Geophysical Research Abstracts
Vol. 17, EGU2015-1394, 2015
EGU General Assembly 2015

Numerical modelling of wind gap formation in fault-bounded mountain ranges

Andrea Hampel (1) and Ralf Hetzel (2)

(1) Leibniz Universität Hannover, Institut für Geologie, Hannover, Germany (hampel@geowi.uni-hannover.de), (2) Westfälische Wilhelms-Universität Münster, Institut für Geologie und Paläontologie, Münster, Germany (rahetzel@uni-muenster.de)

Among the most impressive geomorphological features that document the competition between rock uplift and surface processes are wind gaps, which form in active mountain ranges when rivers are defeated by tectonic faulting. Here we use a three-dimensional numerical model with full coupling between tectonic deformation and surface processes (Kurfess and Heidbach, Comp. Geosci., 2009; Maniatis et al., EPSL, 2009) to investigate the formation and temporal evolution of wind gaps in mountain ranges bounded by an active thrust fault. Range growth in our model occurs by accumulation of slip on a fault plane embedded in a rheologically stratified crust. Our model results reveal that wind gaps do not necessarily form progressively from the center toward the tips of the mountain range. Rather, rivers abandon their valleys asynchronously depending on the evolution of their catchment area upstream of the range and the relative magnitude of diffusive and fluvial erosion. Our study further reveals that the presence of wind gaps are not an unequivocal indicator for lateral fault growth, because they may also form in mountains bounded by non-propagating faults with stationary tips. The elevation of wind gaps above the local base level is a good approximation for the amount of tectonic rock uplift since river defeat and valley abandonment. Overall, our models agree well with the geomorphology and growth history of active mountain ranges in northeastern Tibet (Hetzel etal., Terra Nova, 2004; Palumbo et al., Tectonics, 2009) and New Zealand (Amos et al., Tectonics, 2010).