

The role of geomechanics in Carbon storage project, case study of the Ahnet basin Algeria

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Summary

This work aims to investigate the safety and feasibility of a carbon storage project in the Ahnet basin, Algeria using an integrated geomechanical model. Through the analysis of stress orientation, present-day stress, and fault reactivation risk, we evaluate the suitability of the Silurian reservoir for carbon storage.

Theory

The role of geomechanics in carbon storage projects is crucial in ensuring the safety and effectiveness of the storage process. Geomechanics involves the study of how rocks and subsurface formations behave under stress and pressure. By analyzing the geomechanical properties of the storage site, such as rock strength, permeability, and stability, engineers can assess the feasibility and long-term viability of storing carbon dioxide underground (Fang et al., 2013). This information is important for site selection, design, and monitoring of carbon storage projects (Hardisty et al., 2011). Furthermore, geomechanics helps in understanding the potential risks and challenges associated with carbon storage, such as ground movement, induced seismicity, and leakage of CO₂. Therefore, integrating geomechanical principles and practices into carbon storage projects can help mitigate these risks and ensure the successful implementation of carbon sequestration technologies.

Results

As a result of the FMI logs within the study interval, we inferred the orientation of the horizontal injection drain as N 45°-N 225°. We used a poroelastic approach to estimate the stress regime. A 1.05 psi/ft gradient of overburden stress (S_v) has been obtained from density. Pore pressure has been estimated from the sonic log by a normal compaction trend, indicates a hydrostatic regime from the surface to the top of the Silurian unit with an average pore pressure gradient of 0.43 psi/ft. The poroelastic approach under transverse isotropic vertical conditions (VTI) has been used to calculate the magnitudes. The outlines indicate a gradient close to 0.60 psi/ft of minimum horizontal stress, and 0.80 psi/ft for maximum horizontal. The stress magnitudes results, suggest a normal stress regime in the Ahnet Basin, which allows a good capacity storage for carbon (Fig .1). We study the risk of fault reactivation potential at two Silurian units (sand and hot shale) from the frictional theory analysis. According to the results, the sand unit are a good and safe way to store carbon as opposed to the hot shale unit, which is prone to fault reactivation due to increased pore pressure (Fig. 2).

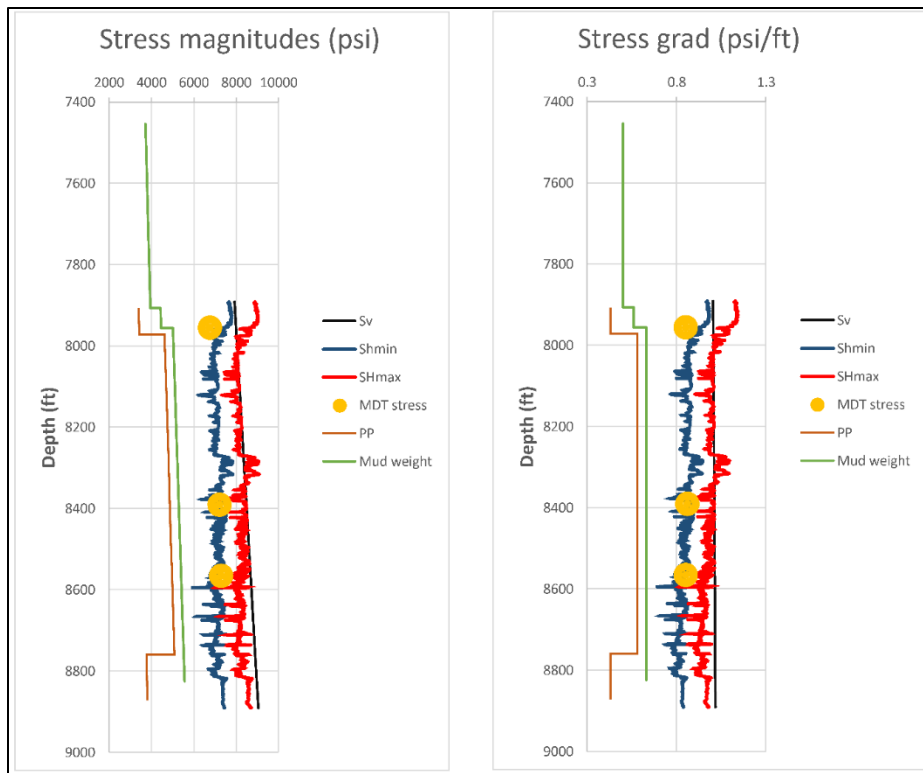


Figure 1: At right Magnitudes of stress components in the studied well, minimum horizontal stress (Shmin) calibrated with micro-fracturing stress points (green). At left stress gradient (psi/ft), (Shmin) calibrated with micro-fracturing stress points (green).

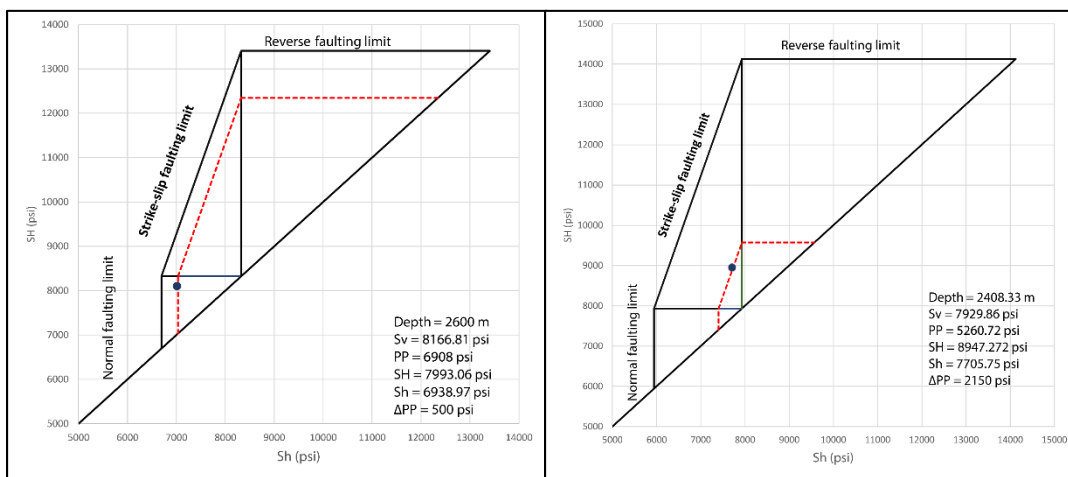


Figure 2: Stress polygons at the Silurian hot shale unit (at left) and the non-shale unit (at right). Frictional faulting limits for three possible stress polygons (normal, strikeslip and reverse faulting regimes) have been plotted along with. Present stress state plotted in this stress polygon indicates normal faulting in Silurian hot shale. The small/squeezed stress polygon marked by dotted red lines present the effect of carbon storage. Red arrow indicates the pore pressure increment to cause fault reactivation and induced seismicity at both section of reservoir.