



Eocene Overview - Gulf of Suez (GOS)

EUG Technical Promotion Team
GPC 2021

Agenda



EGYPT UPSTREAM GATEWAY
MINISTRY OF PETROLEUM & MINERAL RESOURCES

- GOS Overview
- GOS Eocene Overview Surface & Subsurface
- Success Stories
- Untested Eocene Reservoir
- Eocene Reservoir & Production History
- Conclusion

Gulf of Suez Province



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>183 Producing Fields



>8 Bboe Cum. Production



>7 Tcf 2P Gas RR
Dolson, 2016



>12 Bbbl 2P Oil RR
Dolson, 2016



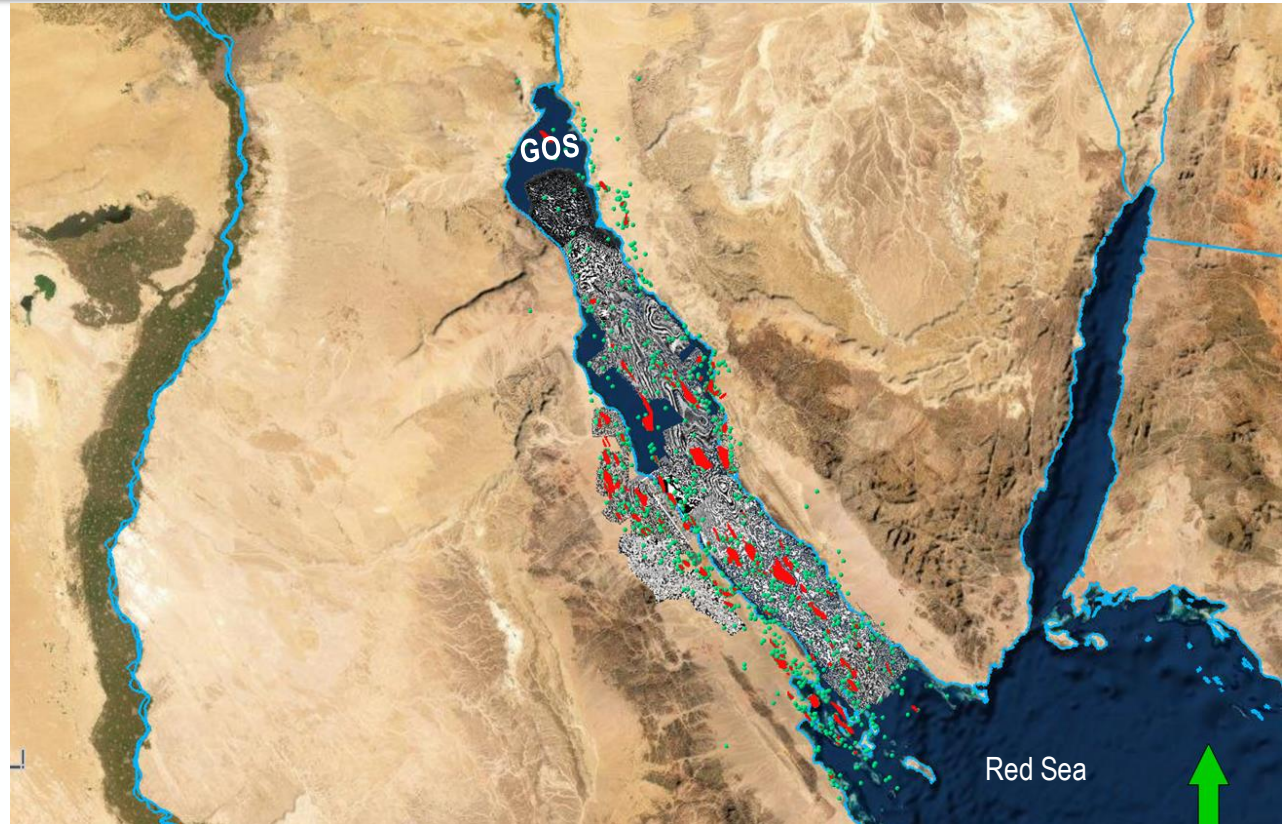
>1100 Xpl. Wells



>3700 Dev. Wells



>62% 3D Seismic data coverage



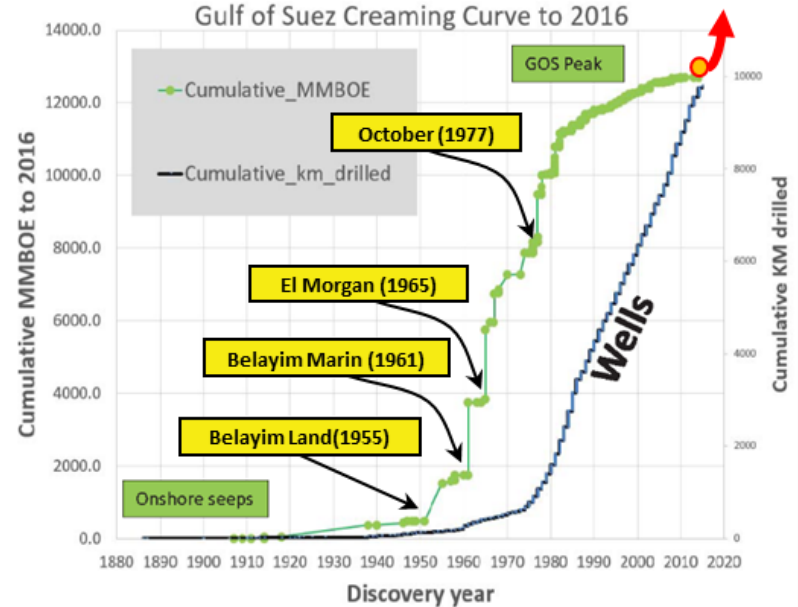
GOS Exploration History Vs. Stratigraphic column



AGE	Group	FORMATION	STRATIGRAPHY	TECTONICS	
GENOZOIC	Recent	Zafarana		Megasquence 5 Extension	
		Pliocene			Wardan
	Late	Zeit			Megasquence 4 Onset Dead Sea Trench
		South Gharib			
		Belayim			
	Middle	Kareem			
	Early	Rudeis			
	Oligocene	Gharandal			Megasquence 3 Extension
		Nukhul (pre-Shoab to Mer) / AbuZenima / Tayiba			
	Eocene	Late			Mokattam
Middle					
Early		Thebes			
MESOZOIC	Paleocene	Esna	Megasquence 2 Inversion		
		Sudr			
	Cretaceous	Maastrichtian		Megasquence 2 Onset Syrian Arc	
		Campanian			
		Santonian			
	Turonian	Matulla			
	Cenomanian	Wata			
	Early	Raha			
	Jurassic	Malha		Megasquence 1 Extension	
		Triassic			
Permian					
PALEOZOIC	Carboniferous	Abu Thora	Megasquence 1 Hercynian orogeny		
	Cambrian	Naqus			
	Crystalline	Araba			
		Basement			

Producing Fields

- Seal
 - Gas Fields
 - Oil Fields
 - Oil & Gas Fields
 - Reservoir
 - Source Rock
- ~ 64% HC Reserves
- Belayim Land
 - Gemsa
 - Ashrafi, Morgan
 - July, 345, Ashrafi, East Zeit, Asl, Shukeir Bay, Tanka E 3
 - Ashrafi, Geisum, Shoab Ali
 - Sudr, Matarna, Asl, NWO, Lagia, Amer, N-Amer, El Hamd, Geisum, ...
 - Ras Fanar North
 - 302, Amer North, GG 83, El Hamd SE
 - Shadwan N 385, Belayim S 367
 - October, 327, 373
 - Belayim Land, Ramadan, Badri,
 - July, Shadwan N 394, Ras Rahmi, Sidki, 365
 - Belayim Marine, Amal, Shoab Ali, Ashrafi, Zeit Bay
- ~ 36% HC Reserves



