

Zonal structure of Aso-4 magma reservoir as estimated from compositions of plagioclase and melt inclusions

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We measured compositions of plagioclase and melt inclusions of four flow units of Aso-4 pyroclastic flow. They are Oyatsu pumice flow, Koei ash flow, Yame pumice flow, and Benri scoria flow with pumice and banded pumice, as defined by Watanabe (1978). They represent the first cycle of Aso-4 eruption sequence.

Plagioclase in pumice shows compositional variation changing from one peak (Koei) to two peaks (Oyatsu and Yame), then back to one peak (Benri pumice). Range of compositional variation becomes wider toward later stage, with the widest peak found in Benri pumice and scoria. Median value of the larger peak is An=35 (Koei), An=45 (Oyatsu, Yame and Benri pumice), and An=90 (Benri scoria). All the samples contain small amount of An55 plagioclase. Difference between core and rim was not found among analyzed samples.

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Bulk composition of pumice is SiO₂=68~70 wt.% for Yame pumice, SiO₂=67~70 wt.% for Oyatsu pumice, and SiO₂=66~67 wt.% for Benri pumice. Distinct composition is found between melt inclusions hosted by plagioclase and orthopyroxene between Oyatsu and Koei pumice. Koei melt inclusions show composition in a narrow range of SiO₂=73~74%, whereas Oyatsu pumice show that of SiO₂=71~74%. Shiihara (2014) reported distinct composition of volcanic glass among tephra of Aso-4A in the east area from Aso caldera. She named them as Group-1 glass (SiO₂=73-74%) and Group-2 glass (SiO₂=71-72.5%), and argued that Group-1 correspond to glass of Koei ash flow deposit, and Group-2, that of Yame pumice flow deposit. Because the composition of our Koei and Oyatsu melt inclusions and those of Shiihara's (2014) Koei and Yame glass are nearly the same, we concluded that Oyatsu and Yame glass represent the same melt. Thus Oyatsu pumice flow that flowed to the west of the caldera and Yame pumice flow that flowed to east and northwest possibly originated from the same or similar source in the magma supply system.

Water content of Koei melt inclusions is more than 4 wt.%, and that of Oyatsu melt inclusions is 2-4 wt.%. Chlorine content of Koei melt inclusions is higher than that of Oyatsu, whereas, sulfur content of the former is lower than that of the latter.

In summary, we estimate that Koei pumice flow represent one magmatic melt, and Oyatsu and Yame pumice flow represent two magmatic melt. Plagioclase of An55 composition represent mafic magma in equilibrium with this plagioclase. This melt was not found as melt inclusions, however, is a possible end member of mixing event prior to the huge eruption. Benri scoria and An90 plagioclase, the final product of the first cycle Aso-4 activity, represent the most mafic magma of the magma supply system. We propose an existence of zoned stratified magma reservoir for Aso-4 magma system, from which magma was mixed, and was evacuated from the upper zones.

Keywords: Aso-4 pyroclastic flow, magma reservoir, melt inclusion, plagioclase