

General Statement of ¹⁴C Procedures at the National Ocean Sciences AMS Facility

All laboratory preparations for AMS radiocarbon analyses of submitted samples occur in the National Ocean Sciences AMS (NOSAMS) Sample Preparation Lab unless otherwise noted on the attached report of final results. Procedures appropriate to the raw material being analyzed include: acid hydrolysis, oxidation of organic carbon, or stripping of CO₂ gas from water samples. CO₂, whether submitted directly or generated at the NOSAMS Facility, is reacted with Fe catalyst to form graphite. Graphite is pressed into targets, which are analyzed by accelerator mass spectrometry along with primary and secondary standards and process blanks.

NOSAMS has two accelerators for AMS radiocarbon measurements, a 3 MV Tandetron system and a 500 kV Pelletron system. AMS radiocarbon measurements determine the ratio of ¹⁴C to ¹²C in an unknown sample relative to the well known ratio in the concurrently measured standard samples. The primary standard for ¹⁴C measurements is NBS Oxalic Acid I (NIST-SRM-4990). Every group of samples processed includes an appropriate blank, which is analyzed concurrently with the group. Process blank materials include IAEA C-1 Carrara marble and the Third International Radiocarbon Intercomparison (TIRI) F Icelandic Doublespar for inorganic carbon and gas samples; Fourth International Radiocarbon Intercomparison (FIRI) A and B wood as well as acetanilide (CE Elantech) for organic carbon samples; a ¹⁴C-free groundwater for dissolved inorganic carbon samples; and a glycine (Sigma Aldrich) dissolved in DOC-free water for dissolved organic carbon samples.

Fraction modern (F_m) is a measurement of the deviation of a sample's radiocarbon content from that of the modern standard. Modern is defined as 95% of the radiocarbon concentration (in AD 1950) of NBS Oxalic Acid I, normalized to $\delta^{13}C_{VPDB} = -19\text{‰}$ (Olsson, 1970). A correction is made to normalize the sample result to a $\delta^{13}C_{VPDB}$ value of -25‰ , assuming a quadratic mass fractionation dependency. The correction is handled differently on each AMS system as detailed below and our report will indicate which method was used

Stable isotope measurements of sample $\delta^{13}C$ are used to calculate F_m values measured on the Tandetron system, unless otherwise specified by the submitter. These $\delta^{13}C$ measurements are made at the NOSAMS Facility with either a VG PRISM or VG OPTIMA mass spectrometer by analyzing a split of the CO₂ gas generated prior to graphite production. The $\delta^{13}C$ values used to calculate the F_m of a sample are specified in the report of final results, including a description of their origin. ¹³C/¹²C ratios are monitored on the Tandetron to prevent misidentification of samples or fractionation outliers, but are not reported.

AMS radiocarbon analyses made on our 500 kV AMS system are corrected to a $\delta^{13}C_{VPDB}$ value of -25‰ using ¹³C/¹²C ratios measured on-line. These ¹³C/¹²C ratios are not reported. Post-analysis stable

isotopic corrections are not appropriate for these samples. Any $\delta^{13}\text{C}$ values reported with these samples were measured on a split of sample CO_2 .

Reporting of ages follows the convention outlined by Stuiver and Polach (1977) and Stuiver (1980). Radiocarbon ages are calculated using the Libby half-life of 5568 years and are reported without reservoir corrections or calibration to calendar years. If a sample collection date is specified on the submittal form, the $\Delta^{14}\text{C}$ activity normalized to 1950 is also reported according to these conventions. The activity or $\Delta^{14}\text{C}$ of the sample is corrected to account for the decay between collection (or death) and the time of measurement.

Atoms of ^{14}C contained in a sample are directly counted using the AMS method of radiocarbon analysis; therefore, internal statistical errors are calculated using the number of counts measured from each target in combination with the errors of the standard. An external error is calculated from the reproducibility of individual analyses for a given target. The error reported is the larger of the internal or external errors. An error associated with uncertainty in the background is also incorporated.

When reporting AMS results of samples run at the NOSAMS facility, accession numbers (e.g. OS-####'s) should be listed together with the results. To avoid confusion, we suggest tabulating OS-numbers and associated radiocarbon ages as they appear on the attached Final Report in addition to any subsequent corrections that may need to be made to the ages. We ask that published results acknowledge support from NSF by including the NSF Cooperative Agreement number, OCE-0753487. The NOSAMS facility would appreciate receiving reprints or preprints of papers referencing AMS analyses made at the NOSAMS facility. Please note the recent creation of a public database of NOSAMS Related Research publications by our institution library (nosams.mblwhoilib.org). We encourage you to submit your publication reference to nosams_bibapp@whoi.edu.

Any sample material not consumed during sample preparation or AMS radiocarbon analysis, and not requiring refrigeration, is archived for two years at the NOSAMS Facility unless other arrangements are made by the submitter.

REFERENCES

- Olsson, I.U., 1970. The use of Oxalic acid as a Standard. *In* I.U. Olsson, ed., Radiocarbon Variations and Absolute Chronology, Nobel Symposium, 12th Proc., John Wiley & Sons, New York, p. 17.
- Stuiver, M. and Polach, H.A., 1977. Discussion: Reporting of ^{14}C data. Radiocarbon, 19:355-363.
- Stuiver, M., 1980. Workshop on ^{14}C data reporting. Radiocarbon, 22:964-966.