

Macro- to Micro-Scale Investigations of the Young-Davidson Orogenic Gold Deposit, Matachewan, Ontario, Canada

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The Archean Superior Province of the Canadian Shield is a crucial gold producing area, contributing around 88% of Canada's total gold output. Within this province, the Cadillac-Larder Lake Deformation Zone, situated in the southern Abitibi greenstone belt of Northern Ontario, is especially important for gold mineralization. The Young-Davidson (YD) Mine, located in Matachewan, Ontario, is found within this structural corridor. Gold mineralization at the YD deposit primarily occurs within syenite, surrounded by a widespread hydrothermal alteration halo. The primary targets for gold production are sulphidized quartz-carbonate veins and sulphidized syenite, which are closely linked to extensive hematite alteration in the syenite.

This study aims to refine the genetic model for the YD deposit and identify key factors influencing gold precipitation through macro to micro-scale investigations. Findings are based on fieldwork conducted in the summer of 2024, including core logging and short-wavelength infrared (SWIR) analysis of 17 drill holes throughout various sections of the ore zone, as well as laboratory analyses performed during the fall and winter of 2025, including petrographic examinations. The collected samples exhibit diverse lithologies, mineralization styles, and alteration zones. Preliminary results indicate that sulfide minerals, such as pyrite and chalcopyrite, are the main minerals associated with gold. High-grade gold is often found as inclusions within disseminated pyrite, particularly in areas with increased quartz veining. Assay data show a strong correlation between higher gold concentrations and greater pyrite abundance.

Detailed analyses of different samples were conducted using reflected light microscopy, whole-rock geochemical data, and SWIR interpretations to gain deeper insights into the formation and evolution of the YD deposit. Trace element analysis via LA-ICP-MS and sulfur isotope studies (³²S, ³³S, ³⁴S) were performed to determine the gold source and establish which mineral generations are linked to gold mineralization. These investigations aim to enhance the understanding of gold precipitation from hydrothermal fluids and contribute to the development of predictive tools for estimating gold grades before mining operations commence.