

Paper Number: 5219

An overview of the geochemistry and palaeo-environment of manganese nodules from the General Nice Manganese Mine (GNMM) in the North West Province, South Africa

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Abstract

The General Nice Manganese Mine (GNMM) hosts a supergene deposit of manganese nodules in the first four to six meters from the earth's surface. This study is aimed at overviewing the geochemistry of the manganese nodules and the palaeo-environment that prevailed during the nodules' formation. X-ray fluorescence was used to analyse 11 major elements (SiO₂, TiO₂, Al₂O₃, Fe₂O₃, MnO, MgO, CaO, K₂O, Na₂O, P₂O₅, Cr₂O₃) and 33 trace elements (As, Ba, Bi, Br, Ce, Co, Cr, Cs, Ga, Ge, Hf, La, Mo, Nb, Nd, Ni, Pb, Rb, Sc, Se, Sm, Sr, Ta, Th, Tl, U, V, W, Y, Yb, Zn, and Zr). Some major elements were plotted against MnO. No real correlation could be seen from these binary diagrams, except from MgO vs Al₂O₃ diagram, which showed a positive correlation. Trace elements (Cu, Co) were also plotted against MnO. They both show similar trends. The clusters from ternary diagrams (Sc-La-Th and Ni-Zn-Co) indicate that these nodules are of the same origin. Values from Mn/Fe (0.08-1.80), Ni/Cu (1.19-2.97), La/Th (2.53-11.90) indicate increase in Mn, Ni, and La. High concentrations of La are characteristics of nodules formed in the upper continental crust, which are enriched in incompatible elements. Enrichment ratios are probably the result of supply of metals from the stromatolitic dolomite bedrock. High Ni and Cu concentrations relative to the ones of Co indicate that these nodules formed in oxic conditions, in a shallow lake form the leaching of the dolomite that has supplied metals during the diagenetic process.

Key words: Manganese nodules, major elements, trace elements, palaeo-environment, supergene.

