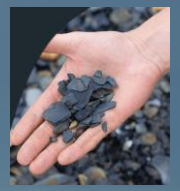
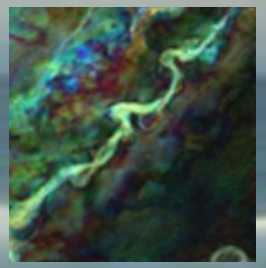
Europa Oil and Gas

Inezgane Licence Offshore Morocco
Multiple Source Rocks, Reservoirs, Seal and Big Prospects.

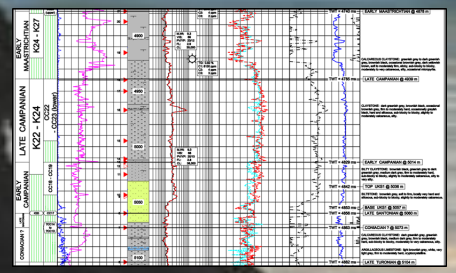
Multiple Source Rocks



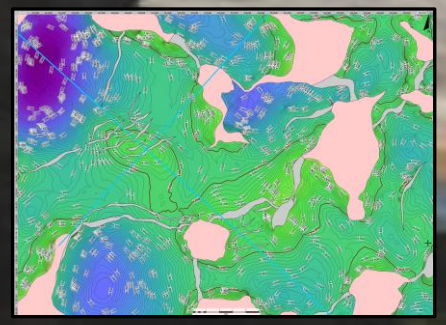
Reservoirs



Seal



Big Prospects



What's not to like?

Jamie White

Prospex at Petex 25th Nov 2021

Thanks to ONHYM for providing the data

Inezgane Licence
Offshore Morocco

Introduction

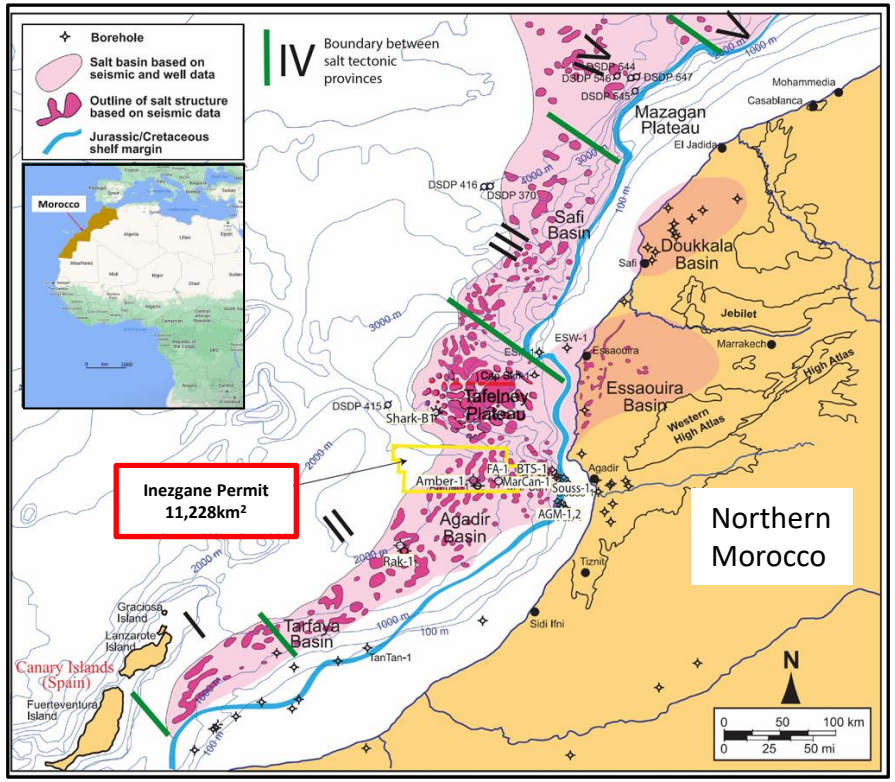
Inezgane Farm-In Opportunity – What has changed from before?

EUROPA Oil & Gas

- Data – High Quality 3D Seismic Data. Ongoing reprocessing project nearing completion.
  - 55% of licence area already covered by Pre stack depth migrated data (mainly RTM) – 6200km^2
  - 1500km^2 re-processed PreSDM data, expected end November, to extend RTM coverage
- Reservoir – Industry perception is that there are no deepwater sandstones offshore Morocco
  - Onshore analysis has revealed large quantities of Lower Cretaceous sandstone with paleocurrent directions towards the deep offshore
  - PaleoScan work has directly imaged deepwater sandstones over all the main prospects from Tertiary to Lower Cretaceous. Reservoir risk is now significantly reduced.
- Source – Presence and Maturity seen as a key risk in offshore Morocco.
  - Onshore World Class Campanian & Cenomanian-Turonian source rocks drilled on block. Albian SR drilled on block
  - Cenomanian-Turonian & Albian mature on block.
  - Short Distance migration pathways from synclines surrounding structures.
- Seal – Always considered low risk – large amounts of shale/salt in the basin
  - Ample salt and mudstone for effective side and top seal
- Structures & Volumes – Thick Lower Cretaceous stratigraphy has yet to be drilled in Morocco
  - Lower risk 4-way structures present
  - Large prospective resources in top 5 prospects across 3 different possible reservoir levels
  - Follow-up potential in multiple prospects & leads
  - Promising Chinguetti style Eocene/Miocene play currently being evaluated
- The main risks Reservoir and Source/Migration have been significantly reduced, structures are large and numerous

Inezgane Introduction

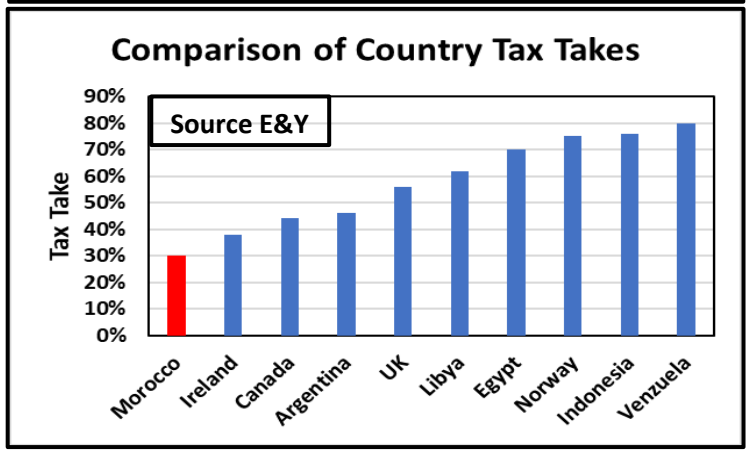
- Morocco
  - Open and welcoming to new entrants – ONHYM engaging and helpful to business needs
  - Excellent fiscal terms – low tax take
- Inezgane Licence
  - Licence commenced November 2019
  - Europa 75% equity and Operator; ONHYM 25% equity
  - Licence area 11,228 km^2
  - Water Depths 300 to 2500m Key prospects <2000m
  - Extensive high quality PSDM/RTM 3D seismic coverage
  - Highly under-explored

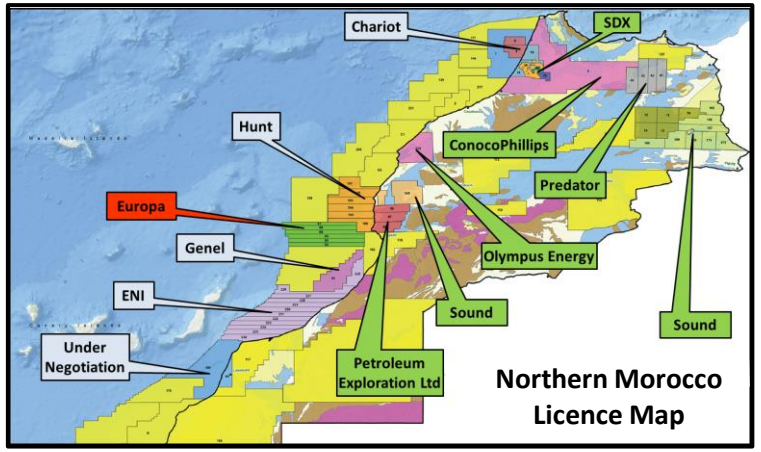


(Modified after Tari and Jabour, 2013)

FISCAL TERMS

- No rentals
- 10-year tax corporate holiday on commercial discoveries
- 10% Oil Royalty
- 5% Gas Royalty

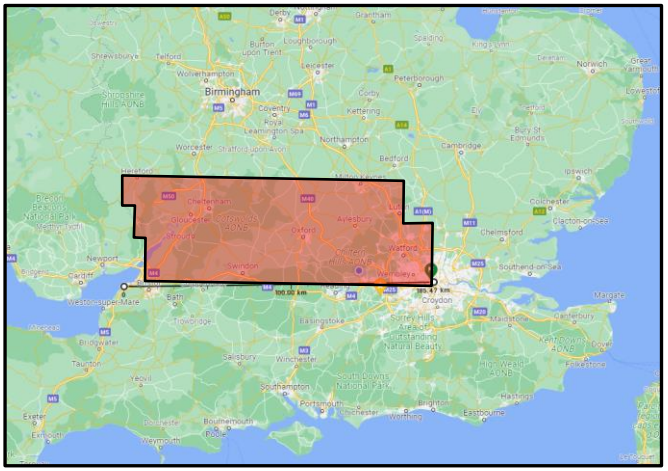




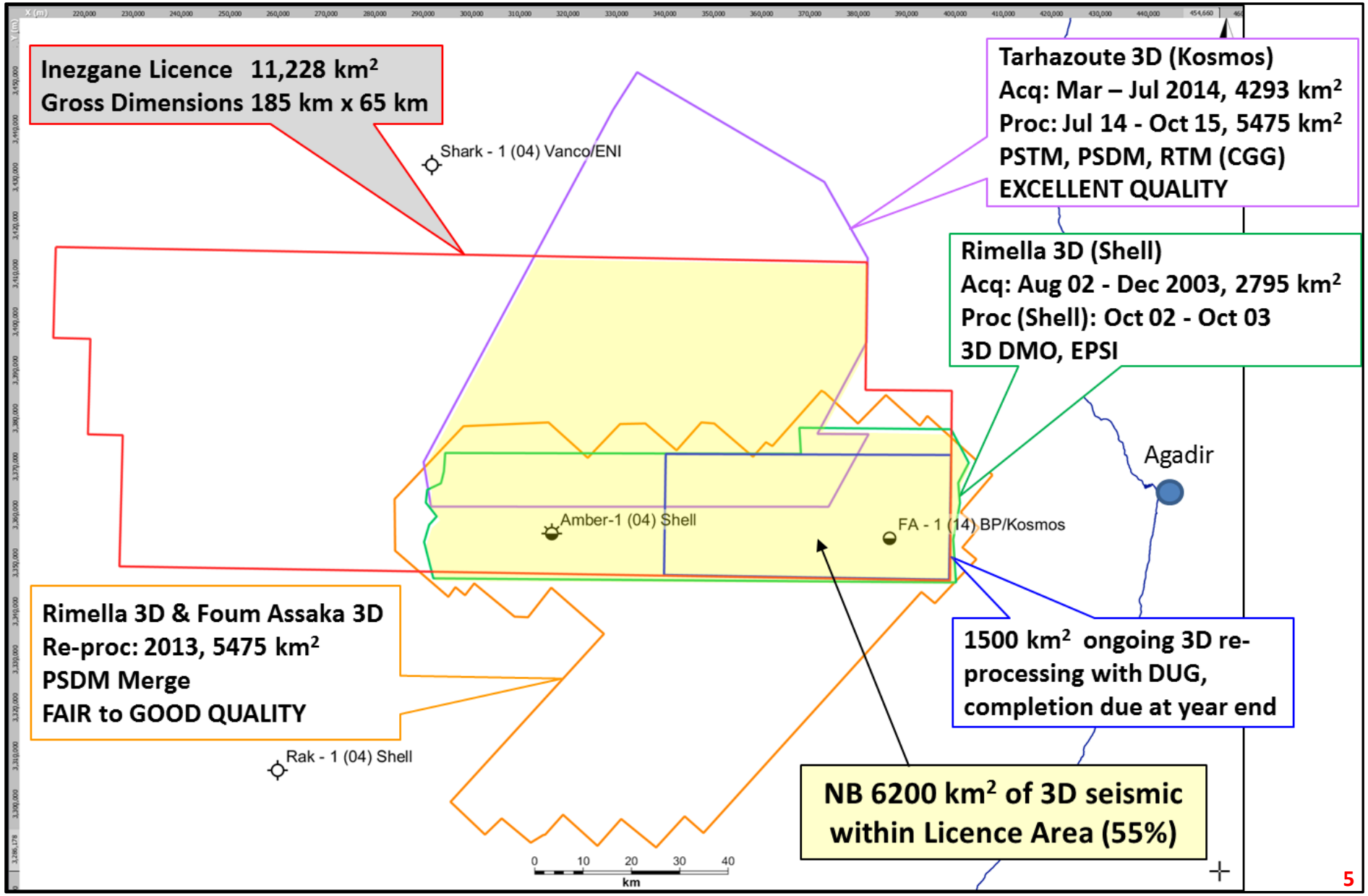
Northern Morocco Licence Map

Seismic Database

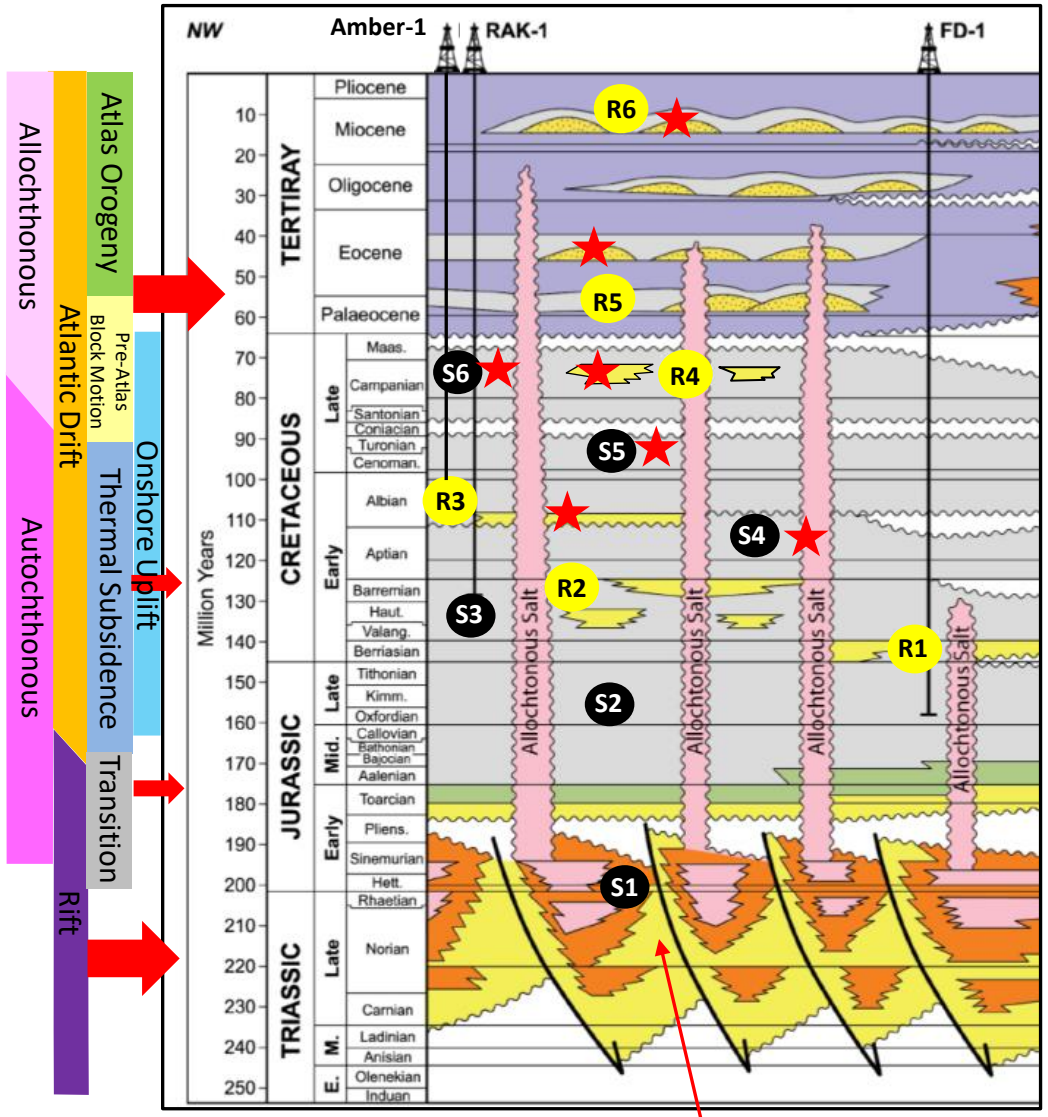
6200 km² of high quality 3D seismic data available to Europa



Inezgane Licence in Southern UK
For scale. Licence area – 11,228km²



Chronostrat: Deepwater – Near Licence Area



KEY S1 Source R1 Reservoir

- S1 Late Triassic-Early Jurassic lacustrine syn-rift
- S2 Mid Jurassic marine
- S3 Lower Cretaceous
- S4 Aptian-Albian (proven on block)
- S5 Cenomanian-Turonian marine (proven on block)
- S6 Campanian/Santonian marine (proven on block)
- R1 Early Cretaceous (Berriasian) Turbidites
- R2 Early Cretaceous (Barremian) Turbidites
- R3 Early Cretaceous (Late Albian) Turbidites
- R4 Upper Cretaceous (Campanian) Turbidites
- R5 Tertiary (Paleocene/Eocene) Turbidites
- R6 Tertiary (Miocene) Turbidites

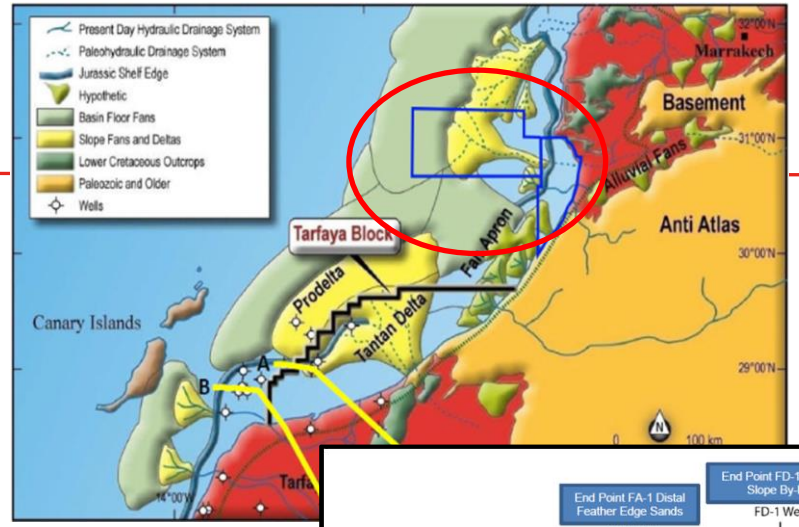
NB Jurassic and Triassic reservoirs too deep

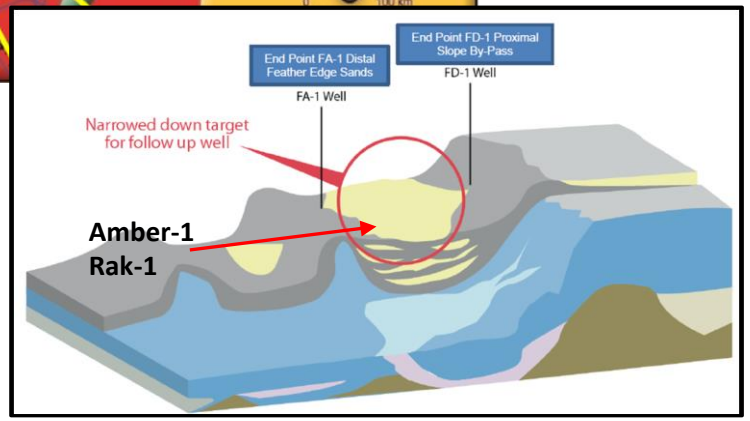
★ **Seen in offshore wells on or close to the block**

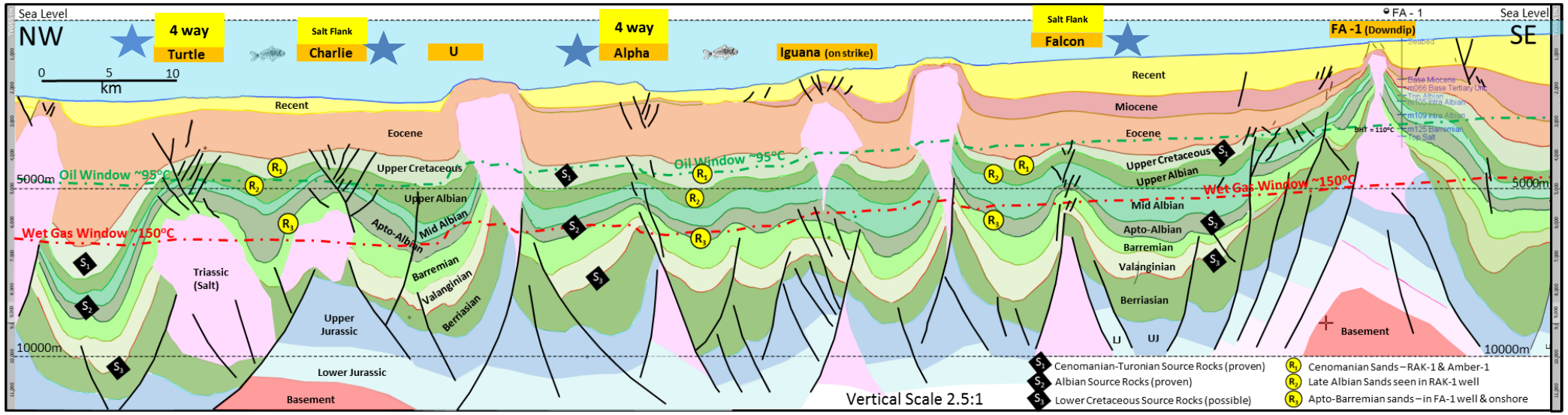
Lower Cretaceous Play

Highly under-explored play

- Early Deepwater drilling focused on Upper Cretaceous and Tertiary plays
- Number of wells targeted mostly salt piercement structures. Wells drilled very close to salt domes with disappointing results.
- Most wells have targeted sands where the Lower Cretaceous **has thinned or the Lower Cretaceous was not reached.**
- The Albian-Aptian-Barremian **fairway** has not been effectively tested by any wells in deep water Morocco.
- Late Jurassic/Early Cretaceous salt diapirism created mini-basins with accommodation space for capture of slope and basin sands.
- Source rocks are extensive within the basin at a number of horizons and many wells have drilled source rocks and/or seen hydrocarbon shows.



