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Clockwise rotation of the Tengchong block around the Eastern Himalayan Syntaxis predates East-West extension

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A key issue for models of Tibetan Plateau evolution is to explain crustal movement around the Eastern Himalayan Syntaxis (EHS). Two end-member models are considered in literature: the classic tectonic escape model calls for lateral displacement of lithospheric blocks; the crustal flow model describes orogenic interior to exterior material flow, channelized within a vertically decoupled lithosphere. Western Yunnan is a key area for tracing material transport around the EHS and to decipher its mechanism. Several authors have observed a wide region of clockwise rotation around the EHS based on GPS velocities. Existing paleomagnetic data confirm clockwise rotation that accumulated since the Late Cretaceous. We present new paleomagnetic data on ca. 40 Ma old mafic dykes from the Tengchong block of the Gaoligong Shan in western Yunnan. The dykes intruded into the granitoids of the Gangdese arc of the Lhasa block, reveal sharp dyke-protolith contacts, and range in width from 1 to 6 m. Magneto-mineralogy has been identified by a rock magnetic study, reflected light microscopy, and SEM/EDX analysis. The sampled dykes can be separated into two groups: Group 1 with magnetite as the main magnetic remanence carrier reveals a secondary magnetic overprint likely imposed at 20 Ma (Ar/Ar thermochronology); Group 2 has Ti-rich titanomagnetite as the primary remanence carrier. For both groups alternating field demagnetization showed significant groupings of remanence directions. Group 1, including two site mean directions of granitoid samples, shows an overall in-situ mean direction of D/I= 34.6°/21.7° (6 sites; α95=24.4, k=9). Group 2 yielded an overall tilt-corrected mean direction of D/I=83.5°/22.4° (6 sites; α95=30.4, k=5.8). The amounts of clockwise rotation since ca. 40 Ma and ca. 20 Ma are 72.0° (rotation rate of 1.80°/Myr) and 22.6° (rotation rate of 1.13°/Myr), respectively. The rotation rates fit the GPS-determined rates of 1.9° to 4°/Myr. The most striking result is that the most significant rotation ($\sim$50°) occurred between 40 Ma and 20 Ma, indicating that the sampled area of the Gangdese arc moved around the EHS during this time period, therefore predating East-West extension of the Tibetan Plateau. This early effect of clockwise rotation can be explained by bending around the Indian indenter similar to the western edge of the Himalaya.