An overview of laser ablation-ICP-MS in the solid earth sciences

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Laser ablation inductively coupled plasma (quadrupole) mass spectrometry gained wide acceptance in geological laboratories across the globe during the 1990s. The method is versatile and robust, allowing the earth scientist to measure the concentrations of a large number of chemical elements in a wide variety of solid materials in situ such as natural and synthetic glasses, tephras, solidified melt inclusions, silicate minerals, oxides, carbonates, sulphides, and metals. Little sample preparation is required, essentially only cutting and polishing a flat surface. Thus, elements that are difficult to retain in solution, following sample digestion, such as high-field elements (Zr, Nb, Hf, Ta, Th, U) and the PGEs are of particular interest. The measurements are quick (typically 2 minutes per spot), precise and accurate (<10%), even at sub-parts-per-million levels, and can resolve spatial differences in element concentration across a sample surface on scales as small as 10 microns. With “depth profiling”, a continuous record of variations in element concentration can be determined as drilling proceeds down into a solid material.

The next decade should see laser ablation-ICP-MS providing a wealth of ultra-precise (TIMS-quality) in situ isotopic ratio data as well, with magnetic sector, multi-collector mass spectrometers coupled to laser systems. Even with conventional quadrupole mass spectrometer systems, however, precise (<1%) in situ measurements of lead isotopic ratios are already being used for geochronologic and tracer studies by several laboratories. Errors of about 10-20 Ma are achieved for zircons of Precambrian age and, as with SHRIMP, inherited cores and metamorphic overgrowths can be dated.