Precise monitoring of CO2 behavior after injection into saline aquifers–mapping change of velocity and attenuation in detail

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A key point, in sequestration of CO2 into saline aquifers, is that the CO2-water fluid does not remain stationary in the subsurface but migrate at speeds related to physical and chemical property of the fluid and the geological structures within the reservoir. Monitoring, verification and environmental safety of CO2 storages are important issues should be addressed before the technology can be accepted by the public for wide scale implementation. Monitoring is necessary to confirm the containment of CO2, to assess leakage paths, and to gain understanding into interactions between CO2, the rock-forming minerals, and formation fluids. By now, seismic surveys provide the most attractive approach for obtaining the spatial coverage required for mapping the location and movement of CO2 in the subsurface.

In order to improve the accuracy of seismic monitoring techniques, we have started a laboratory study. The ongoing study has two main issues. Firstly, we focus on modeling the change of the petrologic properties of typical porosity rocks due to CO2 present. Secondly, we aim to improve the monitoring techniques, particularly the seismic tomography method, for making precise estimation of the CO2-saturation fraction in the pore volume. The present report confirms that the difference tomography method, using differential arrival times and amplitudes determined by waveform comparison, is efficient for imaging the migration behaviour of fluid during injection. Results indicate a that, spatially varying porosity, anisotropy, existing of veins (having very low permeability), are important factors governing CO2 migration and replacement.

Fig.1 Change of P-velocity as a function of the initial velocity (water saturated), during injection of supercritical CO2 in a Tako sandstone sample.