Geologic Modeling and Characterization of the Carbon Stacked Storage of the Minnelusa, Hulett and Lakota of the Dryfork Station Site in Gillette, Wyoming

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Abstract

CO_2 sequestration in geological media is the one of the viable options for the long-term removal of anthropogenic CO_2. The Wyoming Dry Fork CarbonSAFE projects Phases I, II, and III led by the Center for Economic Geology Research (CEGR) of University of Wyoming (UW) have documented that the Dry Fork carbon storage complex is a promising CO_2 storage location, characterized by its favorable geologic conditions (i.e., thick stacked saline aquafers and simple structure), multiple wide extended confining layers, and in close proximity to CO_2 sources. The 3D seismic attribute analysis, petrophysical properties interpreted from geophysical well logs and core observations and measurements to characterize the geological heterogeneity and simulate CO_2 injection in three dimensions. The Dry Fork CCS site is located within the northern Power River Basin about six miles north of Gillette, Wyoming. The reservoir intervals with the greatest potential for CO_2 storage are the Permian-Pennsylvanian Minnelusa Formation, the Middle Jurassic Hulett Sandstone member of the Sundance Formation, and the Lower Cretaceous Lakota Sandstone of the Inyan Kara Group. The project to date has used legacy well data, two newly drilled stratigraphic test wells with more than 625 feet of core, 70 sidewall cores and a complete log suite, a 3 mile by 3 mile 3D seismic survey, and inter-well topography have been used to construct a geologic model to reduce uncertainty. Geologic modeling at the site includes structural and property models that delineate reservoir geometries, lithofacies and fracture feature and porosity and permeability distributions. Within the property models/volumes, we can now isolate individual reservoir horizons and construct maps of the distribution of the petrophysical properties. Results of these modeling efforts are used to evaluate the injections feasibility, injected CO_2 migration and plume development, storage capacity, maximum injection pressure, reservoir pressure propagation, and determining the Area of Review (AOR) for Class VI well application in a 16 township range plot with Dry Fork Station centrally located within it. The simulation results show the heterogeneity of the reservoir petrophysical property has prominent effects on the reservoir injectivity and storage capacity. This project results have significant utility in reducing risk for promoting commercial scale CO_2 storage in stacked deep saline aquifers in the Laramide Basins, Wyoming.