



Grain boundary sliding as the major flow mechanism of Earth's mantle

A research group led by Tomohiro Ohuchi (assistant professor) and Tetsuo Irifune (professor) of the Geodynamics Research Center (GRC) of Ehime University and Yuji Higo (research scientist) of JASRI clarified that the flow of Earth's upper mantle is controlled by the grain boundary sliding of olivine.

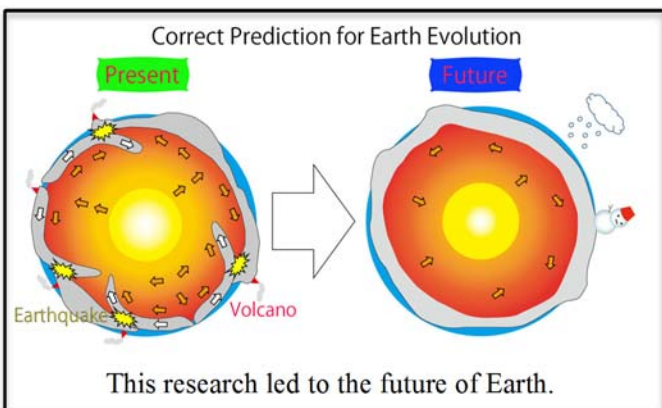
The Earth surface plates (thickness, ~60 km), on which we live, move or subduct along with the flow of the mantle because they float on the viscous mantle. Thus, natural phenomena, such as earthquakes and volcanic eruptions that may cause disasters, occur. Over 45 years since 1970, a generally accepted theoretical model has explained that the flow of the upper mantle is controlled by dislocation creep*1. According to this model, the mantle flow proceeds via the deformation of individual olivine grains. However, the model cannot explain the actual observation results.

The research group carried out experiments at SPring-8 to reexamine the mechanism behind the flow of the mantle. The group clarified that the flow of the upper mantle follows the theoretical model based

on grain boundary sliding*2 of olivine. With this model, the nearly constant viscosity in the upper mantle regardless of depth can also be explained, which means that this model is now the most appropriate model for the evaluation of the flow behavior of the upper mantle.

The flow law of grain boundary sliding obtained in this study should be used to reexamine our understanding on the dynamics of Earth's interior and the evolution of solid Earth.

Professor Irifune and his colleagues have revealed the Earth phenomena using SPring-8, and he was awarded the Shiju Hoshō (a medal of honor with purple ribbon) in 2015, which is one of Japan's most prestigious awards in the field of science, technology, sports and art. Since the establishment of SPring-8 in 1997, eight research studies performed with SPring-8 were awarded such honor.



In the ceremony at Ehime University (left, President Ohashi; right, Professor Irifune)

*1: most common theoretical model under high temperature

*2: recent theoretical model

Also see SPring-8's HP

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