Geophysical Research Abstracts
Vol. 17, EGU2015-1920, 2015
EGU General Assembly 2015

Crust-mantle interactions and crustal deformations, some geological observations

Laurent Jolivet (1), Camille Clerc (1), Pietro Sternai (2), Nicolas Bellahsen (3), Claudio Faccenna (4), Jean-Claude Ringenbach (5), Christian Gorini (3), Sylvie Leroy (3), and Raphaël Pik (6)

(1) Université d'Orléans, ISTO, OSUC, UMR 7327, Orléans cedex 2, France, (2) California Institute of Technology, Pasadena CA, USA, (3) ISTeP UPMC-Paris 6, UMR 7193, Université Pierre et Marie Curie, Paris, France, (4) Dipartimento di Scienze Geologiche, University of Roma Tre, Rome, Italy , (5) TOTAL, Paris La Défense, France, (6) Centre de Recherches Pétrographiques et Géochimiques, Nancy Université, Vandoeuvre-Les-Nancy, France

Crustal deformations at plate boundaries or intracontinental are governed by the relative movements of plates, and most published models consider the lithosphere as the main stress guide in extensional or compressional contexts. The possible contribution of the underlying asthenospheric flow to crustal deformation through viscous coupling is often neglected. Since the early days of plate tectonics, and even earlier, two schools of thought have been developed in parallel whether mantle convection is considered or not. This reflects nowadays in the difficulty of reconciling lithospheric-scale models and global-scale convection models to explain tectonic features observed at the surface. Still, recent studies reemphasized the role of mantle convection in shaping mountain belts or rifts and the consequences of different styles of convection on the geometry and kinematics of mountain belts. We present here a number of geological observations in convergent or divergent contexts that may suggest a strong coupling between asthenospheric flow and crustal deformation. Several of these examples, especially in extensional contexts, show a deformation distributed over wide zones, accommodated by shallow-dipping shear zones and with a constant asymmetry over large distances. This is the case of the Mediterranean back-arc basins, such as the Aegean Sea, the northern Tyrrhenian Sea or the Alboran domain, where extension is taken up by shallow-dipping extensional shear zones and normal faults with a constant asymmetry. A similar image is also observed across the Gulf of Lion passive margin that also belongs to the Mediterranean back-arc basins. Such is also the case of some of the Atlantic passive margins where shallow-dipping normal faults and extensional shear zones control the extraction of the lower crust and the mantle with a constant asymmetry across the entire margin. Finally, the distribution and geometry of normal faults across the Afar region also show a constant asymmetry. We discuss these contexts and search for the main controlling parameters for this asymmetric distributed deformation. These parameters include an original heterogeneity of the crust and lithosphere (tectonic heritage) and a possible contribution of the underlying asthenospheric flow. We discuss the relations between the observed asymmetry and the direction and sense of the mantle flow underneath. Finally, we extend this question to larger-scale processes such as obduction and continental collision.