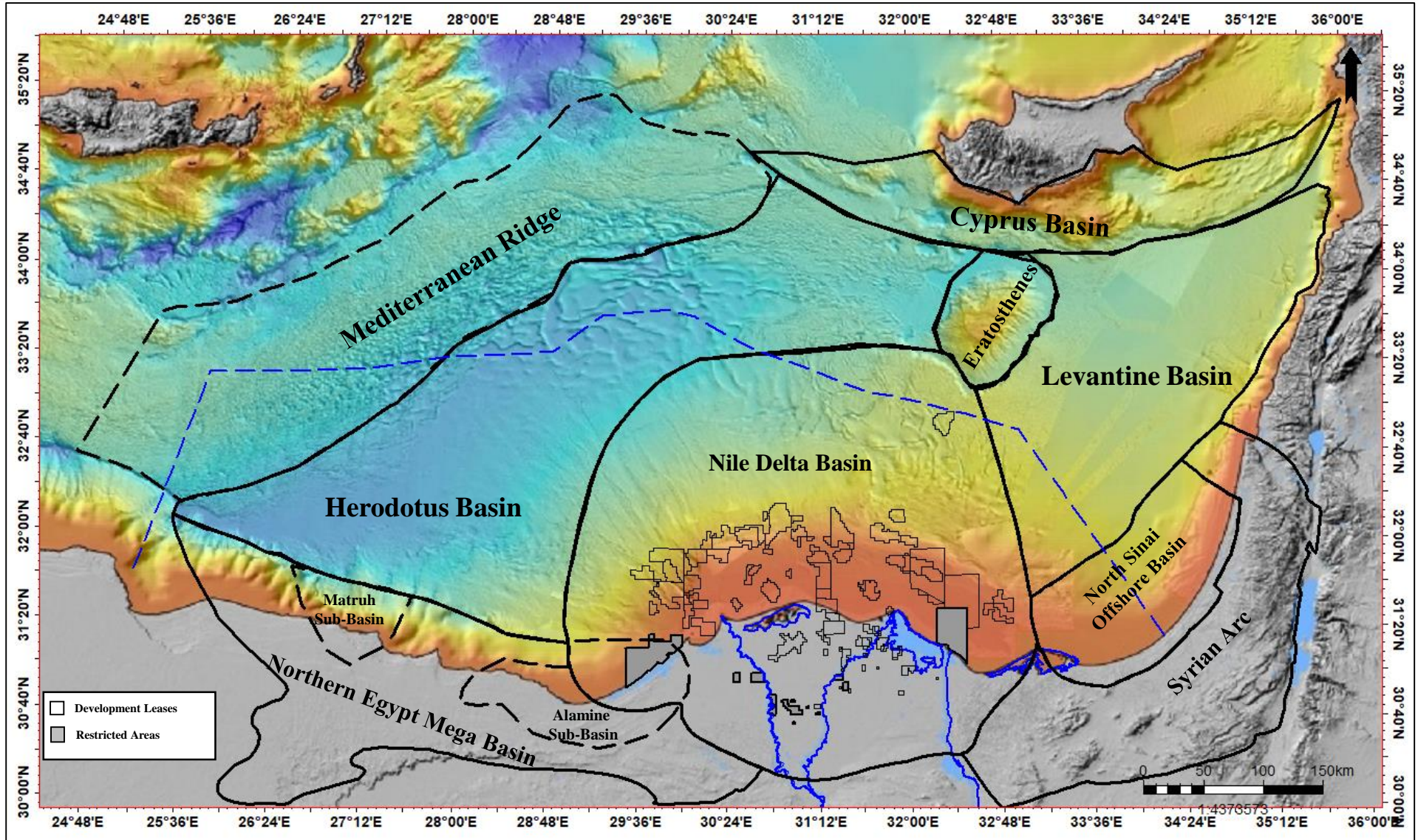


Med. Sea, Nile Delta & North Sinai Sedimentary Basins



Med. Sea, Nile Delta & North Sinai

Sedimentary Basins

□ Nile Delta Basin :

The Nile Delta Basin extends over a large geographical area (approximately 120000 km²) located in the northeastern portion of Egypt, to the northwest of Sinai Peninsula. It straddles the Mediterranean shoreline, with an onshore segment formed by the Nile Delta and an offshore segment extending seaward till lat 30° 30' 00.00"N.

