



Beta Analytic
TESTING LABORATORY

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ISO/IEC 17025:2005-Accredited Testing Laboratory

July 25, 2019

Mr. Keith Freeman
Ring Organic
759 Blossom Hill Road
Los Gatos, CA 95032
United States

RE: Radiocarbon Dating Results

Dear Mr. Freeman,

Enclosed are the radiocarbon dating results for two samples recently sent to us. The report sheet contains the Conventional Radiocarbon Age (BP), the method used, material type, and applied pretreatments, any sample specific comments and, where applicable, the two-sigma calendar calibration range. The Conventional Radiocarbon ages have been corrected for total isotopic fractionation effects (natural and laboratory induced).

All results (excluding some inappropriate material types) which fall within the range of available calibration data are calibrated to calendar years (cal BC/AD) and calibrated radiocarbon years (cal BP). Calibration was calculated using one of the databases associated with the 2013 INTCAL program (cited in the references on the bottom of the calibration graph page provided for each sample.) Multiple probability ranges may appear in some cases, due to short-term variations in the atmospheric ^{14}C contents at certain time periods. Looking closely at the calibration graph provided and where the BP sigma limits intercept the calibration curve will help you understand this phenomenon.

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.

All work on these samples was performed in our laboratories in Miami under strict chain of custody and quality control under ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 accreditation protocols. Sample, modern and blanks were all analyzed in the same chemistry lines by qualified professional technicians using identical reagents and counting parameters within our own particle accelerators. A quality assurance report is posted to your directory for each result.

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

Ronald E. Hatfield Director



REPORT OF RADIOCARBON DATING ANALYSES

Keith Freeman

Report Date: July 25, 2019

Ring Organic

Material Received: June 12, 2019

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 - 527982

Seabird One

18150 +/- 50 BP

IRMS $\delta^{13}C$: -24.3 o/oo

(95.4%) 20241 - 19805 cal BC (22190 - 21754 cal BP)

Submitter Material: Dung
 Pretreatment: (organic sediment) acid washes
 Analyzed Material: Organic sediment
 Analysis Service: AMS-Standard delivery
 Percent Modern Carbon: 10.44 +/- 0.06 pMC
 Fraction Modern Carbon: 0.1044 +/- 0.0006
 D14C: -895.59 +/- 0.65 o/oo
 $\Delta^{14}C$: -896.46 +/- 0.65 o/oo(1950:2,019.00)
 Measured Radiocarbon Age: (without $\delta^{13}C$ correction): 18140 +/- 50 BP
 Calibration: BetaCal3.21: HPD method: SHCAL13

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. $\delta^{13}C$ values are on the material itself (not the AMS $\delta^{13}C$). $\delta^{13}C$ and $\delta^{15}N$ values are relative to VPDB-1. References for calendar calibrations are cited at the bottom of calibration graph pages.



REPORT OF RADIOCARBON DATING ANALYSES

Keith Freeman

Report Date: July 25, 2019

Ring Organic

Material Received: June 12, 2019

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 - 527983

Seabird Two

7260 +/- 30 BP

IRMS $\delta^{13}C$: -21.2 o/oo

(73.1%)

6126 - 6011 cal BC

(8075 - 7960 cal BP)

(22.3%)

6210 - 6135 cal BC

(8159 - 8084 cal BP)

Submitter Material: Dung

Pretreatment: (organic sediment) acid washes

Analyzed Material: Organic sediment

Analysis Service: AMS-Standard delivery

Percent Modern Carbon: 40.50 +/- 0.15 pMC

Fraction Modern Carbon: 0.4050 +/- 0.0015

D14C: -594.96 +/- 1.51 o/oo

$\Delta^{14}C$: -598.33 +/- 1.51 o/oo(1950:2,019.00)

Measured Radiocarbon Age: (without $\delta^{13}C$ correction): 7200 +/- 30 BP

Calibration: BetaCal3.21: HPD method: SHCAL13

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. $\delta^{13}C$ values are on the material itself (not the AMS $\delta^{13}C$). $\delta^{13}C$ and $\delta^{15}N$ 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): SHCAL13)

(Variables: $\delta^{13}\text{C} = -24.3$ o/oo)

