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Seal assessment and estimated storage capacities of a targeted CO_2 reservoir based on new displacement pressures in SW Wyoming, U.S.A.

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Carbon capture and storage locations are being investigated throughout the state of Wyoming, USA, in preparation for sequestration of greenhouse gases. At potential storage sites, confining units must be identified that are capable of ensuring stored carbon dioxide remains in place at depth. Previous fluid inclusion volatile work indicates that Triassic formations in southwestern Wyoming act as a confining system on the Rock Springs uplift (RSU). An investigation of the Triassic Dinwoody Formation using mercury capillary entry pressure was conducted to calculate column height potential for CO_2 sequestration on the RSU.

A stratigraphic test well drilled on the RSU recovered 27.4 meters of core from the Dinwoody Formation. It is dominantly a brownish-red, very fine-grained sandy and micaceous siltstone with minor layers of thin mudstone and minor amounts of anhydrite. Four samples were taken from this core for mercury injection capillary pressure (MICP) analysis. During MICP analysis, mercury is injected into the sample over a range of pressures increased in steps. Only when sufficient pressure is applied will the mercury penetrate into the pore system and at this pressure a confining system will begin to leak. The mercury entry pressures for the Dinwoody samples range from 6.58 to18.85 megapascals and were converted to entry pressures for brine/CO_2 systems.

Previous simulations indicate that sequestering commercial quantities of CO_2 (5-15 megatons CO_2/year) over the course of 50 years can be accommodated at the RSU. Determination of the total possible capacity requires knowledge of the column height, i.e. the vertical thickness of CO_2 that can be safely injected without caprock failure. Using converted pressures for brine/CO_2 systems, the interfacial tensions of CO_2, water, and substrate, as well as the densities of CO_2 and brine, column heights were calculated for the RSU. It has been suggested by other research that supercritical CO_2 and brine may behave as a single wetting phase at elevated pressures and temperatures, resulting in an interfacial tension of 0 milliNewton/meter. Under these conditions the pore throat radius of sealing units is assumed to be the principle inhibitor to flow through the seal. Experimental data indicate pore throat radii range from 39.2 to 113.5 nanometers in the confining system, and preliminary column height calculations indicate that, depending on the size of the plume, reservoir thickness will most likely be the limiting factor to the amount of CO_2 that can be sequestered rather than the column height.