EUROPEAN WORKSHOP ON LASER ABLATION

High precision and spatial resolution chemical interrogation of planetary materials using fs-LA/LIBS in tandem with multi-collector ICP-MS

Jacob B. Setera*[1], Jhanis Gonzalez[2], Charles Sisson[2], Richard E. Russo[2], Justin I. Simon[3]
[1]CASSMAR, University of Texas at El Paso – Jacobs JETS II Contract, NASA Johnson Space Center, Houston, TX, USA.
[2]Applied Spectra, Inc. West Sacramento. CA. USA.
[3]Center for Isotope Cosmochemistry and Geochronology, NASA Johnson Space Center, Houston, TX, USA.

*Corresponding author: jacob.b.setera@nasa.gov

Combining femtosecond laser ablation (fs-LA) with laser-induced breakdown spectroscopy (LIBS), together with multi-collector inductively coupled plasma mass spectrometry (MC-ICP-MS), can provide remarkable insights into the composition, structure, and therefore geologic history of planetary materials and their terrestrial analogs. Using the Applied Spectra iX-fs-Tandem LA-LIBS Instrument and the Nu SP1700 MC-ICP-MS housed within the Center for Isotope Cosmochemistry and Geochronology at NASA Johnson Space Center, we present preliminary tandem fs-LA-(MC)-ICP-MS/LIBS measurements of planetary analog materials. The synergistic integration of fs-LA-LIBS offers high spatial resolution elemental mapping, enabling the identification of microscale variations within samples. Simultaneously, the MC-ICP-MS can deliver precise isotopic analyses, and integrating the two datasets yields a wealth of geochemical information for a given sample.

LA-based chemical mapping experiment designs are contingent on the information sought (i.e., quantitative, or semi-quantitative) and the preferred or available volume of material removed for the analysis. For example, occasionally, there are significant limitations in the depth of ablation due to the sample value, the amount of material available, or simply the need to coordinate with other *in-situ* techniques. In these limited sample scenarios, the “depth-controlled” chemical maps allow for precise post-mapping ion-polishing of the sample, while the isotopic and elemental maps can be used for targeting future analyses (e.g., conventional LA analyses, SIMS analyses, and micro milling for solution ICP-MS/TIMS). The emerging methodology will establish a powerful tool for investigation of astromaterials and materials returned by future planetary sample science missions.