Beta Analytic Inc.
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Consistent Accuracy . . .
. . . Delivered On-time

Darden Hood
President

Ronald Hatfield
Christopher Patrick
Deputy Directors

February 10, 2014

Dr. Barbro I. Dahl
University of Stavanger
Museum of Archaeology
Stavanger, N-4036
Norway

RE: Radiocarbon Dating Results For Samples 2013/15-4, 2013/15-12, 2013/15-20, 2013/15-23, 2013/15-27, 2013/15-29, 2013/15-37, 2013/15-38

Dear Dr. Dahl:

Enclosed are the radiocarbon dating results for eight samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable.

The web directory containing the table of results and PDF download also contains pictures including, most importantly the portion actually analyzed. These can be saved by opening them and right clicking. Also a cvs spreadsheet download option is available and a quality assurance report is posted for each set of results. This report contains expected versus measured values for 3-5 working standards analyzed simultaneously with your samples.

All results reported are accredited to ISO-17025 standards and all analyses were performed entirely here in our laboratories. Since Beta is not a teaching laboratory, only graduates trained in accordance with the strict protocols of the ISO-17025 program participated in the analyses. When interpreting the results, please consider any communications you may have had with us regarding the samples.

If you have specific questions about the analyses, please contact us. Your inquiries are always welcome.

Our invoice has been sent separately. Thank you for your prior efforts in arranging payment. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood
Digital signature on file

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
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MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. Barbro I. Dahl — Report Date: 2/10/2014

University of Stavanger — Material Received: 2/3/2014

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 371951	2320 +/- 30 BP	-26.6 o/oo	2290 +/- 30 BP

SAMPLE : 2013/15-4
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 400 to 360 (Cal BP 2350 to 2310) AND Cal BC 280 to 260 (Cal BP 2230 to 2210)
Cal BC 240 to 240 (Cal BP 2190 to 2180)

Beta - 371952	3490 +/- 30 BP	-26.7 o/oo	3460 +/- 30 BP

SAMPLE : 2013/15-12
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 1880 to 1720 (Cal BP 3830 to 3680) AND Cal BC 1720 to 1690 (Cal BP 3670 to 3640)

Beta - 371953	3160 +/- 30 BP	-26.3 o/oo	3140 +/- 30 BP

SAMPLE : 2013/15-20
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 1490 to 1480 (Cal BP 3440 to 3430) AND Cal BC 1450 to 1380 (Cal BP 3400 to 3340)
Cal BC 1330 to 1320 (Cal BP 3280 to 3280)

Beta - 371954	3470 +/- 30 BP	-26.3 o/oo	3450 +/- 30 BP

SAMPLE : 2013/15-23
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 1880 to 1840 (Cal BP 3830 to 3790) AND Cal BC 1830 to 1690 (Cal BP 3780 to 3640)

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.

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REPORT OF RADIOCARBON DATING ANALYSES

Dr. Barbro I. Dahl

Report Date: 2/10/2014

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 371955 SAMPLE : 2013/15-27 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal BC 510 to 390 (Cal BP 2460 to 2340)	2380 +/- 30 BP	-25.5 o/oo	2370 +/- 30 BP
Beta - 371956 SAMPLE : 2013/15-29 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal BC 410 to 380 (Cal BP 2360 to 2330)	2340 +/- 30 BP	-25.8 o/oo	2330 +/- 30 BP
Beta - 371957 SAMPLE : 2013/15-37 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal BC 1410 to 1260 (Cal BP 3360 to 3210)	3090 +/- 30 BP	-27.0 o/oo	3060 +/- 30 BP
Beta - 371958 SAMPLE : 2013/15-38 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal BC 1410 to 1260 (Cal BP 3360 to 3210)	3100 +/- 30 BP	-26.8 o/oo	3070 +/- 30 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.

