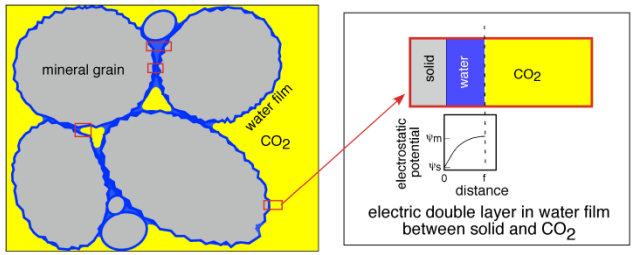
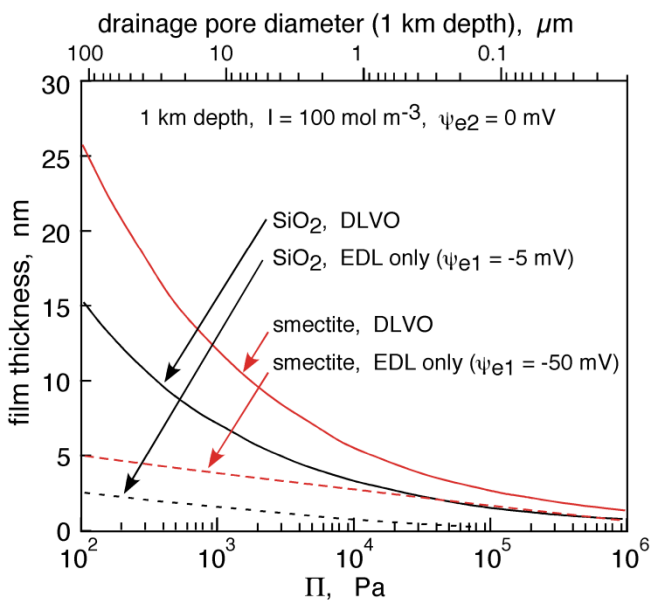
DLVO*-based estimates of adsorbed water film thicknesses in geologic CO_2 reservoirs

* Derjaguin-Landau-Verwey-Overbeek



CO_2 and water film distributions in reservoir pores, and resulting electric double layer within water films.



100 mM brine film thickness dependence on disjoining pressure (Π) for adsorption onto silica versus onto smectite; electrostatic (EDL) and DLVO (EDL+van der Waals) effects.

Scientific Achievement

This study provides theoretical predictions of how thicknesses of water films between mineral surfaces and the supercritical (sc) CO_2 phase depends on properties of the reservoir system.

Significance and Impact

When $scCO_2$ is injected into deep reservoirs, much of the affected volume consists of pores containing both water and $scCO_2$, with water films remaining as the mineral-wetting phase. This work predicts how film thicknesses depend on system properties; understanding required to predict multiphase flow, reactions at mineral surfaces, and transport.

Research Details

- Pressure- and temperature-dependent physicochemical properties determined down to depths of 2 km.
- Reservoir pore-size dependent $scCO_2$ entry capillary pressures, $P_{c,e}$, determined.
- van der Waals and electrostatic components of brine films calculated for disjoining pressures greater than $P_{c,e}$.

Tokunaga, T.K., 2012. DLVO-based estimates of adsorbed water film thicknesses in geologic CO_2 reservoirs. Langmuir, 28, 8001-8009.