Geophysical Research Abstracts, Vol. 9, 03229, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03229

The migration of watersheds in active orogens:

Snapshots from Central Europe and the India-Asia collision zone

J. Robl, S. Hergarten and K. Stüwe

Department for Earth Sciences, Graz, Austria

joerg.robl@uni-graz.at

We present first results about the migration of watersheds in active orogens based on a new numerical code that couples deformation in a thin viscous sheet and fluvial erosion as formulated in Hack's law. The code is also designed to utilize digital elevation models to disturb the initial layer thickness, to use variable viscosities in space and time, to apply precipitation data and regions of variable erodibility.

We use this model to explore the influence of first order parameters on the evolution of drainage divides by using synthetic data sets that allow us a better control on the coupled processes (deformation, erosion). It can be shown that for some parameter sets drainage divides respond very sensitive to even small changes of one critical parameter (e.g. viscosity, vertical strain rate, precipitation, erodibility), but that the course of the major rivers remains nearly unchanged. Alteration of the drainage area may also be an abrupt process (i) if other river networks are captured due to headward cutting. In many cases the flow direction of the downstream part of the captured river becomes successively reversed. (ii) Another likely possibility for a sudden change in drainage area is caused by bypassing and coalescing of rivers in distinct regions of dramatic uplift, in general related to thrusting during a continent-continent collision.

We also apply the model to real scenarios determining rates and direction of the migration of drainages divides in two key areas: Central Europe and the India-Asia collision zone. For Central Europe three river networks, namely Rhine, Danube and Elbe, are interacting. It can be shown that the Rhine drainage system successively increases by consuming the Danube, while the drainage area of the Elbe remains rel-

atively constant. For India-Asia collision zone we have focused on the Indus-Ganges-Brahmaputra drainage divides. Digital elevation models and satellite images show evidence that these three major Himalayan Rivers and their tributaries have been affected by dramatic changes of their watersheds. South draining rivers are headward cutting into the Tibetan Plateau and capture orogen parallel drainage networks following relatively small topographic gradients within the Tibetan plateau as assumed for the Tsangpo-Brahmaputra drainage network. Rapid uplift caused by back thrusting (e.g. Main Frontal Thrust) leads to bypassing of nearly all south draining feeder rivers of the Ganges and to a sudden and dramatic change of the watersheds of these tributaries. Modelling these processes give us ballpark estimates for erosion rates, minimum uplift rates for thrust faults and as a consequence some rough ideas about the interaction between erosion and deformation in continent-continent collision zones.