Geochemical studies on melt generation with numerical modeling beneath petit spots, Northwestern Pacific

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Anomalously young volcanoes (0.05-8.5Ma, Ar-Ar age) called petit spots were discovered on subducting Early Cretaceous Pacific Plate. Hirano et al. (2006) suggested that magmas are brought to the surface along fractures parallel to the direction of the maximum horizontal compression caused by extensional stresses on the base of the downwarping Pacific plate. Based on this model, I investigated the melting condition, (i.e. temperature, pressure and fraction of aqueous fluid) by numerical modeling.

Bathymetry and backscatter image show presence of the layered lava fields over the oceanward slope of Japan Trench, as well as monogenetic volcanoes (Kaiko Knolls). Based on their ages with the present absolute motion of the Pacific Plate (NNR-NUVEL1A), predicted original eruption sites distribute over a broad region (about 600km in length) on the eastward slope of the outer rise (Hokkaido Rise).

Hokkaido Rise is an upward convex swell, resulting from lithospheric flexure associated with subduction of Early Cretaceous Pacific Plate into the Japan and Kuril Trenches. This lithospheric flexure may cause decompression and changes in flow patterns of uppermost mantle. If the melting condition is satisfied, decompression melting along flow lines could occur in an extensive area.

Takahashi (2008) shows that under the dry condition, no melting occurs, while 0.05wt% water causes incipient melting at about 100km depth. These results are consistent with probable origins, melting of garnet peridotite, estimated from geochemical analyses (Hirano et al., 2006). The trace element patterns produced by melting of DMM with the addition of 0.072wt% aqueous fluid from altered oceanic crust approximately fit to those of sampled rocks (melting degree is 0.2-0.4%). Although the circulatory mechanism of the fluid is still unknown, speculateing from the relatively high abundance of Pb, it could have been leaked out from the neighboring subduction zones. It is also consistent with the indicaion of subduction fluid pwocesses estimated from independent component analysis on isotope compostion (Iwamori and Albarede, 2007).