Influence of flow pattern of two-phase fluid flow on deformation of mudstones

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Injection of carbon dioxide into geological formations may result in ground surface deformation. In order to control the ground surface deformation, understanding deformation of rock mass caused by infiltration of carbon dioxide is required. In this study, laboratory experiments were conducted to understand deformation of mudstones caused by infiltration of non-wetting phase fluid. In the experiment, air was injected into a water-saturated cylindrical mudstone sample, which belongs to the Umegase Formation of the Kazusa Group, under hydrostatic external stress condition. During the experiment, both axial and circumferential strains at half the height of the sample were monitored. Numerical simulation of the experiment was tried by using a simulator which can solve coupled two-phase fluid flow and deformation of porous media (Aichi, 2010). Calculated strains were larger than the measured ones. Considering the pore size distribution of the mudstone and the pressure condition set in the experiment, air was thought to flow through preferential flow paths in the sample. Since preferential paths of air were not formed in the numerical simulation due to two-phase fluid flow based on Darcy's law, flow pattern of two-phase fluid flow is suggested to affect deformation of mudstones.

Reference:
Aichi, M. (2010), Thermodynamically consistent multiphase poroelasticity and its application to water-dissolved gas reservoir simulation, PhD Thesis, Dep. of Geosys. Eng., Univ. of Tokyo.

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