New Ideas Unlock Old Plays: Swan-East Recent Gas Discovery, Baltim Canyon Extension, West Delta Deep Marine, Offshore Nile Delta, Egypt*

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Abstract

The West Delta Deep Marine (WDDM) concession, offshore Nile Delta, currently has extensive prolific exploration and development projects, since the mid-1990's. It contributes to Egypt's domestic and export gas supply through Rashpetco (JV. Egas, Shell, and Petronas). Exploration in the offshore Nile Delta province has revealed several hydrocarbon plays, ranging in age from Pleistocene down to Oligocene and Cretaceous. The plays include deep marine turbidites, fluvial systems, shoreface deposits, reefal build up and lagoonal facies.

The Messinian in the WDDM has been explored by four dedicated wells testing different plays and different structural and stratigraphic concepts. Two wells have proved the presence of commercial gas, while the other two wells were dry.

Swan-East well is a recent gas discovery in the Abu-Madi Formation in the extension of the old known play of Baltim Canyon, in the hanging wall of Rosetta Fault. It has two-way dip component and two side seals, forming a combined structural and stratigraphic trap and comprised of a set of complex channels and it countered 35 m net pay, of thermogenic gas and condensates. Swan-East is identified on the 3D seismic survey acquired in 2014, and the target has a positive AVO anomaly that

the unconfined braided fluvial channel system. The aim of this article is to discuss how new ideas help to unlock old know plays, its impact on the portfolio and de-risk other prospects/leads following the Swan-East discovery.

New Ideas unlock old plays; Swan-East Recent Gas Discovery, Baltim Canyon Extension, West Delta Deep Marine

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Outline

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- Objective
- Area of Study & Swan-East Discovery
- Baltim Canyon
- WDDM Messinian Penetrations
- Conclusions

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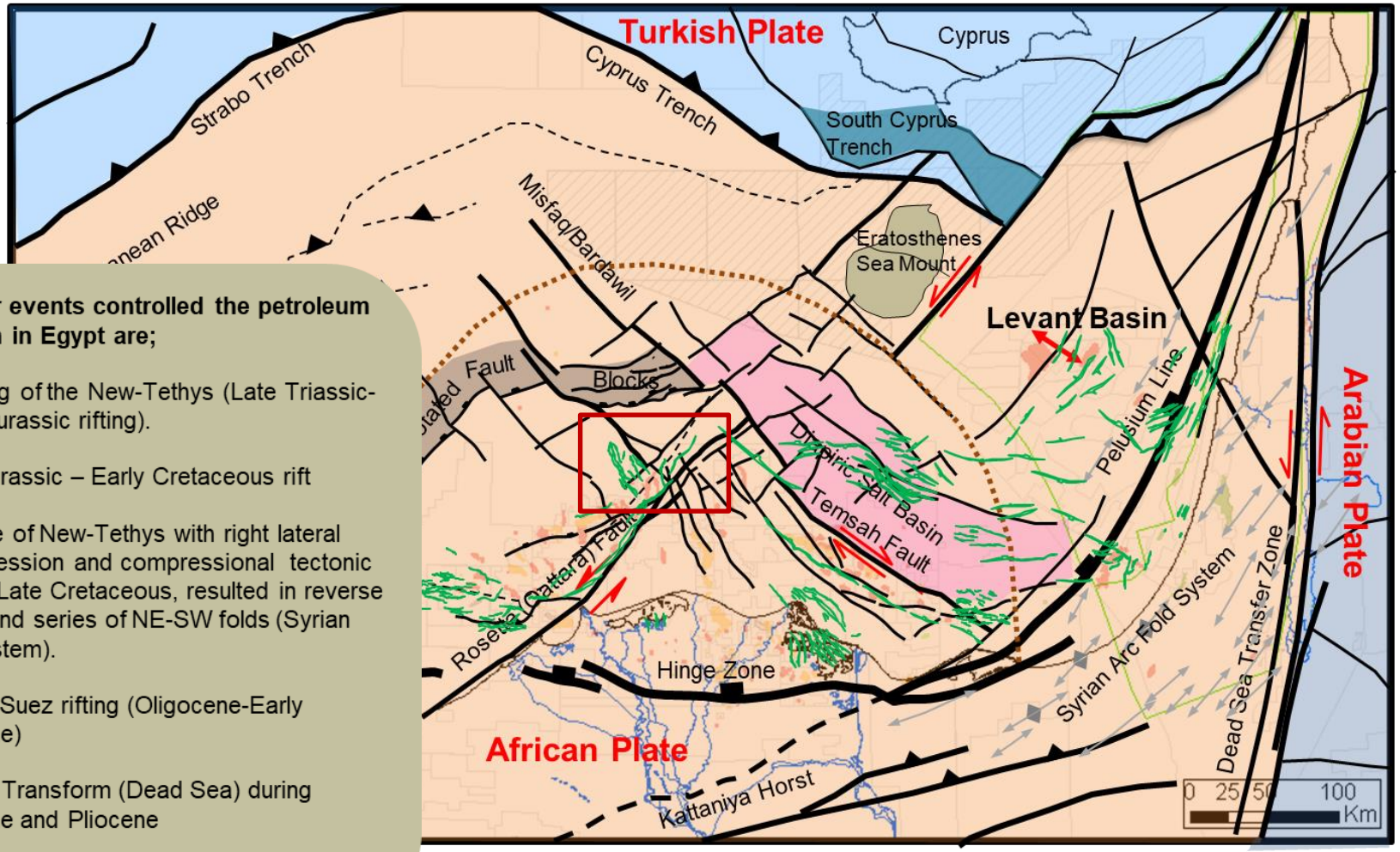
Regional Structural Framework

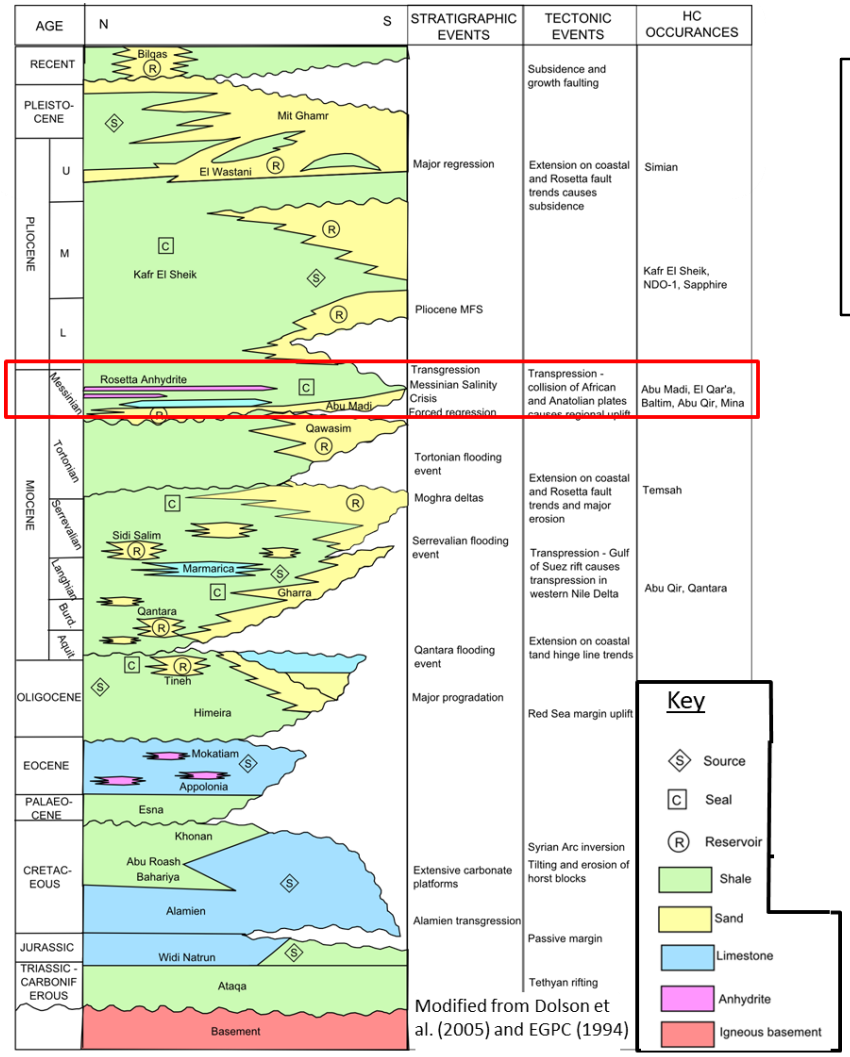
The major events controlled the petroleum system in Egypt are;

- Opening of the New-Tethys (Late Triassic-Early Jurassic rifting).
- Late Jurassic – Early Cretaceous rift
- Closure of New-Tethys with right lateral transpression and compressional tectonic during Late Cretaceous, resulted in reverse faults and series of NE-SW folds (Syrian arc System).
- Gulf of Suez rifting (Oligocene-Early Miocene)
- Levant Transform (Dead Sea) during Miocene and Pliocene
- Late Miocene (Messinian) crisis and deposition of evaporites and super valleys.



After Longacre and others (2007)

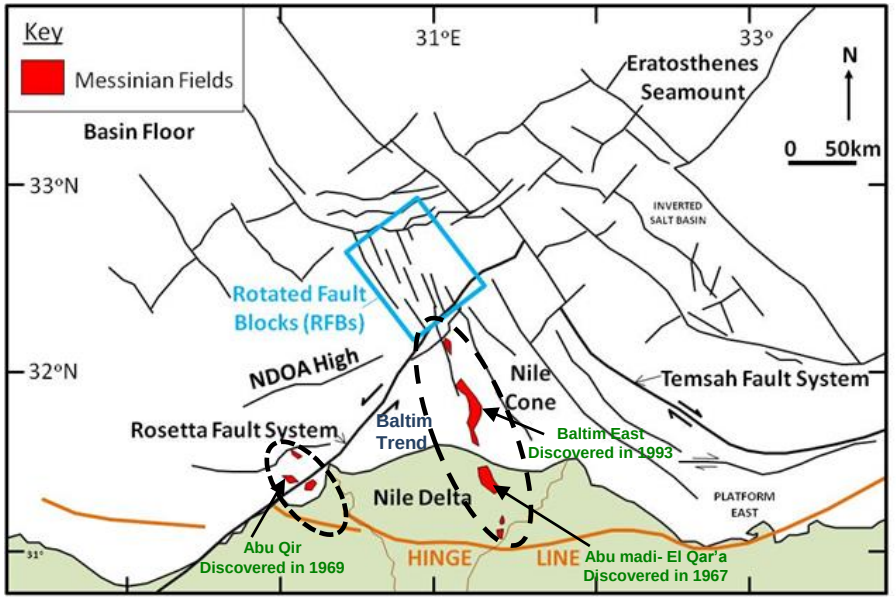
Regional Stratigraphic Column



Modified from Dolson et al. (2005) and EGPC (1994)

Messinian Play

- **Source** = Oligocene shales
- **Seal** = Intraformational shales and Pliocene shales.
- **Reservoir** = Abu Madi Formation – the Messinian fluvial system



Aal et al., 2001

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Objective

- Is there further extension of Baltim NE reservoir fairway toward the North?
- Is Swan East (Messinian level) discovery is Branch of Baltim fluvial system?

