

New data on PGE alloy minerals from a very old collection (probably 1890s), California

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ABSTRACT

We report results of multiple electron-microprobe analyses of nine grains of alloy minerals, 2–5 mm in size, rich in the platinum-group elements (PGE), from a unique, very old collection (~1890s) of placer material from Trinity Co., California. Osmium, iridium, ruthenium, and rutheniridosmine are the principal alloy species poor in Fe (typically <0.5–1 wt%); they appear to be primary. An Fe-enrichment (up to 4.6 wt%) is observed in lamellae of Ir-Ru-Os alloy exsolved from the Fe-poor Os-Ir-Ru alloy host, and also in a rim-like alteration-induced phase developed along the margin in some of the grains of Ir-Ru-Os alloy. Much greater levels of Fe (up to 19.1 wt%), incorporated via the substitution mechanisms: Fe → Ru, Fe → (Os + Ru), and Fe → Ir, were documented in three grains of Fe-Os-Ru-Ir alloys, which attain Fe-dominant compositions, i.e., hexaferrum. These Fe-Os-Ru-Ir alloys and associated exotic phases enriched in unconventional elements, such as W-(Mo)-bearing rutheniridosmine, (Os,Ir)₅(W,Mo) and newly recognized (Ir,Os)₅(W,Mo), appear to be secondary, formed under conditions of low fugacities of O₂ and S₂ as a result of interaction of primary Os-Ir-Ru alloys with a reducing fluid phase. No grains of Pt-Fe alloys were found; these only occur as Pt₃Fe-type (isoferroplatinum or Fe-rich platinum) and Pt₂Fe-type inclusions (<50 μm), enclosed in a matrix of Ir- or Os-dominant alloys rich in Ru. The Pt₂Fe alloy appears to be a compositional variant of Fe-rich platinum, possibly reflecting a lower limit of Pt content possible in the mineral platinum. An Au-Ag alloy, ranging up to Au_{0.99}, precipitated pseudomorphously by a subsolidus reaction between a residual Au-Ag-rich melt and exsolution-induced inclusions of the Pt-Fe alloy phases. Micro-inclusions of olivine, hosted by a ternary alloy Os_{0.33}Ru_{0.33}Ir_{0.30}, are extremely rich in Mg (Fo_{95.1–95.4}), probably reflecting high-temperature reaction involving chromite or magnesiochromite. The alloy grains from the old collection were likely derived from a mineralized zone of ultramafic rocks, rich in chromite-magnesiochromite and poor in overall S, in the Trinity ophiolite complex of northern California.

Keywords: PGE alloy minerals, old collection, Trinity ophiolite complex, northern California