MLF Experimental Report	提出日 Date of Report 29, August, 2017
課題番号 Project No. 2017A0031 実験課題名 Title of experiment Strain analysis in rock materials using Neutron diffraction and AE signal measurement 実験責任者名 Name of principal investigator Jun ABE 所属 Affiliation Comprehensive Research Organization for Science and Society	装置責任者 Name of responsible person Kazuya AIZAWA 装置名 Name of Instrument/(BL No.) Engineering Materials Diffractometer "TAKUMI" (BL-19) 実施日 Date of Experiment 13, May, 2017 – 16, May, 2017

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。（適宜、図表添付のこと）
Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.

-Sandstone, SiO2, phi 25 x L 50 mm

2. 実験方法及び結果 （実験がうまくいかなかった場合、その理由を記述してください。）
Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

To investigate the mechanical behavior of rocks, the strain measurements in rock specimens under uniaxial compression have been performed. Simultaneously, AE signals have also been measured. The experimental setup is shown in Figure1. The resolution ($\Delta d/d$) and the d-value range for neutron diffraction experiments were 0.3 % (medium-resolution mode of TAKUMI) and 1.4-4.2 Å (frame shift mode), respectively. In parallel with lattice strain measurements using neutron diffraction technique, macroscopic strain values were recorded using a strain gauge attached to the surface of a rock specimen. The AE signals were measured using PCI-2 (PHYSICAL ACOUSTICS CORP.). AE waves were detected using AE sensors (Micro 30 or Pico) attached to the compression jigs. The threshold was 40 dB was applied; this threshold level was 2-3 dB higher than noise level. The sampling rate was 10 MHz and the sampling time was 1 msec. Uniaxial compression loading was performed in a step-loaded manner, with a holding time of more than 600 sec. during which neutron diffraction patterns were obtained. The loading rate was 2.4 MPa/min with compression being applied until the rock specimen fractured.

2. 実験方法及び結果（つづき） Experimental method and results (continued)

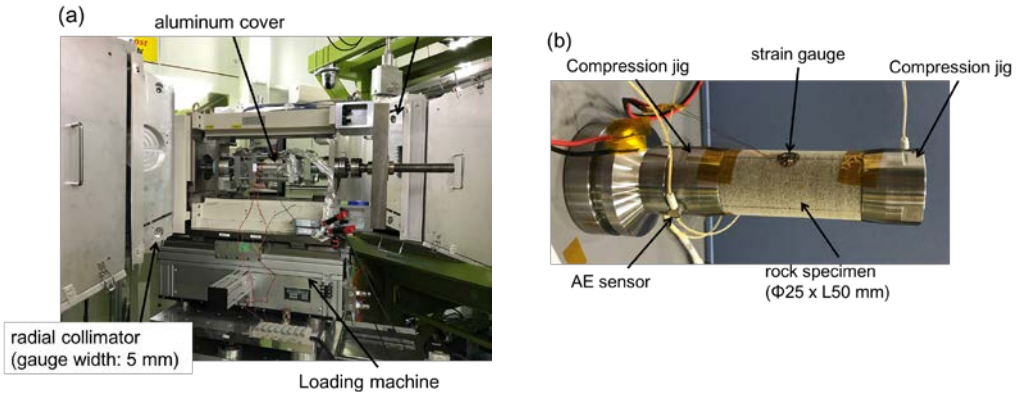

Figure 1. (a) Photograph of the experimental setup for in uniaxial compression. To avoid scattering of sample fragments when a rock sample was broken, aluminum cover was equipped. Cylindrical rock specimen was set in this aluminum cover. (b) Photograph of a rock specimen set inside the aluminum cover. Sensors for AE signal measurement were attached to the compression jig.

Figure 2 shows a stress–strain curve. A discrepancy is found between macro strain and lattice strain; macro strain is larger than lattice strain. And macro strain exhibits a curve indicating plastic deformation behavior whereas lattice strain exhibits elastic behavior.

Figure 3 shows the result of AE signal measurement together with the loading program (black solid line, right-handed axes). The number of AE events per 10 sec. is indicated as a red bar chart (Figure 3(a)), and the amplitudes of each AE events are indicated as blue circles (Figure 3(b)). AE signals tended to be detected during the experiments when the applied load was increased. However, at higher loading condition, AE signals were detected when the applied load was kept. The amplitudes of AE signals were almost constant under loading condition. Many high-amplitude AE events were generated at the time of fracture occurrence. The AE events might be correlated to internal structure change of rock sample, such as grain slip and/or micro crack initiation.

The data analysis is under way.

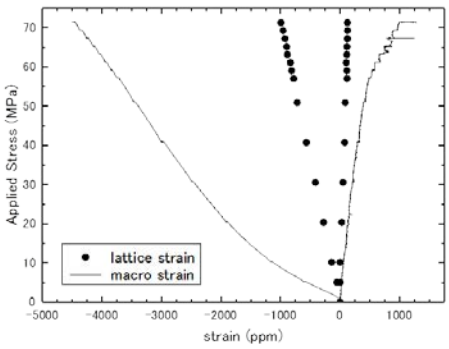

Figure 2. Stress-strain curve. Macroscopic strain measured by a strain gauge is denoted by solid lines, and lattice strain evaluated from the change in lattice parameter value is plotted as circles.

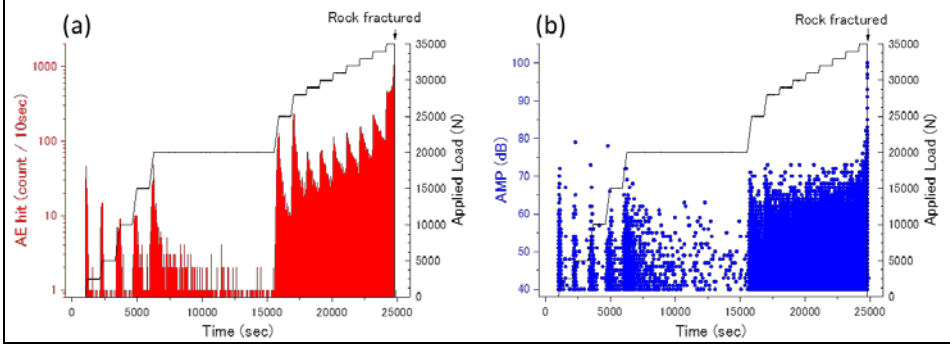

Figure 3. Results of AE signal measurements together with the loading program. (a) The number of AE events per 10 seconds, and (b) the amplitudes of each AE signals are indicated.