”Eocene Carbonate Success Case Study in the Gulf of Suez: Saqqara Field”

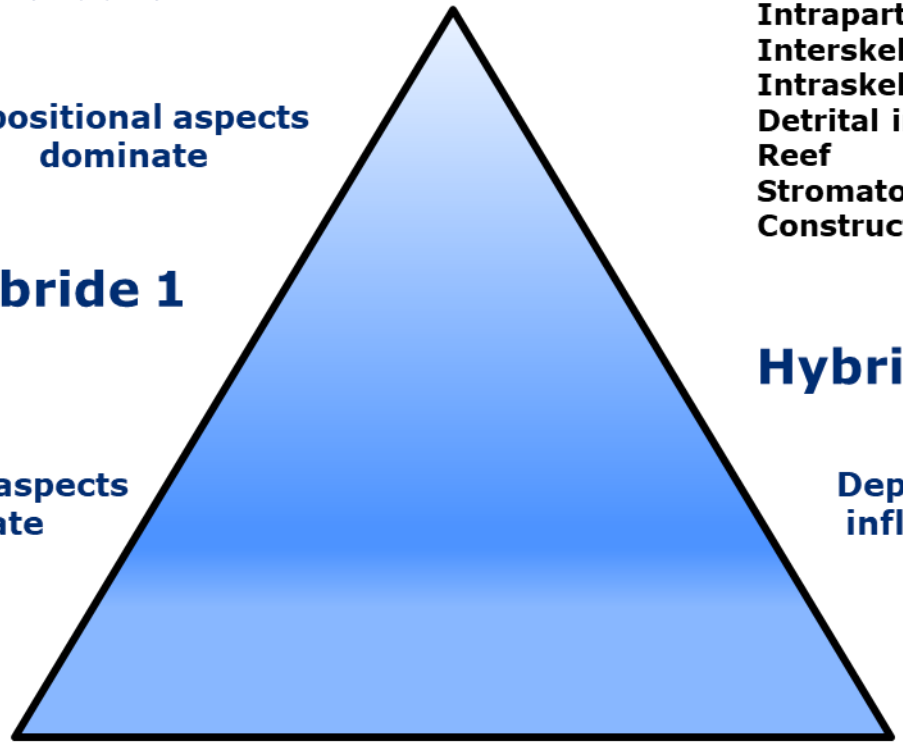
Ahmed Ismail, Omar Kamal, Ahmed A. Kassem, Karim Magdy, Aly bassiouny, Tamer El-Nems, Wael Kassem, Emad El-Sayed, Samy Kamal, Mahmoud Gabr

Agenda

- Theory Behind Carbonate Evaluation
- Data Availability
- Saq-A4 Successful Results
- Eocene Sequence in The Gulf of Suez
- Saqqara Field
- Stratigraphic correlation
- Petrophysical Parameters
- Eocene Reservoir Engineering

Theory Behind Carbonate Evaluation

Genetic classification of carbonate porosity



Depositional

Interparticle
Intraparticle
Interskeltal
Intraskeletal
Detrital infill
Reef
Stromatolites vugs
Constructed vugs

Depositional aspects dominate

Hybride 1

Hybride 3

Diagenetic aspects dominate

Depositional character influencing fracturing

Diagenetic

Hybride 2

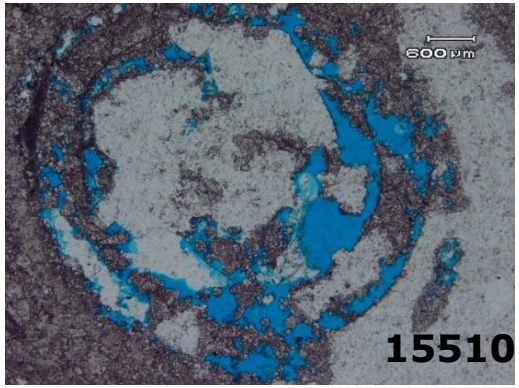
Fracture

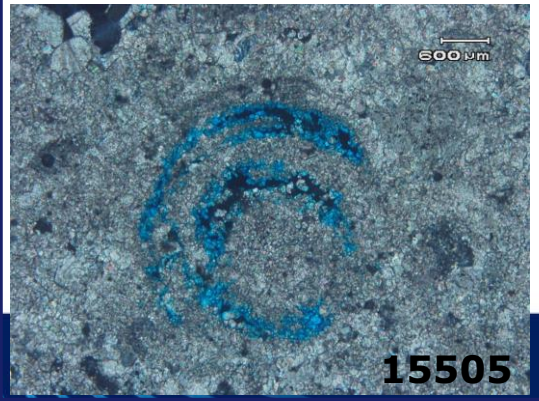
Enhanced	Reduced
Dissolution	Compaction
Replacement	Cementation
Recrystallization	Replacement

