EGU24-3599, updated on 16 Feb 2025
https://doi.org/10.5194/egusphere-egu24-3599
EGU General Assembly 2024

Managing Large-Scale Geologic Storage of CO_2 in the United States: Geomechanical Impacts, Basin-Scale Coordination, and Regulatory Implications

Jens Birkholzer, Yves Guglielmi, Abdullah Cihan, Jonny Rutqvist, Stanislav Glubokovskikh, Matt Reagan, Preston Jordan, Utkarsh Mital, Meng Cao, and Hafssa Tounsi
Lawrence Berkeley National Laboratory, Energy Geosciences Division, Berkeley, United States of America (jtbirkholzer@lbl.gov)

After decades of research on geologic carbon storage (GCS), the world seems to be moving from pilot tests and demonstration experiments to industrial-scale implementation. In the United States, the Bipartisan Infrastructure Law passed in 2021 contributes $2.5 billion for carbon storage commercialization in addition to similarly large investments in point-source carbon capture as well as direct air capture. These federal investments, combined with new tax credits provided by the 2022 Inflation Reduction Act, provide a significant push towards GCS deployment over the coming years and decades, likely creating multiple large storage projects or clusters of integrated projects across hydrogeologic basins. These projects will likely involve injection volumes that may result in large-scale pressure increases in the subsurface and may cause unwanted geomechanical effects, such as generating seismic events and seal integrity concerns per reactivation of critically stressed faults.

Here, we will focus on such large-scale deployment hurdles and discuss related regulatory challenges, using the United States permitting framework as an example. We will begin by illustrating basin-scale pressure impacts expected from geologic carbon sequestration at scale, based on regional modeling studies of future GCS scenarios. With regards to geomechanical implications, we will briefly present lessons learned from two recent field tests—one being a controlled fluid (water and CO_2) injection fault slip and leakage experiment in a clay (sealing) formation, the other a CO_2 storage demonstration site where micro-seismicity has occurred along pre-existing basement faults. We will then introduce ongoing work to transfer the knowledge derived from these experiments to larger injection volumes and scales so that ultimately geomechanical effects can be assessed and coordinated at the scale of large storage complexes. In terms of regulatory implications, we will review the regulatory framework for CO_2 storage wells in the United States and discuss how suitable it is (or not) for permitting a GCS future where sedimentary basins with interconnected reservoirs might host multiple large storage projects. Lastly, we will propose a hierarchical permitting approach for such situations, which would add a general permit for regional coordination of subsurface resources to the existing framework for permitting of individual CO_2 storage projects.