The Nile Delta with its known classical shape resembling the Greek letter “delta”, constitutes the onshore segment of the Basin. It comprises the densely populated cultivated lands spread out between the two branches (Rosetta & Damietta) of the Nile River with small extensions to the west, beyond the Rosetta Branch and to the east, beyond the Damietta Branch. The Nile Delta starts, in the south, at approximately 30km north of Cairo, where the Nile River bifurcates and extends northward for some 160km till the Mediterranean shoreline. The maximum, east to west, extension of the Nile Delta lies at the Mediterranean coast where it stretches for approximately 240km from Alexandria in the west to Port Said in the east. The Nile Delta comprises a plain terrain, rising to only 18m above mean sea level in the south. It is bounded to the east and west by escarpments of raised Pleistocene deposits. Near the Mediterranean coast, a series of large, shallow lagoons form an almost continuous belt from Alexandria to Port Said, the largest of which are the Burullus and Manzala lakes. Discontinuous coastal dunes and dune fields in the east, 4 to 15 meters high, constitute the only local relief.

The offshore segment of the Nile Delta Basin extends seaward from the Mediterranean coastline till latitude 30° 30' 00.00" N and between longitudes 29°E (west of Alexandria) and 33°E (east of Port Said). This segment constitutes 70% of the basin area and comprises the present day continental shelf (in front of the Nile Delta) and the outer Nile Deep Sea Fan System, in water depths reaching up to 2800m. At Alexandria, the continental shelf, with water depths less than 100m, is narrow (less than 30km) and gets broader towards the east till reaching more than 60km in front of Port Said. Moving seaward, outside the continental shelf, the offshore segment of the Nile Delta can be distinguished in to three provinces (western, central & eastern) with distinct morphological and structural characteristics. The seabed of the Western Province, the most currently active part, is characterized by numerous small scale mud volcanoes, few wide calderas and gas chimneys. The Central Province is subject to slope instabilities and sedimentary slides, and is scattered with numerous pockmarks, carbonate pavements and mounds, with a recognizable feature represented by the scarp face of the Rosetta fault. The Eastern Province, bordered on the western side by a major transpressive fault zone, is strongly deformed due to sliding of the Pliocene and Pleistocene on Messinian over a salt detachment level (salt tectonic activity).

Med. Sea, Nile Delta & North Sinai Sedimentary Basins

□ Sinai Peninsula Onshore & Offshore :

Geographically, the Sinai Peninsula comprises an inverted triangle-shaped peninsula, in the northeastern corner of Egypt, its base at the Mediterranean Sea (to the north) and its apex at the Red Sea (to the south). It extends over an area of 60000 km², bordered from the west by the Suez Canal and Gulf of Suez, from the east by the Egyptian-Palestinian international border and Gulf of Aqaba and from the north by the Mediterranean shoreline.

The terrain of Sinai Peninsula is divided into three main areas; North Sinai, Central Sinai and Southern Sinai. North Sinai runs parallel to the Mediterranean coast with flat and uniform landscape comprising wadis and sand dunes interrupted by sand and limestone hilly features (e.g. as in the region of Gebel Maghara). Central Sinai is mostly comprised of the scarcely inhabited El-Tih Plateau, a high area of limestone formed during the Tertiary. Central Sinai extends to the south till the mountainous area of South Sinai. Such southern area is mostly occupied basement rocks with rugged mountainous topography of high altitudes intervened by wadi deposits. The Offshore North Sinai, comprises the southeastern area of the Mediterranean Sea lying between Port Said and El Arish cities with northward extension, for some tens of kilometers, in the shallow to moderate water depths of the Mediterranean.

The Syrian Arc Folds (part of a regional fold system extending from Syria through North Sinai to the Western Desert of Egypt) constitute the NE-SW structural trend in North Sinai (onshore) and the offshore part of the Mediterranean Sea in front of Sinai Peninsula. They comprise asymmetrical anticlines with a gently dipping northwestern flanks and steep or occasionally overturned southeastern flanks; associated with normal and thrust faults and, in some places, basin inversion and uplift. These folds were formed as a result of the southeasterly compressional forces produced by the northward movement of Africa relative to Europe (Alpine Orogeny, Late Cretaceous – Middle Eocene). The prominent NE-SW trend of these folds bends to take a more northerly course in response to the stress field set up by the strike-slip fault zone of the Aqaba-Dead Sea rift. The deepest penetration, Offshore North Sinai, was made by the Mango-1 well which was bottomed at a total depth of 4655m in the Jurassic strata. This well was tested and recovered 10000 Bbl/d oil from the Lower Cretaceous sandstones.

