In-situ trace element and isotope ratio determinations in rock-forming minerals using Laser Ablation Microprobe (LAM)-ICP-MS

Simon E. Jackson, Brian J. Fryer, Henry P. Longerich, and Greg R. Dunning
Department of Earth Sciences, Memorial University of Newfoundland, St. John's, Newfoundland A1B 3X5, Canada

A laser ablation solid sample introduction system, designed for microsampling of minerals in petrographic sections, has been coupled to a SCIEX ELAN ICP-MS to produce a microprobe with trace element and isotope ratio determining capabilities. The system consists of a Q-switched Nd-YAG laser, laser energy attenuation optics, beam steering mirrors, petrographic microscope, sample cell and television observation system.

The response of minerals to the ablation process is strongly dependent upon their structure, tenacity and composition (and consequent absorbtivity). However, ablation pit diameters as low as 30 µm have been achieved in many minerals, allowing studies of chemical zoning in some cases. Simultaneous determination of up to 20 elements in 15 seconds is possible with detection limits as low as 1 ppm. LAM- and solution-ICP-MS analyses of a variety of mineral separates indicate that good accuracy (Fig. 1) and precision (r.s.d. < 10% at > 50 ppm) can be achieved. In addition, the technique has the potential to perform analyses of individual fluid inclusions.

LAM-ICP-MS can also provide rapid isotope ratio determinations of single grains with precision sufficient for application to more radiogenic isotopic systems; e.g., direct dating of U-rich phases such as uraninite (Fig. 2). Preliminary work on zircons suggests that it may rival competing techniques for provenance studies.

With its trace element and isotopic analytical capabilities and low capital costs compared to competing techniques, LAM-ICP-MS has profound potential in igneous, metamorphic and sedimentary petrogenetic research as well as in ore genesis studies and mineral processing.

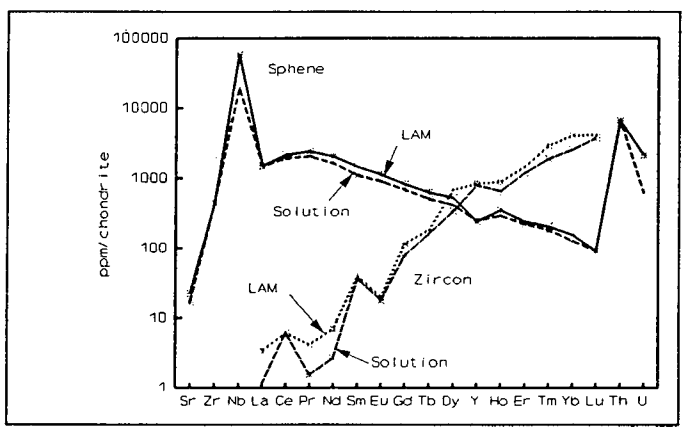

Figure 1

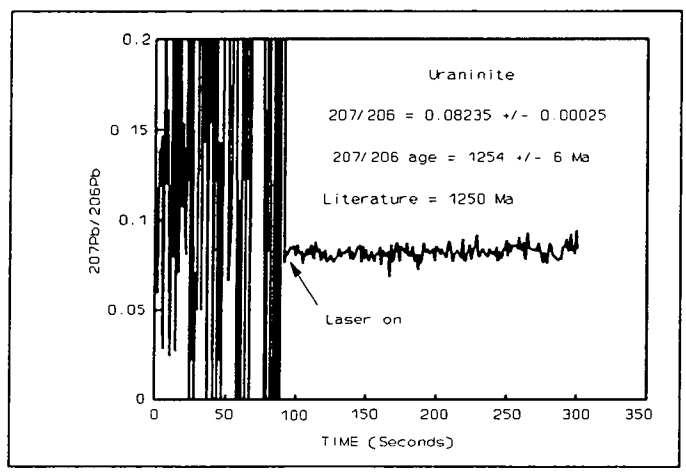

Figure 2