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The Deposition of Elemental Gold from Gold(I)-Thiosulfate Complexes Mediated by Sulfate-Reducing Bacterial Conditions

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Abstract

The role of sulfate-reducing bacteria in the precipitation of elemental gold through a geologic stratum was investigated using column experiments. The mixed culture, dominated by sulfate-reducing bacteria, was isolated from the Driefontein consolidated gold mine, Witwatersrand basin, Republic of South Africa. Bacterially mediated gold precipitation from the gold(I)-thiosulfate complex was more efficient than the corresponding abiotic experiments. In the bacterial systems, sulfate-reducing bacteria (i.e., *Desulfovibrio* sp.) deposited gold inside the cells as spherical nanoparticles. Over time, these nanoparticles of gold were released from the cells and deposited at cell surfaces and in the bulk solutions. Ultimately, these nanoparticles of gold contributed to the formation of micrometer-scale octahedral gold crystals, occasional framboidlike structures (~1.5-μm diam) and millimeter-scale gold foils, typically surrounding the silicate grains. Spherical gold particles (~1-μm diam) were precipitated in the abiotic experiments, and the formation of octahedral gold, framboidlike structures and gold foils were not observed in these experiments. The reduction and enrichment of elemental gold by sulfate-reducing bacteria occurred without the concomitant death of the bacteria, suggesting that in natural systems, this process could go on over geologic time scales, as long as nutrients and gold(I)-thiosulfate were provided to the system.

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