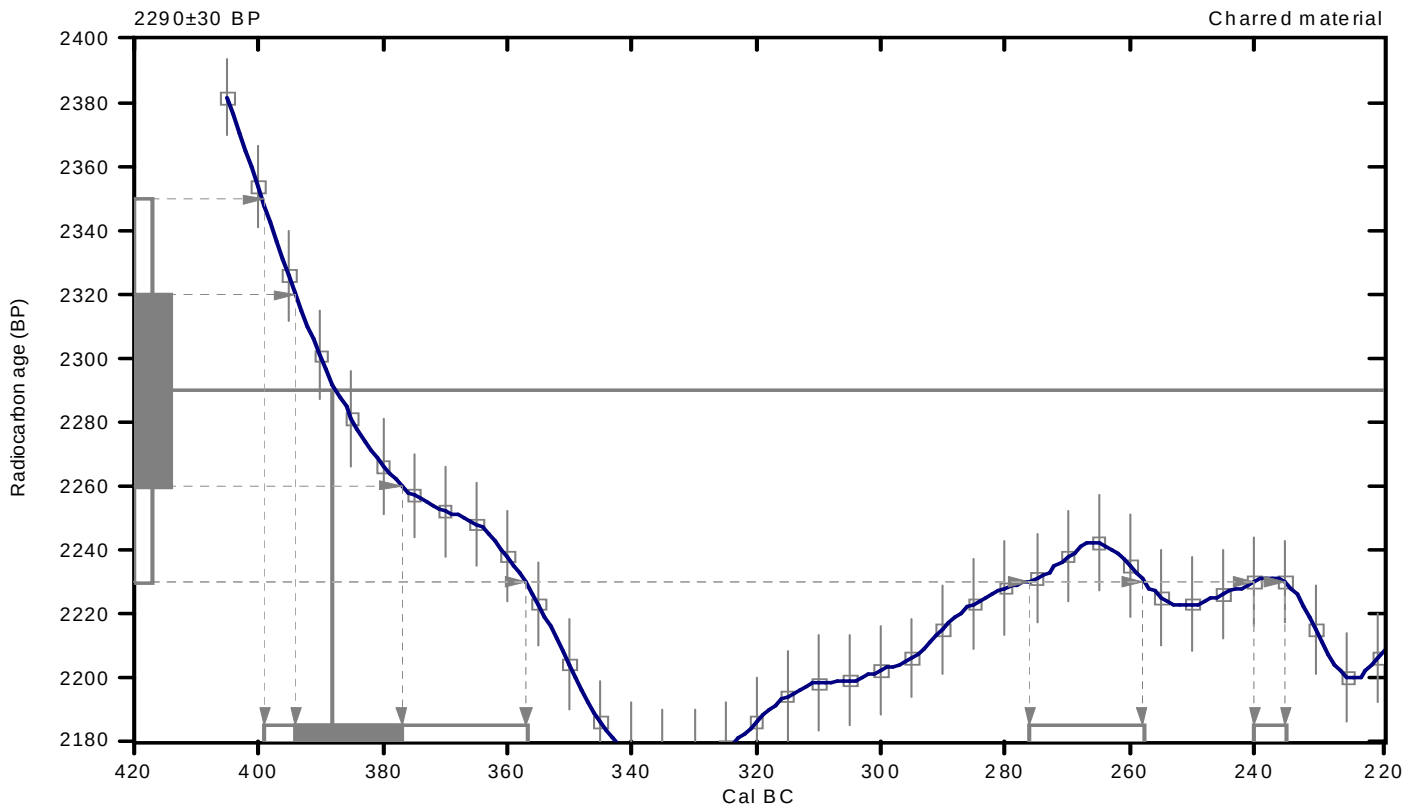
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

