Mass bias: A comparison of solution and laser ablation MC-ICPMS

N.J. PEARSON[1], W.L. GRIFFIN[1], H.-R. KUHN[1], O. ALARD[1,2], K.J. GRANT[1], S.E. JACKSON[1] AND S.Y. O'REILLY[1]

[1]GEMOC Key Centre, Department of Earth and Planetary Sciences, Macquarie University, NSW 2109, Australia (npearson@els.mq.edu.au)

[2]CNRS, Université de Montpellier, 34095 Montpellier Cedex 05, France

The development of in-situ isotope ratio measurements using LAM-MC-ICPMS has proceeded steadily over recent years. To date the most widely used technique is the analysis of Hf isotopes in zircon and this application is now undertaken in many laboratories around the world. Other radiogenic isotope systems (e.g, Sr, Nd, Os, Pb) have been successfully measured in a variety of minerals but despite the demonstrated significance of spatially resolved measurements, these in-situ methods remain relatively restricted in their application. The main limitations (in accuracy and precision) are the trace-level abundance of the elements of interest and the magnitude of isobaric overlap corrections related to parent/daughter ratios. In-situ analysis of 'non-traditional' stable isotopes has not progressed as far as the radiogenic systems and this is mainly due to a lack of understanding of the processes that contribute to isotopic fractionation during ablation and in the plasma.

Recent studies have demonstrated that the origin of isotopic fractionation in LAM-MC-ICPMS is the result of a combination of laser- and ICP-induced fractionation. Whereas internal normalization using stable isotope pairs is able to account for the effects of these processes for radiogenic systems, the in-situ analysis of mass dependent stable isotopes requires careful standard-sample bracketing techniques using matrix-matched materials. The isotopic compositions of different aerosol particle size fractions of Cu metal show an enrichment of up to 0.5 per mil of the lighter 63Cu isotope in the sub-250 nm particles. Isotopic fractionation is further enhanced by preferential ionization of the lighter isotopes from incompletely vaporised particles in the ICP. Analysis of Mg isotopes in olivine (Fo 92) indicates that there is no change in particle size distribution with ablation time and points to the influence of the ICP on isotopic fractionation.

The aims of this study are to provide a framework to understand the parameters and processes that control mass bias in the ICP, especially the differences between solution (wet) and laser (dry) plasma. A series of experiments has been carried out to investigate the contribution of plasma power, extraction voltage, gas flow, torch position, gas composition (Ar±He), sample matrix, and plasma loading on mass bias. Results will be presented for light, middle and heavy mass isotopic systems (e.g. Mg, Cu, Sr, Hf).