
Platinum-Group Elements in the Upper Zone of the Rustenburg Layered Suite of the Bushveld Complex: Preliminary Results from the Bellevue Borehole.

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The Rustenburg Layered Suite (RLS) is generally divided into five zones (Hall, 1932): the basal Marginal Zone (0-800 m of norites), overlain by the Lower Zone (800-1300 m of cyclic units of harzburgite and pyroxenites), the Critical Zone (1300 to 1800 m of cyclic units of chromitite, pyroxenites, and norites), the Main Zone (3000 to 3400 m of norites, gabbronorites and anorthosites), and the Upper Zone (2000 to 2800 m of cyclic units of magnetites, gabbronorites anorthosites, and diorites). The Lower Zone and Critical Zone are enriched in Platinum-group elements (PGE) relative to the marginal rocks (Fig. 1). This enrichment culminates in the formation of the world famous Merensky and UG-2 reefs. In contrast the Main Zone contains little PGE. The PGE content of the Upper Zone is poorly documented. Page et al. (1982) published an initial survey, of Pt, Pd and Rh concentrations of the Upper Zone. For most of the rocks the PGE were present at less than the detection limits. However, Page et al. (1982) do report one location with high values in the lower portions of Upper Zone. Harney et al. (1990) investigated 17 samples from the 300 meters of stratigraphy around the Main Magnetite layer. They found that the samples above the Main Magnetite layer have low levels of PGE (Pt+Pd = 5-10 ppb). Samples below the Main Magnetite layer were somewhat richer (Pt+Pd=40-100 ppb). Subsequently, Harney and von Gruenewaldt (1995) quoted company reports that suggest the presence of up to 6 ppm Pt + Pd in the upper part of the Main Zone. They attribute this enrichment and the enrichment reported by Page et al. (1982) to local hydrothermal action.

As part of a larger project "The Bushveld Complex: its origin, crystallization and interaction with the Kaapvaal lithosphere" headed by Prof. Lew Ashwal we have determined PGE, Ni, Cu, S and full major and trace element analyses in 56 samples of Upper Zone from the Bellevue borehole. This borehole provides a complete section through the Upper Zone and the upper part of the Main Zone. The aims of our project are:

a) To characterize the distribution of the PGE in Upper Zone;

b) To investigate whether there is any enrichment of Pd and Au as is found in the upper parts of the Skaergaard intrusion (Andersen et al., 1998). It is intriguing to note that in the Bushveld the reefs have higher Pt/Pd ratios than the silicate liquids from which they formed (2.3 vs. 1.5) requiring that Pd be concentrated elsewhere (Barnes and Maier, 2002). In contrast the Platinova reef of Skaergaard contains little Pt implying that it has been extracted from the magma before the formation of the Platinova reef. Further the Bushveld reefs form from a relative unfractionated magma with chromite and orthopyroxene on the liquidus. The Skaergaard Platinova reef forms from a highly fractionated magma. Could there be a Platinova type reef in the Upper Zone of the Bushveld, or a Merensky type reef in the lower parts of Skaergaard ?

c) To investigate whether there is any PGE enrichment of the type reported by Harney and von Gruenewaldt (1995) and Page et al. (1982).

d) To investigate whether magnetite will concentrate Os, Ir, and Ru. Capobianco et al. (1994) have shown in experiments run at high oxygen fugacity that magnetite can concentrate Ru by analogy one would expect Os and Ir to also be concentrated in the magnetite.

Our preliminary results show that for most of the Upper Zone the PGE concentrations are extremely low. In most rocks Pt and Pd do not exceed 1 ppb. Osmium and Ru are present at less than detection limits of 0.2 and 1 ppb respectively. Iridium concentrations range from 0.08 to 0.3 ppb, Au from 0.1 to 7 ppb, Rh from <0.1 to 0.5 ppb. There does not appear to be an enrichment of Pd over Pt so the Pd "missing" from the reef rocks remains to be found. There is an enrichment in all of the PGE, with Pt+Pd = 3 ppm in the cyclic unit of the lower most magnetite layer of the Upper Zone. While it is difficult to make a direct stratigraphic correlation with the enrichments reported by Page et al. (1982) and Harney and von

Gruenewadlt (1995), the enrichments are in approximately the same stratigraphic position, i.e. close to the change from the Main Zone to the Upper Zone. The magnetite layers do not appear to be enriched in Os, Ir, and Ru and hence magnetite

does not appear to have concentrated these elements. Iridium, Pd, Re, Au, Se and Cu all show a positive correlation with S suggesting that sulfides control these elements.

