

Long-term evaluation of volcanic activity of Tarumai volcano

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Tarumai volcano has repeated three eruptive stages with long dormancy, Ta-d (ca. 9000 years ago), Ta-c (2500~2000) and historic activity (since AD 1667). In order to evaluate long term eruptive activity of the volcano, we focus on the historic and Ta-c stages to compare the magma plumbing system of these stages. Juvenile materials of both Ta-c and historic activities are mainly pyroxene andesite and dacite, accompanied with olivine-bearing mafic magma. These show evidence for magma mixing. Ta-c activity consists of three eruptive episodes, Ta-c1, Ta-c2 and Ta-c3 in order of eruptive age. In the case of Ta-c1 eruption, mixed magma between low-K felsic and mafic end-member magmas erupted. However, distinctive felsic end-member magma, medium-K type, has been active since Ta-c2 eruption. Activity of both medium-K felsic and mafic magmas have continued in the historic activity.

The juvenile materials of Ta-c2 stage range from SiO₂=53 to 63%, and are mainly dacitic andesite with SiO₂=62%. These show linear trends in Harker diagrams, indicating mixing of two end-member magmas. Considering compositional relationship among phenocrystic minerals, clinopyroxene of Mg#=71, orthopyroxene of Mg#=63 and plagioclase of An=70 are equilibrium, and are considered to crystallize from the felsic end-member magma. On the other hand, mafic one contains calcic plagioclase and magnesian olivine (Fo=76). In addition, distinctive type of phenocrysts of intermediate compositions can be also recognized. Considering linear trends in Harker diagram, it suggests that these phenocrysts are derived from mixed magma between the felsic and mafic end-member magmas. Thus, it is concluded that Ta-c2 eruption occurred from a zoned magma chamber with a hybrid layer of two end-member magmas. The hybrid layer had changed to be more mafic with advancing activity. In the following eruptive episode, Ta-c3, juvenile materials had changed to be more mafic, and range from SiO₂=57 to 61. Although these are mixing products between mafic and felsic magmas, proportion of hybrid magma in the mixed magma had increased.

Considering temporal variations in juvenile materials of Ta-c2 and Ta-c3 episodes, although both eruptions occurred from the same zoned chamber, proportion of felsic magma in the mixed one has decreased in Ta-c3 episode. Judging from geological evidence, eruption rate of Ta-c3 episode was lower than Ta-c2 episode. Thus, this low proportion of felsic magma indicates that the felsic end-member magma had been exhausted in the zoned chamber during Ta-c3 episode. Major eruptive magma in Tarumai volcano has been felsic during the last 3000 years. Exhaustion of the felsic magma has led to end of the Ta-c eruptive activity. This is quite similar to the situation of the historic activity. Although mixing between felsic and mafic magmas has occurred since AD 1667, the proportion of the felsic magma in mixed one has largely decreased during eruptions in 19th century. Considering lower eruption rate during 19th century, felsic magma has been exhausted as in the case of the Ta-c activity.

Scale of eruption had decreased after repeated two large eruptions in both Ta-c and historic activity. In the case of Ta-c stage, a long dormancy had started after smaller scale of eruption(s). This sequence should be consistent with the exhaustion of felsic magma which has played a major role of eruption. In the case of the historic activity, scale of eruptions during 19th century has largely decreased after two large eruption in AD 1667 and 1739. In addition, felsic end-member magma should be consumed during 19th century. The present state of the volcano is similar to latest stage of the former eruptive activity. It can be concluded that the exhaustion of felsic magma in the zoned chamber is a possible signal of end of eruptive activity.