Origin of the compositional diversity in the post-caldera volcanism of Aso volcano

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Between 270 and 29 ka, Aso volcano produced a wide range of magma compositions from basaltic to rhyolitic, but after 25 ka it mainly produced basaltic magmas, leading to a decrease of compositional variation. Aso volcano produced four gigantic caldera-forming pyroclastic flows, all of which probably represent an existence of a single zoned magma chamber, as suggested by previous geological and geochemical studies. However, it is difficult to create a wide compositional range of post-caldera magmas from a single magma chamber model, when the following observations are considered. (1) Petrographycal characteristics and bulk rock compositions show an existence of seven distinct magma groups; 1. 2px-rhyolite, 2. bt-rhyolite, 3. hb-dacite, 4. 2px-dacite, 5. aphyric andesite, 6. porphyritic andesite, 7. basalt-basaltic andesite. These seven magma types were active in a spatially restricted area. (2) Disequilibrium textures observed in all post-caldera volcanic products and an existence of xenocrysts indicate that the processes other than simple fractional crystallization of the basaltic magma played an important role in producing the compositional diversity of magmas. (3) Bimodal plagioclase phenocryst core compositions of the porphyritic andesite and heterogeneous groundmass glass compositions of the 2px-dacite, hb-dacite, aphyric andesite, porphyritic andesite and basalt-basaltic andesite could be evidences of magma mixing. (4) Incompatible trace element plots clearly show a mixing line between two end members, one being the basaltic magma, and the other probably being the silicic magma. (5) Basalt-basaltic andesite having high An % (90-95) of plagioclase cores with abundant phenocrysts would be low-MgO high-alumina basalt generated by fractionation of primary magma derived from the hydrous mantle. Younger vents extruding basaltic magmas are centered in the caldera, whereas older vents extruding andesitic, dacitic, and rhyolitic magmas are distributed around them. At least two magma reservoirs, basaltic and silicic, seem to have existed beneath Aso caldera after 90 ka and produced the wide compositional variations of magmas by mixing. Current basaltic activities of central cones of Aso seem to represent a decrease of the silicic end member input.