

## Research project on the prediction of CO<sub>2</sub> behavior in a saline aquifer

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### 1. Introduction

Sequestration of CO<sub>2</sub> in geologic formations is expected to be one of the technologies the Kyoto signers would deploy to meet the emission targets. In recent years preliminary field tests have been performed in Japan to determine feasibility of geologic sequestration. One of the tests included a small-scale experiment in a depleted oil field in Nagaoka, Central Japan.

Unlike the oil and gas reservoirs, saline aquifers with monocline and anticline structures are widely distributed in Japan and have significant storage capacity. These aquifers could be vital for successful deployment of geologic sequestration technology in Japan. Before this could happen, further studies focused on determining the sequestration potential and long-term storage behavior of these aquifers are necessary. AIST commenced a new 3 year project in 2005FY under the framework of the RITE project.

### 2. Major focus areas and their goals

#### 2.1 Development of conceptual models for faults

Japan is one of the most tectonically active regions in the world. The faults could be completely open and act as high permeability conduits or could be filled due to mineral deposition and prevent CO<sub>2</sub> seepage. Some of the preliminary outcrop analyses show faults filled with mineral deposits. As part of this project extensive data on fault properties will be collected and analyzed.

#### 2.2 Evaluation of mechanical integrity of cap rocks:

Cap rocks provide sealing capacity for storage of CO<sub>2</sub> in saline aquifers. As pressure in saline aquifers increases due to storage of large amounts of CO<sub>2</sub>, it is expected to have an effect on the long-term mechanical integrity of the cap rock. Currently there is no data available on the mechanical behavior of seals in Japan. As part of this project we will collect data on visco-elastic behavior of rocks.

#### 2.3 Estimation of the movement of ground water flow

Ground water flow in the aquifer has the potential to carry CO<sub>2</sub> away from the intended target zone intended for long-term storage. It is, therefore, important to estimate the direction and speed of general flow in saline aquifers. We intend to establish the technology required to estimate the movement of the general flow using the ground-water deep well databases in Japan.

#### 2.4 Comparison of numerical simulators

Currently a number of numerical simulators are available to simulate injection and storage CO<sub>2</sub> in a saline aquifer. The previous study shows that there are slight differences in the calculation results from different numerical simulators. As part of this project we will compare results of three simulators (GEM, STAR, TOUGH2 etc.), which are currently used in Japan.

#### 2.5 Development of a numerical model for saline aquifers

As part of the Nagaoka project, a numerical model was developed. In order to evaluate the sequestration capacity of saline aquifers in Japan a more generalized and precise numerical model is needed. A numerical model will be developed using the knowledge and data acquired during this project. In addition, data collected during the Nagaoka and other CO<sub>2</sub> sequestration field tests in Japan will also be used in the model development process. The model will be used to determine ultimate CO<sub>2</sub> storage capacity in saline aquifers as well as long-term storage potential of aquifers.

### 3. Conclusions

This paper will provide an overview of a research project focused on determining the ultimate sequestration potential of saline aquifers in Japan. The final goal of the project is to construct a generalized numerical model for CO<sub>2</sub> storage in saline aquifers in Japan. The numerical model will be used for risk assessment studies and to determine feasibility of CO<sub>2</sub> sequestration in saline aquifers. The knowledge and data developed as a result of this project will be applicable not only to saline aquifers but also other potential geologic sequestration sites such as depleted oil and gas fields.