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Evolution of continental subduction in the Pamir-Hindu Kush region: insights from seismic tomography, tectonic reconstructions and numerical modelling

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The geometry and the timing of subduction within the Pamir-Hindu Kush seismic region, in the western syntaxis of the India-Eurasia collision zone, are investigated. This area is worldwide the most active region of intermediate-depth seismicity not associated with oceanic subduction. The three-dimensional pattern of seismicity is characterised by the change in the dip of the inclined seismic zone from steeply north dipping in the Hindu Kush to southward dipping under the Pamir. A number of geological studies suggest the presence of two converging subduction zones, with steep northward subduction of Indian lithosphere beneath Hindu Kush and southward subduction of Asian lithosphere under Pamir. Here we use tomographic images and seismicity distribution to deduce the geometry of subduction in the Pamir-Hindu Kush seismic region, then we use the results of previous studies of block reconstruction to infer the timing and rate of this subduction. By measuring the length of the Indian slab in the Hindu Kush region we have an estimate of the size of India after the slab breakoff process that most likely occurred at the early stage of the collision. We compare this size with paleomagnetic reconstructions to obtain an estimated age of slab breakoff at 45 Ma. If we assume that vertical subduction occurs in a stationary position, then we infer that after slab breakoff, India continued its northward motion, pushing the Asian lithosphere, until the northern boundary of India reached the present-day Hindu Kush region, where it began to subduct some 8 Ma ago. We apply 2D thermal and mechanical numerical modelling to compute the temperature distribution and brittle field along two vertical sections in the Hindu Kush and Pamir regions. For the

Hindu Kush we introduce parameters reproducing fast and near vertical subduction, whereas in the Pamir region we use the results from published studies to reproduce slower subduction. Modelling results are consistent with the present-day distribution of intermediate-depth seismicity.