



ISO/IEC 17025:2017-Accredited Testing Laboratory

January 15, 2025

Aisha Huseen
Museum für Naturkunde, Berlin.
Invalidenstrasse. 43.
Berlin, 10115
Germany

Dear Aisha Huseen,

Enclosed are the radiocarbon dating results for the 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 2020 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.

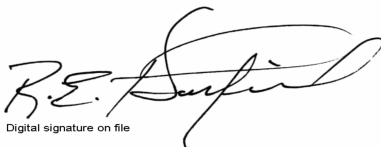
Reported results are accredited to ISO/IEC 17025:2017 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators here. Since Beta is not a teaching laboratory, only graduates trained to strict protocols of the ISO/IEC 17025:2017 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 unless otherwise requested. The reported d13C values were measured separately in an IRMS (isotope ratio mass spectrometer). They are NOT the AMS d13C 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,



Digital signature on file

Mr. Ron Hatfield
Laboratory Management Group / President



REPORT OF RADIOCARBON DATING ANALYSIS

Submitter **Aisha Huseen**

Received Date **December 16, 2024**

Company **Museum für Naturkunde, Berlin.**

Report Date **January 15, 2025**

Laboratory Number **Beta-726143**

To validate report, scan this QR code on a mobile device or go to <https://verify.betalabservices.com> and enter the requested information.

Sample Code **M4/2019**



Conventional Radiocarbon Age **101.00 +/- 0.38 pMC**

Ratio of Stable Isotopes
IRMS $\delta^{13}\text{C}$: -17.3 o/oo
IRMS $\delta^{18}\text{O}$: 0.0 o/oo

95.4% Probability Calibrated Range(s)

(74.2%) 2016 - Post 2019 cal AD (-66 - Post -69 cal BP)
(21.2%) 1955 - 1957 cal AD (-5 - -7 cal BP)

Submitter Material Shell (Freshwater)

Pretreatment (Shell):acid etch

Analyzed Material Shell

Analysis Service AMS-Standard Delivery

Percent Modern Carbon 101.00 +/- 0.38 pMC

Fraction Modern Carbon 1.0100 +/- 0.0038

D^{14}C 10.01 +/- 3.76 o/oo

$\Delta^{14}\text{C}$ 0.89 +/- 3.76 o/oo (1950:2025)

Measured Radiocarbon Age (without d^{13}C correction): 102.60 +/- 0.38 pMC

Calibration BetaCal 5.0: High Probability Density Range Method: INTCAL20 + NHZ3

Results are ISO/IEC-17025 accredited. All work was done at Beta 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 10years 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 1sigma counting statistics. Calculated sigmas less than 30BP on the Conventional Radiocarbon Age are conservatively rounded up to 30. d^{13}C values are on the material itself (not the AMS d^{13}C). d^{13}C and d^{15}N values are relative to VPDB. References for calendar calibrations are cited at the bottom of calibration graph pages.



REPORT OF RADIOCARBON DATING ANALYSIS

Submitter **Aisha Huseen**

Received Date **December 16, 2024**

Company **Museum für Naturkunde, Berlin.**

Report Date **January 15, 2025**

Laboratory Number **Beta-726144**

Sample Code **Oy/2021/A**

To validate report, scan this QR code on a mobile device or go to <https://verify.betalabservices.com> and enter the requested information.



Conventional Radiocarbon Age **102.14 +/- 0.38 pMC**

Ratio of Stable Isotopes
IRMS $\delta^{13}\text{C}$: -12.3 o/oo
IRMS $\delta^{18}\text{O}$: 0.6 o/oo

95.4% Probability Calibrated Range(s)

(75.2%) **2013 - Post 2018 cal AD (-63 - Post -68 cal BP)**
(20.2%) **1955 - 1957 cal AD (-5 - -7 cal BP)**

Submitter Material Shell (Freshwater)

Pretreatment (Shell):acid etch

Analyzed Material Shell

Analysis Service AMS-Standard Delivery

Percent Modern Carbon 102.14 +/- 0.38 pMC

Fraction Modern Carbon 1.0214 +/- 0.0038

D^{14}C 21.39 +/- 3.81 o/oo

$\Delta^{14}\text{C}$ 12.16 +/- 3.81 o/oo (1950:2025)

Measured Radiocarbon Age (without d^{13}C correction): 104.81 +/- 0.38 pMC

Calibration BetaCal 5.0: High Probability Density Range Method: INTCAL20 + NHZ3

Results are ISO/IEC-17025 accredited. All work was done at Beta 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 10years 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 1sigma counting statistics. Calculated sigmas less than 30BP on the Conventional Radiocarbon Age are conservatively rounded up to 30. d^{13}C values are on the material itself (not the AMS d^{13}C). d^{13}C and d^{15}N values are relative to VPDB. References for calendar calibrations are cited at the bottom of calibration graph pages.



