

Banded iron formation-hosted gold deposits of Nunavut: Styles, settings and timing

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Numerous gold deposits and prospects of Nunavut are hosted in, or associated with, Neoproterozoic banded iron formations (BIF). These deposits display a diversity of styles and varying levels of structural complexity, largely due to overprinting Archean and Paleoproterozoic tectonometamorphic events. For instance, gold at Meliadine is associated with a Proterozoic crustal-scale fault and its splays. In contrast, the Portage and Goose deposits of the Meadowbank mine are associated with intensely poly-deformed BIFs occurring along an inferred long-lived Archean lithotectonic boundary. At Amaruq, steeply-dipping high-strain zones, stratabound replacements and shallowly-dipping auriferous vein systems are developed in folded BIFs and cherts, away from any known major crustal-scale fault. Gold at the Vault deposit (Meadowbank mine) is associated with shallow-dipping sericite-carbonate-pyrite shear zones related to a nearby Paleoproterozoic thrust. Gold at Back River is associated with Archean subvertical high-strain zones that are axial planar to shallowly-plunging fold hinges, whereas at Lupin it is associated with similar Archean high-strain corridors but steeply-plunging folds.

The mineralized zones directly hosted in BIF units largely comprise two dominant styles: 1) discordant to stratabound pyrrhotite-arsenopyrite-loellingite-gold replacement associated with quartz veining and diffused zones of silicification, often referred to as “silica-flooding”; and 2) gold-bearing shear zone-hosted fault-fill and extensional quartz-carbonate veins and stockworks developed in folded BIF and associated units along reverse shear zones. Although many of the studied gold zones are controlled by Paleoproterozoic structures, especially in the Churchill Province in Eastern Nunavut, gold is hosted in Neoproterozoic rocks, raising the possibility for an Archean contribution on the gold endowment. Therefore, important aspects of gold metallogenesis in Nunavut, such as the timing of gold introduction, its source(s), and the age and nature of the major ore-forming events are being investigated. Understanding the timing relationship can provide some insight on whether gold was introduced into the system during the Archean and simply remobilized, and/or introduced later during the Paleoproterozoic. Recent and ongoing work in Nunavut includes structural mapping at the deposit scale, drill core logging, geochemical characterization of the host rocks and mineralized zones, and radiogenic and stable isotope analyses on sulphides. Various geochronological techniques are also used including U-Pb ID-TIMS/SHRIMP analyses on zircon, $^{39}\text{Ar}/^{40}\text{Ar}$ on amphiboles and micas, and Re-Os on sulphides.

Initial results indicate that BIF-hosted/associated gold mineralization in Nunavut originates from a protracted and/or multiphase Precambrian hydrothermal history, during which contrasting structural and metamorphic events had a major impact on the geometry, and style(s) of gold mineralization, with a number of characteristics unique to specific deposits/areas.

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