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The Impacts on Pressure Stabilization and Leasing Acreage for CO_2 Storage from Utilizing Oil Migration Concepts

M. Ulfah, S. D. Hovorka, A. P. Bump, and S. A. Hosseini

ABSTRACT

Favorable geological storage for CO_2 has long been pictured as large anticlines with thick sandstones, similar to oil reservoirs in the petroleum system. Unlike oil, however, stored CO_2 does not need to be recoverable, which opens the possibility of using dissolution and residual trapping to augment the capacity of buoyant traps and tap more of the bulk rock volume. The work presented builds on that idea, asking the following question: If we inject CO_2 down to the syncline—analogous to the carrier bed in the petroleum system—how would this injection mechanism impact storage capacity and plume shape, migration, and stabilization? To address the question, we built a reservoir model, based on seismic interpretation of Middle Miocene strata, offshore Galveston, Texas. 3D seismic and well logs were used to characterize key intervals. The reservoirs chosen for modeling are progradational-aggradational sands with mud intercalation and have a higher degree of heterogeneity than the more conventional reservoirs commonly targeted for CO_2 storage. Modeling investigated how far the CO_2 plume would migrate under two scenarios: injecting CO_2 at the base of the salt withdrawal basin (syncline scenario) and injecting CO_2 at the base of the structural closure, similar to common injection well location for EOR purpose (base scenario). For each scenario, we separately simulated injection of 30 MT of CO_2 and 60 MT of CO_2 continuously for 30 yr and observe the plume and pressure evolution for 100 yr after the injection stops. The simulation shows that injecting the CO_2 into the syncline limits the vertical migration of CO_2, thus making synclinal injection more secure. In the syncline scenario, the geological layer around the injection point is more heterogeneous than the base scenario, thus the CO_2 tends to migrate laterally. Additionally, in the syncline scenario, the plume does not even reach the upper part of the anticline, allowing us to safely store an additional amount of CO_2 into the reservoir. Moreover, the simulation also shows that with the syncline scenario, the times needed for the reservoir to reach its stabilized

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pressure after the end of injections are faster. To summarize, CO_2 injection at the base of the syncline could provide additional storage, increase the safety of the project from the limited vertical plume migration, and expedite plume stabilization, which could result in the decrease of monitoring frequency as the project runs and also impact the operating cost for the project in the long run.