Alteration of Mancos Shale by CO_2-charged Brine

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Objectives of Research

Laboratory experiments at pressures and temperatures typical for GCS to understand time-dependent geochemical reactions and chemo-mechanical coupling in heterogeneous shale caprock.

Impact on Specific Challenges

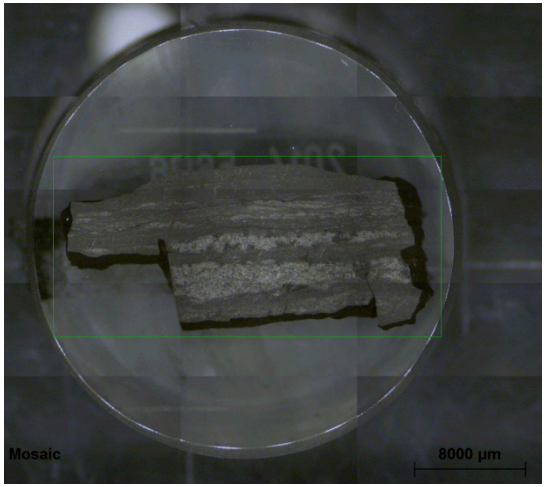
Sustaining large storage rates

Controlling undesired or unexpected behavior

Approach: Experiments with shale caprock

Alteration at low p CO_2	Alteration at high p CO_2	Nano-pillar indentation
Mineral dissolution kinetics at conditions representative of the diffuse part of the CO_2 plume in contact with shale caprock.	Mineral dissolution kinetics, at conditions where supercritical CO_2 and brine coexist and are in contact with shale caprock.	Comparing the unaltered and CO_2-brine-altered shale: deformation modes, contact hardness, resistance to plastic deformation, time constants for time-dependent deformation, and the fracture resistance.

Mancos Shale Cross-section



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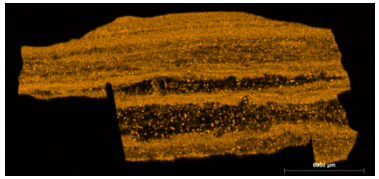
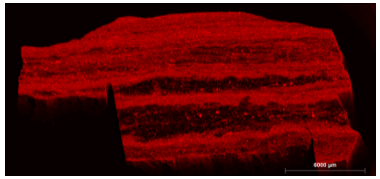
CFSES

