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July 27, 2017

Benjamin Arbuckle
University of North Carolina at Chapel Hill
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RE: Radiocarbon Dating Results

Dr. Arbuckle,

Enclosed is the radiocarbon dating result for one sample recently sent to us. As usual, specifics of the analysis are listed on the report with the result and calibration data is provided where applicable. The Conventional Radiocarbon Age has 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.

The reported result is accredited to ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 standards and all pretreatments and chemistry were performed here in our laboratories and counted in our own accelerators here in Miami. 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 analysis.

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 d13C was measured separately in an IRMS (isotope ratio mass spectrometer). It is NOT the AMS d13C which would include fractionation effects from natural, chemistry and AMS induced sources.

When interpreting the result, please consider any communications you may have had with us regarding the sample. As always, your inquiries are most welcome. If you have any questions or would like further details of the analysis, please do not hesitate to contact us.

Our invoice will be emailed separately. Please forward it to the appropriate officer or send a credit card authorization. Thank you. As always, if you have any questions or would like to discuss the results, don't hesitate to contact us.

Sincerely ,



Digital signature on file



REPORT OF RADIOCARBON DATING ANALYSES

Dr. Benjamin Arbuckle

Report Date: July 27, 2017

University of North Carolina at Chapel Hill

Material Received: July 20, 2017

Sample Information and Data	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 - 470052	Hx7-305	1010 +/- 30 BP	IRMS $\delta^{13}\text{C}$: -21.3 o/oo IRMS $\delta^{15}\text{N}$: +6.6 o/oo
Submitter Material: Bone (Non-heated)		(82.4%) 973 - 1049 cal AD	(977 - 901 cal BP)
Analyzed Material: Bone collagen		(10.4%) 1085 - 1124 cal AD	(865 - 826 cal BP)
Pretreatment: (bone collagen) collagen extraction with alkali		(2.6%) 1136 - 1150 cal AD	(814 - 800 cal BP)
Analysis Service: AMS-Standard delivery			
Percent Modern Carbon: 88.19 +/- 0.33 pMC			
Fraction Modern Carbon: 0.8819 +/- 0.0033			
D14C: -118.15 +/- 3.29 o/oo			
$\Delta^{14}\text{C}$: -125.27 +/- 3.29 o/oo(1950:2017)			
Measured Radiocarbon Age: (without d13C correction): 950 +/- 30 BP			
Calibration: BetaCal3.21: HPD method: INTCAL13			
Carbon/Nitrogen: CN : 3.4 %C: 42.58 %N: 14.60			

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 ^{14}C 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. $\delta^{13}\text{C}$ values are on the material itself (not the AMS $\delta^{13}\text{C}$). $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ 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: $\delta^{13}\text{C} = -21.3$ o/oo)

Laboratory number **Beta-470052**

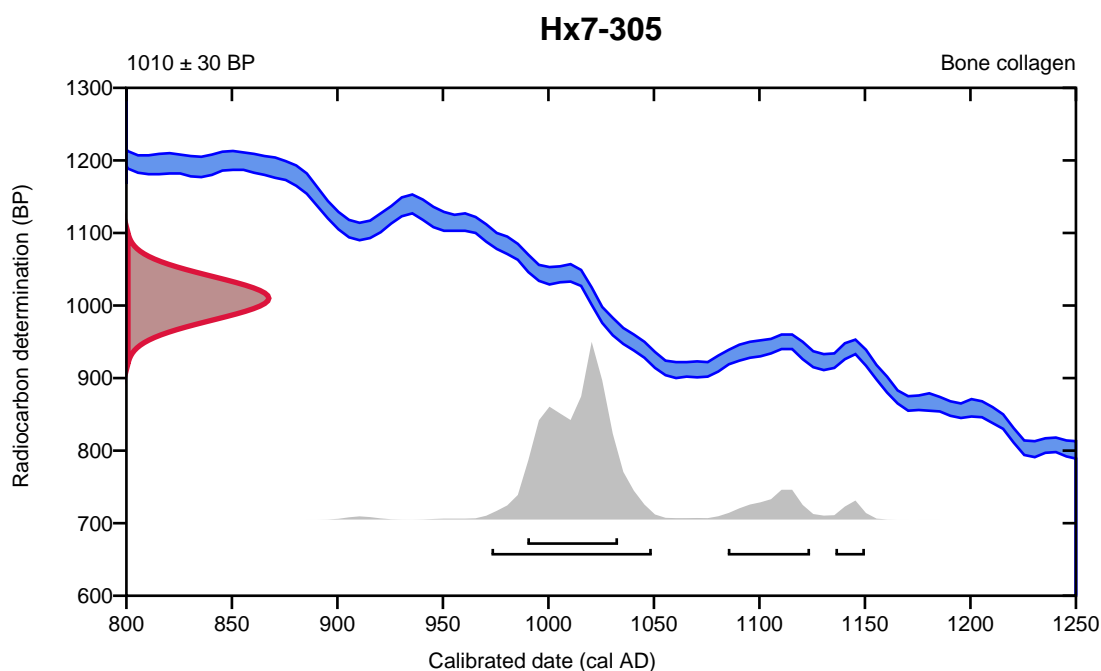
Conventional radiocarbon age **1010 \pm 30 BP**

95.4% probability

(82.4%)	973 - 1049 cal AD	(977 - 901 cal BP)
(10.4%)	1085 - 1124 cal AD	(865 - 826 cal BP)
(2.6%)	1136 - 1150 cal AD	(814 - 800 cal BP)

68.2% probability

(68.2%)	990 - 1033 cal AD	(960 - 917 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, Radiocarbon55(4).



Radiocarbon Dating

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The Radiocarbon Laboratory Accredited to ISO/IEC 17025:2005 Testing Accreditation PJLA #59423

Quality Assurance Report

This report provides the results of reference materials used to validate radiocarbon analyses prior to reporting. Known-value reference materials were analyzed quasi-simultaneously with the unknowns. Results are reported as expected values vs measured values. Reported values are calculated relative to NIST SRM-4990B and corrected for isotopic fractionation. Results are reported using the direct analytical measure percent modern carbon (pMC) with one relative standard deviation. Agreement between expected and measured values is taken as being within 2 sigma agreement (error x 2) to account for total laboratory error.

Report Date: July 27, 2017
Submitter: Dr. Benjamin Arbuckle

QA MEASUREMENTS

Reference 1

Expected Value: 0.44 +/- 0.10 pMC

Measured Value: 0.43 +/- 0.03 pMC

Agreement: Accepted

Reference 2

Expected Value: 129.41 +/- 0.06 pMC

Measured Value: 129.54 +/- 0.39 pMC

Agreement: Accepted

Reference 3

Expected Value: 96.69 +/- 0.50 pMC

Measured Value: 96.83 +/- 0.29 pMC

Agreement: Accepted

COMMENT: All measurements passed acceptance tests.

Validation:

Date: July 27, 2017