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Technical Conference Paper

Concerns about Sulfur Deposits in Caprock Overlying Salt Domes

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Abstract

In some salt domes, sulfur is sometimes precipitated during the process of caprock evolution. With sulfur, one can have bacterial action creating SO_4^{--} and H_2S with the potential for corrosion of any tubular penetrating the caprock.

The caprock over these salt domes is often vuggy and the bacteria live in the vugs (bugs in vugs). Also, the caprock can be brecciated through caprock processes such as alteration and the upward propagation of the salt spines below. This vuggy, brecciated caprock state is evidenced by many lost circulation problems that were often encountered when drilling through these types of formations. Differential motion of the caprock and the salt below plus the internal caprock alteration processes will put loads on any tubular penetrating the caprock into salt storage caverns.

Also, when the sulfur has been mined from this caprock, residual high temperatures may remain in the caprock for decades. These elevated temperatures, combined with the presence of SO_4^{--} and H_2S, would enhance the potential for corrosion and attacking of any cemented casings penetrating the caprock. There have been recorded failures of casing in such instances at hydrocarbon storage sites in salt caverns in Texas.

Residual high temperatures are found in the upper portion of the caprock of a particular Texas hydrocarbon storage site in salt due to the mining of sulfur between 1912 and 1935. The temperatures resulted from injection of superheated water in the mining process. Residual elevated temperatures are confirmed by reasonably recent (2001 and later) and earlier temperature surveys taken in the storage wells at this site. Two and three dimensional diagrams of residual temperatures at this storage site were constructed from the temperature surveys.

Because of potential for caprock fluids to attack the casing system, a simplified model was constructed which would identify the storage well casings most at risk, at least on a relative basis. A simplified model was used because of the difficulty of modeling any fluid flow in the caprock. Other simplifying assumptions had to be made of the heat flow

in order to attain average temperatures to which casing were exposed. This model involves an “average” maximum temperature and time of exposure. The result is an estimate (or educated opinion) of which wells would be at most risk.

In this framework of the processes related to caprock formation, and to upper salt spine movement, incidents in neighboring domes are discussed.

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Key Words

Casing, Temperature, Sulfur, Caprock, Cement, Salt Spine