309-18 Poster Zappone, Alba

DEFORMATION AND SEISMIC PROPERTIES DURING MELT EMPLACEMENT: AN EXPERIMENTAL STUDY

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Keywords: Dyke emplacement; Experimental deformation; Seismic properties; melting

Partial melt generated in the asthenosphere should cross the entire lithosphere to reach the surface. This melt is often channeled in narrow zones, in which the transport is facilitated by the peculiar stress geometry. Such zones often correspond to high strain zones. It is common to observe in the exposed lower crustal or upper mantle some mafic dyke swarms associated with high strain zones. In order to better understand the mechanisms of magma transport in the lithosphere we have conducted an experimental work focused on determination of melt concentration and strain distributions around basalt dykes in a San Carlos olivine matrix, by using the high-pressure, high-temperature Paterson apparatus at MIT. Undrained triaxial compression experiments have been conducted after hot-pressing San Carlos olivine with 10% MORB, fully encapsulated by nickel shells. Creep and constant displacement rate experiments were performed at 1473 K and confining pressure of 300MPa, at constant stresses (80-160MPa) and constant strain rates ranging from 3x10-4 to 5x10-5s-1. Microstructural observation and chemical analyses of the melt distribution showed an increase of MORB matrix from ca.10% in proximity of the dyke (1-2mm) to ca.4-5% at 3-4mm away. Since only geophysical investigation (mainly seismic waves) can directly access the upper mantle, we conducted also a petrophysical investigations on the same material at the same temperature-pressure conditions, using the internally-heated Paterson gas apparatus at ETH especially designed for the measurements of physical properties of rocks at hydrostatic pressures. Vp were measured during heating and cooling of cold pressed synthetic aggregate of both San Carlos olivine and MORB and on a layered sample olivine-MORB-olivine. A significant decrease of both velocity and of the amplitude of the seismic signal were observed during experiments involving MORB at temperatures above 1273 K. After removal of the sample jacket, it was observed that melt from the MORB layer had migrated into the olivine matrix, suggesting a brittle intrusive mechanism such as hydrofracturing, acting even in hydrostatic stress conditions.

309-19 Poster Aizawa, Yasutaka

PERMEABILITY STRUCTURE OF THE CENOZOIC FORMATIONS IN NIIGATA PREFECTURE AND ITS IMPLICATION FOR UNDERGROUND CO2 DISPOSAL

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Keywords: CO2; permeability; porosity; basin; Niigata

As you know, Carbon dioxide is one of the greenhouse effect gases. To restrain from increasing CO2, we propose CO2 sequestration. There are several methods; one of them is reserving in underground. As for the disposal volumes of CO2, we select aquifers which cap rocks lies on. Aquifer means that it has large pores between grains which are composed of strata. In Japan, this project has started since 2000 and about ten thousands tons of CO2 have being put into the aquifer of 1100 meters below the ground by TEIKOKU OIL COMPANY.But now the behaviors of fluid (CO2 with water) in underground haven't been known much. Also, the influence and safety on Geosphere haven't been clear.It is essential to analyze quantitatively hydraulic constants with permeability and porosity in deep underground. Especially, for estimating the permeability in the basin, it needs to consider the effects of consolidation with dynamics and time dependency. And Japan lies on the mobile belt, so that the effects of faults and clacks and so on must be considered.And then we select the central western part of Niigata Prefecture, Japan on Cenozoic. This place is a part of oil and natural gas fields, and many folds what is called active underground exists here and there. Because they have been investigated fully, there are data of the boring cores and the geophysical logging. We think this area is best.At first, the geological time dependency by using continuous sediments could be examined, so that we measured the hydraulic constants (the permeability and the porosity etc) in a laboratory, and then estimated the best aquifers. According to these data, we consider reserving CO2 in the underground.

309-20 Poster Mizoguchi, Kazuo

FRICTION AND MICROSTRUCTURE OF NOJIMA FAULT GOUGE AT SEISMIC SLIP RATES

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Keywords: fault gouge; Nojima fault; friction; microstructure; earthquake

Since earthquakes were thought to be caused by frictional slip along faults, many friction tests on rocks have been done. However most of them were low slip rates or small displacements tests. When earthquakes occur, faults move at about 1m/s and relative displacements reach to a few meters. We can know nucleation process or initial phase of earthquakes by the previous studies, but can not know acceleration process or co-seismic phase of earthquakes. Thus we have been trying to do high-velocity friction tests on rocks using rotary-shear testing machine. The fault gouge used in the experiments is blue gray gouge derived from granodiorite collected at a surface outcrop of the Nojima fault. The fault was located at the northwest margin of the Awaji Island (southwest Japan) and activated at 1995 Kobe earthquake. A series of experiments were performed at a constant normal stresses of 0.3 to 2.1 MPa and a constant equivalent slip rates of 1.03 m/s (1200rpm), with different displacements of 0 to 60 m under room temperature, unconfined and dry conditions. The representative mechanical behavior of a simulated fault is as follows. At the initiation of a run, friction coefficient rapidly increased to about [0.8 to 1.0] and then gradually decreased. The friction coefficient finally attained to nearly constant [0.2 to 0.6]. The steady state fiction level was strongly dependent on normal stress and the value at the maximum stress 2.1 MPa was lower than 0.25. This suggests that frictional strength of a fault might become lower at deeper depth. We observed thin sections of experimental specimens stopped at various displacements to investigate the relationship between mechanical behaviors and microstructures. Grain size reduction by comminution occurs along the rotational side just after the beginning of the experiments, and then a deformation zone [DZ] formed along the rotational side. The boundary between the DZ and non-DZ could be obviously recognized. The DZ became wider and a strong preferred orientation formed along a Y shear plane in the DZ with increased displacement. The above microstructures were observed at the friction weakening stage. At the steady state friction, a wavy boundary between the DZ and non-DZ, folding and fluttering structures in the DZ, were observed. The structures at the steady state friction have not reported in other experimental studies of fault gouge and might be textural characteristics of seismic fault motions.

