Oral | Symbol S (Solid Earth Sciences) | S-CG Complex & General

[S-CG65_2AM2]Stress and Crustal Dynamics

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Fri. May 2, 2014 11:00 AM - 11:30 AM 423 (4F)

Deformation and stress fields and their temporal changes are keys to understanding the Earth's crustal dynamics. Methods for estimating crustral stress state have been developed in each discipline such as seismology, structural geology and geotechnology. For example, the following methods are widely employed; stress tensor inversion techniques to analyze focal mechanisms of earthquakes, orientations of faults, dikes, veins and microcracks gathered from outcrops and hand specimens, in situ stress measurements in boreholes and paleopiezometers such as calcite twins and micro boudinages. For the purpose of discussing crustal dynamics, this session aims at sharing achievements and unsolved problems in studies of crustal stress and deformation interdisciplinarily. We welcome presentations of methodology, application, rock experiments, and numerical simulations.

11:15 AM - 11:30 AM

[SCG65-P03_PG]Permeable fractures detected by geophysical loggings and their relation to in-situ stress

3-min talk in an oral session

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Keywords:permeable fracture, geophysical logging, in-situ state of stress, tensile fracture, shear fracture

We examine a relation between the orientation of permeable fractures and the state of in-situ stress by using several logging data measured in 16 boreholes at hard rock sites. Geological Survey of Japan, AIST has constructed 16 integrated borehole observation stations in and around the Kii Peninsula and the Shikoku Island since 2006. Three boreholes with different depths of about 600, 200, 30 m were drilled at each site and various kinds of geophysical loggings were conducted. We obtained the values of strike and dip angle of all fractures including the permeable ones from the borehole wall images of borehole televiewer/camera. Permeable fractures intersecting the borehole were detected by analyzing the logging data of fluid electric conductivity, sonic and temperature. The magnitude and orientation of horizontal principal stress were estimated from hydraulic fracturing stress measurements at 6 sites and the orientation of maximum horizontal stress (SHmax) were evaluated at 11 sites from the images of borehole breakout and/or induced tensile fracture. The preliminary results from the 6 hydraulic fracturing sites are as follows: The total numbers of all fractures and the permeable ones at each site are in ranges from about 2,000 to 5,000 and from about 20 to 30, respectively. The distribution of the orientation of all fractures at each site shows various values of strike and dip angle. We classify the fractures in three types: tensile fracture (Mode I fracture), shear one and others among the distribution by considering the in-situ state of stress at each site. The tensile type has orientations parallel to SHmax and relatively high dip angles. The shear fracture is optimally oriented for shear failure in the current stress field. It is difficult at any sites to say that characteristics of the distribution of the

orientation of all fractures are described only with tensile or shear failure types. Next, an examination of the permeable fracture orientation shows that large number of the permeable ones at the Niihama site have strike orientations almost parallel to SHmax and high dip angles. This feature is different from that for all types of fractures at this site. This suggests that the current stress field controls the existence of the permeable fractures at Niihama site. On the other hand, the distributions of the orientations of permeable fractures at other 5 sites have different characters from the Niihama case: The orientations of permeable fractures have the same tendency with all fractures including non-permeable fractures.