プチスポット火山下の海洋マントルの構造
Structure of suboceanic mantle below petit-spot volcanoes

*平野 直人[1]
*Naoto Hirano[1]

1.東北大学東北アジア研究センター
1.Center for Northeast Asian Studies, Tohoku University

Petit-spot volcanoes were first identified as eruptions on the subducting plate off the Japan Trench due to lithospheric flexure related to plate subduction (Hirano et al., 2006). Such volcanoes are likely to occur worldwide, as similar lavas have also been reported off the Chile and Java trenches (Hirano et al., 2013; Taneja et al., 2014). The magma that erupts from petit-spot volcanoes originates from the asthenosphere and ascends along the concavely flexed zone of the outer-rise prior to the zone of plate subduction. The occurrence of such volcanoes may not be limited to the zone of outer-rise warping of lithosphere prior to subduction, as they also occur in extensional basin-and-range settings (Valentine & Hirano, 2010) and lithosphere experiencing glacial rebound in the region south of Greenland (Uenzelmann-Neben et al., 2012). The geochemistry of lavas and entrained xenoliths from petit-spot volcanoes provides clues to the structure and dynamics of suboceanic mantle, which had previously been difficult to explore. Spatial variations in the geochemistry and ages of petit-spot lavas show the systematic distribution of melt pockets in the source mantle, which move with plate motion (Machida et al., 2015). Yamamoto et al. (2014) reported on areas of asthenosphere melt and its migration against plate motion. The CO_2 emissions of petit-spots are important globally and indicate a mantle source, probably asthenosphere (Hirano, 2011; Okumura & Hirano, 2013).
Monogenetic petit-spot volcanoes in the Japan Trench have erupted in clusters at 1.8, 4.2, 6.0, 6.2, and 8.5 Ma (Ar-Ar age data: Hirano et al., 2001; 2006; 2008; Machida et al., 2015). Most of the lava samples from this region do not contain phenocrysts, in spite of their differentiated compositions of 45-52 wt% SiO_2 and Mg# of 50-65 (Hirano et al., 2006); therefore, the magmas must have been differentiated in the magma chamber. Petrography and geobarometer analyses of peridotitic xenoliths show that they ascended rapidly through the upper lithosphere, as the deepest xenoliths originated from ~42 km depth, corresponding to the middle of the subducting Pacific lithosphere (Yamamoto et al., 2014). These data indicate that the magma stagnated and differentiated at depths below the middle lithosphere. The high CO_2 contents of petit-spot lavas raise the possibility that CO_2 affects the source components and their melting. Lithospheric contamination must occur during magma ascent. The lower lithosphere below clusters of petit-spot volcanoes is possibly subjected to metasomatism by carbon-rich (or highly alkaline) melt.

