

Structural and diagenetic controls on CO₂ leakage in a natural long-term carbon sequestration analogue, Little Grand Wash fault, Utah

Scientific Achievement

Determined footprint of fault-controlled CO₂ leakage in a natural long-term analogue of a carbon sequestration sandstone reservoir.

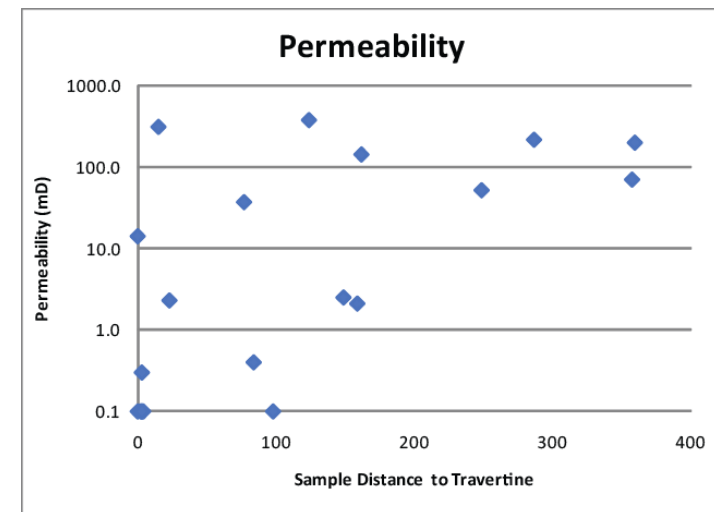
Significance and Impact

Highly focused flow and limited lateral extent of CO₂ footprint around fault leakage conduits requires dense monitoring networks in sequestration applications.

Research Details

- CO₂-related alteration as a proxy for paleo-leakage of CO₂ along exhumed fault leakage conduits.
- Distribution of CO₂ alteration indicates that flow is focused along narrow (10-50 m wide) structural conduits within the reservoir sandstone units.
- CO₂-related calcite cement precipitation significantly reduces porosity & permeability of sandstones, restricting flow through the conduit.
- Presence of multiple paleo-leakage conduits indicative of shift of active conduits along fault zone over time'