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

Laboratory number:	**Beta-371951**
Conventional radiocarbon age:	**2290±30 BP**
2 Sigma calibrated results: (95% probability)	**Cal BC 400 to 360 (Cal BP 2350 to 2310) and Cal BC 280 to 260 (Cal BP 2230 to 2210) and Cal BC 240 to 240 (Cal BP 2190 to 2180)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 390 (Cal BP 2340)
1 Sigma calibrated result: (68% probability)	Cal BC 390 to 380 (Cal BP 2340 to 2330)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton,et.al.,2009, Radiocarbon 51(4):1151-1164, Reimer,et.al, 2009, Radiocarbon 51(4):1111-1150, Stuiver,et.al,1993, Radiocarbon 35(1):1-244, Oeschger,et.al.,1975,Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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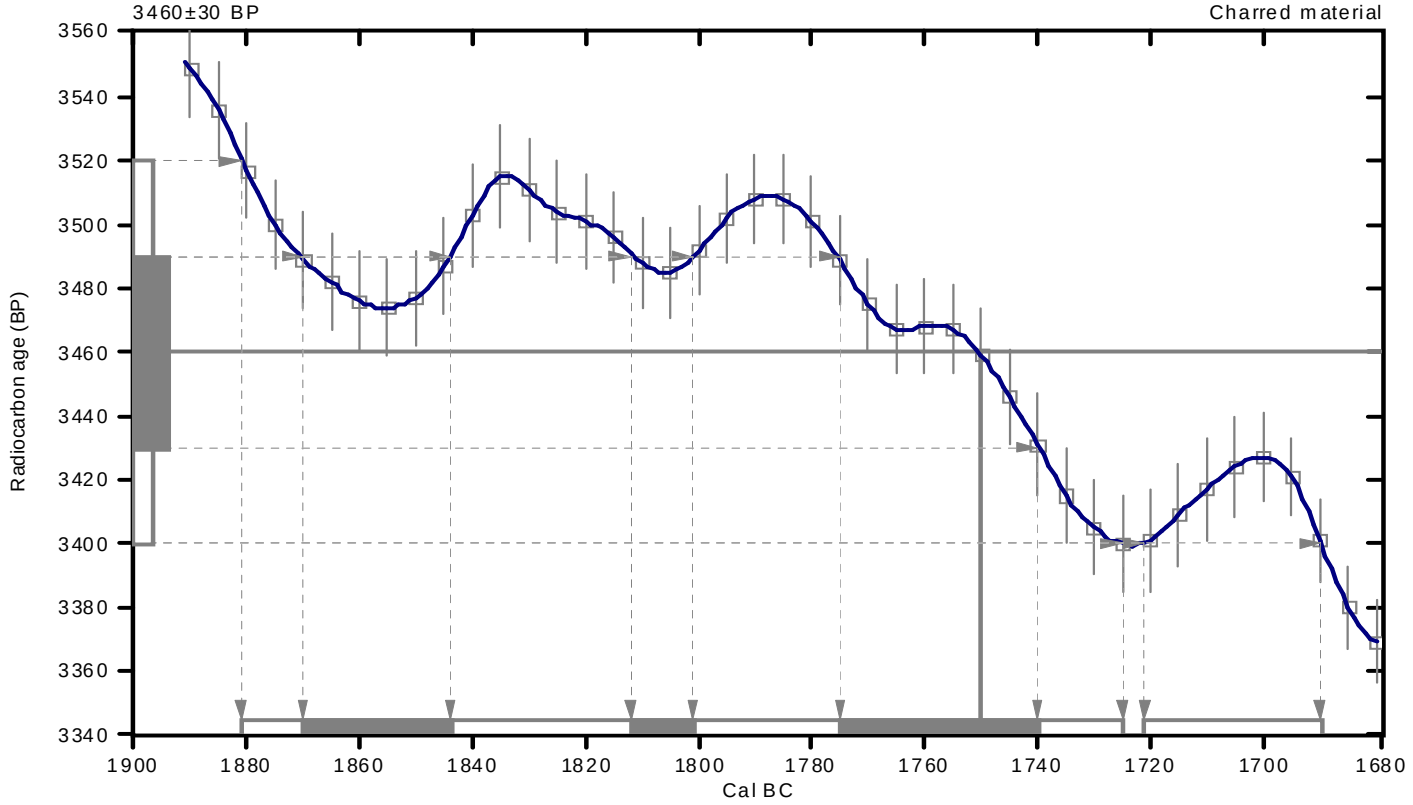
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.7:lab. mult=1)

Laboratory number:	**Beta-371952**
Conventional radiocarbon age:	**3460±30 BP**
2 Sigma calibrated results: **(95% probability)**	**Cal BC 1880 to 1720 (Cal BP 3830 to 3680) and** **Cal BC 1720 to 1690 (Cal BP 3670 to 3640)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 1750 (Cal BP 3700)
1 Sigma calibrated results: (68% probability)	Cal BC 1870 to 1840 (Cal BP 3820 to 3790) and Cal BC 1810 to 1800 (Cal BP 3760 to 3750) and Cal BC 1780 to 1740 (Cal BP 3720 to 3690)



