Microbial gold (trans)formation: Examples from Europe and Asia

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The biogeochemical cycle of gold (Au), which leads to transformation of Au grains is driven by geomicrobial processes mediated by biofilms living on Au grain surfaces. In this study we investigated Au grains from 49 temperate, tropical and arctic sites from variety of physicogeochemical scenarios. These include glacial, eluvial and alluvial placer deposits derived from epi- and hydrothermal primary deposits in Germany, Switzerland, UK, Finland, Russia and the Philippines. In these environments little research has been conducted to link gold grain morphologies and chemistry to geomicrobial processes. Gold grains were analysed using (focused ion beam)-scanning electron microscopy and electron microprobe analyses as well as Next Generation Sequencing to examine grain morphologies, compositions, and assess biofilm communities, respectively. Gold grains from all sites show abundant secondary Au morphotypes indicative of Au/Ag dissolution and Au neoformation. For example, secondary nano-particulate and bacteriomorphic Au embedded in exopolymeric materials were particularly abundant on grains from Hübli (Switzerland), Ochill Hills (UK) and Tabionan (Philippines). Grains from Sulzburg (Germany) and Ghanmain (UK) display distinct 'spongy' surface textures highly indicative of silver (Ag) de-alloying. Biofilms were also detected on all grains and consisted of a range of bacterial groups. Generally, communities were dominated by *Proteobacteria* (> 40%), with *β-Proteobacteria* abundant across all sites. Some organisms detected on the Au grains were known surface colonizers in biofilm formation (*Acidovorax spp.*), involved in metabolic turnover and biogeochemical cycles (*Brevundimonas sp., Herminiimonas sp.*) and known for metal, specifically Au, detoxification and biomineralisation *(Arthrobacter spp., Cupriavidus sp., Geobacter sp.,* and *Rhodoferax sp.)* [1]. In conclusion, these results demonstrate that geomicrobial processes play a critical role in the transformation of Au grains in temperate, tropical and arctic environments in Europe and Asia.

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