Young lava field on subducting 130Ma Pacific Plate: Volcanism induced by lithospheric flexure

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The northwestern part of Pacific Plate, off Japan Trench, consists of Early Cretaceous oceanic crust and Late Cretaceous seamounts. No present-day volcanic activity has been reported on such a cool, thick and old Cretaceous lithosphere; however, anomalously young alkali-basalt lava (5.95Ma Ar-Ar age) was discovered at 39o23.2'N, 145o15.5'E, on the oceanward slope of Japan Trench during ROV KAIKO dive (10K#56) in 1997 (Hirano et al., 2001). Because only one outcrop and two samples were discovered in 1997, distribution of lava fields and nature of knolls were still undetermined. To better understand the causes for these volcanisms, R/V KAIREI and YOKOSUKA cruises (KR03-07, KR04-08, YK05-06, KR05-10) were operated, during which we obtained geophysical data, and dredged rock samples.

Bathymetry and backscatter image show the presence of layered lava fields over the oceanward slope of Japan Trench, as well as monogenetic volcanoes (Kaiko Knolls). These volcanoes measure 0.9-5km in width by 50-400m in height by 0.006-1.009km3 in volume, and are arranged in the WNW-ESE direction, coincides with the direction of current Pacific Plate motion. Based on their ages (4-8Ma) with the present absolute motion of the Pacific Plate (NNR-NUVEL1A), predicted eruption sites correspond to a broad region (about 400 km 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. According to the plate subsidence models by Parsons and Sclater (1977), the 130 to 133 Ma part of the Pacific Plate, currently subducting beneath northern Japan, should be at a depth of approximately 6000 mbsl. Nevertheless, the shallowest part of the Hokkaido Rise is only 5200 mbsl. This lithospheric flexure may cause decompression and changes in flow patterns of uppermost mantle. Melting conditions were obtained through comparison between one-dimensional temperature structure (Turcotte and Schubert, 1982) and peridotite solidus with different water content (Iwamori, 2004). Under the dry condition, no melting occurs, while 0.2% water causes incipient melting at 170km depth. Water content of 0.4% and 1% would cause melting at depth of 136km and 112km, repectively. These results consistent with probable origins, slightly melting of garnet peridotite, estimated from geochemical analysis (Hirano et al., 2001). If the melting condition is satisfied, decompression melting along flow lines could occur in an extensive area. To better understand a possible mechanism of magma generation, we construct numerical models of mantle flow and melting beneath an outer rise.