CO_2 Storage Technology

Background and Objective

It is necessary to use coal which is evaluated to have huge potential in the world for supplying a stable source of electricity in the future. However it is also needed to reduce CO_2 emissions from thermal power plants into the atmosphere for preventing global warming. Therefore CCS technology which captures CO_2 from thermal power plants and storages into underground is being developed.

In this project, we collected information on the latest CCS activities in Japan and from around the world, and developed technologies for storing CO_2 underground considering the characteristics of geological structures around thermal plants in Japan.

Main results

1. Site evaluation technology

At coastal areas underground which are considered as CO_2 storage candidate sites, the geological structure and tectonics affecting occurrence and activity of faults were summarized and the characteristics of faults in each area were also summarized. An investigation and evaluation flow of faults at coastal areas which are considered as candidate sites were also proposed (Fig. 1).

These results were obtained through the funded research of the Research Institute of Innovative Technology for the Earth (RITE).

2. Understanding CO_2 performance

It is confirmed that calcium carbonate ($CaCO_3$) crystal grew 2.2 micro meters in three hours in the field experiments where CO_2 dissolved water containing 0.4% or 0.8% of CO_2 was injected into rock at a temperature of around 200 degrees Celsius through the 1,100 m deep well. These results showed that CO_2 can be stored as carbonate minerals relatively faster at high temperature condition. It was found that electric resistivity in the well suddenly decreased by injecting CO_2 dissolved water. This result showed that the electrical survey will be effective for CO_2 distribution monitoring (Fig. 3).

3. Monitoring technology

CO_2 detecting and monitoring methods around sea floors were proposed with developing elastic wave tomography equipment set on the sea floor and introducing AUV with attaching some chemical sensors [V09034] [V09035]. Numerical simulation showed that gravity and electric self-potential would decrease of about 70 micro gal and about 200 millivolts respectively when a total of 5 million tons of CO_2 is injected into underground through a well at a depth of 950m. Therefore these methods can be used for CO_2 distribution monitoring.

4. Environmental effect evaluation in the sea

It was shown that CO_2 diffusion in the sea around Japan can be analytically estimated by using a high resolution regional sea model with horizontal resolution of 10 km.

5. CCS activity survey in Japan and the world

CCS obligation standard in Britain was summarized as a result of the world CCS activity survey [V09010]. The process for residential acceptance for CCS in the ZeroGen Project in Australia was summarized [V09004].

