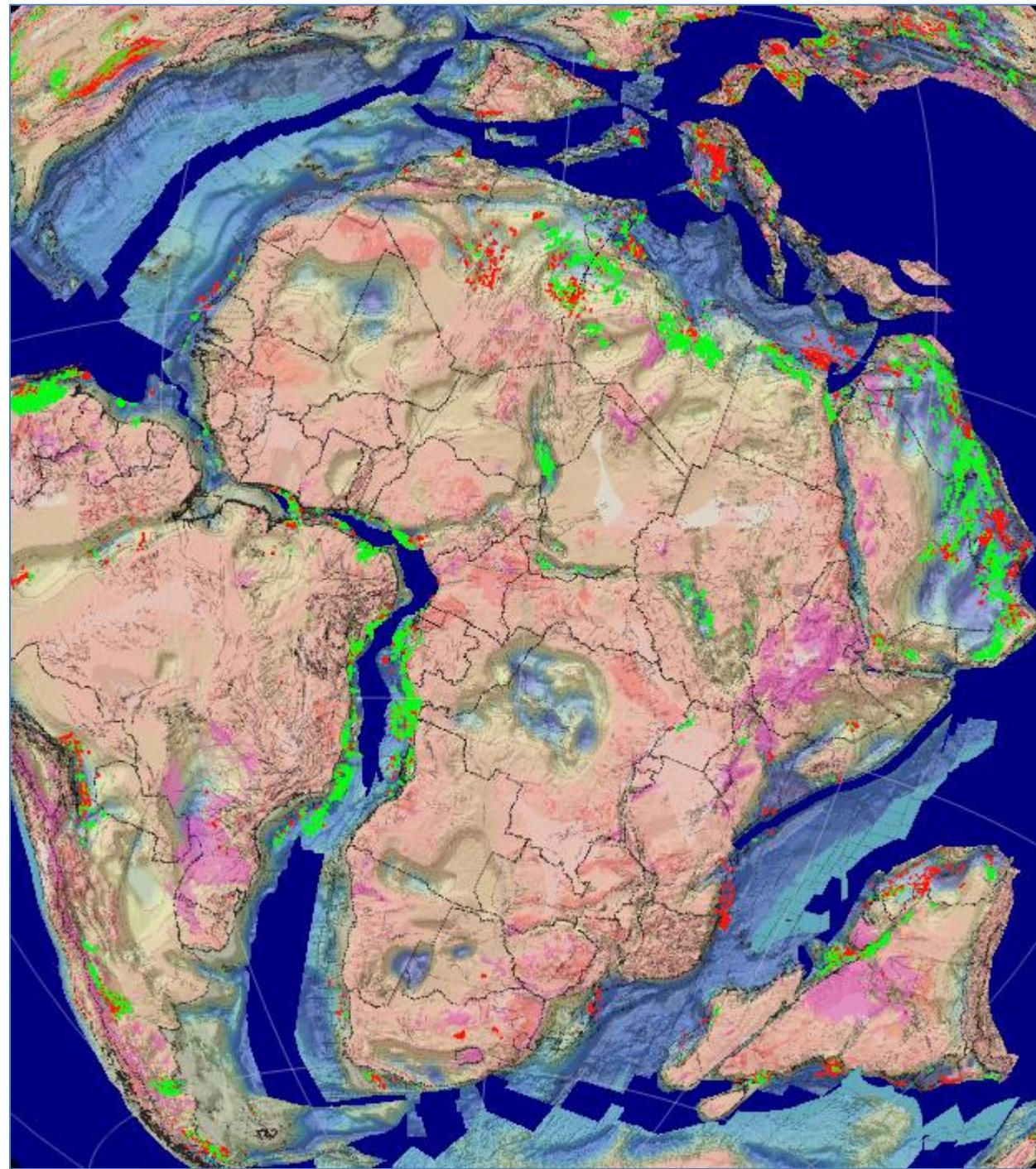


The African Atlantic Margin



The African Atlantic Margin: (musings from the desk of a retired geologist)

West Africa accounts for a large proportion of recent global deep water discoveries. The passive margin contains an enviable list of headline discoveries equaled by only those in Guyana/ Suriname, Brazil, Mozambique and GOM. Some prominent recent discoveries are:

- 1) Mauritania: Tortue Ahmeyim, Orca
- 2) Senegal: Yakaar Teranga, SNE
- 3) Cote D'Ivoire: Baleine
- 4) Ghana: Sankofa, Eban- Akoma, Afina
- 5) Nigeria: Owowo 2/3
- 6) Gabon: Leopard, Boudji
- 7) Angola: Agogo, Ndungu, Azul, Cameia
- 8) Namibia: Venus, Graff, La Rona, Jonker
- 9) S Africa: Brulpadda, Liuperd

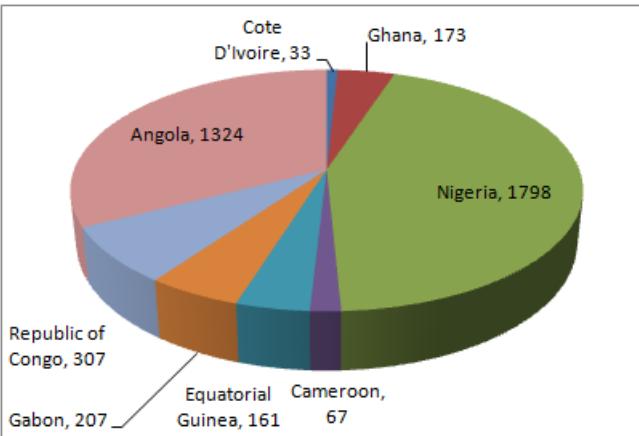
Current major Players in West Africa are Total, ENI, Shell, Exxon, Chevron, BP and NNPC.

West Africa's largest producers (Nigeria and Angola) are currently facing declining crude oil and condensate production with only a small number of new projects set to come online in the next five years. IOCs have been more cautious than ever over their OG investments in their legacy areas in West Africa ... as some of the huge discoveries made over the past decade have seen significant delays due to above ground issues (Niger Delta) with no final investment decision (FID) in sight.

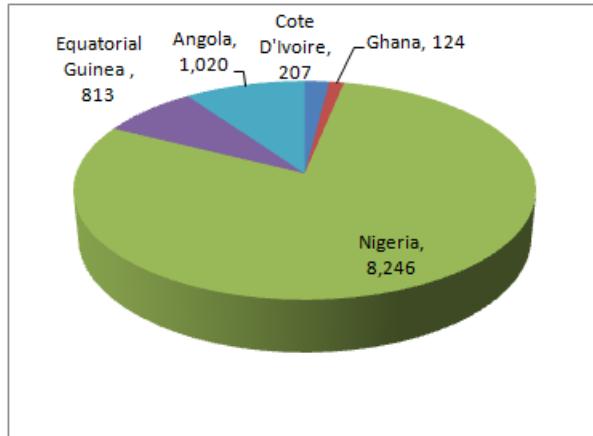
There is additional pressure on European majors to decarbonize and a lot of capital is being diverted to more gas-intensive, lower-carbon projects in countries with better fiscal terms such as Mauritania, Senegal and Mozambique. Some of these new frontiers are poised to be major LNG producers as their gas discoveries come online over the next few years.
(Offshore 2021)

The lack of significant new IOC investments in W Africa outside of their existing core areas opens up quite a lot of business opportunities for savvy smaller players who can deal with the above ground issues in the region. Deepwater oil exploration will still be the main draw in the region due to fresh impetus from SNE in MSGBC, Baleine in Tano and Venus/ Graff in the Orange basin.

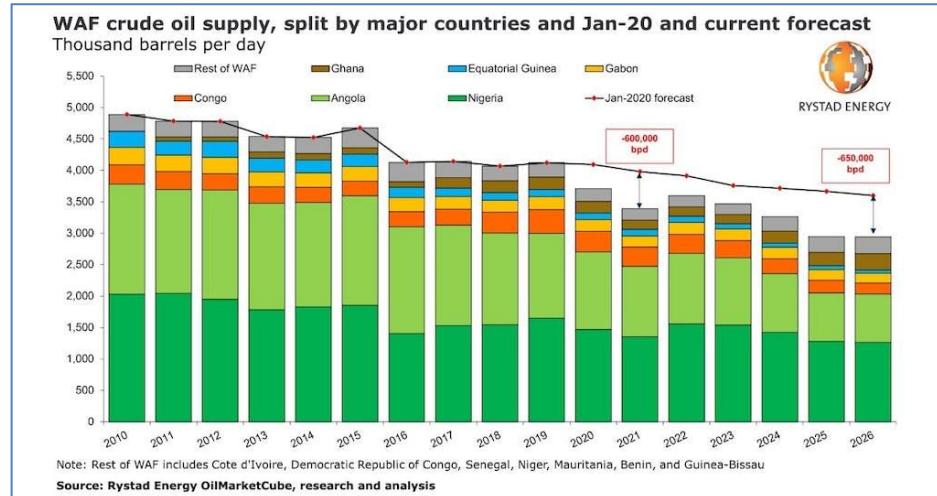
Major Oil Producers BOPD



Major Gas Producers MMCFD



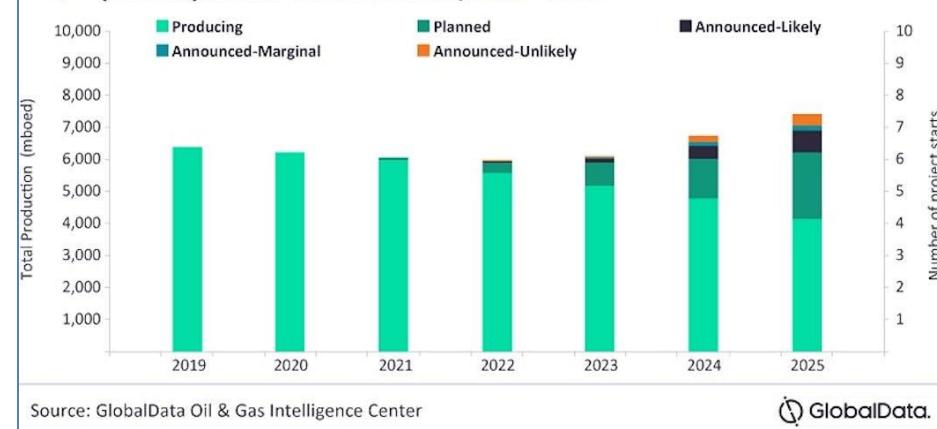
BP World Energy Stats 2021, World Odometers Info



Declining Oil Prod

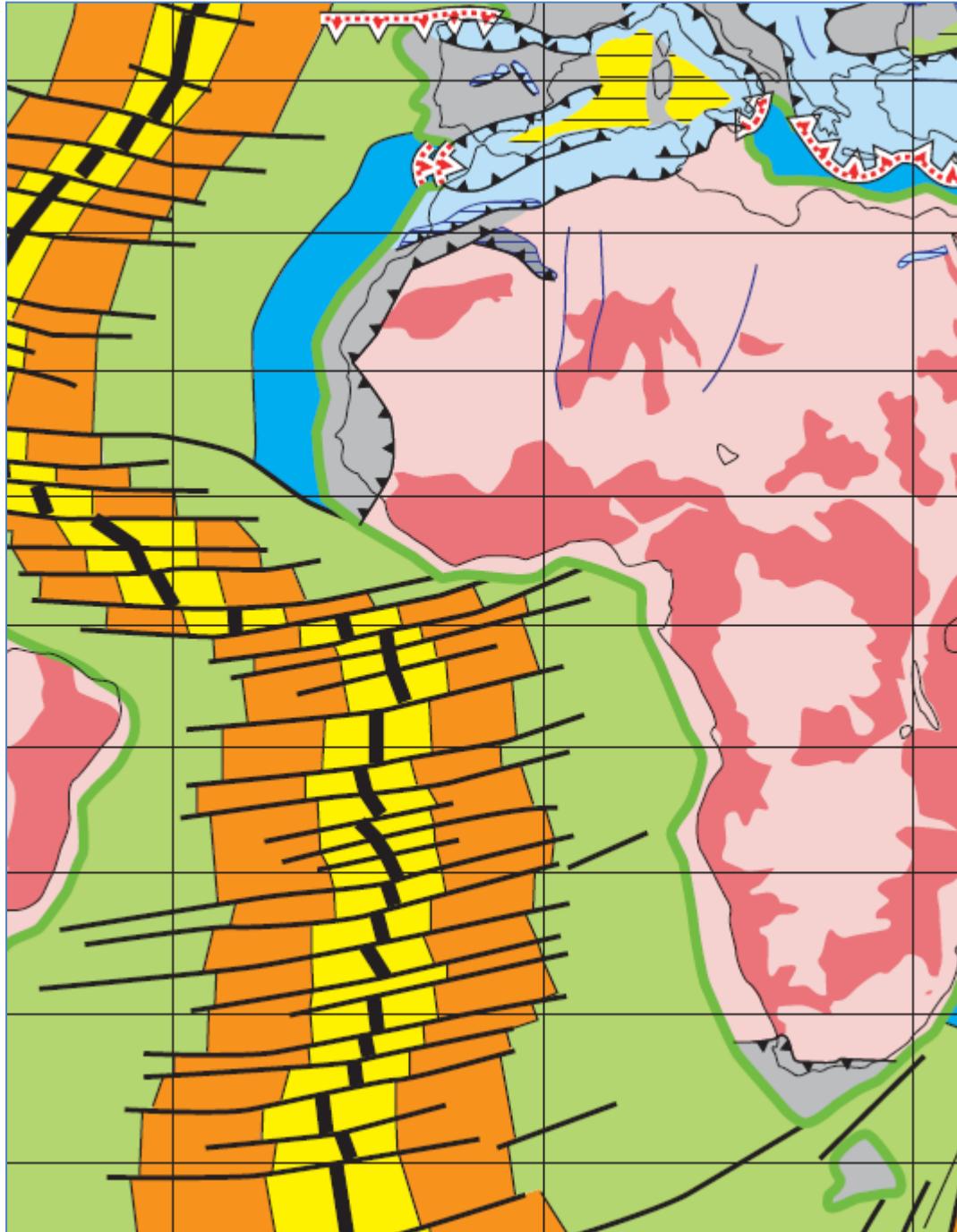
OGJ 2021, Rystad

Production outlook from producing, planned, and announced projects (mboed) in sub-Saharan Africa, 2019–2025

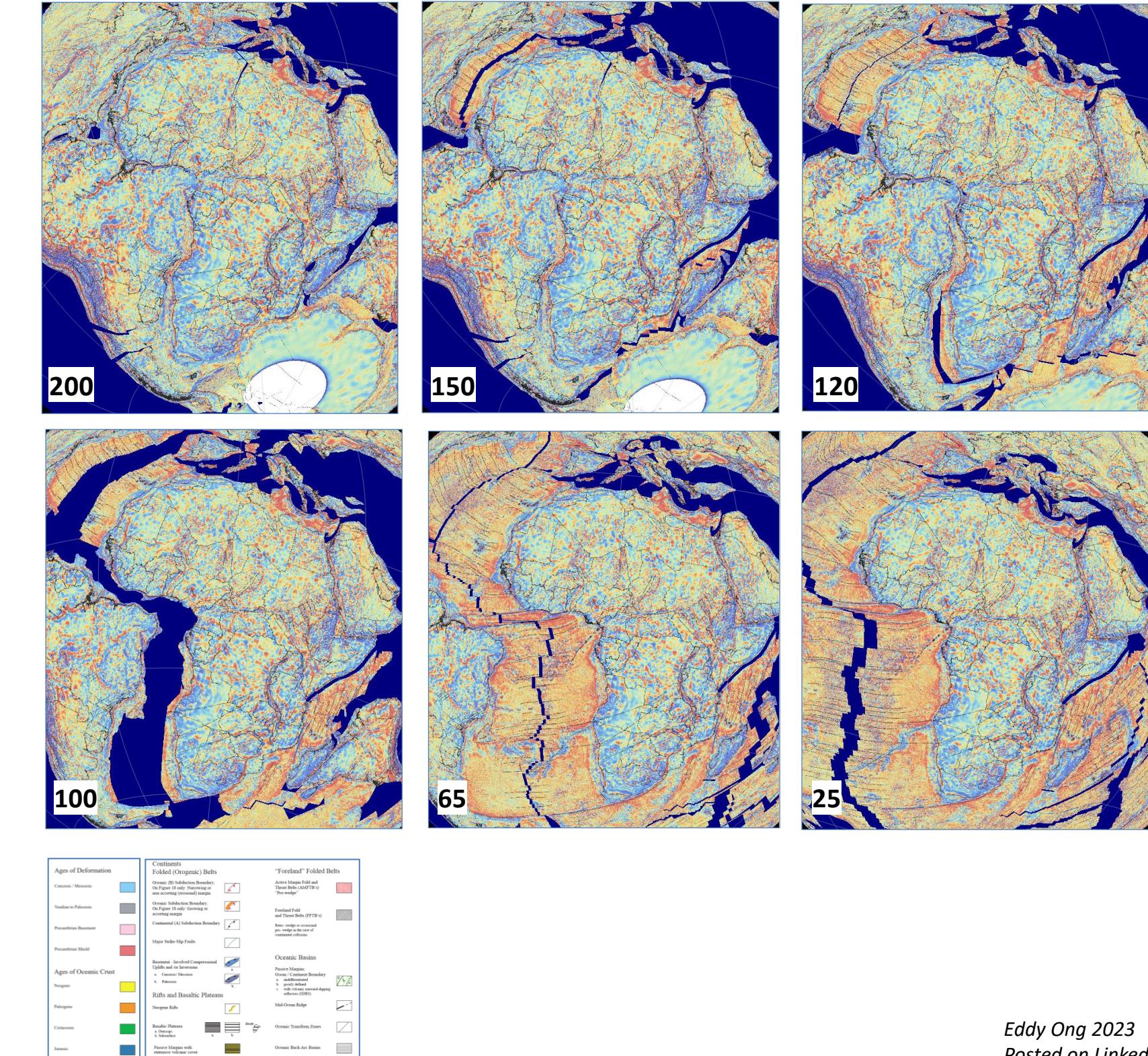


New LNG Gas Projects is expected to replace declining oil prod.

Tectonic Setting and Reconstruction

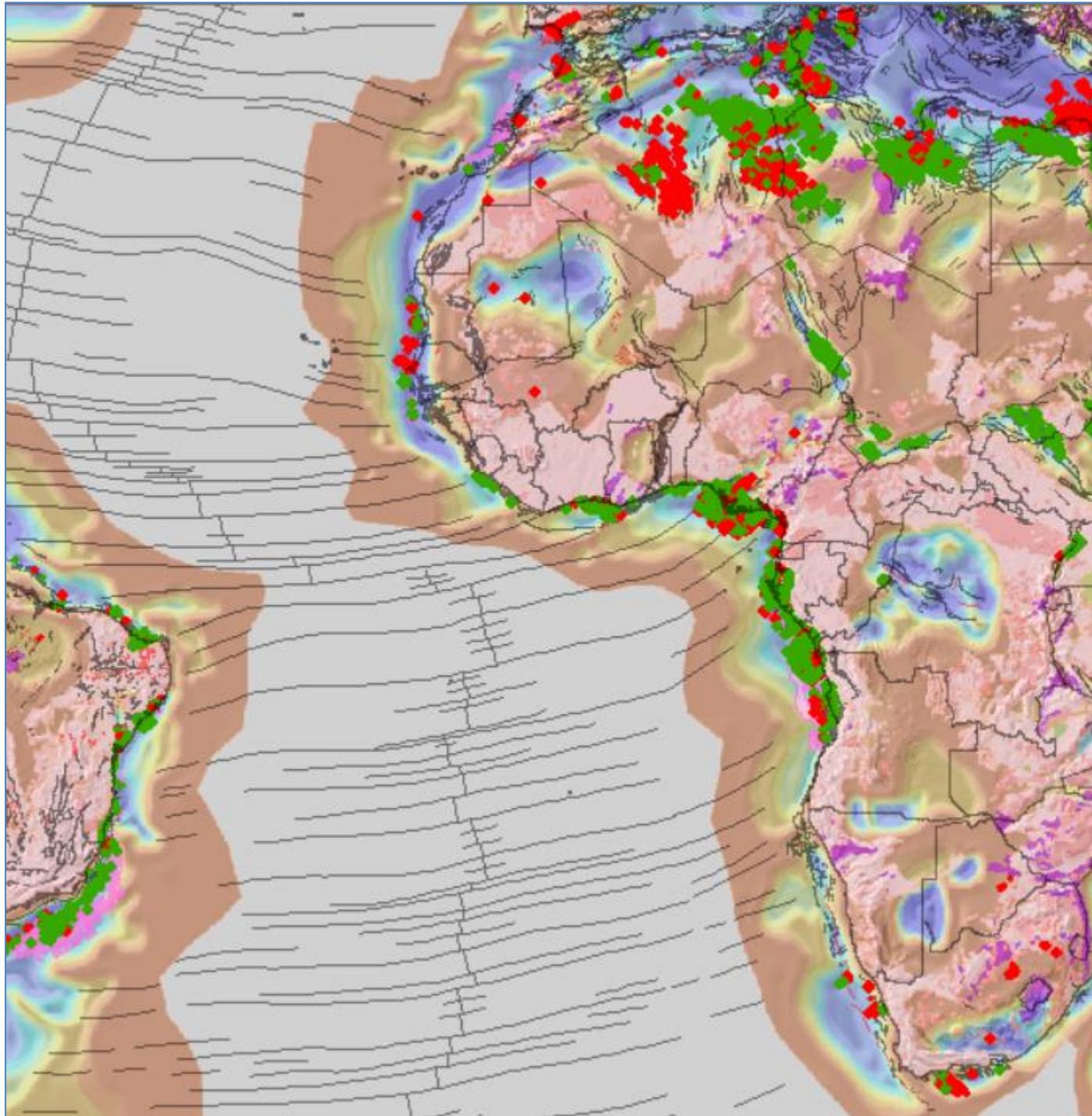
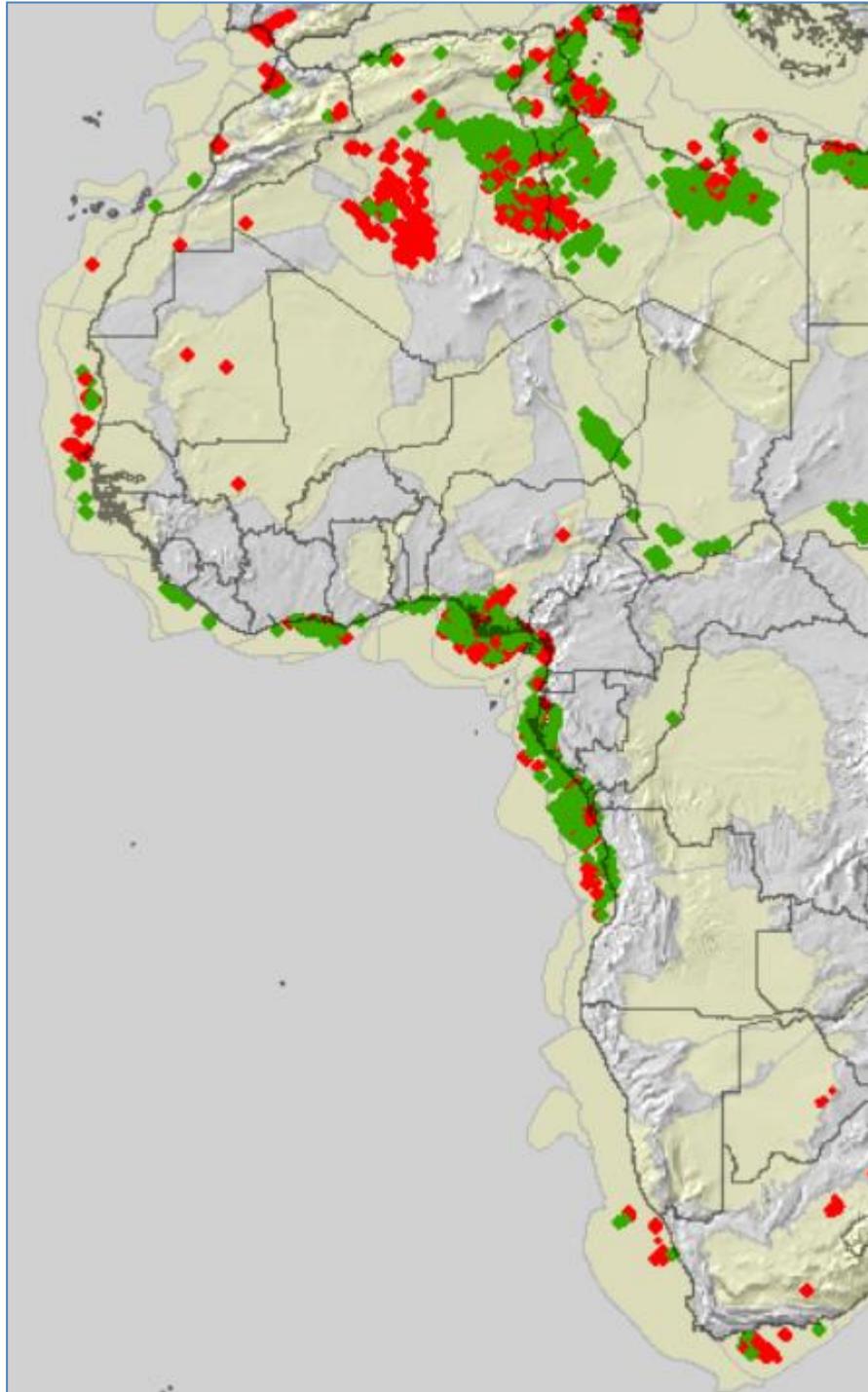


Bally et al 2020

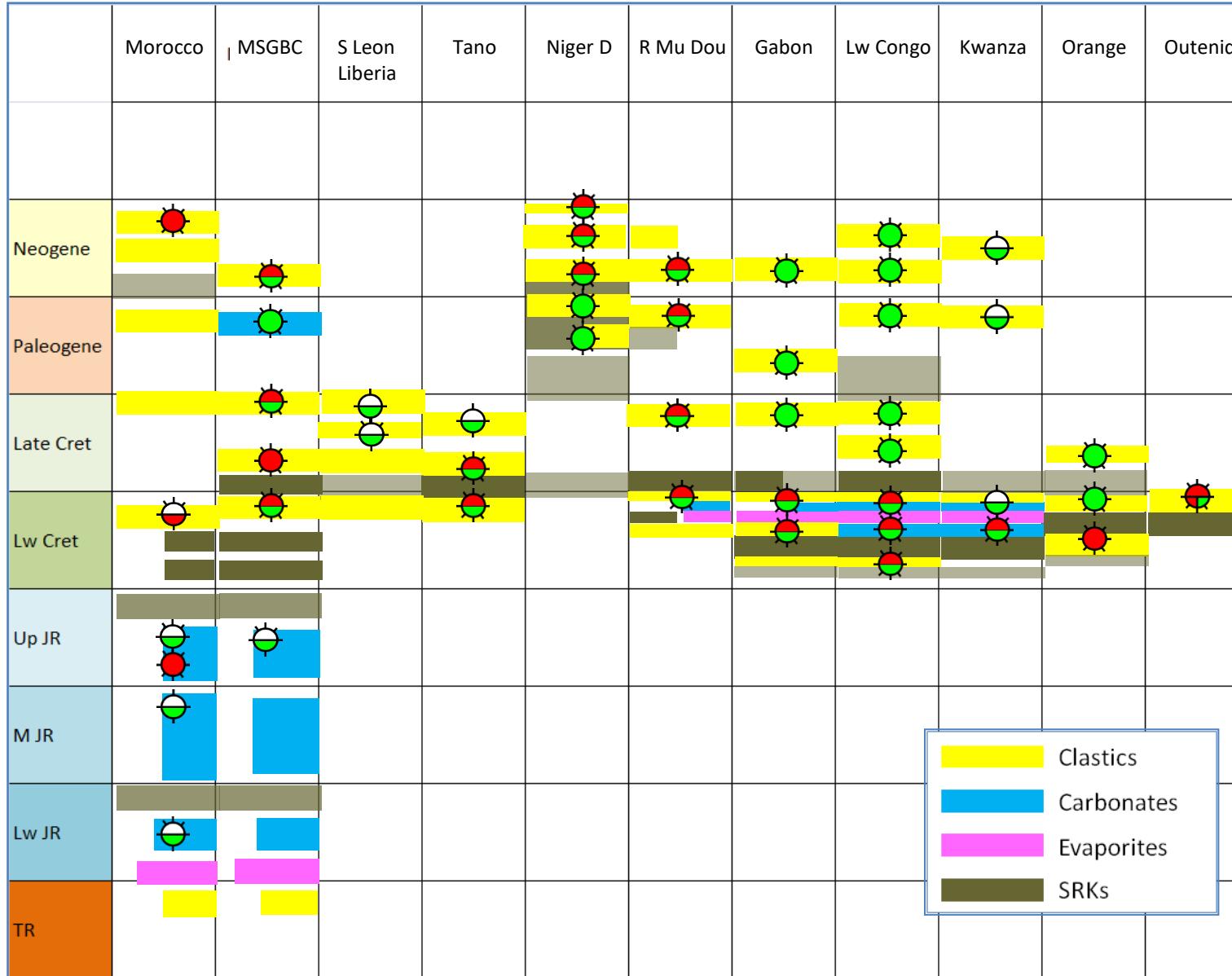


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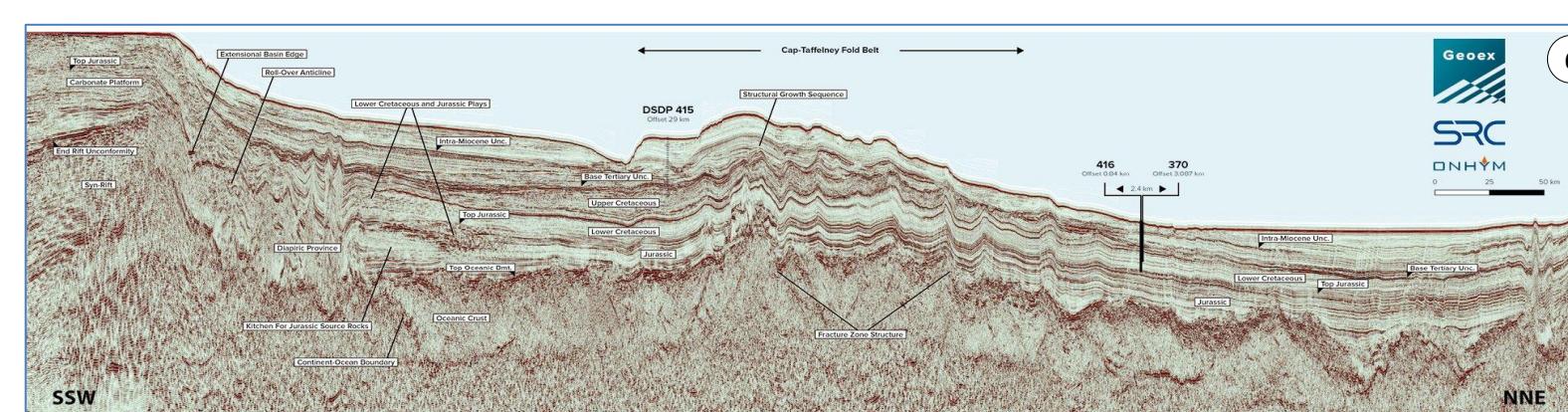
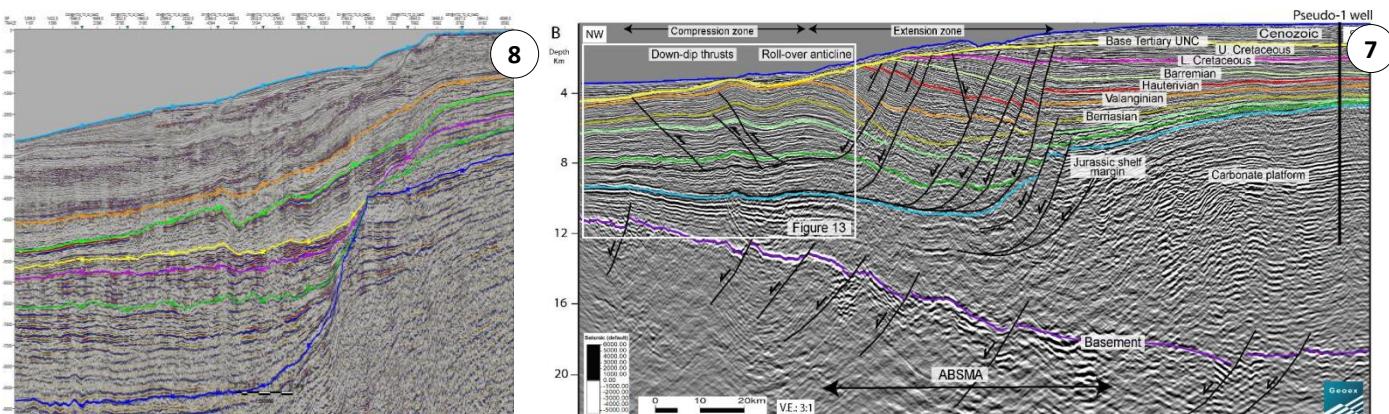
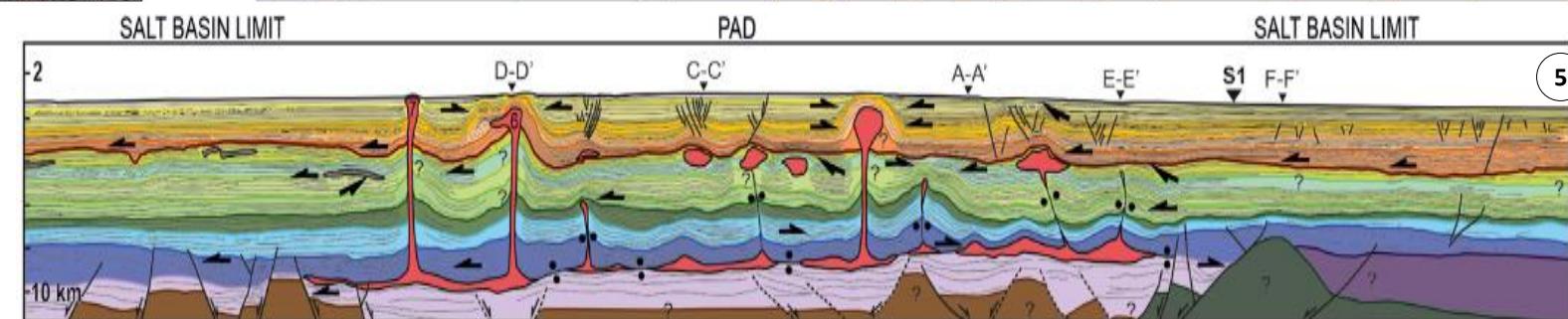
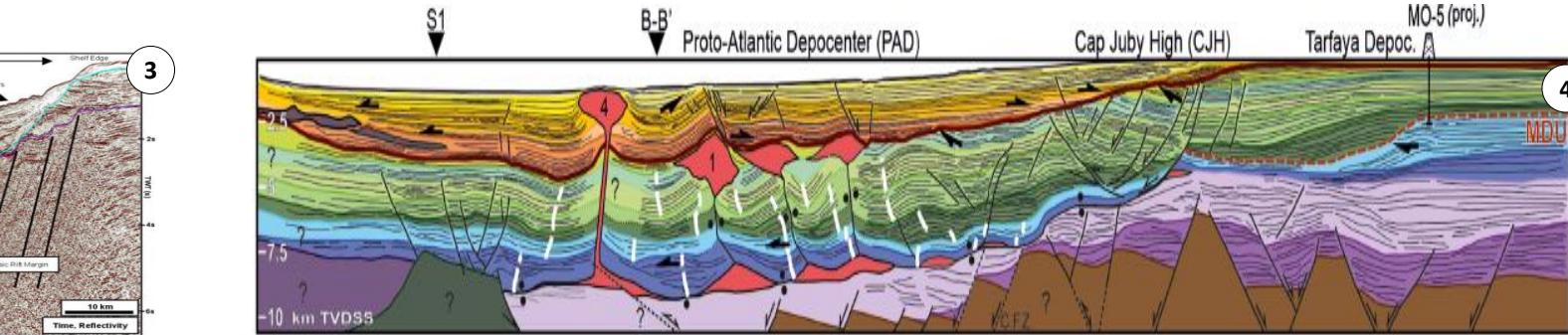
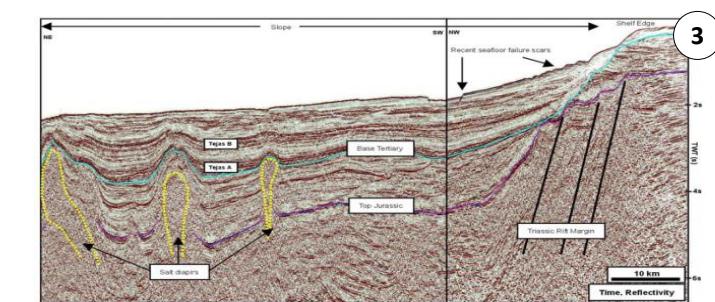
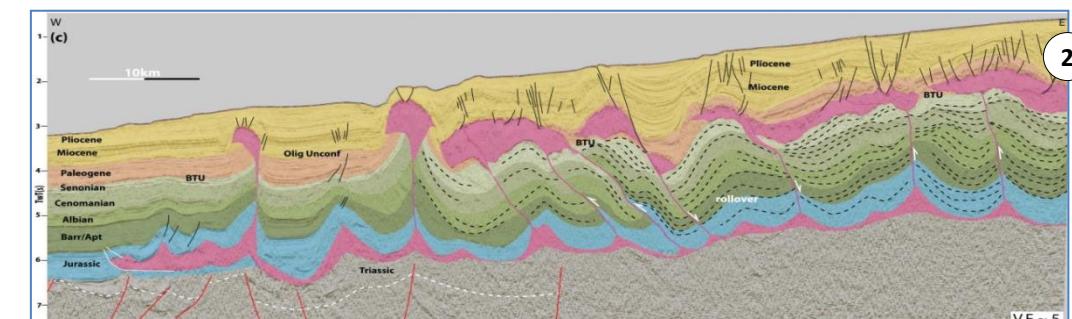
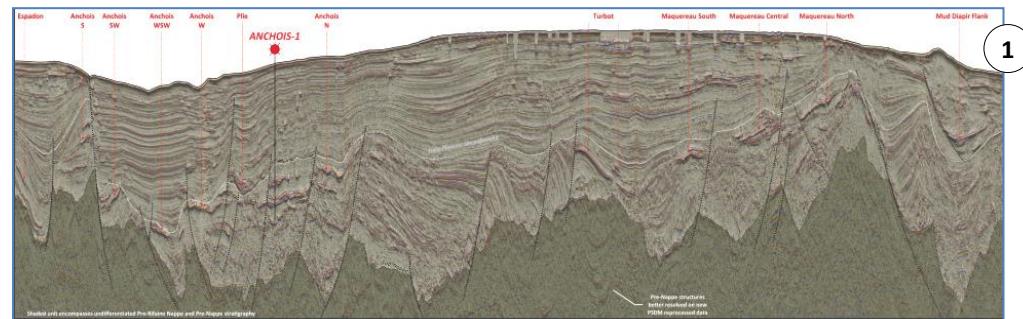
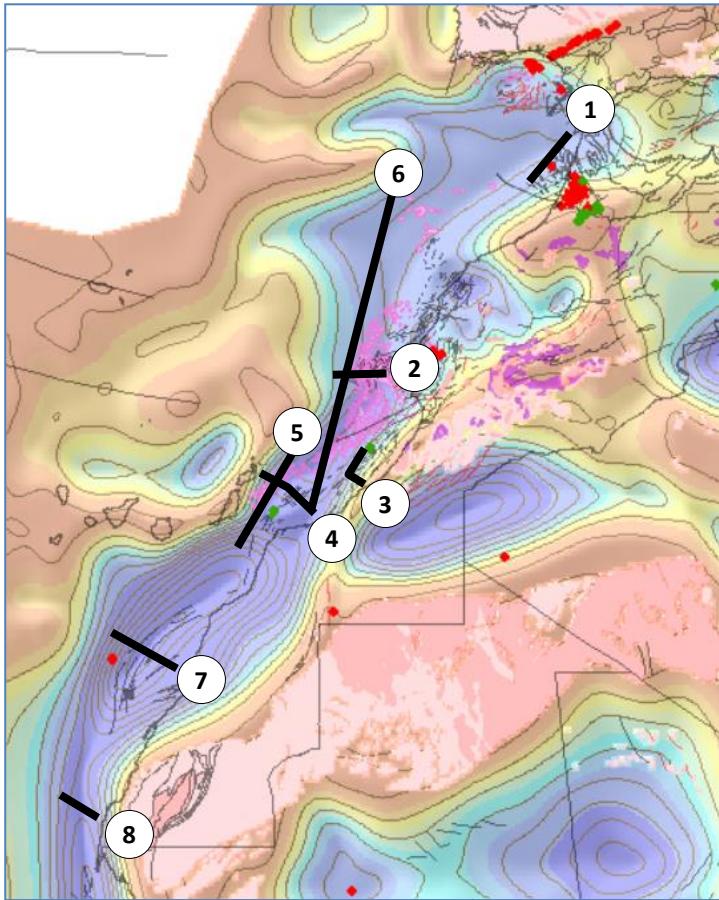
OG Fields and Reg Structure



