Direct-ascended petit-spot magma from asthenosphere with little or no assimilation

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Petit-spot is alkaline monogenetic volcano distributed at the localities of plate-flexure such as the concavely flexed zone of the outer rise prior to plate subduction and rebounding lithosphere after glacial unloading. Petit-spot volcanism is unlikely related to mantle plumes or hotspots because they are randomly distributed without making seamount tracks. Alkaline melt erupted at petit-spot volcanoes originate from asthenosphere which move upward through the oceanic lithosphere by tectonic forces associated with plate flexure. Therefore, sampling the petit-spot lavas may be the only way for us to gain the materials directly from the asthenosphere below oceanic plate.
In the case of petit-spots at the concavely flexed lithosphere, the base of the lithosphere is extended so that the least compressive principal stress (σ_3) is perpendicular to the flexural axis. Otherwise, the σ_3 changes to be parallel to the flexure axis below the upper lithosphere, where the stagnation of ascending melt is speculated at the mid-depth of lithosphere. During the stagnation, melt could experience various degrees of fractionation and/or assimilation with lithospheric mantle materials (Valentine and Hirano, 2010). Pilet et al. (2006) showed the chemical similarity between clinopyroxene observed in petit-spot mantle xenoliths and clinopyroxene from melt-metasomatized continental mantle peridotites. They argued the petit-spot melt experienced metasomatic interaction with lithospheric peridotite. Thus, it is indispensable to ignore consider the lithospheric interactions when we estimate the asthenospheric composition from petit-spot lava. We present the geochemical variation of petit-spot lavas in relation to the tectonic regime of subducting Pacific Plate.
Submersible investigation of petit-spot lava field off the Pacific coast of northeastern Japan, called Site C, was conducted in 2014 (YK14-05). In this cruise, we found a young petit-spot volcano (~ 0.1 Ma) on outer rise and collected fresh lavas. The lavas are low-SiO_2 and strongly alkaline relative to previously reported petit-spot basalts. In contrast to aphyric petit-spot basalts previously reported, strongly alkaline lavas in this study contain much olivine phenocryst, indicating more rapid magma ascending than other petit-spots caused by unique tectonic regime below the young volcanoes on the outer rise. We found that such tectonic forces of both upper and lower lithosphere below their eruptions sites are clearly correspond to geochemical variations.

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