Geophysical Research Abstracts
Vol. 13, EGU2011-10335, 2011
EGU General Assembly 2011

Thrusting sequences by the maximum strength theorem coupled to erosion laws

Baptiste Mary (1), Bertrand Maillot (1), and Yves Leroy (2)

(1) Université de Cergy-Pontoise, Dept. Géosciences et Environnement, Cergy-Pontoise, France (bertrand.maillot@u-cergy.fr), (2) CNRS, Ecole Normale Superieure, PARIS, France (leroyy@geologie.ens.fr)

The numerical modelling of shallow tectonic structures meets challenges of two types: first, assumptions must be made on the values of complex rheological parameters (elasticity, plasticity criterion, plastic flow rule) that are usually only measured in the lab., therefore at far shorter time and space scales; second, the transition from a localised shear deformation in a band to a discontinuity sensu stricto, and the accumulation of large slip on the discontinuities are still difficult to implement in computational tools. These difficulties are avoided in our approach thanks to two simplifications. First, the rocks are solely described by their density, their rupture criterion (e.g. Coulomb criterion), and slip-weakening (drop in friction angle once failure is detected). Second, the deformation is assumed to be entirely accomodated by slip along faults between rigid blocks (as in most kinematic models of fault-related folding). Given a tectonic forcing, the maximum strength theorem – part of limit analysis – provides the optimal positions, lengths and dips of the faults. The application of the theorem at each step of shortening provides an extremely efficient, semi-analytic method for predicting thrusting sequences above a décollement in 2D vertical cross-sections. We show here that the coupling of this new method to 1D and 1.5D erosion laws provides a numerical tool to predict the actual shape and the development of mountain belts. We examine in particular the relations between slip-weakening on thrusts, lifetime of thrusts, thickness of thrusted units, and erosion, and compare our results to analog experiments, and structures in the Western Foothills of Taiwan. The proposed method being semi-analytical, it is possible to explore fully the parametric space and thus to perform a complete quantitative comparison, deducing likely frictional history of thrusts from their observed geometry and the surface topography.