R004-12
D 会場 ： 11/26　AM1（9:15-10:45）
10:15〜10:30:00

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Investigation of thermoremanent and viscous remanent magnetization in the Zenkoji debris avalanche deposits

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Volcanic eruptions and associated massive debris avalanches triggered by unstable slope collapse are hazardous natural phenomena that cause severe damage to populations and infrastructure, including depositing debris over wide areas and long distances. Investigating the mechanisms of pyroclastic flow and debris avalanches deposition, as well as forecasting future events is critical for developing effective disaster prevention and mitigation strategies.

Mt. Usu (SW Hokkaido) is one of the most active volcanoes in Japan, erupted several times in historical times since its activization in 1663 AD. The Usu stratovolcano was formed around 30 ka, and subsequent sector collapse produced the large Zenkoji debris avalanche deposit (~0.3 km3) on the southern slope. There is some debate over the timing of the collapse. Miyabuchi et al. (2014) suggests that the volcanic edifice collapsed around 30 ka based on sedimentary structures. Fujine et al. (2016) suggests that the volcanic edifice collapsed around 20 ka based on radiocarbon dating and analysis of volcanic ash, pollen, and diatoms. In this study, we performed comprehensive magnetic measurements of Zenkoji samples to reconstruct the transport processes of the debris avalanche and constrain its age.

We collected block samples from the boulders near Usu Bay. One-inch core samples were cut from the block samples and used for magnetic measurements. Stepwise thermal demagnetization (THD) of the samples was conducted to evaluate the temperatures during transportation. Then, viscous remanent magnetization (VRM) dating was also applied to constrain the age of the flow event. The age estimation was carried out by identifying the unblocking temperatures of the VRM components aligned with the geomagnetic field.

The THD results show no evidence of high unblocking temperature components aligned with the present geomagnetic field direction, suggesting that the deposits were transported as debris flows after cooling, rather than as hot pyroclastic flows. This result supports the interpretation that the mountain collapse was not synchronous with the eruption (Miyabuchi et al., 2014). The maximum unblocking temperatures of VRM components were identified in the range of 320 – 380 ℃, and the estimated ages were significantly older than 30 ka. Such high unblocking temperatures are likely affected by the remanence in the ferromagnetic minerals of the groundmass, including acquisition of thermochemical remanent magnetization during cooling or thermal alteration during laboratory heating.

To address these issues, this study applies stepwise THD measurements to single plagioclase crystals. So far, a unblocking temperature has been successfully identified in one sample. The maximum unblocking temperature of VRM component of the plagioclase crystal is 180 ℃, significantly lower than those observed in the one-inch core samples. Although the estimated age still exceeds 30 ka, the single-crystal approach shows greater potential for accurate age determination. We will present the results of ongoing single-crystal experiments and discuss their implications for understanding the transport processes of the Zenkoji debris avalanche.