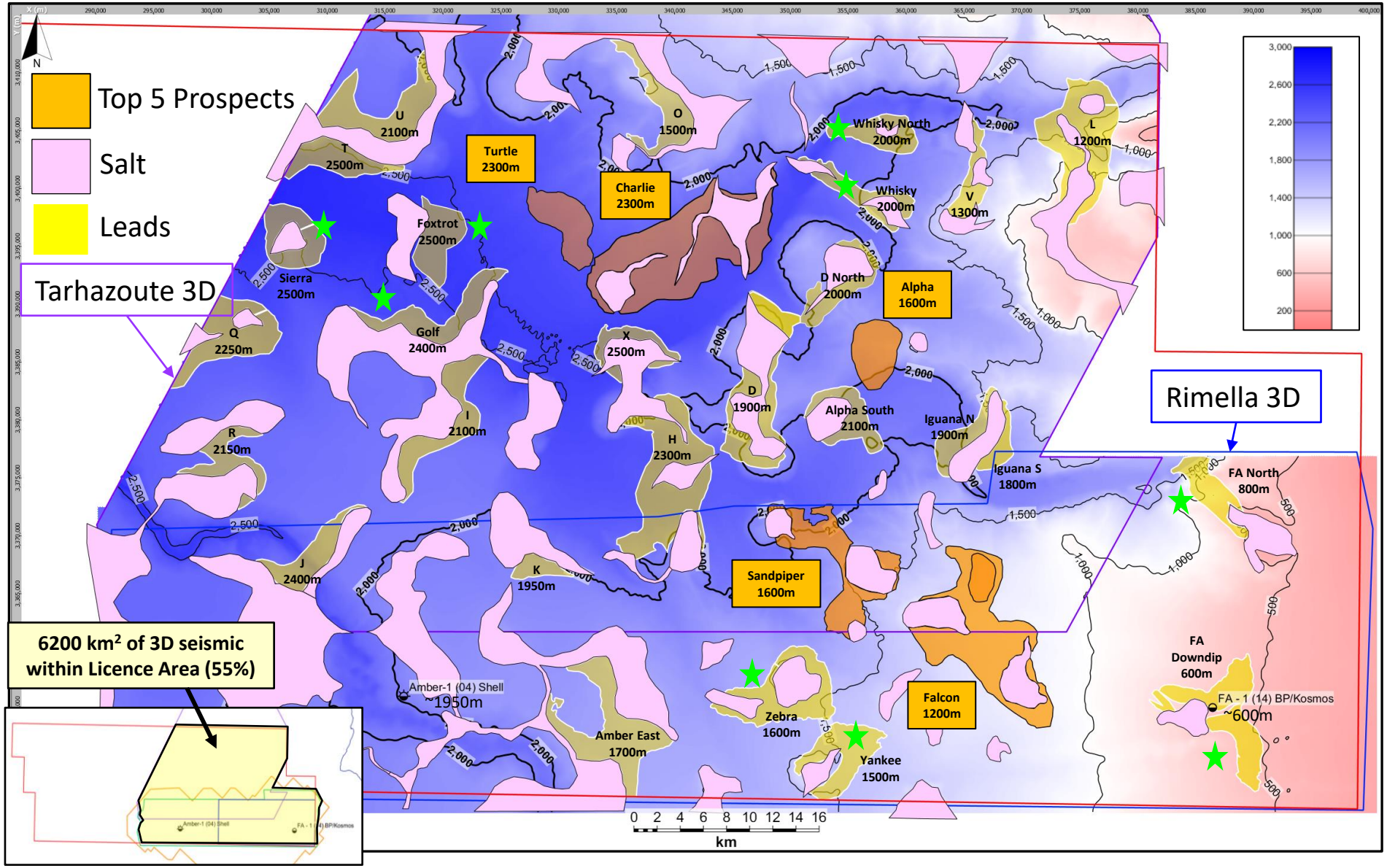




Top 5 Prospect

Water Depth (m),Top Five Prospects & Leads & Follow Up Potential

All defined on 3D seismic



6200 km² of 3D seismic within Licence Area (55%)

Top 5 Prospects - Albian
Pmean STOIIP 5 BBBO
Pmean Reserves 2.1 BBBO

★ Top 14 Prospects - Albian
Pmean STOIIP 10.5 BBBO
Pmean Reserves 4.6 BBBO

Additional 16 Leads - Albian
Pmean STOIIP 9.1 BBBO
Pmean Reserves 4 BBBO

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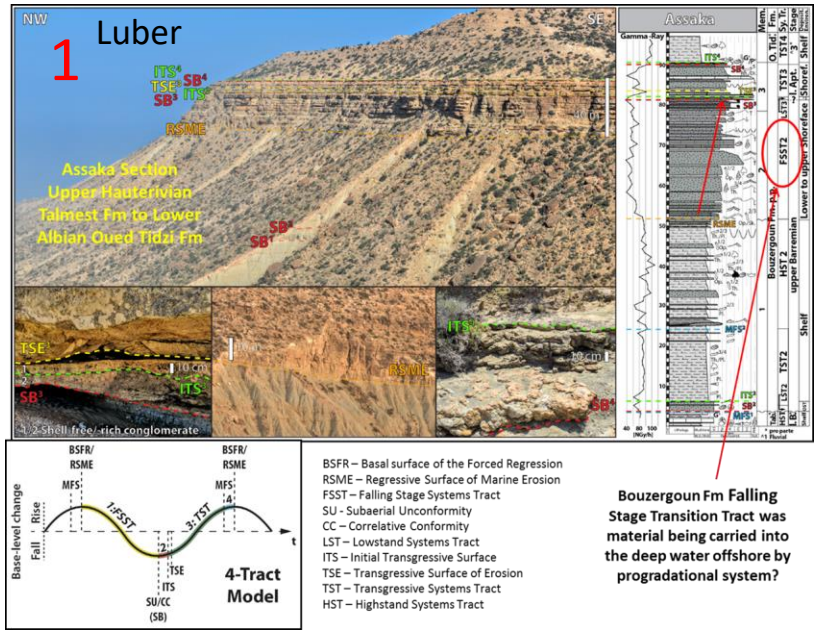
Offshore Morocco

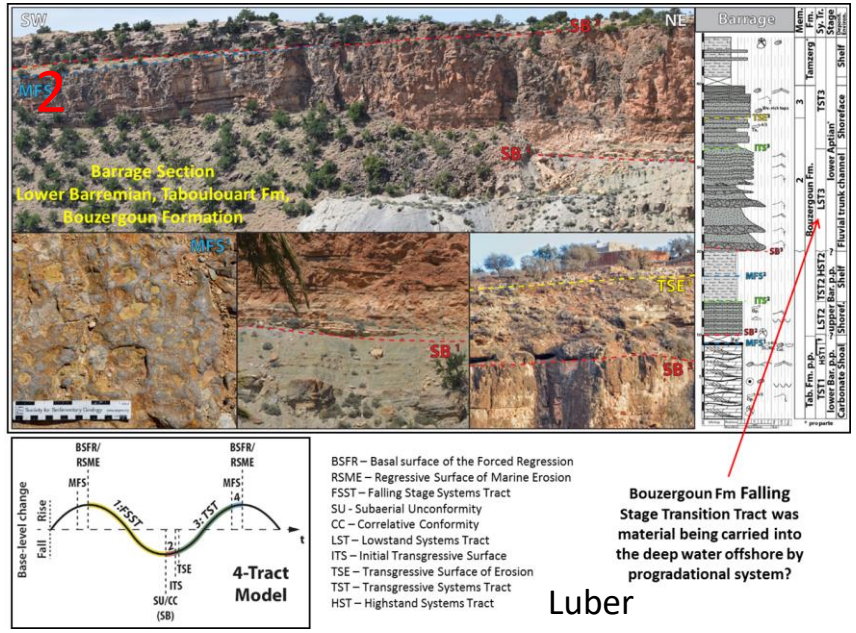
Reservoir

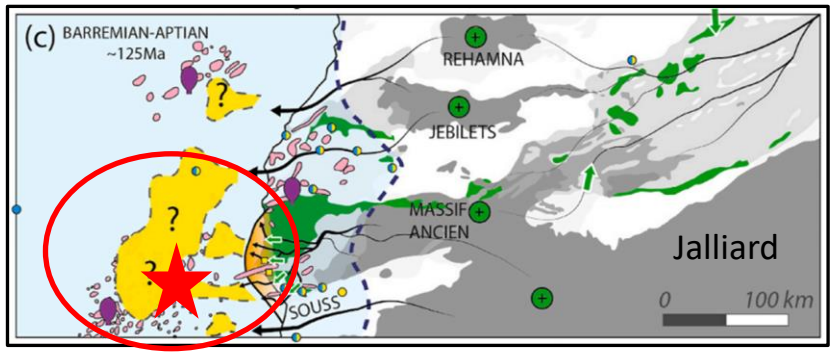
Sand in the deepwater of Morocco

Lower Cretaceous Outcrop Studies –

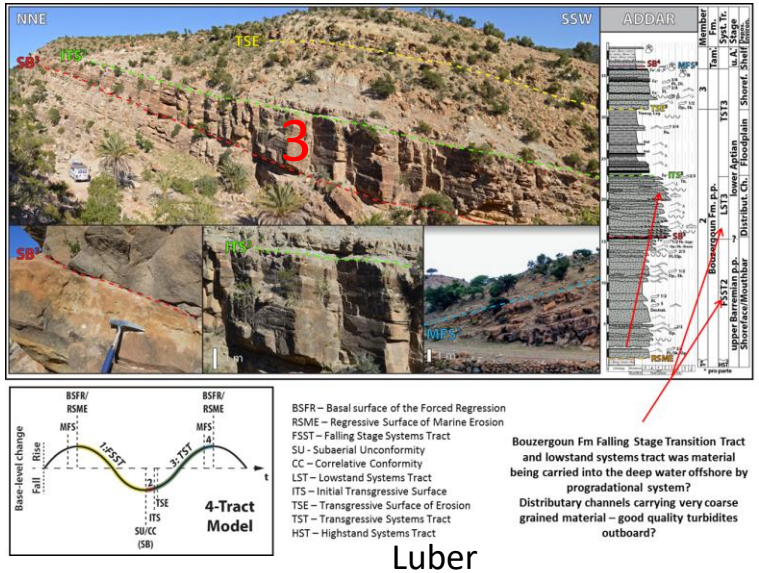
Onshore Basin Luber et al 2017/Jalliard 2018

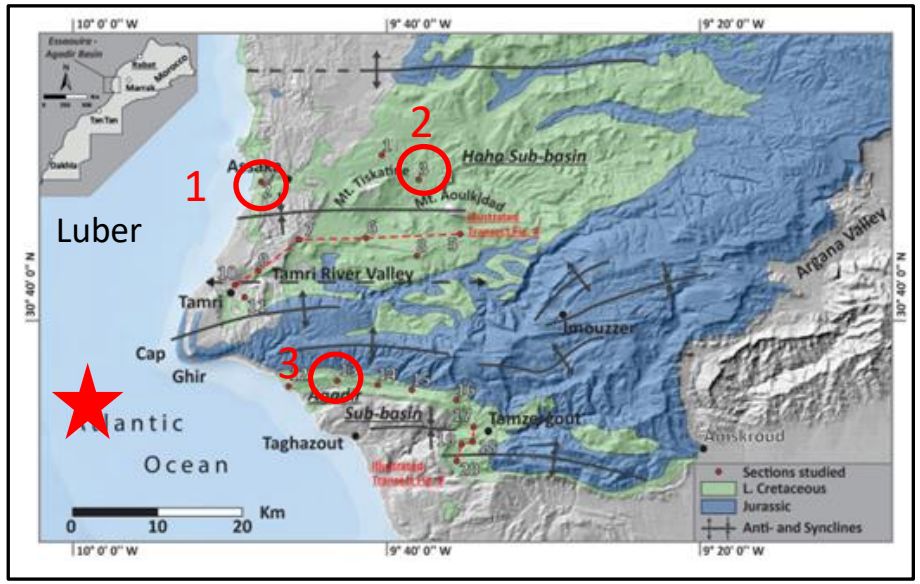


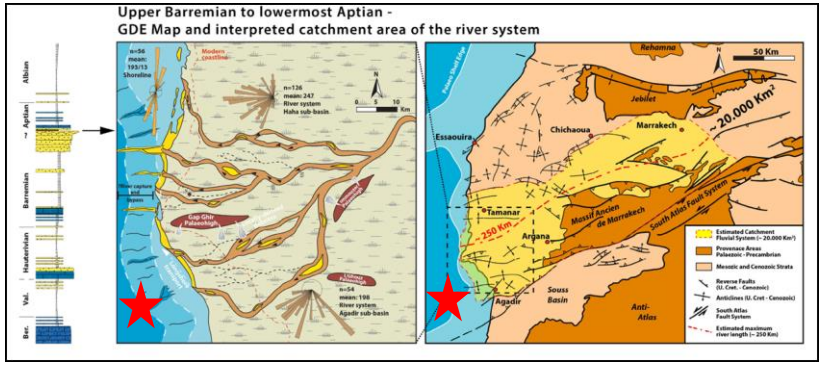




Thick sands predicted offshore in Bouzergoun Fm Apto-Barremian







The estimated catchment area for the Moroccan offshore was 20,000km^2 (yellow)
This is larger than the Thames basin

Lower Cretaceous Reservoir

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Barremian – Albian Sands seen in DSDP 370

DSDP 416: Thick sequence of stacked thin turbidite ssts of Albian to Valanginian age

Rak-1: 25m net of Albian ssts – av Ø 22.3%

Amber 1: Lwr Cret not penetrated

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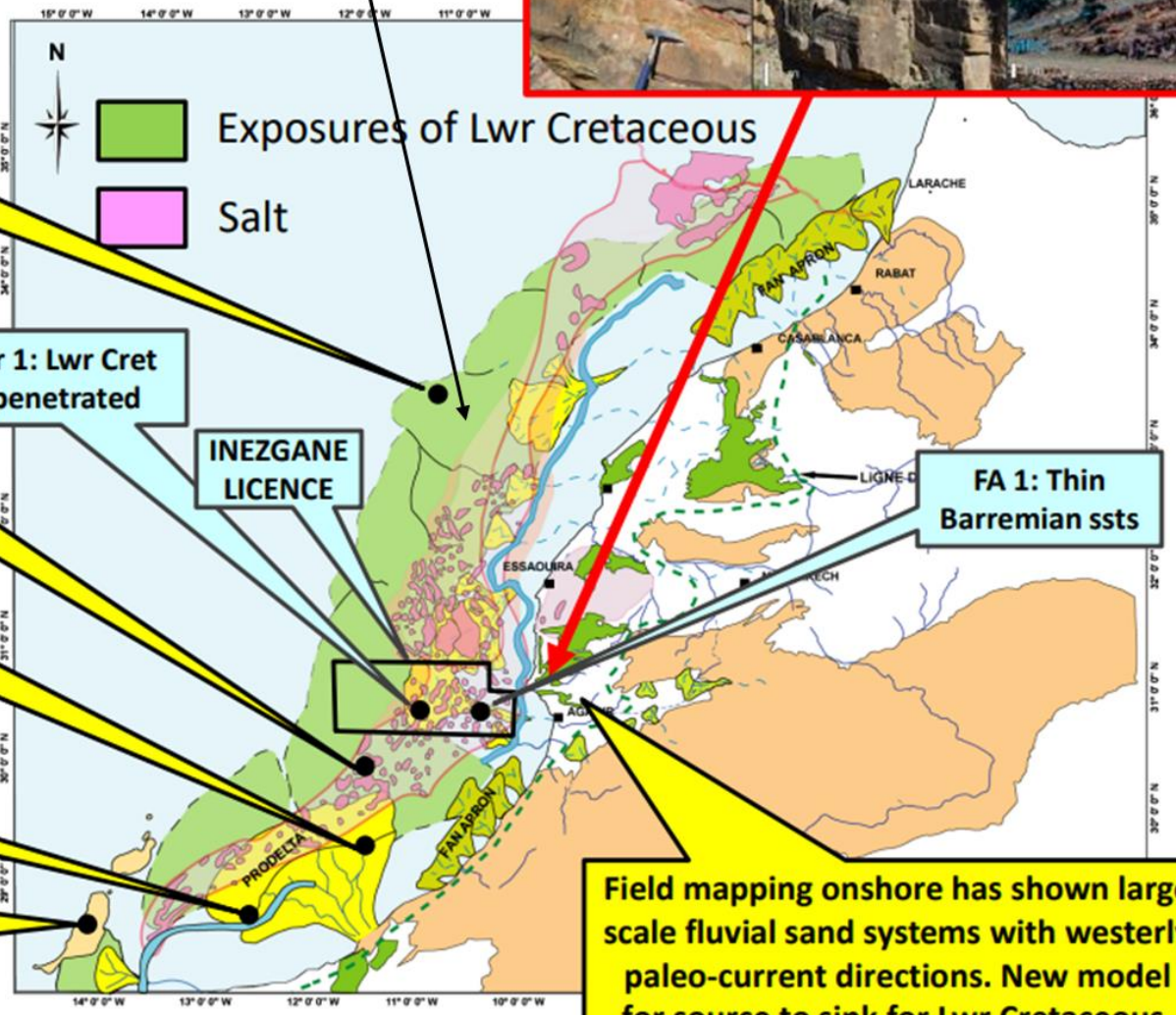
FD-1: 10m single sst within Albian section - av Ø 24%

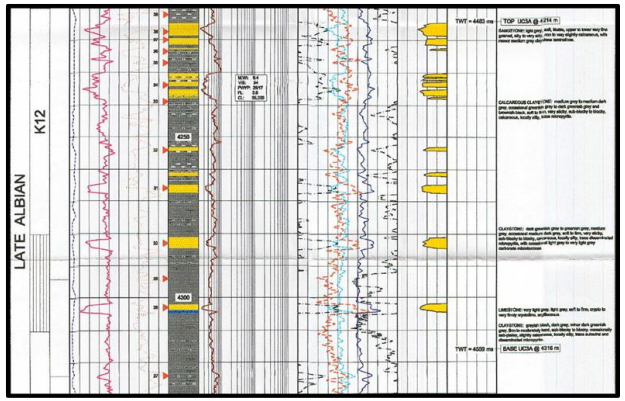
FA 1: Thin Barremian ssts

MO-1: Lower Cretaceous delta-top and channel ssts in Tan Tan delta. Feeder system?

