United States Geological Survey

Reston Stable Isotope Laboratory

Report of Stable Isotopic Composition

Reference Material USGS24

(Carbon Isotopes in Graphite)

This reference material (RM) is intended for calibration of stable carbon ($\delta^{13}C$) measurements of carbon-bearing substances with an elemental analyzer (EA) and an isotope-ratio mass spectrometer or laser absorption spectrometer. This RM consists of 0.8 g of USGS24 graphite. There is no limit on distribution. USGS24 was prepared by the Reston Stable Isotope Laboratory (RSIL) of the U.S. Geological Survey, Reston, Virginia [1]. This RM may also be available from the U.S. National Institute of Standards and Technology (NIST) [2] as RM 8541 or from the International Atomic Energy Agency (IAEA) [3].

Recommended Values: Stable carbon isotopic compositions are expressed herein as delta values [4] relative to VPDB (Vienna Peedee belemnite) on a scale normalized such that the $\delta^{13}C$ values of NBS 19 calcium carbonate and LSVEC lithium carbonate are +1.95 ‰ and –46.6 ‰, respectively [5]. The $\delta^{13}C$ value of USGS24 with expanded uncertainty is [5]:

Reference value: $\delta^{13}C_{VPDB\text{-}LSVEC} = -16.05 \pm 0.07$ ‰

The uncertainty is an estimated expanded uncertainty ($U = 2u_c$) about the reference value that provides an interval that has about a 95-percent probability of encompassing the true value [6]. The value of the consensus mean, and the associated combined standard uncertainty were calculated using a multivariate Bayesian approach [5].

Technical coordination for this RM was provided by Haiping Qi of the RSIL.

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August 17, 2026

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Expiration of Reference Value: The reference value for the isotopic composition of USGS24 is valid until December 31, 2049, provided the RM is handled in accordance with the instructions given in this Report of Stable Isotopic Composition (see "Instructions for Use"). A reference value is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of RM Certification: The Reston Stable Isotope Laboratory (RSIL) will monitor this RM over the period of its certification. The RSIL will notify the purchaser if substantive technical changes occur that affect the certification before the expiration of this report.

Distribution and Stability: USGS24 is stable at normal room temperatures. The RSIL has monitored this RM for a period of twenty years, and no change in isotopic composition has been observed. To minimize the potential for contamination, it is recommended that this RM be stored in the container in which it is supplied.

Instructions for Use: USGS24 can be interspersed among every 10–15 samples. Ideally, users also may choose to use USGS40 L-glutamic acid, along with USGS41 L-glutamic acid, which is enriched in ^{13}C and ^{15}N, to make isotope-ratio-scale adjustments. A pair of USGS40 and USGS41 RMs can be used at the beginning, the middle, and the end of the analysis sequence to enable satisfactory scale correction and correction of drift with time.

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

- The $\delta^{13}C$ values of all carbon-bearing substances be expressed relative to VPDB-LSVEC on a scale such that the $\delta^{13}C$ values of NBS 19 calcium carbonate and LSVEC lithium carbonate are +1.95 ‰ and –46.6 ‰, respectively [5], even though LSVEC is no longer recommended as a RM for $\delta^{13}C$ measurement [7].
- 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 [8].

REFERENCES

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