Stratigraphic Analysis of the Amsden and Broom Creek Formations (Permo-Carboniferous) in the Williston Basin: A Stratigraphic Model for a Conventional Carbon Storage Unit

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Abstract

This is a summary of the results of a student-led analysis and assessment of the Broom Creek and Amsden Formations in the subsurface of the Williston Basin in west-central North Dakota. The Broom Creek Formation has been selected as a potential carbon storage unit because of the porosity and permeability of aeolian and nearshore sand facies commonly occurring in the middle and upper part of the formation (which currently functions as a saline aquifer). Project CarbonSAFE was an initiative sponsored by the DOE and local and state agencies and carried out by the EERC, and the initiative resulting in the selection of the Broom Creek. Summit Carbon Solutions is currently developing a carbon storage field in west central North Dakota and is currently connecting it (via pipeline) to ethanol plants in the upper Midwest. The formation occurs over 6000 ft. down in the subsurface and overlies the Amsden Formation (Pennsylvanian) which consists of many similar facies and is overlain unconformably by the Opeche Formation which consists or a thick interval of red siltstones and anhydrite. The Broom Creek has great potential for carbon storage because of its depth, the high porosity and permeability of the aeolian facies, and other interbedded facies functioning as seals (siltstone & anhydrite layers). The Broom Creek lacks detailed stratigraphic assessment as it was never exploited for hydrocarbons. To rectify this lack of knowledge and explore the storage potential of this interval, the EERC supervised the coring of the Broom Creek, the description and analysis of these cores as well as a section of 3D Seismic in Mercer and Oliver Counties in North Dakota (near the potential carbon storage field). A sequence stratigraphic analysis of cores will recognize key surfaces which may allow for a high-resolution constraint on the vertical and lateral distribution of facies. We have examined 5 cores of the Amsden and Broom Creek Formations. An east to west cross section (from the basin edge towards the central parts) of the Broom Creek suggests that the formation is a depositional sequence that can be divided into upper and lower parts. The lower part consisting or peritidal carbonates, anhydrite, nearshore sands, and aeolian sands. The upper part is comprised of facies interpreted as near-shore sands, aeolian sands, and cherty/dolomitic marine carbonates. Both the upper and lower parts (based on facies stacking patterns) contain meter-scale shallowing upward cycles, and the boundary between upper and lower parts appears to be a maximum flooding horizon. Further analysis may reveal more about the geologic history of this formation and provide more information about potential storage volumes of interval of interest.