United States Geological Survey

Reston Stable Isotope Laboratory

Report of Stable Isotopic Composition

Reference Material USGS77

(Hydrogen and Carbon Isotopes in Polyethylene Powder)

This reference material (RM) is intended for normalization of stable hydrogen (δ^2H) and carbon (δ^{13}C) measurements of unknown polyethylene, $(C_2H_4)_n$, and similarly behaving hydrogen- and carbon-bearing substances. A unit consists of 1 g in a glass vial. There is no limit on distribution. This RM was prepared by A. Schimmelmann (Indiana University, Bloomington, Indiana).

Recommended values: Stable hydrogen isotopic compositions are expressed herein as delta values [1] relative to VSMOW (Vienna Standard Mean Ocean Water) on a scale normalized such that the δ^2H value of SLAP (Standard Light Antarctic Precipitation) is –428 ‰ [2,3]. Stable carbon isotopic compositions are expressed herein as delta values relative to VPDB (Vienna Peedee belemnite) on a scale normalized such that the δ^{13}C values of NBS 19 calcium carbonate and LSVEC lithium carbonate are +1.95 ‰ and –46.6 ‰, respectively [4]. The stable hydrogen- and carbon-isotope delta values of USGS76 caffeines with combined standard uncertainties are:

Reference	$\delta^2H_{VSMOW\text{-}SLAP}$	$\delta^{13}C_{VPDB\text{-}LSVEC}$	Data source
USGS77	–75.9 ± 0.6 ‰	–30.71 ± 0.04 ‰	[5]

Technical coordination for this RM was provided by Arndt Schimmelmann of Indiana University and Haiping Qi of the U.S. Geological Survey Reston Stable Isotope Laboratory (RSIL).

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Expiration of Reference Value: The reference value for the isotopic composition of USGS77 is valid until December 31, 2036, provided the RM is handled in accordance with the instructions given in this Report of Stable Isotopic Composition (see "Instructions for Use"). The reference value is nullified if the RM is damaged, contaminated, or otherwise modified.

Source of the RM: The following description is taken from Schimmelmann and others [5]. This RM is custom-synthesized, low density polyethylene powder with a grain size of ~0.1 mm, and it was purchased from Alfa Aesar (10 kg, $(CH_2CH_2)_n$, CAS # 9002-88-4). Users will receive aliquots of 1 g in glass vials as RMs for δ^2H and δ^{13}C normalization.

Maintenance of RM Report of Isotopic Composition: The U.S. Geological Survey RSIL will monitor these RMs and will notify the purchaser if substantive technical changes occur that affect their isotopic compositions.

Distribution and Stability: A distribution unit is available in amounts of 1 g in a glass vial that is vacuum sealed in a plastic pouch. USGS77 is stable at normal room temperatures when stored under dry conditions. To minimize the potential for contamination, it is recommended that USGS77 be stored in the container in which it was supplied. Storing in a dark and cool place is preferred. Two kilograms of the polyethylene powder were extruded to form a string with a diameter of ~1 mm in collaboration with the Australian Nuclear Science and Technology Organisation (ANSTO). Isotopic measurements at the USGS and Indiana University indicated that USGS77 powder and the string PE77 have indistinguishable isotopic compositions. String PE77 is available exclusively from ANSTO (ndf-enquiries@ansto.gov.au; http://www.ansto.gov.au/ResearchHub/Bragg/Facilities/NationalDeuterationFacility/).

Instructions for Use: USGS77 can be interspersed among every 10–15 unknowns. It can be used with other hydrogen or carbon isotopic RMs. To prevent USGS77 from degrading over time, after it is opened, it is recommended that users always close the cap tightly after usage and store in a dry desiccator or in a refrigerator.

Reporting of stable-isotope-delta values: The following recommendations are provided for reporting stable hydrogen and carbon isotope-delta values. It is recommended that:

- The δ^2H values of all hydrogen-bearing substances be expressed relative to VSMOW-SLAP on a scale where the δ^2H of SLAP = –428 ‰ exactly [3].
- The δ^{13}C values of all carbon-bearing substances be expressed relative to VPDB-LSVEC on a scale such that the δ^{13}C values of NBS 19 calcium carbonate and LSVEC lithium carbonate are +1.95 ‰ and –46.6 ‰, respectively [4], even though LSVEC is no longer recommended as a RM for δ^{13}C measurement [6].
- Authors report delta values of international distributed (secondary) isotopic reference materials as though they had been interspersed among and used for normalization of unknowns, as appropriate for the measurement method. In this manner, measurement results can be adjusted in the future as analytical methods improve and consensus values of internationally distributed isotopic reference materials change.
- Reporting of delta values relative to SMOW and PDB (Peedee belemnite) be discontinued [7].

REFERENCES

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