

Exploration/Development Opportunities in Central and Southern Africa in a \$60/Bbl Oil, \$3/Mcf World

MMEA Scout Group
The RAF Club

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Disclaimer

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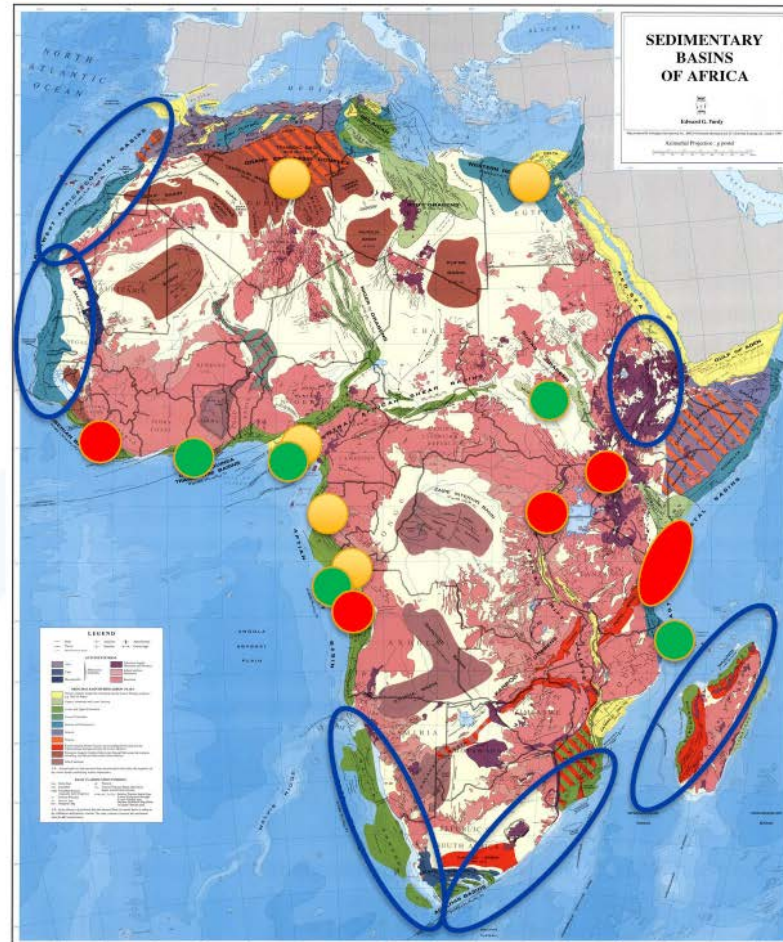
Today's Agenda

- What does \$60 oil and \$3 gas mean to an African E&P team?
- A word on Nigeria
- West Africa Pre-Salt, a mixture of fortunes
- Onshore Rifts, timing, timing and seals

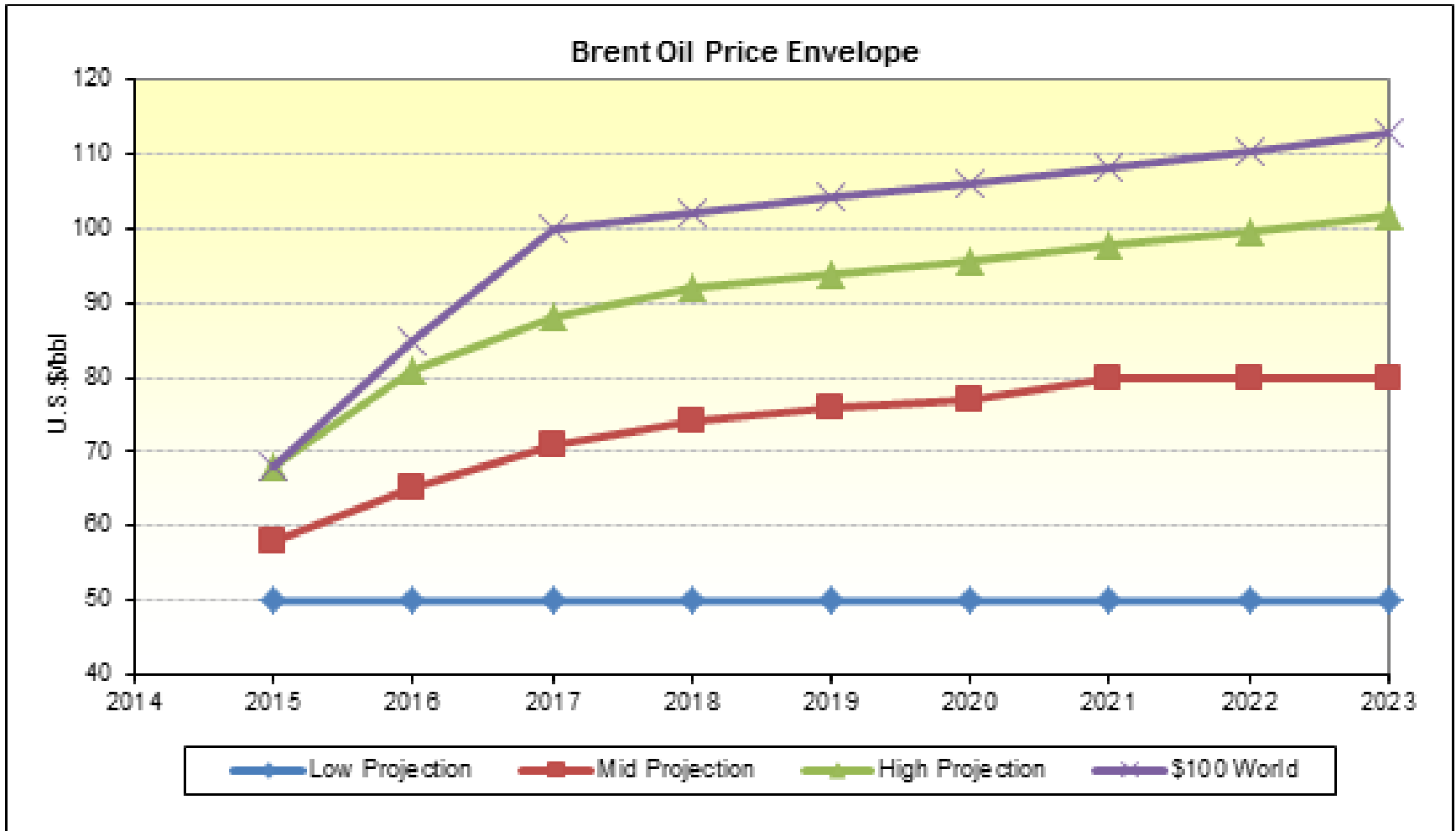
Bullish Africa Exploration View from 2013

African Basins

- Frontier ○
- Emerging ●
- Growing ●
- Maturing ●

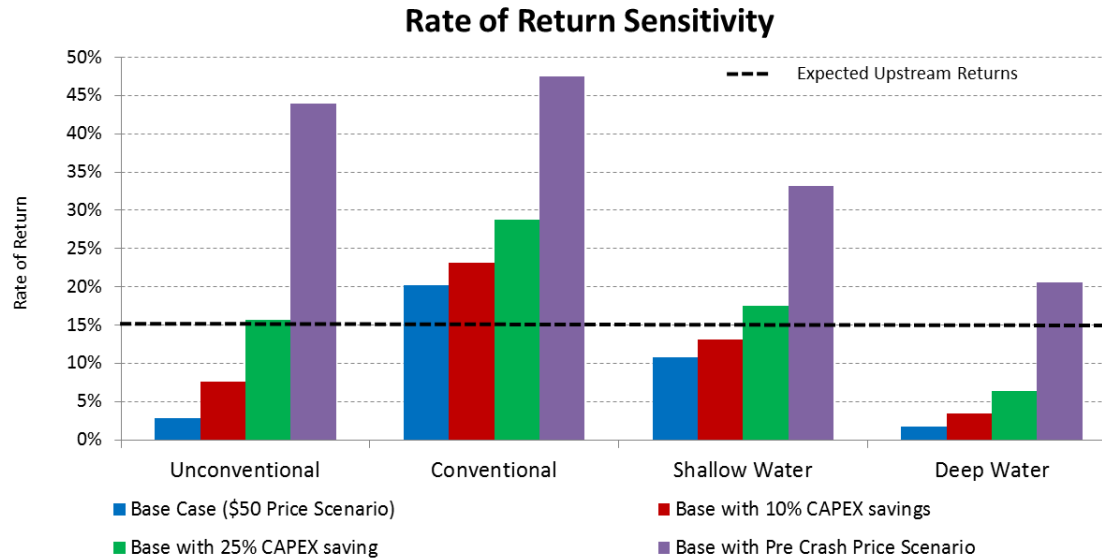


Some Plausible Price Scenarios

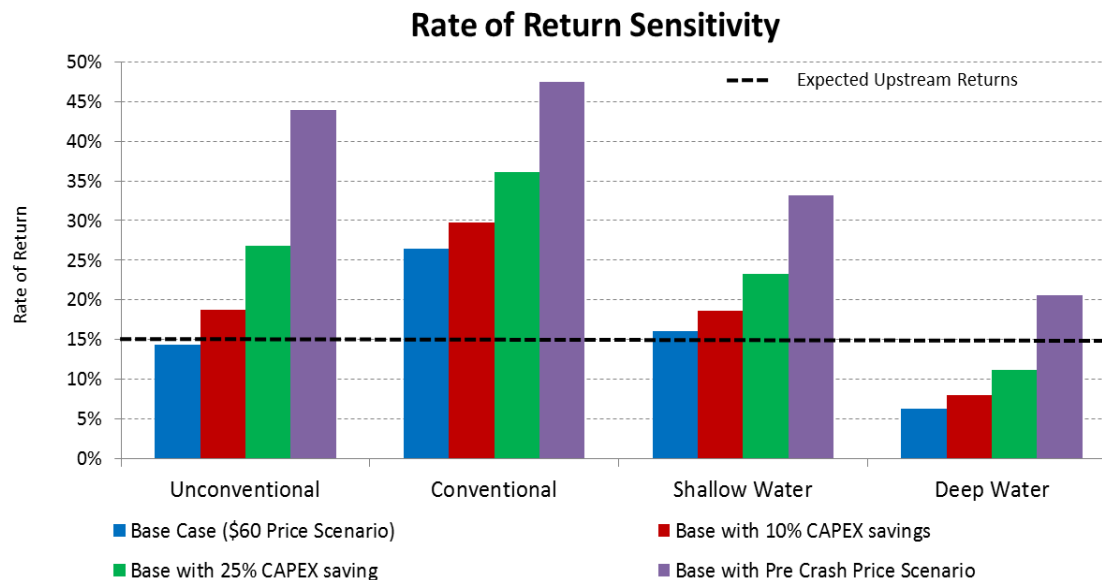


Impact of Cost Savings not Linear Across Business Segments

\$50 World

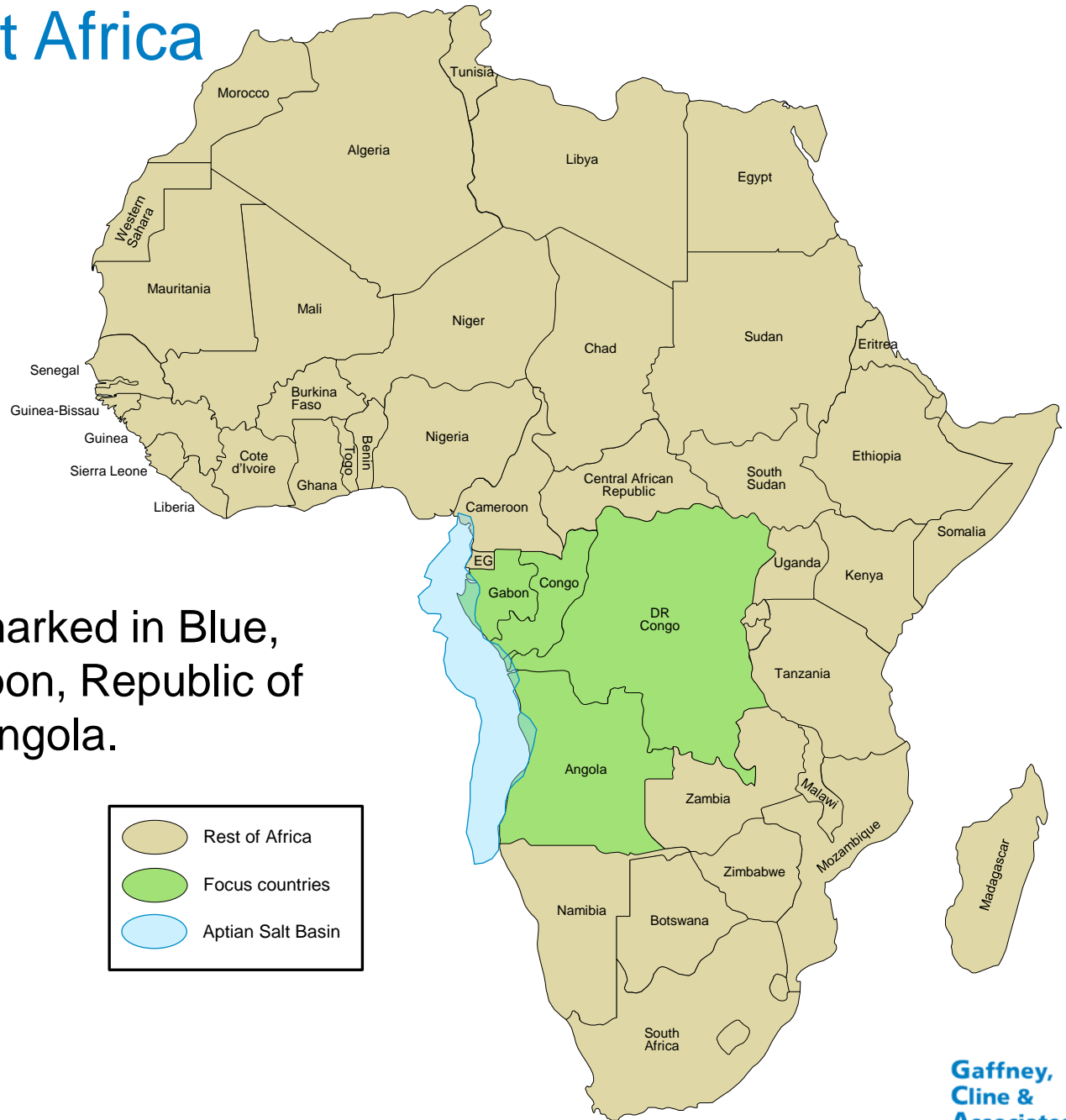


\$60 World

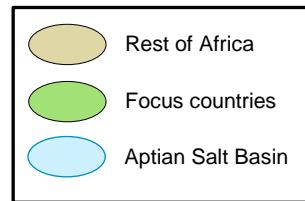


Pre-Salt West Africa

The Big Upside?
But where is it working?

