Whole Rock Analysis with LIBS – Paving the Way to Downhole Chemical Investigations

Fernando Fagundes Fontana[1, 2], Ben van der Hoek[1, 2], Caroline Tiddy[1, 2], Steven Tassios[3, 2], Neil Francis[4, 2], Jessica Stromberg[4, 2], Yulia Uvarova[4, 2]
1. University of South Australia, Mawson Lakes, SA, Australia, 2. Mineral Exploration Cooperative Research Centre - MinEx CRC, Mawson Lakes, SA, Australia, 3. CSIRO Mineral Resources, Clayton, VIC, Australia, 4. CSIRO Mineral Resources, Kensington, WA, Australia

Laser-Induced Breakdown Spectroscopy (LIBS) is a well-established in situ analytical technique capable of multi-element analysis with limited to no sample preparation requirement. LIBS has been applied to downhole groundwater monitoring and analysis of geological materials in harsh and remote environments such as on Mars and in the deep sea. In this study, LIBS is adapted to geochemical analysis in a drill hole environment. The development of a downhole deployable tool for chemical analysis would represent a paradigm shift for the exploration and mining industries by enabling (near) real-time geochemical assay. Here we demonstrate successful emulation of whole rock geochemical assay for major elements in discrete rock types of various textures and mineralogy (13 rock samples in total) using LIBS spot data, collected along continuous, 1mm-spaced transects over 1-metre drill core intervals (i.e. 1000 LIBS spot analyses per metre). Results of whole rock geochemistry from traditional laboratory assay and LIBS are remarkably similar. For instance, silicon differences between results do not surpass 14% for the whole sample set. Investigation of optimal LIBS sampling strategies for whole rock analysis shows that a range in the number of LIBS spot analyses is required to emulate whole rock geochemistry within 1% error and 95% confidence (e.g. microgranite: ~50 spots; dolostone: ~560 spots per metre). The accuracy of whole rock LIBS analysis and optimal number of analyses are largely dependent upon elemental range of distribution, grain size, and element deployment (host minerals behavior). Overall, the results of this study show promise in development of strategies for rapid whole rock geochemical analysis down a drill hole.