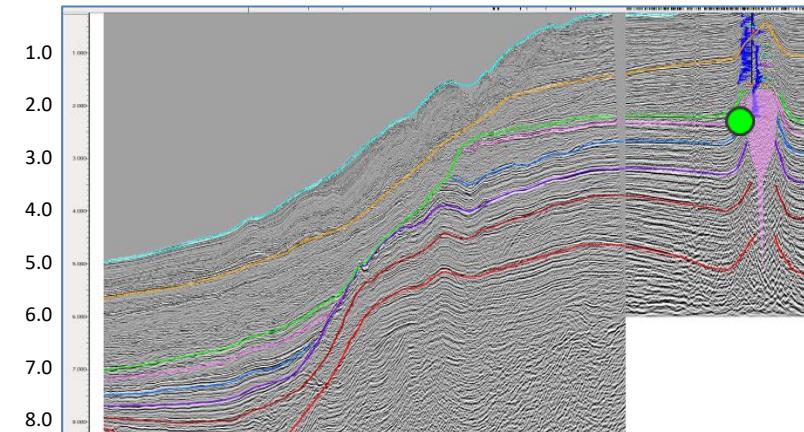
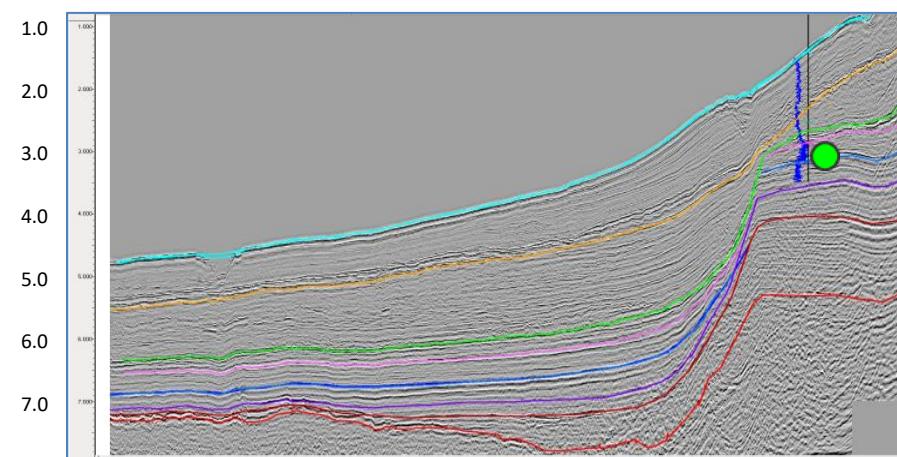
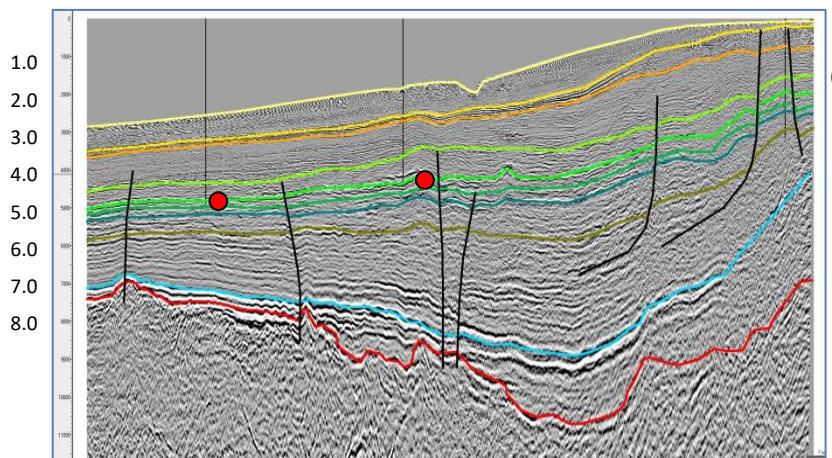
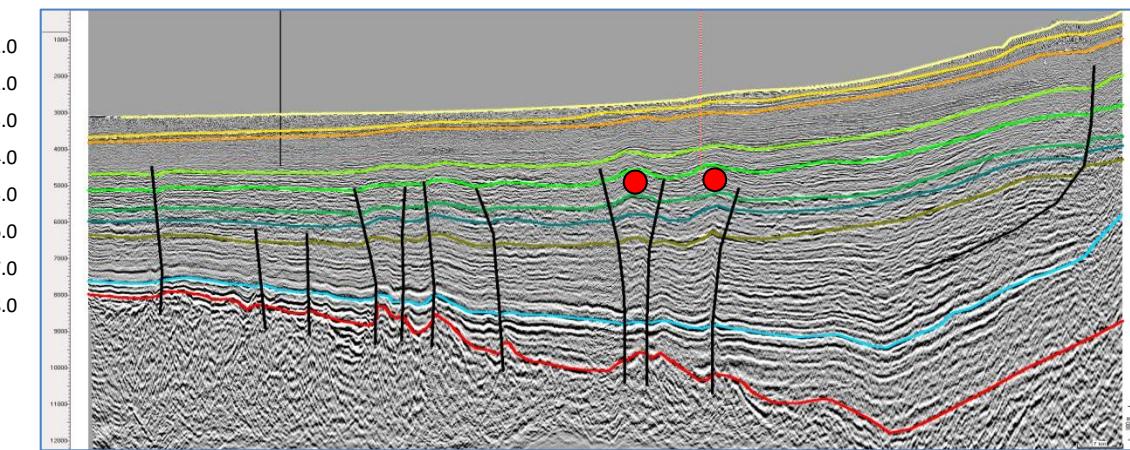
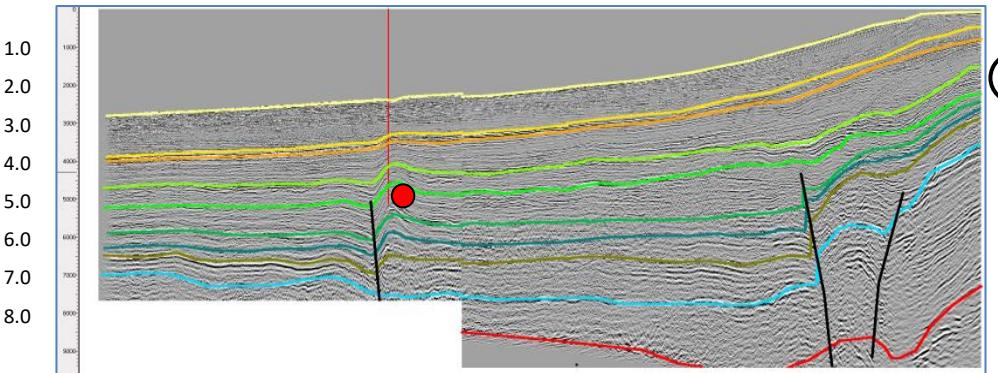
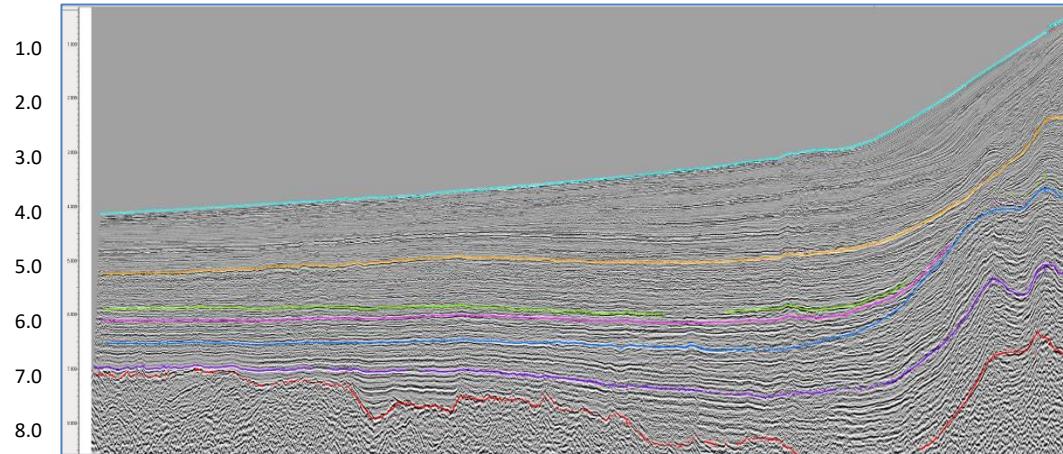
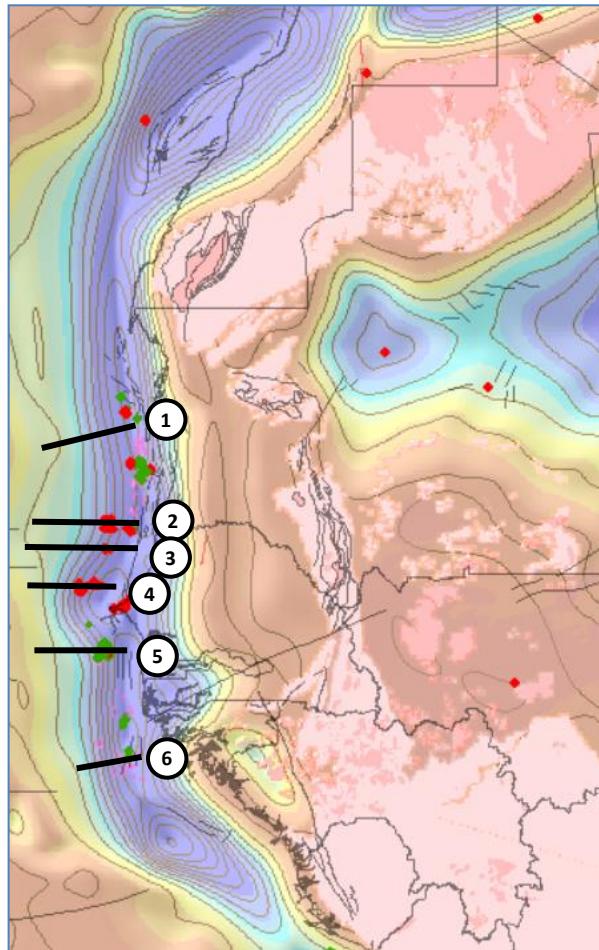
Some Generalized Stratigraphic Columns



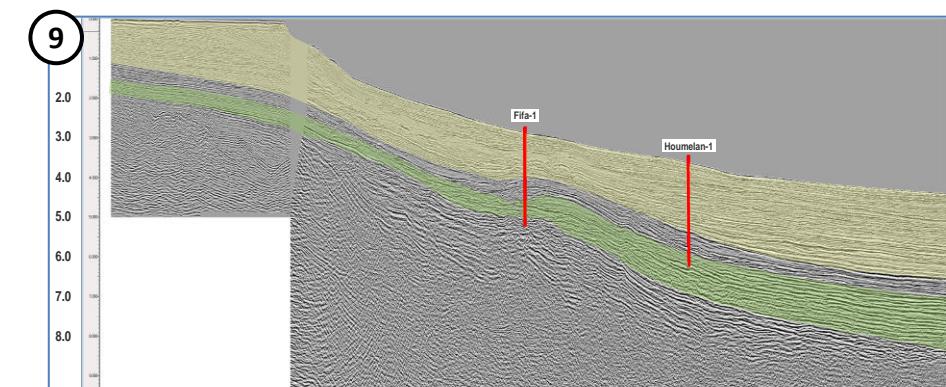
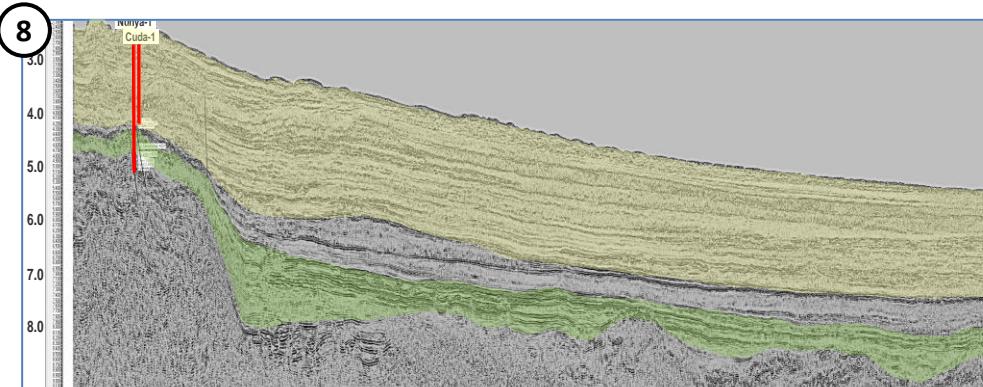
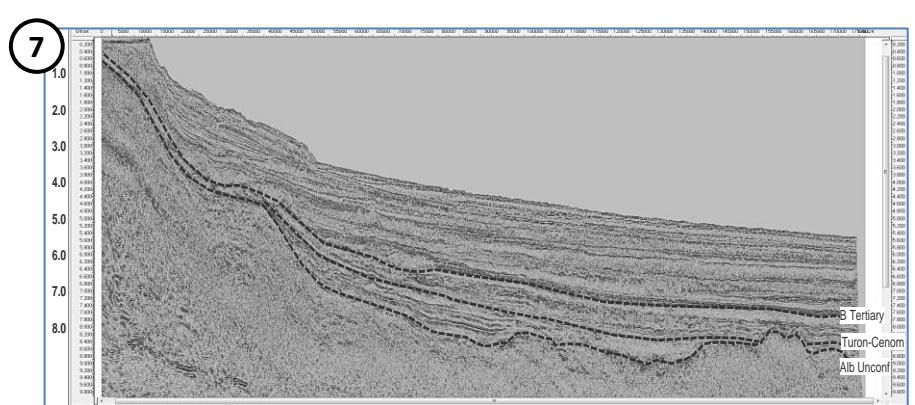
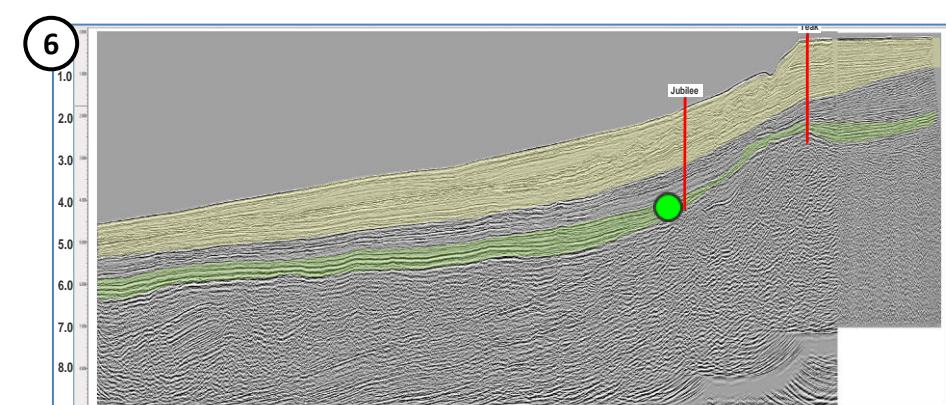
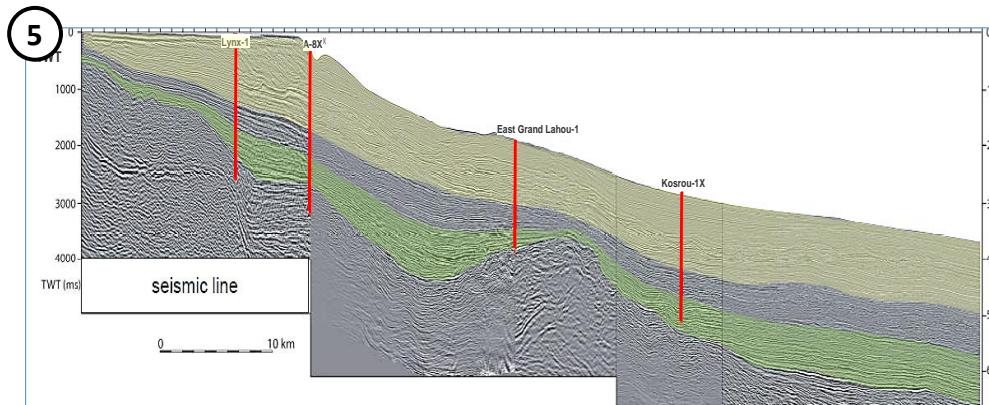
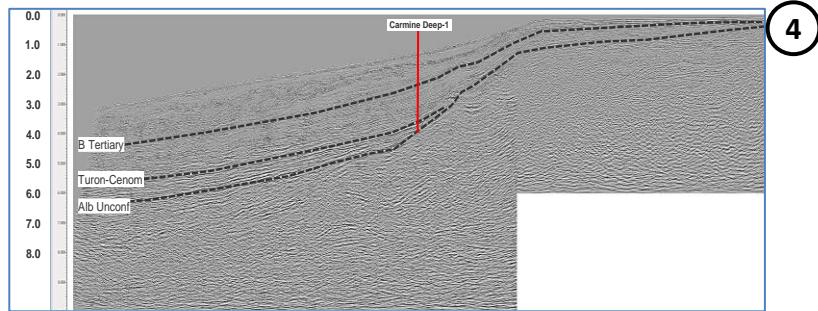
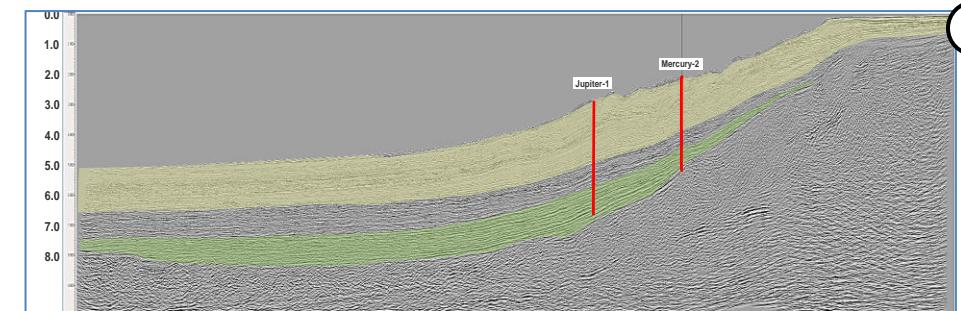
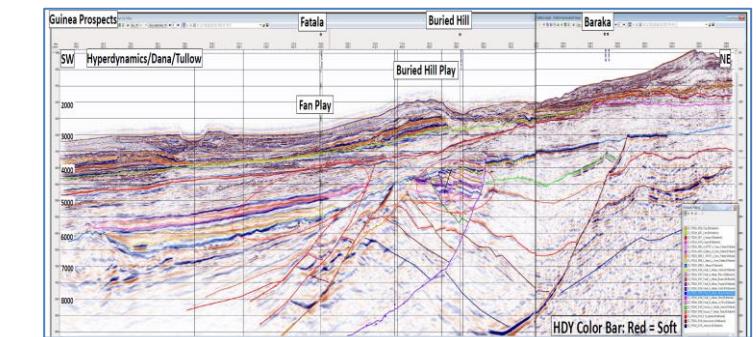
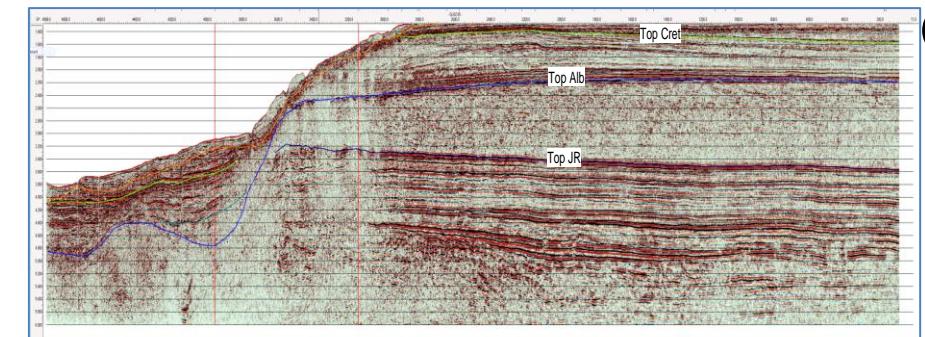
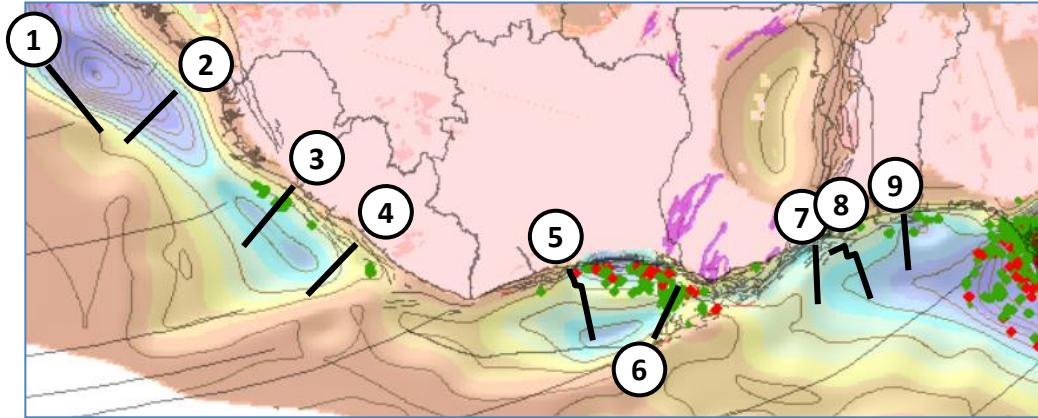
Regional Struct Profiles



Regional Struct Profiles

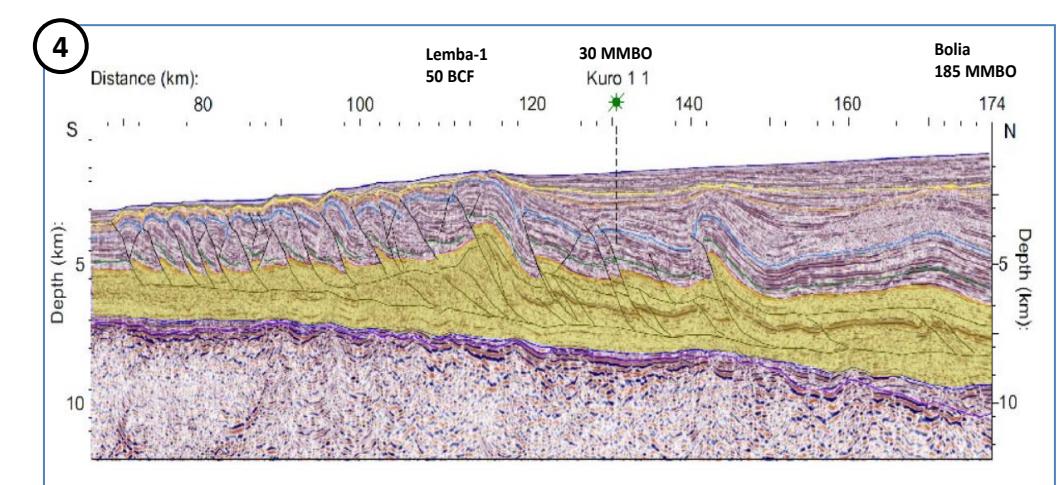
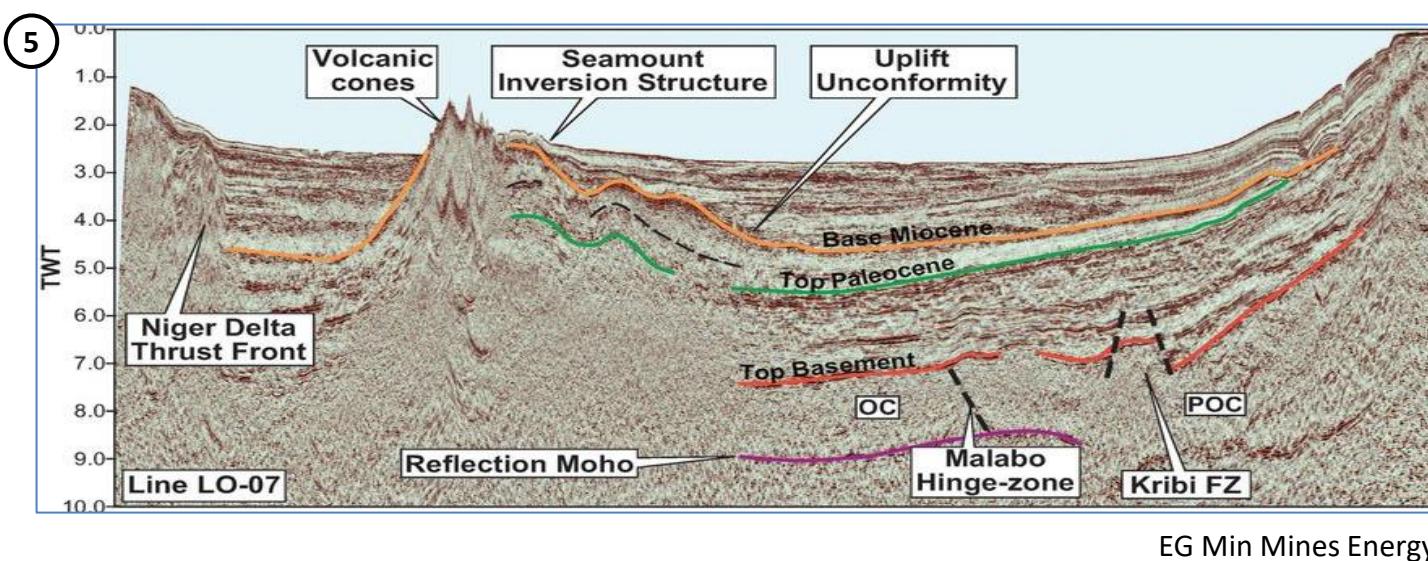
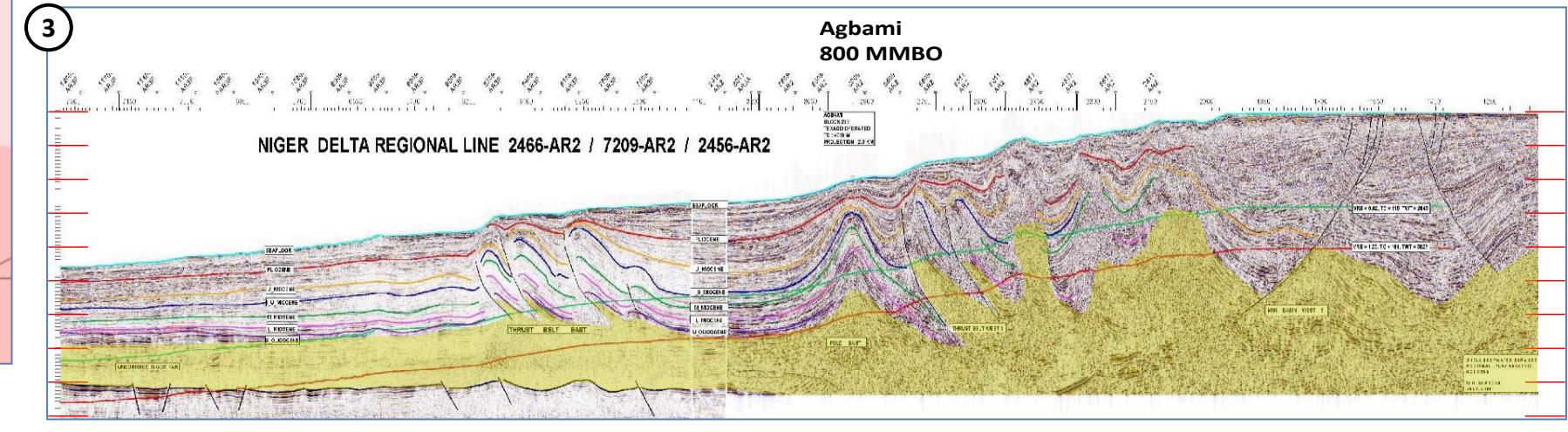
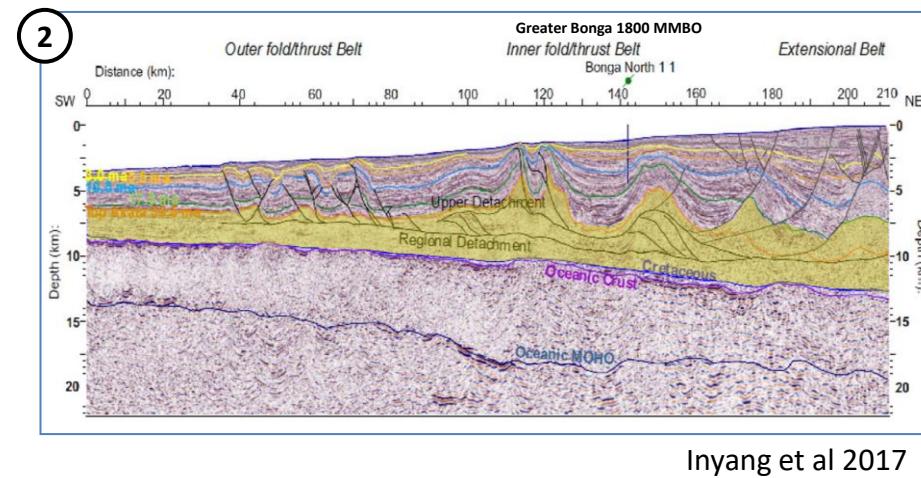
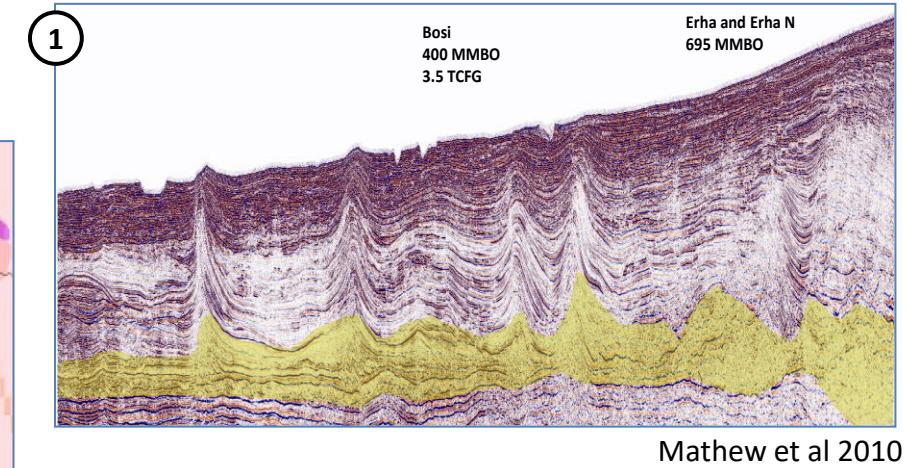
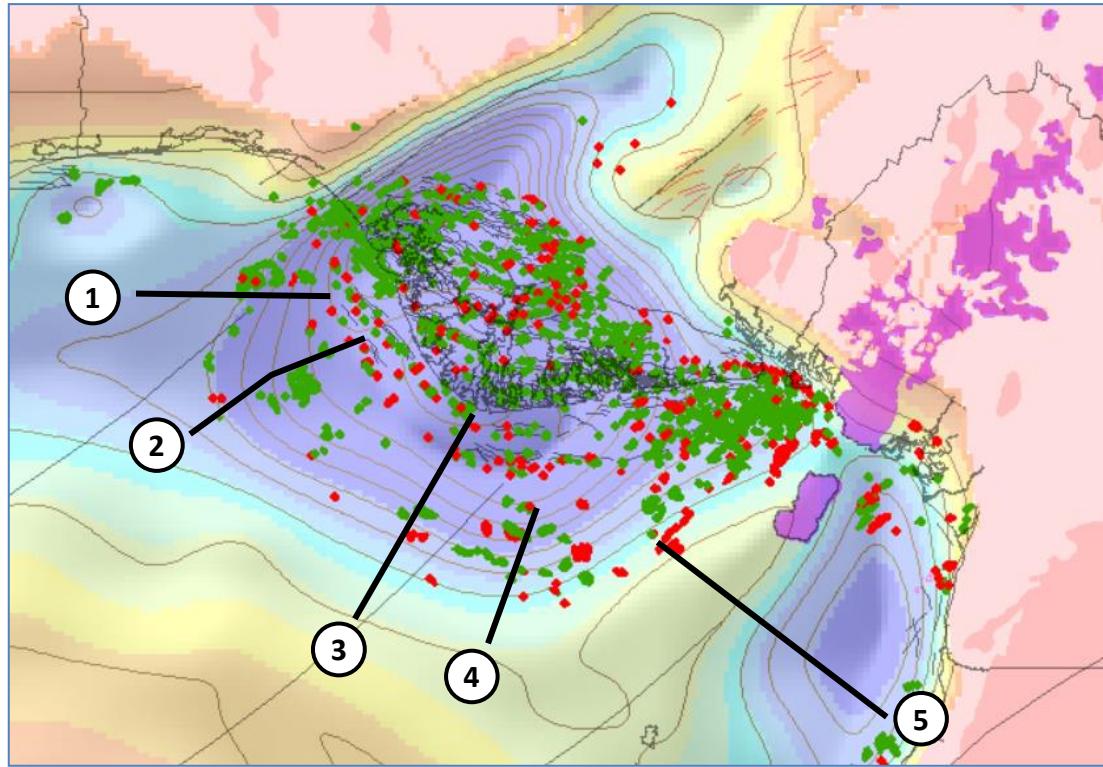


Regional Struct Profiles

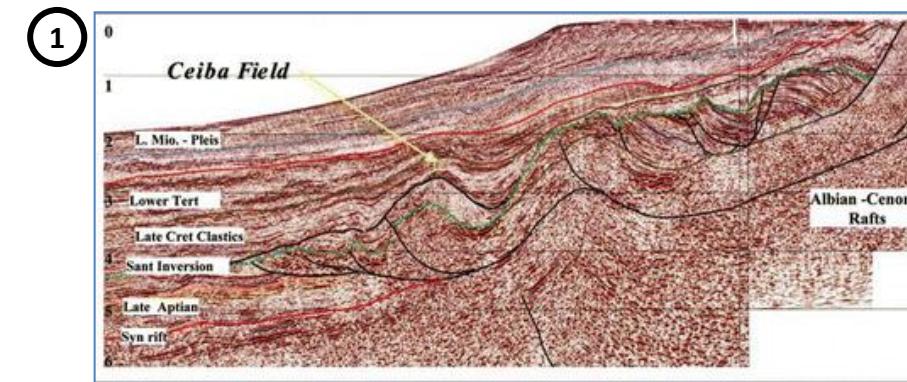
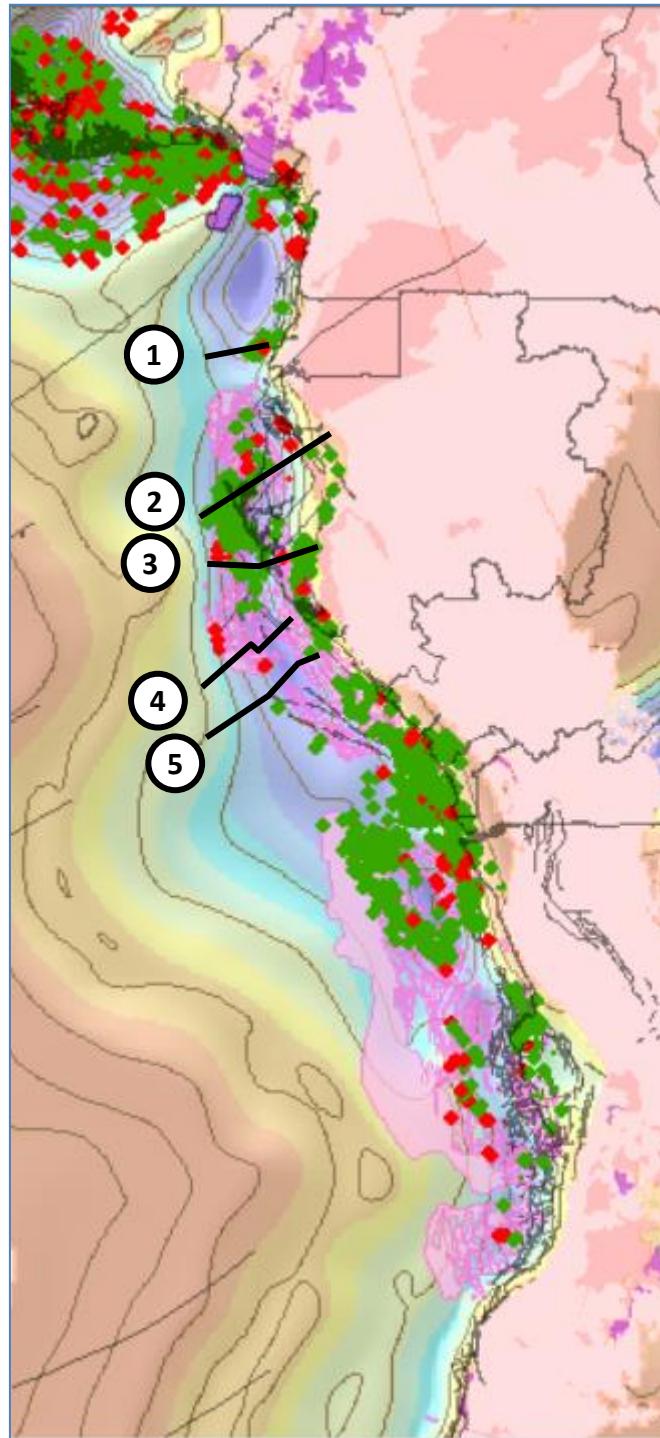


Tertiary
Early Post Rift

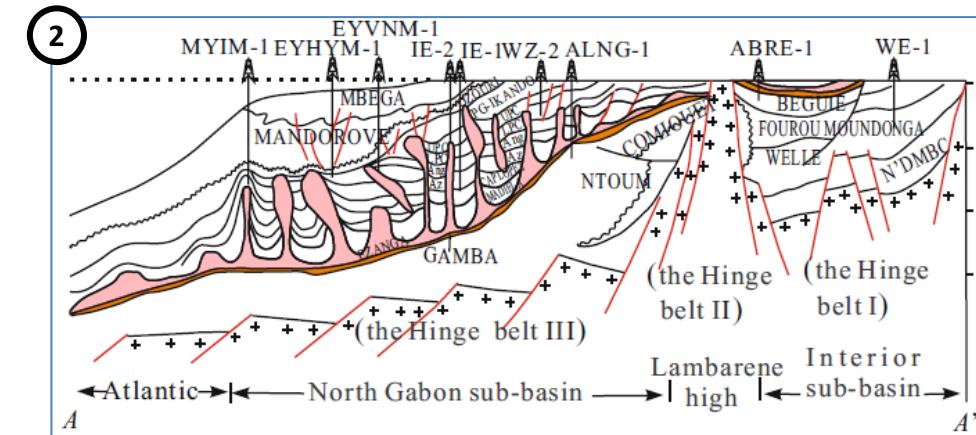
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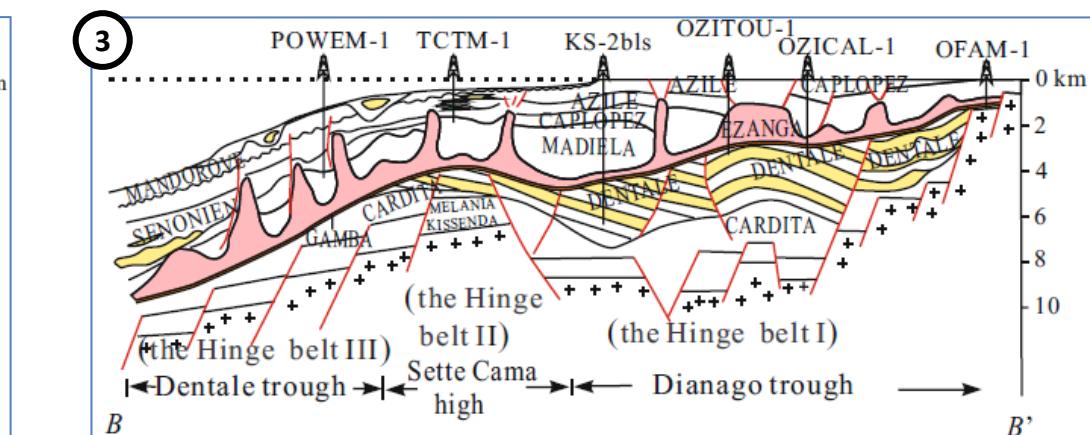
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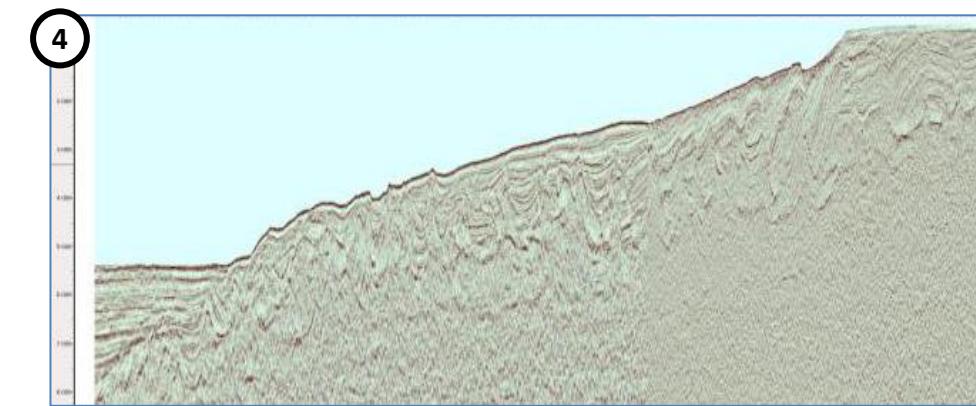
Dally et al 2002



A Chen et al 2013



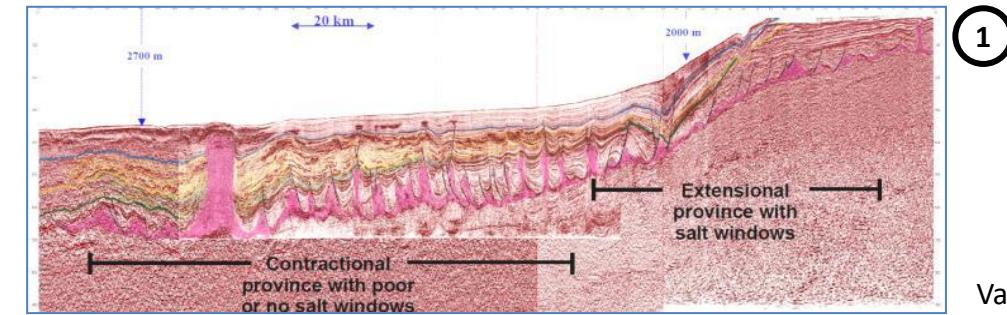
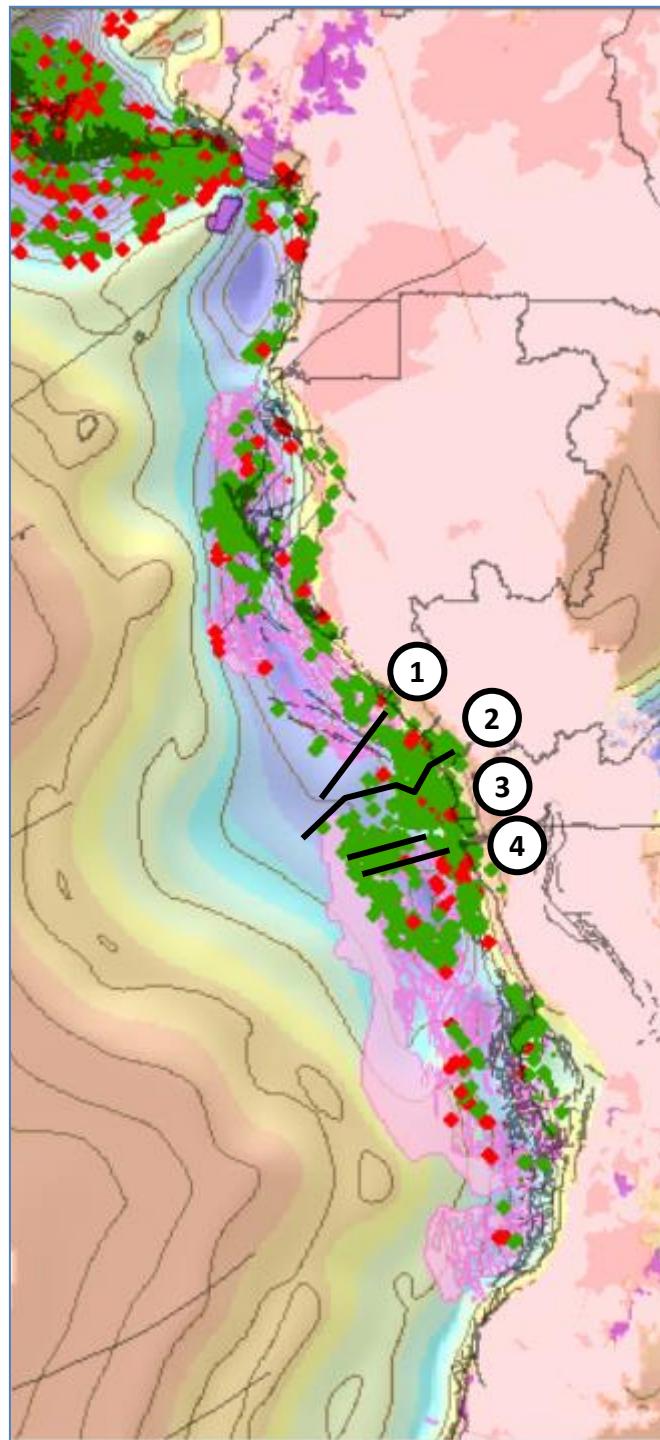
A Chen et al 2013



