Unconventional Resources in WD

GPC Workshop 2023

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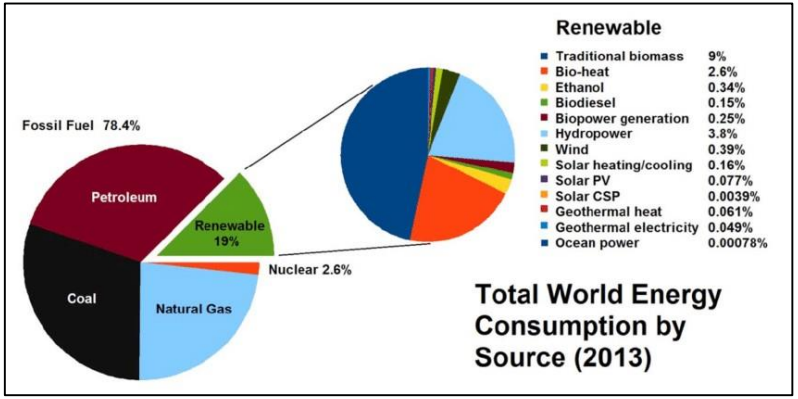
Agenda

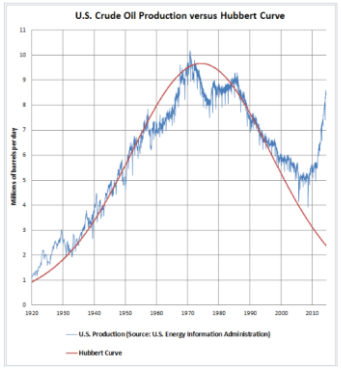
- Introduction
- WD Activities & Potentialities
- WD Unconventional Resources
- Summary
- Way Forward

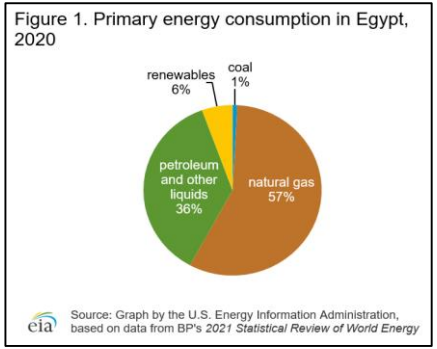
Why Unconventional Resources

1. The Conventional resources are running out and the sources of renewable energy are not enough to fill in the gaps of total energy demand
2. Growing population and income per capital
3. Modern life depends basically on electricity an/or natural gas

- Marion king Hubbert in 1956 used a curve fitting technique to correctly predict that U.S oil production would peak by 1970 The use of hydraulic fracturing & new discoveries caused US production to rebound during 2000s

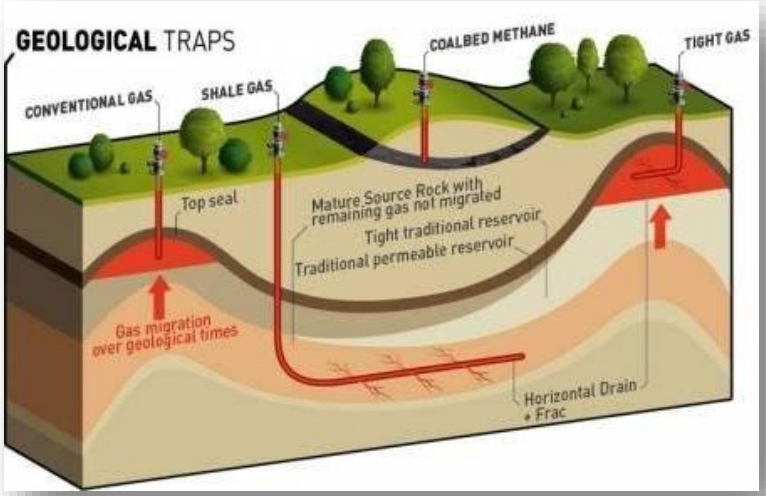






Conventional & Unconventional

Conventional	Unconventional
Contain Oil and gas can flow naturally easily	Low permeability makes the flow is not easy
Oil and gas is migrated from the source to reservoir	Oil and gas doesn't migrate
The reservoir rock e.g. • Sandstone • Fractured limestone • Fractured dolomite • Fractured basement	The reservoir rock e.g. • Shale Gas /Oil • Tight Sands • Tar Sands
Easily production by direct method	We stimulate reservoir by creating a fracture method



Western Desert Activities

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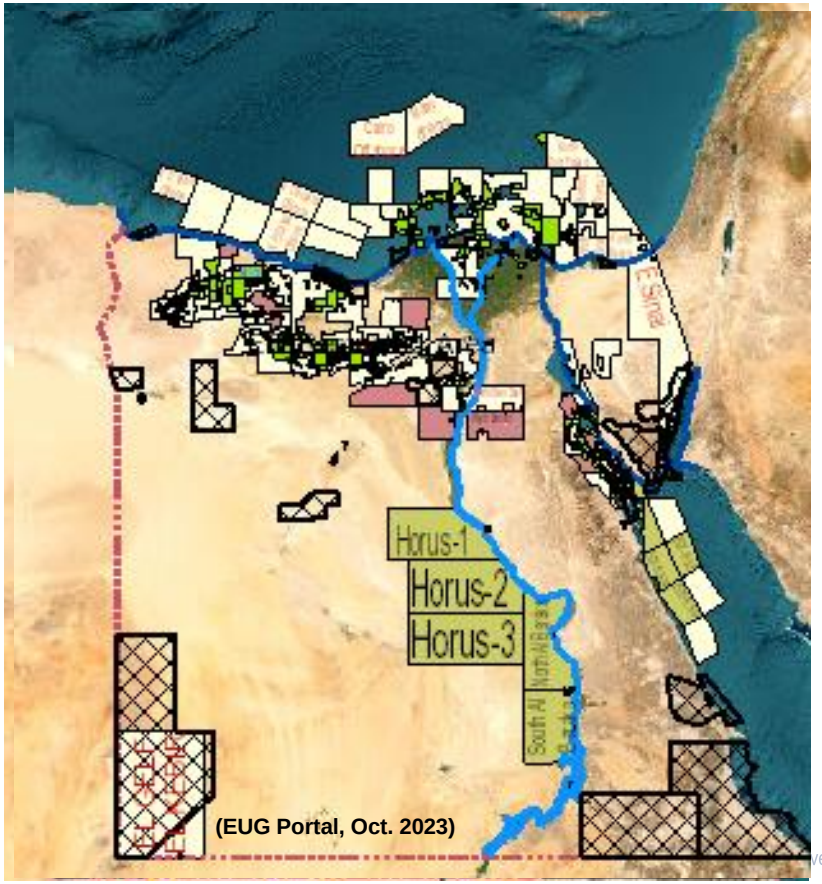
- ***Area***
  Exploration Concession ≈ 85,850 km^2
  Development leases ≈ 12,600 km^2
- ***Current Concessionaire***
  Apache, APEX, Capricorn, Cheiron, Enpedco, Energean, GPC, HBSI, IEOC, IPR, Kuwait Energy, Naftogas, North Petroleum, NPC, Sahara, Sipetrol, Tharwa, Transglobe, United Energy
- ***Data***
  - 71,000 km^2 of 3D seismic (169 surveys)
  - Thousands of kilometers of 2D seismic lines
  - More than 6,700 Wells
- ***Basins***
  Abu Al Gharadig, Matruh, Alamein, Gindi, Beni Suif,
  Faghur ,Shoshan , KomOmbo and Siwa
- ***Targets***
  Tertiary, Cretaceous, Jurassic and Paleozoic
  (Depth range 1000m to 6000m)
- International digital bid round for EGPC & GANOPE for Oil and Gas include 23 exploration blocks in Gulf of Suez , Eastern Desert ,Western Desert & Red Sea through Eug platform



