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Role of the Tectonic inheritance on multi-phased rifting of the Sperchios Basin (Greece), north-western boundary of the Aegean Plate

Frank Chanier, Jacky Ferriere, Olivier Averbuch, Virginie Gaullier, and Fabien Graveleau

Univ. Lille, CNRS, Univ. Littoral Côte d'Opale, UMR 8187, LOG, Laboratoire d'Océanologie et de Géosciences, F59000 Lille, France

The Aegean plate is characterized by active extension, mainly occurring during the Pliocene to the Quaternary. This extensional deformation is considered as the upper plate response to the rollback of the northward subducting African slab. In Central Greece, it has led to the formation of large rifted basins, such as the Corinth Rift or the Sperchios basin. Both are experiencing active tectonics, as seismicity and morphotectonic analysis demonstrate. In this study, we focus on the East-West Sperchios basin, which has developed obliquely across a major NW-SE thrust zone separating the internal and external zones of the Hellenides mountain range. This range has developed since the late Jurassic, with the obduction of the Maliac Ocean, up to the Eocene times, with the collision of the External Zones. The Frontal Thrust of the internal Hellenides constitutes a major discontinuity within the crust, which may have influenced the development of the Sperchios basin.

Our field investigations indicate that the southern boundary of the Sperchios rifted basin shows several large E-W to NW-SE normal faults that accommodate km-scale offsets. Our fault plane analysis showed a variety of fault orientations, all with dip-slip slicken-slides. It suggests at least two major episodes of extension, starting with a NE-SW direction in the Pliocene and then followed by a N-S direction. The latter is still active today and confirmed by geodetic studies and by earthquakes focal mechanisms.

The early NE-SW episode of extension (mainly Pliocene in age) is expressed in the field by low-angle normal faults, dipping 20 to 30° northeastward, more or less parallel to the Frontal thrust of the Internal Hellenides. These low-angle normal faults are separating the platform limestones of the external zones from the upper tectonic units of the internal zones. We suggest that these low-angle normal faults are corresponding to the earlier stage of rifting and that they are rooted in the major thrust system. The 30 to 40° change in the extensional direction (turning North-South) led to the development of a new set of normal faults, dipping about 60°, and crosscutting the former inverted thrust front. However, this second set of normal faults, responsible for the present Sperchios Basin, appears also to be influenced by the crustal inheritance since the rifted basin is progressively interrupted toward the west, immediately after crossing this major crustal thrust zone. We document in this study the interactions between the successive extensional episodes with the large-scale crustal heterogeneities of the crust that developed during orogenic building.