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THE LONG VALLEY WELL - PHASE II OPERATIONS

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Abstract:

Phase II of the Long Valley Exploratory Well was completed to a depth of 7588 feet in November 1991. The drilling comprised two sub-phases: (1) drilling 17-1/2 inch hole from the Phase I casing shoe at 2558 feet to a depth of 7130 feet, plugging back to 6826 feet, and setting 13-3/8 inch casing at 6825 feet, all during August-September 1991; and (2) returning in November to drill a 3.85-inch core hole deviated out of the previous wellbore at 6868 feet and extending to 7588 feet. Ultimate depth of the well is planned to be 20,000 feet, or at a bottomhole temperature of 500°C, whichever comes first.

Total cost of this drilling phase was approximately \$2.3 million, and funding was shared about equally between the California Energy Commission and the Department of Energy. Phase II scientific work will commence in July 1992 and will be supported by DOE Office of Basic Energy Sciences, DOE Geothermal Division, and other funding sources.

Drilling Operations:

The first task, which went relatively smoothly, in Phase II drilling was to fish a string of core rod stuck in the core hole since Phase I. Approximately 230 feet of the fish came out in one piece, and the remaining 10+ feet was milled up and pulled out with magnets. Rotary drilling then continued in the same Bishop Tuff entered at 2040 feet during Phase I. This formation, with some rhyolite intrusions, extended to 5900 feet, and progress in it was excellent, with more than 300 feet drilled on some days.

At 5900 feet, the borehole intersected the top of a highly mixed breccia. This rock includes fragments of both its neighbors: the Bishop Tuff above it and the Mount Morrison roof pendant below it. Although a 30-foot spot core was taken in this formation, the mechanism of the breccia's origin is still not clear. This is a significant stratum, extending from 5900 to 6645 feet. It is also a considerably harder rock than the Bishop Tuff; rate of penetration dropped and hole deviation increased in this interval.

True "basement" rock starts at 6645 feet; this is the metamorphic rock (hornfels) of the Mount Morrison roof pendant, so named because it outcrops near Mount Morrison north-west of the drill site. This unit was originally sedimentary rock, but was metamorphosed by the heat from a large granitic intrusion approximately 90 million years ago. It is hard and abrasive, with severe bit wear and rates of penetration frequently under 10 feet per hour. Hole deviation also increased in this interval, reaching almost 5° from vertical at a depth of 7130 feet. Deviation this large would present a problem at the beginning of Phase III drilling, but directional re-drilling at the bottom of this hole would have been very expensive. To avoid both of these scenarios, the well was plugged back to 6825 feet, where deviation was under 2-1/2°.

Before casing was set at this depth, 26 sidewall cores were taken in the interval between 3000 and 6700 feet, and the open hole was logged with conventional wireline tools (oriented caliper, gamma ray, sonic, dual induction) and a borehole televiwer. Following casing, preparations were made for approximately 700 feet of continuous wireline coring below the casing shoe. A 6-1/8 inch rathole was drilled approximately 50 feet below the shoe, and a string of Ocean Drilling Program drill pipe with an orienting wedge at the bottom was run into the hole and hung there with the wedge in the rathole. The drill pipe/wedge assembly guides the coring string out the side of the plugged-back wellbore and also forms a relatively small annulus around the core rods to reduce vibration and improve cuttings transport.

After a hiatus of about a month, a small coring rig was mobilized and placed on the floor of the big drill rig in such a position that it could run the core string through the string of hanging drill pipe. (This is the same coring technique used at the end of Phase I.) The core rig was used to rotate the core rods and provide fluid circulation through the core string, while the big rig provided hoisting capability for tripping the core string, as well as electrical power to operate both rigs. The core hole entered the formation from the wellbore at 6868 feet

and reached 7588 feet. All the cored interval was in the same rock (hornfels) as the lower part of the 17-1/2 inch hole. Coring was fairly slow (average rate-of-penetration about 3 feet/hour), but obtained more than 99 percent core recovery. Several temperature logs have been done in the core hole since the completion of coring; bottomhole temperature has stabilized at approximately 104°C.

The information available from this well now includes: drilling contractor's daily reports; Sandia daily reports; mudlogger's daily reports; suite of open-hole wireline logs; 30' of spot core from 6030' depth; 26 side-wall cores between 3000' and 6700'; approximately 700' continuous core between 6868' and 7588'; hole trajectory surveys; records of all drilling fluids and additives; and repeated temperature logs in the well since completion of the coring.

Proposed Scientific Work:

The well is available for scientific investigation and still has the drill pipe hanging in the wellbore for access to the core hole. Several experiments have been proposed for the summer of 1992, including hydrofracture, fluid sampling, injection/permeability tests, gravity measurements, wireline logs in the core hole, vertical seismic profiling in the cased hole, and, finally, a passive seismic monitor fixed semi-permanently in place. If the proposed program is completely funded, some of the experiments will require pulling the drill string out of the hole; in this event, further access to the core hole will be lost.