

SCG068-01

Room:104

Time:May 22 14:15-14:30

Focast of natural phenomena and safety analysis for safety of geological disposal

Junichi Goto^{1*}, Ryuta Hataya¹, Eiichi Ishii¹, Takeshi Ebashi¹, Katsuhiko Ishiguro¹, Hiroyuki Tsuchi¹

¹NUMO

Since Japan is located in a tectonically active zone, requirements for implementing the geological disposal system will include selection of the repository site from locations where significant impacts of natural phenomena such as volcanism, fault activity and uplift/erosion can be avoided in the future. Future occurrence of such phenomena should be forecasted based on trends that have occurred around the area in question in the past to forecast whether significant impacts can be avoided in the future. Data on the geological environment of the disposal sites and on long-term geological evolution are then obtained to allow selection of a location with suitable conditions for ensuring long-term post-closure safety.

Forecasts of natural phenomena in the future have been made, based mainly on an extrapolation method. In Japan, there is consensus that forecasting natural phenomena one hundred thousand years into the future will be possible based on geological records for the past hundreds of thousand years. However, for a geological disposal system based on confinement and isolation, the time when the maximum dose occurs may substantially exceed one hundred thousand years and strategies for evaluating natural phenomena further into the future are required. Activities for addressing this issue are ongoing as described later.

Management of uncertainties is a key issue for NUMO's quality assurance activities. Generally, uncertainties associated with site characterization include those associated with data and conceptualization of the geological environment, and with forecasts of natural phenomena. Information on such uncertainties will have to be provided for the repository design and safety assessment. Through coordination of repository design and safety assessment, key structures, geological environment characteristics and phenomena that affect the feasibility of constructing the disposal facility and long-term post-closure safety should be identified and reflected in the investigation plan for the subsequent stage (or phase), which should have the effect of reducing uncertainties.

Activities to support safety assessment from the scientific point of view have started recently in NUMO. Scientific advances in the last decade in areas such as plate movement, volcanism, fault activity and uplift/subsidence have been compiled, together with international perspectives on the evaluation of natural phenomena and safety assessment, to identify issues for discussion. The results of the discussion stimulated a study on the stylization of natural phenomena on an individual area-phenomenon basis. The Tohoku area in northern Japan was subdivided into several regions based on differences in the mode of crustal deformation and trends in uplift/subsidence for each region will be investigated on the very long-term.

Keywords: geological disposal, siting, safety analysis, natural phenomena, future forecast, uncertainty

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SCG068-02

Room:104

Time:May 22 14:30-14:45

Focast of natural phenomena and safety analysis for safety of geological disposal

Takeshi Ebashi^{1*}, Ryuta Hataya¹, Junichi Goto¹, Manabu Inagaki¹, Katsuhiko Ishiguro¹, Hiroyuki Tsuchi¹

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In an actual disposal facility, different events will interact in a complex manner and will evolve over a long time frame. Accordingly, it will not be straightforward to realize them all in detail in the context of scientifically demonstrating future conditions. Defining of conditions will thus involve simplifying physical and chemical phenomena and checking the conservativeness of this approach in the context of safety assessment, rather than making efforts to pursue strict scientific correctness, to reduce the number of factors to be considered and reduce coupling between these factors.

In this study, based on the above, the relationship between future prediction in site characterization and scenario classification in safety assessment, and scenario development methodology of natural phenomena are illustrated.

Keywords: geological disposal, siting, safety analysis, natural phenomena, future forecast, uncertainty

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SCG068-03

Room:104

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Rethinking of NF concept in crystalline rock

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Since established NF multi-barrier concept in H-12 report, underground research has been conducted and provides realistic data for underground environment. The data and knowledge enable us to develop more realistic NF concept in order to adjust the characterization methodology also to define the barrier function by combination of synthetic barrier materials and natural barrier system. The paper here discuss how we have to rethink to develop the realistic NF concept to for coming on site characterization and safety assessment with compiled URL data set in crystalline rock, in Japan.

