A thermochemical model for CO_2-water interfacial tension

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Interfacial tension (IFT) of the CO_2-brine systems is a key parameter to study the fate of CO_2 in the context of geological storage in deep aquifers. IFT contributes to the control of the repartition of the fluids in the host rock porosity, and then on the transport properties of the permeable medium, like the specific relative permeabilities. It also plays an important role on the risk of leakage through the cap rock and determines the quality of sealing.

In order to include this parameter in modeling studies concerning the short- and long-term behavior of a deep CO_2 geological storage, a practical formulation of the CO_2-water IFT has been developped in this study.
With only one physical meaninful adjusted parameter, the model can describe the CO_2-water IFT for temperatures and pressures ranging from 10 to 110°C and 0.1 to 40 MPa, respectively.

The model relies on the approach proposed by Rusanov and Prokhorov [1], where a number of required parameters can be calculated *a priori* from existing equations of state in the CO_2-H_2O system and geochemical equilibrium constraints. In the proposed model, focus was emphasized on the CO_2 mole fraction at the interface in order to describe correctly CO_2-water IFT data available in the literature [2, 3].

Depending on temperature, results suggest an important increase of the interfacial CO_2 mole fraction as a function of CO_2 fugacity up to a given value (> 5 MPa). For higher fugacities the interfacial CO_2 mole fraction decreases and reaches a plateau. This behavior appears critical for the description of the CO_2-water intefacial tension.

In combination with our previous work, [4], this new results will allow more comprehensive modeling of IFT of CO_2-brines.

[1] Rusanov & Prokhorov (1996) *Interfacial tensiometry*, Elsevier. [2] Chiquet *et al.* (2007) *Energy Conv. Manag.* **48**, 736–744. [3] Jho *et al.* (1978) *J. Coll. Interf. Sci.* **65**, 141–154. [4] Leroy *et al.* (submitted to *GCA*)

Fracturing, cementation and feedback in a small-offset oblique slip fault in sandstone

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Small oblique-slip faults that cut outcrops of low-porosity marine and fluvial sandstones have associated fracture arrays that vary in spatial arrangement and porosity preservation depending on sandstone composition. Steeply dipping faults have displacements of ~ 1 m to tens of meters; in the subsurface these faults would likely be near or below seismic detection. Cement textures in fractures in Late Proterozoic Applecross Formation and Cambrian Eriboll Formation sandstones match those found in cores from producing tight gas sandstones, showing that the youngest fractures in these well exposed rocks are useful reservoir analogs. Faults have narrow cores of breccia surrounded by disseminated mostly opening-mode fractures. Older fluvial sandstone have halos of long, straight fractures that increase in length and abundance near fault cores. Halos are meters to tens of meters wide; width is fairly uniform along fault traces. In contrast, younger marine sandstones cut by the same faults have more abundant fractures that have a wider range of strikes and greater trace connectivity. Simple fracture halos are absent; instead, wide patches and irregular zones of high but fairly uniform fracture intensity are present along or between fault traces. Fracture arrays in both types of sandstone arise in part from development and evolution of subsidiary fractures at a range of scales. Applecross and Eriboll sandstones differ in composition (subarkose vs. quartzarenite) and, consequently, propensity for fractures to seal readily under the influence of the same thermal history. Although quartzose Eriboll sandstones contain more fractures, these are mostly narrower and are more likely to be quartz filled compared with those in the lithic and feldspar-rich Applecross, where quartz cement growth is impaired by the widespread presence of non-quartz substrate (feldspar, clay minerals) on fracture walls.