Geophysical Research Abstracts
Vol. 16, EGU2014-627, 2014
EGU General Assembly 2014

Analogue modeling of dike intrusions: insight into rift formation and evolution

Daniele Trippanera (1), Joel Ruch (1), Valerio Acocella (1), Andrea Giordano (1), and Eleonora Rivalta (2)

(1) Roma Tre, Dipartimento di Scienze, Rome, Italy (daniele.trippanera@uniroma3.it), (2) Deutsches GeoForschungsZentrum (GFZ), Potsdam

Recent data have demonstrated that magma emplacement may play a major role in reactivating pre-existing faults during discrete rifting episodes. However, the role played by magma in shaping the geometry of rifts structures, such as normal faults and extension fractures, and how they evolve in time remains still debated.
We address these questions by means of analogue models of dike intrusions. Our setup consists of a sandbox with a basal slot progressively filled with iron sheets (the dikes analogue). We simulate the upper brittle crust with dry crushed silica sand. Using this material, 1 cm in the models corresponds to approximately 200 m in nature. In particular, we tested the effect of varying the depth to the intrusions (1-8 cm) and the geometry of the top of the intrusion complex (sharp or flat top).
The vertical and horizontal deformation at the surface have been monitored by cameras and laser scan, with sub-millimeter resolution. These tools allow us to use the Time Series and Particle Image Velocimetry (PIV) technique to quantify and reconstruct the time evolution of rift development. In addition, the cross sections of each model reveal the geometry, kinematics and temporal evolution of the structures forming the rift. Our results show that a depression forms at the surface upon intrusion of several dikes. The depression is bordered by outer inward normal faults and, in the case of deeper intrusions with flat top, also by inner arcuate normal/reverse faults. Therefore, we find the shape and the kinematics of the faults and the deformation pattern at surface depend on the dike tip geometry and intrusion depth.
We compared the structures observed in the analogue models with examples from natural cases observed along divergent plate boundaries (including Iceland and Ethiopia) and episodes of dike intrusions as revealed by geodetic data.
We find a close similarity between the models and their natural prototypes and most of the variability of the rift structures observed in the field can be reconciled with analogue intrusion-induced structures in our models. This suggests that rift structure and evolution along divergent plate boundaries may be largely magma-induced.