Dolson, 2016

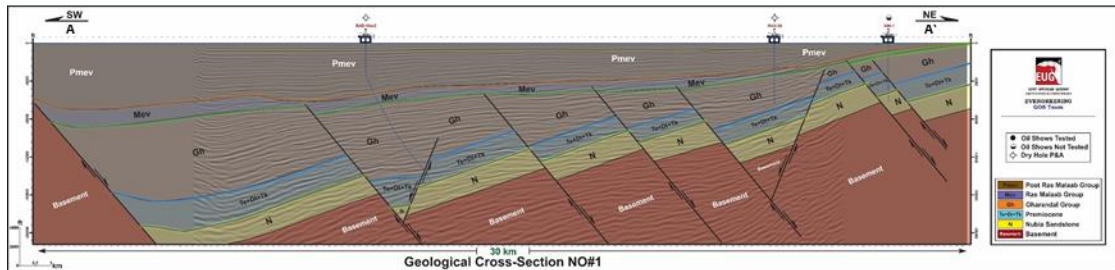
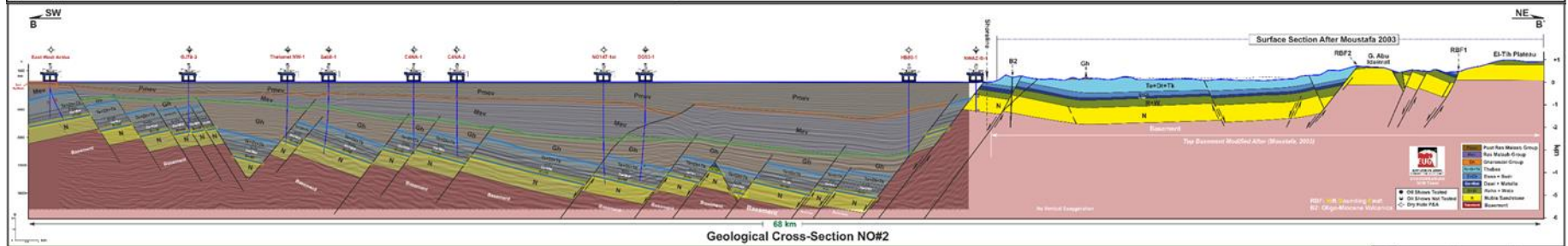
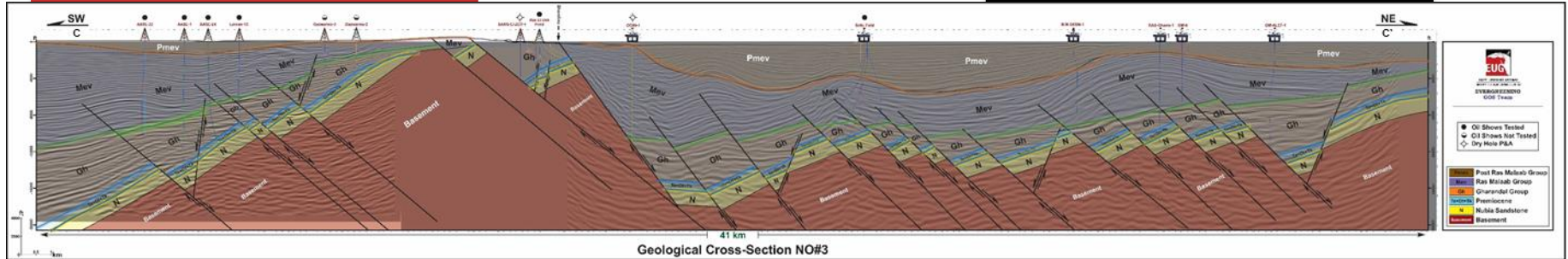
Source : Peijs et al. (2012)

● Source Rock	● Gas Fields
● Seal	● Oil Fields
● Reservoir	● Oil & Gas Fields

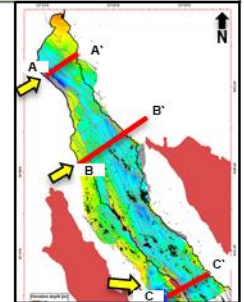
Seismic section with Mapped levels



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More than 650 Km
X-section created to
map accurate
structures

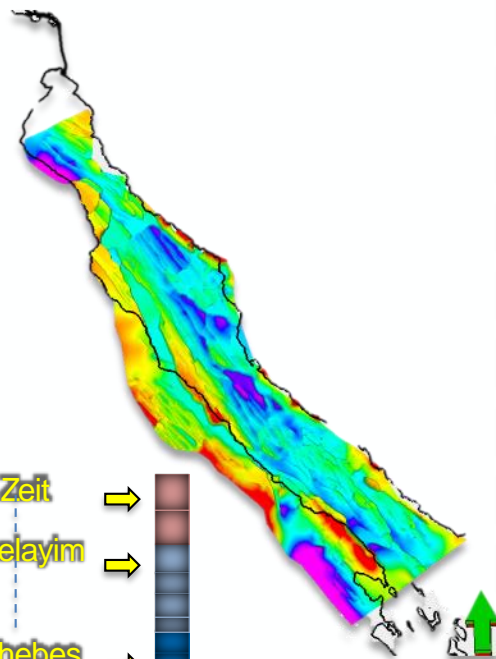


GOS Structure Maps – EUG Regional Mapping

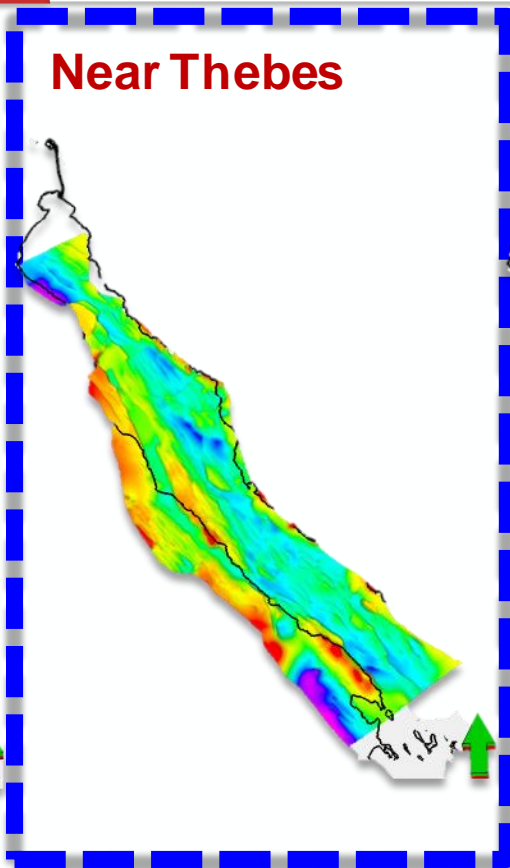


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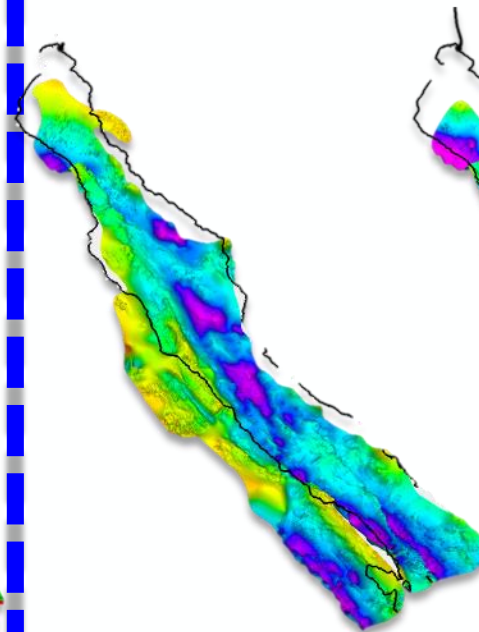
Near Nubia



