THE LITHOGEOCHEMICAL CHARACTERIZATION OF THE HONDEKLOOF NICKEL MINERALIZATION, KLIPRAND AREA, GARIES TERRANE, NAMAQUALAND, SOUTH AFRICA.

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Abstract

A series of magmatic Ni-Cu (Co-Zn) sulphide mineralization, namely the Hondekloof deposit, is present at Kliprand area in the border between the Northern Cape Provence and Western Cape Province of South Africa. The deposit occurs in the central parts of the metamorphic high grade Garies Terrane, Namaqua Sector, along the south-western margin of the Mesoproterozoic Namaqua-Natal Metamorphic Province (Figure 1).

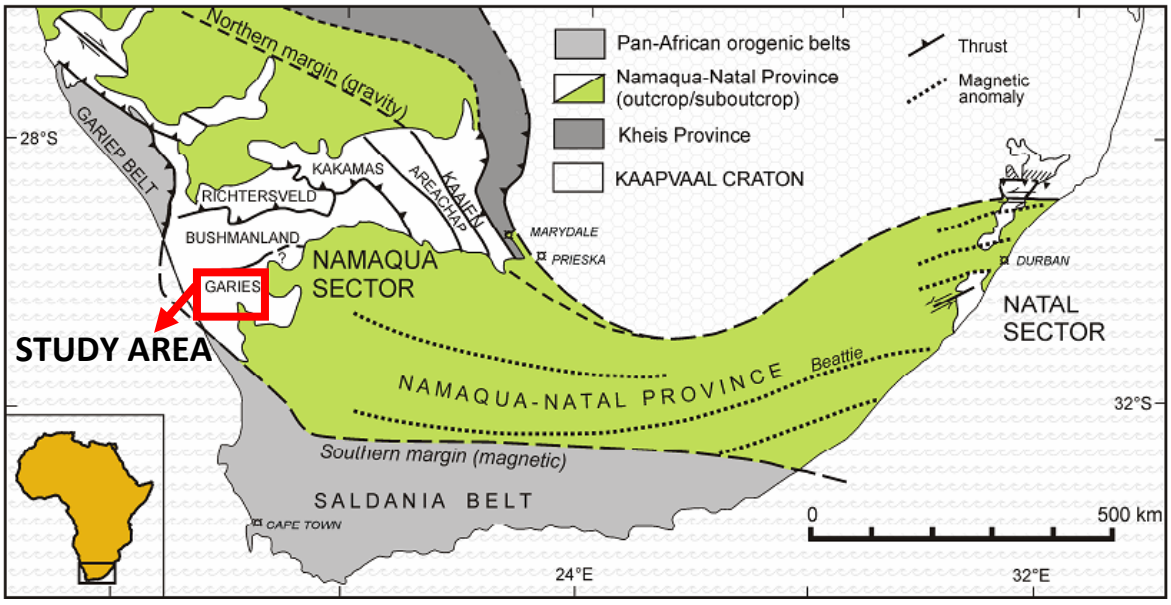

Figure 1. Simplified geological map of southern Africa, from Cornell et al. (2006)

Given the sub-economic value yielded from evaluation of three of its massive sulphide lenses known the Hondekloof has relatively little attention in terms of ongoing scientific research. Therefore many aspects related to the genesis, classification and tectonic evolution of the deposit, to date, remain relatively unclear. The present contribution has therefore been geared to addressing some of those issues in view of the new data obtained.

Six exploration boreholes were logged, examined and sampled at the deposit site in Kliprand. A total of seven host rocks, namely the meta-gabbronorite, biotite gneiss, feldspathic-biotite-garnet gneiss, pink gneiss, meta-syenite as well as enderbite along with the garnetiferous quartzofeldspathic rock, distributed unevenly in different boreholes, are found exceptionally well preserved in borehole data. A comprehensive geological investigation involving core, petrographic and geochemical analysis, undertaken in view of producing a new set of data and interpretation has added significantly to our current understanding of this deposit. It became evident that the Hondekloof deposit and its host rocks locally formed within a rift continental back-arc basin and that are carrying a signature of a regional collisional subduction system.

The meta-gabbronorite forming parts of the succession of the pre-to-syn-tectonic Ookraal Suite, metamorphosed up to granulite facies metamorphism occurs as the actual host rock hosting the base metal sulphides in association with ortho-and-clinopyroxene, and less so plagioclase in a disseminated fashion. Both enderbite and garnetiferous quartzofeldspathic rocks occur as the melt products seen as veins formed during the prograde dehydration metamorphism. The geochemical indices of which the combination of element-ratios such as TiO_2/Al_2O_3 vs. $CaO + Al_2O_3$, and TiO_2/Al_2O_3 vs. CaO/Al_2O_3 and MgO/Al_2O_3 vs. TiO_2 as well as Cr vs Ni and $Cr + MgO + Fe_2O_3$ vs. Ni and more, created as vectors, have significantly shown potentials for pointing out towards the direction of the mineralization (Fig. 2).

