Direct analysis of various geological materials using 213 nm and 193 nm laser ablation systems and ICP-MS

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Laser Ablation ICP-MS has come a long way since its introduction in the mid-eighties. Most common commercial systems are using 266 nm, 213 nm or 193 nm. Laser energy in the deeper UV range is more efficient at delivering the laser energy to a wider variety of samples, allowing uniform sampling of even transparent materials. This is of special importance when analysing a variety of geological samples.

The CETAC LSX-213 Laser Ablation system is operating at a wavelength of 213 nm and is optimised to deliver homogenized "flat-top" energy profile with > 4mJ, 5 ns laser pulses with repetition rates of 1-20 Hz. The use of Helium as a carrier gas improves sample transport efficiency and reduces fractionation. It finds its application in the analysis of several types of geological samples, such as soils and sediments, Otoliths, gemstones, quartz samples, and other materials. Various applications are discussed.

For the most challenging and highly transparent samples the best suitable wavelength is 193 nm. Due to the use of a very stable Excimer Laser, its high energy density of up to 45J/cm² at 193 nm, and a highly homogenized beam profile, the GeoLas Pro has advantages for very precise geochronology and fluid inclusion analysis, especially for very small craters down to 4 µm in diameter. The use of a powerful petrographic microscope enables the identification of even very small features of a few micrometers. Features and Applications for this 193 nm Excimer Laser system are discussed.

Petrology of shoshonitic lamprophyres and related carbonatites in the Svecofennian Domain

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The latest stage of magmatism related to the Svecofennian Orogen involved numerous, low-volume bimodal shoshonitic granitoid intrusions. Several contemporaneous shoshonitic lamprophyre dyke swarms are found thoughout the Svecofennian Domain, as well as three small calciocarbonatite dyke swarms. We present petrological data on these dyke rocks and consider their genetic relationships.

The shoshonitic lamprophyres in the Lake Syväri area of eastern Finland occur as a swarm of narrow dykes. Additional lamprophyre dykes are found in the west Lake Ladoga region, Russian Karelia. Age deteminations (SIMS U-Pb, zircon) from both areas give concordant intrusion ages of 1.78-1.77 Ga. Petrographically, these lamprophyres are characterized with aggregates of biotite in a fine-grained matrix of K-feldspar, plagioclase, calcite and apatite. Typical accessory minerals are titanite, magnetite, baryte, pyrite, ilmenite, diopside and allanite. Blebs or vesicles of carbonate minerals have been found in samples from both areas. They are strongly enriched in LREE, P, F, Sr and Ba. Similar enrichment is seen in shoshonitic lamprophyres in the west Lake Ladoga region, Russia, and their plutonic equivalents in the easternmost part of the Svecofennian Domain.

The three calciocarbonatite intrusions occur at Halpanen in southeast Finland as a single, relatively large dyke as well as at Naantali, southwest Finland and Panjavaara, east-central Finland as swarms of small dykes. In addition to calcite, the dykes contain 5-10% modal fluorapatite. Typical accessory minerals include magnetite, bastnäsite, monazite, titanite, allanite and baryte. The carbonatite intrusions also show strong enrichment in LREE, P, F, Sr, and Ba, along with depletion in Nb and Ta. Preliminary age determinations from monazite suggest an intrusion ages between 1.78-1.76 Ga. $\varepsilon_{Nd}(1800)$ was found to be near zero, indicative of metasomatic mantle enrichment from ca. 1.9 Ga subduction. $\delta^{13}C$ ratios fall between –8 and –15‰ for all carbonatite intrusions as well as the carbonate vesicles in the Lake Ladoga region lamprophyres. Intensity of enrichment as well as the CO_2/H_2O ratio increases from west to east, a trend parallel to that described by Andersson *et al*. (2006).

Despite the wide geographic distribution of these intrusions, the combined petrological and geochemical evidence suggest a genetic relationship between the lamprophyre and carbonatite dykes, as well as the shoshonitic granitoid intrusions.

References

Andersson, U.B., Eklund, O., Fröjdö, S. and Konopelko, D., 2006. *Lithos* **86** (2006) p. 110-136