ピナツボカンラン岩の微細組織観察：交代作用及び変形履歴の推定

Deformation and metasomatic histories of Pinatubo peridotite estimated from microstructural observation

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Deformation microstructures of olivine in naturally deformed peridotites are useful for examining the rheological properties and deformation history in the upper mantle. Particularly, slip system of deformed olivine is especially well known as an indicator for the deformation conditions, such as temperature, stress, pressure or water content. Here, we try to estimate the deformation history of deformed peridotite by means of the microstructural observation and slip system determination. Two types of amphibole-bearing harzburgite samples (namely P-3 and P-4) collected from Pinatubo volcano were analyzed using optical microscope, SEM, EBSD, TEM and STEM. Kawamoto et al. (2013) suggests that these peridotites were affected by the intense metasomatism. We report the relationship between the deformation history and metasomatic reaction.
Pinatubo peridotites are composed of relatively coarse olivine grains with several mm in size, and partly fine orthopyroxene and amphibole aggregate with tens to hundreds μm in size. The fine grained aggregate in P-4 is more than in P-3. The grain boundaries of the coarse grains exhibit irregular shapes. And these grains show the undulose extinction and well-developed subgrain boundaries. The coarse olivine grains contain a lot of fluid inclusions. Additionally, the fine olivine grains exist along the secondary inclusions within some coarse olivine grains.
The LPO patterns of the coarse olivine grains in the both samples imply the dominant activation of [100]{0kl} slip system, which is developed under high temperature, low pressure and dry deformation conditions. On the other hand, the dominant slip systems obtained from the direct characterization of dislocations by TEM are [100](001), [001](010) or [001](100), which activate under moderate to high water content condition. The discrepancy of the obtained slip systems is probably caused by the overprinting due to the changing of deformation conditions. Dislocation microstructures are more easily modified by later deformation events than LPOs.
We conclude from the characterization of microstructures in combined with the result of Kawamoto et al. (2013) that Pinatubo peridotite experienced deformation and metasomatic events in the following manner. Pinatubo peridotites have originally deformed under high temperature, low pressure and dry conditions in the back-arc region. Then, they have moved to the fore-arc region due to the corner flow, and have been affected by the fluid-related metasomatism. Finally, they have undergone the annealing process within the upwelling magma.
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