Med. Sea, Nile Delta & North Sinai Sedimentary Basins

❑ Herodotus Basin :

The Herodotus Basin extends over a large geographical area (approximately 90000 km²) located in the northwestern offshore portion of Egypt, to the north of the Western Desert. Herodotus Basin is mainly located in the ultra deep-water part of the east Mediterranean. It is bounded by the leading edge of East Mediterranean Ridge to the north, Nile Data Basin to the southeast and Northern Egypt Mega Basin to the southwest. The Herodotus Basin extends from the coastline across a relatively narrow shelf into deep water with depths ranging from zero to 3200m.

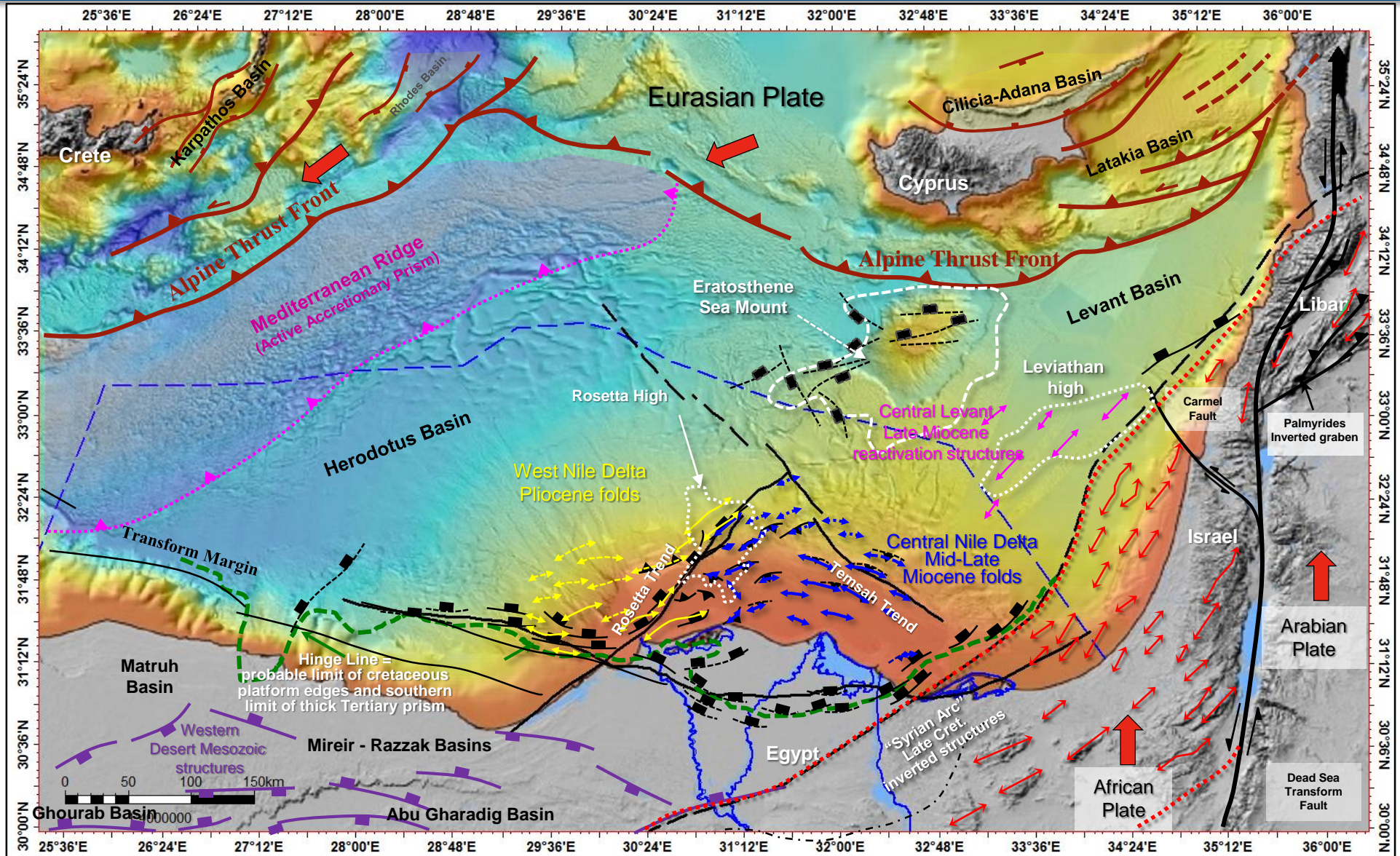
Tectonically, Herodotus Basin is the northernmost of the Africa north-facing passive margin, which is the result of the opening of the Neo-Tethys during mid-Jurassic to early Cretaceous times.