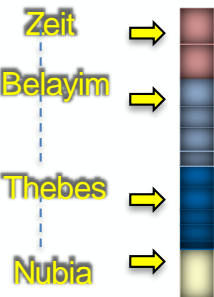
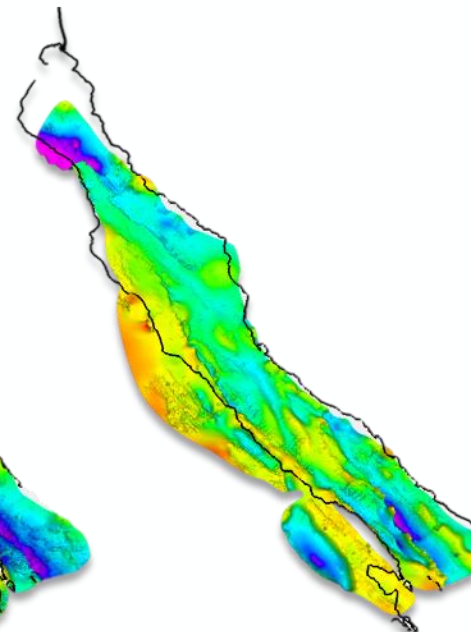
Near Thebes



Near Belayim



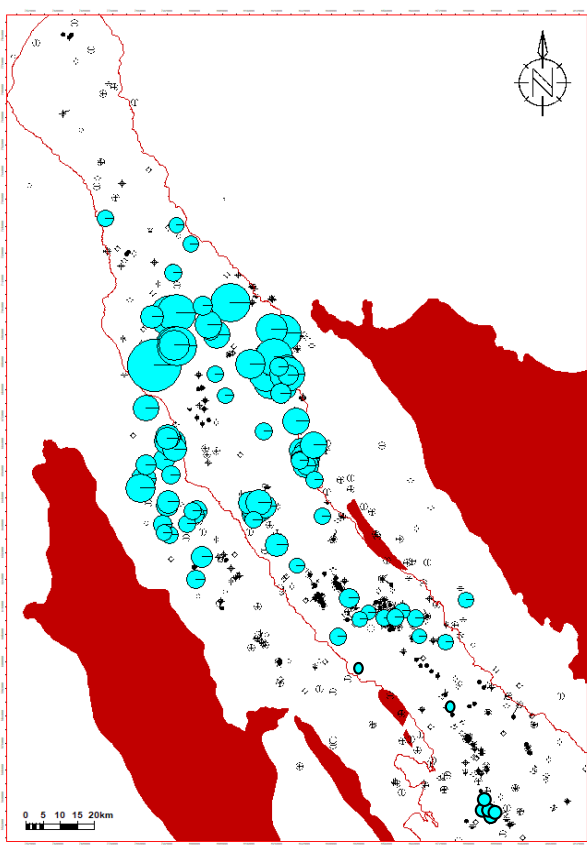
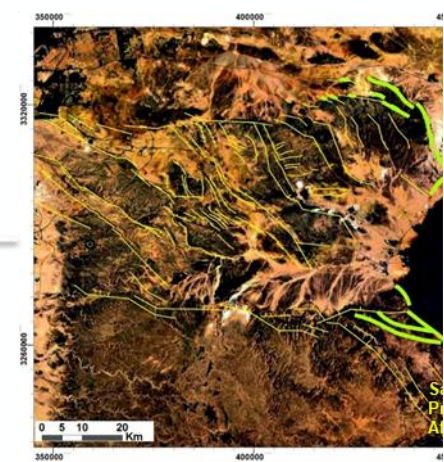
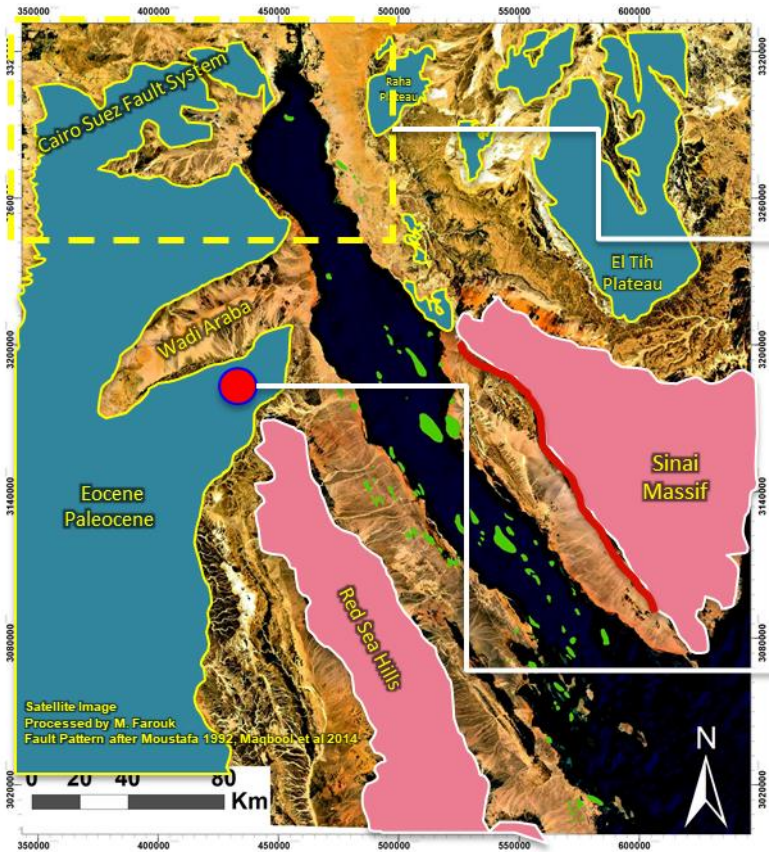
Near Zeit



Eocene Distribution



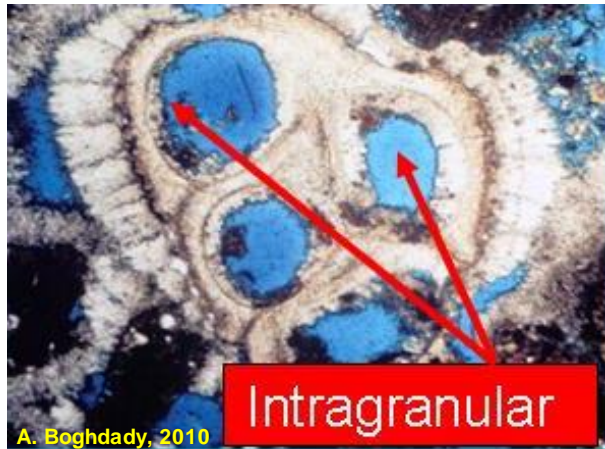
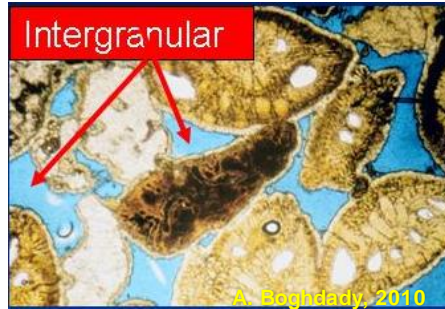
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What Controlling Carbonate Reservoir P. Performance