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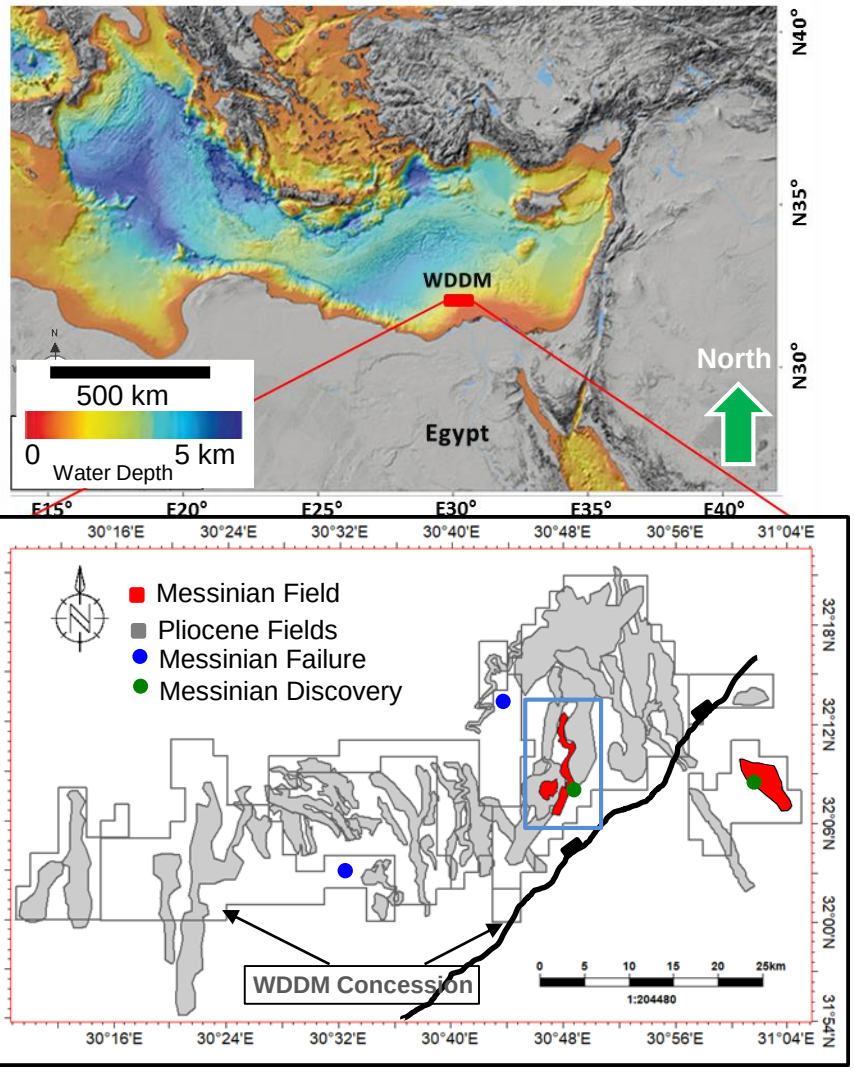
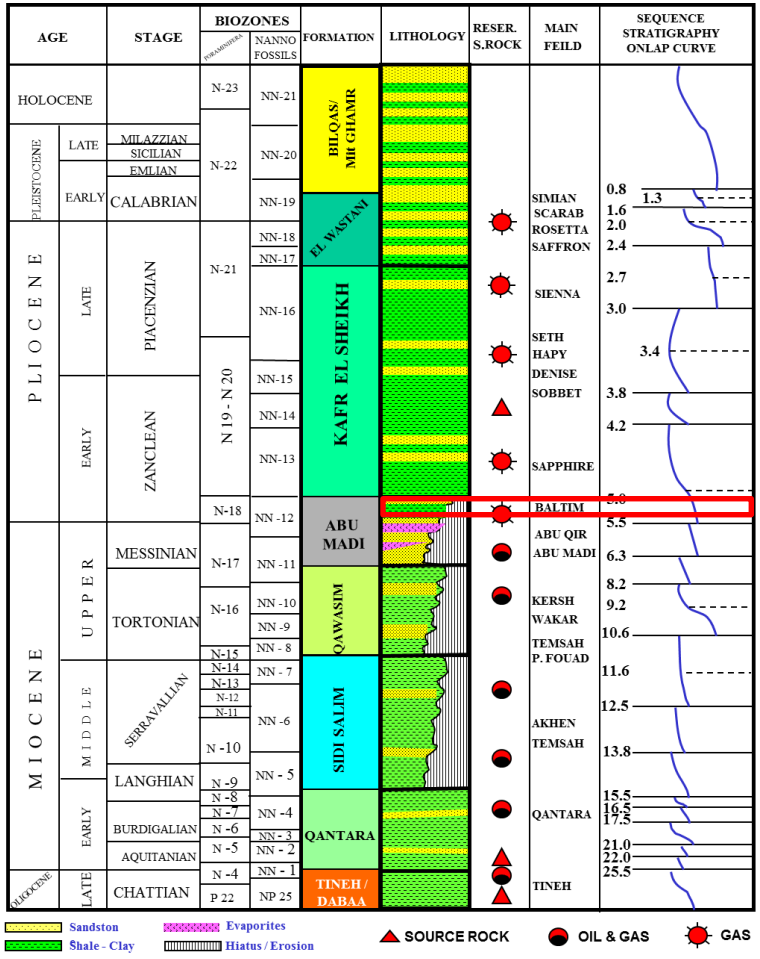
Area OF Study

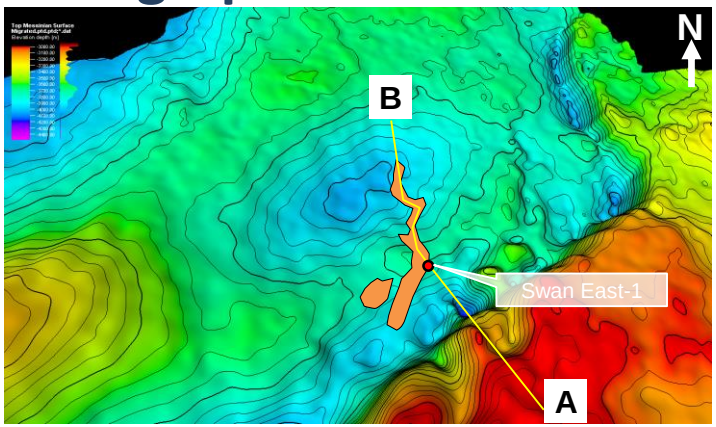
- West Delta Deep Marine (WDDM) development leases, located offshore the Nile Delta
- Area: 1366km²
- Water depth ranging from 100 to 1200 m
- Block was awarded in 1995
- First discovery was made in 1996
- Two Messinian dry wells and one Gas discovery prior to drilling Swan East-1
- The Swan East-1 Gas discovery;
  - Drilled in 2018
  - Abu Madi Formation (Messinian reservoir level)
  - Located 80 km off Alexandrian
  - In water depth ~500m



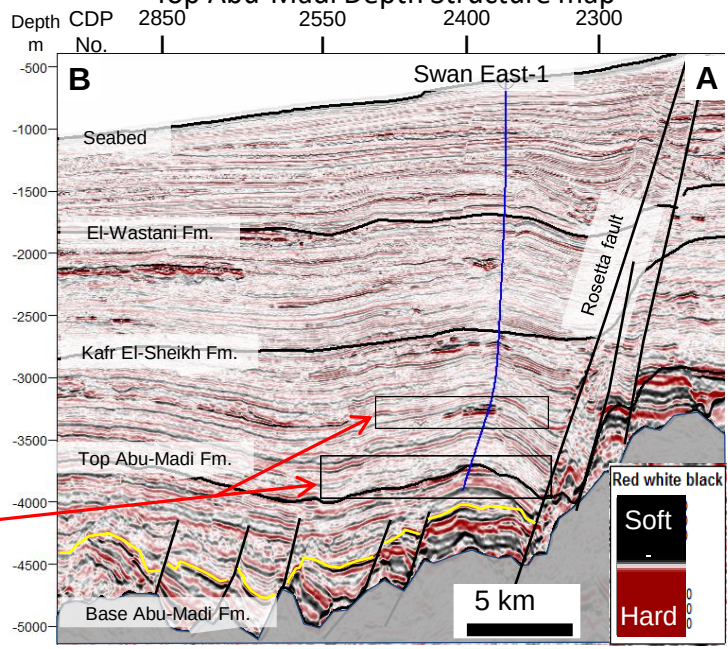
Generalized Stratigraphic Column



Nile Delta stratigraphic column and hydrocarbon system



Top Abu-Madi Depth Structure map

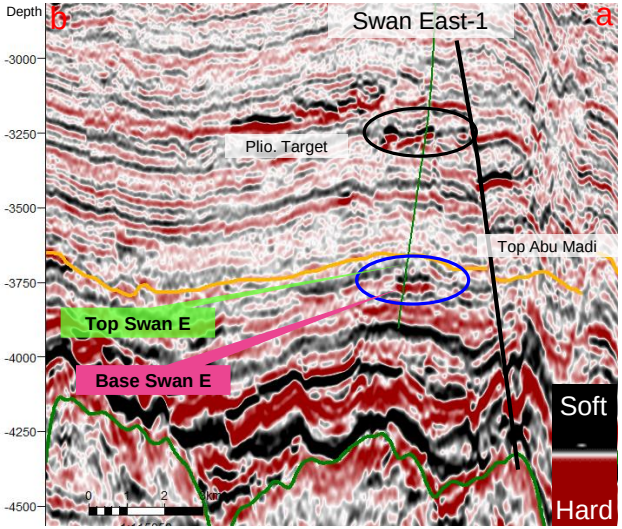


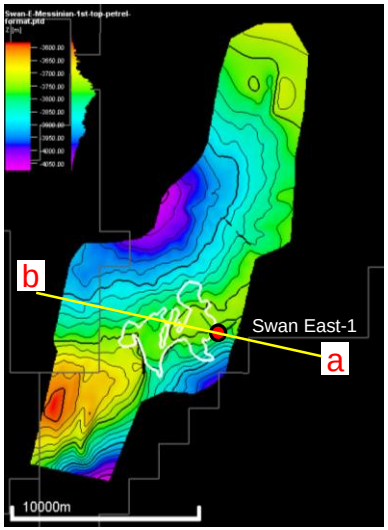
Swan East-1 was planned to test two targets