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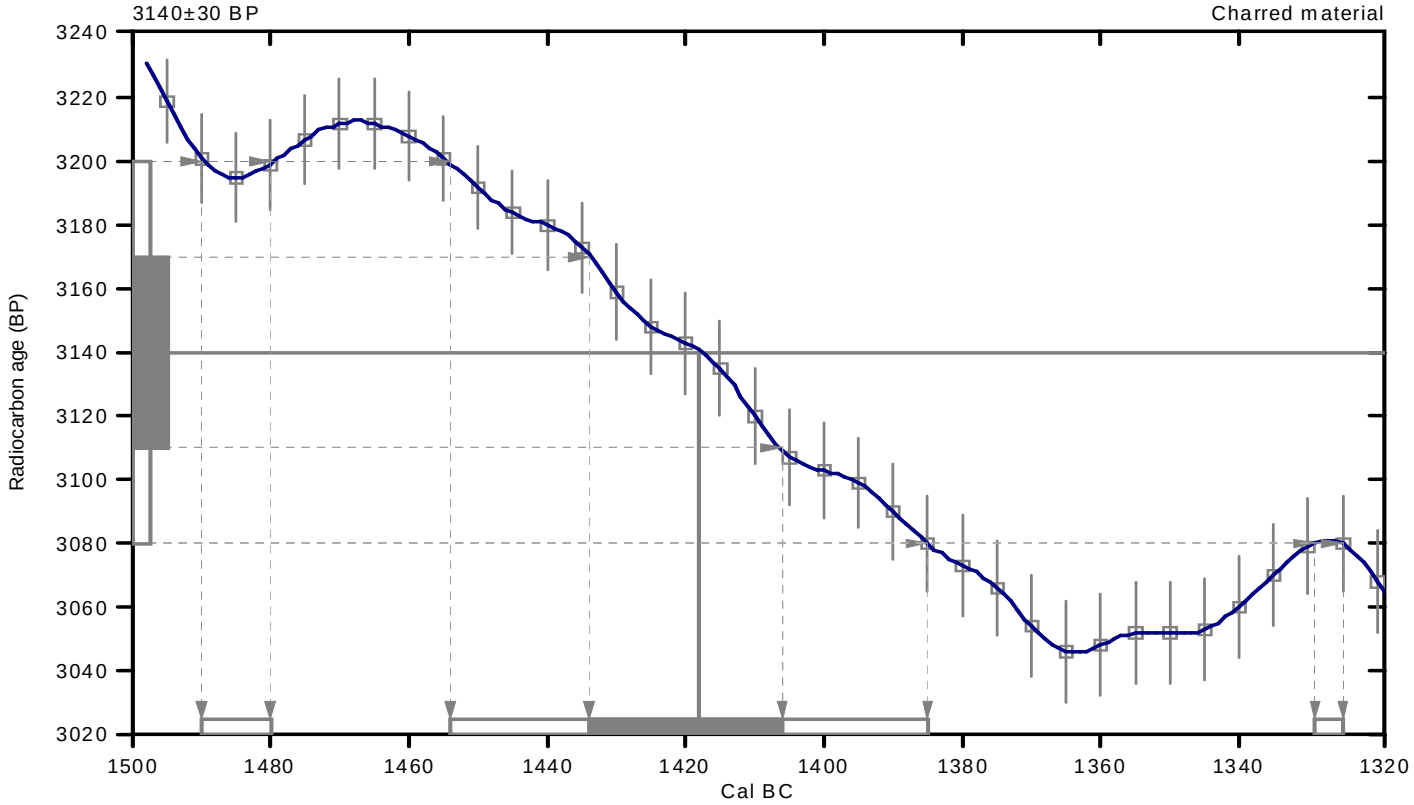
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.3:lab. mult=1)

Laboratory number:	**Beta-371953**
Conventional radiocarbon age:	**3140±30 BP**
2 Sigma calibrated results: (95% probability)	**Cal BC 1490 to 1480 (Cal BP 3440 to 3430) and Cal BC 1450 to 1380 (Cal BP 3400 to 3340) and Cal BC 1330 to 1320 (Cal BP 3280 to 3280)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 1420 (Cal BP 3370)
1 Sigma calibrated result: (68% probability)	Cal BC 1430 to 1410 (Cal BP 3380 to 3360)



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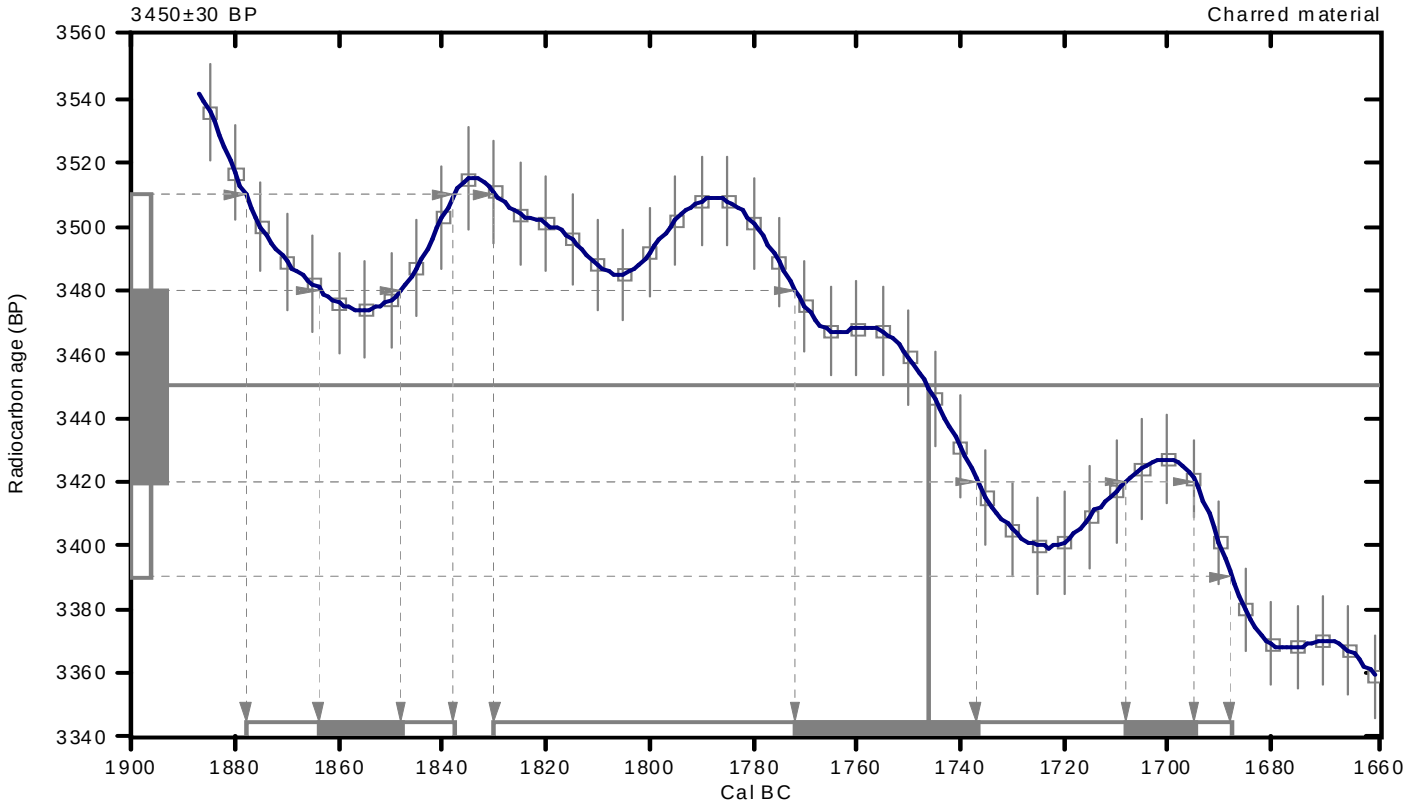
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.3:lab. mult=1)

