

Estimation of Non-traditional stable isotopes reference values for geological reference materials

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The homogeneity of reference materials and the precision of their reference values are fundamental prerequisites for ensuring the accuracy of non-traditional stable isotope analyses. Nevertheless, the field currently suffers from a significant methodological gap in robust homogeneity assessment and reference value estimation protocols. To address this gap, we implemented an analytical framework that integrates data acquisition from the Geological and Environmental Reference Materials database (GeoReM) with rigorous quality control measures based on ISO guidelines and the IAG Certification Protocol. This approach enabled us to systematically report the isotopic compositions of 14 non-traditional stable isotopes along with 63 isotopic compositions. The statistical results show that most of reference materials are homogeneous. However, our investigation revealed notable inconsistencies in the $\delta^7\text{Li}_{\text{LSVEC}}$ values of AGV-1 and AGV-2, indicating potential limitations in their reliability as Li isotope reference standards. Furthermore, the Mg isotopic composition of NISTSRM980 exhibited substantial heterogeneity, corroborating previous research findings and raising concerns about its suitability for high-precision isotopic measurements. In conclusion, this study provides a comprehensive set of reference values for widely used materials and establishing a rigorous, standardized protocol for their estimation. Beyond these methodological advancements, the study provides actionable recommendations for the selection of reference materials, underscoring the critical role of material homogeneity and measurement precision in ensuring the reliability of isotopic analyses.