United States Geological Survey

Reston Stable Isotope Laboratory

Report of Stable Isotopic Composition

Reference Material USGS41a

(Carbon and Nitrogen Isotopes in L-glutamic Acid)

This reference material (RM) is intended for normalization of stable isotopic carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) measurements of similarly behaving carbon- and nitrogen-bearing substances [1]. This RM is a replacement for USGS41[2] whose supply is exhausted. It consists of 0.5 g of USGS41a L-glutamic acid. There is no limit on distribution. USGS41a 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 [3] 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 [4]. Stable nitrogen isotopic compositions are expressed relative to atmospheric nitrogen, which is isotopically homogenous [5]. On this scale, the $\delta^{15}N_{AIR}$ value of USGS32 KNO_3 is +180 ‰ exactly. Stable carbon and nitrogen isotopic compositions with combined uncertainties of USGS41a are [1]:

Stable carbon isotopic composition:	$\delta^{13}C_{VPDB\text{-}LSVEC} = +36.55 \pm 0.08$ ‰
Stable nitrogen isotopic composition:	$\delta^{15}N_{AIR} = +47.55 \pm 0.15$ ‰

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

Reston, Virginia 20192
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Expiration of Reference Value: The reference values for the isotopic composition of USGS40a 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 Report of Stable Isotopic Composition: The U.S. Geological Survey RSIL will monitor this RM and will notify the purchaser if substantive technical changes occur that affect its isotopic compositions.

Distribution and stability: A distribution unit is available in amounts of 0.5 g in a glass vial that is vacuum sealed in a plastic pouch. USGS41a is stable at normal room temperatures when it is stored under dry conditions. To minimize the potential for contamination, it is recommended that this RM be stored in the container in which it is supplied. Storing it in a dark, cool place is preferred.

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. This new material is the replacement for USGS41, whose supply is exhausted. USGS41a has higher chemical purity than USGS41. It is recommended that users should cease using USGS41 because recent findings indicate that USGS41 is more hydroscopic than USGS41a due to the possibility of pyroglutamic acid formation [1]. This small amount of hydroscopic pyroglutamic acid can trap some atmospheric CO_2, which will decrease the $\delta^{13}C$ value of USGS41 by 0.3 to 0.5 ‰ compared to the assigned value of +37.63 ‰. Both USGS40 and USGS41a can be used to quantify the mass fractions of carbon and nitrogen of unknowns. To prevent USGS41a from degrading over time, after it is opened, it is recommended that users always close the cap tightly after usage and store it in a dry desiccator.

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 [4], even though LSVEC is no longer recommended as a RM for $\delta^{13}C$ measurement [6].
- The $\delta^{15}N$ values of all nitrogen-bearing substances be expressed relative to atmospheric nitrogen [5].
- 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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