ALTERATION OF DETRITAL PLATINUM-GROUP-MINERALS (PGM) IN RIVERS OF THE EASTERN BUSHVELD COMPLEX

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The Bushveld Complex, South Africa, is the world’s largest resource and leading producer of platinum-group elements (PGE). Current mines work the Merensky Reef, the UG-2 chromitite and the Platreef in the Critical Zone; limited platinum production from ultramafic pipes has long ceased. Although the initial discovery of platinum in the Bushveld Complex in 1924 was made by panning in a river bed, exploitation of placer PGM was never economic.

More than 6000 PGM grains were separated from stream sediments of rivers draining the Critical Zone of the Eastern Bushveld Complex. The PGM assemblage is composed of grains of Pt-Fe alloy (73.2 %), braggite-cooperite (14.2 %), sperrylite (10.2 %), and a variety of rarer PGM including laurite, Rh-sulfides, Pd-Sb-As-Te phases and Ru-rich alloys. Unaltered PGM nuggets occur in about equal proportions as mono- or polyphase grains.

Pt-Fe alloy grains are up to 1.6 mm in diameter (usually 100-200 micrometer). More than 78% of the Pt-Fe grains have compositions ranging from [Pt3Fe] to [Pt1.5Fe] (ferroan platinum). The remaining Pt-Fe alloys are solid solutions of tetraferroplatinum [PtFe], ferronickelplatinum [Pt2FeNi] and tulameenite [Pt2FeCu]. Almost 75 % of the [PtFe] grains and 43 % of the ferroan platinum grains are altered. Ferroan platinum is frequently mantled by [Pt(Fe,Cu,Ni)], and many of these rims have an additional outermost rim close to [Ni2FePt] in composition. In addition, Pd-Pb and Pd-Hg phases are also present in the alteration rims. Pt-rich or Ru-rich oxides represent further oxidation products of primary PGM.

More than 50 % of the investigated Pt-Pd sulfides (braggite-cooperite) are severely corroded and rimmed by a porous phase of native Pt, which occasionally has distinct
contents of Pd. In contrast, most of the sperrylite grains are unaltered. In summary, the mineralogical composition of placer PGM from the Eastern Bushveld does not unequivocally indicate a single source of PGM. Contributions from the Merensky Reef, the UG-2 chromitite, other chromitites, and Pt-bearing dunite pipes have to be considered. The complex alteration features probably came into existence during the magmatic-hydrothermal and/or long-lasting diagenetic-weathering and post-depositional history of the PGM in this part of the Bushveld Complex.