Lentini et al 2010

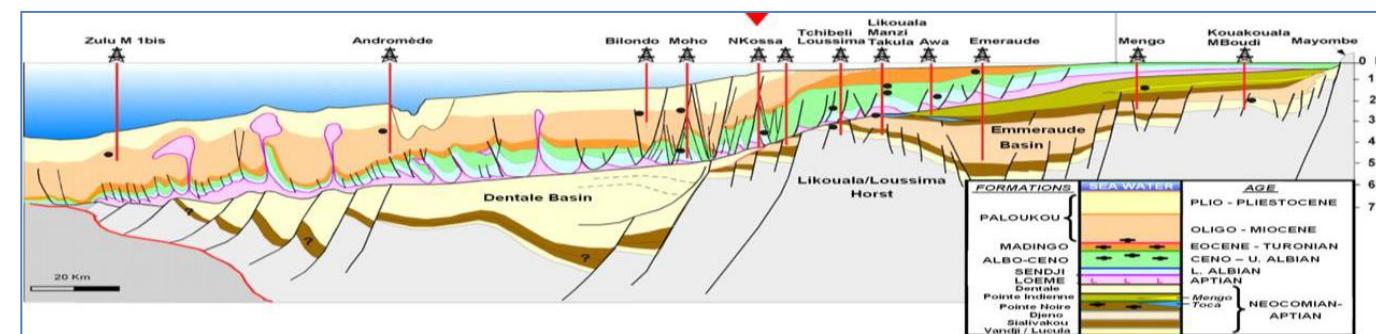
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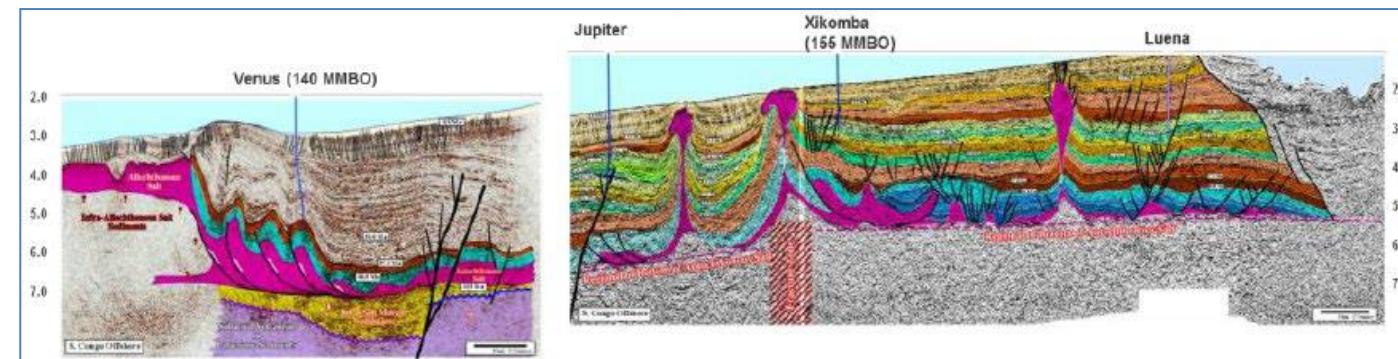
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Vanco Presentation



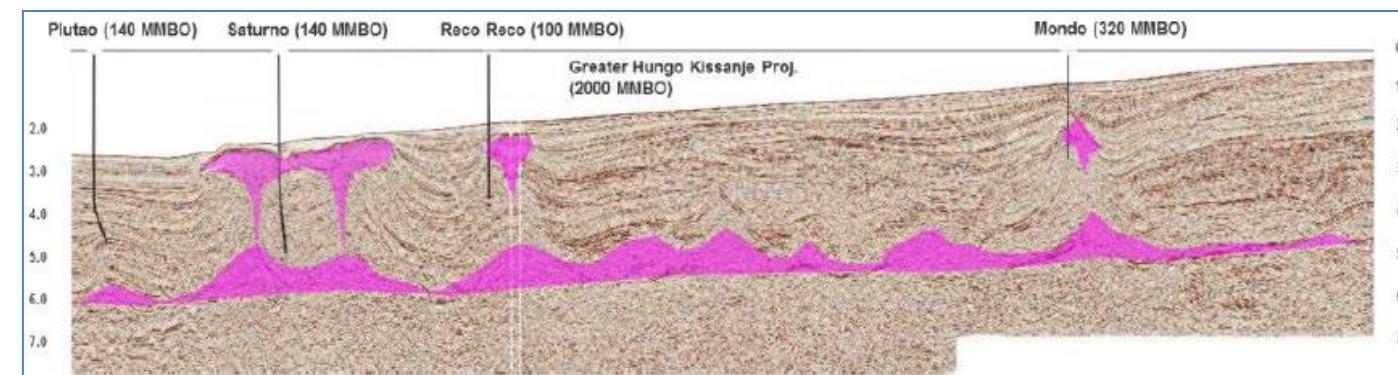
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Wonham et al 2010



3

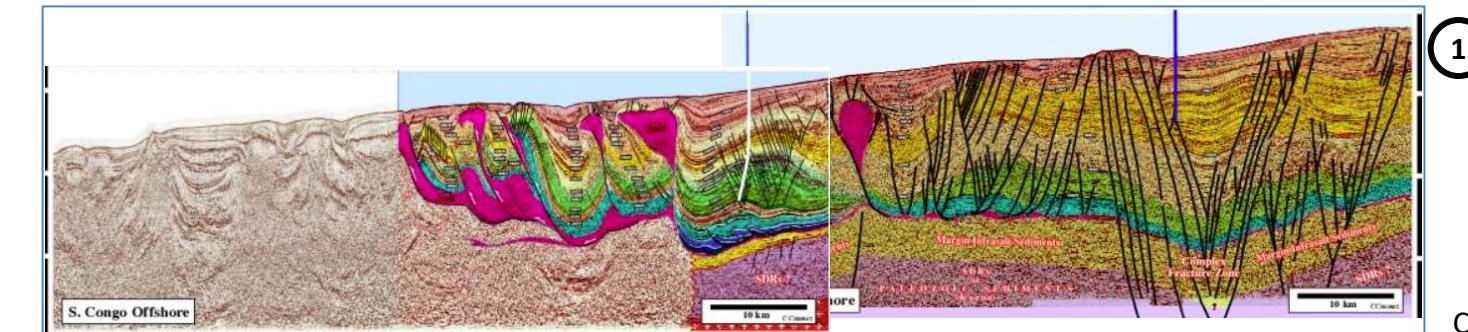
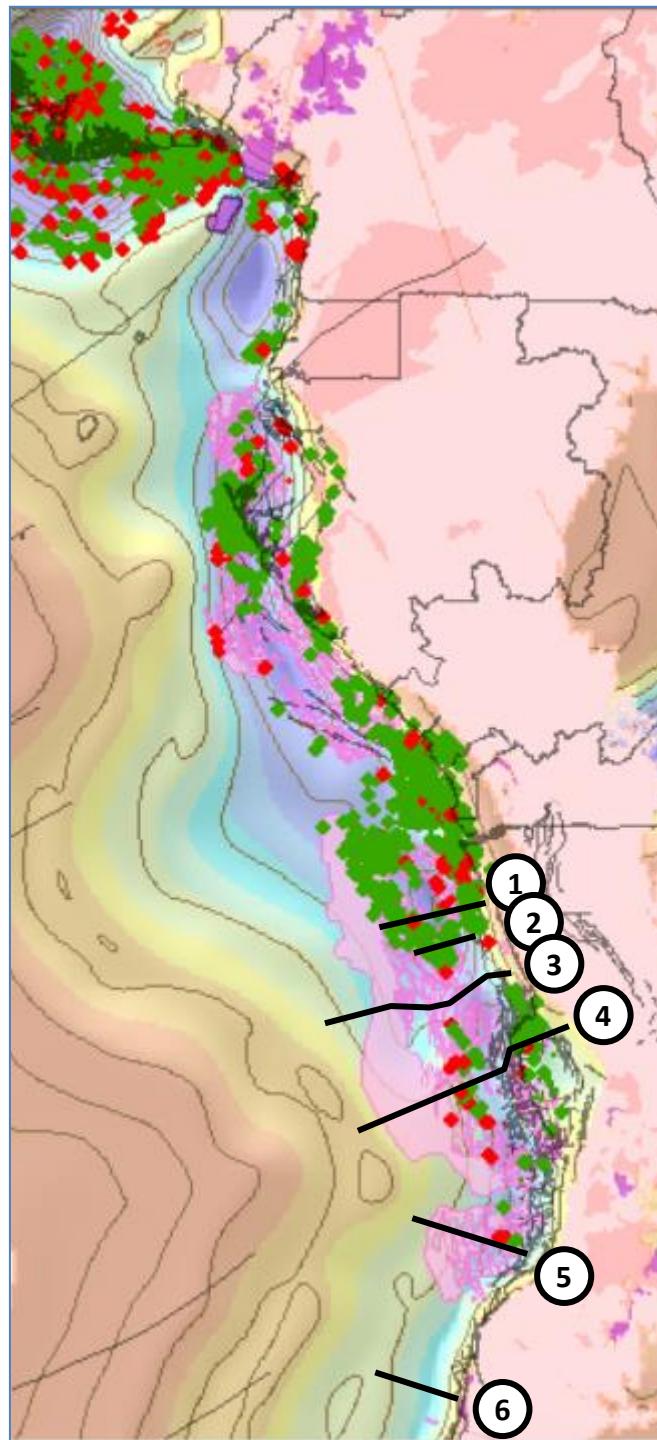
Cramez 2013



4

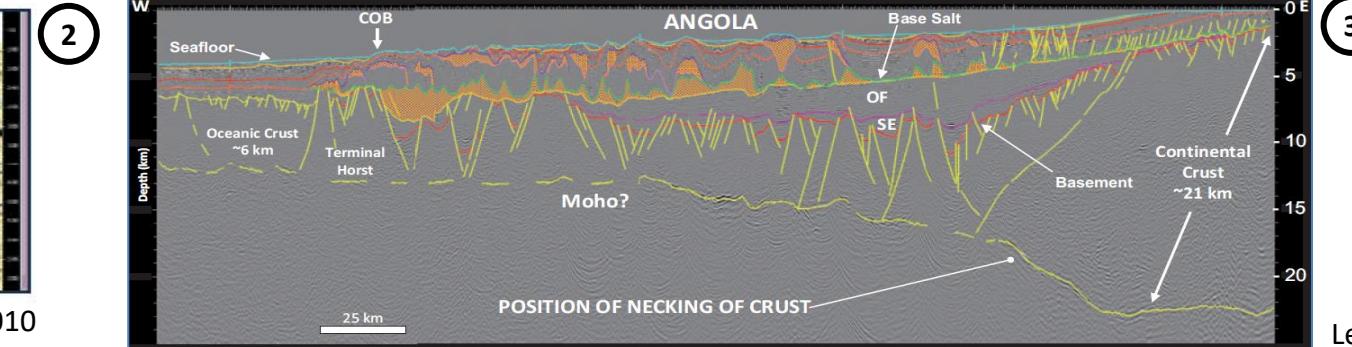
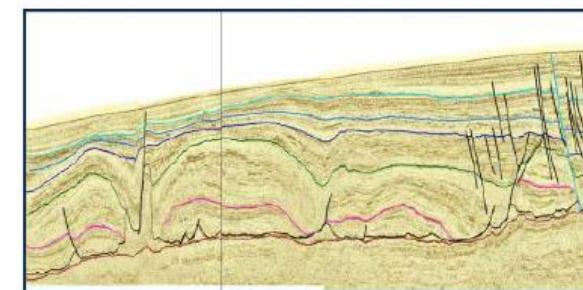
Cramez 2013

Regional Struct Profiles



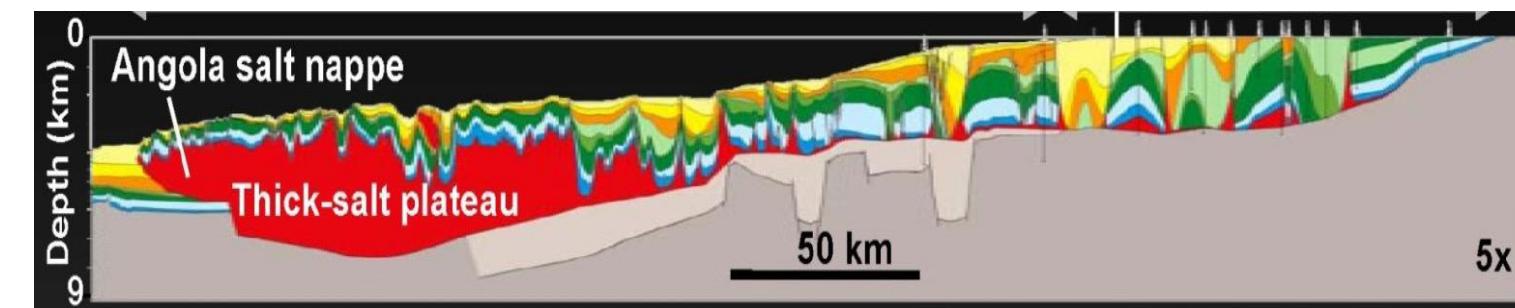
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Cramez 2013



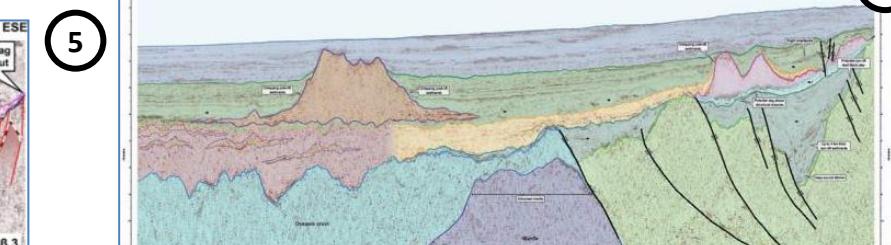
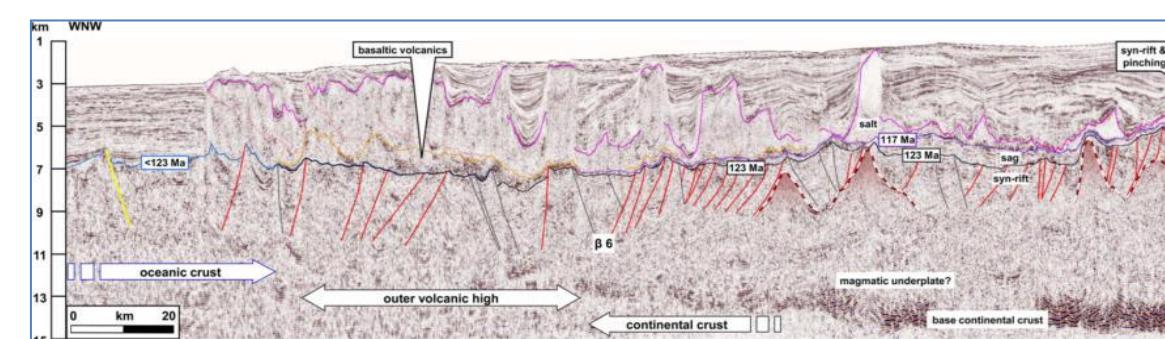
2

Lentini et al 2010



3

Jackson n Hudec 2009



4

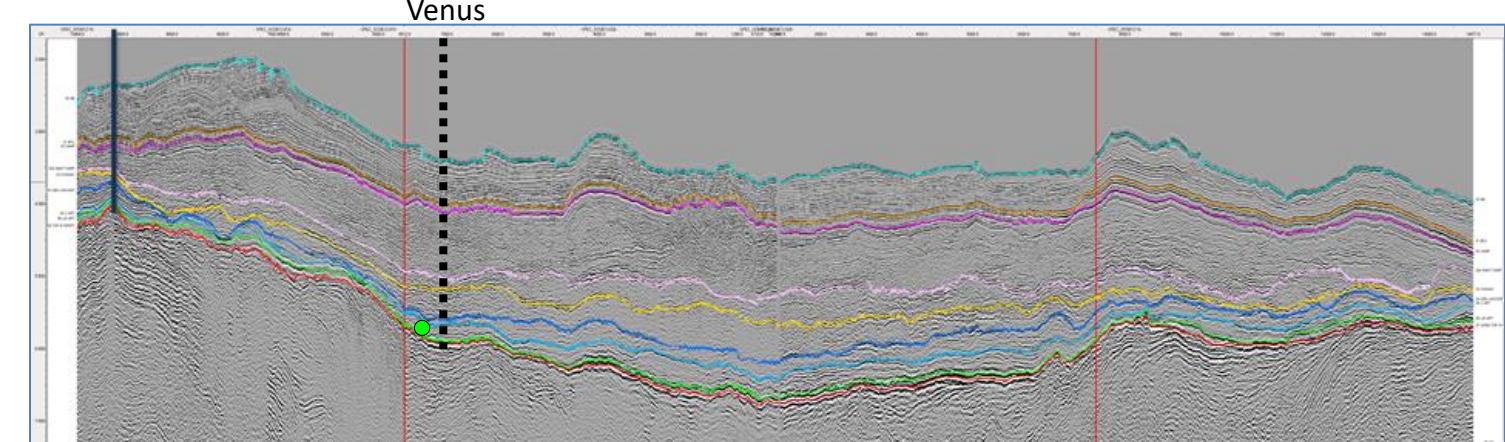
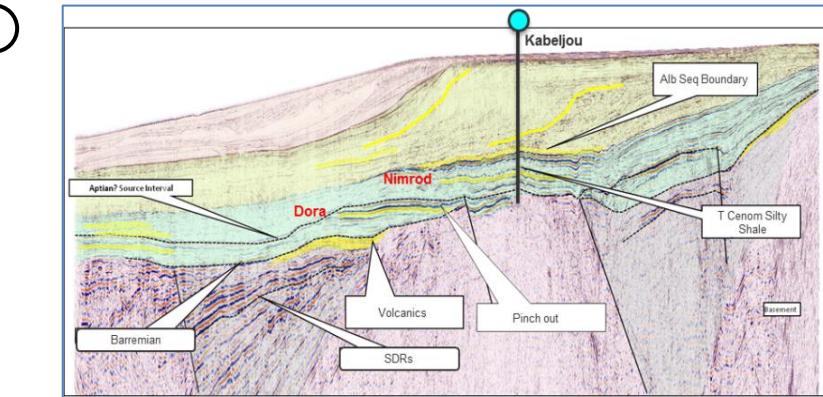
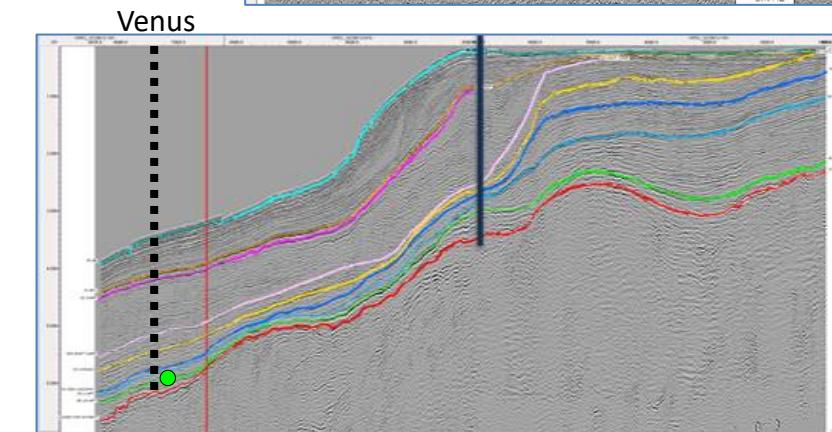
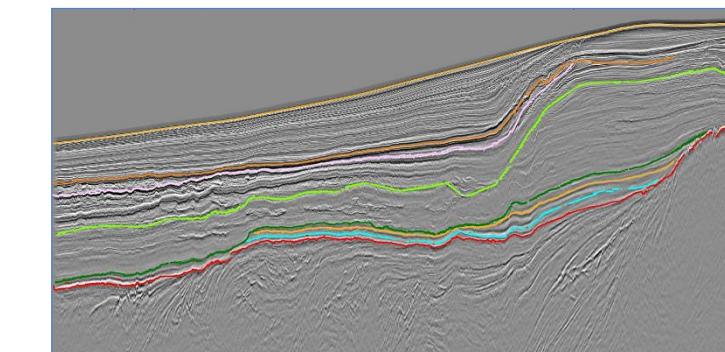
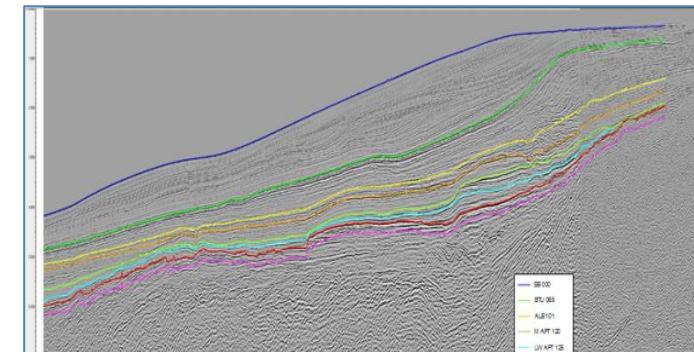
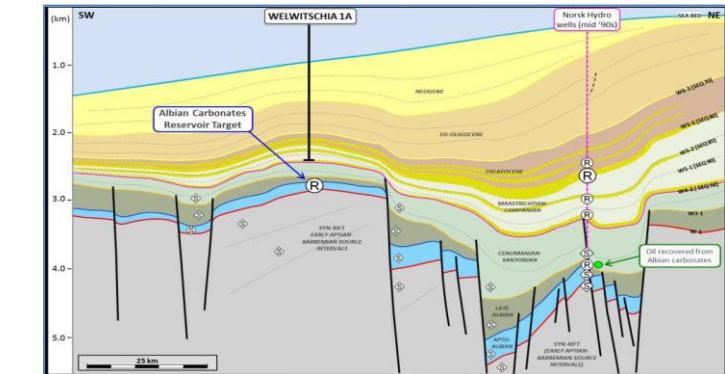
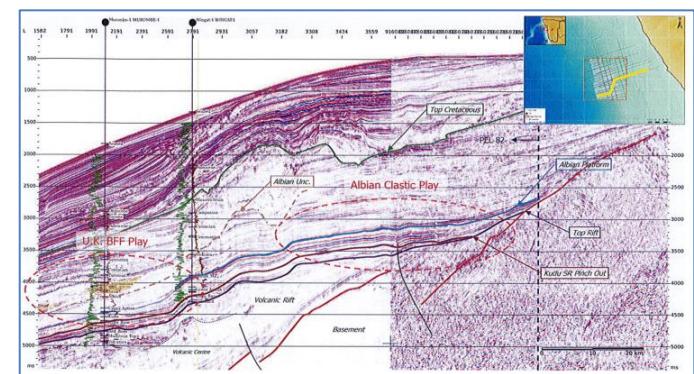
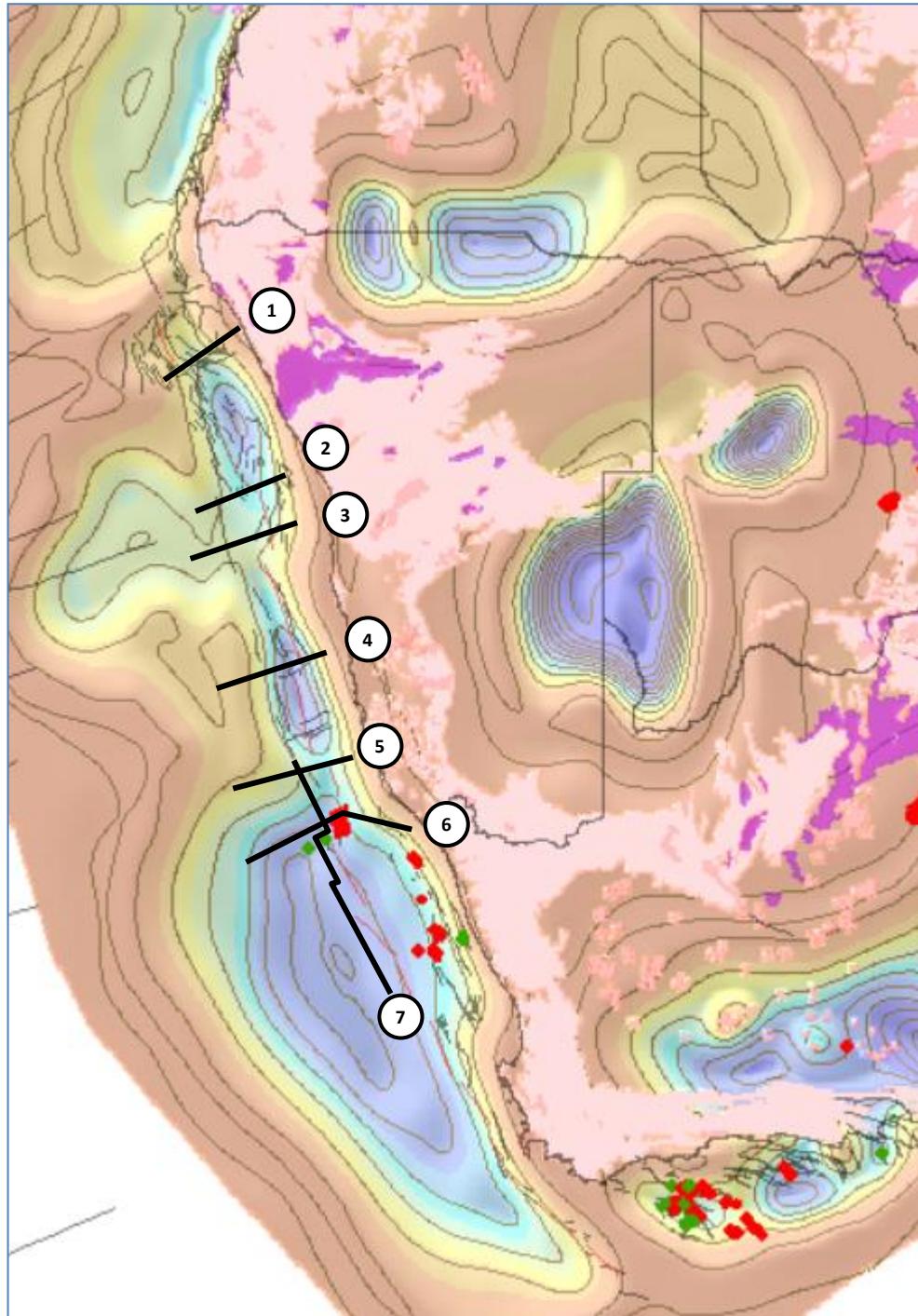
Tyrell n Vartan 2018

Quirk et al 2013

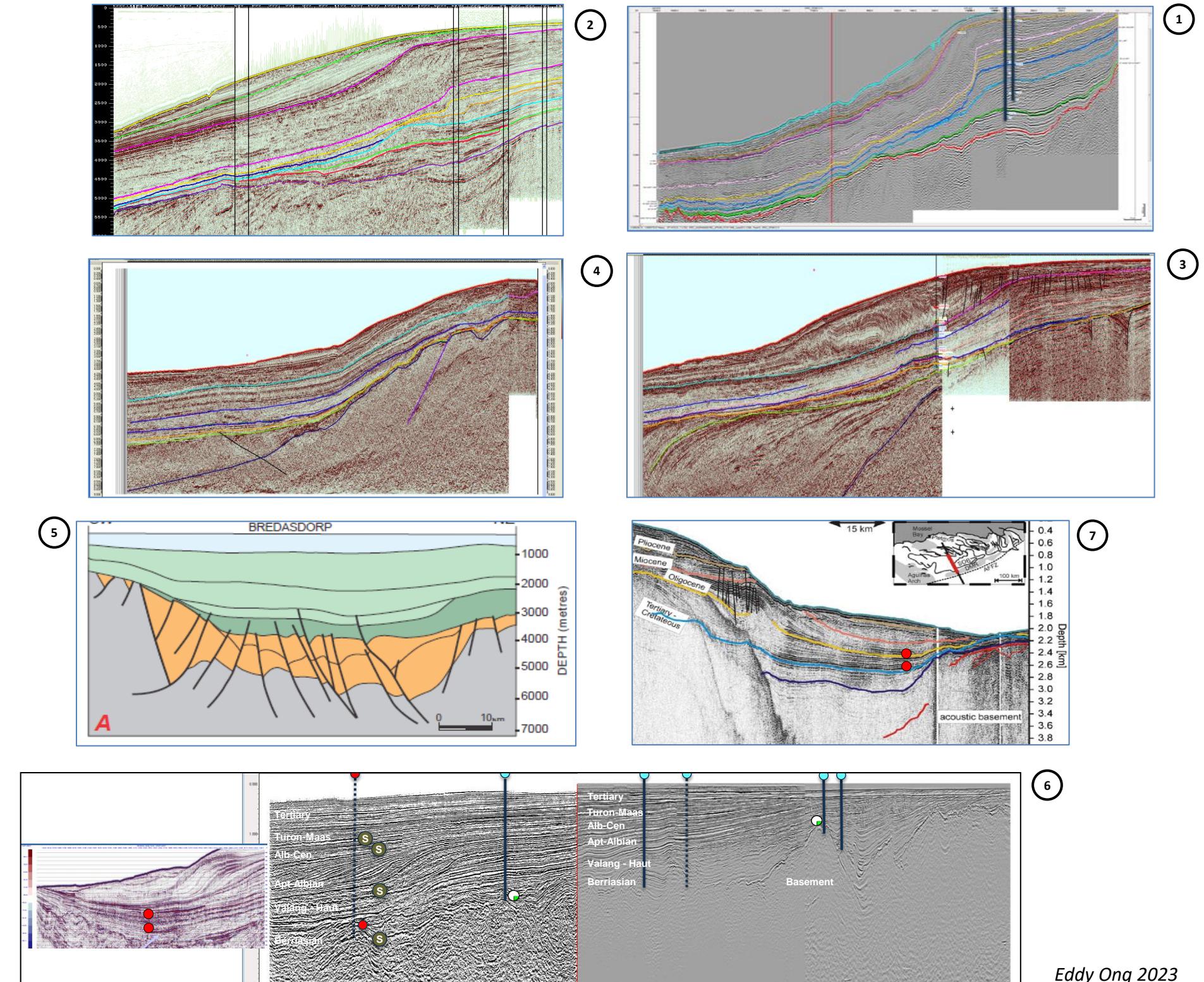
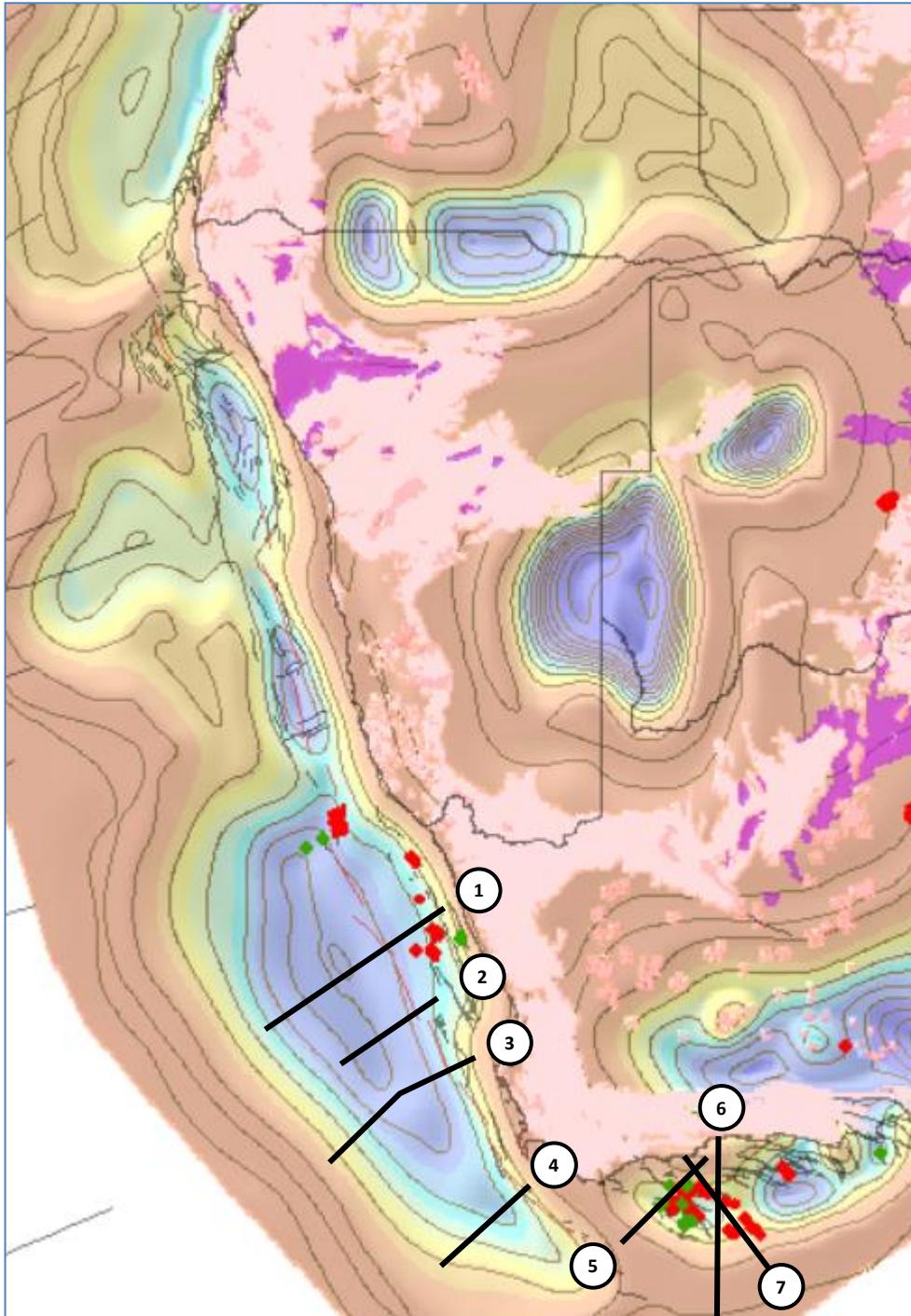
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Regional Struct Profiles



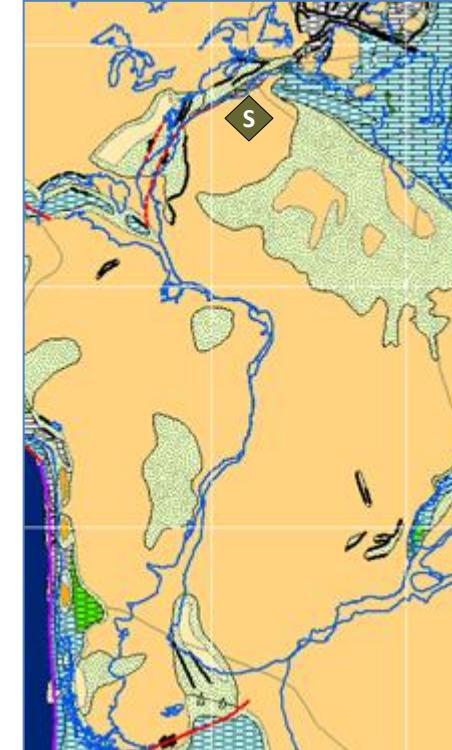
Regional Struct Profiles



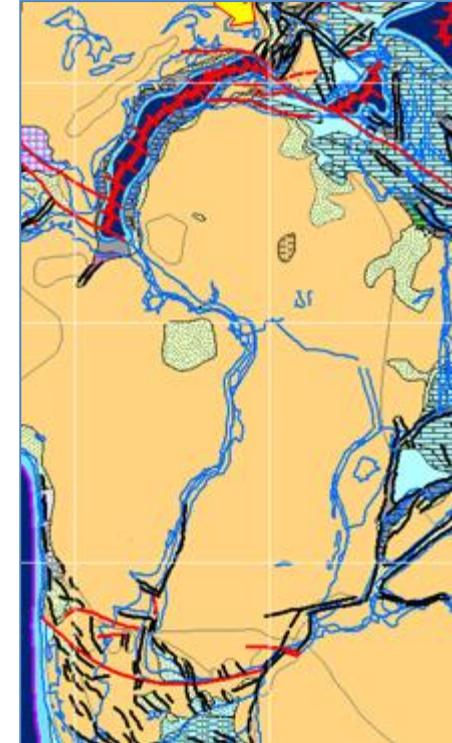
Indicative OG Shows and Paleofacies: Jurassic



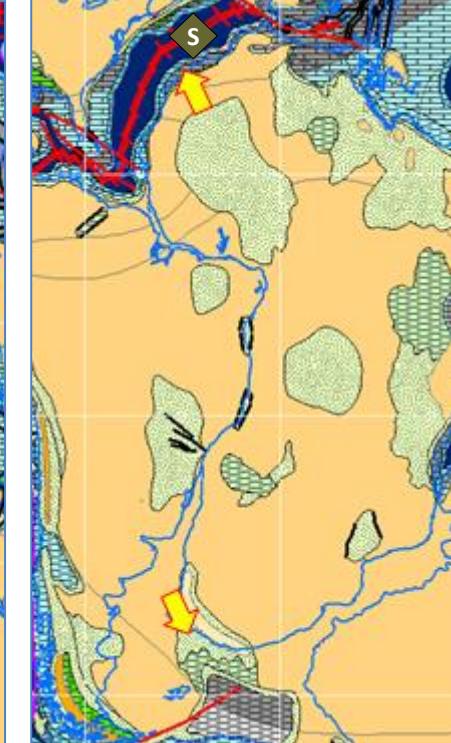
Early Jurassic



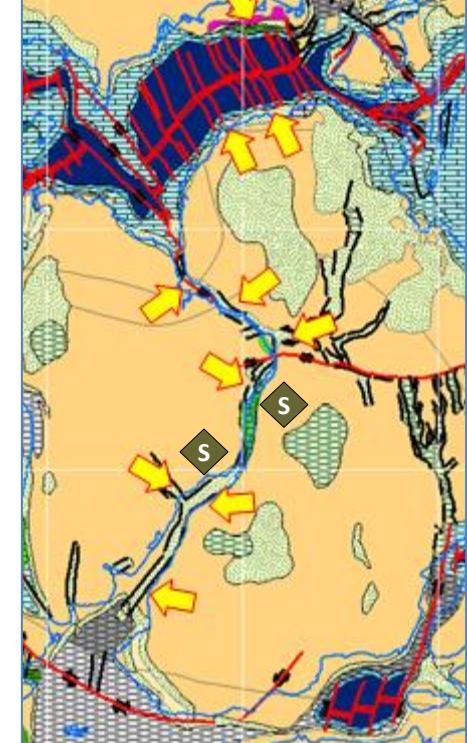
Middle Jurassic



Late Jurassic



Early Cretaceous

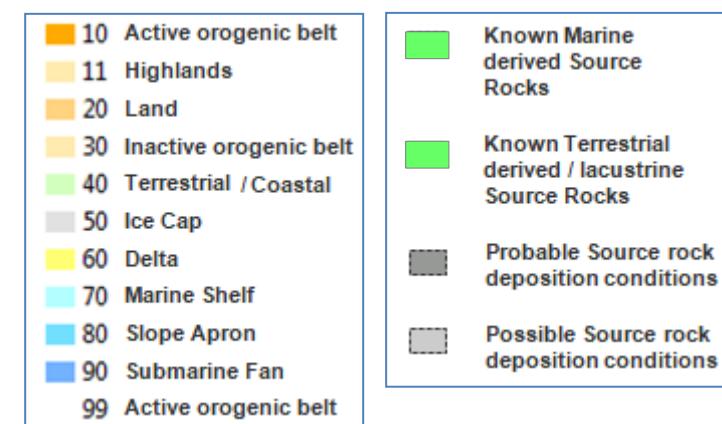
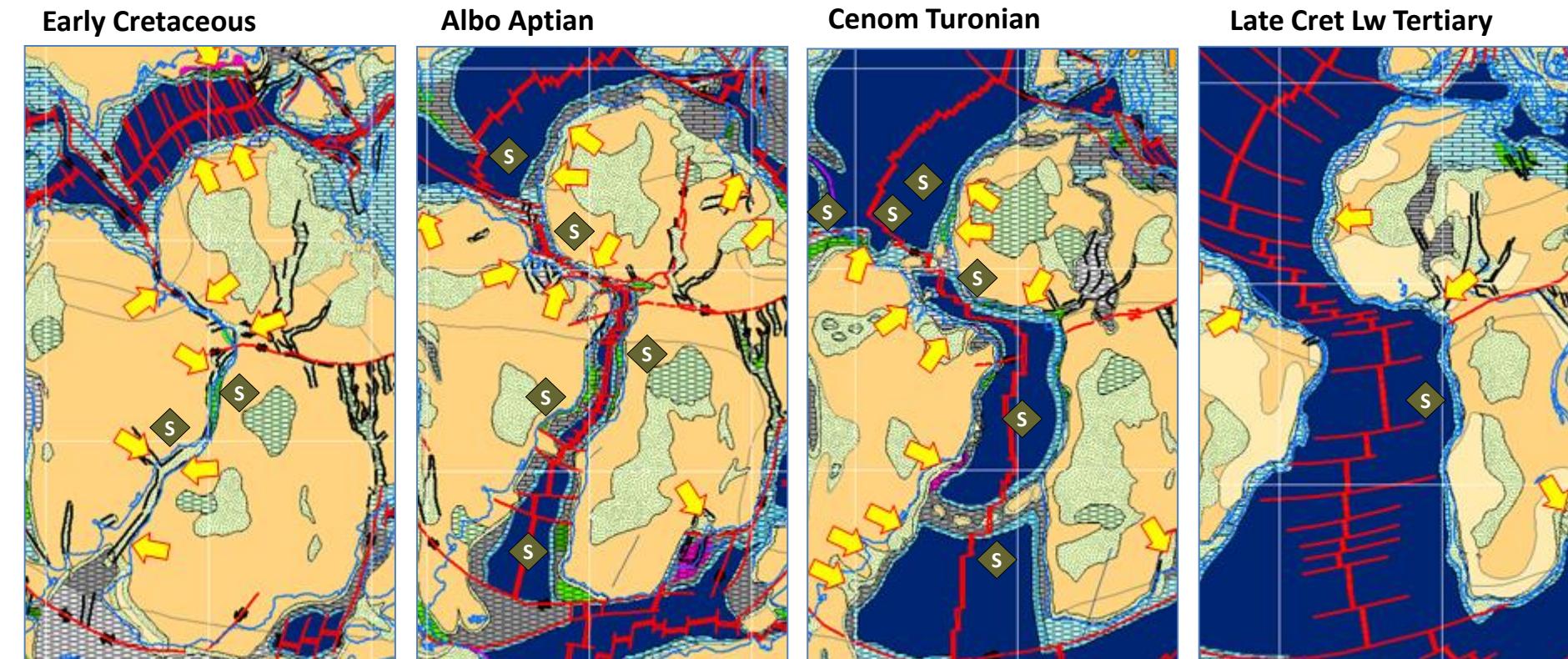
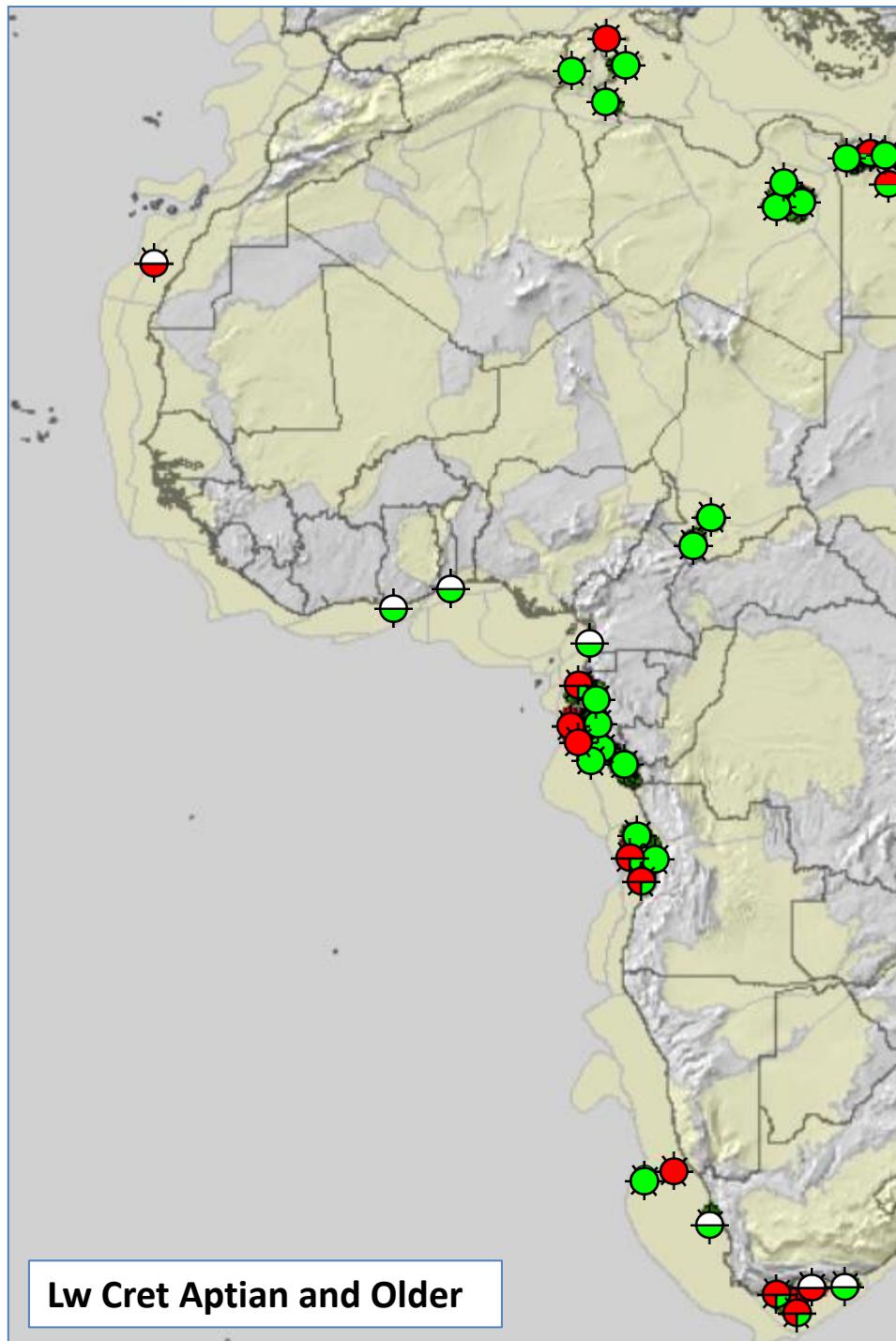