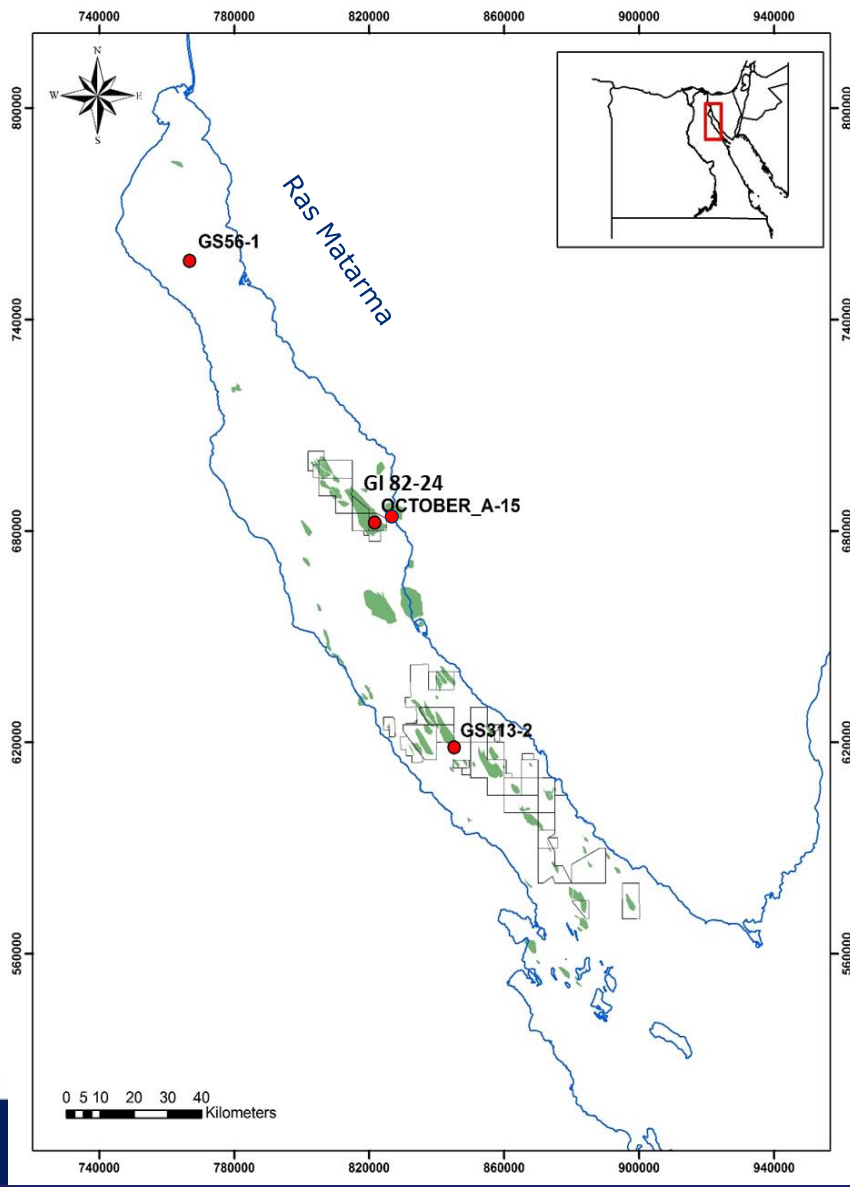
Wayne Ahr, 2008

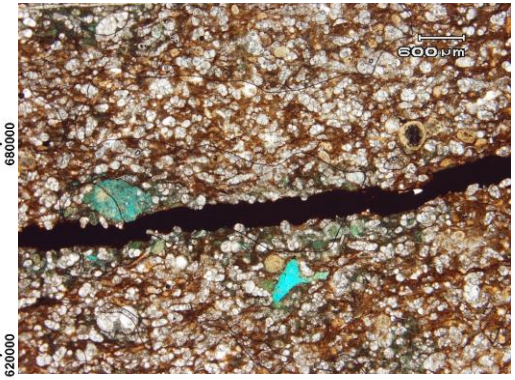
GUPCO Carbonate Evaluation

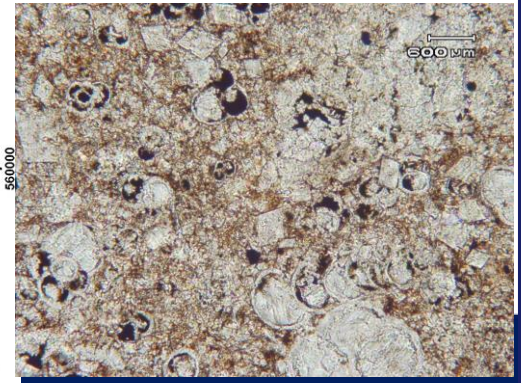
(Data Availability)



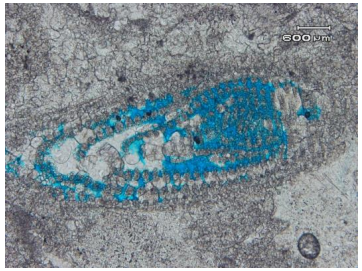


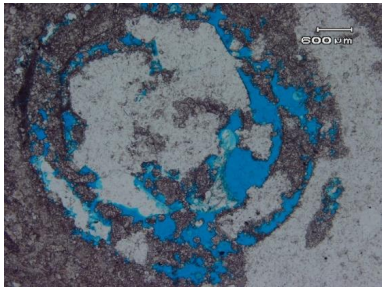


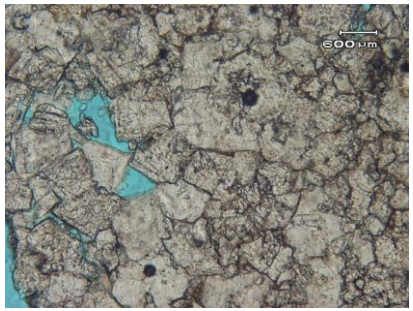


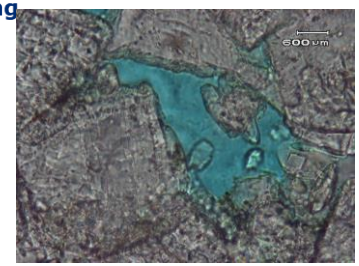


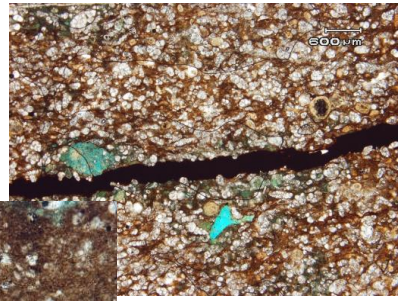
Theory Behind Carbonate Evaluation











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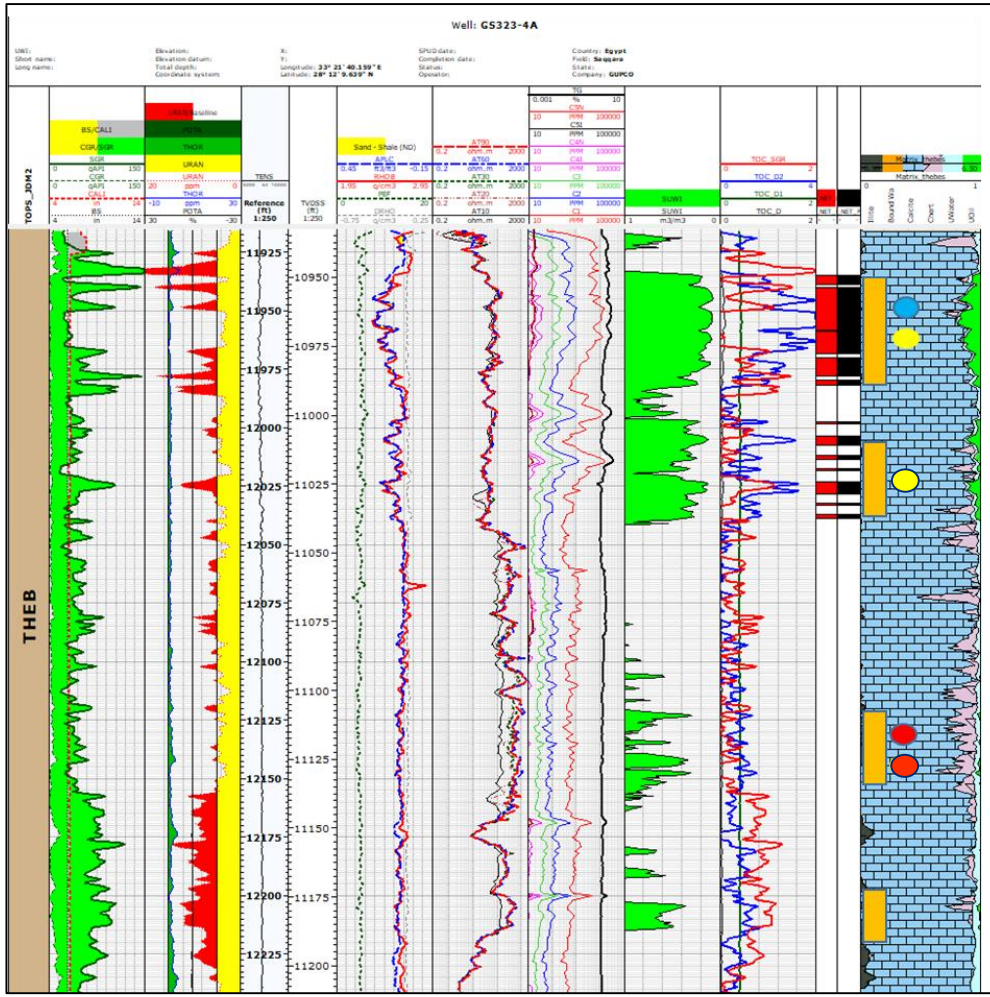
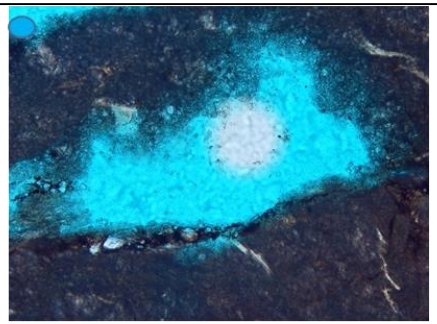
Diagenetic Hybride 2 **Fracture**

