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New insights into the rifting process in the western part of the Corinth Rift (Greece) from relocated seismicity

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The Rift of Corinth, in Greece, is one of the most active rifts in Europe, with several instrumental and historical large earthquakes with magnitude larger than 5.5, numerous active swarms, a significant background seismicity and an extension rate of 11-16 mm/year. Focusing on the western part of the rift, the seismic activity is monitored since 2000 by a network of 12 three-component stations (CRLNET). Over the period 2000-2007, it was analyzed in terms of multiplets and precisely relocated using double difference techniques. This detailed analysis brings new insights into the geometry of faults at depth, the nature and the structure of the active zone at 6-8 km depth previously interpreted as a possible detachment, and more generally into the rifting process. The seismicity exhibits a complex structure, strongly varying along the rift axis. The detailed picture of the seismic zone observed below the rift indicates that its shallower part is 1-1.5 km thick with a complex micro-structure, and its deeper part, 0.1-0.3 km thick slightly dips to the north (10-20°), with a micro-structure consistent with its general slope. Although the nature of the seismic zone remains an open question, the presence of seismicity underneath the main active area, the strong variability of structure along the rift over short distances, and the complex micro-structure of the shallow part revealed by the multiplet analysis are as many elements against the hypothesis of a mature detachment under the rift: it more likely represents a layer of diffuse deformation. The geometry of the main active faults is not well defined at depth, as no seismicity is observed between 0 and 4 km, except for the Aigion fault rooting in the seismic layer at 6 km depth with a dip of 60°. A distinct cloud of seismicity may be associated with the antithetic Kalithea fault, on which the 1909 Foki earthquake (Ms=6.3) may have occurred. The link between the 1995 rupture (Ms=6.2) and the faults known at the surface has been better constrained, as the relocated seismicity favours a rupture on an offshore, blind fault dipping at 30°, rather than on the deeper part of the Helike fault. This has important consequence for seismic hazard, as the 1995 event would then have reduced the Coulomb stress on the Helike fault. To explain the seismic observations analyzed here together with the geodetic observations, we propose a new mechanical model for the rifting process in this region, implying a non-elastic, mostly aseismic uniform NS opening below the rift axis, coupled with the downwards growth of a yet unmature detachment: the reported GPS rates would result from this deep, silent source, and the seismicity would reveal the detachment position, not yet connected to the ductile lowed crust; in such a model, the strong fluctuation of micro-seismicity would result from small strain instabilities, undetected by cGPS.