Physics of the Earth and Planetary Interiors 258 (2016) 15–27

Contents lists available at ScienceDirect

Physics of the Earth and Planetary Interiors

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

Crustal structure beneath northeast India inferred from receiver function modeling

Kajaljyoti Borah [a], Dipok K. Bora [b,*], Ayush Goyal [c], Raju Kumar [a]

[a] Department of Earth Sciences, Indian Institute of Science Education & Research Kolkata, Mohanpur 741 246, West Bengal, India
[b] Department of Physics, Diphu Government College, Diphu, Karbi Anglong 782 462, Assam, India
[c] Department of Physical Sciences, Indian Institute of Science Education & Research Kolkata, Mohanpur 741 246, West Bengal, India

ARTICLE INFO

Article history:
Received 19 April 2016
Received in revised form 6 July 2016
Accepted 7 July 2016
Available online 9 July 2016

Keywords:
Northeast India
Crustal shear velocity structure
Receiver function
Sediment structure

ABSTRACT

We estimated crustal shear velocity structure beneath ten broadband seismic stations of northeast India, by using H-Vp/Vs stacking method and a non-linear direct search approach, Neighbourhood Algorithm (NA) technique followed by joint inversion of Rayleigh wave group velocity and receiver function, calculated from teleseismic earthquakes data. Results show significant variations of thickness, shear velocities (Vs) and Vp/Vs ratio in the crust of the study region. The inverted shear wave velocity models show crustal thickness variations of 32–36 km in Shillong Plateau (North), 36–40 in Assam Valley and ~44 km in Lesser Himalaya (South). Average Vp/Vs ratio in Shillong Plateau is less (1.73–1.77) compared to Assam Valley and Lesser Himalaya (~1.80). Average crustal shear velocity beneath the study region varies from 3.4 to 3.5 km/s. Sediment structure beneath Shillong Plateau and Assam Valley shows 1–2 km thick sediment layer with low Vs (2.5–2.9 km/s) and high Vp/Vs ratio (1.8–2.1), while it is observed to be of greater thickness (4 km) with similar Vs and high Vp/Vs (~2.5) in RUP (Lesser Himalaya). Both Shillong Plateau and Assam Valley show thick upper and middle crust (10–20 km), and thin (4–9 km) lower crust. Average Vp/Vs ratio in Assam Valley and Shillong Plateau suggest that the crust is felsic-to-intermediate and intermediate-to-mafic beneath Shillong Plateau and Assam Valley, respectively. Results show that lower crust rocks beneath the Shillong Plateau and Assam Valley lies between mafic granulite and mafic garnet granulite.

1. Introduction

The Earth's crust is the upper rigid part of the lithosphere. There are three crustal divisions – oceanic, transitional, and continental; of these, oceanic and continental crusts dominate. Compared to oceanic crust, continental crust is thick (~40 km on average), less dense (~2.7 g/cm^3), and is composed of highly diverse lithologies that yield an average intermediate or andesitic bulk composition (Taylor and McLennan, 1985). The continental crust has age varying from ~4.0 Ga to the recent. Thus the continents preserve a rich geological history of Earth's evolution. Following the compilations of the seismic velocity structure of the continental crust based on seismic surveys across the globe, continental crust is divided into sediment, upper, middle, and lower crust with the corresponding shear wave velocity of <3.0, ~3.0–3.5, 3.5–3.8, 3.8–4.2 km/s, respectively (Christensen, 1996; Rudnick and Gao, 2003). Rudnick and Fountain (1995) and Rudnick and Gao (2003) argued that Vp higher than 7.0 km/s (Vs $\geqslant$ 4.0 km/s) corresponds to mafic rocks. For a variety of mafic lower crustal rocks, the Vs increases to 3.8 km/s for felsic granulite, 3.9 km/s for mafic granulite, and >4.1 km/s for garnet granulite rocks. The upper crust being the most accessible part of the Earth has been the subject of numerous direct geological investigations. So, rock types in the upper continental crust are reasonably well known. On the other hand lower continental crust is less accessible than the upper crust and hence the distribution of rock types in the lower crust remains uncertain. Our view of the lower continental crust is based chiefly on a few uplifted slices of the crust in collisional orogens and from xenoliths brought to the surface in young volcanics. The most important and globally correlated boundary within the Earth's lithosphere is the transition from the crust to the mantle, known as the Mohorovicic discontinuity (Moho). Steinhart (1967) provided a globally consistent definition, which stated that the Moho to be the depth at which the Vp increases rapidly or discontinuously to 7.6–8.6 km/s. If steep velocity gradient are not present, then the Moho is interpreted as the level at which Vp > 7.6 km/s (Vs > 4.3 km/s) (Steinhart, 1967; Jarchow and Thompson, 1989). This has been

* Corresponding author.
E-mail address: dipok23@gmail.com (D.K. Bora).

http://dx.doi.org/10.1016/j.pepi.2016.07.005
0031-9201/