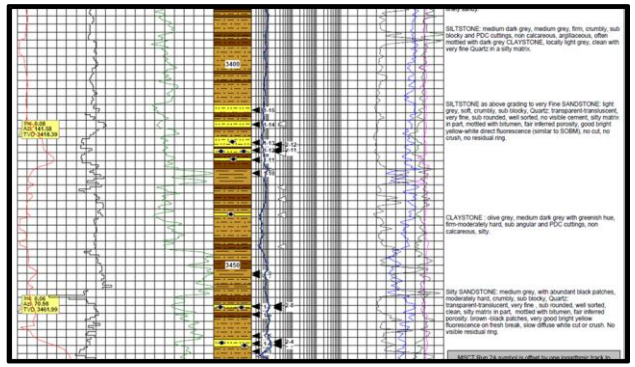
Fuerteventura: Thick sequence of stacked thin turbidite ssts of Aptian to Valanginian age



Field mapping onshore has shown large scale fluvial sand systems with westerly paleo-current directions. New model for source to sink for Lwr Cretaceous.



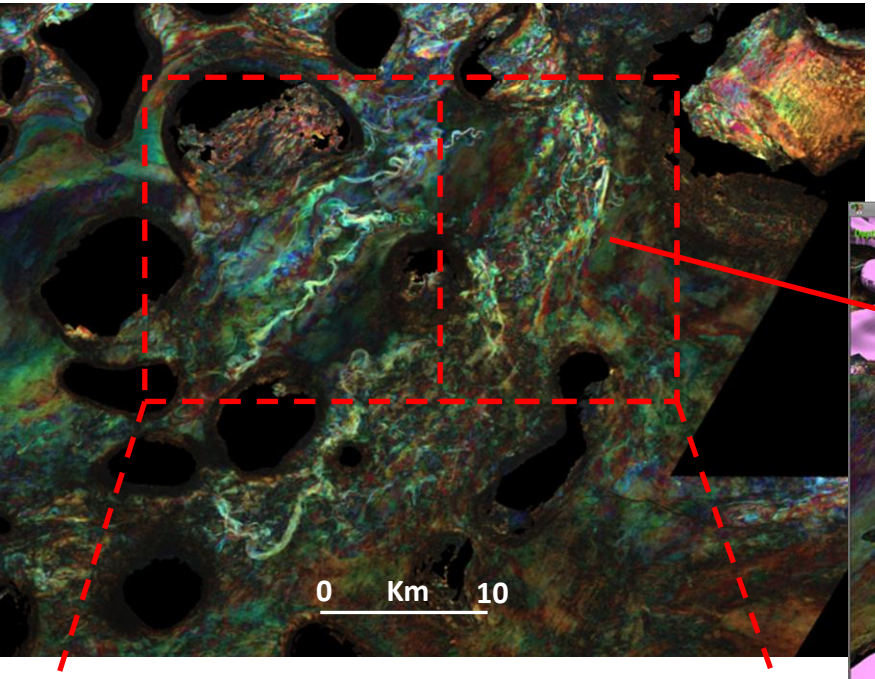
RAK-1 Thin Sands totalling 25m of net Albian

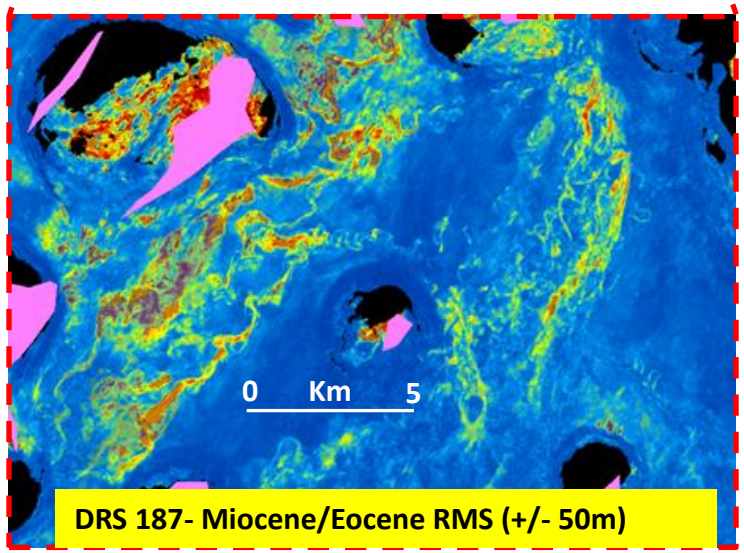


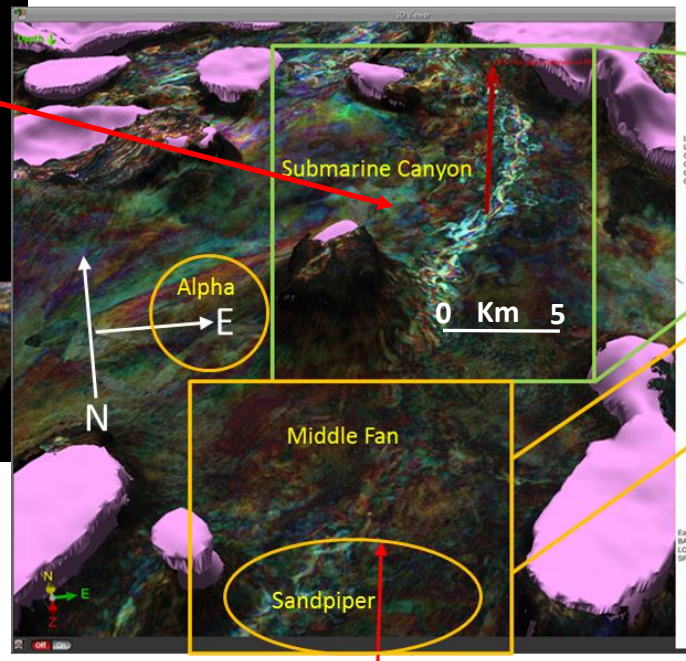
FA-1 Thin Sandstones with oil odour and fluorescence

Reservoir – DRS Study (Lyme Bay Consulting)

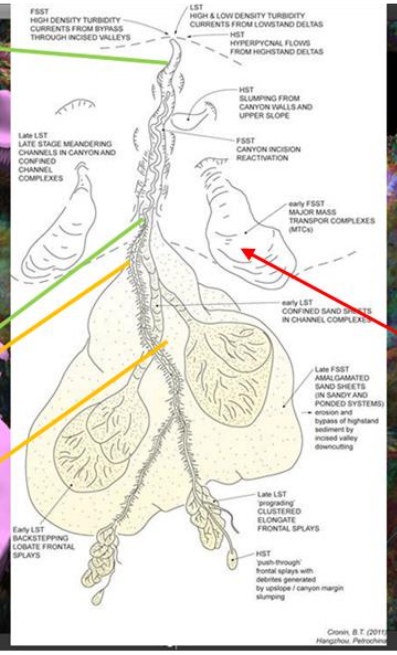
Textbook quality Eocene & U. Cretaceous

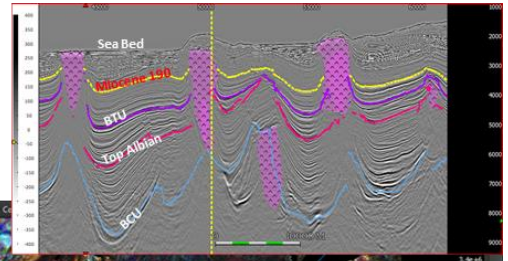


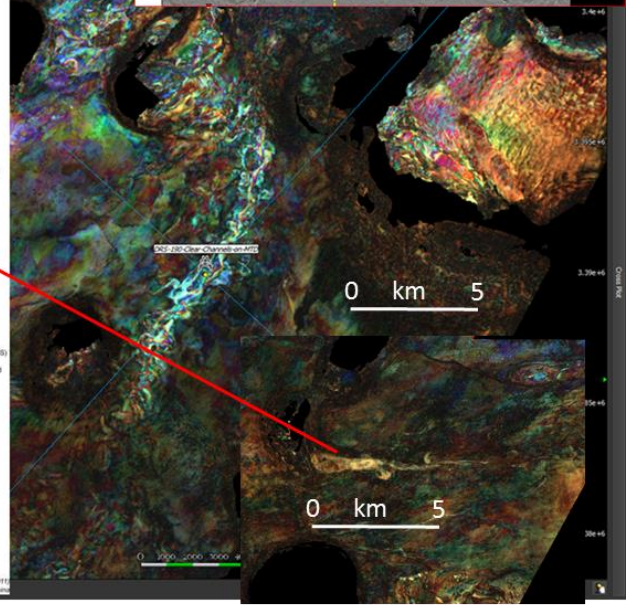


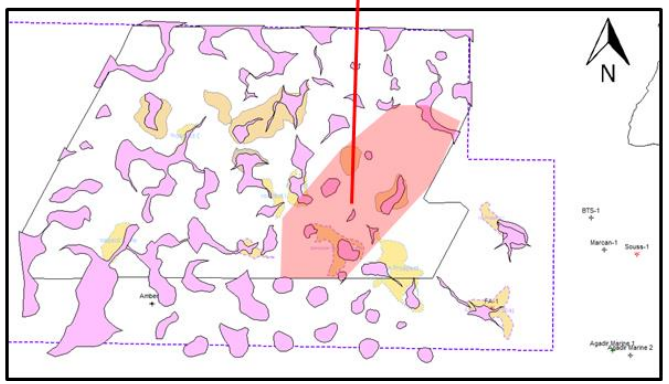


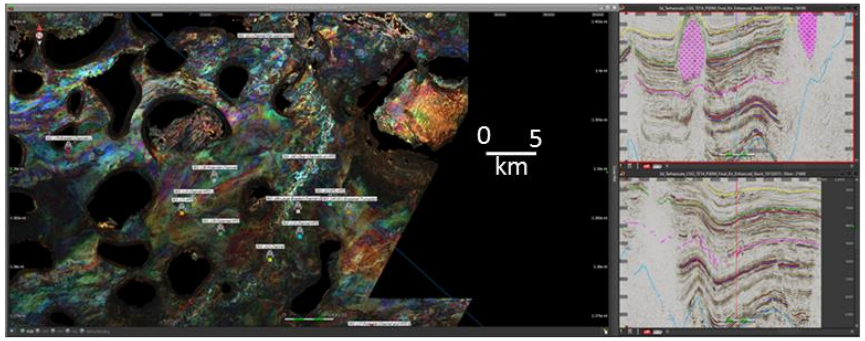
Deep water model after B.Cronin (pers comm)





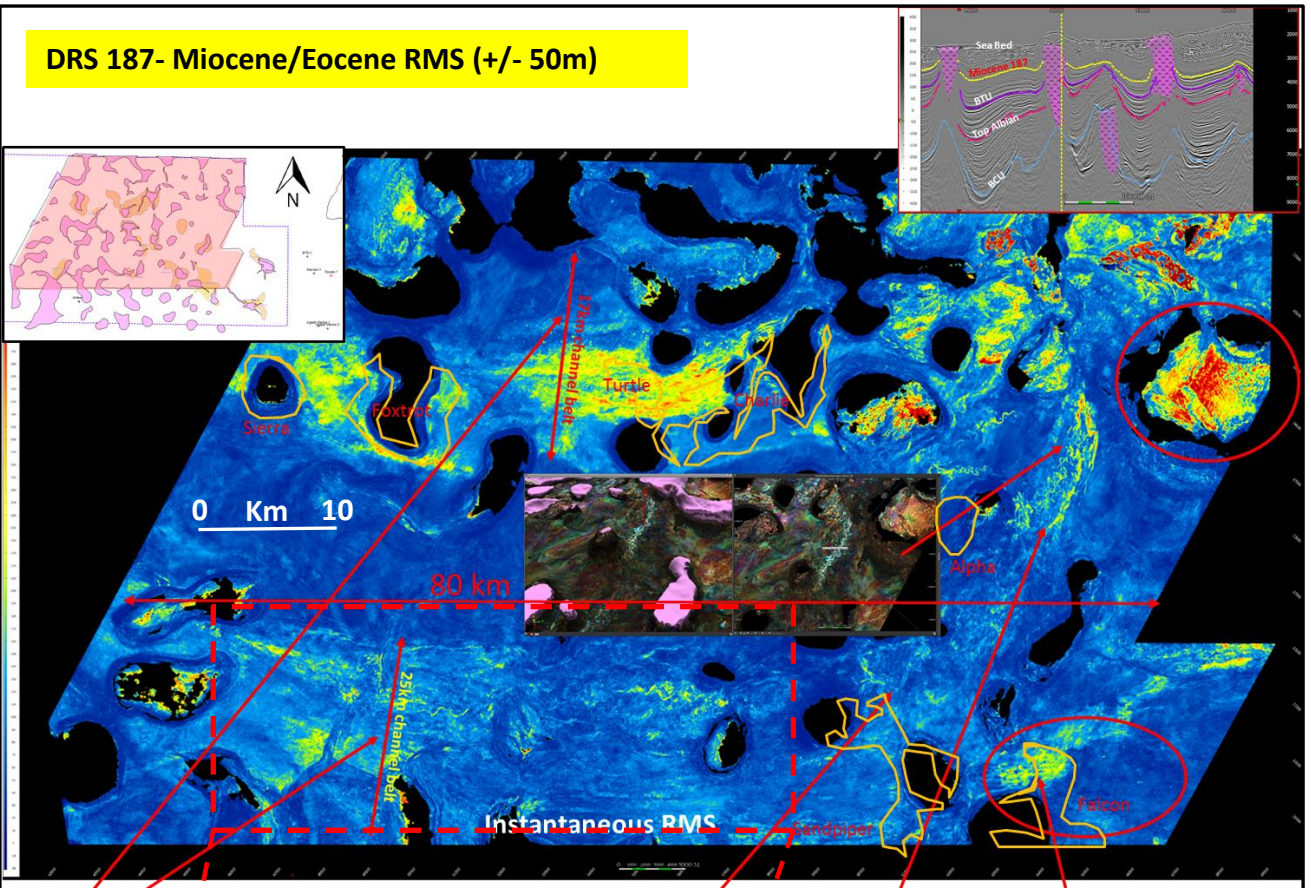






DRS 187 – Miocene/Eocene

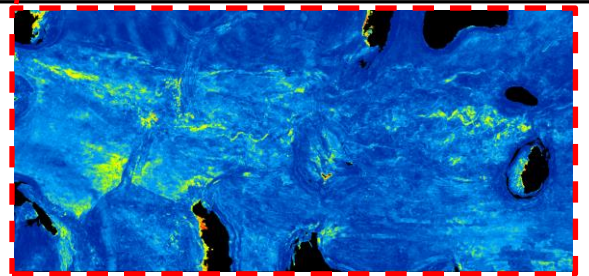
DRS 187- Miocene/Eocene RMS (+/- 50m)



NB Sandy sections are pale yellow/white with obvious channels seen

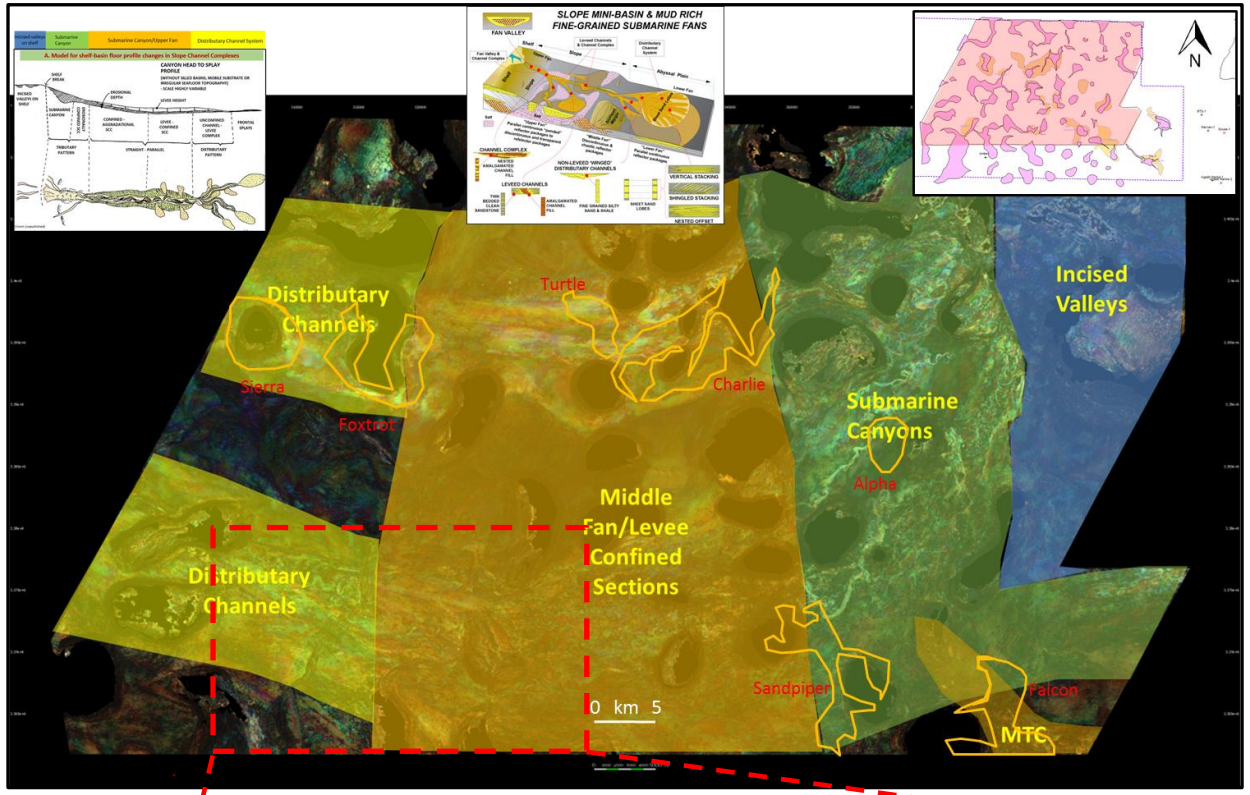
NB Channels can be brights or dims

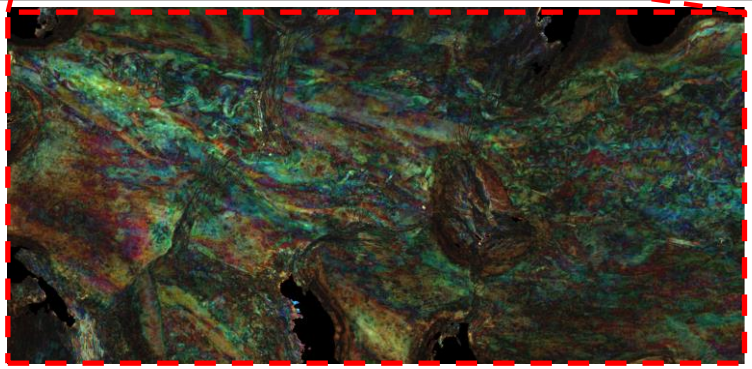
Scattered blocks in MTC



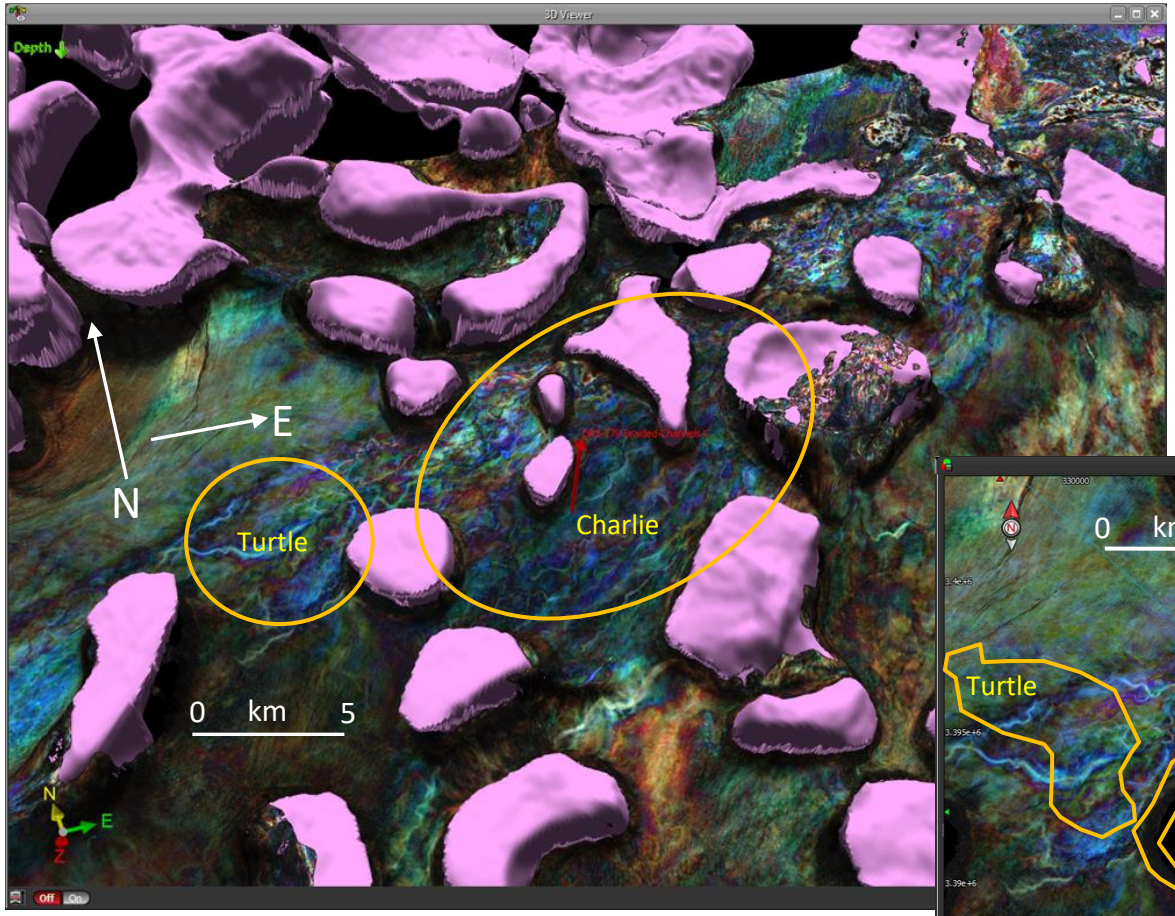
Spectral Decomposition (14,23,37 Hz)