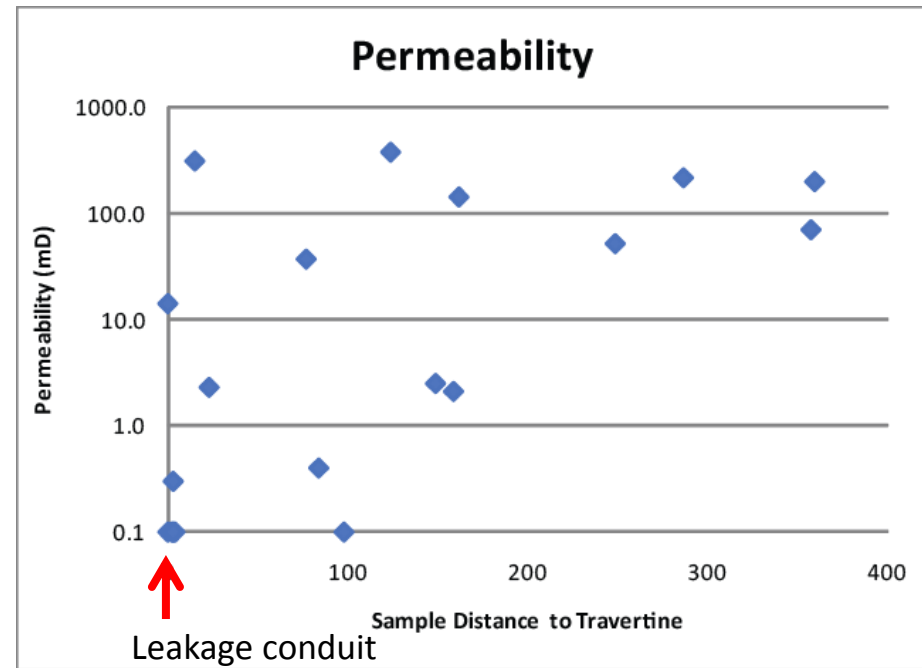
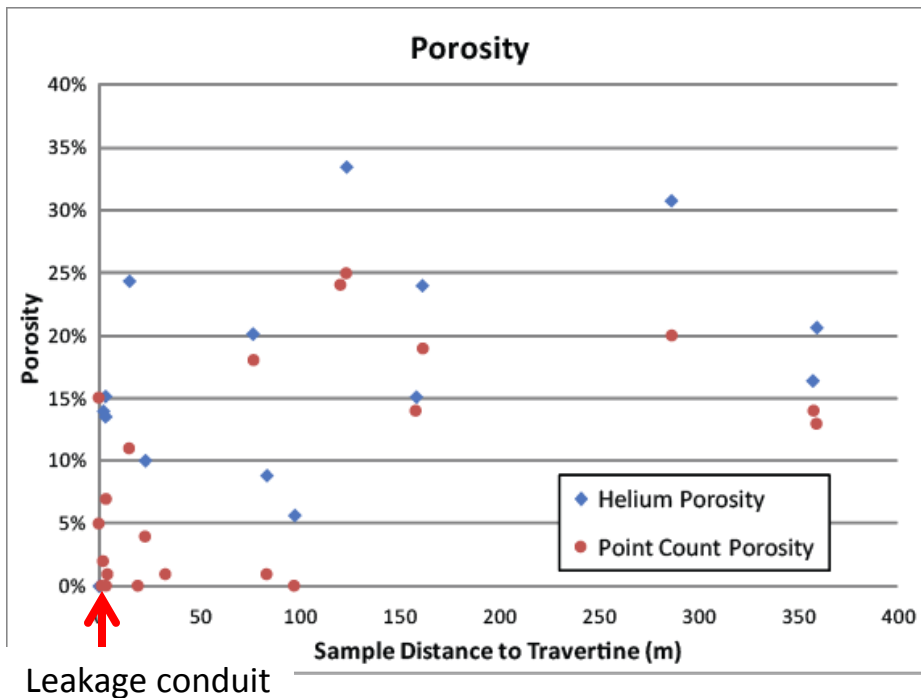
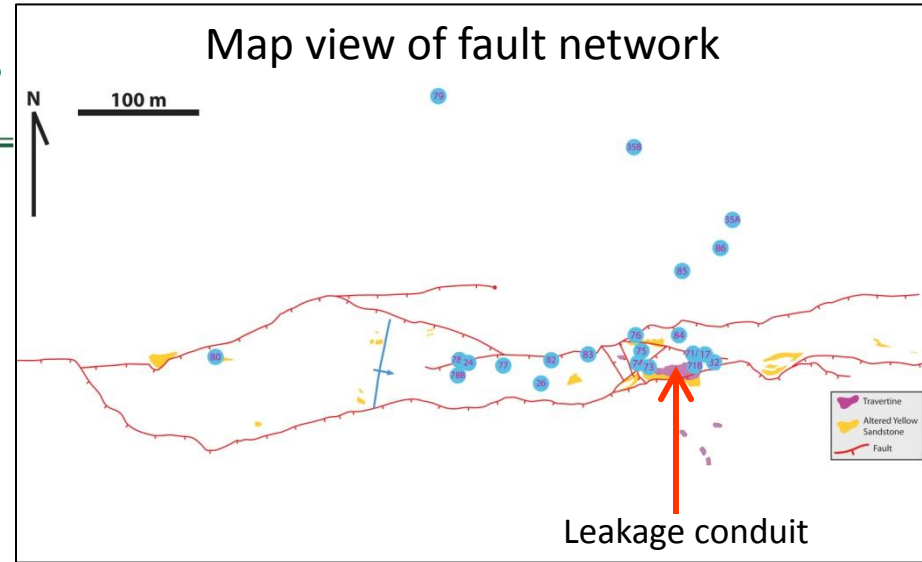
Urquhart, A., & Eichhubl, J.P., Structural and diagenetic controls on CO₂ leakage in a natural long-term carbon sequestration analogue, Little Grand Wash fault, Utah. In prep.



