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Reconciling evidence for Tethyan intra-oceanic subduction and a two-stage collision between India and Eurasia

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We present a plate tectonic model for the India-Eurasia collision that includes a time-dependent network of evolving plate boundaries with synthetic plates constructed for now-subducted Tethyan ocean floor, including back-arc basins that formed on the southern Eurasian margin. Southern Eurasia and Southeast Asia are riddled with dismembered oceanic arcs indicating long-lived intra-oceanic subduction. This intra-oceanic subduction may have extended further west into the India-Eurasia convergence zone in the NeoTethys, which was consumed during Greater India's northward trajectory towards Eurasia from the Early Cretaceous. Fragments of obducted oceanic crust within the Himalayan Yarlung-Tsangpo Suture Zone, between India and Eurasia, cluster around two age groups, the Late Jurassic and mid Cretaceous (Barremian-Aptian). The adakitic, boninitic and MORB-affinities of the various ophiolites along strike suggest that there was at least one generation of intra-oceanic subduction, whose plate boundary configuration remains uncertain, though it is best preserved in the Kohistan-Ladakh Arc. Paleomagnetic and magmatic characterisation studies from the ophiolites suggest that the intra-oceanic arc was as far south as the equator during the Early Cretaceous before subduction resumed further north beneath the southern Eurasian margin (Lhasa terrane) to consume the back-arc basin. During ~80-65 Ma, a hiatus in subduction-related magmatism along the southern Lhasa terrane may indicate the approach of the back-arc spreading centre towards the active Andean-style margin. We incorporate these observations into a regional, self-consistent plate tectonic model for the dispersal of East Gondwana, simultaneously considering geophysical data and seafloor spreading histories from abyssal plains offshore West Australia and East Antarctica, including Jurassic seafloor age data from offshore NW Australia that limits northern Greater India to a maximum of ~1000 km. This Greater India collided with the Tethyan intra-oceanic arc, including the Kohistan and Ladakh arcs, from the Mid Paleocene. Greater India's leading edge, bearing the intra-oceanic arc, finally closed the Tethyan seaway with progressive suturing to Eurasia from the Mid-Late Eocene, which coincides with the age of the youngest marine deposits found between India and Eurasia. Our model of mid-ocean ridge and subduction zone geometries, locations and divergence/convergence vectors through time can be represented as a time-dependent plate velocity mesh and is testable by combining coupled plate-mantle simulations with mantle seismic tomography. The model also provides a basis for future modifications in order to assimilate new data and test alternative tectonic scenarios.