THE SICILY CHANNEL

A Newly Re-Emerging Petroleum Area on the North Africa Plate Margin

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Selected Giant (+700mmboe) Fields of the Mediterranean (source: AAPG)
Application of new seismic technology (Dual Sensor + 3D) in conjunction with a subsequently adapted appropriate tectonic model lead to the conclusion that field size distributions and YTF predictions from very close by producing areas may not be correct and may lead to overoptimistic or too pessimistic assumptions.

..in other words:

*Surprises are still possible...*
Old expectations/ prejudices and reasons for historic neglect

Insights ("imaging") from dual sensor technology (in combination with 3D)

New regional tectonic subdivisions

Impact on exploration potential
STUDY AREA: TUNISIAN VIEW

Tectonic provinces as published at time of 2008 ADX country entry: **Gulf of Hammamet (GOH) – Pelagian basin YTF – FSD statistics apply?**

Source: ADX “country entry” study with ISIS
The “Tunisian view” suggested that the underexplored border area of Italy and Tunisia belongs to the Pelagian Basin (Gulf of Hammamet) petroleum system and hence the YTF and field size distributions of the related fields would apply.

The **YTF of 1.2 Billion bbls oil & 5 TCF gas** (USGS estimate) for the Pelagian & Tellian system sounded encouraging....

**BUT**

......WHERE EXACTLY IS IT??

Source: M. Lakin, ENVOI
CONCLUSIONS 2(2) PRE-3D

.......AND HOW BIG?

Field size distribution with a P50 of 20 mmboe for the nearby Gulf of Hammamet fields indicates that only the high productivity shallow marine Miocene clastic reservoirs ("Birsa") can be explored for economically and leaving the Cretaceous and Jurassic out?
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HOPE, MODEL AND (SEISMIC) REALITY

Source: Anschutz 2004 in house report

Location of Geostreamer 3D

Dougga-1

Location of Geostreamer 3D

25 km

Pliocene

73 km section

Pliocene

Mid-Late Miocene

Dougga-1

Lower Miocene Ain Grab reservoir

OLIGOCENE UNC: Bou Dabbous (source & res.)

Maastricht Abiod (reservoir)

Albian-Cenomanian Bahloul (main source)

Jurassic Nara (reser.)
On conventional 2D the prospective section beneath the Oligocene was seismically invisible.

Example from PSTM hydrophone brute stack shows events far beneath Oligocene (Pyrenean) Unconformity.
THE NEED FOR DUAL SENSOR 3D

2D Line GE04-11 (best 2D available, shot in 2004, much higher fold than 3D)
CARBONATE RESERVOIR GEOMETRIES

Dougga U. Cretaceous (Abiod) Carbonate Reservoir: Undrilled Upside

Isochron map of Abiod – Near Sidi Kralif

Canyon

Ain Grab

Abiod

3D Resolution: site survey quality
3D DEFINITION OF SPILL POINT

Note shallow section resolution
3D DEFINITION OF SPILL POINT

- Note dimming
- Note bending of main normal fault
Gas leakage due to reverse fault reactivation along $\text{Shmax}$ (critically stressed, shear failure)

- Note dimming ZONE (for no obvious seismic acquisition or processing quality issue)
- Note that fault throw approaches abruptly zero
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GENERALIZED STRUCTURAL ELEMENTS

SICILY (Europe)

TUNISIA (Africa)

NILDE oil field

DOUGGA condensate field

MAMOOURA oil field

Tazerka oil & gas condensate field

Belli oil field

GOH

Tunisia

Sicily

Legend:
- volcanic
- graben/ place
- thick syncline
- anticline
- normal fault
- strike slip/transpressional fault
- high
- thrust fault
- Wells
- Completed
- Gas injector
- Perhaps
- Perm}

km

0 40
PLAY DIAGRAM AND CROSS SECTION

Legend:
- Volcanics
- Sediments
- Source rocks
- HC plays/traps
- Unconformities

1. Tortonian Flexural Belt
2. Foothill Belt
Inverted Foreland
Pliocene Graben
L. Miocene Foredeep Sediments
L. Miocene Piggyback
(Cret-Jurassic source)
Triassic Shelf (dolomites)

770 sqkm 3D

Pivot point

(Deep Source)
Remarkable continuity of structural belts across major recent wrench – graben systems (Dougga-West to Nilde oil field: 85 km distance!)
3D HELPS TO BUILD MODEL FOR 2D AREAS

- Inverted Basin Trap style
- Footwall Trap style

Areas:
- Tortonian Flexural Belt (1)
- Foothill Belt (2)
- Inverted Foreland (3)
- Cap Bon (Extension)
- Tortonian Flexural Belt (2)
- Foothill Belt (3)
- Messinian
- AinGrab
- Abiod
- Dougga West
- Dougga (Extension)
- Pyrenan
- Cap Bon Ramp
- Dougga
- Dougga West
- Tazerka High

Wells
Old expectations/prejudices and reasons for historic neglect

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What appears as a simple tilted horst block in one direction is in reality a structure created by Oligo./ Miocene thrusting, Pliocene trans-tension and renewed present day strike slip movement. (Note: Dougga has a +500 meter gas column, nevertheless).

The underlying deeper structures are in the order of +100 sqkm closure!
STRATIGRAPHIC THICKENING

Large underlying thrusts create space for subsequently deformed piggy back basins and related stratigraphic thickness changes.
• The Sicily Channel consists of several different tectonic belts, each with its own risk profile and expected field size. Due to very few wells and lack of modern seismic data able to image below the Pyrenean (Oligocene-Miocene) unconformity, field size distributions and YTF assumptions from the producing Gulf of Hammamet (Pelagian basin) have often been applied for “practical” (fit for) purpose.

• Dual Sensor (PGS Geostreamer) 3D seismic has successfully imaged the deeper section and uncovered the underlying tectonic engine.

• Foreland oil & gas discoveries – mostly in Gulf of Hammamet – are abundant. Excellent Tertiary age clastic reservoirs (“Birsa”) with high flow rates (+20,000bbls/day per well) allow for economic development of small to moderate sized structures, typically 5 to 25 sqkm closure within a tilted horst block type, often with partial crossfault leakage.
- The inverted foreland belt and foothills are under-explored, but proven (Douga, Belli, Lambouka, Nilde). In contrast to the foreland, large to very large structures in the order of 30 to 90 sqkm closure can be mapped on 3D seismic. Simple and large anticlines in the foothill belt (i.e. fault bend folds) are expected to have little leakage risk and stacked pay potential. (Douga has a proven +500 m gas condensate column)

- Tortonian (and progressively older) thrust belts and deeper stratigraphy – are practically unexplored, and contain very large to GIANT but often complex structures. Closure areas in excess of 100 sqkm can be mapped. This area is not yet covered with 3D seismic on the Tunisian side (Italy: recently acquired Shell Geostreamer 3D).
...in lieu of a grand finale

THANK YOU FOR YOUR TIME!

....AND THE PLIOCENE HAS NOT EVEN STARTED IN TUNISIA!