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Tectonics/Erosion/Sedimentation interactions in active mountain belt forelands : comparisons between experimental modeling and north-east Tian-Shan piedmont (Xinjiang, China)

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Mountain belt topography results from complex coupling between crustal deformation, surface processes (erosion, sedimentation) and climate variability (Summerfield, 2000 ; Burbank and Anderson, 2001, Delcaillau, 2004, Persson *et al.*, 2004).

In Graveleau *et al.* (2005), we described a new approach based on quantitative analogue modeling to study tectonics/erosion/sedimentation couplings in mountain belts. We demonstrated that it was possible to study mountain range morphology by using (scaled) analog experiments and realistic boundary conditions in terms of tectonics and surface processes (Dominguez *et al.*, submitted). Since that time, we've modified the experimental set-up (rainfall device) and improved material composition to study more specifically the morphologic evolution of active range piedmonts. In this part of the range, interactions between deformation and surface processes are enhanced as most of the tectonic activity is usually concentrated here and often associated to rapid relief formation and high sedimentation/erosion rates.

This work aims at analyzing how morphological markers (alluvial fans, fluvial terraces, erosional surfaces…) used to study piedmont tectonic activity (fault kinematics, crustal shortening, erosion and sedimentation rates…) form, evolve through time and record active deformation.

We succeed in modeling tectonic controlled relief formation, landward thrust propagation and syntectonic sedimentation. During each experiments, model surface evolution and fault kinematics are continuously surveyed using image processing techniques and laser interferometry. These data are used to study topography evolution, determine erosion and sedimentation rates cartography and quantify mass transfer at different stages of the experiment. Thrust faults initiation and propagation are also measured to quantify fault slip and uplift rates variations. At the end of each experiment, cross-sections are performed trough the model and digitized to study the internal model structure (fault and fold geometries, syntectonic sedimentation). These data are compared to Digital Elevation Models, structural and kinematics GPS measurements acquired on propagation folds located at the front of the northern piedmont of the Tian-Shan range (West of Urumqi, Xinjiang Province, China). We focused our investigations on rivers cutting through emerging folds and active thrusts and compare our results on terrace formation and deformation with analytical relations between uplift rate, shortening rate and sedimentation rate. We also tested how model structure and morphology are affected by contrasted tectonic or climatic forcings in terms of shortening rates and climatic regime (dry or wet). Our results are compared to Western Tian-Shan and Taiwan orogens which are respectively characterized by slow and rapid convergence rates (10 mm/yr for western Tian-Shan and 50 to 70 mm/yr for Taiwan) and desert and tropical climatic conditions (mean precipitation rates $<$ to 300 mm/yr for Western Tian-Shan and 2500 mm/yr. for Taiwan) [Poisson, 2002 ; Dadson *et al.*, 2003]

Key-words : Analog modeling, fold-and-thrust belt dynamics, relief, foreland, propagation fold, Tian-Shan.

REFERENCES :

Avouac, J.P., P. Tapponnier, M. Bai, H. You et G. Wang, Active thrusting and folding along the northeastern Tien Shan and late Cenozoic rotation of Tarim with respect to Dzungaria and Kazakhstan, *J. Geophys. Res.*, **98**, 6755-6804, 1993.

Burbank, D.W., and Anderson, R.S., 2001, Tectonic Geomorphology, Blackwell Scientific, Oxford, 270 p.

Dadson, S. J., Hovius, N., Chen, H., Dade, B., Hsieh, M. L., Willett, S. D., Hu, J. C., Horng, M. J., Chen, M. C., Stark, C. P., Lague, D., et Lin, J. C., Links between erosion, runoff variability and seismicity in the Taiwan orogen. *Nature*, 426, 648-651, 2003.

Delcaillau, B., 2004. Reliefs et tectonique récente. Nouveau Précis de Géomorphologie. Paris : Vuibert, 262 p.

Graveleau, F., Dominguez, S., Malavieille, J., 2005, A new Approach for Quantitative analogue modeling of Tectonics/erosion/sedimentation interactions in Mountain belts, abstract in EGU General Assembley, Vienna, Austria, EGU05-A-10579.

Persson, K. S., D. Garcia-Castellanos, and D. Sokoutis (2004), River transport effects on compressional belts: First results from an integrated analogue-numerical model, *J. Geophys. Res.*, 109, B01409, doi:10.1029/2002JB002274.

Poisson B., Impact du climat et de la tectonique sur l'évolution géomorphologique d'un piémont : Exemple du piémont Nord du Tian Shan depuis la fin du Pléistocène, Thèse de l'Université de Paris XI, 260 p., 2002.

Summerfield, M.A., Geomorphology and global tectonics, John Wiley & Sons ed., 2000.