Vp and Vs measurements of blueschists: implications for the origin of high-Poisson's ratio anomalies in the subducting slab.

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P-wave and S-wave velocity (Vp, Vs) measurements of two-types of blueschist, i.e. lawsonite-bearing and epidote-bearing types, have been performed using ultrasonic pulse transmission technique up to 1.0 GPa and 400 C, in order to evaluate the structure of the subduction zone inferred from the seismic tomography. The low-variant mineral assemblages of the lawsonite-bearing (lawsonite + crosstie + chlorite +/- pumpellyite + albite + quartz) and the epidote-bearing blueschists (epidote + glaucophane/crosstie + winchite + chlorite + albite + quartz) suggest that these rocks were equilibrated under 0.6-0.8 GPa, below 300 C, and 0.8-1.0 GPa, 350-400 C, respectively. The recent thermal modeling for the subducting Philippine Sea Plate beneath the southwest Japan suggests that the studied lawsonite and epidote blueschists can be formed below Kii Peninsular and Shikoku-Chugoku areas, respectively.

As the blueschists have a prominent foliation and lineation, the P-wave velocity shows a relatively high anisotropy correlating with the rock fabric (ca. 5-10 % for the lawsonite blueschist, and ca. 11 % for epidote blueschist). The following average velocities are obtained at each peak P-T condition, Vp = 7.21-7.24, Vs = 3.82-4.01 (km/s) for lawsonite-blueschist (at 0.8GPa, 250 C), and Vp = 7.38, Vs = 4.26 (km/s) for epidote-blueschist (at 0.8 GPa, 400 C). The newly obtained Vp (and Vs) of blueschists are higher than other low/intermediate-grade metabasites, such as zeolite facies (Vp = 6.32), pumpellyite-actinolite facies (Vp = 6.44), greenschist (Vp = 6.90) and amphibolite (Vp = 7.02), but lower than the ultrahigh-pressure eclogite (Vp = 8.27). Poisson's ratios, calculated from the average Vp and Vs at each peak P-T condition, are 0.29 for lawsonite blueschist and 0.25 for epidote blueschist.

The Vp and Poisson's ratio determined by the experiment can predict the seismic structure in several areas, e.g., the oceanic crust of the Philippine Sea Plate subducting beneath Shikoku-Chugoku area may gradually increase Vp from 5.9-6.3 (km/s) at shallower level (10 km depth), through 7.3-7.4 (km/s) at 30 km depth, to more than 8.3 (km/s) at deeper than 50 km depth, and may decrease Poisson's ratio from 0.29 at shallower level to 0.25 at 30 km depth. The seismic wave velocity tomography indicates that Vp and Poisson's ratio (P) of the oceanic crust subducting beneath Shikoku-Chugoku area increase from Vp = ca. 6.5 (km/s) and P = ca. 0.25 at 20 km depth to Vp = ca. 7.5 (km/s) and P = over 0.31 at 35 km depth. The area with high-Poisson's ratio anomalies (P = over 0.31) roughly corresponds with the source regions of the deep low-frequency tremors beneath Shikoku. From the petrophysical point of view, the high-Poisson's ratio anomalies cannot be explained only by the transition of Poisson's ratio of the high-pressure metamorphic rocks derived from the oceanic crust, but possibly by the fluid dehydrated from the subducting slab.