

Platinum Group Elements in the Uitkomst Complex, South Africa

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Abstract

The mafic-ultramafic Uitkomst Complex of South Africa is a tubular intrusion that is believed to be coeval and cogenetic with the 2054 Ma Bushveld Complex. It consists of a thin (3.5-m) basal gabbroic phase that is overlain by ca. 450 m of ultramafic rocks and 250 m of gabbroic and dioritic rocks. The basal 300 m of the intrusion hosts disseminated Ni-Cu-platinum group element (PGE) sulfides (100 Mt at ca. 0.55% Ni, 0.17% Cu). In addition, several lenses of massive sulfides (2.9 Mt at 2.04% Ni, 1.13% Cu, and 6 ppm total PGE) are situated in the immediate floor of the intrusion. We determined the PGE concentrations in 86 samples from the Uitkomst Complex. The rocks containing disseminated sulfides have up to 3 ppm total PGE and the massive sulfides have up to 7 ppm total PGE. Sulfide segregation was triggered by assimilation of external sulfur from the country rocks adjacent to the intrusion. The most important contaminant was probably dolomite of the Malmani Subgroup that includes sulfidic shale interlayers. The composition of the magmatic sulfides can be modeled by applying an *R* factor (mass ratio of silicate melt to sulfide melt) of between 800 and 1,000. The sulfides in the ultramafic rocks show little tendency of metal depletion with height and thus appear to have segregated from successive surges of fertile magma. This suggests that the basal portion of the Uitkomst Complex crystallized in an open magmatic system, e.g., a magma conduit. The gabbroic and dioritic rocks in the upper portion of the complex are relatively PGE depleted (Cu/Pd mostly higher than in primitive mantle), suggesting that they crystallized from the residual magmas to the ultramafic rocks in a closed magmatic system.

Some of the ultramafic rocks in the central portion of the complex are S poor (mostly <700 ppb S) but contain relatively high amounts (30–250 ppb) of total PGE. These rocks have unusually low Pd/Tr (0.6–ca. 10), Cu/Zr (typically <0.5), and high Pt/Pd (up to 19), suggesting that either Pd, Cu, and S were remobilized or that the magma was undersaturated in sulfide liquid at the time the rocks formed and that platinum group minerals (PGM) crystallized.

The present study suggests that sill-like bodies of Bushveld affinity that intruded dolomitic rocks may generally have an enhanced potential to host massive magmatic Ni-Cu-PGE sulfides.

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