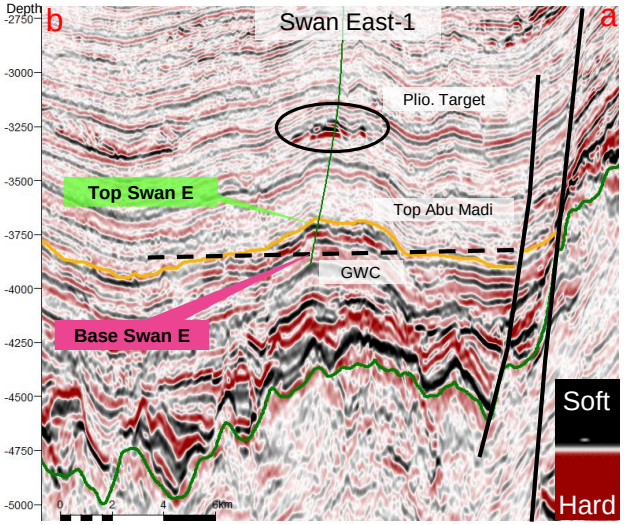
- Lower Pliocene (Kafl El Sheikh Fm)&
- Messinian (Upper Abu Madi Fm)

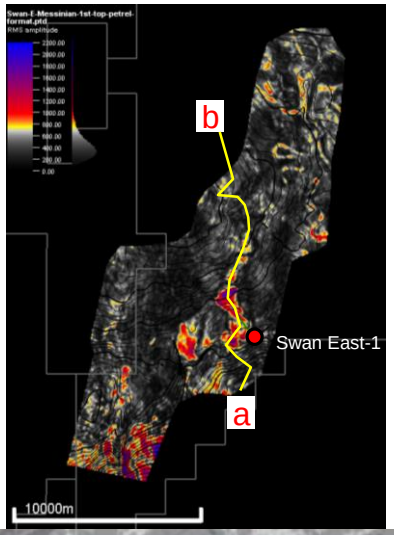
Swan East-1 Well

- Drilled in Aug 2018
- Possible rollover structure, developed with the movement of Rosetta fault.
- Swan-East (Messinian level) trap style represented by two way dip and two way stratigraphy closure similar to most of Pliocene reservoirs.
- The Messinian target consist of slope meander channel from south to north and the western sheet.
- There is clear DHI (bright spot) and become dim below Hydrocarbon-water contact (Class II-III Gas Sand).

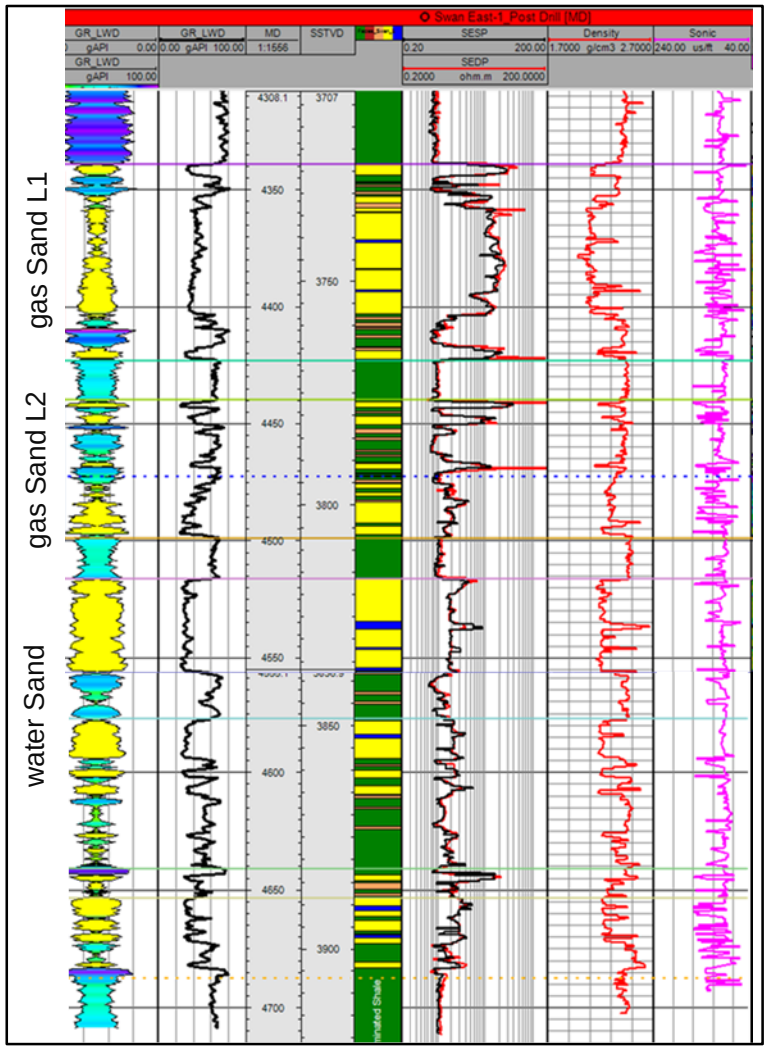




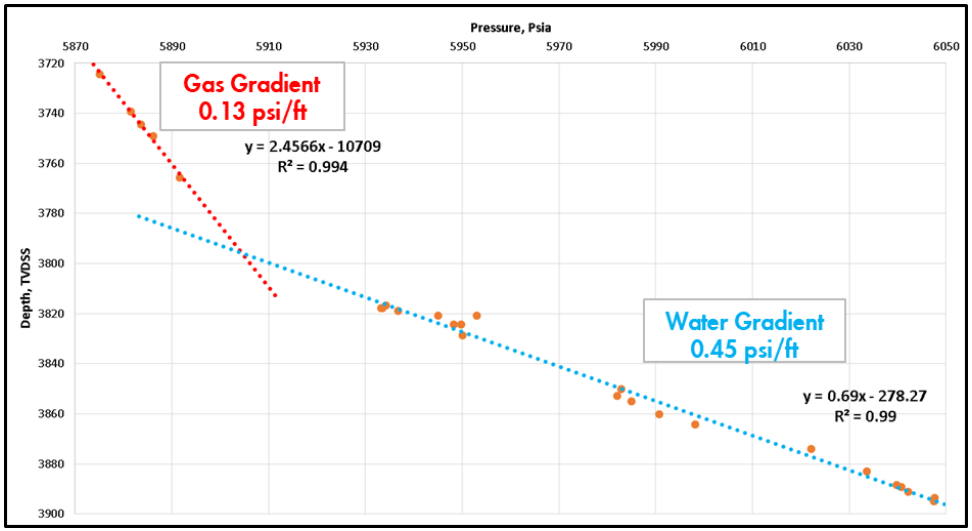




Swan East-1 Well (Messinian Petrophysical evaluation)

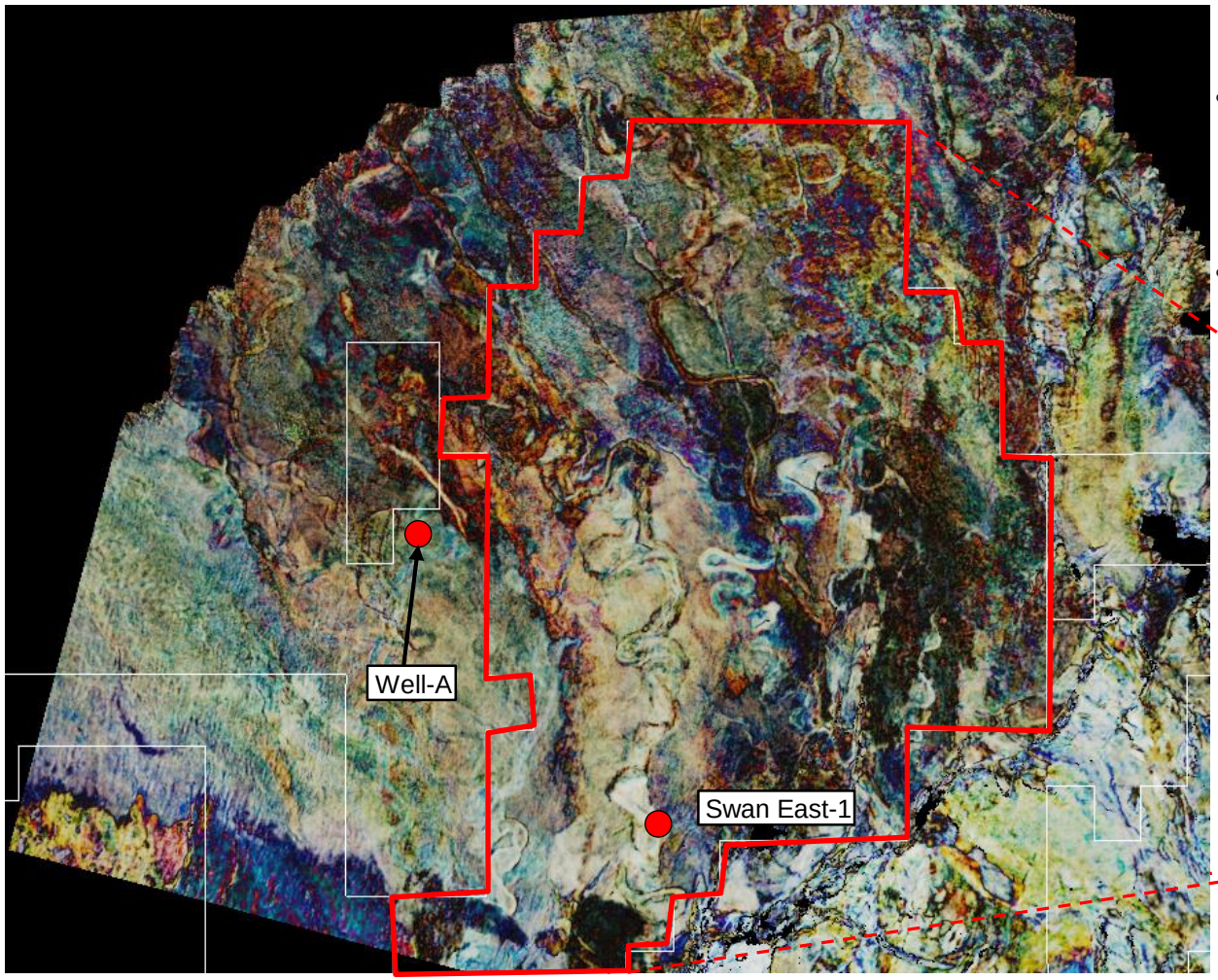


- Swan East encountered **175** m of Gross Sand thickness and **32** m net pay, with an average porosity **25%**.
- In addition, there is a potential **6**m of gas bearing thin bedded interval.