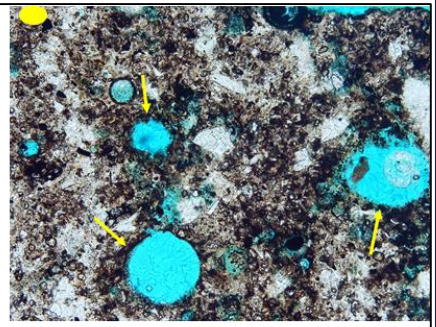
Enhanced	**Reduced**
Dissolution	Compaction
Replacement	Cementation
Recrystallization	Replacement

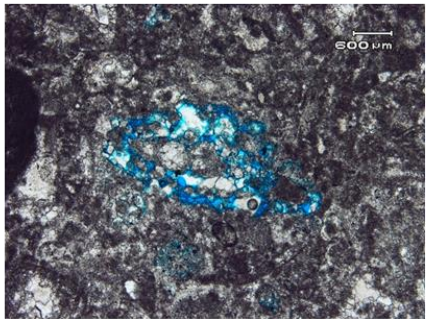
- Intercrydtalline dolomitic wackstone– diagenetic aspect control
- Foraminiferal packstone – diagenetic aspect control
- Mud-Wackstone– diagenetic aspect control
- Formainiferal wackstone– diagenetic aspect control
- Formainiferal wack-packstone– diagenetic aspect control

