Fingerprinting Gold Mineralization in the Timmins Gold Camp: Synchrotron Trace Element Analysis of Gold and Pyrites from the Dome Mine Ankerite Veins

Jessica M. Stromberg,[1*] Erik Barr,[2] Lisa L. VanLoon,[3] Dirk Schumann,[1,4] and Neil R. Banerjee[1]

[1]Western University, London, Ontario, Canada N6A 3K7
[2]Goldcorp Porcupine Gold Mines, South Porcupine, Ontario, Canada P0N 1H0
[3]Canadian Light Source, Saskatoon, Saskatchewan, Canada S7N 2V5
[4]Fibics Incorporated, Ottawa, Ontario, Canada K2E 0B9

*E-mail, jessica.m.stromberg@gmail.com

The Dome mine, located in the prolific Timmins gold camp of the Abitibi greenstone belt, is characterized by multiple generations of gold mineralization of which the youngest is a unique set of massive 2679–2960 Ma ankerite veins. These veins run over 550 m in strike and 900 m in vertical height, and were subject to multiple mineralization events, having been subsequently overprinted by the main-stage quartz veining and mineralization seen across the camp. Gold is intimately associated with pyrite mineralization and found as inclusions, along grain boundaries and fractures, and as "invisible" gold. Characterizing associations between trace metals and gold, as well as the nature of the invisible gold and trace metal speciation, is integral to understanding mineralization history of the ankerite veins and of the Timmins camp.

Synchrotron X-ray spectroscopy has been used to characterize the trace element content of a suite of gold-bearing pyrite grains from the Dome ankerite veins. Using a synchrotron X-ray source provides unprecedented collection speeds and spatial resolution with low detection limits. Both micro X-ray fluorescence (uXRF; mapping and point analysis) and X-ray absorption near edge structure (XANES) spectral data were collected at the Canadian Light Source, Advanced Photon Source and Cornell High Energy Synchrotron Source. Multiple generations of gold mineralization have been identified with variable trace element associations and gold content, representing at least three distinct fluid events. The speciation of Cu, Ni, Au, and As have been characterized and variability is seen in As speciation within the growth haloes of individual grains. Secondary ion mass spectrometry (SIMS) and high-resolution transmission electron microscopy (HRTEM) with high-angle annular dark-field (HAADF) imaging were also employed to better constrain the nature of the invisible gold. Invisible gold occurs both as metallic gold nanoparticles in pyrite grains as well as bound in the crystal lattice of arsenopyrite inclusions. This information provides insights into fluid evolution and mineralization history at the Dome mine and is contributing to a better understanding of gold mineralization events in the Timmins camp.