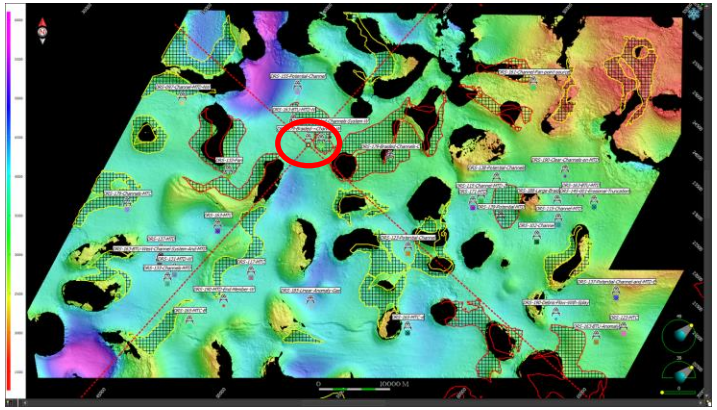
Deep Water Depositional systems highlighted

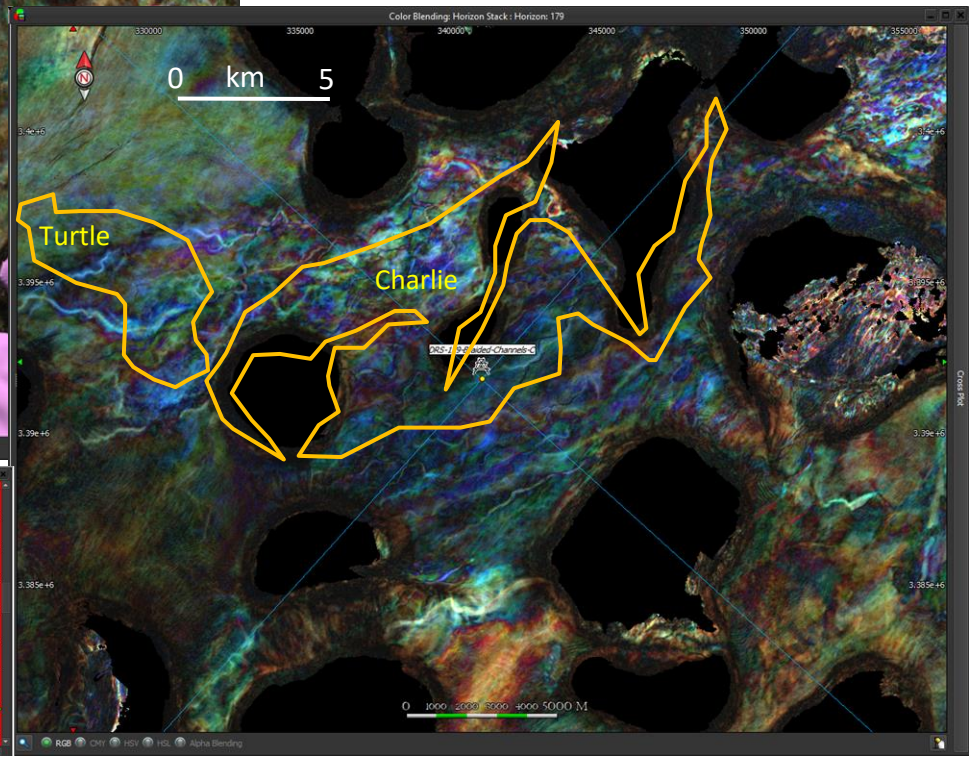


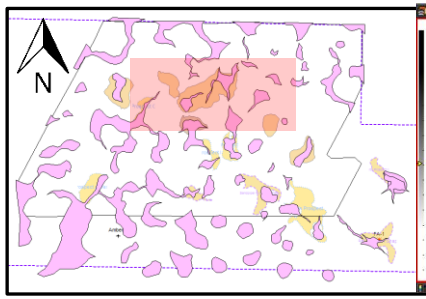


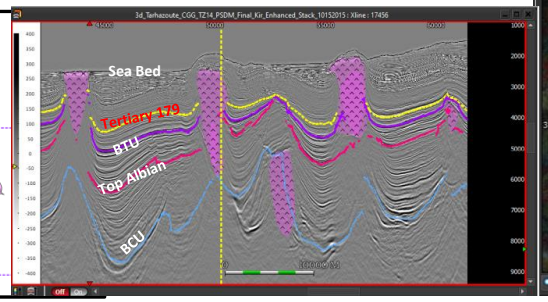
DRS 179 – Tertiary (Eocene)





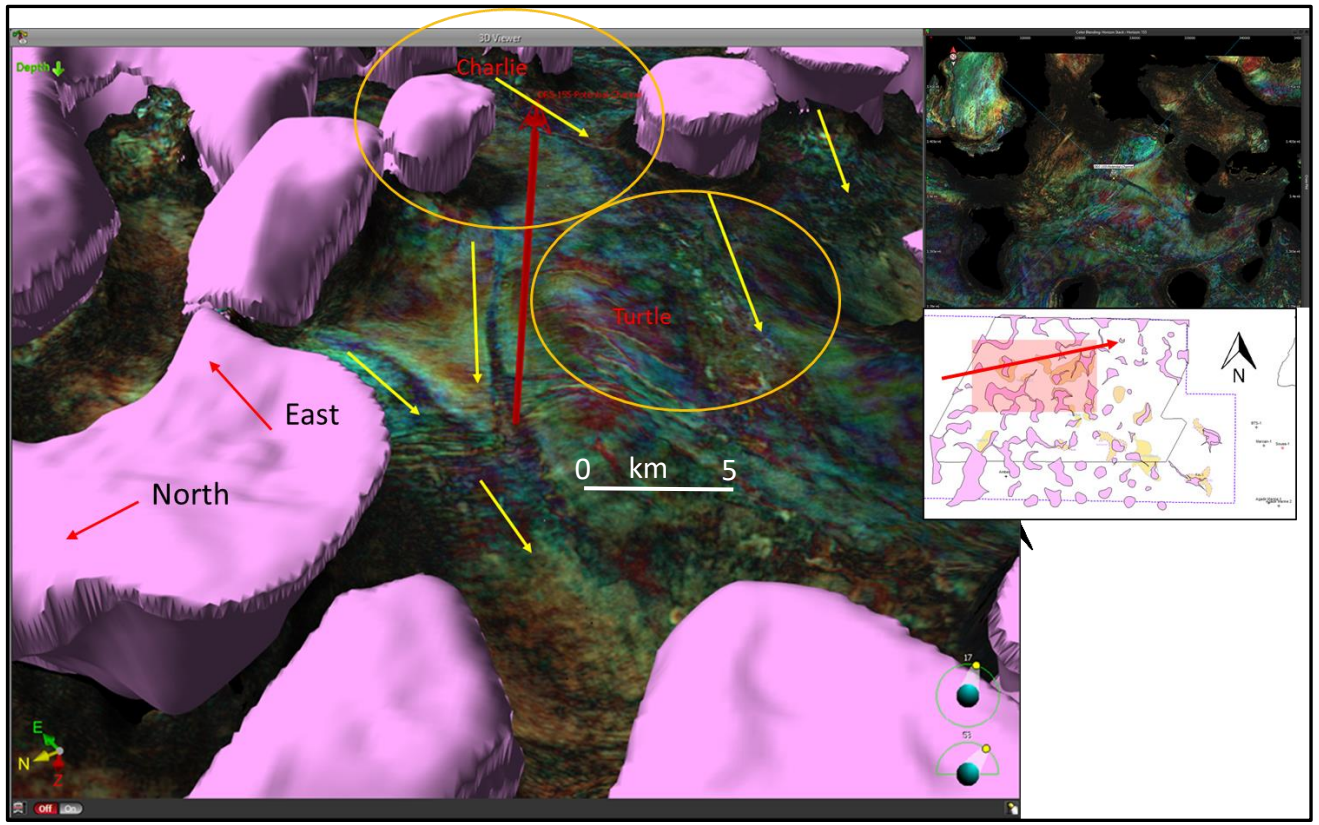


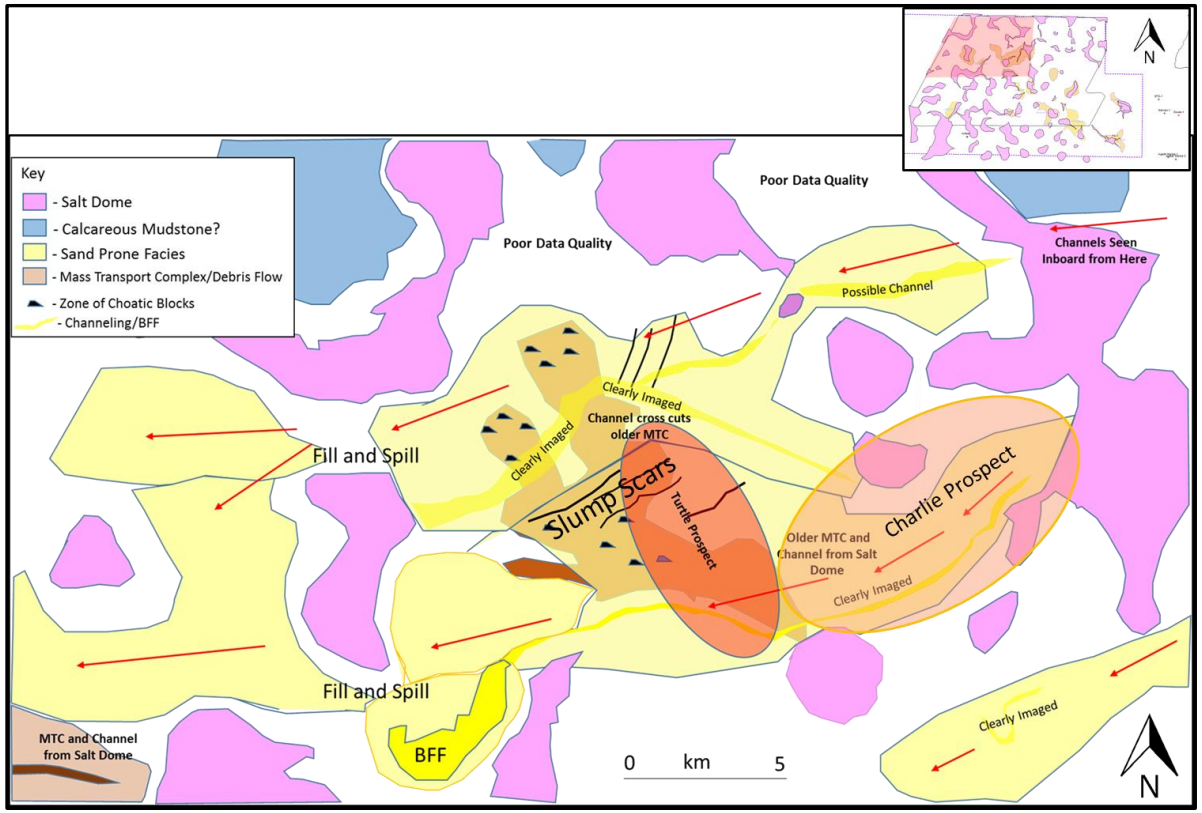




DRS 155 – Upper Cretaceous (Campanian)

– 3D image looking updip (east)

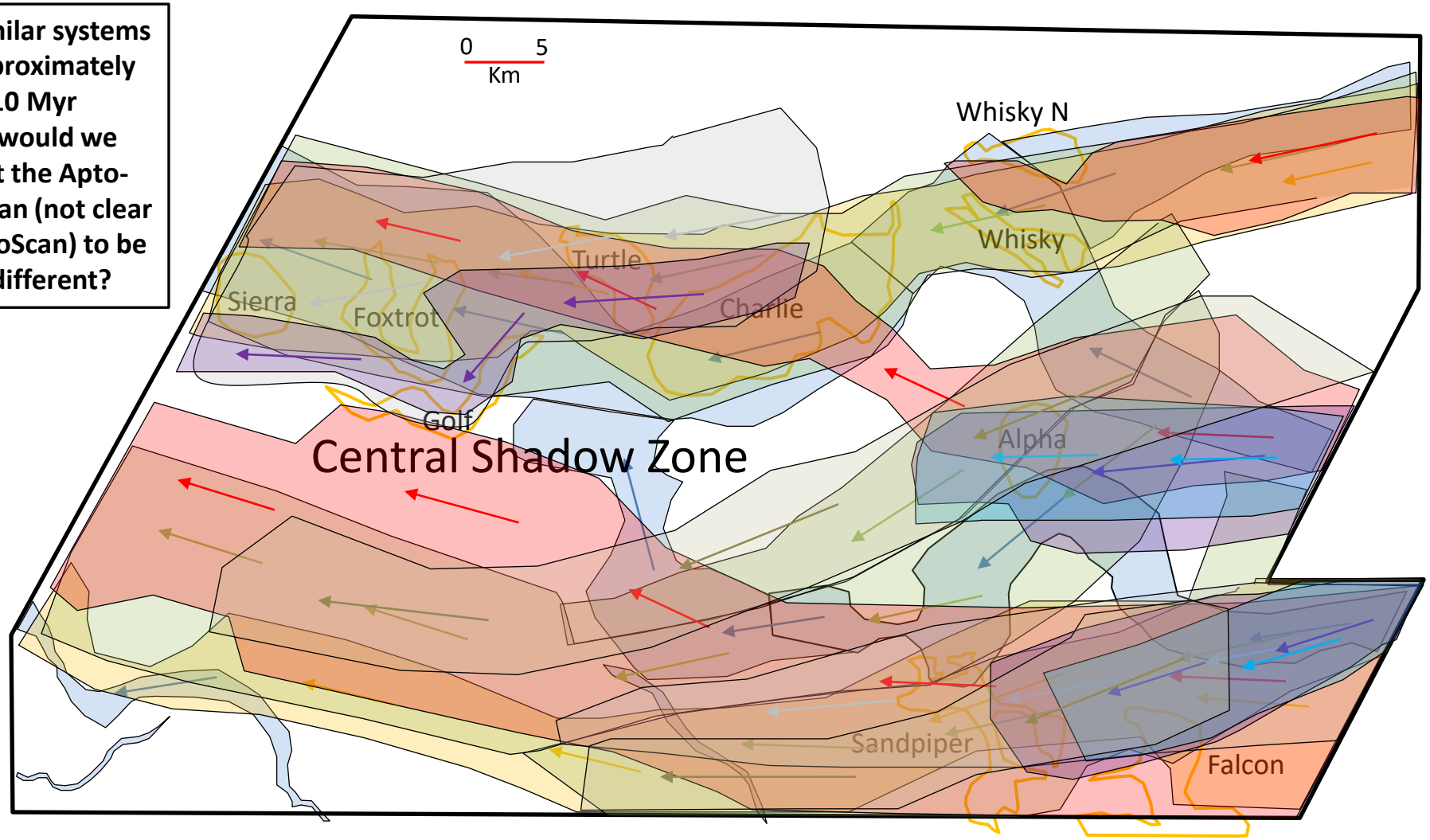




Key point is sand is being delivered to the edge of the 3D survey (over 80km) in Cretaceous times. Turtle prospect seems to be well placed to receive a sand charge. Locally material is shed off salt domes in the form of MTC's

The present is the key to the past……
Depositional Systems through time

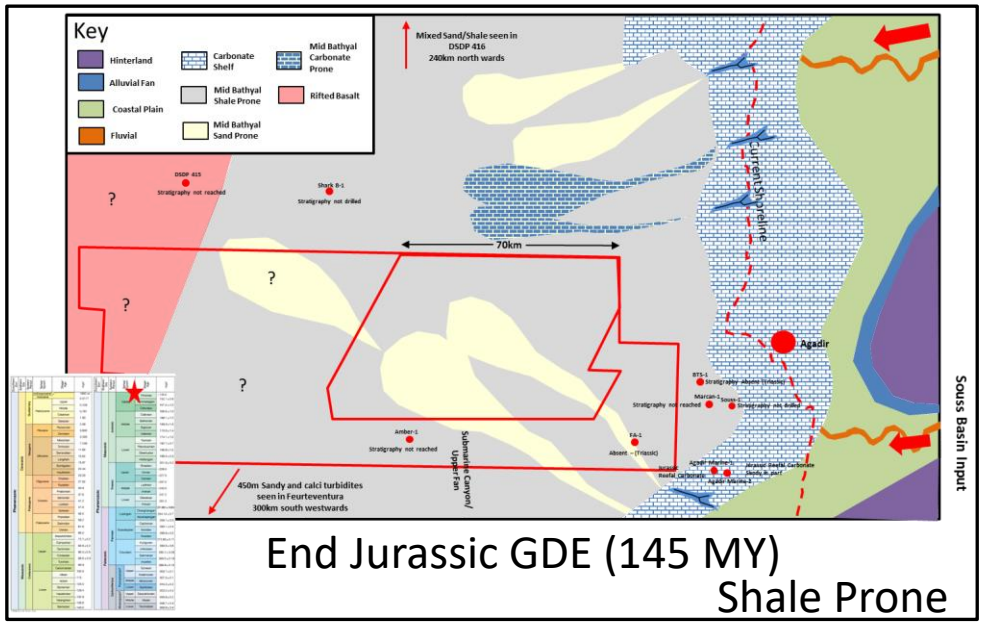
Very similar systems for approximately 110 Myr
Why would we expect the Apto-Barremian (not clear on PaleoScan) to be any different?



