Geologic and Stratigraphic Characteristics of Multiple Stacked Sealing Formations at the Rock Springs Uplift, Wyoming

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Abstract

No less than six sealing formations are present at the Rock Springs Uplift WYCUSP CO2 storage site providing redundant assurance of effective CO2 storage. Isopach maps (Figures 2, 3, and 4) and petrophysical log cross sections (Figure 6) of these intervals indicate the existence of stacked sealing formations. These formations trap fluids in the area, although breach of stratigraphically deep seal along large scale faults or at several of these reservoirs is evident.

Summary

Variations in thickness, lithology, and ductility play important roles in a sealing formation’s ultimate effectiveness, as does the lateral extent of the factors that trap each one. Two storage reservoir units have been characterized at the WYCUSP site, the delimitation of the Mississippian Madison Limestone, and the Pennsylvanian Weber Sandstone. Two seal formations, the upper Madison limestone facies, and the Amsden Formation, comprised of shale, dolomite, and sandstone. The upper Madison limestone (Figures 5, 6, 10 meters thick at the site) exhibits excellent confining properties, but is not laterally continuous. The Amsden (Figures 6, 7, 137 meters thick at the site) is in thin section regionally but is laterally continuous. Above the Weber, the Chugwater Group, comprised of shale, siltstone, and fine-grained sandstone, the combined thickness of the seal at the site is 370 meters. Stratigraphically higher, and offering great seal and fine-grained sandstone, the combined thickness of the seal at the site is 970 meters. Stratigraphically higher, and offering great seal competency are the Pennsylvanian Amsden and Phosphoria formations, the money shale, and the Weber sandstone. Oil and gas reservoirs outlined on the isopach maps demonstrate the effectiveness of the sealing units. Fluid compositions between the Weber and the Madison vary greatly, and each unit produces hydrocarbons and CO2 from structural traps. Two storage reservoir units have been characterized at the WYCUSP site, the dolomites of the Mississippian Madison Limestone, and the Pennsylvanian Weber Sandstone. Two seals separate these units, the upper Madison limestone facies, and the Amsden Formation, comprised of shale, dolomite, and sandstone. The upper Madison limestone (Figures 5, 6, 10 meters thick at the site) exhibits excellent confining properties, but is not laterally continuous. The Amsden (Figures 6, 7, 137 meters thick at the site) is in thin section regionally but is laterally continuous. Above the Weber, the Chugwater Group, comprised of shale, siltstone, and fine-grained sandstone, the combined thickness of the seal at the site is 370 meters. Stratigraphically higher, and offering great seal competency are the Pennsylvanian Amsden and Phosphoria formations, the money shale, and the Weber sandstone. Oil and gas reservoirs outlined on the isopach maps demonstrate the effectiveness of the sealing units. Fluid compositions between the Weber and the Madison vary greatly, and each unit produces hydrocarbons and CO2 from structural traps.

Study Site and Targeted Stratigraphy

SSSUS 1, 2, 3, 4, 5, 6

Figure 1: Stratigraphic section showing the stratigraphic interval of interest. The upper Madison limestone, the Amsden Formation, the Pennsylvanian Amsden Formation, the upper portion of the Upper Cretaceous, and the upper portion of the Mississippian Madison Limestone are highlighted in pink. The stratigraphic interval of interest is marked by the pink shaded area.

Figure 2: Stratigraphic section showing the stratigraphic interval of interest. The upper Madison limestone, the Amsden Formation, the Pennsylvanian Amsden Formation, the upper portion of the Upper Cretaceous, and the upper portion of the Mississippian Madison Limestone are highlighted in pink. The stratigraphic interval of interest is marked by the pink shaded area.

Isopach Maps

Figure 3: Chugwater Group/Dinwoody Formation

Figure 4: Amsden Formation

Figure 5: Upper Madison Limestone

Figure 6: Cross Section

Conclusions

Permeability and Effective of these formations is demonstrated by numerous oil and gas reservoirs in the area. The Rock Springs Uplift is geologically a very large-scale faulted trap, and the oil and gas fields and WYCUSP storage site are independent of any primary trapping mechanism. These fields are traps that have exploited the stratigraphicuper position across the uplift in a variety of stratigraphic and structural traps. Although the existence of these fields is proof of seal effectiveness, possible fluid migration along large scale faults at several of the field sites (Brady North and South) is evident. These fields do not penetrate the stratigraphically average higher than the Lower Cretaceous. This possible fault where the oil is known to exist plays an important role, which closed or partially closed, which would increase the possibility of sealing.

References


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