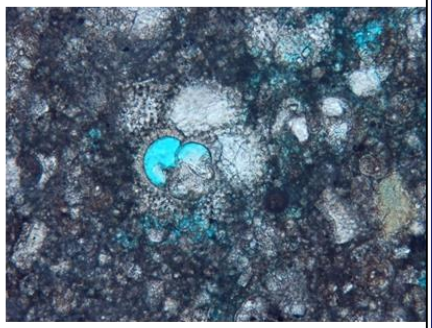
Saq-4A…….Pore-Type Results

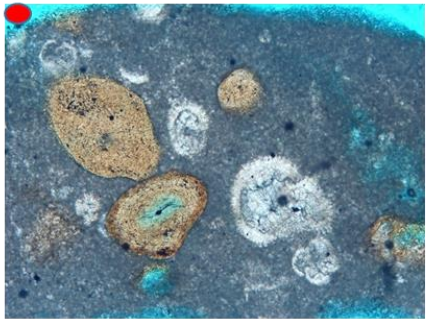


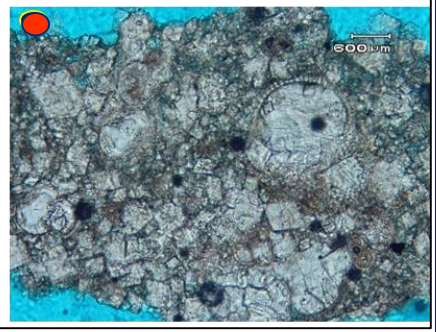




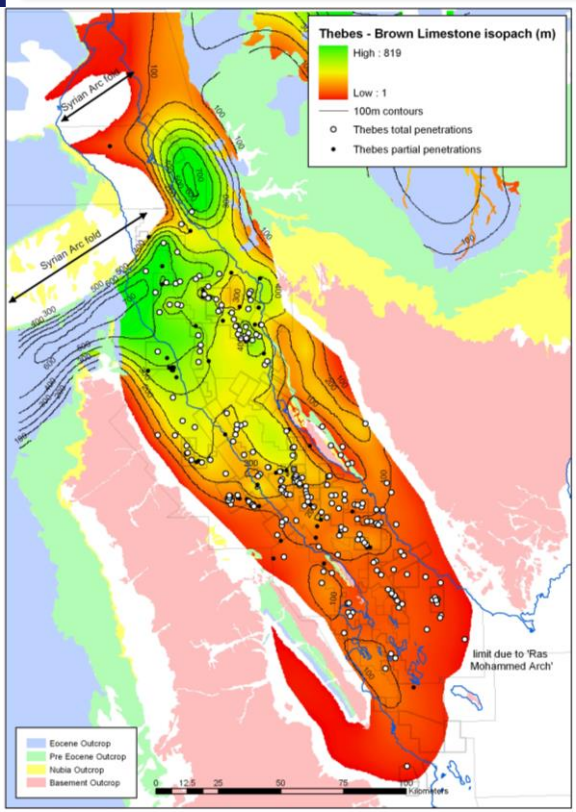




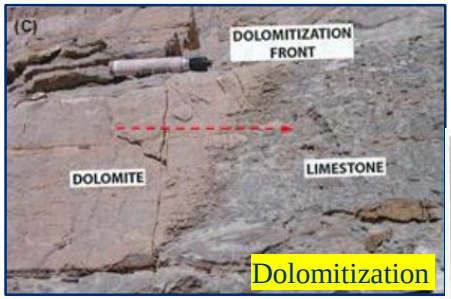




Eocene Sequence in the Gulf of Suez

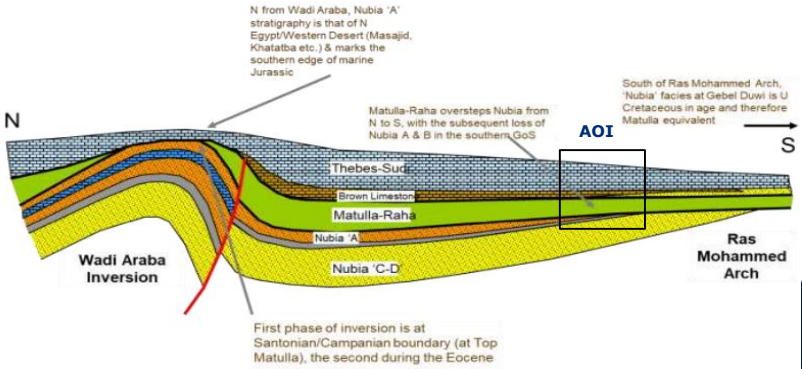


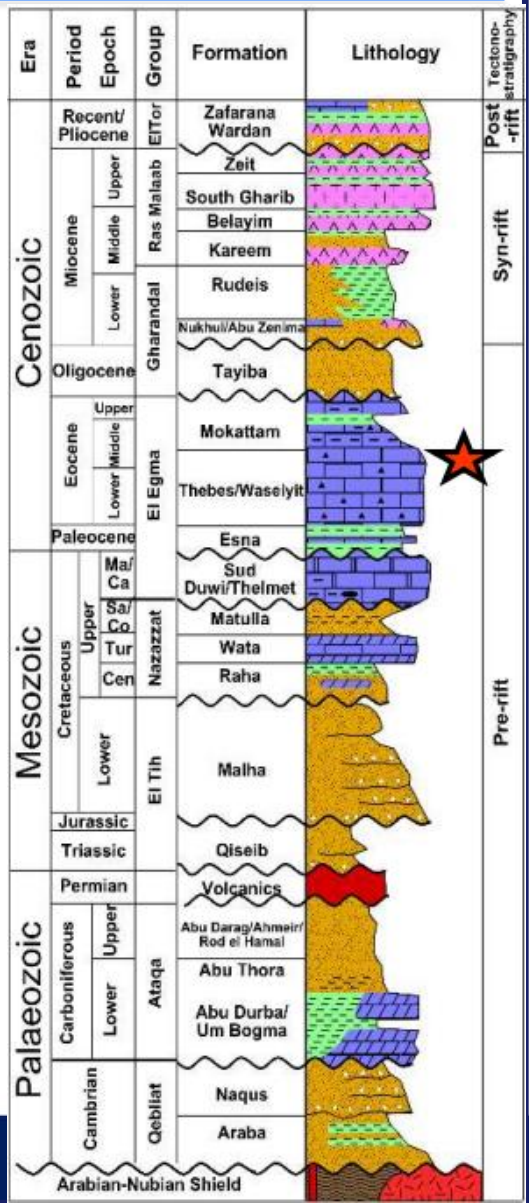
Peijs et al. 2004



Dravis et al., 2014

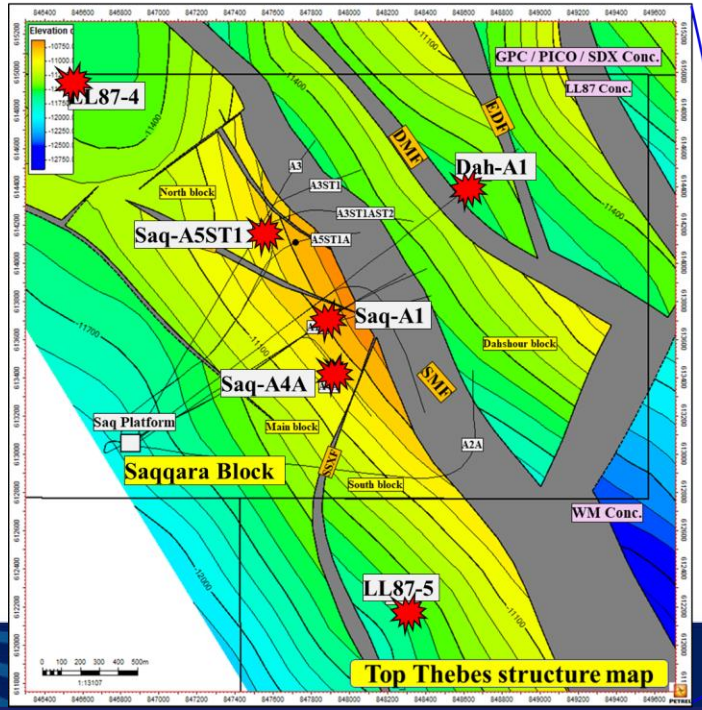
GUPCO started to produce from two pore systems, the fracture and dissolution carbonates from Saqqara and Edfu fields.

