Theoretical CO_2 Storage Efficiencies Determined From CO_2-EOR Modeling at the Offshore Petronius and Cognac Oilfields, Gulf of Mexico

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Abstract

Depleted offshore oilfields within the Gulf of Mexico (GOM) are excellent targets for CCS because these fields contain reservoirs with high porosity at depths and temperatures amenable to CO_2-EOR and CO_2 storage. The Petronius and Cognac Fields located off the coast of Alabama and Louisiana respectively both contain primary oil recovery depleted reservoirs and occur within remarkably different geologic settings representing a variety of tertiary recovery and CO_2 storage targets throughout the GOM. We assess the maximum theoretical CO_2 storage capacity of a reservoir at each field and determine CO_2 storage efficiencies based on the results of CO_2-EOR reservoir simulations. The J2 sand at the Petronius Field and the J sand at the Cognac Field were chosen as storage targets and modeled for EOR using reservoir simulations. At the Petronius Field, injection scenarios result in stored CO_2 volumes that range from 3.5 Mt - 10.8 Mt. Injection scenarios at the Cognac field range from 2.03 - 2.85 Mt CO_2. To determine the maximum theoretical storage capacity, the density of supercritical CO_2 was calculated at reservoir temperature and pressure conditions and multiplied by the total reservoir pore volume within the modeled CO_2 plume area. Storage efficiencies were calculated by dividing the stored CO_2 amount determined from EOR modeling by the maximum theoretical capacity. As a result, the Petronius Field has a maximum CO_2 capacity of 26.6 Mt while the Cognac Field has a smaller capacity of 9.14 Mt. From this, storage efficiencies are calculated and the

Petronius efficiency ranges from 37.0% - 56.5% while efficiency at the Cognac Field is 22% - 31%. These storage efficiencies signify that both reservoirs are highly amenable to supercritical CO2 storage. The higher efficiency reported for the Petronius field is in part a result of the relatively thin net thickness of the storage interval. The Cognac J Sand has a cooler average reservoir temperature of 130°F. The Cognac field occurs immediately off the coast of Louisiana where fast sediment accumulation rates are known to reduce upward heat flow through the sedimentary column that suppresses the localized geothermal gradient. We determine that areas of fast sedimentation with low geothermal gradients offer uniquely cool reservoir temperatures at elevated depth thus increasing the density of injected CO2. This effect increases the CO2 capacity of the reservoir enabling greater storage efficiency and highlights the potential for CO2 storage within the GOM in areas of fast sediment accumulation.