

Buoyancy of slab as a cause of deep tremors

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Deep seismic tremors on the plate boundary are common in areas from Tokai to Shikoku but not in Kyushu. The boundary is the eastern margin of Kyushu. No deep tremors were observed in the western areas, though these areas lie on the same subducting slab. The boundary is very sharp. One possible difference between the two is the age of ocean.

The Parece Vela ridge separates the Philippine Sea plate into two. Ocean depths of Parece Vela basin and Shikoku basin are 5000m and 4500m, respectively. It is known that the Shikoku basin is geologically younger than the Parece Vela basin. The Japan Sea basin with a depth of 3500m is the youngest. The Pacific Ocean with a depth of about 6000m is the oldest and characterized with a thick and cold oceanic mantle. The thickness of cold oceanic mantle is the key to understand the occurrence of deep seismic tremors. A slab with positive buoyancy resists sinking of oceanic slab from the continental one at the plate boundary. On the other hand, negative buoyancy has no effect on the plate boundary.

We estimated the thickness of cold oceanic mantle relative to the Pacific mantle. Assuming isostasy and no cold oceanic mantle under the Japan Sea crust, we can estimate the density difference between oceanic mantle and asthenosphere. Using this density difference, we estimated the thicknesses at Shikoku and Parece Vela basins, as $0.41H$ and $0.61H$, respectively, where H is the thickness of oceanic mantle under the Pacific. If the thickness is $0.43H$, the buoyancy is zero. That is, the slab beneath Shikoku can resist separating of oceanic slab and gives rise to tremor generation and that under Kyushu sinks smoothly.