Present Day
Early Miocene (204) — 11 MY
Miocene/Eocene (187) — 34 MY
Base Tertiary (163) — 66 MY
Campanian (155) — 72 MY
Campanian/Santonian? (146) — 83 MY
Basal Upper Cretaceous (137) — 100 MY
Intra Albian (113) — 110 MY

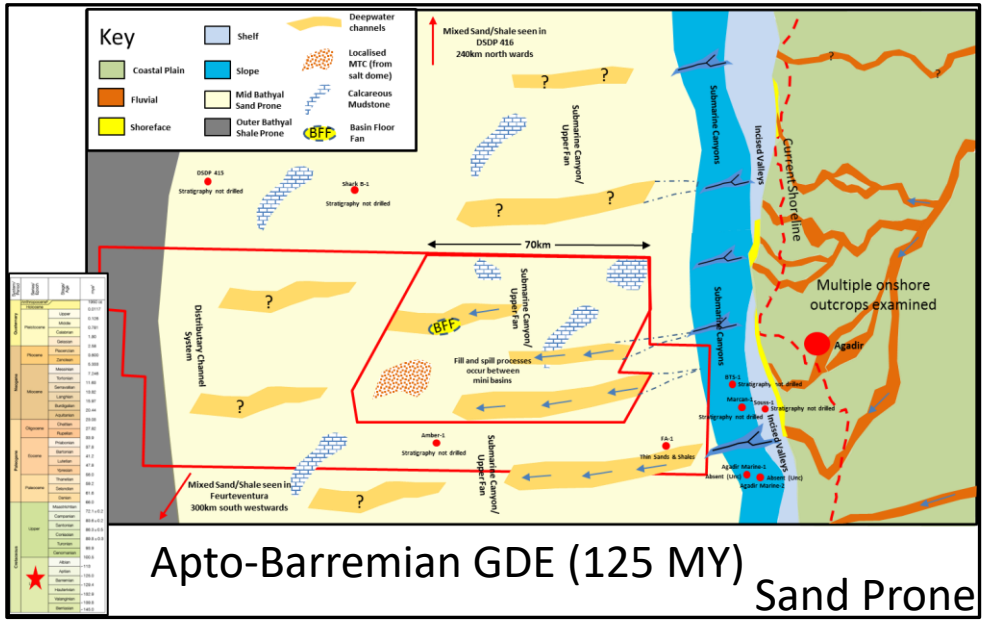
GDE Maps through time End Jurassic - Cenomanian

(from PaleoScan/Well Data/Regional Data)



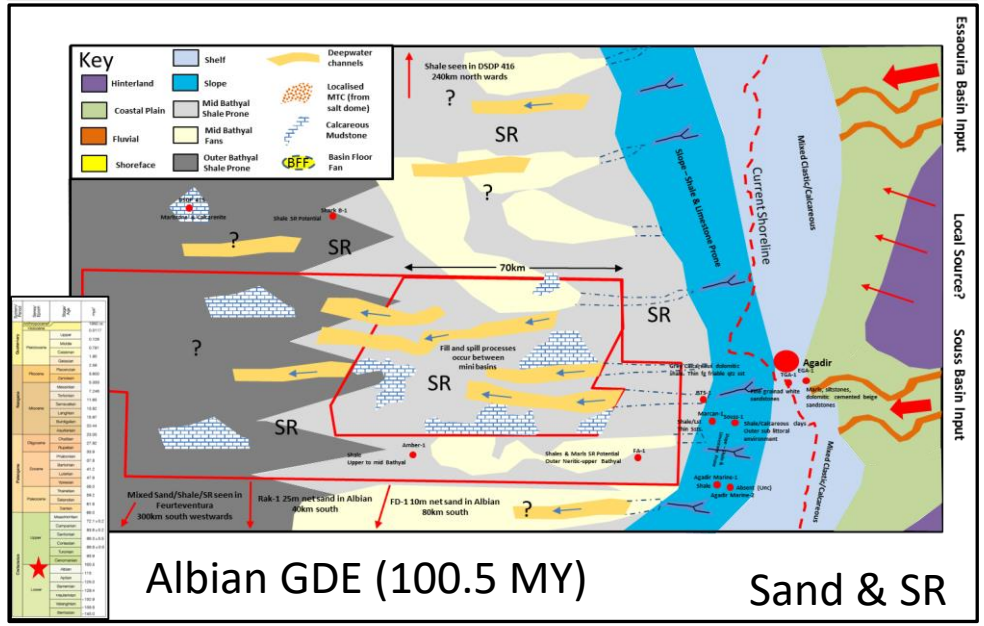
End Jurassic GDE (145 MY)

Shale Prone



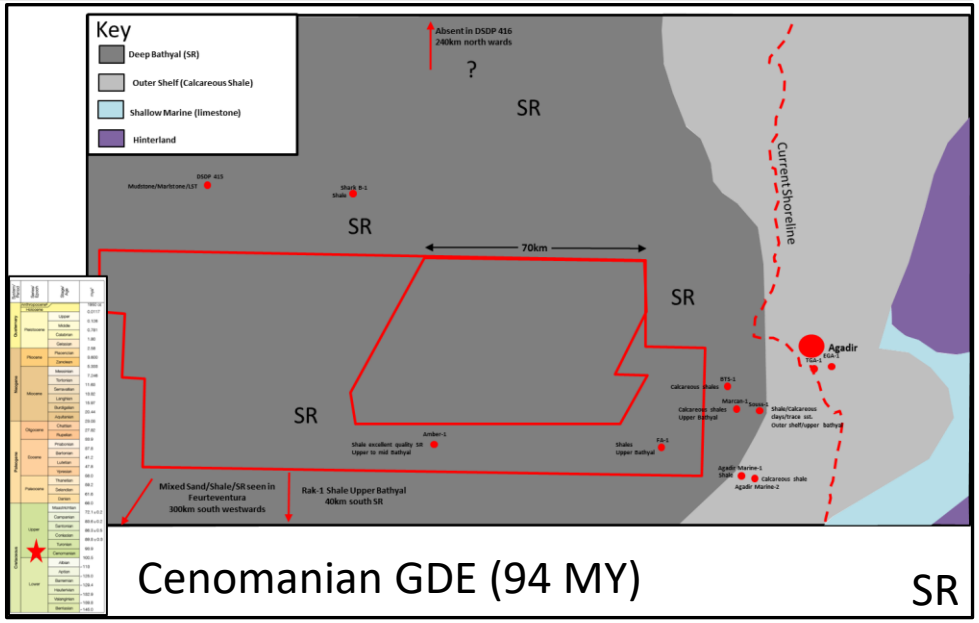
Apto-Barremian GDE (125 MY)

Sand Prone



Albian GDE (100.5 MY)

Sand & SR

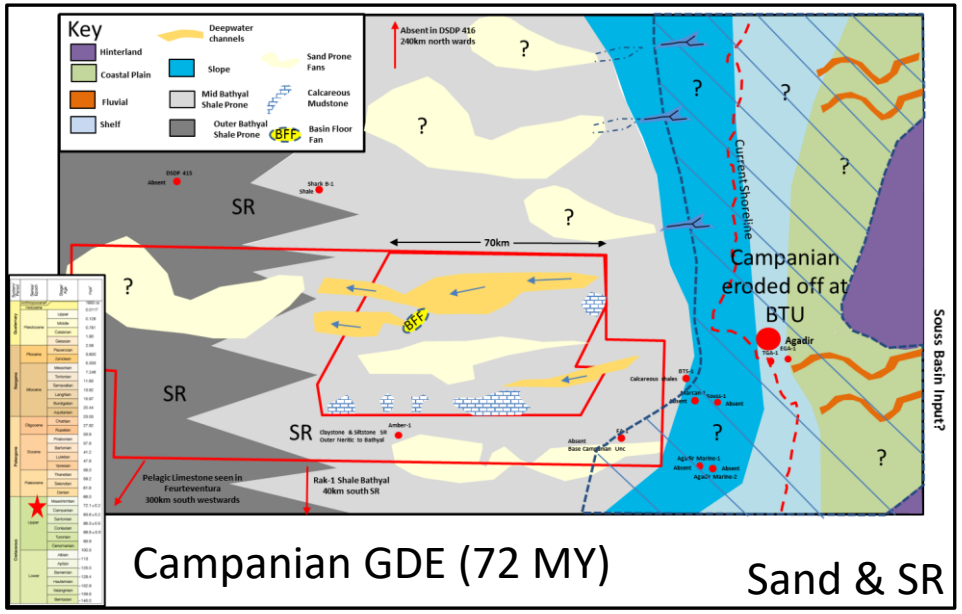


Cenomanian GDE (94 MY)

SR

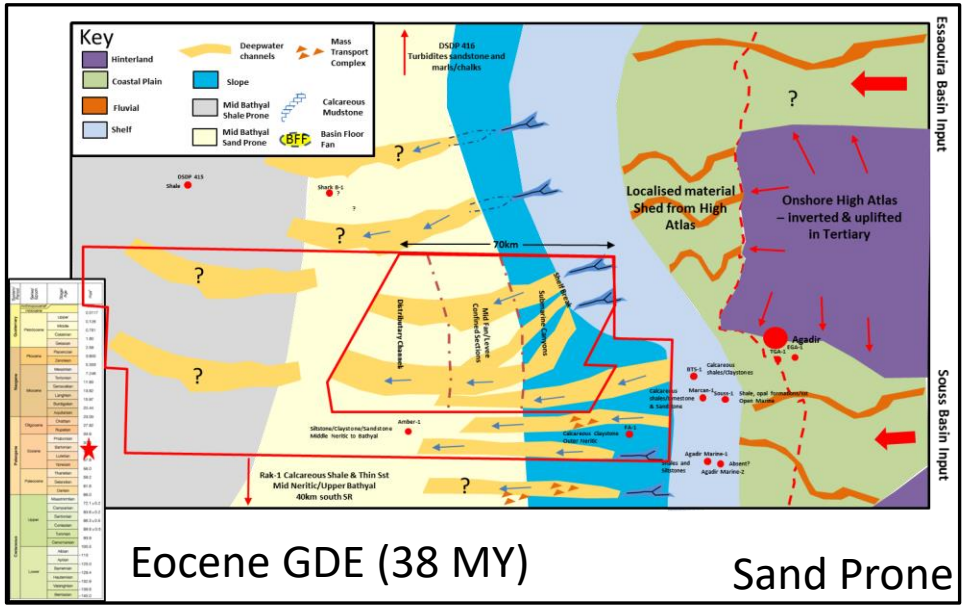
GDE Maps through time Campanian – Present Day

(from PaleoScan/Well Data/Regional Data)



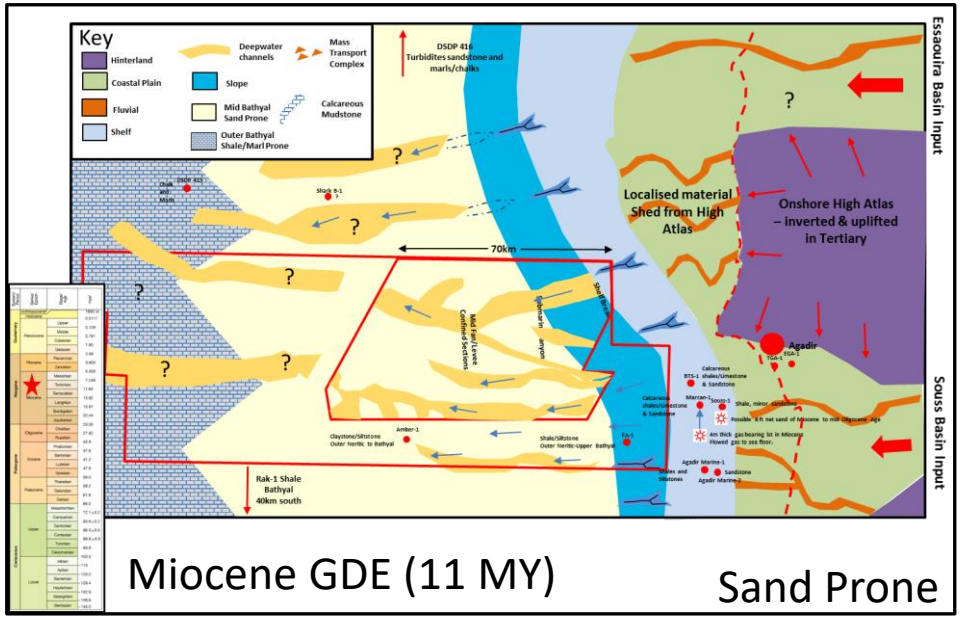
Campanian GDE (72 MY)

Sand & SR



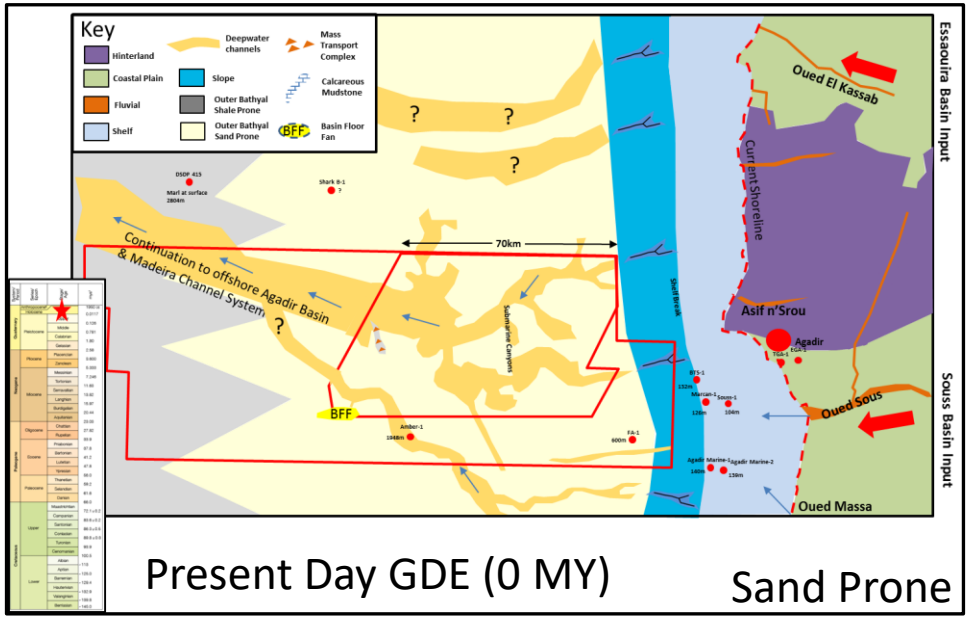
Eocene GDE (38 MY)

Sand Prone



Miocene GDE (11 MY)

Sand Prone



Present Day GDE (0 MY)

Sand Prone

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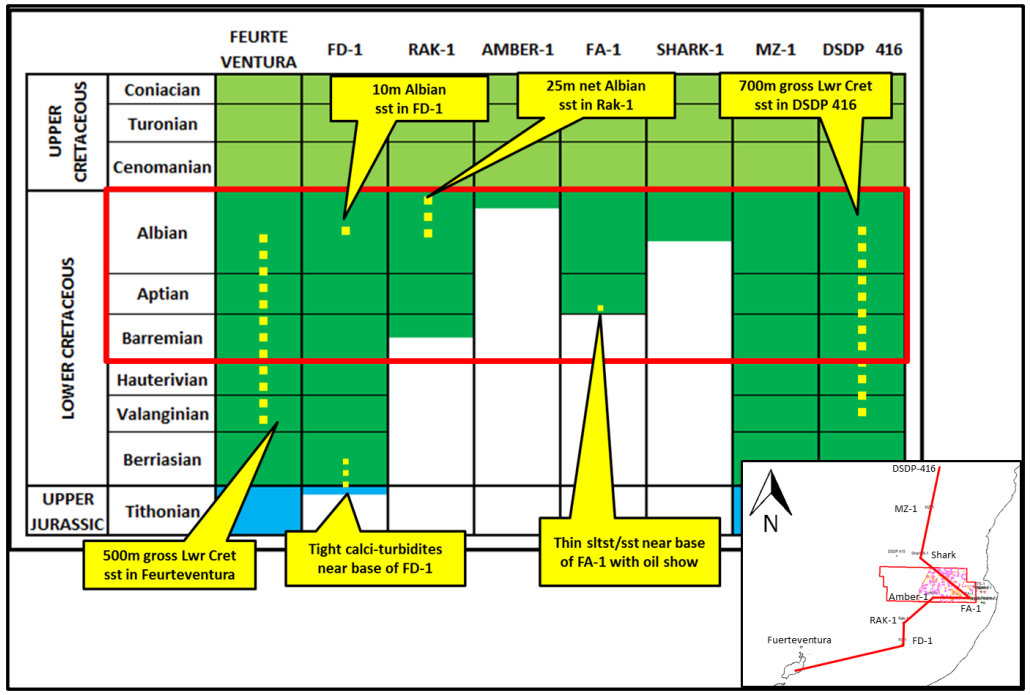
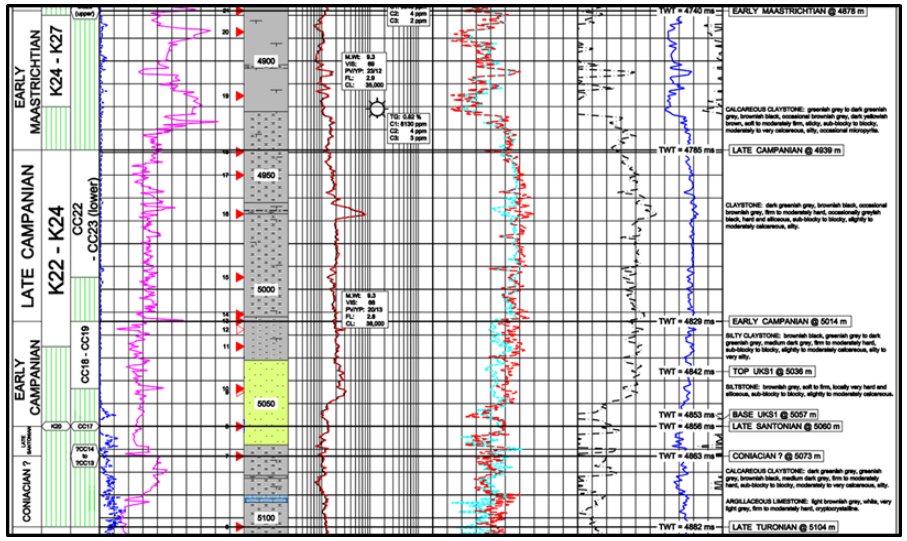
Offshore Morocco

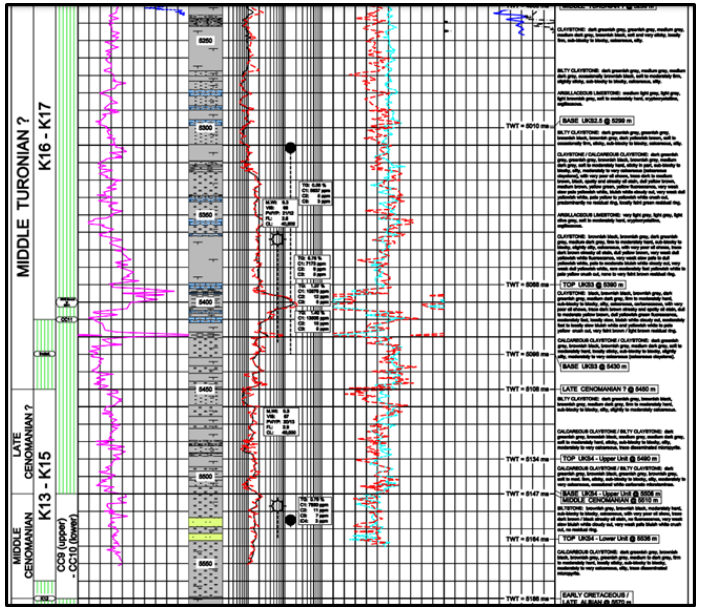
Seal

Seal – Lower Cretaceous Stratigraphy





20m siltstone in over 210m of shale Maastrichtian-Coniacian



340m of shale Turonian-Cenomanian

- To date large amounts of shale have been drilled within the basin.
- Onshore analysis has revealed periods of sand deposition interspersed with periods of shale deposition.
- Analogue basins reveal periods of sand deposition interspersed by shale deposition driven by changes in bathymetry. Onshore outcrops see intercalated seal and sand assemblages.
- Salt flank structures trapped against impermeable salt
- Seal risk is considered low on block.

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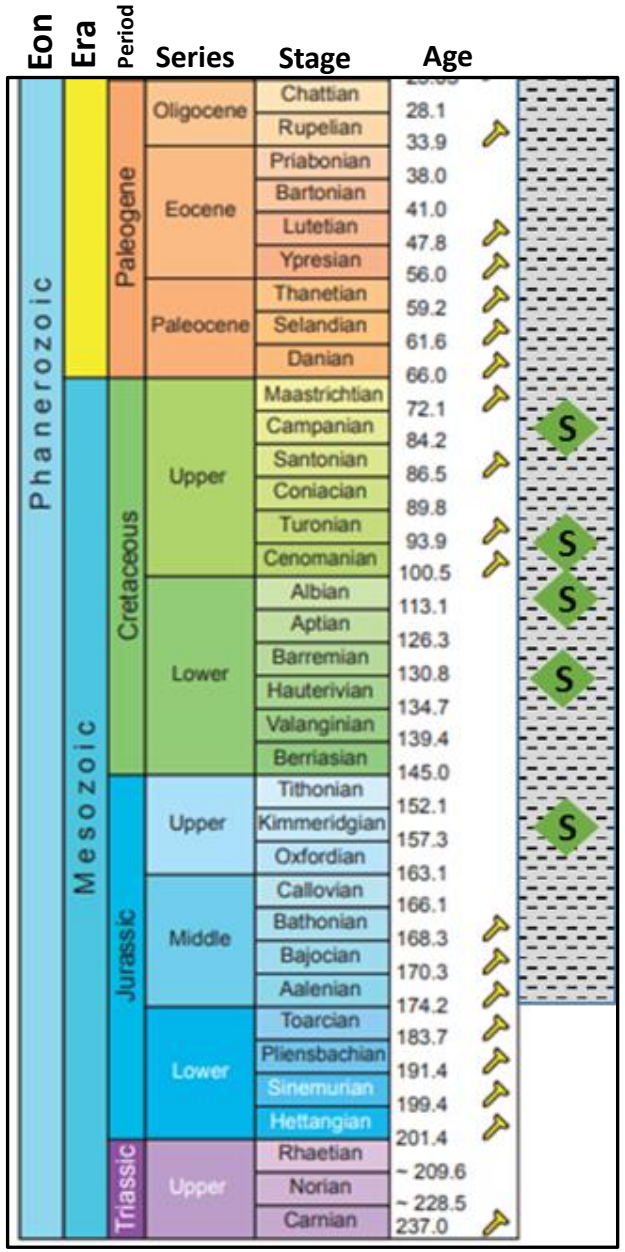
Source Rocks

Source rocks are present.

