

«Petroleum Systems Offshore Cyprus»

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INTRODUCTION

The area considered for assessing the **Petroleum Systems Offshore Cyprus** is bounded by the Egyptian Margin to the South, the Levant Margin to the East, Turkey to the North, and the termination of the flat Herodotus Abyssal Plain to the West (longitude 30°E) with the Island of Cyprus in the Center. While in terms of **regional geology** the entire area is taken into account, in terms of **petroleum potential** only the **offshore area south of the Island of Cyprus** (i.e. within the Exclusive Economic Zone of the Republic of Cyprus) was considered. There, regularly-gridded recent 2D speculative seismic profiles (more than 19,000 km) were acquired and processed by Petroleum Geo-Services as well as a 3D survey in the Cyprus Arc. This allows for a new geological interpretation of the region and for better assessing its prospectivity.

GEOLOGICAL SETTING

The main tectonic and stratigraphic events which shaped **offshore Cyprus** and control its hydrocarbon prospectivity are linked to the history of the Tethyan Region since the Permo-Triassic and dominated by changes in the relative movement of the African, Arabian, Anatolian Aegean and Eurasian plates.

A - A period of rifting from the Triassic to the mid-Jurassic and spreading during the upper Jurassic and the lower Cretaceous. This event resulted in the separation, along a set of transform faults broadly oriented NNW-SSE, of a sliver of continental crust from Arabia resulting in the **Eratosthenes continental block** (ECB). After rifting finished a thick (around 4 to 5 km) carbonate platform developed on the ECB, as it did on the Levant margin. **Two basins** were also formed :

- 1. The Levantine basin** containing a thick infill of essentially deep water sediments (around 12 km) with probably some oceanic crust indicated by a positive Bouguer gravity anomaly in its axis. The well preserved eastern margin of the ECB is hence the conjugate margin of the Levant passive margin and the post-rift sediments of the basin pinch-out along its slope.
- 2. The Herodotus basin** with an oceanic crust and a very thick sedimentary section (12 to 15 km).

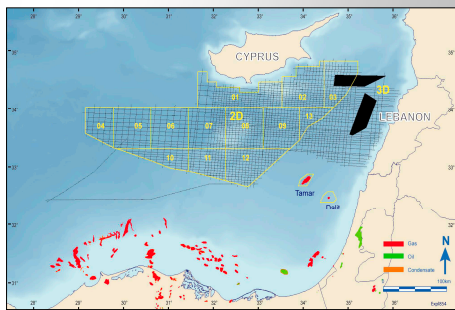
B - In common with the whole Tethyan area there was a period of NS compression in the Upper Cretaceous. This formed the **Cyprus arc**, overthrust to the south on the **older structural elements** from northern Arabia to Turkey (Antalya) through the island of Cyprus.

C - This phase of compression continued until the Eocene and there is seismic evidence of subduction of the northern Levantine basin below the Cyprus arc.

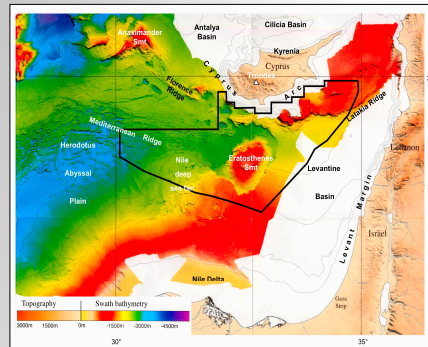
D - Beginning in the late Eocene-early Oligocene, an important change in the tectonic regime occurred in connection with the beginning of the separation of Arabia from Africa and this had significant structural and sedimentary consequences offshore Cyprus. **Two phases can be defined, before and after a tectonic climax in the latest Miocene-early Pliocene**, linked to the expulsion southwestward of the Anatolian-Aegean microplate.

- During the Oligocene-Miocene**, anticlines were formed in the **Levantine basin**. The prospectivity of these has been proven by the Noble Energy gas discovery of Tamar (Israel). The very broad **High** bounding the western side of the **West Eratosthenes sub-Basin** is of the same age. This tectonic change allowed the input of large volumes of clastic sediment into the eastern Mediterranean. It produced the **Nile delta and associated deep sea fan** with its' variety of potential reservoirs. This fan extends into offshore Cyprus, but **essentially west of the ECB**. During the latest Miocene, and in common with the rest of the Mediterranean area, very **thick Messinian evaporites** were deposited in the basinal areas of the eastern Mediterranean: the Levantine and Herodotus basins. Erosion of the Egyptian margin during the Messinian sea level drop generated **low-stand deltas** into the saline Messinian Herodotus basin, west of the ECB. Mass slidings and local diapiric structures deformed the Nile deep sea fan sediments west of the ECB.

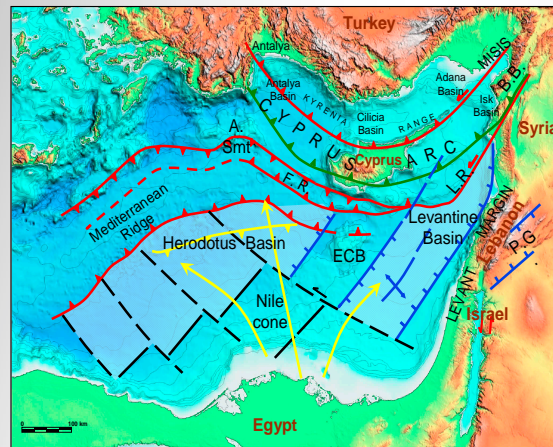
- After the latest Miocene**, in connection with the expulsion of the Anatolian-Aegean microplate, tectonic deformation affected the Cyprus arc and a broad zone at its forefront. In the NE, a strike-slip regime dominates with the formation of the **Latakia fault zone** separating the arc from the Levantine basin. To the west, at the level of the island of Cyprus, the regime becomes compressional with reverse faults, thrust anticlines and an elongated pop-up structure with a core of Messinian salt. Further to the west, the zone of deformation broadens again and merges with the **Mediterranean ridge**.