Laboratory number:	**Beta-371954**
Conventional radiocarbon age:	**3450±30 BP**
2 Sigma calibrated results: **(95% probability)**	**Cal BC 1880 to 1840 (Cal BP 3830 to 3790) and** **Cal BC 1830 to 1690 (Cal BP 3780 to 3640)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 1750 (Cal BP 3700)
1 Sigma calibrated results: (68% probability)	Cal BC 1860 to 1850 (Cal BP 3810 to 3800) and Cal BC 1770 to 1740 (Cal BP 3720 to 3690) and Cal BC 1710 to 1700 (Cal BP 3660 to 3640)



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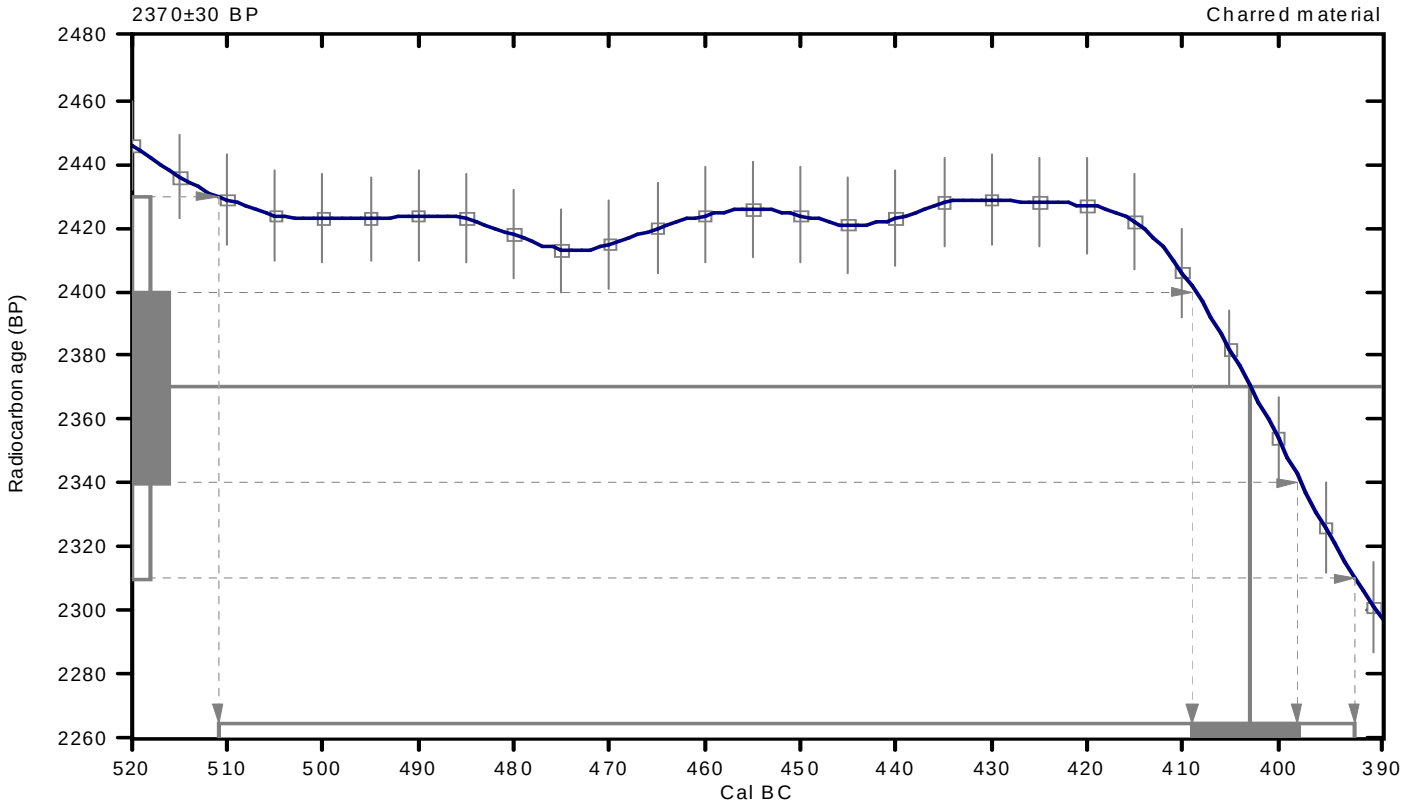
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