Keywords: NF concept, Crystalline rock, Barrier function

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SCG068-04

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Hydrochemical Characterization at Mizunami Underground Research Laboratory - Adequacy assessment of the result of surfac

Mizuno Takashi^{1*}, Aosai Daisuke¹, Shingu Shinya¹, Yamamoto Yuhei¹, Fukuda Akari¹, Hagiwara Hiroki¹

¹JAEA

Progress of hydrochemical study in MIU project conducted by JAEA is reported in this paper.

Keywords: MIU, hydrochemistry, influence of shaft construction

SCG068-05

Room:104

Time:May 22 15:15-15:30

Natural analogue study using U, Th, REEs to identify the pragmatic hydrogeological structure in sedimentary rock

Teruki Iwatsuki^{1*}, Teruyuki Honda², Hiroaki Murakami¹

¹Japan Atomic Energy Agency, ²Tokyo City University

U, Th and REEs abundances in sedimentary rocks were analyzed to understand the long-term mobility of these elements and to develop the evaluation method of the pragmatic solutes transport path at Horonobe area, Japan. The abundances of U, Th and REEs in rock matrix were generally homogeneous suggesting that no large-scale movement occurred in spite of distinct hydro-chemical condition in the sedimentary rocks. The detail analysis of peculiar points such as fracture and fault as a possible solutes transport path shows the accumulation and leaching of U, Th and REEs at some faults with connection and continuousness at specific depth. The fault and accompanied alteration possibly facilitates to leach and move the heavy-REEs (HREEs) from primary rock. Then those elements seem to have a tendency to concentrate into carbonate mineral vein in the fracture. The some clay-rich fault parts enriches in U, Th and light to medium-REEs (LREE~MREEs) compared with background rock. The clay minerals in the fault would entrap those elements and delay its transport though the fault can become a solutes transport path. From the viewpoint of solutes transport, remarkable transport path is fracture and fault (fracture media) rather than rock matrix (porous media) in sedimentary rocks at the area. Analysis of the heterogeneity of analogue elements around fault (fracture) is efficient method for the screening of pragmatic solutes transport path from the innumerable faults and fractures.

Keywords: horonobe area, sedimentary rock, solute transport path, natural analogue, rare earth element

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SCG068-06

Room:104

Time:May 22 15:30-15:45

Hydrogeological investigations for validation of groundwater flow modelling

Kazuyuki Matsusue^{1*}, Masahiro Munakata¹, Kimikazu Hisada¹, Hideo Kimura¹

¹Nuclear Safety Research Center, JAEA

It is necessary to evaluate the influence on the environment by the groundwater flow analysis in the safety assessment of geological disposal of the radioactive waste.

We studied to acquire the new data to validate the large area groundwater flow model in the Horonobe region, Hokkaido.

A borehole of 700m and 2 boreholes of 150m were excavated respectively on the east side of the Horonobe Underground Research Laboratory and the west side.

We acquired the hydrogeologic data of the hydraulic head, the hydraulic conductivity, and the groundwater chemistry, etc.

Keywords: groundwater flow model, borehole, hydraulic conductivity, groundwater chemistry, hydraulic head

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SCG068-07

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Study of chlorine-36 dating of groundwater in the SAB-2 borehole, Horonobe, Hokkaido

Kimikazu Hisada^{1*}, Masahiro Munakata¹, Kazuyuki Matsusue¹, Hideo Kimura¹

¹Nuclear Safety Research Center, JAEA

A deep drilling project (SAB-2 borehole, 710m deep) has been conducted in the Horonobe area, Hokkaido, Japan for the safety assessment of geological disposal of radioactive waste. We report a result of investigation of groundwater age using chlorine-36.