✓ Primary Porosity

- ✓ Intergranular
- ✓ Intragranular



What Controlling Carbonate Reservoir P.Performance

✓ Secondary Porosity

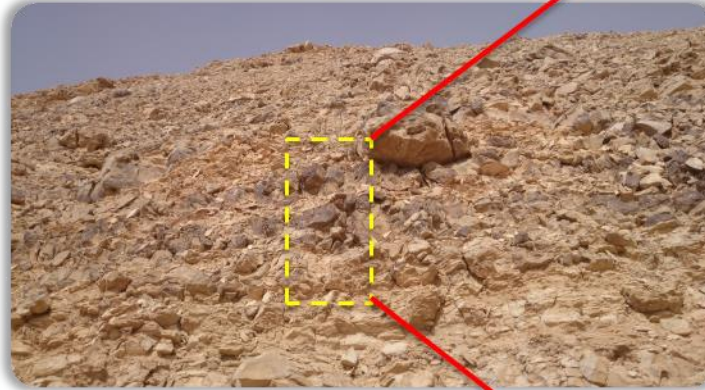
✓ Intercrystalline

✓ Vuggy

✓ Moldic

✓ Fracture

Carbonate is More susceptible to diagenesis more than terrigenous



Eocene, Fractured Cherty LS, Gebel Gharamul
Captured By: M. Farouk

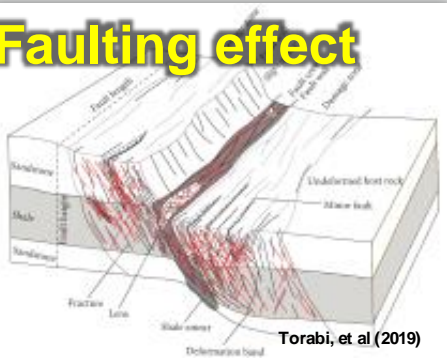


What Controlling Eocene Reservoir P. Performance



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Faulting effect



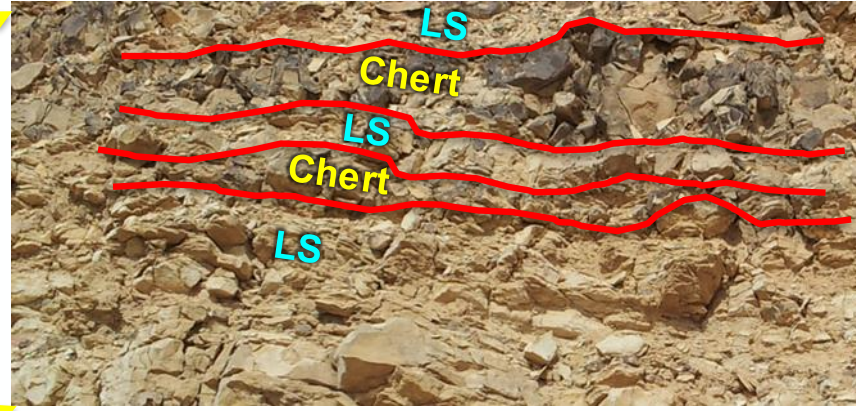
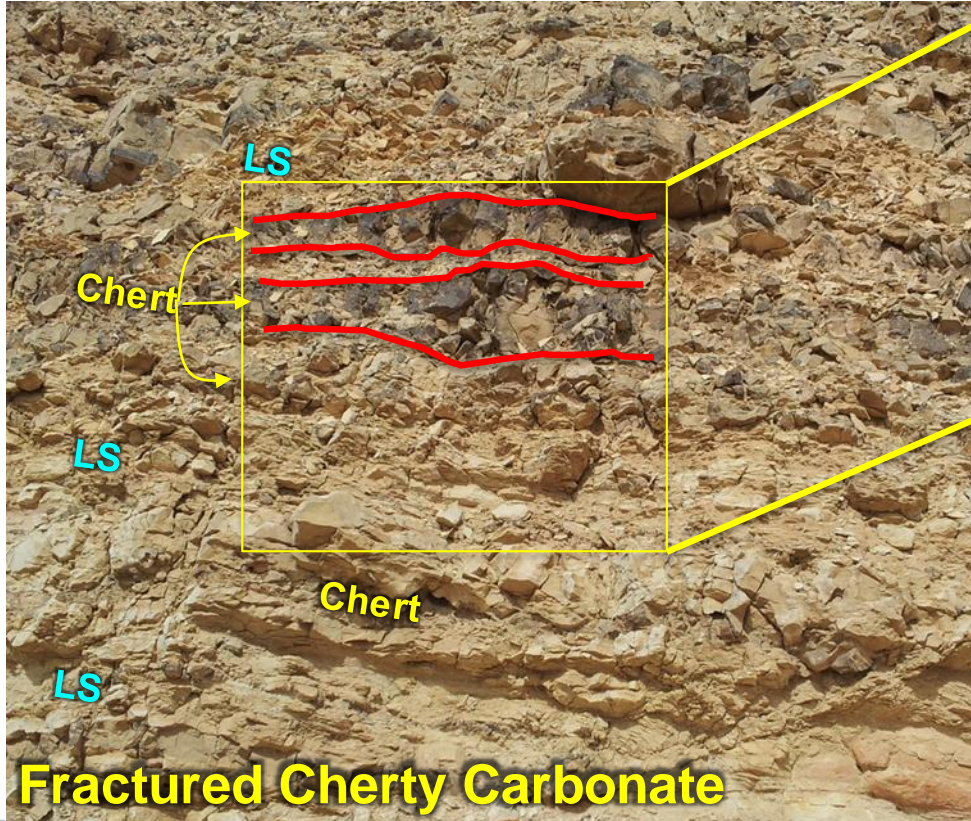
Eocene fm, Galala Rd, Captured By: I. Abdo



