Genesis of ultra-high-Ni Ol in high-Mg andesite lava triggered by seamount subduction in the northeast Kamchatka

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The northeast Kamchatka has undergone extremely dynamic processes, such as (1) hot asthenospheric injection around the slab edge (Yogodzinski et al., 2001), and (2) subduction of the Emperor Seamount Chain (Davaille and Lees, 2004). These processes are considered to be affecting the most active volcanism in the world (Klyuchevskoy Volcanic Group) (Dorendorf et al., 2000) and the northward shallowing of the subduction dip angle (Gorbatov et al., 1997). A monogenetic volcanic East Cone, EC (Fedorenko, 1969) is located in the forearc area ~60 km above the subducting Pacific Plate, which is supposed to be old and cold (~100 Ma, Renkin and Sclater, 1988). In this case, an volcanic zone other than forearc magmatism is expected to be formed above the slab of 100 km depth (Iwamori, 1998) induced by slab-derived fluid and the corresponding mantle melting. We found that the EC lavas exhibit primitive characteristics and show variability in rock-type including high-Mg andesite (HMA) and relatively primitive basalts in time (0.73–0.12 Ma) and (30 km x 60 km area). Olivine phenocrysts in the EC lavas also show different characteristics in each rock-type. Ultra-high-Ni olivine (Ni ~6300 ppm) was observed in HMA, which contain ~6300 ppm Ni, the highest value recorded in arc lavas to date (e.g., Straub et al., 2008). On the other hand the primitive basalt includes moderately-high-Ni olivine (Ni ~2900 ppm). These features reflect the dynamic processes in the northeast Kamchatka.
We discussed the enigmatic forearc magmatism based on the genetic conditions of the HMA, primitive basalt, ultra-high-Ni olivine, and temporal engagement of the seamount subduction. Inversion for trace element compositions involving subducting slab, slab-derived fluid, DMM-type mantle and melt, together with detailed inspection of the assemblages, compositions and zoning profiles of phenocrysts, indicate several isolated melt pockets and/or veins formed at the initial stage of crystallization in the mantle, each being derived from different degrees of pyroxenization along fluid pathways. Silica-rich fluids derived from a subducted seamount expelled beneath the forearc area and its chemical characteristics. Melting of heterogeneously veined mantle with such fluids produced the various primary melts in limited time and space.

Keywords: high-Mg andesite, high-Ni olivine, seamount subduction