Keywords: chlorine-36, groundwater age, Horonobe

SCG068-08

Room:104

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Estimation of groundwater retention time by Carbon-14 in the sedimentary rocks at the Horonobe study site

Hiroaki Murakami^{1*}, Yuki Amano¹, Yoko Saito-Kokubu¹, Teruki Iwatsuki¹

¹Japan Atomic Energy Agency

Dissolved inorganic carbon (DIC), $\delta^{13}\text{C}$ and $^{14}\text{C}/^{12}\text{C}$ ratio in sedimentary rocks were measured to understand the residence time of groundwater at Horonobe area, Japan. Siliceous mudstone of Wakkanai Formation and diatomaceous mudstone of Koetoi Formation containing fossil water and methane gas are distributed at the study area. Groundwater samples were collected at 140m and 250m depth. Groundwater samples were enough to overflow. After NaOH and SrCl_2 were added to the samples to induce SrCO_3 precipitation, the precipitated SrCO_3 was converted to CO_2 by reacting with phosphoric acid in a vacuum line. All samples were analyzed by an Accelerator Mass Spectrometer (JAEA-AMS-TONO).

Measured values of DIC, $\delta^{13}\text{C}$, $^{14}\text{C}/^{12}\text{C}$ in the groundwater samples were from 430 to 690 mg/L, from +19.3 to +21.8 permil and from 0.39 to 1.04 pMC (percent Modern Carbon), respectively. If all ^{14}C in samples were originated from CO_2 in the air, large quantities of air contact with the sample. This shows that; ^{14}C in the samples are not contamination. As a result of simply calculation, the ^{14}C ages were about 40,000 year BP. However, ^{14}C activity is diluted by non-active carbon ('dead carbon') from various carbon sources which are carbonates or organics. Thus, it is necessary to clarify the isotopic attenuation by dead carbon and process of isotopic fractionation in this area and to correct the ^{14}C ages.

Keywords: groundwater, retention time, isotope, ^{14}C

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SCG068-09

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Study on Preparation methods for Validation data of Groundwater Flow System in a Sedimentary Rock Area

Ryutaro Sakai^{1*}, Masahiro Munakata¹, Hideo Kimura¹

¹Nuclear Safety Research Center, JAEA

In the safety assessment for a geological disposal of radioactive waste, it is important to establish validation methods for regional groundwater flow system more than 300m at depth to estimate radionuclide migration to human environment through groundwater flow system. The study discussed application of data and assessment methods for model validation based on multiple indicators such as hydrology, groundwater chemistry, temperature and age of groundwater in case of the Hamasato in Horonobe area where a lot of in-situ data about groundwater were measured.

This results show that multiple indicators such as hydrology, groundwater chemistry, temperature and age of groundwater are applicable to validate the groundwater flow property and groundwater flow boundary.

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SCG068-10

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Study on Temporal Change of Hydraulic Conductivity for Long-term Groundwater Flow Analysis

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¹Nuclear Safety Research Center, JAEA

We studied the temporal change of hydraulic conductivity to be considered in the safety assessment of geological disposal facility. Based on the measured geological properties performed in Horonobe area, it is appeared that the correlation between the depth and hydraulic conductivity. Then, we estimated the temporal change of hydraulic conductivity in this area.

Keywords: Geologic Disposal, Safety Assessment, Groundwater Analysis

SCG068-11

Room:104

Time:May 22 17:00-17:15

Effect of confining pressure on the chemico-osmotic property of sedimentary rock

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¹AIST

Precise characterization of groundwater flow system is necessary for performance assessment of geological disposal of radioactive waste. In low-permeability sedimentary formations in coastal regions, heterogeneous salinity distributions may induce chemical osmosis, causing fluid pressure anomalies from hydrostatic pressures. In order to characterize the groundwater flow systems with salinity gradients, the magnitude of chemical osmosis needs to be identified by an approach with the combination of experiments and numerical modeling. This study developed a laboratory apparatus for chemical osmosis experiments that simulates in-situ lithostatic pressures, and performed a series of experiments using a siliceous mudstone, taken from Horonobe area in Hokkaido, under confining pressures ranging from 1 to 20 MPa. The measured pressure differences between the ends of disc-shaped rock sample range from 9.1 to 26.4 kPa. The salinity differences are almost consistent in a series of experiments, and range from 0.110 to 0.118 M NaCl. From the measured salinity and pressure differences, the reflection coefficients approximated from van't Hoff equation ranges from 0.020 to 0.049, and show the correlation with the confining pressure. Based on the results derived from this study, potential osmotic pressures induced by the salinity differences between fresh and saline waters should be examined using the field scale numerical model for further studies.