309-21 Poster Noda, Hiroyuki

VARIETY OF PERMEABILITY STRUCTURE OF FAULT ZONES AND ITS EFFECT ON PORE PRESSURE AND TEMPERATURE RISE DUE TO FRICTIONAL HEATING DURING FAULT DISPLACEMENT

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Keywords: fluid flow; earthquake; permeability; friction; thermal pressurization

Sibson [1973] explained the scarcity of pseutotachylyte by the interaction of frictional heat and fluid flow. During an earthquake, excess pore pressure generated by frictional heating may cause reduction in frictional strength and heat genaration rate with presence of water. This process is called thermal pressurization. Hydraulic parameters of the fault core are important in this process because low permeable faults are able to keep the high pressure fluid within the deformation zone. As permeability varies by orders depending on lithology and effective pressure, it is important to measure hydraulic properties of each fault. In this work, hydraulic parameters of several active faults in Japan (the Hanaore fault in central Japan, the Nojjima fault in Awaji island, the Iida-Matsukawa fault in Nagano prefecture, and the Neodani fault in SouthWest Japan) are measured and the effect of thermal pressurization was estimated for each fault based on mathematical model by Lachenbruch [1980].We picked up natural fault gouge samples from outcrops, and measured hydraulic parameters using pore pressure oscillation method and constant flow method with nitragen gas as pore fluid. The experiments were performed with the high pressure deformation and fluid flow gas apparatus at Kyoto university. Permeability of fault gouge ranges very widely from around 10^-19[m^2] for the Nojima fault to more than 10^-15[m^2] for the Iida-Matsukawa fault at effective pressure of 80MPa. This difference affects stress reduction cueve and temperature rise during displacement of faults. Dc, weakening distance of a fault, ranges from tens of centimeters for impermeable faults and several meters for permeable faults, depending on depth, relative velocity, and width of deformation zone. Temperature rise at the center of deformation zone ranges from less than 100[K] for impermeable faults up to around 600[K] for permeable faults at 5km depth and 3m displacement. For impermeable cace, pore pressure rise distributed only within 10cm from the center of deformation zone. This result implies the importance of study on permeability structure of individual fault zones.

309-22 Poster Egydio-Silva, Marcos

ANISOTROPY OF MAGNETIC SUSCEPTIBILITY APPLIED TO TECTONIC ANALYSIS IN GRANULITES OF THE RIBEIRA FOLD BELT (SE BRAZIL)

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Keywords: SUSCEPTIBILITY MAGNETIC; ANISOTROPY; GRANULITE; FOLD BELT; TECTONIC ANALYSIS

Kinematic analysis has become a standard approach in tectonic analysis. Criteria for recognizing displacement direction and sense have been determined, and the importance of mapping foliation and stretching lineation is widely recognized. These linear and planar structures are the most basic and fundamental observation needed to determine the displacement direction in orogenic areas. Consequently, the absence of a macroscopically visible planar and/or linear structure impedes any kinematic analysis. Lineations may be particularly difficult to determine in high-grade metamorphic terrains, as in granulite facies rocks. To overcome this problem, we have applied the Anisotropy of Magnetic Susceptibility (AMS) technique, as a tool to indirectly measure mineral preferred orientation fabrics, in a suite of granulite facies rocks in Ribeira belt, southeast Brazil.The Ribeira belt is characterized by an inflection of the structural trend from = NS within the northern domain, to = ENE in the southern domain. This change in structural trend is associated to a transition from thrusting dominated deformation in the northern domain to wrench-faulting dominated transpression in the southern and central domains.The AMS measurements were performed on 664 samples from 72 sites. The mean magnetic susceptibility is 7.535 x 10-3 SI. The degree of anisotropy varies from 1.32 up to 4.312, with an average value of 1.516. The shape parameter T is generally positive meaning that an oblate ellipsoid shape is dominant in the area.Measured magnetic lineation and foliation are correlated with the modification of the deformation pattern along the Ribeira belt. In the northern domain the magnetic foliation trends NNE and dips gently Estward; it bears a =E-W magnetic lineation suggesting a thrust tectonic regime. In the southern domain the magnetic lineation is parallel to the trend of the deeply dipping magnetic foliation, as expected in a transcurrent tectonic regime.

309-23 Poster Spacek, Petr

DEFORMATION AND SEISMIC PROPERTIES OF CRUSTAL ROCKS

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Keywords: deformation; seismic properties; crustal rocks; ultrasonic method; averaging method

Are we able to measure the strain of the crustal rocks by means of seismic methods? What part of lithospheric anisotropy can be related to crustal deformation? Laboratory analysis can give us some answers.In order to investigate the elastic properties of various crustal rocks which are due to deformation-induced lattice re-orientations and to distinguish these features from crack-related properties we use the following two methods:-ultrasonic pulse-transmission method based on P-wave velocity/amplitude (Vp / Ap) measurements in 132 independent directions on spherical rock samples at pressures up to 400 MPa;-averaging method which uses the elastic parameters of constituent mineral phases, their volume fractions and lattice orientation distribution.A/ Effect of (micro)cracksWith the use of ultrasonic method we investigate the directional dependence of P-wave velocity and attenuation on (micro)crack distribution. Multiple measurements are carried out at several

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