, 2018

Laboratory Number

Sample Code Number

Conventional Radiocarbon Age (BP) or
Percent Modern Carbon (pMC) & Stable Isotopes

Calendar Calibrated Results: 95.4 % Probability
High Probability Density Range Method (HPD)

Beta - 497223

TURSIA2013-34

1280 +/- 30 BP

IRMS δ13C: -26.5 o/oo

(95.4%)

662 - 774 cal AD

(1288 - 1176 cal BP)

Submitter Material: Woody Material

Pretreatment: (wood) acid/alkali/acid

Analyzed Material: Wood

Analysis Service: RadiometricPLUS-Standard delivery

Percent Modern Carbon: 85.27 +/- 0.32 pMC

Fraction Modern Carbon: 0.8527 +/- 0.0032

D14C: -147.30 +/- 3.18 o/oo

Δ14C: -154.28 +/- 3.18 o/oo(1950:2,018.00)

Measured Radiocarbon Age: (without d13C correction): 1300 +/- 30 BP

Calibration: BetaCal3.21: HPD method: INTCAL13

Results are ISO/IEC-17025:2005 accredited. No sub-contracting or student labor was used in the analyses. All work was done at Beta in 4 in-house NEC accelerator mass spectrometers and 4 Thermo IRMSs. The "Conventional Radiocarbon Age" was calculated using the Libby half-life (5568 years), is corrected for total isotopic fraction and was used for calendar calibration where applicable. The Age is rounded to the nearest 10 years and is reported as radiocarbon years before present (BP), "present" = AD 1950. Results greater than the modern reference are reported as percent modern carbon (pMC). The modern reference standard was 95% the 14C signature of NIST SRM-4990C (oxalic acid). Quoted errors are 1 sigma counting statistics. Calculated sigmas less than 30 BP on the Conventional Radiocarbon Age are conservatively rounded up to 30. d13C values are on the material itself (not the AMS d13C). d13C and d15N values are relative to VPDB-1. References for calendar calibrations are cited at the bottom of calibration graph pages.

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: $\delta^{13}\text{C} = -26.9$ o/oo)

Laboratory number **Beta-497221**

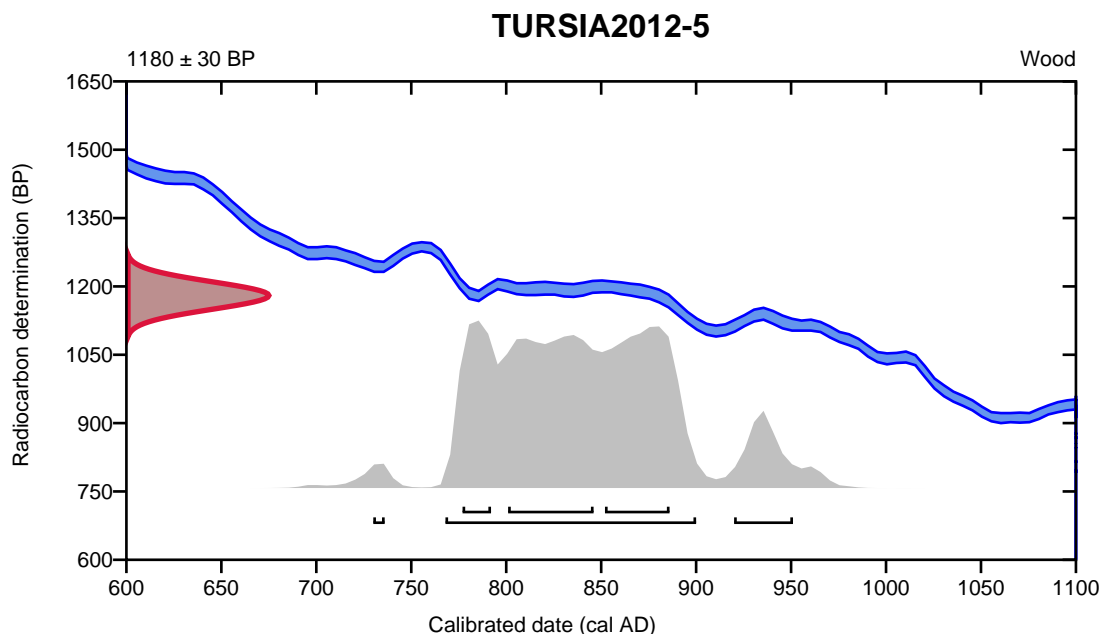
Conventional radiocarbon age **1180 ± 30 BP**