Keywords: sedimentary rock, chemical osmosis, osmotic pressure, laboratory experiment

SCG068-12

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Comparison of pore water chemistry after extraction from sedimentary rock by different methods

Reo Ikawa^{1*}, Seiji Nishizaki¹, Isao Machida¹, Masaru Koshigai¹, Atsunao Marui¹, Narimitsu Ito¹

¹Geological Survey of Japan, AIST

It is difficult to obtain physical data in sedimentary rock with low permeability, because the groundwater velocity reduces as the depth increases. In regions with this type of rock, geochemical data is very important to understand the groundwater flow conditions. However, in situ groundwater sampling is very difficult because of the sampling schedule, cost, and technical requirements. Many previous studies have suggested that geochemical data from pore water could be used in these cases. Squeezing, centrifugation, leaching, and direct equilibration have been proposed as major extraction methods for pore water. Among these methods, squeezing has been used in the widest range of studies. However, water sampling by squeezing needs to be conducted under appropriate pressure conditions, because rock failure from excessive pressure can influence the chemical and isotopic composition of the pore water. In this regard, centrifugal extraction is advantageous, because it is not influenced by rock failure. However, the application range of this method to rock samples is small, and isotopic fluctuation can occur because of the long exposure time of the sample to the air. To date, the pore water chemistry after centrifugal and squeezing extraction has not been compared in detail for Japanese soft sedimentary rock.

The purpose of this study was to clarify the advantages and disadvantages of both extraction methods based on chemical analysis of the pore water. Both methods altered the isotopic composition of the pore water rather than its chemical composition. For water samples extracted by the same method, extraction conditions such as pressure and rotational speed also influenced what specific ions were present in pore water. The latest results from this study will be reported.

Keywords: pore water, squeezing, centrifugation, water chemistry, stable isotopic ratio

SCG068-13

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Effect of microorganisms on migration of radionuclide - Sorption of actinides on microbial cells in aerobic condition -

Toshihiko Ohnuki^{1*}, Wakari Iwai¹, Naofumi kozai¹, Yohey Suzuki²

¹JAEA, ²AIST

Introduction:

The actinides (An) may migrate through fracture in the components of geologic formation. Microorganisms exist in these fractures, and consequently, Ans released are adsorbed by microorganisms. However, whilst there are considerable data on the sorption and retention of Ans by inorganic components of fracture, the effects of microorganisms on the migration of Ans are not fully understood.

The structure of cell surface of microorganism differs between Gram-negative and Gram positive microorganisms. The adsorption of actinides may differ between Gram-negative and Gram positive microorganisms. In this study, we have studied the adsorption of U(VI) by *Shewanella putrefaciens* (Gram-negative) and *Bacillus subtilis* (Gram-positive).

Experimental:

The cells of the microorganisms were grown for 2 days in medium solution at 30°C were washed three times with 0.1 mol/L NaCl solution. Harvested cells were contacted with aqueous solution containing 1.0×10^{-5} mol/L U(VI) and 0.01 mol/L NaCl. The pHs of the exposure solutions were adjusted to 3, 4, 5, and 6. The cell density was changed from 0.02 g/L to 0.5 g/L. The effect of the presence of Ca^{2+} ions, citrate ions, and glucose was examined. The chemical states of the adsorbed U(VI) on the cell of *S. putrefaciens* were determined by U_{LIII} EXAFS spectrum measured at BL-27B at photon factory of KEK, Tsukuba.

Results and discussion:

The concentration of U in the solution was the same between 2 and 4 h after exposure of the cells to U(VI), indication that the adsorption was attained to equilibrium within 2 h. At pH 3 the concentration of U after exposure of two kinds of microorganisms of 0.02 g/L to U containing solution was approximately 2×10^{-6} mol/L. The concentration of U decreased with increasing solution pH. The charge of the cell surface increased negatively with increasing solution pH, resulting in the ascent of adsorption of U with increasing pH. The EXAFS analysis indicated that U was associated with phosphoryl functional groups. These results indicated that U was adsorbed on the functional groups of the cell surface.

