

Paragenesis of Copper-enriched Sulphides in the Okiep Deposits, South Africa

Matebello Petunia Mokoena¹, Ben Hayes¹

¹University of the Witwatersrand, Johannesburg, South Africa

The Okiep Copper District, located in the Northern Cape, South Africa, is part of the Bushmanland Subprovince of the Namaqualand-Natal Metamorphic Province. The Bushmanland Subprovince comprises polydeformed and metamorphosed rocks that were intruded at ~1060-1030 Ma by the mafic-intermediate Koperberg Suite (KBS). The KBS forms a swarm of irregular and discontinuous sheet- and plug-like bodies that are spatially associated with narrow high-strain zones known as “steep structures”. Copper mineralisation is associated with sulphide-bearing mafic rocks of the KBS. The origin of the copper mineralisation is enigmatic and is generally regarded as magmatic in origin, analogous to magmatic Ni-Cu-PGE systems. It is further hypothesised that the magmatic sulphides were extensively oxidised by regional granulite metamorphism and late-stage, magmatically derived hydrothermal fluids. New field and drillcore samples were studied from the KBS to characterise the styles of copper mineralisation. The rock types included leuconorites and mica-bearing leuconorites. Microtextures revealed deformed plagioclase laths and orthopyroxene grains rimmed by smaller plagioclase, apatite, hypersthene and phlogopite; exhibiting granoblastic polygonal and porphyroblastic textures. Three copper mineralisation styles are recognised, consistent with previous literature. Narrap mineralisation comprises pyrrhotite, pentlandite, magnetite and chalcopyrite, which occur as semi-massive, net-textured vein-like mineralisation and are associated with leuconorites. Narrap mineralisation resembles an MSS assemblage, which is typical of magmatic sulphide ores. Carolusberg mineralisation consists of chalcopyrite, bornite and magnetite and is associated with mica-bearing leuconorite. Carolusberg mineralisation is unusual for magmatic sulphide assemblages. The presence of a transitional mineralisation style (pyrite, pyrrhotite, bornite and magnetite), also associated with mica-bearing leuconorite, suggests Narrap mineralisation was converted to Carolusberg mineralisation by oxidation. Extensive oxidation may have occurred during the regional high-temperature granulite metamorphism that coincided with KBS emplacement. The impact of metamorphism is apparent from the sub-solidus textures of the KBS, observed in the lithological rocks and reactional textures within the Transitional mineralisation.