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A preliminary study of crustal structure in Taiwan region using receiver function analysis

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SUMMARY

Selected teleseismic data observed at temporary and permanent broad-band stations have been analysed using the receiver function method in order to investigate the very complex crustal structure in Taiwan region. Very significant azimuthal variations of radial and transverse receiver function responses from broad-band stations could be attributed to, among other things, the sampling of incoming seismic waves across the nearby subduction zone, a subsurface dipping interface, or a localized anisotropic region. A mid-crust discontinuity, interpreted as the Conrad discontinuity, can be identified at 18–20 km depth beneath TATO and TPUB stations in the Western Foothills, but is absent beneath the two nearby stations SSLB and TDCB in the Central Mountain Range. The separation of upper and lower crust beneath the Western Foothills and the steady increase in crustal velocity as a function of depth across the entire thicker crust beneath the Central Mountain Range suggest that the tectonic evolution of the crust may be significantly different for these two adjacent regions. Although a 'thin-skinned' model may be associated with the tectonic evolution of the upper crust of the Western Foothills and Western Coastal Plain, a 'thick-skinned' or 'lithospheric deformation' model can probably be applied to explain the crustal evolution of the Central Mountain Range. A trend of crustal thinning from east (50–52 km) to west (28–32 km) is in very good agreement with the results from two east–west-trending deep seismic profiles obtained using airgun sources. The thinner crust (20–30 km) beneath TWB1 station in northeastern Taiwan can be associated with the high-heat-flow backarc opening at the western terminus of the Okinawa trough behind the subduction of the Philippine Sea plate. The relatively simple crustal structure beneath KMNB station, offshore southeastern China, depicts typical continental crust, with the Moho depth at 28–32 km. An apparent offset of the thickest Moho beneath NACB station from the topographic high in the central Central Mountain Range suggests that the Taiwan orogeny has probably not reached its isostatic status.

Key words: broad band, crustal structure, Moho, receiver function.

GJI Seismology

INTRODUCTION

The island of Taiwan is located along the Eurasian and the Philippine Sea plate boundary. A mix of active subduction and collision between the two plates has contributed to the active mountain building processes and tectonic evolution around the Taiwan region. In northern Taiwan, the Philippine Sea plate has been subducting beneath the Eurasian plate in a NW direction along the Ryukyu arc, while in southern Taiwan, the South China Sea plate has been subducting eastwards beneath the Luzon arc of the Philippine Sea plate (Fig. 1). Between the two subduction zones, the Eurasian plate and the Philippine Sea plate collide in central eastern Taiwan along a north–south-trending suture zone, known as the Longitudinal Valley. As a consequence of plate collision, actively uplifted and highly metamorphosed mountain ranges formed, including the Central Mountain Range to the west of the suture zone on the Eurasian plate and the Coastal Range to the east of the suture zone on the Philippine Sea plate. As shown in the summary of major tectonic units in Taiwan region (Fig. 2), the continental margin part of Taiwan consists of four NNE–SSW-trending structural belts based on rock type and degree of deformation. From west to east, the Coastal Plain, the Western Foothills, the Western Central Range, and the Eastern Central Range are separated by faults or structural discontinuities (Ho 1988). The orogeny in Taiwan region is very young, commencing about 4 million years ago, and is still very active. Owing to the oblique collision of the Luzon arc with the continental margin, the younger collision zone in Taiwan is extending southwards, i.e. the collision is more advanced along the northern