Laboratory number **Beta-527982**

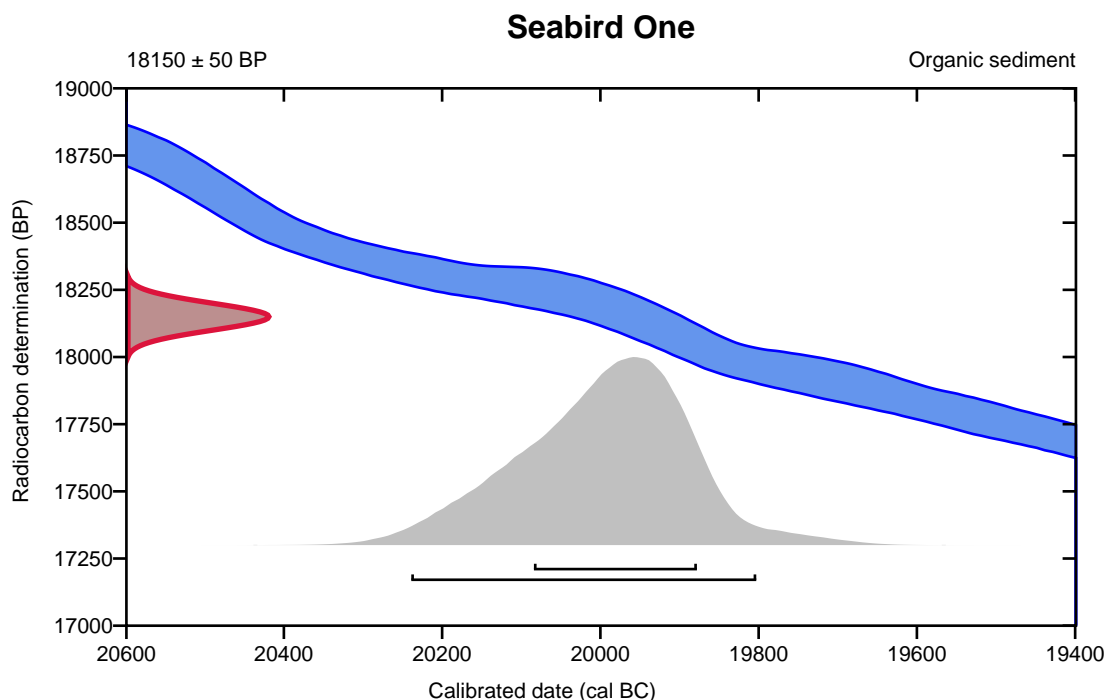
Conventional radiocarbon age **18150 \pm 50 BP**

95.4% probability

(95.4%) 20241 - 19805 cal BC (22190 - 21754 cal BP)

68.2% probability

(68.2%) 20086 - 19880 cal BC (22035 - 21829 cal BP)



Database used
SHCAL13

References

References to Probability Method

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

References to Database SHCAL13

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

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): SHCAL13)

(Variables: $\delta^{13}C = -21.2$ o/oo)

Laboratory number **Beta-527983**

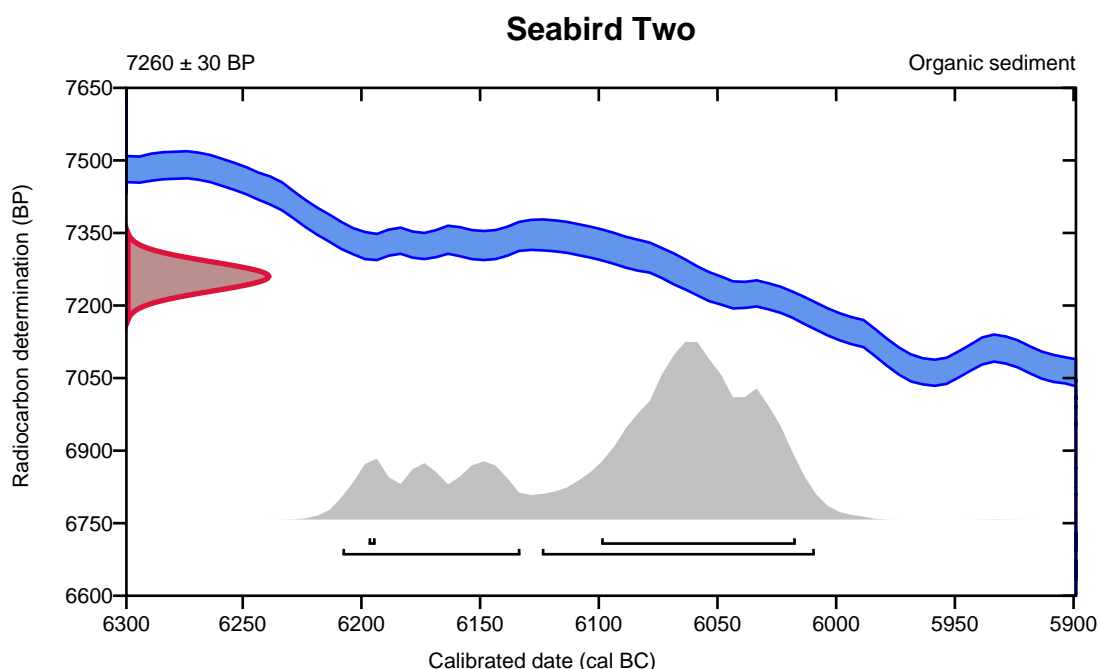
Conventional radiocarbon age **7260 \pm 30 BP**

95.4% probability

(73.1%)	6126 - 6011 cal BC	(8075 - 7960 cal BP)
(22.3%)	6210 - 6135 cal BC	(8159 - 8084 cal BP)

68.2% probability

(67%)	6101 - 6019 cal BC	(8050 - 7968 cal BP)
(1.2%)	6199 - 6196 cal BC	(8148 - 8145 cal BP)



Database used
SHCAL13

References

References to Probability Method

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

References to Database SHCAL13

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



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 25, 2019
Submitter: Mr. Keith Freeman

QA MEASUREMENTS

Reference 1

Expected Value: 129.41 +/- 0.06 pMC

Measured Value: 130.22 +/- 0.37 pMC

Agreement: Accepted

Reference 2

Expected Value: 0.42 +/- 0.04

Measured Value: 0.43 +/- 0.03 pMC

Agreement: Accepted

Reference 3

Expected Value: 96.69 +/- 0.50 pMC

Measured Value: 96.79 +/- 0.28 pMC

Agreement: Accepted

COMMENT: All measurements passed acceptance tests.

Validation:


Digital signature on file

Date: July 25, 2019