

On the characteristics of collision

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It is generally believed that buoyancy of the continental or island-arc crust makes subduction of the lithosphere difficult in collision zones. However, there remains a question whether the buoyancy is a unique condition for generating collision. This is because an oceanic plate subducted in front of the trailing continental plate provides the slab pull to pull the continental crust down to tens or hundreds of km depth. When the continental crust is subducted deeper than 100 km, part the crustal material transforms into eclogite denser than asthenosphere and might have its own driving force for subduction. However, we do not see any example in which lithosphere having continental crust is subducting over hundreds of km depth. This suggests that there might be another factor which characterizes collision other than the buoyancy. Recently low-frequency tremors (LFT) have been found around the Moho depth of the Southwest Japan forearc, forming a narrow zone along the strike of the arc (Obara, 2002). In the four locations, LFT is lacking. They are Kanto, N. Izu, E. Shikoku, and S. Kyushu. Seno and Yamasaki (2003) noted that these are the places where island-arc crust is subducting (or colliding in N. Izu). They proposed that dehydration of the subducted crust does not occur beneath these regions, because it is composed mainly of tonalite, lacking the quantity of hydrous minerals seen in normal subducting oceanic crust. They showed that almost no earthquake occurs within the subducted crust in such regions, consistent with dehydration embrittlement hypothesis for intraslab seismicity. Among the four places cited above, only N. Izu is the collision zone where the Izu-Bonin volcanic ridge is impinging into central Honshu. There is a marked difference between N. Izu and the other three places. Not only LFT, but also the intraslab seismicity is completely missing in N. Izu, whereas there is intraslab seismicity in the other places. In Kanto, E. Shikoku and S. Kyushu, there is intraslab seismicity in the mantle part. This implies that the mantle portion of the slab in these regions is serpentinized by some reasons. This contrast with N. Izu suggests that absence of seismicity, i.e. dehydration, in the entire portion of the slab would affect the rheological nature of the plate interface and its vicinity, and might characterize collision. This is reflected on the difference in interseismic crustal deformation between the subduction zone and the collision zone, the former is described by the back-slip model, but the latter is described by the detachment model.