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Petrologic study of magma generation and storage system beneath Narugo volcano - for comparison with gephysical data -

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1. Introduction
The Narugo volcano area is selected for the case study of the project of "Geofluid" and three dimensional geofluid map will be established by detailed seismologic and electromagnetic observation. It is very important to compare these results to those obtained by petrologic and geochemical studies, because the magma is one of the components of the geofluid. In this study, the magma generation and storage system beneath the Narugo volcano revealed by petrologic study of the eruptive products is presented and compared to the previously reported geophysical image.

2. Geologic and petrologic outline of the Narugo volcano
The activity of the Narugo volcano began with eruptions of pyroclastic flows, the Nizaka pyroclastic flow (ca.73ka) and Yanagizawa pyroclastic flow (ca.45ka). Large caldera, which is ca. 7km in diameter, was formed by these explosive eruptions. Afterwards, rhyolitic lavas and lava domes were extruded into the caldera. These lavas can be divided into three units, east lava domes, northern lava flows, and western lava flows in ascending order. The age of the youngest one is estimated to be ca.12ka. These lavas show same phenocrystic assemblage (qtz, plg, cpx, opx, and Fe-Ti oxides) and the groundmass is mainly composed of glass. Mafic inclusions, which are quench products of mafic magmas intruded to the felsic magma body, are observed in all lavas.

3. The magma generation and storage system beneath Narugo volcano estimated by petrologic study
The three lavas show same phenocrystic assemblage and same chemical composition of groundmass glass, however, looking at in detail, whole rock compositions, modal amount of phenocrysts, and chemical compositions of phenocrysts show slight variability among three lavas. Taking account of the distance of the eruption centers and the difference in eruption ages, each of these three lavas would be derived from a distinct rhyolitic magma chamber. The magmatic temperature and depth for these magma chambers are petrologically estimated to be ca.800~850 degrees C and <10km. Further, estimated temperature obtained by rim compositions of pyroxene phenocrysts and Fe-Ti oxides is higher than those by core of pyroxene phenocrysts, which suggests heating event of the rhyolitic chambers before extrusion. The heating was caused by the underplating of basaltic magmas, which were formed by the melting of the upper mantle, to the rhyolitic chamber. The trace element model calculations show the rhyolitic magmas can be produced through partial remelting or melt extraction from previously stalled fully or partially crystallized basaltic magma.

4. Comparison to the geophysical data
Many hypocenters of micro-earthquakes and S-wave reflectors are detected in the upper crust beneath the Narugo volcano, and also the tomographic imaging of seismic velocity structure do

not indicate the presence of melt but H_2O in this part. Thus the petrologically estimated shallow rhyolitic magma chambers would have solidified enough or the scale of these is too small to be detected by the geophysical observation.
In terms of the deeper part, the tomographic imaging shows a broad region of partial melt in the lower crust to the uppermost mantle. The lower crustal part of this zone would correspond to the petrologically estimated rhyolitic magma generation zone, whereas, the upper most mantle part would be correlated to the zone of generation of basaltic magma. These explanations should be refined by using the forthcoming new geofluid map.

Keywords: geofluid, magma, Narugo volcano, rhyolite, basalt, Seismic tomography