

Depositional Facies Analysis of the Cotton Valley Group Using Well Logs and Cores: Implication for Carbon Sequestration

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Abstract

The Cotton Valley Group (CVG) contains tight sandstones with heterogeneous reservoir properties due variations in depositional environments and diagenesis. It has served as a hydrocarbon target since the 1940s and with recent advances in technology, there is renewed exploration. Across northern Louisiana, the CVG has moderate to good reservoir properties, whereas those south extending westward across the Sabine uplift into east Texas have poor reservoir properties. With reservoir depletion, coupled with relatively simple mineralogy, these sandstone units may serve as good, localized CCUS reservoirs, or could benefit from secondary gas recovery.

This work studies the depositional conditions and reservoir characteristics, both temporally and spatially, within the CVG, Claiborne Parish, Louisiana, with the aim of creating a preliminary geologic assessment for carbon sequestration in the area. This research utilizes both geophysical and sedimentological analyses, centered on core from the Worley Estate 29H-1 well focusing on the lower sandstone units. A combination of core descriptions, thin section analysis, scanning electron microscopy (Joel 61000 SEM), x-ray fluorescence (Niton XL3t GOLDD+) and nuclear magnetic resonance (Corespec 1000) are used to characterize reservoir properties. These were then correlated to the associated well logs (gamma ray, neutron porosity, and density), and reservoir properties are extrapolated across the Blackburn Field, northwestern Claiborne Parish. Overall, this group represents deposition in a near-shore lagoonal environment, containing sequences quartz arenite, thinly bedded shales and carbonates. Porosity and permeability vary throughout the reservoir, restricted by carbonate cementation or protected by chlorite pore coatings. The sandstones of the CVG may not be regarded as ideal CO₂ storage reservoirs due to its low porosity-permeability characteristics which are as a result of the extensive carbonate cementation. However, CO₂ may dissolve the calcite and enhance porosity/permeability and precipitate as various carbonate minerals when the solution becomes saturated, creating a permanent storage mechanism.