Source Rocks

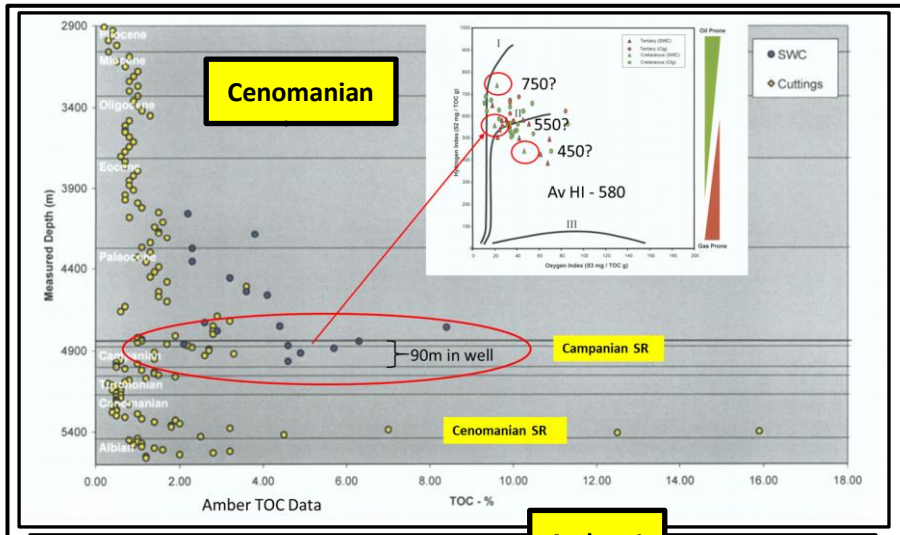
- Number of candidate source rocks at various stratigraphic levels based on samples (well cuttings and outcrop) and shows as follows:
  1. Campanian
  2. Cenomanian-Turonian
  3. Albian
  4. Barremian
  5. Upper Jurassic

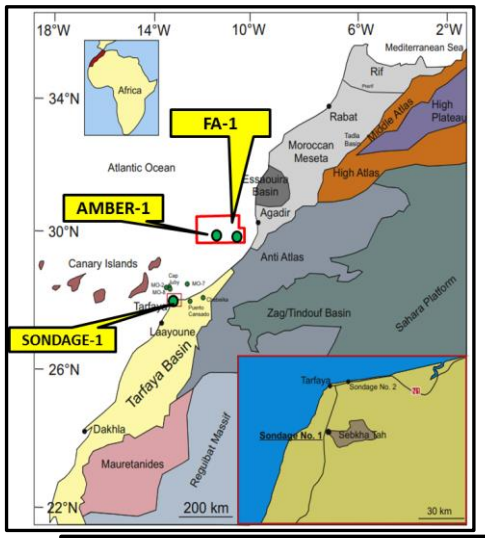
- Given the current depth of burial within the area at this stage of the source rock evaluation Europa have focussed on the potential of the Campanian, Cenomanian-Turonian and Albian source rocks

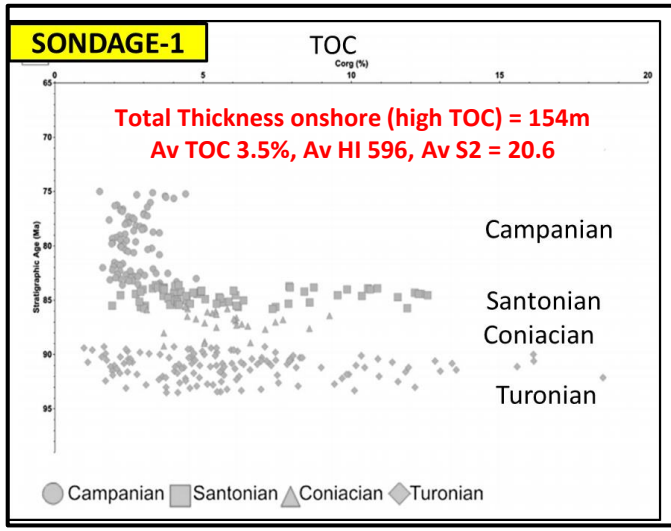


1. Drilled on block
2. Drilled on block
3. Drilled on block

Source Rocks – Campanian/C-T/Albian

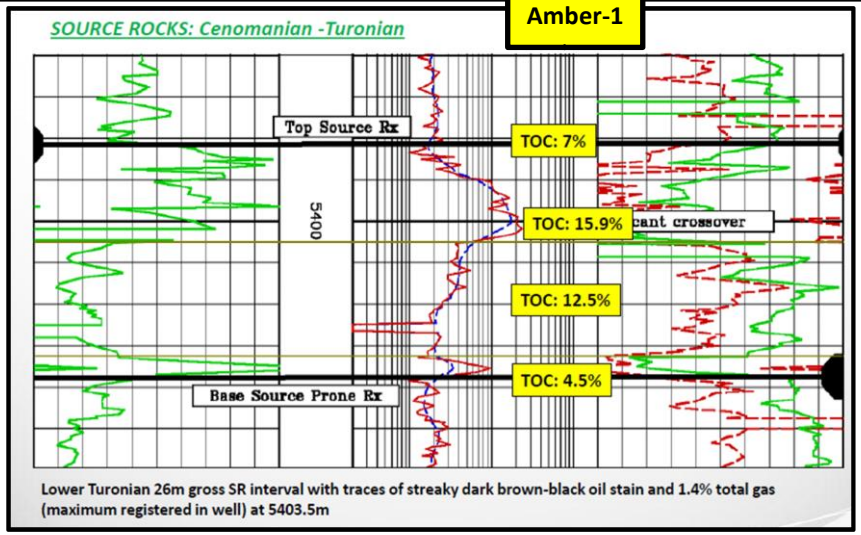






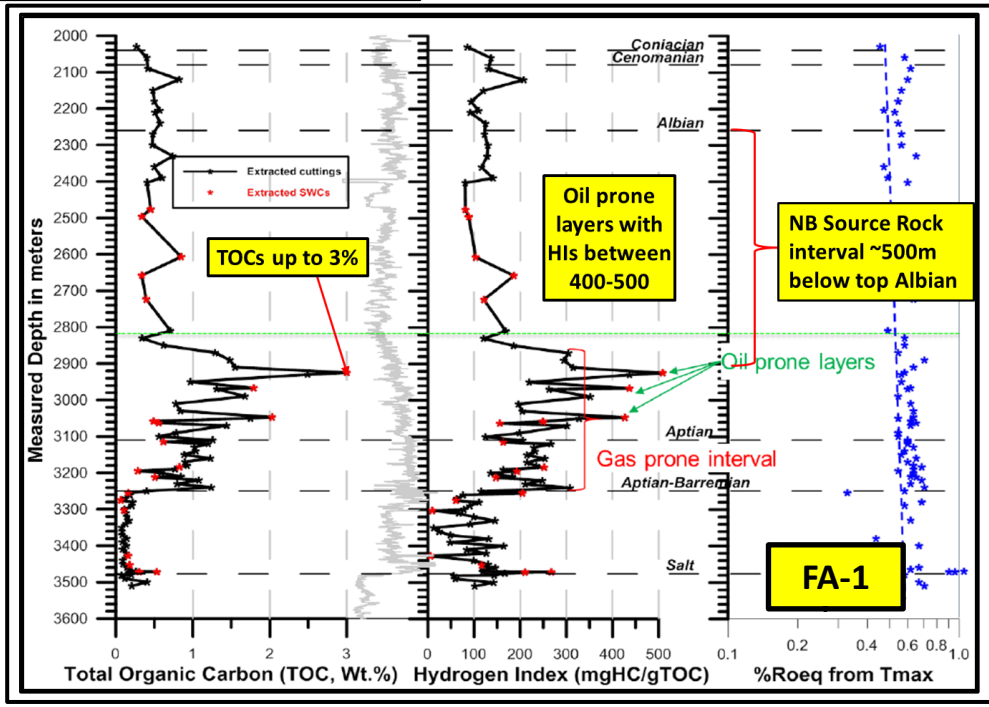
Campanian Inputs = HI 596, Thickness 134m, TOC 3.5. Campanian Expulsion Potential 36 MMBLS/km²

Campanian SR proven on block



Cenomanian Inputs = HI 600, Thickness 50m, TOC 10% C-T Expulsion Potential 38 MMBLS/km²

Cenomanian SR proven on block

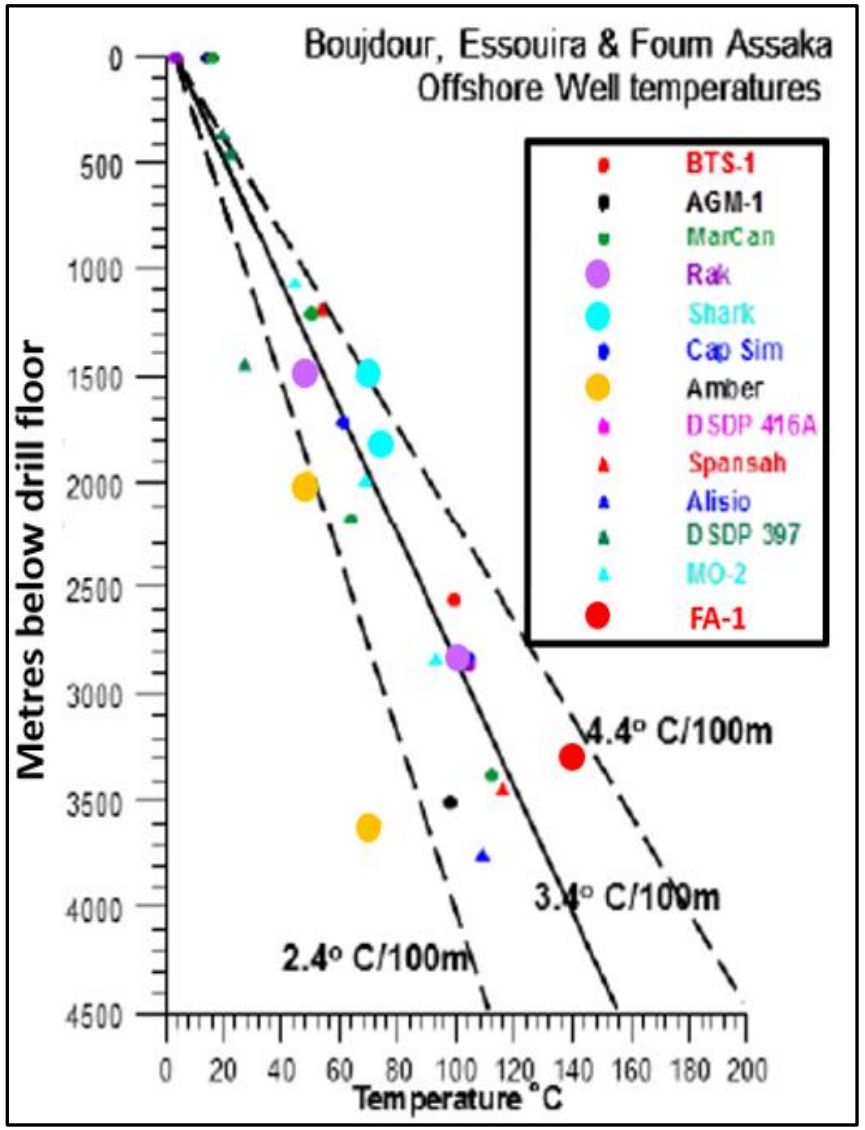


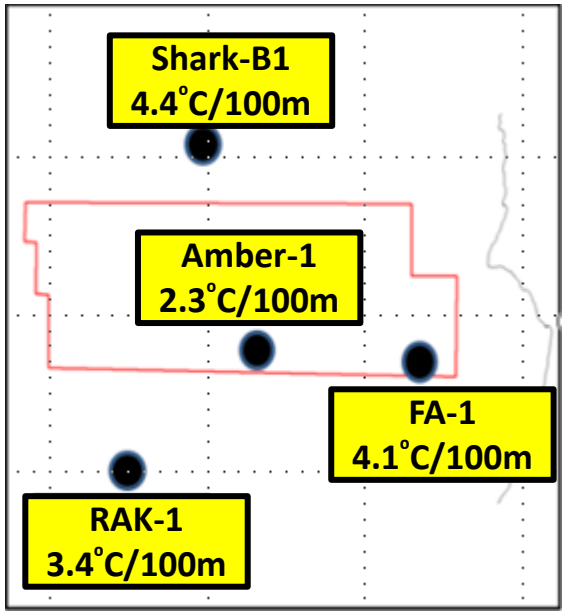
Albian Inputs = HI 340, Thickness 50m, TOC 5% Albian Expulsion Potential 9.5 MMBLS/km²

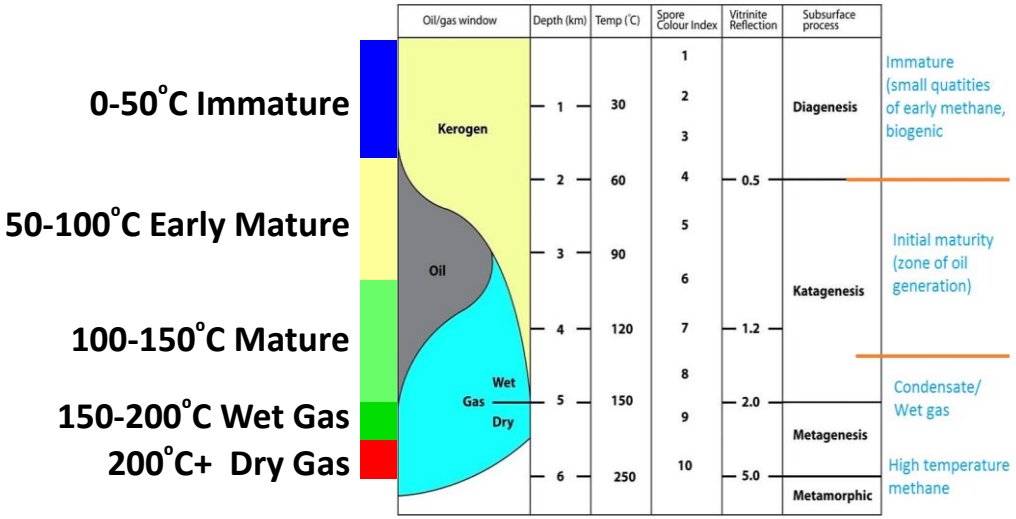
Albian SR proven on block

Geothermal Gradients from Nearest Wells

Large range due to variable effects of salt bodies







Mid-case of 3.3°C/100m used for maturity maps. 2.5 & 4.1°C/100m used as end member cases

Top Campanian SR Maturity Maps at 3.3°C/100m

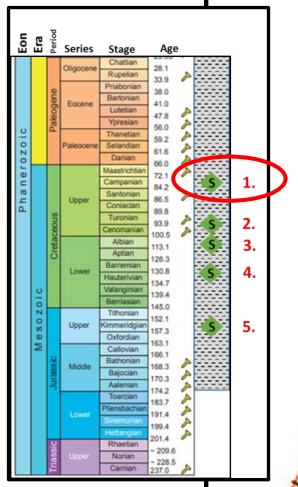
Fetch Areas and Expulsion Volumes shown for Top 5 Prospects

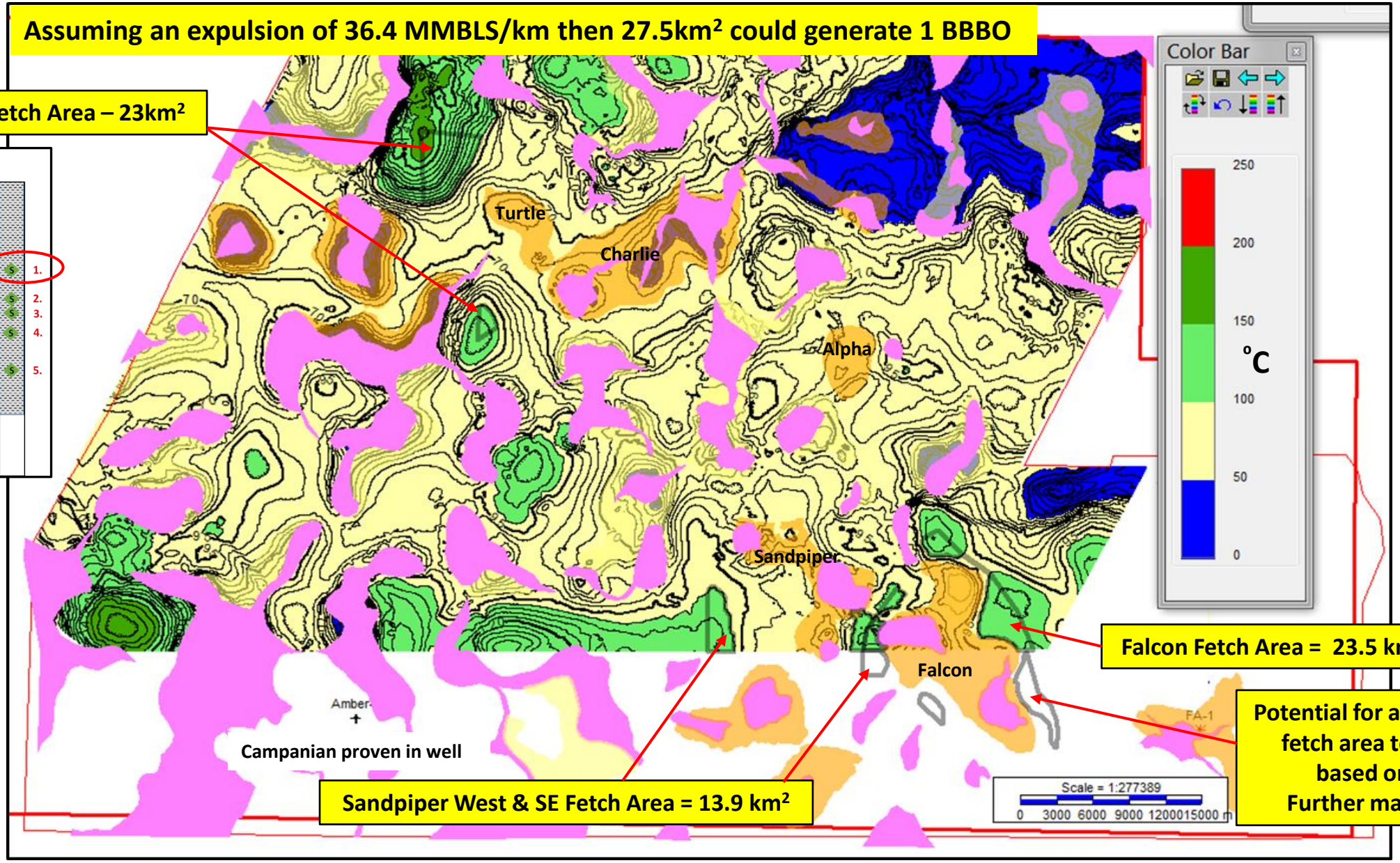
EUROPA Oil & Gas

Assuming an expulsion of 36.4 MMBLS/km then 27.5km² could generate 1 BBBO

3.3°C/100m

Turtle Fetch Area – 23km²





Falcon Fetch Area = 23.5 km²

Potential for a further 14.6 km² of fetch area to south of Falcon based on Albian map. Further mapping underway

