Eruptive history of post-caldera volcanoes of Kutcharo caldera, inferred from tephrostratigraphy in eastern Hokkaido, Japan

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Many tephra layers associated with post-caldera volcanoes of Kutcharo caldera (e.g. Mashu, Atosanupuri volcanoes) are recognized above KpI (35ka), which is the last caldera-forming ignimbrite from Kutcharo caldera, in Nakashunbetsu and Shari area (east and north of Kutcharo volcano, respectively), eastern Hokkaido. Although eruptive history of Mashu volcano during the last 10000 years was revealed by geologic and petrologic studies of Mashu Tephra Formation (TF), systematic investigation of the tephra layers older than Mashu TF was not carried out. To reveal the entire history of post-Kutcharo caldera volcanoes, we performed geologic and petrologic study of these tephras.

In Nakashunbetsu area, tephra layers above KpI were described by previous studies as Nakashunbetsu TF (Nu-r˜a), Chanai TF (Ch-d˜a) and Mashu TF, in ascending order. Dominant tephras in Nakashunbetsu and Chanai TF (Nu-d, f, i, l, n, p, r and Ch-a, b, d) are characterized by aphyric (˜9%), dense and white˜grayish brown colored pumice fall deposits. These often include gray pumice. On the other hand, four tephra layers (Nu-a, e, g, Ch-c) consist of porphyritic (10%˜), vesicular and white pumice. One of the tephras, Nu-g characteristically contains many isolated crystals. The thickness and grain size of these pumice fall deposits in Nakashunbetsu/Chanai TF increase toward to the west. Although these tephras consists of 2-pyroxene dacite, Nu-q (well-sorted sand sized pumiceous ash) contains hornblende. In Shari area, Yambetsu Pumice (YmP), Ohachidaira pumice (OhP), Higashikayano Pumice (HkP), Toyozumi Pumice (TyP), Nakashari Pumice (NaP), Kohnan Pumice (KoP) and Mashu TF in ascending order, were described by Sumita (1988). YmP, HkP, NaP and KoP are mainly composed of aphyric, dense pumice and often contain gray pumice. These features are similar to those of major pumice falls in Nakashunbetsu/Chanai TF. TyP is same as Nu-g in terms of containing many isolated crystals. OhP and Nu-q commonly contain hornblende.

Glass compositions of these tephras are divided into three groups (low, medium and high-K groups). Tephra layers composed of aphyric, dense and white to gray pumice are grouped in low-K (K2O=0.4-0.9%). Tephras characterized by porphyritic, vesicular and white pumice are medium-K group (K2O=1.6-2.5). The grouping of low and medium-K tephras of Shari area has already been described by Sumita (1996). OhP and Nu-q shows high K2O contents (K2O=4.2-4.9), which is not common in volcanic rocks of eastern Hokkaido.

We can make the correlations of main tephras in Shari area with the stratigraphy of Nakashunbetsu area as follows: Ymp to Nu-r, OhP to Nu-q, TyP to Nu-g, NaP to Ch-b, and KoP to Ch-a, respectively. Nu-g is originated from Ohachidaira caldera in central Hokkaido, where caldera-forming eruption occurred at 30Ka.

Lithofacies and lithology of Low-K tephras are similar to those of the Mashu TF. This low-K type of magmatism in Kutcharo volcanic area has not been reported except for in the Mashu and adjacent Nishibetsu volcano, on the eastern part of Kutcharo caldera. The low-K tephras could be derived from these volcanoes. On the other hand, medium-K tephras have the same lithofacies and petrology as proximal pyroclastic deposits around Atosanupuri and Nakajima volcanoes. It suggests that source volcanoes of medium-K group could be Atosanupuri/Nakajima volcanoes.

Based on these data, we can construct the eruptive history of post-caldera volcanoes of Kutcharo caldera. In the Mashu/Nishibetsu volcanic area, more than a dozen pyroclastic eruptions had occurred frequently during the last 35000 years. On the other hand, a few pyroclastic eruptions generated from the Atosanupuri/Nakajima volcano. After that, eruptive style of Atosanupiri volcano has changed to effusive (dome-forming) eruptions during the last 15000 years.

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