Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09526, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09526
EGU General Assembly 2008

Consequences of tectonic advection on relief dynamics

D. Lague, F. Van den Berg, P. Davy, J.-J. Kermarrec
University Rennes I, CNRS, Géosciences Rennes, FRANCE (Dimitri.Lague@univ-renes1.fr)

Any horizontal component of tectonic deformation induces a transport of the topography. This effect operates from the scale of a thrust to the scale of a mountain belt. Numerical models of landscape evolution have illustrated some expected effects: (i) the apparent advection of the main divide inducing an asymmetry of the relief; (ii) possible inheritance of valley position across the main divide. Despite a geometrical consistency with some natural systems, a fundamental aspect of channel dynamics was missing in these studies: lateral erosion in channels. As vertical erosion is able to counteract the tectonic uplift, theoretically river channels not aligned with the direction of tectonic advection could counteract tectonic advection by lateral erosion. To study this effect we performed a series of small scale experiments of landscape evolution with controlled rate of tectonic uplift and advection. In these experiments, lateral (and vertical) erosion in micro-channels is "naturally" present.

The experimental setup consists of a box that can be inclined from 30 to 90° by steps of 15°, filled with silica paste. The bottom of the box is pushed by a step-by-step motor at a very precise rate. The eroded surface is always (40x60 cm^2). Precipitation rate is uniform and constant throughout the experiment and digitization at various steps allow precise geometrical characterization of the reliefs.

For most of the tested rates of advection, the topography reached a macroscopic steady-state in which the main divide asymmetry is roughly proportional to the advection rate, and independent of the uplift rate. However, we document cases in which the erosion cannot cope with a too large advection rate and no steady-configuration is obtained. Small rivers perpendicular to the direction of advection are advected passively. Some large rivers can erode laterally back into advected material, resulting in a net migration rate significantly smaller than the tectonic advection rate. This size

dependency effect induces several drainage captures with small catchment “colliding” with larger one advected more slowly.

To better pinpoint the role of lateral erosion, we also use a numerical model (Eros) in which channel lateral erosion is taken into account. We briefly present the resulting dynamics in a context more consistent with natural systems.