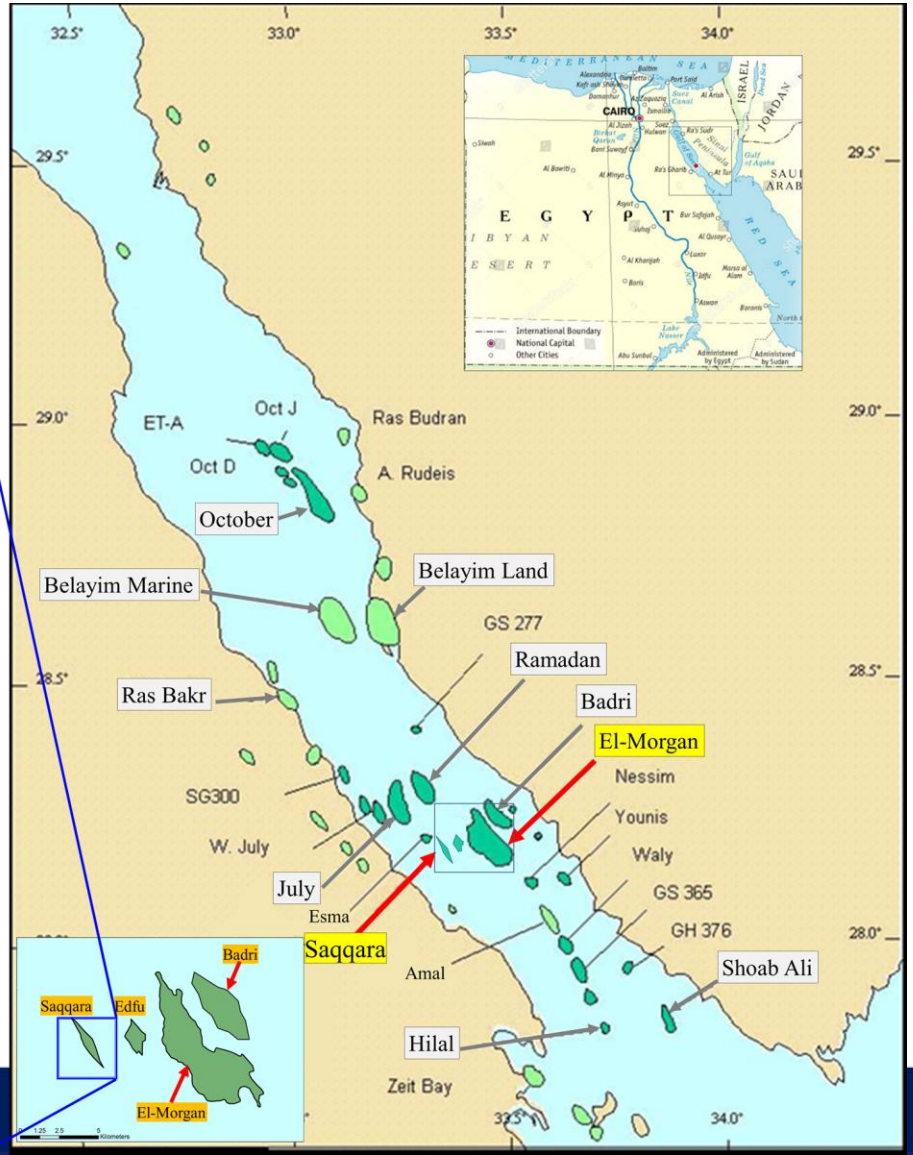




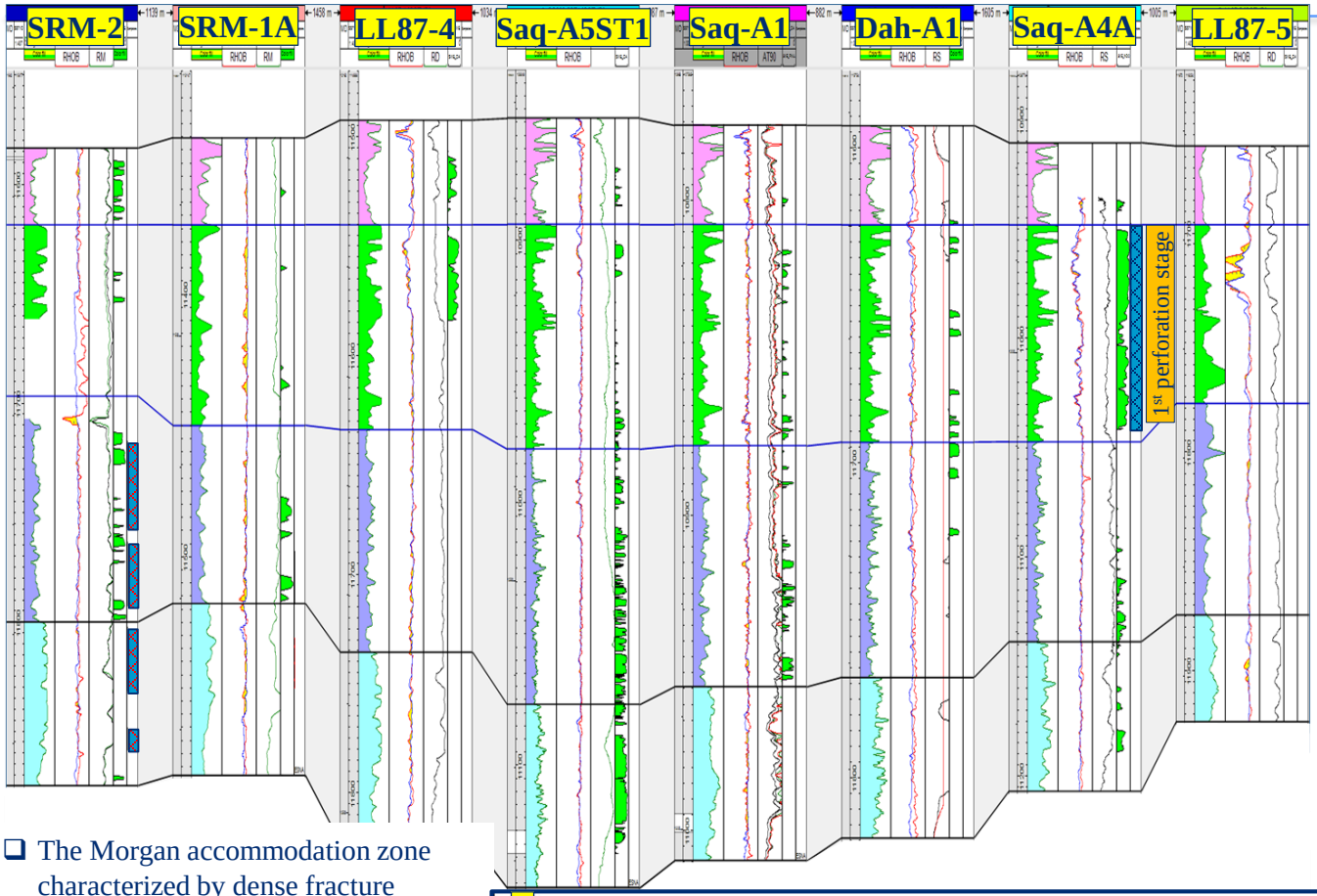
Saqqara field Story

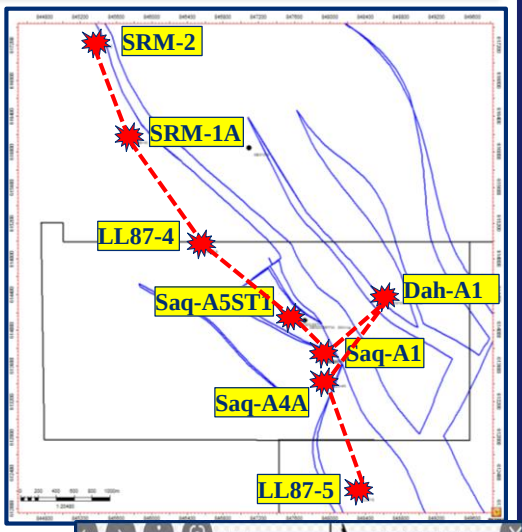
- Saqqara field discovered in 2003 by GS323-1 where encountered oil bearing in both of Nubia and Nezzazat Group.
- The field started production from Nubia S.st. the high quality reservoir of the Pre-Miocene section since 2008, followed by Nezzazat Group on 2012.
- GUPCO recently started to produce an oil from Thebes formation from Saq-A4A for 8 months ago with initial rate ~500 bopd and Traces WC, with cumulative production ~ 120,000 barrel oil.