❑ Mediterranean Ridge :

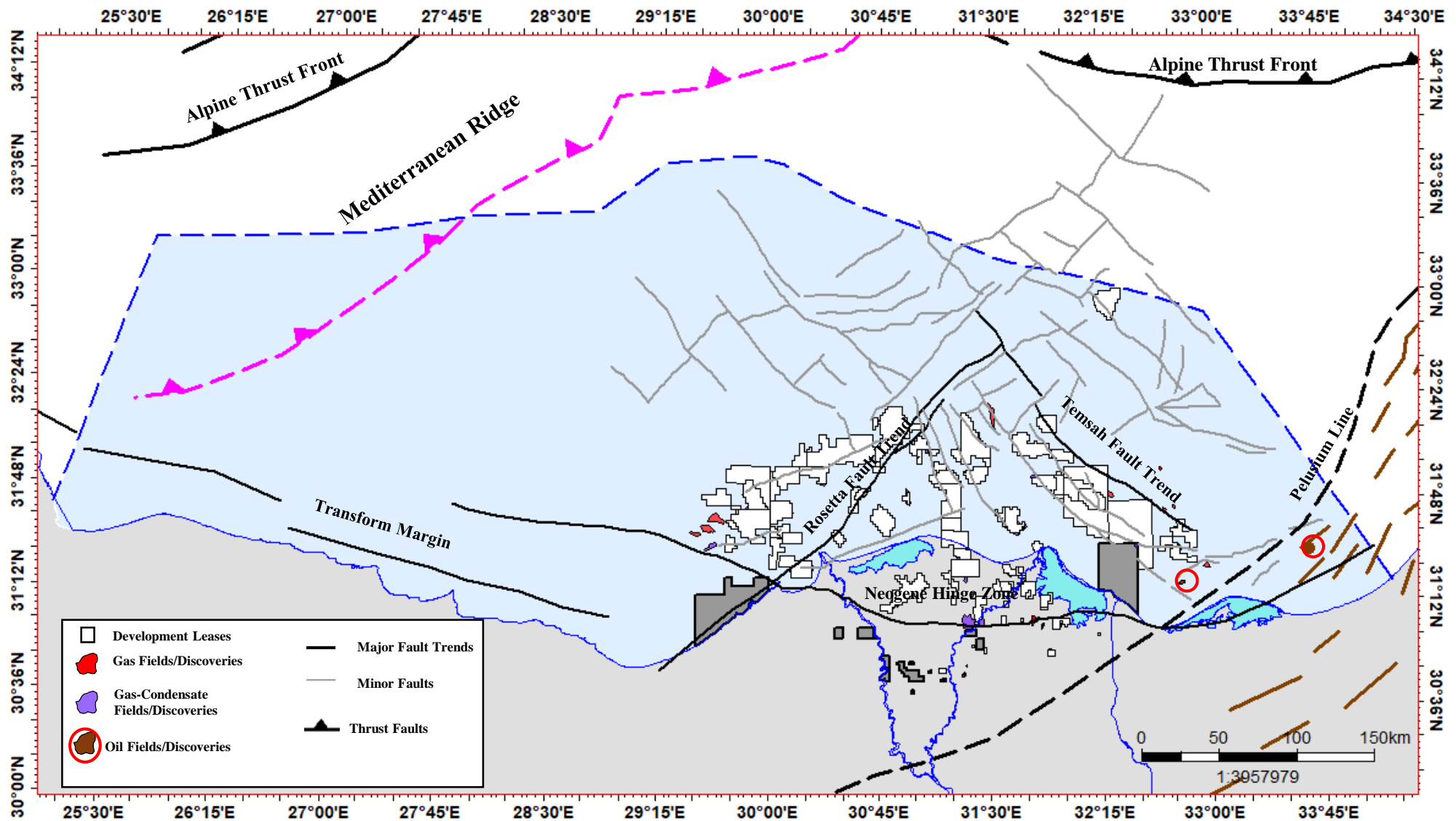
The Mediterranean Ridge (Eastern Mediterranean) is a large accretionary complex wedge that results from the Africa–Europe–Aegean plates convergence. It comprises distinct major structural domains facing different forelands: (1) An outer domain is bounded to the south by the ridge toe. Underneath the Ionian and Levantine outer Ridge, Messinian evaporites act as a major decollement level. (2) An axial, or crestal, ridge domain with mud diapiric and mud volcano activity is bounded to the north by backthrust. (3) A less tectonized inner Ridge domain, possibly a series of former forearc basins, abuts the Hellenic Trench. The ridge displays strong along-strike variations. These variations can be interpreted as consequences of an ongoing collision against the Libyan continental promontory.

