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Laser Ablation With High Resolution Inductively Coupled Plasma Mass Spectrometry

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The advent of UV wavelength solid-state lasers and high-resolution inductively coupled plasma mass spectrometry (HR-ICP-MS) has made possible significant advances in geochemical microanalysis. UV Solid-state lasers (266 nm, 213 nm, and 193 nm) create significantly smaller elemental fractionation than IR lasers. Magnetic sector ICP-MS instruments combine higher sensitivity and lower backgrounds at high mass elements than quadrupole ICP-MS instruments, and exhibit more uniform ionization of solid elements than possible by Secondary Ion Mass Spectrometry (SIMS). Further, high mass resolution enables the more sensitive analysis of elements that have significant isobaric interferences, e.g. Cr, Fe, etc. Calibration of LA-ICP-MS requires knowledge of the instrumental response using relative sensitivity factors (RSFs). New research shows that RSFs are not matrix-sensitive for a large range of elements with First Ionization Potential (FIP) less than 8 ev, provided an internal standard is used. Calibration of laser ablation for such elements is then possible using RSFs obtained from solution nebulization. A matrix-dependent ionization occurs for elements with high FIP that depends on the sample loading of the plasma. In comparison with SIMS, laser ablation provides better analysis of elements with high FIP, more rapid analysis, rapid sample change (no vacuum system), easier sample preparation, and a laser ablation system is at least three times cheaper than a comparable SIMS system. The coupling of laser ablation and multi-collector ICP-MS allows isotopic analysis of a wide range of elements, but the ICP source does not permit the analysis of stable isotopes of H, C, N, and O. A few applications of laser ablation microanalysis will be described, including the analysis of siderophile elements and analysis of major and trace elements in tiny particles.

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