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Laboratory scale monitoring of CO_2 sequestration using complex electrical conductivity and seismic property changes derived by seismic interferometry

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In order to realize and maintain a successful CO_2 storage endeavor, a program of careful monitoring of the changes in reservoir properties is necessary. The way the reservoir properties change is generally case-specific, as such modifications are principally related to the distribution of pores, fluid composition, and the thermodynamic conditions. Of the various geophysical methods, so far seismic and electrical methods have been primarily used with varying success to monitor remotely the changes in a carbon capture and storage (CCS) reservoir. However, a quantitative characterization of the dynamic reservoir properties has remained difficult mainly due to three reasons. First, laboratory calibration of rock-physical models used to extract the reservoir properties from geophysical data is challenging. Second, quantitative and integrated geophysical approaches that are specifically sensitive to changes in fluid (supercritical CO_2 and brine) saturation, salinity and pressure are yet to be developed. Third, the difficulty to capture reliably in surface measurements the seismic signature of the changes in a CCS reservoir without the unwanted effects of overburden changes has been an obstacle. In order to address these issues, we have developed a laboratory facility where simultaneous seismic and electrical measurements can be performed on a reservoir rock under realistic pressure and temperature conditions. Changing saturation and salinity could be quantified on dynamic measurements of complex electrical conductivity. Application of seismic interferometry could resolve changes in seismic velocity in the reservoir due to fluid substitution. The approach of joint inversion of these two data types can be applicable to realistic, quantitative field-monitoring.

Biography

Ranajit Ghose is an Associate Professor at Delft University of Technology, The Netherlands. His areas of research interest are high-resolution seismic with focus on shear wave, near-surface and geotechnical geophysics, quantitative integrated approaches in geophysics, seismic attenuation, poro-elasticity and property estimation, seismic wave propagation in fractured media and anisotropy and monitoring CO_2 sequestration. He is presently the Editor-in-Chief of the journal "Near Surface Geophysics".

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