

Three-dimensional P and S Wave Velocity Structures beneath Japan - Part 2 -

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Japan Meteorological Agency is developing the hypocenter determination method that uses 3-D velocity structure. For the purpose, we determine the prototype of 3-D P and S wave velocity structures beneath Japan.

In this study, we applied the method proposed by Zhao et al. (1994) to the area from 20N to 48N, from 120E to 154E and shallower than 800 km. The grid interval was about 10 km in the shallow areas of main 4 lands, and was about 30 km in other areas. For the inversion, we explicitly defined the Conrad, the Moho and the upper boundary of the Pacific plate.

We used 283,319 P arrival times and 138,119 S arrival times of 11,614 regional earthquakes and 336 teleseismic ones, observed at 2,540 stations. Those included arrival times observed by temporary pop-up type oceanbottom seismometer, and of blasts.

We obtain 3-D P and S wave velocity structures beneath Japan, which are more accurate than conventional ones. Active volcanoes locate at the edge portions of P and S wave low velocity zones and of high V_p/V_s value zones at the depth ranging from 10 km to 40 km. These zones come from the influence of magmas beneath the active volcanoes. Prominent P and S wave low velocity zones exist along the Okinawa trough at the depth ranging from 30 km to 50 km. In those areas, V_p/V_s values are high. The feature shows that some mantle materials contribute to the rifting of the Okinawa trough. The epicenters of large crustal earthquakes occurred after 1900 locate at the edge portions of P and S wave low velocity zones at the depth ranging from 20 km to 30 km. Moreover, many active faults locate at the edge portions of P and S wave low velocity zones at the depth ranging from 10 km to 30 km. Those are because the edge portions of P and S wave low velocity zones might represent weak sections of the seismogenic crust, caused by active volcanoes, magma chambers and the dehydration of the subducting slabs, as mentioned in Zhao et al. (2000). Nonvolcanic deep tremors associated with subduction in southwest Japan that is described in Obara(2002) keep from low V_p/V_s value zones. This is because there are not enough fluids to trigger tremors in these zones. P and S wave low velocity zones and high V_p/V_s zones exist at slip areas of silent earthquakes at the depth ranging from 20 km to 30 km. This implies that plate boundary materials serpentinize to weaken interplate coupling in the areas. Prominent and wide P and S wave low velocity zones exist beneath central Japan at the depth ranging from 30 km to 40 km. They locate at the volcanic front related to the subducting Pacific plate. Moreover, seismicity around the Philippine Sea plate is very low in those areas. Therefore, magma genesis processes related to the subducting Pacific plate possibly activate those around the Philippine Sea plate.

References: Obara, 2002, Science, 296, 1679-1681; Zhao et al., 1994, JGR, 99, 22313-22329.; Zhao et al., 2000, JGR, 105, 13579-13594.