EVOLUTION OF MOUNTAIN BELT LANDSCAPES : Insights from laboratory experiments

Fabien Graveleau
Department of Geosciences, National Taiwan University

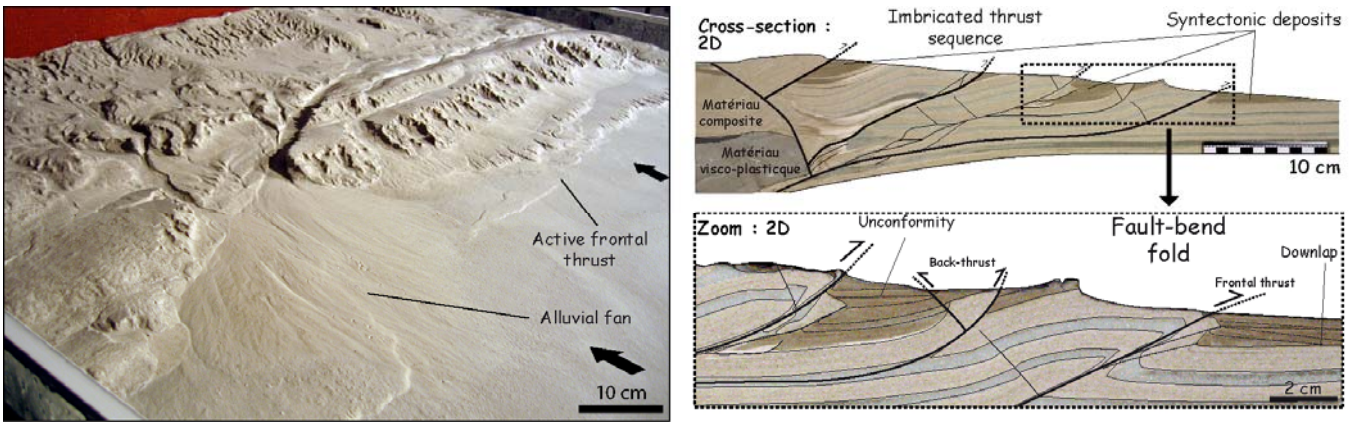
The evolution of a mountain belt is controlled by complex interactions between geological processes that create reliefs (Tectonics) and processes that erase them (surface processes : Erosion and Sedimentation). Understanding those interactions between Tectonics, Erosion and Sedimentation on the field is often difficult as observations are like a snapshot in the long history of the mountain range evolution. It is hard to understand the past of what we observe and even harder to imagine how it could evolve. In addition, data collected on the field are often sparse in both time and space and therefore difficult to merge in a comprehensive single model.

To study some coupling mechanisms between these processes, we have analyzed topographic data collected in the Tian Shan mountain range (NW China) and have developed a new experimental modelling technique. The modelling approach uses an experimental set-up and an analogue material specifically designed to study simultaneously tectonic structures (faults, folds), detailed morphology (drainage basins, rivers, alluvial fans) and stratified sedimentation. Accurate measurement techniques based on laser interferometry and image correlation are also used to quantify the topographic and kinematic evolution of experiments.

Our experiments represent a new approach for the study of mountain landscape evolution. Our results indicate that tectonics mainly controls this evolution. The propagation of deformation and the formation of relief both significantly influence the development of drainage networks, the evolution of drainage basins and the formation of landscape features. Particularly, a study of alluvial fans and watershed dimensions suggests that there is a dynamical equilibrium between uplift, erosion and morphology. In addition, our results show that terrace nucleation is controlled by thrust activity and hydrography adjustments. Folding of terraces responds to a homothetic deformation pattern.

This new methodology brings promising perspectives in the fields of geomorphology, seismotectonics and sedimentology.

Key words : Experimental modelling, Landscape evolution, Mountain range, Tectonics, Tian Shan.



Experimental results: a) Morphology in surface and (b&b') structural and stratigraphic style.