Maximizing Subsurface Storage Capacity in Sedimentary Systems by Combined CO2-H2O Injection

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Large-scale CO2 injection into the subsurface is a key technology to lower CO2 emissions from point sources such as power plants. Deep saline aquifers have by far the largest capacity of potential storage space, however many are poorly characterized, which increases risk of leakage through undetected faults or gaps in the caprock. Gas and oil fields are much less extensive but are secure storage locations for CO2, as the presence of hydrocarbons proves their ability to contain buoyant fluids for geological timescales. Moreover, great deal is known about their size and ability to conduct fluids efficiently and the profits from enhanced oil recovery (EOR) as a result of CO2 flooding may offset the cost of storage.

In this work we propose using combined CO2 and water injection to engineer a more secure storage strategy in both aquifers and oilfields. Injection of water and CO2 increases the volume of the reservoir that comes in contact with CO2, allowing for substantially increased capillary trapping of the supercritical-CO2 phase during the injection phase of the project, and decreasing the reliance on an impermeable caprock to contain buoyant CO2. Counter-intuitively, injection of water and CO2 has the further benefit of increasing the oil recovery and volume of CO2 that can be stored in a combined CO2/EOR project because of minimized gas cycling.