The disseminated nature of the sulphide mineralization as well as metamorphism on the ores conclude that the mineralization occurred syn-genetically to its host rock and that the deposit was buried to a depth of at least 20 km within the crust to experience a granulite facies metamorphism (assuming the geothermal gradient of the Garies Terrane at the time was $35^oC/km$). Thereafter was uplifted, eroded and exhumed to occur at shallow level as it is within a granulite facies Terrane at present day. In particular, the presence of partial melt product, such as enderbite, within the meta-gabbronorite and the mineralization of many of them, suggests that some of the sulphide ores likely locally may have been remobilized during prograde dehydration metamorphism.

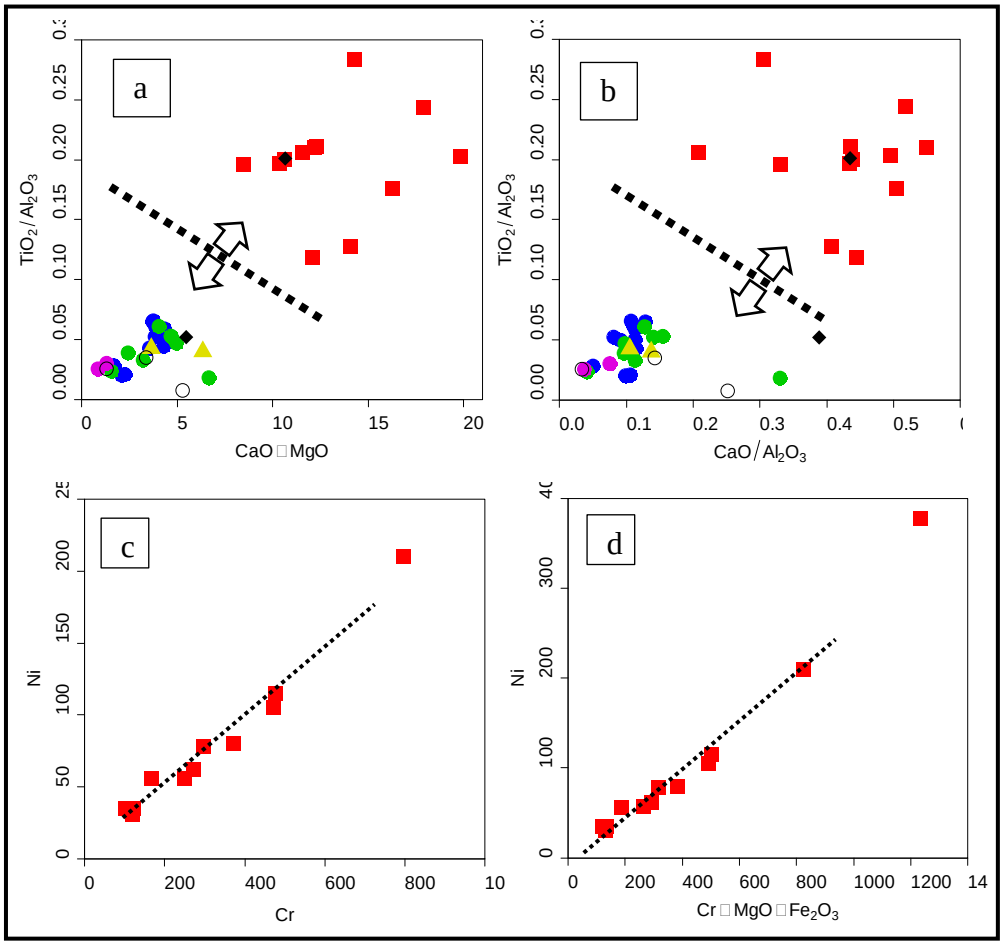

Figure 2. Geochemical indices as vectors for pointing out towards the direction of the mineralization. a) TiO_2/Al_2O_3 vs. CaO + MgO; b) CaO/Al2O3 vs. TiO2/Al2O3; c) for discrimination of the actual host, the meta-gabbronorite from the large group of host. b) Cr vs Ni and Cr + MgO + Fe_2O_3 vs. Ni as pathfinders of Ni within the meta-gabbronorite. The dotted line and opposite headed arrows indicate the separation.

The results obtained conclusively in view of the criteria applicable for classifying a magmatic Ni sulphide mineralization conform to the fact that the Hondekloof deposit could be well classified as being: a 1) low-MgO type, a 2) conduit type and a 3) disseminated type of magmatic Ni sulphide mineralization.

References

CORNELL, D.H., THOMAS, R.J., MOEN, H.F.G., REID, D.L., MOORE, J.M., GIBSON, R.L. (2006). The Namaqua-Natal Province In: Johnson, M.R., Anhaeusser, C.R., Thomas, R.J. (Eds.), The Geology of South Africa. Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria, 325–379.