3-D velocity structure under the Kyusyu region derived from tomography

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We estimated both P and S wave velocity (Vp, Vs) structures beneath the Kyushu region by applying a tomographic method to 52,914 P and 45,861 S wave arrival times from 1293 local earthquakes. The Kyushu subduction zone in southwest Japan is characterized by active subduction of the young Philippine Sea plate beneath the Eurasian plate. Shallow and intermediate-depth earthquakes occur actively down to a depth of about 200 km. Active arc volcanoes form a distinct volcanic front in the central portion of island; the volcanic front coincides with the 100-150 km isodepth of the Wadati-Benioff zone. All of the volcanoes in Kyushu are very active; a few of them have erupted in the last two decades, such as Unzen and Sakura-jima volcanoes. In recent years, installation of stations progressed splendidly and now more than 157 stations exist in Kyushu. Our results show that the subducting Philippine Sea slab is imaged clearly as a high-velocity zone. It has a thickness of about 35 km and a P wave velocity 3-5% and a S wave velocity 2-5% faster than the normal mantle. Very slow velocity anomalies exist in the mantle wedge and extend to the forearc region down to the subducting Philippine Sea slab beneath northern Kyushu. These results indicate that regimes of melting and magmatism in a subduction zone with a young slab is different from those with old slabs. Dehydration and melting occur beneath the arc and forearc regions above a young slab such as in northern Kyushu, while they occur beneath the volcanic front and back arc above old slabs such as Northeast Honshu and South Kyushu. The formation of magmatism and volcanism in Kyushu is considered to be related to the convective circulation process in the mantle wedge and the dehydration of the subducting Philippine Sea slab. After estimating the P and S wave velocity structure we calculate Poisson's ratios from Vp and Vs. Low-Vp, low-Vs, and high Poisson's ratio zones are extensively distributed along the volcanic front in the uppermost mantle and extend to the back arc side in the mantle wedge. These results imply the presence of a vast amount of melts in the uppermost mantle. In contrast, the lower crust beneath active volcanoes exhibits low Vp, low Vs, and low Poisson's ratio. This feature suggests the existence of H2O (rather than melt) right beneath the active volcanoes. Another characteristic of the Philippine Sea slab is that the seismicity in the slab shows a single seismic zone, and exhibits down-dip tensional (DDT) stresses. These results suggest that the slab subduction is caused by slab pull with little resistance in the mantle since the Philippine Sea slab has not reached the 660 km discontinuity.