95.4% probability

(87.5%)	768 - 900 cal AD	(1182 - 1050 cal BP)
(7.2%)	920 - 951 cal AD	(1030 - 999 cal BP)
(0.7%)	730 - 736 cal AD	(1220 - 1214 cal BP)

68.2% probability

(31.9%)	801 - 846 cal AD	(1149 - 1104 cal BP)
(24.6%)	852 - 886 cal AD	(1098 - 1064 cal BP)
(11.7%)	777 - 792 cal AD	(1173 - 1158 cal BP)



Database used
INTCAL13

References

References to Probability Method

Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. *Radiocarbon*, 51(1), 337-360.

References to Database INTCAL13

Reimer, et.al., 2013, *Radiocarbon*55(4).

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: $\delta^{13}C = -25.0$ o/oo)

Laboratory number **Beta-497222**

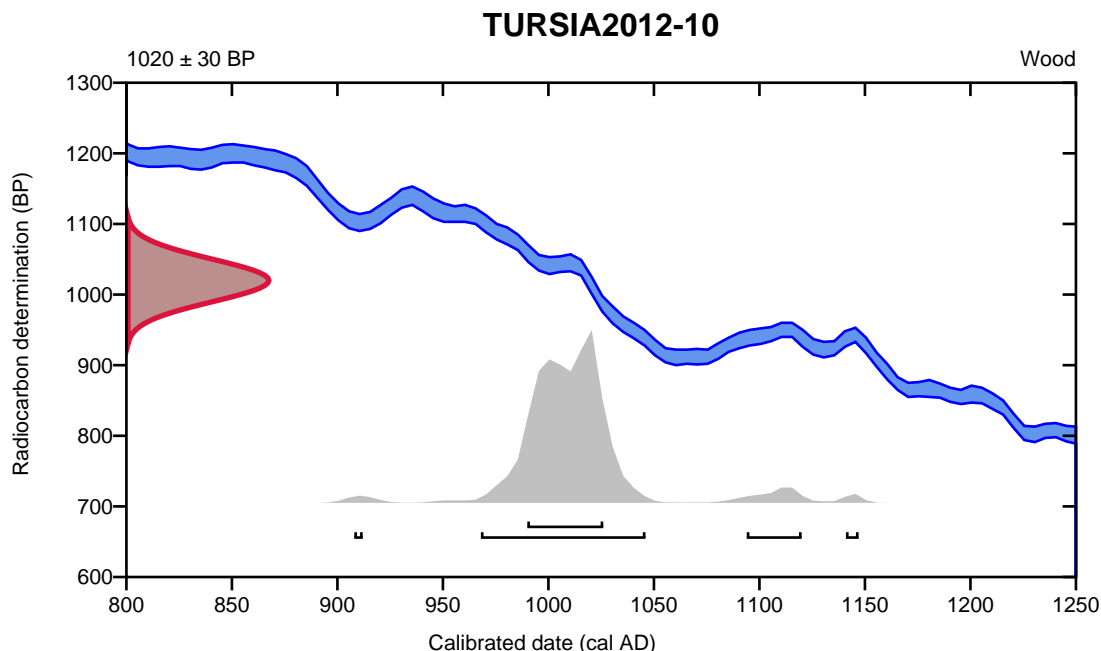
Conventional radiocarbon age **1020 ± 30 BP**

