Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SCG068-P01 Room:Convention Hall Time:May 22 11:45-12:45

Evaluation of long time deformation around Horonobe area using modelling techniques

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Nuclear power generation has a problem of emission of high-level nuclear waste. It will take several tens or hundreds of thousands of years that radioactivity of waste does not harm human body. Deep geological disposal may be appropriate for permanent disposal, but it is necessary to evaluate the safety of disposal system by predicting long-range geological movements. Uplifted geology may be easily eroded and this makes underground facilities to be shallow to the surface. Overburden decreases by denudation may also activate pre-existing faults. We performed analogue model experiments which incorporate uplift and denudation, and evaluated geological movements of an on-shore thrust belt for a million years.

The analogue model experiments were to observe forming process of geologic structures in a laboratory. In this study, we simulated fold-and-thrust belt by compressing dry sand whose deformation behaviour is similar to that of the upper crust. Uplifted sand was eroded at constant time interval during a series of experiments to observe the effect of the frequency of denudation. We also recorded images of cross section to analyze structural behaviour with digital image correlation (DIC) technique that can estimate velocity and shear strain in the images by tracing mass of particles between each image.

The results show that the structural movement is basically similar in every experiment thus experimental configurations will not affect the results.

Keywords: geological disposal, geological structure, denudation, analogue model experiment

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Development of Hydrologic Characterization Technology of Fault for Preliminary Investigations: Fault Type Classification

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NUMO and LBNL have carried out a project to develop an efficient and practical methodology to characterize hydrologic property of fault since 2007, for the early stage of siting a deep underground repository. In the project, we tried construction of the type classification method based on the hydrologic characteristic of a fault, and applied the method to the Wildcat fault in Berkeley, California, US. The Wildcat fault is non-active right-lateral strike-slip fault which is believed to be a splay of the active Hayward fault. Our type classification assumed the contrasting hydrologic feature between the linear northern part and the spread southern part of the Wildcat fault. At the southern part at which fault spreads, it was expected that the continuity of fault was scarce and there was a groundwater flow across the fault. For the purpose of verifying the validity of this type classification, geological survey, geophysical exploration and hydrologic tests of the southern part of the Wildcat fault were carried out. However, from the result of hydrologic tests, it is expected that the Wildcat fault has interrupted the groundwater flow across the fault. The type classification method is due to be improved based on these results of field survey and borehole tests.

Keywords: Fault, Hydrologic characterization, Type classification, Preliminary Investigation

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Development of Hydrologic Characterization Technology of Fault Zones for Preliminary Investigations

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NUMO and LBNL have been developing a systematical methodology of investigation and evaluation for understanding and estimating hydrologic characteristics by considering geological characteristics of fault. We carried out borehole survey for understanding characteristics and structure of the Wildcat fault, which runs in LBNL, measurement of water level and water pressure and hydrologic test in boreholes. We report the results of core observation, microfossil analysis, radiometric dating (U-Pb), thin section observation and characteristics of geology and geological structure obtained through correlation between BHTV data and core observation. Major faults exit on formation boundaries or with 'tuff', 'tuff breccia' together. Four major faults were recognized in the south part of the Wildcat fault and they form a duplex-like structure that branches southeastward.

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Applicability of the grounded source airborne electromagnetics to coastal areas

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Coastal areas are one of important candidates for geological disposal of high-level radioactive waste in Japan. At the stage of preliminary investigation, airborne geophysical survey is a powerful tool to investigate underground structure. In coastal areas, it is important to know the boundary between fresh water and saline water, which can be estimated by measuring electrical resistivity. As for airborne electromagnetics, conventional frequency-domain type is not suitable for our purpose because it can survey only shallow depth. In order to enhance survey depth, grounded electrical source airborne transient electromagnetics, or GREATEM, was applied to a coastal area where sedimentary rocks prevail. It was found that our result was fairly in good agreement with previous data, and hence our approach is useful as an investigation tool for coastal areas.

