Tectonophysics 687 (2016) 129–138

Contents lists available at ScienceDirect

Tectonophysics

journal homepage: www.elsevier.com/locate/tecto

Continental like crust beneath the Andaman Island through joint inversion of receiver function and surface wave from ambient seismic noise

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ARTICLE INFO

Article history:
Received 17 May 2016
Received in revised form 7 September 2016
Accepted 9 September 2016
Available online 10 September 2016

Keywords:
Andaman Islands
Crustal structure
Joint inversion
Receiver function
Ambient noise
Continental crust

ABSTRACT

We study shear wave velocity structure of the crust beneath the Andaman Island through joint inversion of the teleseismic receiver function and Rayleigh wave group velocity measurements from 10 broadband seismographs over the Island. The group velocities in the periods from 5 to 21 s are obtained using cross-correlation of six month's ambient seismic noise data recorded by these seismic stations. Joint inversion results show ~2 to 6 km thick subsurface low shear velocity (*Vs* ~1.3–2.5 km/s) layer followed by a 12–14 km thick layer of silicic material (average *Vs* ~3.5 km/s). The lower crust is mapped as an 8–12 km thick mafic layer with *Vs* ~4.0 km/s. Uppermost mantle shear wave velocity is ~4.55 km/s. The near-surface low-velocity layer is interpreted as the Andaman flysch sediments. The crustal thickness beneath the Andaman Island varies from ~24 km in the north to ~32 km in the south. The shear wave velocity-depth results show that the crustal structure beneath the Andaman Island is akin to *continental crust*, possibly the Burma continental crust. The subducting Indian plate may lie down below this overriding plate.

1. Introduction

Understanding the origin and evolution of the continental crust in different tectonic environments is one of the vital, challenging and considerably debatable issues of the Earth Sciences. In general, the formation of the continental crust is considered to be completed in the Precambrian (*e.g.*, Taylor and McLennan, 1995; Condie, 1998). However, few studies advocate for the continental crustal growth during Phanerozoic and, primarily through either by vertical addition of basaltic magmas or by lateral accretion of intra-oceanic/island arc in a subduction environment (*e.g.*, Rudnick, 1995; Clift et al., 2009). While Island arcs are considered to be one of the principal sites of crustal genesis and growth, the available knowledge about the composition and structure of the Island arcs is inadequate for a better understanding of genesis and evolution of the continental crust. With two contrasting average bulk compositions (basalt *vs* andesite), as suggested for the Island arcs, the Island arc model for the growth of continental crust is debatable (Holbrook et al., 1999 and references within).

The Andaman-Nicobar Island arc in the NE Indian Ocean marks the eastern margin of the Indian plate and forms an important transitional tectonic link between the eastern Himalayan syntaxis in the north and Sunda arc in the south (Fig. 1a–b). The knowledge of crustal structure beneath the Andaman-Nicobar Island arc can provide a good contribution towards nature of the crust below an Island arc and its possible role in understanding the evolution of the continental crust.

Hitherto, with the available geological and geophysical studies the nature of the crust beneath the Andaman-Nicobar arc, *e.g.*, oceanic (basaltic bulk composition) or continental (andesitic bulk composition), is a matter of debate. Based on onshore structural and stratigraphic data, Acharyya (2007) advocated for a continental crust below the Andaman-Nicobar arc. While Curray (2005), using reversed seismic sections in the offshore Indo-Burma Range, argued for its oceanic character. Modeling of gravity field data suggested 40–47 km thick upper lithosphere with mainly oceanic crust below the Andaman-Nicobar arc (Radhakrishna et al., 2008). In a recent study, based on modeling of satellite gravity data, local earthquake waveform data and preliminary qualitative interpretation of receiver function, Rao et al. (2011) reported a 30 km thick oceanic double crust. The authors interpreted a double crustal column comprising the overriding Burma plate, having a thickness of about 21 km including a 5 km thick sedimentary layer, and subducting Indian crust with an apparent thickness of about 9 km. Based on the timing of Moho converted *P-to-S* wave in the receiver function, Rao et al. (2011) estimated the crustal thickness variation from 16 km in the north to 20 km in the south Andaman. In absence of any derived seismic velocity model for the region this result,

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http://dx.doi.org/10.1016/j.tecto.2016.09.013
0040-1951/