

Seismic stability evaluation of CO₂ storage site using hydraulic-mechanical coupled analysis by NMM

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A big earthquake causes strong seismic wave with long duration. In the case of the 2011 off the Pacific Coast of Tohoku Earthquake, duration of strong motion is more than six minutes and long-period seismic wave causes large displacement in wide area of the Japan island. We have little knowledge about the effects of such long period strong motion on fluid saturated layers at depth. Consequently, evaluating the integrity of CO₂ containment during earthquakes is one of the important issues in Japan. We developed a method to evaluate the pore pressure build up due to deformation and fluid migration caused by an earthquake, and the integrity of the containment of the storage sites.

Then we applied the method on the simple three layered model. The horizontal length of the model is 20 meters and the vertical length is 10 meters. The input horizontal accelerations as sinusoidal waves of 4 Hz and 200 gal as the maximum acceleration for four cycles. This method evaluates the integrity by the safety factor response from the effective stress solved by the hydraulic-mechanical coupling analysis using NMM (Numerical Manifold Method).

The bottom layers case, the response by effective stress decreases about 20 % compare to that by total stress. And the pore-pressures response depends on the combination between the elastic modulus and the permeability of the strata.

This method could be solving the continuous and the discontinuous planes as faults in existing the strata around CCS site.

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