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Dynamics of the Balkans deformation : regional impact of the Western Hellenic subduction-collision transition

Marianne Métois (1), Nicola D'Agostino (2), and Alex Copley (3)

(1) Laboratoire de Géologie de Lyon, Terre, Planetes, Environnement, CNRS UMR5276, Université Lyon 1 - ENS Lyon, Villeurbanne, France, (2) Istituto Nazionale di Geofisica e Vulcanologia, Centro Nazionale Terremoti, Via di Vigna Murata, 605, Roma, Italia, (3) COMET, Bullard Laboratories, Department of Earth Sciences, University of Cambridge, Cambridge, UK

The increasing number of GPS measurements in the Balkan Peninsula over the last decades has brought new insights on the kinematic of the Eurasian plate there, revealing a significant (5 mm/yr) clockwise rotation motion of the entire region around the Scutari-Pec line in North Albania [Métois et al. 2015]. The focal mechanisms of recent earthquakes in this seismically active area are consistent with this deformation pattern.

In this study, we use simple dynamic models based on the thin viscous sheet approximation to test the influence of realistic kinematic boundary conditions and gradients of gravitational potential energy on the predicted surface deformation in the region. In addition, we compare the surface velocity field with maps of azimuthal anisotropy at depth to assess whether mantle motions may drive part of the observed lithosphere deformation.

We show that the observed shearing and rotation around Albania can be explained at the first order by kinematic boundary conditions applied on a viscous lithosphere ($\eta \sim 2.10^{21}$Pa.s), while GPE gradients may control the smaller-scale patterns of deformation.

Our models appear to be very sensitive to the abrupt velocity-change imposed across the Kefalonia fault in northern Greece where the subduction to collision transition takes place. We propose that the large-scale shearing of the region observed in the GPS data results mainly from this lithospheric tearing, that is one of the most active structure in the area. This hypothesis implies that the slab tearing initiation would have been an important controlling factor on the tectonic history of the Balkans and that the current velocity gradient across the Kefalonia fault is probably sufficient to trigger a large scale shearing propagating up to central Serbia.