The Geochemistry of Banded Iron Formation (BIFs) at the Meadowbank Gold Deposit, Churchill Province: Implications for the Sources of Fluids in Gold-Mineralized in BIF Deposits

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Abstract

Among mineral deposits in Archean cratons, gold mineralization is important with >20 000 metric tons of gold produced from greenstone belts in 2001. Of the Archean-early Paleoproterozoic gold deposits, several different types of mineralization are known including Algoma-type Banded Iron Formation (BIF) where gold is associated with localized sulfide-facies zones within the regionally extensive oxide-facies. It is commonly accepted that the shale-normalized chemical signature of REE+Y of chert bands in Algoma-type BIFs may reflect one of three processes which may be relevant to the nature and origin of the gold mineralization: (1) direct seawater precipitation, (2) contribution of hydrothermal fluids, and (3) replacement. An essential question in regards to the mineralization is, therefore, whether the gold mineralizing fluids have a preference for one geochemical type of iron formation versus another. In order to assess the relevance of these competing models, we report herein the results of a LA ICP-MS study of chert samples within different Algoma-type BIFs from the Meadowbank deposit (24.5 Mt proven/probable ore reserves grading 2.8 g/t (2011) hosed in the Neoarchean Woodburn Lake Group of the Rae Domain of the western Churchill Province, Canada. This study used 39 carefully selected and characterized (i.e., petrography and SEM-EDS imaging) chert samples from both the main deposit, the Central BIF, and four additional BIFs, the Far West, West, East and Grizzly zones, with data collected using line traverses across the chert bands. The geochemistry indicates that an ambient seawater signature (characterized by enrichment in HREE relative to LREE, positive La, Gd and Y anomalies) dominates the samples with a lesser hydrothermal component (characterized by a positive Eu anomaly), but that the influence of both crustal contamination and overprinting hydrothermal fluids can also be detected. These initial results indicate that the methodology employed provides a reliable means to assess and interpret the chemical signature of BIFs hosting gold mineralization. In the present case the results for the Meadowbank deposit suggest that chert from mineralized BIF units do not record an unusual chemical signature that may be used as a vector for potential gold mineralization.