THE GEODYNAMICS SEMINAR №602

Acoustic emission monitoring at high pressures using small sensors optimized for D-DIA apparatuses

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2023.11.17(Fri.) 16:30 ~

Venue: Meeting Room #486
Science Research Bldg. 1, 4th floor.
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Keywords: 1. Intraslab earthquakes
2. Acoustic emission
3. In situ experiments

To understand the process triggering intraslab earthquakes occurring at depths greater than ~40 km, some recent experimental studies on faulting of rocks have been conducted using a D-DIA apparatus combined with an acoustic emission (AE) monitoring system (e.g., Schubnel et al., 2013). As supported by scaling laws, AE, which is an acoustic wave radiated from a propagating microcrack, is equivalent to a natural earthquake due to an unstable slip of a natural fault. The sample size is typically less than 3mm in diameter in high-pressure and high-temperature experiments using a multi-anvil apparatus, while the uncertainty in AE hypocenter location is limited to ±1mm (e.g., Ohuchi et al., 2017).

In this study, we examined two methods to improve the accuracy in AE hypocenter location determined in high-pressure and high-temperature experiments: i) to minimize the size of AE sensor (down to 2mm in diameter) which is inevitably correlated to the location uncertainty; and ii) application of waveform CC combined with a source relocation algorithm (based on Template-Matching method: Lei et al., 2022).

We conducted in situ deformation experiments on olivine aggregates using a D-DIA apparatus "SPEED-Mk.II" combined with an AE monitoring system at the BL04B1 beamline of SPring-8. The experimental conditions correspond to those of the interior of subducting slabs (500-700℃, ~3 GPa). Throughout the deformation runs, semi-brittle flow associating AE radiation dominated the sample shortening was observed with increasing AE frequency. In near future, we will compare AE hypocenter locations with spatial distribution of faults in the recovered samples using X-ray microtomography.

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