Decrease in permeability in reservoir sandstone with decreasing distance to fault CO₂ leakage conduit—Little Grand Wash fault, Utah.

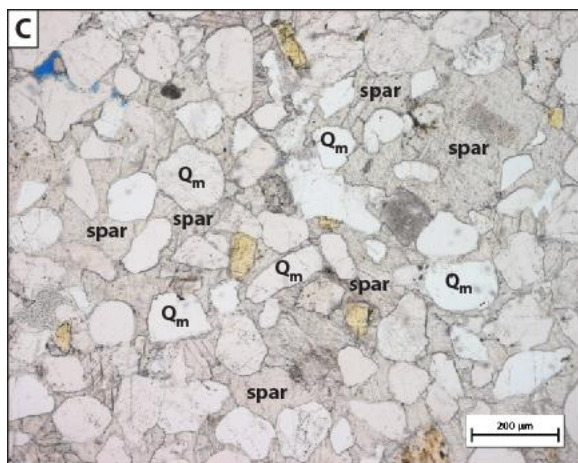
Porosity & permeability trends

- CO₂ related cement spatially limited to vicinity of fault relay zone.
- Decrease in porosity from ~20% to ~0%.
- Decrease in permeability ~3 orders of magnitude toward leakage conduit.

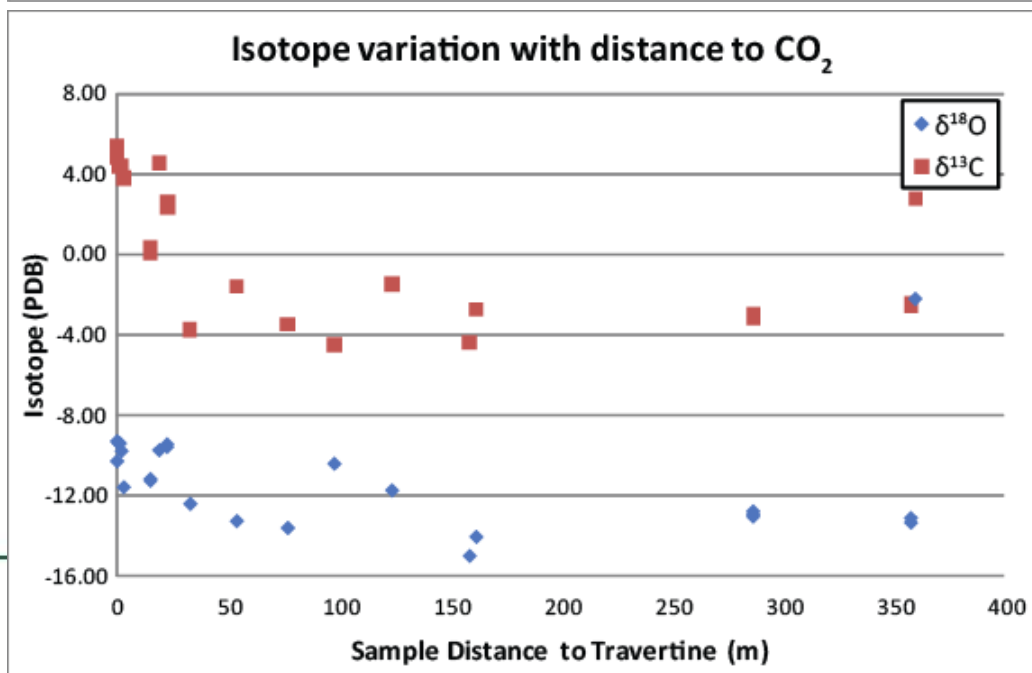
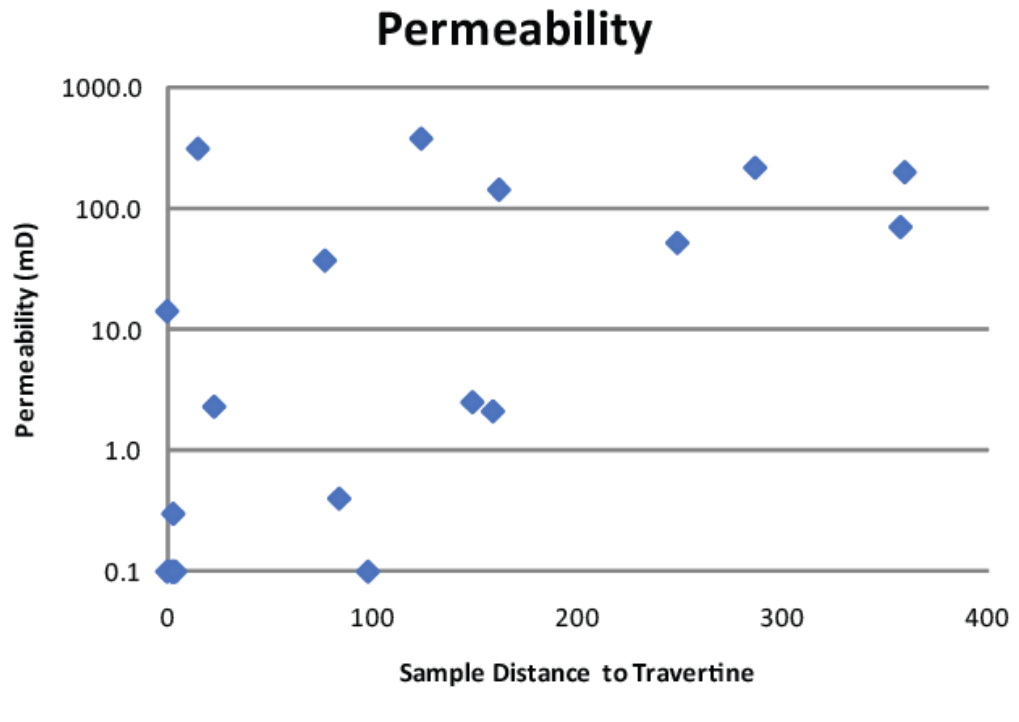


Carbonate cementation around CO₂ flow conduit

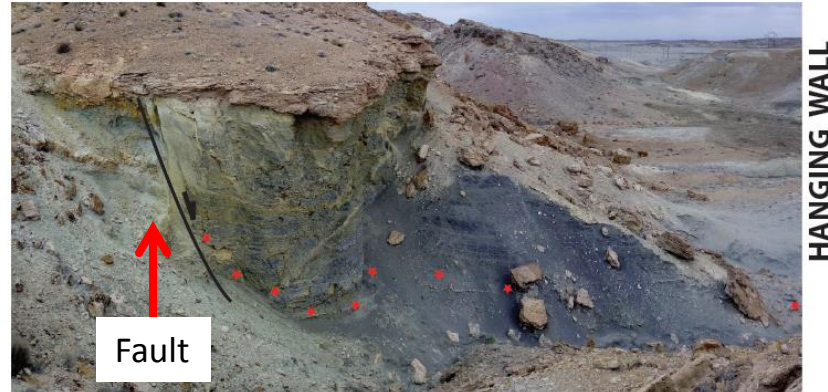
- Sandstone pores occluded with calcite cement
- ¹⁶O depletion of carbonate pore cement adjacent to flow conduits due to CO₂ phase separation
- Width of CO₂ conduit ~10-50 m



