Monitoring of seismic velocity in CO_2 storage sites using a continuous and controlled seismic source

Tatsunori Ikeda
CO_2 storage division
International Institute for Carbon-Neutral Energy Research, Kyushu University

Monitoring of injected CO_2 behavior in field-scale (m-km) is one of the important issues in CO_2 geological storage. During and after CO_2 injection into reservoirs, we should monitor the spatial distribution of injected CO_2 to ensure that injected CO_2 is stored in the reservoirs without CO_2 leakage. A time-lapse (repeated) seismic survey is the most popular approach to monitor CO_2 storage sites based on temporal change in seismic velocity. However, the monitoring interval of such repeated seismic surveys is limited due to huge cost of each survey. As a result, accidental incidents of CO_2 injection reservoirs (e.g., CO_2 leakage) cannot be immediately detected from the conventional seismic monitoring.

To overcome the difficulty related to low temporal resolution in monitoring, we developed seismic monitoring system using a continuous and controlled seismic source. Our monitoring system has a potential to identify change in seismic velocity associated with shallow CO_2 leakage owing to the high temporal resolution and accuracy (Ikeda et al., 2016). As a result of application to the CO_2 storage site in Canada, we identified change in the shallow subsurface related to environmental influences (e.g., freezing) (Ikeda et al., 2017). Since the temporal variation of shallow subsurface masks small change in deep reservoirs caused by CO_2 injection, our shallow monitoring results contribute to accurate monitoring of injected CO_2 in deep reservoirs. The shortcoming of our monitoring system was the low spatial resolution because only a fixed single seismic source is available. To overcome this, we developed novel seismic processing to extract seismic velocity with high spatial resolution (Ikeda et al., 2018). Therefore, our monitor system might make it possible to identify spatial distribution of CO_2 leakage.

References

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