Kinetics of Silica Deposition as a Control on Silica-to-Ore Ratio in Mineralized Epithermal Veins

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Banded veins in high-grade, low-sulfidation epithermal deposits are characterized by a variety of microtextures. Bands containing ore minerals display distinctive textural characteristics indicative of gentle boiling or flashing. This includes bands that originally were entirely composed of silica microspheres and contain dendritic ore minerals. The noncrystalline silica is typically recrystallized to quartz. These bands are thought to have formed during flash vaporization, as this process results in the generation of large amounts of vapor, causing deposition of silica and carbonates, as well as ore minerals from the resulting supersaturated liquid. In geothermal systems, which are modern analogs to epithermal systems, flashing occurs at the back-pressure plate precipitating scales. In geothermal power plants such as the Coso geothermal system in California, the flashed liquid is cooled and subsequently injected underground in reinjection wells. Scaling at Coso is pronounced in these wells and not restricted to the back-pressure plate where a drop in pressure occurs. In this study, petrographic investigations were performed on scales forming in the reinjection wells. These consist of banded accumulations of noncrystalline silica forming microspheres. The silica microspheres range up to several micrometers in size and are closely packed. Although silica supersaturation in the liquid was probably already reached during flash vaporization, the deposition of silica occurs along the entire subsequent flow-path of the flashed liquid and in the reinjection wells. As the silica is not deposited at the flash point only, the kinetics of silica deposition may be an important control on the silica to ore ratio that develops in mineralized bands in epithermal veins.