Presence of Ca^{2+} ions between 0.01 and 0.05 mol/L in the solution did not affect the adsorption of U by *S. putrefaciens*. Adsorption of U by *B. subtilis* decreased with increasing concentration of Ca^{2+} ions. Presence of citrate ions reduced the adsorption of U(VI) by *S. putrefaciens* and *B. subtilis*. The presence of glucose did not affect the adsorption U(VI) on *S. putrefaciens*, but decreased the adsorption of U(VI) by *B. subtilis*. These results suggest that the presence of cations and organic acids affect the adsorption of An by microorganisms, and the adsorption of U(VI) are different between Gram-negative and Gram-positive microorganisms.

This study was supported by grants from the Nuclear and Industrial Safety Agency (NISA).

Keywords: Geological disposal, adsorption, microorganism, long-lived radionuclides, migration

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SCG068-14

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Biogeochemical Biogeochemical Investigations of Granitic Groundwater from the Grimsel Test Site, Switzerland

Uta Konno^{1*}, Mariko Kouduka¹, Yohey Suzuki¹, Ito Kazumasa¹, Yoshio Watanabe¹

¹AIST

As collaborative efforts between Nagra and AIST, we investigated biogeochemical properties of granitic groundwater from the Grimsel Test Site, Switzerland. We selected 5 boreholes depending on flow rate and hydrogeological unit, and total cell counting, metabolic activity measurements, DNA-based analysis for microbial populations and analyses for stable isotopic compositions of gases were performed in addition to basic geochemical analyses. For quality control, it is necessary to flush, at least, three borehole volumes before sampling. This is because stagnant water in a borehole could be colonized by distinct microbes from those in formation water. As microbes initially colonized in a borehole would also be of our interest, we sampled groundwater at the beginning and at the end of flushing. In this presentation, biogeochemical profiles and microbial populations found from the granitic groundwater will be shown to discuss their generic and site-specific features.

This study was supported by grants from the Nuclear and Industrial Safety Agency (NISA).

SCG068-15

Room:104

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Natural analogue study on long-term reaction of bentonite and highly alkaline groundwater

Masaya Oi^{1*}, Naotatsu Shikazono¹, Minoru Yamakawa², Naoki Fujii²

¹Graduate School of Keio University, ²RWMC

Geological disposal of high level nuclear waste has been planned and developed in many countries worldwide. In Japan, it is to be vitrified and an overpack enclosing metallic containers that contain the vitrified waste is to be placed in a deep geological repository with the multibarrier system consisting of an engineered barrier and a natural barrier by geological formations. One of the possible buffer materials for the engineered barrier is bentonite, which should possess the property of long-term stability, although the functions required for it depend on the method of disposal of the waste. When used with cement materials as reinforcing agents, however, the functions required for the bentonite-based barrier material may deteriorate due to such phenomena as dissolution and change of properties by highly alkaline groundwater formed by reactions of the cement materials with groundwater. Since it takes hundreds of thousands of years for the radioactivity of high level nuclear waste to decrease to the natural background level, it is impossible to clarify the reaction mechanism of bentonite and highly alkaline groundwater in the laboratory for such a long time. An appropriate method to examine such a long-term system is natural analogue study which is an investigation of a natural system that has some similarities with a radioactive waste repository and its surrounding environment.

The Mangatarem district, in the Philippines, was chosen as a study area in this natural analogue study due to the following reasons:

?Ophiolite suite is widely distributed and may be utilized for elucidation of the reaction mechanism of basic rocks with groundwater. Ophiolite is layered rock consisting of several rocks such as peridotite, gabbro and basalt.

?There are natural bentonite ore deposits (Saile Mine) in the district, where observation of the deposit outcrop is possible.

?Evidence is found that there existed highly alkaline groundwater at Saile Mine in the past (Mn-staining), which enables us to examine the reaction of bentonite with such a highly alkaline groundwater.

?There are world-prominent eruption spots of highly alkaline groundwater in the district (Manleluag National Park).

?There are regions where bentonite is currently interacting with highly alkaline groundwater (Bigbiga).

