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Revisiting the Tectono-Stratigraphic Evolution of the Eastern Mediterranean Offshore Levant and Nile Delta

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Although the Eastern Mediterranean has become the focus for increased oil and gas exploration following significant discoveries in the pre-Messinian succession offshore Egypt and the Levant Margin, understanding its tectono-stratigraphic evolution is the first and most important step towards building reliable geological models that underpin petroleum play assessment. The Eastern Mediterranean Basin has evolved through a complex and poorly understood tectonic history. Disagreement within the scientific community relates to the age of rifting, the orientation of the crustal stretching direction and the type of crust underlying the Levant Basin and, by proxy, the magnitude of stretching.

We present, for the first time, an interpretation of deep (i.e. 12-20 sec TWT) regional 2D seismic lines covering the entire Levant Basin. We have interpreted nine seismic surfaces (from top basement to seabed) from which depth and isopach maps for key surfaces and intervals have been generated. To constrain the rifting age, we have used a reverse subsidence modelling technique and restored the Middle Jurassic and the Late Cretaceous basin geometry along a NW-trending seismic profile from the Levant Basin. The restorations, for a specific rifting age, that meet geological constraints on water depth that are obtained from well data and seismic stratigraphy, are considered as viable solutions. The type of crust that underlies the Levant Margin has been inferred from the magnitude of the lithospheric stretching derived from gravity inversion and crustal thinning.

Our interpretation of top basement and the Middle Jurassic depth-structure maps suggests that rifting in the Levant Basin led to the development of two main depocentres; in the northern Levant and the southern Levant, in the vicinity of the Nile Delta. These depocentres are separated by a series of NE-trending, fault- bound structural highs (i.e. Jonah and Leviathan). The orientation of the faults suggests they formed in response to NW-SE extension, which is further supported by the observation of a NW-SE-striking transform fault along the north-western Egyptian Margin. Reverse subsidence modelling indicates that rifting ages between 200 Ma and 176 Ma are required to restore the Middle Jurassic and the Upper Cretaceous surfaces to match the geological constraints on Middle Jurassic and Late Cretaceous palaeo-water depths. This predicted rifting age is in partial agreement with the rifting ages proposed by Gardosh et al. (2010) and Longacre et al. (2007) models. However, it disagrees with the rifting ages proposed by other models (i.e. Dercourt et al., 1986; Stampfli et al., 1991; Robertson, 1998; Garfunkel, 1998,2004).

High values of lithospheric stretching (Beta > 5) are predicted by gravity inversion and crustal thinning in northern Levant which suggests that sea floor spreading is very likely to have occurred following rifting. We believe that a remnant of the Neo-Tethys Ocean is preserved because of the collision of the continental Eratosthenes Seamount with the Cyprus Arc, which locked up the subduction process.