



Kaiyuan Mei, Yuna Cai, Quan Xue, Pania Newell, Liwei Zhang*

Institute of Rock and Soil Mechanics, Chinese Academy of Sciences, Wuhan, Hubei Province, 430071, China;

University of Chinese Academy of Sciences, Beijing, 100049, China

Adjunct Faculty, School of Computing, Adjunct Faculty, Department of Civil Engineering, The University of Utah, Utah, USA

Supercritical CO₂ (ScCO₂) invades oilwell cement under geological CO₂ sequestration conditions. With the penetration of ScCO₂, cement structure prone to damage when the coupled effects of capillarity and carbonation were found. Microstructural evolution of oilwell cement samples was investigated by the CT scanning and the quantitative image-based analysis and show that ScCO₂ with the high humid condition would penetrate much deeper than the dry ScCO₂ because of the capillarity effects. Due to the deep saline condition in the sequestration formation, the penetration of ScCO₂ was retarded by the salt deposition, comparing with the ultrapure water (UP water) conditions. For further assessment of this coupled mechanism, the permeability property and contact angle changes were proposed to analyse the interface region between ScCO₂, saline/UP water and oilwell cement

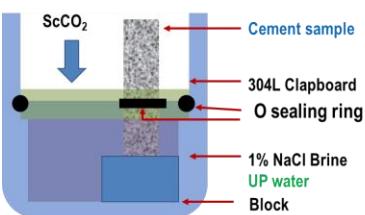


Salt deposition and severe corrosion



Designed kettle:

- 1) Isolating the ScCO₂ dissolving into the water below clapboard.
- 2) Isolating the water or brine vaporing into the ScCO₂.
- 3) This kettle will provide a pressure imbalance condition when simulating the sealing conditions.

