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Magma plumbing system of 30 ka caldera-forming eruption of Ohachidaira in the Taisetsu volcano, Central Hokkaido, Japan

Eiichi Sato[1*], Keiji Wada[2]

[1]Geological Survey of Japan, AIST, [2]Hokkaido University of Education

The 30 ka caldera-forming eruption of Ohachidaira started with plinian pumice fall and pyroclastic flow. The deposits contain pumice (SiO_2= 63.6-68.4 wt.%), scoria (SiO_2= 56.6-59.2 wt.%), and banded pumice. This study elaborated magma mixing processes through mineralogical and petrological analyses of the eruption products.

Disequilibrium petrological features such as coexistence of An-rich (type A: An_{70-90}) and An-poor (type B: An_{40-60}) plagioclase phenocrysts were observed. Type A plagioclase phenocrysts were further classified into two sub-types on the basis of MgO content in the cores; type A-1 (MgO > 0. 05 wt.%) and type A-2 (MgO < 0.05 wt.%). Type A-1 and type A-2 plagioclase phenocrysts are probably derived from two mafic magmas, whereas type B plagioclase phenocrysts are derived from a silicic magma. The pumice mainly contains type B plagioclase phenocrysts with rare type A-2 plagioclase phenocrysts. The scoria contains the three types of plagioclase phenocrysts (type A-1, type A-2, and type B).

These disequilibrium assemblages of the products can be explained by the three-stage magma mixing. Initially, mafic magma including the type A-2 plagioclase phenocrysts was injected into the bottom of silicic magma chamber. At this time mixing of the two magmas was suppressed due to high viscosity of the silicic magma (Campbell and Turner, 1986), and a density-stratified magma chamber was formed. The first stage mixing caused by an interfacial instability between the two magmas would have occurred in the stratified magma chamber. In this stage, the silicic magma was entrained into the lower mafic magma layer, and mixed magma was formed in the lower layer.

In the second stage, another mafic magma including the type A-1 plagioclase phenocrysts was injected into the bottom of magma chamber. The mafic magma and the mixed magma formed in the first stage mixing can easily mix in the lower layer because viscosities of the two magmas may be similar. In this stage, new mixed magma containing the three types of the plagioclase phenocrysts was formed in the lower layer. During the eruptions, the lower layer magma was sucked into the conduit due to viscous force of the upper layer silicic magma (Blake and Ivey, 198 6). The third stage mixing was caused by forced convection during the ascent through the conduit. The banded pumice was probably formed in the third stage.

Keywords: Ohachidaira caldera, magma mixing, plagioclase