Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.27839

Trace element geochemistry of pyrite from orogenic gold deposits of the Abitibi greenstone belt

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Northeastern Ontario hosts some of the world's largest orogenic gold deposits within the Porcupine-Destor and Larder Lake-Cadillac deformation zones which crosscut the Abitibi greenstone belt. Despite the importance of these deposits, their mechanisms of formation and fluid sources are not fully understood. Both magmatic and metamorphic fluids have been proposed as potential gold sources, with some studies suggesting that metamorphic fluids can be derived from devolatilization of multiple rock types including carbonaceous shales, komatiites and basalts.

In this project, we will use pyrite morphology and trace element geochemistry of gold bearing samples from gold camps in the Abitibi region to better understand their origins. Pyrite morphology from these samples will be examined using reflected light microscopy and scanning electron microscopy, then trace element geochemistry of the pyrite will be collected using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). The trace element contents will be used to collect information regarding the oxidation state, pH, salinity and temperature of ore forming fluids. Machine learning techniques will then be applied to synthesize and understand the data. In addition, some of the trace elements to be examined are critical metals, including cobalt, nickel, antimony and tellurium. By creating associations between various trace elements, their depositional mechanisms and fluid sources, we can better predict which gold deposits may also have potential as critical metal sources.

Preliminary results from 501 LA-ICP-MS data points have shown a regional Au-Ag-Te-(Bi) correlation across Timmins, Kirkland Lake, Detour and Matachewan camps. Arsenic varies widely between deposits and shows no regional correlation with Au, but appears to be controlled by host lithology with intrusion-hosted samples having the lowest arsenic. Overall, this study aims to better characterize the fluid sources and depositional mechanisms of gold camps within the fertile Abitibi greenstone belt.