A one-column separation of Ca and Sr for accurate isotopic analysis using MC-ICPMS

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Ca stable isotopes, often combined with Sr radiogenic isotopes, has been emerging as a novel tracer for research in Earth science, life science and biomedicine. But high-accurate and precise yet fast and economic analysis of Ca isotope compositions is still a challenge, particularly for samples with complex matrices (e.g., carbonatite and low-Ca silicate rocks), partly due to the lack of efficient chromatographic methods and insufficient attentions paid on matrix effect on Ca isotope analysis. In this study, we discovered that Ca isotope measurements using standard-sample-standard bracketing MC-ICPMS are very sensitive to effects of matrix like REE, Al and Cr, resulting in a systematic offset for measured data. This “cryptic” matrix effect may be one of reasons causing large interlaboratory differences in previously reported Ca isotope compositions for some standard reference samples (e.g., seawater and basalts). A new simplified one-column separation protocol based on AG 50W-X12 exchange cation resin was developed, which significantly improves the efficiency of Ca purification and enables to eliminate nearly all undesired elements and obtain clean Ca and Sr analyte solutions at one time. Ca and Sr isotope analysis were carried out using low-resolution MC-ICPMS, with the long-term external precision being 0.05‰ (2SD) for $\delta^{44/42}$Ca in our routine protocol. Our technique was demonstrated to be high-accurate and valid for most natural samples including water samples, carbonate/carbonatite rocks, low-Ca silicate rocks, and probably biological samples. Merits of stability, economy, simplicity, high-accuracy and high-precision of our technique on Ca-Sr analysis makes it potentially of wide applications, including on the field of high-temperature geochemistry and on those fields in requirement of high sample throughput such as biomedicine and geological mapping.