

## Thermal and compositional structures of the mantle wedge and origin of volcanic activities of the Sengan region, Northeast Japan

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Subduction zones are considered to be a major site of material flux into the Earth's mantle. Associated with subduction of the plates, a series of remarkable events occur, yet the dynamics and material circulation in subduction zones are poorly constrained. Recently, existence of along-arc periodical structures with about 50 km wavelength have been found in the northeastern Japan arc based on distribution of the volcanoes (Kondo et al., 1998), topography / bouguer anomaly (Tamura et al., 2002) and thickness of seismically low-velocity zone in the mantle wedge (Nakajima et al., 2001), indicating a periodical three-dimensional structure in the mantle wedge. In order to investigate the origin of the three-dimensional structure and dynamics in subduction zones, we focus on magmatism, since genetic conditions of magmas reflect the physico-chemical conditions of the mantle-crust system. In this study, we investigate three-dimensional thermal and compositional states of the mantle wedge beneath the northeastern Japan arc, based on the compositional variations of volcanic rocks.

In this study, a volcanic region called Sengan region (50km-50km) in the northeastern Japan arc is focused. Erupted lavas have been sampled from 20 Quaternary volcanic bodies to cover the whole area, under which the low-velocity zone is thicker beneath the central part and thinner toward the marginal part (Nakajima et al., 2001). Detailed examinations of the spatial variation of composition and differentiation processes have been carried out.

First, crustal processes have been examined with petrological analyses, using numerical calculation and thermodynamic model MELTS (Ghiorso and Sack, 1995). Volcanoes in the Sengan region are divided into two different groups on the basis of fractionation processes. Compositional trends of the first group can be reproduced by fractional crystallization from basaltic magma. These volcanoes are mainly distributed on the outer rim of the cluster. Magma mixing of high MgO andesite and dacite with fractional crystallization is observed in the second group, based on AFC calculation (DePaolo, 1981), mineralogy (Sakuyama, 1979) and a mass balance analysis of the compositional trend. Such volcanoes with magma mixing are distributed at the central part of the volcanic cluster associated with voluminous silicic igneous rocks such as Tamagawa welded tuff (Suto, 1987) and Kakkonda granite (Kanisawa et al., 1994). Major element compositions of those voluminous silicic igneous rocks show similar range to that of partial melts of amphibolites (e.g; Beard and Lofgren, 1991).

Pressure, temperature and H<sub>2</sub>O-content of the source region of magmas in the mantle wedge have been estimated to minimize compositional difference between the composition of partial melt calculated at a given P, T, H<sub>2</sub>O-content and that estimated from the observed volcanic rocks (assuming olivine maximum fractionation). Thermodynamic model pMELTS (Ghiorso et al., 2002) were utilized to calculate the composition of partial melt of a peridotite. Estimated temperature of melt source region in the mantle beneath the Sengan region shows no systematic. On the contrary, mantle beneath the central part of the cluster shows higher H<sub>2</sub>O-content than the outer rim. The H<sub>2</sub>O-rich regions in the mantle wedge are located beneath the low-velocity zone in the crust, where volcanoes with magma mixing and silicic igneous rocks are distributed. It has been shown by the MELTS calculation that the melting degree of crustal rocks (gabbro or granite) is elevated more than 10 wt. % with addition of 1 wt. % of H<sub>2</sub>O (when temperature and pressure are assumed to be 1000 degree and 5 kbar). It is suggested that a mantle-derived wet magma had supplied heat and H<sub>2</sub>O to the crust and induced higher degree of melting and efficient magma mixing in the central part of the volcanic cluster. On the outer rim of the cluster, primitive basaltic magma had ascended without crustal melting / magma mixing.