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Strain analysis in Rock samples using Neutron diffraction at J-PARC/BL19 ”TAKUMI”

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A high-intensity proton accelerator facility named J-PARC (Japan Proton Accelerator Research Complex) has been constructed at Tokai in JAPAN. Various neutron experiments using high intensity pulsed neutron beam are being performed at J-PARC. The Engineering Materials Diffractometer ”TAKUMI” was constructed at BL19 in J-PARC, which is dedicated to investigate the stress-strain state using neutron diffraction technique. In order to develop neutron diffraction technique applicable to rock samples, strain measurements in rock sample have been performed at TAKUMI. As results, in spite of the long neutron path length (ca. 40 mm) and small sample gauge volume (2 x 2 x 2 mm), sufficient neutron diffraction patterns could be obtained. In addition, as results of in situ strain measurements under uniaxial compression loading, discrepancy was found in strain values obtained by strain gauge and neutron diffraction. It was suggested that macroscopic strain value of rock sample included intragranular strain and intergranular slip.

In order to utilize underground environment, e.g. CCS, accurate estimate of crustal stress is indispensable. Borehole core sample might have residual strain corresponding to crustal stress the core sample was taken. Neutron diffraction measurements of borehole core sample have been performed, and we have attempted to analyze residual strain in borehole core sample.

A borehole core sample is a tuff, which was taken by drilling in underground rock mass (depth: 589m) at Mie in 2009. Variations of the P-wave velocity exhibited orthotropic anisotropy. Lattice plane spacing of quartz grain and that of feldspar grain varied with measurement position. It was speculated that quartz grains contain tensile strain, on the other; feldspar grain contains compression strain. Residual strain in borehole core might become helpful to estimate states of the crustal stress where the core was taken. Therefore, it is expected that strain measurements using neutron diffraction serve to understanding of stress state in underground environment.

Keywords: Neutron diffraction, strain measurement