Petrological study of Pinatubo 1991 eruption ~ Discussions of magma plumbing model~

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Introduction

Pinatubo volcano which locates at Northern Luzon island, Philippines caused cataclysmic eruption on June 15, 1991. This eruption includes the four main eruptive products, dome lava andesite on June 7 (J7-LD), basaltic mafic enclave in J7-LD (J7-ME), andesitic scoria from first Plinian eruption on June 12 (J12-P) and dacite pumice from climactic Plinian eruption on June 15 (J15-C). J15-C is separated into two types which constitute gray, precise and phenocryst-poor pumice (J15-CP) and white, bubbly and phenocryst-rich pumice (J15-CR). There are many petrological studies of Pinatubo volcano 1991 eruption, and magma plumbing model of this eruption is established by Pallister*et al.* (1996). Their model indicates magma mixing that andesitic magma is generated by mixing between felsic magma and mafic magma in magma reservoir. However, we carry out whole rock and mineral compositions of 1991 products in detail, and obtain the new findings of magma plumbing model of 1991 eruption.

Analytical methods

We made many thin sections and observed them under polarizing microscope, and counted the modal compositions of phenocrysts.Whole rock and mineral compositions were determined by X-ray fluorescence (XRF) and Scanning electron microscope / Wavelength dispersive X-ray spectroscopy (SEM-WDS) at Hokkaido University, respectively.

Results and Discussions

1991 products mainly include plagioclase and amphibole phenocrysts, and there is a few olivine, clinopyroxene, biotite, quartz and opaque minerals. For Harker diagram of major elements, all products stand in a straight line and it means magma mixing trend. J15-C composition, however, has compositional variation and another trend which crosses the mixing trend. J7-LD and J12-P also have slightly crossed compositional variation. This crossed trend and compositional variation are clearly confirmed in K_2O and Rb contents. The contents of amphibole and biotite which include many potassium do not relate the compositional variation. Therefore, felsic magma of Pinatubo volcano has had the compositional heterogeneous before mafic magma injected into felsic magma reservoir.

Plagioclase and amphibole cores have wide compositional range. According to calculating the equilibrium melt compositions from plagioclase and amphibole cores, we estimate the two felsic endmember that are less-evolved melt, D1 and more-evolved melt, D2. Their melt compositions correspond with glass compositions hosted in melt inclusions of plagioclase and amphibole crystals. Above discussion indicates that felsic magma has the heterogenous, and we estimate that the heterogeneous felsic magma was generated by mixing between D1 and D2.

For minerals of 1991 products, normal and reversal zonings coexist and are repeated from line profile analyses. The melt composition and temperature of magma were heterogeneous and convection occurred in magma reservoir because the composition of plagioclase depends on the melt composition and temperature of magma.

Conclusions

The compositional variation of dacitic magma is consistent with one of minerals, plagioclase and amphibole, for example. The felsic magma has compositional heterogeneous before mafic magma injection, and two different compositional endmember magma coexist (D1 and D2). The continuous compositions of felsic magma were generated between D1 and D2 because of the convection in magma

reservoir. Before 1991 eruption, mafic magma injected into the heterogeneous felsic magma and mixed together, so that andesitic magma which has slightly compositional variation was generated.

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