

Augmentation of Magma Database by using a simple method to estimate groundmass SiO₂ content

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We developed a simple method to estimate groundmass SiO₂ contents (preeruptive melt SiO₂ contents) by using mass balance calculation between bulk rock, bulk phenocryst and melt compositions. This method helps us to augment the Magma Database, which has been constructed to examine relationship between magma properties and eruption behavior for volcanic eruptions in Japan during the last one hundred thousand years.

The simple method is based on uniformity in total phenocryst SiO₂ content. We examined total phenocryst SiO₂ contents of 44 magmas, ranging from basaltic to rhyolitic bulk composition, in the Magma Database. The total phenocryst SiO₂ contents were calculated from modal data and representative phenocryst compositions. We found that the magmas have uniform total phenocryst SiO₂ contents of 47.4 wt% (S.D.=1.5 wt%) if their phenocryst assemblages are quartz-free. If quartz phenocryst are contained, the total phenocryst SiO₂ contents increase with fractions of quartz phenocryst and have 64 wt% at the maximum. This evidence validates an assumption of uniform total phenocryst SiO₂ contents (47.4 wt%) in mass balance calculation for the quartz-free magmas.

We compiled ca.40 literature data of bulk SiO₂ and phenocryst content for mainly lava eruptions, which are minor in the Magma Database. Melt SiO₂ contents of the compiled examples were estimated by the simple method, and their relationship between melt SiO₂ content and eruption magnitude (M) were compared with those of the Magma Database. This compilation augmented examples of small to intermediate magmatic eruptions (M=3-5) with basaltic to rhyolitic melt compositions. This data augmentation has little effect on the already known maximum magnitude of M=5 for basaltic to dacitic melt eruptions.

Keywords: magma, petrological analysis, eruption magnitude, database