Clockwise rotation and tilting in the Tethyan Himalaya of SE Tibet deduced from paleomagnetic data: Implications for the Miocene tectonic evolution of the NE Himalaya

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Crustal movement around and away from the Namche Barwa syntaxis is indicated in the Asian velocity field inferred from GPS data and Quaternary fault slip rates (e.g., Gan and others., 2007; Fig. 1). Nevertheless, there is limited field-based control on the rotational history of the north-eastern Himalayan arc. Exploring the polyphase nature of deformation within the Cretaceous diorite dykes and the Triassic flysch in the eastern Tethyan Himalaya (90°-92°E), combined with new remote sensing data and the existing thermo-geochronological data, allows us to unravel the kinematic relationship between our new paleomagnetic remanence vectors and the deformation phases.

Rock magnetism analyses in the Cretaceous diorite dykes indicate that the characteristic remanent magnetization is mainly carried by pyrrhotite. This is supported by a Hopkinson peak and decay at 325 °C in high-temperature susceptibility curves, SIRM saturation field values > 300 mT, and a sharp decrease of remanent magnetization at ~325 °C during thermal demagnetization of the SIRM. The characteristic remanence magnetization is likely of thermal origin and post Eo-Himalayan folding as suggested by two facts: (i) thermochronological data in the Triassic flysch indicate that a peak metamorphism above the Curie temperature of pyrrhotite was reached for the last time at ~22 Ma at the end of the D2 tectonic phase (Dunkl and others., submitted); (ii) in situ mean declinations are approximately constant in the Qonggyai valley, despite of the double vergence of folds and related axial planar foliation, south-vergent in the southern domain and north-vergent in the northern domain. Therefore the magnetization can be evaluated as a record of the Early Miocene field. Calculated vertical-axis rotations in Nagarze-Yamdrok Lake area and Qonggyai valley indicate a trend from no apparent rotation in the west to 20° clockwise rotation in the east with respect to the stable Indian plate (Fig. 1).

Our data suggest that the strong Miocene strain partitioning between local E-W extension (with unclear influence of reactivation of older structures as strike-slip faults) in an eastward regional motion or extrusion of the upper crust (like show the GPS and rigid rotation velocity field; Gan and others., 2007) around the eastern syntaxis could have been accommodated by the obtained clockwise rotation pattern. Additionally, the observed pattern of tilting around horizontal axis in the Qonggyai valley may reflect concealed North Himalayan doming.

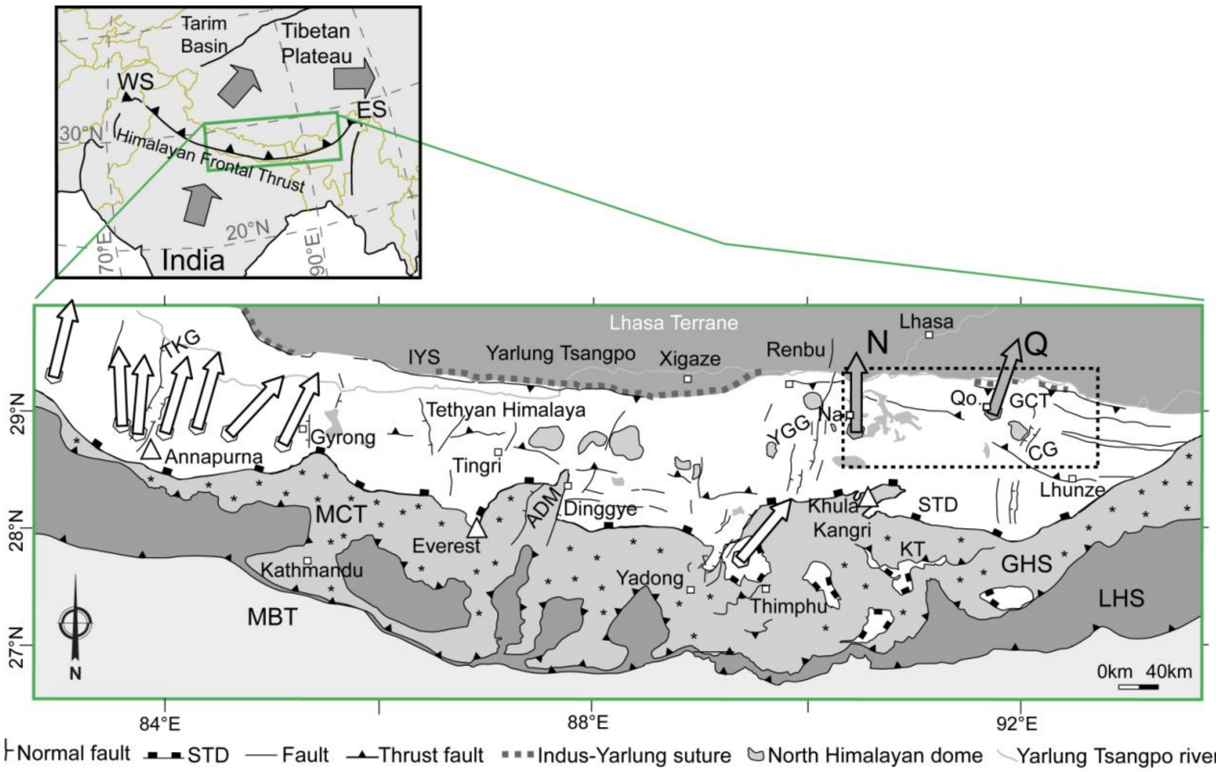

Figure 1. Simplified geological map of the central and eastern Himalaya (after Pan and others, 2004; Kellett and others, 2009). White arrows indicate published paleomagnetic block rotations in the western-central Tethyan Himalaya (age of the remanence is 30-20 Ma; Schill and others, 2004 and references therein) and in NW Bhutan (age of the remanence is ~15 Ma; Baule, 2004) relative to the Indian plate. Study area location within the dashed-line box and corresponding block rotations at Nagarze area (N) and Qonggyai valley (Q) versus India and since ~22 Ma. TKG, Thakkhola Graben; IYS, Indus Yarlung Suture zone; ADM, Ama Drime Massif; YGG, Yadong-Gulu Graben; Na, Nagarze; Qo, Qonggyai; CG, Cona Graben; STD, South Tibetan Detachment; KT, Kakhtang thrust; GHS, Greater Himalayan sequence; MCT, Main Central Thrust; LHS, Lesser Himalayan sequence; MBT, Main Boundary Thrust. Inset map shows location of Western Syntaxis (WS), Eastern Syntaxis (ES) and this vertical-axis block rotation map. Arrows are generalized GPS motions relative to Siberia (Tapponnier and others, 2001).

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