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

Laboratory number:	**Beta-371955**
Conventional radiocarbon age:	**2370±30 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 510 to 390 (Cal BP 2460 to 2340)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 400 (Cal BP 2350)
1 Sigma calibrated result: (68% probability)	Cal BC 410 to 400 (Cal BP 2360 to 2350)



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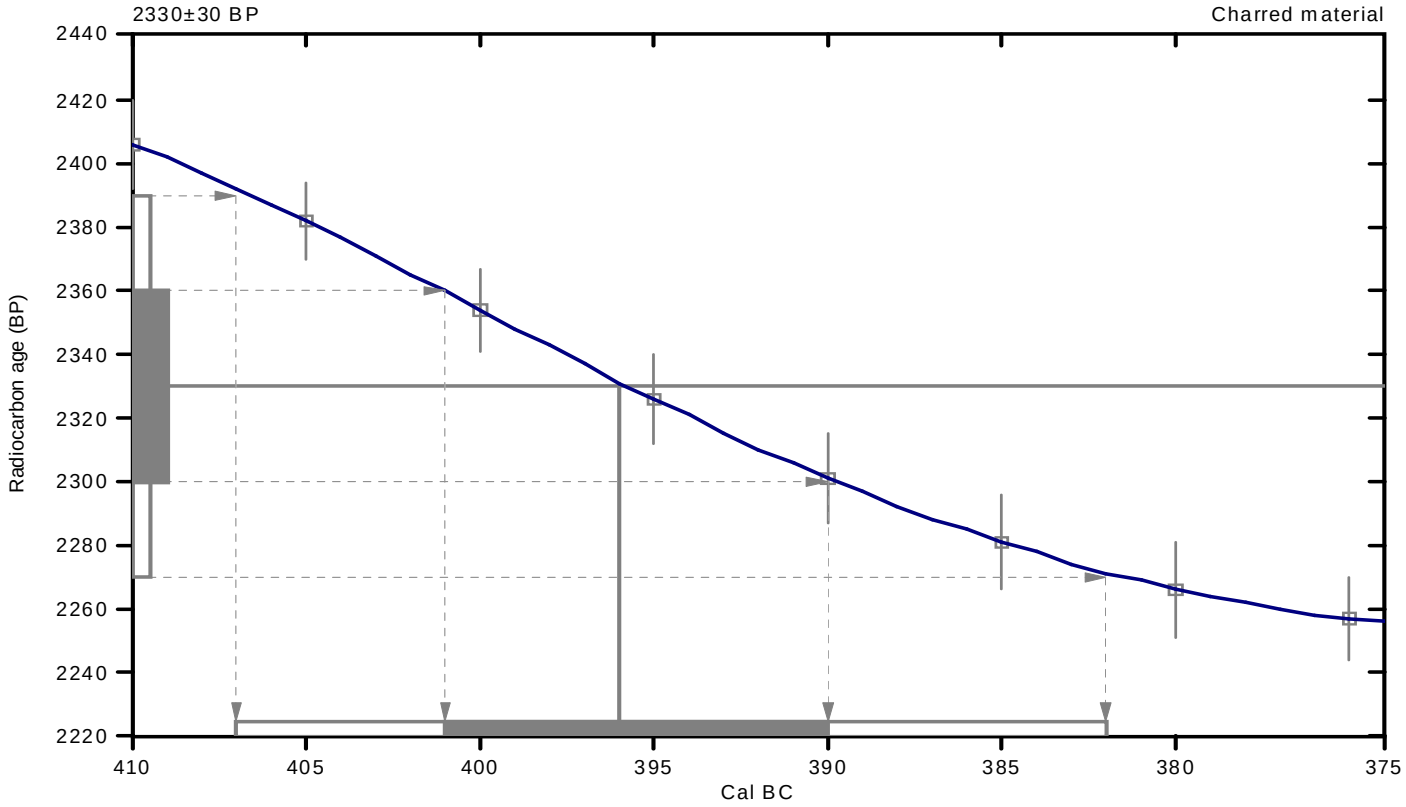
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.8:lab. mult=1)