REPORT OF RADIOCARBON DATING ANALYSIS

Submitter **Aisha Huseen**

Received Date **December 16, 2024**

Company **Museum für Naturkunde, Berlin.**

Report Date **January 15, 2025**

Laboratory Number **Beta-726145**

Sample Code **Oy/2021B**

To validate report, scan this QR code on a mobile device or go to <https://verify.betalabservices.com> and enter the requested information.



Conventional Radiocarbon Age **104.58 +/- 0.39 pMC**

Ratio of Stable Isotopes
IRMS $\delta^{13}\text{C}$: -16.7 o/oo
IRMS $\delta^{18}\text{O}$: 1.5 o/oo

95.4% Probability Calibrated Range(s)

(95.4%) 2008 - 2012 cal AD (-58 - -62 cal BP)

Submitter Material Shell (Freshwater)

Pretreatment (Shell):acid etch

Analyzed Material Shell

Analysis Service AMS-Standard Delivery

Percent Modern Carbon 104.58 +/- 0.39 pMC

Fraction Modern Carbon 1.0458 +/- 0.0039

$\delta^{14}\text{C}$ 45.83 +/- 3.90 o/oo

$\Delta^{14}\text{C}$ 36.39 +/- 3.90 o/oo (1950:2025)

Measured Radiocarbon Age (without $\delta^{13}\text{C}$ correction): 106.37 +/- 0.39 pMC

Calibration BetaCal 5.0: High Probability Density Range Method: INTCAL20 + NHZ3

Results are ISO/IEC-17025 accredited. All work was done at Beta 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. References for calendar calibrations are cited at the bottom of calibration graph pages.



BetaCal 5.0
Calibration of Radiocarbon Age to Calendar Years
(High Probability Density Range Method: INTCAL20 + NHZ3)

(Variables: $\delta^{13}\text{C} = -17.3$ o/oo)

Beta-Laboratory Number **726143**
Percent Modern Carbon (F14C) **101.00 +/- 0.38 pMC**

95.4% Probability Calibrated Range(s)

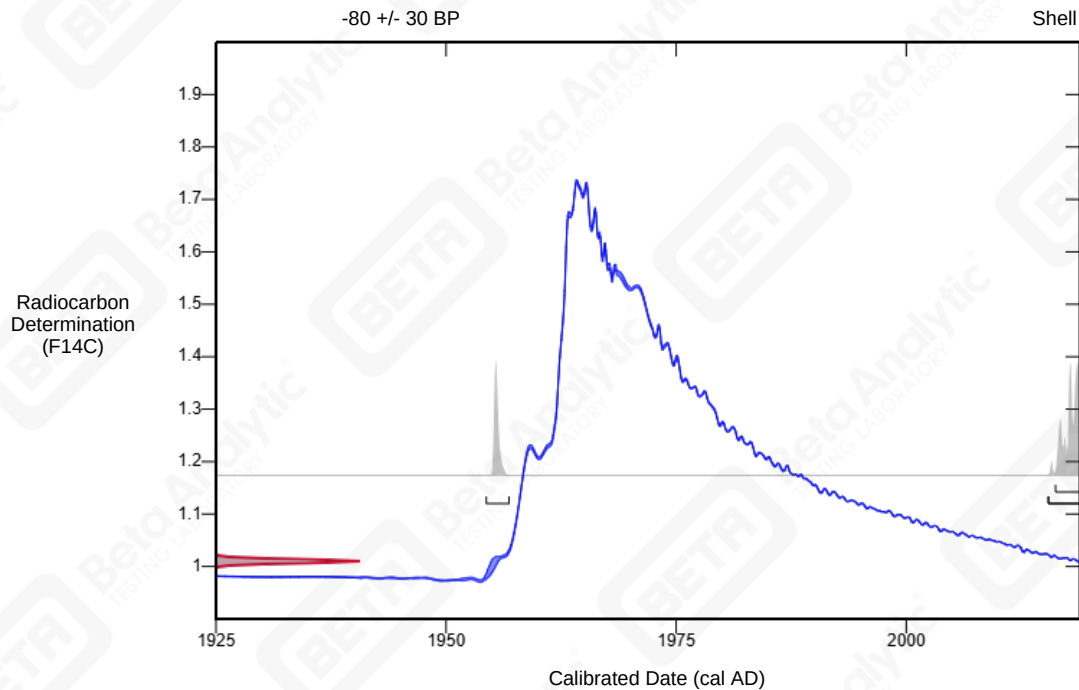
(74.2%) 2016 - Post 2019 cal AD (-66 - Post -69 cal BP)
(21.2%) 1955 - 1957 cal AD (-5 - -7 cal BP)