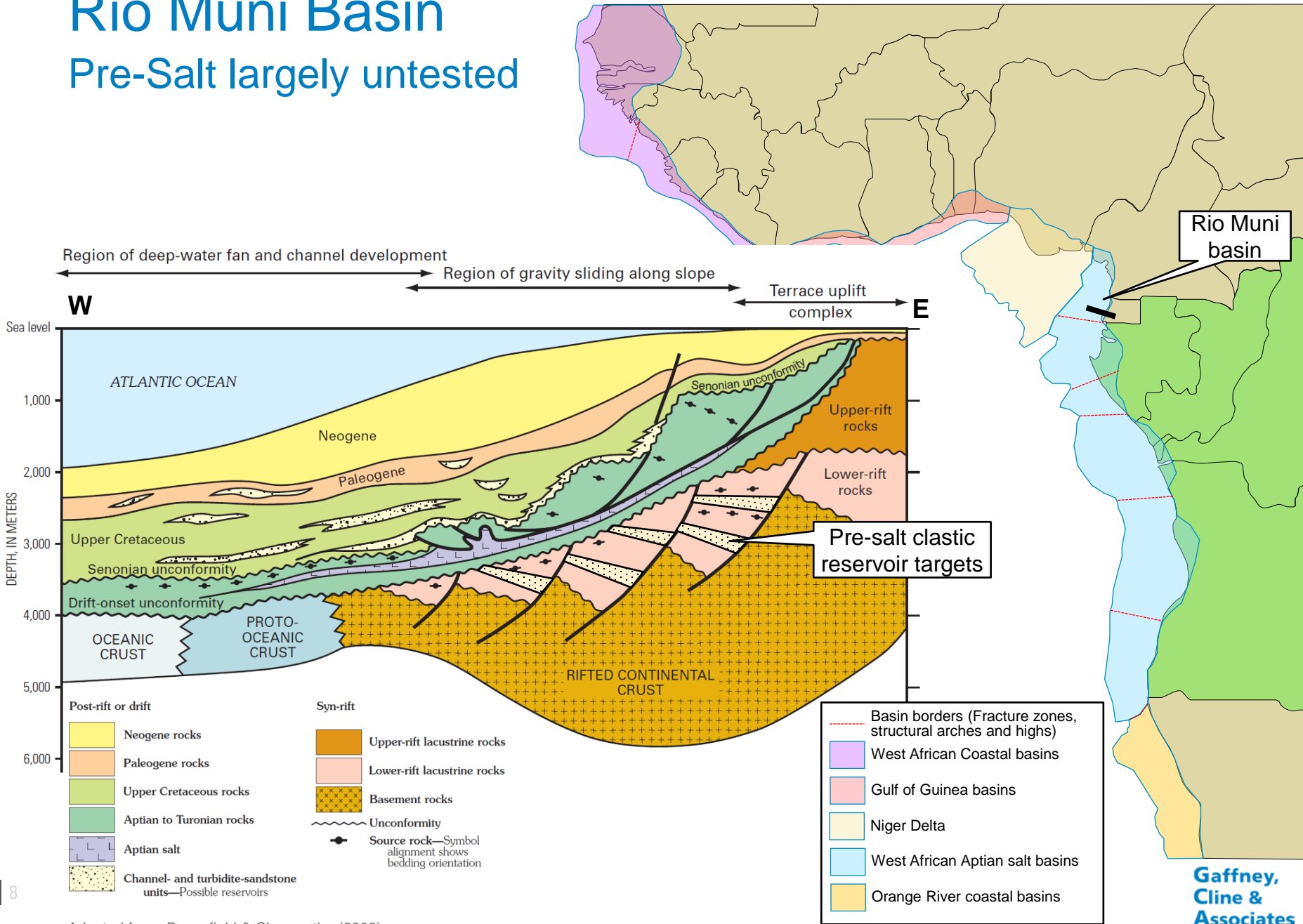


Aptian Salt Basin marked in Blue,
spans offshore Gabon, Republic of
Congo, DRC and Angola.



Rio Muni Basin

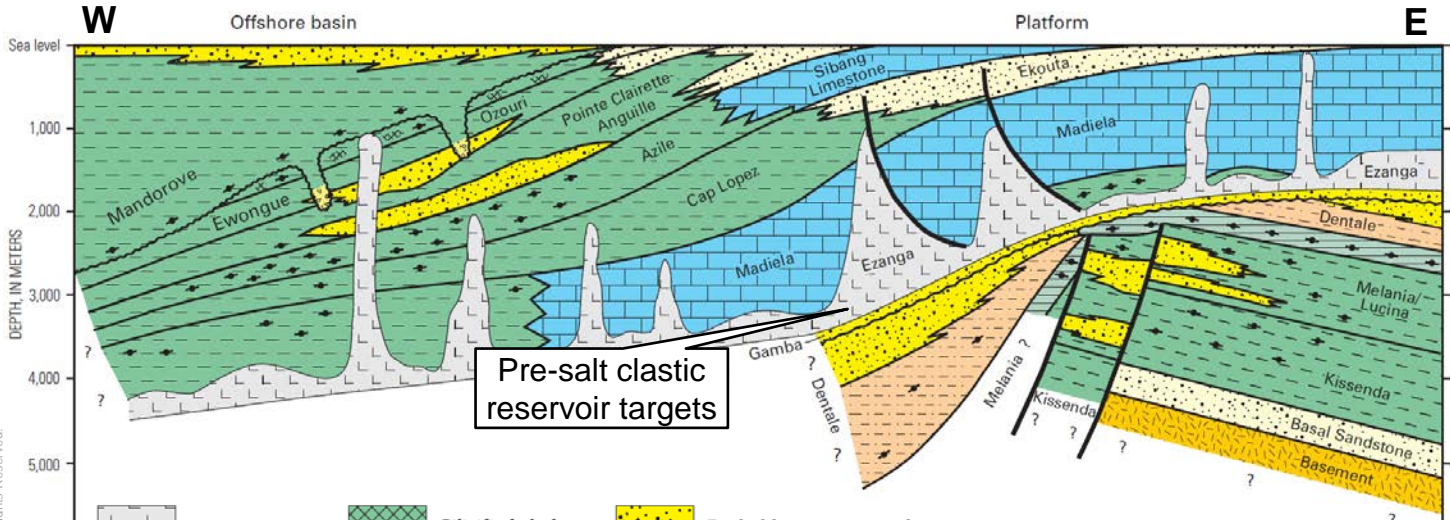
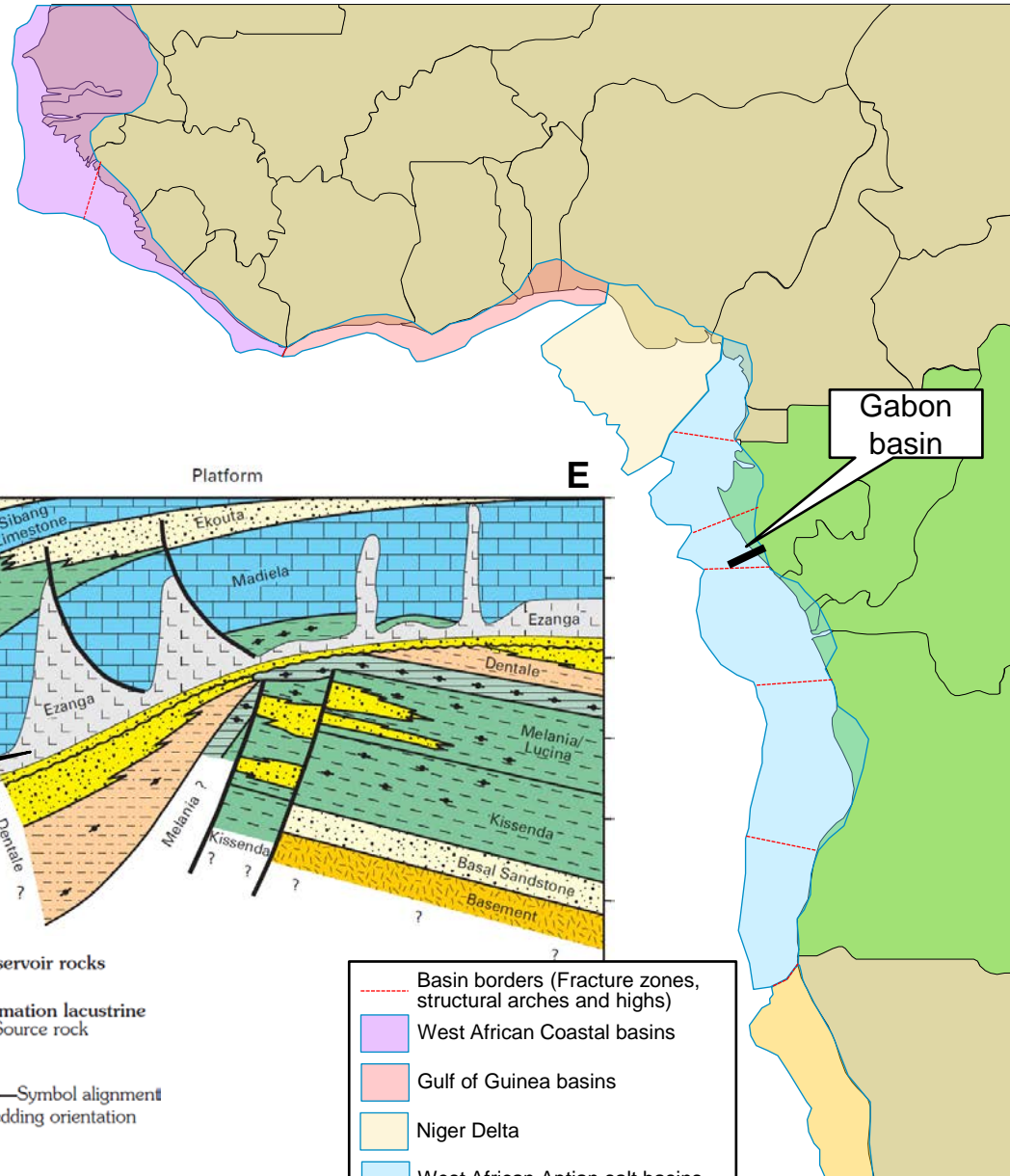
Pre-Salt largely untested



Adapted from: Brownfield & Charpentier (2006)

Gabon Basin – Pre-Salt

Mature oil play on shelf but
 Diaman-1B (Total), Leopard-1
 (Shell) tested thick gas pays in
 Water depths 5,500'-6,500'

