Paleogeographic and Stratigraphic Controls on the Distribution of thick Rapitan Iron Formation (NWT and YT)

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Abstract

The Rapitan iron formation contains one of the largest undeveloped iron deposits on Earth. Deposited in a rift basin during the Neoproterozoic "snowball Earth" glacial episode (ca. 711 Ma), this hematite-jasper iron formation is stratigraphically associated with glacioclastic turbidites and diamictites. The Rapitan Group overlies the rift-related Coates Lake Group and is widespread in the Mackenzie and Wernecke Mountains (NWT and YT). Iron formation of economic thickness is limited to the Snake River area, which straddles the territorial border. The limited geographic extent of the iron formation within the Rapitan Group remains unexplained, a problem that is further compounded by the geographically discontinuous nature of the entire group's exposure. Exposures of the Rapitan Group appear to define two sub-basins: the Snake River basin (YT and NWT), which contains thick iron formation (locally >100 m thick), and the Mountain-Keele-Redstone River (MKRR) basin (NWT), in which the iron formation is much thinner (local maximum 35 m). Iron formation and glacioclastics in the two sub-basins have distinct sedimentological characteristics. In the Snake River basin, the iron formation is generally hematite-rich and a significant proportion of the jasper is nodular; in the MKRR subbasin the iron formation is generally poorer in hematite and is dominated by bedded and locally silty jasper. Glacioclastic turbiditic rocks of the Sayunei Formation, which underlies the iron formation, consist of siliceous, hematitic mudstone and siltstone, with thin intervals of coarser clastic material in the MKRR, whereas much sandier and clast-rich material dominates in the Snake River sub-basin. Geographically, the margins of the two sub-basins correspond to crustal-scale basin-bounding faults previously defined in underlying successions, and other faults approximately match the limits of iron formation exposure within these basins. This distribution suggests that the sub-basins were the only areas where the Rapitan Group was deposited, and that differentiation into two sub-basins was depositional, rather than erosional or structural. This interpretation is supported by the locally abrupt pinch-outs of the entire Rapitan Group. Thus, basin architecture and the supply of clastic material are the major controls on the character, distribution, and thickness of the Rapitan iron formation and the Rapitan Group as a whole.