Development of Large-Scale Aparatus for Gas Production from Methane Hydrate Layer

JIRO NAGAO*, YUSUKE JIN AND YOSHIHIRO KONNO

ProTech/MHRC, National Institute of Advanced Industrial Science and Technology (AIST), Sapporo 062-8517, Japan (correspondence: jiro.nagao@aist.go.jp)

Background

To utilize methane hydrate as valuable natural gas resources, a suitable gas production technique and conditions shoul be established. Experimentally the production method and suitable conditions have been investigated using the core samples. The reproducible results on how methane hydrate dissociates under various conditions could be presented from core-sample experiments. Whereas a core-scale experiments in a laboratory can demonstrate the heat transport process, a dissociation of methane hydrates in an actual reservoir is dominated by the material flow process. In order to couple data obtained from core-scale experiments with the results of field-scale production tests, a large-scale gas production apparatus was conducted at the AIST [1], financially supported by MH21 Research Consortium.

Certification of Apparatus

A large-scale production system for methane hydrate production tests can perform the dissociation experiments under the similar conditions of the actual reservoir under a deep sea floor. Developed large-scale apparatus is shown in Fig.1. The steel vessel has an inner diameter of 1000 mm, a height of 1500 mm and a volume of 1710 L. An overburden pressure of up to 16.5 MPa can be applied for sandy sample. The temperature of the vessel can be controlled from −5 to 20°C. A production well of a steel pipe with a diameter of 100 mm and a length of 1000 mm with holes is connected to a gas and water separator. Holes in the side and bottom of vessel are provided to allow the insertion of gas, water and temperature/pressure sensors. Real-time observations of the rate of the production of gas and water can be performed.

Fig.1 Developed large-scale apparatus

[1] Nagao (2012) Synthesiology **5**, 89-97.

Microbially mediated redox processes in lactate stimulation with sedimentary rock and groundwater

T. NAGAOKA[1]*, T.NAKAMURA[1], Y.SASAKI[2], T.ASANO[2], T.ITO[2], Y.AMANO[3], T.IWATSUKI[3] AND H.YOSHIKAWA[2]

[1]Bioengineering sector, Environmental Science Research Laboratory, Central Research Institute of Electric Power Industry, 1646 Abiko, Chiba, 270-1194, Japan (*correspondence: nagaoka@criepi.denken.or.jp)

[2] Geological Isolation Research and Development Directorate, Japan Atomic Energy Agency, Tokai, Ibaraki, Japan

[3] Geological Isolation Research and Development Directorate, Japan Atomic Energy Agency, Horonobe, Hokkaido, Japan

It is significant to investigate the geochemical groundwater evolution around the nuclear waste repository, because geochemical condition could influence the radionuclide migration behavior and corrosion of barrier materials in the repository. Therefore, a laboratory jar experiment was conducted with deep subsurface sedimentary rock and groundwater, in order to assess the response of the geochemical and microbial communities toward redox processes. The redox process was induced by exposure to air and discontinuation to sediment suspension, which simulated the process occurring during operation of nuclear waste repositories, i.e., tunnel excavation, transport of waste containers, and final backfilling. During the experiments, redox potential, dissolved oxygen, and pH in the suspension were measured, and the concentrations of dissolved ions concentration, HCl-extractable iron, and also head space gasses in the jar were analyzed. Moreover, microbial DNA was extracted from the suspension, and PCR-DGGE analysis was performed to analyze the response of microbial communities toward the geochemical changes. As a results, after discontinuation of air exposure with lactate amendment, redox potentials decreased from ca. +100 mV to -600 m V (vs. Ag/AgCl), and some sequential terminal electron-accepting process (TEAPs) was observed with the reactions of aerobic respiration, iron reduction and hygrogen fermentation. The related species of the microbes along with TEAPs, e.g., *Pseudomonas sp*. for aerobic respiration and *Shewanella sp*. for iron reduction, was also detected. These results indicated that the microbial activities would affect the geochemical changes in nuclear repositories.

This study was performed as a part of “Project for Assessment Methodology Development of Chemical Effects on Geological Disposal System” funded by Ministry of Economy, Trade and Industry, Japan.

DOI:10.1180/minmag.2013.077.5.14