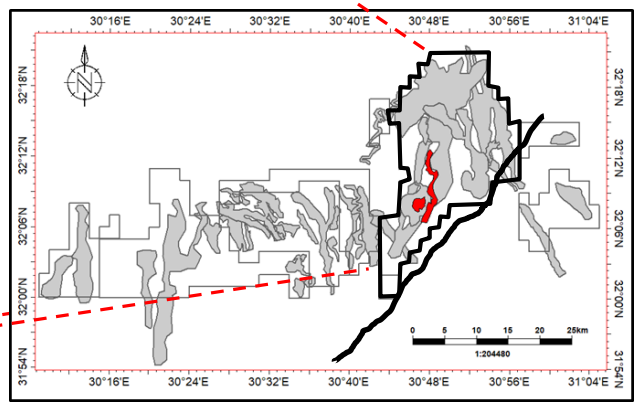


Formation Pressure (PSI)

Key Attribute for Messinian level

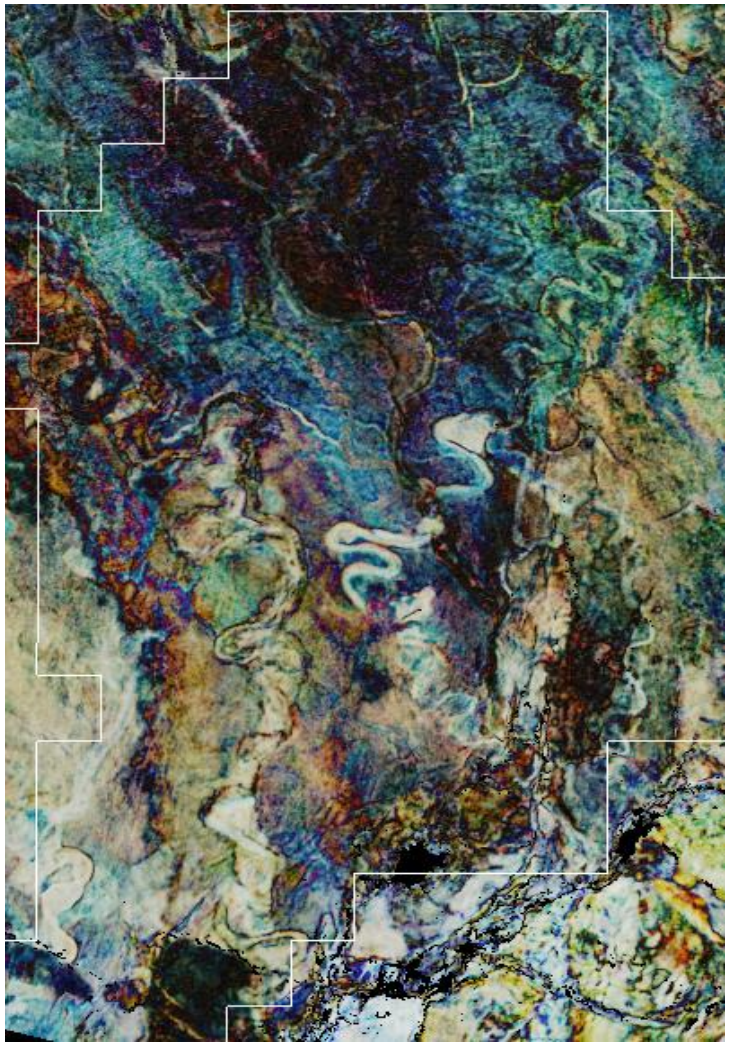


- Spectral decomposition is a key attribute in Abu Madi level for that area.
- The map shows major meander channelized features from top Abu Madi to top Mars Group.

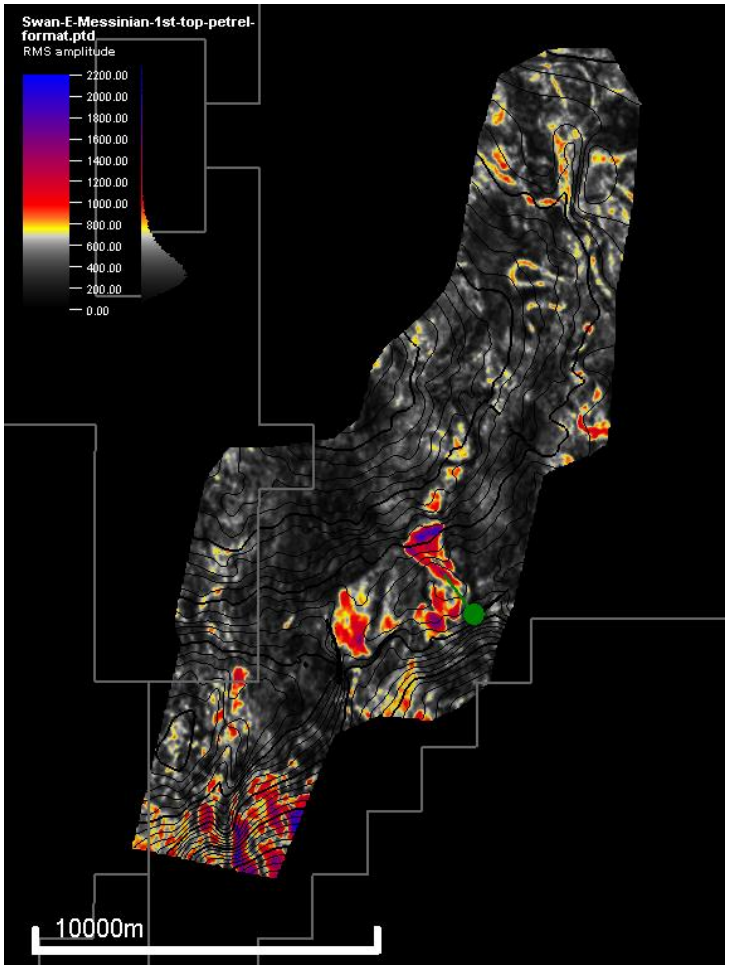


Regional spectral decomposition map for rotated fault blocks area.

Key Attribute for Messinian level



Spectral decomposition at different windows



RMS amplitude map from Top to Base

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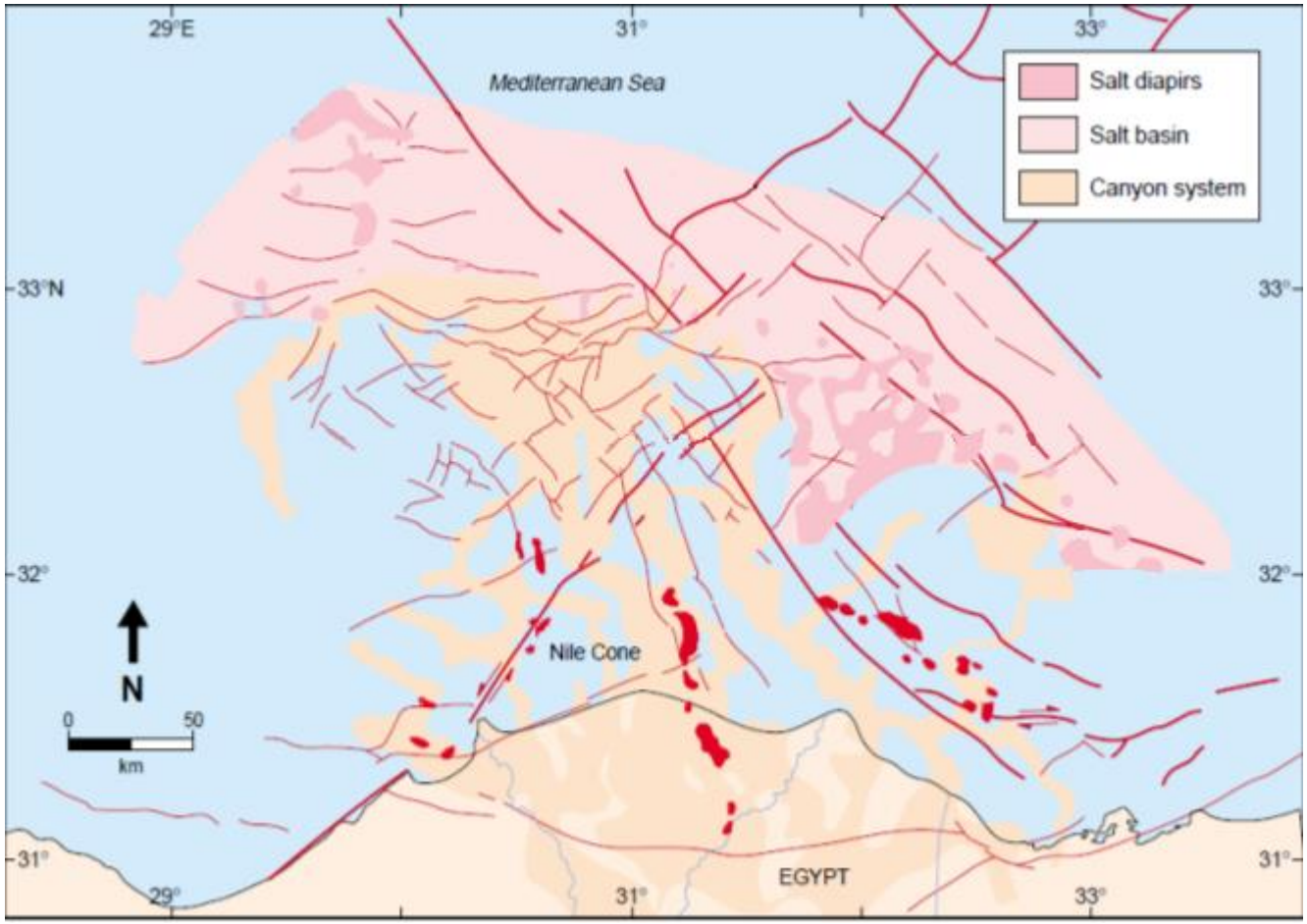
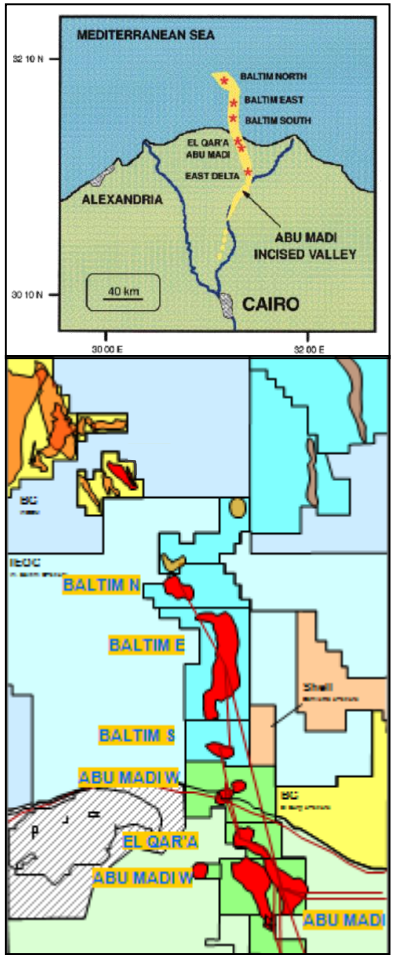
Messinian Depositional System

