Simulation of Geophysical Monitoring for Carbon Sequestration into Saline Aquifers

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An appropriate monitoring program is indispensable for an individual geological carbon sequestration project to detecting subsurface changes within the reservoir, to provide for potential risk such as CO_2 leakage through the caprock, and to improve the predictive capability of reservoir simulation. Repeat geophysical monitoring should be an powerful and efficient tool in CO_2 geosequestration as geophysical measurements can detect temporal and spacial changes around reservoir from earth surface.

We carried out numerical simulations of an aquifer system underlying a eastern portion of Tokyo Bay and calculated the temporal changes in geophysical observables caused by subsurface changes due to CO_2 injection in order to study geophysical monitoring technique for geological CO_2 sequestration into deep saline aquifers. We used the STAR general-purpose reservoir simulator (Pritchett,1995) with the CO2SQS equation-of-state package (Pritchett,2005) which treats three fluid phases (liquid- and gaseous-phase CO_2 and an aqueous liquid phase) to calculate the evolution of reservoir conditions, and then used various 'geophysical postprocessors'to calculate the resulting geophysical observables by seismic reflection, self-potential(SP), and magnetotelluric(MT) survey. Seismic reflection and SP are quite responsive to short-term disturbances and MT required long-term to detect apparent resistivity changes in this case study.

Although the result should be highly site-specific, these numerical simulation technique provide a powerful tool to find an appropriate combination and layout of repeat geophysical measurements to monitor geological CO_2 sequestration.