Tandem LA-ICP-MS & LIBS; A new micro-analytical technique for the measurement of every element in the Periodic Table

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Laser Ablation ICP-MS (LA-ICP-MS) has been widely accepted as a microanalytical technique for in-situ trace (ppb) elemental analysis on the micron scale in a variety of geologic materials. LA-ICP-MS (single or multi-collector) provides both elemenal and isotopic measurements critical for a wide range of geological research by generating a fine grained aerosol (nm scale) during the laser ablation event and delivering that aerosol to the ICP ion source of the mass spectometer via an inert carrier gas. LA-ICP-MS, however, suffers from limitations in analyzing high ionization potential elements as well as elements subject to atmospheric and argon based interferences. LA-ICP-MS also has limitations in analyzing major elements due to detector saturation. An alternative laser ablation technique, Laser Induced Breakdown Spectroscopy (LIBS), employs an optical spectrometer integrated into the laser ablation system that analyzes the laser induced plasma at the sample surface across the entire optical spectrum for emission lines of every element in the periodic table. Elements that are difficult or impossible to measure with LA-ICP-MS are now possible to analyze with LIBS down to low ppm levels with CCD and/or ICCD detection. We introduce a new laser based technique, “Tandem LA-LIBS”, that combines LA for ICP-MS and LIBS into one integrated laser ablation system. This system has the effect of expanding the elemental coverage and the dynamic range of the laser ablation experiment as measurements from ppb to % level matrix elements can now be analyzed in a single ablation experiement. We present both femtosecond and nanosecond Tandem LA-LIBS quantiative and qualitative data on wide range of geological materials for those elements that are difficult or impossible by traditional LA-ICP-MS techniques such as F, H, O, N, C, S, halogens, etc. We also demonstrate that the simultaneous measurement of trace, minor and major elements are now possible in a single laser ablation experiment with Tandem LA-LIBS technology.