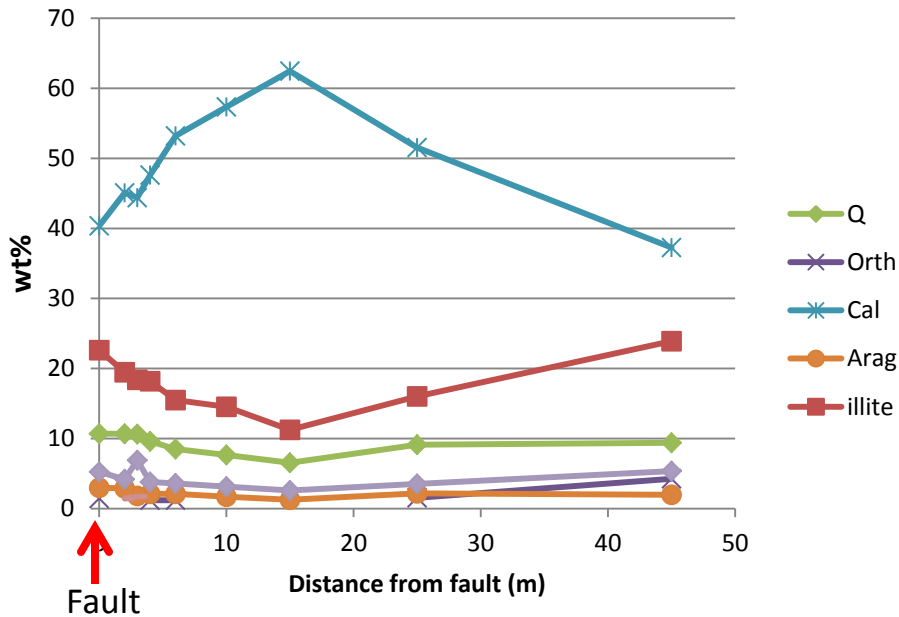
Petrographic thin section of reservoir sandstone with pore space occluded by calcite mineral cement.



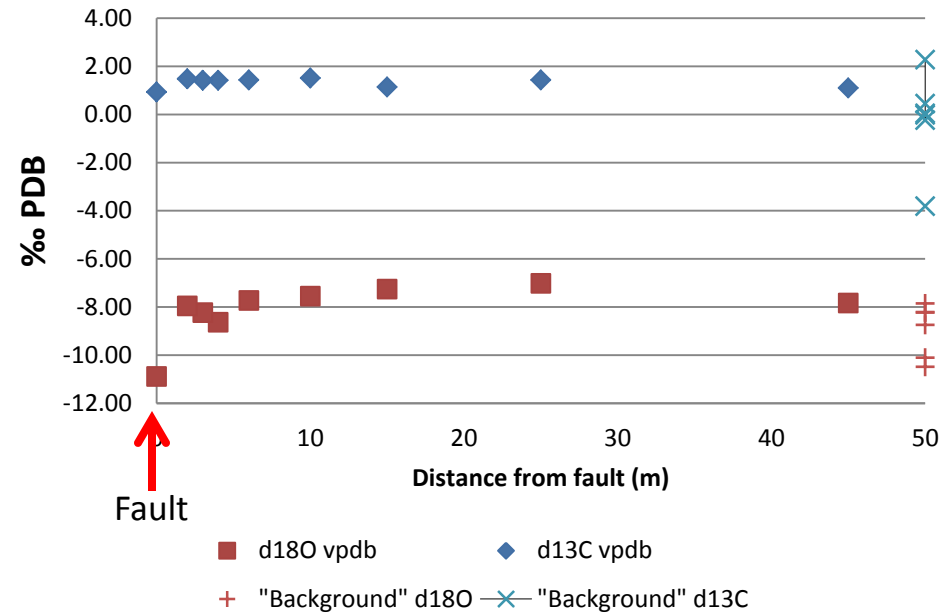
CO₂ leakage footprint in shale caprock (Mancos Shale)



XRD bulk sample mineralogy



Bulk sample (matrix) stable isotopes



Mudrock topseal failure by chemically assisted fracture

