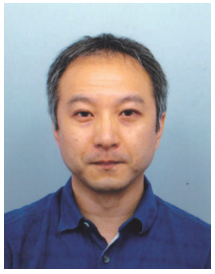
【Grant-in-Aid for Scientific Research (S)】

Broad Section B



# Title of Project : Experimental study on syn-deformational reaction processes at high pressures: Implications for slab weakening and deep earthquakes

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Research Project Number : 18H05232 Researcher Number : 40312540
Keyword : Earth's deep material, transformation, deformation, high pressure, synchrotron radiation

## 【Purpose and Background of the Research】

Large deformation of subducting slabs and deep earthquakes in the mantle transition zone (Fig. 1) are still unresolved issues in mantle dynamics. Previous studies have suggested that the grain-size reduction due to non-equilibrium transformations leads to weakening and/or shear instability, which may be responsible for the slab stagnation and deep earthquakes. However, there have been few direct experimental evidences on the coupling process. We conduct synchrotron radiation and FIB-TEM studies combined with seismological investigation to constrain the role of the olivine transformations on the slab weakening and deep earthquakes.

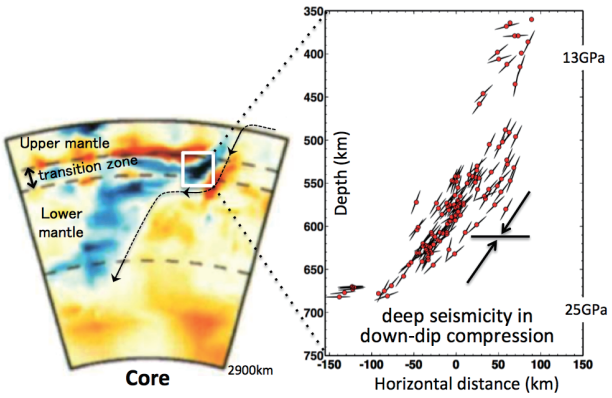


Fig. 1 Large deformation of subducting slab and distributions of deep earthquakes in mantle transition zone.

## 【Research Methods】

We conduct high-pressure deformation experiment at mantle transition zone conditions by using D-DIA and D-111 type apparatus. We focus on the interaction between deformation and the olivine-spinel and the post-spinel transformations. Simultaneous in-situ observations of reaction kinetics, creep behaviors, and acoustic emission (AE) activities are possible with the use of synchrotron X-ray and AE measurement system (Fig. 2). Reaction and deformation microstructures in recovered samples are examined by FIB-TEM analysis. The result is compared with that observed in shocked meteorites. We also conduct seismological studies on the field of metastable olivine, topography of the 660 km discontinuity, multiple discontinuities, and their relationships with distributions of deep earthquakes.

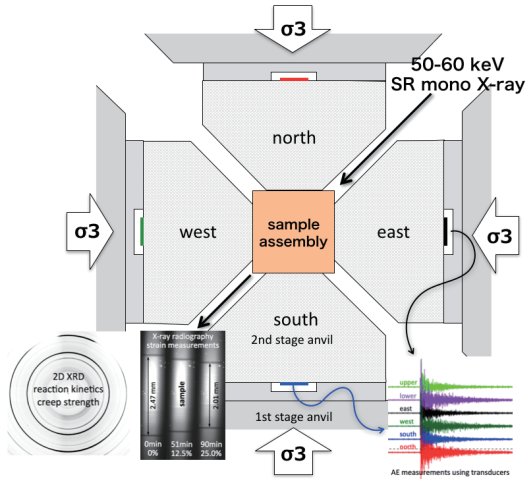


Fig. 2 D-DIA type high-pressure deformation apparatus and in-situ observations of transformation kinetics, creep behaviors, and AE activities

## 【Expected Research Achievements and Scientific Significance】

By using these techniques, we investigate the details of reaction-induced weakening, shear localization, and shear instability under mantle transition zone conditions. Interdisciplinary research combining high-pressure mineral physics with meteoritics and seismology is crucial to understand the slab behaviors in mantle transition zone.

## 【Publications Relevant to the Project】

Doi N., Kato T., Kubo T., Noda M., Shiraishi R., Suzuki A., Ohtani E., Kikegawa T., Creep behavior during the eutectoid transformation of albite: Implications for the slab deformation in the lower mantle. Earth Planet. Sci. Lett., 388, 92-97, 2014

## 【Term of Project】 FY2018-2022

## 【Budget Allocation】 108,400 Thousand Yen

## 【Homepage Address and Other Contact Information】

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