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Mechanics and seismotectonics of the western rift of Corinth: New insights from a multidisciplinary approach

Pascal Bernard (1), Hélène Lyon-Caen (2), Anne Deschamps (3), Sophie Lambotte (4), Pierre Briole (2), Mary Ford (7), Christian Beck (5), Aurelia Hubert-Ferrari (8), and the Corinth Rift Laboratory Team

(1) IPGP, CNRS UMR7154, PRES Sorbonne Paris Cité, France, (2) ENS, CNRS UMR8538, Paris, France, (3) Géosiences Azur, CNRS UMR6526-UNSA, Sophia-Antipolis, France, (4) IPG Strasbourg, CNRS UMR7516, France, (7) Université de Lorraine, Centre de Recherches Pétrographiques et Géochimiques, CNRS (UMR 7358), 15 rue Notre Dame des Pauvres, BP 20, Vandœuvre les Nancy Cedex, F-54501, France, (5) ISTERRE, CNRS UMR 5275, Grenoble, France, (8) Université de Liège, Belgique

The western rift of Corinth is one of the most active extensional zones in the world, with several moderate to large historical earthquakes (M>6) per century. It is structured by a set of EW striking, en-echelon active normal fault segments 10 to 20 km long, some of which are only a few tens of kyr old, and presents an interseismic, steady NS extension rate of 1.5 cm/year, concentrated on less than 10 km. The resulting, extremely high strain rate (10**-6 per year) is accompanied with a high level of microseismicity, mostly concentrated in a layer gently dipping towards north, between 5 and 10 km, beneath the Gulf. Within the Corinth Rift Laboratory (CRL : www.crlab.eu) project, new seismological, geodetic, and tectonic studies, complemented by mechanical modeling, allow us to better understand the present-day seismic and aseismic deformation. We present here an overview of our recent findings, which are analyzed in more detail in complementary presentations of this session.

The combined analysis of the evolution of the fault network since 400 kyr, from onland and offshore studies, and of the fault geometries outlined by the micro-seismicity relocation, better constrains the fault geometry and slip rates. Combined with historical seismicity of the various fault segments, these data can be used to better assess the related hazard. The combined analysis of the spatio-temporal fluctuation of micro-seismicity, and of the strain monitoring, through borehole strainmeter, GPS, and InSAR analyses, suggests the occurrence of slow slip or creep on some faults at shallow depth and, at larger depths, of pore pressure migration in the main active layer, with little creep. The contrast between the reported steady NS opening, from GPS, and the strong fluctuation of microseismicity level, seems to indicate variable location of the related strain sources, which seems to contradict the reference model of a north-dipping, active detachment supposed to match the seismogenic layer (Rigo et al 1996) ; these observations, together with the complex geometry of the seismic layer, and with the fault-like structures inferred from microseismicity discovered beneath this « detachment », led us to propose, as an alternative model, a rifting model with a rather symmetrical (« mode I ») NS opening, complemented by a young, unmature 'blind detachment', growing downdip towards the north but not yet connected to the ductile, middle crust. Moderate earthquakes like the Aigion 1995 rupture (M=6.2) and the Pyrgos sequence of 2010 (two M=5.3) might be typical contributors to the downward growth of this detachment . If projected upwards, these events seem to have occurred on blind faults, shifted towards the north with respect to the main normal faults outcropping to the south.

The combined analysis of geological, seismological and geodetic data of the western rift of Corinth thus reveals a very rapidly evolving tectonic system, interplaying the activity of old and of new, growing faults, probably forced by a dominantly axial strain source at midcrustal depth, and possibly influenced by hypothetical fluid migration from the Mediterranean subducted plate, 50 km deeper, and by the SW propagation of the North Anatolian Fault.