Geological study of the 1000 yBP Ma-b eruption, Mashu volcano, eastern Hokkaido: Especially for the change of eruption style.

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Mashu volcano is located at the southeastern rim of Kutcharo caldera in eastern Hokkaido, Japan. Mashu volcano began to erupt 35000 yBP (Hasegawa *et al.*, 2009) and the eruptive history of recent 14000 years has been divided into three stages: stratovolcano building stage, caldera-forming stage and central cone building stage (Katsui *et al.*, 1975). Ma-b eruption of 1000 yBP is the largest eruption (VEI=5of) central cone building stage. Ma-b tephra has been divided into six sub unit: Ma-b1~Ma-b6 (Katsui, 1962; Kishimoto *et al.*, 2009), details of its eruption style, eruption sequence and change of magma are not clear. Eruption sequence of Ma-b eruption was reconsidered by geological survey, grain size analysis, component analysis and whole-rock chemical composition analysis.

Based on facies and component ratios, we divided Ma-b tephra into six sub units; Ma-b1 to Ma-b6 in descending order as Kishimoto *et al.* (2009). Ma-b6, the lowest unit of Ma-b tephra, is thin gray-brown ash deposits consisting of pumice, crystals and lithics of sand size. We found it only in one section of northern area of Mashu volcano. Ma-b5 is well-sorted, clast-supported yellowish-white pumice fall deposits. This unit is the largest scale among Ma-b tephra, and distributed in wide area of northern Mashu. Ma-b4 is alteration of comparatively well-sorted ash layer and poorly-sorted lapilli tuff layer with pumice scattered in ashy matrix. Ma-b4 usually contains accretionary lapilli. The lower part of Ma-b4 shows cross-laminated structure, and ratio of pumice increases in the upper part. Then, we consider that Ma-b4 consists of pyroclastic surge and ash fall deposits. Ma-b3 is yellowish-white pumice fall deposits and distributed in the WSW area of Mashu. Ma-b2 is a pyroclastic surge deposit, consisting of pumice and lithics scattered in gray-brown ash deposits, and contains lots of accretionary lapilli. Ma-b1 is a poorly-sorted pumice fall deposit distributed in WSW area. The layer consists of pumice coated by silt size ash, suggesting that it would be supplied from wet column. Juvenile materials of Ma-b tephra are composed of vesiculated pumice and blocky to flaky, blue-gray to black lithic fragments. Matrix of these lithic fragments is fresh and glassy, containing very small bubbles in it. In addition, there also exist small amount of altered lithic fragments. As for juvenile materials, ratios of pumice in Ma-b6, Ma-b5 and Ma-b3 are more than 90%, but Ma-b4 and Ma-b2 contains >70% lithic fragments. On the other hand, Ma-b1 consists of ca. 70% pumice and ca. 20% lithic fragments. These juvenile materials are pyroxene dacite (SiO_2=67.3~69.7% and K_2O=0.6~0.7%), and SiO_2 contents decrease ca. 1% from Ma-b5 to Ma-b1.

From changes of facies of each unit, we considered the eruption sequence of Ma-b as follows. Detail of Ma-b6 is not clear because it distributes in limited area, it is considered that Ma-b6 would be started with small explosion. Ma-b5 is a plinian eruption and discharged pumice fall deposits. This eruption is the largest one through Ma-b. Considering that thickness and grain size become thinner and smaller, the eruption scale of the following eruptions abruptly decrease. Eruption style of Ma-b4 changes to phreatomagmatic eruption by interaction of magma and external water. Flaky texture (Wohletz, 1983) and small bubbles of lithic fragments are consistent with it. Ma-b3 is pumice fall deposits from plinian eruption, but changed to phreatomagmatic again in Ma-b2. Ma-b1 is considered as phreatoplinian eruption and erupted pumice fall deposits coated by ash.

Ma-b eruption repeated phreatomagmatic eruption, suggesting that aquifer may exist under Kamuinupuri

volcano. Transition of eruption style should be determined by interaction of uprising magma and external water. Eruption rate of Ma-b is the maximum in initial stage, and then phreatomagmatic eruptions frequently occur as decreasing eruption rate.

Keywords: Mashu volcano, tephrostratigraphy, phreatomagmatic eruption, active volcano