Modified after Golonka 2007, Golonka 2009

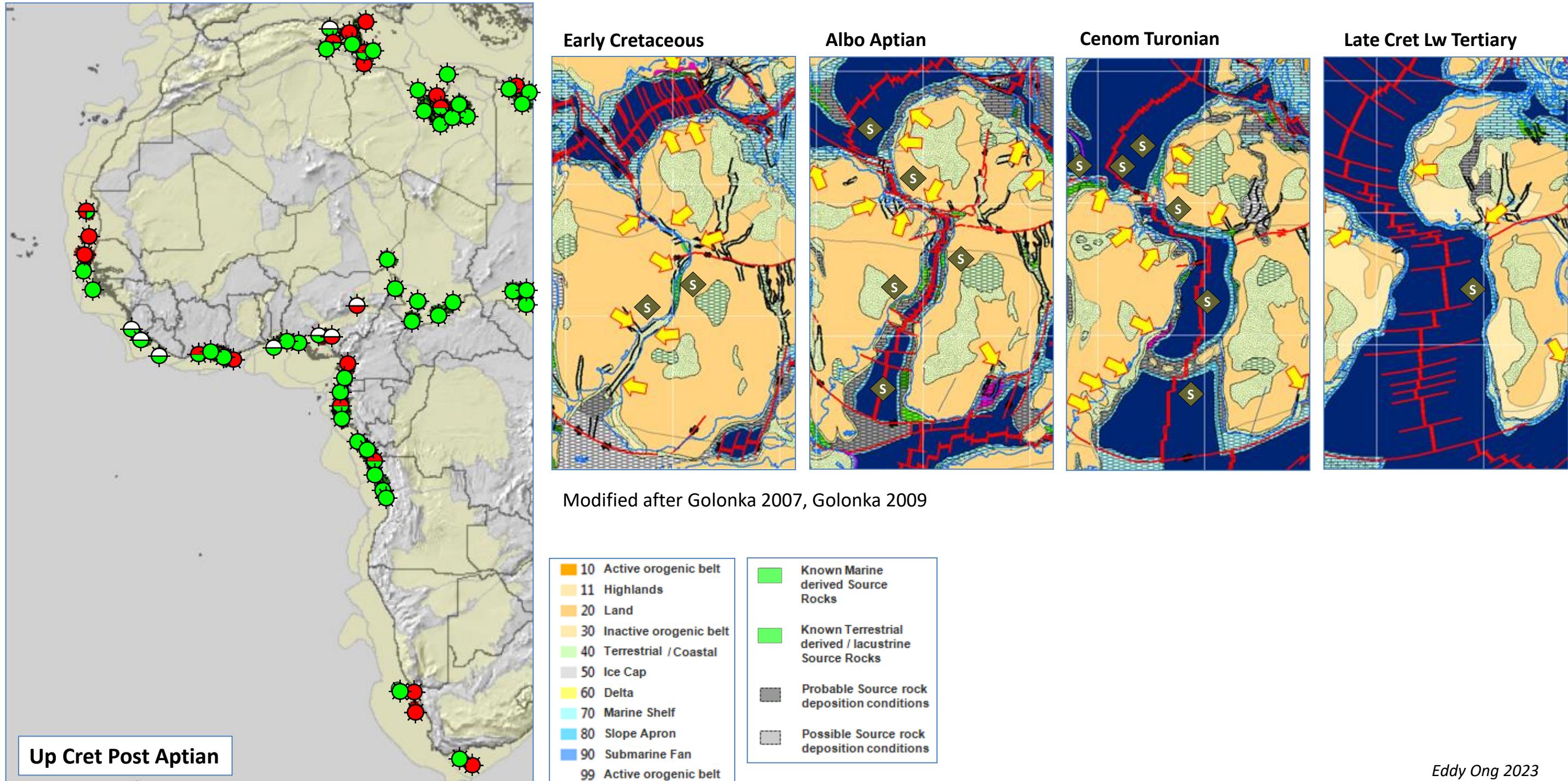
- 10 Active orogenic belt
- 11 Highlands
- 20 Land
- 30 Inactive orogenic belt
- 40 Terrestrial / Coastal
- 50 Ice Cap
- 60 Delta
- 70 Marine Shelf
- 80 Slope Apron
- 90 Submarine Fan
- 99 Active orogenic belt

- Known Marine derived Source Rocks
- Known Terrestrial derived / lacustrine Source Rocks
- Probable Source rock deposition conditions
- Possible Source rock deposition conditions

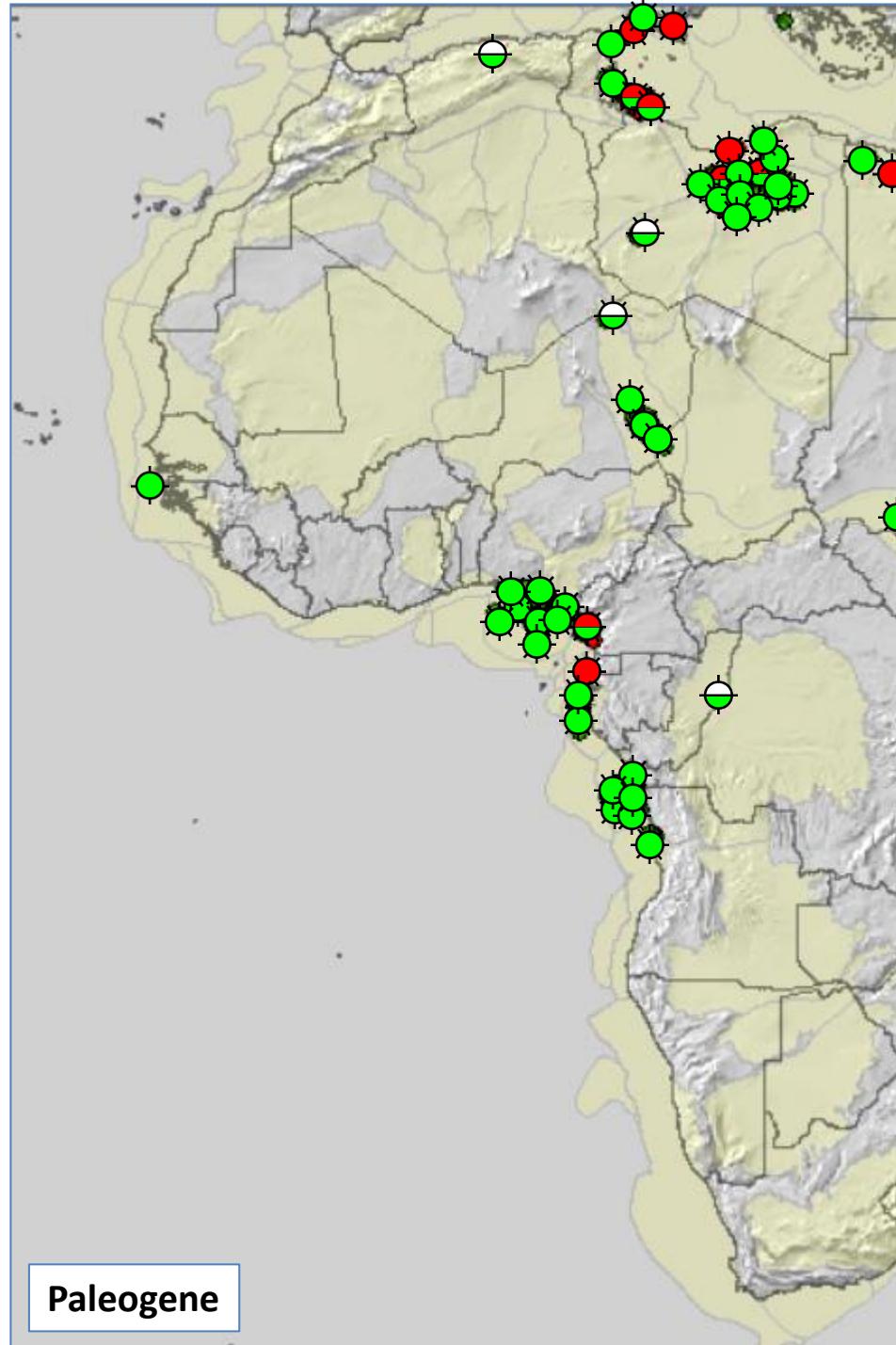
Indicative OG Shows and Paleofacies: Lw Cretaceous



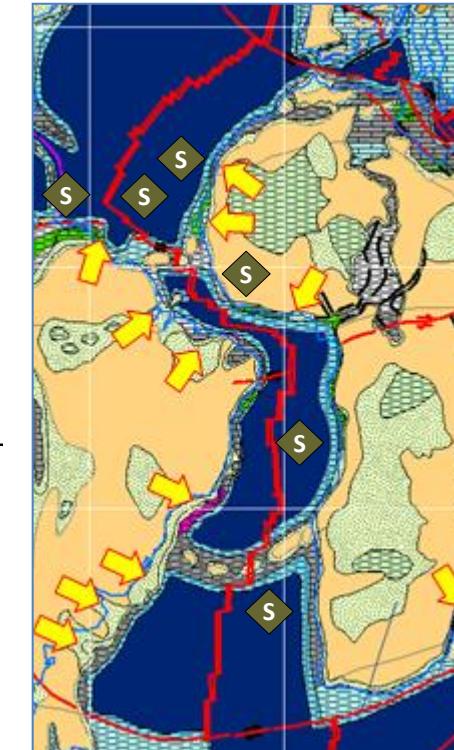
Indicative OG Shows and Paleofacies: Late Cretaceous



Indicative OG Shows and Paleofacies: Paleogene



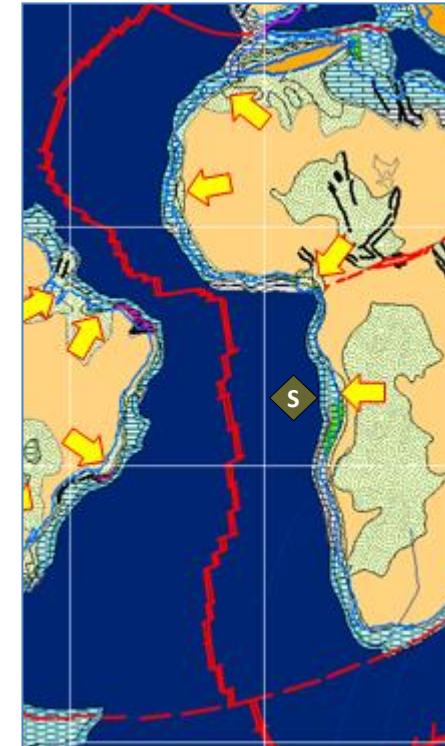
Cenom Turonian



Late Cret Lw Tertiary



Eocene



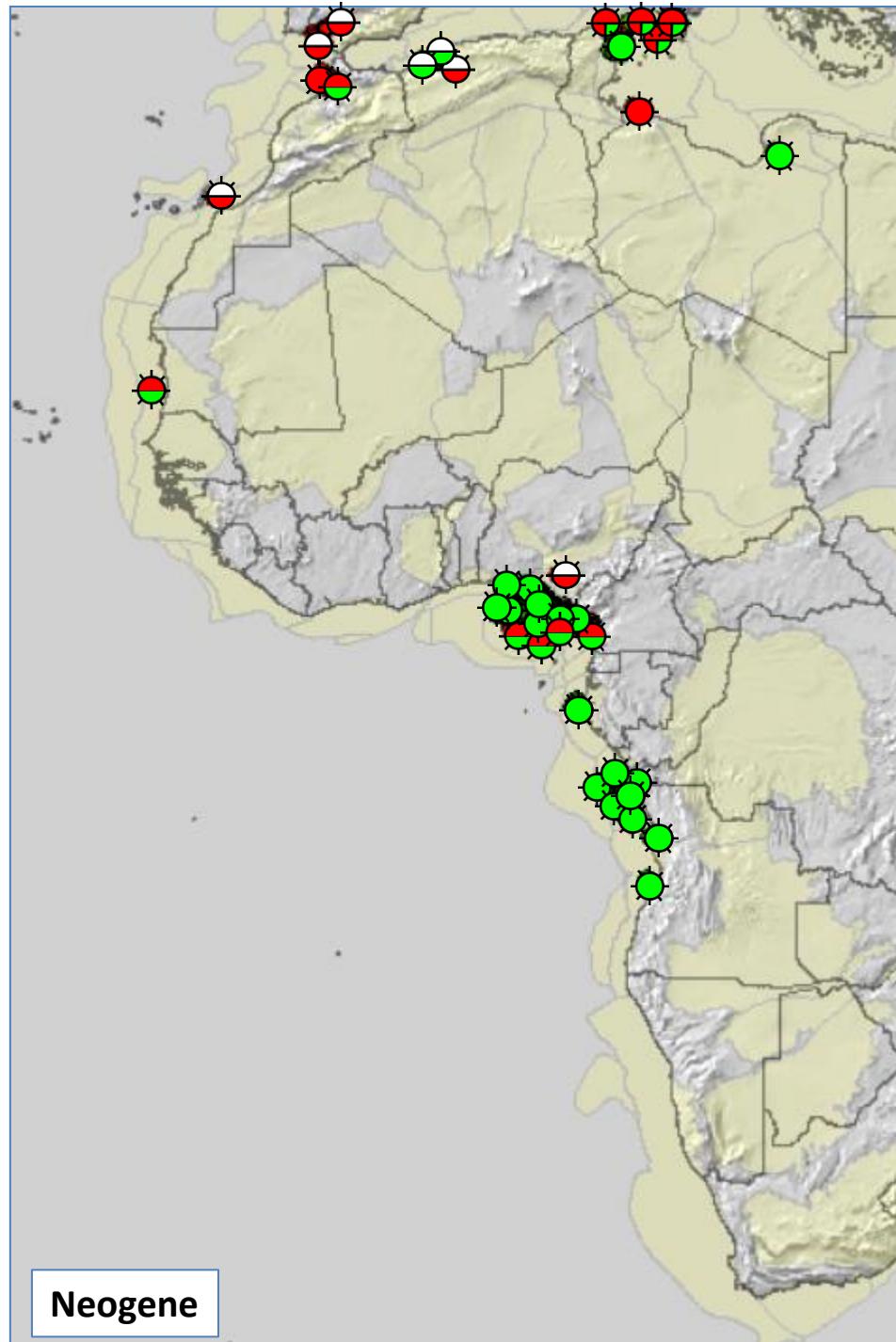
Oligocene



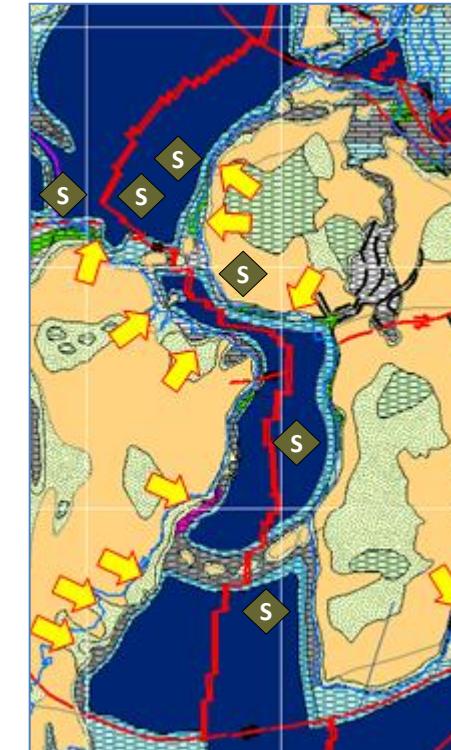
Modified after Golonka 2007, Golonka 2009

- Known Marine derived Source Rocks
- Known Terrestrial derived / lacustrine Source Rocks
- Probable Source rock deposition conditions
- Possible Source rock deposition conditions

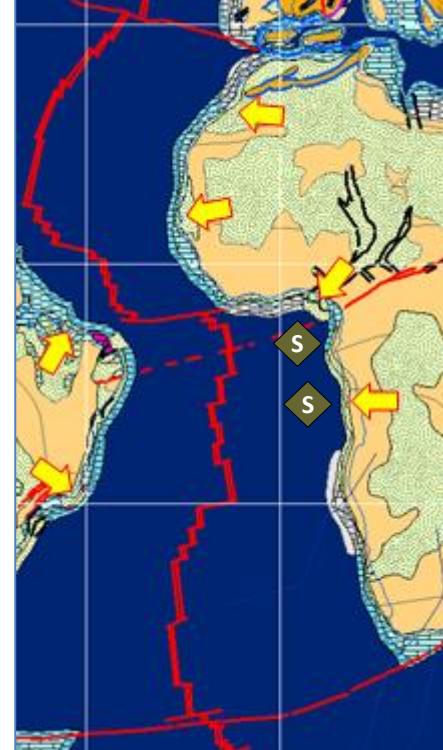
Indicative OG Shows and Paleofacies: Neogene



Cenom Turonian



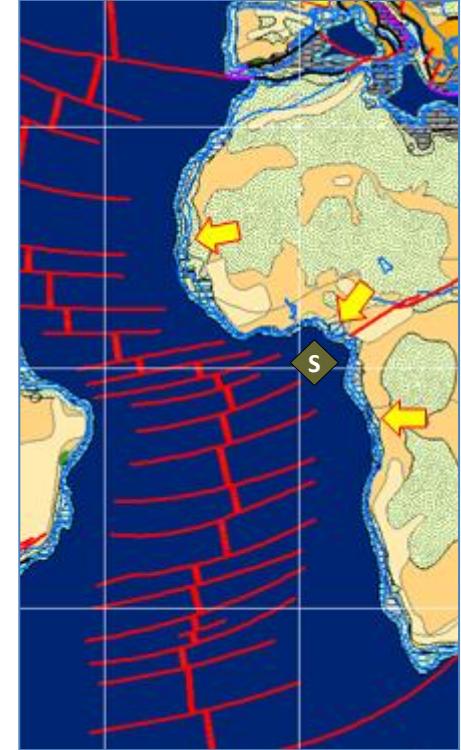
Oligocene



Early Miocene



Middle Miocene

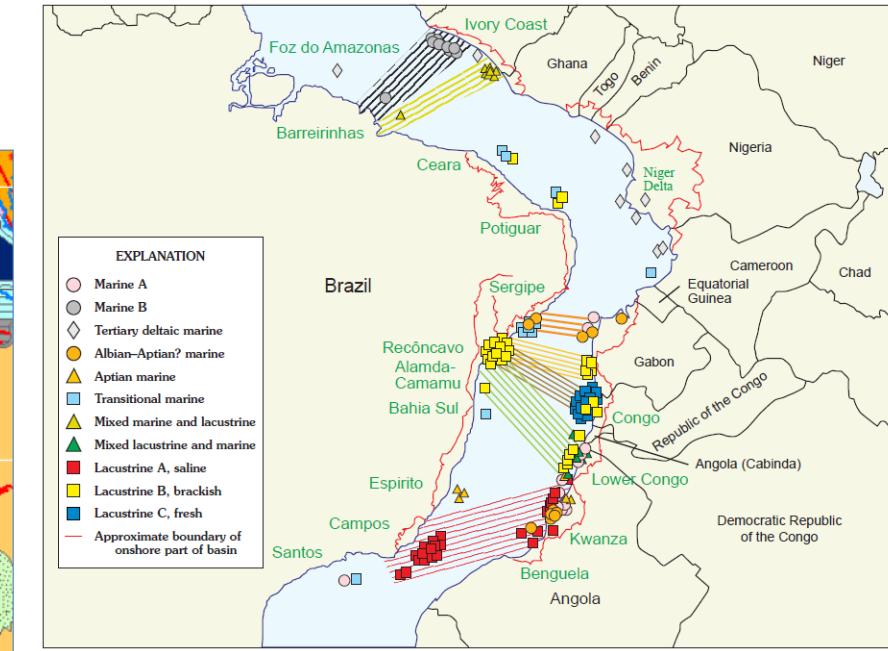
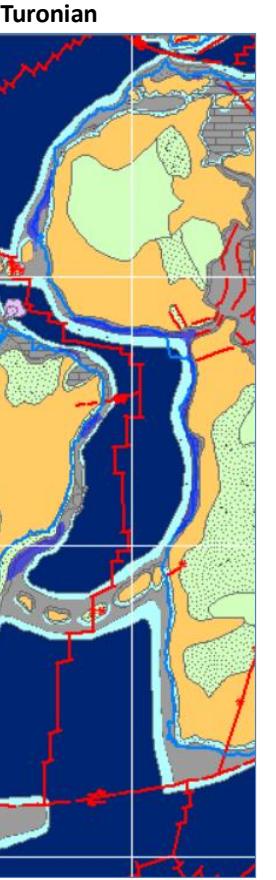
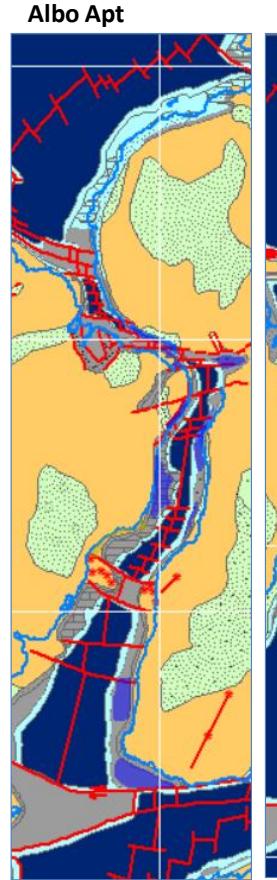
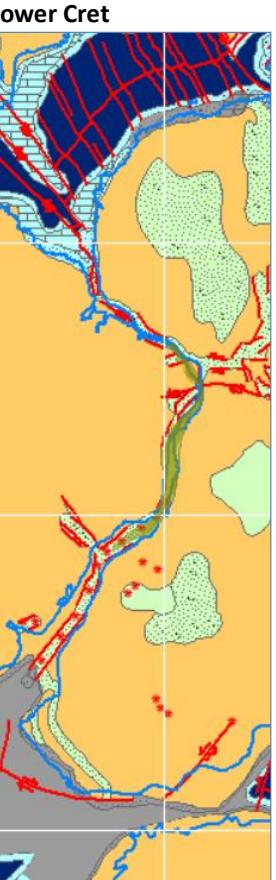
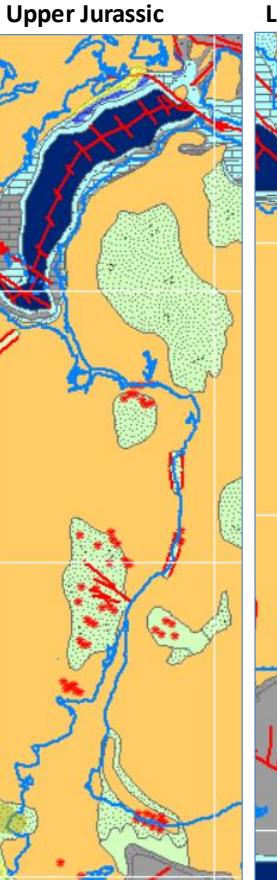
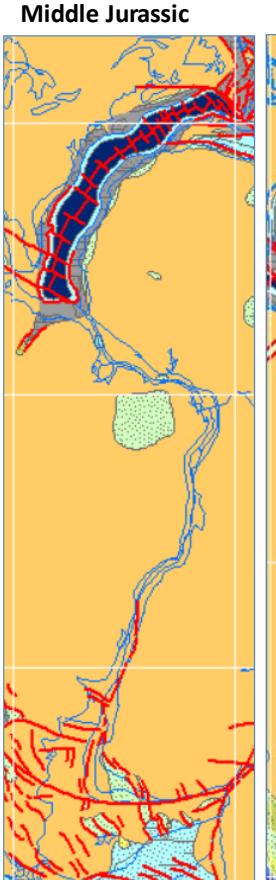
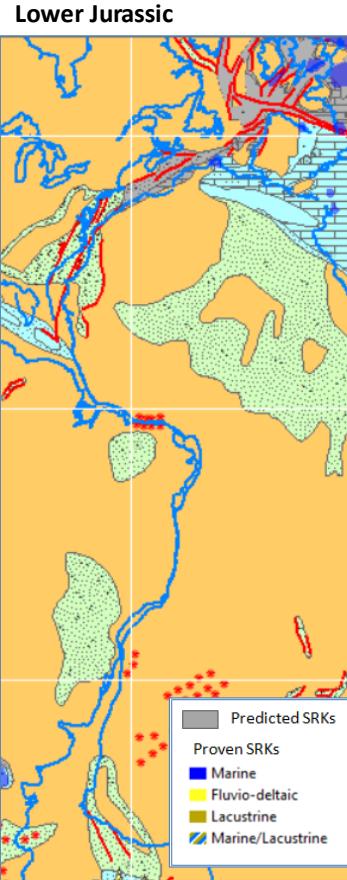


Modified after Golonka 2007, Golonka 2009

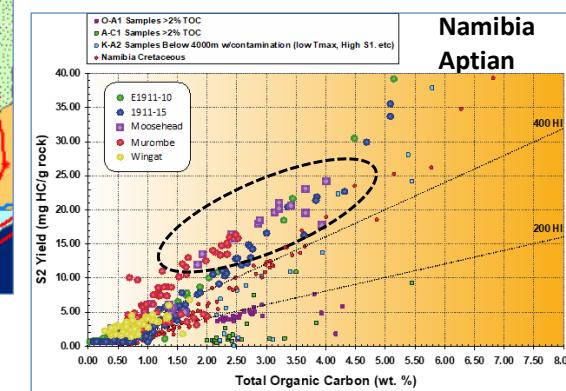
- 10 Active orogenic belt
- 11 Highlands
- 20 Land
- 30 Inactive orogenic belt
- 40 Terrestrial / Coastal
- 50 Ice Cap
- 60 Delta
- 70 Marine Shelf
- 80 Slope Apron
- 90 Submarine Fan
- 99 Active orogenic belt

- Known Marine derived Source Rocks
- Known Terrestrial derived / lacustrine Source Rocks
- Probable Source rock deposition conditions
- Possible Source rock deposition conditions

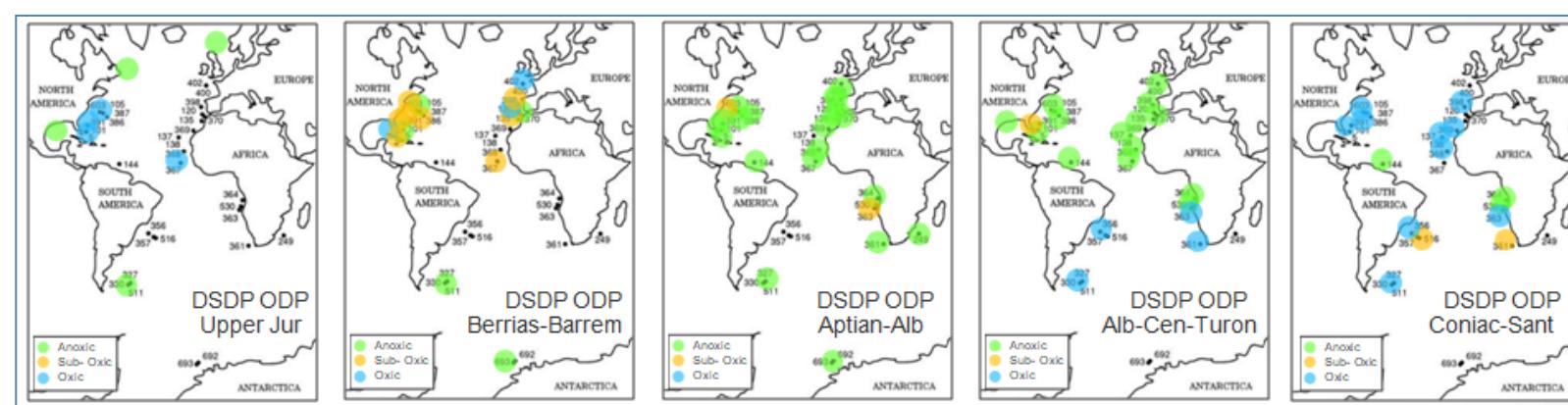
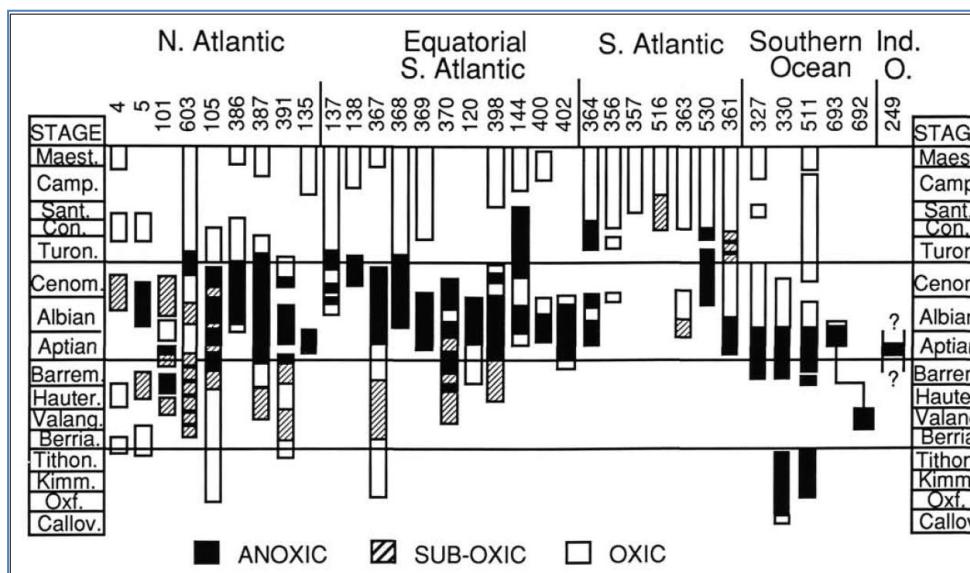
Predictive and Proven SRK Types



USGS 2006 mod after Schiefelbein et al 1999, 2000



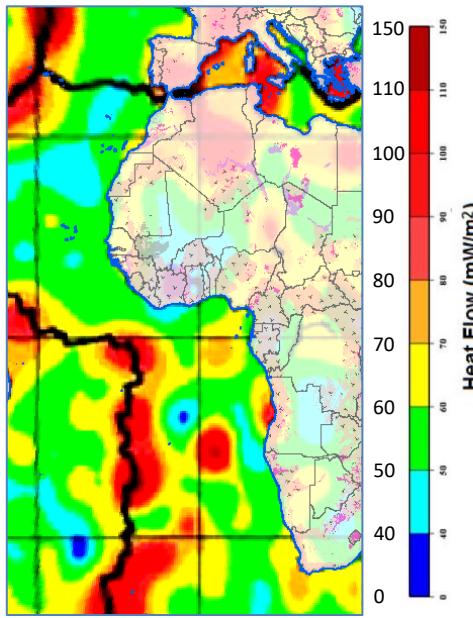
Mello et al., 2011,
2012, 2014 and 2015



Mod after Mutterlose n Sherwood 1990

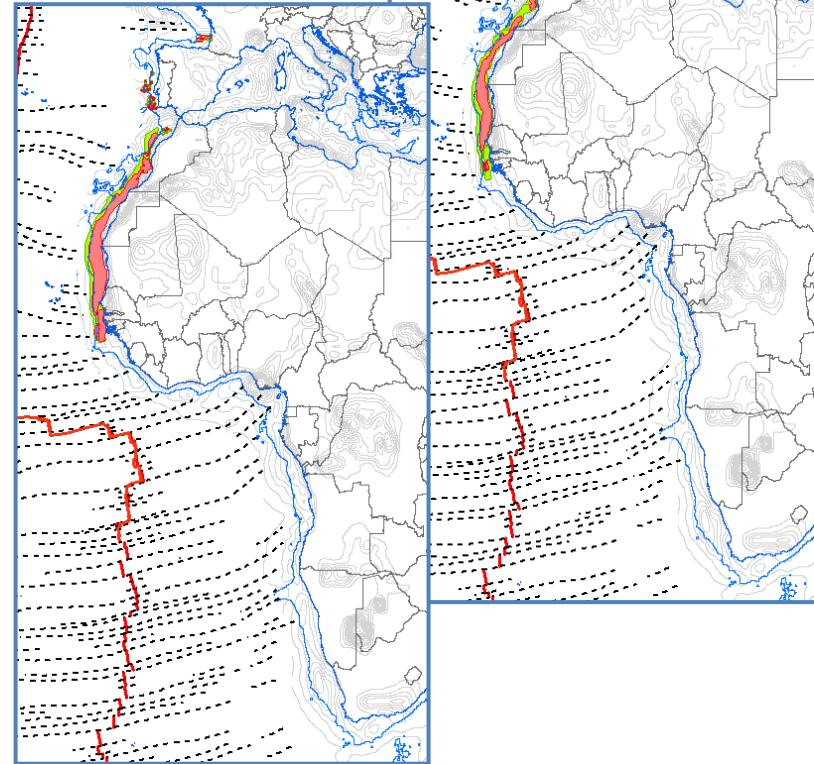
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Indicative Thermal Maturity

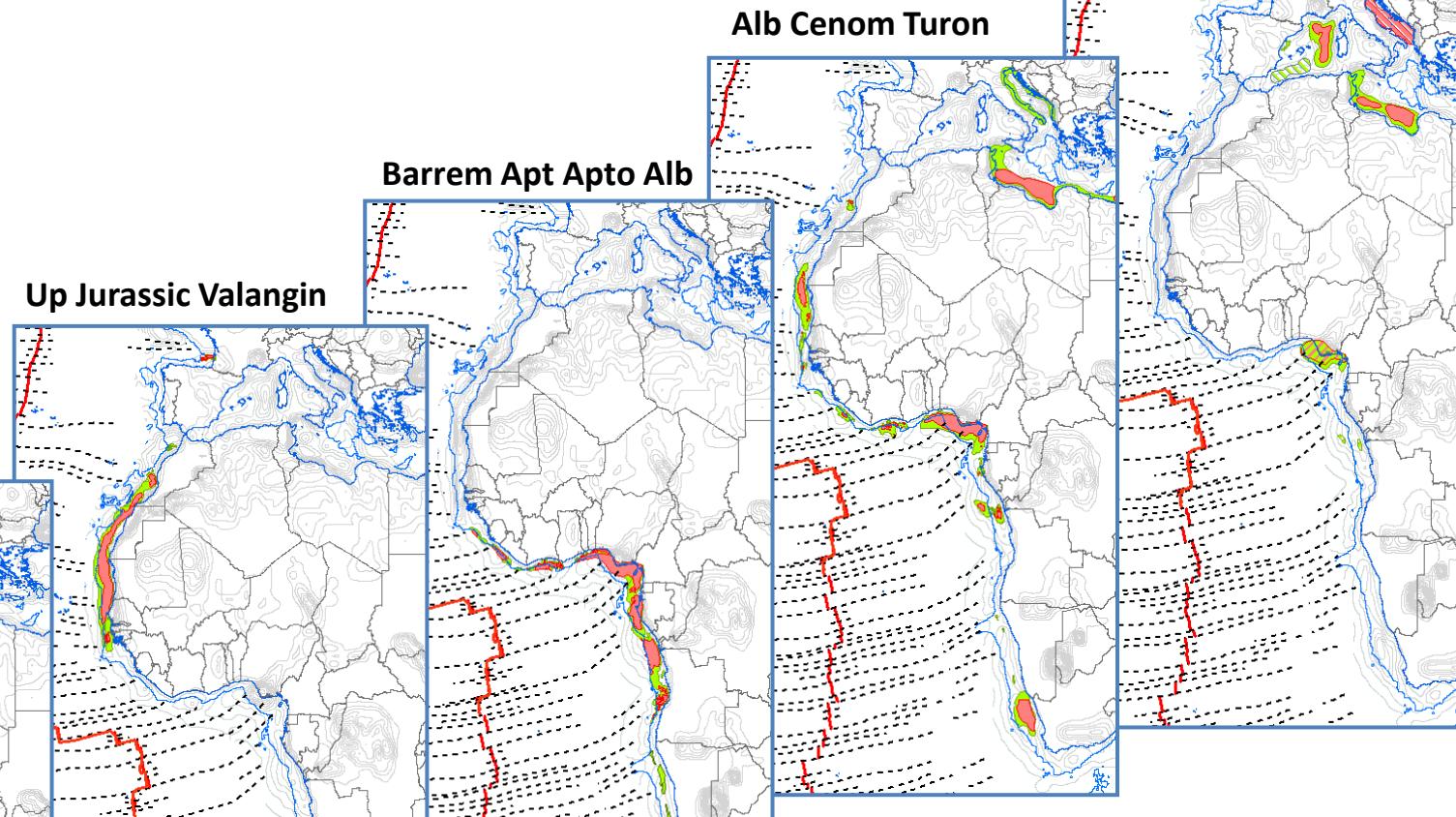


Hamza & Vieira (2012)

