Geology and Structural Relationships of the Meadowbank BIF-Hosted Gold Deposit, Nunavut, Canada

V. Janvier[1], P. Mercier-Langevin[2], S. Castonguay[2], B. Dubé[2], V. McNicoll[3], S. Pehrsson[3], M. Malo[1], B. De Chavigny[4], O. Côté-Mantha[5]

[1]Earth Sciences Department, Institut National de la Recherche Scientifique, Québec, QC, Canada; [2]Geological survey of Canada, Québec, QC, Canada; [3]Geological Survey of Canada, Ottawa, ON, Canada; [4]AgnicoEagle Ltd. exploration office, Val d'Or, QC, Canada

Abstract

The Meadowbank banded iron formation (BIF)–hosted world-class gold deposit is hosted in the polydeformed and metamorphosed 2711 Ma Pipedream-Third Portage sequence of the Woodburn Lake Group. The mine sequence are comprises intermediate to felsic volcaniclastic rocks, BIFs, mafic and ultramafic rocks, and quartzite. At least four phases of regional *Trans-Hudsonian* (Proterozoic) deformation affect the cryptically tectonized Archean rock sequence: Isoclinal F_1 folds and early shear zones are affected by coplanar N-trending isoclinal F_2 folds and D_2 shear zones that cut the stratigraphy and mineralization. Moderately-inclined, open to tight, chevron-style F_3 folds and open to closed SW-plunging F_4 folds further affect the deposit, resulting in complex polyphase geometry.The bulk of the gold at Meadowbank is associated with pyrrhotite hosted in iron-formation especially at or near the contact with sheared ultramafic rocks. Gold-rich quartz-pyrrhotite ± pyrite veins are locally developed within neighbouring intermediate volcaniclastic rocks. The ore-associated mineral assemblages include grunérite / cummingtonite and chlorite in BIF layers, whereas sericite ± chlorite and carbonates dominate in altered volcaniclastic rocks. The metamorphic grade increases southward along the deposit, where biotite, Fe-Mg amphibole and garnet occur in variable proportion. Detailed lithogeochemistry has been instrumental to discriminate several signatures possibly originating from different protoliths. Lithostratigraphy and structural analysis suggest that the bulk of the gold was introduced prior to D_2, plausibly along D1 shear zones, and was later locally remobilized. Deposit- and regional-scale lithogeochemistry and new U-Pb zircon ages indicate that the Meadowbank deposit is located near the boundary between two distinct lithological assemblages (2711 Ma and 2717 Ma) separated by long-lived shear zones that could have controlled gold deposition and distribution. Our study indicates that structural analysis, lithogeochemistry and U-Pb geochronology are essential tools for understanding the geometry and controls of the deposit and timing of gold introduction.