Western Desert Potentialities

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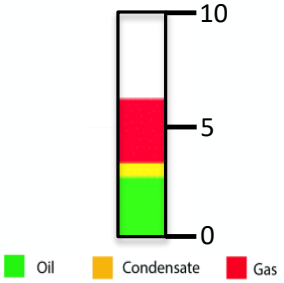
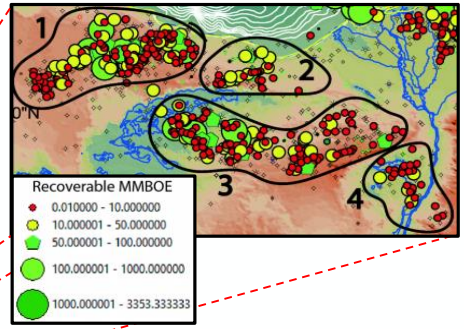
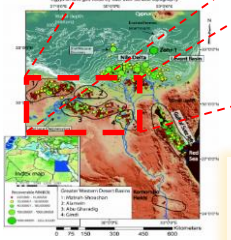
Found volumes
More than 6.5 Billion BOE

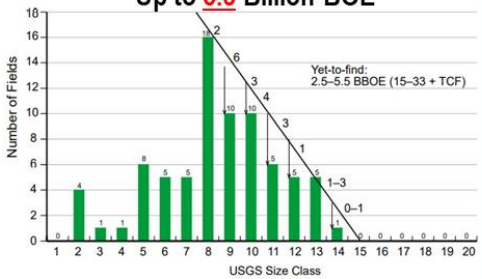


Big Discoveries
Up to 1 Billion BOE Recoverable/field

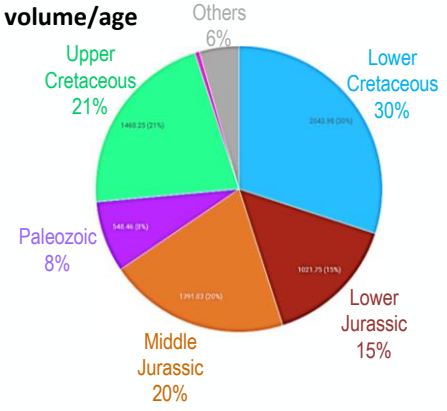


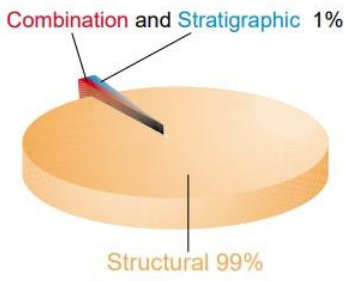


Yet-to-find volumes
Up to 5.5 Billion BOE



Percentage of Recoverable volume/age





Combination and Stratigraphic traps are extremely under-explored

261,000 STB Oil/day
17,800 STB Cond./day
800 MMscf/day

(EUG Portal, Sept. 2023)

Paleozoic and Jurassic still underexplored
(John Dolson, The Geology Of Egypt 2020)

WD Source Rocks

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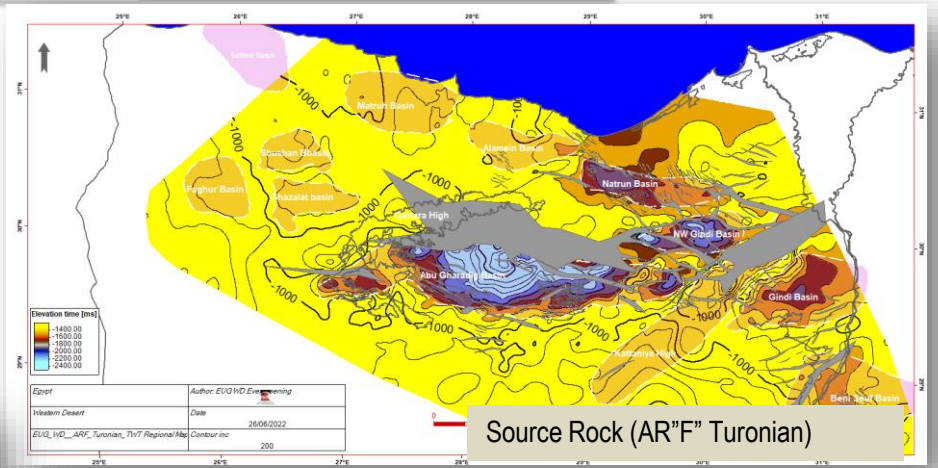
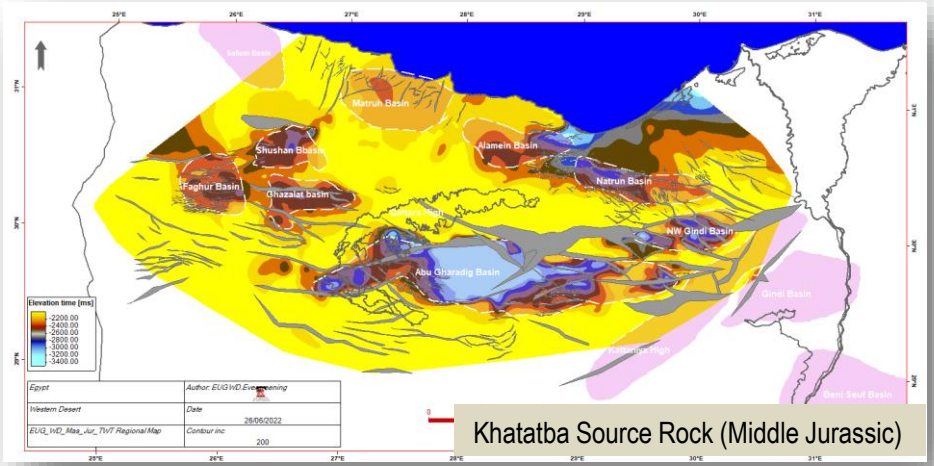
AR"F" Turonian

- Has (TOC) values between 1.6 and 6.63 wt%
- According to the organo facies of ARF which is type 2 it need around 3000 m and the R0 from 0.6 to 0.7 to be in oil window
- Distributed over Abu al Gharadig ,Alamien ,NW Gindi, Gindi and Beni Seuf basins



Source Rock (AR"F" Turonian)



Khatatba Source Rock (Middle Jurassic)

The Khatatba Shale

- Has (TOC) values between 1.6 and 6.63 wt%Thermal maturity of Ro 1.0% to 1.3%
- Distributed over Abu Gharadig, Alamein, Natrun and Shoushan-Matruh

