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2D Thermo-mechanical modelling of Cenozoic lithospheric deformation in the Himalaya and Pamir - Tien Shan orogen

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The Pamir-Hindu Kush region located in the western syntaxis of the Himalaya is the locus of a large number of intermediate-depth earthquakes and an almost vertical high velocity zone, seen in seismic tomography. The seismicity is not clearly related to oceanic subduction and forms an S-shaped zone between north-western Afghanistan and the eastern Pamir. In depth, the earthquake hypocenters are forming what some authors interpret as a V-shaped pattern which supports the model of two converging subduction zones to explain the observations. However, other models propose a single but highly contorted Indian slab or even a Rayleigh- Taylor instability due to a higher density in the lithosphere compared to the asthenosphere.

As part of the TIPAGE project (**TI**en Shan - **PA**mir **GE**odynamic program) our aim is to find lithospheric scale models consistent with all major observations as well as to find controlling factors for the extreme Cenozoic shortening in the Pamir-Tien Shan orogen. For our current modeling approach we use the finite-element code SLIM3D which allows coupled thermo-mechanical treatment of deformation processes. The code is capable of highly nonlinear elasto-visco-plastic rheology including diffusion, dislocation and Peierls creep mechanism and allowing self-consistent generation of faults. It incorporates free surface boundary conditions and is equiped with petrological routines for gabbro-eclogite, coesite-stishovite phase transitions.

We run several 2D cross-section models in order to explain the high velocity zone below the Pamir-Hindu Kush and the seismicity which distingushes the region from the rest of the Himalaya. In a typical model setup India has two parts: the 'inner part' which comprises 35-45 km thick continental crust and relatively thick cratonic mantle lithosphere; the 'outer part' has 25-30 km thick crust and a less depleted, more ocean-like lithosphere. Inside of Asia we place an "inclusion" of thicker cratonic lithosphere, like that of the Tarim (Tadjik) block and vary only the initial distance between the outer part of India and the Tarim (Tajik) block. Our hypothesis is: The high velocity zone below the Pamir - Hindu Kush is the last remaining and hanging undetached part of the semi continental - oceanic 'outer india' shelf and has only survived due to mechanical locking with delaminated mantle lithosphere of the Tarim (Tadjik) block.

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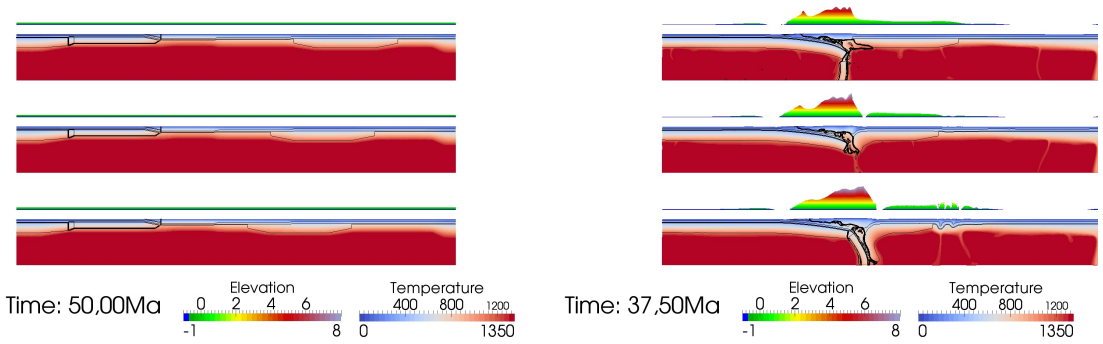

Figure 1: Varying only the initial distance between Tarim and India has a profund influence on the behaviour of our model. Mechanical locking is occuring only in the lower most model.