Geophysical Research Abstracts, Vol. 7, 10161, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10161

Structural Style of Lithosphere Scale Inversion: Feedback Relations between Mountain Building and Surface Processes.

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Inversion of sedimentary basins and passive margins at various stages of their evolution is modeled with thermo-mechanical viscous-plastic finite element techniques. We focus on two aspects of the inversion and collision process: 1) the role of the strength of the lower crust on the style of inversion, and 2) feedback relations of surface processes with the tectonic deformation and their control on the style of lithosphere inversion. The model involves a crustal layer of 35 km thick and a lithosphere of 125 km. All materials follow frictional-plastic strain softening, or thermally activated viscous flow laws. The model is thermally coupled and the thermal evolution is calculated.

During a first phase the model is extended to form a rift basin. The rift basin or passive margin geometry is then used as initial condition for a phase of lithosphere scale inversion and collision. Using a prior rift or passive margin formation phase allows examining the role of pre-existing heterogeneity on the style of inversion and continental collision. We examine the effect of very simple end member surface process models on the style of mountain building: 1) No erosion and no sedimentation, 2) No erosion and complete sedimentation, 3) Complete erosion and complete sedimentation. Very contrasting behavior is observed for these end-member variations in surface process model.

The model results indicate that the efficiency of surface process models to remove and distribute mass in the system forms a strong control on the overall style of inversion and collision. Without erosion or sedimentation deformation migrates outward into the foreland after an initial phase of orogenic growth. In the end-member case where erosion removes all topography, deformation is localized in the core of the orogen with strong asymmetric exhumation.