[Journal of Geodynamics](https://www.sciencedirect.com/journal/journal-of-geodynamics)

[Volume 127](https://www.sciencedirect.com/journal/journal-of-geodynamics/vol/127/suppl/C), June 2019, Pages 16-30



**An appraisal of crustal structure of the Indo-Burmese subduction region**

<https://doi.org/10.1016/j.jog.2019.05.002>[Get rights and content](https://s100.copyright.com/AppDispatchServlet?publisherName=ELS&contentID=S0264370718301790&orderBeanReset=true)

**Highlights**

* •

The first image of [crustal structure](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/crustal-structure) of the Indo-Myanmar subduction region.

* •

Map of subducted Moho across the [subduction zone](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/subduction-zone).

* •

Physio-chemical composition of the Indian pate and Burmese [micro plate](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microplate).

* •

Recent [seismicity](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/seismicity) and [geodynamics](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/geodynamics) of the study region.

**Abstract**

We analyzed teleseismic receiver functions of 9 sites to determine the [crustal structure](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/crustal-structure) beneath the Indo-Burmese subduction region (IBR), which is seismically one of the most active subduction zones of the Indian subcontinent. The receiver function analysis of the primary and reverberated phases allowed us to image the down going Moho beneath the Burmese [micro plate](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microplate) parallel to the subducting slab. We observed that this [subduction zone](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/subduction-zone) is characterized by sharp dip of a thick (˜45 km) crust in the Indian Territory, which steeply bends down to ˜57 km in the Burmese Territory separated by the Churachandpur Mao Fault (CMF). The Imphal valley, located in the central part of the IBR, has a sedimentary thickness of 2.5 km. The Poisson’s ratio values correlate well with the tectonic units comprises the subduction region. We observed high Poisson’s ratio values throughout the region, which reflects bulk mafic to ultramafic crustal composition. Our observations of Poisson’s ratio beneath the IBR reveal that the Indian crust along the IBR is oceanic in nature, which is possibly the Tethyan oceanic crust of Southeast Asia.

**Introduction**

The Indo-Burmese subduction region (IBR) is a prominent active subduction zone in the entire Indian plate, where the Indian plate is subducting beneath the Burmese arc (Fig. 1A). This ˜700 km long arc is seismically active and can produce large earthquakes with foci deep down to 250 km (Ni et al., 1989; Satyabala, 2003; Rao and Kalpana, 2005; Angelier and Baruah, 2009; Kundu and Gahalaut, 2012; Baruah et al., 2013). The underlying structure is a pivotal cause for depth wise seismicity along an inclined plane extended from the Bengal basin to the Central Myanmar basin (Kundu and Gahalaut, 2012; Steckler et al., 2016). The earthquakes in the IBR and Sagaing fault regions occur in response to partitioning of the India-Sunda motion along two distinct boundaries; one under the accretionary wedge of the Indo-Burmese arc, where the foci of the earthquakes clustered in two depth ranges, in 30–60 km in the Indian Territory part (Fig. 1B), which is generally referred to as eastward gently dipping surface that coincides with the Indian slab (Ni et al., 1989). Another cluster of events, up to depth of 200 km depth are observed along the steep slab towards east in the Burmese part (Kundu and Gahalaut, 2012). In this highly seismically active region, some geophysical investigations, mostly passive seismology and geodetic studies have been carried out by different researchers (Chandra, 1975, 1976; Ni et al., 1989; Chen and Molnar, 1990; Gupta et al., 1990; Satyabala and Gupta, 1996; Rai et al., 1996; Rao and Kumar, 1997; Rao and Kalpana, 2005; Gahalaut and Gahalaut, 2007; Angelier and Baruah, 2009; Kundu and Gahalaut, 2012; Baruah et al., 2013, 2015; Gahalaut et al., 2013). Rai et al. (1996) have inferred high velocity slab convergence operating in the Indo-Burmese ranges from their teleseismic travel time residual analysis of paired shallow and intermediate depth earthquakes occurring in this region.