Upper Cretaceous Discoveries

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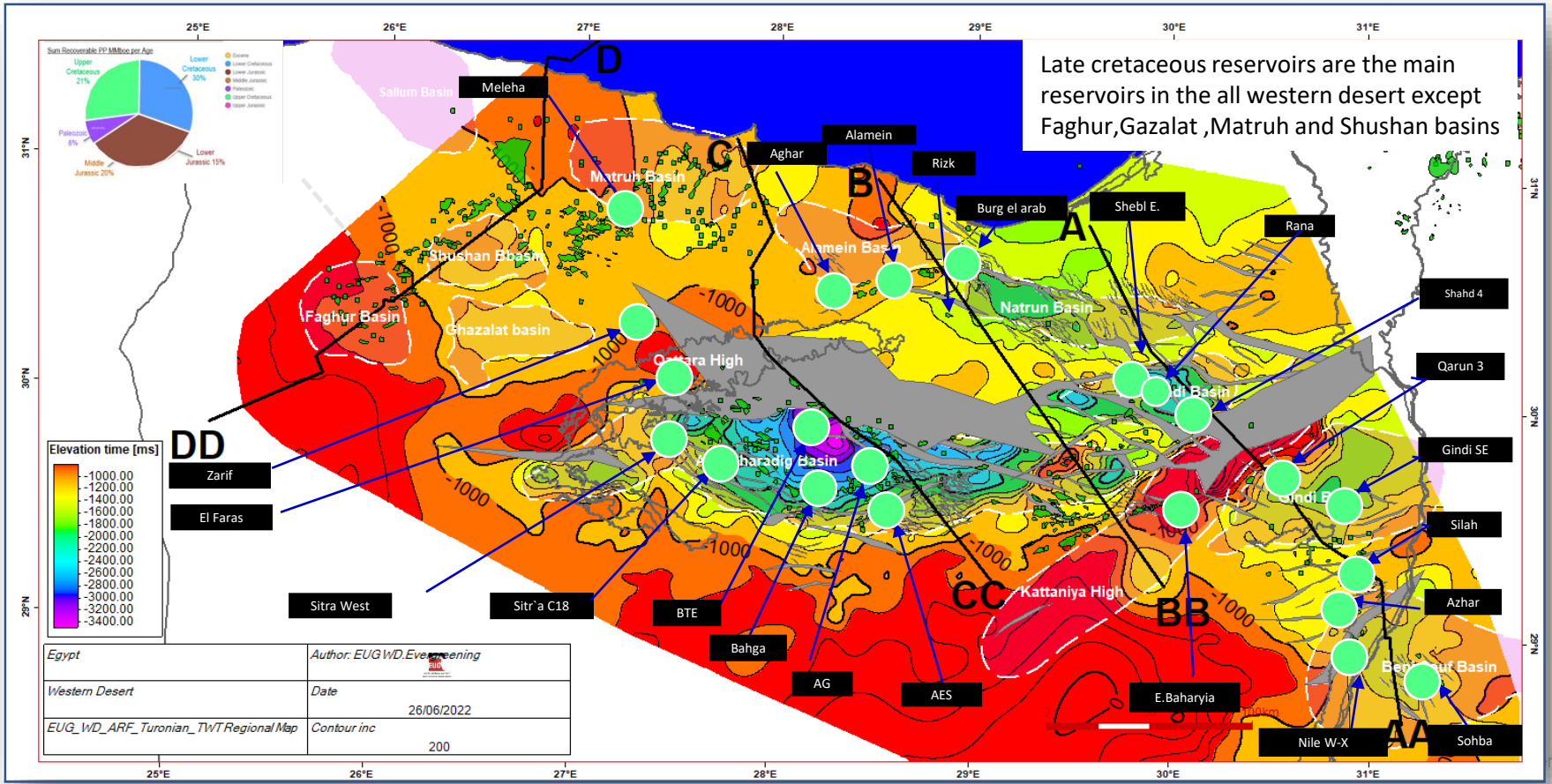

Lower Cretaceous Discoveries

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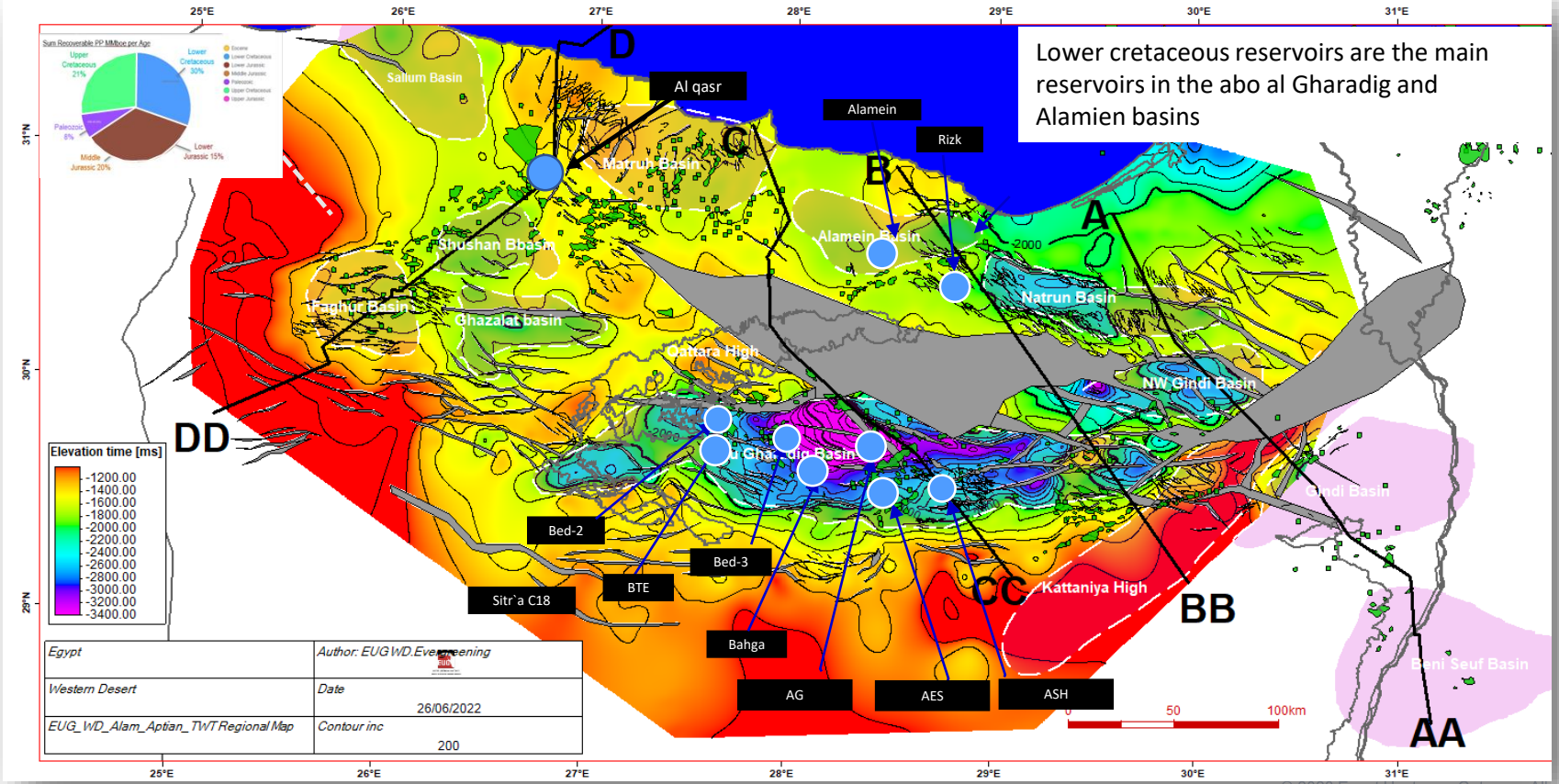

