Microseismic Monitoring at the CCS Fields

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Abstract

In CCS, carbon dioxide (CO2) is captured from a large emission source and transported by pipelines or shipped to the storage sites. Then it is injected into deep geological formations with a sufficient overlying caprock layer to contain the CO2 within the formation. Injection of CO2 will increase the formation pressure in the target reservoir. This will decrease the effective pressure and will also lead to geomechanical deformation of the rocks. To guarantee safety of storage, the CO2 injection must be controlled not to damage the caprock. In hydrocarbon and geothermal reservoirs, it is well known that the injection or production of fluids can induce microseismic events. Because of their small size, induced microseismicities usually are monitored using borehole instruments. The technology has been applied successfully to the CO2 injection sites. As part of the monitoring component of the Weyburn CO2 injection project, geophones were installed in a disused borehole to record the microseismic events in relation to changes in injection and production in nearby wells. The event magnitudes detected by the geophones ranged between -3 to -1 and the largest events recorded have magnitudes less than -1.0, and many are smaller than -2.0.

This presentation will give a simple review on microseismic monitoring results observed at the onshore CO2 injection sites such as Weyburn (Canada) and Lacq (France), and will also introduce an unconventional monitoring system with permanent OBC (Ocean Bottom Cable) deployed at the offshore oil and gas fields in North Sea. We are developing a similar OBC system to carry out both time-lapse seismic survey and microseismic monitoring at the potential offshore CO2 storage sites in Japan. Japan is one of the most seismically active countries. To monitor earthquakes, JMA (Japan Meteorological Agency) operates an earthquake observation network comprised of about 200 seismographs and 600 seismic intensity meters. It also collects data from over 3,600 seismic intensity meters managed by local governments and the National Research Institute for Earth Science and Disaster Prevention (NIED). We are conducting the second offshore field test with the OBC system, aiming to compare natural seismic data obtained by OBC with the onshore Hi-net (High Sensitivity Seismograph Network Japan, operated by NIED) records. The filed survey results will provide important

insights into the conceptual design of a cost-effective seismic monitoring system at the Japanese offshore potential storage sites.