Fractures Carbonate

Eocene fm, Sant Paula, Hurghada Rd
Captured By: M. Farouk

What Controlling Eocene Reservoir P. Performance



**Mechanical Layering
Enhancing the Fracture
development in Brittle
Rock Units**

Fractured Cherty Carbonate

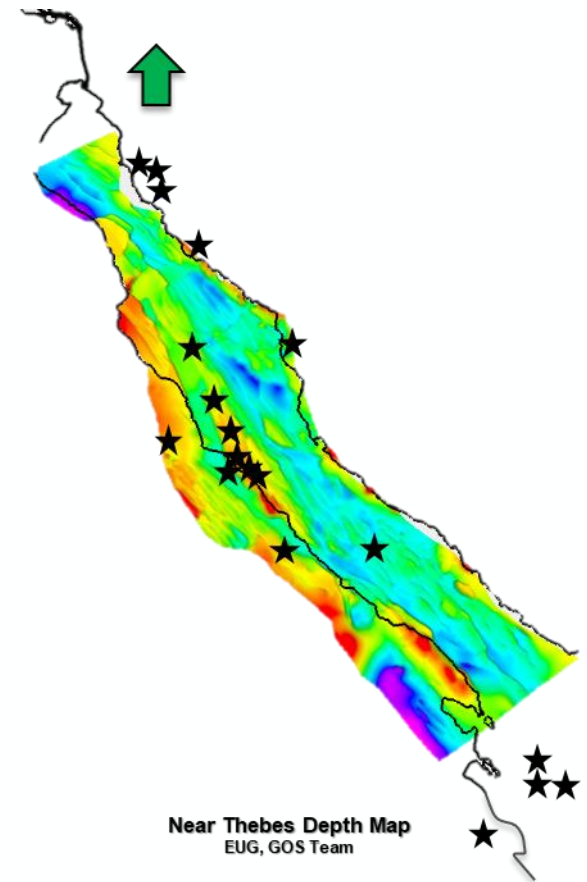
Success Stories

Producing Fields from Eocene - GOS

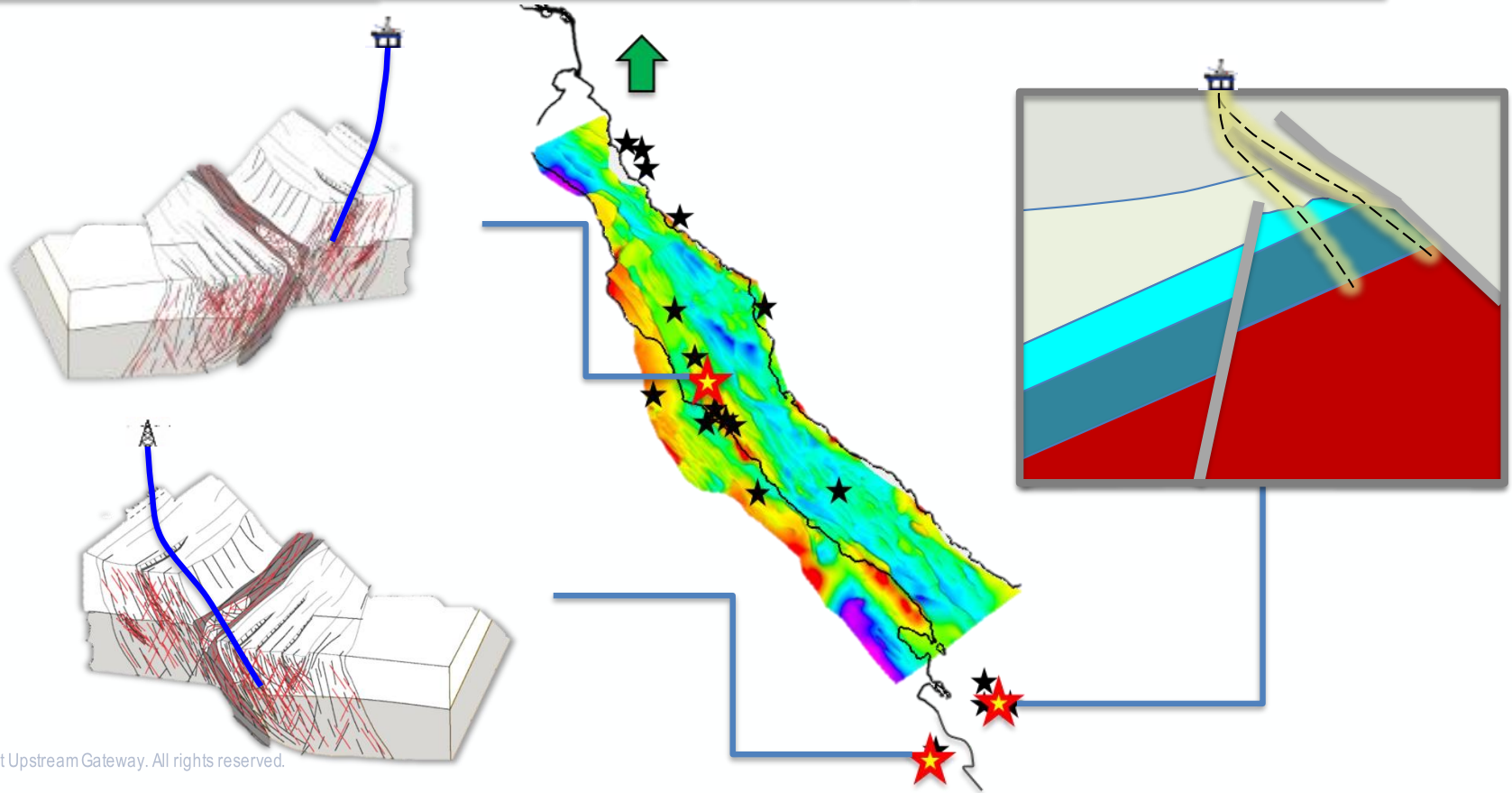
- ✓ 20 fields producing from Eocene in the GOS region (onshore/offshore), Exs.

(Sudr, Asl, Matarma, Elhamd, Bakr, Amer, FF, HH, HH 83/2, Belayim Marine, Belayim Land, NWO, North East Geisum, South Geisum, Gemsa, E.ARTA, Naser, Yusr, SOROCO, Lagia)

- ✓ Average STOIIIP **2000 MMSTB Oil**
- ✓ Average Cum. Produced **180 MMSTB**

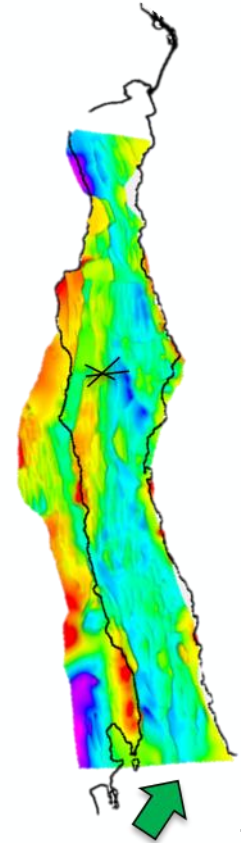
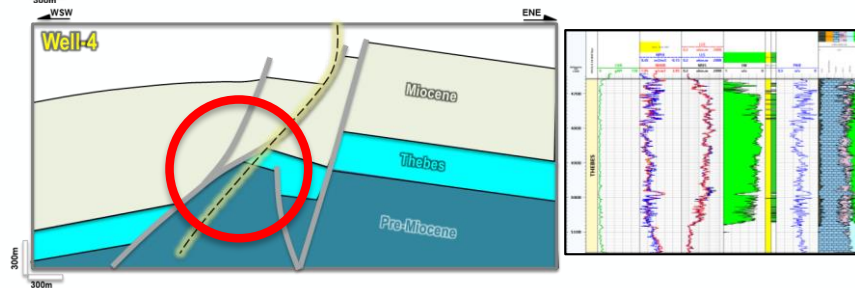
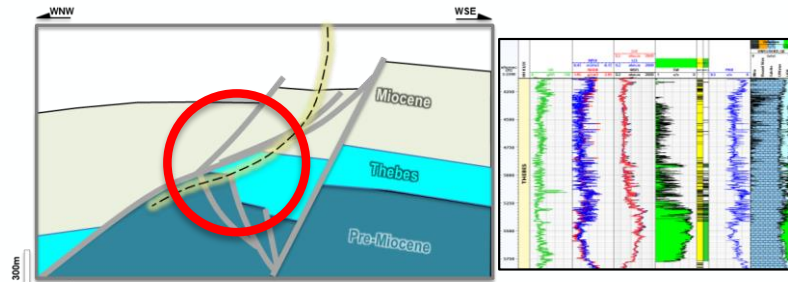
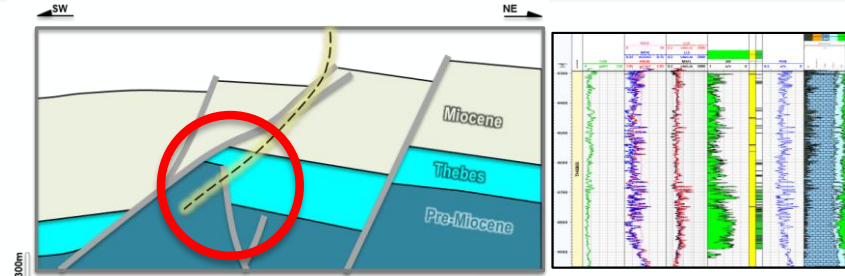
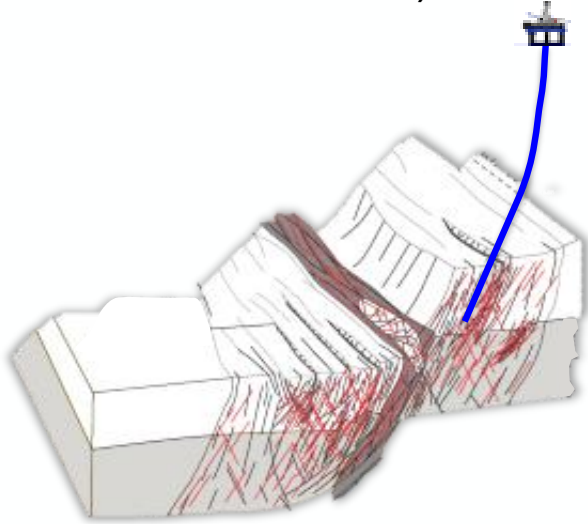