Jurassic and Paleozoic Discoveries

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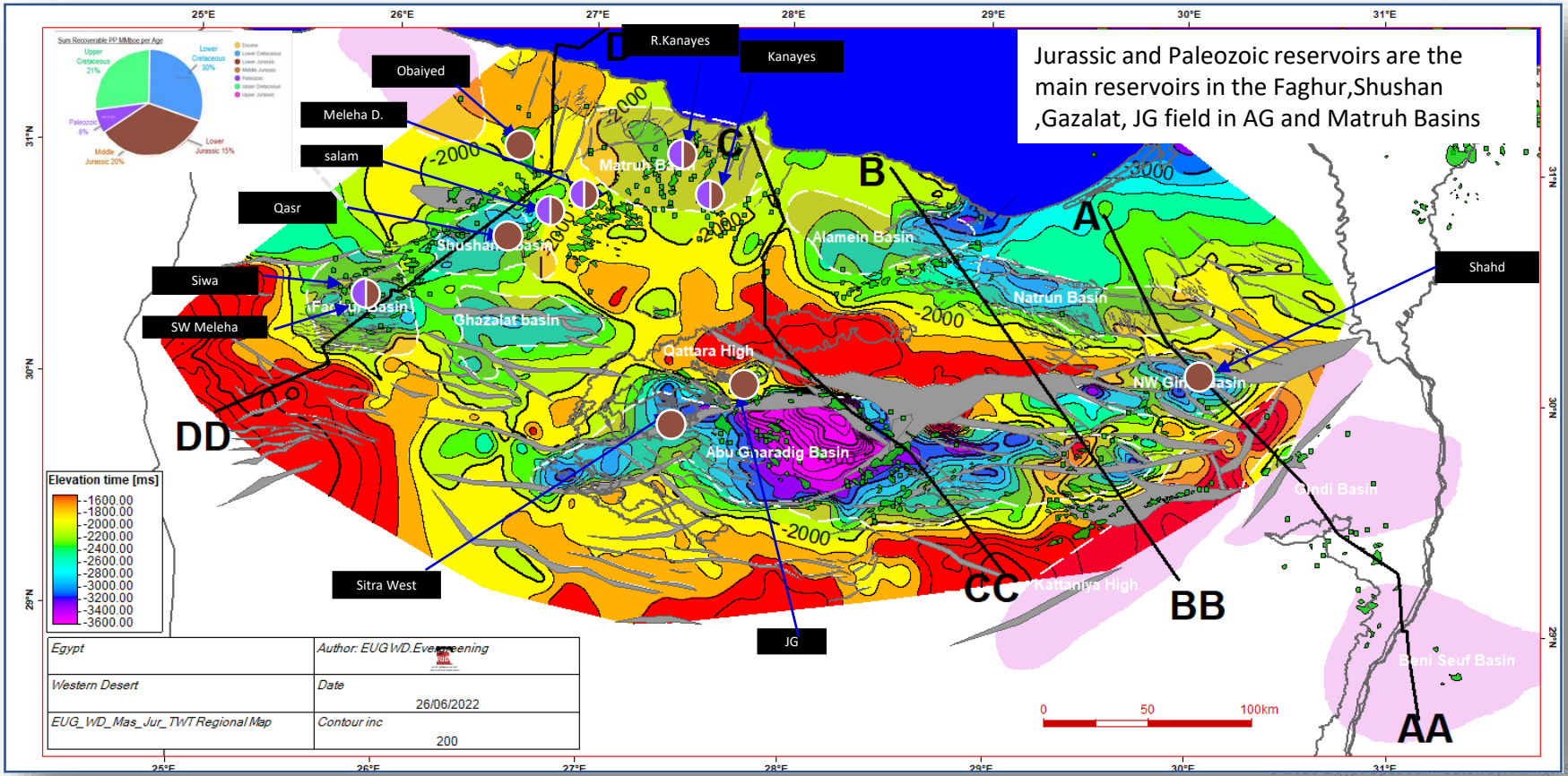
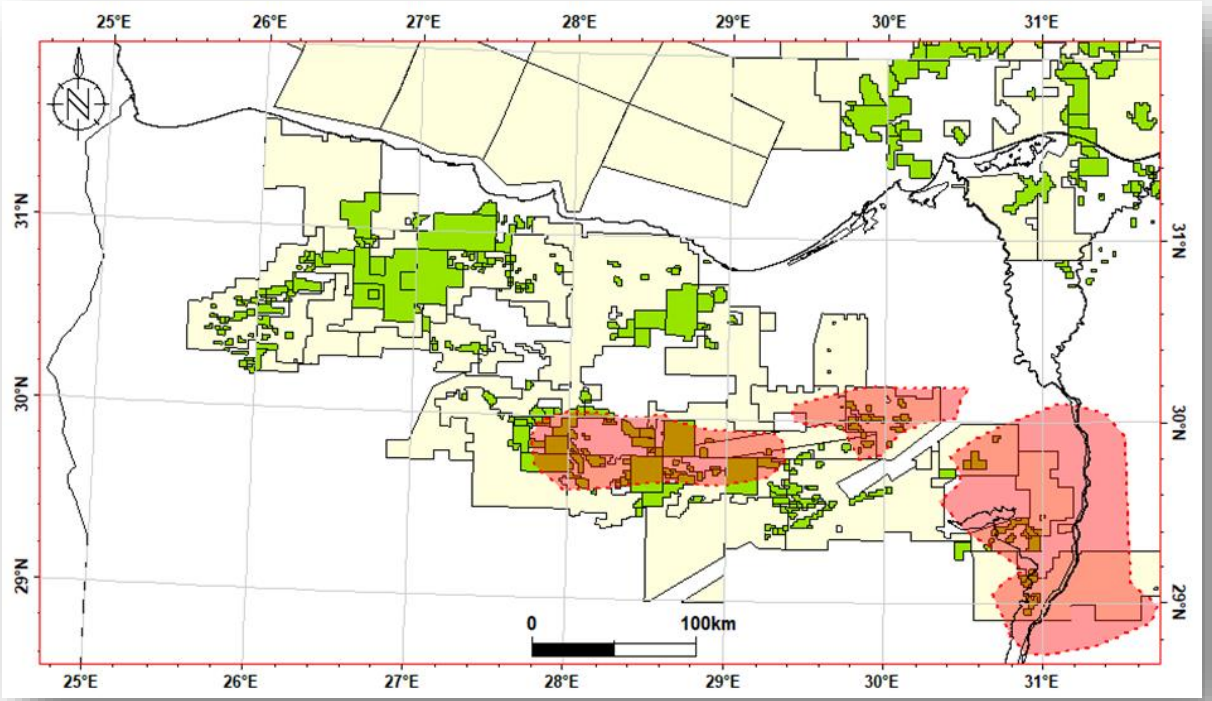


Abu Roash “F” (Cret.) Ucon.Reservoir

- The red polygon represents areas where Abu Roash ”F” is expected to be mature and can be treated as unconventional reservoir
- Proven to be working as unconventional reservoir in BED-1
- Generally, the results of geochemical and petrophysical evaluation show that ARF has good reservoir quality comparing with the most of commercially developed unconventional resources all over the world