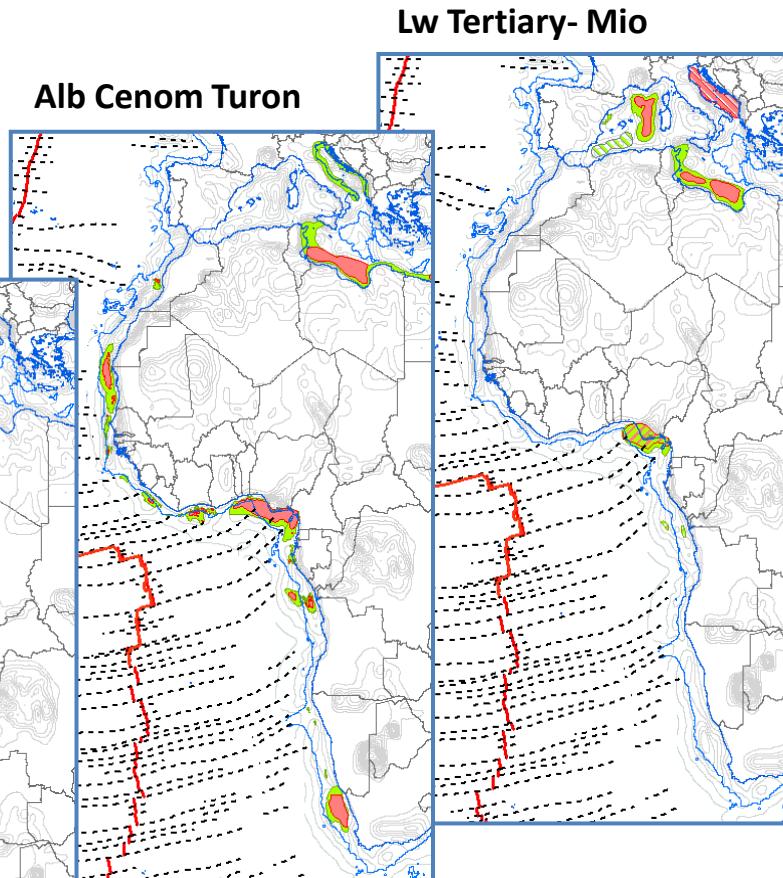
Lower Jurassic



Up Jurassic Valangin

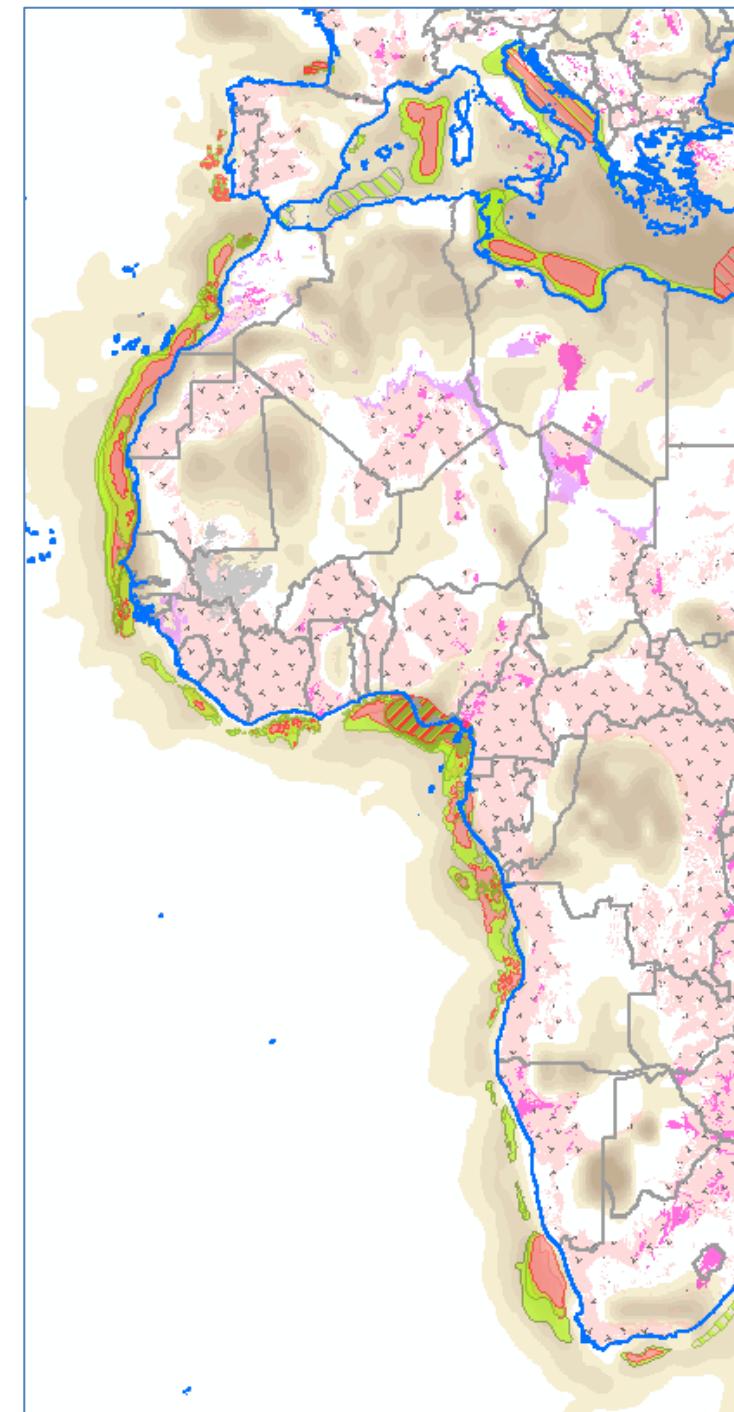


Barrem Apt Apto Alb



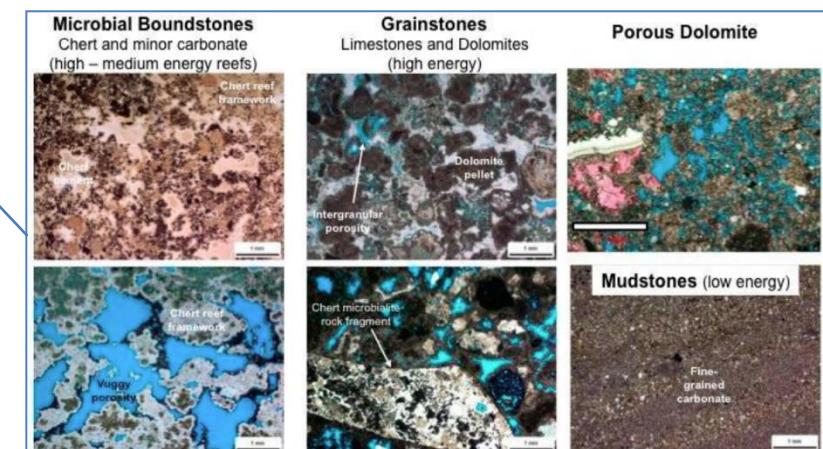
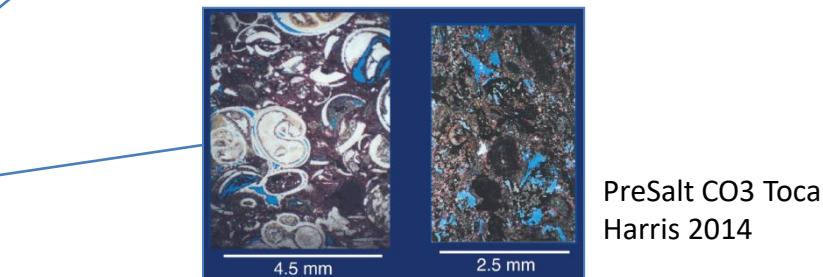
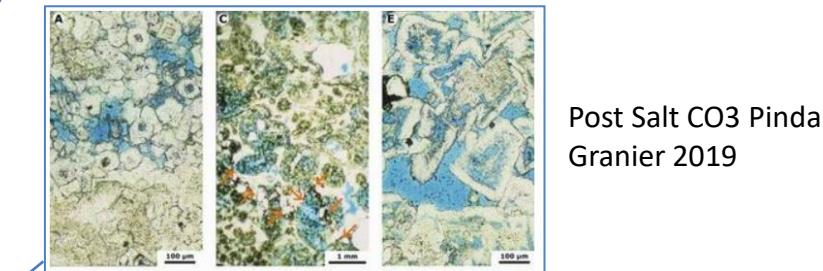
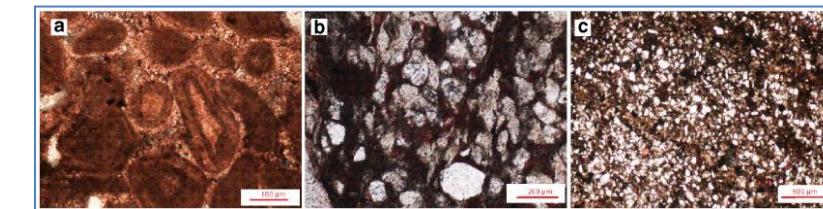
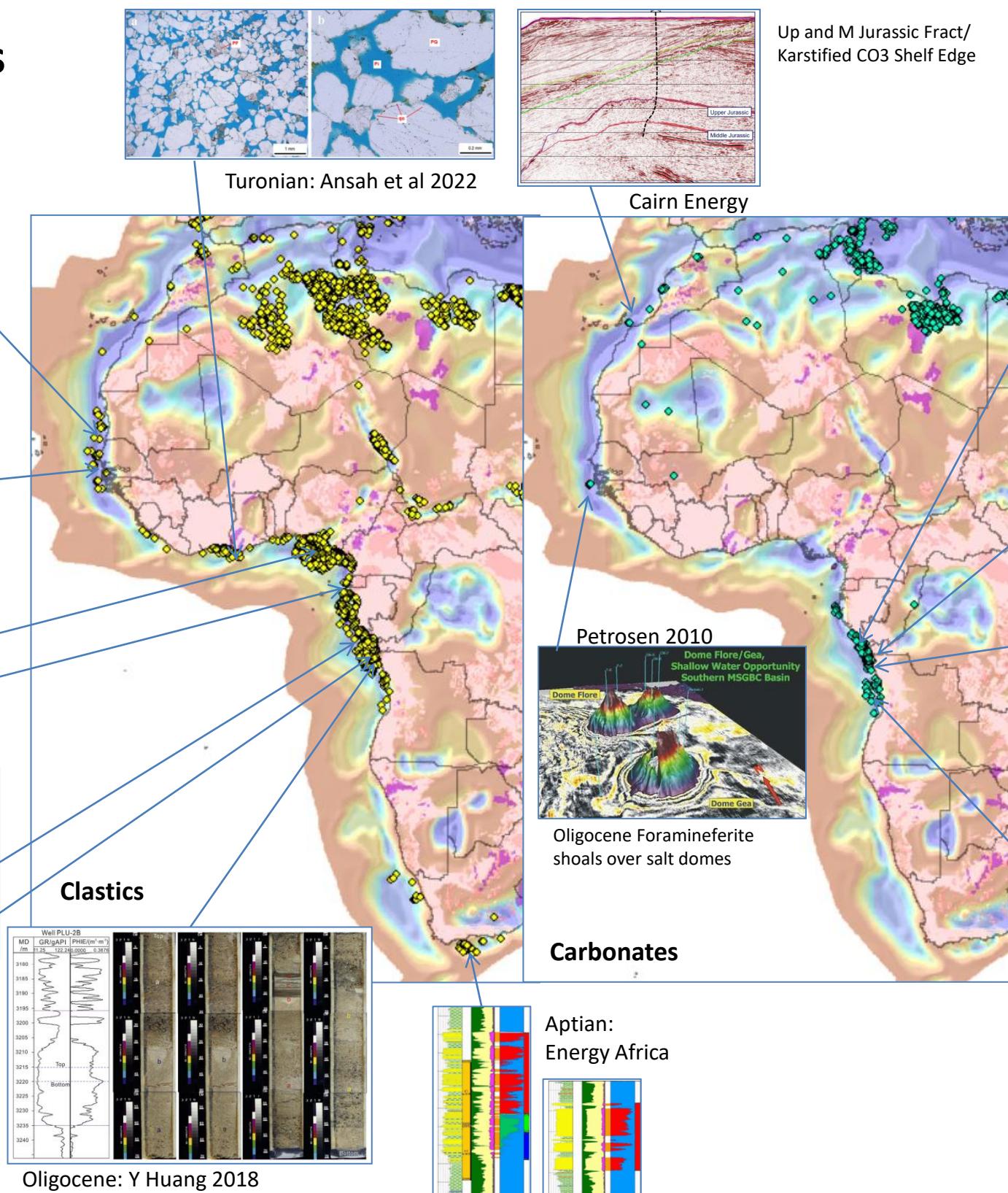
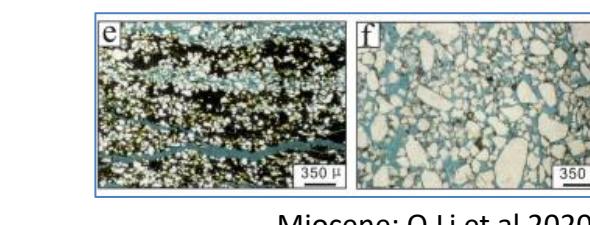
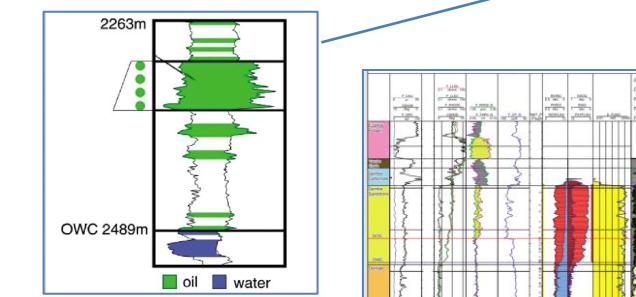
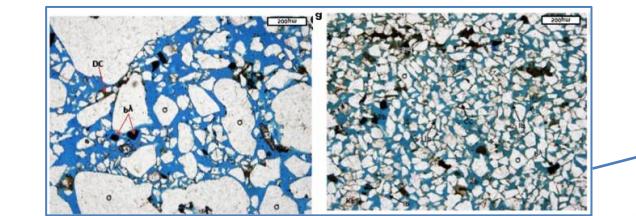
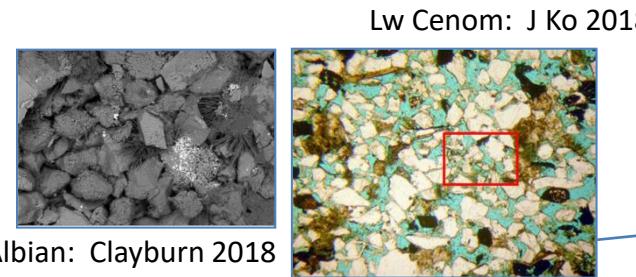
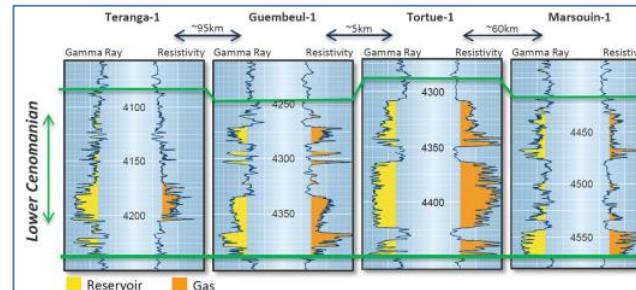
Lw Tertiary- Mio

Stacked Generative Windows



Various Sources

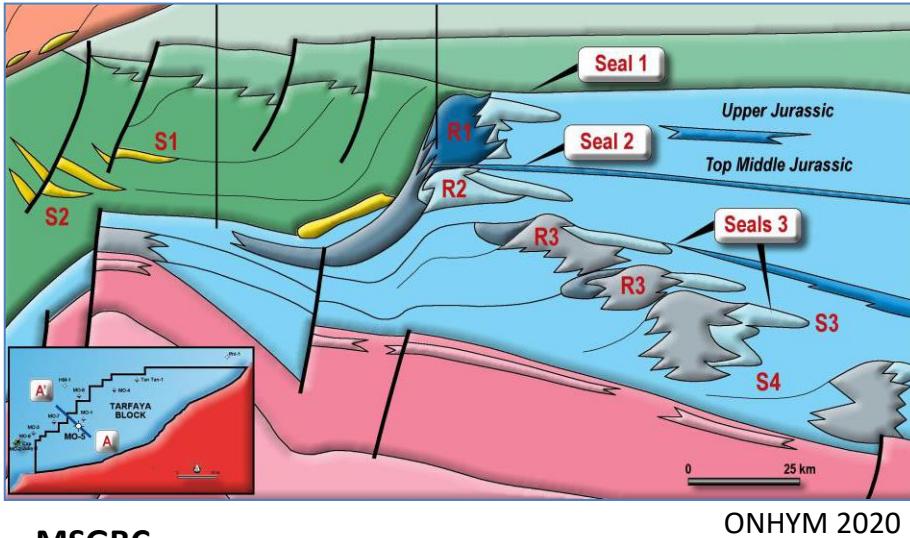
Some Typical Reservoirs



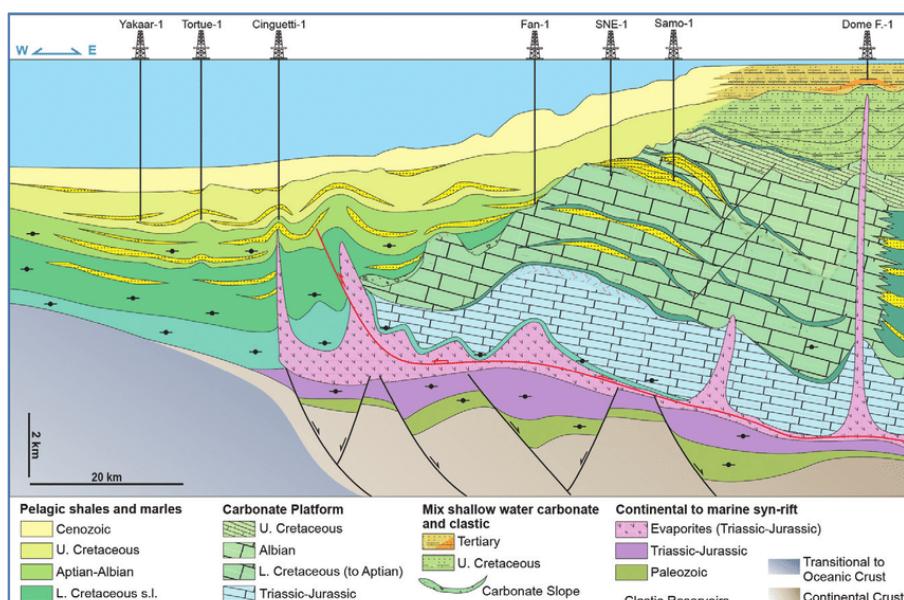
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Some Play Types

Offshore Morocco

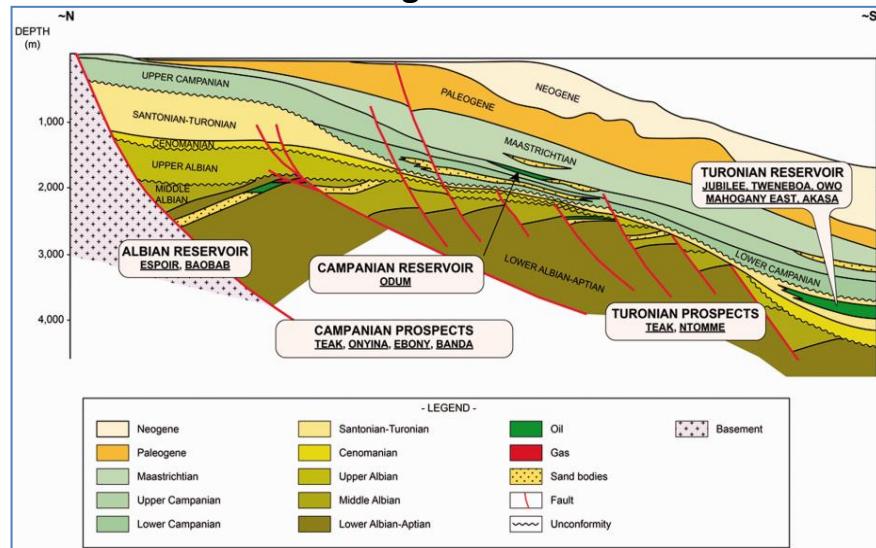


MSGBC



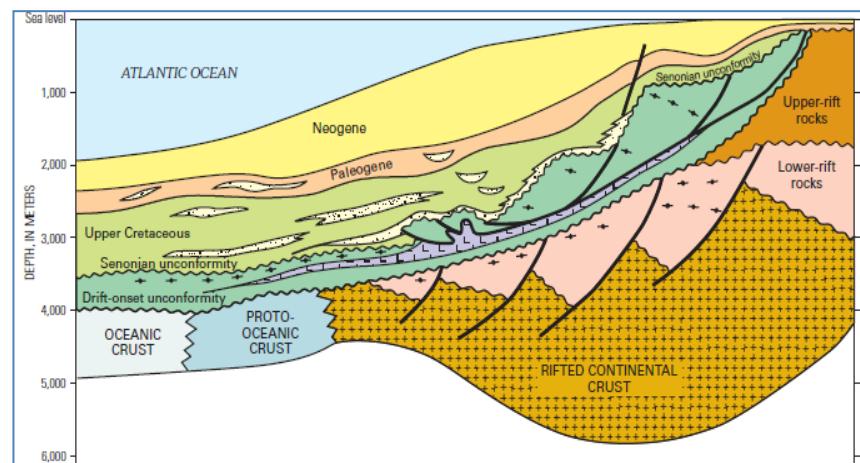
Esestime et al 2020

African Transform Margin



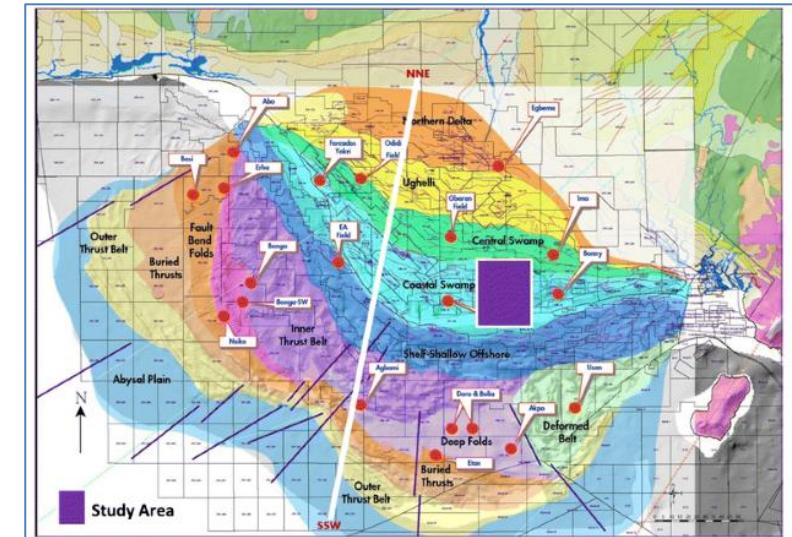
Z Wen et al 2019

Rio Muni



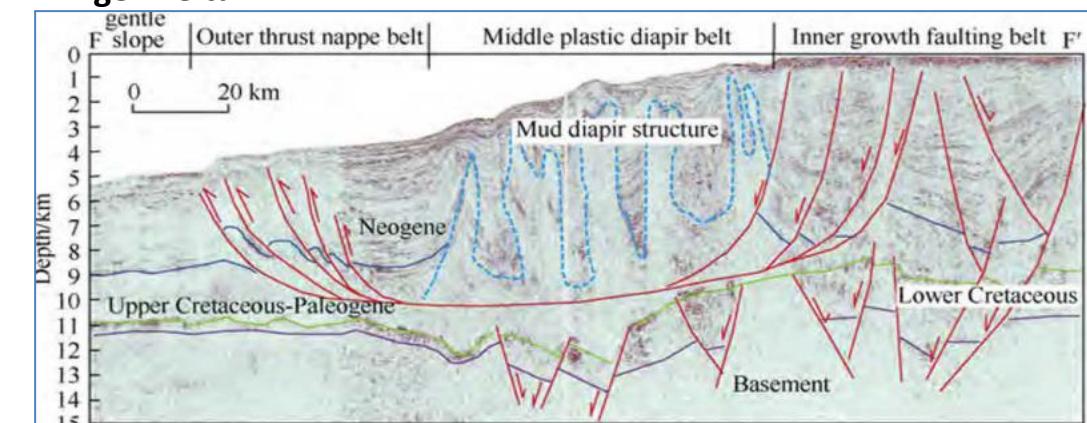
USGS 2006

Niger Delta



Dim n Onuoha 2017

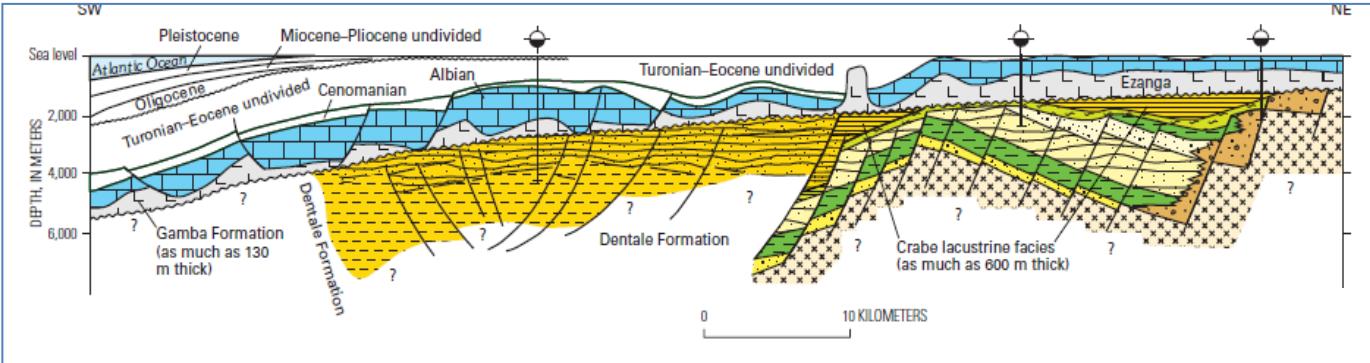
Niger Delta



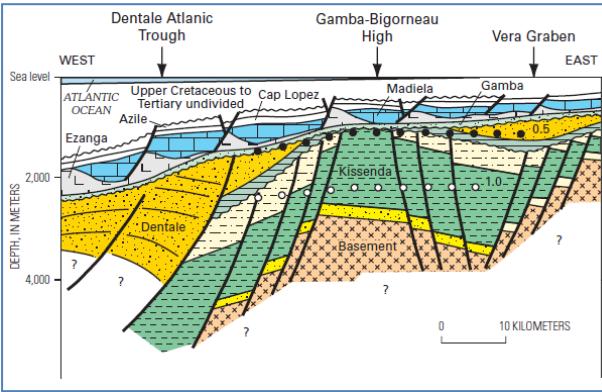
Zhixin et al 2016

Some Play Types

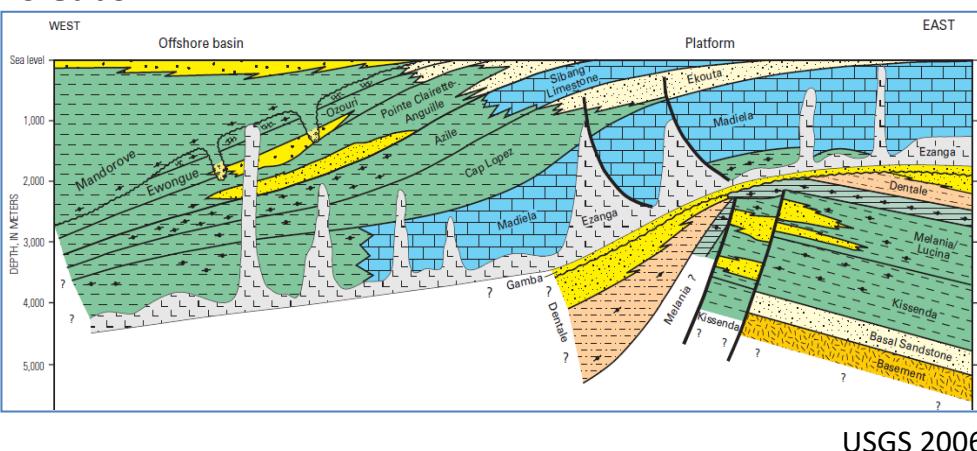
N Gabon



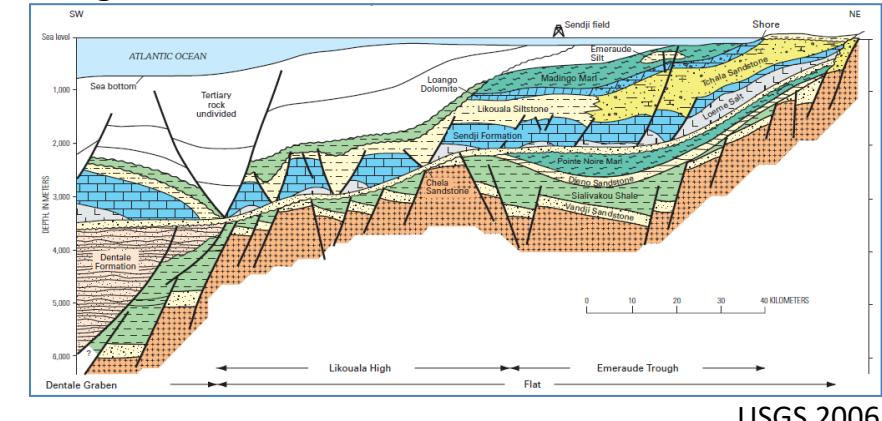
N Gabon



S Gabon



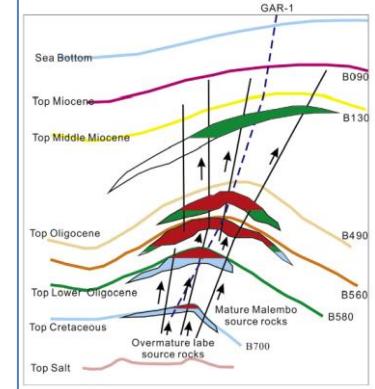
Congo



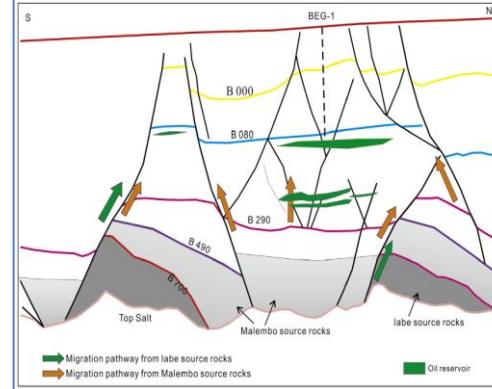
USGS 2006

USGS 2006

Lw Congo

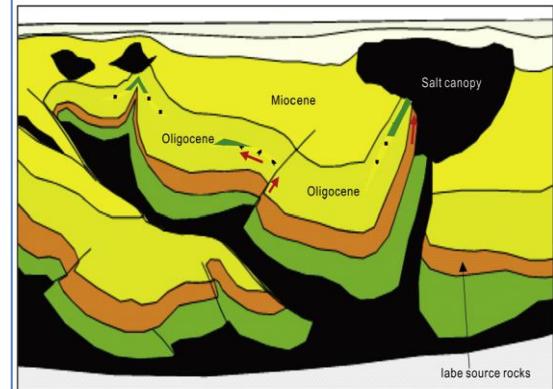


Lw Congo



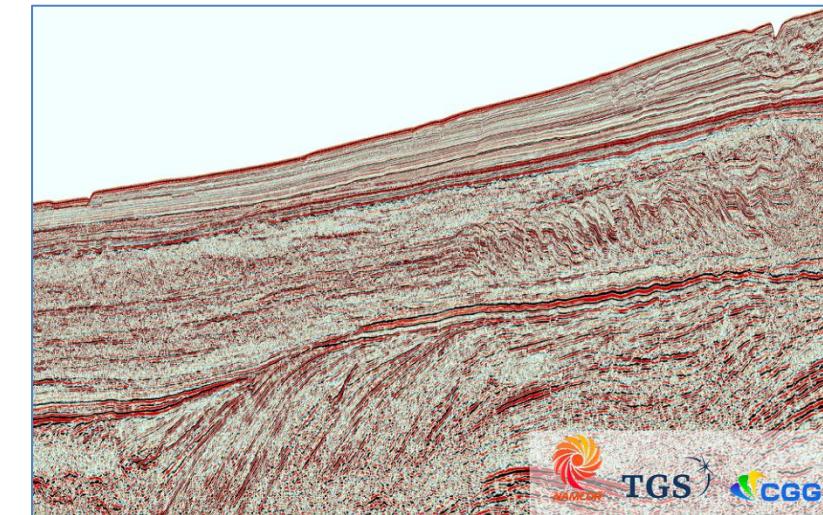
Huang n Zheng 2018

Lw Congo

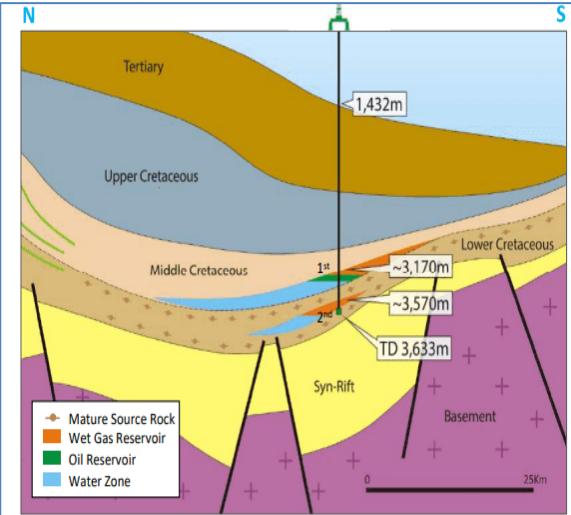


Huang n Zheng 2018

Orange

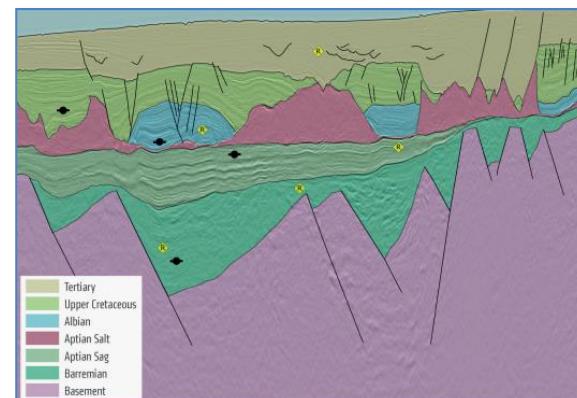


Outeniqua



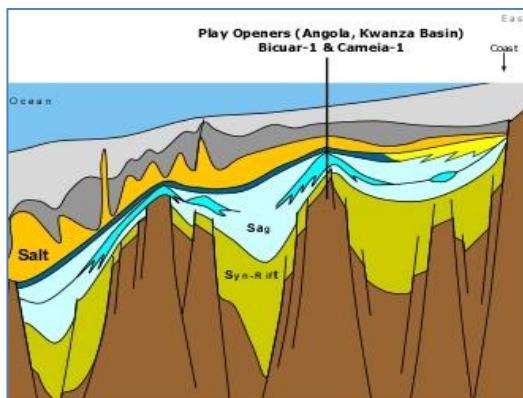
Africa Energy

Kwanza



Plummer n Tilton 2021

Kwanza

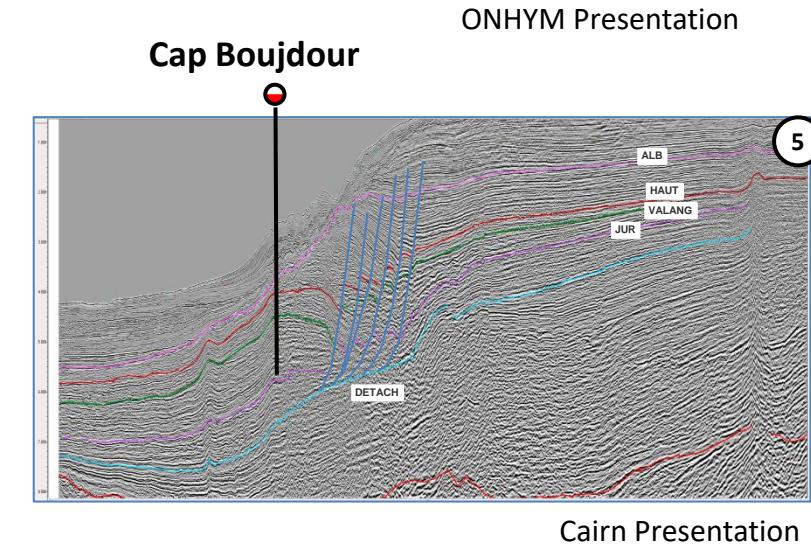
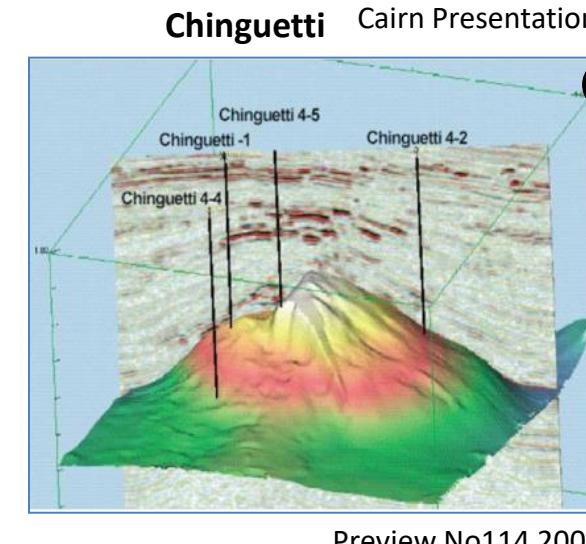
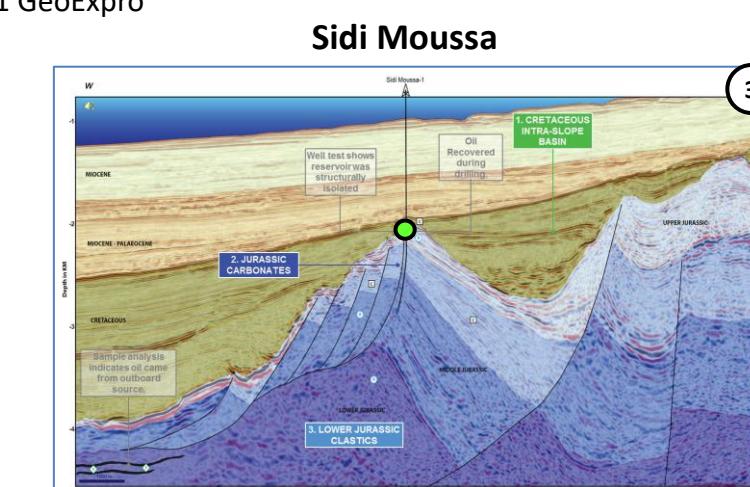
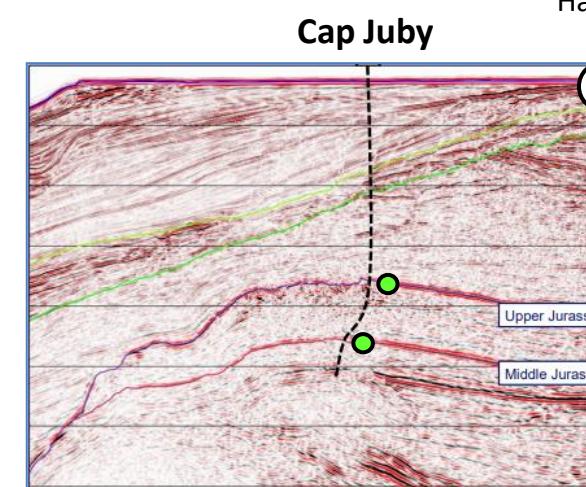
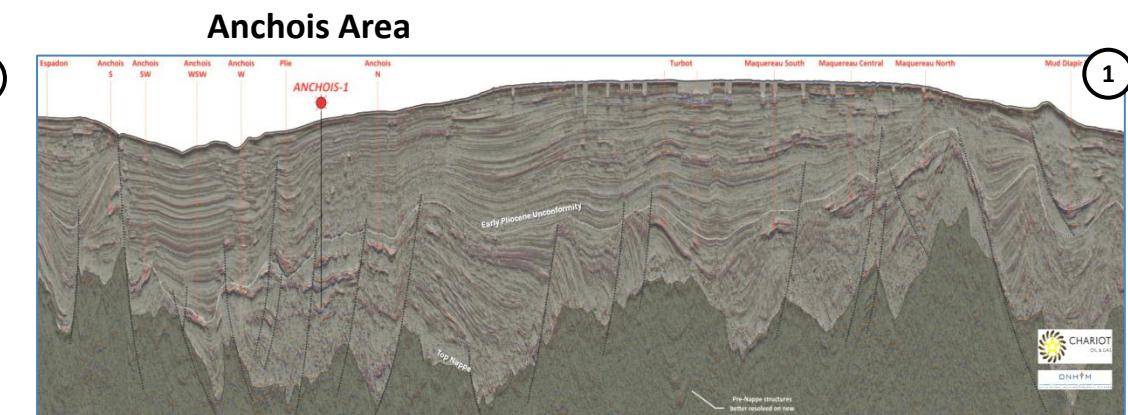
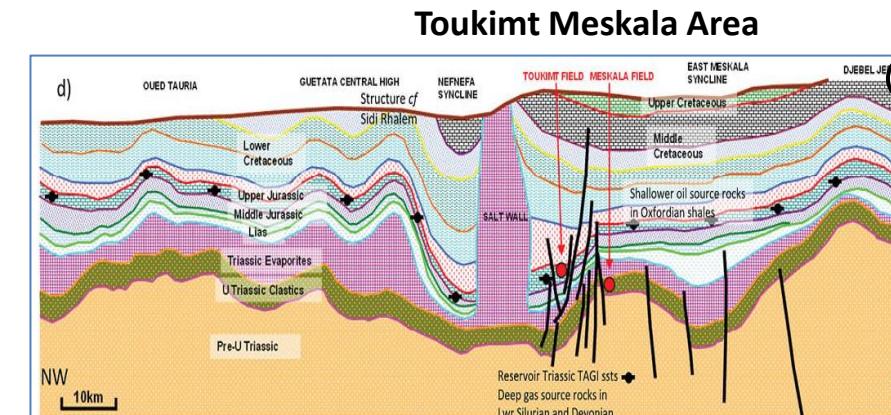
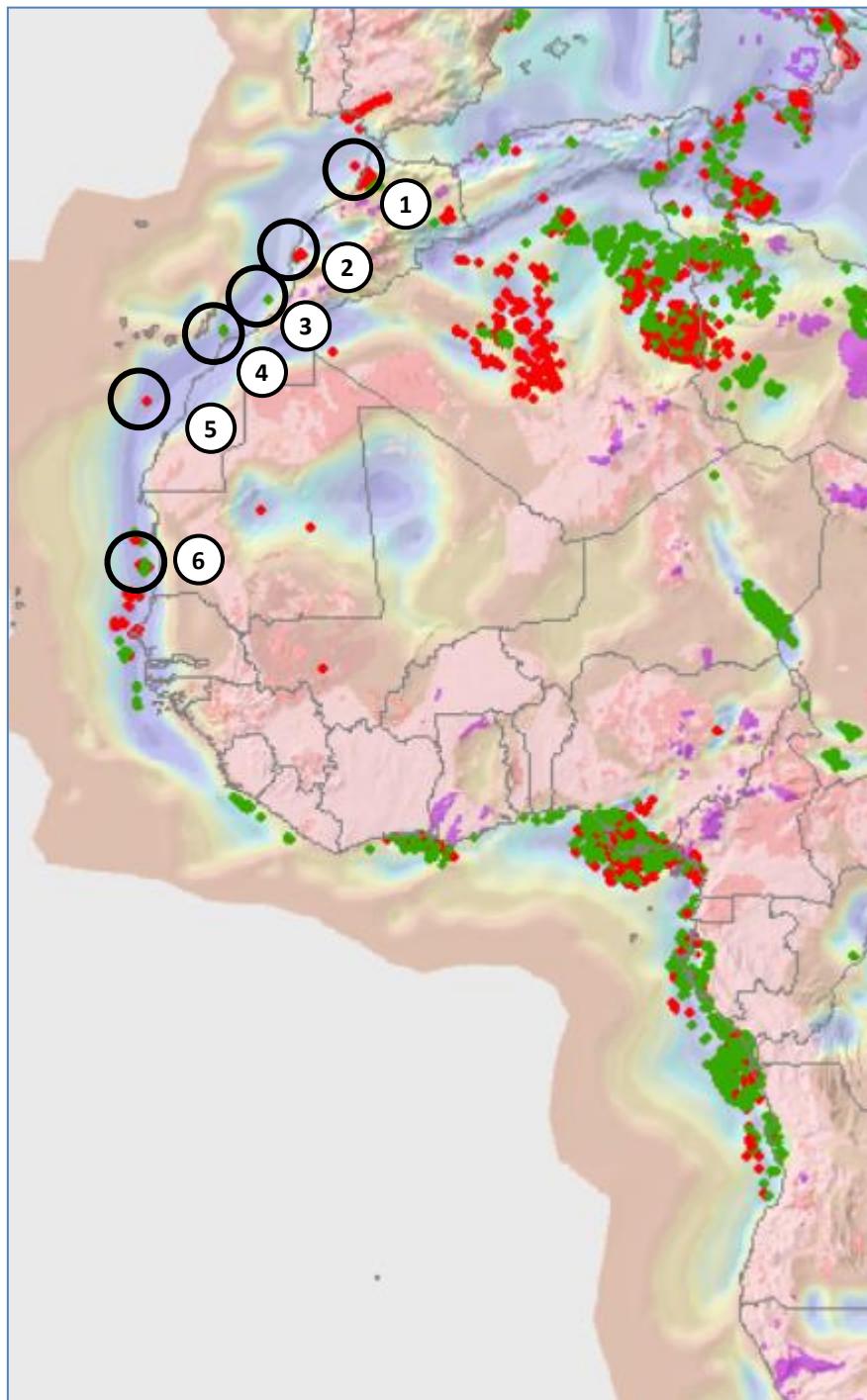


