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Precise Sr isotope microanalysis of plagioclase by LA-MC-ICPMS and its application to the Azuma volcanic rocks, NE Japan

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Sr isotope system is widely applied as a tracer and chronometer in geochemical studies. Variations in Sr isotope ratios recorded in chemical zoning of plagioclase crystals of volcanic rocks provide important information on the magma generation process. In-situ Sr isotope microanalysis on plagioclase by laser ablation multicollector inductively coupled plasma mass spectrometry (LA-MC-ICPMS) has been an effective tool. However its accuracy and precision have been limited mainly by (1) high gas blank from Kr, (2) isobaric overlap of ^{85}Rb on ^{86}Sr, and (3) matrix dependent mass bias. We have overcome these problems by applying (1) on peak background subtraction of Kr signal, (2) solution (ARIDUS II)-laser aerosol dual intake system for an accurate overlap correction factor and mass bias factor determinations, and (3) use of an in-house plagioclase external standard (Miyakejima anorthite megacryst, An_{95}) with standard-sample bracketing analytical method. We have confirmed that the anorthite standard is chemically and Sr isotopically very homogeneous using EPMA and micro milling (MM)-TIMS methods. All the LA-MC-ICPMS analyses were performed using a 193nm excimer LA system coupled to a MC-ICPMS (Thermo Fisher Scientific NEPTUNE). The spot size used was 200micrometer in both diameter and depth. The same andesite plagioclase phenocryst (An_{92}) in a lava from Azuma volcano was analyzed by using LA-MC-ICPMS and MM-TIMS. The results were ^{87}Sr/^{86}Sr = 0.70618+/-28 (2SE) and 0.70614+/-36 (2SE), respectively. With the use of above analytical protocols and the matrix-matched external standard, accuracy of an unknown plagioclase improved from +/- 0.0001 to +/- 0.00004 levels in ^{87}Sr/^{86}Sr ratios. We observed systematic discrepancy in the analytical results between solution (SRM987)-based and matrix-matched external corrections. This improvement is due to closer match of the concomitant matrix element between the plagioclase sample and the anorthite standard. Such the mass bias occurs during high mass loading to the ICP plasma by a large volume laser ablation. Use of the anorthite standard is valid for various plagioclase crystals with different An content at least up to An_{50}.
Keywords: LA-MC-ICPMS, Sr isotope microanalysis, plagioclase