A/R “F” (BED Area) Example # 1

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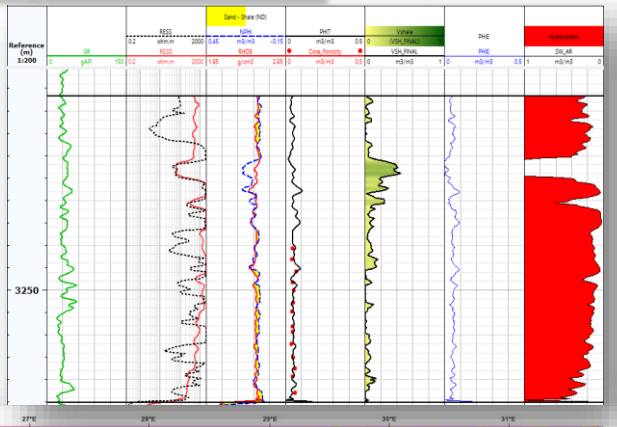
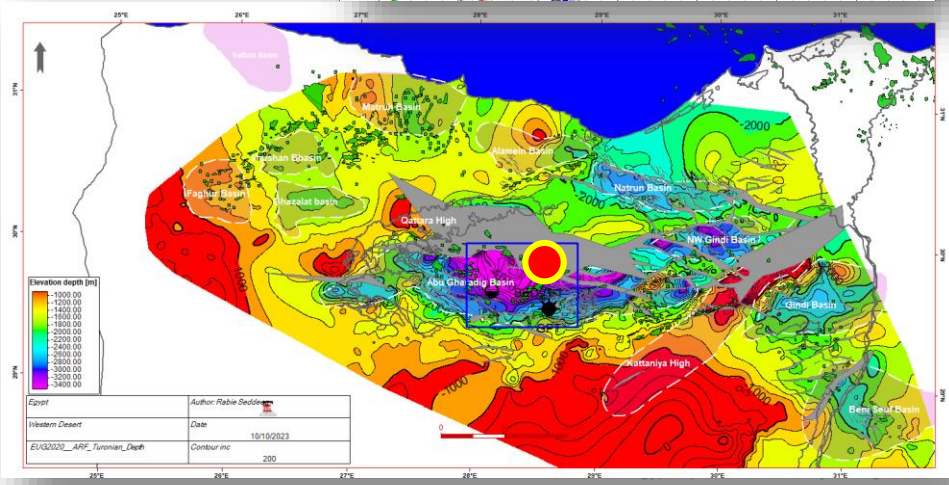
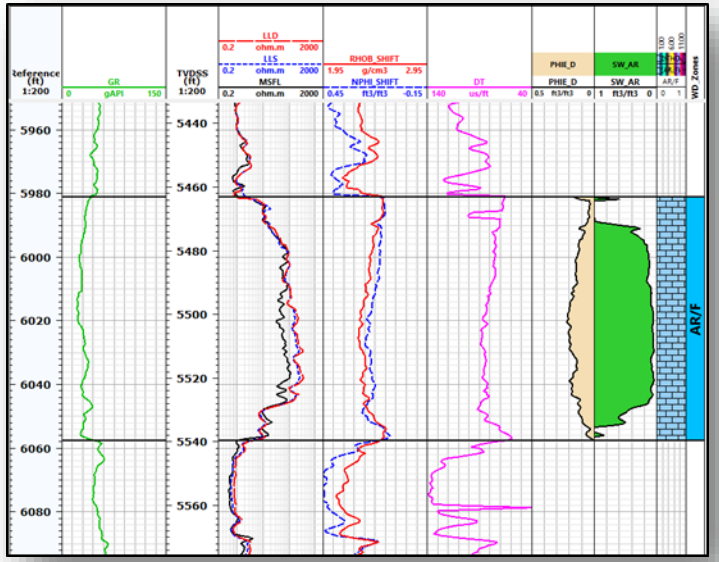
- Low Permeability up to 0.1 md
- Low porosity after correction with core porosity (Correction based on TOC and grain density).
- High fractured reservoir based on formation micro scanner image.
- Oil Shows and gas shows
- Clear separation between deep resistivity and flushed resistivity indicate presence of fractures.
- The Production is proved depending on the fracture support rather than matrix support.

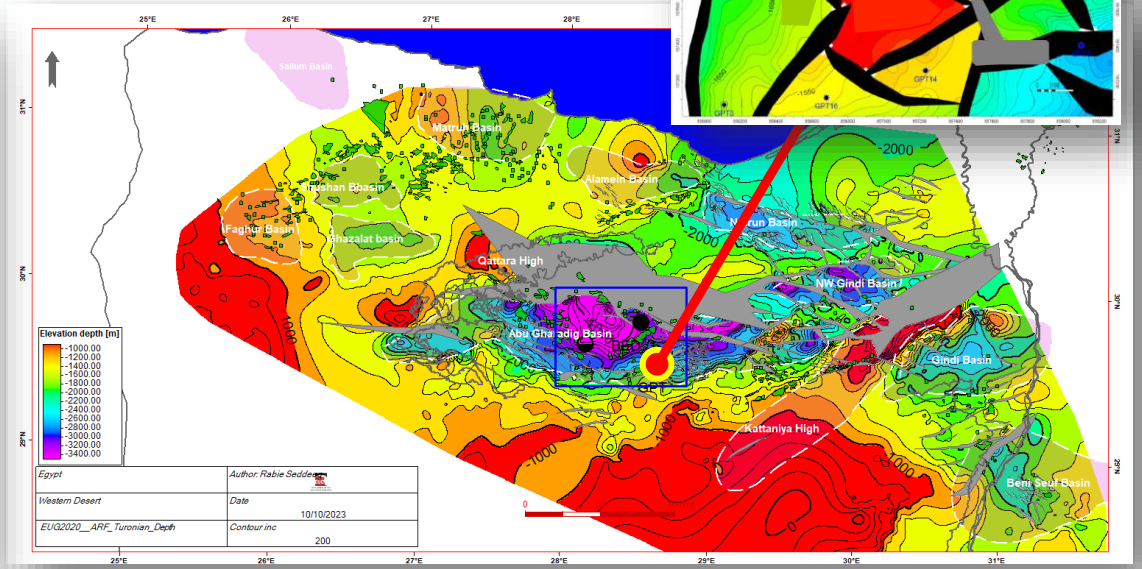




A/R “F” (GPT Area) Example #2

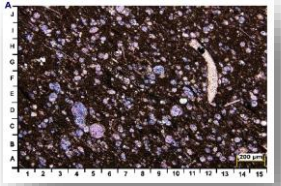
- Initial Rate: 1 MMSCFD.
- Stabilized rate: 0.75 MMSCFD
- Added Reserve: 800 MMSCFD

