Geophysical Research Abstracts
Vol. 20, EGU2018-11916, 2018
EGU General Assembly 2018

Subducting of continental rise, slope and shelf basins in Taiwan oblique arc-continent collision

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The active Taiwan arc-continent collision is oblique, showing a south-to-north transition from oceanic to continental subduction, resulting from the impingement of the N-S trending Luzon Arc of the Philippine Sea plate with the NE-SW trending Asian passive margin on the Eurasian plate. Here we focus on the role of major sedimentary basins of the continental shelf and slope that are below the Eurasian subduction interface and are undergoing initial stages of subduction, currently imaged to depths of 35-50km in seismic tomography. In this study, we integrate deep multi-scale geophysical/geologic transects across the plate boundary in southern and central Taiwan with maps of the Eurasian subduction interface, the base of the sedimentary and metasedimentary upper crust and the Eurasian Moho, based on local Vp and Vs tomography. These maps and transects reveal deep sedimentary basins below the Eurasian subduction interface.

The deepest basins on the Eurasian continental shelf in central and northern Taiwan (north of Tainan) consist of N-S trending rift basins extending to depths of 35-50km containing quartz-rich sediments or metasediments based on velocity analysis. These basins are of probable Paleogene age, with the allochthonous Hsuehshan range of Taiwan being a likely outcropping of this deep stratigraphy. Allochthonous Miocene strata of the western Taiwan thrust belt represent the shallowest levels of these rift basins, based on retrodeformable cross sections and maps. Much of the deep seismicity (>15km) below the Eurasian subduction interface is associated with the margins of these deep rift basins, including many of the tremor events. These basins reach their greatest depths, approaching 50km, under the eastern Central Mountains where Eurasian lower crust is subducting vertically.

In contrast, south of Eurasian shelf-slope break (south of Tainan) Taiwan-derived Pliocene-Pleistocene orogenic strata rapidly thicken southwards to depths of >20km near Kaohsiung and Pingtung, based on tomography and velocity analysis, forming the giant Tainan basin depocenter. This thick basin extends eastwards underneath the metamorphic rocks of the Central Mountains, showing a strong velocity inversion at $\sim$10km depth marking the Eurasian subduction interface. Under eastern Taiwan this basin is interpreted to subduct to a depth of 50km based on seismic tomography. This thick sedimentary basin is highly overpressured based on vertical gradient in seismic velocities and the existence of mud volcanoes. The base of this sedimentary basin, near the top of thinned lower crust, is seismically illuminated and is likely also a detachment. The main-shock hypocenter of the 2016 Meinong earthquake (Mw=6.4) was along this detachment and additionally triggered slip on the shallow thrust belt of the 5km deep main subduction interface east of Tainan. Geodetic data from southwest Taiwan indicates a current southwestward extrusion parallel to the continental slope; we speculate that the deep detachment at the base of the Tainan basin is the detachment required for this extrusion. This southwestward extrusion appears to extend over the entire massive offshore accretionary wedge of southwest Taiwan as indicated by its southwestward surface slope, based on consideration of critical-taper wedge mechanics.