Sequestration of Super Critical CO_2 and Alteration of Mudstones and Casing Cements: An Experimental Approach

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Underground sequestration of CO_2 is a key technology to reduce CO_2 emission to the air. To avoid possible leakage of the injected gas to the surface in a few thousands-year-time scale, we should understand how and how much the formation barrier such as cap rocks (mudstones) and casing cement can be altered by CO_2. The purpose of this experimental research is to examine possible changes in mineral compositions and physical properties of such formation barrier when exposed to super critical CO_2 and formation water saturated with CO_2 for a few months to years.

Preliminary results are acquired on four specimens: two types of casing cement and two types of mudstone. Half of these are immersed in super critical CO_2 (60 degrees centigrade, 1500psi) and rest of them are stored in formation water for up to nine months respectively. The super critical CO_2 is saturated with water (i.e. wet gas), whereas the formation water is naturally saturated with CO_2 (i.e. carbonated water). Visible changes in cement specimens include clear crystallization of aragonite on the surface and in the pore space, which reduces porosity and permeability. This suggests the casing cement could upgrade the sealing ability during exposure to super critical CO_2. In mudstones, however, little change is observed in the experimental time scale.