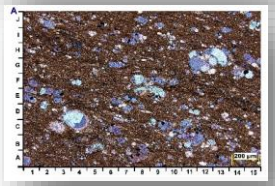


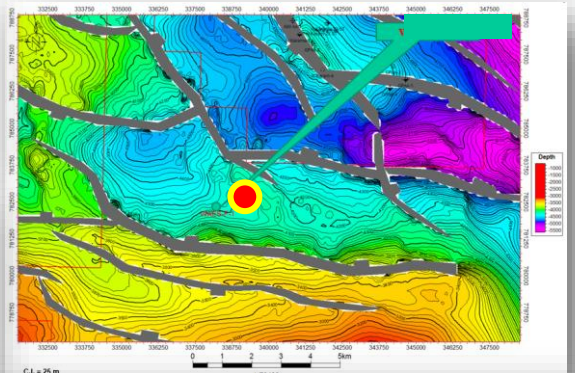


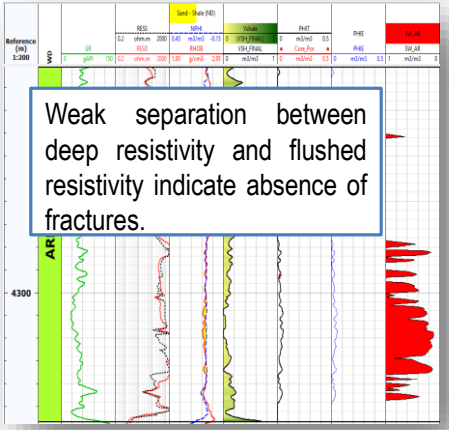
A/R “F” (WAES Area)) Example #3

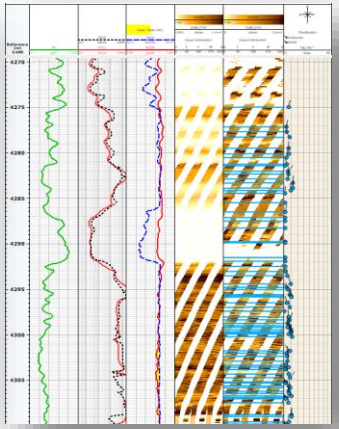
- This well drilled to ARF at 4220 TVDSS outside closure.
- Low matrix permeability.
- Very low porosity up to 4 % (corrected based on TOC and grain density).
- No fractured encountered from BHI.
- Vitrinite reflectance from 0.82 to 0.9 %.
- Tested with no flow due to absence of fractures

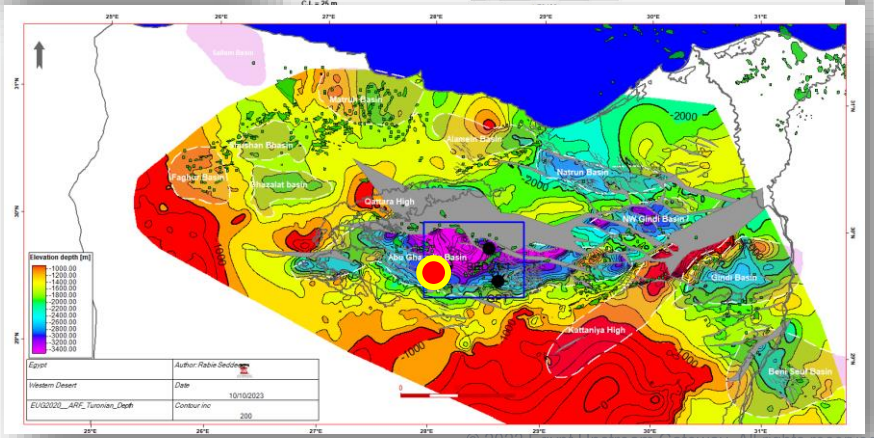












A/R “F” (Gindi Area) Example #4

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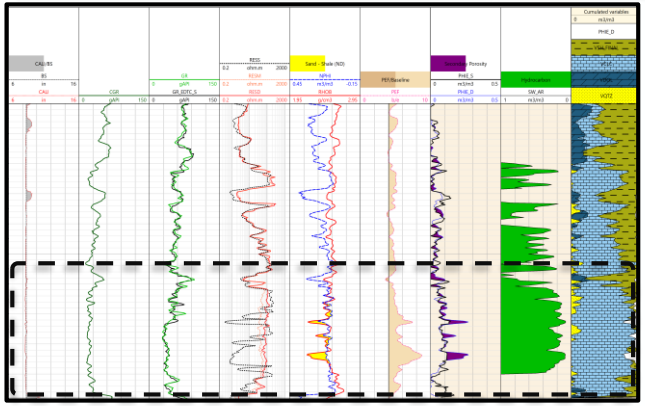
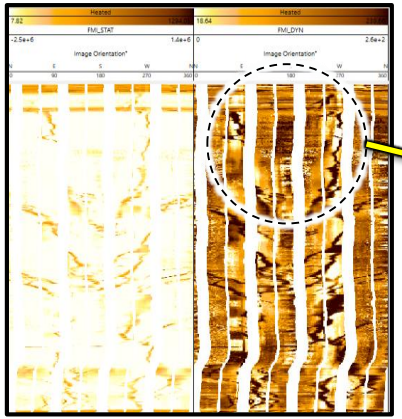
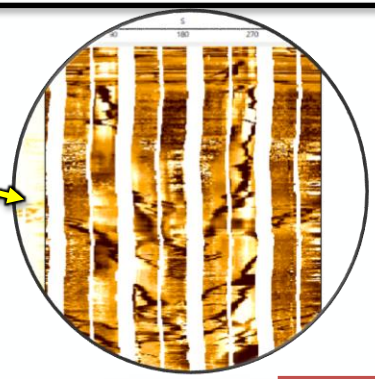
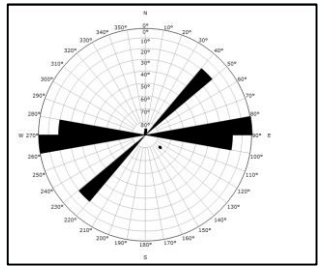
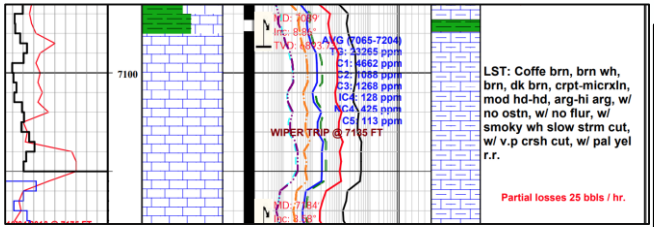




