THE GEODYNAMICS SEMINAR

No 659



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Geodynamics Research Center

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Venue: Meeting Room #486

Science Research Bldg. 1, 4th floor.

Ehime Univ.



In situ observation of faulting in olivine at high pressures and high temperatures using high-flux synchrotron X-rays

The mechanisms of intraslab earthquakes at depths of > 40 km are fundamentally different from those of shallow earthquakes because the frictional strength of silicate rocks is proportional to the confining pressure. To understand the process triggering intraslab earthquakes, many experimental studies on faulting of slab-forming rocks have been conducted at upper mantle pressures. Previous studies have revealed that shear localization induced by dehydration of hydrous minerals (e.g., Okazaki & Hirth, 2016) or adiabatic shear heating (e.g., Kelemen & Hirth, 2007) is essential for the occurrence of faulting at high pressures. We conducted in situ triaxial deformation experiments on olivine aggregates at pressures of 1-3 GPa and temperatures of 700-1250 K under nominally dry conditions using a D-DIA apparatus, installed at BL15XU, SPring-8. At strains higher than 0.1 (i.e., beyond the yielding point), both softening (i.e., decrease in stress and/or increase in strain rate) and a decrease in acoustic emission (AE) rate were observed prior to the occurrence of faulting. Faulting was observed at 880-1150 K. Most of unstable slips proceeded within 1 s and associated a sudden stress drop (~0.5 GPa) and temporal radiation of large AEs. In contrast, neither stress drops nor AEs were associated with a few "aseismic" unstable slips. Differential stress continuously increased when stable slip proceeded and the stable slip was terminated by the occurrence of another unstable slip. Our observations suggest that unstable slips can be divided into two types (i.e., seismic and aseismic ones) under the P-T conditions of shallow subducting slabs.

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