Scanning unpolished drill cores with laser ablation quadrupole ICPMS

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The scanning of unpolished drill cores using LA-ICPMS has the potential to provide extensive geochemical information rapidly and with very little sample preparation. The technique has extremely low detection limits, particularly on the heavier elements (ppb level) and simultaneously provides information on whole-rock geochemistry, mineral abundance,and mineral chemistry. It also has the capability of providing Pb isotopic data as well as geochemical and size information on mineral inclusions that are much smaller than the spot size.

The technique tested in this study involves scanning the laser using a 50 µm spot size pulsing at 20 Hz moving along the core at 150-300 µm s^{-1} (0.9-1.8 cm per min). A total of 45 elements were measured every 0.1s using the quadrupole ICPMS. A complex and new data reduction technique was used to correct for the different ablation rates of various minerals and mineral mixtures. This technique involves first identifying the minerals and mineral mixtures present using the raw laser ablation signal and then normalising the data to the expected sum of all the elements analysed for that mineral or mineral mixture. Other corrections were also applied, such as correcting for the behaviour of elements in rapid scanning mode (used on cores) relative to the elements analysed in spot mode (used on primary calibration standards).

The results were evaluated in three ways:

- Comparing the laser-derived whole-rock chemistry with those from samples analysed using conventional whole-rock X-ray fluorescence techniques.
- Comparing the chemistry of various minerals with those analysed using the more conventional LA-ICPMS spot techniques
- Comparing the modal abundance of the minerals identified by LA-ICPMS with those from automated scanning electron microscopy.

The results show that while the technique is very accurate for many elements, major challenges remain for others. Although the technique shows promise, further work is required to make it robust for a wider range of applications and sample types.