Sandpiper West & SE Fetch Area = 13.9 km²

Campanian

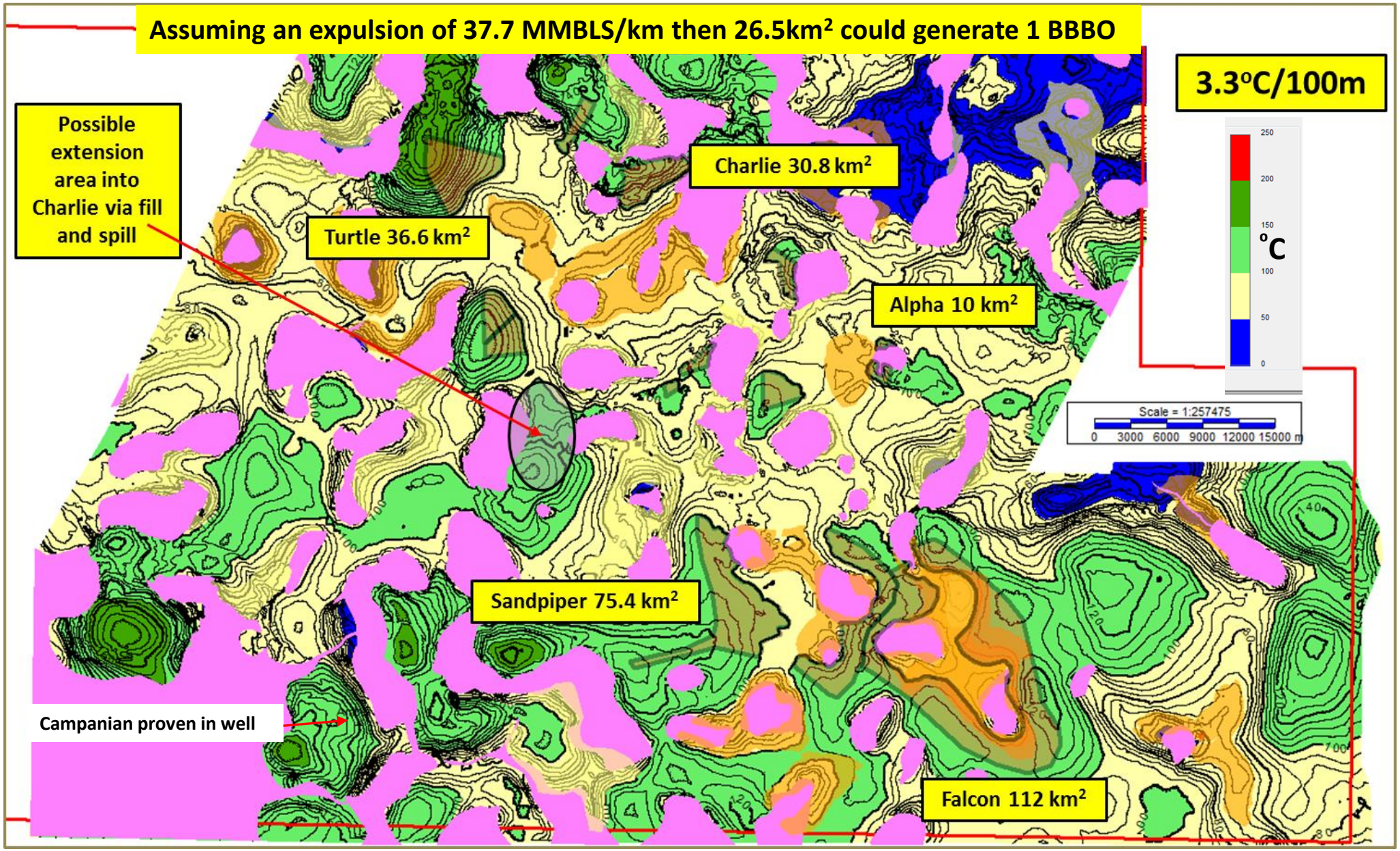
Campanian/Santonian source rock proven in Amber-1 and onshore. SR is mature in parts of the licence including Turtle, Sandpiper and Falcon kitchens (not Alpha or Charlie). High expulsion potential.

Top Cenomanian SR Maturity Maps at 3.3°C/100m

Fetch Areas and Expulsion Volumes shown for Top 5 Prospects

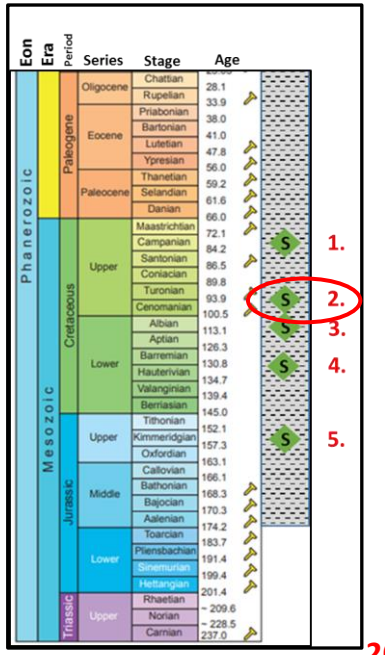
EUROPA Oil & Gas

Assuming an expulsion of 37.7 MMBLS/km then 26.5km² could generate 1 BBBO



Cenomanian

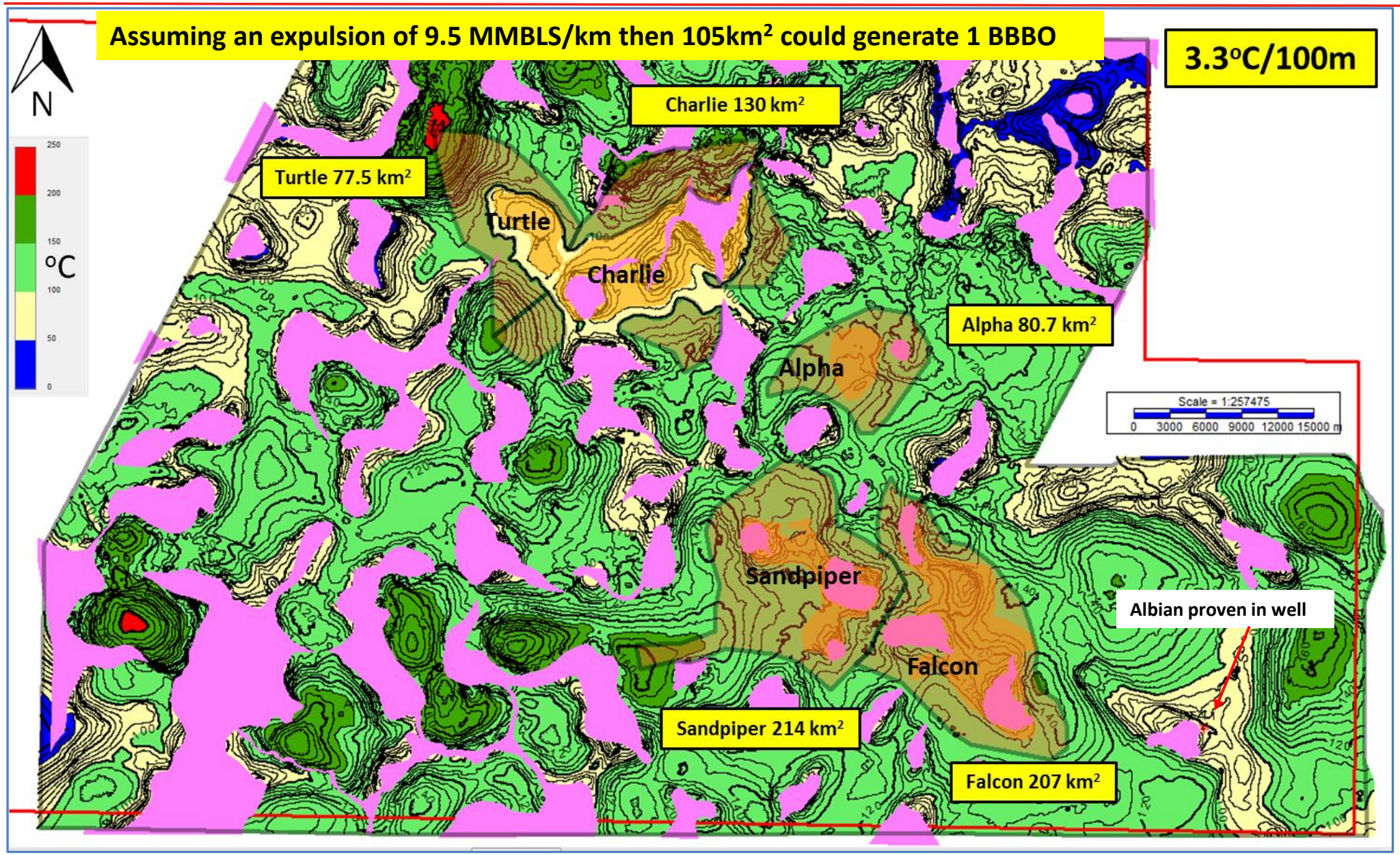
World Class Cenomanian Source Rock confirmed by well data and is widespread. CT source mature over large parts of the licence including the main prospects. High expulsion potential.



Top Albian SR Maturity Maps at 3.3°C/100m

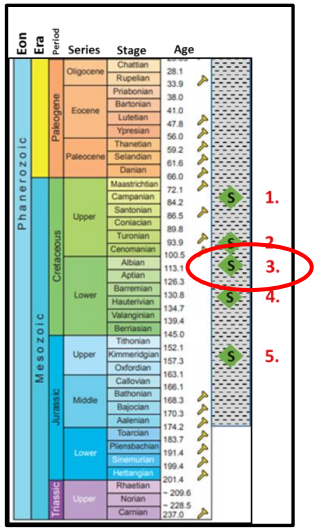
Fetch Areas and Expulsion Volumes shown for Top 5 Prospects

EUROPA Oil & Gas



Albian

Albian source rock confirmed by well data and is widespread.
Albian source rock is mature and sits optimally in oil window over almost all of the licence.
Large kitchen areas to all prospects and leads compensates for modest expulsion potential.



Inezgane Licence
Offshore Morocco

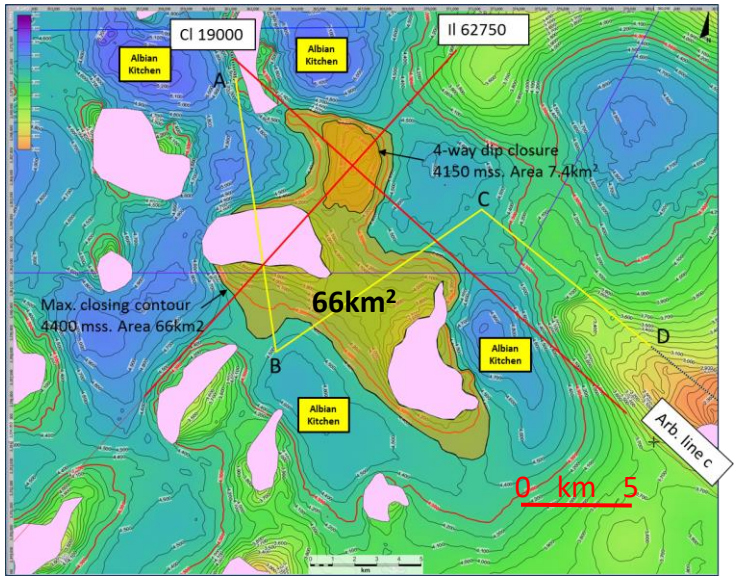
Big Prospects

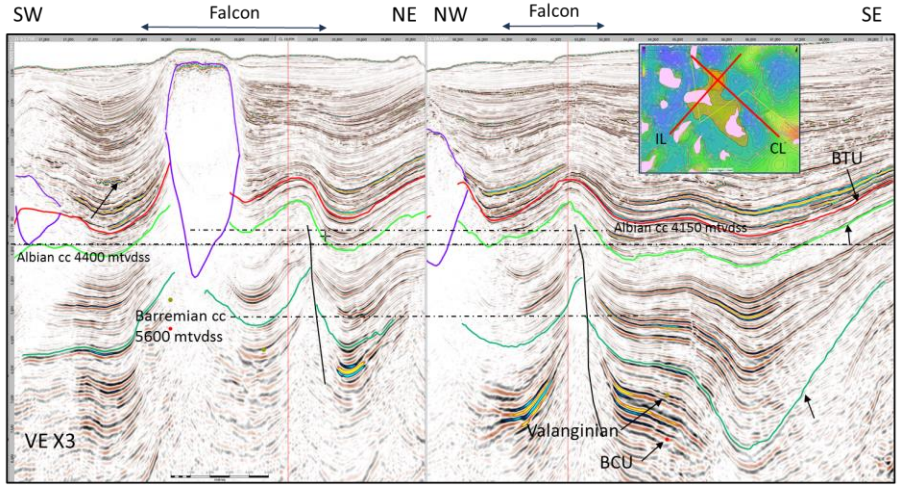
Multiple stacked pay opportunities exist in Morocco. In the Europa evaluation sand is predicted at Apto-Barremian, Albian and Campanian levels – classic West Africa play

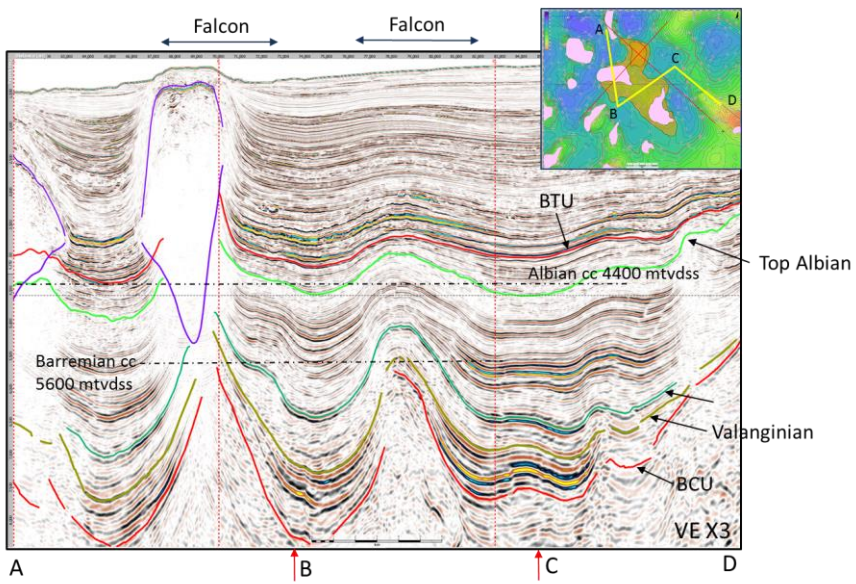
New Eocene/Miocene play has been developed

Falcon & Charlie/Turtle Prospect

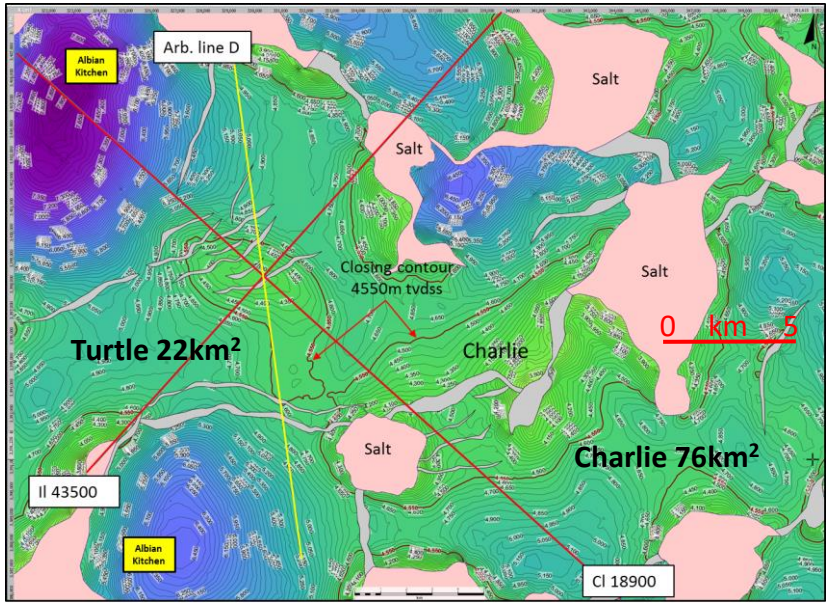
Top Albian depth map & Seismic Lines

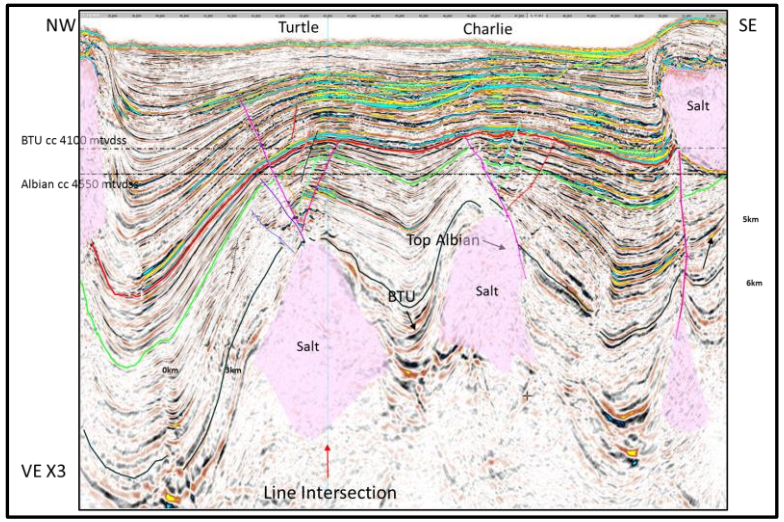


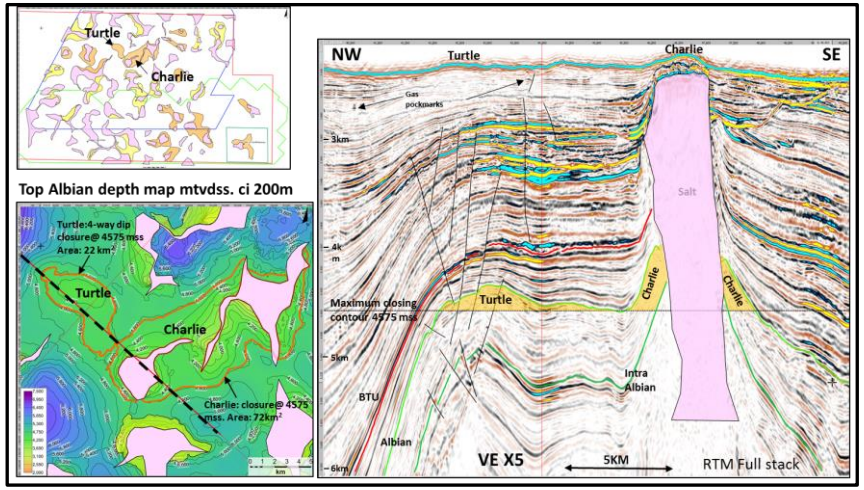




Falcon (salt flank) & Small 4 way







Turtle (4 way)/Charlie (salt flank)

