Available online at www.sciencedirect.com

SCIENCE DIRECT®

Tectonophysics 401 (2005) 23–54

TECTONOPHYSICS

www.elsevier.com/locate/tecto

Crustal-scale seismic profiles across Taiwan and the western Philippine Sea

Kirk McIntosh[a,*], Yosio Nakamura[a], T.-K. Wang[b], R.-C. Shih[c], Allen Chen[b], C.-S. Liu[d]

[a]*Institute for Geophysics, Jackson School of Geosciences, The University of Texas at Austin, 4412 Spicewood Springs Rd., Bldg. 600, Austin, TX 78759-8500, USA*
[b]*National Taiwan Ocean University, Institute of Applied Geophysics, Keelung, Taiwan*
[c]*Institute of Seismology, National Chung Cheng University, Chiayi, Taiwan*
[d]*Institute of Oceanography, National Taiwan University, Taipei, Taiwan*

Received 14 January 2004; accepted 28 February 2005
Available online 13 April 2005

Abstract

We have used combined onshore and offshore wide-angle seismic data sets to model the velocity structure of the Taiwan arc–continent collision along three cross-island transects. Although Taiwan is well known as a collisional orogen, relatively few data have been collected that reveal the deeper structure resulting from this lithospheric-scale process. Our southern transect crosses the Hengchun Peninsula of southernmost Taiwan and demonstrates characteristics of incipient collision. Here, 11-km-thick, transitional crust of the Eurasian plate (EUP) subducts beneath a large, rapidly growing accretionary prism. This prism also overrides the N. Luzon forearc to the east as it grows. Just west of the arc axis there is an abrupt discontinuity in the forearc velocity structure. Because this break is accompanied by intense seismicity, we interpret that the forearc block is being detached from the N. Luzon arc and Philippine Sea plate (PSP) at this point. Our middle transect illustrates the structure of the developing collision. Steep and overturned velocity contours indicate probable large-scale thrust boundaries across the orogen. The leading edge of the coherent PSP appears to extend to beneath the east coast of Taiwan. Deformation of the PSP is largely limited to the remnant N. Luzon arc with no evidence of crustal thickening to the east in the Huatung basin. Our northern transect illustrates slab–continent collision—the continuing collision of the PSP and EUP as the PSP subducts. The collisional contact is below ~20 km depths along this transect NE of Hualien. This transect shows elements of the transition from arc–continent collision to Ryukyu arc subduction. Both of our models across the Central Range suggest that the Paleozoic to Mesozoic basement rocks there may have been emplaced as thick, coherent thrust sheets. This suggests a process of partial continental subduction followed by intra-crustal detachment and buoyancy-aided exhumation. Although our models provide previously unknown structural information about the Taiwan orogen, our data do not define the deepest orogenic structure nor the structure of

* Corresponding author. Tel.: +1 512 471 0480; fax: +1 512 471 0348.
E-mail address: kirk@ig.utexas.edu (K. McIntosh).

0040-1951/$ - see front matter
doi:10.1016/j.tecto.2005.02.015