CHARACTERIZING THE WEEKS ISLAND SALT DOME: DRILLING OF AND SEISMIC MEASUREMENTS FROM BOREHOLES

by

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ABSTRACT

Four vertical and two slanted boreholes were drilled for geologic characterization and diagnostics of a sinkhole which developed over the salt mine converted for oil storage by the U. S. Strategic Petroleum Reserve. The primary purpose of the four vertical holes was to provide the geometry for cross-well seismic tomography, which would aid definition of the sinkhole collapse structure. An additional task was to obtain wireline core through the unstable overburden and salt, and to obtain geophysical logs. One of the slant holes was to penetrate the overburden and core through normal salt into the sinkhole; the other was to penetrate the surface expression of the sinkhole.

The requirements for the seismic holes were sometimes in conflict with those for wireline coring: hole spacing (close enough to receive signals, far enough from the sinkhole for a drill rig), minimum hole ID (big enough for transmitter and receiver to fit and be interchanged (impacting the wireline coring), and the avoidance, if possible, of nested tubulars in the well (making wireline coring contingencies difficult). The surface owner, Morton International, required successful cementing through the alluvium, and a 250 foot vertical depth limitation on the wells was agreed upon.

Crosswell seismic data were generated across the sinkhole along two separate vertical imaging planes. As crosswell data were taken, simultaneous recordings were made from surface geophones. Chevron's clamped borehole seismic vibrator was the energy source for both sets of measurements. A multi-station borehole seismic receiver system, developed by Sandia and OYO Geospace, was used to record the crosswell

data. Data acquisition from the crosswell and reverse vertical seismic profiles led to the production of 3D tomograms. These velocity images suggest the sinkhole collapse is complicated, not a simple vertical structure.

The coring operation was moderately difficult. Limited core was obtained through the alluvium; the quality of the salt core from the first two vertical wells was poor. Core quality improved with better bit selection, mud, and drilling method. After early differential sticking and hole stability problems, the drilling fluid program provided fairly stable holes allowing open hole logs to be run. All holes were cemented successfully, but it took three attempts in one vertical hole and three "top jobs" in one slant hole.

A remarkable result from one slant hole was coring through normal salt and penetrating into the sinkhole throat. Drilling of this slant hole was to be shut down when either: (1) the sinkhole was penetrated, or (2) when a total vertical depth of 250 feet was reached. Total vertical depth when the sinkhole was penetrated was 249 feet.

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