UNIVERSITY OF CALIFORNIA
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Mineralogic and Fluid Inclusion Study of Ore-Mineralized Fractures in Drillhole State 2-14, Salton Sea Scientific Drilling Project, California, U.S.A.

A Thesis submitted in partial satisfaction
of the requirements for the degree of

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by

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ABSTRACT OF THE THESIS

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This report is based on a detailed investigation of drill core recovered from Salton Sea Scientific Drilling Project drillhole, the State 2-14, Imperial Valley, California. During the drilling of this 3.2 km deep drillhole, 220 m of drill core were recovered and brines in excess of 240,000 TDS were sampled. The focus of this report is on ore mineralization in these core samples, which occurs primarily in nearly vertical fractures. The study involved petrographic, fluid inclusion and microprobe investigations into the chemical and thermal history of the fractures during mineralization.

Hand sample and petrographic investigations revealed eight principal Vertical Fracture Zones (VFZ's) in the cores. Characteristically, the mineralization sequences

proceeded from early silicates to carbonates, then concluded with sulfides. In certain fracture zones, a final phase of hematite mineralization was pervasive. Only the fracture zones which display the late stage hematite mineralization are now open suggesting that in situ they are presently interacting with a geothermal fluid. The principal gangue minerals include epidote, quartz, adularia, calcite, ankerite and anhydrite. Sulfide minerals include chalcopyrite, pyrite, galena, sphalerite and pyrrhotite.

Fluid inclusion analyses on calcite, sphalerite and quartz in VFZ 1, 2, 3, 4 and 7 indicate that salinities of the mineralizing fluids increase with depth from 12 to 26 wt.% NaCl equivalents. A comparison between State 2-14 brine analyses and estimated fluid inclusion liquid compositions indicate that either the inclusion fluids were much more Ca enriched, or that experimental data in the system NaCl-CaCl2-H2O do not accurately model these complex brines. An erratic profile of paleotemperatures versus depth from fluid inclusion homogenization temperatures suggests that shallow temperatures were once as much as 45 C higher than the ambient temperatures measured downhole. Boiling and fluid mixing may all have contributed to this observation, yielding cooler, more oxidized brines.

Microprobe analyses of sphalerite grains, to determine the FeS content, yield log sulfur fugacities of -10 to -11 in VFZ's 1 and 2. Widely fluctuating microprobe data from

single crystals of both sphalerite and pyrrhotite in VFZ-3 suggest that either the analyses were not precise or that highly variable conditions existed during mineral growth.

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