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Offshore Cyprus and Lebanon, a Future Hydrocarbon Player

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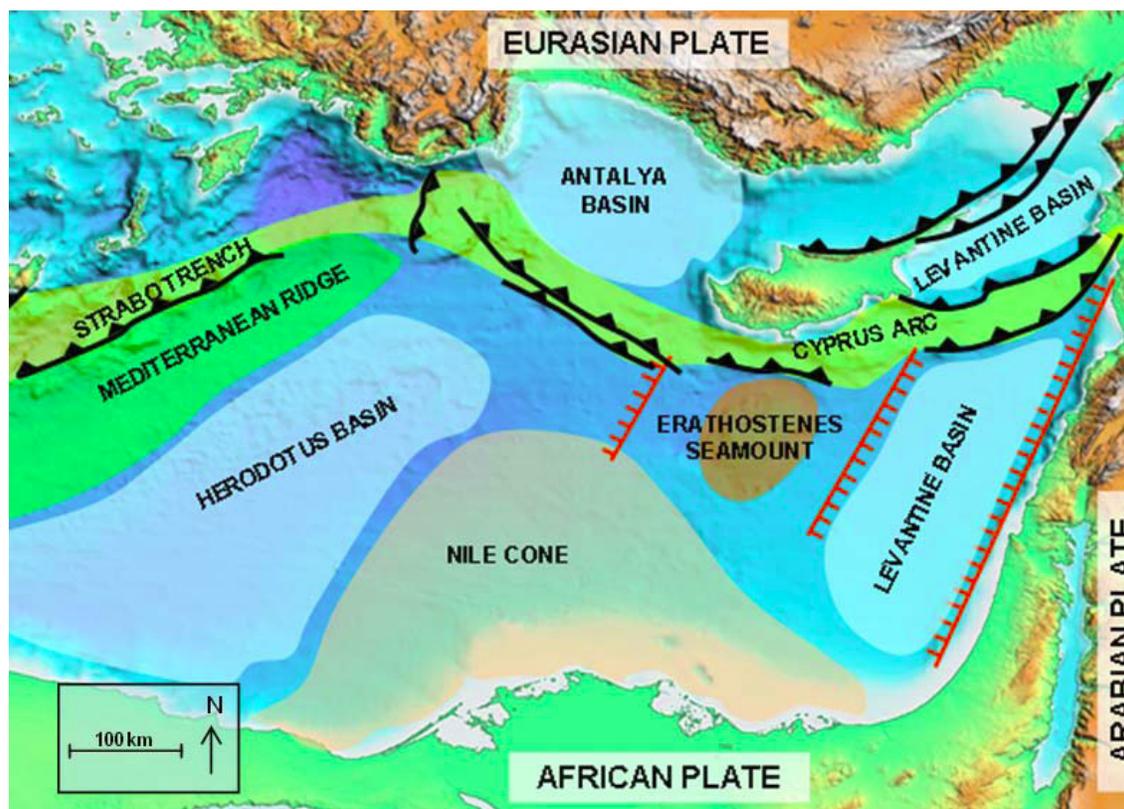


Figure 1: Map showing the main structural elements in the Eastern Mediterranean (modified from Sage and Letouzey, 1990)

Eastern Mediterranean and especially offshore Cyprus and Lebanon are covering a huge unexplored area of more than 100,000 sq km (Figure 1). As of today very little exploration has been done in this area despite the area is located close to an already proven hydrocarbon province in offshore Egypt and the Nile delta. The lack of exploration

is mainly due to no licensing rounds arranged, except for the first round in Cyprus back in 2007 but also because it is deep water and has been lacking seismic coverage. This is set to change. More than 25,000 line km of dual sensor seismic data, several big pre Missinian anticlines and upcoming license rounds for both countries including more



than 80,000 sq km of open acreage has recently fueled the industry's interest together with the very encouraging Tamar discovery in offshore Israel located in Levant basin 60 km from offshore Cyprus and Lebanon. The discovery is extremely important for the area since it basically prove up the area as prospective.

Offshore Cyprus

The geology offshore Cyprus can be split into different geological provinces because of the varying pre Messinian geological setting. Even though the geology is varying from West to East it has one thing in common, which is also common for the most of eastern Mediterranean; the Messinian Salt. The evaporate layer is found offshore Egypt, Libya, Israel, Lebanon, Syria and Cyprus and is basically masking the pre Messinian layers.