Geometry forms a 1300-km-long and 150- to 300-km-wide curved feature extending over much of the deep basin from the Ionian to the Levantine seas

Med. Sea, Nile Delta & North Sinai Tectonic Framework



Med. Sea, Nile Delta & North Sinai Structural Elements



Med. Sea, Nile Delta & North Sinai

Structural Elements

❑ Neogene Hinge Zone :

The Hinge Zone or the Nile Delta Faulted Flexure Zone comprises a major structural element related to the crustal breakup of the southern Neo-Tethys during the Jurassic-Cretaceous time. It comprises a roughly E-W oriented, arcuate, narrow zone of normal faults forming a westward continuation of the hinge line of North Sinai and Palestine. The Hinge Zone crosses the onshore part of the Nile Delta Basin at approximately latitude 31° N, near the city of Kafr El Sheikh. It separates the basin into the South Delta Block (to the south) and the North Delta Basin (to the north), through a series of the down to the north normal faults forming a narrow zone reaching up to 20 kilometers wide. The Nile Delta Hinge Zone marks the edge of carbonate platform development in the Mesozoic, as well as the southern limit of thick deltaic sedimentation in much of the Tertiary, becoming less influential in the Pliocene. At the Faulted Flexure, seismic reflections from the top of the Eocene carbonates disappear at 6 seconds off the bottom of commercially recorded seismic sections. Thus, under the North Delta basin the structure of the Mesozoic- Eocene sequence is as yet largely unknown. An intermediate Slope province over and just north of the Faulted Flexure is characterised by crescentic down-to-the-north, concave gravity faults that cut through thick Oligocene and Miocene clastics.

❑ Misfaq/Bardawil (Temsah) Fault :

The Misfaq/Bardawil fault escarpment comprises multi terraces bound by major NW-trending listric fault lineaments extending some 200km from the Bardawil Lake in Sinai into the ultra deep waters of the Mediterranean. The fault escarpment has developed over an Early Miocene-Pliocene depocenter of sand/shale sequences by down-to-the-northeast gravity sliding and growth faulting. Along the growth faults, numerous NW-trending hanging-wall rollover anticlines are developed, often cut by (in-trend) antithetic faults and NE cross elements related to the Pelusium shear lineament. This structural arrangement has created excellent possibilities for structural/stratigraphic traps involving a thick sand sequences (mainly of Serravalian age, Port Fouad and Temsah sands) forming the only prospective tract in the east delta area.

Med. Sea, Nile Delta & North Sinai Structural Elements

❑ Qattara-Eratosthenes (Rosetta) Fault

The Rosetta fault zone extends some 180km from the shoreline east of Alexandria into the ultra deep waters of the Mediterranean. It is composed of a series of en-echelon, sub-parallel growth faults stepping down to the northwest. The growth faulting was triggered in the Early Pliocene by the shear movements along the Eratosthenes lineament. During Middle Pliocene to Pleistocene/Recent times, the growth faulting was accelerated in a syn-sedimentary fashion by the sediment load of the thick west delta lobe, which accumulated in the area. Along the growth faults a complex pattern of NE-trending hanging-wall rollover anticlines and channels are developed, often intersected by (in-trend) antithetic and cross faults. This complex structural setting has generated favorable conditions for development of structural/stratigraphic traps involving thick sand sequences of Late Pliocene to Pleistocene age (Kafr El Sheik and El Wastani formations) forming the principal prospective tract in the west delta area beyond the Rosetta line. Southeast of the Rosetta trend, Abu Madi sands occasionally form an additional prospective tract proven in the area of the fields of Abu Qir, West Abu Qir and North Abu Qir.

❑ Pelusium Line

The Pelusium Line, an ENE to WSW trending lineation passing just to the north of Cairo, is postulated to be the boundary between continental and oceanic crust and also marks the abrupt southeastern limit of thick Messinian evaporites. The eastern extension of the Pelusium Line cuts ENE across the continental shelf of North Sinai before bending northwards forming a series of NNE to SSW striking faults that follow the continental slope of Palestine. In North Sinai it separates belts of contrasting structural orientation. Left-lateral trans-current movement along the Pelusium fault zone has created a compressional stress field for halokinesis in the Diapir Belt and Levant platform.