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Characteristics of Crustal Deformation Rates of the Eastern Himalayan Syntaxes derived from GPS Data

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Abstract: Here, the principal data used for this study of about 400 GPS stations around the Namcha Barwa syntaxis (88-104°E, 20-34°N) are from the Crustal Movement Observation Network of China (CMONOC). Besides the CMONOC data set, we collected three additional velocity data sets from Jade et al. (2017), Zheng et al. (2017), Gupta et al. (2015), Kreemer et al. (2014), Liang et al. (2013), Banerjee et al. (2008), Gan et al. (2007), etc. These collected data are used to demonstrate the detailed deformation characteristics among different individual tectonic units within the area of interest, and produce a crustal motion image of the collision zone.

The collected data from the GPS networks in the concerned areas has been amalgamated into a common fixed reference frame by using the least-square collocation method, as suggested in Zhan et al. (2015). In order to get a continuous strain rate map of the plateau, we use a “spline in tension” technique (Wessel and Bercovici, 1998) with the tension parameter $t = 0.95$ to interpolate the GPS velocities on 0.5° ~ 0.5° (longitude and latitude) grids, and then calculate the strain rate tensor in every 0.6° ~ 0.6° area with the nine interpolated velocities on the grids. The tension parameter t ($0 \le t < 1$) in the spline in tension algorithm represents the portion of the strain energy resulting from tension relative to total strain energy (Wessel and Bercovici, 1998). Notice that the strain energy here refers to strain within the spline, not strain in the Earth. When $t = 0$, the algorithm corresponds to a minimum curvature biharmonic spline. As the tension parameter increases, the squared curvature integrated over the entire surface becomes larger, and, as $t = 1$, the algorithm approaches a whole data based linear interpolation (Gan et al., 2007).

As shown in the fig. 1a, it depicts two significant maxima of compression rates and one peak value of dilatation rate. The dilatational strain tiptop rate of 113.7 nanostrain/year found around 100.9°E, 28.1°N has been explained by existence of a series of nearly N-S striking normal faults which are located in the post-arc active extensional accretionary region of the India-Eurasia continental collision. One of the two topmost compression rates located in the north of the Himalayan Main Frontal Thrust around 27.5°N, between 93.7°-94.3°E and reaches nearly 115 nanostrain/year; the other reaching 80~152 nanostrain/year is located in the northeast margin of the Namcha Barwa syntaxis between 28.0°–29.5°N and 95.0–97.0°E, in which area the Himalayan Main Boundary Thrust and the Himalayan Main Frontal Thrust meet the Lohit Thrust and the Mishmi Thrust. Moreover, we also recognize several compression poles and extension poles with respect to the

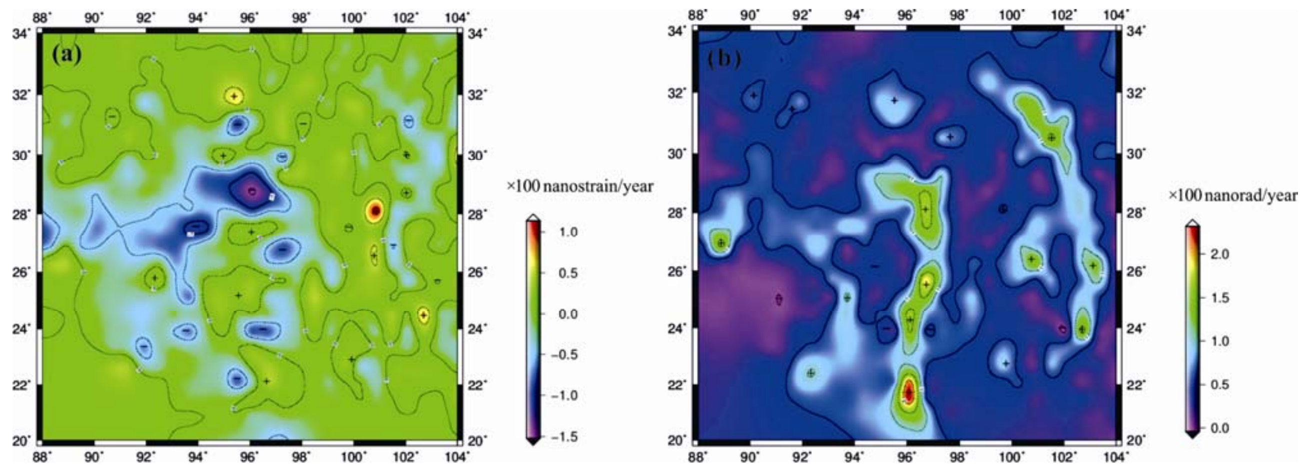

Fig. 1. Results of GPS strain rate of the Eastern Himalayan Syntaxes.
(a) Areal dilatation rate; (b) Strain rate in the longitude direction.

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surroundings within the area of interest, and all of these poles are well-indicated to distribute along the major active faults. Notice that the obtained shear strain rate field in Figure 1b shows that serious shear deformation are closely related to the plate boundary and/or sub-plate boundary where exists major active strike-slip faults in the concerned range. Maximum shear anomaly poles mainly spread along the central Sagaing Fault (tiptop shear rate of ~229.5 nanorad/year), the Himalayan Frontal Thrust (tiptop shear rate of ~162.1 nanorad/year), and the Xianshuihe-Xiaojiang fault (tiptop shear rate of ~161.5 nanorad/year).

The deformed area is limited to a relatively narrow belt mainly along the Himalayan Main Frontal Thrust and the central Sagaing Fault, which both indicate high risk areas prone to earthquake.

Key words: Eastern Himalayan Syntaxes, GPS data, Crustal deformation rates.

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