Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.21983

Assessing the potential of *Actinomycetota* gold biomineralization

DR. JEREMIAH PAUL SHUSTER, PHD[1], SANTONU KUMAR SANYAL[2], BARBARA ETSCHMANN[3], JOËL BRUGGER[3] AND PROF. GORDON SOUTHAM, PHD[4]

[1]Western University
[2]Commonwealth Scientific and Industrial Research Organisation
[3]Monash University
[4]The University of Queensland

Presenting Author: jshuste3@uwo.ca

Gold is subjected to weathering despite being considered an "inert" precious metal. Under Earth's near-surface conditions, gold usually occurs as placer electrum (i.e., gold/silver alloy) grains, highlighting the environmental factors that promote primary source weathering as well as gold transport. A common feature of placer electrum grains are enriched gold rims, up to 99% pure, demonstrating gold and silver weathering on the micrometer scale. Because placer electrum grain surface textures are heterogeneous, concave surfaces accumulate clays and organic matter. These fluid-grain-sediment interfaces are active sites where gold/silver dissolution and gold re-precipitation processes occurs and contributes to the formation of bactriomorphic gold/silver structures and pure gold nanoparticles, respectively. These polymorphic layers highlight the biogeochemical cycling of gold. Previous studies revealed that diverse bacterial communities are associated with placer electrum grains, including metal-tolerant bacterial species. These microorganisms can contribute to gold enrichment on grain surfaces by promoting both gold dissolution and reprecipitation. For this study, the potential of *Actinomycetota* gold biomineralization was assessed by combining molecular and scanning electron microscopy analytical techniques. Bacteria from the *Actinomycetota* phylum was detected from placer electrum grains obtained from the Kaapvaal valley in South Africa. Using focused ion beam milling and scanning electron microscopy, filamentous structures (ca. 1 μm in diameter and 10's of micrometers in length) were observed within polymorphic layers and interpreted as remenants of mycelia produced by *Actinomycetota*. Some of the hyphae retained their filamentous structure and were mineralized in gold nanoparticles less than 100 nm in diameter. It is reasonable to suggest that these gold nanoparticles could contributed to enriched gold rims through mechanical reshaping during grain transport. Alternatively, gold nanoparticles loosely bound to the grain surface could be dispersed and "lost" within the host sediment, producing a dispersion halo important to exploration. The characterization of mycelia-producing bacteria associated with fine gold nanoparticles further highlights gold/silver weathering within polymorphic layers on gold grains. The microbial communities associated with gold grains are increasingly complex with *Actinomycetota* - common soil bacteria contributing to the dynamic biogeochemical cycling of gold.