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Nature of the Moho in Japan and Kamchatka

Takaya Iwasaki (1), Vadim Levin (2), Alex Nikulin (2), and Takashi Iidaka (1)

(1) Earthquake Research Institute, the University of Tokyo, Tokyo, Japan (iwasaki@eri.u-tokyo.ac.jp, +81-3-5689-7234), (2) Rutgers Univeristy, New Jersey, USA (vlevin@eos.rutgers.edu)

The Kamchatka peninsula and the islands of Japan are located along the eastern margin of the Asian continent. The natures of the Moho in these areas have been studied for decades, with a variety of geophysical methods, including active and passive seismic methods, gravity and other techniques.

The Moho and the upper mantle structures in the NE Japan and SE Japan Arcs have been investigated well both from active and passive seismic source studies. The Moho depth in the NE Japan is ranging from 30 to 40 km. Almost parallel to the present volcanic front, there exists a belt of deep Moho (34-36 km) with a lower Pn velocity (7.5-7.7 km/s). Amplitude analysis of the PmP phase indicates that the Moho beneath the NE Japan Arc is not a simple velocity contrast, but rather a gradual transition. Toward the backarc side, remarkable crustal thinning is recognized. Actually, the Moho depth decreases from 35 km beneath the central part of NE Japan to 18 km beneath the Sea of Japan. This thinning is evident in the upper crust, while the lower crust remains constant in thickness. This may be explained by the continuous magmatic underplating beneath the rifted crust or deformation under a simple shear mode, allowing the lower crustal thickness to remain unchanged.

The Moho in the SW Japan Arc is also at a depth of 30-40 km. The Pn velocity is 7.7-7.8 km/s, slightly higher than that in the NE Japan, although this value was mostly sampled in the eastern half of the SW Japan Arc where the recent volcanic activity has been less effective. Fluids expelled from the subducted oceanic lithosphere (the PHS plate) play an important role in controlling the structure of the mantle wedge. As these fluids leak into the mantle wedge they induce serpentinization there, transforming original mantle materials to those of lower velocity and higher Vp/Vs. The crustal thinning of the SW Japan Arc is characterized by notable decrease in upper crustal thickness, which is similar to the case of the NE Japan Arc.

The Moho and uppermost mantle structures beneath the southern part of the Kamchatka have a lot of similarities to those beneath the NE Japan Arc. Earlier DSS investigations and converted wave analyses show that Moho is situated at a depth of 38-40 km along the east coast of Kamchatka, that is beneath the volcanic front, but decreases to about 32 km near the west coast. Moho depth values based on modern receiver function methodology are also ranging from 31 to over 38 km. Moho is a fairly simple boundary under the western coast of Kamchatka, while in the Central Kamchatka Depression and especially along the eastern coast it is likely gradational. Uppermost mantle material beneath the Moho is complex, with additional impedance contrasts that are likely anisotropic in their properties being present under the entire Kamchatka peninsula. The dominant anisotorpy-inducing fabric varies from site to site along the west coast, but is almost universally trench-normal along the east coast. The seismic velocities beneath Kamchatka are very low (7.4-7.8 km/s for P-wave and 4.1-4.2 km/s for S wave). Also, gradual structural change is recognized around the Moho beneath the active volcanoes. These features are quite similar to those in NE Japan Arc.