## What Do the Pyrites Tell Us About the Young-Davidson Orogenic Gold Deposit, Matachewan, Ontario, Canada?

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The Archean Superior Province within the Canadian Shield plays a key role in Canada's gold production, accounting for approximately 88% of the country's total output. A particularly important region within this province is the Cadillac-Larder Lake Deformation Zone, located in the southern Abitibi greenstone belt of Northern Ontario. The Young-Davidson (YD) orogenic gold deposit in Matachewan, Ontario, Canada is located at the western end of this zone. This deposit primarily hosts gold within syenite, which is surrounded by a widespread hydrothermal alteration halo. The main zones of mineralization include quartz-carbonate and syenite veins with sulfide mineralization, often accompanied by intense hematite alteration within the syenite.

This research focuses on refining the genetic model of the YD deposit and identifying key mechanisms responsible for gold precipitation, using a combination of macro- to micro-scale techniques. We utilize a combination of core logging, reflected and transmitted light microscopy, geochemical analysis, and sulfur isotope analyses from various lithologies, alteration styles, and mineralization types within and distal to the ore zone. The results highlight pyrite as the principal gold-hosting mineral, with high-grade gold commonly found as inclusions in disseminated pyrite, particularly in quartz-rich zones. Whole-rock geochemical data show a strong positive correlation between gold content, pyrite abundance, and total sulfur.

To better understand the deposit's evolution, pyrite textures were examined using reflected light microscopy, and their geochemical characteristics were compared with whole-rock and sulfur isotope analyses. LA-ICP-MS trace element and sulfur isotope (S32, S33, S34; SIMS) analyses were conducted to determine the origin of the gold and to link specific generations of pyrite to gold mineralization. These integrated approaches aim to advance the understanding of hydrothermal gold deposition processes and contribute to the development of predictive tools for estimating gold grades ahead of mining activities.