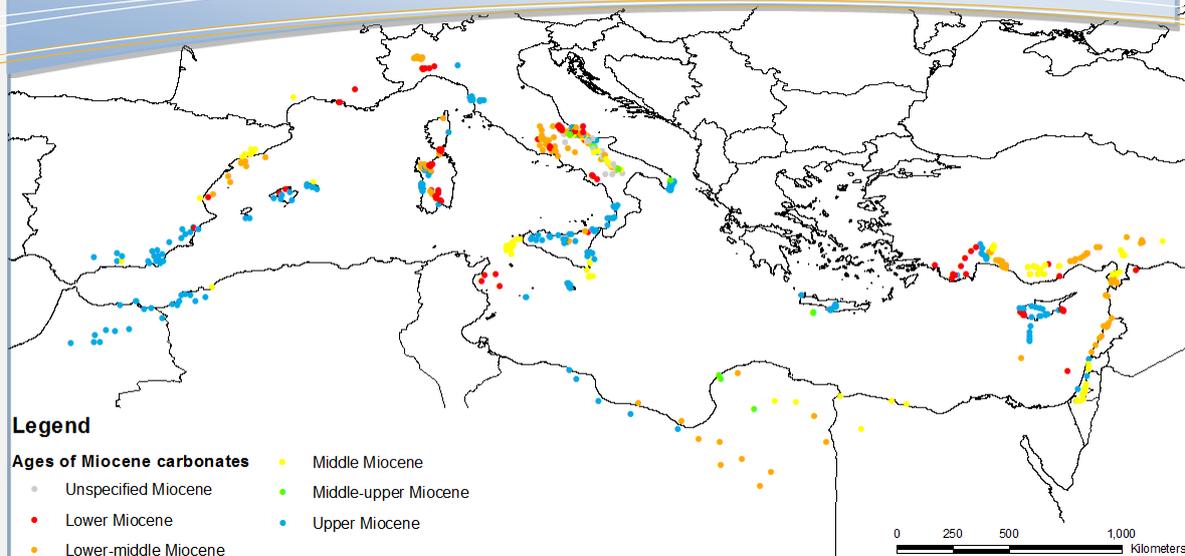


HC POTENTIAL OF SHALLOW WATER MIOCENE CARBONATES IN THE MEDITERRANEAN SEA



Location of the main outcrops and localities with Miocene shallow water carbonates in the Mediterranean Sea

This study reviews the characteristics and distribution of the Miocene shallow water carbonates of the Mediterranean Sea and surrounding areas. It includes a summary of the paleogeography/paleoclimate characteristics and tectonic domains during the Miocene and a comparison between the geometries, compositions and main petrophysical properties of the carbonate settings in the area.

Carbonate reservoirs in the Mediterranean Offshore are usually of Mesozoic age; reservoirs hosted in Miocene shallow water carbonates are limited and occur as secondary reservoir, reported mostly in the Italian onshore and offshore. The depositional environment is usually characterized by a ramp profile, often with some siliciclastic input. The discovery of Zohr Gas Field by ENI opened a completely new play concept for the Mediterranean, focusing on high relief isolated carbonate platforms; during the first exploration stages, the few available information indicated that the reservoir in the Zohr field was as old as Miocene, but later studies and more data collection allowed to confer the most part of the reservoir to Cretaceous platform. Nonetheless, the initial spotlight on the Miocene carbonates highlighted very promising reservoir potential of this type of deposits in the peri-Mediterranean area.

The study collects information from public domain sources and from the GEPlan internal database, and focuses on outcrop and subsurface data. A total of over 800 localities show Miocene shallow water carbonates either outcropping, discovered by wells, cited or described in papers or indicated in geological maps.

Miocene carbonates of the Mediterranean area outcrop in several localities, from Spain and Morocco in the West to Turkey, Cyprus, Lebanon and Syria in the East, and are characterized by different geometries ranging from homoclinal ramps, distally steepened ramps, flat-topped platforms, reef-rimmed shelves and mixed carbonate-siliciclastic ramps with patch or fringing reefs.

The depositional profile of the platforms, their internal architecture and their facies heterogeneities, are the result of a complex interplay between global and local effects, of production and reworking processes, different accommodation, sea level oscillations, paleoceanographic and paleoclimatic changes, trophic resources distribution and biological evolution. An important role is also played by the tectonic instability that characterized several Mediterranean regions during Miocene. The Miocene shallow water carbonates facies often lack lateral extension and continuity, and are characterized by variable and locally abundant siliciclastic input.

Miocene carbonates show in general variable matrix reservoir properties, with porosity that locally can reach 20% or more and permeability that ranges from a few millidarcies (Nilde, Bomba and Val d'Agri fields) to several hundred millidarcies (Cigno and Vallecupa, Ombrina Mare fields). The good matrix porosity is a direct effect of the initial rock porosity and is strongly related to the rock texture and the depositional environment conditions.

One of the unique characteristics of the Mediterranean area is related to the geological evolution of the area at the end of the Miocene, associated to the closure and drowning of the Mediterranean Sea and the development of the Messinian salinity crisis. The impact of this crisis in different parts of the basin varies and the products associated to this period are also variable. In the case of the Miocene carbonates sequences deposited in shallow water areas, the Messinian event produced, in most of the cases the exposure of the Miocene sequences and the development of karst processes and associated meteoric diagenesis. These processing had a direct impact on the reservoir characteristics of the Miocene sequences, modifying the pre-Messinian sequences.

Considering the previous exploration activity and the good petroleum potential it is clear that the basin has been underexplored and that the Miocene carbonate reservoirs have been overlooked and underestimated.

The Western Sector of the studied area covers mainly areas affected by Tertiary rifting (with the exception of the Betic Cordillera), the Miocene carbonate sequences were deposited in mixed systems or small carbonate platform/ramps. The associated reservoirs are extremely heterogeneous in terms of petrophysical properties and with limited lateral and vertical extension. The exploration potential of the Western Sector of the Mediterranean area is limited.

The Central Sector is characterised by the development of large and extended ramps during the Miocene, with a very limited siliciclastic input. The associated reservoir facies are laterally extended and they show good porosity but variable permeability. The area still preserves exploration potential both onshore and offshore for targeting Miocene carbonates.

Finally, the Eastern sector can be divided into two parts; the northern part has been poorly explored because of the structural complexity. The exploration potential of the northern part is limited because of the limited extensions of the carbonate systems and present high risks because of the structural complexity. The discovery of the Zohr field in the southern part of the western sector has opened large exploration potential associated to all the isolated platforms developed in the Levantine Basin or on trend with the Eratosthenes High.

The study has been conducted by GEPlan Consulting s.r.l. based in Ferrara, Italy. GEPlan is an oil and gas consulting firm that can provide innovative and integrated services for exploration, appraisal and development projects. It has specialist skills in the characterization of carbonate and fractured reservoirs and in the Italian and Circum-Mediterranean Oil and Gas Prospectivity. This study is part of larger collection of basin studies. These reports describe the geological characteristics of the basin and its evolution through time and they cover the most important aspects related to the hydrocarbon exploration and prospectivity, identifying and characterising the proved and possible plays in the area.

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Enclosures:

- ArcGIS 9.3 and 10.3 project
- **Enclosure 1:** GIS project user guide
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