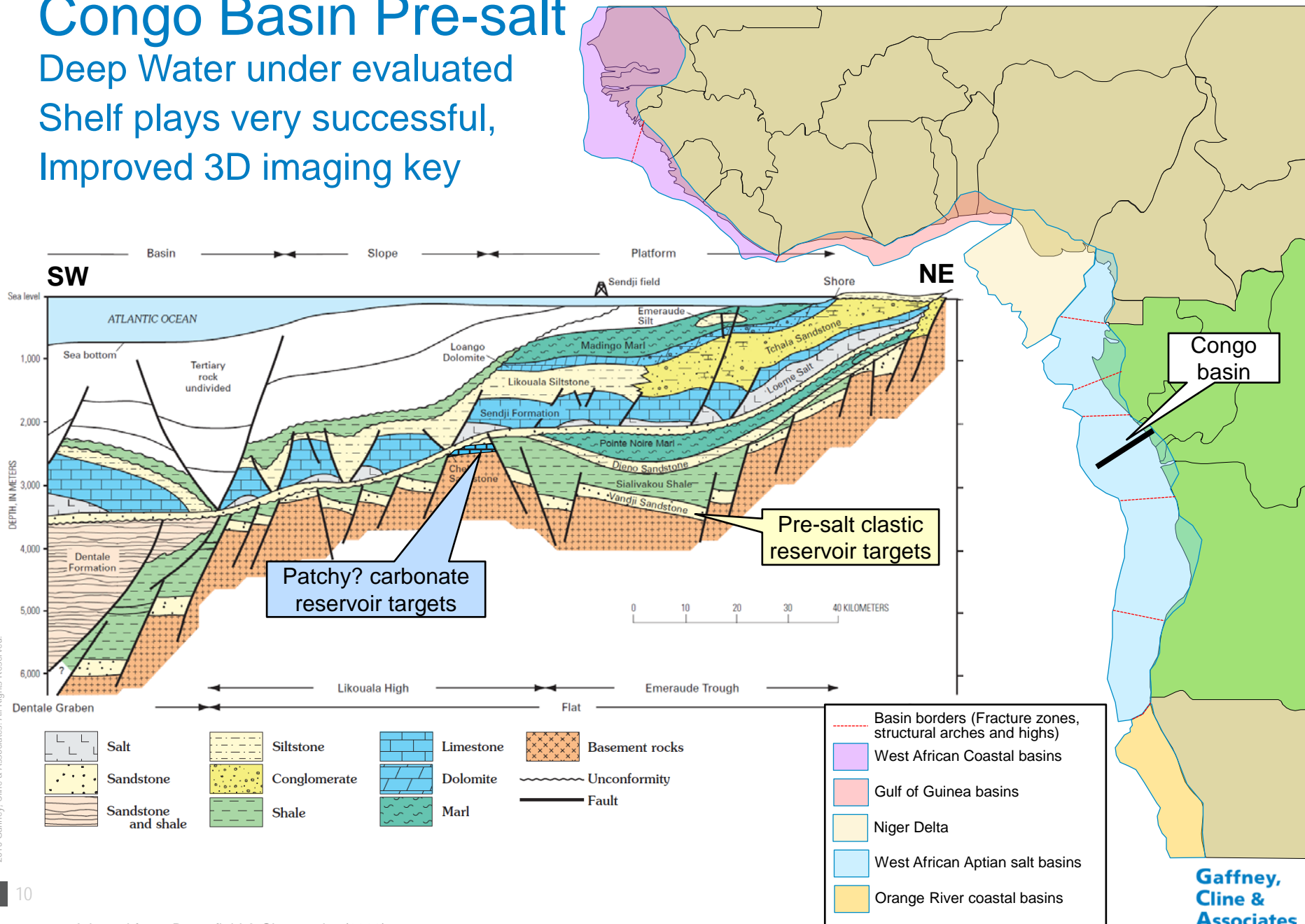


- Basin borders (Fracture zones, structural arches and highs)
- West African Coastal basins
- Gulf of Guinea basins
- Niger Delta
- West African Aptian salt basins
- Orange River coastal basins

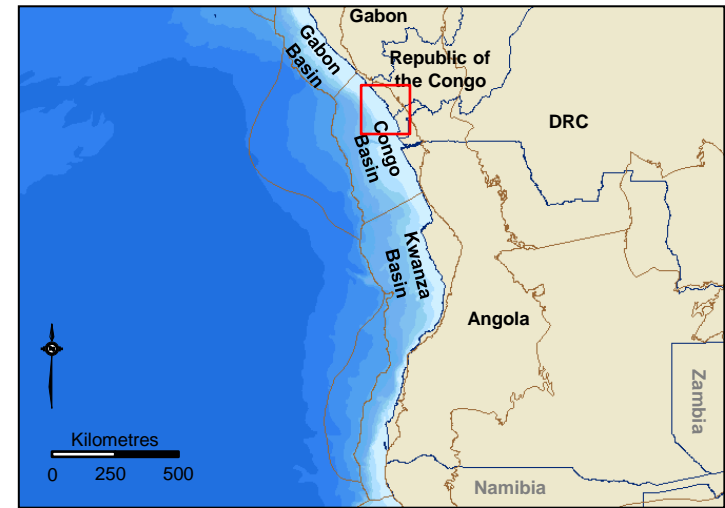
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Congo Basin Pre-salt

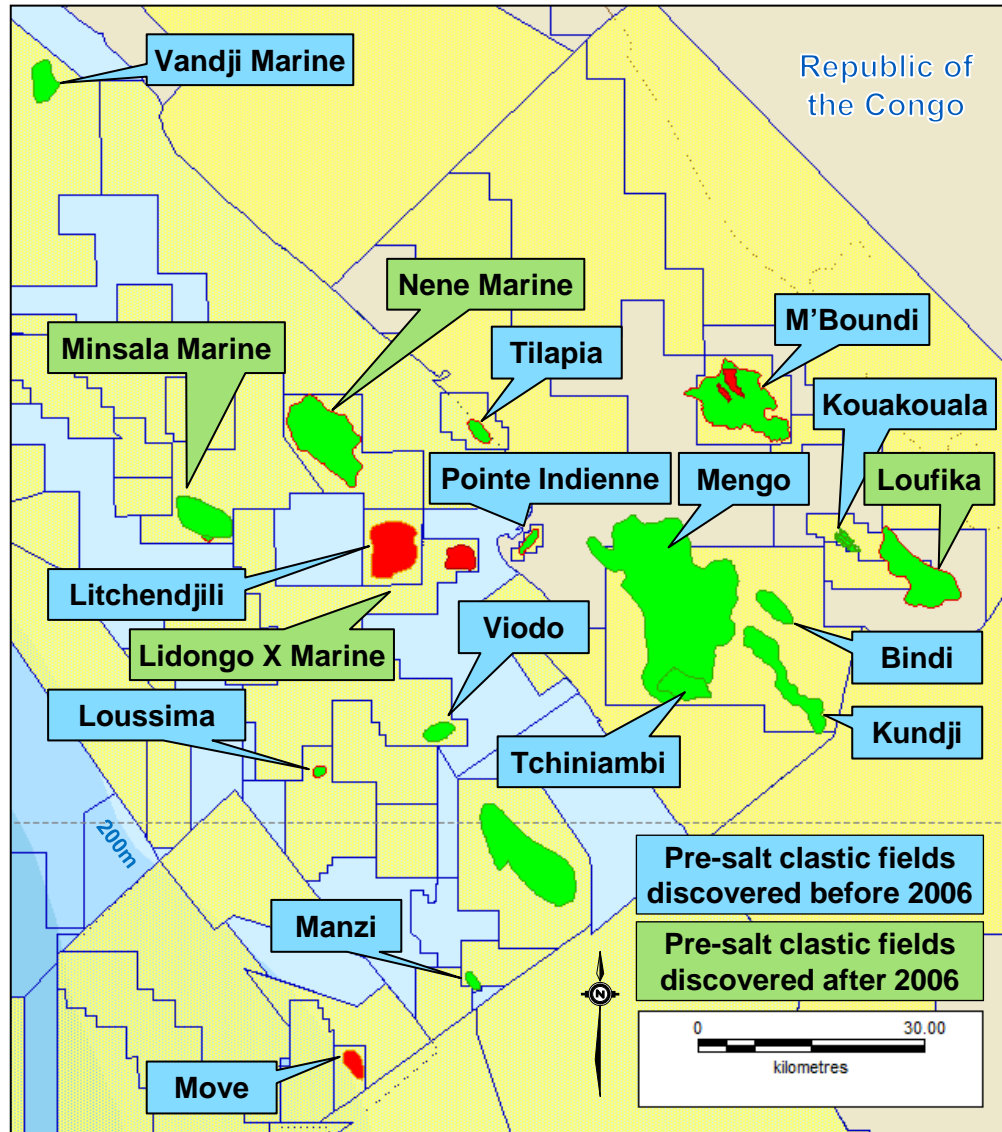
Deep Water under evaluated
Shelf plays very successful,
Improved 3D imaging key



Deloitte Petroview October 2014 Sub Saharan Africa Dataset

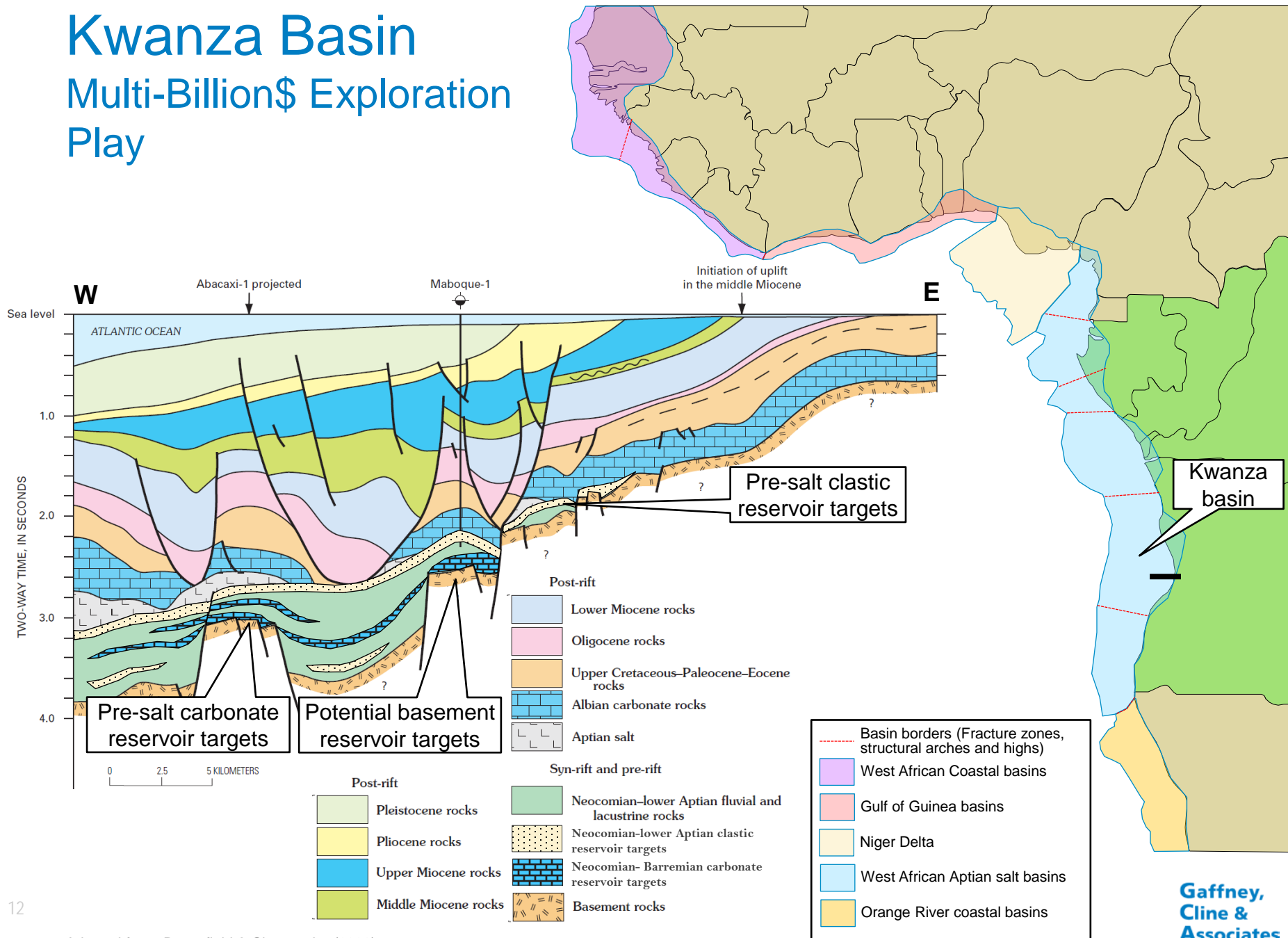


- The first pre-salt clastic field discovered was Pointe Indienne in the Republic of the Congo in 1957.
- Multiple discoveries in the pre-salt clastic play through to the present.
- Hydrocarbons encountered are a combination of oil and gas.
- All in <200m water depth.

