Continuous country rock contamination and hydrothermal alteration of the Ni-Cu-PGE sulphide-bearing (ultra-)basic Uitkomst Complex, South Africa

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This mineralized ultrabasic to basic igneous complex of Bushveld Complex age (De Waal et al., 2001) and with affinity to a Bushveld complex primary magma composition Gauert, 1998) deserves further investigation, since new drill core material became available. An intersection of the downdip extension of the complex of constant thickness reveals upper gabbronoritic units which are geochemically evolved and strongly contaminated with quartz by assimilation of country rocks.

Hydrothermal, partly deuteric alteration is widespread over the complex, but pronounced in its lower and upper zones. Selective, connate to meteoric fluid ingress, controlled by contact metamorphism (Sarkar et al., 2008) and structure (Joubert, 2013), led to significant deuteric alteration. Highly talc-carbonate altered chromitiferous peridotite sections show formation of cube-shaped spinels, probably indicating auto-metamorphic conditions. Auto-metamorphism of the ultrabasic rocks produced a wide range of non-sulfide assemblages, despite the relatively restricted compositional range within each rock type; a crucial variable is the XCO₂ of the metamorphic fluid. The sulphide mineralogy of the ultramafic-hosted deposit is influenced by the temperature and composition of the hydrothermal fluid. Reduction reactions associated with the serpentinization fronts in the dunitic adcumulates gave rise to Ni-Fe alloy and native Cu bearing assemblages. Greenschist facies hydration gave rise to serpentinites, hosting assemblages rich in pentlandite and in some cases violarite and marcasite, mackinawite, millerite, and valleriite. Oxidized fluids associated with low temperature talc-carbonate alteration in the chromitiferous peridotite formed Ni-sulphide minerals coexisting with pyrite and hematite. Both the sulfide and nickel components in the ore may contain substantial proportions of the total nickel budget. Low temperature alteration effectively redistributed the sulfide elements in serpentinites, leading to highly variable Cu/(Cu+Ni) ratios. In areas of thorough alteration nickel can almost completely reside in sulphide minerals. The country rock contamination in the marginal zones and the alteration appear to continue along the downdip extension with nearly constant intensity over a distance of at least 9 km towards north-west.

References: