Lebanon´s Second Offshore Licensing Round 2019

GEOLOGY OVERVIEW AND PROSPECTIVITY

LEBANESE PETROLEUM ADMINISTRATION

PROSPECTIVITY

The Eastern Mediterranean region has produced significant discoveries in recent years and is believed to still have massive hydrocarbon deposits to be discovered.

Such recent exploration successes have stimulated the Lebanese government to acquire an extensive volume of 2D and 3D multi-client seismic data covering almost the entire Lebanese offshore acreage (Fig. 1). This is a remarkable, probably unique situation, whereby such wealth of information has been made available even before the award of the first two exclusive petroleum licenses for exploration and production.

Using the available data, interested companies can learn more about the offshore hydrocarbon potential (up to the prospects' level) and plan according to similar geological affinities with existing discoveries in the Eastern Mediterranean.

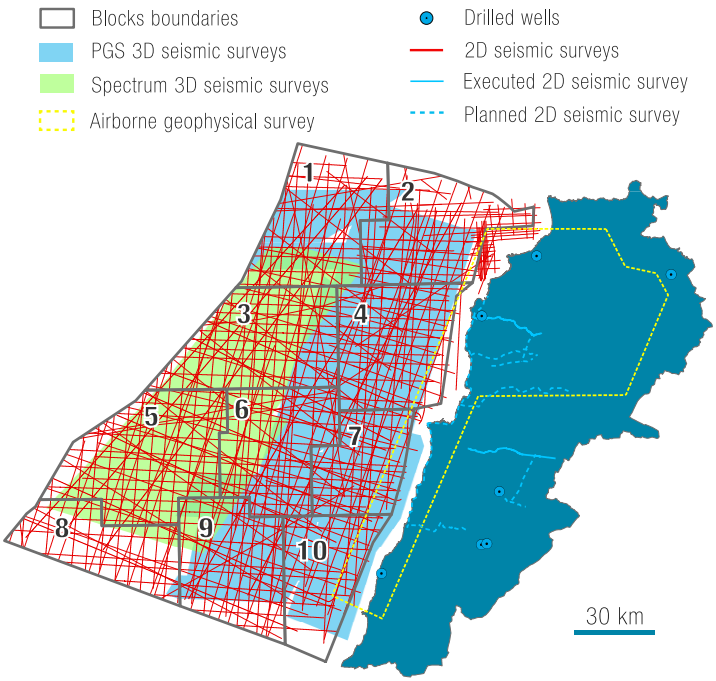

Figure 1 Available Geophysical Data

GEOLOGICAL HISTORY

The eastern Mediterranean margin, incorporating coastal and offshore Syria, Lebanon and Palestine is commonly referred to as the 'Levant margin'. This margin is integral to an understanding of the evolution of the eastern Mediterranean. Its origins date back to the multi-phase rifting of the super-continent of Gondwana during the Mesozoic, and separation of a series of micro-plates from the Afro-Arabian region that lasted until the Early Jurassic (Fig. 2).

Mesozoic Rifting and Subsidence

The Levant margin developed as a N-S transform margin, at a high angle to the adjacent Palmyride Rift, which trends NE-SW through Syria. The Palmyrides developed into an aulocogen (rift) during the Late Triassic. The sedimentation in the Mid-Late Permian to Early Triassic is clastic dominated on the continental platforms and basins, with facies changing to carbonates with the development of the basin.

A post rifting thermal subsidence took place and lasted for ~ 60 ma spanning from the Late Jurassic to the Turonian.

Late Cretaceous Compression

In the Cretaceous to the Paleogene time, the Levant Basin and associated margins were subject to a compressive regime due to the continent-continent collision of Europe and Africa that resulted in the obduction of ophiolites across the region. The Latakia ridge represents the frontal-most structure of the deformation zone that is subject to ongoing northward subduction of the eastern Mediterranean portion of the African plate below the Turkish component of the European plate – the Anatolian subplate.

Afro-Arabian Separation and Messinian Salinity Crisis

The Levant margin also contains elements of more recent and ongoing plate movement. The whole margin is transected by a north-south trending intra-plate strike-slip system, termed the Dead Sea Transform Fault, (DSTF). This marks the northward continuation of the Dead Sea rift and is a sinistral fault creating a number of compressive and restraining bends along its course.

Movement along this fault has contributed to the recent morphology of the onshore Levant margin and has also been the site of many historical oil seeps and hydrocarbon shows. During the Late Miocene, in the Messinian, a salinity crisis occurred. The Messinian salinity crisis is an important geological event where the Mediterranean Sea went into a cycle of nearly complete dryness, resulting in the deposition of up to 2,000 meter thick evaporitic layer. This had been caused by reduced connectivity between the Atlantic and the Mediterranean, attributed by tectonic uplift of the Gibraltar seaway and sea level fluctuations.

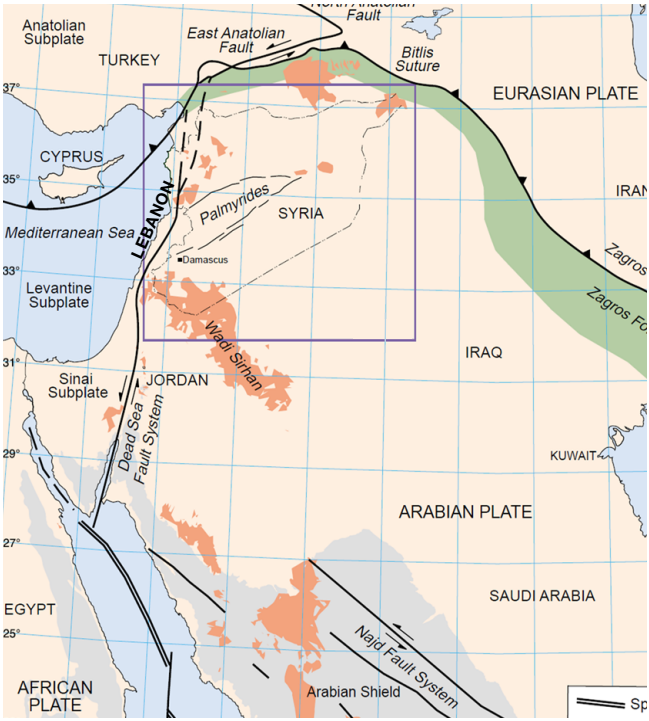

Figure 2 Geologic Setting

PETROLEUM SYSTEMS OFFSHORE LEBANON

Basin modelling shows a strong potential for mixed biogenic and thermogenic systems offshore Lebanon (Fig. 3). Recent studies reveal the potential for several gas-prone and oil-prone source rocks in the Levant basin. 3D thermal history and maturity modelling indicate that these source rocks, found from the Triassic to Miocene intervals, have reached their maturity.
Recent discoveries in the Eastern Mediterranean validated the presence of gas accumulation generated from these source rocks in subsalt Oligocene and Lower Miocene sands. These source rocks further proved their prosperity in the recent carbonate discoveries such as Zohr in Egypt and Calypso in Cyprus.

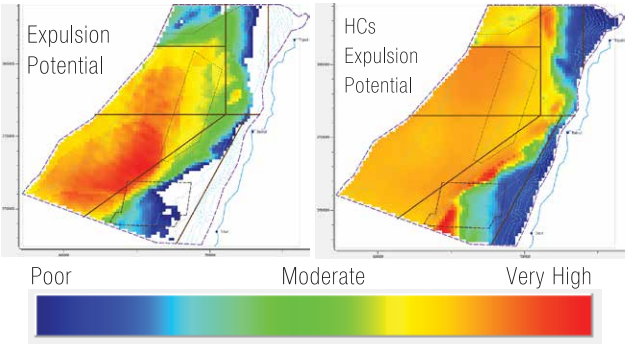

Figure 3 Hydrocarbon Expulsion Potential

The study of the regional framework and the interpretation of seismic profiles, coupled with petroleum system modeling allows dividing the Lebanese offshore into three major geologic zones: Latakia Ridge, Deep Basin and the Margin with water depths ranging from 33 meters to 2119 meters.
Each zone (Fig. 4) is characterized by specific structural and sedimentological features promoting geological diversity Offshore Lebanon.

- The Margin: promising stratigraphic traps and carbonate buildups.
- Latakia Ridge: Anticlinal structures.
- Deep Basin: Anticlinal structures as well as shallow dip faulted anticlines.

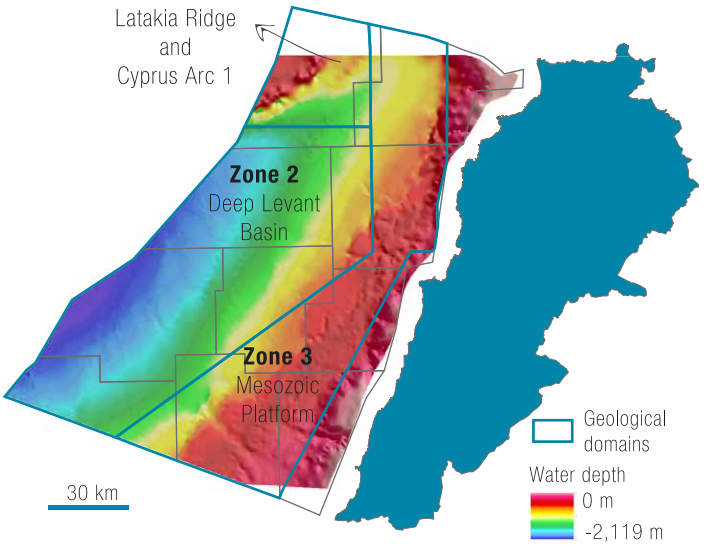

Figure 4 Geological Domains Offshore Lebanon

KEY ASPECTS

Various traps are identified within each geologic zone.
The Oligo-Miocene succession offshore Lebanon are excellent targets for biogenic and thermogenic hydrocarbons. These traps are clastic in nature and are sealed by intraformational shales as well as the Messinian evaporitic layer.
The margin zone holds promising stratigraphic traps (Fig.5), such as pinchouts onlapping over the Senonian unconformity with associated direct hydrocarbon indicators.

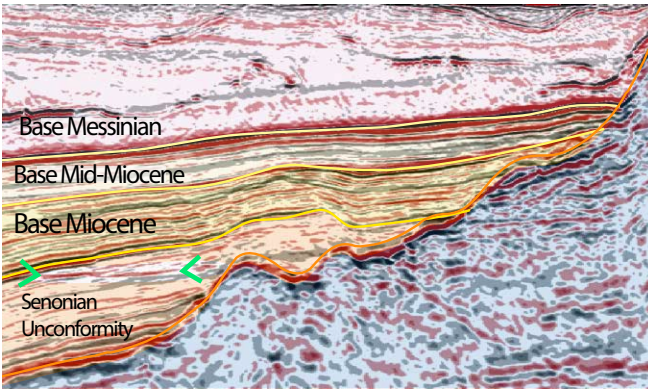

Figure 5 Stratigraphic Trap showing Flatspot

Perfectly symmetrical anticlinal structures (4-way dip closures) are extending over the margin, transition zone and the Latakia ridge (Fig. 6).

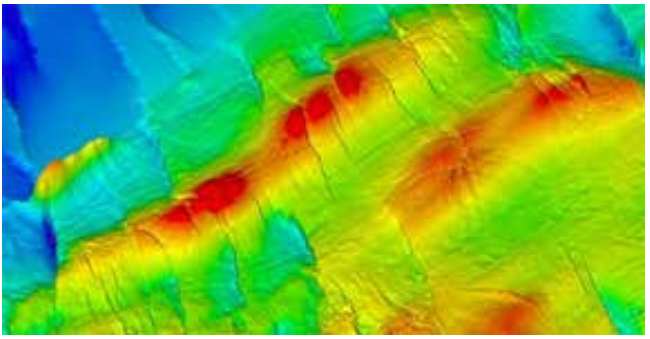

Figure 6 Anticlinal Trap 4 way Dip Closure

Furthermore, the deep basin includes numerous shallow dip faulted anticlines (3-way and 4-way dip closures) analogous to those discovered in the Eastern Mediterranean (Fig.7).

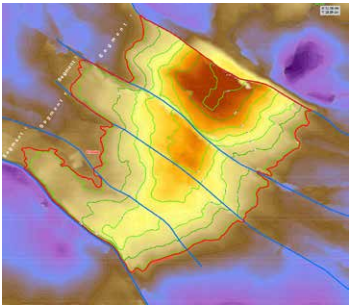

Figure 7 Faulted Anticline
Courtesy of Spectrum

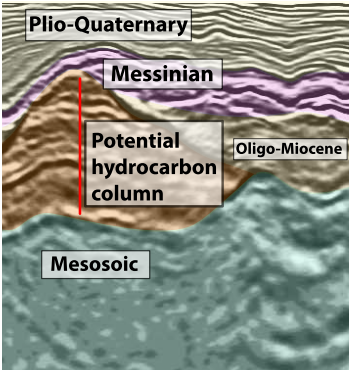

Figure 8 Carbonate Buildup

In addition, seismic profiles indicate the presence of carbonate platforms and encouraging buildups of the same nature along the margin (Fig.8). Given the impact of recent giant carbonate discoveries in the Eastern Mediterranean, these carbonate build-ups constitute interesting targets for any future exploration activities.

The second licensing round offers a unique opportunity to explore a wide range of prospective targets offshore Lebanon from siliciclastic, calciclastic to bioclastic lithology.

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