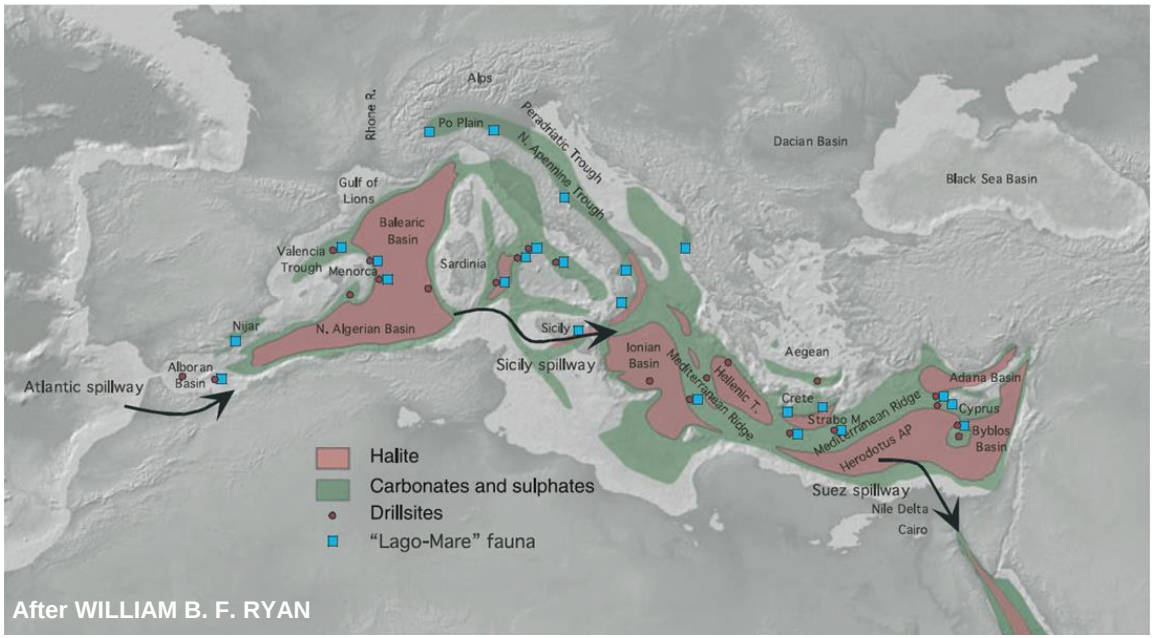


Aal et al., 2001

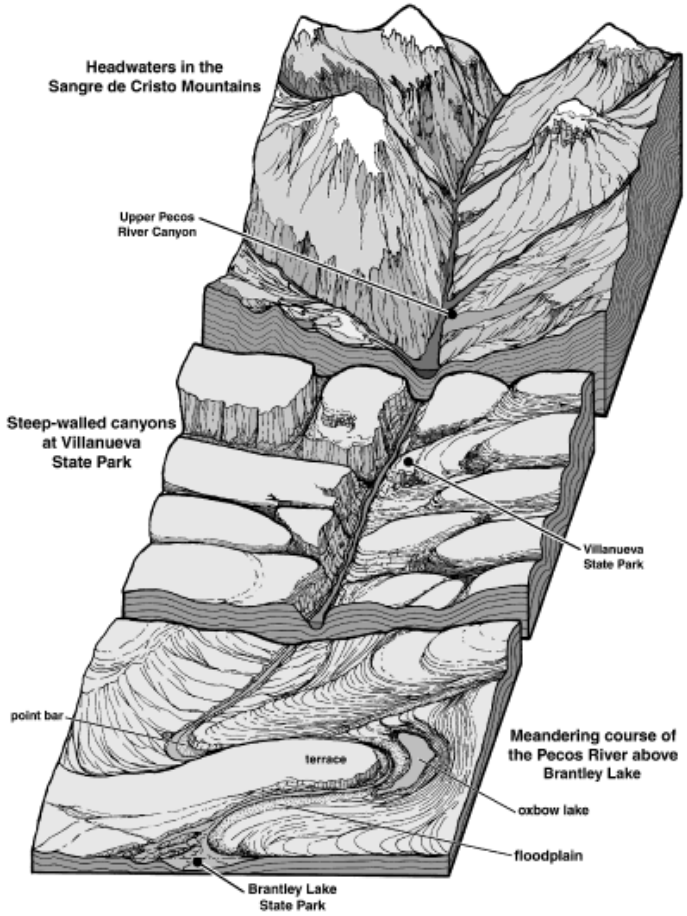


Messinian Canyon

Messinian Depositional System



http://retosterricolas.blogspot.com/2011/10/messinian-salinity-crisis-13-salt-all.html



http://geoinfo.nmt.edu/tour/state/brantley_lake/home.html

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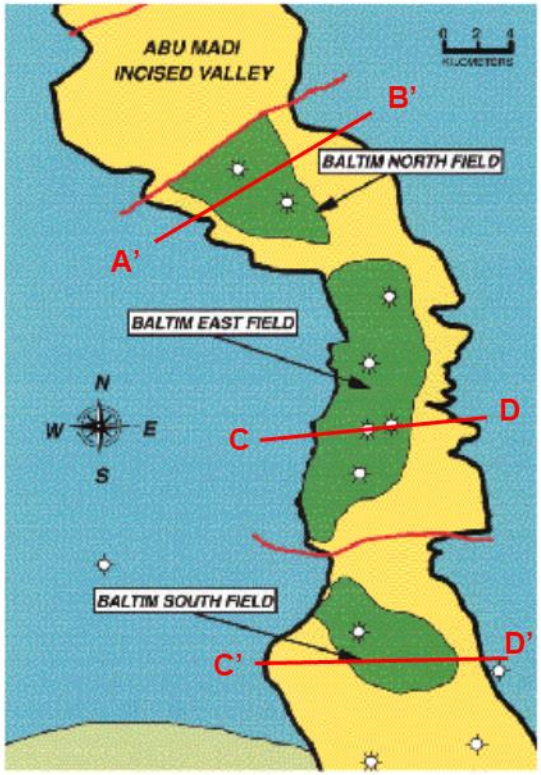
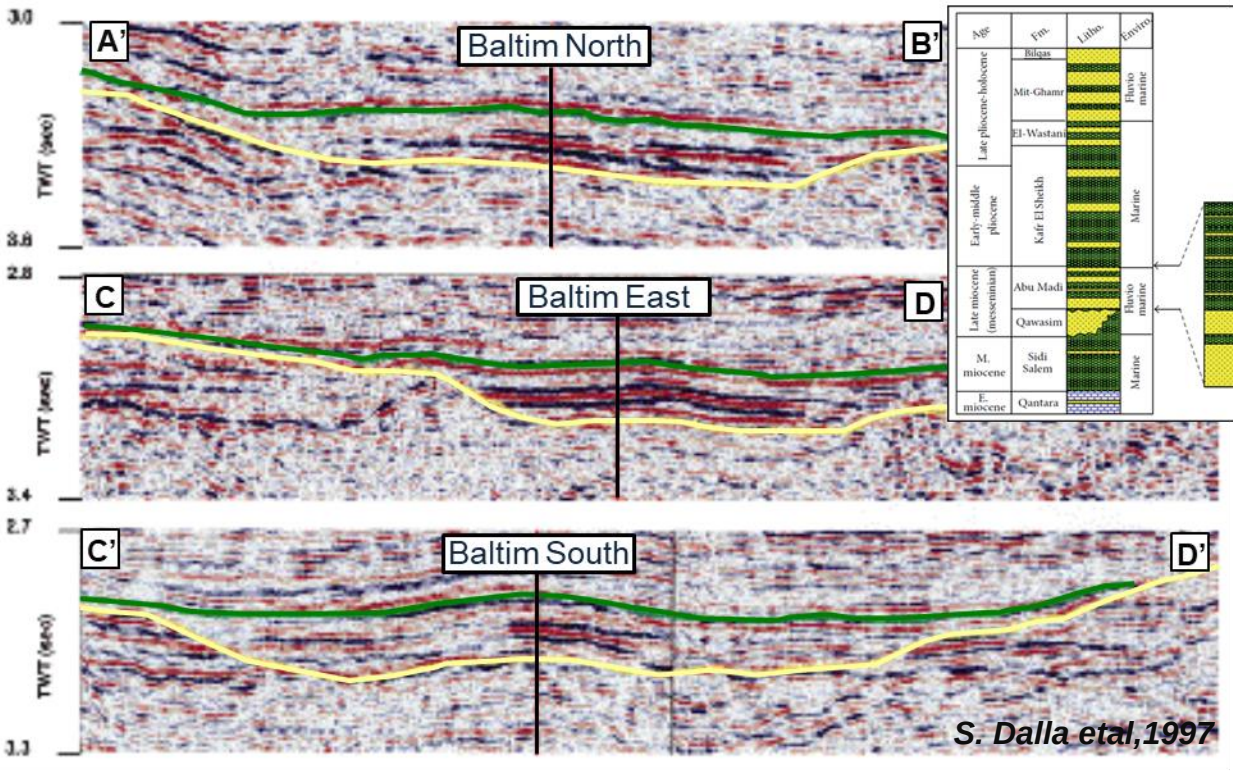
Baltim Canyon





- Several Gas fields have been discovered along Abu Madi/Baltim supper valley from onshore to the offshore Nile Delta since 1993.
- Including; Baltim North and Baltim North East to the SE of WDDM development leases.
- Generally, these reservoirs represented by three levels of sand in Abu Madi formation deposited during the Mediterranean Messinian "salinity crisis" inside an incised valley for a better delineation called Abu Madi Valley.
- Abu Madi/Baltim valley can be traced on the available seismic records from onshore to offshore for more than 100 Km.

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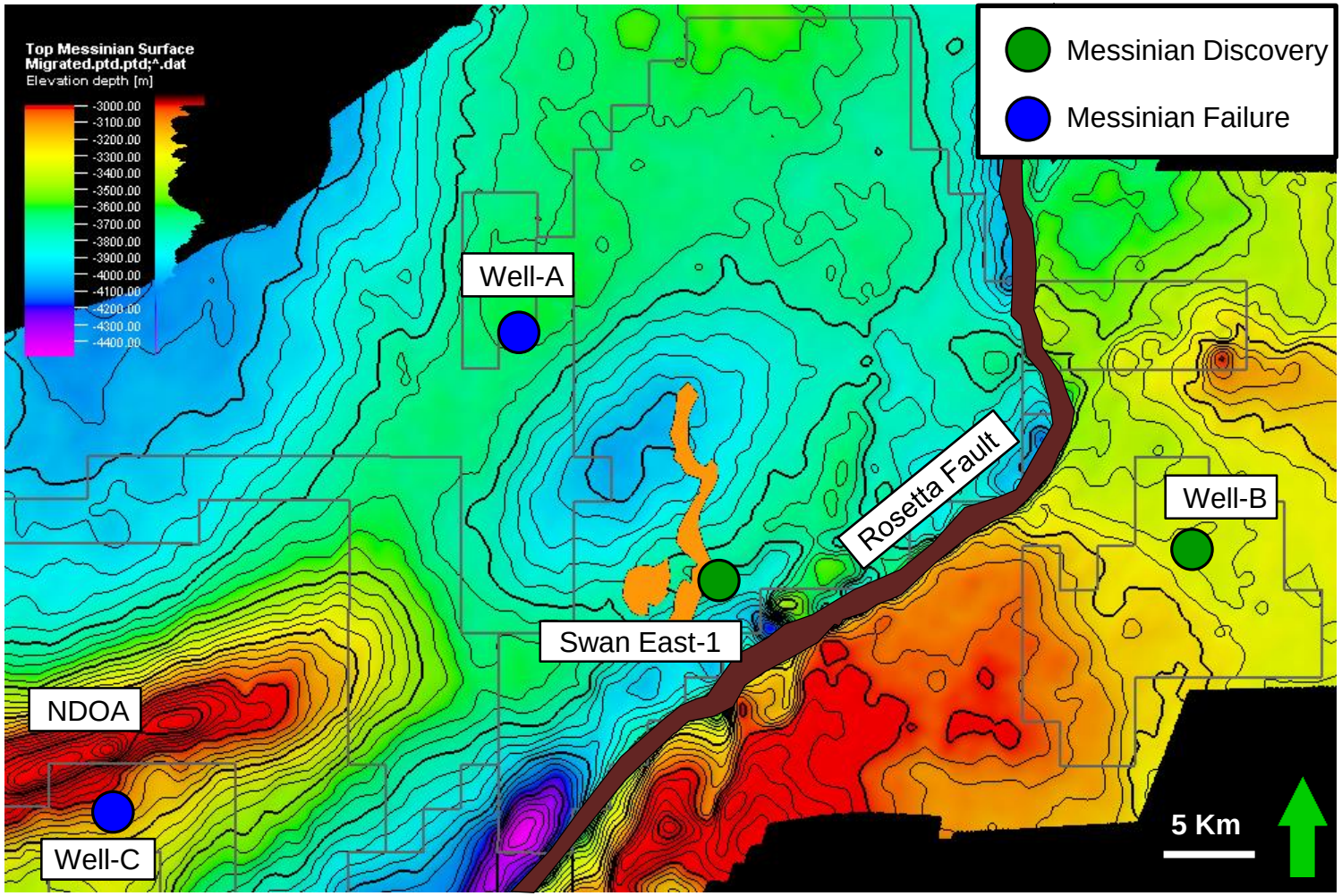
Messinian Penetration In WDDM