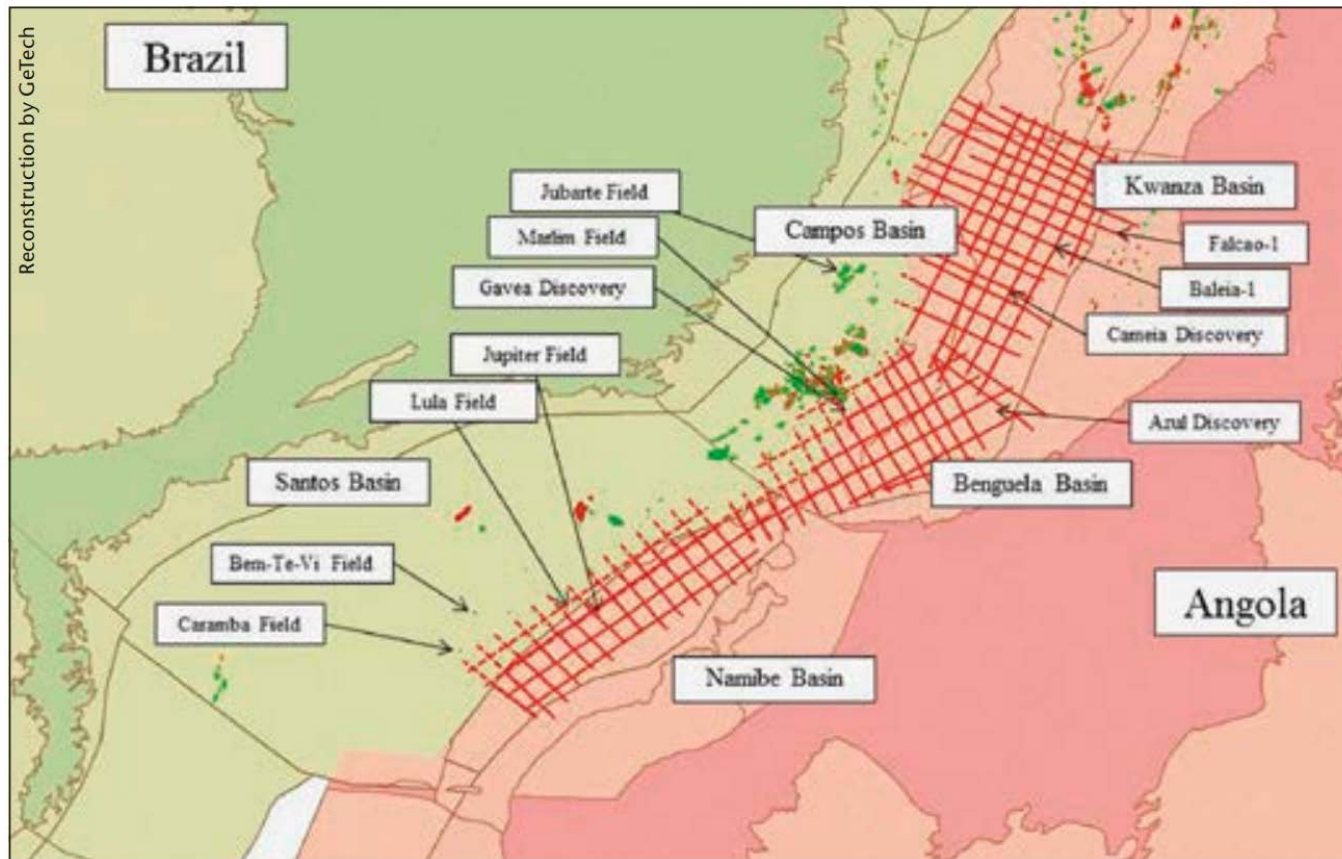


Kwanza Basin

Multi-Billion\$ Exploration Play



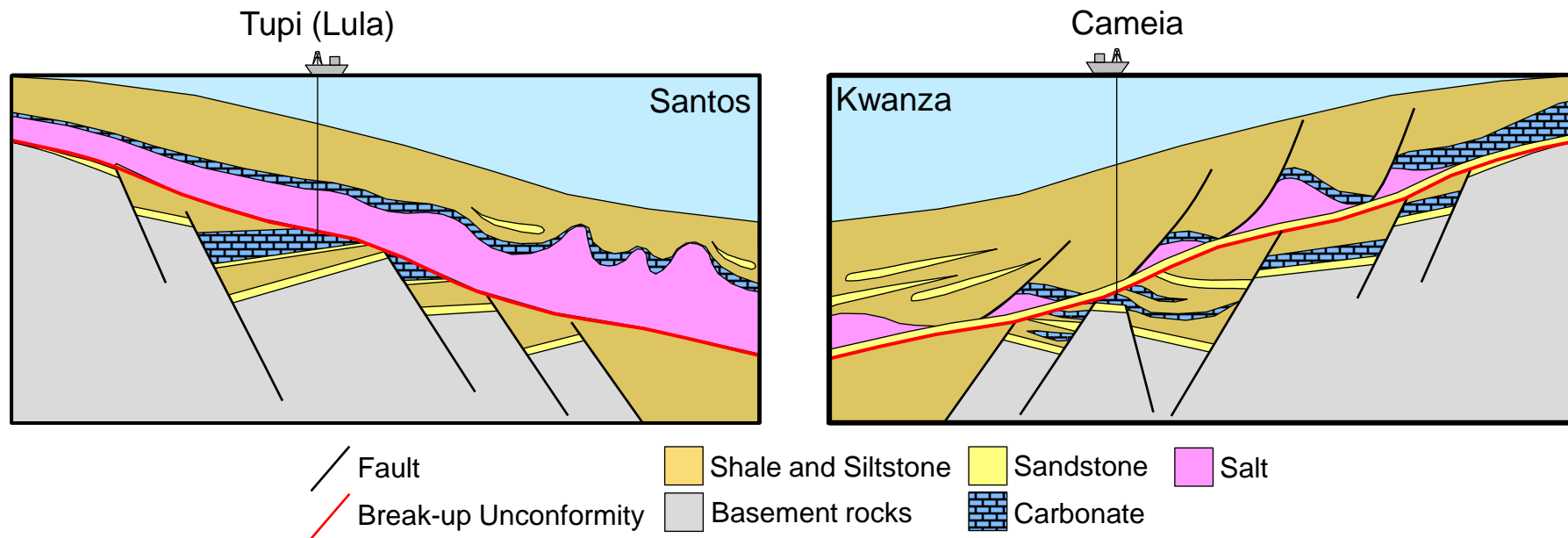
How Similar is W. Africa to Santos/Campos Basin?



The Santos and Campos basins of Brazil were formed adjacent to those in Angola during the rifting event analogous stratigraphy and structure?

The Brazilian Analogue

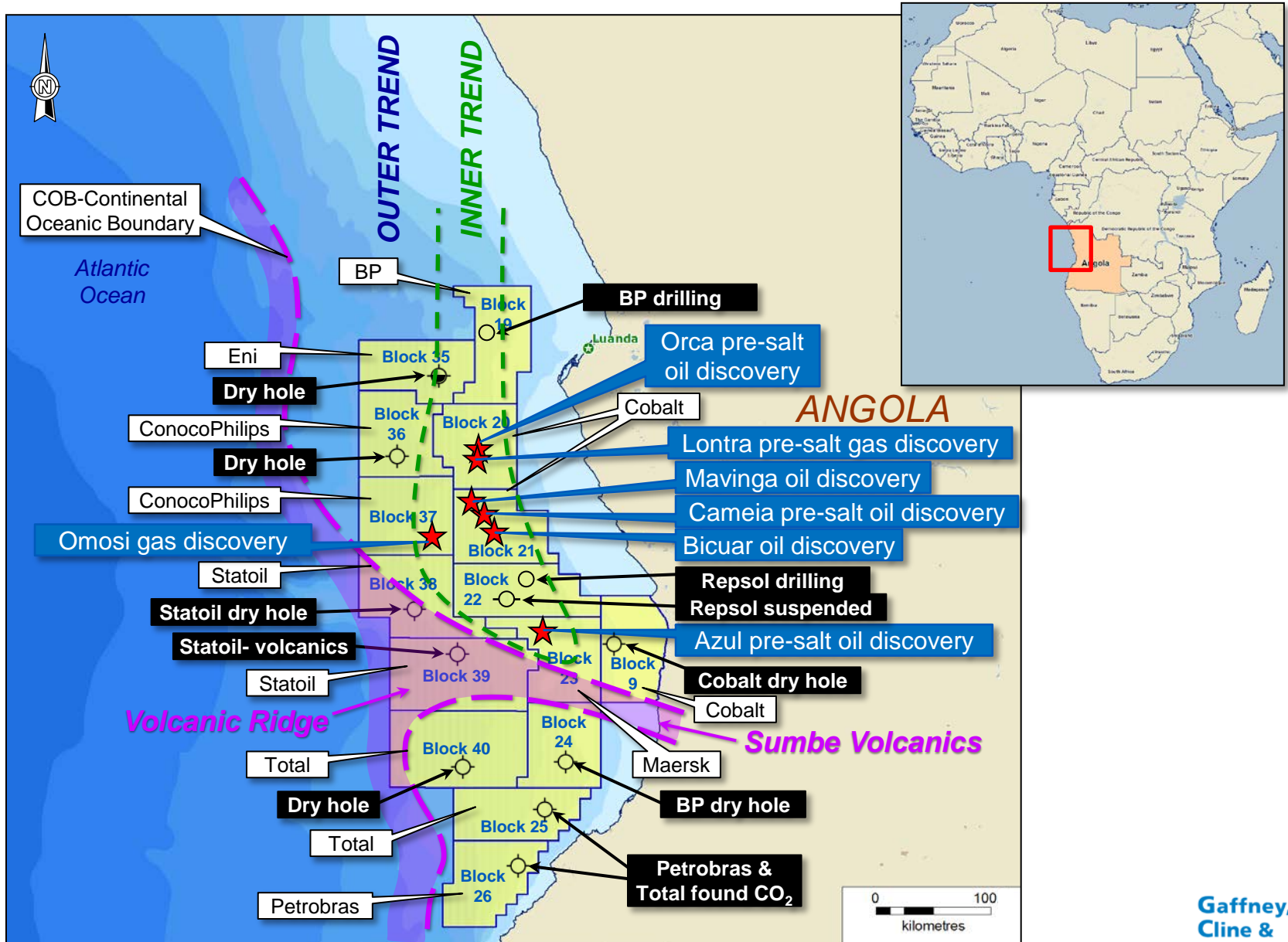
Is this an appropriate analogue?



- Comparable pre-salt clastic and carbonate lithologies encountered on both margins, but @ different scale
- Vital differences between them, notably thickness of salt in the Santos basin compared to thin or absent salt in parts of the Kwanza.

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Kwanza Basin Pre-Salt Drilling Activity



Gas Developments – are they realistic at \$3/Mcf?

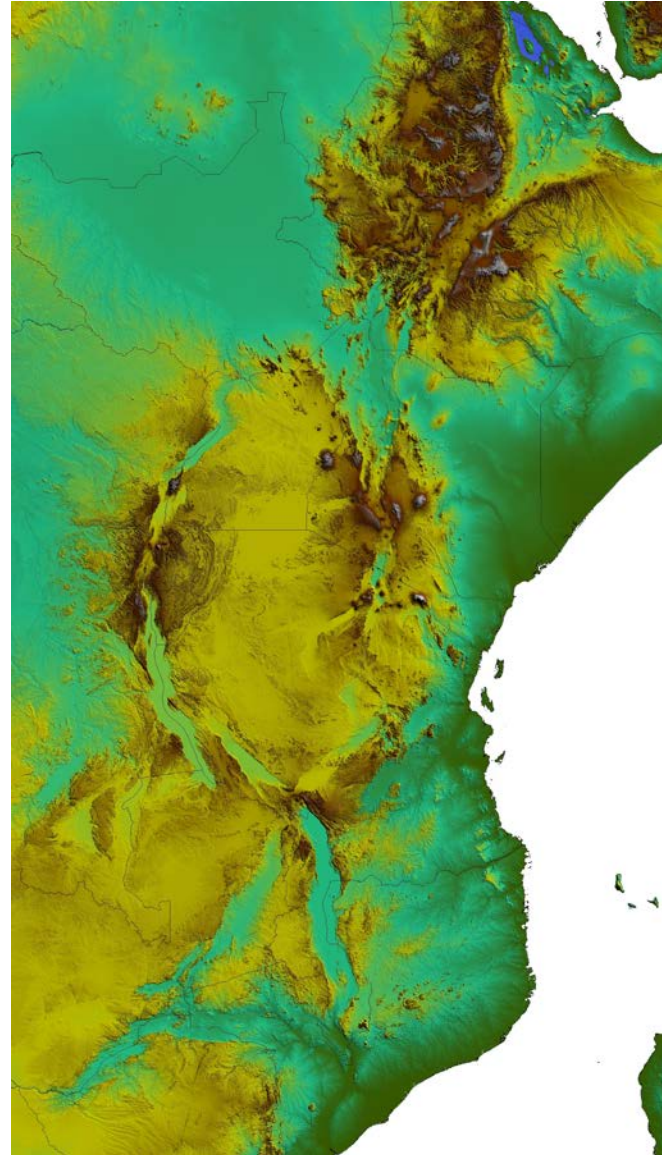
- Many of the Deep Water West African pre-salt discoveries are gas rich, in contrast to the predominance of oil found in the pre-salt of Brazil
 - Angolan contract terms, operators not entitled to any gas
 - Gabon, both Congos more favourable gas terms, lack of infrastructure or clustered resources
 - FLNG may be viable, especially for dry gas! New builds too costly, conversion of 30+ year old LNG carriers underway
- African Gas Demand (+ 1 Billion people in next 30 years)
- Ghana, Cote d'Ivoire, Cameroon, Gabon, Mauritania & Nigeria all have local gas markets not linked to oil prices
 - Developments need funding for gas utilization projects based on Power Generation or Petrochemicals
 - Backed by International Agencies with gas payment guarantees
 - African gas for African transport fuels a mid-term option

East African Rifts, so Many to Choose from


Extensionally reactivated
Precambrian orogenic belts, form
the East African Rift System
(EARS)

Digital Elevation Model
SRTM data - NASA


Brown, D. *Structural complexities of the East African rifts and the implications for exploration and production* (Poster), PESGB-HGS Africa Conference, September 2013




