High-Resolution Quantitative LA-ICP-TOFMS Imaging

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In this presentation, we describe advances in laser ablation (LA) inductively coupled plasma time-of-flight mass spectrometry (ICP-TOFMS). In particular, recently developed low-dispersion LA cells have been shown to provide transfer of ablated aerosol within 10 ms. This fast aerosol transport minimizes the dilution of ablated aerosol, which leads to high instantaneous concentration of analyte in the ICP and improved signal-to-noise (*S/N*) ratios. When low-dispersion LA is combined with ICP-TOFMS instrumentation, a complete elemental mass spectrum can be measured for each LA shot. This technology enables shot-resolved elemental imaging at LA frequencies that are typical of continuous (steady-state) LA-ICPMS. The speed and sensitivity now available with LA-ICP-TOFMS instrumentation enable the use of smaller LA spot sizes for improved spatial resolution without worsening time-of-analysis or multi-elemental measurement capabilities.

We have developed a two-volume LA cell ("tube cell") that delivers complete ablated aerosol transport to the ICP-TOFMS in less than 10 ms. This cell is designed to allow elemental imaging of large samples (up to 50 x 75 mm) in at laser repetition rates >20 Hz. With this setup, we have achieved single-shot absolute detection limits down to 60 attograms (^{238}U); this sensitivity enables the simultaneous detection of major, minor, and even some trace elements at LA spot diameters down to 1 μm with minimal sample consumption. Here, we describe the performance of our LA-ICP-TOFMS imaging setup and its application to the high-spatial-resolution, quantitative elemental imaging of heterogenous geological samples, including meteorite specimens and rock thin sections.