Geodynamic model of recent deformation in central Eurasia

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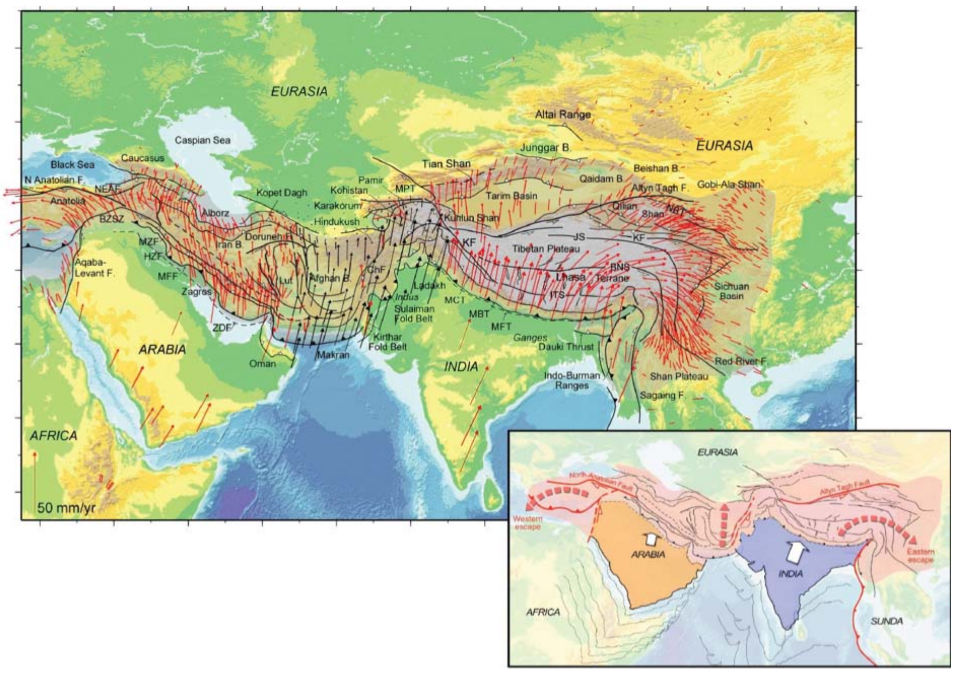
Central Eurasia hosts wide continental orogenic belts between India and Arabia with Eurasia, showing diffuse or localized deformation occurring up to hundreds of kilometres from the primary plate boundaries. Although numerous studies have investigated the neotectonic deformation in central Eurasia, most of them have focused on limited segments of the orogenic systems. Here we explore the neotectonic deformation of all of central Eurasia, including both collision zones and the links between them. We use a thin-spherical sheet approach in which lithosphere strength is calculated from the lithosphere structure and its thermal regime. We investigate the contributions of variations in lithospheric structure, rheology, boundary conditions, and fault friction coefficients on the predicted velocity and stress fields. Results (deformation pattern, surface velocities, tectonic stresses, slip rates on faults) are constrained by independent observations of tectonic regime, GPS and stress data. The modelled velocity field shows two large west- and east-directed continental escape toroidal velocity fields along the NW corner of Zagros-Iran and the NE corner of Himalaya-Tibet orogenic systems fitting GPS measurements. These modelled tectonic extrusions were the result of both strain rate and crustal and lithospheric thickness variations between the harder Eurasia plate and the softer amalgamated continental blocks that configured the southern margin of Eurasia before collision. The northern boundaries of Western and Eastern continental escapes are the North Anatolian fault and the Altyn Tagh fault, respectively. The linking zone between the Arabia-Eurasia and India-Eurasia collisions across the Afghan block shows an homogeneous N-directed velocity field with no deflection caused by the Arabia or India continental indentors.

To simulate the observed extensional faults in the Tibetan plateau a weaker lithosphere is required, provided by a change in the rheological parameters. A softer Tibetan plateau is compatible with the proposed lithospheric thinning beneath it. The southward movement of the SE Tibetan plateau can be explained by the combined effects of the Sumatra trench retreat, a thinner lithospheric mantle, and strik-slip faults in the region. This study offers a comprehensive model for regions with little or no data coverage, like the Arabia-India inter-collision zone, where the surface velocity is northward showing no deflection related to Arabia and India indentations.



Tectonic map of the collision zone between Arabia and India plates with Eurasia plate, integrating GPS-derived velocities (red arrows) and horizontal velocities calculated from the model (black arrows). The sketch in the lower corner shows the inferred northward velocity direction of the inter-collision zone (Pakistan and Afghan block), as well as the Eastern and Western escape tectonics produced by the westernmost Arabia and the easternmost India indenters. Thin black lines indicate the northward drift of Arabia and India plates.