95.4% probability

(90.3%)	968 - 1046 cal AD	(982 - 904 cal BP)
(4.1%)	1094 - 1120 cal AD	(856 - 830 cal BP)
(0.7%)	1141 - 1147 cal AD	(809 - 803 cal BP)
(0.3%)	908 - 912 cal AD	(1042 - 1038 cal BP)

68.2% probability

(68.2%)	990 - 1026 cal AD	(960 - 924 cal BP)
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Database used
INTCAL13

References

References to Probability Method

Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. *Radiocarbon*, 51(1), 337-360.

References to Database INTCAL13

Reimer, et.al., 2013, *Radiocarbon*55(4).

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: $\delta^{13}C = -26.5$ o/oo)

Laboratory number **Beta-497223**

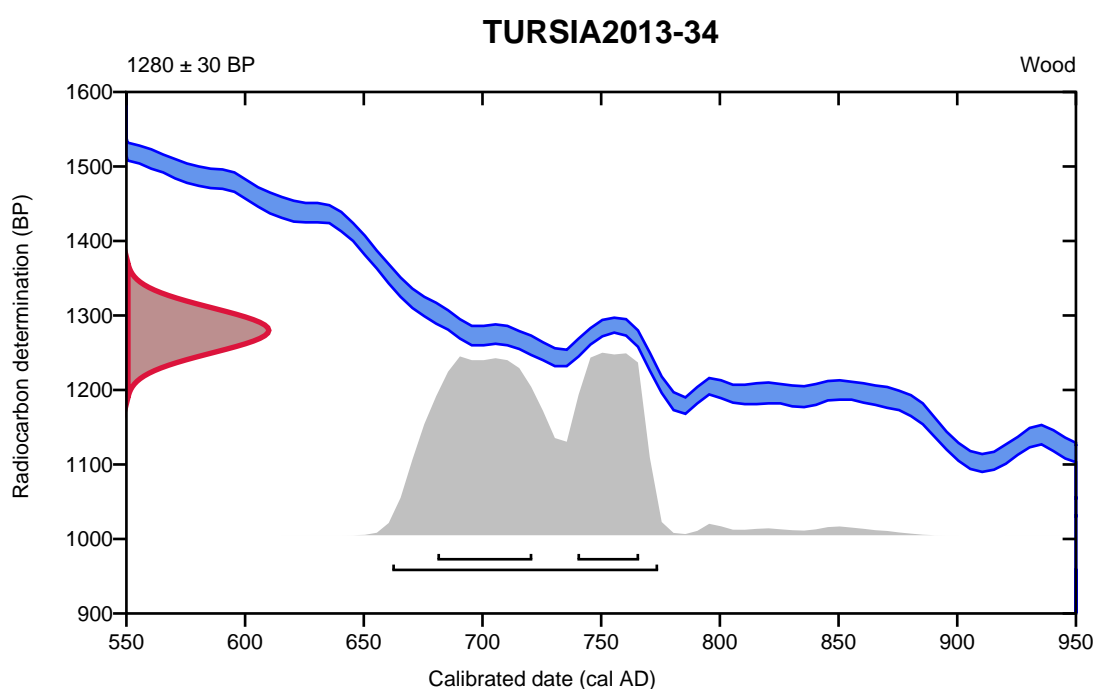
Conventional radiocarbon age **1280 ± 30 BP**

95.4% probability

(95.4%) 662 - 774 cal AD (1288 - 1176 cal BP)

68.2% probability

(40.8%) 681 - 721 cal AD (1269 - 1229 cal BP)
(27.4%) 740 - 766 cal AD (1210 - 1184 cal BP)



Database used
INTCAL13

References

References to Probability Method

Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. *Radiocarbon*, 51(1), 337-360.

References to Database INTCAL13

Reimer, et al., 2013, *Radiocarbon*55(4).