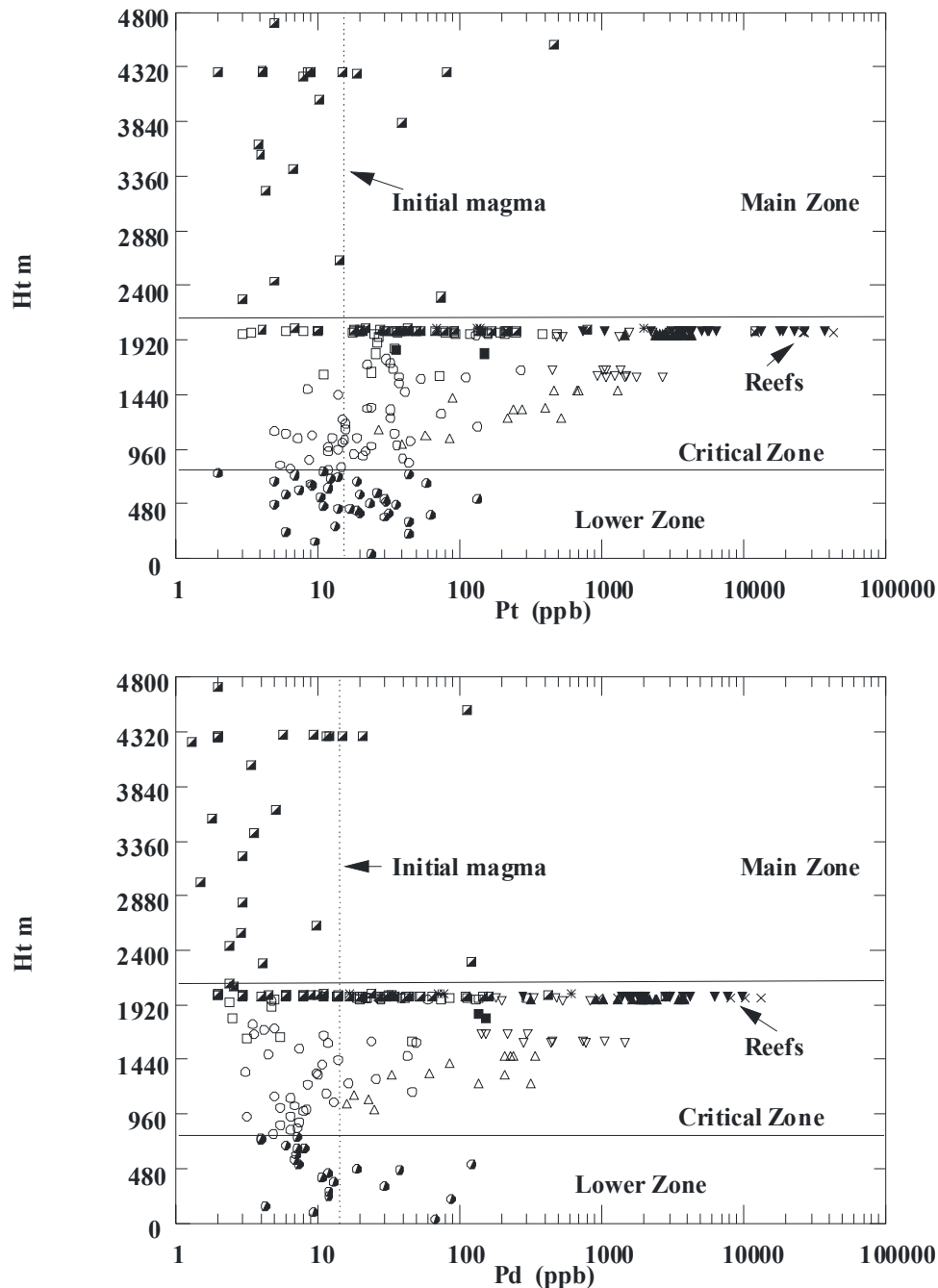


Figure 1. Variations in Pt and Pd content through the Bushveld Complex. Data from Barnes and Maier (in press) and references therein. Circles = peridotites and pyroxenites, triangles = chromitites, x = reefs; squares = mafic rocks.

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