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How crustal-scale strike-slip faults initiate and further develop: The Red River fault and the East Himalaya Syntaxis as a result of the two-stage

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One major question of tectonics is how and where major intracontinental transcurrent strike-slip faults initiate. Models assume an important rheological contrast between rheologically weak and strong lithologies, e.g. at margins of a stiff craton and juxtaposed mobile belts (Molnar & Dayem, 2010 and references therein). Several models assume weakening of the lithosphere by uprise of magma, e.g., formed by subduction or break off of the previously subducted lithosphere or as K-granites at the bases of a metasomatized lithosphere. In the case of slab break-off following oblique convergence, orogen-parallel strike-slip accommodation has been documented. Especially, the spatiotemporal relationships between synkinematic plutons and crustal-scale strike-slip faults have been documented worldwide. It is a matter of continuous debate whether strike-slip faults nucleate where melts have previously weakened the crust/lithosphere or whether pre-existing faults represent the preferred pathways for the ascending melt. A few further models document the role of lateral boundaries of metamorphic core complexes. The significance of some of these processes could be studied along the Red River (RR) fault, SE, Asia. Here we propose a model, how the development of RR fault evolved in response to the two-stage India-Asia collision that recently was proposed by van Hinsbergen et al., (2012 and references therein) and the interaction of the northeastern corner of the East Himalayan Syntaxis with Himalayan-Burman/Indochina collision belt.
We propose a four-phase tectonic evolution for the RR fault. During the Eocene accretion of the Tethyan block to Asia, the Sichuan foreland subducted and Eocene K-granites evolved, which started to vertically extrude and introduced, causing a zone of weakness within the crust (Phase 1) along the future RR fault. Another consequence of continuing shortening after the Tethyan block-Asia collision (Stage 1 collision) is lateral extrusion of blocks, and the Lhasa-Indochina block extruded towards east and southeast (Phase 2) initiating and continuously evolving to the Oligocene sinistral RR fault. Synkinematic granites and evolving migmatites within obliquely uprising metamorphic core complexes localized and enhanced the rheologically weak boundary. Possibly, southward subduction of oceanic crust underneath the Indonesian island arc created suction and a pulling force for the southeastward extruding Lhasa-Indochina block up to ca. 20 Ma, later interrupted by the westward progression of the opening South China Sea across the southern termination of the RR fault. The second, main stage of India-Asia collision (Stage 2 collision), after consumption of the Greater India oceanic basin, led to disruption of the coherent Lhasa-Indochina block by inception of the East Himalayan syntaxis (Phase 3) at the interface between Himalayan and Burman A-subduction zones. A consequence of the disruption is the first dextral (Phase 3) and subsequent ENE-WSW extensional (Phase 4) reactivation of the RR fault.

References

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