Keywords: Airborne electromagnetics, Geological disposal, Coastal area

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Systematization of the management methodology on borehole core for evaluation the geological environment in coastal area

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Coastal area has the characteristic geological environments which would be radionuclide migration pathway such as the salt-water/ fresh-water interface and the concealed faults. And upgrading development of evaluation methodology to clarify them has been required. Therefore, we are carrying out the deep drilling survey to the depth of 1,004m on the coastal area of Horonobe town in Hokkaido and the laboratory analysis of the core. The analysis and laboratory tests of borehole core are important to understand the geological environments in the site. And wide-range information related to groundwater, rock properties and geology is required. However, if more information is required, the core management methods will be more complex because of the contents is deferent depend on the analysis and the laboratory tests. And incorrect core management would be caused the adverse effects on the results. So, the best core management is reliability requirement of evaluation methodology. In this study, we analyzed the contents on work and mindfulness from in-situ investigation to laboratory tests due to establish a systemized core management methodology. From the results to apply the developed methodology, it was possible to minimize the implications of the results. And an issue cited as a further shortening of working hours and a greater flexibility with a plan changes. In this report, we will mainly present the contents of the applied management methodology.

Keywords: Systematization, Manegement methodology, Borehole core, Geological environment, Coastal area

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Experimental study for a long term behavior of near-field of HLW disposal hole by centrifuge model test

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The objective of this paper is to evaluate the long term behavior in the high level wastes geological disposal repository and the neighborhood (called ”near-field”) by the centrifuge model test. To clarify the long term phenomena in the near-field, the researches by the full-scale test and the numerical analysis have been carried out. However, it is difficult due to a place, time, and economic restraint and a verification of the applicability of the model. If the experiment of the small model of near-field by the centrifugal equipment that can supplement these problem points becomes possible, a long term reliability of the disposal repository can be improved by acquiring the empirical laboratory data. The model specimen consists of rock mass (Tage tuff), bentonite buffer (Kunigel-V1) and model waste (SUS). A rock mass was cut into a core with a diameter of 180 mm and length of 180 mm. The borehole of 54 mm in a diameter and 127 mm in a height was opened at the center of the rock mass. These are the size of 1/30 of the HLW disposal hole proposed in the report of CRIEPI and FEPC (1999). After the bentonite buffer and model waste were enclosed in the borehole of rock mass, the rock mass was enclosed with the pressure vessel, and then, centrifuge model tests were conducted at 30 G of centrifugal force field with confining pressures and injection pressures. The confining pressure was loaded in the conditions of 2, 5 and 10 MPa under the isotropic hydraulic pressure. The injection pressure and back pressure for the permeability test was constantly controlled by half the confining pressure and 0.5 MPa, respectively. We measured the strains of rock mass, swelling pressure of bentonite and displacement of model waste in the tests. In the confining pressure condition of 2 MPa (TG-01), the swelling pressure of bentonite remarkably increased until about 30 hours passed and was nearly constant until about 160 hours passed. After that, the swelling pressure re-increased, and then, gradually decreased after 230 hours passed. The observed maximum swelling pressure showed approximately 1.7 MPa. Similarly trend was observed in the displacement of model waste though the displacement showed subsidence until 30 hours passed. The equivalent maximum subsidence showed approximately 1.5 mm. The values of strain increased until 30 hours passed, and then, were nearly constant. In the confining pressure condition of 5 MPa (TG-03), the swelling pressure of bentonite continuously increased until about 120 hours passed, and then, was nearly constant after about 150 hours passed. The displacement of model waste remarkably subsided until about 50 hours passed and then, was nearly constant after that. The maximum values were observed approximately 1.6 MPa for swelling pressure of the bentonite, approximately 1.5 mm for equivalent subsidence of the model waste. In the confining pressure condition of 10 MPa (TG-05), the swelling pressure showed a similar trend to TG-03, on the contrary, the value obviously large: approximately 3.0 MPa at peak, and finally approximately 2.1 MPa. The displacement of model waste remarkably rose until about 120 hours passed and then, was nearly constant after that. The equivalent maximum rise showed approximately 21 mm. The values of strain gauges attached to the side face of rock specimen showed the rapid increase until 60 hours passed, and then, were nearly constant. The values of strain gauges attached to the top-end face of rock specimen showed the rapid decrease until 60 hours passed, and then, were nearly constant.

Keywords: Centrifuge, High-level radioactive waste, Near-field, Long term behavior, Model test