Textural analysis of Blast deposits from the May 18, 1980, eruption of Mount St. Helens

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On 18 May 1980 at 08:32 LT, the northern flank of Mount St. Helens (in southern Washington State, USA) collapsed by an M5 earthquake. The landslide caused a giant lateral "Blast" originating from cryptodome. Hoblitt and Harmon (1993) reported two juvenile rock types - gray dacite and black dacite - that are derived from the same cryptodome magma. They are different in bulk density, but their textures have not been analyzed in details. In the present study, therefore, we carry out the textural analysis of two cryptodome dacite - gray dacite and black dacite -, and discuss processes that may have generated two different types of products.

Samples were taken from five layers of deposits at two sites –STOP 6 and STOP 7-. STOP 7 is 45° clockwise from north about 5 km from the vent. STOP 6 is 70° clockwise from north about 10 km from the vent. Samples from three layers, "upper", "middle", and "lower" were taken at STOP 6. Samples from two layers "upper" and "lower" were taken at STOP 7. We made a following analysis. (1) Grain size analysis, (2) Component analysis (8-16 mm), (3) Bulk density (8-16 mm), (4) Texture analysis (void and crystal). In analysis of grain size distribution, we sieved the five samples by $2^{-\phi}$ mm metal mesh sieve (ϕ = 2, 1, 0, -1,-2, -3 -4 -5). As the result, it is found that the average grain size of STOP 6 is larger than STOP 7. On the basis of color and vesicularity of grains, we classified each 8-16mm samples into four types ("gray dacite", "black dacite" "lithic", and "others"). As the result, it is found that gray dacite and black dacite occupy 70-80 % in volume at each layer. Also, deposit at STOP 7 include more black dacite than at STOP 6. We measured bulk volume of all particles of gray and black dacites with 8-16 mm at each sites by the 3D scanner, and calculated bulk density. As the result, the density of juvenile dacites shows clear bimodal distribution, with peaks at 1.9 gcm^{-3} (gray dacite) and 2.3 gcm^{-3} (black dacite). We observed the texture (void and crystal) of 8-16 mm gray and black dacite particles that represent each layer by reflection microscope and SEM. As the result, although both of them has microlites (small crystals of 1 μ-30 μm) in groundmass, they have quite different textural characteristics as follows: Gray dacites show uniform distribution of rounded vesicles with various sizes (1 μ-200 μm) whereas black dacites show remarkable heterogeneity in vesicle abundance and morphology, that is void-free regions and void-rich regions consisting of angular voids (0.1-1 mm) surrounded by microlites. In addition, in black dacites cracks develop connecting the void-rich regions regardless of presence of phenocryst and groundmass.

From results of the textural study, we speculate that gray dacites had experienced decompression vesiculation, whereas, black dacites had experienced vesiculation by cooling crystallization before the sadden decompression. We suggest that, a first rising magmas corresponding to black dacites had been cooled and crystallization-induced vesiculation at the location close to the surface, and a magmas beneath the cooled magma in cryptodome, corresponding to gray dacites, had preserved relatively large amount of volatile component. Thus, the landslide made cracks in the black dacite magmas by brittle fracturing and bubbles in the gray dacite magmas by vesiculation. Such differences in volatile contents and history in vesiculation and crystallization result in the textural difference revealed by this study.

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