Neogene Rift Basins

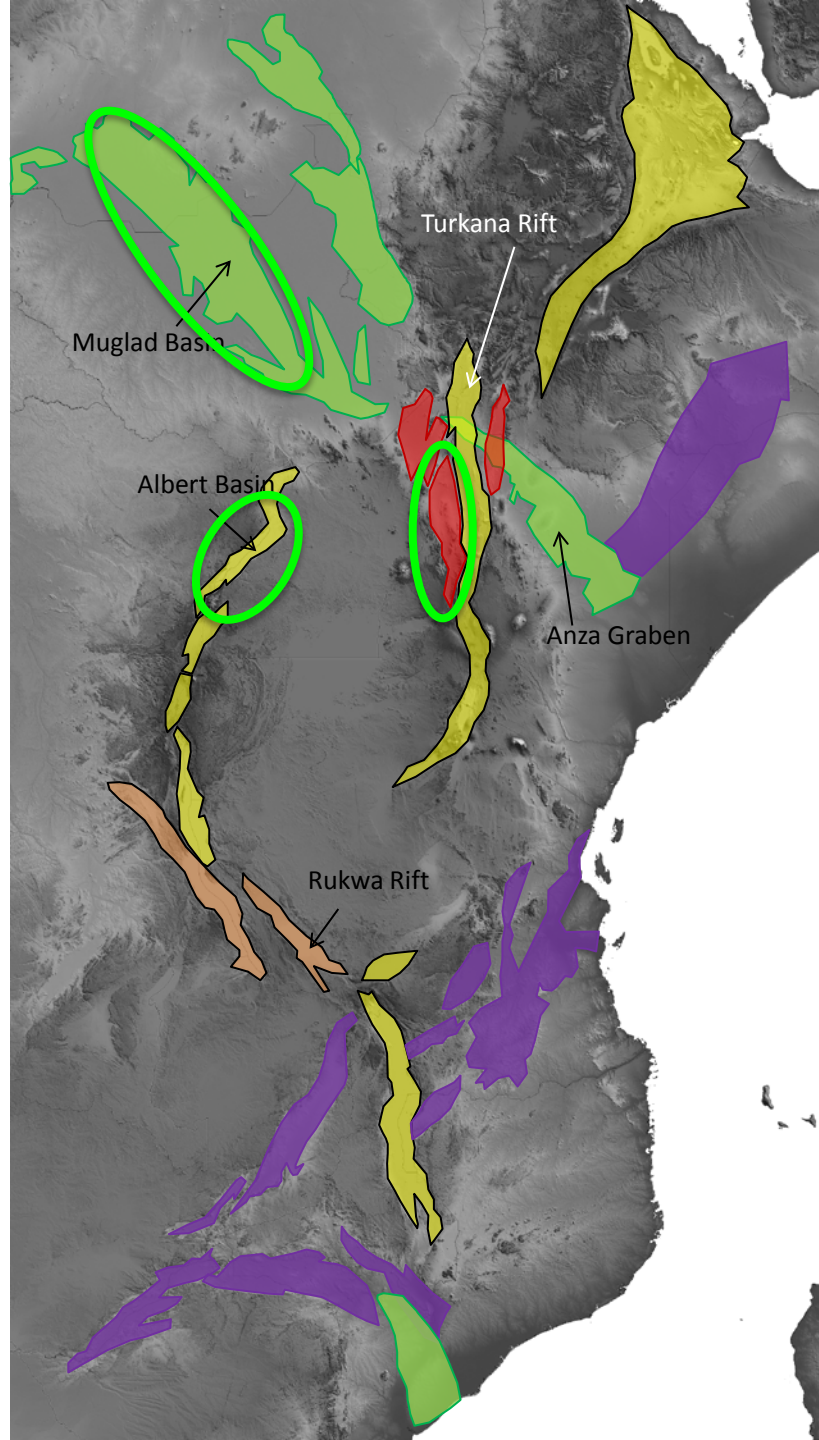

Karoo Rifts
reactivated in
Neogene


Paleogene-
Neogene Rift Basins

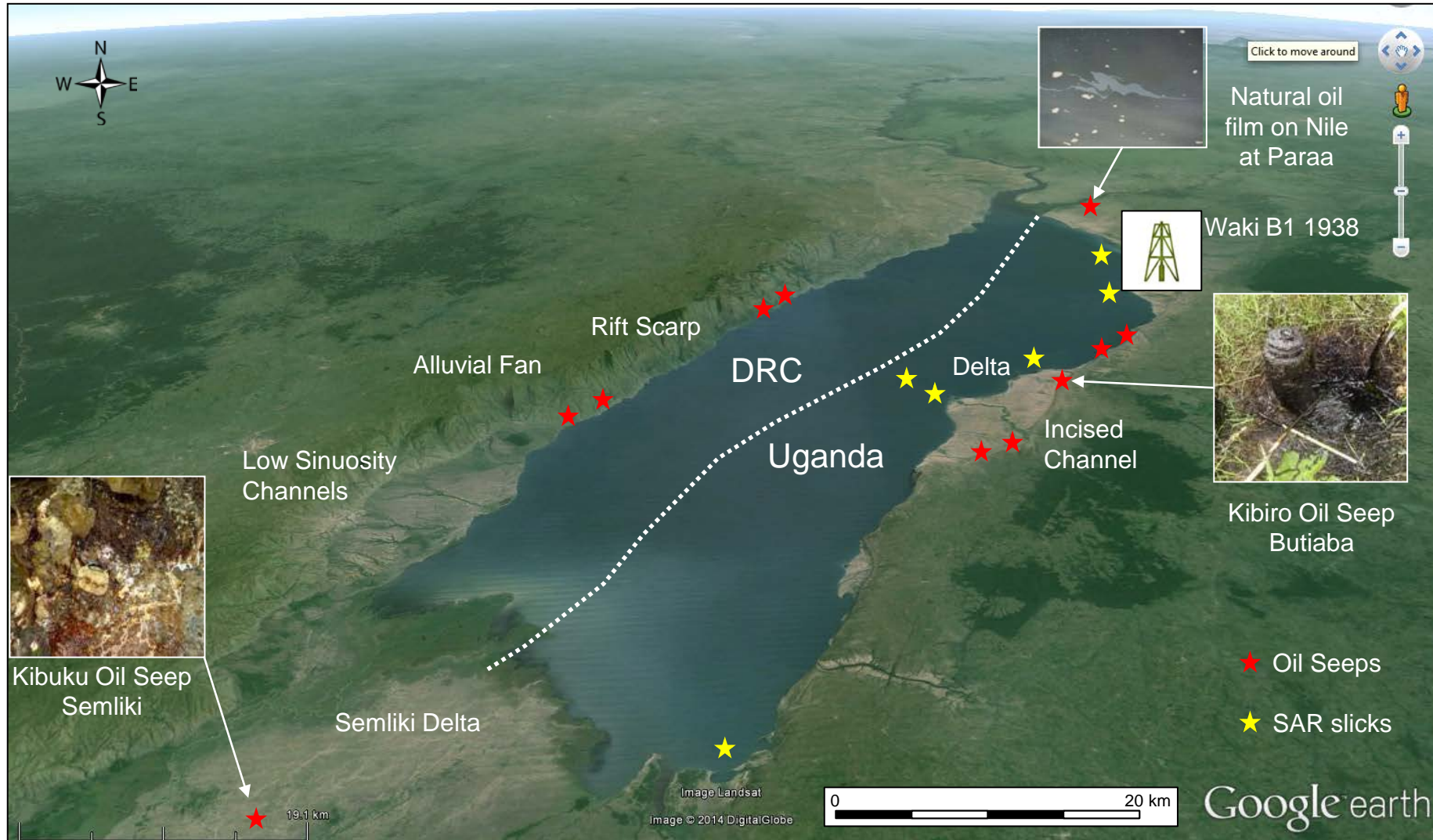

Cretaceous Rift
Basins


Permian-Triassic
Karoo Rift Basins

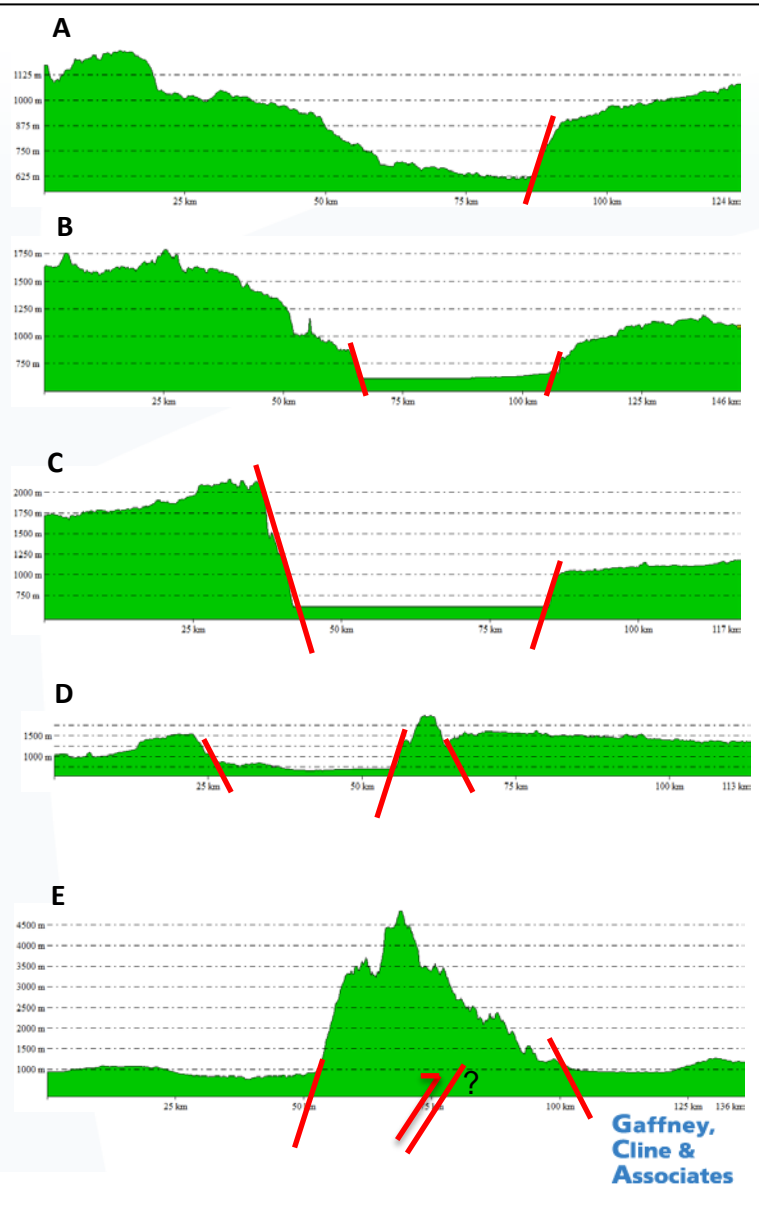
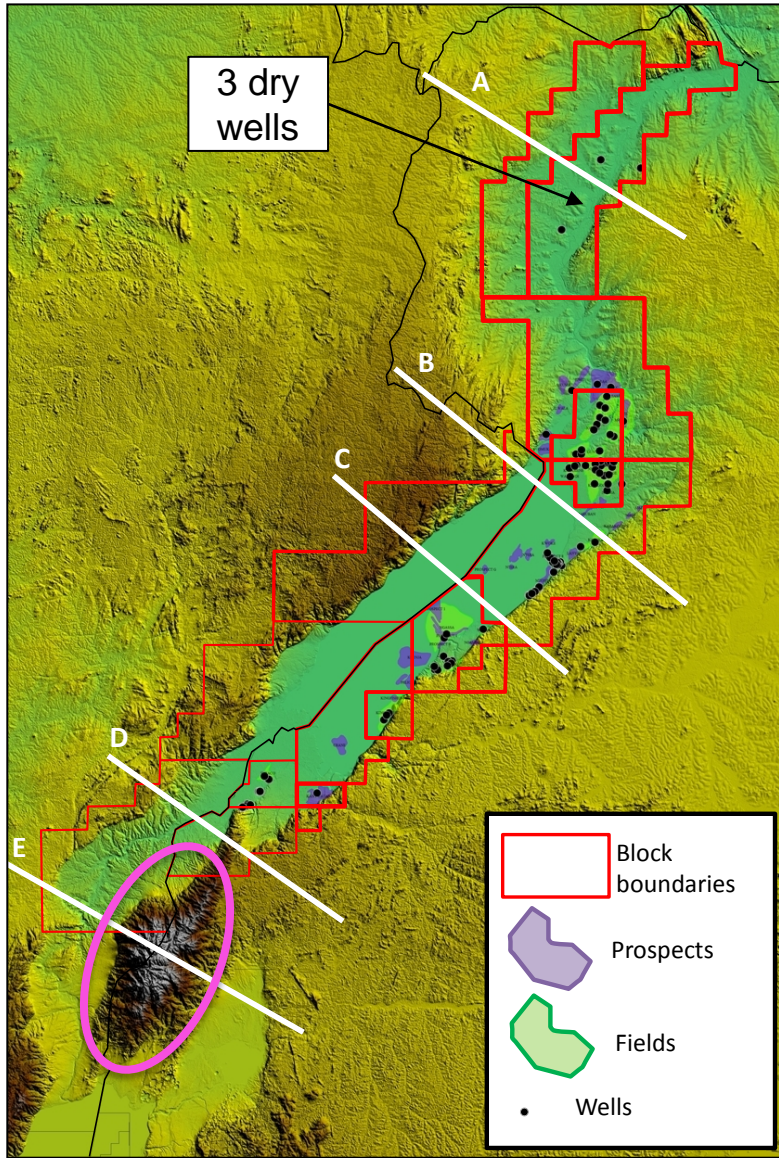
SRTM data
Source: NASA
From Africa Oil &
Macgregor, 2012