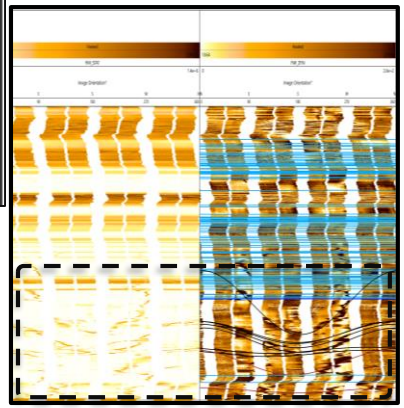


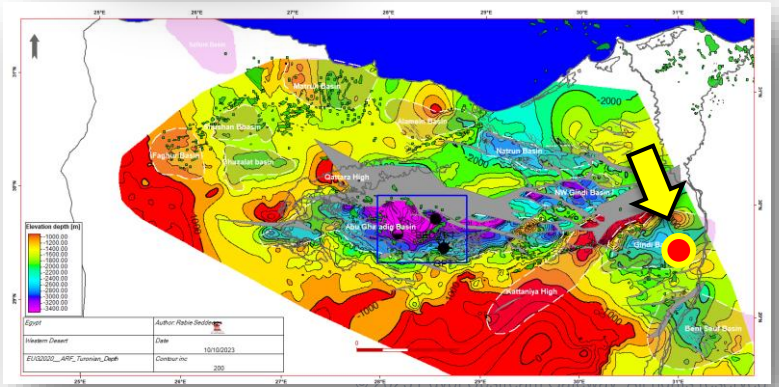


AVG.POR	AVG.SW	Possible Net pay
10 %	12 %	32 ft



Oil and Gas shows

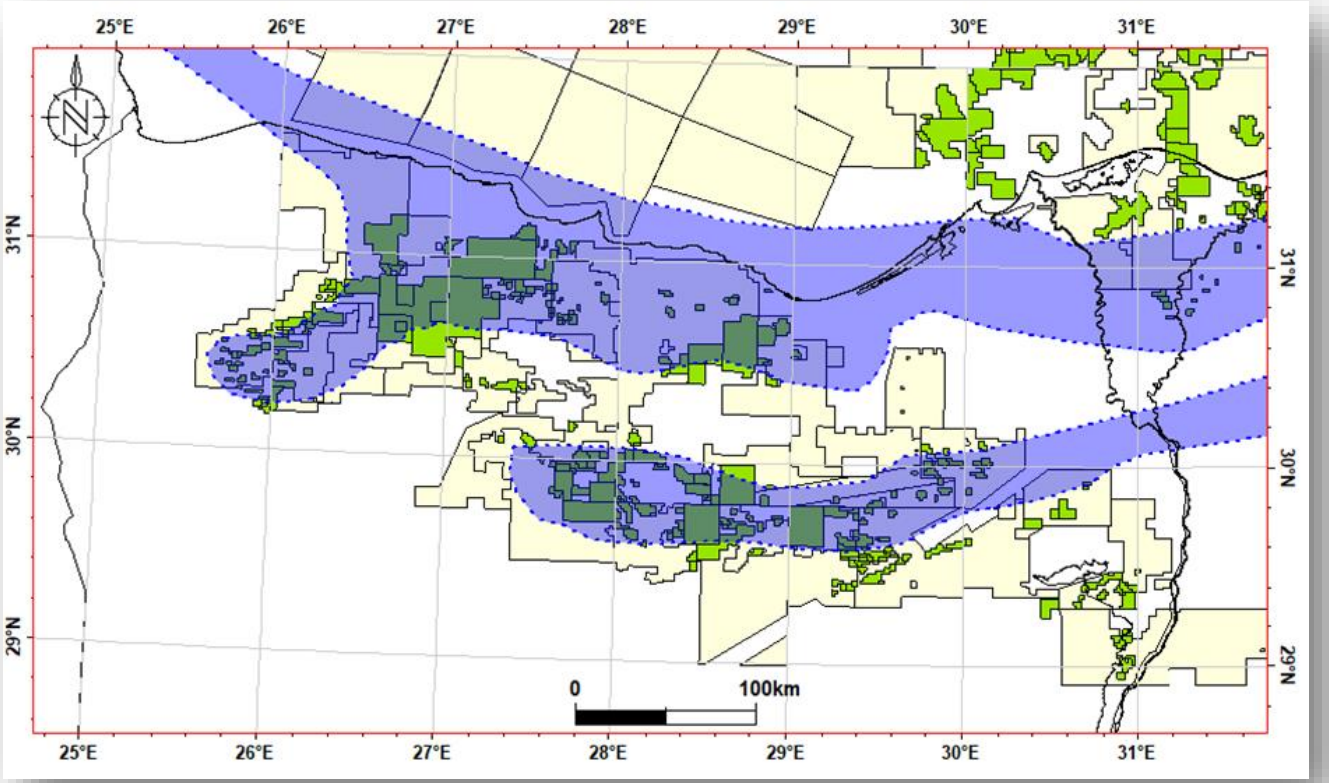




- Fractured potential zone with high resistivity separation & several conductive fractures.
- Two sets of conductive fractures encountered in this well: 1- NW-SE 2- E-W

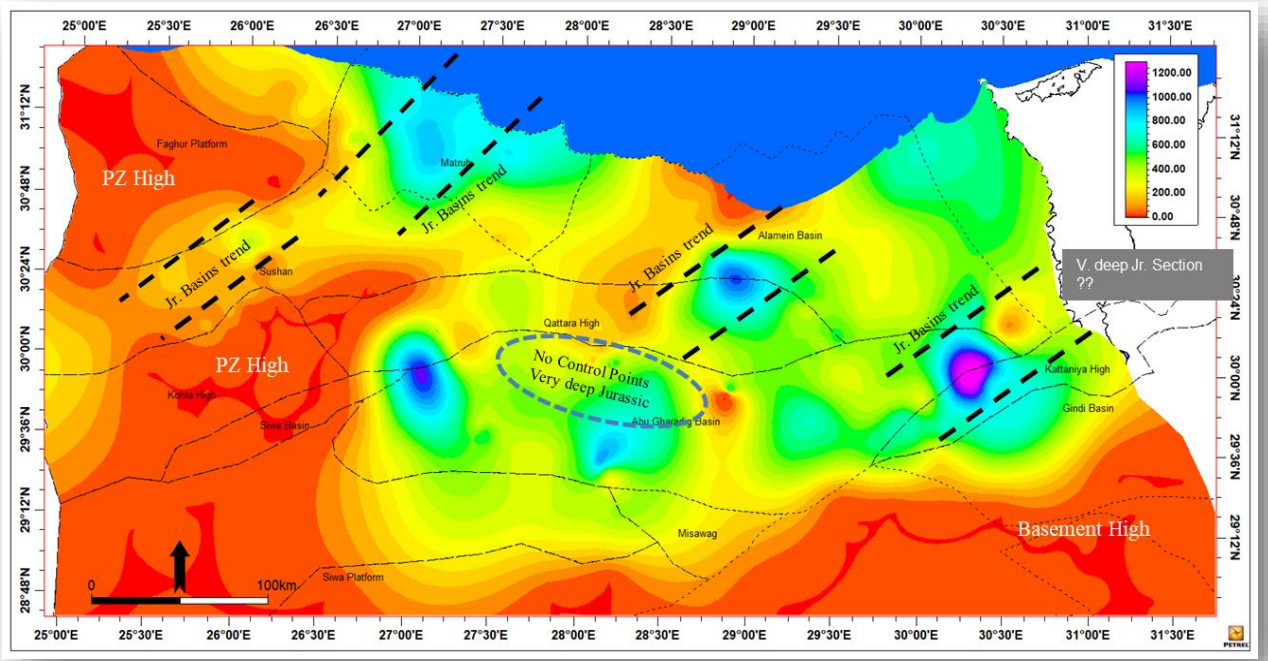
Khatatba shale (M.Jurassic) Ucon.Reservoir

- The blue polygon represents areas where Khatatba shale rock is expected to be mature work as unconventional reservoir
- Oil-prone in the eastern part and gas-prone in the western part
- Tested as unconventional reservoir