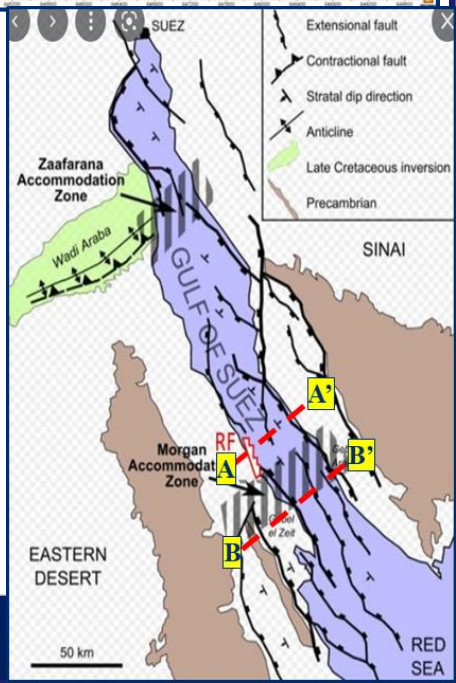


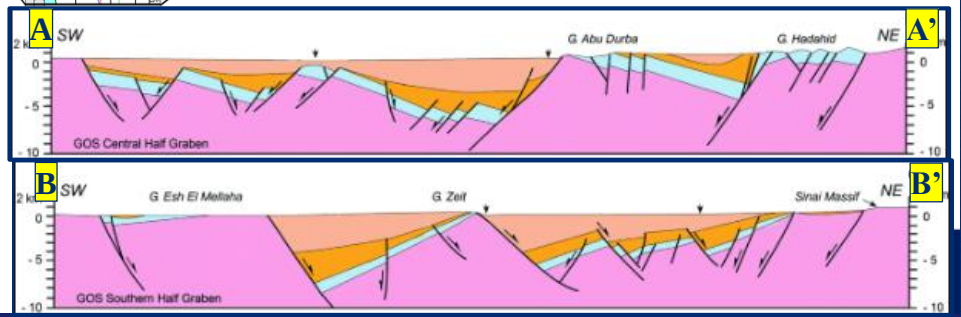


Thebes Stratigraphic Correlation



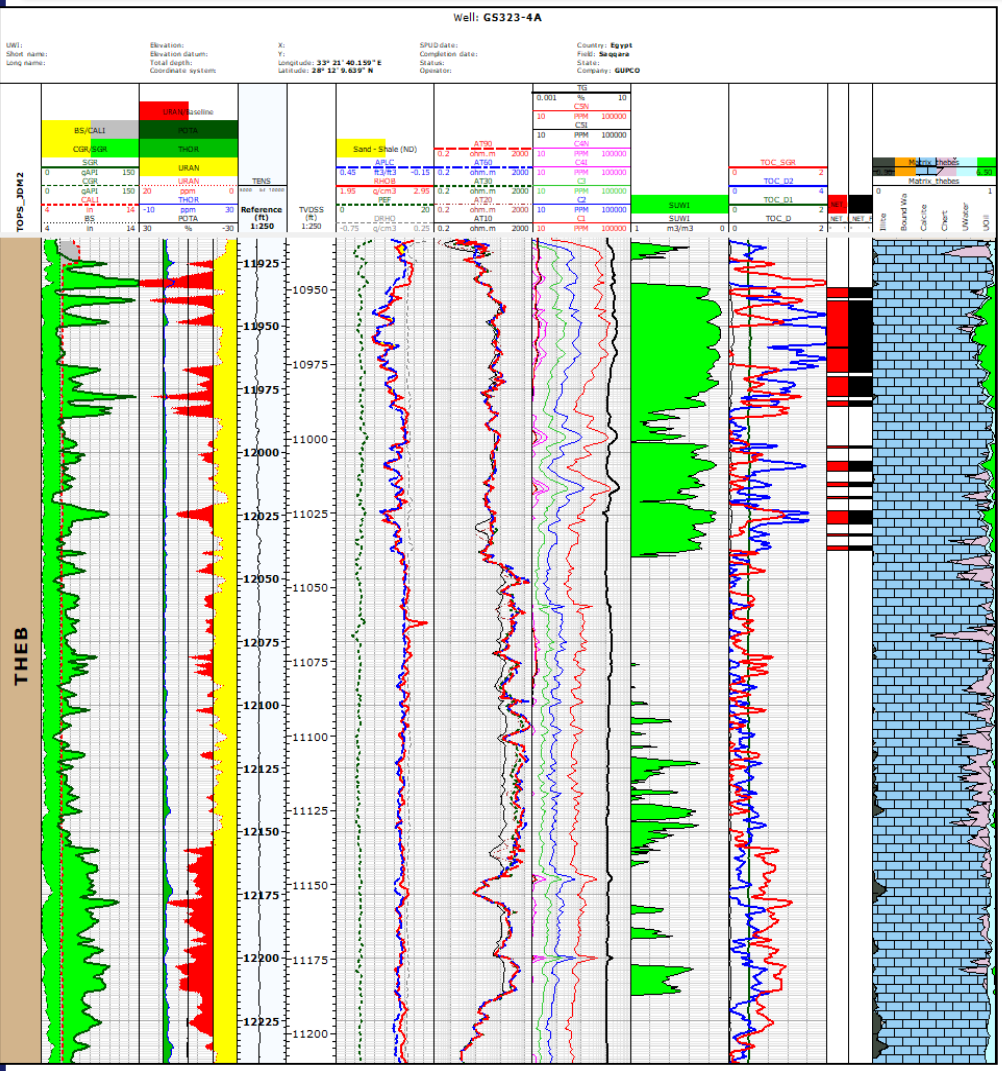






- The Morgan accommodation zone characterized by dense fracture systems in the brittle rocks of the Pre-Miocene section due to blocks dip flipping between Central and south provinces of GOS.
- GPC & Gupco produced commercial oil from this accommodation zone from the Eocene and upper senonian sections.

Petrophysical Parameters

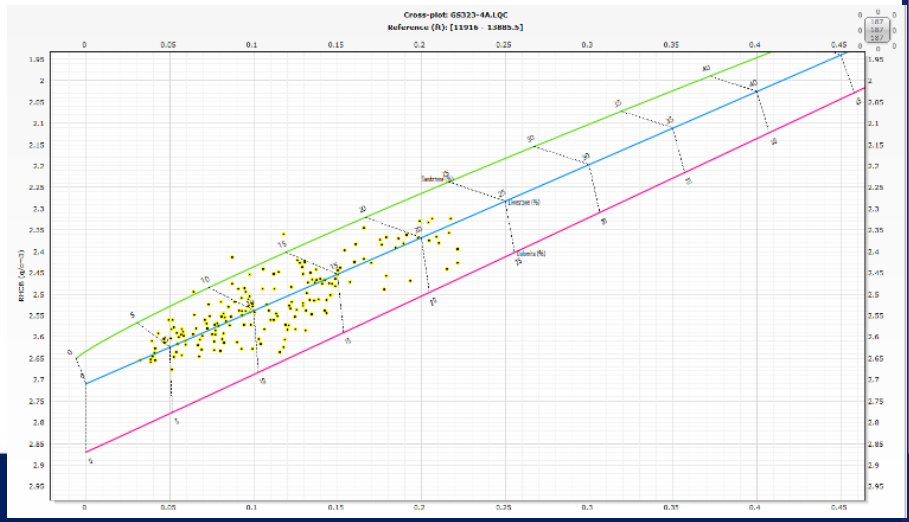


RW	0.022
m	2.2
n	2.5

average chloride (CL-) 70000 ppm

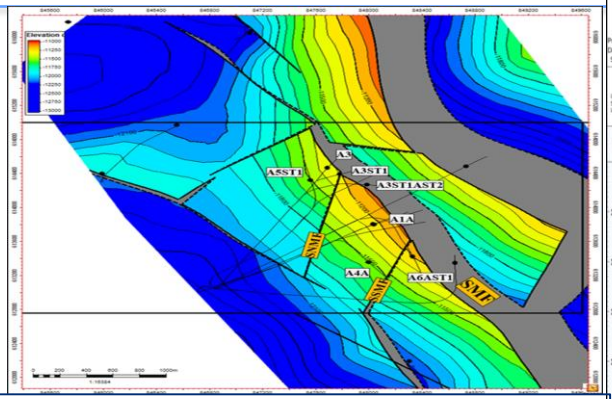
Rw = 0.02 ohm-m @ 260 F

Well	Flag Name	Gross	Net	Av_Porosity	Av_Water Saturation
GS323-4A	RES	1969.5	58	0.13	0.15
GS323-4A	PAY	1969.5	58	0.13	0.15



Saq-A4 Thebes Success Story
(Reservoir Engineering)

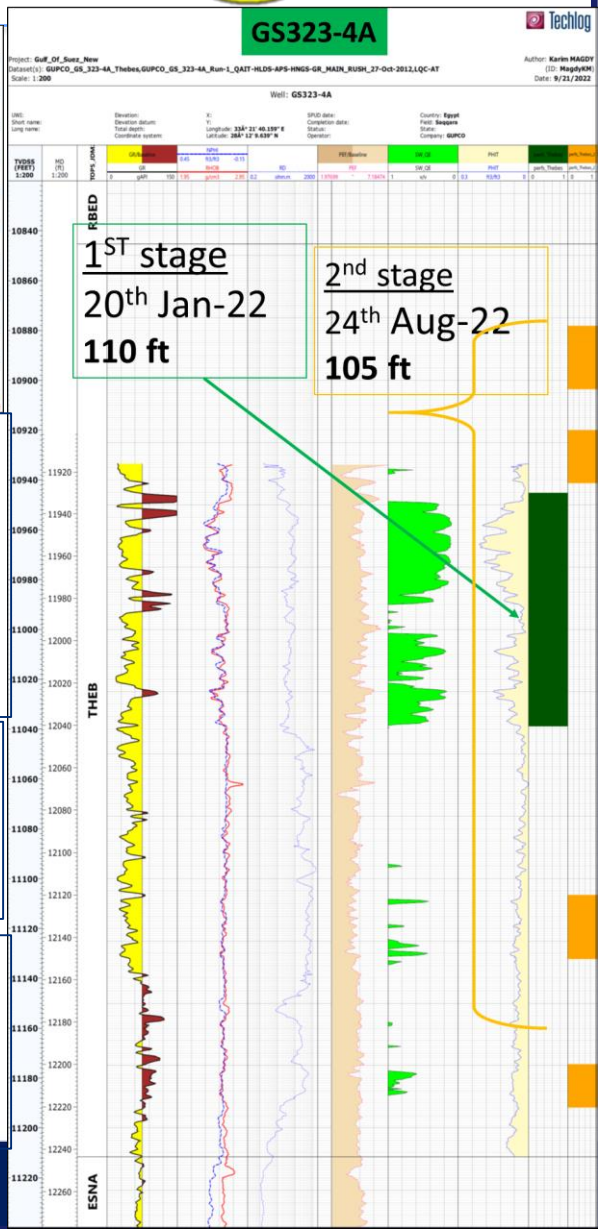
Discussion
- The subject well was completed in Dec. 2012 as a Nezzazat producer.
- On Jun., 2019, The well was worked-over to change the scaled tubing string
- Due to operational problems during the work-over the well P.I had significantly dropped in Nezzazat with difficult possibility to restore it.



