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A Core Hole into the Hydrothermal System of the Long Valley Caldera

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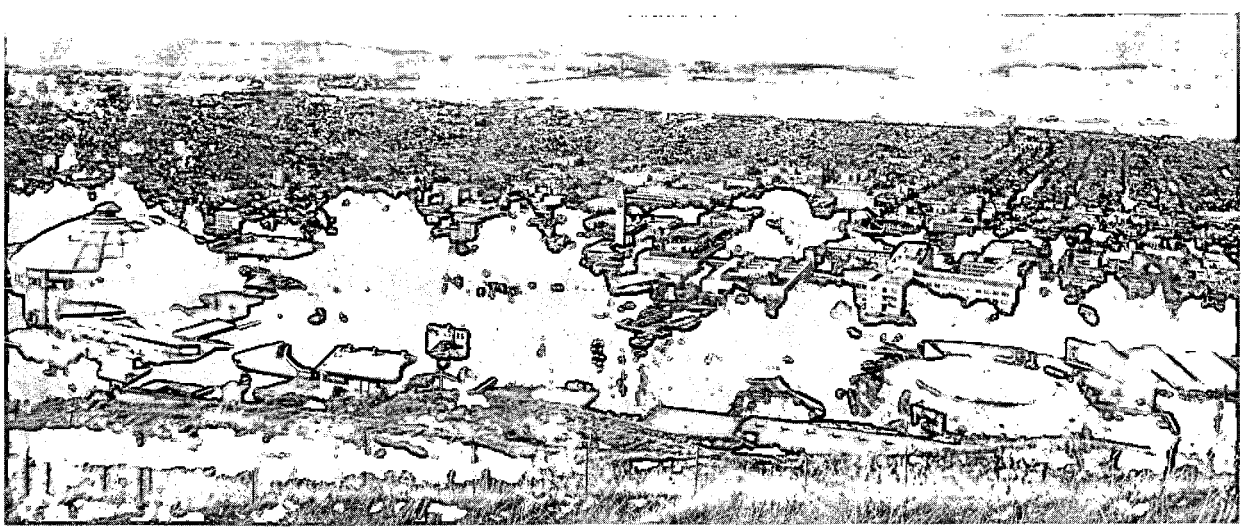

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A CORE HOLE INTO THE HYDROTHERMAL SYSTEM OF THE LONG VALLEY CALDERA

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To investigate the present-day hydrothermal system, the "Shady Rest" hole was continuously cored 715m into the southwestern moat of the Long Valley caldera (Figure 1). The hole intersected 100m of glacial till and 300m of postcaldera rhyolite before entering the welded Bishop Tuff and bottoming in that unit (Figure 2). A sharp temperature rise over the upper 350m, and near-isothermal conditions below reflect the presence of ~ 200°C water moving through open, calcite-lined fractures in silicified Early Rhyolite and the Bishop Tuff. The depth to the Bishop is the shallowest encountered in holes in the caldera, and the temperatures measured are among the hottest observed in wells drilled within the caldera.

Difficulties were encountered in completing the hole; sloughing, squeezing, and lost circulation prevented installation of casing over the full 715 m depth. Attempts to redrill and recover the portion of the hole below 245 m resulted in a "new" hole, diverging from the original at 241 m (Figure 3). The "new" hole was cored to a depth of 426 m, where N-sized casing (6 cm I.D.) was cemented in and filled with water; temporarily configured as a thermal gradient hole.

Following repeated temperature surveys to determine an equilibrium profile, a portion of the casing in the high temperature zone was perforated, the fluids were sampled. Preliminary chemical analyses and calculated geothermometer temperatures are compared with analyses of a Casa Diablo geothermal well fluid in Table 1. The similarities in most of the chemical concentrations and in ionic ratios suggest that the Shady Rest fluids are the predominant constituents of fluid flowing through the Casa Diablo geothermal field. The higher Ca concentration at Shady Rest is probably due to the abundant calcite that lines the open fractures of the high temperature zone. Calculated Na/K/Ca chemical geothermometer temperatures for the Shady Rest and Casa Diablo well samples are higher than those measured down-hole, but are similar

to the temperature measured at Unocal's 44-16 hole (218°C), ~ 6 km northwest of Shady Rest.

Planned investigations of Shady Rest core include alteration mineralogy, $^{87/86}Sr$ and $^{12/13}C$ measurements on fracture calcite, and $^{18/16}O$ and H/D determinations on fracture minerals and whole-rock specimens. Uranium-series disequilibrium will be investigated in intervals indicated by gamma-ray logs. Major- and trace chemical constituents of fluid and gases will be analyzed, and measurements of fluid inclusion temperature will be attempted.

The hole serves the multiple purposes of identifying a potential geothermal resource for Mammoth Lakes, as a point for monitoring changes in hydrologic and fluid chemical parameters, and as an indicator of a principal heat source for the caldera's hydrothermal system. It was the consensus of participants at recent Long Valley hydrothermal workshops that a 1 to 2 km-deep hole should be drilled to resolve the critical question of the flow paths in the hydrothermal system of the western moat area and the location of the associated heat source. In this respect, the Shady Rest hole can be considered a "stepout" west of Casa Diablo, to test the rationale for the deeper hole. Though the Shady Rest hole does not penetrate deeply enough to fully delineate the characteristics of the hydrothermal system in the western moat, it does confirm the presence of 200° + water, and provides access to hydrologic and geochemical information otherwise unobtainable until a deeper hole is drilled. Such information will prove invaluable in siting and determining the depth of the deeper hole.

The Shady Rest hole was drilled under the joint auspices of the USDOE's Office of Basic Energy Sciences, the California Energy Commission, and Mono County.

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