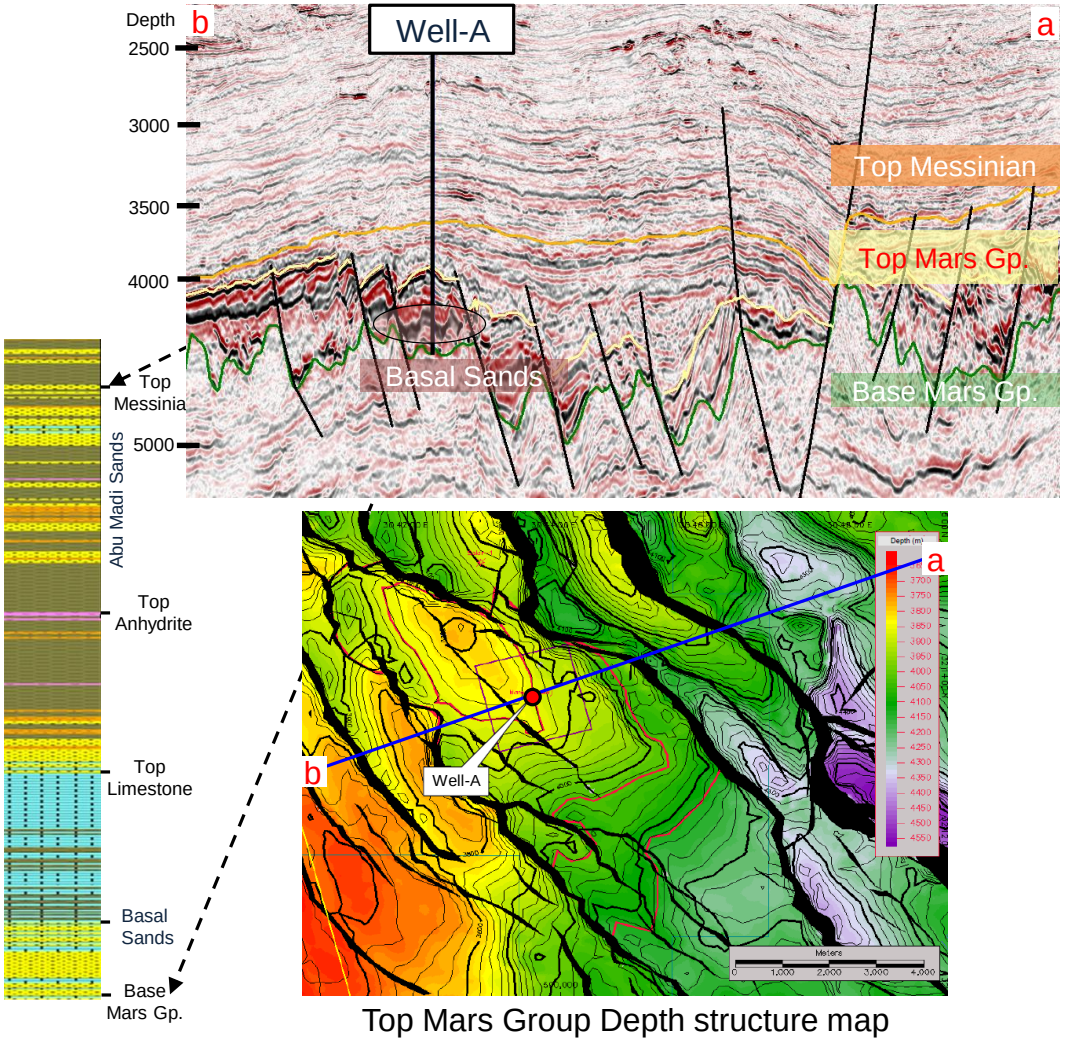


Well-A

- Drilled in February 2005
- Well-A was drilled to test the possible reservoirs in rotated fault block area (RFBs) in the downthrown block of the Rosetta Fault.
- The Target was a combination of three way dip closure with one way fault closure.
- Well-A penetrated about 94 m good quality water bearing sands near the Base Mars reservoir.

Reason of failure

- Access to charge.



Top Mars Group Depth structure map

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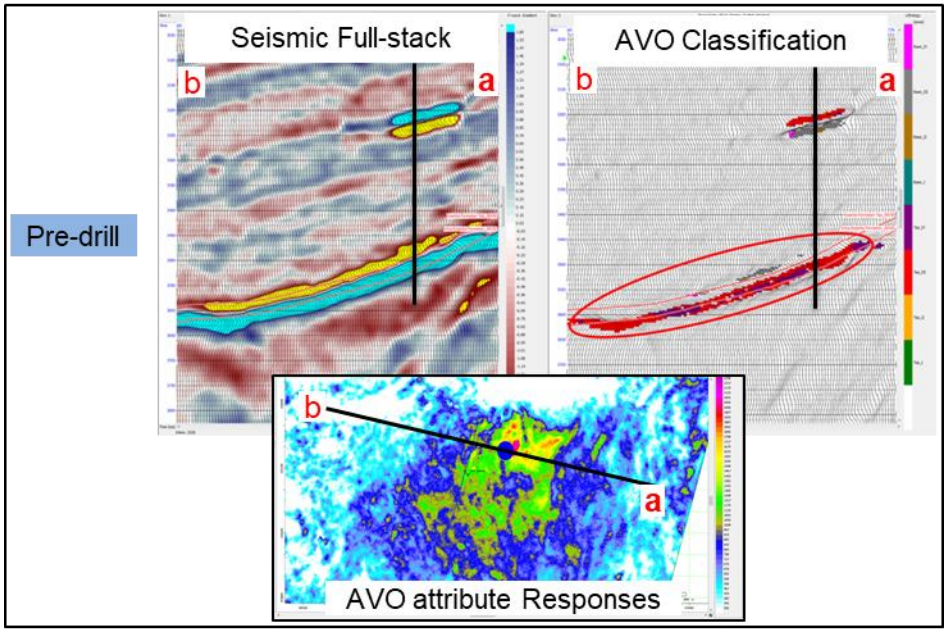
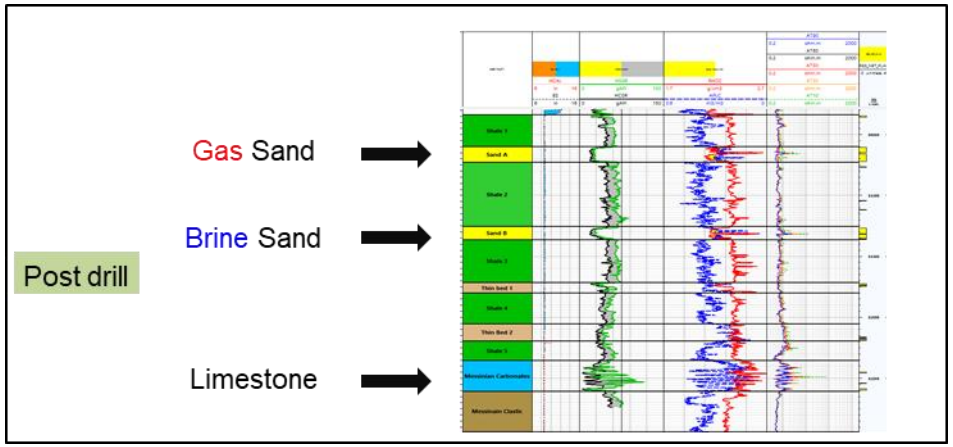
Well-C

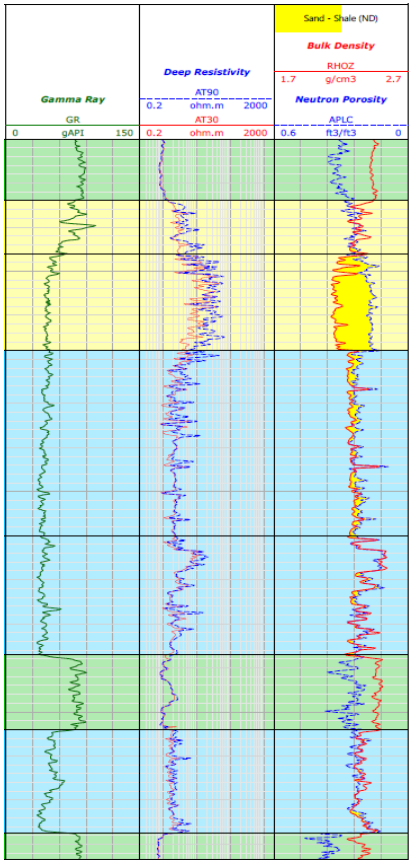
- Drilled in April 2017
- Well-C was targeting two reservoirs; S40 and Messinian sands.
- The well was a play opener, supported by AVO anomaly
  - Class III being sand reservoir below Messinian carbonates
- No sand reservoir below Messinian limestone:
  - Seismic amplitude response is not consistent with the AVO synthetic seismograms.
  - The AVO response was misleading due to amplitude scaling inaccuracy.

