The Ngala Hill PGE-Skarn (Southern Malawi)

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Crystalline rocks of Neoproterozoic to Lower Palaeozoic age, mainly paragneiss with lesser orthogneiss, underlie the greater part of Malawi and are collectively referred to as the Malawi Basement Complex. This basement is intruded by mafic and ultramafic bodies that are interpreted as syn to late tectonic in age, intruded during the waning stages of the Pan African orogenic event.

The Ngala Hill prospect is located some 55 km by road to the south of Blantyre, within the Chikwawa district of southern Malawi at the foothill of the Blantyre Highlands. Several small intrusive bodies (1-5 km²), including the Ngala Hill intrusion, are distributed along the western edge of the Malawi Basement Complex. Their locus is probably controlled by the Thyolo fault, a major Rift Valley parallel crustal shear. Previous work by the geological Survey of Nyassaland and its successor, the Geological Survey of Malawi, established that a number of the ultramafic intrusions are associated with base metal showings, including the Ngala Hill prospect.

The Ngala Hill prospect consists of quartz-feldspar-amphibole gneisses of the Basement Complex, intruded by the Ngala Hill ultramafic body, which is an arch-shaped intrusion with dimensions of 2 x 0.7 km. The intrusion is comprised essentially of metapyroxenite with no evidence of differentiation observed. The rocks display various degrees of alteration, mainly hornblendisation, which begins with replacement of intercumulus material by hornblende, followed by replacement of pyroxene by hornblende, ultimately resulting in an almost monomineralic, coarse crystalline hornblendite. The hornblende rich lithologies form elongated lenses that often contain subidiomorphic, newly formed diopsidic pyroxenes and minor olivine and locally display malachite staining.

Following encouraging results from initial grab samples Phelps Dodge started an exploration program for PGEs on Ngala Hill in 1999. Follow up work by trenching indicated significant PGE mineralization. One trench returned 1.41 g/t Pt+Pd+Au and 1430 ppm Cu over a length of 64 m. In 2000 Placer Dome became involved on the project. More than 600 m of trenching was completed on the property, followed by a diamond drilling program

Encouraging results were received from a number of trenches, for example 12 m @ 3 g/t PGE+Au and 70 m @ 1.12 g/t, including 8 m @ 3.3 g/t. The average trench depth was between 1.5 m and 2 m and sampled material consisted of saprock or saprolite. Drilling could not repeat the trench values, with no significant mineralization intersected in any of the core samples. The correlation between Cu and PGE assay values noted in weathered trench samples was not observed in the core samples. Cu and Ni values in fresh rock were also significantly lower than in saprock/saprolite samples.

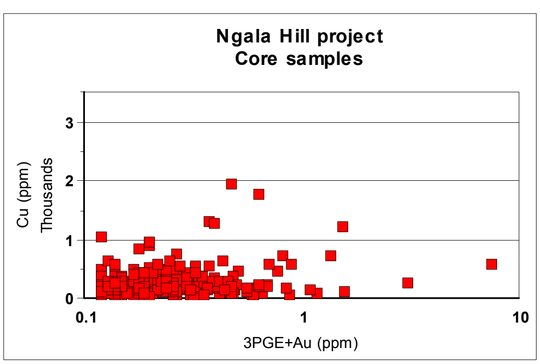

Figure 1. *PGE vs Cu, core samples.*

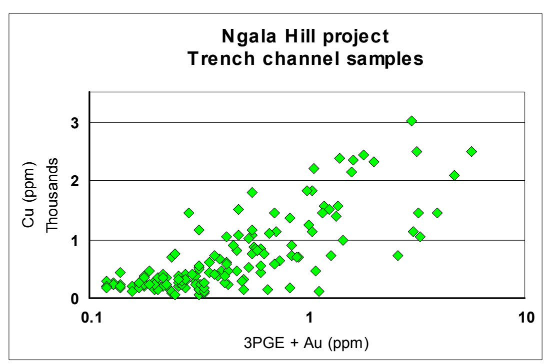

Figure 2. *PGE vs Cu, trench samples.*

PGEs (especially Pd) are mobile under acidic and oxidising conditions. There are enough sulfides in the mineralised zone to create acidic regolith conditions during weathering. Once in solution the PGEs and Au are precipitated where the acidic fluids are buffered by the host rock. This is a continuous process, active during weathering and surface wasting, and is largely limited to the saprolitic portion of the weathering profile. This process leads over time to a surface near enrichment in noble metals within the saprolite. Pt is preferentially enriched over Pd as it is less mobile, i.e some of the Pd is transported in solution further than Pt. This can lead to a marked change in the Pt-Pd ratio in the enrichment zone relative to mineralization hosted in fresh rock. Preferential enrichment at Ngala is indicated, with the Pt-Pd ration in trenches being approximately double that of the ratio in core samples.

During weathering base metals are also concentrated in the saprolite and redistributed in a mushroom shaped enrichment zone. This leads to the apparent relationship between Cu and PGEs in the near-surface environment. Co-precipitation of PGEs with chrysocolla is indicated. Similar saprolite hosted PGE enrichments have also been reported from areas elsewhere that have undergone tropical weathering.

Of interest is the strong hydrothermal overprint of the rocks. Several meter wide zones of garnet-magnetite skarn were encountered. The garnets (almandine-pyrope) display retrograde reaction features forming a symplectitic plagioclase-pyroxene reaction rim. Additional alteration products observed are diopside, olivine, massive phlogopite, chlorite, epidote, carbonate, quartz and feldspar. These minerals indicate that at least Al, Si and K have been added to the system. The alteration minerals comprise a typical skarn assemblage.

Associated with the alteration are various amounts of sulfides, largely pyrrhotite, pyrite and chalcopyrite. The sulfides occur interstitial to, and as inclusions in, secondary minerals, associated with quartz and finely dispersed in meta-pyroxenites. Microprobe work has shown that Pt, Pd and Au tellurides are associated with these hydrothermal sulfides. The presence of tellurides, the morphology of the sulfides, and the association with interstitial quartz point to a hydrothermal origin for the platinum group mineralization.

The mineralization at Ngala Hill is interpreted as a retrograde magnesian PGE-Au exoskarn. The aeromagnetic data show a significant magnetic high associated with the zone of mineralization. The magnetic anomaly extends for several kilometres beyond the outcrop. The strong aeromagnetic anomaly associated with Ngala Hill points to an oxidised intrusive at depth as the driving force behind the skarnification process.