Success Stories



Success Stories (Example-1 Up-thrown side)

Fracture intensity increase beside the damage zone of the main bounding fault (Up thrown side)

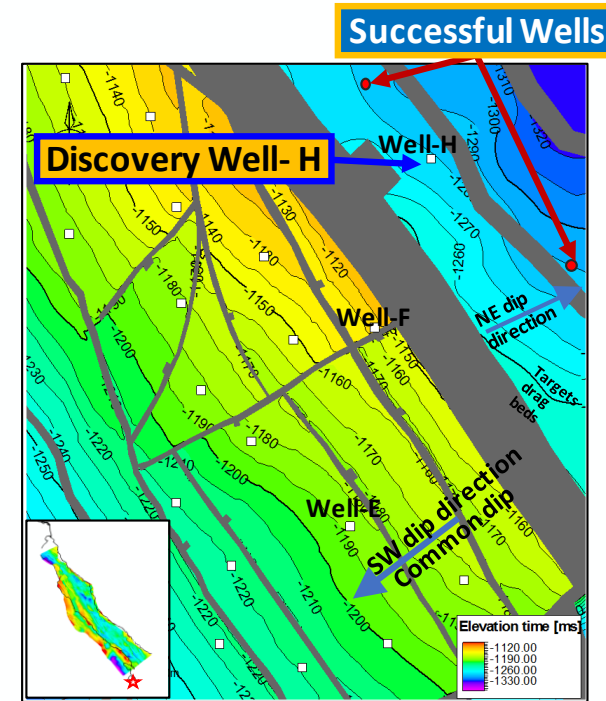
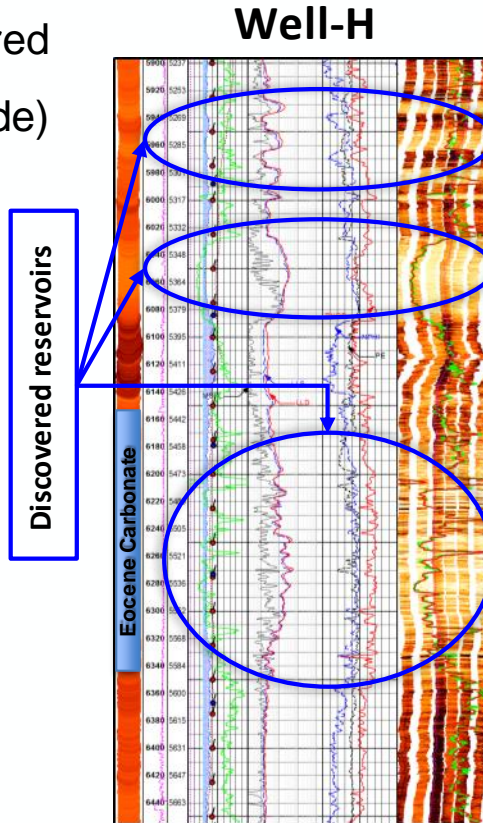
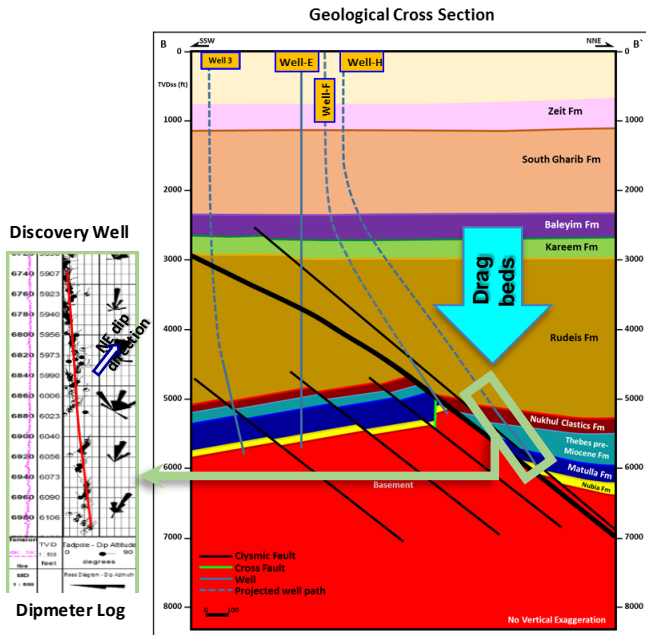


Success Stories (Example-2, Down-thrown side)



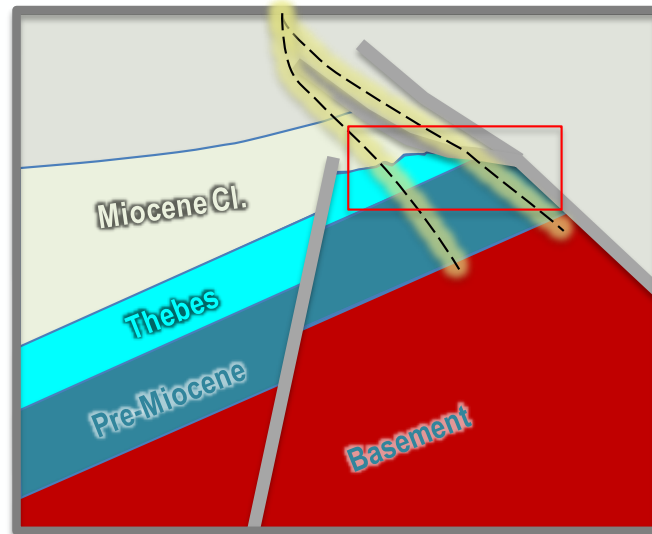
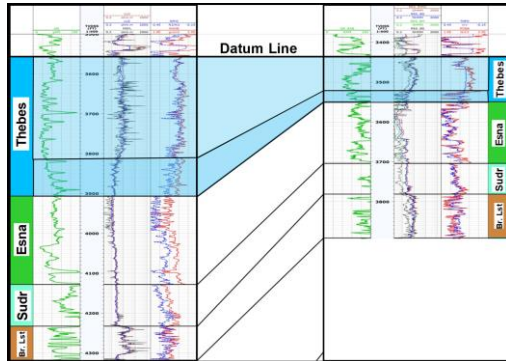
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- ✓ Latest Eocene reservoir discovered in GOS Region (Down thrown side)

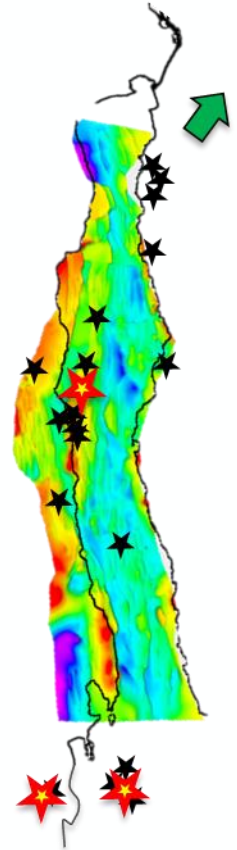


Success Stories (Example-3, Up-thrown side)

- ✓ Eocene reservoir discovered (Fracture near fault & erosion surface) in GOS Region



