Risk assessment and safety control in CCS by a natural analogue study-CO2 flux and concentration with isotope measurements-

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Environmental (risk) assessment and safety control technique are quite important in CO_2 geological storage business. However, they have to be evaluated for a very long period as CO_2 should be stored in a geological layer for more than 100 years, Therefore it is very hard to evaluate directly. To solve this problem a natural-analogue study, which inquires the environmental change at present by the comparison with a past geology phenomenon, is one of possible approaches. We also planned

the borehole site which could be reached to basement rock overlain by the thick deposits.

At Matsushiro in Nagano Prefecture, earthquake swarm occurred at August, 1965, around Mt. Minakami and lasted for about two years. A lot of spring water accompanied by CO_2 gas was discharged along the crack and landslide caused by the earthquakes. Matsushiro should be one of the best fields to apply the natural-analogue approach to increase our knowledge about the CO_2 release from the ground and to apply the results to the risk and environmental assessments. We will make a conceptual model for the release of CO_2 and carry out the numerical simulation based on the model to understand the CO_2 movement and to make a guideline for the assessment and safety control. At first we conducted several surveys to understand the geological settings at present. In this study, the survey results of CO_2 soil gas content and CO_2 flux are presented with carbon isotope ratio measurements.

Deep groundwater contained much CO_2 gas gushed at the surface and was said to cause the Matsushiro earthquake swarm. If the deep groundwater is still gushing till now, CO_2 isolated from the deep groundwater may be blowing off at the surface. For this reason, we planned to measure CO_2 to detect the upward flow of the groundwater. Since CO_2 is also produced by activity of a microbe, we make a survey plan to measure isotope of the carbon to distinguish CO_2 in a deep groundwater origin. A survey of the CO_2 gas concentration in soil was conducted before the CO_2 flux measurements to pick up the high CO_2 concentration area. The selected regions are located along the crack and landslide happened during the Matsushiro earthquake swarm.

The instrument of the CO_2 flux measurement is made in Italy with an accumulate chamber which collects the gas from soil. The collected gas is led to a detector and analyzed to measure the concentration. Gas flux is calculated by the temporal change of the gas concentration. The isotope measurement is carried out using vial containers, which is drawn a vacuum in the laboratory before the gas sampling. Gas samples were collected at the same region where CO_2 fluxes were measured. Moreover, hot spring gas and the gas which is blowing off as bubble in the paddy field were also collected to compare the soil gas samples.

CO_2 flux showed the highest value (2.03 ppm/sec) and soil CO_2 gas concentration also showed the highest value of 5.2% at a survey point. Therefore, more detail survey was carried out around that point because it is located within a waste section where no apple tree is grown up though trees are grown up at the surrounding sections. However the measured values of the CO_2 flux were distributed widely and no remarkable CO_2 flux, which suggested the upward flow of the deep groundwater, was detected. The carbon isotope ratio (^{13}C) at the hot spring gas is close to those at marine limestone and volcanic gas and is different from those in an organic origin, implying that the gas in hot spring and the paddy field bubble come from the deep groundwater.

CO_2 gas from the deep layer was expected at no vegetation section but was undetectable by the CO_2 flux survey. The pass which leads the deep gas into the surface might be too narrow to detect directly. This study was carried out as a part of the international collaborative research project supported by METI.