Lake Albert Potential Identified in 1890's, First Well 1937/8

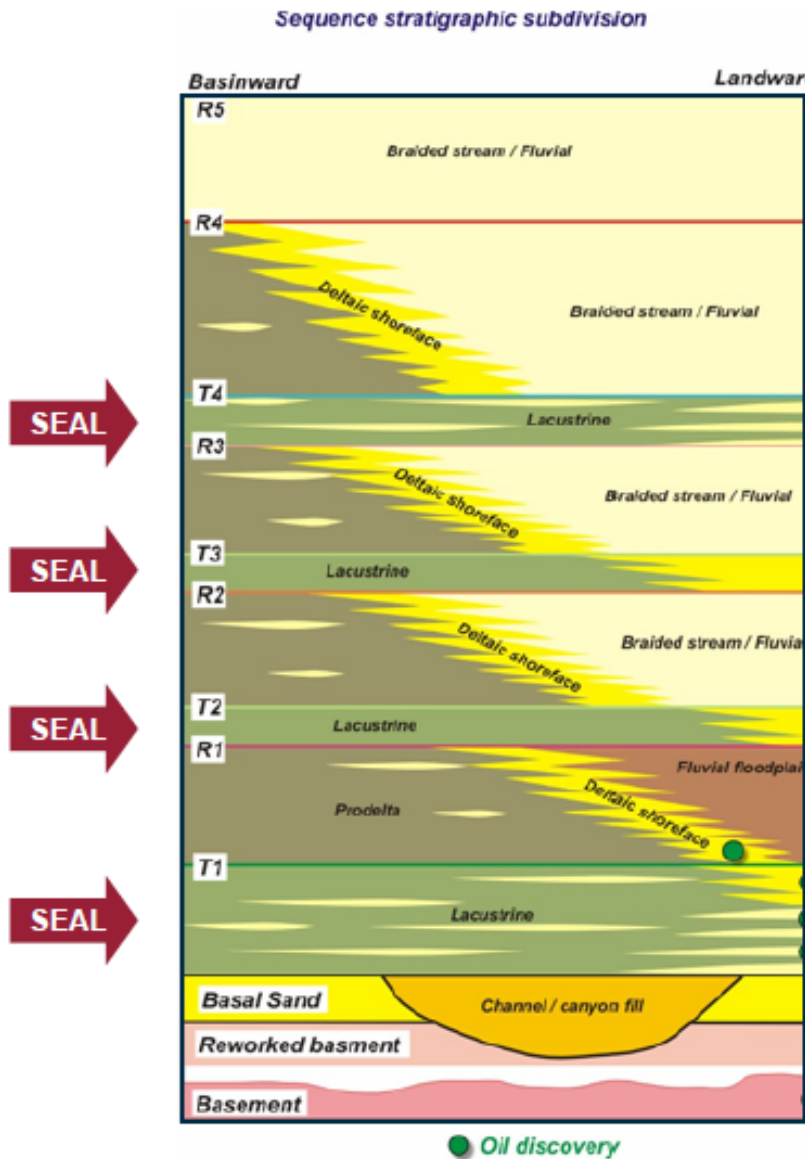


A Stable African Craton?



SRTM data Source: NASA, Blocks, Fields, Prospects and Wells from Petroview

Albert Basin Stratigraphy

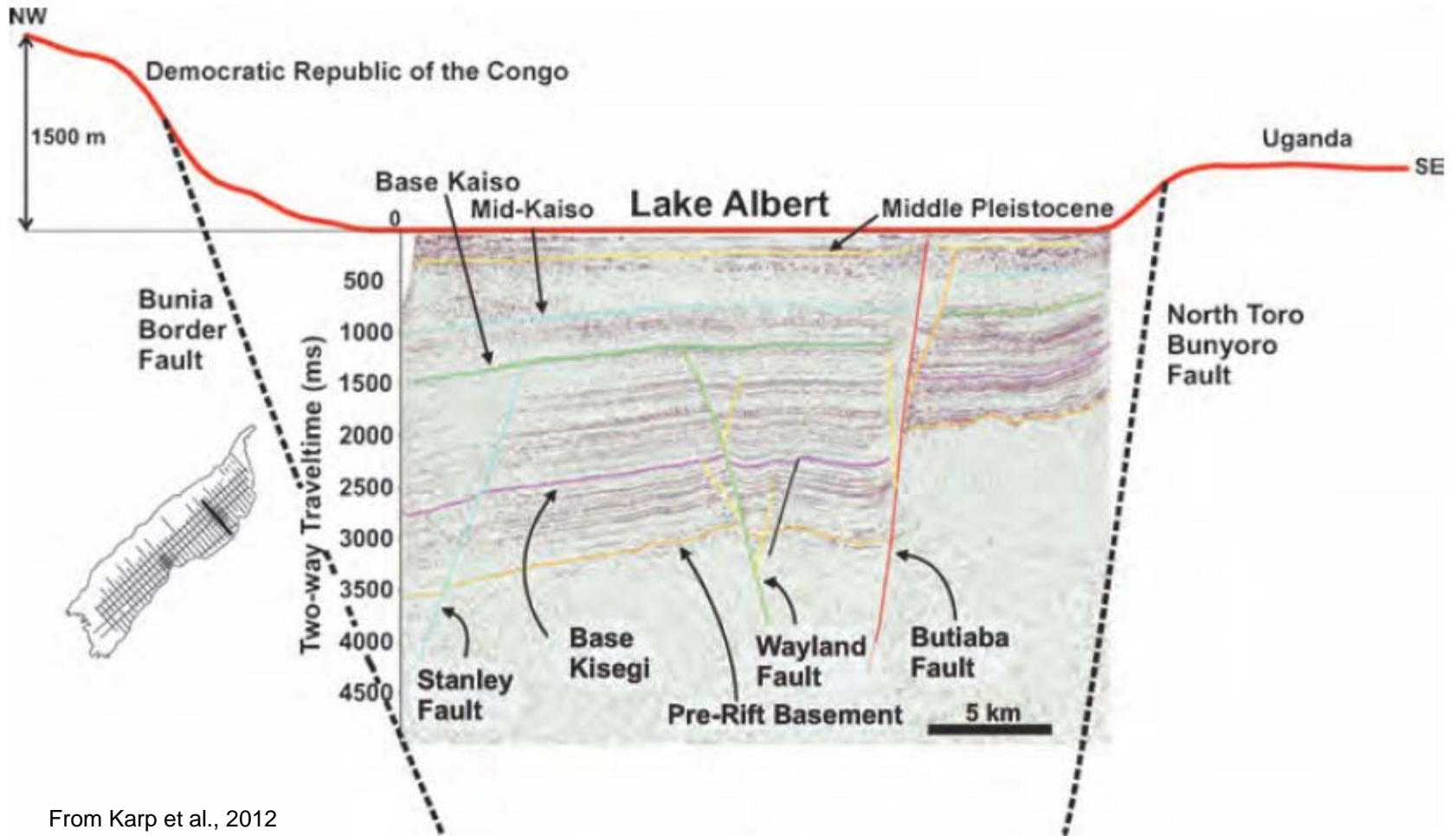


- Reservoir units
 - Thick well sorted sands
 - Porosities advertised 27-32%
 - Permeabilities advertised 200-8,000 mD

