

Iron ores of the Hotazel Formation, Northern Cape Province, South Africa

A.J.B. Smith^{1,2}, J. Gutzmer^{2,3,4}, N.J. Beukes^{1,2}, and B.C. Chisonga^{2,5}

1.

DST-NRF Centre of Excellence for Integrated Mineral and Energy Resource Analysis, Department of Geology, University of Johannesburg, Auckland Park, Johannesburg, South Africa, 2006.
Email: bertuss@uj.ac.za; nbeukes@uj.ac.za

2.

PPM Research Group, Department of Geology, University of Johannesburg, Auckland Park, Johannesburg, South Africa, 2006.

3.

Helmholtz Zentrum Dresden-Rossendorf, Helmholtz Institute Freiberg for Resource Technology, Freiberg, Germany, 09599. Email: j.gutzmer@hzdr.de

4.

Department of Mineralogy, TU Bergakademie Freiberg, Freiberg, Germany, 09599.

5.

Datamine, Illovo, Johannesburg, South Africa, 2196. Email: benny.chisonga@dataminesoftware.com

The ~2.4 Ga Hotazel Formation of the Transvaal Supergroup of South Africa is best known for hosting the largest land-based manganese deposit in the world, namely the Kalahari Manganese Deposit (KMD). The Hotazel Formation comprises three manganese formations interbedded with four banded iron formations (BIFs). Where the ~2.0 Ga pre-Gamagara unconformity intersects the Hotazel BIFs, medium to high grade hematite iron ore is developed. More porous, medium grade iron ore is also developed where the ~45 Ma Kalahari unconformity or faults connected to this unconformity intersects the BIFs. The thicker iron ore beds occur towards the top of the formation and can be up to 5 m thick. Both laminated and massive ores are developed and above the unconformity poorly sorted conglomeratic ore occurs in places. The laminated ore comprises fine- to medium-grained, compact, randomly orientated hematite aggregates, whereas the massive ore comprises non-laminated, medium- to coarse-grained, inequigranular hematite. The Fe_2O_3 content of the ores vary between ~70 and 97 wt%, with elevated MnO contents of up to ~11 wt% also observed. The rare earth element (REE) concentrations in the ores show similar distributions but higher contents to that of the original BIFs. Slight positive Eu anomalies are observed in both ore and BIF, whereas the majority of ore samples show moderate to strong true positive and negative Ce anomalies. The hematite $\delta^{18}\text{O}_{\text{SMOW}}$ values in the ore show a range of -1.4 to -0.1 ‰. The occurrence of the Hotazel iron ores at the top of the formation above unaltered BIF and in contact with the pre-Gamagara unconformity, the strong Ce anomalies and the higher hematite $\delta^{18}\text{O}_{\text{SMOW}}$ values suggest these ores were formed through supergene processes. High Eh and high pH meteoric waters leached silica and oxidized all iron-bearing phases to hematite to form iron ore.