# Geological disturbance, lithospheric fertilization, and petit-spot volcanoes of oceanic plate prior to subduction

*Naoto Hirano[1,2], Kazuto Mikuni[2], Yosuke Shimbo[2], Norikatsu Akizawa[3], Shiki Machida[4]

1. Center for Northeast Asian Studies, Tohoku University, 2. Graduate School of Science, Tohoku University, 3. Atmosphere and Ocean Research Institute, the University of Tokyo, 4. Ocean Resources Resurech Center for Next Generation, Chiba Institution of Technology

The petit-spot basalts previously reported in front of the Japan, Mariana, Sunda, Tonga, and Chile Trenches are expected to contribute elucidating asthenospheric components just below the suboceanic lithosphere. The entrained xenoliths composed of all sections of suboceanic lithosphere (pelagic sediment, chert, basalt, dolerite, gabbro, and peridotite) provide the comprehensive structure and dynamics of suboceanic lithosphere floating on the convective asthenosphere. The melts and xenoliths are authentically the first materials which we obtain below abyssal plain far from mid-oceanic ridges and seamounts (hotspots) because the rock-samples from lithospheric mantle have been limited only for abyssal peridotites and oceanic core complexes peridotites in the mid-ocean ridge and back-arc spreading center, and xenoliths in the lavas erupted on the hotspot. Here, we provide a perspective view of the petrological and geochemical structure of submarine lithosphere and asthenosphere below the petit-spot volcanoes, where the oceanic plates are generally recognized as old and cold part prior to the subduction.

Several submersible dives near Japan Trench axis observe the cross section of a petit-spot volcano composed both of a volcanic cone and basement sills where the edifices are truncated by normal faults due to subducting “horst and graben” structure on trench-oceanward slope. The shipboard geophysical survey observed the volcanic sills underlying petit-spot volcanic edifices along the Moho discontinuity or submarine chert section as well. The area of apparently thin sediment layer corresponding the petit-spot volcanic field was recognized using seismic reflection survey. The geological disturbance of subsurface structure due to the formation of petit-spot volcanic fields is a candidate of a factor controlling the hypocentral region of interplate earthquake after the subduction.

The majority of the petit-spot lava samples of NW Pacific Plate without phenocrysts in spite of their fractionated compositions (45–52 wt% $SiO_2$) indicate magma differentiation below entrainment depths of olivine xenocrysts and peridotitic xenoliths from upper lithosphere, where the ascending magma would be stored at the depth of rotation of the $\sigma_3$ stress axis from the extensionally lower to the compressional upper part of the concavely flexural part of lithosphere. The direct ascent petit-spot lavas (DAPs), erupted atop the outer-rise, showing more primitive compositions (less than 45 wt% $SiO_2$, and richer in volatiles), are a contrast to the majority of petit-spots. The xenoliths entrained from lithospheric mantle were derived from a region metasomatized by multiple petit-spot melt infiltrations prior to the ascent by host magma, implying the presence of “hidden petit-spot melts” not to reach to surface (i.e. dikes or percolations into lithospheric mantle). The lithospheric geotherm estimated using the peridotitic xenoliths obviously shows higher values than that of GDH1 model.

The depletions of Zr, Hf, and Ti toward other incompatible elements of petit-spot lavas are common features plausibly due to the melt sourced from the garnet-stability field of carbonated mantle, which are similar features only to peralkaline lavas erupted at the latest stage of hotspot volcanoes, but inconsistent with the majority of hotspot lavas (OIBs) in the world. The primitive melt of DAPs notably shows the

 

strongest depletions in those, implying the straight ascent of melt from the carbonated source mantle without the magma-fractionations in lithosphere. The component of recycled materials in the source (low $^{143}Nd/^{144}Nd$ at a given $^{87}Sr/^{86}Sr$, high $^{208}Pb/^{204}Pb$ at a given $^{206}Pb/^{204}Pb$, and low $^{26}Mg/^{24}Mg$), however, do not show any correlations between DAPs and other petit-spot lavas of NW Pacific, implying the multiple source components both of carbonated and radiogenic materials in the asthenosphere.

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