- Seals
 - Laterally extensive lacustrine shales

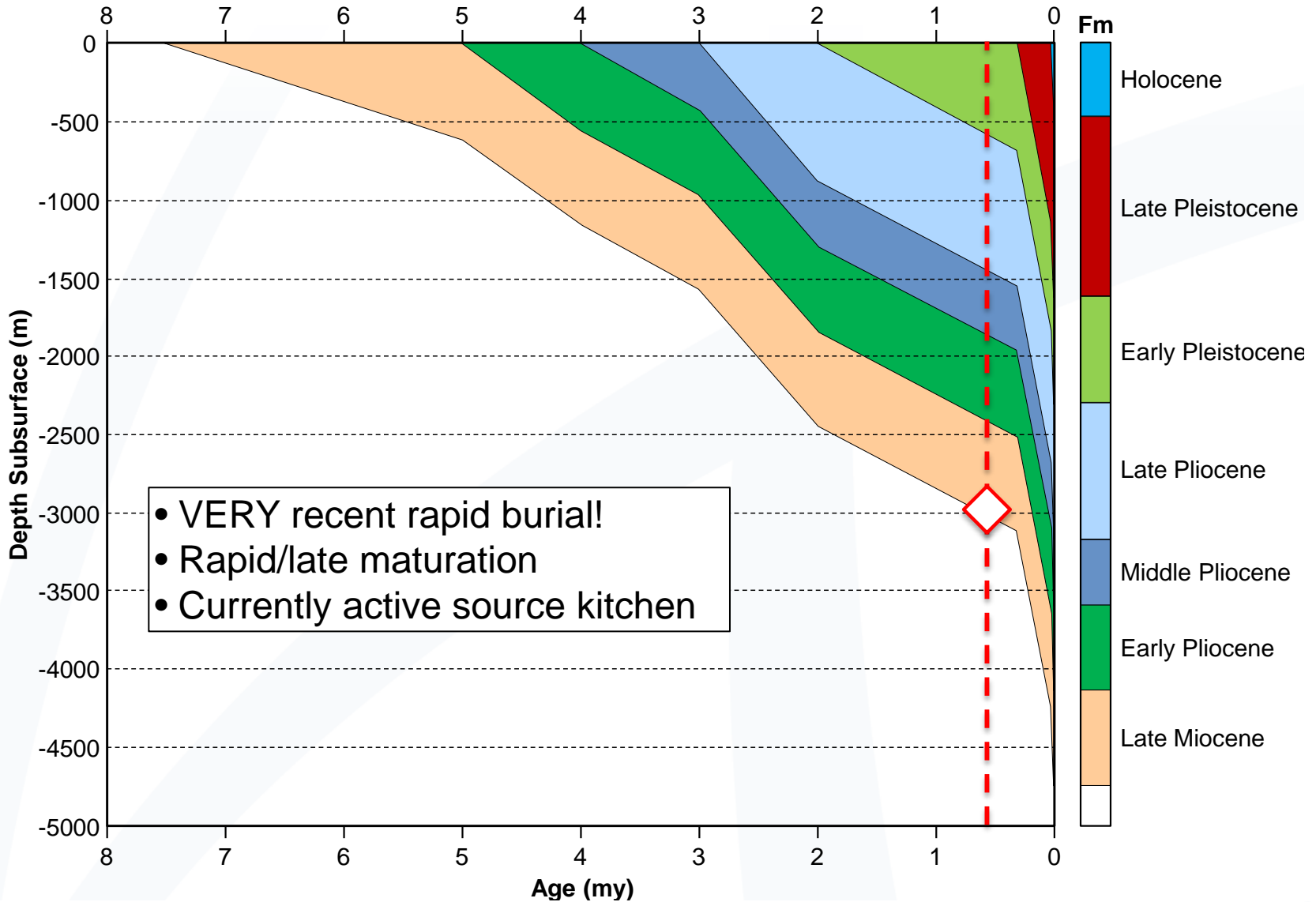
From Karp et al., 2012

Albert Basin Structure



From Karp et al., 2012

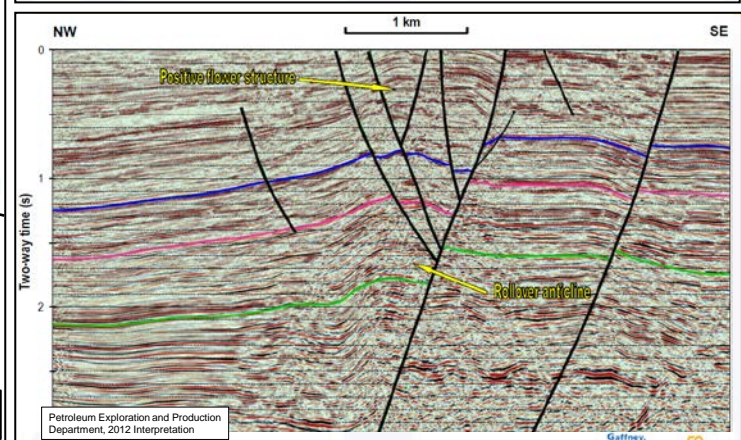
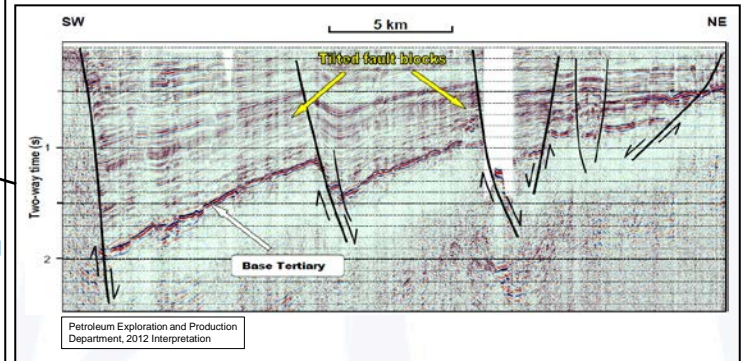
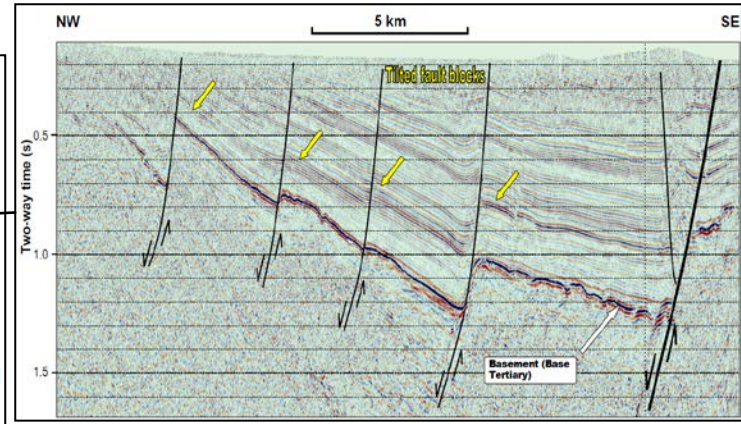
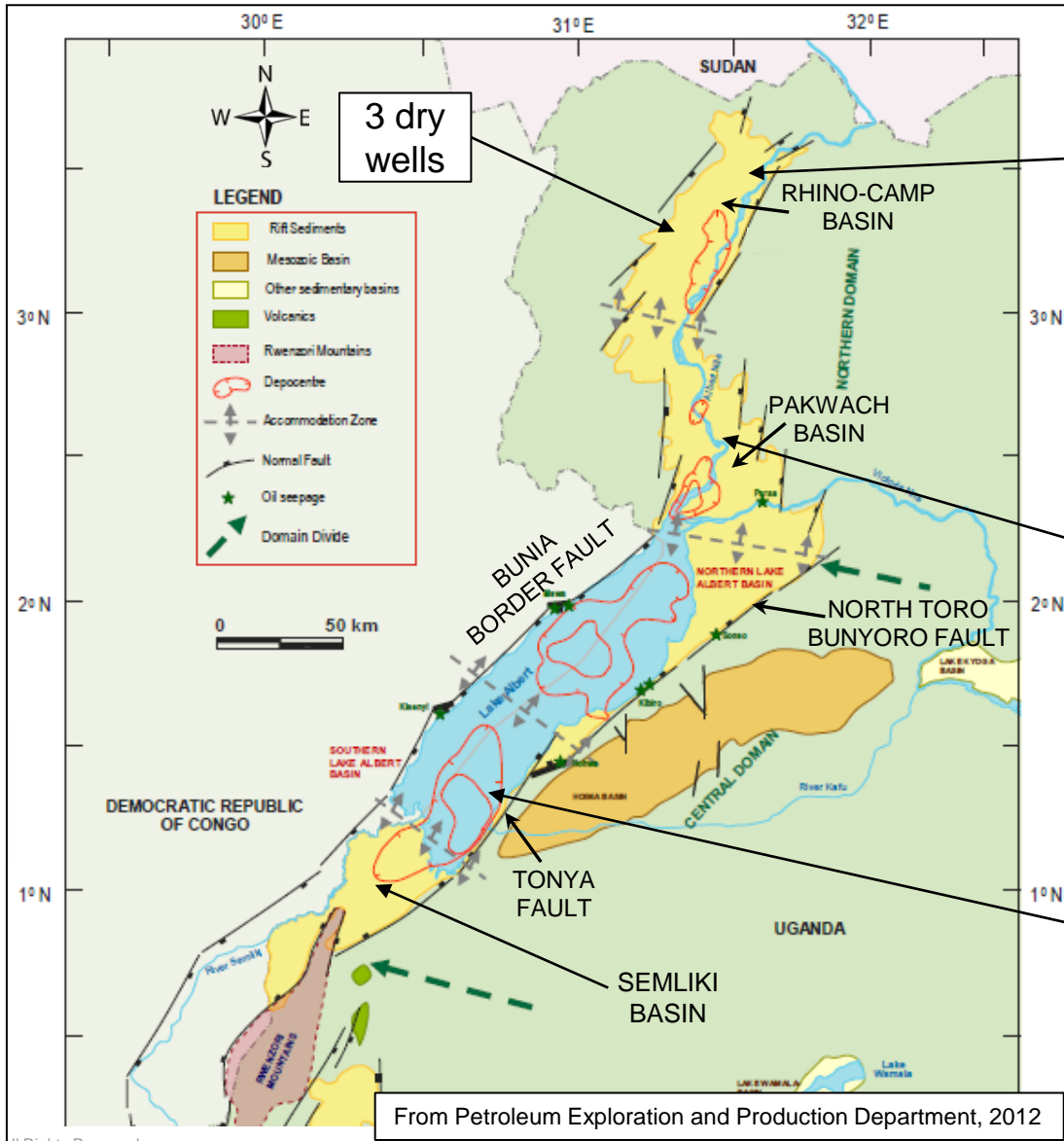
Albert Basin Burial Depth



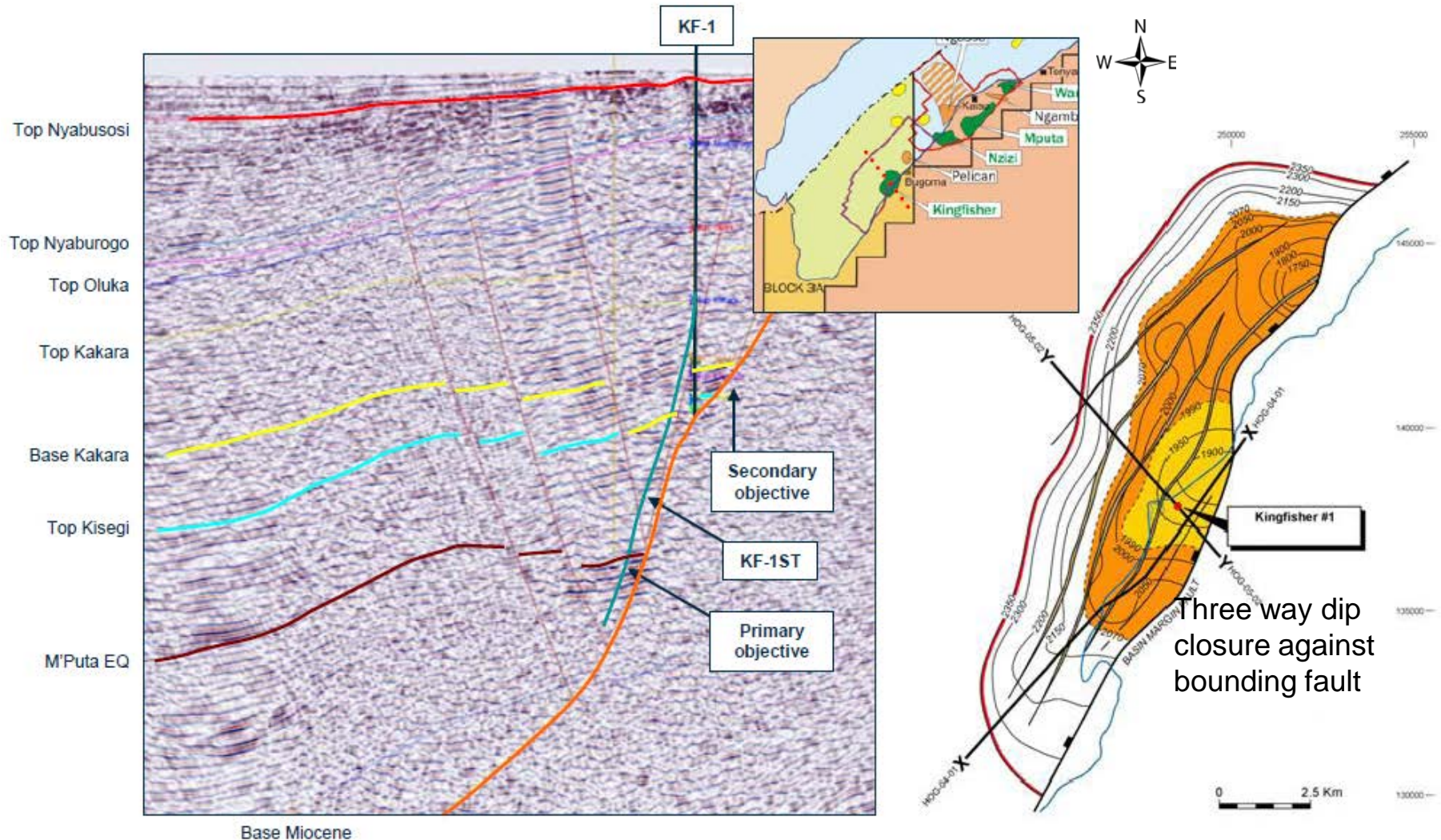
Rwenzori Mountains - “Mountains of the Moon”



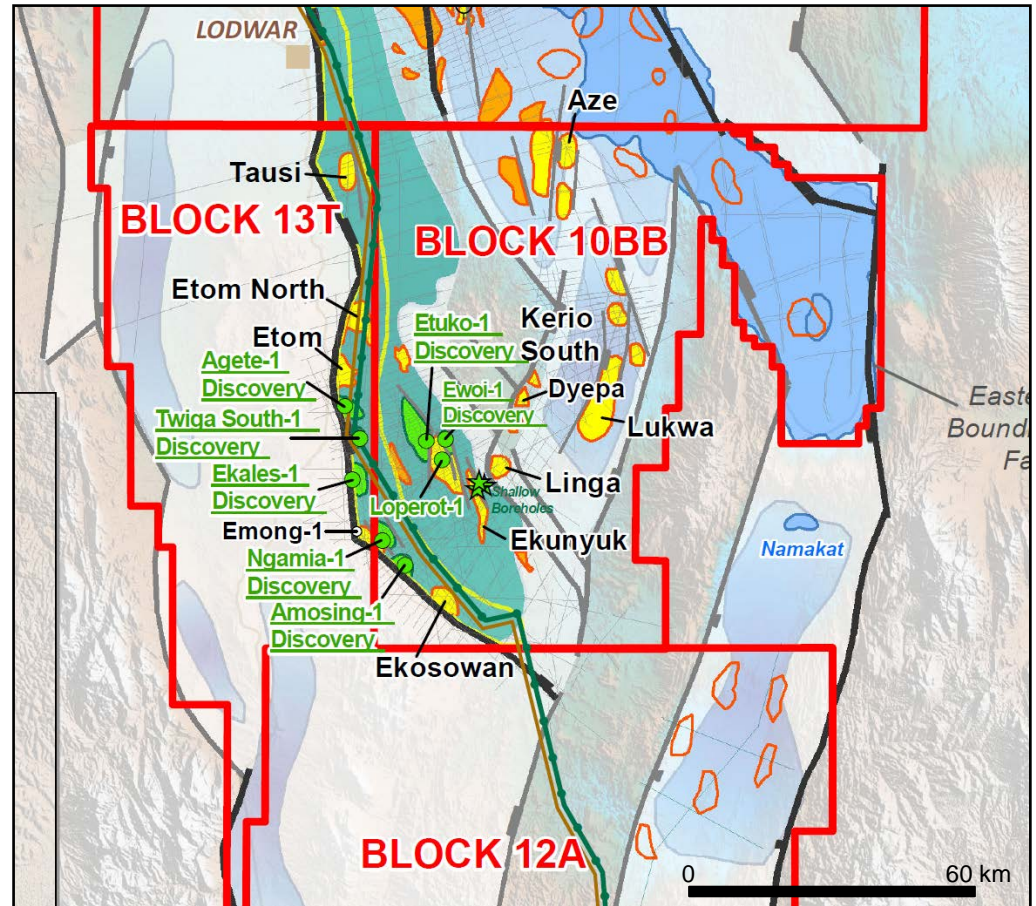
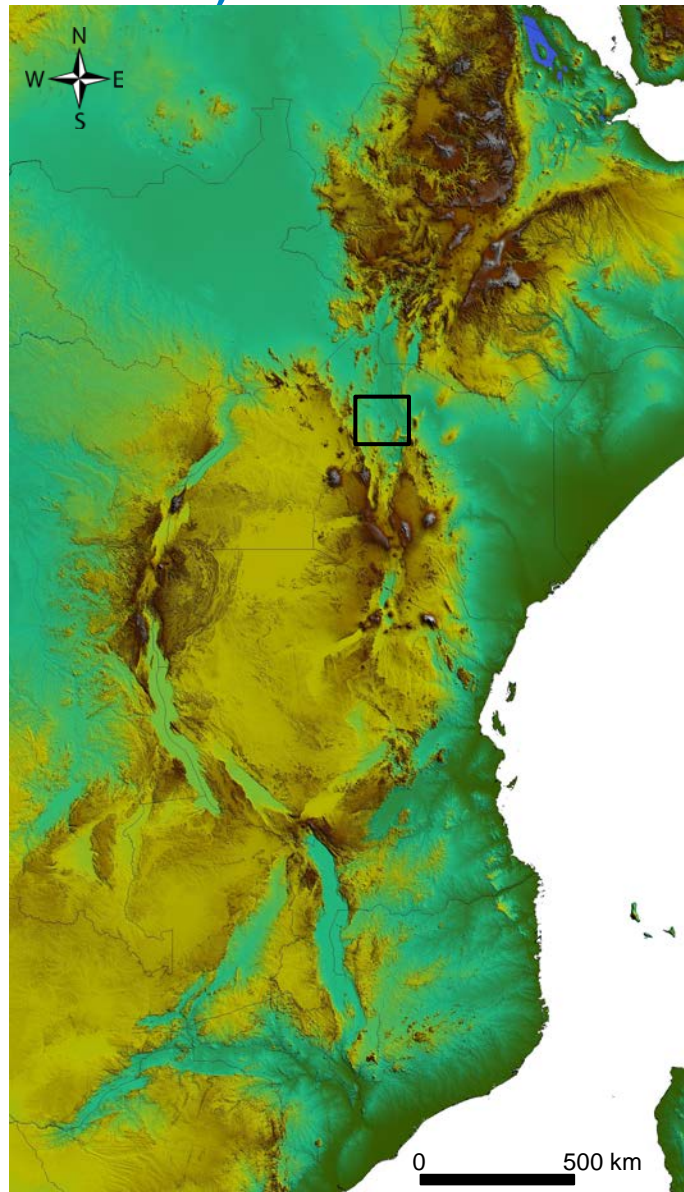
Tectonic Elements



