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Geometry of Moho Depth beneath Northeastern Indian Plate by Joint Inversion of Gravity and Seismological Data

L. Indiver Singh[1], Avinash Kumar Chouhan[1], Sarda Maibam [1]

[1]Department of Earth Sciences, Manipur University, Imphal, India

Email: indiverlaiphrakpam@gmail.com

Abstract

The northeastern region of the Indian plate, situated between the Indo-Eurasian plate, the Indo-Burman subduction zone, and the world's largest Ganga–Brahmaputra delta, forms one of the most complex seismotectonic domains across the globe. This region has experienced several of the deadliest earthquakes and hosts one of the largest hydrocarbon deposits in India. Despite its geological, seismotectonic, and economic significance, information on Moho depth beneath NE India has remained limited due to sparse and uneven geophysical data coverage. In this study, we attempt to address this gap using a regularized nonlinear inversion of satellite gravity data constrained by seismological observations. Sedimentary layer effects (-3 to -68 mGal) and terrain corrections (5 to 381 mGal) were applied through tesseroid-based forward modelling using CRUST 1.0 and ETOPO1 elevation data, respectively. The terrain-corrected Bouguer anomaly and 37 seismologically derived Moho depth estimates were used as input for the inversion. A systematic parameter search was carried out across six regularization coefficients, reference Moho depths ranging from 32 to 40 km, and crust–mantle density contrasts between 300 and 500 kg/m^3. The optimum crust–mantle depth and density contrast, corresponding to the minimum mean square error, were obtained at 32 km and 450 kg/m^3, respectively. The resulting Moho depth varies from 26 to 67 km across the NE Indian plate. The thickest crust (50-67 km) is observed beneath the Himalayan orogenic belt, reflecting the underthrusting of the Indian plate beneath the Eurasian plate, whereas the thinnest crust (26-30 km) occurs beneath the Ganga–Brahmaputra deltaic domain. The Shillong Plateau exhibits Moho depths of 32–35 km, while the Indo-Burman subduction zone shows crustal thicknesses of 35-45 km. The inverted Moho geometry is consistent with previous geophysical studies and provides improved constraints on the seismotectonic and geodynamic processes operating in NE India.

Keywords: Gravity, Seismology, Inversion, Moho depth, NE India, Himalaya

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