Laboratory number:	**Beta-371956**
Conventional radiocarbon age:	**2330±30 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 410 to 380 (Cal BP 2360 to 2330)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 400 (Cal BP 2350)
1 Sigma calibrated result: (68% probability)	Cal BC 400 to 390 (Cal BP 2350 to 2340)



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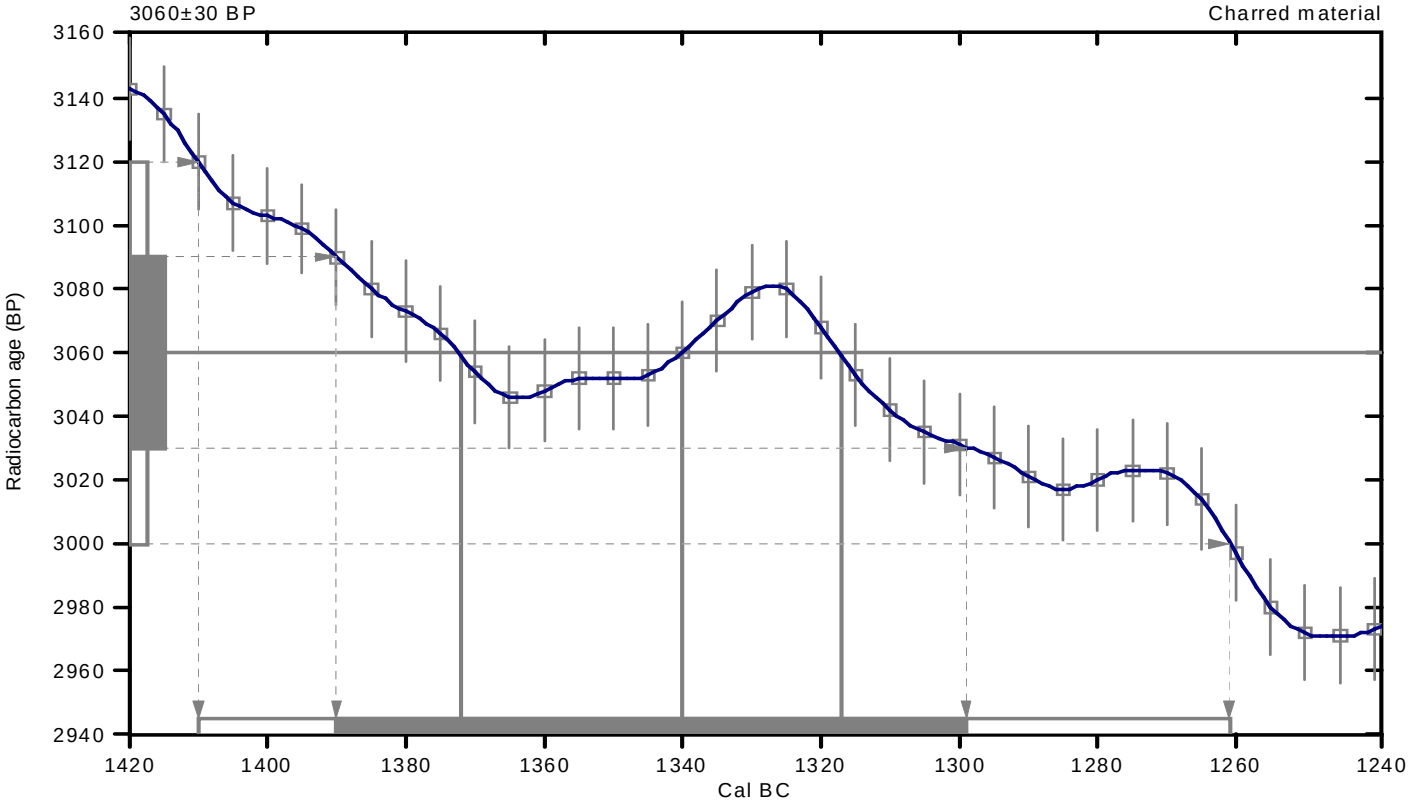
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27:lab. mult=1)

