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[1] Skipton et al. (2025) *JMG* 43, 287–314.

Upgrading Archean banded-iron formation in northern Baffin Island, Arctic Canada, during Paleoproterozoic amphibolite-facies metamorphism

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North Baffin Island in Arctic Canada features a series of deformed Archean greenstone belts that host the high-grade, large-tonnage Mary River deposit, one of the richest iron ore deposits in the world. These hypogene deposits are interpreted to have formed following desilification and upgrading of banded-iron formations within the greenstone stratigraphy, driven by interaction with fluids derived from a metamorphic and/or hydrothermal origin. Recent work has revealed evidence for polymetamorphic reworking of the wider area during the Paleoproterozoic, associated with the progressive amalgamation of the Nuna supercontinent [1]. However, the timing and conditions of metamorphism in the greenstone belts is poorly constrained, precluding analysis of how metamorphic processes may have affected the grade of the deposit.

In this study, we apply integrated phase equilibria modelling and U-Pb monazite geochronology to garnet-bearing samples from greenstone belts 50km to the northeast (`Tuktuliarvik', TU) and 75km to the southeast (`Felsenmeer flats', FF) of the highest-grade portion of the deposit, where mining operations are presently focused. The results show that TU experienced conditions of c. 560-600 °C and 6–7 kbar at 1858.5 ± 2.3 Ma. In contrast, FF records conditions of c. 700-750 °C and c. 3–6 kbar at 1790.2 ± 7.0 Ma. Confidence in the distinct pressure-temperature conditions is afforded by similar bulk compositions in each belt yielding distinct assemblages (garnet-staurolite-gedrite at TU versus garnet-cordierite-gedrite at FF). Both belts feature evidence for desilification during prograde metamorphism, with quartz either absent or present in minimal proportions in the matrix compared to forming relatively abundant inclusions in porphyroblastic phases. Changes in the Fe-bearing accessory phases in both regions indicate that prograde metamorphism was also accompanied by oxidation, as pyrite and/or ilmenite-bearing assemblages are replaced or joined by hematite and spinel-group phases. *T*-*X*Si pseudosections are used to analyse the effects of Si-loss at TU, indicating that staurolite and gedrite modes decrease, and chlorite and hematite modes increase, consistent with petrographic observations. The results indicate that phase equilibria were characterised by silica-undersaturated conditions during peak amphibole-facies metamorphism, and suggest that metamorphic fluids can drive upgrading of banded-iron formations.