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Opportunities for Rapid, Field-Based Sulfide Deportment and Trace Element Chemistry Using Laser-Induced Breakdown Spectroscopy (LIBS)

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The grain size, mineral associations, and trace element chemistry of sulfide minerals are key controls in the successful extraction, liberation, and recovery of economic metals. Traditionally, sulfide deportment and trace element chemistry are determined by microanalytical techniques such as scanning electron microscopy (SEM) or laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). While providing high precision, these methods are completed on lab-prepared materials and as a result, sulfide deportment information is often insufficient to capture sulfide variability prior to designing the processing flowsheets. This lack of initial data can then result in costly modifications to already established milling and recovery circuits.

Laser-induced breakdown spectroscopy (LIBS) is an atomic emission method that can be used to rapidly assess mineral chemistry. Field-portable LIBS systems allow for low-cost, rapid analysis and require no sample preparation beyond a clean analysis surface. This method is capable of detecting most elements in the periodic table, including elements with low atomic numbers (e.g., Li, Na, and Mg), which are difficult to distinguish using most other portable field instruments. The rastering capabilities of some LIBS systems can produce geochemical maps reflecting intra-mineral chemical variability as well as textural and spatial relationships of minerals in the analysis area. Sulfide grain size, intra-mineral chemistry, and mineral grain boundary associations (e.g., chalcopyrite in contact with bornite) ultimately have implications for the successful, economic extraction of raw materials and treatment of tailings in the mineral industry. The application of field-based portable LIBS provides an opportunity for rapid and cost-effective sulfide deportment and trace element chemistry on most geological material available throughout the exploration and mining cycle. The ability to collect fit-for-purpose, high-density deportment data through a project’s life provides better statistical sampling of ore and gangue minerals, which can be used to build more robust geometallurgical models and mine plans.