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Pyrite Development at the Young-Davidson Gold Deposit

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The Young-Davidson (YD) Mine is located within the Cadillac–Larder Lake Deformation Zone (CLLDZ) near Matachewan, Ontario, and represents a syenite-hosted orogenic gold system characterized by extensive hydrothermal alteration. Gold mineralization is primarily hosted by sulphidized syenite associated with strong hematite alteration and quartz veins that cut syenite intrusions.

This study aims to constrain the controls on the formation and evolution of the YD gold deposit through a detailed investigation of pyrite. We conducted petrographic analysis using reflected light microscopy, combined with in situ trace element analysis (LA-ICP-MS) and in situ sulfur isotope measurements by secondary ion mass spectrometry (SIMS).

Preliminary results from sulfur isotope analyses (650 SIMS spots collected from 62 samples) show that Δ33S values range from −0.2 to +0.3‰, while δ34S values vary between −11.5 and +5.9‰. Suggesting a non-sedimentary source of the sulfur and variable redox environmental during pyrite precipitation. To further characterize the different pyrite generations, trace element concentrations were measured on the same analytical spots by using LA-ICP-MS. These datasets are being integrated to determine the source of sulfur and gold and to identify which pyrite generations are genetically associated with gold mineralization.

The next phase of the study will involve fluid inclusion analyses to constrain the physicochemical conditions of the gold bearing fluids and iron isotope measurements by using femtosecond LA-MC-ICP-MS (fs-LA-MC-ICP-MS) to gain additional understanding into fluid evolution. These results aim to improve our understanding of gold transport and precipitation at the Young-Davidson.