

V_p, V_s, and Poisson's ratio anomalies beneath Kyushu: Implications for volcanism and forearc mantle wedge serpentinization

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We determine detailed 3-D V_p and V_s structures of the crust and upper mantle beneath the Kyushu Island, southwest Japan, using a large number of arrival times from local earthquakes. From the obtained V_p and V_s models, we further calculate Poisson's ratio images beneath the study area. By using this large data set, we successfully image the 3-D seismic velocity structures beneath Kyushu down to a depth of 180 km with a reliable spatial resolution than previous studies. Our results show very clear low V_p and low V_s anomalies in the crust and uppermost mantle beneath the northern volcanoes, such as Abu, Kujyu and Unzen. Low velocity anomalies are seen in the mantle beneath other volcanoes. In contrast, there are no significant low velocity anomalies in the crust or in the upper mantle between Aso and Kirishima. The subducting Philippine Sea slab is imaged generally as a high-velocity anomaly down to a depth of 150 km with some patches of normal to low seismic wave velocities. The Poisson's ratio is almost normal beneath most of the volcanoes. The crustal seismicity is distributed in both the high and low velocity zones, but distinctly in the low Poisson's ratio zone. A high Poisson's ratio region is found in the forearc mantle above the slab in the junction area with Shikoku, whose high P-wave velocities preclude a possibility of serpentinization; this high Poisson's ratio would be caused by water-filled cracks in the wedge induced by dehydration from the Philippine Sea slab. The Poisson's ratio is normal to low in the forearc mantle in middle-south Kyushu. This is consistent with the absence of the low-frequency tremors, and may indicate that the dehydration from the subducting crust is not vigorous in this region.