

# Laser ablation MC-ICP-MS: shedding new light on in-situ isotope ratio measurement

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The development of the multi-collector ICP-MS has greatly enhanced the capability for in-situ high precision isotope ratio analysis. Although we can build on experience from laser ablation trace element analysis on single-collector ICPMS, there are additional and complex issues to be considered in LAM-MC-ICPMS. Some are common to solution analysis (eg mass bias) but others are a consequence of the complex matrix of natural samples.

Accurate analysis requires rigorous correction procedures for mass bias and isobaric interferences. Instrument sensitivity, elemental concentration and grain size are the main controls in determining laser conditions and ablation times, and thus analytical precision. Signals produced by laser ablation are transient, but operating conditions for the laser can be chosen to achieve near steady-state signals. Frequency, laser fluence and spot size settings all contribute to signal stability and intensity.

In the analysis of major elements in common rock-forming minerals (eg Mg in olivine; Fe in pyrite) sensitivity is not a problem and isobaric interferences are negligible. In analyses of the Hf isotopic composition of zircon, corrections for REE interferences are critical. The measurement of isotopic ratios of trace elements presents greater problems; successful applications include Os in mantle sulfide; Sr in cpx, plagioclase and carbonate; Pb in feldspar. In some cases the best precision has been obtained at the expense of spatial resolution or in minerals with very low parent/daughter ratios. Further improvements will come with wider use of multi-ion counting systems; this will require the development of more stable detectors and more complex calibration routines. Laser-induced isotopic fractionation remains poorly documented and understood. It is unclear if fractionation occurs during ablation, during transport or within the plasma due to particle size distribution and/or matrix effects.

Compared with SIMS, a much wider range of isotopic systems has been developed on the LA-MC-ICPMS. There is a critical need for isotopically homogeneous reference materials that can be used to verify accuracy and for standard-sample bracketing in the measurement of mass-dependent isotopic fractionation.