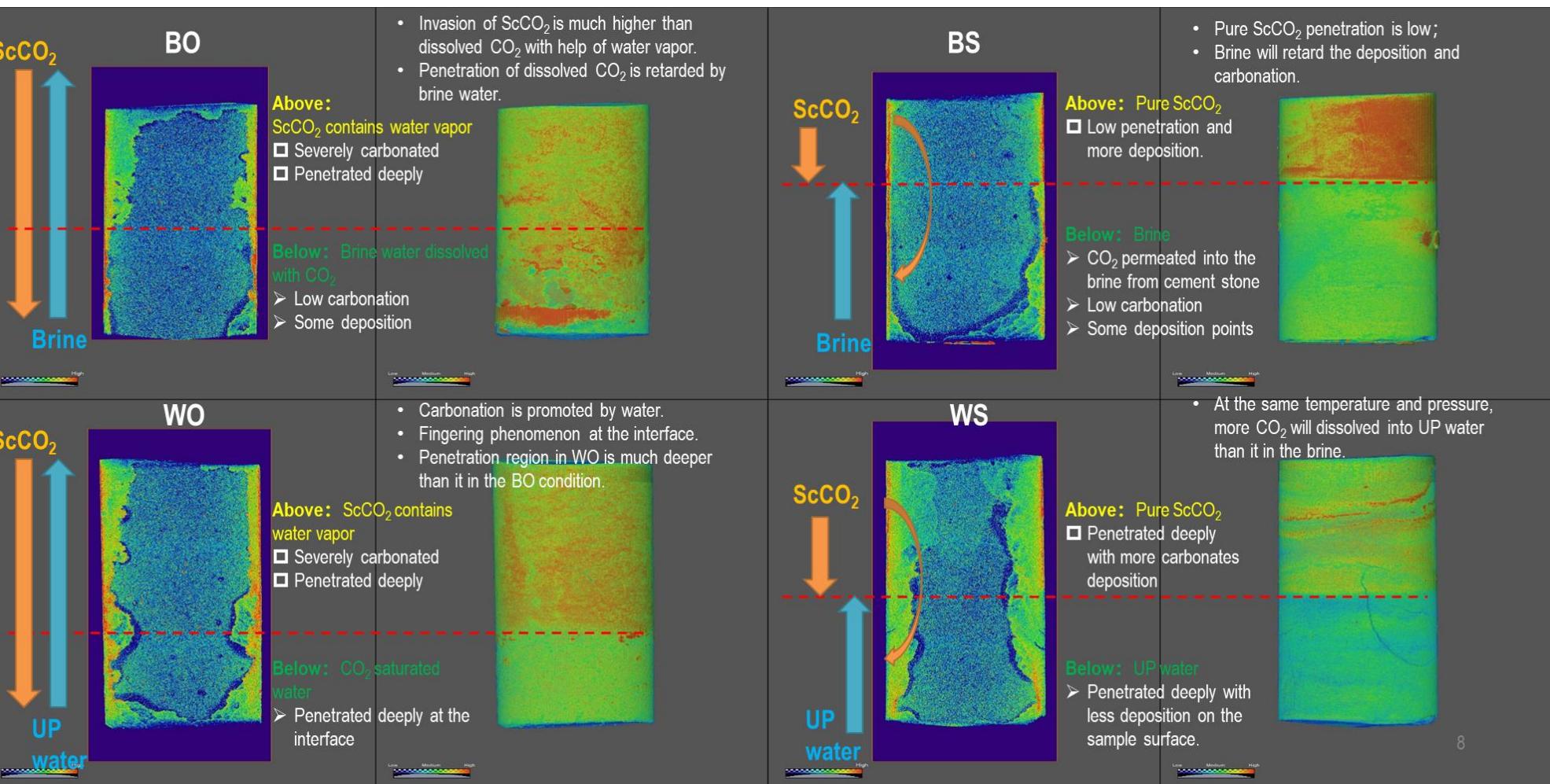
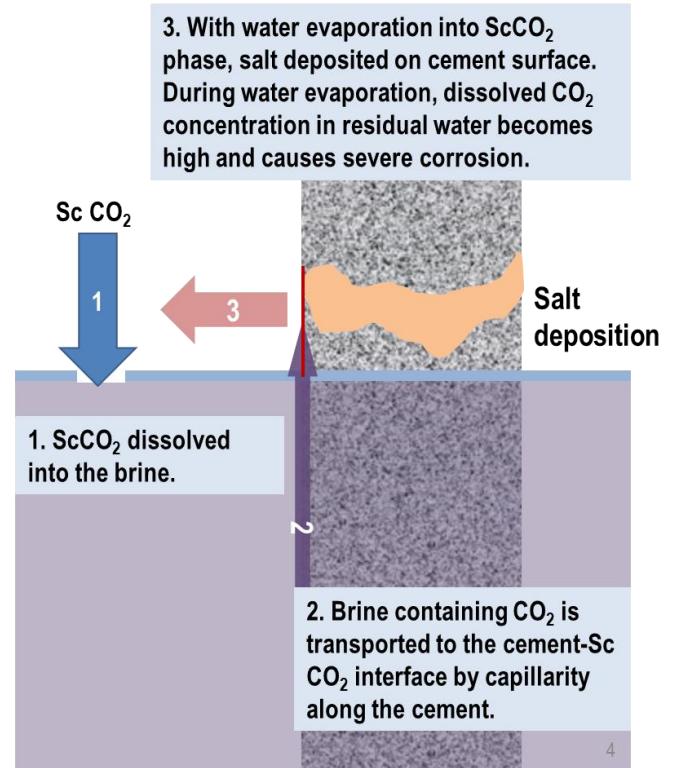


Experiment parameters:

Sample: G class oilwell cement with w/c=0.44;
Temperature: 62 °C;
Pressure: 17 MPa CO₂;
Time: 14 days;

Four comparing groups:

- BO -- Brine dissolved with ScCO₂
- BS -- Brine isolated from ScCO₂
- WO -- UP water dissolved with ScCO₂
- WS -- UP water isolated from ScCO₂



- Deposition on the surface should be carbonates, salts or mixture of two in the different conditions.
- The interface region between ScCO₂ and brine/ UP water should involve the contact angle and the wetting properties of two phases.
- At the imbalance condition, how to figure out the capillarity effects of cement stone.