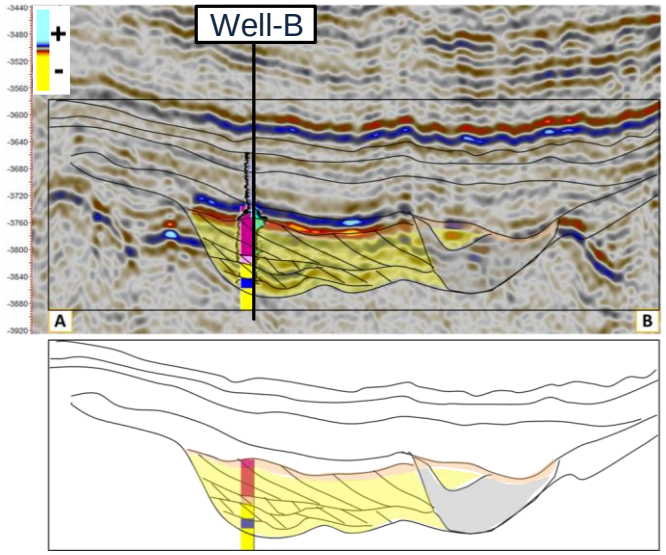


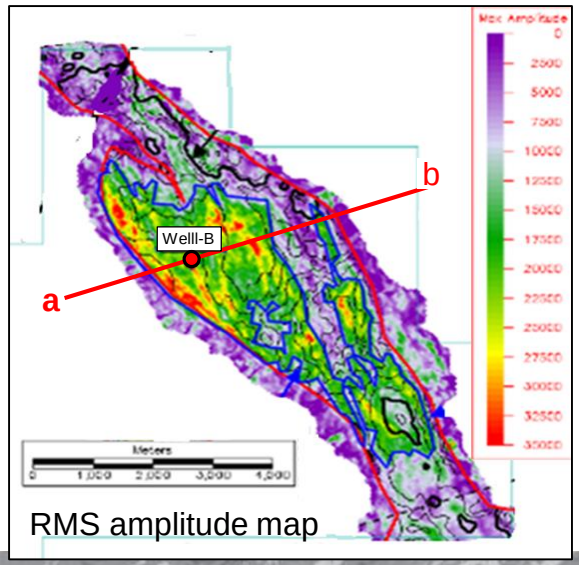


Well-B

- Drilled in Jan 2006
- The discovery is located on the footwall of Rosetta fault, targeting Abu Madi Sands.
- Well-B was designed to test Abu Madi Sands.
- it is believed to be an analogue of Baltim fields.
- The well encountered Gross thickness: 103.5m, Net Pay: 35m, PHI: 0.19, and Sw: 0.33







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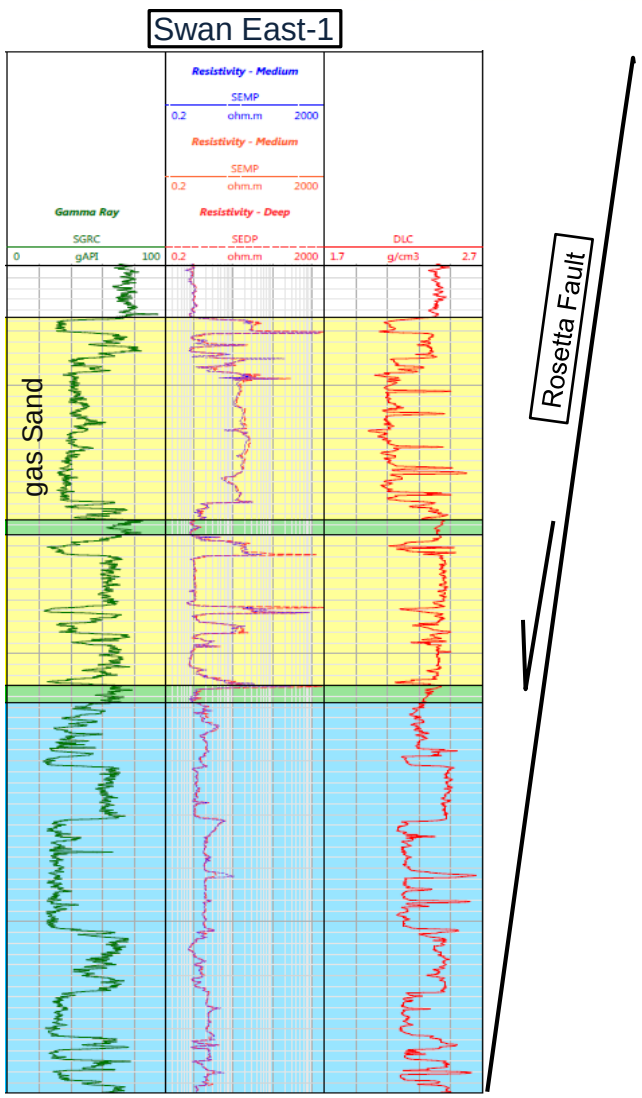
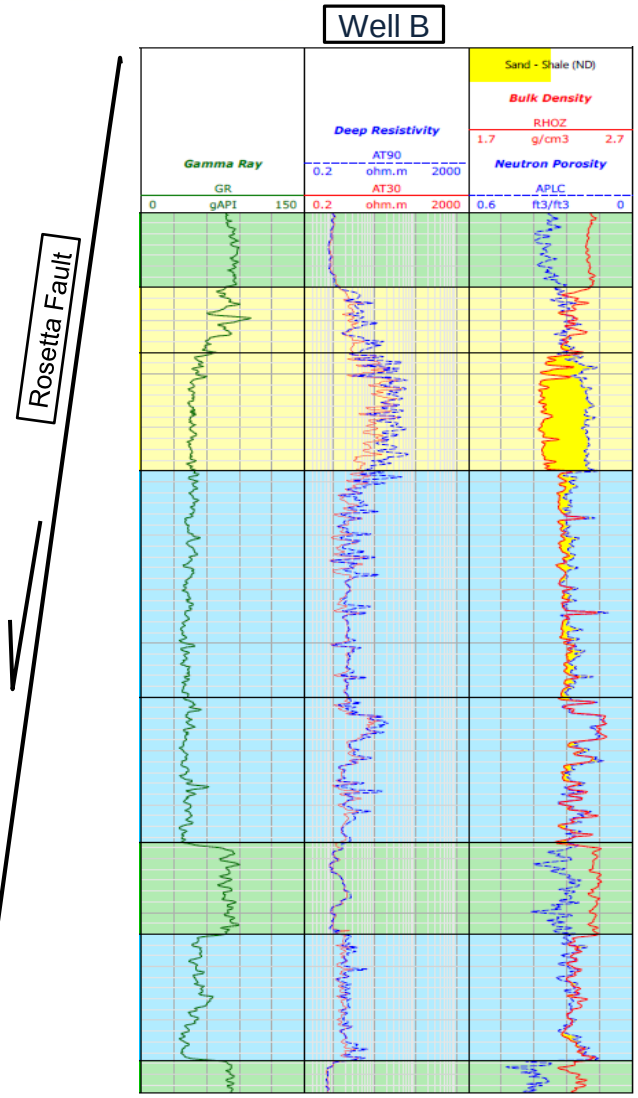
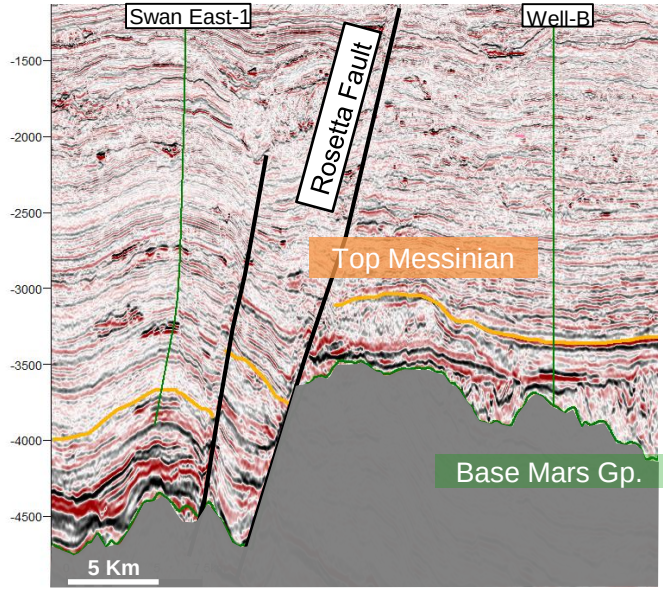
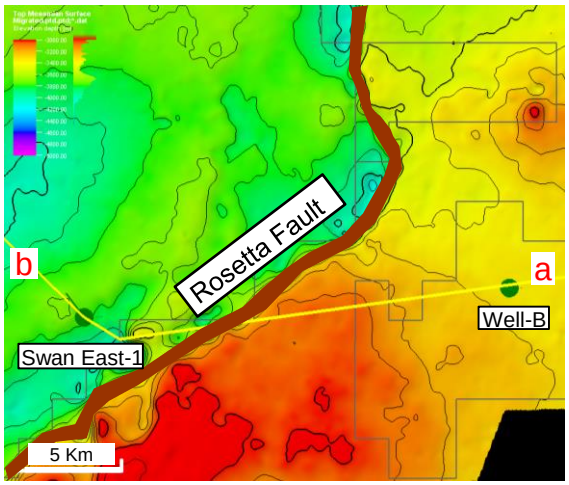
Well B and Swan East-1

