

Laser Ablation Sampling in Liquid (LAL) for High-Precision and High-Spatial-Resolution Isotope Analysis of Insoluble Geological Minerals

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One of the primary challenges in the isotopic analysis of insoluble geological minerals, like barite, lies in the rapid processing of these insoluble minerals into a test-ready solution. In this research, a Laser Ablation Sampling in Liquid (LAL) technique for insoluble geological minerals is introduced and proven to be a high-precision and high-spatial-resolution isotopic analysis method when combined with multicollector inductively coupled plasma mass spectrometry (MC-ICP-MS). The Ba isotope analysis in barites serves as an illustrative example.

Contrary to the previous whole-rock analysis pretreatment of insoluble barites, LAL enables the acquisition of suspended nanometer-sized particles from the sample surface, which then dissolve in the droplet. Subsequently, after adding an appropriate amount of ^{135}Ba - ^{137}Ba double-spike, the resulting mixture can be readily analyzed without the need for further digestion and purification steps.

The $\delta^{137/134}\text{Ba}$ isotopic compositions of four natural barites were in excellent agreement with the recommended values obtained by the double-spike method, thus validating the accuracy of the proposed approach. The long-term external precision of $\delta^{137/134}\text{Ba}$ measurements was better than $\pm 0.05\%$ (2SD). This proposed method can generate high-spatial-resolution and high-precision isotopic composition data without the complex pre-processing of insoluble geological minerals.