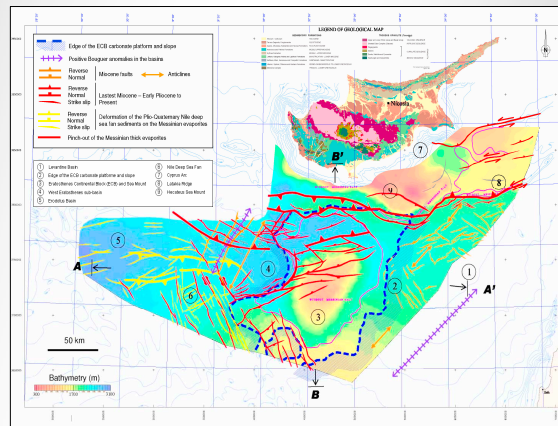
Map of the blocks Offshore Cyprus with seismic coverage and hydrocarbon occurrences



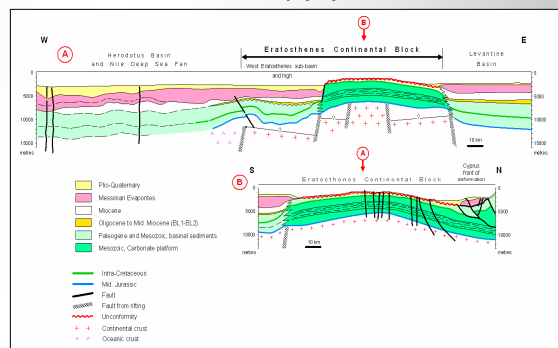
Physiography of the Eastern Mediterranean Sea (from MediMap Group, Ifremer-CIESM (2005))
 Smt = Seamount; Black line = boundary of the PGS survey offshore Cyprus



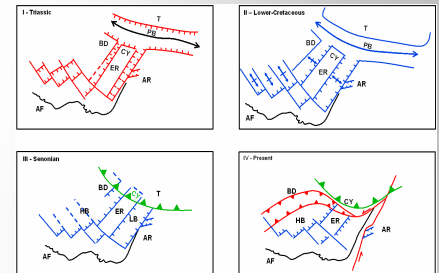
Main structural features of the Eastern Mediterranean
 In blue: Mesozoic structures – In green: front of the Ophiolites
 In red: Neogene structures – In yellow: Nile sedimentary input
 ECB = Eratosthenes Continental Block; A: Smt = Anaximander Seamount; B.B. = Baïr-Bassit
 Isk.B. = Iskenderun Basin; Dashed lines = Mesozoic transfer-transform faults



Structural sketch map of the Offshore Cyprus
 Location of the A and B depth geological cross-sections

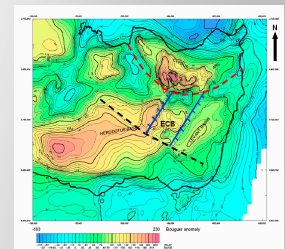


EW (A) and NS (B) schematic depth geological cross-sections

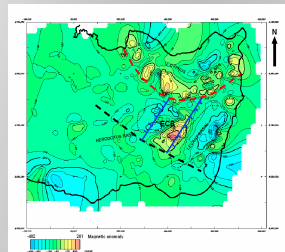


Paleotectonic sketch maps of the Eastern Mediterranean since the Triassic

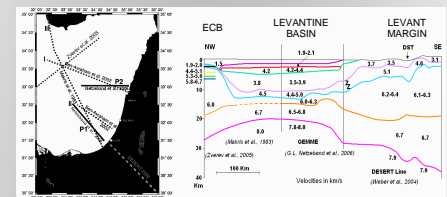
(I) Triassic, beginning of rifting. (II) Lower Cretaceous, after rifting and spreading. (III) Senonian, formation of the Cyprus Arc and Ophiolite Belt. (IV) Present, with the Mediterranean Ridge.
 ER = Eratosthenes Continental Block; CY = Cyprus; BD = Bey Daglari; HB = Herodotus Basin; PB = Pamphylian Basin; T = Taurus; AR = Arabia; AF = Africa; MR = Mediterranean Ridge.



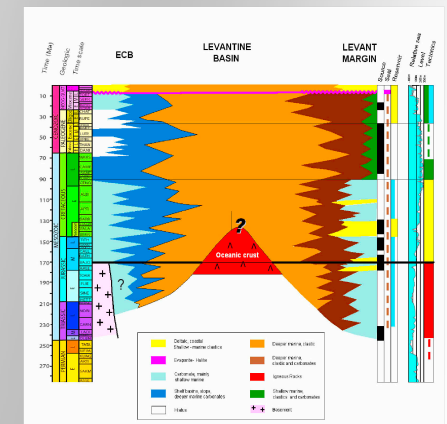
Bouguer gravity anomalies map
 (from Woodside, 1977)
 In red: front of the Ophiolites



Magnetic anomalies map
 (from Woodside, 1977)
 In red: front of the Ophiolites



(A) Location map of the seismic refraction profiles in the Eastern Mediterranean (after Netzeband et al., 2006, modified)
 (B) Crustal structure between the Levant and the Eratosthenes Continental Block from refraction profiles (velocity in km/s) (after Netzeband et al., 2006, modified)



Schematic chrono-stratigraphy from the Eratosthenes Continental Block (ECB) to the Levant Margin through the Levantine Basin.

On the ECB, the succession is hypothetical. The nature of the crust under the Levantine Basin is uncertain. A ridge of oceanic crust is figured.