

CEE 595F – Geotechnical Engineering Seminar

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Shales as barriers for deep geological storage

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Abstract

In deep geological storage, it is important to find a proper barrier material that will avoid or limit acidic fluid migration. Shales that are ductile and have high capillary entry pressure and low permeability can be considered as good candidates for the caprock in geological CO₂ storage and host material in nuclear waste storage. Experimental techniques have been developed to characterize the behavior of clay-rich materials at elevated pressures. Intact and remolded specimens of Opalinus clay – a Jurassic shale from Switzerland – are brought to the conditions of deep (> 1 km depth) geological storage and fully saturated with in-situ brine. Poromechanical parameters and failure characteristics are measured in drained and undrained conventional triaxial compression experiments. CO₂ breakthrough pressure and permeability of shale are assessed in oedometric tests on thin (12 mm) samples. The experimentally measured parameters are used to evaluate the shaly caprock deformation for the case of geological carbon storage, where cooling is likely to occur around injection wells. Additionally, the reported experiments show pronounced time-dependent or viscous deformation of shales. This may lead to the formation of high-permeability pathways in low-permeable rock, especially at the elevated temperatures.