Laboratory number:	**Beta-371957**
Conventional radiocarbon age:	**3060±30 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 1410 to 1260 (Cal BP 3360 to 3210)**

Intercept data

Intercepts of radiocarbon age with calibration curve:	Cal BC 1370 (Cal BP 3320) and Cal BC 1340 (Cal BP 3290) and Cal BC 1320 (Cal BP 3270)
1 Sigma calibrated result: (68% probability)	Cal BC 1390 to 1300 (Cal BP 3340 to 3250)



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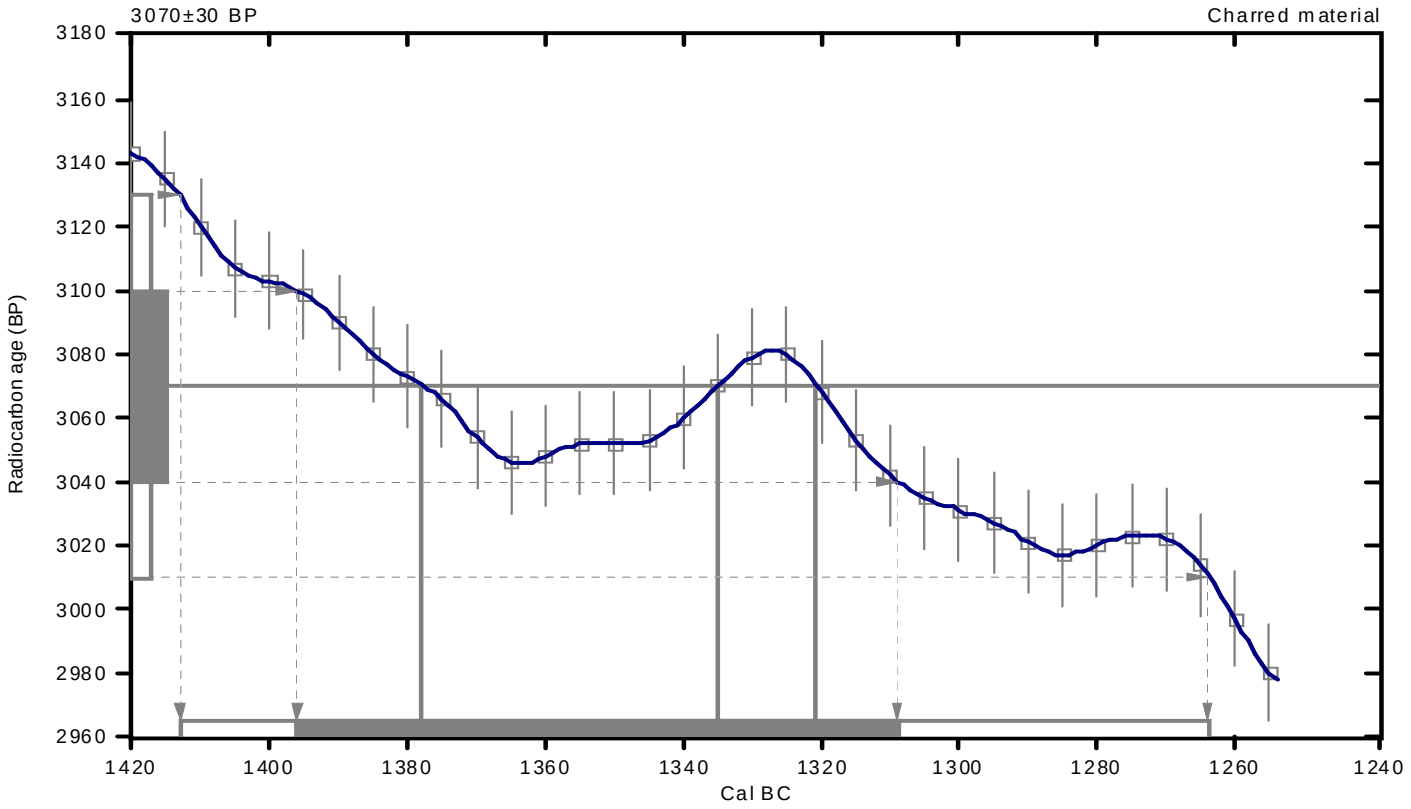
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.8:lab. mult=1)

Laboratory number:	**Beta-371958**
Conventional radiocarbon age:	**3070±30 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 1410 to 1260 (Cal BP 3360 to 3210)**

Intercept data

Intercepts of radiocarbon age with calibration curve:	Cal BC 1380 (Cal BP 3330) and Cal BC 1340 (Cal BP 3280) and Cal BC 1320 (Cal BP 3270)
1 Sigma calibrated result: (68% probability)	Cal BC 1400 to 1310 (Cal BP 3350 to 3260)



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