# Meso and microstructures of non-active crush zone in granite at the Monju site

*Koji Shimada[1], Shigeru Sueoka[1], Shuji Terusawa[1]

1. Japan Atomic Energy Agency

Examples of meso- and microstructures of non-active minor crush zones are useful for an activity evaluation of minor crush zones. Crush zones to be evaluate (active or non-active) during important building constructions are usually minor crush zones. Research on the deformation structures of such minor crush zones is rare. We show the example of meso- and microstructures from non-active minor crush zones in granite located near the prototype of fast breeder reactor Monju. The activity of the minor crush zone ceased at intrusion of basaltic dyke (ca. 19 Ma; Sueoka et al., submitted). A right-lateral slip (ca. 10 cm) along the principal slip zone is observed along one of the minor crush zones. Along the principal slip zone, dragged strain maker indicate mean shear strain of 1.6 within 9.3 mm thick zone assuming that the deformation was simple shear. These mesoscopic observations suggest that the deformation was ductile. A 1-cm-thick cataclasite zone mainly consists of quartz, plagioclase, K-feldspar and biotite. Clay minerals due to alteration of plagioclase are observed. Dynamic recrystallization of quartz is not observed. Most of the quartz and feldspar fragments are between 0.5 and 1 mm in size. Biotite in the zone is typically stretched and defining foliation of the cataclasite. The sigmoidal shape of the biotite indicates a right-lateral sense of shear for the foliated cataclasite. The coexistence of the intracrystalline plastic deformation of biotite and the crushing of other granular minerals in the foliated cataclasite indicates that the most recent slip is the semi-brittle flow. The deformation microstructure of biotite indicates that the deformation condition of the latest slip is high-temperature and the minor crush zone is non-active fault.

**References:** Sueoka et al., Fission-track dating of faulting events accommodating plastic deformation of biotites. JGR-SE submitted.

Keywords: crush zone, Monju, granite

 

# Installation of observation device for soil loss in a decontaminated forest

*Takayoshi Watanabe[1], Yasuo Ishii[1], Tadafumi Niizato[1], Yoshito Sasaki[1], Katsuaki Mitachi[1]

1. Japan Atomic Energy Agency

We installed an observation device for soil loss in a decontaminated forest of Fukushima Prefecture. 4,491 g of soil were gathered in the device. There is a correlation between volume of soil loss and rainfall.

Keywords: accident at the Fukushima Daiichi Nuclear Power Station, forest decontamiantion

 

# Fracture visualization by resin injection and rock texture observation

*Ai Hamada[1], Kimio Miyakawa[1]

1. Central Research Institute of Electric Power Industry

Fractures developing in the rock can play as a main path for nuclide released from the deep geological repository. Fracture width is one of the important parameters for evaluating transport properties in the rock, therefore its measurement method of visualized fractures injected by fluorescence-doped resin has been developed at Grimsel test site in Switzerland. Fracture visualization technique by using resin injection has been advanced for applying to the domestic crystalline rock sites. In this study, we observed thin sections using a drill core sample which was drilled at −300m stage in the Mizunami Underground Research Laboratory of Japan Atomic Energy Agency (JAEA) after injecting yellow-colored epoxy resin into the fracture in a laboratory. The thin sections were made across the resin-filled fracture with some filling minerals. As a result, under a polarizing microscope, the width of the resin filled fracture is around 0.17mm on average, and the small scale of calcite (around 0.05mm) and the smaller scale of calcite (around 0.005mm) are recognized. In the former type, opaque minerals and fragmented plagioclase also are seen together. On the other hand, the latter type has no other minerals in calcite and it is relatively observed at uppermost part of the fracture surface. Furthermore, we measured the widths of the fractures injected by blue colored resin pressed under 15-17MPa before making thin sections and it was around 0.006mm on average. Blue resin filled fractures are seen along grain boundary of minerals or in cracks inside quartz. In future works, we will make thin sections of core samples −500m stage and apply the same methods of resin injection. This study is commissioned by the Agency for Natural Resources and Energy in the Ministry of Economy, Trade and Industry. Resin injection tests were conducted as a part of a collaborative research with JAEA.

Keywords: geological repository, resin injection, fracture visualization, crystalline rocks, Toki granite, Mizunami URL

 

# The backfilling test in the groundwater recovery experiment (1)Observation of saturation and swelling process

*Kentaro Takayasu[1], Ryuji Takeuchi[1], Hironori Onoe[1]

1. Japan Atomic Energy Agency

The Groundwater REcovery Experiment in Tunnel (GREET) is conducted by making the Closure Test Drift (CTD) recovered with water at the depth of 500m. Backfilling test is conducted as a part of GREET to acquire physical property change of the backfill material.
Bentonite mixture was constructed into two pits excavated 1m in depth on the floor of the CTD. Hydraulic pressure, soil pressure and moisture content were measured to grasp the groundwater saturation process and the swelling process of backfill material.
The moisture content in the pits got almost fully saturated till one month after. During water filling event, both hydraulic pressure and soil pressure reached 3.1 MPa at maximum. The swelling pressure of the backfill was calculated as 0.03-0.09 MPa.
Observation inside the pit will be continued, and characteristics of backfill material will be investigated again. Changes of hydraulic pressure and soil pressure will be simulated and the construction method will be validated.

