Eruption sequence of 7.6 ka caldera-forming eruption from Mashu-volcano eastern Hokkaido, japan

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Mashu volcano is located on eastern Hokkaido, Japan. The volcano has a 7.5 km x 5.5 km caldera in the summi. This caldera was formed by explosive eruption at 7.6 ka (Kishimoto et al.,2009; Yamamoto et al.,2010). In the previous geological study, caldera-forming eruption deposits were described as preceding pyroclastic fall deposits Ma-j to Ma-g and pyroclastic flow deposit Ma-f (Katsui et al.1975). Kishimoto et al. (2009) resulted that Mashu caldera-forming eruption consists of initial Phreatomagmatic eruption (Ma-j), followed by Plinian falls (Ma-i~Ma-g), and a catastrophic pyroclastic flow (Ma-f). After that, Hasegawa et al.(2017) subdivided Ma-f into 7 layers (Ma-f1 to Ma-f7 in descending order) suggesting of more complex eruption sequence of Mashu caldera. In this study, we carried out geological survey, grain size analysis and components analysis (for 2~32 mm size grains) to reveal detailed eruption sequence of Mashu caldera.

Ma-f6 and Ma-f7 are pyroclastic density current deposits (PDC), and rich in gray/banded pumice(40~60 wt%,5~21 wt%, respectively).Median (MdΦ) for Ma-f6 and Ma-f7 are -1.00Φ to 0.89Φ.Ma-f5 (pyroclastic fall deposit) and Ma-f4 (PDC) contain a large amount of accretionary lapilli(each 89wt%,82wt%,respectively).Pumice and lithic fragments are coated by silt size ash. MdΦ for Ma-f4 is -0.55Φ to 3.22Φ, that is finer than Ma-f6 and Ma-f7. Ma-f3 is clast supported PDC containing large amount (>90wt%) of lithic fragments. Lithic fragments are composed of dominant dacite, and minor amount of plutonic and altered rock fragments. MdΦ for Ma-f3 is -3.47Φ to -1.37Φ indicating of lack for very fine sand and silt particles. Ma-f2 is PDC often showing cross lamination. Ma-f2 contains a lot of granule sized lithic fragments (70wt%) and pumice (30wt%). MdΦ for Ma-f2 is -1.84Φ to 1.16Φ . Ma-f1 is the brown ash layer, containing pumice (52wt%) and lithic fragments (48wt%). Boundary between Ma-f1 and Ma-f2 is obscure and grain size gradually decrease to the top. MdΦ for Ma-f1 is -1.22Φ to 1.80Φ. Ma-f1 and f2 can be observed above Ma-f3 without exception.

Based on the data, Ma-f1 to Ma-f7 can be grouped as Ma-f7~Ma-f6, Ma-f5~Ma-f4, Ma-f3~Ma-f1 with different eruption styles. Dominant juveniles change from white pumice to banded/gray pumice from Ma-i to Ma-g in ascending order. Componentry of Ma-f7 and Ma-f6 are consistent with the change of those of underlying Ma-i~g suggesting that Ma-i~Ma-6 are sequential products from single Plinian column. Ma-f5 and Ma-f4 show the characteristics of Phreatomagmatic eruption style. After the collapse of Plinian column to generate PDC of Ma-f6 and Ma-f7, the water/magma ratio might be increased and resulted in change in the eruption style. Volume of lithic fragments drastically increase in Ma-f3~1 that infer caldera collapsed occurred in this phase. Lithofacies of Ma-f3 to Ma-f1 correspond to Layer 1~Layer 3 (Wilson,1985) that are typical sequence formed by fluidal, high-energy PDC. In conclusion, caldera-forming eruption sequence of Mashu volcano could not be from single Plinian column but consist of diverse styles of distinct phases as first Plinian, second Phreatomagmatic and final caldera collapse events.

Keywords: tephra, caldera, Phreatomagmatic-eruption, eruption-sepuence