Justifications for Thebes
- While drilling Thebes, mud gases increase and noticed while logging, increasing in porosity up to 14% corresponding to increase in resistivity reading up to 100 Ohm.m with decreasing in uranium concentration which reflect presence of reservoir fluid (Not source rock).
- The petro physical evaluation for Thebes reservoir showing +/- 110 ft net pay with average porosity 14% and water saturation 21%.

Recommendations
- Bottom intervals were isolated by setting inflatable plug at 12,600' ORKB capped with 200 ft of cement as per DOS using CTU.
- Perforate the 1st stage higher quality Thebes (110') then make Acid
- Perforate the 2nd stage lower quality Thebes (105') then make Acid

Results
- In the first stage ,Thebes started with 300 BOPD Gain then acidized a month after with oil rate increase to 500 BOPD.
- The oil rate dropped to 300 BOPD then after 2nd stage perforation and acidizing Oil rate increased to 500 BOPD



Well Saq-A4 Acid Story

Brief history

- The subject well was completed in Dec. 2012 as a Nezzazat producer however due to bad cement job the well had produced form Nubia and Nezzazat.
- Due to hard scale deposition that results from commingle production of two different water compositions (are not compatible)
- Isolation using inflatable plug had Benn done using CTU to isolate Nezzazat and recomplete the well as Thebes

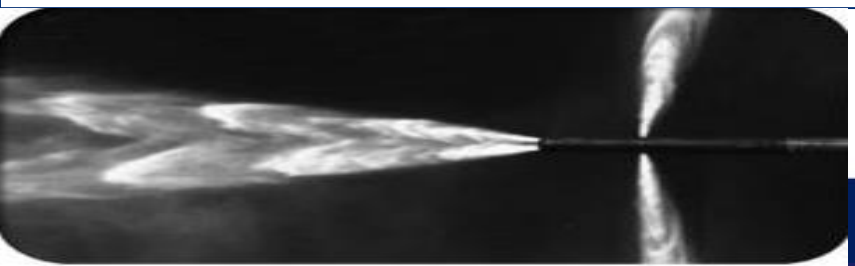
Sequence of events

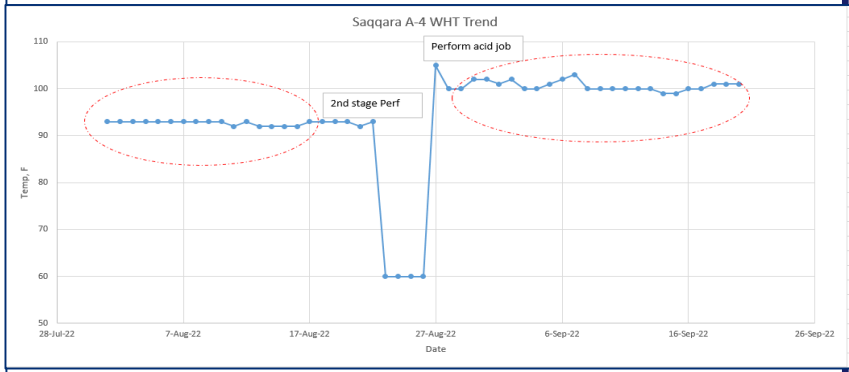
- The well has been initially perforated in Thebes then leave the well to produce without acid (+/- 250 BFPD and traces water cut)
- Proceed with acid job but some operational problem has been raised leading that the job was not completely efficient, however the liquid rate for the well has increased to +/- 350 BFPD with traces water cut.

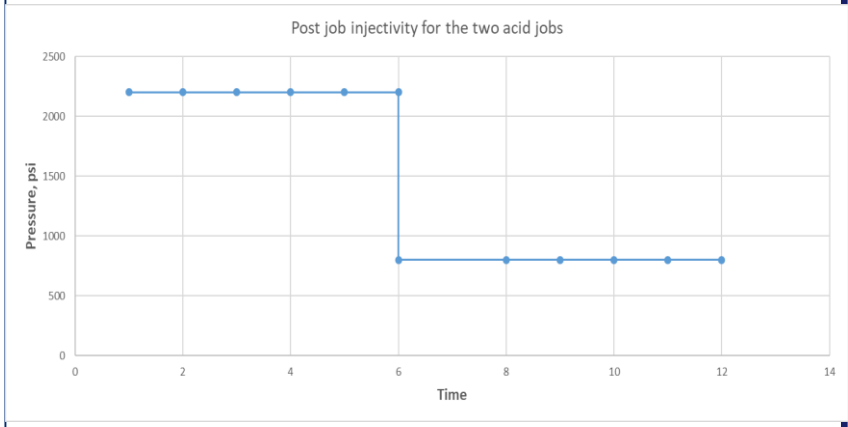
- The well rate dropped to 300 BOPD thus Additional 105 ft had been added followed directly with acid stimulation but with modifications in the job design the well rate increased to 550 BFPD with traces water cut.

Lesson learned

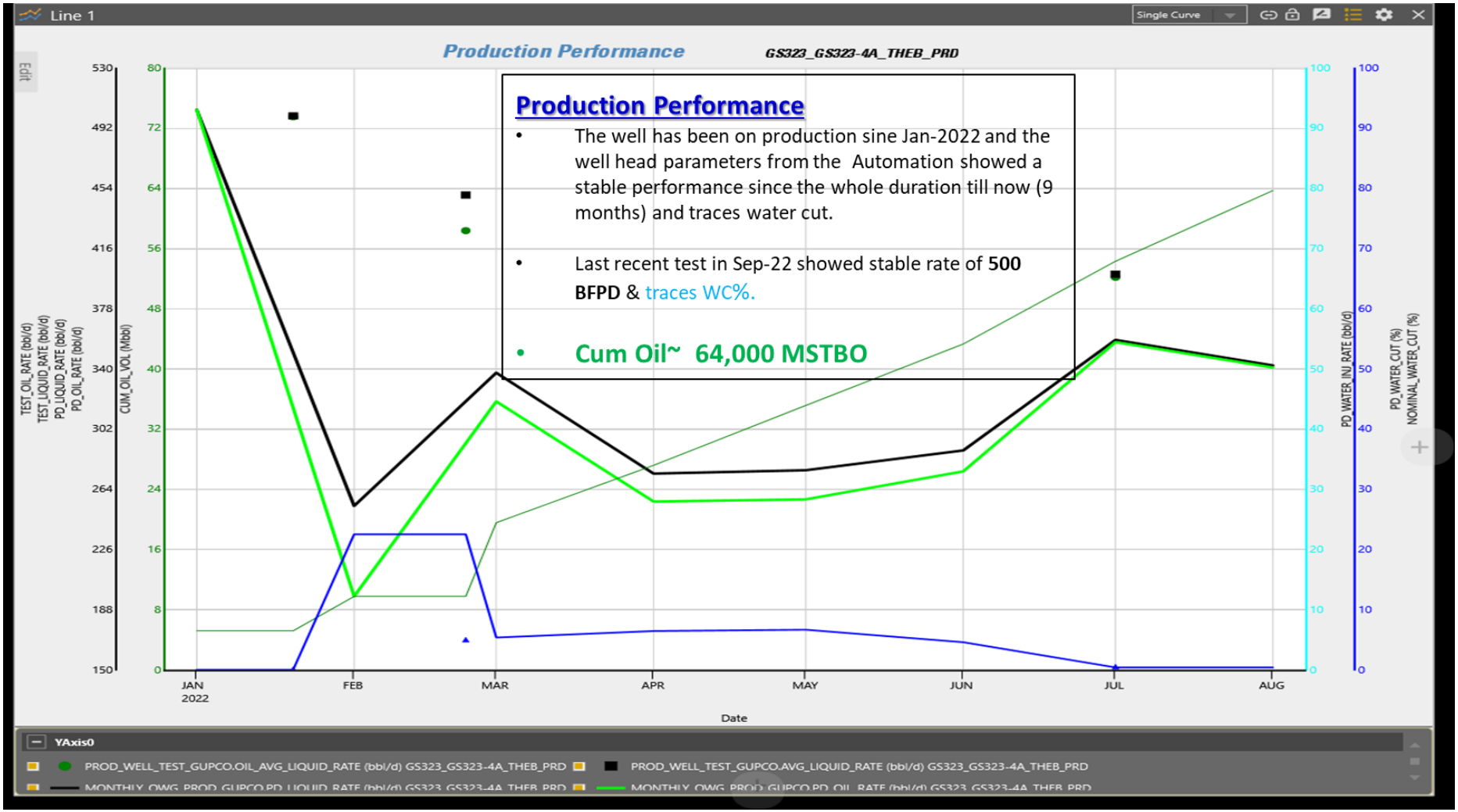
- There is no need for any organic solvents in case of using organic acids especially at high temperature as these solvents will alter wettability leading to less permeability (became very tight) .
- Optimize volumes of acid break-stages in order to create worm holes and provide continuous pumping for main acid treatment.
- Using TFA pulsonix for better acid diversion



