

New insights on 3-D plates interaction near Taiwan from tomography and tectonic implications

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Abstract

Recent tomographic results are used to trace the South China Sea and Philippine Sea subducting slabs, south and northeast of Taiwan along the Manila and Ryukyu trenches, respectively. In particular, the 3-D plates interaction beneath Taiwan is discussed based on a close-up view of the tomographic sections together with earthquake hypocenters distribution. Our study indicates that: (1) the east-dipping South China Sea slab can be followed to the north, up to the latitude of Hualien, (2) the Eurasian plate subducts beneath most part of the Taiwan island down to the 670 km-depth discontinuity, (3) the north-dipping Philippine Sea slab can be followed slightly west of the longitude of Hualien. Both plates thus interact beneath northern Taiwan where the arc–continent collision is paroxysmal. (4) Slab detachment is envisaged at the northern edge of the subducted Eurasian plate beneath the Coastal Range of Taiwan, which may facilitate the northwestward motion of the Philippine Sea plate with respect to Eurasia. Slabs geometries obtained from tomographic sections allow us to reconstruct the Late Neogene plate kinematics and dynamics in this region. Our main conclusions are: (1) The size of the original South China Sea was about twice its present size. (2) The subducted part of the West Philippine Basin i.e. the largest oceanic basin of the Philippine Sea Plate, extends only 400 km north of the Ryukyu Trench. (3) Slab detachment might have occurred 3–5 my ago beneath the central and northern Ryukyu Arc along a weak zone that is aligned with the Gagua Ridge: an ancient plate boundary. (4) The Ryukyu Trench has propagated westward from 126°E of longitude (southeast of Miyako Island) to the locus of the present arc–continent collision, along a major lithospheric tear that cut through the continent–ocean boundary first, and then through the continental lithosphere. As a consequence, the southern Ryukyu margin developed progressively from east to west as a subduction zone during the last 8 my. It has been elaborated onto a passive margin which corresponded to the edge of the Eurasian continental shelf bordering the South China Sea prior to Pliocene. (5) The Southern Okinawa Trough rifted during the last 2 ± 1 Ma following the propagation of the subduction zone. (6) Subduction of the Eurasian margin probably stopped recently beneath northern Taiwan and a flip of subduction from west to east is being initiated near Hualien. © 2001 Elsevier Science B.V. All rights reserved.

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