

The reason why no low-frequency tremor is found in some areas of southwest Japan: Implications for variation of seismic coupling

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Generally along the Nankai Trough, the Philippine Sea plate (PSP) with a normal oceanic crust (the Shikoku Basin) is subducting. In contrast, in the Sagami Trough and the Hyuganada region, the PSP with an island-arc crust, i.e., the fore-arc of the Izu-Bonin Ridge and the remnant arc (the Kyushu-Palau Ridge), respectively, is subducting. North of Izu, the volcanic Izu-Bonin ridge is colliding. The regions with smaller seismic slip seen above correspond to those where an island-arc crust is subducting. Interestingly, the low-frequency tremor in the fore-arc wedge at the Moho depth has not been observed in these regions (Obara, 2002). I suggest that subduction of an island-arc crust diminishes dehydration from the subducted crust, because it consists mostly of non-metamorphosed granite, and then prevents occurrence of the low-frequency tremor in the fore-arc (In fact, there is one more region where no low-frequency tremor has not been found; it is E. Shikoku. Here the PSP with an anomalous oceanic crust, i.e., the Kinan Seamount chain of which nature might be close to an island-arc crust, is subducting).

Accepting the dehydration embrittlement hypothesis for slab seismicity, there are two types of earthquakes in the slab; one is representing dehydration from the metamorphosed oceanic crust, and the other is representing dehydration from the serpentinized slab mantle. If the inference stated above is correct, it is expected that earthquakes would not occur in the crustal part of the slab in the regions where an island-arc crust is subducting. This in fact can be demonstrated from the seismicity distribution and the observation that later phases traveling within the low-velocity channel through the subducting crust are not found (Hori, 1990).

The amount of dehydration from the crust would affect the mode of occurrence of interplate earthquakes at the thrust zone. At the thrust zone deeper than 10 km, the lithostatic pressure would amount to 0.3 GPa, and some weakening mechanism is required to cause an earthquake. Elevated pore fluid pressure would be the most plausible mechanism. The source of fluid is most likely that dehydrated from the subducting oceanic crust, because the dehydration of sediments occurs at much shallower depth. It is then expected that large interplate earthquakes would be less frequent in the places where an island-arc or continental crust is subducting.