United States Geological Survey

Reston Stable Isotope Laboratory

Report of Stable Isotopic Composition

Reference Materials USGS57 and USGS58

(Hydrogen in biotite and muscovite)

These powdered hydrous mineral reference materials (RMs) are intended mainly for isotope-delta normalization of stable hydrogen (δ^2H) measurements of unknown hydrous minerals [1]. A unit consists of 0.5 g powdered RM. There is no limit on distribution. These RMs were prepared by the Reston Stable Isotope Laboratory (RSIL) of the U.S. Geological Survey, Virginia [1].

Recommended values: Stable hydrogen isotopic compositions are expressed herein as delta values [2] 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 ‰ [3,4]. Stable hydrogen-isotope delta values of USGS57 and USGS58 biotite and muscovite, respectively, with combined standard uncertainties are:

Reference	$\delta^2H_{VSMOW-SLAP}$	Mass fraction hydrogen	Mass fraction water	Data source
USGS57	–91.5 ± 2.4 ‰	0.416 ± 0.002 ‰	3.74 ± 0.02 %	[1]
USGS58	–28.4 ± 1.6 ‰	0.448 ± 0.002 ‰	4.03 ± 0.02 %	[1]

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

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Expiration of Reference Value: The reference values for the isotopic compositions of USGS57 and USGS58 are valid until December 31, 2049, provided the RMs are handled in accordance with the instructions given in this Report of Stable Isotopic Composition (see "Instructions for Use"). A reference value is nullified if a RM is damaged, contaminated, or otherwise modified.

Source of the RM: Two phyllosilicate RMs having δ^2H values sufficiently different to encompass most natural hydrous minerals were sought. Five powdered biotite and four muscovite materials with different particle sizes ranging from 74 to 250 μm (200 to 60 mesh) were purchased from Antai Mining Co., Ltd. (Lingshou County, Shijiazhuang, Hebei Province, China).

Preparation of the RMs: The biotite and muscovite were separated from natural rocks in China and crushed in an industrial-scale factory. The biotite with particle size of 177 μm (80 mesh) and the muscovite with particle size of 149 μm (100 mesh) were found to be suitable RMs, and they were designated as USGS57 and USGS58, respectively. About 2 kg of each material was tumbled in a large glass jar for seven days to ensure isotopic homogeneity of the mineral grains.

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 0.5 g in vials. USGS57 and USGS58 are chemically stable at normal room temperatures. To minimize the potential for contamination, it is recommended that each RM be stored in the container in which it was supplied.

Instructions for Use: USGS57 and USGS58 biotite and muscovite isotopic reference materials, respectively, are intended for δ^2H normalization of unknown mineral samples. Because these two materials were produced in an industry-scale factory, we cannot rule out the possibility that small particles with substantially different δ^2H values may be intermixed in the RMs. To be cautious, it is recommended that at least two or three of the same RM be analyzed at the beginning, the middle, and the end of a run with an amount of hydrogen no less than 16.7 μg. Analyzing a mineral sample with a particle size ≤ 74 μm and ≥177 μm is not recommended based on Qi and others [1]. Users should be cautious in analyzing hydrous minerals with on-line HTC systems because conversion of hydrogen in minerals to molecular hydrogen may not be quantitative, depending upon chemical composition of minerals (e.g. higher iron content) and particle size of minerals. There is no significant difference in hydrogen isotopic compositions of these two RMs whether analyzed using a glassy carbon-filled reactor method or a Cr-filled reactor method [1].

Reporting of stable-isotope-delta values: The following recommendations are provided for reporting stable hydrogen 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 [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 be discontinued [5].

REFERENCES

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