The axial basins of the Levant Rift and their tectonic significance

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The Levant rift system, which extends from the northern Red Sea to the East Anatolian Fault, is distinguished by the distinctive geological asymmetry of its facing flanks, and by a series of axial basins of variable dimensions. The basins are bounded by conjugate normal faults that downthrow the central block and uplift the margins, and are separated by threshold zones of subdued structures, both in the down-faulted rift and in the uplifted flanks. Dubertret (1932) attributed the asymmetry to large strike-slip displacement, and Quennell (1958) initiated the concept that the basins were pull-apart basins, and served as evidence for a 107 km of sinistral offset along the rift system. Then Freund (1970) and Jaffe and Garfunkel (1987) suggested further that the pull apart basins are a proof that the Levant rift tectonically transformed the opening of the Red Sea into lateral displacement along the East Anatolian Fault. However, since the lengths of the various basins differ considerably, because direct evidence for large lateral displacement is lacking, because the timing of the rifting is contentious, and as the large lateral displacement is incompatible with the geology of Syria and Lebanon (Dubertret, 1970), analog structural models were use to verify if indeed the rifted Levant basins indicate large lateral offset.

Experiments of oblique extension showed repeatedly that the configuration of the structural products varies with the obliquity of the extension, its angular deviation from the normal. A slight deviation from normal extension (e.g. ~5o) produces a wedge of continuous propagation. Digression of 15o-30o generated at first a simultaneous series of axial basins, which, with time, become interconnected, to form a continuous rift comprising basins and thresholds. Even though the development of the basins comprises lateral displacement due to the deviation, there is no correlation between the length of the basins and the lateral offset. An increase of the lateral deviation to 45o-60o generates a series of parallel strike-slip faults with a rift of secondary structural signature (Mart and Dauteuil, 2000; Agostini et al., 2009).

Rifted basins of variable lengths are not unique to the Levant Rift, and they were encountered in the East African Rift (Gawthorpe et al., 1993) – rifted domains known for their oblique rifting, and in the northern Red Sea (Bonatti, 1985). Therefore the series of analog experiments of oblique rifting is compatible with the tectonic interpretation that the Levant Rift system is the product of oblique continental break-up, and forms a prime example of an emerging oceanic ridge. The interpretation that the Levant rift is a transform fault seems poorly founded.