Supergene transformation of Tasmanian 'osmiridium' nuggets - The role of biofilms

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(Geo)biological cycling plays a fundamental role for the formation of secondary platinum (Pt) and gold (Au) in placer environments [1] [2]. In contrast, little is known about the mobility of other platinum-group-elements, *e.g.*, osmium (Os) and iridium (Ir), under Earth surface conditions. To assess if geomicrobial processes affect Os and Ir, forty grains of Os-Ir alloys ('osmiridium' in the local mining literature) were collected from three alluvial placer deposits in Tasmania, Australia, and analyzed using electron-microscopic and bio-molecular sequencing tools.

Grains were angular to slightly rounded and between 0.3 and 3 mm in diameter. Grains were commonly covered by a polymorphic layer consisting of active sheet-like biofilms composed primarily of prokaryotic cells, intermixed/overlying micro-crystalline Fe-oxides, organics and clays. Gram-negative γ- and β-*Proteobacteria* were the most common groups of bacteria on the grains. In addition, *Acidobacteria*, *Verrucomicrobia* and α-*Proteobacteria* were detected. Many of detected bacteria were closely related to well-known metal-resistant bacteria, *e.g.*, *Cupriavidus metallidurans* or *Pseudomonas* spp. Iridium nano-particles occurred throughout the polymorphic layer, and abundant nano- and micro-crystalline Ir aggregates were observed at the contact between the polymorphic layer and the nuggets, suggesting that Ir is less mobile than Os under surface conditions. Overall a refining process similar to that occurring on Au-Ag grains seems to take place, in which Ag (Os) is released to the environment and Au (Ir) is (bio)geochemically recycled on the grain surface and forms a layer of secondary Au (Ir). In conclusion, we present the first direct evidence for the active involvement of biofilms in the transformation of grains of Os-Ir alloys, and the mobility of Os and Ir in Earth surface environments.

[1] Reith *et al* (2013) *Minerals* **3**, 367-394; [2] Reith *et al* (2014) *Earth Sci. Rev.,* **131**, 1-21.