The estimates of regional deformation and major fault movements from Global Positioning System (GPS) measurements divide the area covered in this study into two major geodynamic regions (Vigny et al., 2003; Maurin et al., 2010). The predominant northward movement of the Indian plate towards the Sunda plate by a rate of approximately 37 mm/year, occurs in dextral motion along the Sagaing fault at a rate of about 20–22 mm/year and the remaining 15–17 mm/year is accommodated in the IBR region (Bertrand et al., 1998; Socquet et al., 2006; Gahalaut and Gahalaut, 2007). The source of deformation in the Sagaing region is caused by westward movement of the Burmese plate. The roll back of the subducting Indian plate and the relative displacement along the Sagaing fault is significant (Rao and Kalpana, 2005). Several big to large earthquakes (6.2 Mb, 6th May 1984; 6.2 Mb 18 May 1987; 6.3 Mb 15 April 1992; 5.7 Mw, 18 September 1995; 6.7 Mw, 4 January 2016) are known to have occurred within the Indo-Burma region and to the west of the ranges of Indian Territory of this subduction range (Le Dain et al., 1984; Gupta et al., 1984; Gahalaut et al., 2016).

It is observed that the Northern Indo-Eurasian under thrusting zone is studied in great detail in recent years; the IBR has received relatively little attention, as large parts of this region are covered with dense forest, difficulty in accessibility. Along with the lack of communication facility and scarcity of seismic data, very few geophysical studies have been done in IBR. Here we have made an attempt to study the geodynamics of the region using seismic data of 9 broad band stations installed in this region. The main results of this study are based on receiver function analysis. We compared our results with previously known structural characteristics and discussed the implications of IBR subduction. While more measurements are desirable, this study presents for the first time the imaging of the deep structure, where structural velocity models are very limited.

**Section snippets**

**Geo-tectonic framework**

The IBR is a complex tectonic region where major tectonic and subduction events are identified from late Lower Cretaceous to Mid-Miocene and Quaternary periods (Mitchell, 1993).

This subduction tectonics continues into the Andaman-Sumatra subduction zone. The NNW-SSE to NE-SW trending IBR, having a width of 250–700 km, is a Tertiary orogenic belt that consists of a number of tectonic domains, which were generated due to the east-west directed compressional stresses induced by the highly oblique

**Data set and methodology**

We have used data from 6 seismograph stations deployed by National Center for seismology (NCS) for the period Jun, 2011 to December 2012. We also used 3 stations of Myanmar National Network (MM) fetched from Incorporated Research in Seismology-Data Management Consortium (IRIS-DMC) site for the period January 2016 to May 2017. The NCS data set has flat velocity response for frequency range of 0.016−50 Hz with Taurus data logger with sampling rate 40 Hz, whereas MM network data has sampling rate

**Receiver functions observations**

The three-component waveform data of teleseismic earthquakes recorded at 9 stations were analyzed in the present study. A common feature of the computed RFs at all the stations is that, the Moho converted Ps phases are clearly identified in amplitude and sharpness, however the arrival time for different azimuths events are not uniform. The resulting RF traces are illustrated for LEKHA, KOHI, TMU and MDY stations (Fig. 2a–d) and remaining all other stations RFs are shown in Supplementary Fig.

**Discussions**

The IBR merges with the Eastern Himalayas at the eastern syntaxis zone in the north, while this belt continues into the Andaman and Nicobar Islands to the south. This central domain is characterized by North-South trending folds, which are a result of east-west compression acting regionally against the Burmese plate. As this study region consists of different tectonics, viz., Tripura Fold Belt, Indo-Myanmar region and Shan Plateau, so obvious difference in the structural deformity and

**Conclusion**

In this study, we report estimates of crustal parameters like Moho depths, Poisson’s ratio, and shear wave velocities of the Indo-Burmese subduction region, which are largely unknown to us. In summary, for the first time, the crustal structure beneath this subduction zone is imaged using RF stacking, in which a clear Moho dip is also observed parallel to the Wadati-Benioff zone. The average crustal thickness of the stations in the folded belt is around ˜42 km. The average crustal thickness of

**Acknowledgements**

We sincerely appreciate the technical staff of both National Centre for Seismology (MoES) network and IRIS-MM network in maintaining and archival data of all the Broadband stations. We acknowledged Dr. Vineet K. Gahalaut, Director, NCS for his encouragement in this study. First author acknowledged Ms. Antara Sharma, Geoscience Division, NEIST, Jorhat for some figure preparation. The GMT software package distributed by Wessel and Smith (1995) was used for drafted the figures.