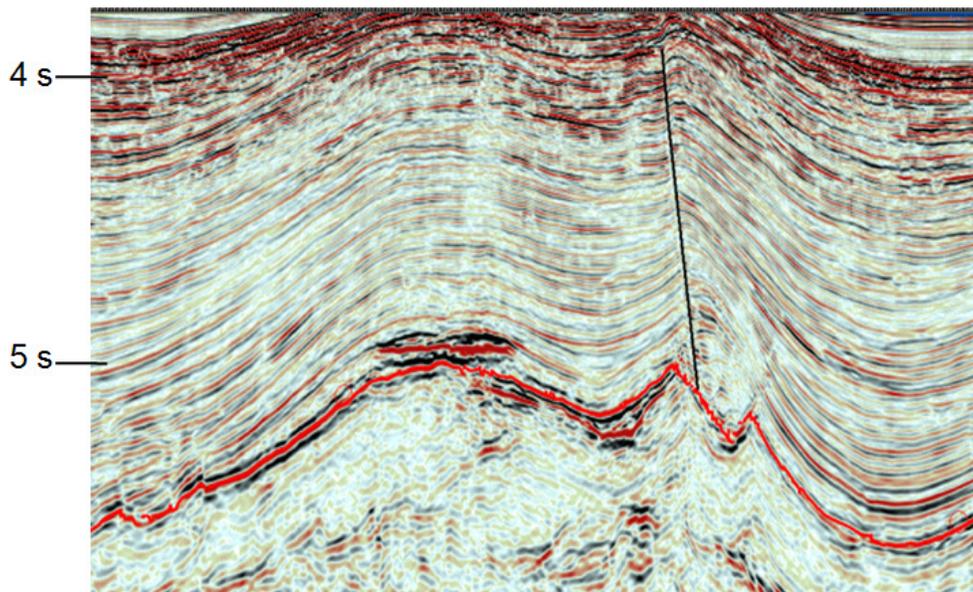


Figure 2: Post Messinian flat spot in the Herodotus basin.

The Herodotus basin located in the western part is a thick pre Messinian sediment basin, heavily faulted giving several large fault blocks. From seismic data it is possible to identify fault blocks as old as Jurassic/Cretaceous age. Due to its complex geology and massive faulting the imaging is challenging but several anticlines are seen with one of the biggest around 500 sq km. In the post Messinian

sequence several hydrocarbon indicators have been identified which are probably of biogenic origin (Figure 2).

The Eratosthenes Seamount, located 100 km south of Cyprus (figure 1), is a large anticline covering about 4,000 – 4,500 sq km. The origin and composition of this structure has been the subject to a lot of discussions over the last



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decades. Krasheninnikov and Hall (1994) interpreted part of the structure as a seafloor exposure of Precambrian crystalline rocks of the Afro Arabian plate. Later, based on results from the ODP program, Robertson et al. (1998) interpreted the structure as a horst block with an overlying carbonate platform. The ODP program drilled several shallow wells at the seamount back in 1995 and in leg 160

carbonates from Aptian time were discovered. Recent seismic data further add valuable information on the seamount and its structure is now better understood. In particular, the dual-sensor technology's ability to record more of the low frequency events in the seamount has helped interpretation of the structure.