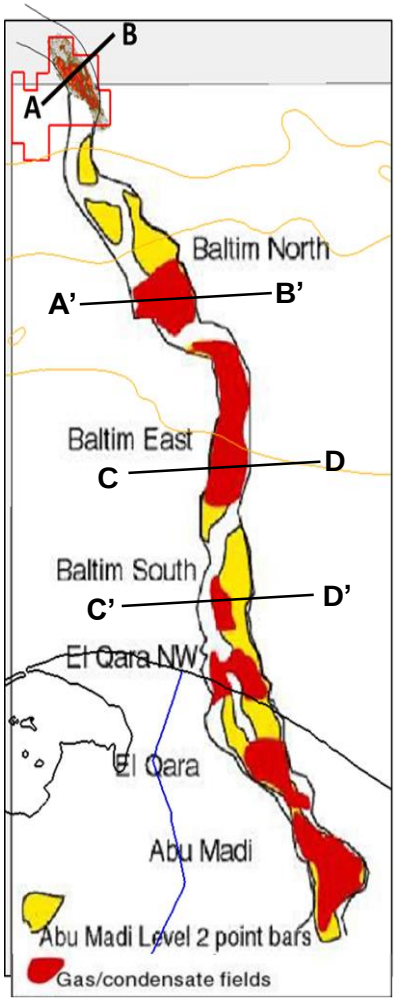


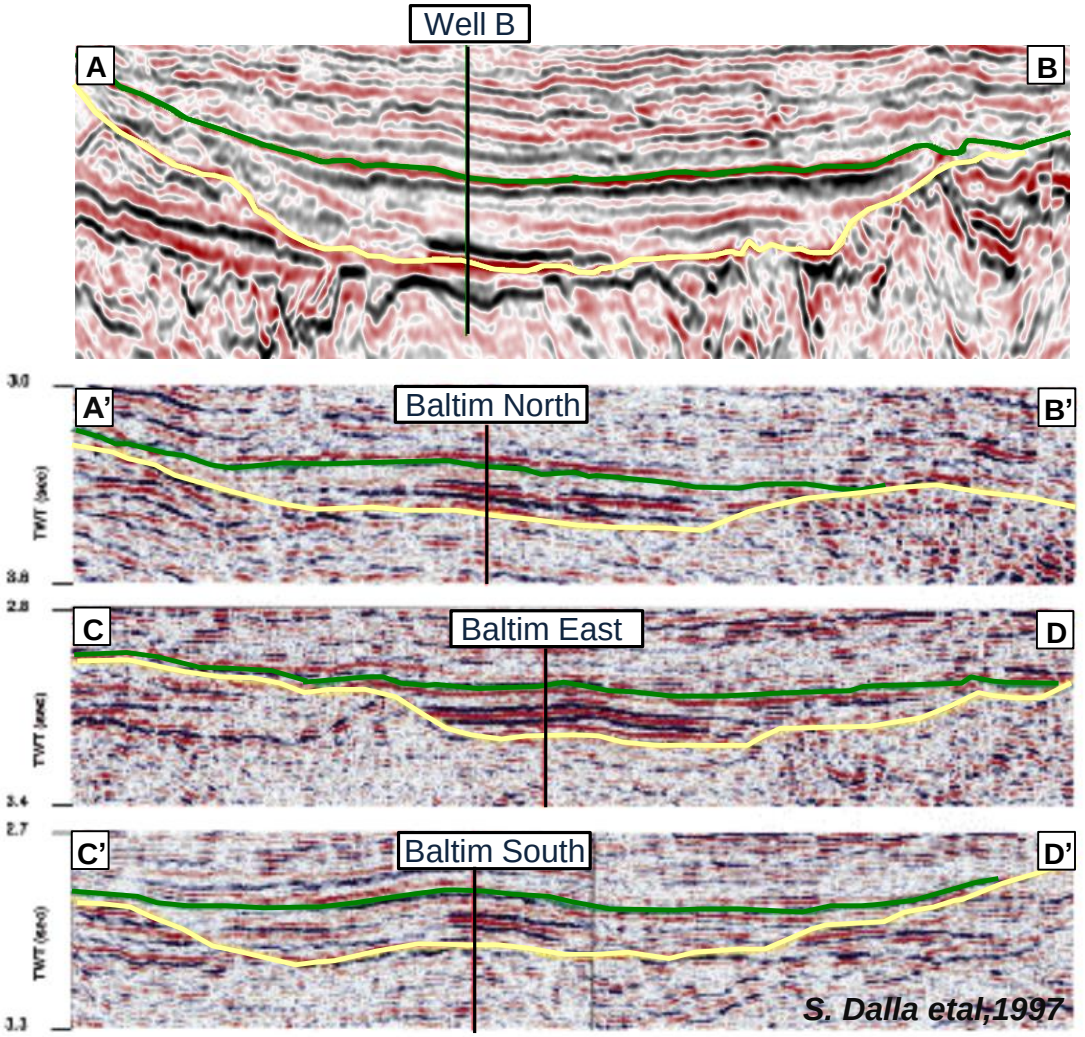






Well B in comparison with Baltim





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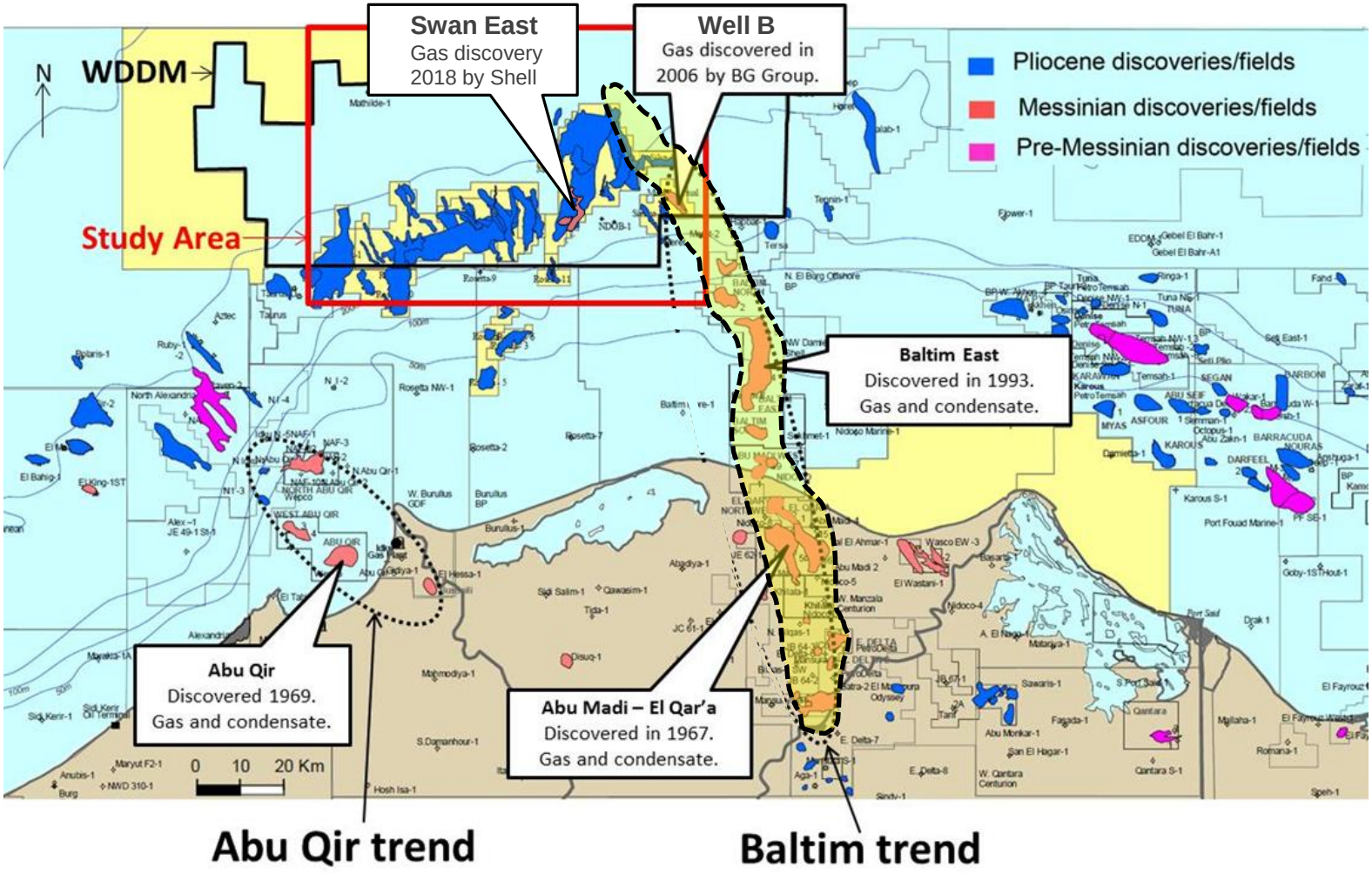
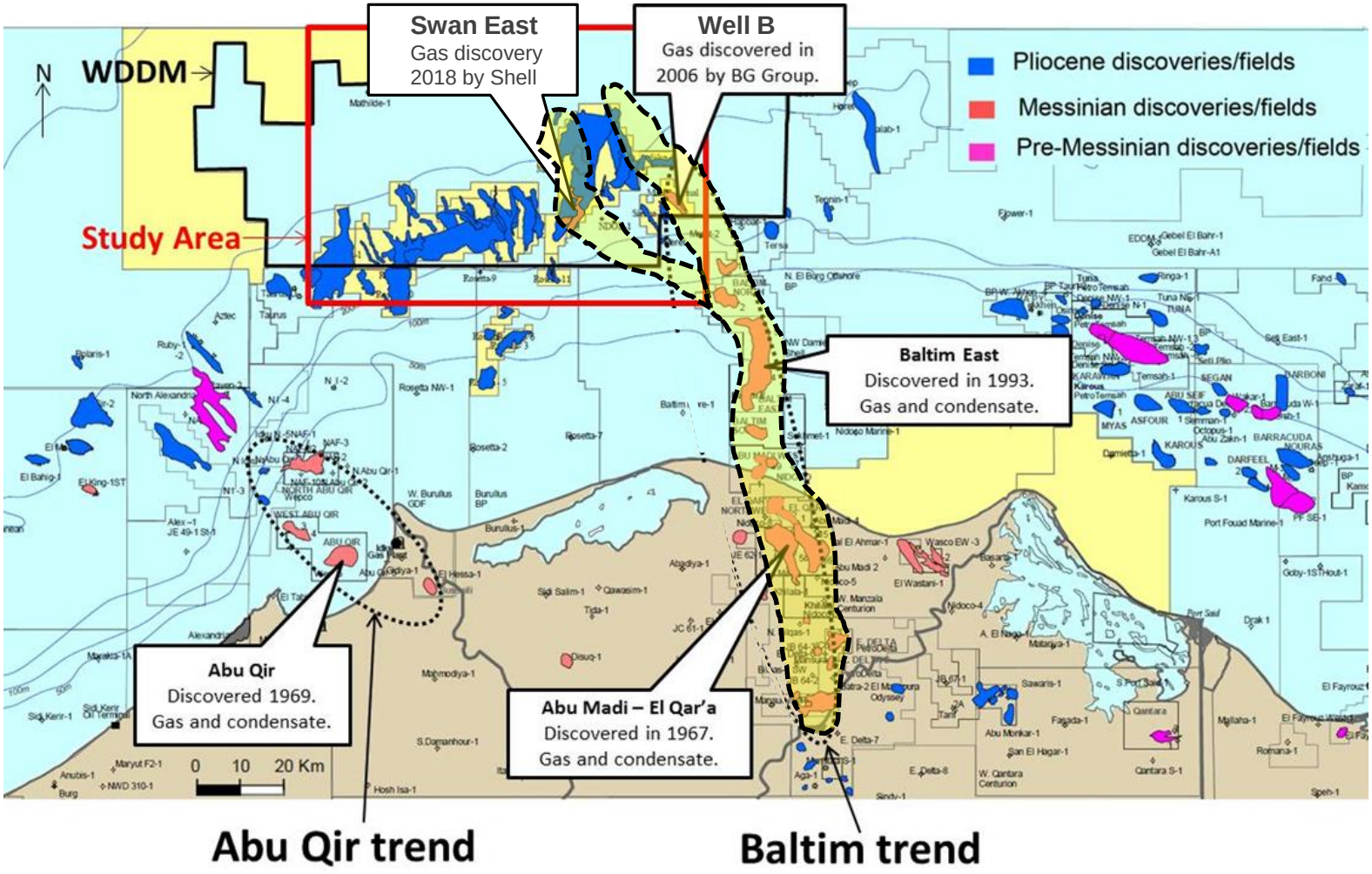
Is there a northward extension to the Baltim trend?



Is there another branch of Baltim canyon?



Conclusions

- There is **significant Messinian prospectivity** in the area of WDDM Concession.
- **Well B** is considered to be an extension of Baltim fluvial system to the north.
- **Swan East Messinian reservoir** possibly related to Baltim fluvial extension, supporting the Messinian reservoir fairway extension and Presence for the eastern part of WDDM area and high grading reservoir presence for the remaining Messinian leads in support of seismic attributes.

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Acknowledgment

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