On the geoelectric monitoring at the CO2 sequestration into an aquifer

Toshiyuki Tosha[1]; Tsuneo Ishido[2]; Shinichi Takakura[2]

[1] AIST; [2] GSJ/AIST

1. Introduction

Greenhouse gases including CO2 in 2001 marked a 2.5% decrease from those in 2000 but increased more than 5.2% as compared in the base year of 1990 in Japan. Geological sequestration to an aquifer is considered to be the most feasible way to reduce the greenhouse-gases at atmosphere and seismic surveys are often proposed as a monitoring method. We have carried out geoelectric measurements during an air injection into a saline aquifer in order to find out other, feasible monitoring methods during the sequestration.

2. Air Injection

CO2 is planed to be injected into the aquifer at depth of about 1000m and, if the normal geothermal gradient is taken into account, CO2 might be injected in the super-critical condition. Therefore, the examination of monitoring methods by the super-critical CO2 is also desirable. Deep wells enough for CO2 to be in the super-critical condition are, however, not available for the experiment. We planed to use a shallow well with air for the injection gas. A 100m Class well drilled by the old Geological Survey of Japan was used for the experiment. Geoelectric changes were observed on the surface during the injection of air into the well. The air injection was performed continually for about 3 hours in the morning and the afternoon in a day and was repeated for two days.

3. Measurements

Resisitivity and self-potential (SP) measurements were carried out. The resisitivity measurement was conducted along the survey line of about 100m with the electrodes installed every 3m and with an about 50mA constant current. Electrodes for the SP survey were placed at intervals of about 30m along the east-west and north-south survey lines. The both measurements were started on three days before the air injection and lasted after the injection.

4. Results

4-1. Resisitivity

In the background measurement before the injection high resisitivity of more than 1,000 ohm-m was observed. Low resisitivity of about 200 ohm-m was also found around the injection well due to the conductive casing pipe of the well. Another low resisitivity layers were appeared at the depth of about 50m, indicating the aquifer for the air injection. The increase of the resisitivity was observed at the aquifer layers although the position for the low resisitivity layer associated the well did not changed during the air injection. The decrease of the resisitivity was also found at the aquifer close to the injection well. It implied that air intruded into the aquifer layers around the injection well and water migrated into the dry layer, resulting in the increase and the decrease of the resisitivity.

4-2. SP

The increase of SP was apparent starting after the injection and was larger close to the injection well, implying that the change was cause by the air injection. One of the reasonable explanations on the phenomenon is change caused by the oxidation-reduction.

The oxidation-reduction potential is often observed around the conductive ore deposit. An electron moves to oxidization environment at the surface from reduction environment at the subsurface when a conductive object exists connecting the both environments, resulting in the negative SP anomaly at the surface. The air injection has increased oxygen partial pressure at the aquifer around the well and decreased the electron movement along the conductive casing pipe. This caused the relaxation of the negative anomaly.

5. Conclusion

The experiments using the geoelectric change due to the air injection were conducted to evaluate the geoelectric methods for the monitoring in the geological sequestration of CO2 into an aquifer. The apparent change of resisitivity and SP were observed by the air injection. The geoelectric monitoring technique as well as the seismic monitoring commonly used now is possible for the monitoring in the CO2 sequestration.