Mancos shale characterization

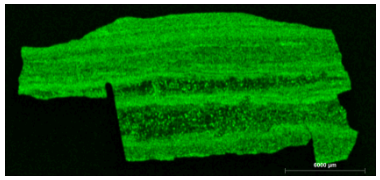
K Map



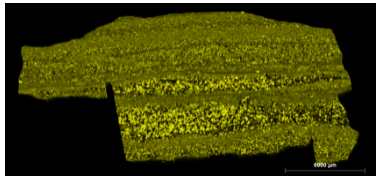
Fe Map

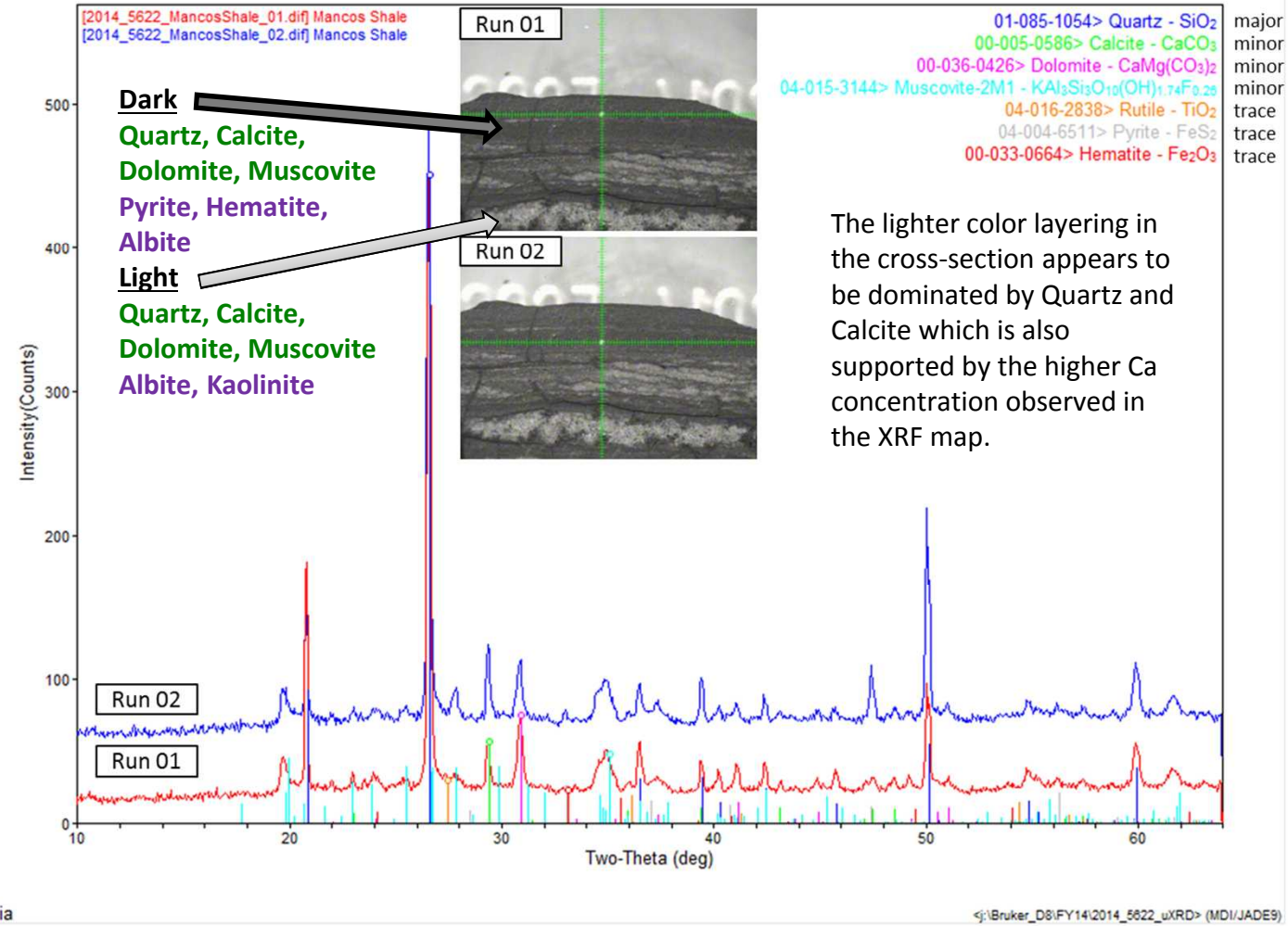


Al Map



Ca Map



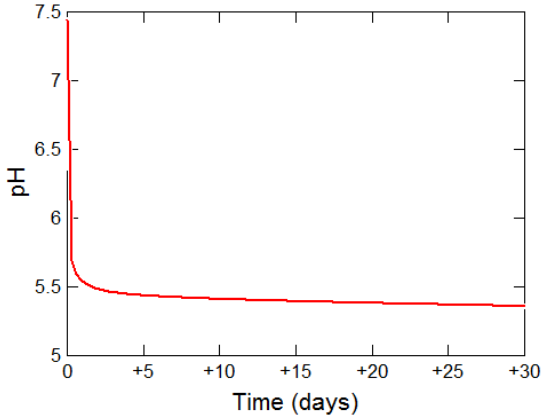


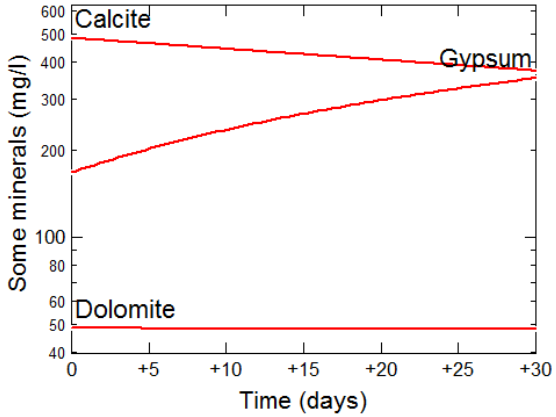
The lighter color layering in the cross-section appears to be dominated by Quartz and Calcite which is also supported by the higher Ca concentration observed in the XRF map.

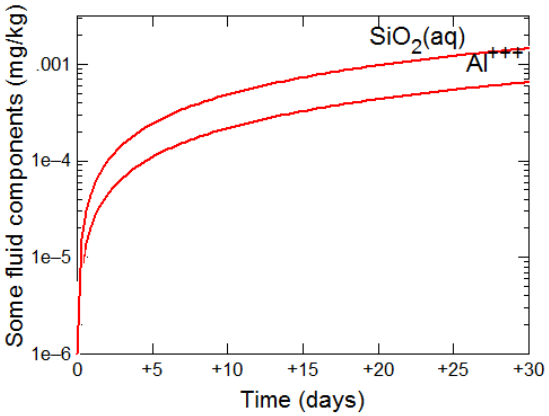
Low p CO_2 experiments

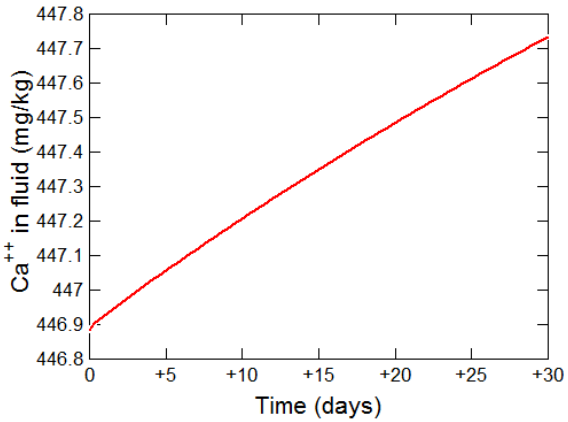
- Stirred reactor pressurized with CO_2
- Powdered shale + brine
- Sample brine and solids at time intervals

Expected results (geochemical modeling predictions)









Synthetic brine

pH	7.44	Fe^{2+}, mg/L	2
Cl^-, mg/L	1589	Ca^{2+}, mg/L	484
NO_3^-, mg/L	4.1	Na^+, mg/L	19000
SO_4^{2-}, mg/L	47251	Mg^{2+}, mg/L	2700
		K^+, mg/L	20.5