Keywords: Groundwater recovery experiment in tunnel, Backfilling test, Backfill material, Bentonite

 

# Geochemical analysis of groundwater chemistry after the drift closure in granite

*Kazuki Hayashida[1], Toshihiro Kato[1], Mitsuru Kubota[1], Teruki Iwatsuki[1]

1. Japan Atomic Energy Agency

This study aims to understand the hydrogeochemical condition and dominant process after the drift closure. To this aim the drift closure experiment was conducted in the granitic rock of 500 m below ground level of Mizunami Underground Research Laboratory. The groundwater chemistry such as major chemical component, pH and redox condition has been monitored in closed drift for 1 year.
Dominant processes on chemical evolution of isolated groundwater in the closed drift were identified as follows; continuous replacement by surround rock water, microbial reduction, water –mineral interactions with evaporite, shotcrete and granite.

Keywords: groundwater chemistry, granite

 

# Geochemical Modeling of long-term evolution for granitic groundwater

*Hiroaki Murakami[1], Takahiro Watanabe[1], Teruki Iwatsuki[1]

1. Japan Atomic Energy Agency

To understand long-term geochemical stability at deep underground condition in Toki granitic area, we consider about water-rock interaction by thermodynamics calculation using typical granitic minerals, such as anorthite, calcite, quartz, albite and K-feldspar. pH ranges were estimated by the PHREEQC program using measured values for residence time of groundwater and mineral composition in the Toki area. This study indicates that pH values of the granitic-groundwater would be alkaline (ca. 8-10) when the meteoric water is the main source in the area.
Acknowledgement: This study was carried out under a contract with METI as part of its R&D supporting program for developing geological disposal technology.

Keywords: granite, groundwater, geochemical modeling

 

# Estimation of geological strain rates in the Japanese Islands

*Tsuyoshi Watanabe[1], Koichi Asamori[1]

1. Tono Geoscience Center, Japan Atomic Energy Agency

For the deep geological disposal of high-level radioactive waste, it is important to assess the long-term stability of the geological environment around a repository for time frames greater than 100,000 years. Under the current framework, empirical laws, which indicate uniform modes and rates of crustal movements of the Japanese Islands, have been determined from previous research on the crustal deformation in the latter half of the Quaternary period (Kasahara and Sugimura, 1978; Matsuda, 1988). Applying the empirical laws to estimate the condition of future geological environments, extrapolation of well known crustal velocities has been done as one approach for making long-term predictions. However, strain rates estimated from geodetic data are about one order of magnitude larger than those estimated from geological data (Ikeda, 1996; Sagiya, 2004; Shen-Tu et al, 1995). Accordingly, it is necessary to consider spatiotemporal variation of crustal deformation in order to estimate future geological environments with higher reliability. Therefore, we have endeavored to establish a method to estimate long-term crustal movements by considering deformation patterns from past to present based on geological data and by conducting numerical simulations introducing the heterogeneous viscoelastic structure of the crust and mantle derived from geophysical observations.
To this end, we estimated the geological strain rate of the Japanese Islands using inland active fault data. Applying the dislocation theory of Okada (1985), we calculated crustal velocities accompanied with fault slips on 443 active inland faults in an elastic half space, based on the fault parameters such as average slip rate for 1,000 years, fault strike, dip, rake, length, and fault location. This calculation illustrates the geological velocities of crustal deformation when earthquakes occur on active inland faults. Next, we calculated geological strain rates from the crustal velocities. In this study, the average strain rate at any specific grid point is determined by assuming that the crustal deformation progresses with a uniform strain rate within a certain radius around the grid point (Shen et al., 1996).
From the calculations, horizontal crustal velocities of less than 4 mm/yr and vertical velocities varying between -1 mm/yr to 3 mm/yr were determined. For the vertical deformation, we determined uplift of ~0.3 mm/yr across the entire Japanese Islands, and subsidence of ~1 mm/yr along the Niigata Kobe Tectonic Zone and on the Pacific side of the Tokai district. Subsidence of up to 5 mm/yr on the Pacific side of Northeast Japan has been shown from the results of GPS observations and leveling (Murakami and Ozawa, 2004). The deformation pattern indicated from geodetic data seems to be the reverse of the pattern determined from geological data. A feature of the estimated strain rate field is that the Japanese islands are characterized by crustal shortening in the direction of oceanic plate subduction. We found that crustal shortening of the Ou Backbone Range is in the E-W direction, in the Niigata Kobe Tectonic Zone it is in the NW-SW direction. Crustal shortening and extension which reflects the right-lateral strike slip of the faults along the Median Tectonic Line and extension of the Kyushu district in the N-S direction were found. These results are generally consistent with those in geodetic observations (e.g., Sagiya et al., 2000). In future, we plan to compare the strain rate derived from GNSS data and to develop a method to estimate long-term crustal movement.

This study was carried out under contract with the Agency of Natural Resources and Energy (ANRE), part of the Ministry of Economy, Trade and Industry (METI) of Japan as part of its R&D program supporting development of technology for geological disposal of high-level radioactive waste. We used the active fault database of the National Institute of Advanced Industrial Science and Technology for the analysis.

 

Keywords: active fault, geological strain rate, dislocation

 