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Estimating composition of primitive magma by using opx, and temporal and spatial change of HMA magmatism in NE Shikoku

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In the subduction zone, oceanic plates start sinking into the mantle, and continental crusts are generated and eroded. So it is important for understanding the evolution of plate-tectonics. As for the subduction initiation, temporal change of thermal structure and water content of the mantle wedge is mainly estimated by numerical simulations (Iwamori, 2000 *etc*.), but there are few constraints from material informations. Using magma information is a possible method to estimate thermal structure of the Earth (Green, 1981). Although it is necessary to estimate chemical composition of the primitive magma, the effects of crystal differentiation and, especially in subduction zone, crustal process (magma mixing, crustal assimilation, and degassing) should be evaluated. Moreover, the magmatism in subduction zone is assumed to be affected by mantle flow in mantle wedge (Tatsumi *et al*., 1983; Tamura, 2003). To estimate such upwelling, Sakuyama *et al*. (2009) investigated temporal and spatial change of the magma generation field.

SW Japan is an example of juvenile subduction zone. Shikoku basin initiated to sink 17 Ma ago, and magamatisms migrated from forearc to reararc (Kimura *et al*., 2005). In the Setouchi volcanic zone, the generation of high-Mg andesite (HMA) has been discussed from the view of thermal structure of the mantle wedge and subducting plate (Tatsumi & Hanyu, 2003 *etc*.), but there remains some questions about magma mixing and degassing, and about temporal and spatial change of magma generation field.

In this study, we suggest a method to estimate the primitive magma composition by using oscillationally-zoned opx, and apply to the HMA in the Setouchi volcanic zone. And we try to estimate the magma generation mechanism by evaluating temporal and spatial change of magmatism in the area.

Firstly, we investigated a HMA in Mt. Kiyama, central part of NE Shikoku, Japan (Sato, 1982 *etc*.). It has the most primitive composition (SiO_2: 57.3wt%, MgO: 8.56wt%, Mg#: 69.3), and it contains olivine, opx, and cpx as phenocrysts. The olivine phenocrysts are normally-zoned, and their highest Mg# (87.6) is lower than the equilibrium value calculated from whole rock composition of the HMA (88.7). Therefor the olivine phenocrysts are considered to be crystallized in closed system. On the other hand, opx phenocrysts are reversely-zoned, and their composition boundaries are sharp. Moreover they have higher Mg# (up to 91.5) than calculated equilibrium value (88.8). Accordingly, these opx could record the composition of more primitive melts. And zoning pattern among opx is consistent, so they could reflect compositional change of the same melt.

According to Putirka (2005), the composition of primitive magma can be estimated by adding fractionated olivine or opx until the melt's composition become in equilibrium with the opx which has the highest Mg#. But we must remove the effects of magma mixing before it. Kuritani (1998) used the fact that the An content of plagioclase phenocryst can be changed in a magma chamber reflecting the difference of temperature or water content. He investigated the pattern of zoning and quantity ratio of them, and estimated mixing ratio.

We estimated the change of melt composition. (1) Calculating the melt compositions from opx composition by using distribution coefficients. (2) Comparing the change of the melt composition and modeled composition in Rayleigh fractionation or magma mixing. (3) Estimating mixing ratio by evaluating the pattern of zoning in opx and their quantity ratio, and estimating end member of mixing. (4)According to the true fractionation trend, determining primitive magma composition which is in equilibrium with opx having the highest Mg#.

By applying this method to the HMA in Mt. Shichihousan, western part of NE Shikoku (Kawabata & Suto, 2000), we estimated the spatial change of primitive magma composition and magma generation field.

Keywords: subduction, Southwest Japan, primitive magma, magma mixing, High-Mg andesite