Top 5 Prospects Summary

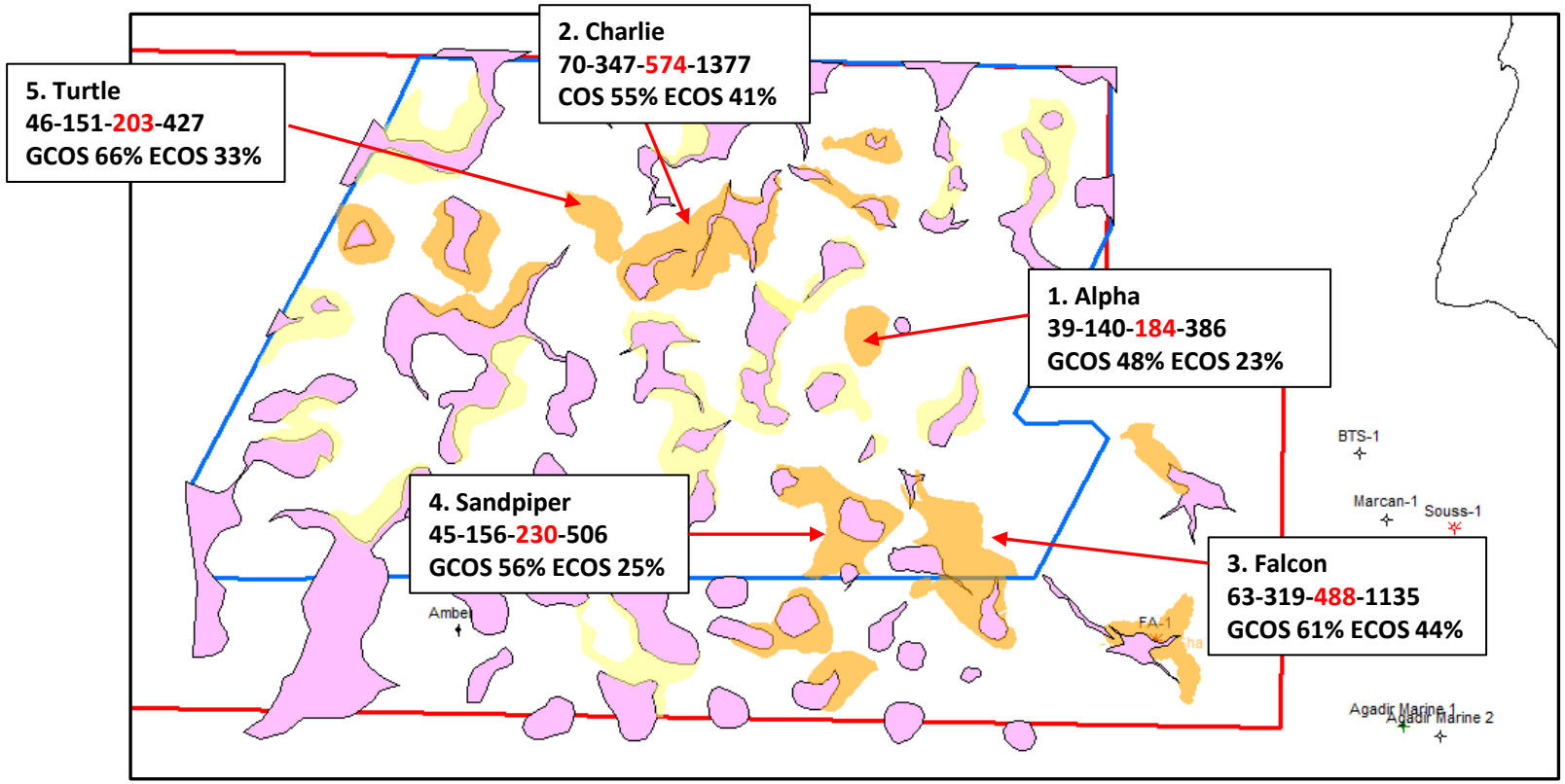
Top 5 Prospects		PRIMARY TARGET				SECONDARY TARGET				TERTIARY TARGET			
		Area of Closure	Unrisked Prospective Resources (mmboe) at Albian Level			Area of Closure	Unrisked Prospective Resources (mmboe) at Campanian Level			Area of Closure	Unrisked Prospective Resources (mmboe) at Barremian Level		
No.	Name	km^2	P_{90}	P_{mean}	P_{10}	km^2	P_{90}	P_{mean}	P_{10}	km^2	P_{90}	P_{mean}	P_{10}
1	Alpha	20	60	201	391	9	20	53	98	25	39	150	302
2	Charlie	72	220	893	1924	61	57	271	582	49	36	216	498
3	Falcon	66	66	495	1321	72	44	279	630	40	37	197	432
4	Sandpiper	33	66	253	512	31	34	112	221	52	44	229	504
5	Turtle	22	77	243	466	10	35	89	160	15	26	104	211
Total (mmboe)				2085				804				896	

- **Top 5 Prospects**
  - Wide range of structural styles including 4-way dip, salt flank and salt under-hang
  - Stacked potential at Albian, Campanian and Barremian
  - All prospects have mean resources in excess of **200 mmboe** at Albian level – primary target
  - Total mean resource in excess of **2 billion barrels (oil equivalent) at Albian level**
  - Significant additional reserves potential at Campanian and Barremian – secondary & tertiary targets
  - Prospect risk estimates between 22% and 33% for Albian and improve markedly when prospects are consolidated

Top 5 Prospect 3 level Consolidation

Campanian, Albian and Barremian levels

Prospect	P90	P50	Pmean	P10	GCOS %	Risked Mean MMBOE	ECOS (150 MMBOE)
Falcon	63	319	488	1135	61	298	44%
Charlie	70	347	574	1377	55	316	41%
Turtle	46	151	203	427	66	134	33%
Alpha	39	140	184	388	48	88	23%
Sandpiper	45	156	230	506	56	129	25%

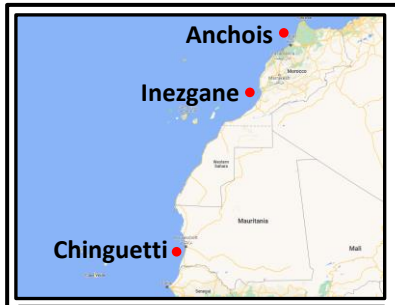


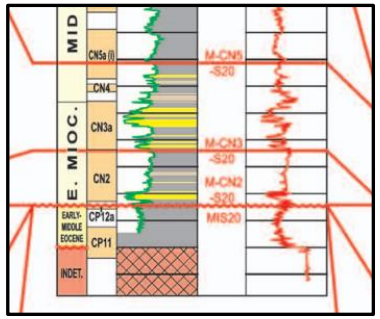
Albian Prospect Shapes Shown

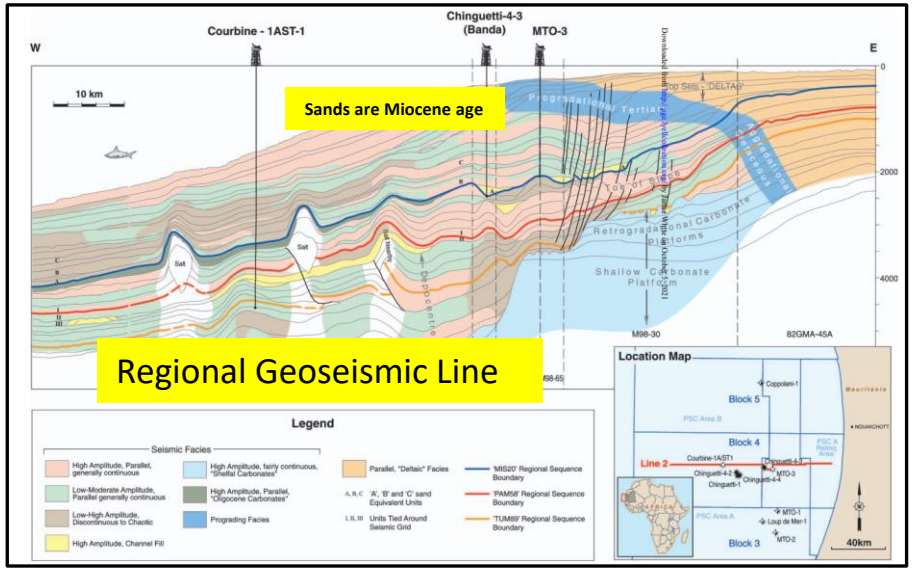
Regional Miocene Fields (Chinguetti & Anchois)

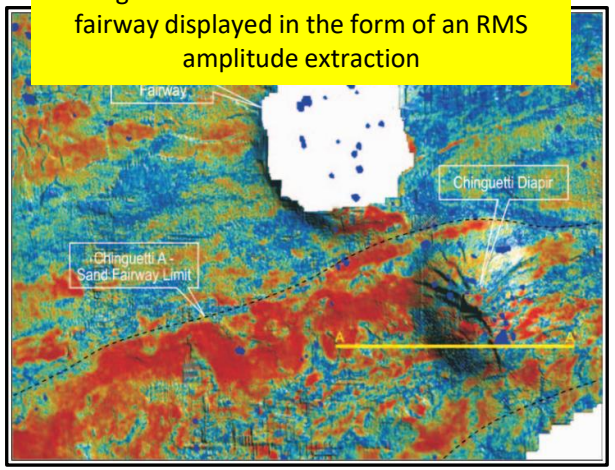
– Analogues to Inezgane?

EUROPA Oil & Gas

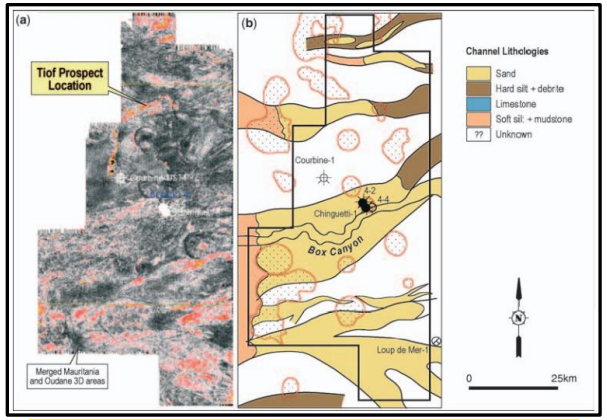






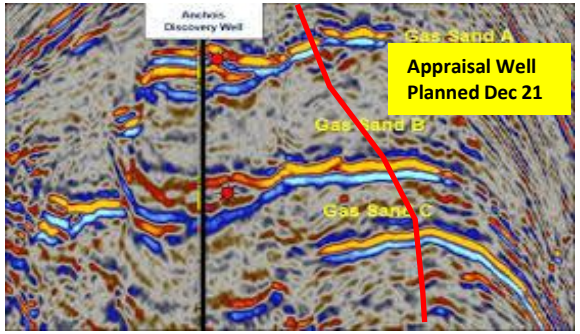


Chinguetti Oil Field

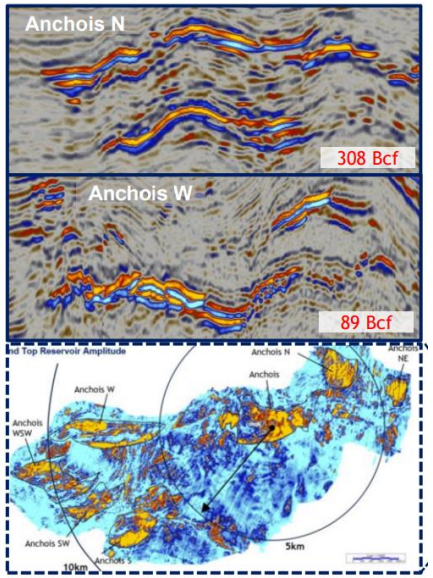


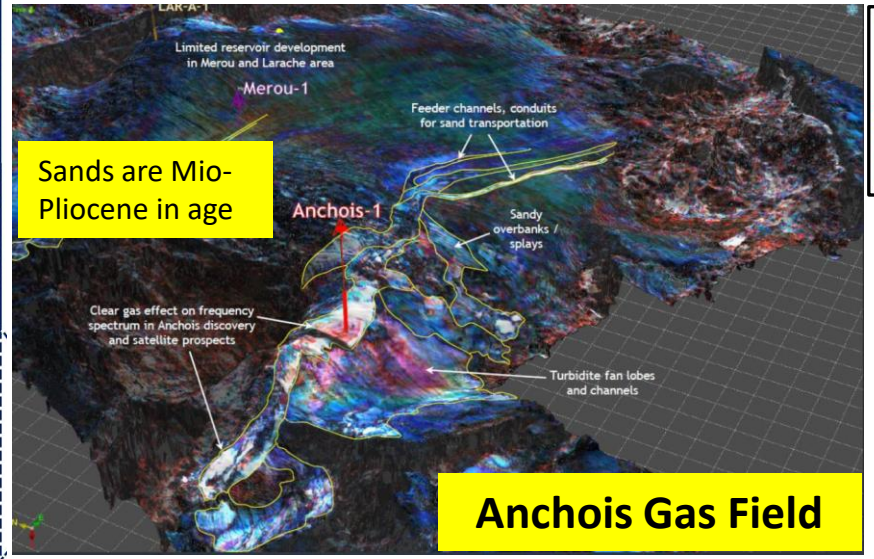
Bathyal Turbidites within the Chinguetti Canyon

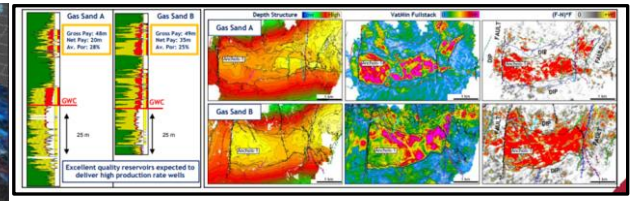
Figures after Year 2005

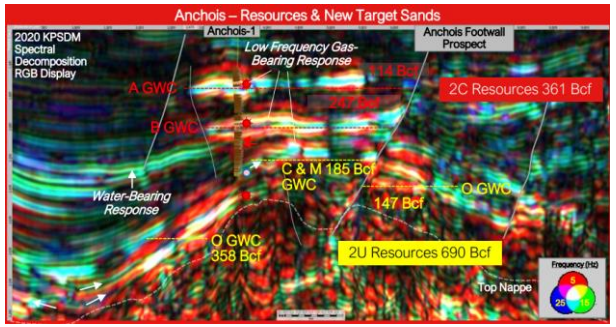


Reservoirs are directly imaged on seismic data, with distinctive seismic signatures, showing bright, high amplitudes and far-offset (AVO) seismic anomalies, increasing the confidence in the lateral extent of the sands away from the discovery well location and other systems on-block







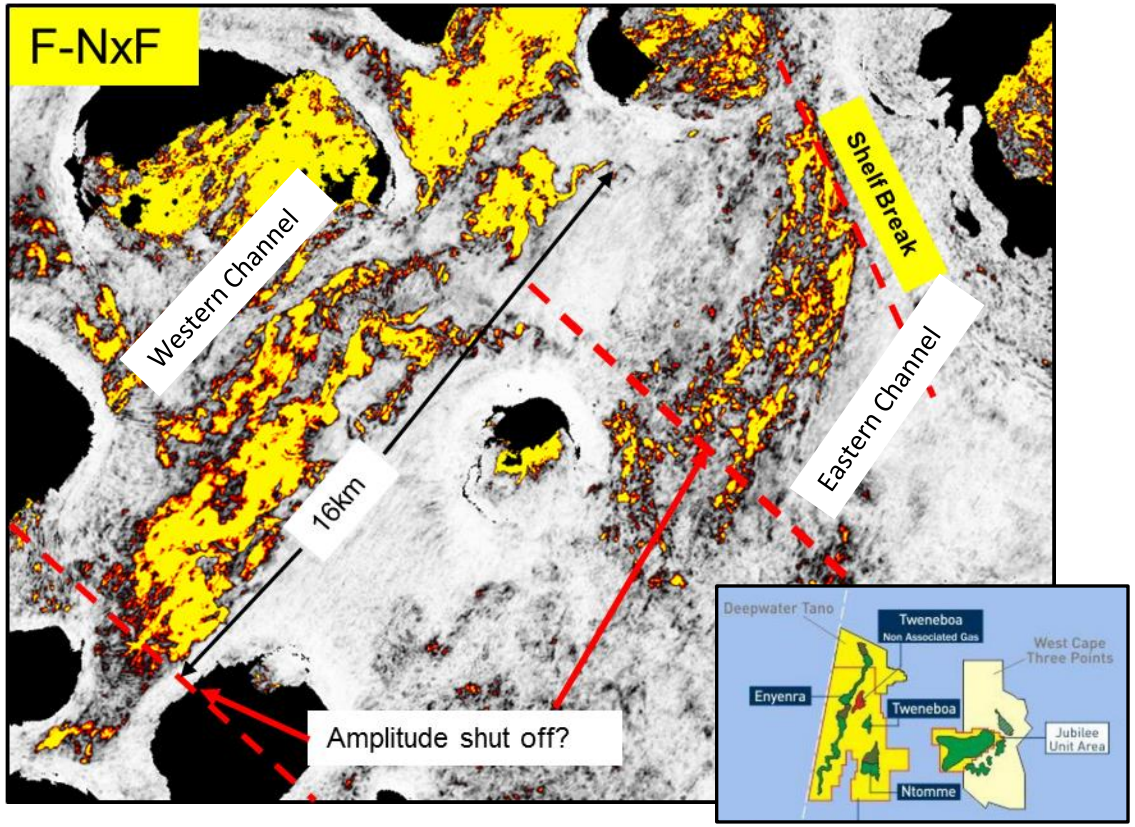


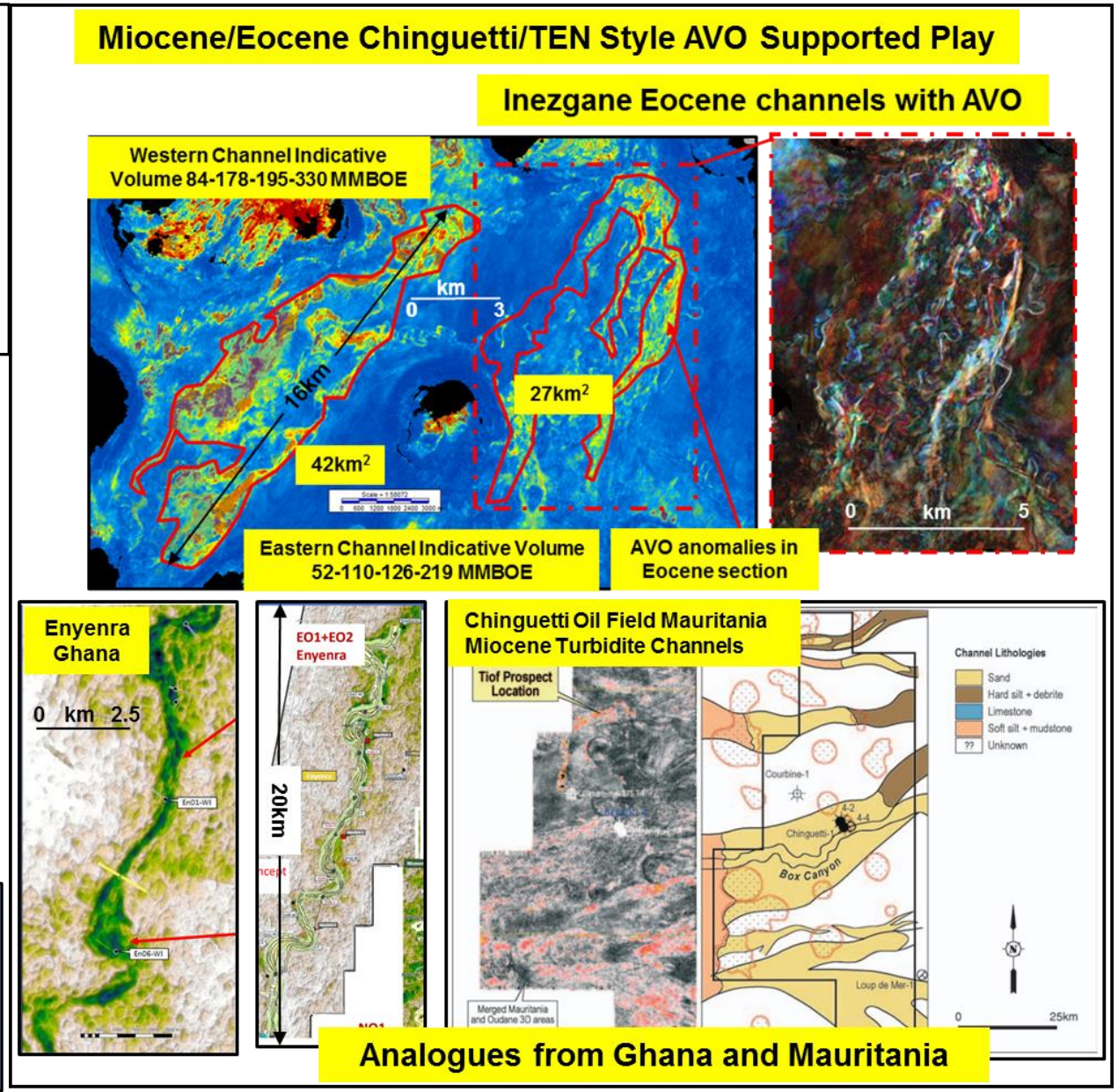
Figures after Chariot Energy

Tertiary Potential –

Miocene/Eocene/ Chinguetti/Ten Area Play

- Channel Systems clearly imaged
- Comparable in scale to amplitude play of TEN area in Ghana.
- Indicative of working hydrocarbon system?
- AVO supported – more work ongoing. Rock Physics needed to understand nature of AVO. Potential play uncovered.





Conclusion

Multiple Source Rocks	✓	Source rocks proven on block at Campanian, Cenomanian-Turonian and Albian levels. Mature Kitchens surround the top 5 prospects
Reservoirs	✓	Onshore work has proven the existence of fluvial/shallow marine sandstones with an offshore paleocurrent direction. PaleoScan work has confirmed the presence of sand in the deep offshore down to the Campanian/Albian level.
Seals	✓	Shales and Salt proven in the basin
Big Prospects	✓	Large prospect size at three prospective levels. STOIIP of over 5 BBBO (Albian) alone in Top 5 prospects. Upside potential in potential Mio/Eocene play.

Opportunity for a farminee to obtain a significant equity in return for back costs on a ground floor basis.

- **If you are interested in more information please contact either myself or Ian Wilson**
  - **Jamie White – jamie.white@europaoil.com**
  - **Ian Wilson – ian.wilson@europaoil.com**

Thank you for your attention we hope you enjoyed the walk & talk through our Inezgane Licence.