# United States Geological Survey

## Reston Stable Isotope Laboratory

# Report of Stable Isotopic Composition

## Reference Material USGS40

## (Carbon and Nitrogen Isotopes in L-glutamic Acid)

This reference material (RM) is intended for calibration of stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) measurements of unknown carbon- and nitrogen-bearing substances with an elemental analyzer (EA) and an isotope-ratio mass spectrometer by quantifying drift with time and quantifying isotope-ratio-scale contraction when used with USGS41 L-glutamic acid enriched in $^{13}C$ and $^{15}N$ [1]. This RM consists of 2 g of USGS40 L-glutamic acid [1]. There is no limit on distribution. USGS40 was prepared by the Reston Stable Isotope Laboratory (RSIL) of the U.S. Geological Survey, Reston, Virginia [1].

**Recommended Values:** Stable carbon isotopic compositions are expressed herein as delta values [2] relative to VPDB (Vienna Peedee belemnite) on a scale normalized such that the $\delta^{13}C$ values of NBS 19 calcium carbonate and L-SVEC lithium carbonate are +1.95 ‰ and –46.6 ‰, respectively [3]. Stable nitrogen isotopic compositions are expressed relative to atmospheric nitrogen, which is isotopically homogenous [4]. Stable carbon isotopic [3] and nitrogen isotopic [1] compositions with combined uncertainties and mass fractions of carbon and nitrogen [1] of USGS40 are:

| | |
|---|---|
| Stable carbon isotopic composition: | $\delta^{13}C_{VPDB\text{-}LSVEC} = -26.39 \pm 0.04$ ‰ |
| Mass fraction of carbon: | $w_C = 40.8$ % |
| Stable nitrogen isotopic composition: | $\delta^{15}N_{AIR} = -4.52 \pm 0.06$ ‰ |
| Mass fraction of nitrogen: | $w_N = 9.52$ % |

Technical coordination for this RM was provided by Haiping Qi of the U.S. Geological Survey Reston Stable Isotope Laboratory.

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**Expiration of Reference Value:** The reference values for the isotopic composition of USGS40 are 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"). 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**: USGS40 is stable at normal room temperatures. The RSIL has monitored this RM for a period of more than a decade, 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**: Ideally, users may choose to use USGS40, along with USGS41a L-glutamic acid, which is enriched in $^{13}C$ and $^{15}N$, to make isotope-ratio-scale adjustments. A pair of USGS40 and USGS41a 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. These RMs should be interspersed among every 10–15 unknowns. USGS40 and USGS41a may be used to quantify the mass fractions of carbon and nitrogen of unknowns.

**Reporting of Stable-isotope-delta Values:** The following recommendations are provided for reporting stable carbon and nitrogen 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 [3], even though LSVEC is no longer recommended as a RM for $\delta^{13}C$ measurement [5].
- The $\delta^{15}N$ values of all nitrogen-bearing substances be expressed relative to atmospheric nitrogen [4].
- 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 [6].

REFERENCES

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[3] Coplen, T. B., Brand, W. A., Gehre, M., Gröning, M., Meijer, H. A. J., Toman, B., and Verkouteren, R. M., 2006, New guidelines for $\delta^{13}C$ measurements: Analytical Chemistry, v. 78(7), p. 2439–2441. https://doi.org/10.1021/ac052027c
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