Through the investigation of the Mangatarem district with the above mentioned features, we tried to elucidate the following two points: 1) the origin of the highly alkaline groundwater and 2) the long-term interaction of bentonite with highly alkaline groundwater

At present, we are mainly trying to elucidate the long-term interaction of bentonite with highly alkaline groundwater. Analyses were made for rock samples collected from trenches of the bentonite mine and an outcrop of the quarry in 2009 and 2010. The major element contents of these samples were determined by XRF, and the contents of rare earth elements and trace elements (mainly heavy metals) were measured by ICP-MS. The constituent minerals of the samples were identified by XRD. Analytical results reveal some differences between the trench and outcrop samples. Assuming that the source rock of bentonite and zeolite is common for the rock samples of the two sampling points, those differences are probably attributable to the difference in the reaction of the source rock with the highly alkaline groundwater that had come up along faults. The trench samples collected from deeper parts in the ground have been influenced by the highly alkaline groundwater more substantially than the outcrop samples.

Keywords: high level nuclear waste, natural analogue study, bentonite, highly alkaline groundwater, basic rocks, rare earth element

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SCG068-16

Room:104

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Study on investigation techniques of uplift rate using sediment of incised meander scars

Ken-ichi Yasue^{1*}, Shin-ichi Tanikawa¹, Atusi Ninomiya², Atsushi Tanase³

¹JAEA, ²SRED, ³CSC

We focused on the incised meander scars to be distributed along the river and carried out a study of the estimate technique of the uplift rate using the sediment on the scars. More than 800 incised meander scars in Japanese Islands were extracted by interpretation of 1:25000 topographical maps. The scars are distributed over various altitudes. As a case study, we studied about uplift rate using the incised meander scars in an area along Totsukawa River where typical scars were distributed over various altitudes. The sediment was got by machine digging with high preservation quality of the unconsolidated materials. Sedimentation age was estimated by volcanic ashes analysis. The age of the sediment on the incised meander scars of relative height approximately 90 m from the present riverbed is approximately 300-400 thousand years ago. From these results, given the dynamic equilibrium of the riverbed height, the uplift rate is estimated at a few ten centimeters for one thousand years. It is an assignment to increase case studies to show validity of the estimation technique of the uplift rate using the sediment on the scars. In addition, the comparison with the result of different techniques is an assignment.

Keywords: uplift, denudation, incised meander scars, detached meander core

SCG068-P01

Room:Convention Hall

Time:May 22 11:45-12:45

Evaluation of long time deformation around Horonobe area using modelling techniques

Masashi Nakatsukasa^{1*}, Yasuhiro Yamada¹

¹Kyoto University

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

SCG068-P02

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Time:May 22 11:45-12:45

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

Shiro Tanaka^{1*}, Kiichi Ueta¹, Toshinori Sasaki¹, Hisatoshi Ito¹, Takaomi Hamada¹, Takuma Hasegawa¹, Kenzo Kiho¹, Kimio Miyakawa¹, Kazuhiro Tsukuda¹, Junichi Goto², Kenji Karasaki³

¹CRIEPI, ²NUMO, ³LBNL

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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SCG068-P03

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Development of Hydrologic Characterization Technology of Fault Zones for Preliminary Investigations

Takaomi Hamada^{1*}, Hisatoshi Ito¹, Keiichi Ueta¹, Shiro Tanaka¹, Toshinori Sasaki¹, Takuma Hasegawa¹, Kenzo Kiho¹, Kimio Miyakawa¹, Kazuhiro Tsukuda¹, Junichi Goto², Tiemi Celia Onishi³, Kenzi Karasaki³

¹CRIEPI, ²NUMO, ³LBNL

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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SCG068-P04

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Applicability of the grounded source airborne electromagnetics to coastal areas

Kazuhiro Tsukuda^{1*}, Hisatoshi Ito¹, Kenzo Kiho¹, Hideshi Kaieda¹, Koichi Suzuki¹, Toru Mogi², Sabry Abd Allah², Akira Jomori³, Youichi Yuuki⁴

¹CRIEPI, ²Hokkaido Univ., ³NeoScience Co., ⁴Oyo Co.

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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SCG068-P05

Room:Convention Hall

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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