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Crustal shear-wave velocity structure beneath northeast India from teleseismic receiver function analysis

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ABSTRACT

We investigated the seismic shear-wave velocity structure of the crust beneath nine broadband seismological stations of the Shillong–Mikir plateau and its adjoining region using teleseismic *P*-wave receiver function analysis. The inverted shear wave velocity models show ~34–38 km thick crust beneath the Shillong Plateau which increases to ~37–38 km beneath the Brahmaputra valley and ~46–48 km beneath the Himalayan foredeep region. The gradual increase of crustal thickness from the Shillong Plateau to Himalayan foredeep region is consistent with the underthrusting of Indian Plate beyond the surface collision boundary. A strong azimuthal variation is observed beneath SHL station. The modeling of receiver functions of teleseismic earthquakes arriving the SHL station from NE backazimuth (BAZ) shows a high velocity zone within depth range 2–8 km along with a low velocity zone within ~8–13 km. In contrast, inversion of receiver functions from SE BAZ shows high velocity zone in the upper crust within depth range ~10–18 km and low velocity zone within ~18–36 km. The critical examination of ray piercing points at the depth of Moho shows that the rays from SE BAZ pierce mostly the southeast part of the plateau near Dauki fault zone. This observation suggests the effect of underthrusting Bengal sediments and the underlying oceanic crust in the south of the plateau facilitated by the EW-NE striking Dauki fault dipping 30^0 toward northwest.

1. Introduction

The northeastern region (NER) of India is one of the most complex tectonic domain in the world which is manifested by the ongoing India-Asia collision to the north and Indo-Burmese subduction to the east (Bilham and England, 2001; Angelier and Baruah, 2009; Kayal et al., 2010, 2012). The region has experienced two great earthquakes (Ms ~ 8.7), the 12 June 1897 Shillong earthquake (Oldham, 1899) and the 15 August 1950 Assam earthquake and more than 20 large ($M > 7.0$) earthquakes (Nandy, 2001; Kayal, 2008).

Several hundred earthquakes ($M > 4.0$) are recorded during the past few decades in the region. In addition to the national network run by the India Meteorological Department (IMD), the North-East Institute of Science and Technology-Jorhat (NEIST-J), the National Geophysical Research Institute-Hyderabad (NGRI-H), Geological Survey of India (GSI) and several universities established temporary and permanent analog networks since 1982. Since 2001 the network is upgraded to broadband digital stations with global positioning systems (GPS) timing. The tectonic complexity of the region is evidenced by the sustained seismicity as well as surface geological features. The Shillong–Mikir Plateau, Brahmaputra valley, Indo-Burmese Subduction zone and Eastern Himalayan Syntaxis are the distinctive geological units of the region.

A number of studies have been made on seismicity and seismotectonics of the region (Angelier and Baruah, 2009; Kayal et al., 2006; Baruah et al., 2013; Bora et al., 2013). However, the subsurface structure of the distinctive geological units of the region is less studied, which is crucial to understand the geodynamic of the region. Prior to 2001, most of the studies (De and Kayal, 1990; Kayal and Zhao, 1998; Rai et al., 1999; Sitaram et al., 2001; Bhattacharya et al., 2005, 2008, 2010) were focused on the crustal structure of the NER India in general and Shillong–Mikir Plateau (SMP), in particular, using the analog data. Now, most of the seismic stations are upgraded to broadband digital stations. The recent broadband waveform data accrued from these stations allowed few researchers to adopt receiver function (RF) analysis technique

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