Geophysical Research Abstracts
Vol. 16, EGU2014-12619, 2014
EGU General Assembly 2014
© Author(s) 2014. CC Attribution 3.0 License.

Frictional healing in simulated anhydrite fault gouges: effects of water and CO_2

Anne Pluymakers, Elisenda Bakker, Jon Samuelson, and Christopher Spiers
Universiteit Utrecht, HPT laboratory, Utrecht, Netherlands

Currently, depleted hydrocarbon reservoirs are in many ways considered ideal for storage of CO_2 and other gases. Faults are of major importance to CO_2 storage because of their potential as leakage pathways, and also due to the possible seismic risk associated with fault reactivation. Both in the Netherlands and worldwide, anhydrite-rich rocks are a common topseal for many potential storage sites, making it likely that crosscutting faults will contain fault gouges rich in anhydrite. In order to assess the likelihood of fault reactivation and/or fault leakage, it is important to have a thorough understanding of the fault strength, velocity dependence and of the potential to regain frictional strength after fault movement (healing behavior) of anhydrite fault gouge. Starting with a natural anhydrite (>95wt% CaSO4), with minor quantities of dolomite (<5wt% (Ca,Mg)CO_3), we conducted direct shear experiments on simulated anhydrite fault gouges with both a slide-hold-slide and velocity-stepping sequences. Pore fluid phase was varied (air, vacuum, water, dry/wet CO_2), and pressure and temperature conditions used are representative for potential CO_2 storage sites, with an effective normal stress of 25 MPa, a temperature of 120°C and, where used, a pore fluid pressure of 15 MPa. First results indicate that frictional healing in anhydrite is strongly influenced by the presence of water. Dry fault gouges exhibit no measurable frictional healing for hold times up to 1 hour, whereas wet gouges show significant healing and stress relaxation, even for short duration hold periods (30s), suggesting a fluid-assisted process such as pressure solution might be of importance. Interestingly, while many materials exhibit a log-linear dependence of frictional drop on hold time (i.e. "Dieterich-type" healing), our results for wet gouge indicate a non-linear increase of frictional drop with increasing hold time. To determine if pressure solution controls frictional healing we will perform control experiments using a CaSO4 precipitation inhibitor. In the context of CO¬2 storage, the presence of CO_2 does not lead to differences in frictional healing either dry or wet, however, small amounts of water dissolved in otherwise dry CO_2 does appear to result in frictional healing behavior similar to fully wet samples. Furthermore, the presence of CO¬2 affects the velocity dependence from velocity weakening for fully dry CO_2 to velocity strengthening in slightly wet CO_2, in line with previous experiments which have shown that only dry anhydrite fault gouge exhibits velocity weakening under these conditions.