Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.9734

Microbeam isotopic analysis of geological samples by LA-MC-ICPMS. IAG Young Scientists Award

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The developed laser ablation technique combined with multi-collector inductively coupled plasma mass spectrometry (LA-MC-ICPMS) has emerged as a more attractive tool for in situ isotopic analysis with high spatial resolution which can decipher micro-scale fractionation processes at sub-grains. Radioactive isotopes and nontraditional stable isotopes are useful for tracking geological evolutions in the solar system. We devoted to the development of new strategies for microbeam isotopic analysis of geological samples by LA-MC-ICPMS using radioactive Sm-Nd isotopic system and stable Fe isotopes as examples. For in situ Sm-Nd isotopic analyses, a robust analytical protocol for high-precision simultaneous determination of $^{147}Sm/^{144}Nd$ and $^{143}Nd/^{144}Nd$ ratios with high spatial resolution can be achieved using the high-sensitivity set-up. Compared with conventional set-ups, signal enhancements of both Sm and Nd were improved by a factor of 2.9 with the use of high-sensitivity cones and the addition of nitrogen at 3–6 ml min^{-1} to the central channel gas of the ICP. This method has great advantage in revealing the petrogenesis of the exiguous and tiny extraterrestrial samples such as Chang'E-5 basalts. For in situ Fe isotopic analyses, a proposed isobaric interference correction and mass bias correction method using a new synthetic Cr standard is a useful tool for providing high-quality in situ Fe isotopic data of geological samples with both low and high Cr concentrations. Moreover, the addition of water vapor after the ablation cell efficiently reduces or eliminates the matrix-dependent fractionation of Fe isotopes without reducing signal intensity. Due to their wide application prospects, the developed Sm-Nd and Fe analytical methods can be of immediate benefit for LA-MC-ICP-MS analysis in universal labs.