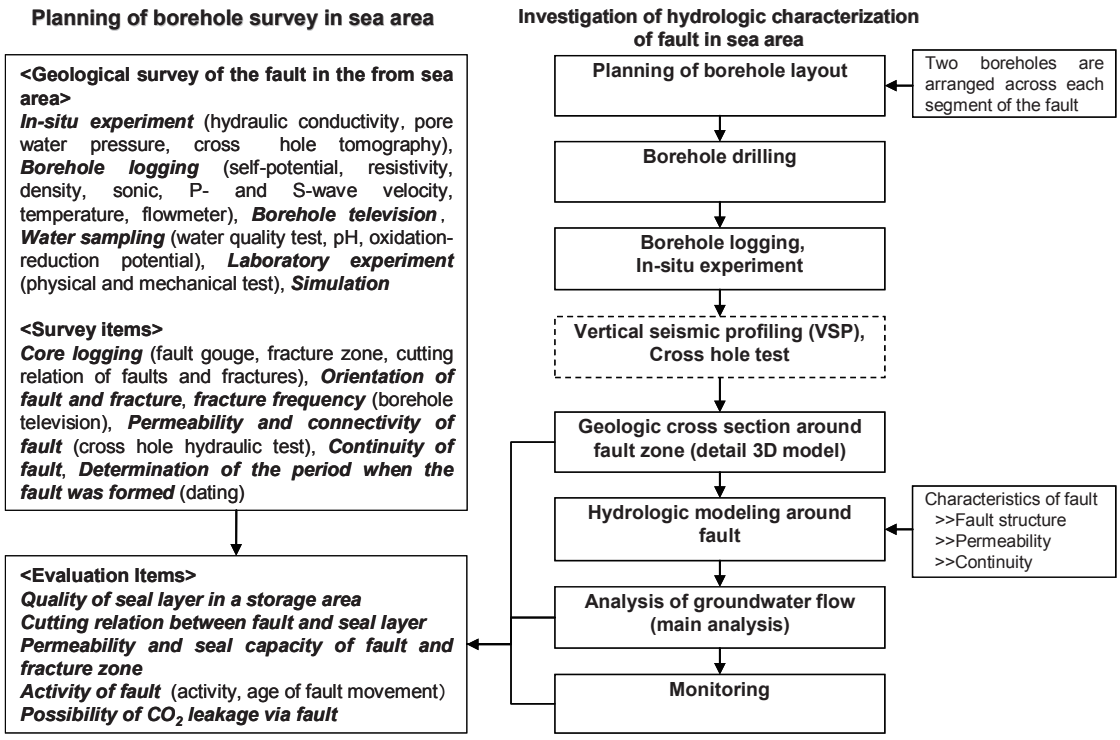

Fig. 1 Preliminary investigation flow of hydrologic characterization of fault at coastal areas

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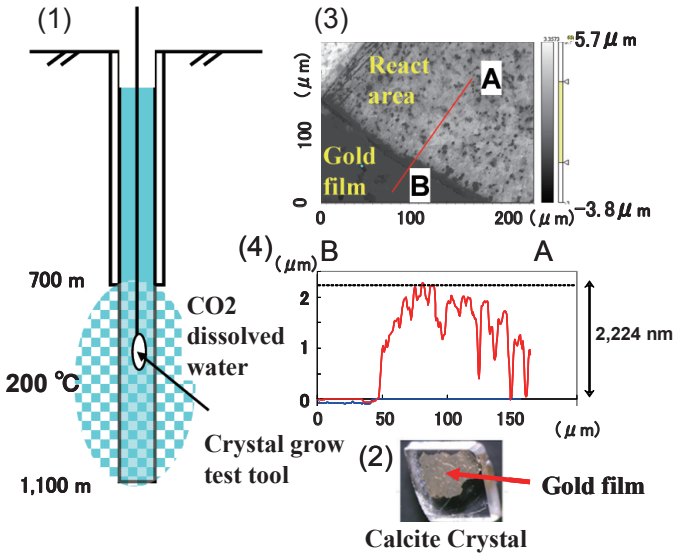

Fig. 2 Calcite crystal growth test result

CO_2 dissolved water was injected into rock at a depth of 1,100 m and at a temperature of 200 degrees C. (1) Calcite crystal sample was suspended in the well at 950 m depth for three hours. (2) The sample was partially covered with gold film. (3) The crystal surface was observed by microscope. (4) The surface in the reacted area was measured to have grown about 2.2 micrometers.
(Collaboration research results with RITE)

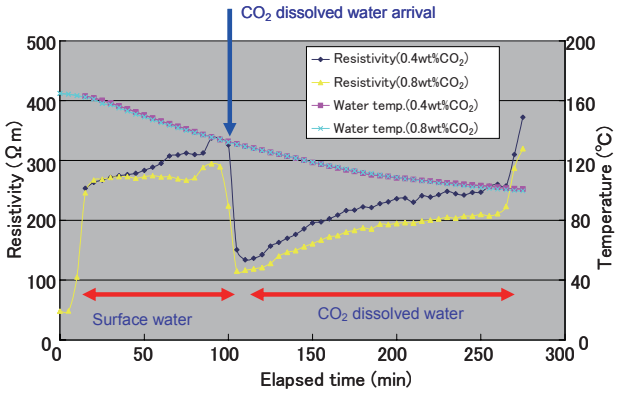

Fig. 3 Electric resistivity in the well change during CO_2 dissolved water injection

Electric resistivity change was detected by the resistivity log in the well during CO_2 dissolved water injection like in the Fig. 2 test. These results showed that the electric resistivity measurement can be used as a CO_2 monitoring method.