Geophysical Research Abstracts
Vol. 17, EGU2015-5672, 2015
EGU General Assembly 2015

How diking affects the longer-term structure and evolution of divergent plate boundaries

Daniele Trippanera (1), Valerio Acocella (1), Joel Ruch (2), and Eleonora Rivalta (3)

(1) Roma Tre, Dipartimento di Scienze, Rome, Italy (daniele.trippanera@uniroma3.it), (2) King Abdullah University of Science and Tecnhology, KAUST, Thuwal, Saudi Arabia , (3) 3Deutsches GeoForschungsZentrum (GFZ), Potsdam

Recurrent diking episodes along divergent plate boundaries, as at Dabbahu (2005, Afar) or at Bardarbunga (2014, Iceland) , highlight the possibility to have m-wide opening in a short time (days to weeks). This suggests a prominent role of magma enhancing transient plate separations. However, the role of diking on a longer term (> 102 years) and its influence on the structure and the evolution of a divergent plate boundary is still poorly investigated. Here we use field surveys along the oceanic Icelandic and continental Ethiopian plate boundaries, along five eruptive fissures and four rift segments. Field observations have also been integrated with analogue and numerical models of dike emplacement to better understand the effect of dike emplacement at depth and at the surface. Our results show that the dike-fed eruptive fissures are systematically associated with graben structures formed by inward dipping normal faults having throws up to 10 m and commonly propagating downward. Moreover, rift segments (i.e. mature rift zones), despite any asymmetry and repetition, are characterized by the same features as the eruptive fissures, the only difference lying in the larger size (higher fault throws, up to 40 m, and wider deformation zones). Analogue and numerical models of dike intrusion confirm that all the structural features observed along the rift segments may be dike-induced; these features include downward propagating normal faults bordering graben structures, contraction at the base of the hanging walls of the faults and upward propagating faults. Simple calculations based on the deeper structure of the eroded rift segments in eastern and western Iceland also suggest that all the fault slip in the active rift segments may result from diking. These results suggest that the overall deformation pattern of eruptive fissures and rift segments may be explained only by dike emplacement. In a magmatic rift, the regional tectonic stress may rarely be high enough to be released through regional faulting, suggesting that regional tectonics has negligible direct impact compared to diking in shaping the studied plate boundaries on the longer-term.