Cobalt Presentation

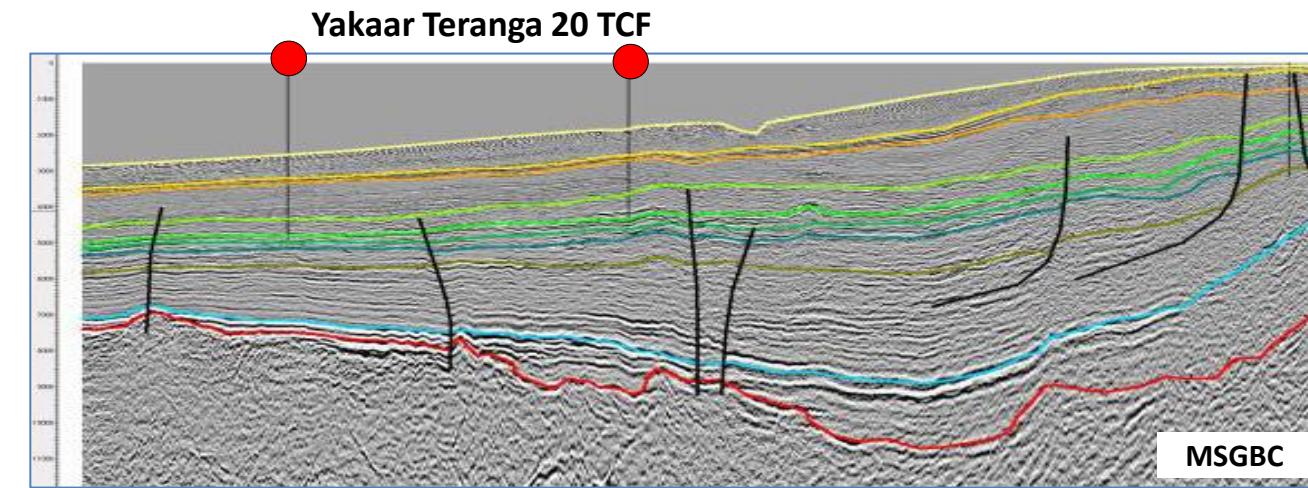
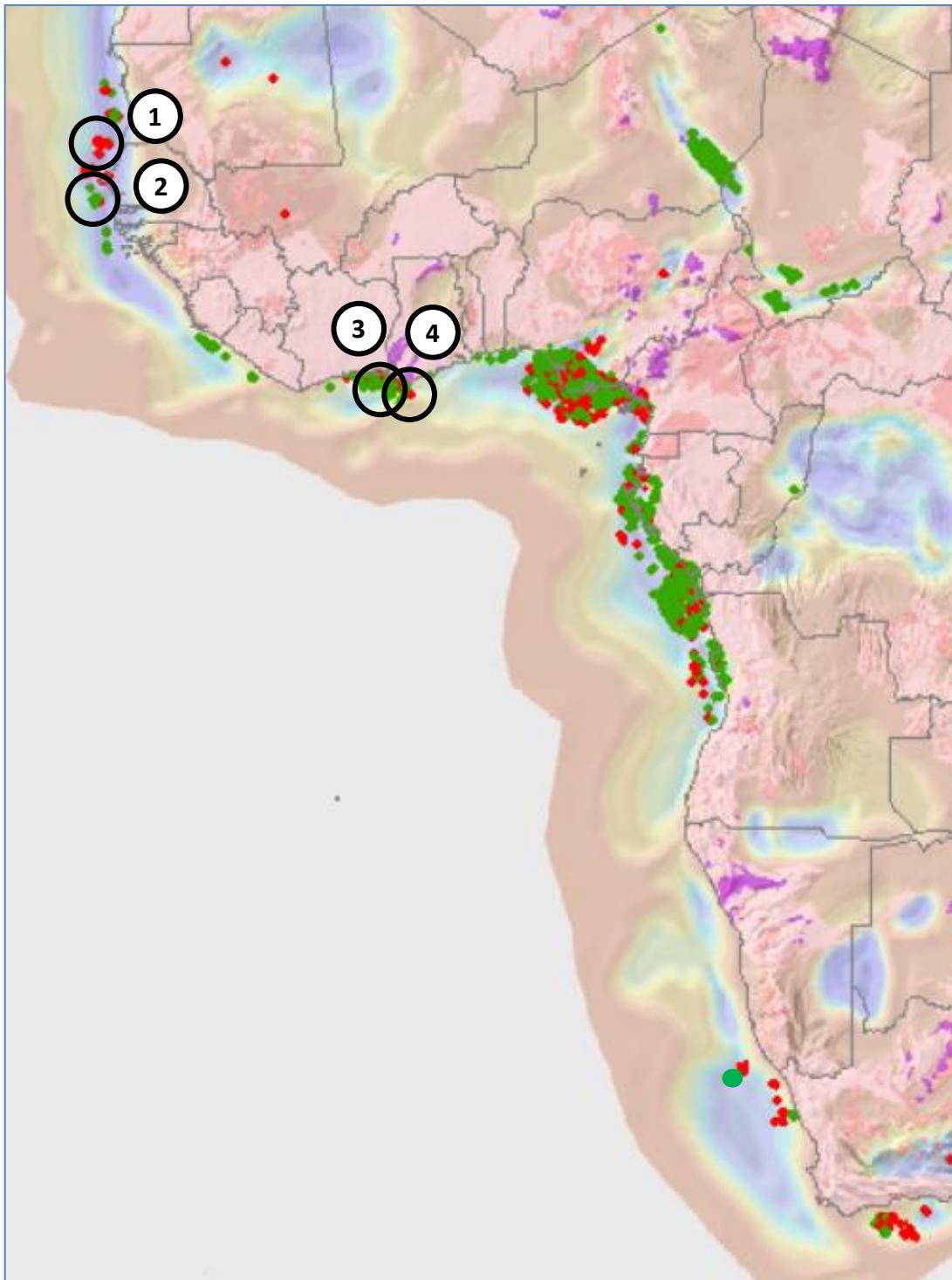
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Some NW Africa Plays with Noteworthy Hyd Occurrence

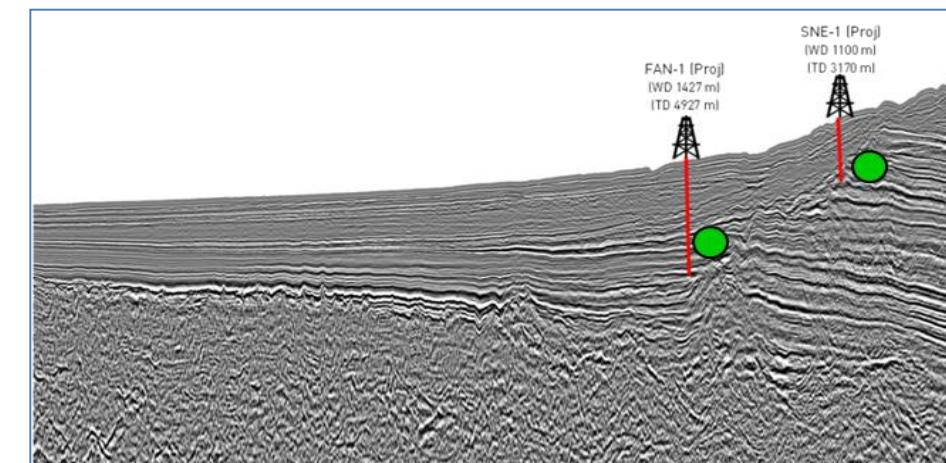


Some Large Fields



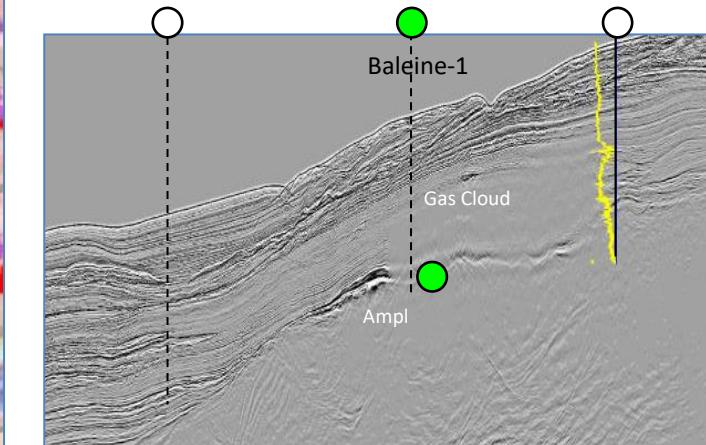
SNE 0.64 BBO, MSGBC

Industry Presentations

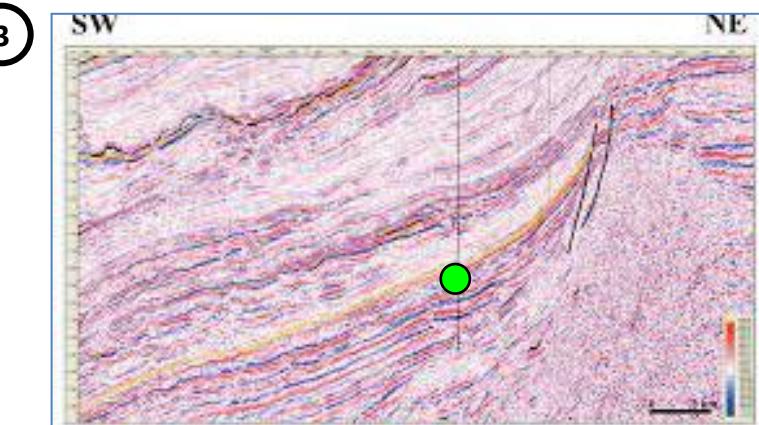


Industry Presentations

Baleine 1.25 BBOE, Tano CDV

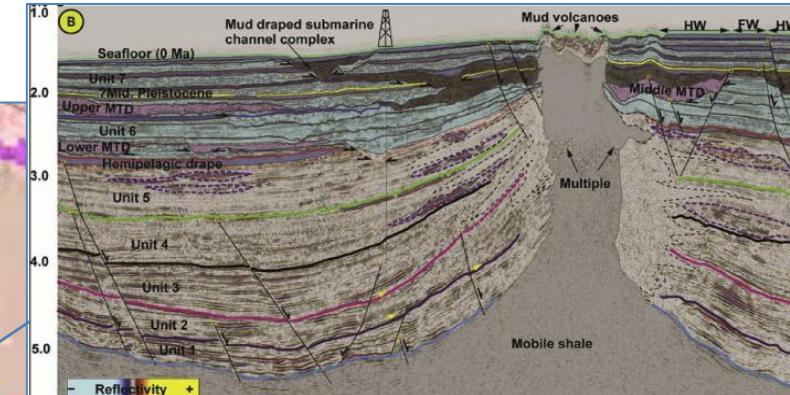
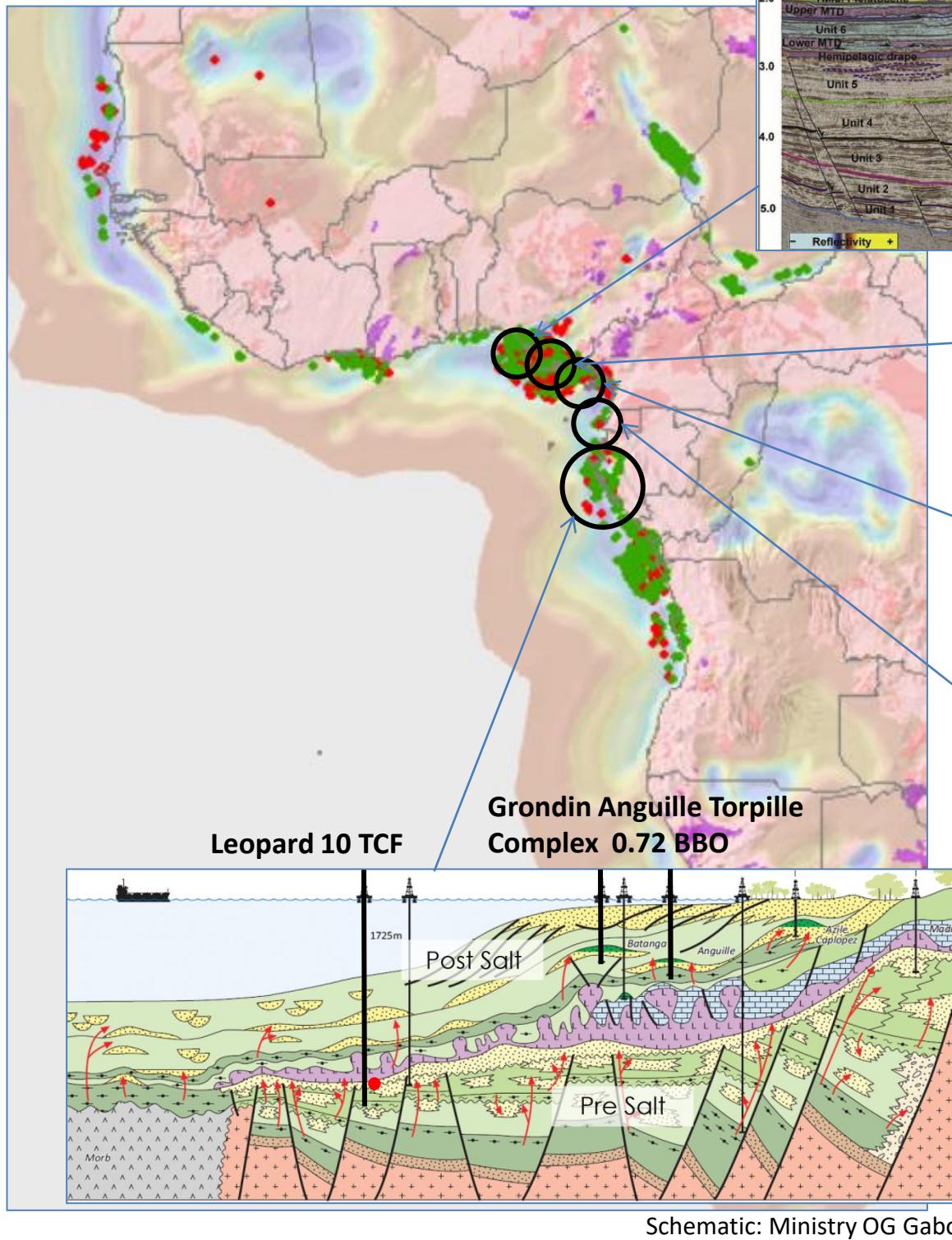


Jubilee 1.0 BBO, Tano Ghana



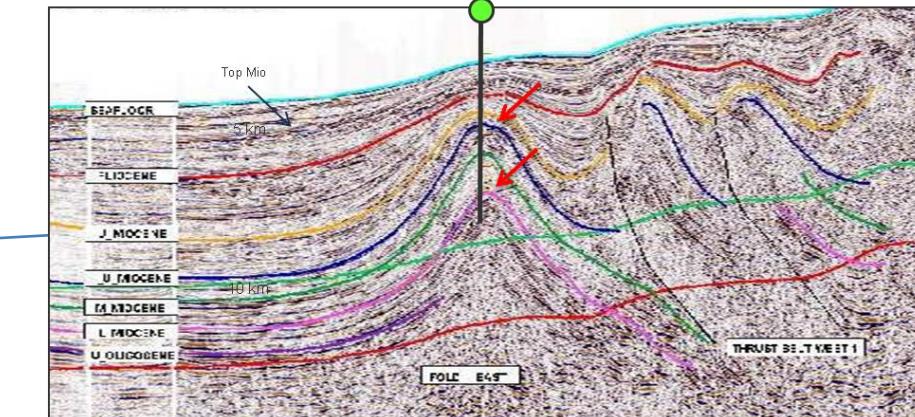
Bonga 1.3 BBO, Niger Delta

Some Large Fields



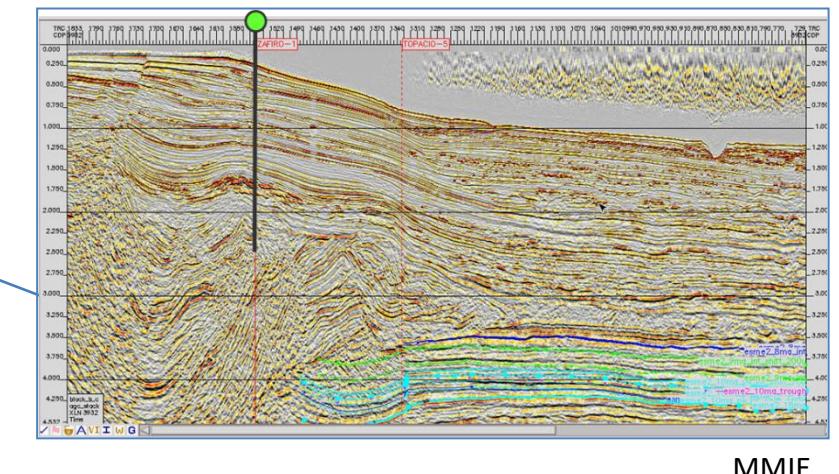
Chima et al 2019

Abagmi 1.0 BBO, Niger Delta



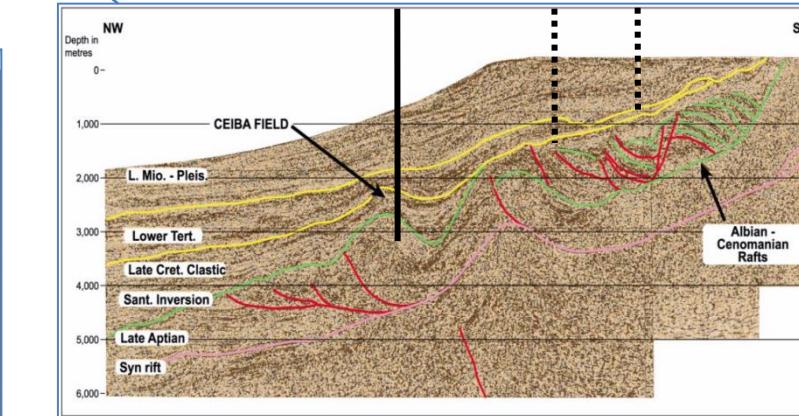
Moser et al 2006

Zafiro 1.5 BBO, Niger Delta

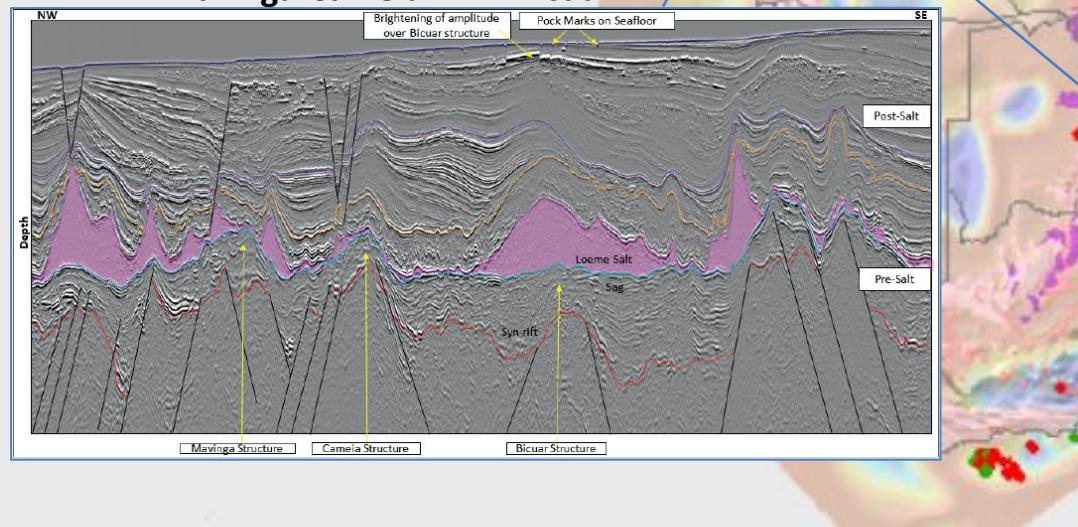
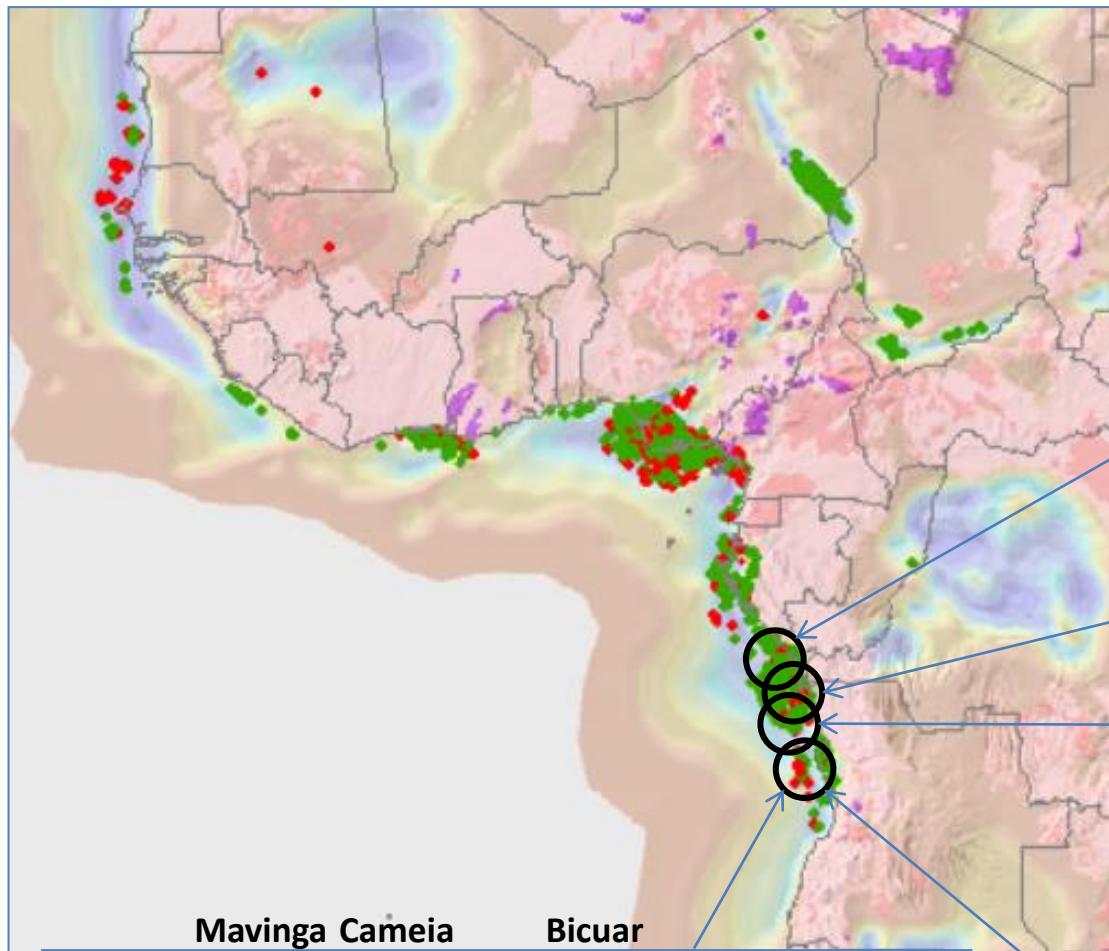


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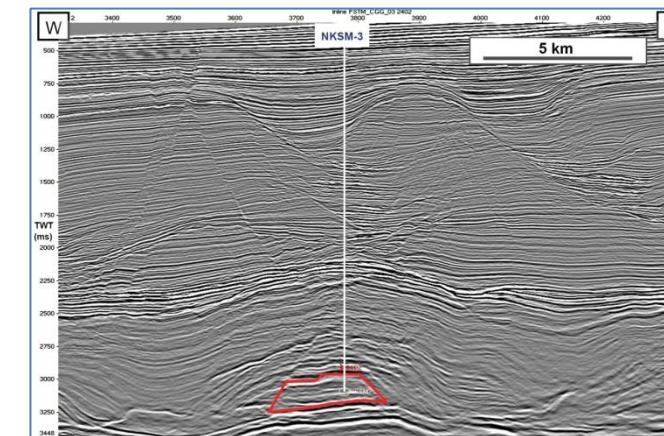
Ceiba Okume Elon Complex 0.5 BBO



Some Large Fields

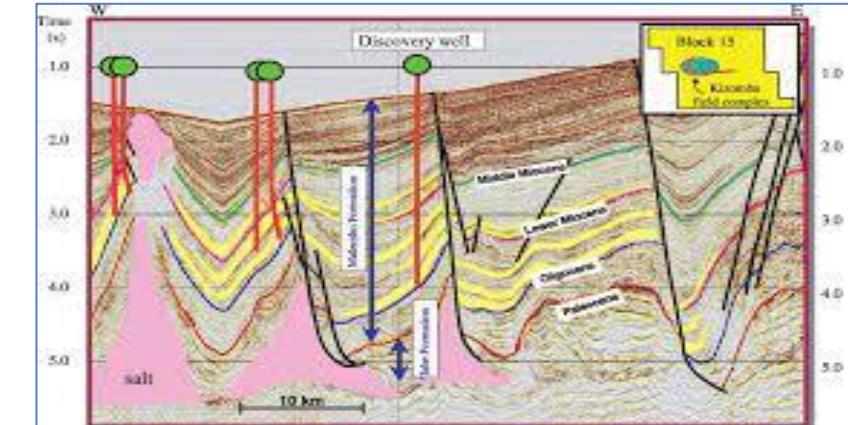


N'kossa 0.38 BBO



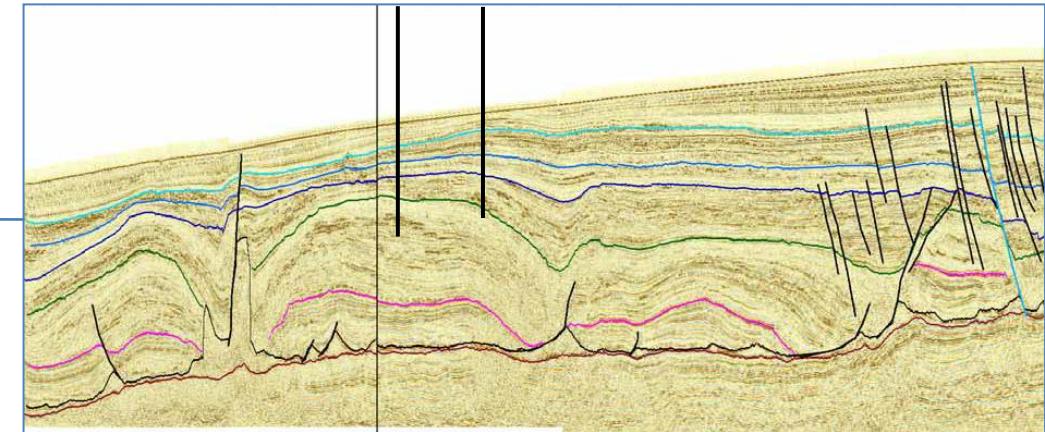
Wonham et al 2010

Kizomba Complex 1.85 BBO



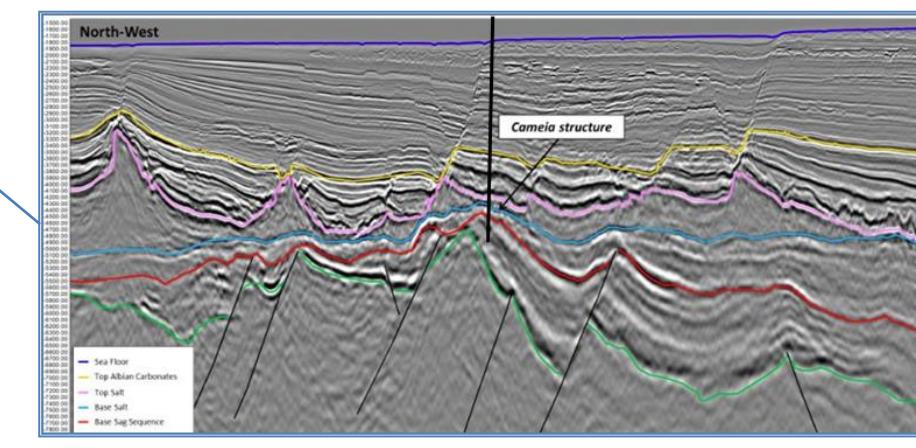
Reeckmann et al 2003

Girassol, Dalia 2.50 BBO



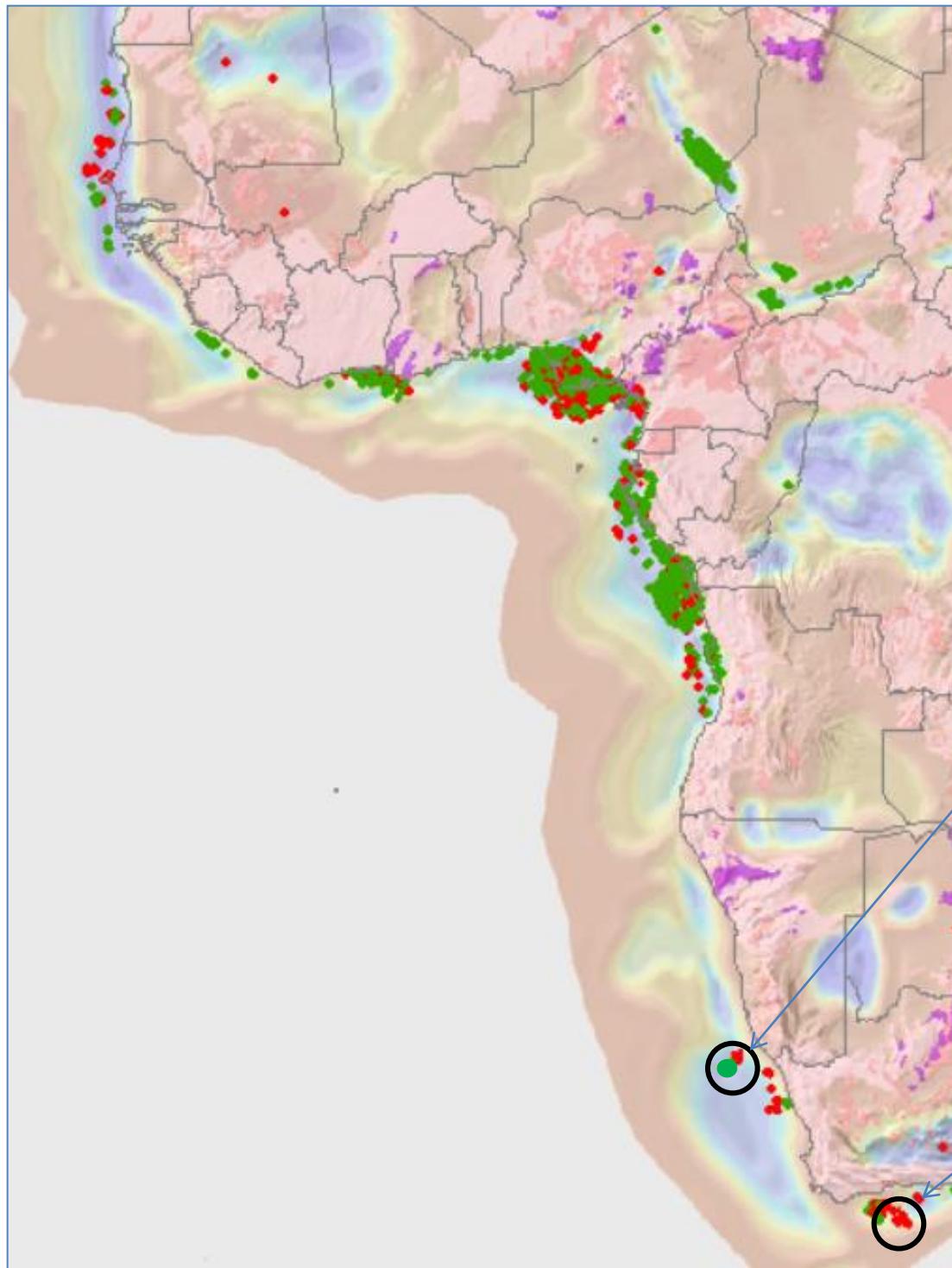
Guevara et al 2010

Cameia, 0.46 BBO, Kwanza

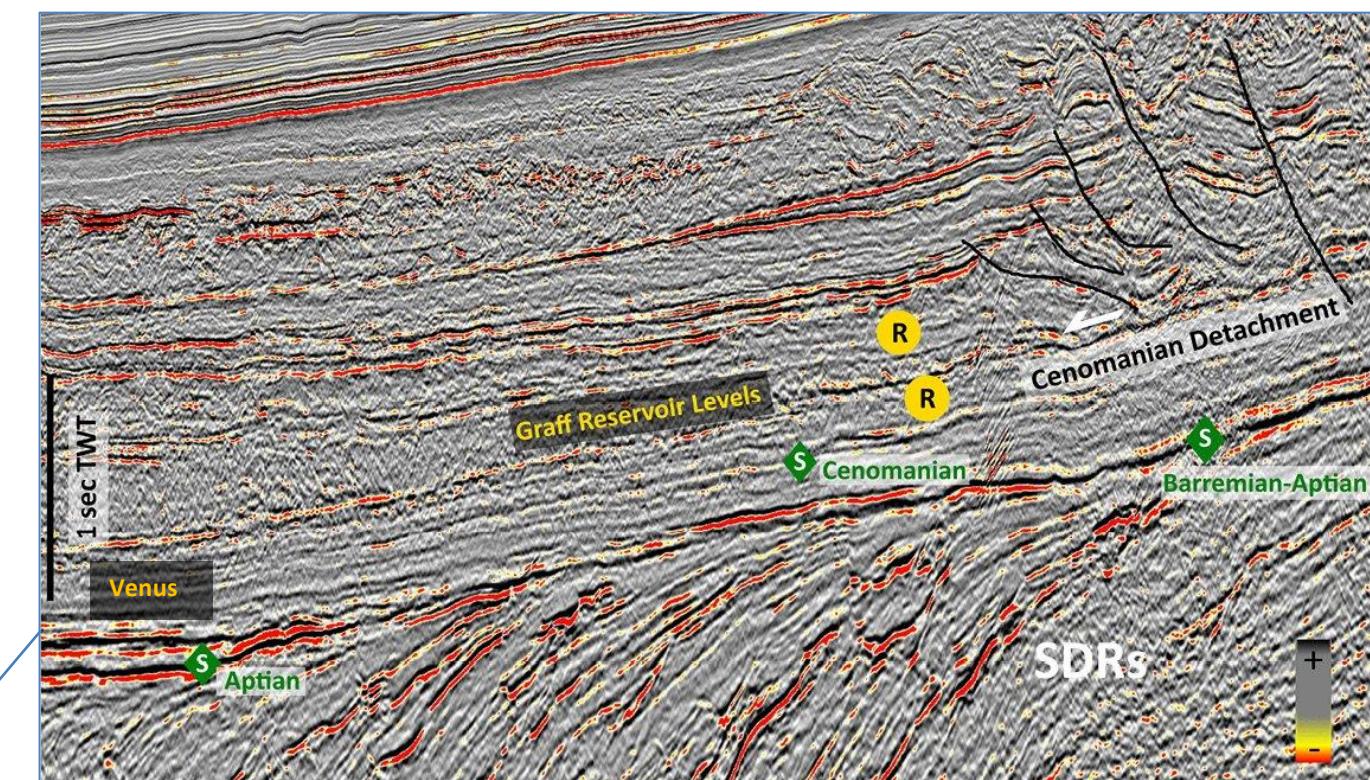


CGG

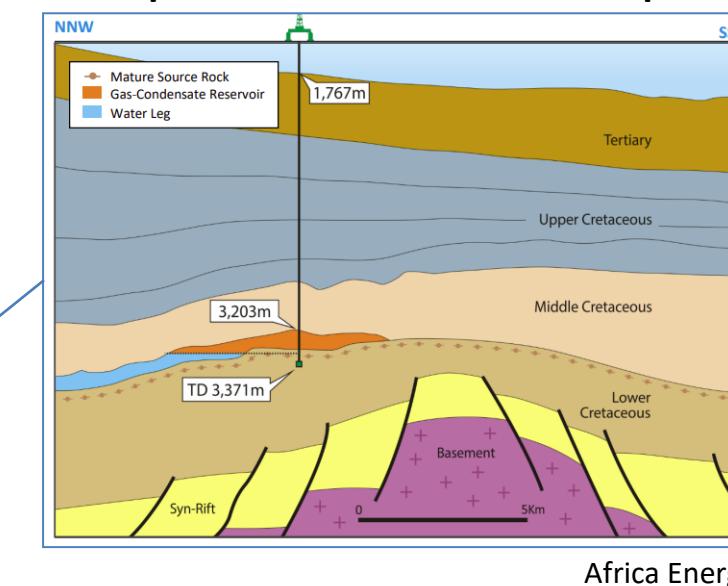
Some Large Fields



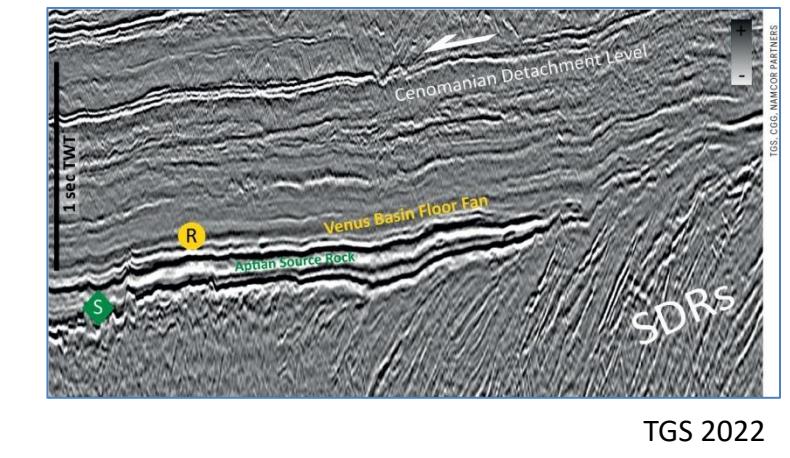
Venus, Graff 3.5 BBO, Orange



Luiperd, 2 TCF 0.1 BBC, Outeniqua

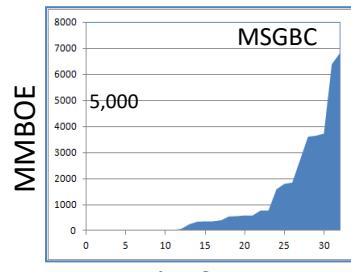


Venus Fan, Orange

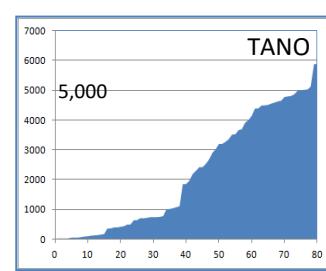


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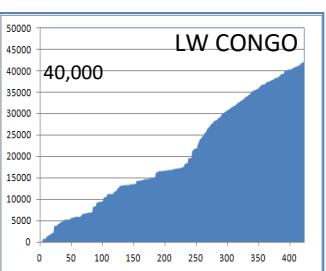
Indicative Cum MMBOE Disc Sequence