68.2% Probability Calibrated Range(s)

(68.2%) 2017 - Post 2019 cal AD (-67 - Post -69 cal BP)

The range in red above, may extend beyond 2018.875 cal AD

M4/2019



Database Used

INTCAL20 + NHZ3

References

References to Probability Method

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

References to Database INTCAL20 + NHZ3

Hua, et al., 2022, Radiocarbon 64(4): 723-745.

Reimer, et al., 2020, Radiocarbon 62(4): 725-757.



BetaCal 5.0
Calibration of Radiocarbon Age to Calendar Years
(High Probability Density Range Method: INTCAL20 + NHZ3)

(Variables: $\delta^{13}\text{C} = -12.3$ o/oo)

Beta-Laboratory Number **726144**
Percent Modern Carbon (F14C) **102.14 +/- 0.38 pMC**

95.4% Probability Calibrated Range(s)

(75.2%) 2013 - Post 2018 cal AD (-63 - Post -68 cal BP)

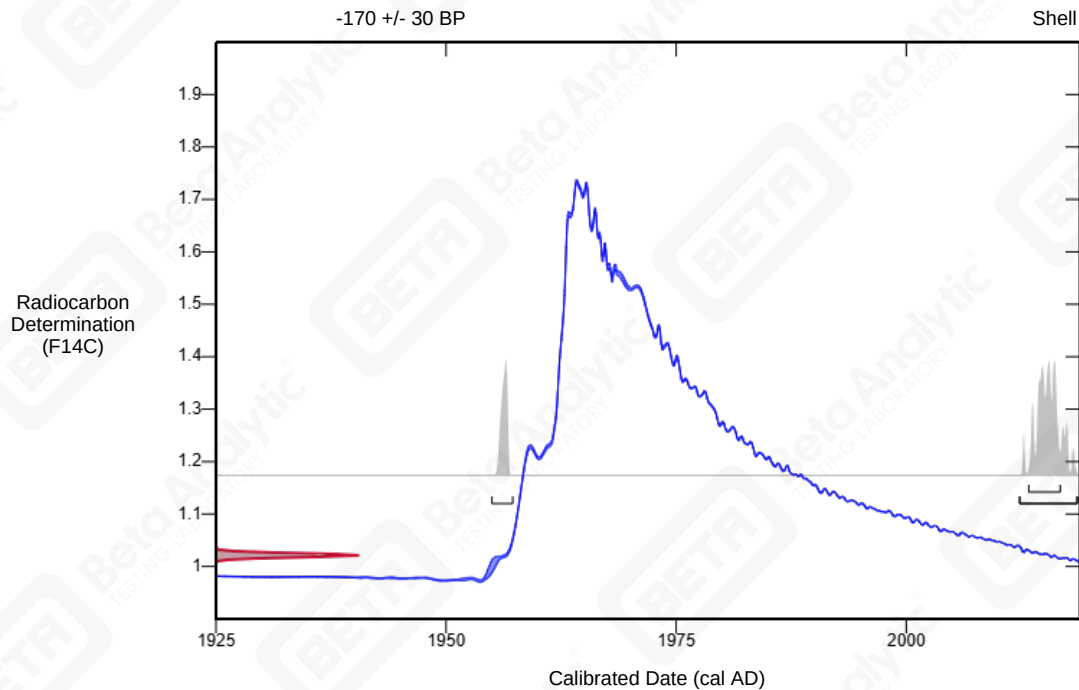
(20.2%) 1955 - 1957 cal AD (-5 - -7 cal BP)

68.2% Probability Calibrated Range(s)

(68.2%) 2014 - Post 2016 cal AD (-64 - Post -66 cal BP)

The range in red above, may extend beyond 2018.875 cal AD

Oy/2021/A



Database Used

INTCAL20 + NHZ3

References

References to Probability Method

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

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Hua, et al., 2022, Radiocarbon 64(4): 723-745.

