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 (**Figure 4, 5, and 6**) and petrophysical log cross section (**Figure 6**) of three intervals indicate the regional lateral extent of the units. Proven seal effectiveness of these formations is demonstrated by numerous oil and gas reservoirs in the area, although breach of stratigraphically deeper seals along large scale faults at several of these reservoirs is evident.

Summary

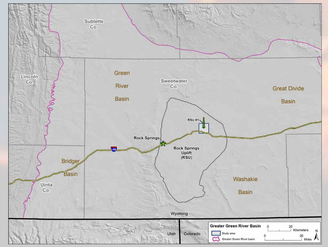
Variations in thickness, lithology, and ductility play important roles in a sealing formation's ultimate effectiveness, as does the lateral extent of the facies that make up each one. Two storage reservoir units have been characterized at the WYCUSP site, the dolomites of the Mississippian Madison Limestone, 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 (**Figure 5**), 35 meters thick at the storage site, exhibits excellent confining properties, but is not laterally continuous. The Amsden (**Figure 4**), 127 meters thick at the storage site, varies in thickness regionally but is laterally continuous. Above the Weber, the Chugwater Group, combined with the Dinwoody Formation (**Figure 3**), form the primary sealing unit for the storage site. 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 redundancy, are several laterally continuous seals, including the Gypsum Springs Formation, the Mowry Shale, and the Baxter Shale.

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

Figure 1:

Study site and RSU#1 well location (in box) in southwest Wyoming on the northeast flank of the Rock Springs Uplift



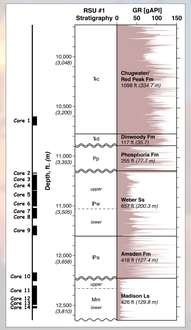


Figure 2:

Stratigraphic column and gamma ray log for the study site's targeted sealing stratigraphy and associated reservoirs. Targeted seals (the Triassic Red Peak Formation, Pennsylvanian Amsden Formation, and the upper portion of the Mississippian Madison Limestone) are highlighted in pink.

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Isopach Maps

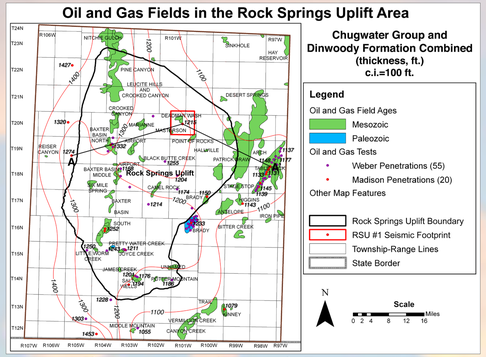

Figure 3: Chugwater Group/Dinwoody Formation

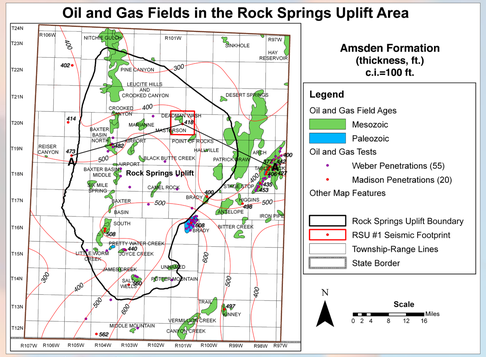

Figure 4: Amsden Formation

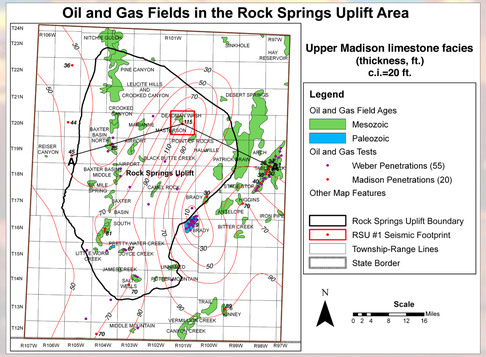

Figure 5: Upper Madison Limestone

Conclusions

Proven seal effectiveness of these formations is demonstrated by numerous oil and gas reservoirs in the area. The Rock Springs Uplift (RSU) is intrinsically a very large-scale fluids trap, and the oil and gas fields and WYCUSP storage site are dependent on it as a primary trapping mechanism. These fields are interspersed throughout the stratigraphic section and across the uplift in a variety of structural and stratigraphic traps. Although the existence of these fields is proof of seal effectiveness, possible fluid migration along thrust faults at several of the field sites (Brady North and South) is evident. These faults do not propagate up the stratigraphic section higher than the Lower Cretaceous. This possible breach of seals lower in the column brings into play the importance of seals higher up in the stratigraphic section, specifically the Baxter Shale.

References

DeBruin RH (2007, 2012) Oil and gas map of Wyoming. Wyoming State Geological Survey Map Series 55 (MS-55). Scale 1:500,000

Oil and Gas Fields Symposium Committee (eds) (1979) Wyoming oil and gas fields symposium, Greater Green River Basin, Wyoming. Wyoming Geological Association

Special thanks to Ron Surdam

Cross-section

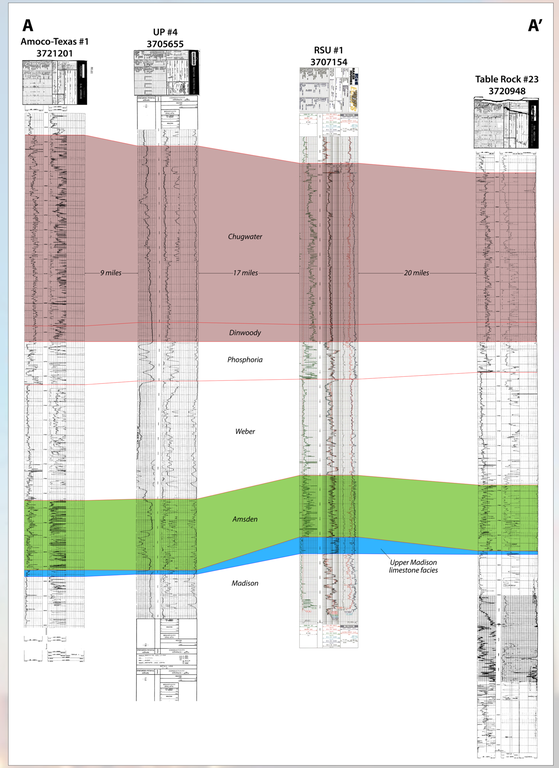

Figure 6: Cross Section

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