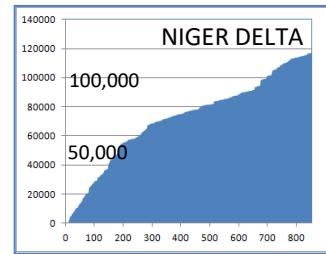
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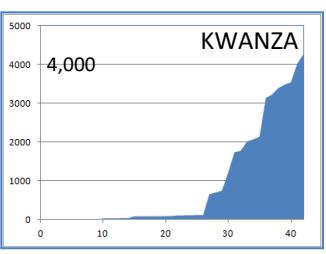
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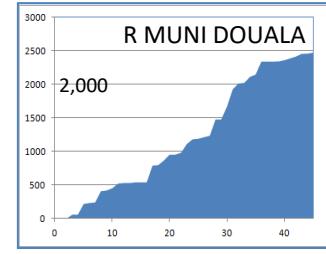
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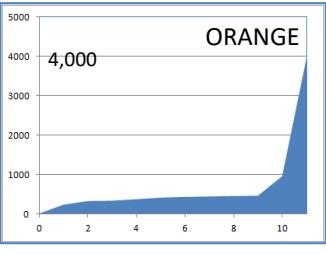
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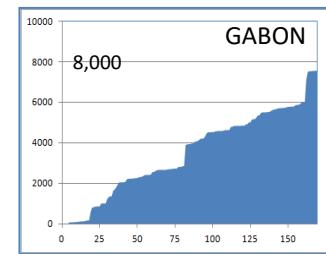
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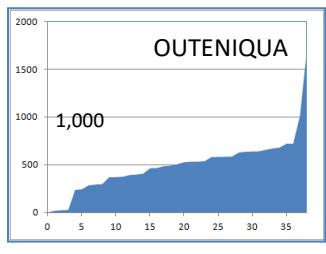
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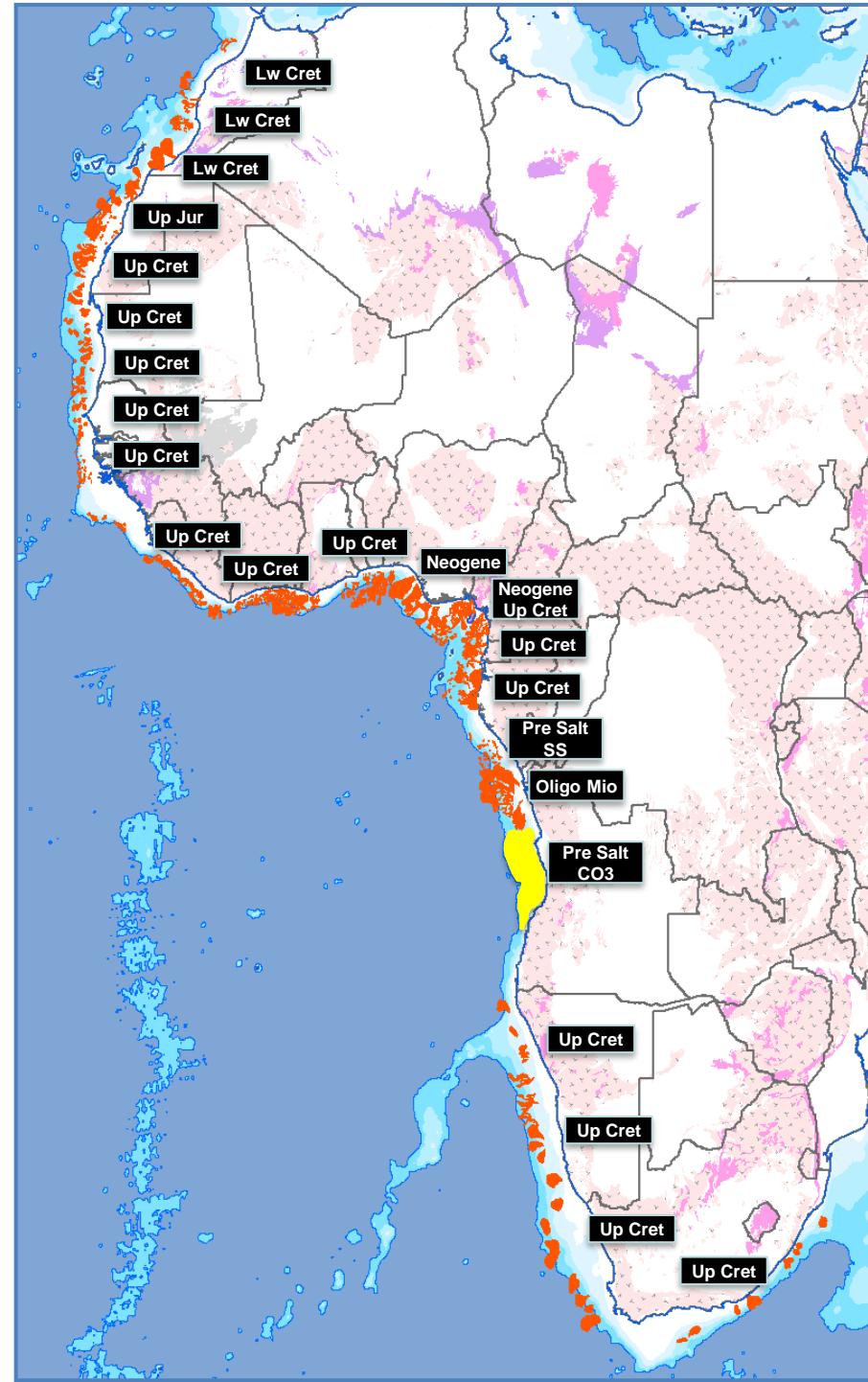
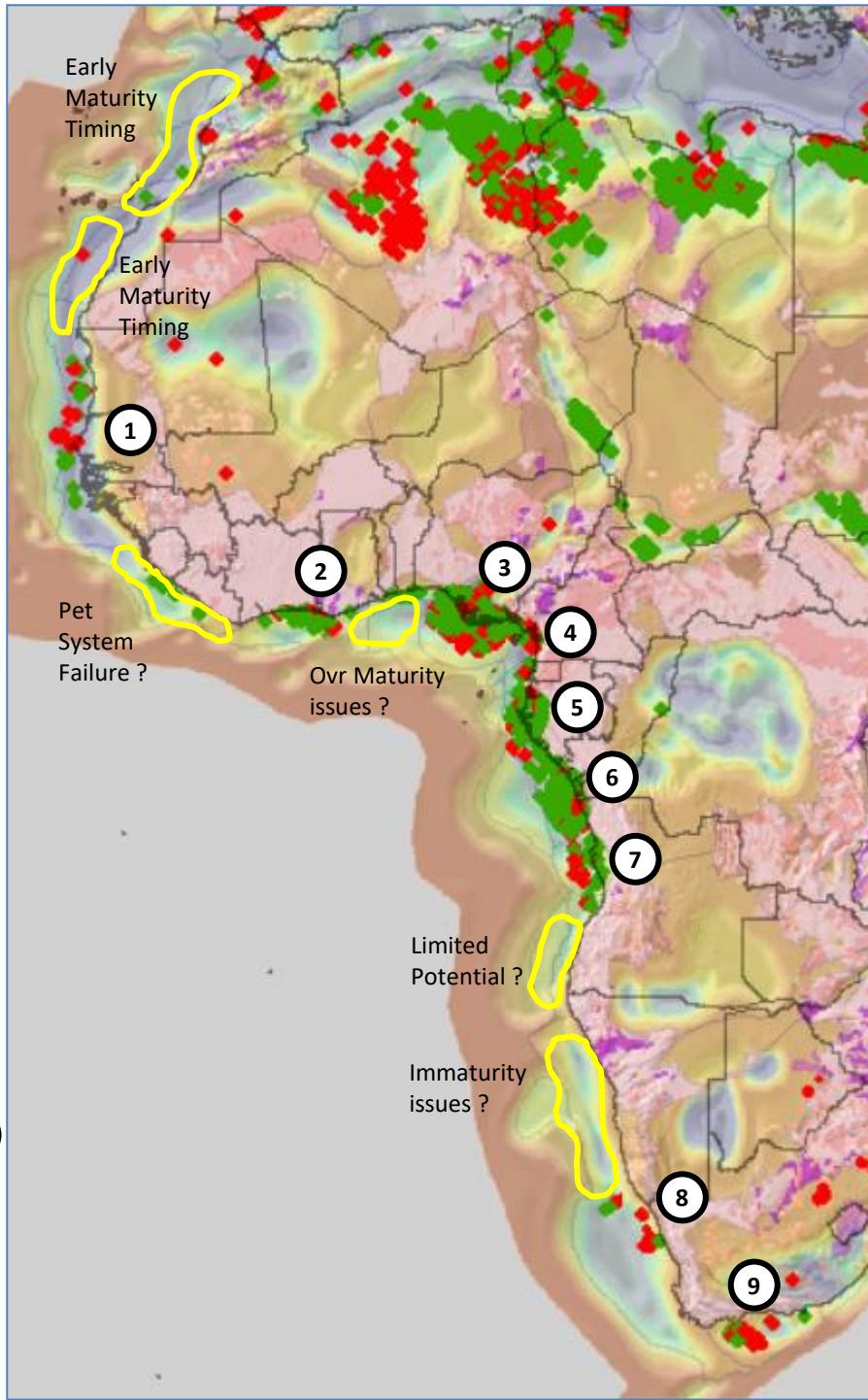
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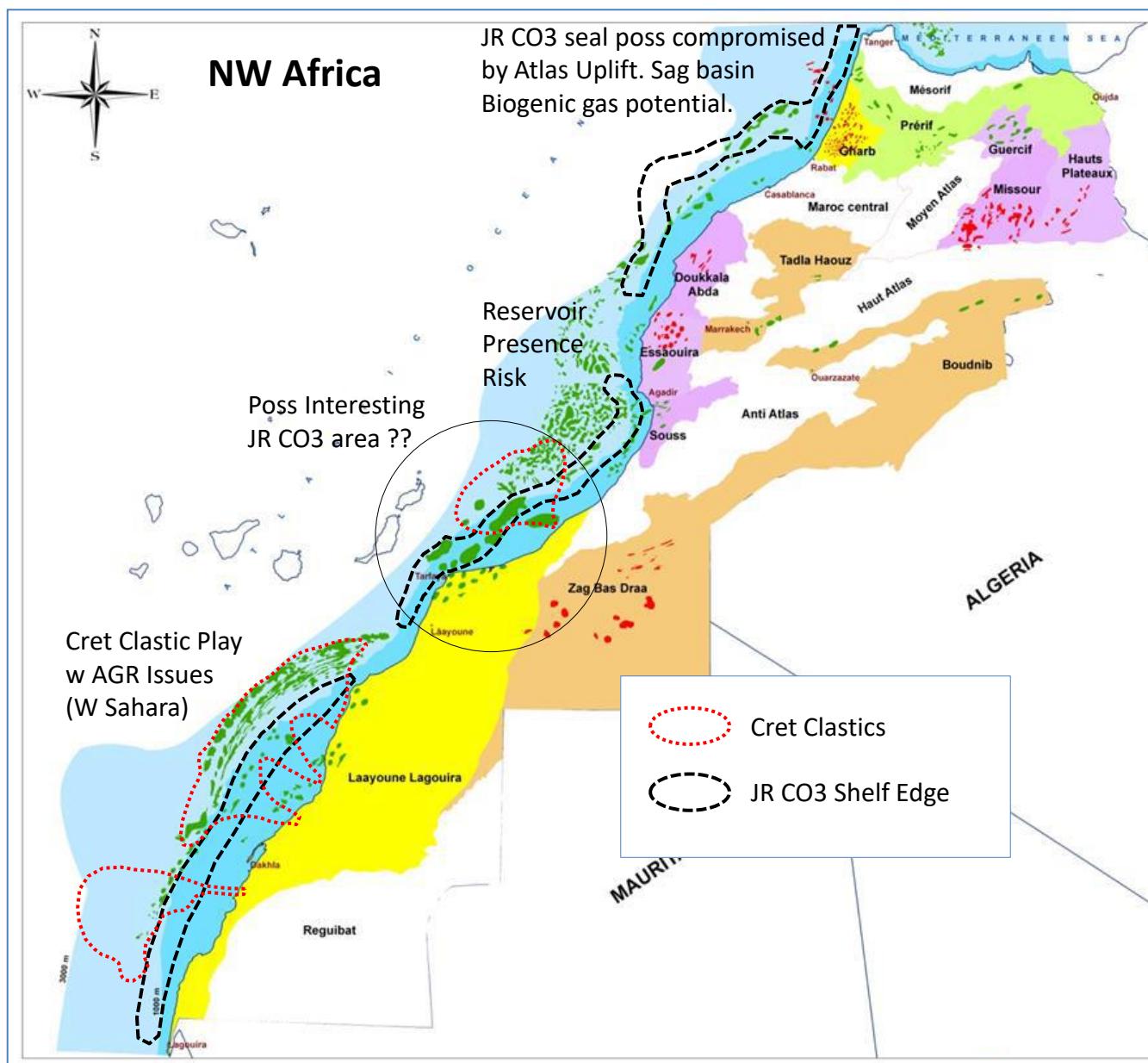


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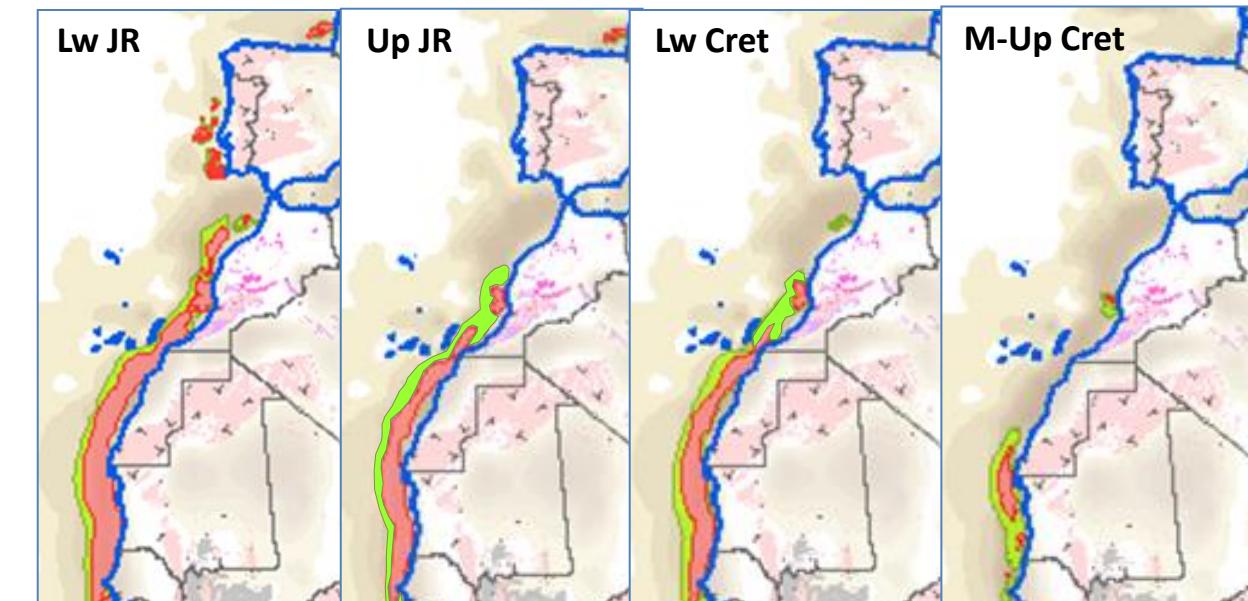
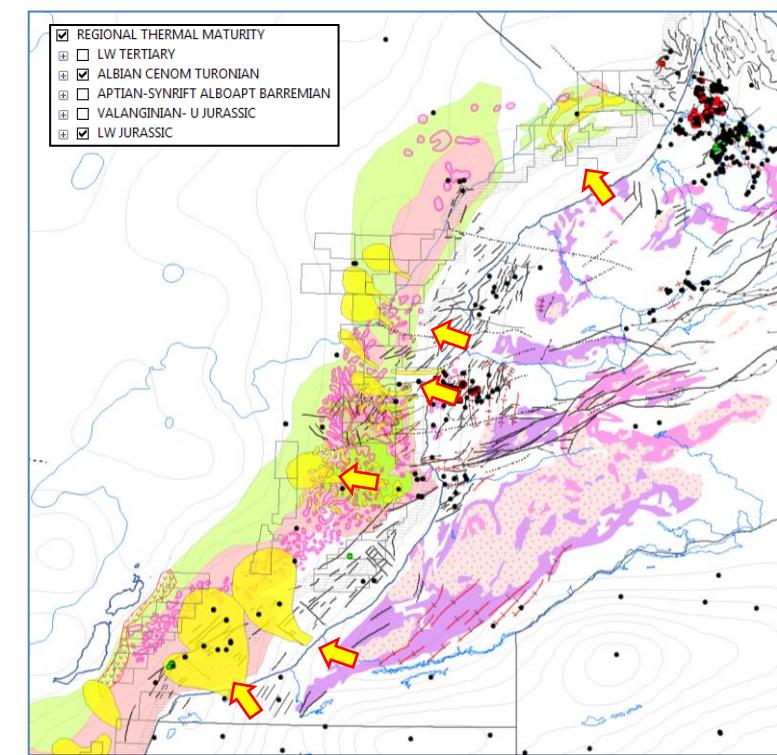
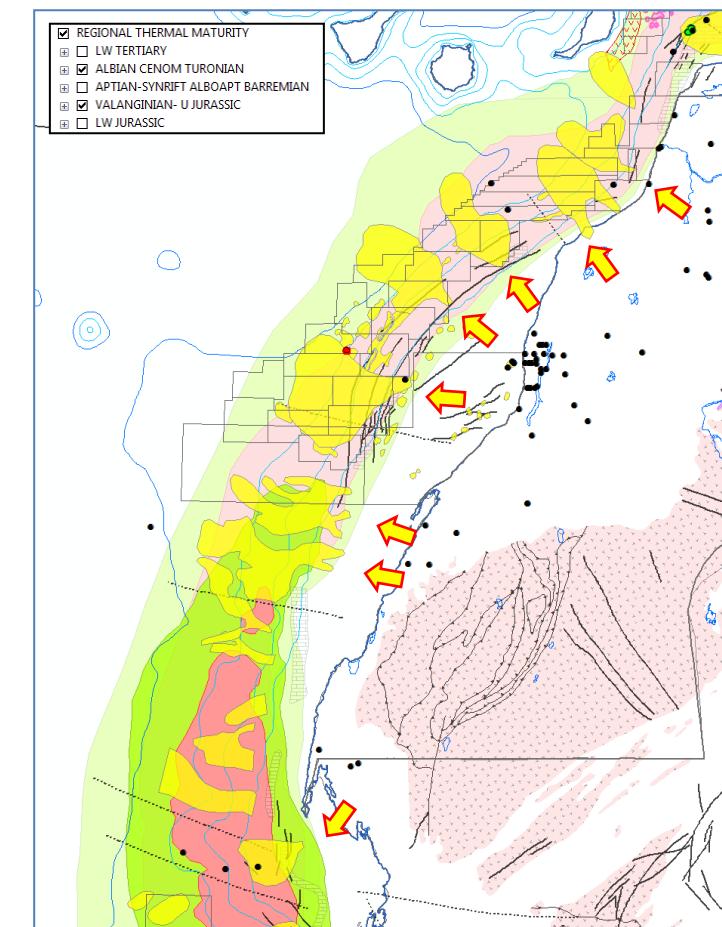


Some Fairway Ideas

NW Africa

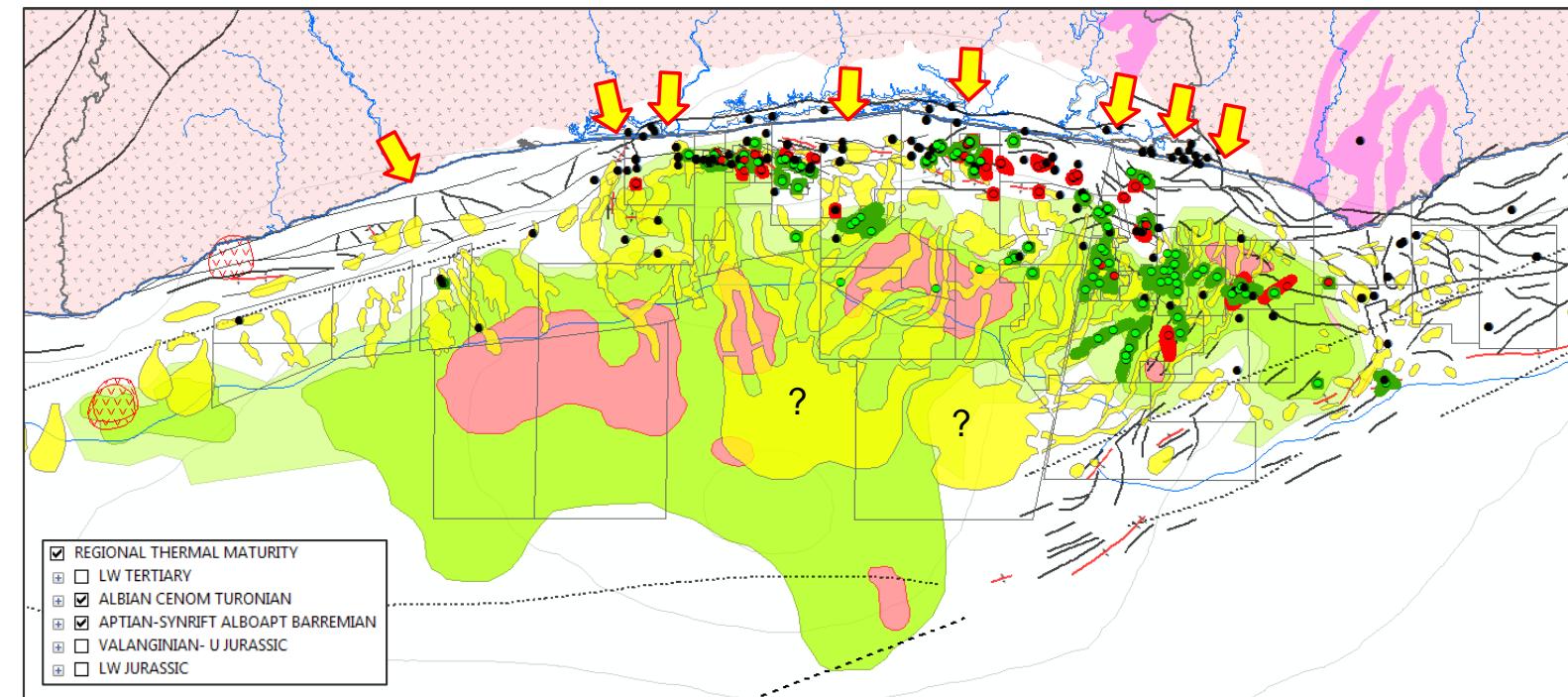
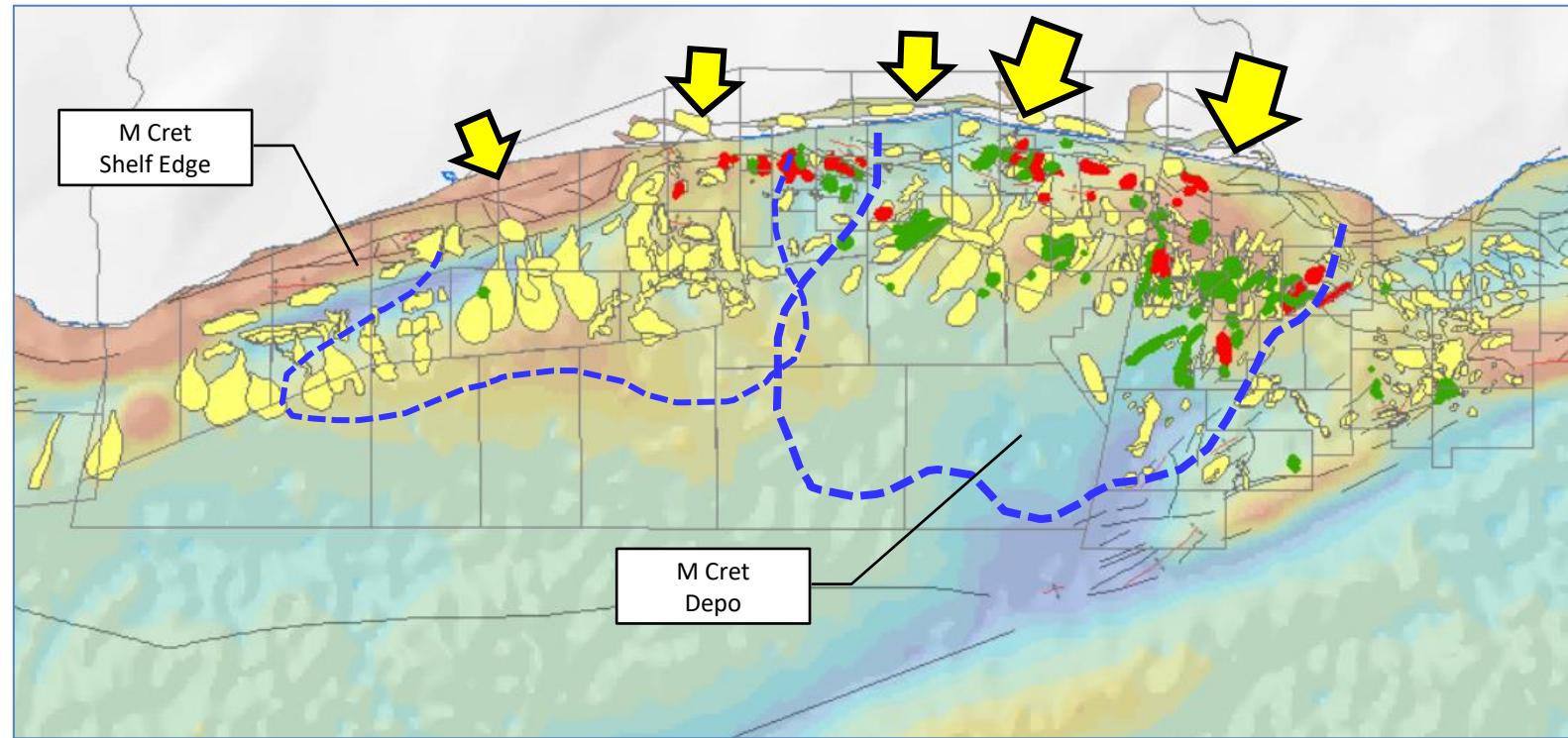


Modified after ONHYM International Pavilion 2018, A Galhom 2020

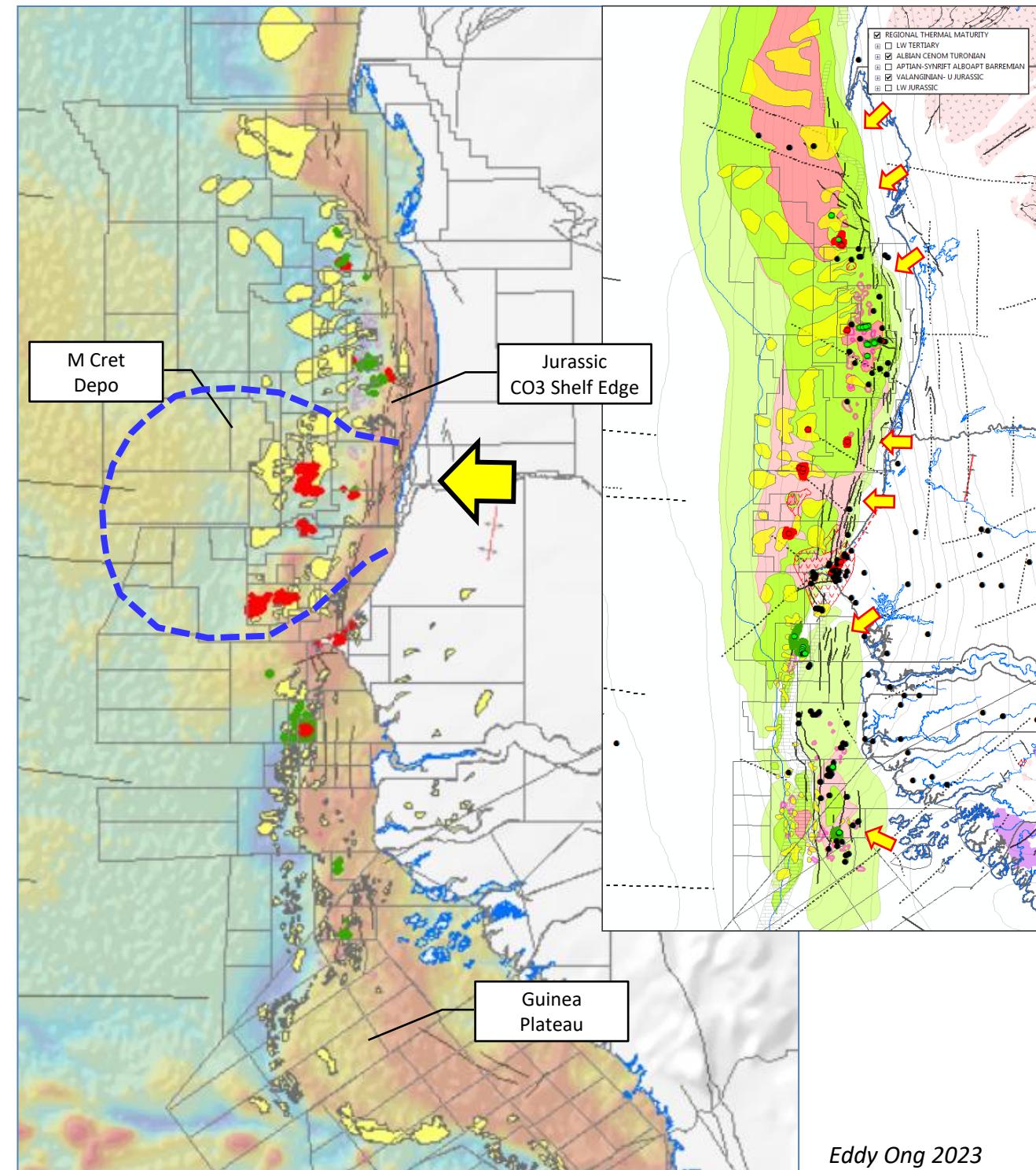


Eddy Ong 2023
Posted on LinkedIn

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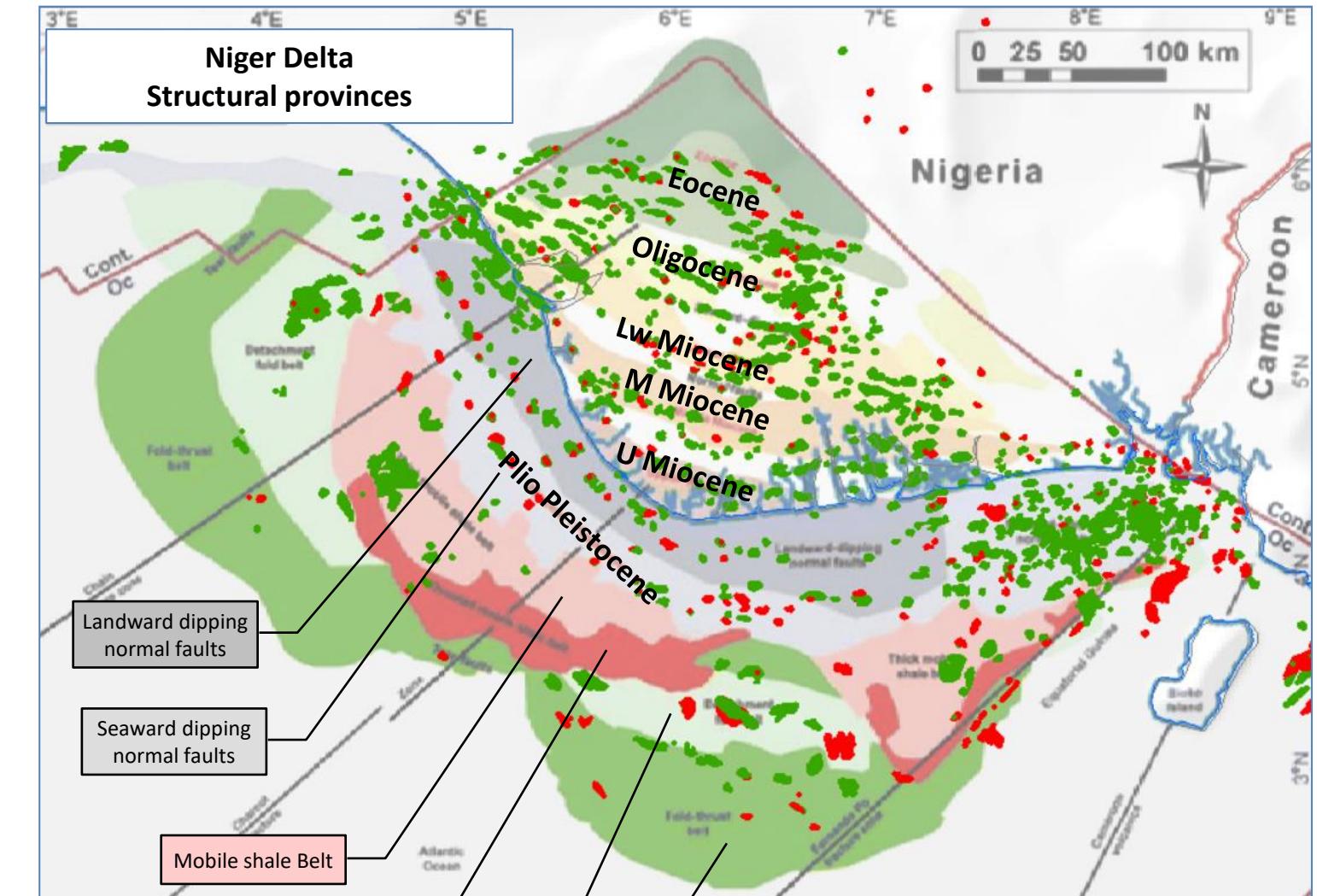
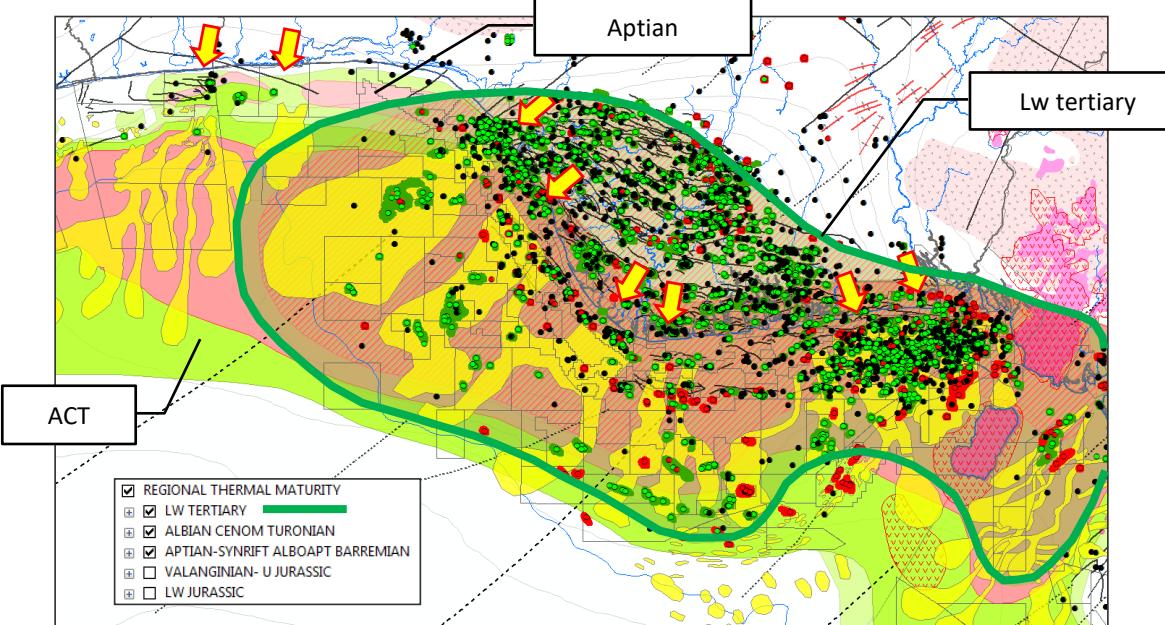
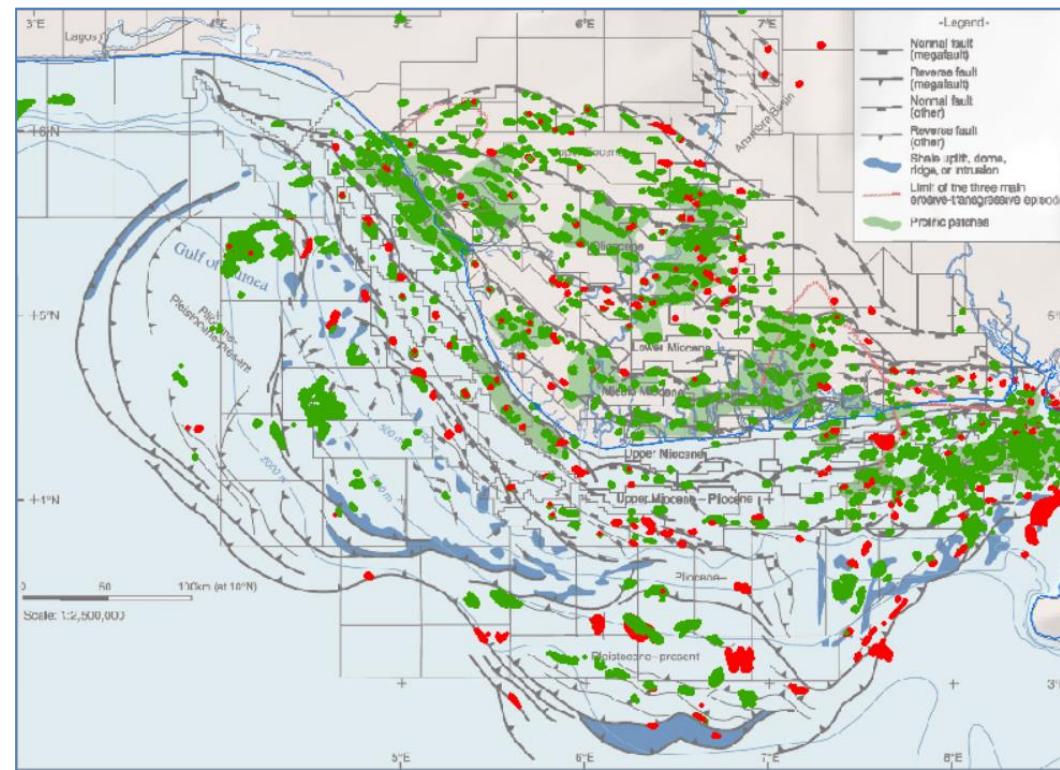


MSGBC Basin



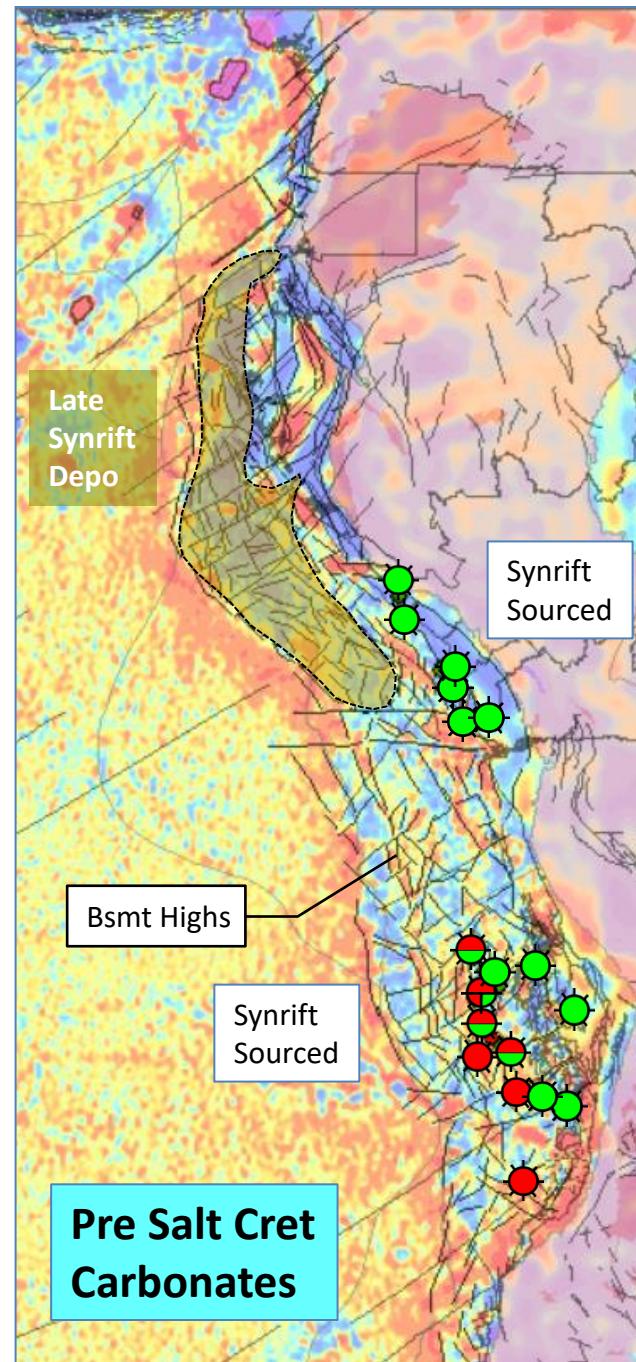
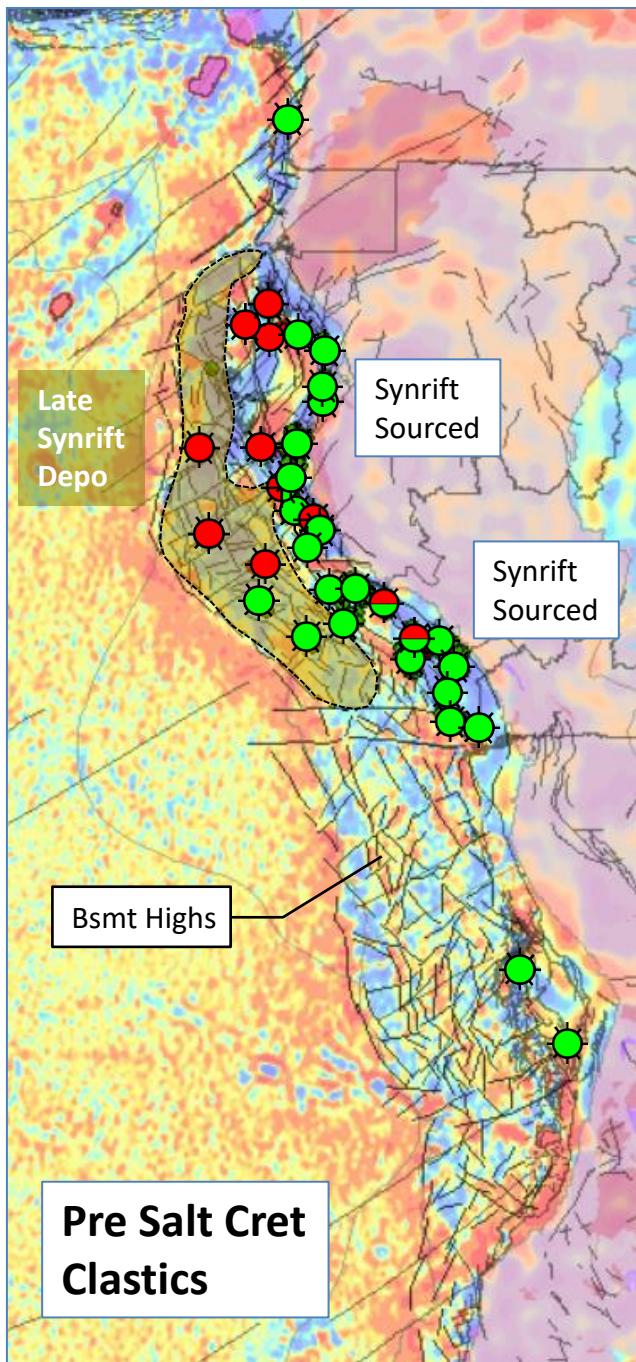
Some Fairway Ideas

Niger Delta Basin

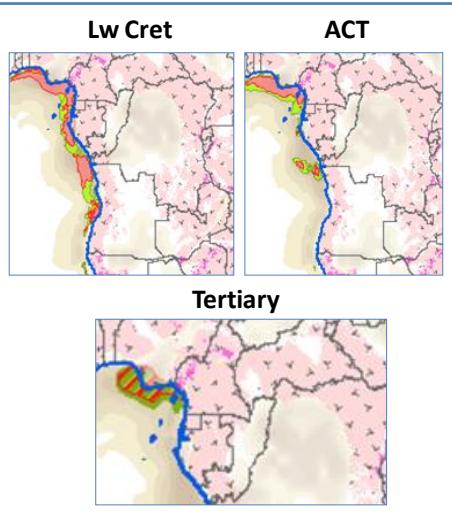
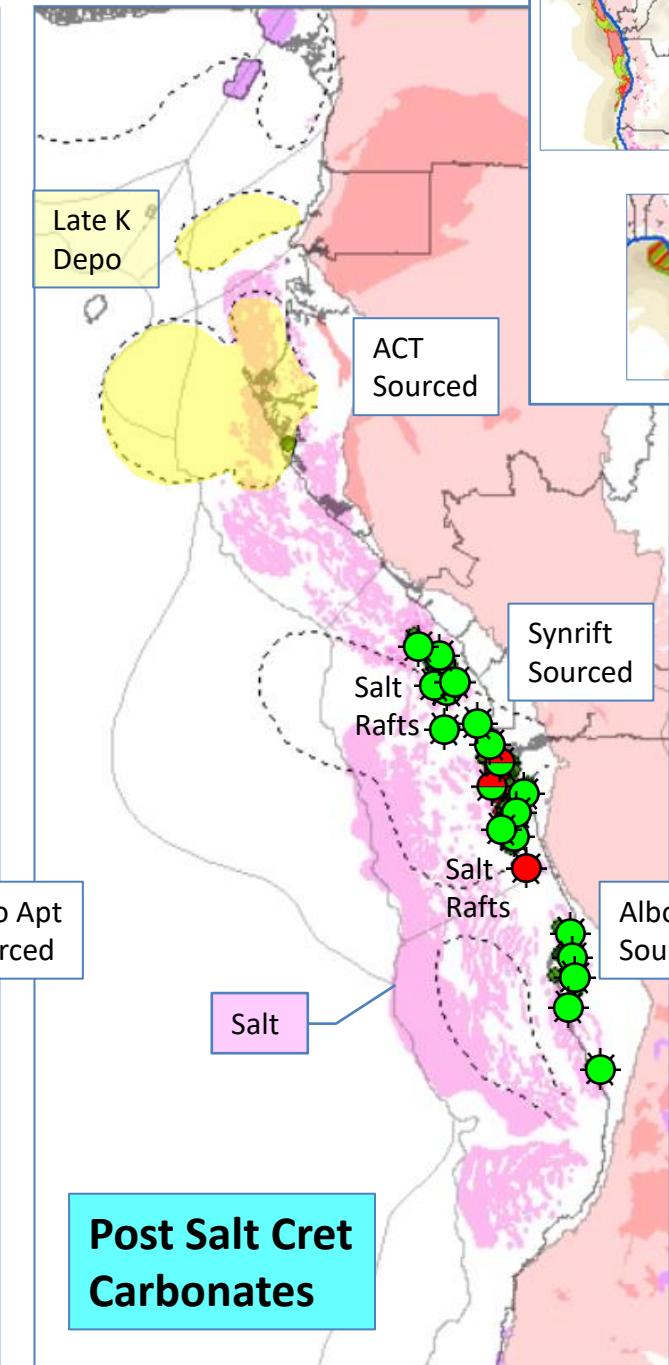
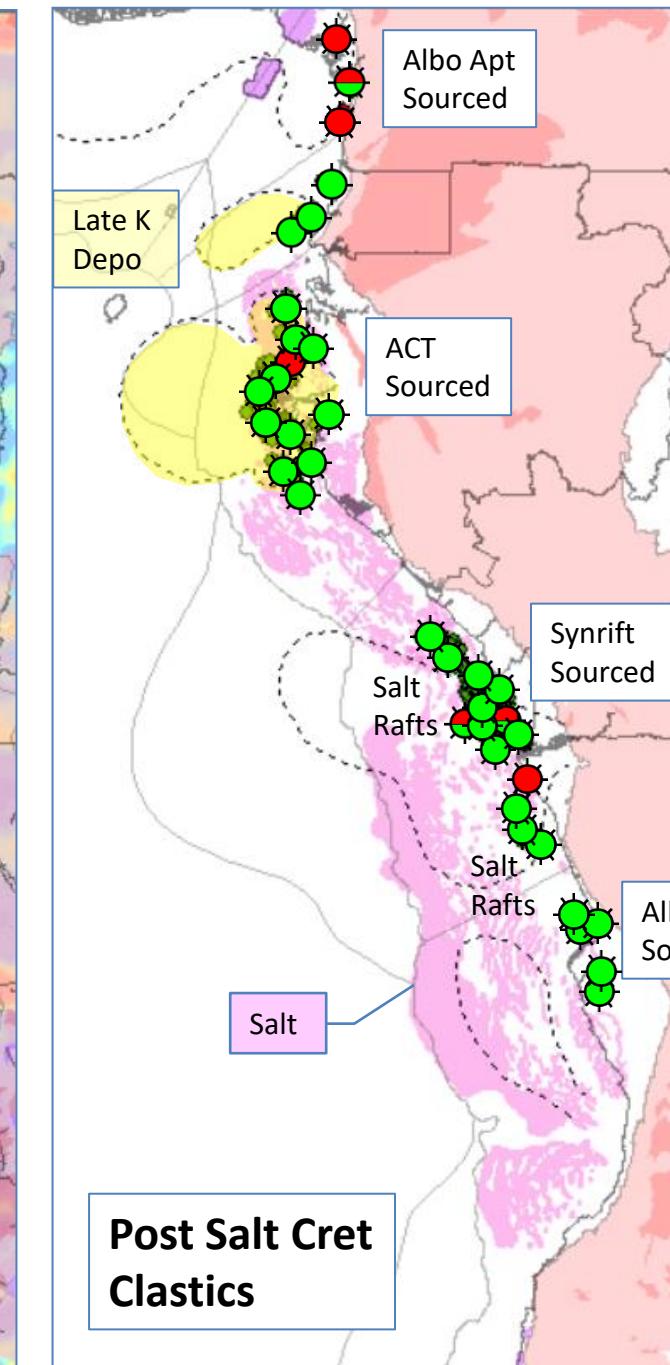