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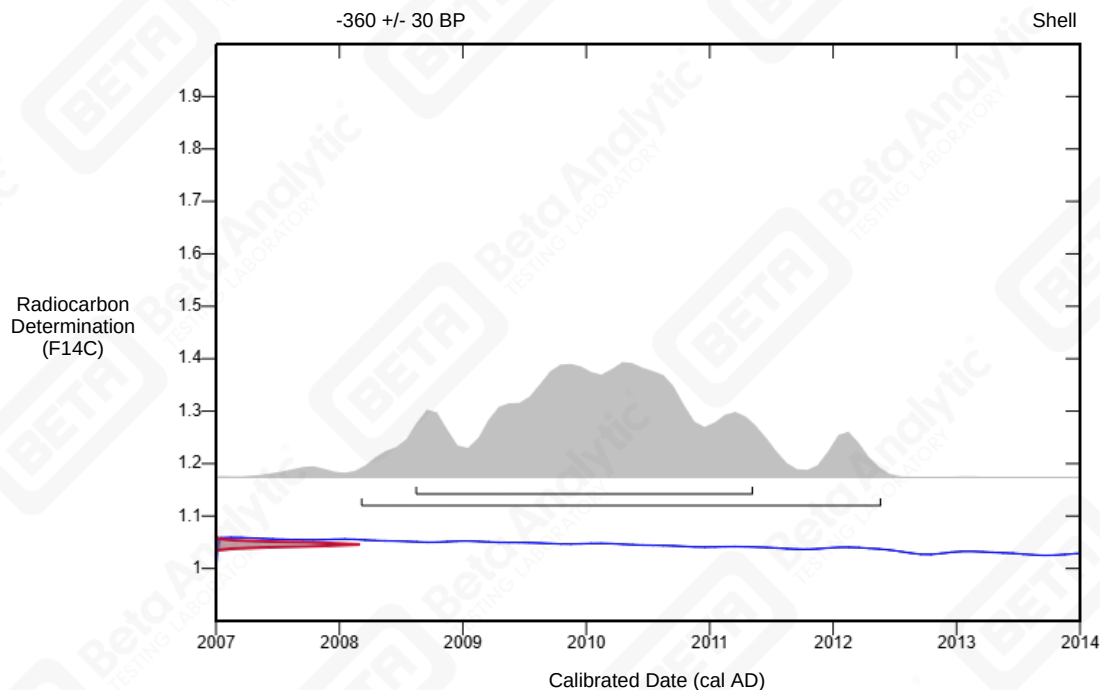
BetaCal 5.0
Calibration of Radiocarbon Age to Calendar Years
(High Probability Density Range Method: INTCAL20 + NHZ3)

(Variables: $\delta^{13}\text{C} = -16.7$ o/oo)

Beta-Laboratory Number 726145
Percent Modern Carbon (F14C) 104.58 +/- 0.39 pMC

95.4% Probability Calibrated Range(s)
(95.4%) 2008 - 2012 cal AD (-58 - -62 cal BP)
68.2% Probability Calibrated Range(s)
(68.2%) 2009 - 2011 cal AD (-59 - -61 cal BP)

Oy/2021B



Database Used

INTCAL20 + NHZ3

References

References to Probability Method

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

References to Database INTCAL20 + NHZ3

Hua, et al., 2022, Radiocarbon 64(4): 723-745.

Reimer, et al., 2020, Radiocarbon 62(4): 725-757.



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-4990C 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 January 15, 2025

Submitter Aisha Huseen

QA MEASUREMENTS

Reference 1

Expected Value 129.41 +/- 0.06 pMC

Measured Value 129.55 +/- 0.32 pMC

Agreement Accepted

Reference 2

Expected Value 0.44 +/- 0.04 pMC

Measured Value 0.44 +/- 0.04 pMC

Agreement Accepted

Reference 3

Expected Value 95.86 +/- 0.37 pMC

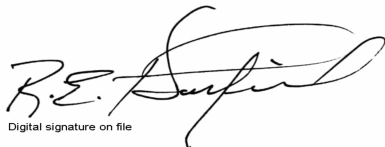
Measured Value 95.62 +/- 0.36 pMC

Agreement Accepted

Comment All measurements passed acceptance tests.

Validation

Date January 15, 2025


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