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Paleoproterozoic manganese enrichments of the Guiana Shield: a record of changes in global redox conditions?

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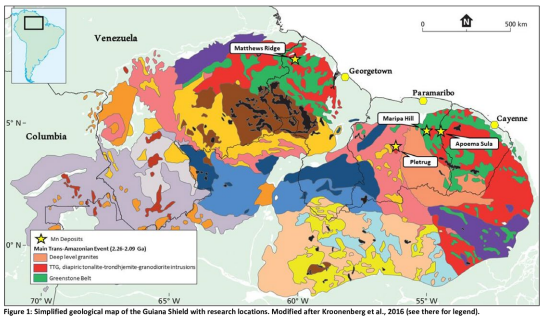

Figure 1: Simplified geological map of the Guiana Shield with research locations. Modified after Kroonenberg et al., 2016 (see there for legend).

Mn deposits, which are common around 2.1 Ga, are found on numerous cratons on the African continent (e.g. [1]) and northeastern Brazil [2]. Primary Mn deposition occured as Mn-carbonate or oxides in response to changing local and perhaps global redox conditions during the Paleoproterozoic. Mn deposits of the Rhyacian Greenstone Belt of the Guiana Shield (2.3-2.1 Ga) at Apoema Sula, Maripa Hill, Pletrug and Lada Sula in Suriname and Matthews Ridge, Guyana are interpreted as metamorphosed chemical sediments intercalated within the meta-volcanic base of the greenstone belt.

Leading rock types are (1) Mn-carbonates with spessartine, Ca-Mn-carbonate, tephroite and pyrophanite, (2) Mn-calcsilicate rocks with spessartine, tremolite, rhodonite, Mn-diopside, minor quartz and calcite, and (3) gondites with spessartine, quartz, Mn-amphibole, biotite and chlorite. The Mn deposits in Suriname localities are associated with schists, phyllites and quartzites, all organic-rich. At Matthews Ridge, phyllite interlayers occur with manganiferous phyllites and banded manganese formation [3] that resemble cyclothem patterns in Serra do Navio Brazil [2].

Apoema Sula and Maripa Hill seem to have originated from Fe-Mn-argillaceous-arenaceous protoliths mixed with organic-rich material. Variation in mineralogy and metal content of Pletrug reflect differences of the protolith. The Matthews Ridge deposit suggests an organic-rich/clayey protolith. The Pletrug Mn-carbonates have ~39 wt.% MnO and Mn-calcsilicates ~19 wt.% MnO. Several samples record positive Ce anomalies, similar to deposits investigated by Cabral et al. (2019). These data suggest a possible link to global changes in redox conditions, which will be addressed further, as the Mn deposits' age coexist with rapid changes of Earth's atmospheric oxygen.

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