Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SGC54-19 Room:201A Time:May 20 15:15-15:30

A new analytical bias correction for in-situ Sr isotope analysis of plagioclase crystals using LA-MC-ICPMS

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A new analytical protocol was developed for correcting baseline-induced biases during the analysis of Sr isotope ratios in plagioclase using excimer laser-ablation Aridus-dual-intake-system multiple-collector inductively coupled plasma mass spectrometry (LA-MC-ICP-MS). Residual analytical biases of 84Sr/86Sr and 87Sr/86Sr were observed after applying on-peak background subtractions and mass-fractionation corrections using the conventional 86Sr/88Sr exponential internal normalization. The residual biases occurred only for samples analysed with LA and not for solution analyses using Aridus with the same instrumental setup. Based on observations from the ablation of NaCl and olivine crystals, we concluded that this was due to suppression and enhancement of the Kr baseline by loading of the LA sample aerosols and by the introduction of Kr from the samples, respectively. We also found that both the 84Sr/86Sr and 87Sr/86Sr isotope ratios were affected proportionally by the baseline biases of the LA analyses of an isotopically/compositionally homogeneous anorthite plagioclase (MkAn) from Miyakejima, Japan, and similar results were seen in theoretical calculations. Therefore, the bias correction for the target 87Sr/86Sr ratios was available using the shift in the simultaneously measured 84Sr/86Sr from the natural ratio. We then determined the correlation factors between 84Sr/86Sr and 87Sr/86Sr by analyzing MkAn, which reproduced the theoretical factors obtained from numerical simulations. By applying the new correction protocol, the accurate measurement of unknown plagioclase samples was possible. This was confirmed by comparisons with the results of micro-milling thermal ionization mass spectrometry (MM-TIMS) of the same plagioclase crystals with various compositions. The new correction technique improved reproducibility by a factor five, providing a basis for an accurate Sr isotope analysis using LA-MC-ICP-MS.

Keywords: Sr isotope, laser ablation, MC-ICPMS, bias correction