

Origin of Fibrous Quartz in High-grade Epithermal Veins

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High-grade epithermal veins commonly contain layers of fibrous quartz, which can be composed of the length-fast quartz variety chalcedony or length-slow quartzine. Previous workers have suggested that fibrous quartz in epithermal veins is formed through precipitation in open space. However, based on the study of silica deposits from hydrothermal systems having different ages and thermal histories, it is shown here that at least certain types of fibrous quartz form because of the maturation of a noncrystalline silica precursor originally deposited along the vein walls.

Silica deposits from Porkchop Geyser in the Yellowstone National Park in Wyoming and silica scales from a production well at the Hudson Ranch geothermal power plant in the Salton Sea geothermal field in California contain botryoidal layer(s) of noncrystalline silica identified as opal-AN. The opal-AN has smooth and glass-like surfaces, lacking any internal features under the microscope in plane-polarized light. Under crossed-polarized light, however, the opal exhibits conical extinction patterns and fine concentric banding. In the scale samples from the Hudson Ranch power plant, which formed within about a year in the production wellhead, fibrous textures are present under crossed-polarized light despite the fact that the samples are structureless and glass-like in plane-polarized light.

Colloform vein samples from epithermal deposits including McLaughlin in California and Creede in Colorado contain fibrous quartz having similar micro-textural characteristics, including conical patterns and fine concentric banding suggesting that they formed through maturation of an opal-AN precursor. Raman spectroscopy showed that the fibrous quartz contains minor amounts of the monoclinic silica phase moganite. Deposition of the opal-AN precursor likely occurred due to silica supersaturation caused by vapor formation in the hydrothermal liquids.