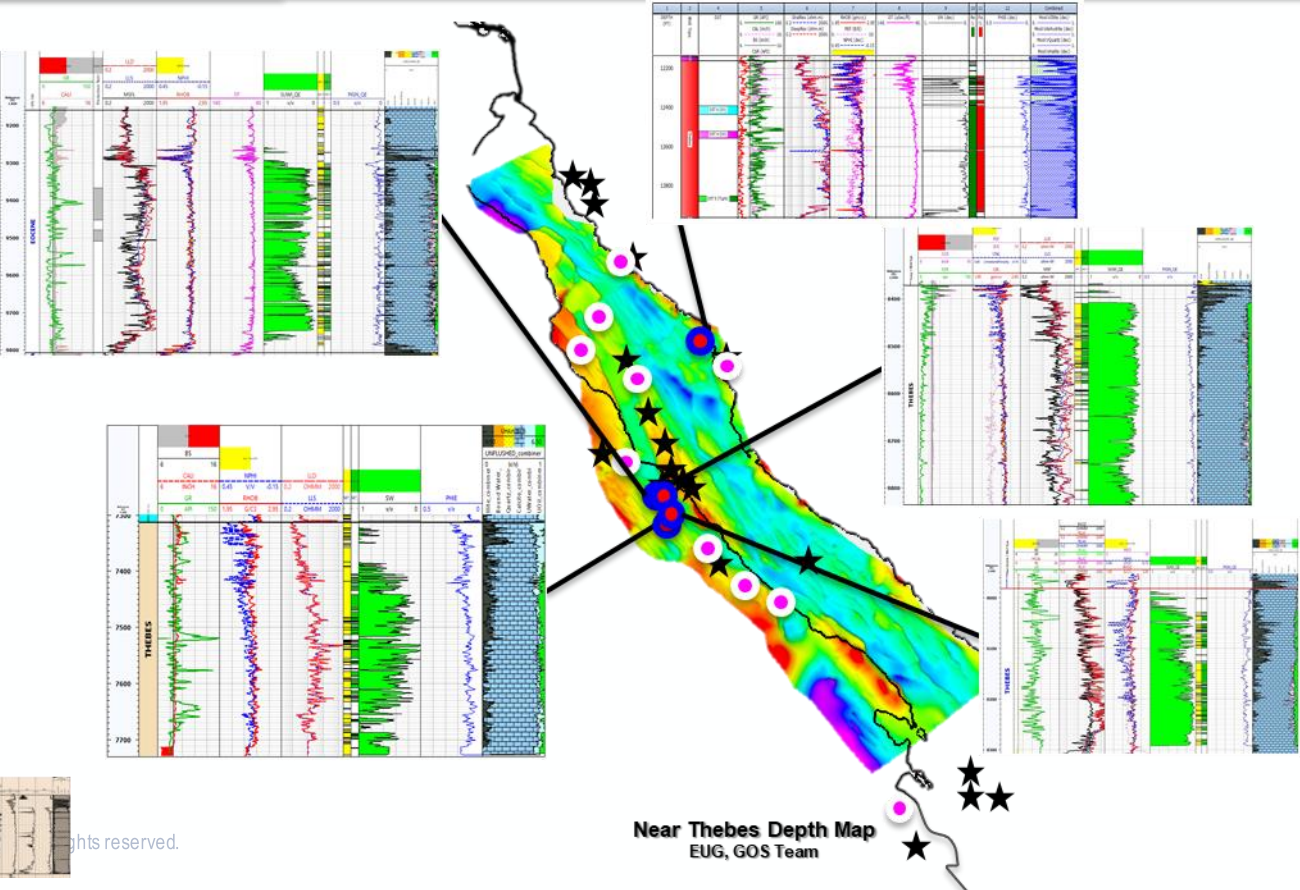
Eocene fm, Galala Rd,
Captured By: I. Abdo



Untested Eocene Reservoir



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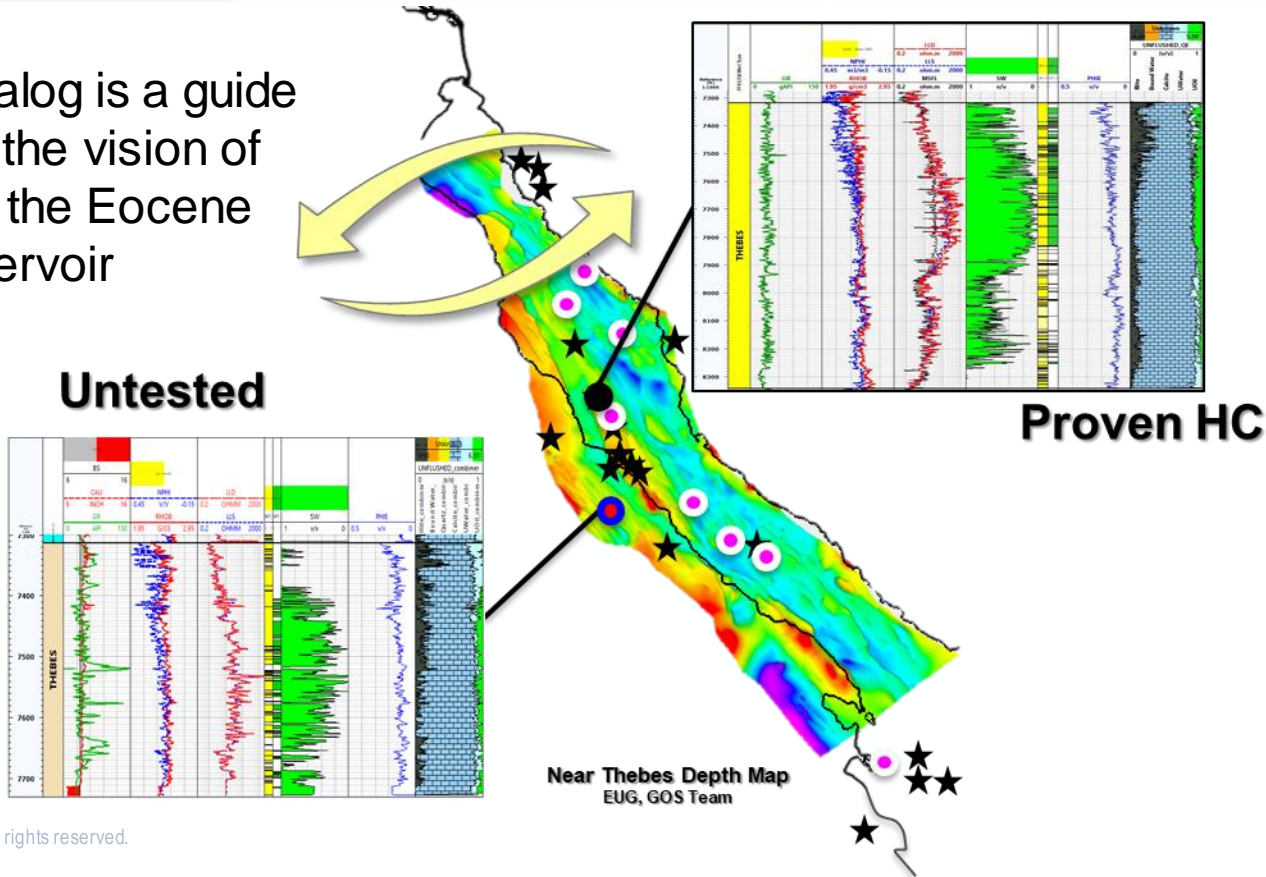
Near Thebes Depth Map
EUG, GOS Team

Untested Eocene Reservoir



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Character analog is a guide to enhance the vision of developing the Eocene Reservoir



