

Sulfide Dendrites in Silica Scales at the Salton Sea Geothermal Field, California

Aaron Adsit¹, Thomas Monecke¹, Santiago Rocha²

¹Center to Advance the Science of Exploration to Reclamation in Mining, Department of Geology and Geological Engineering, Colorado School of Mines, Golden, United States,

²CyrQ Energy, Salt Lake City, United States

The Salton Sea geothermal field is located within an active pull-apart basin developed by the San Andreas fault - Imperial fault transtensional step-over in southern California. The field is hosted by a ~10-km-thick succession of metamorphosed sedimentary rocks and an overlying <5-km-thick succession of Holocene fluvial deposits that were intruded by bimodal volcanic rocks. The geothermal reservoir associated with the volcanic activity has been exploited since the 1960s. The production fluid is unusually saline with a high total dissolved solid content of up to 32 wt. % and base metal concentrations of up to 8 ppm Cu, 790 ppm Zn, and 84 ppm Pb occurring in solution.

Silica scales collected from a production well at the Hudson Ranch 1 geothermal power station contain abundant sulfide minerals in a light brown, smooth, finely banded, non-crystalline silica matrix. The sulfides form multi-branching dendrites that are up to one millimeter in size. Bulk samples of the scales contain up to 7.72 wt.% Zn, 4.09 wt.% Pb, and 5819 ppm Cu. The scales are layered with some layers containing primarily sphalerite and galena dendrites while others are dominated by chalcopyrite. Textural evidence suggests that dendrite growth originally occurred in a gel-like matrix, allowing diffusion of solutes from the fluids flowing over the top of the scale to the site of dendrite growth. At the location of scale formation, two-phase flow conditions occurred at temperatures of ~260°C, with vapor forming ~8 – 12 wt. % of the production fluid. The wellhead sampled was rimmed only 12 months prior to sampling, suggesting that silica deposition and ore mineral dendrite growth occurred rapidly. These observations provide important constraints on the ore-forming processes in epithermal deposits.