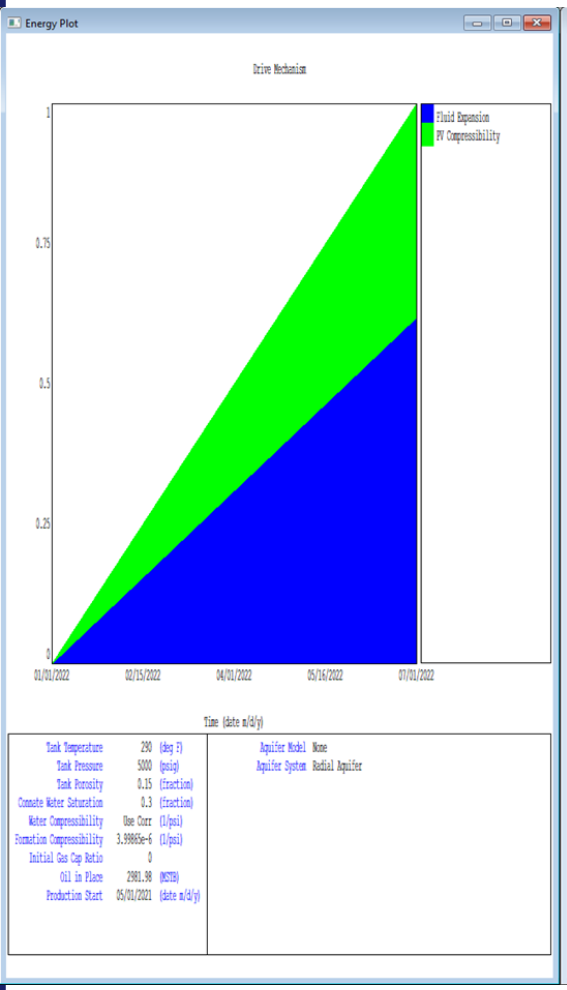


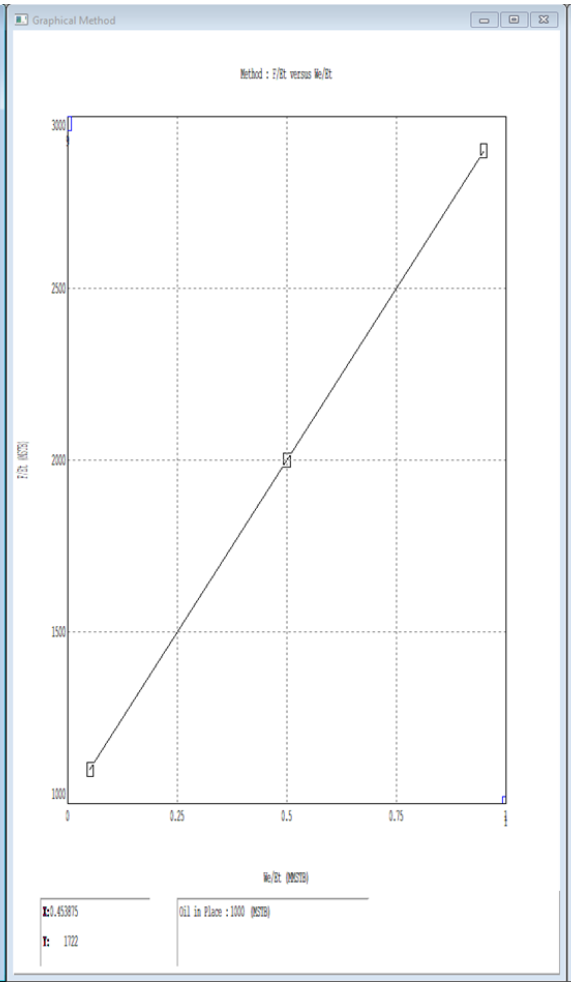


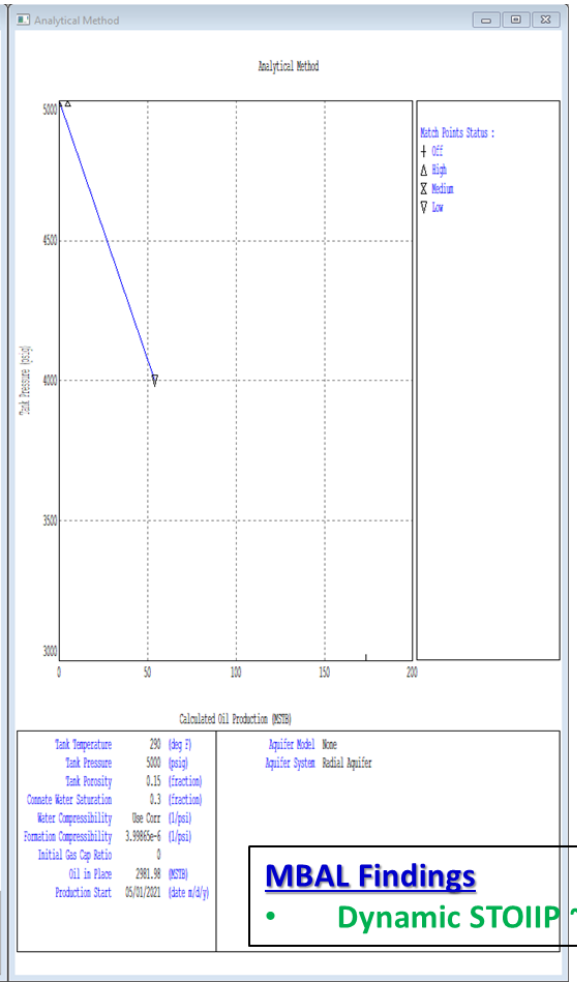
Well Saq-A4 Thebes Success Story



Well Saq-A4 Thebes MBAL







MBAL Findings

- Dynamic STOIIP ~ 3 MMSTBO

Thank You