

Effects of Uplift and Subsidence on Storage Operations, Sour Lake Salt Dome- A Case History

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ABSTRACT

Sour Lake is a large piercement salt dome located in southern Hardin County, Texas that is utilized for cavern storage by Huntsman Corporation and others. During 1998, Huntsman field personnel noticed that the base of the concrete basin surrounding the S-5 cavern well was cracking and being displaced upwards. The S-5 well is located near the present edge of a small lake that originated approximately 1500 feet to the northeast with the sudden appearance of a sinkhole in October 1929. The original pond has continued to expand as a result of subsidence in a southwest direction. Huntsman initiated a geologic investigation of the area to determine if the deformation occurring at the S-5 well was related to this subsidence feature and the future impact on the storage operation.

The geologic investigation showed that while the Sour Lake diapir has maintained a near-surface position since at least Yegua time and appears to represent a passive "down-building" stage, the central area of the dome where the storage caverns are located has been moving upward since late Frio time. Further detail mapping of the top of caprock in the central area showed that the S-5 well was located on a pronounced structural closure indicating separate spine movement in this area. Review of well histories in the area of this spine show that beginning in the late 1960's, a re-pressuring of the caprock and the adjacent sands had occurred in this area. Upward movement of this salt spine can account for the pressure increases and the deformation at the S-5 well that had continued while the study was in progress. An investigation of the strata overlying the central area of the salt dome showed that the salt movement over this area had developed a complex graben system as a result of extension and faulting. Surface subsidence follows the graben block and is often bounded by near-surface faulting. A comparison of the 1923 and 1965 topography allowed areas of uplift and subsidence to be determined. These areas agreed with the projected graben fault patterns indicating that the 1929 sinkhole and the continued subsidence in this area were related to salt and accompanying fault movement.

Early in 2000, Huntsman had the concrete cellar and the underlying stabilizing plate removed from around the S-5 well as traces of crude oil was now leaking into the cellar. The outer 24-inch casing was not damaged, but the 16-inch casing had sheared off from the fitting at the base of the wellhead and the oil was coming from the space between the 16 and 13 5/8-inch casing. It was also observed that the 13 5/8 and 9 5/8-inch casing appeared to be under abnormal stress. These findings supported the geologic conclusions regarding upward salt movement as the

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