Geophysical Research Abstracts
Vol. 14, EGU2012-10759, 2012
EGU General Assembly 2012

Lateral rheological lithospheric heterogeneities in the tectonic evolution of intra-plate deformation

E. Calignano (1), D. Sokoutis (2,3), E. Willingshofer (2), and J.P. Burg (4)

(1) VU-University Amsterdam, Faculty of Earth and Life Sciences, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands (e.calignano@vu.nl), (2) VU-University Amsterdam, Faculty of Earth and Life Sciences, , De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands; now at: Faculty of Geosciences, Department of Earth Sciences, Utrecht University, Budapestlaan 4, PO Box 80021, 3508 TA Utrecht, The Netherlands, (3) Department of Geosciences, University of Oslo, PO Box 1047 Blindern, N-0316 Oslo, Norway, (4) Geologisches Institut, ETH-Zürich and Universiteit Zürich, Sonneggstrasse 5, 8092 Zürich, Switzerland

Lithospheric-scale analogue models were used to investigate the deformation pattern and topography development characterizing mountain building in intra-plate settings as a function of the presence of lateral rheological heterogeneities. The presented series of models is the first part of a broader project that aims at the understanding of the interference pattern of short and long wavelength deformation as a function of the location and reactivation of pre-existing heterogeneities within the lithosphere (crust versus mantle) upon shortening and its bearing on dynamically supported topography. Three layers (brittle crust/ductile crust/weak ductile mantle) models characterized by the presence of a "disturbance zone" (DZ) were deformed at a constant velocity under normal gravity conditions. DZ is striking perpendicular to the compression direction and located either in the ductile mantle or in both ductile crust and mantle. Lithospheric thickness, width of the DZ and relative lateral strength contrasts have been the main investigated parameters. Experimental results show that in the absence of a DZ the deformation history of a relatively weak lithosphere is characterized by early occurrence of pop-up and pop-down structures in the central part of the model. There deformation remains localized, in correspondence of a broad synform developed in the ductile part of the lithosphere. The presence of a DZ located in the ductile mantle and characterized by a small strength contrast with respect to the surrounding lithospheric blocks localizes the deformation at its boundaries. Deformation starts close to the DZ inner boundary and propagates forward (away from the moving wall), leaving an undeformed region underlined by a relatively flat Moho above the DZ. Distribution of pop-up and pop-down structures in the brittle crust appears to correlate with the position of synforms in the ductile lithosphere. Reducing the thickness of the lithosphere the strain becomes wider distributed in the upper crust where fore- and back-thrusts are closely spaced although an undeformed region above the DZ located in the ductile mantle remains present. The width of the DZ determines the wavelength of upper crustal deformation and the timing of its forward propagation. When a wider DZ is present strain concentrates at the inner boundary and structures at its outer boundary appear later in the deformation history. When the upper boundary of the DZ is located at the brittle-ductile transition a broader undeformed region is present in the central part of the model. Upper crustal structures are not directly aligned with the DZ boundaries. The results of this series of models contrast with the deformation pattern observed in previously conducted models characterized by stronger strength contrast between converging plates and an intervening weak zone. In this case the weak zone was deformed into a broad slightly asymmetric antiformal structure with prominent Moho uplift, flanked by a doubly vergent fold and thrust belt. Our modelling results provide valuable insight in favourable rheological conditions for the transfer of strain in intra-plate settings and are applicable to natural laboratories.