Origin of Ru-Os-Ir alloys from the Evander Goldfield, Witwatersrand Basin (South Africa)

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The Late Archean placers of the Witwatersrand Basin (South Africa) are not only unparalleled in their gold-uranium deposits, but are also a leading source for osmium production as a by-product of gold mining from rocks underlying the Ventersdorp Supergroup, which is about 2.7 Ga old [1]. The compositionally diverse platinum-group minerals (PGMs) from the Evander Goldfield, situated in the eastern part of the Witwatersrand Basin, have been studied by a number of techniques including SEM, EPMA and LA MC-ICP-MS.

The characteristic feature of PGMs from Evander is a predominance of Ru-rich alloys and unnamed polycomponent alloys of the system Ru-Os-Ir-Pt(±Fe), which prevail over other PGMs. Equilibrium phase-relationships of ruthenium and osmium alloys at Evander, based on the restricted solid solution in the binary systems Os–Ru, Ir–Ru and Os–Ir [2], and the presence of a ruthenium-enrichment trend in Ru-Os-Ir(±Pt) alloys, are indicative of high temperatures and pressures, which could only be reached under mantle conditions [3].

The Os-isotope results identify a restricted range of 'unradiogenic' $^{187}Os/^{188}Os$ values for coexisting Ru-rich alloy and Ru-Os sulfide pairs that form primary PGM assemblages. For the major set of PGMs (n=92), independently of their chemical composition, at least three groups with distinct mean $^{187}Os/^{188}Os$ values were distinguished (0.1052±0.0003, 0.1070±0.0006 and 0.1085±0.0004). The mean T_{RD} (Re-depletion) model ages, calculated relative to CHUR [4], correspond to 3.24±0.05, 2.99±0.07 and 2.78±0.05 Ga, respectively. The Os-isotope data are used to discriminate between detrital *vs* hydrothermal origins of noble metal mineralization within the Witwatersrand basin.

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