Sheba's Ridge – An Unconventional Setting for Platreef, UG2 and Merensky-Style PGE-BMS Deposits in the Bushveld Complex

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The southern periphery of the Dennilton Dome in the eastern Bushveld Complex contains a number of unusual settings for PGE mineralisation. To the east, the high-grade deposits (ca. 15-30 g/t) of PGE on the farm Blaauwbank were commented upon in Wagner's famous 1929 treatise. The area of Loskop Suid, part of Cluff Mining's Sheba's Ridge property, has been explored sporadically over the past 25 years, and is being explored extensively at present.

The basal contact of the Bushveld Complex traces the rim of the Dennilton Dome for 50 kilometres, south of the town of Groblersdal, in the western extension of the eastern Bushveld Complex. At Sheba's Ridge, the floor rocks comprise metamorphosed dolomite, quartzite and shale of the Transvaal Sequence along more than 9 kilometres of strike. These rocks dip south at 50-80°.

The lowermost unit of Bushveld layered rocks at Sheba's Ridge has attributes that resemble the **Platreef**, so far identified only in the northern limb of the Complex, and will be so named. It crops out along more than 9 km of strike, and comprises a 200-500 metre-thick sequence of feldspathic pyroxenite, locally intruded by harzburgite sills. Up to four units within this sequence, each 8-15 metres thick, contain base metal sulfide (BMS) and associated PGE. The sulfides occur as large irregular blebs and disseminated. The major phases are pentlandite, pyrrhotite, and chalcopyrite. Pentlandite also occurs as exsolution in pyrrhotite. Bulk compositions are typically 0.1% Ni, 0.1% Cu with 1.8-2 ppm Pt+Pd+Au (2E+Au) and Pt:Pd ratio of unity. Corroded blocks of limestone, cordierite-hornfels and calc-silicate are scattered throughout the pyroxenite, and may be the cause of the typical high CaO (4-8%) of the rocks. δS34 values in the pyroxenite range from –5.4 to –1.6. The calc-silicates are invariably associated with development of chromitite and PGE-bearing BMS (best drill intersection 8 metres at 4.5 ppm 2E+Au within which is a zone of 4.2 metres 8.2 ppm 2E+Au). The xenoliths are most common along the upper contact of the pyroxenite within a 50-100 metre thick norite unit. This gives rise to a discontinuous zone of Cr, Ca, K, Ni, Cu and PGE enrichment, and soil geochemical anomalies of >1000 ppm Cu and >500 ppm Ni. Chromitite is irregularly developed along more than 5 km of strike on this plane. It is tentatively correlated with the lower- to upper Critical Zone transition, and here termed the Intermediate Chromitite Layer (**ICL**).

Approximately 400-500 metres of norite, with inter-layered pyroxenite, anorthosite, and sporadic chromitite, typical of the upper Critical Zone elsewhere in the Bushveld Complex, lie above the Platreef and ICL. Xenoliths of quartzite and calc-silicate are common in outcrop and borehole core. A chromitite layer, broadly equivalent to the UG2 chromitite, lies above this strongly layered sequence, here termed the **Platchro** layer. This is characterised by variable thickness, lithology, and grade. It extends along more than 7 km of strike, with near surface expression marked by a strong magnetic signature and soil geochemical anomaly (Cr, Ni, Cu). More than 20 drill intersections have intersected the Platchro layer. The borehole core shows that the layer has no defining internal stratigraphy. It occurs as a mineralised interval, ranging in thickness from 0.8 to 8 metres, within which it ranges from solid chromitite, chromite-bearing pyroxenite, and isolated blocks of finely-layered chromitite set irregularly within a pyroxenite matrix. The hanging wall is generally pyroxenite, but can be norite or anorthosite. The footwall is generally anorthosite, but can be norite. The massive chromitite (typically, but not invariably the thinner inter-sections) have evenly-distributed PGE mineralisation. "Blocky' Platchro can have relatively PGE-barren chromitite with value carried in a pyroxenite matrix. The Cr/Fe ratio is 1.34, similar to UG2. BMS are pentlandite and chalcopyrite, occurring as clusters interstitial to chromite. Some of the better mineralisation can occur in pyroxenite with disseminated chromite. The mineralisation is generally bottom-loaded, with the basal 2.5 metres carrying most PGE. The average grade of the Platchro is 3.9 ppm 2E+Au (~4.5 ppm 5E+Au) over

1.5 metres, with Pt:Pd of 1.4 - 2.4, 0.08% Ni, and 0.06% Cu. The best intersection is 4.9 ppm Pt+Pd+Rh+Au over 2.0 metres. The resource of Platchro at Sheba's Ridge is considerable: intersections have been made down-dip to depths in excess of 500 metres.

A BMS-PGE mineralised pyroxenite interpreted as the Merensky reef occurs 80 – 100 metres above the Platchro layer. This pyroxenite is imperfectly developed, and ranges from a 1.5 metre thick unit with all the typical features of Merensky elsewhere in the Complex, to a weakly mineralised, four-metre thick body of medium-to-coarse-grained pyroxenite with indistinct upper and lower contacts. Where the reef is well developed, the internal stratigraphy consists of a thin, basal chromitite (with high-grade PGE and BMS mineralisation), a coarse-grained feldspathic pyroxenite with 3-5% modal sulfide as the body of the reef, and a diffuse upper contact into pyroxenite. Weak and erratic mineralisation can be carried into the hanging wall and footwall. The better developed reef on the Sheba's Ridge property has a bulk grade of ~ 4.5 ppm (2E+Au), with Pt:Pd of 2.5, 0.2% Ni and 0.1% Cu.

Where the Sheba's Ridge Merensky is thicker, it more closely resembles the reef on the south- eastern part of the western limb, near the town of Brits, but with PGE mineralisation along the basal contact instead of the top. More typical PGE values are 2.5 ppm (2E+Au), unchanged Ni and Cu at 0.2% and 0.1%, respectively, and a Pt:Pd ratio that ranges between 2.5 and 0.8. As the PGE mineralisation is bottom-loaded, a viable Merensky mining operation may be possible.

The top of the Critical Zone is marked by a prominent anorthosite layer about 25 metres thick, above which is the two-pyroxene gabbro of the Main Zone.

All the major PGM-carriers that are currently mined in the Bushveld Complex have been identified in one small area at Sheba's Ridge. The occurrence of Platreef, a UG2-like layer, and Merensky reef on the same property, within 500 metres of contiguous mafic layered stratigraphy, is defined for the first time. This feature, as well as features such as the upward change in the Pt/Pd ratio from Pd-rich to Pt-rich through this interval, challenges existing genetic models.