Production Status for Thebes Reservoir



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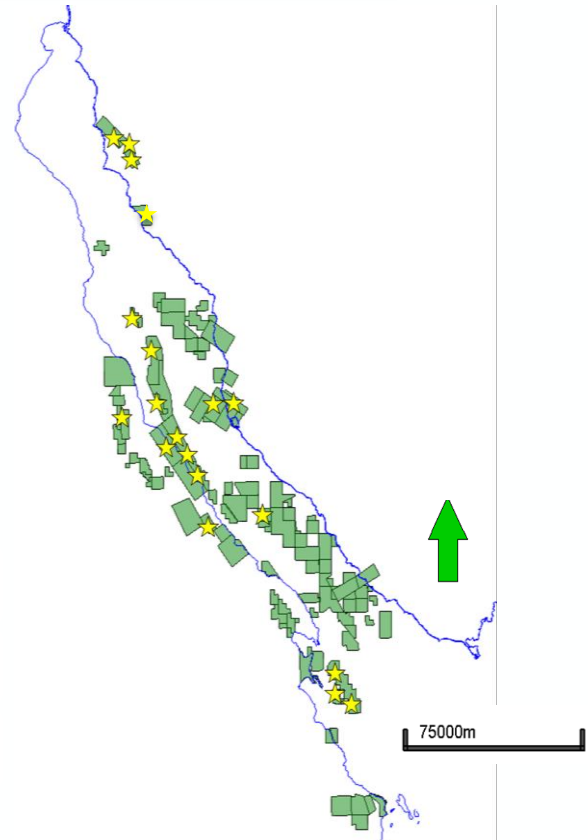
Thebes Reservoir

- GPC
- Petrosalam
- Soroco
- Gemsa
- Petrogulf
- Petromalaha
- Petrodara
- Petrobel

Total Produced Fields: 20

Total Produced Wells: 166

Thebes Production is around 4% Egypt daily production



Thebes Potential



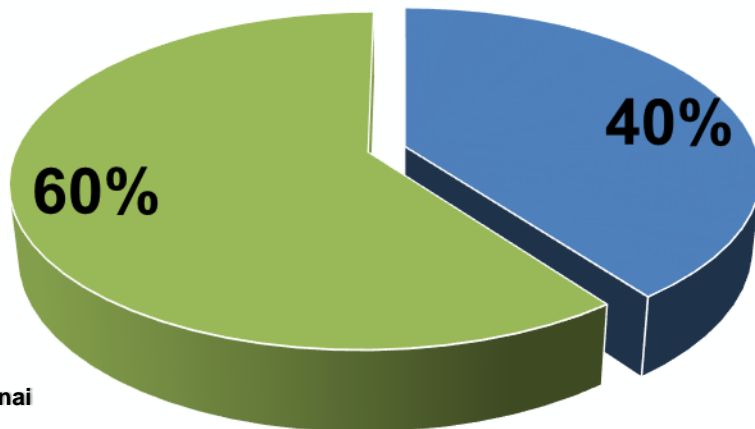
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Original Oil in Place : 2 Billion STB

Average Decline Rate: 16 %

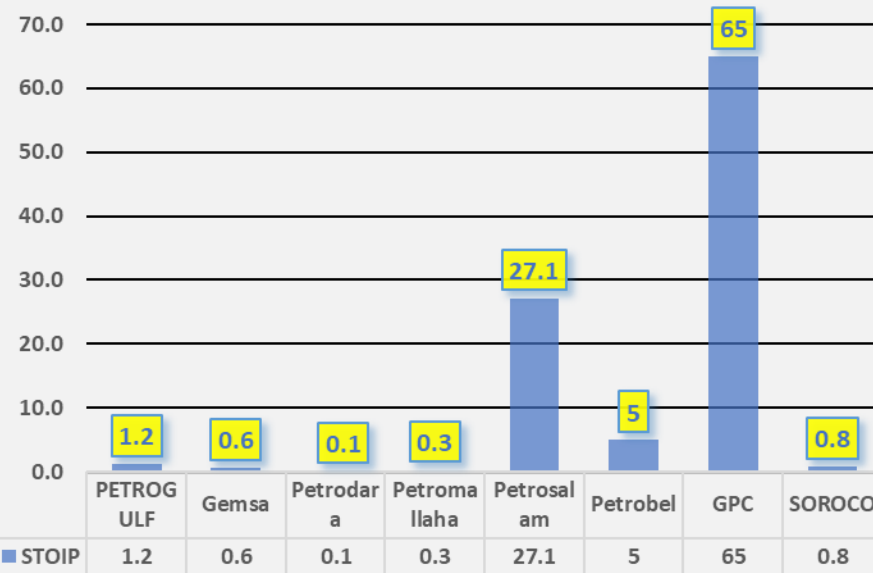
Average Recovery Factor: 14 %

Thebes STOIP, %



- GOS
- ED & Sinai

THEBES STOIP, %



Thebes Production Share

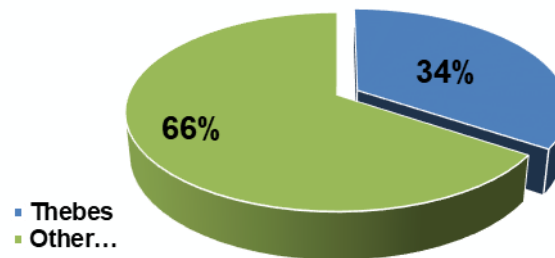


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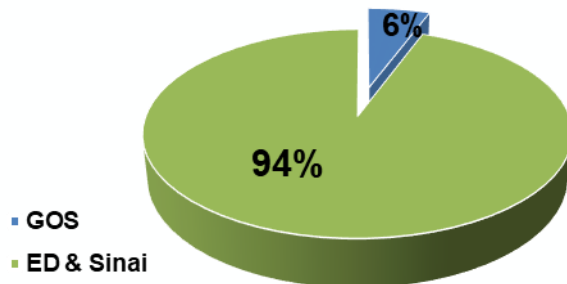
Carbonate Reservoirs



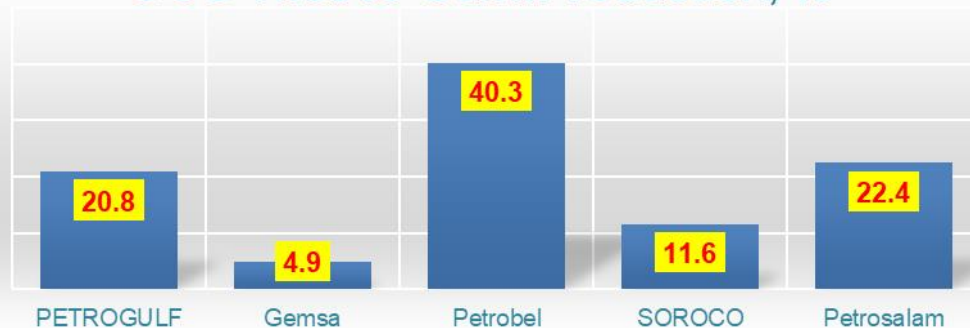
Cumulative Production, %



Thebes Cum.Production, %



GOS Thebes Cum.Production, %



Production & Reservoir Challenges

- Partially Damage that has an impact on Production.
- Water Flooding require good understanding of carbonate fractures.
- Reservoir Heterogeneity cause low sweep efficiency and high residual oil.
- Rock Complexity effect on the screening criteria of EOR Implementation.
- Eocene carbonate is a tight formation in some areas, with a permeability ≈ 0.13 mD

Conclusion

- Exposed Eocene features are a good chance for further reservoir understanding
- Primary and Secondary porosity control and contribute to the reservoir quality and the second porosity is the more contributor Like Fracturing due to faulting and mechanical Layering
- We should look after successful analogs with similar to our cases.
- Potentiality in Thebes is fact and still high percentage are undeveloped
- Eocene reservoir Share about 34% of total Cumulative carbonate Production
- The Eocene production history supports new investments and future projects
- Right Action is to Start **NOW** ...



Thanks