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Repeated multi-electrode resistivity measurements of a small-scale carbon dioxide gas injection experiment

Shinichi Takakura[1*], Toshiyuki Tosha[1]

[1]AIST

Monitoring of injected carbon dioxide (CO_2) is required in order to perform the geological storage safely and effectively. The use of electrical resistivity prospecting is expected as one of the monitoring approaches because resistivity is sensitive to changes of water and CO_2 contents in rocks and soils. Moreover it may be useful for presumption of the storage volume of CO_2 since resistivity is strongly correlated with water and CO_2 saturations. In order to confirm it, we repeated multi-electrode resistivity measurements during a small-scale carbon dioxide gas injection experiment.

In this experiment, CO_2 gas was injected with the gas cylinders into a depth of about 47.5 m of the groundwater observation well in the AIST Tsukuba Central 7. We made a 112 m-long NNE-SSW survey line which crosses immediately the well. Forty-three electrodes were placed at approximately 2 m intervals in the section of 87 m of north sides of the line and one electrode was put on the southernmost end of the line. Using pole-dipole, irregular dipole-dipole and Schlumberger electrode arrays, resistivity data were collected before, during and after the injection. The 2-D analyzed resistivity sections were influenced by metal structures such as well casing and fences in the neighborhood of the well. In order to detect the resistivity changes, the ratio of the resistivities obtained during two different surveys at times were calculated. As a result, resistivity changes were observed near the well after the injection. This presentation shows the interpretation of the resistivity changes and describes the efficacy and the limitation of resistivity monitoring in a CO_2 geological storage.

Keywords: CO2 geological storage, monitoring, resistivity, electrical resistivity prospecting, CO2 gas injection experiment