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# Effects of rheology, composition and surface erosion during collision of India and Eurasia

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The collision of northward moving Indian and relatively stationary Eurasian tectonic plate, ongoing since around 55Ma, has created the Himalayan orogen. Lying on the western syntaxis of Himalaya, the Pamir-Hindu Kush is well known for being the locus of enigmatic intermediate depth seismicity and large Gneiss domes. Although the Pamirs and Tibet are belonging to the same collision zone, the former one has been subjected to extreme Cenozoic shortening, with the strains by more than 2 times higher than in Tibet.

As members of the TIen Shan - PAmir GEodynamic program (TIPAGE), our aim is to find lithospheric scale models and controlling factors consistent with all major geodynamic observations, e.g. timing of uplift events of the Tien Shan and the occurrence of anomalous high temperatures below the Pamirs. Furthermore the amount of northward Indian unterthrusting, as well the existence of southward dipping Tadjik-micro-plate below the Pamirs needed to be explained.

Since lithosphere exhibits elastic, brittle and viscous properties, highly sophisticated numerical tools are necessary to explain these diverse effects. For this purpose we employ the Finite Element code SLIM3D/2D developed in our group in Potsdam, additionally equipped by routines modeling phase transformations in the crustal rocks and surface erosion and sedimentation routines.

We run several N-S oriented 2D cross section models, studying the influence of rheological and compositional parameters, e.g. friction of the Indian/Eurasian plate interface, the Eurasian lithospheric strength south of Tadjik and the thickness of Tadjik strong lithosphere inclusion.

Our models are starting at 60 Ma and incorporate part of Neo-Thetys, cratonic India and Greater India extension as well as Eurasia. Inside Eurasia we place a single heterogeneity, the Tadjik-micro-plate.

Our model reproduce well present day lithospheric structure, high surface heat flow and surface topography as well as timing of deformation if the following key conditions are met:

1) The friction of the India-Eurasia interface must have been much lower then 0.1, (similar to San Andreas Fault System), but higher than 0.02 (similar to a weak subduction zone). The most appropriate values are lying between 0.04 and 0.06, similar to the Nazca - subduction in central Andes.

2) Mantle lithosphere delamination was triggered by eclogitization of Eurasian crust and enforced by rather thin initial lithosphere south of Tadjik (<120 km).

3) Strength of the Tadjik micro plate was much larger than strength of the rest of the Asian lithosphere but also weaker than the Tarim micro plate. Therefore in contrast to the lithosphere of Tarim, the lithosphere of Tajik has failed and underthrusted southward.

4) Surface erosion that is necessary to get a steep topography gradient at the Himalayan front. This can be accomplished by a high precipitation rate and an orographic barrier at around 5 km.