Nwaezeapu et al 2019, Wiener et al 2010

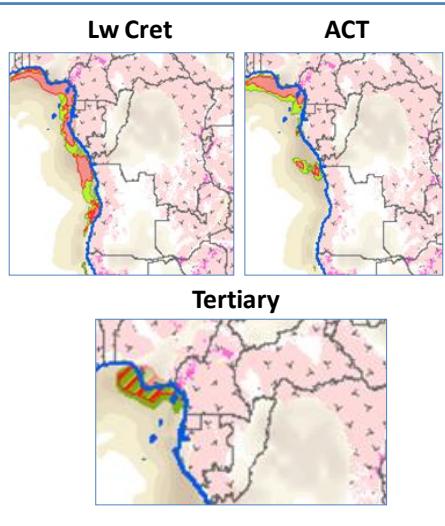
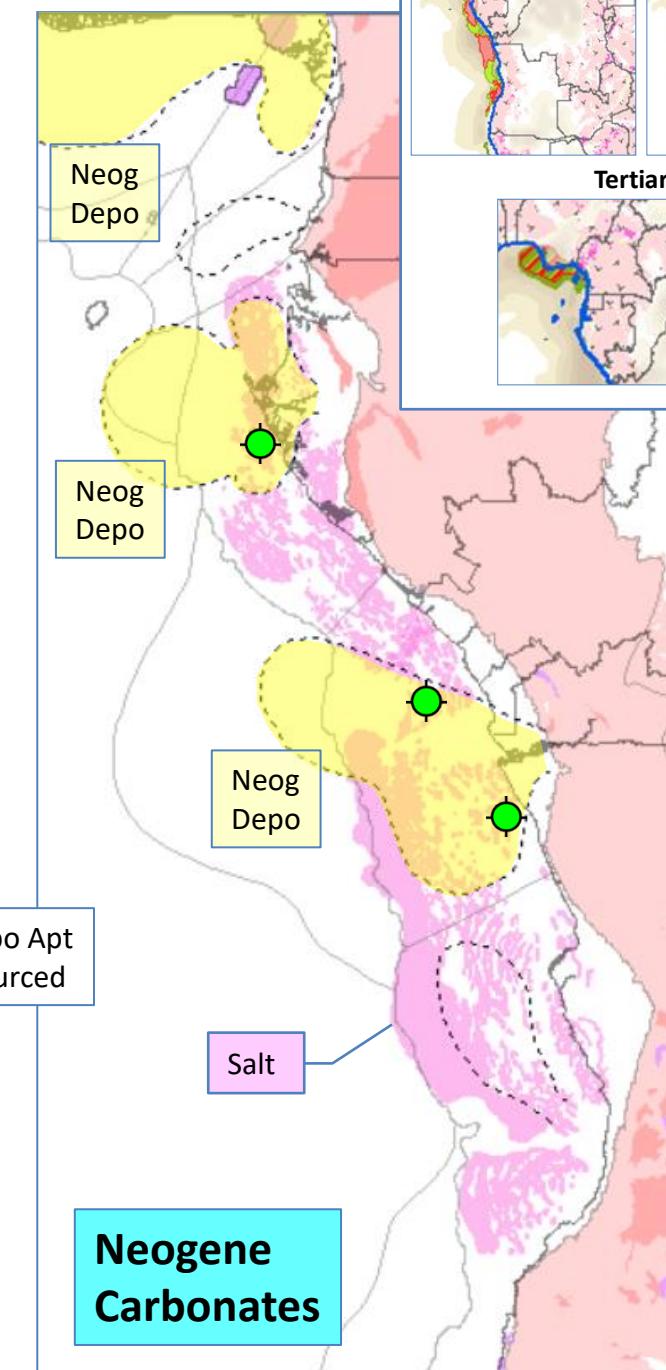
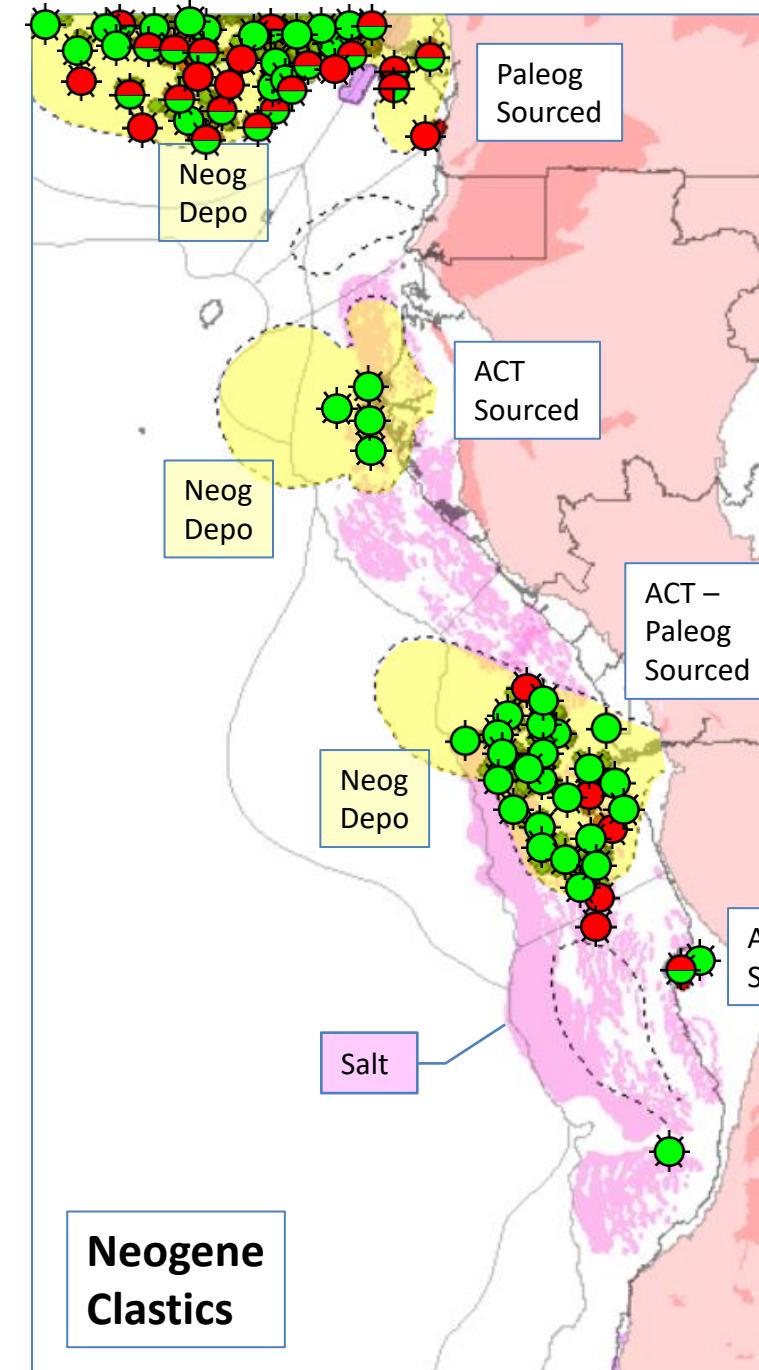
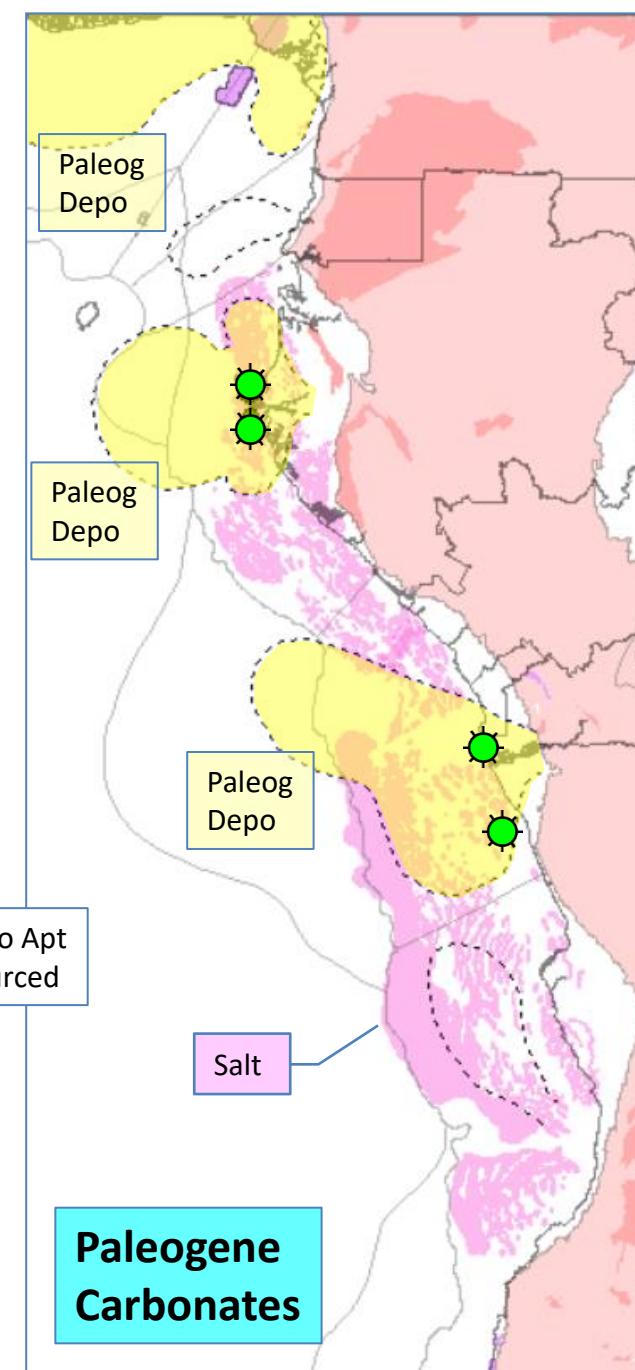
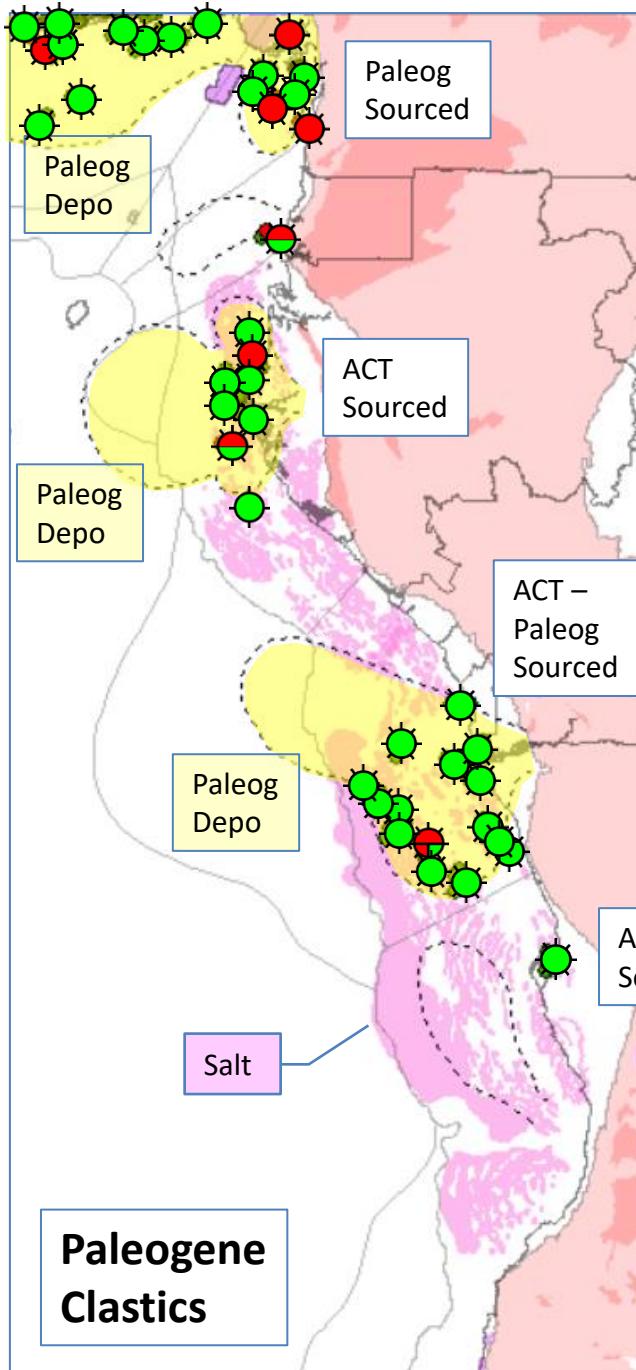
Some Fairway Ideas



W Afr Aptian Salt Basin

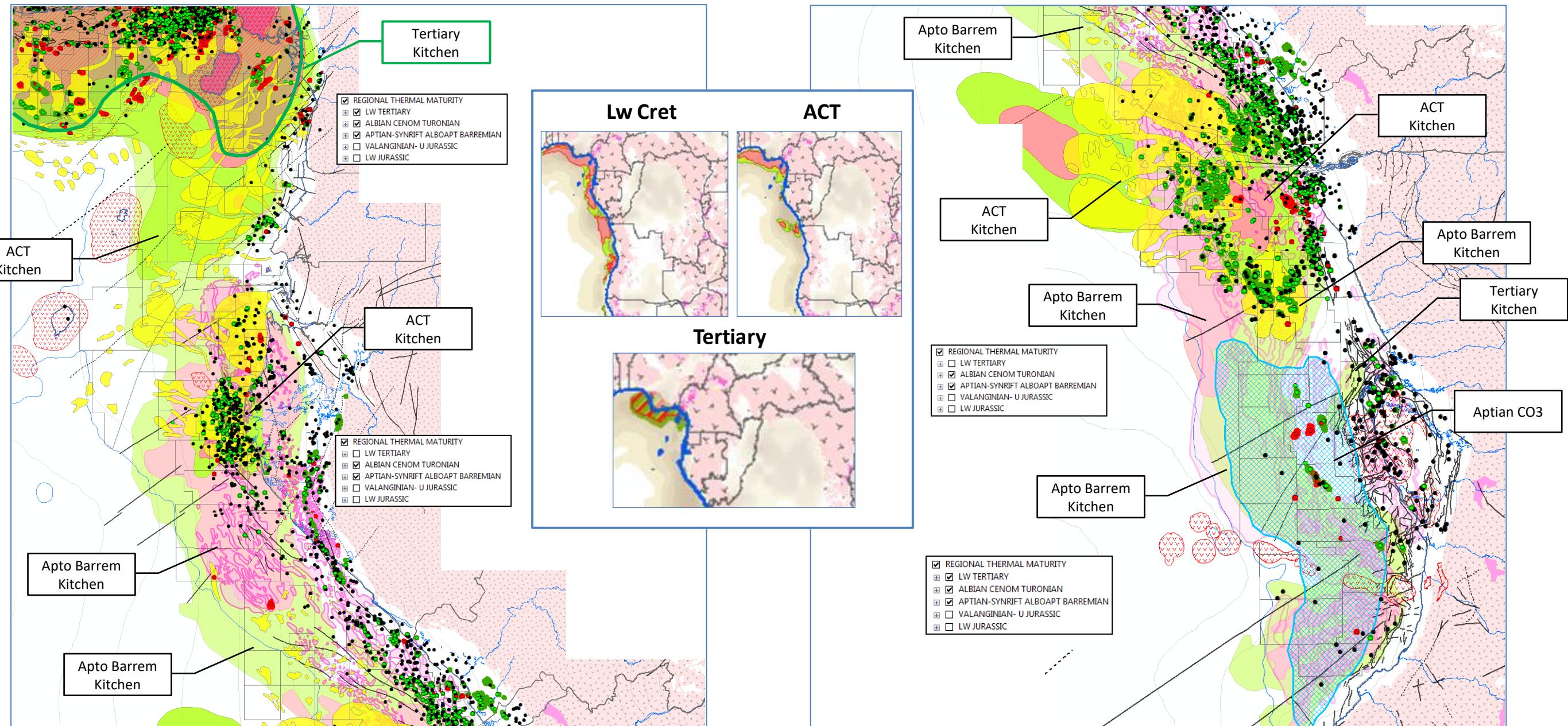


Some Fairway Ideas



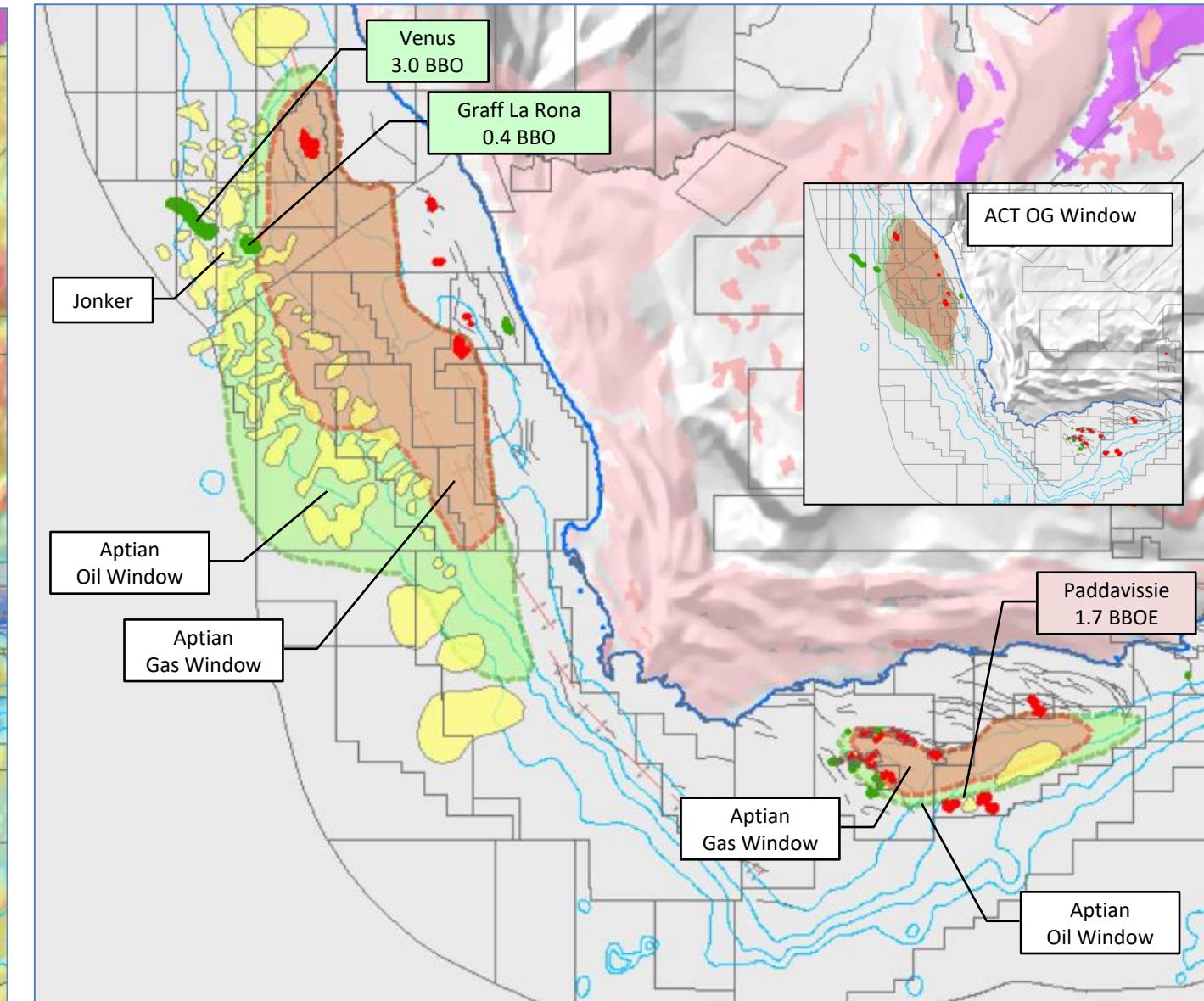
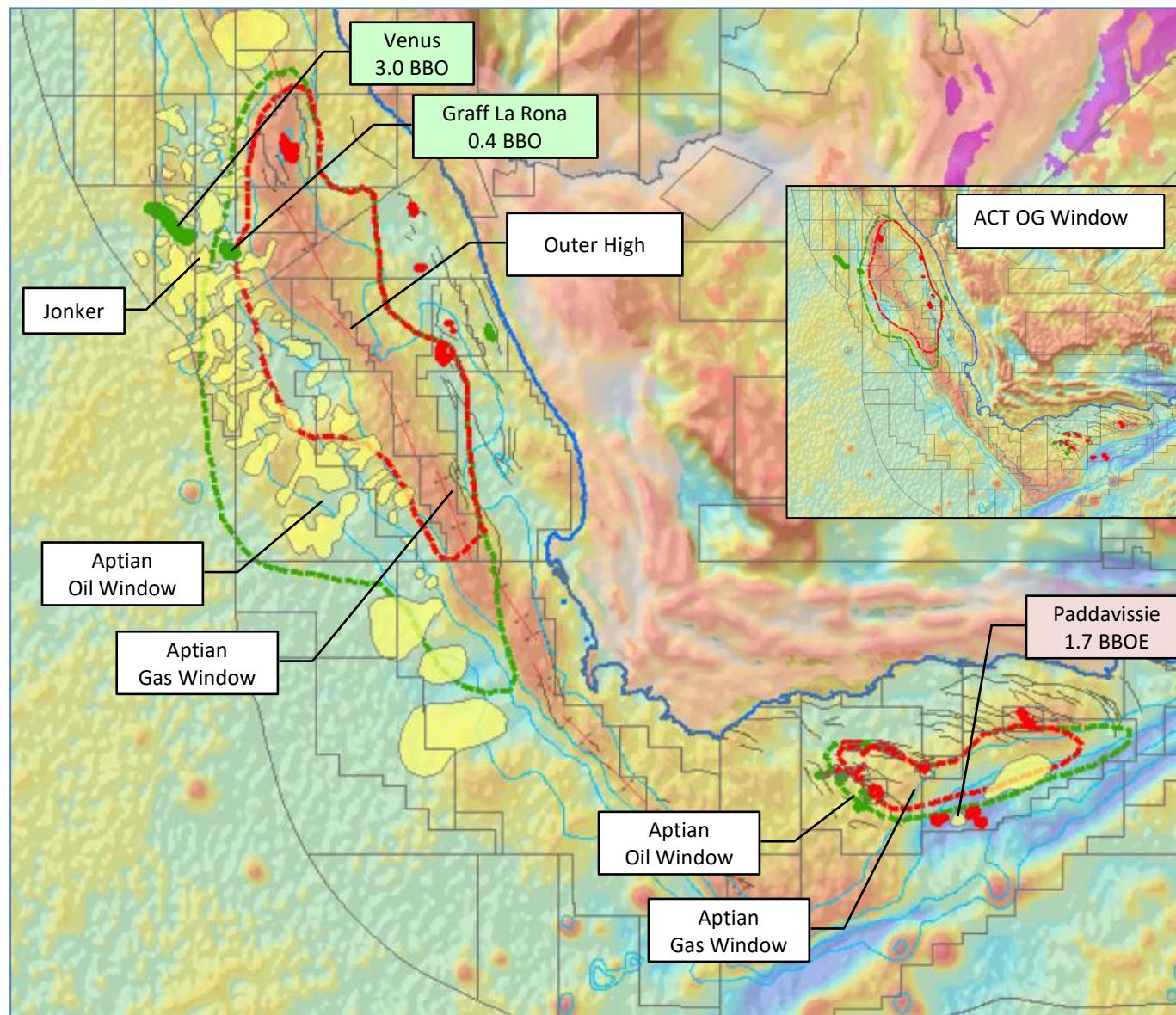
Some Fairway Ideas

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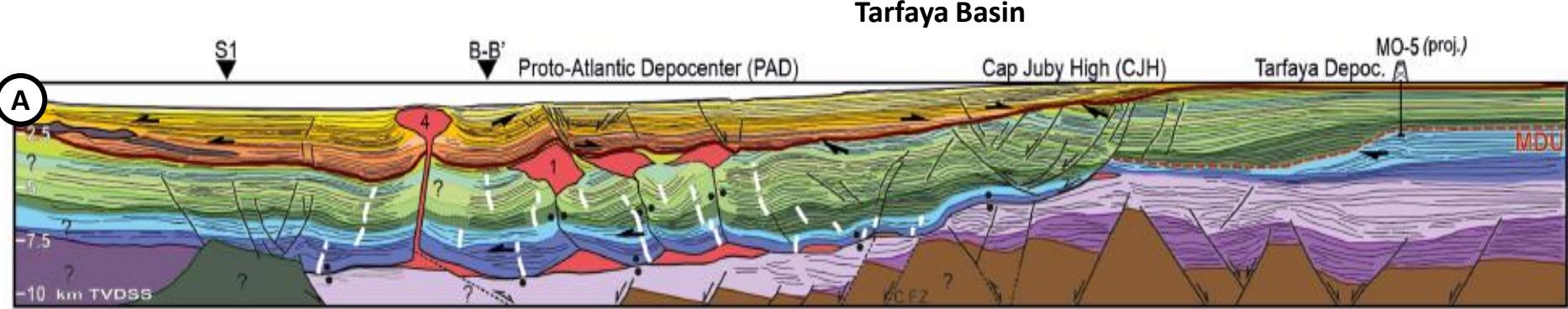
Some Fairway Ideas

SW Africa

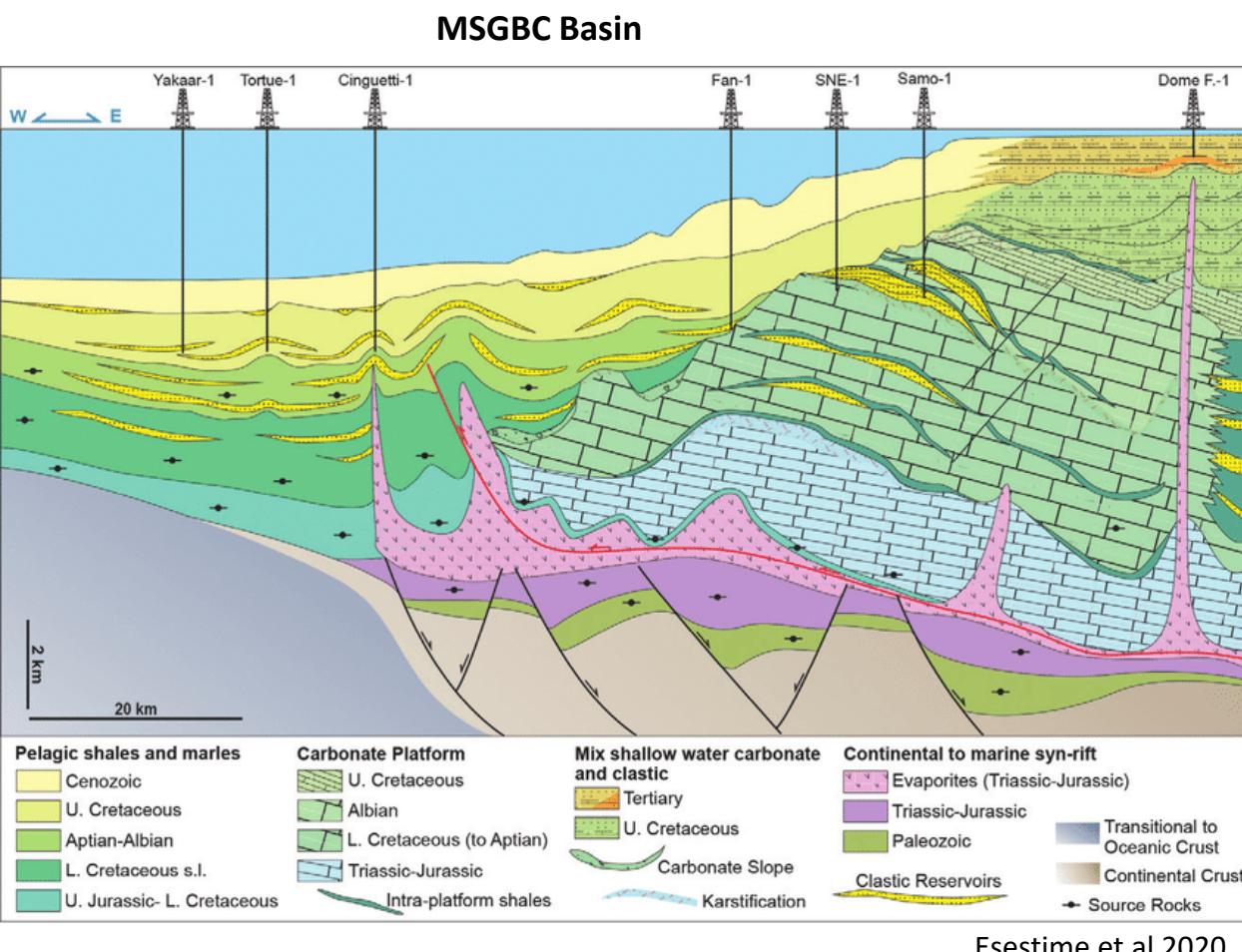


Tarfaya CO3 Shelf Edge

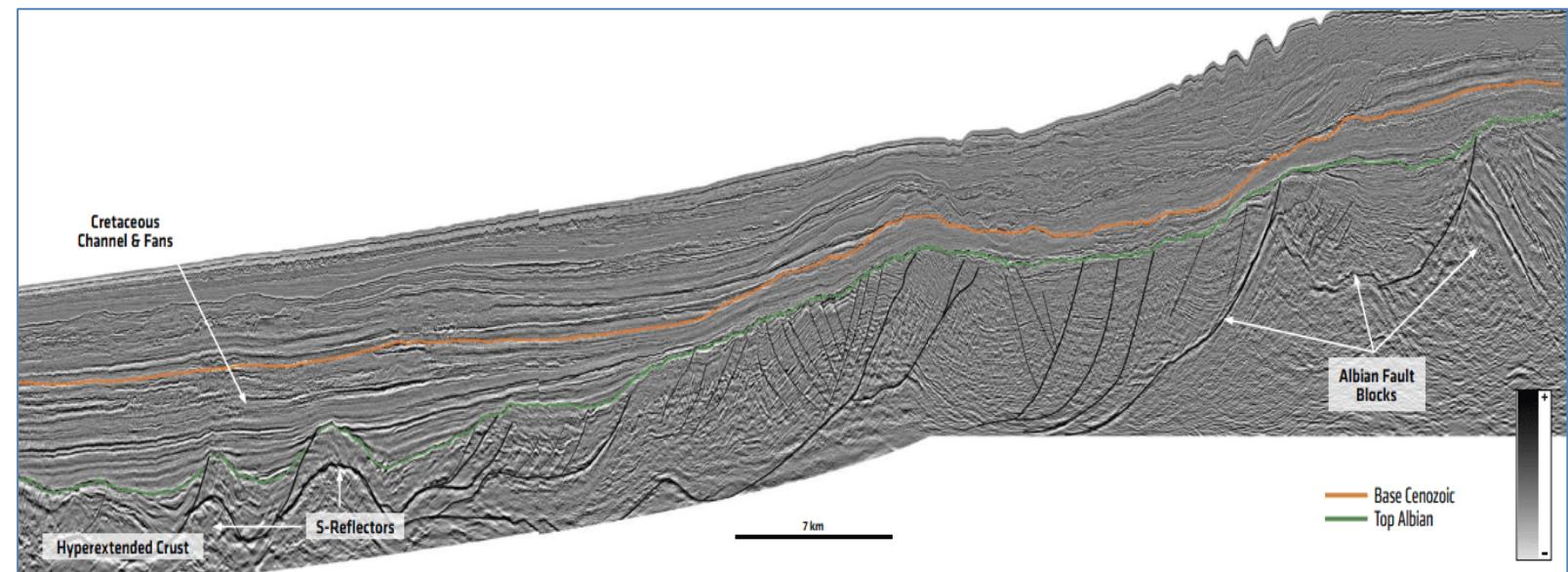
Hero Lines



Uranga et al 2022

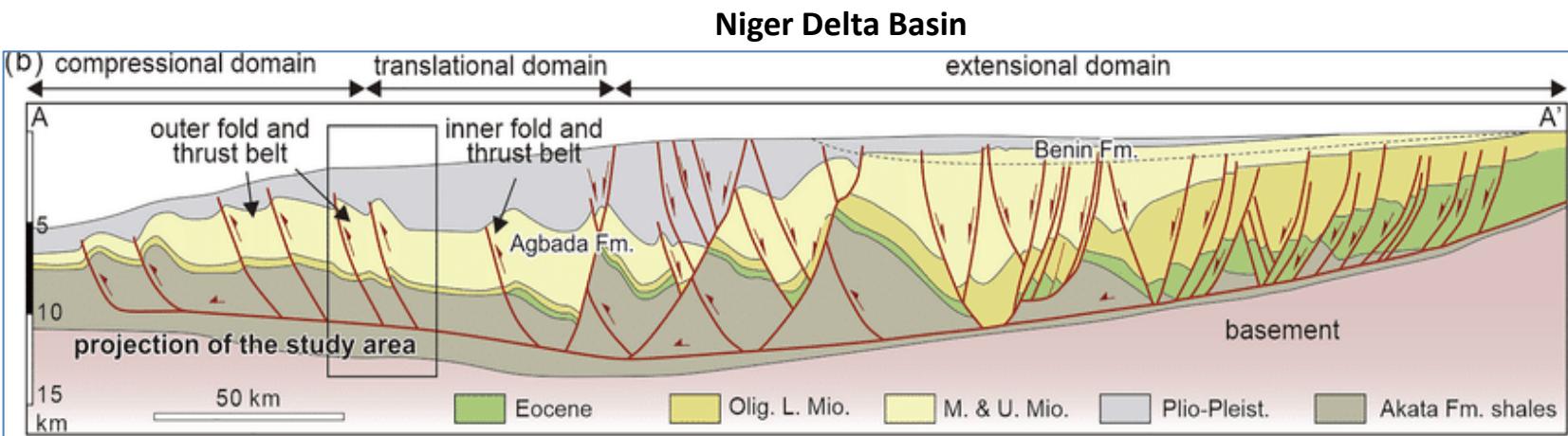


Tano Cote d'Ivoire Basin

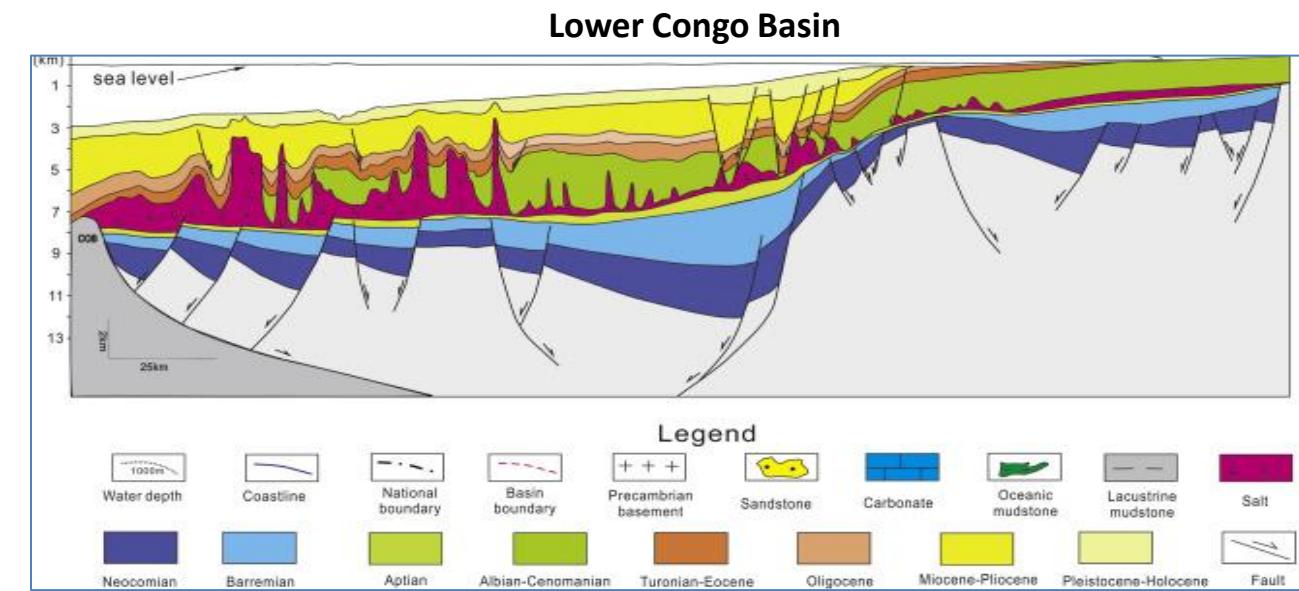


Powell et al GeoExpro

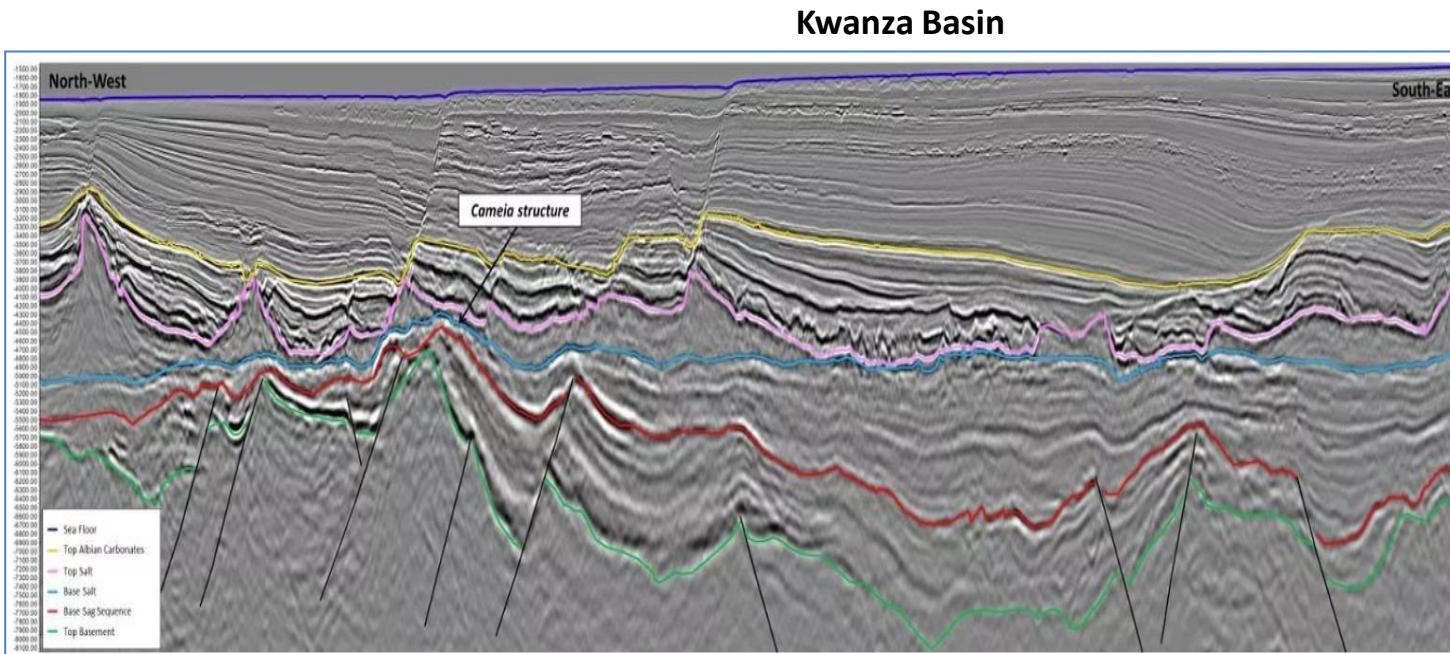
Hero Lines



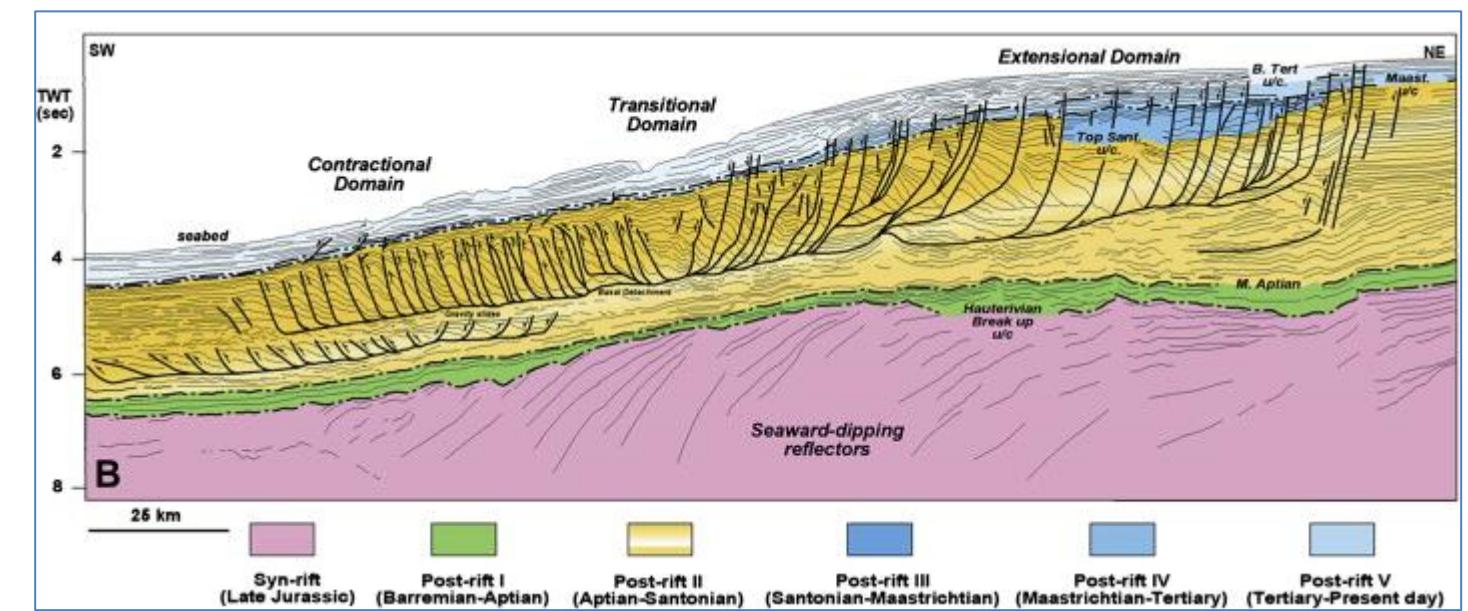
Zhang et al 2021



Li et al 2020



Duval et al 2015



Vera et al 2010