Biogeochemical formation of secondary gold particles: Implications for gold dispersion

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The biosphere drives the cycling of gold under surface to near-surface conditions thereby contributing to gold dissolution and the formation of micrometre-scale 'bacterioform' structures on the surface of gold grains as observed from specimens sampled from a range of placer deposits. Nanophase colloids and euhedral crystals commonly occur on the surface of gold grains and are associated with clay-silt sediments, residual organics and biofilms. The presence of these secondary gold particles suggests that a fraction of gold leached from the grain surface is re-precipitated within detrital material. Variations in secondary gold particle size and morphology can be interpreted as different 'generations' of gold dissolution and re-precipitation. Overall, these structures represent the biogeochemical processes that contributed to the transformation of gold within the natural environment. To test the hypothesis that gold grains can 'grow' under surface conditions, four experimental systems were constructed to represent simplified models of gold grain-bearing environments. Millimetre-scale gold grains and nanometre- to micrometre-scale gold particles were synthesized within these laboratory models. Surficial textures and morphologies of synthesized gold grains were analogous to those on natural gold grains. The structural and chemical characterization of natural and synthesized secondary gold structures provides a better understanding of how biogeochemical processes contribute to the dynamic transformation of grains. These transformations could provide greater insight into gold dispersion in natural environments and help refine targets for mineral exploration.