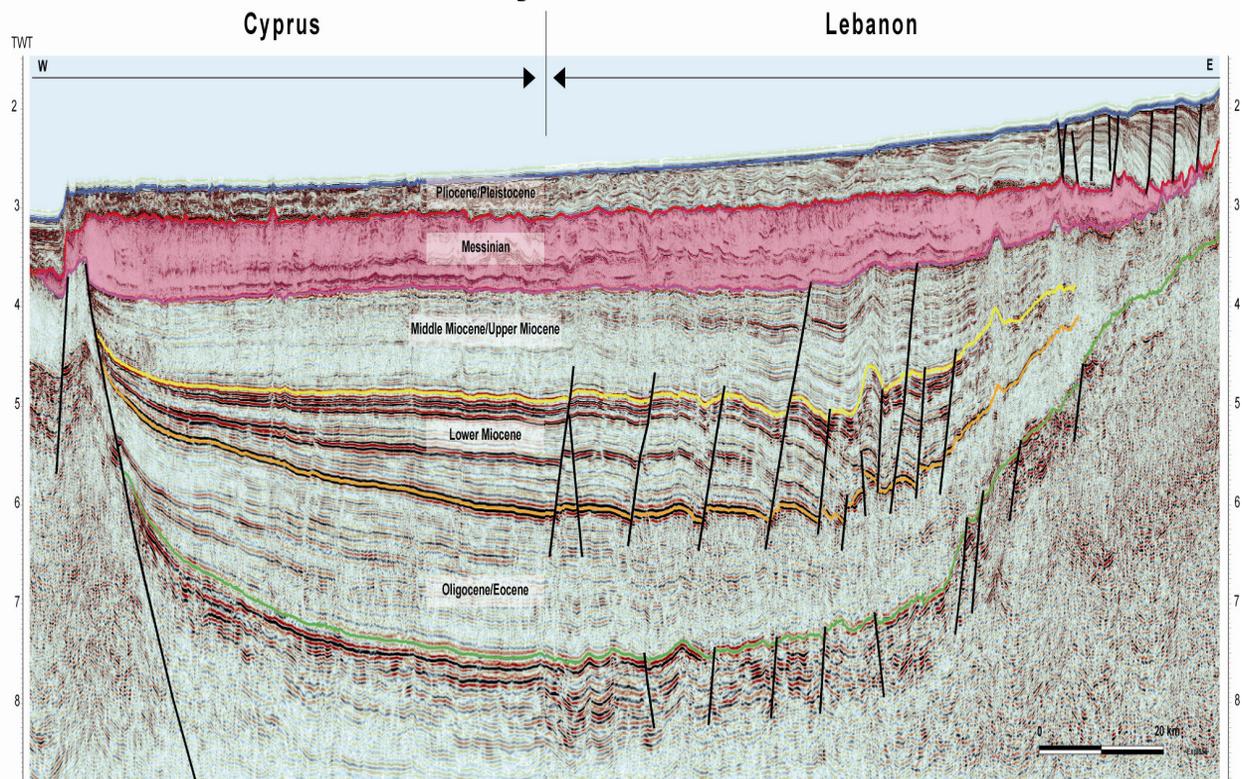


Figure 3: Seismic section, East-West from Lebanon to Cyprus.



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Levantine basin

The Levant basin is stretching from Israel in south to Syria in north and is delineated by the Eratosthenes to the west and the coastline to the East. The basin consists of a thick pre Missinian sediment basin overlaid by a relatively thick and continuous salt layer. Since no direct well ties have been available the interpretation of the deeper sections have been difficult but based on available information the base of the basin is believed to be the Senonian unconformity, a lot younger than earlier believed. The pre Missinian sequences show several big anticlines, narrow in an east-west direction but long in north-south direction indicating some large tertiary east-west compaction. The anticlines can be followed thru the thick sediment package all the way to the base of the basin.

Petroleum Geology

Cyprus and Lebanon have never really been subject to any hydrocarbon exploration. A few wells have been drilled in the fifty – sixties onshore Lebanon in the Bekaa valley with some shows of hydrocarbons but not anything significant. The Levant basin has been subject to a lot of interest from the industry but has not been open to exploration yet. It has also been asked questions about source and reservoir quality and it has been difficult to draw analogues from offshore Nile delta where the discoveries mainly are post Missinian. With the recent giant Tamar discovery offshore Israel in the Levant basin it have basically been confirmed that the Levant basin is prospective. The lower Miocene Tamar discovery has been reported to consist of 3 sub sequent high quality sand reservoirs and with its location close to both Cyprus and Lebanon it is likely that the lower Miocene also here have good reservoir quality. The hydrocarbon source is more difficult to identify but Jurassic in one candidate. The western offshore and the Herodotus Basin is in general complex with a lot of thrusting and faulting were several big 4-way closure structures are

identified together with a set of interesting Cretaceous/Jurassic fault blocks. Several hydrocarbon indicators as flat spots, amplitude anomalies and gas chimneys further enhance the hydrocarbon potential (Semb, 2009). These are seen basically in all parts of offshore Cyprus and Lebanon and are identified both in the pre and post Messinian sediment packages.

Conclusion

Based on the promising structures and elements identified in the seismic data and the big recent discovery in offshore Israel, offshore Cyprus and Lebanon are expected to receive a lot of attention from the oil and gas industry with regards to upcoming license rounds and will be an important player in the future search for hydrocarbons.

References

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