Geophysical Research Abstracts
Vol. 15, EGU2013-11290, 2013
EGU General Assembly 2013

Influence of rheological and frictional slip properties on fault mechanics, deformation rates and localization phenomena: The Corinth Rift case

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The Gulf of Corinth in Greece is one of the most active extensional regions in the Mediterranean area. However, there are still open questions concerning the role and the geometry of the numerous active faults bordering the basin, as well as the mechanisms governing the seismicity.

In geodynamics, advances in understanding complex physical processes such as lithospheric deformation or faulting mechanics rely increasingly on the development of sophisticated numerical modeling able to quantify the influence of the unknown rheological parameters and involved complex phenomena.

In the framework of the Corinth Rift Laboratory (CRL http://crlab.eu) project, this work is devoted to the exploration of some aspects of fault mechanics. We start by considering a two-dimensional numerical model of one single normal fault slipping continuously embeded in an elastic-viscoplastic media. In this case, the effects of rheological and geometrical parameters on the deformation localization, on the horizontal and vertical surface deformation velocities are examined. The openning and uplift rates at different extension periods are compared to the GPS velocities measured in the CRL region. This comparaison allows to constrain the upper crust rheological parameters as well as their variation with depth . We then introduce a second fault, antithetic to the first one, for a more realistic representation of the CRL region where faults dipping north and south bordering the gulf of Corinth are clearly identified. The effect of the antithetic fault in accommodating the lithospheric extension is discussed. Also, changes in the distribution of the frictional-plastic deformation as well as in the onshore and offshore topography are highlighted. The last part of this work is dedicated to the study of a fault zone over multiple seismic cycles. Long term deformation obtained from a continuously sliping fault model is compared to that obtained from the superposition of seismic cycles and the fine structure of inter- and co-seismic deformation is studied. The experience acquired with the 2D modeling is then used to present preliminary 3D models based on a simplified 3D geometry of main active faults obtained from the CRL-SISCOR working group.