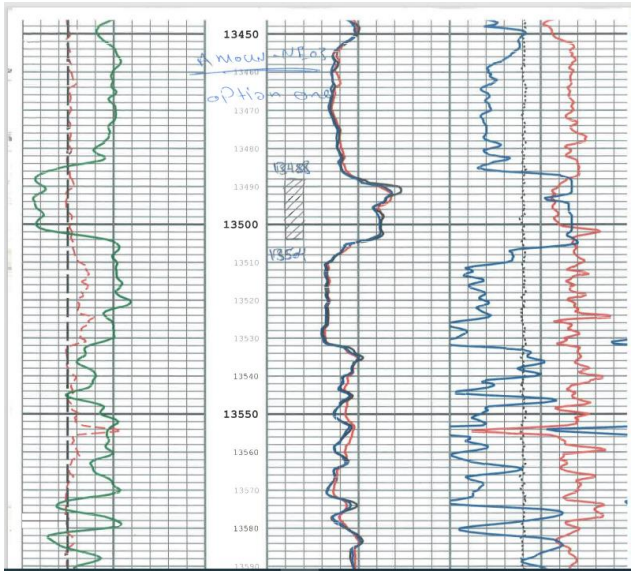
M. Jur. Khatatba Growth thickness Map

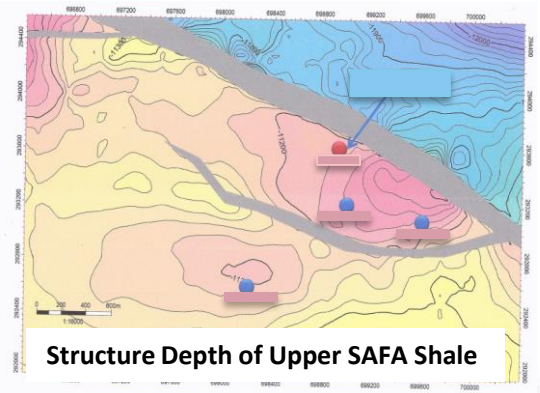
- The thickness of Khatatba Formation ranges from 200 m to over 1200 m
- The type section of the upper Safa Mbr. ranges in thickness from 80 m to 200 in Basinal area , with an estimated net pay of 50 m to 100 m (EIA)



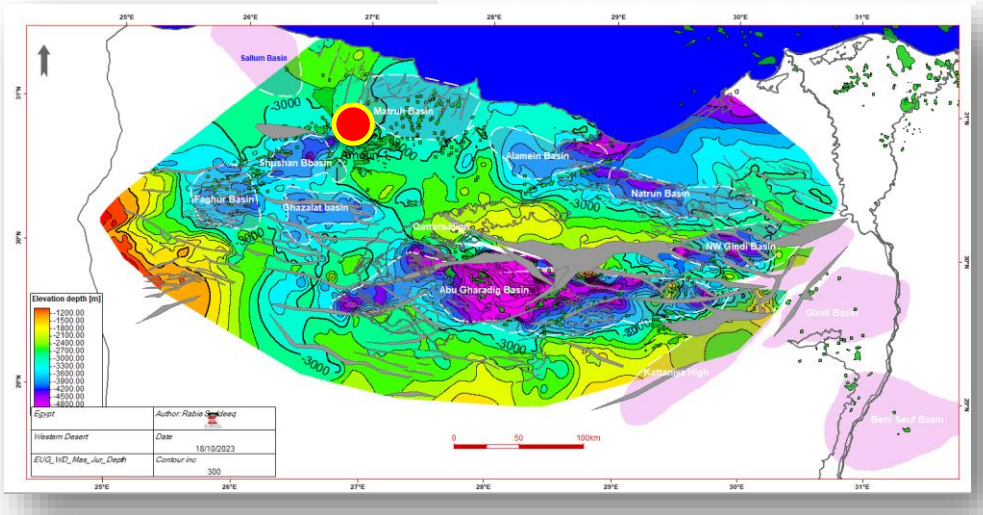
M. Jurassic Khatatba shale gas

WHFP	BFPD	WC%	BOPD	Gas, MMSCFD	Comments
20	45	90	5	0.015	Slug flow





Structure Depth of Upper SAFA Shale



Shale Gas &Oil Resources of WD

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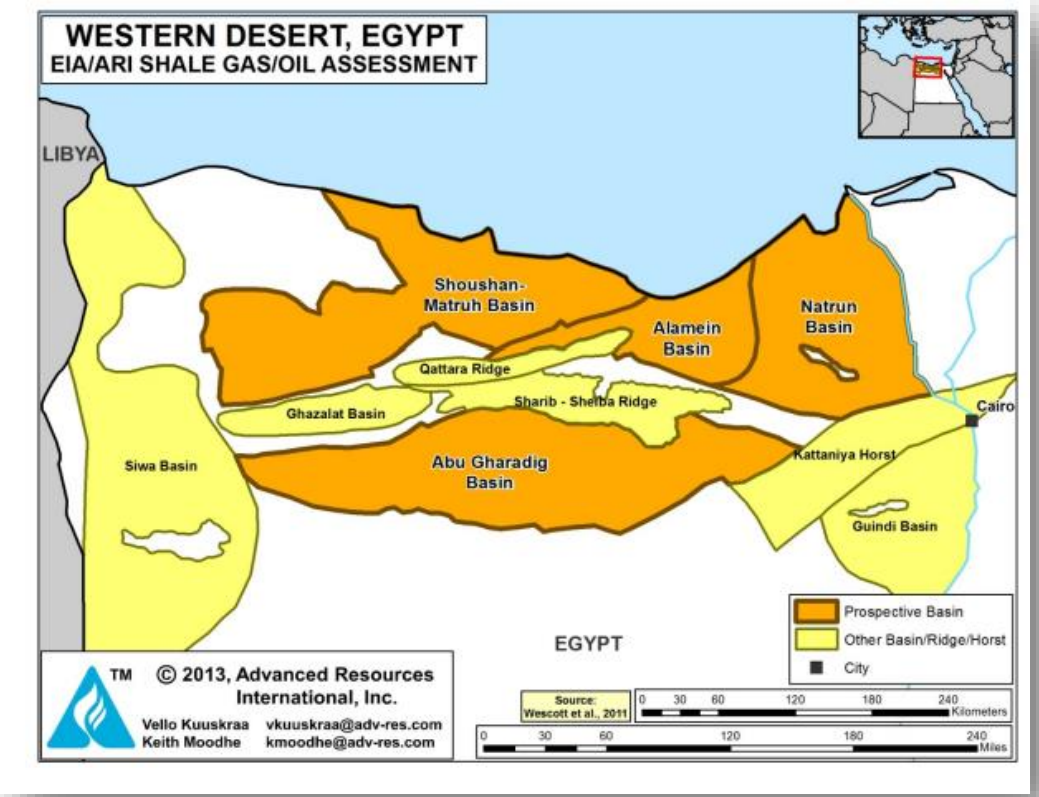
- The initial estimation of Khatatba Shale contains approximately 535 Tcf of unrisked shale gas in-place, with 100 Tcf of risked,
- The initial estimation of the Khatatba Shale contains about 114 billion barrels of unrisked shale oil in-place, with 4.6 billion barrels of risked,



Summary

- The unconventional petroleum potential can add more reserves and increase the production. .
- The first step should be to undertake larger scale studies and tests to evaluate this potential,
- determine the most appropriate technologies and procedures, before launching the development of unconventional petroleum resources.
- Unconventional oil and gas have represented a booming development of these resources in the recent years.

Way Forward

- To propose a new legal framework for unconventional resources to attract the new investors .

- Deepening technical studies to include unconventional resources in western desert ,Eastern Desert and Gulf of Suez.

- Interact with international companies internally and externally to expand the unconventional resources in Egypt.

Thank you