Changes in hydraulic properties associated with fault development in sedimentary rocks from the Otway Basin using true triaxial testing techniques

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Increases in fluid pressure or tectonic stresses deep underground can trigger fault formation or reactivation. Newly formed faults or existing faults that have reactivated may be potential pathways for migrating fluids such as stored carbon dioxide associated with CCS, which can potentially migrate upward toward the surface. Fluid migration associated with such fault development is therefore important when considering the feasibility of a CCS project. Surprisingly, there are few reports documenting the changes in permeability associated with fault development due to the technical difficulty of such experiments. In this study, we measure the permeability in the direction parallel to the fault plane during fault development under true triaxial stress conditions. In addition, the P-wave velocity in the direction across the fault plane was measured simultaneously with the permeability. In the experiments, sandstone, siltstone and mudstone samples collected from CO2CRC drill core from the Otway Basin, Australia were used. The observed change in permeability with fault development was different for each rock type. In the sandstone, the permeability changes are small even if a fault is formed, which is due to the high permeability of the host rock. In siltstone and mudstone, fault gouges were formed, and fracture zones with higher permeability than the host rock resulted. Therefore, even if a fault gouge develops, fluid migration will occur in a direction parallel to the fault plane through the damage zone. In addition, in the siltstone specimen after the experiment, slip in the carbonate layer was confirmed from observation, which suggests that the friction coefficient of the carbonate layer is extremely low.

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