Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

U004-01 会場: 302 時間: 5月24日09:00-09:20

Seismic constraints on slab dehydration and deep water transportation beneath Japanese islands

Seismic constraints on slab dehydration and deep water transportation beneath Japanese islands

川勝 均[1*]

Hitoshi Kawakatsu[1*]

[1]東京大学地震研究所

[1]ERI, University of Tokyo

Water in the mantle is expected to play essential roles in various significant problems of geodynamics, and delineating its location and abundance in the mantle was considered as one of the most important issues in the current solid geophysics. Here we report our progress in this regard based on high-resolution reflectivity analyses for the Japanese subduction zone.

We first present seismic image indicating the transportation of water into the mantle wedge of the subduction zone beneath northeastern Japan reported in Kawakatsu & Watada (2007, Science). The reflectivity profiles of seismic waves obtained from migrated receiver functions (RFs) of teleseismic earthquakes recorded by the dense Japanese seismic network, Hi-net, show strong signature of the dehydration of the subducting oceanic crust in the depth interval of 50-90km. Below this depth range, a low-velocity layer on the top of the subducting plate, which we infer as a channel of serpentinite that brings water into the deep mantle, is observed. The overall feature of our image is remarkably similar to the result of the numerical simulation of the water transportation beneath the Japan arc (Iwamori, 2007, Chem. Geol.), and thus provides a strong line of evidence for deep water transportation within the mantle wedge of the subduction zone. Our result indicates that a significant amount of water (several weight percent H2O) is transported at least to a depth ~130-150km through this channel.

To image the subducting Pacific plate better, we have extended the above treatment by introducing a "vectorial receiver function" method (Kawakatsu, 2008, JpGU, AGU). A signature corresponding the low-velocity channel atop of the slab can be traced as deep as ~350km, suggesting at least water may be transported to the depth. Below 350km right beneath central/southwestern Japan, there also exist signatures inside of the slab which we attribute to those originated from the postulated meta-stable olivine wedge (MOW; Iidaka and Suetsugu, 1992, Nature). We observe both velocity decrease (from shallow to deep) and increase corresponding respectively to the upper and lower edge of the MOW which is expected to have several percent slower seismic velocity relative to the surrounding normal slab (Kaneshima et al., 2007, EPSL). The existence of the MOW indicates insignificant amount of water (~100ppm) present in the subducting slab in the region (Hosoya et al., 2005, GRL, Yoshioka and Torii, 2008, AGU), thus a deep "dry" cold slab.

We have also investigated the seismic structure of the Philippine Sea plate beneath the Kii-peninsula in terms of interval vp/vs ratios, geometry and anisotropy of the subducting oceanic crust, using a large number of receiver functions (RFs) of Japanese network data (Kumar et al., JpGU, 2009). The modeling results for stations close to the trench indicate very anomalous vp/vs ratios (>2.2) providing a possible evidence for over pressured fluids within the subducting oceanic crust. These results are similar to those recently reported from the Cascadia subduction zone, where the anomalously high vp/vs values have been interpreted in terms of pervasive presence of water trapped in fluid form by a sealed (impervious) plate boundary, resulting in pore pressures near lithostatic values (Audet et al., Nature, 2009). Beneath the Kii-peninsula, these regions of high vp/vs ratios are located above and seaward of the low frequency earthquakes (LFEs). The difference in the mode of waster transportation beneath northeast and southwest Japan may be attributed to the difference of thermal state of the subducting oceanic plates.

キーワード:レシーバー関数

Keywords: receiver function