Geophysical Research Abstracts
Vol. 16, EGU2014-4141, 2014
EGU General Assembly 2014

The effects of mass redistribution due to erosion and sedimentation on the distribution of fault activity within extensional fault arrays: An investigation by using fully coupled 3D finite-element models with a landscape evolution tool.

Georgios Maniatis, Heidi Turpeinen, and Andrea Hampel
Institut f. Geologie, Leibniz Universität Hannover, Hannover, Germany (maniatis@geowi.uni-hannover.de)

Mass redistribution on the Earth's surface creates loads that may influence the rate of crustal deformation. Using three-dimensional finite-element models solved with the commercial finite-element software ABAQUS and implementing the landscape evolution with the CASQUS tool (Kurfeß and Heidbach 2009) we investigate how surface processes may affect the spatiotemporal distribution of fault slip within horst and graben structures in extensional tectonic settings.

The finite-element models comprised of normal faults arranged in en echelon arrays that form graben or horst structures within a 200 km x 200-km-wide and 15-km-thick upper crust. Previous studies have shown that surface processes may affect fault slip rates on normal faults during extension phases and prolong fault activity after the onset of tectonic quiescence (Maniatis et al., 2009, Turpeinen et al., in press). In the present study we show that not only the parameters controlling the surface processes (e.g. diffusion constant) have an effect on the slip rate of individual faults but also the spatial distribution of erosion and deposition affects fault slip rates to different degrees depending on the fault's position within an array. By adding a subsequent phase of tectonic quiescence to the models, we investigate how ongoing erosion and sedimentation might prolong fault slip accumulation for up to millions of years after the cessation of extension across the fault arrays. Our models show that the amount and duration of additional fault slip are controlled by parameters such as the diffusion constant, fault length and fault dip.

The results of the present study therefore imply that the feedbacks of erosion and deposition on tectonics should be additionally considered when evaluating the spatial distribution of fault activity within graben and horst systems. Furthermore, the potential of erosion and sedimentation to prolong fault activity in extensional settings should be taken into account when constraining the timing of the cessation of regional extension phases.

References

Kurfeß, D., Heidbach, O., 2009. CASQUS: a new simulation tool for coupled 3d finite element modeling of tectonic and surface processes based on ABAQUS™ and CASCADE. Comput. Geosci. 35, 1959–1967. http://dx.doi.org/10.1016/j.cageo.2008.10.019.

Maniatis, G., Kurfeß, D., Hampel, A., Heidbach, O., 2009. Slip acceleration on normal faults due to erosion and sedimentation—results from a new three-dimensional numerical model coupling tectonics and landscape evolution. Earth Planet. Sci. Lett. 284, 570–582. http://dx.doi.org/10.1016/j.epsl.2009.05.024.

Turpeinen, H., Maniatis, G., Hampel, A., Slip on normal faults induced by surface processes after the cessation of regional extension—Insights from three-dimensional numerical modelling, Geomorphology (in press), http://dx.doi.org/10.1016/j.geomorph.2013.12.008