Applications of Laser-Induced Breakdown Spectroscopy in the Study of Orogenic Gold Hydrothermal Rocks

WATTS, J.F.[1] , LAWLEY, C.J.M.[2] , GAGNON, J.E.[1] , AND REHSE, S.J.[3]

[1]Department of Earth and Environmental Sciences, University of Windsor, 401 Sunset Avenue, Windsor, Ontario, Canada (*correspondence:watts114@uwindsor.ca, jgagnon@uwindsor.ca)

[2]Natural Resources Canada, Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario, Canada (christopher.lawley@canada.ca)

[3]Department of Physics, University of Windsor, 401 Sunset Avenue, Windsor, Ontario, Canada (rehse@uwindsor.ca)

Orogenic gold systems are complex and are often characterized by overprinting hydrothermal, metamorphic, and deformation histories. Laser-induced breakdown spectroscopy (LIBS) represents a rapid, robust, and in situ geochemical technique to unravel the cyptic and overprinted hydrothermal footprint of these systems. Here we apply LIBS to define the spectral fingerprint of gold veins and their associated hydrothermal alteration halos at the Lynn Lake greenstone belt (Manitoba, Canada). We demonstrate that field-based LIBS, which was completed on sawed drill core surfaces, is suitable for the characterization of hydrothermal ores, including the detection of micrometric native gold grains. Direct detection of gold is difficult, if not impossible, with other field-based geochemical techniques. Textural relationships between gold and hydrothermal alteration minerals are also important for unravelling the relative timing of hydrothermal events and the geological conditions of ore formation. Qualitative imaging by LIBS also reveal major to trace elemental compositions of gold grains, quartz, carbonate, sulfide and mica minerals that are important for documenting multiple generations of hydrothermal alteration assemblages.

Discriminant Function Analysis (DFA) is an effective chemometric technique for the objective classification and discrimination of hydrothermal mica minerals related to mineralization. Independent variables are created using unique combinations of atomic emission line intensities and simple emission line ratios to maximize the variance between sample groups [1]. Preliminary results suggest that LIBS is useful in identifying compositional differences in biotite, a mineral that represents a potential vector to gold mineralization [2]. The combination of LIBS imaging with robust chemometric techniques are particularly useful in exploiting known geochemical associations and inform real-time decision making in an exploration context.

[1] Putnam *et al.* (2013), *Spectrochim. Acta B, **84**, 161 -167*

[2] Gaillard et al. (2018), Ore Geology Reviews, **95**, 789-820

This abstract is too long to be accepted for publication.
Please revise it so that it fits into the column on one page.