Magma database of large-scale volcanic eruptions in Japan during the last one hundred thousand years

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In order to assess future large-scale eruptions, it is important to understand characteristics of past large-scale eruptions. For Japanese volcanoes, high-quality databases of volcanic eruptions have been developed, for example Japanese active volcanoes (Kudo and Hoshizumi, 2006-) and one-million years chronology of volcanic eruptions (Hayakawa, 1996-). These databases involve eruptive age, eruptive style and eruption magnitude, M, defined by Hayakawa (1993) and Pyle (2000). In contrast, it is often the case that properties of magma that caused these eruptions remain unrevealed. We have sampled and analyzed eruptive products of ca. 90 eruptions in Japan during the last one hundred thousand years and are constructing a database of magmatic properties. This database involves mainly large scale eruptions with M=4-8 and additionally historic famous small eruption of M=1-3. In this presentation, we show magma and melt compositions, and phenocryst contents. These magmatic properties are important factors controlling physical properties of magmas, and thus eruption dynamics. We examine relationship between these magmatic properties and eruption characteristics.

Bulk rock compositions (magma compositions) were obtained by XRF analysis. For groundmass compositions (assumed to be melt compositions at preeruptive chamber condition) and phenocryst contents, two methods were taken depending on occurrence of groundmass crystallization. For microlite-free groundmass, compositions of groundmass glass were obtained by EPMA analysis. Phenocryst contents were estimated by chemical massbalance calculation of K2O between bulk rock, phenocryst and groundmass. For microlite-bearing groundmass, groundmass compositions were estimated by chemical massbalance calculation between bulk rock, phenocryst and groundmass. Representative compositions of phenocryst were obtained by EPMA analysis. Modal abundances of phenocryst were obtained by image analysis of back-scattered electron images and elemental maps with 1-4 cm^2 area by EPMA.

Examining relationship between eruption magnitude, M, and magmatic properties, some interesting correlations are found. Rhyolitic melt (>70 wt% SiO2)-bearing magmas (andesitic to rhyolitic magmas) caused M=4-8 eruptions. In contrast, basaltic to dacitic melt (<70 wt% SiO2)-bearing magmas (basaltic to andesitic magmas) caused M=1-5 eruptions. For rhyolitic melt-bearing magma, the maximum eruption magnitudes are correlated with phenocryst content. Phenocryst-rich magmas with 20-50 vol% phenocryst have the maximum eruption magnitude with ca.6, where phenocryst-poor magmas with 0-20 vol% cause caldera-forming eruption with M=8 at the maximum. These correlations may be important clues to petrological assessment for future large-scale eruption.