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Inversion of travel times to estimate Moho depth in Shillong Plateau and Kinematic implications of Stress analysis in Northeastern India.

Distribution of Moho depth is estimated in Shillong and Mikir Hills plateau of northeastern India using travel time differences between reflected P(PmP), S(SmS), P to S , S to P converted waves at the Mohorovičić (Moho) and the first P and S arrivals using 203 local earthquakes recorded by regional seismic network. The Moho depth was estimated with considered epicentral distance ranged from 70 km from 250 km. The reflection and conversion point are uniformly distributed in the study area which is mainly controlled by the geometry of the events and locations of the stations used in this study. A total of 966 reflected (PmP and SmS) phases arrival times from the seismograms of 180 numbers of shallow earthquakes and 70 converted (PS and SP) phases arrival times from 23 intermediate depth earthquakes. The magnitudes of the analyzed events range from 2.1 to 4.3 and the focal depths of 180 events range between 0 to 30 km while 23 numbers of event range between 38 to 49 km. For PmP phase, this could be identified from 0.5 to 2.8 seconds after the first P-arrival. In case of SmS phase, the arrival times are observed within 1.0 to 3.5 seconds after the first Sarrival. The usage of converted phase in addition to reflected phase reduced the rms. value of travel times from 0.351sec to 0.332 after five iterations. It is observed that the Moho is thinner beneath the Shillong Plateau about 33-35 km and is the deepest beneath the Brahmaputra valley to the north about 39-41 km, deeper by 5-6 km below the Shillong plateau. The study indicates thinnest crust (~33) in the western part of the Shillong Plateau in the Garo Hills region.

Based on stress inversion of 285 double couple focal mechanisms of earthquakes, with 5 as average magnitude, we determine the regional seismotectonic stress in Northeast India. Although N-S compression prevails at the scale of the whole area, different seismotectonic regimes deserve separate consideration, as a function of geographic location and depth.

Consistent with India-Eurasia convergence, N-S compression dominates in the Eastern Himalayan region, where E-W extension also occurs as a result of permutation between principal stress axes. N-S compression also affects north-eastern regions of the Indian Plate including the Bengal basin, the Shillong-Mikir massif and the Upper Assam Valley. Despite the absence of significant motion related to present-day locking, the existence of widespread N-S compression in the Bengal Basin, far from the Himalayan front, is compatible with the already proposed convergence between the Shillong-Mikir-Assam Valley block and the Indian craton, including a probable component of eastward extrusion for this block accounted for by the additional occurrence of nearly W-E compression in this block.

More complicate are the stress patterns in the Indo-Burma Ranges, where a variety of stress regimes occur. N-S compression occurs in these areas, but mainly at depth where it affects the descending slab of the Indian lithosphere, as a result of increasing bending of the Burmese arc in its northernmost, NE-SW trending segment. Arc-perpendicular extension, with WNW-ESE trends in the northernmost arc segment and ENE-WSW trends in the main N-S arc segment, is also present in the upper lithosphere of the Indo-Burma ranges, in relation to the subduction beneath the Burmese arc. Major stress regimes in the Indo-Burma region are characterised by compression in the upper lithosphere that varies in trend from NE-SW in the inner and northern domains of the belt to E-W in the outer domains.

Considering the kinematic implications of the published geodetic information, we analyse the relationships between the present-day relative displacements of major blocks and the seismotectonic stress regimes that we have determined using focal mechanisms of earthquakes. This comparison reveals high levels of consistency between the clockwise change in the direction of compression in the Burmese arc region and the corresponding clockwise change in vectors of present-day relative displacement of north-western Sunda with respect to Burma (SSW-directed) and Burma with respect to India (SW-directed), as a typical illustration of partitioning across a mountain belt at an oblique convergence boundary.

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