Petrology of the caldera-forming eruption of Nigorikawa Caldera, Southwest Hokkaido, Japan

*Yasuaki Kaenda[1], Takeshi Hasegawa[1]

1. University of Ibaraki

The Nigorikawa volcano, which has a caldera approximately 3 km in diameter is located in southwest Hokkaido, Japan. Nigorikawa caldera was formed by ca. 12 ka explosive eruptions. Previous studies by Yanai et al. (1992) suggested that the caldera-forming eruption deposits (Ng) were divided into 4 units: Ng-c, Ng-b, Ng-a fall, Ng-a flow, in ascending order. The reflective index of volcanic glasses increases from Ng-c (bottom: n = 1.489) to Ng-a (top: n = 1.504) (Yanai et al., 1992). However, there is no systematic geochemical data, such as volcanic glass and whole rock chemistries, for Ng units. In this study, we performed field surveys and sampling and determined petrological features for juvenile clasts of Ng units to reveal the caldera-forming magma plumbing system of this volcano.
Ng can be characterized by containing a large amount of hornblende phenocryst. Ng-c is a cross-bedded, pyroclastic surge deposit, which consists of dominant fine ash and rare pumice clasts. We newly divided Ng-b into lower pyroclastic fall (Ng-b fall) and upper pyroclastic surge deposits (Ng-b surge). Ng-a fall and flow are pyroclastic fall showing reverse grading, massive pyroclastic flow deposits, respectively. Although the distribution of Ng-a flow was reported within 5 km around the caldera (Yanai et al., 1992), we found and described Ng-a flow at several outcrops 15 km far from the source. On Ng-a flow, pyroclastic surge deposit was observed. In this study, we refer to it as Ng-a surge. In addition, another pyroclastic flow deposit (Ng-x) containing hornblende phenocryst was discovered above Ng-a surge with intervening thin soil layer at 4.5 km northest from the source. Consistent chemical composition with other Ng units suggests Ng-x was derived from Nigorikawa caldera.
These geological data infer that eruption volume and duration of Nigorikawa caldera-forming eruption could be larger and longer than previously reported, respectively. Juvenile clasts of Ng can be classified into three types: white pumice (WP), gray pumice (GP), banded pumice (BP). We recognized all type of juvenile clasts in all units, and the dominant component is WP. There is no enough petrological data of Ng-c obtained because of fine lithofacies. The phenocryst assemblage of WP is Pl + Hb ±Cpx ±Opx ±Opq ±Qtz, and with hyalopilitic texture. Petrography of GP is almost the same as WP, except for the absent of Qtz, and a groundmass texture of GP is hyaloophitic. In the Harker diagrams, almost of WP (SiO_2 = 61.2 - 63.7 wt.%) and GP(SiO_2 = 54.6 - 57.4 wt.%) plot on a single linear trend, and BP plots between WP and GP. Systematic vertical change of chemical compositions inferred by Yanai et al., (1992) could not be recognized. GP of Ng-b is the most mafic and show a distinct trend from main linear trend, especially in Na_2O-SiO_2, Ba-SiO_2, Zr-SiO_2 diagrams. The volcanic glass composition of WP and white part of BP show common composition as SiO_2 = 71.2 - 78.2 wt.%. Chemical trends of volcanic glass are almost similar to those of whole rock composition. The heterogeneous texture of BP and the existence of three types of juvenile clasts in all units indicate mixing and mingling of different types of magma are main processes in Nigorikawa caldera-forming eruption. Chemical trend converges to felsic side (at SiO_2 = 61.2 - 63.7 wt.%) suggesting single felsic end member magma. On the other hand, two distinct trends for GPs of Ng-b and Ng-a imply that at least two different mafic end member magmas had existed. Magma plumbing system of Nigorikawa caldera-forming eruption might be composed of shallower and larger felsic magma, producing white pumice, and two mafic magmas that successively injected into the felsic magma at different phases.

Keywords: Nigorikawa caldera , Petrology

