Mineralogical study of iron ore formation in Algoma-type BIF, Temagami, ON

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Algoma-type banded iron formation (BIF) is a chemical precipitate from ocean water which is associated with deep marine lithologies like black shale and volcanic rocks. In the Archean, the ocean was anoxic and contained abundant Fe. Oxidation of reduced Fe could lead to precipitation out of the water column. An accumulation of Fe precipitate formed Algoma-type BIF in a deep marine setting during a period of volcanic quiescence. The depositional environment and a common spatial proximity to volcanogenic massive sulfide (VMS) deposits suggest a hydrothermal impact on Algoma-type BIF formation. A model which resembles the VMS formation model has been suggested to explain how iron precipitates were enriched to iron ore. In the model, conversion between magnetite (reduced Fe) and hematite (oxidized Fe) is a nonredox reaction controlled by Fe-bearing hydrothermal fluids during deposition. Our study sampled an Algoma-type BIF in Temagami, ON at the Sherman Mine. Detailed outcrop mapping shows a complex relationship between BIF facies with millimeter- to centimeter-scale cyclic banding. Deformation appears to be predominantly syndepositional, though quartz veins which cross-cut banding are pervasive in the Temagami BIF. Along banding, changes in the redox state of Fe are common. A package of black chert layers (containing magnetite) will become jasper, (containing hematite) at the same lateral position. This paragenetic relationship is constrained to cherty bands which are often separated by magnetite dominated bands. This suggests the change likely occurred during deposition, while the Fe was still in a hydrous precipitate form. Other petrographic evidence, such as an association between coarse grained magnetite and quartz veins, suggest stages of ore formation occurred after deposition. Previous studies of BIF standards from the Temagami BIF show that the chlorite facies adds a significant detrital component to BIF bulk geochemistry. Understanding secondary alteration of and detrital contributions to the BIF will isolate the geochemical profile of the primary Temagami BIF, which contributed to the metal budget of deep marine settings in the Archean.