Kingfisher Discovery – 2006/2017, ~ 200 Million Barrel



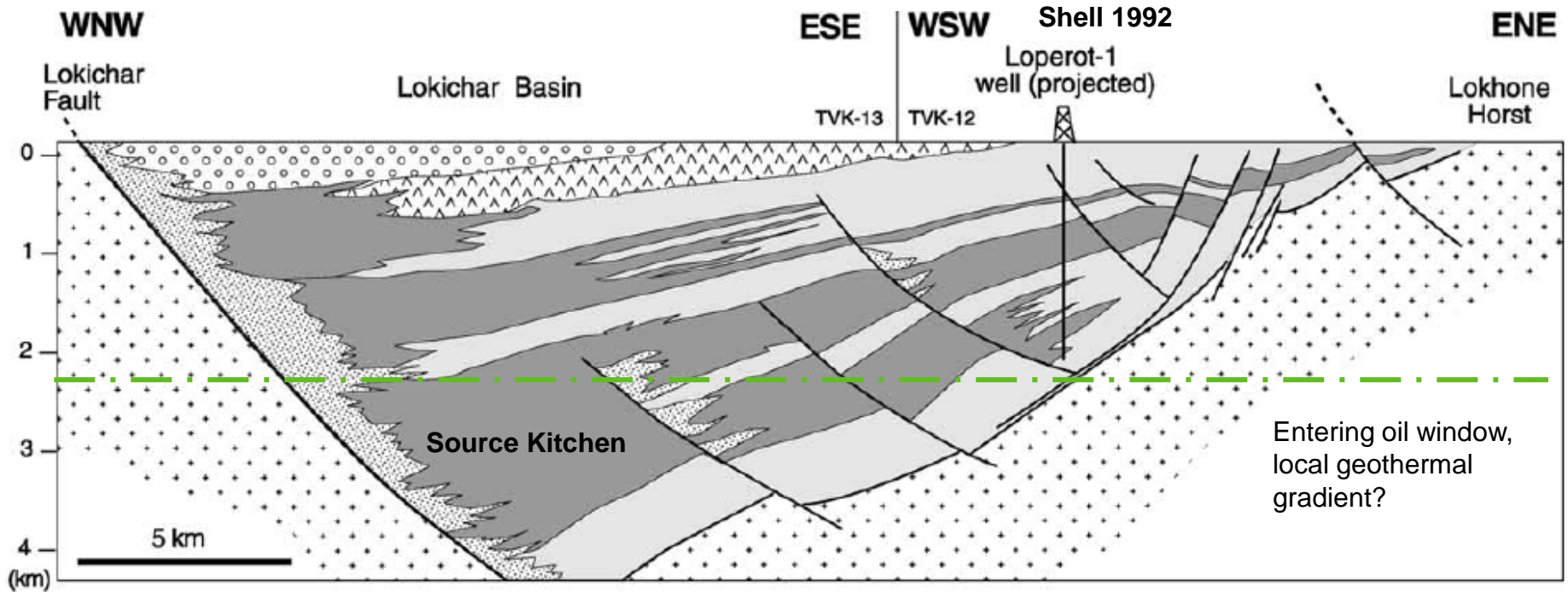
South Lokichar Basin (Courtesy Africa Oil, D.M. Jarrett)









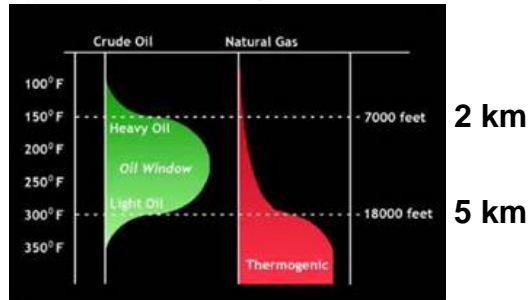
Source: AOC

- The South Lokichar Basin forms part of the Eastern Branch of the EARS
- Lies to the southwest of Lake Turkana

South Lokichar Basin – Half Graben

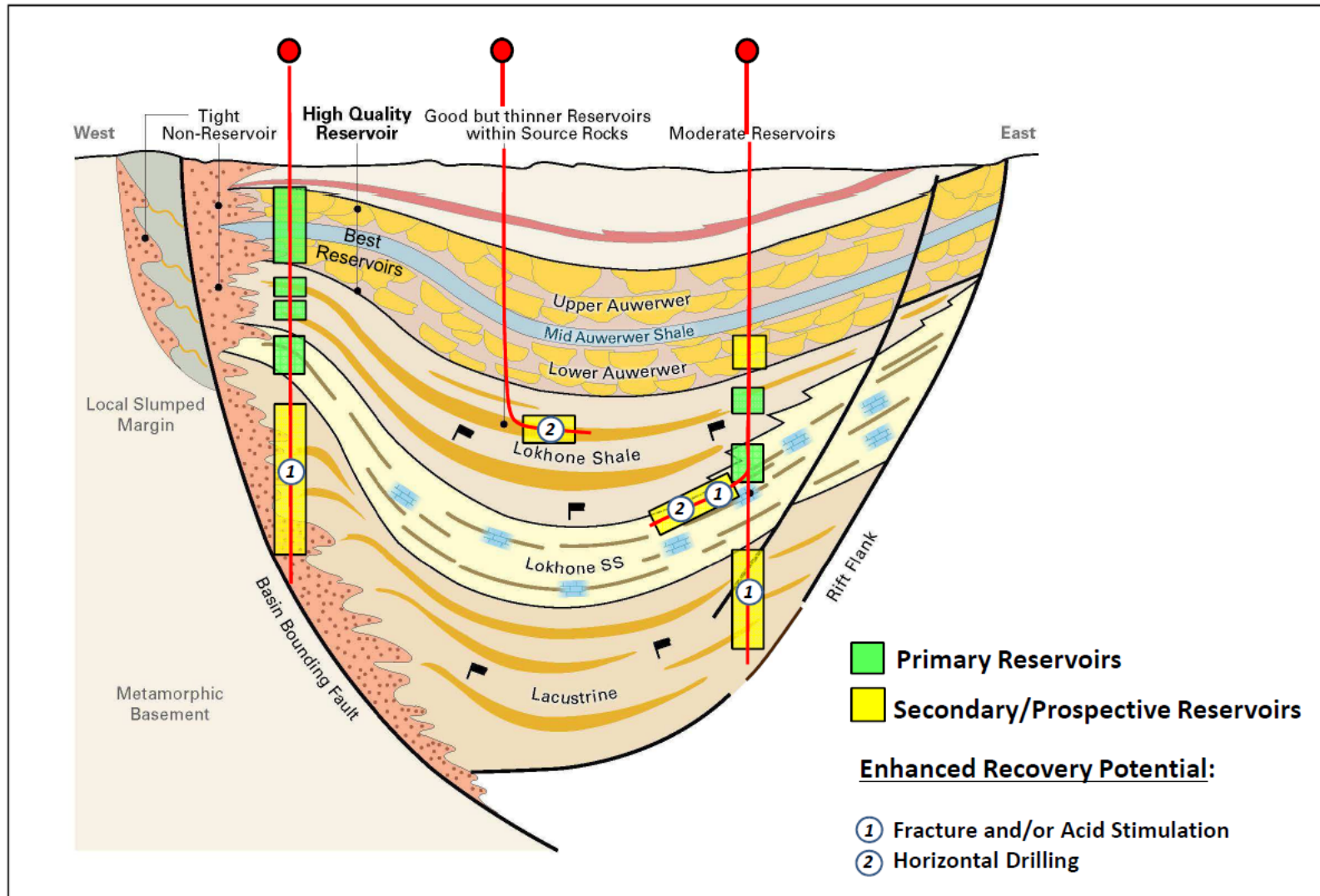


-  Precambrian basement
-  Fine-grained lacustrine deposits
-  Middle Miocene volcanics
-  Fan deposits
-  Mixed sands and shales
-  Plio-Pleistocene sediments

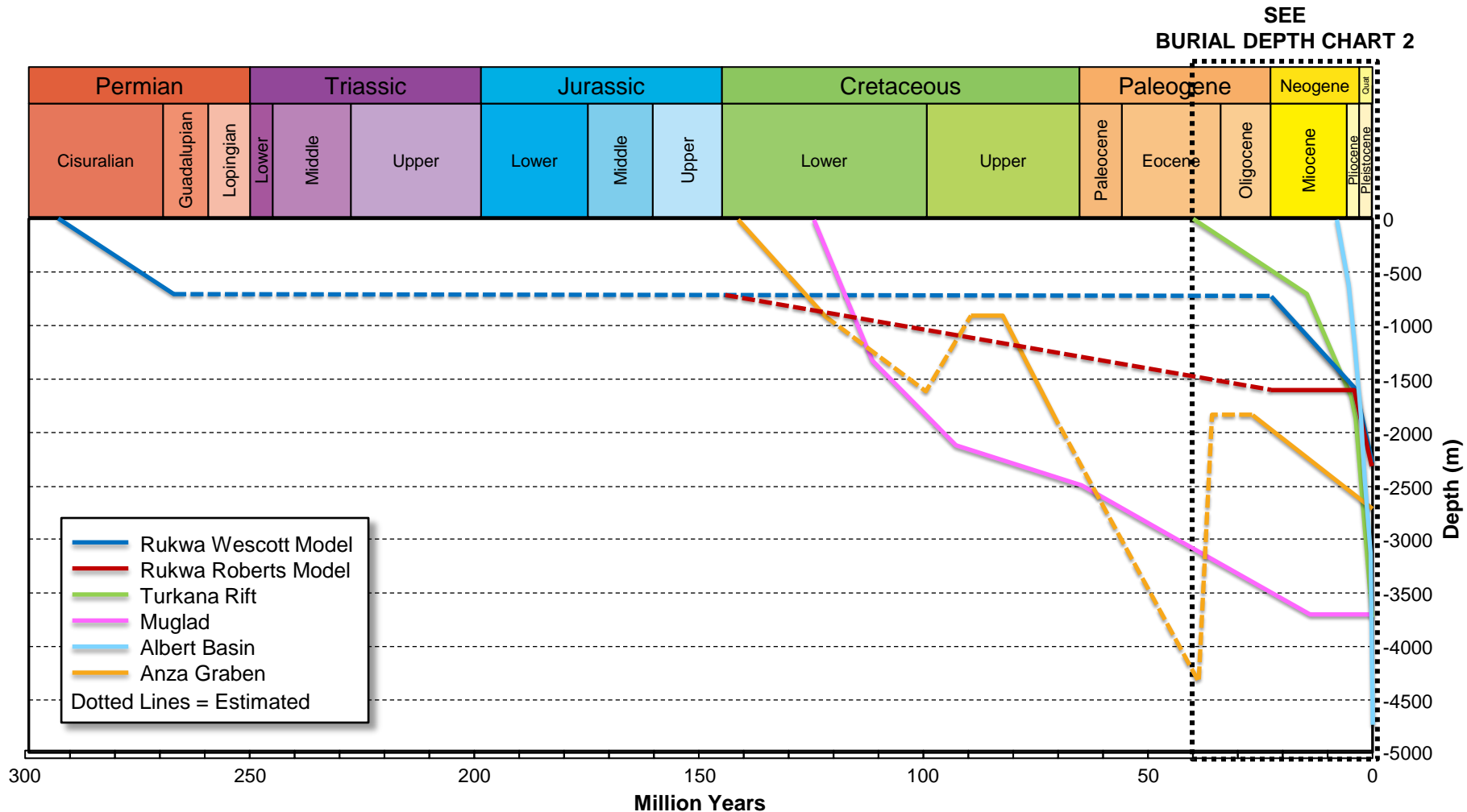


Source: AOC

South Lokichar Basin (schematic), Reservoirs and Seals



Comparison with Other Rifts Burial History



Based on interpretation by Heritage Oil and data in Le Gall et al., 2005, Morley et al., 1999b, Wescott et al., 1991, Roberts et al., 2004, Roberts et al., 2010, Schull, 1988 and Morley et al., 1999c.

Key Takeaways for African E&P

- Oil & Gas Prices
 - Potentially have to live with \$50-60 oil and \$3 gas for several years
 - adapt E&P portfolio to deliver value to our shareholders/investors
 - Cost reductions will enhance onshore/shallow water economics faster than in deep water for similar tax regimes
 - Tax breaks on existing PSC's will be tough to negotiate with <1 year of low oil prices
- Timing
 - Cashflow is king, many of the 1970's explorers in the Chad and Sudan rift basins were not around when oil exports began 20+ years later
 - Lake Albert timeline is 1997-2017 for first "local" oil, timing of pipeline to coast?
 - Kenyan oil appraisal for "fast track" development;
 - Scope to move oil without waiting for a \$3B pipeline, a trade-off between higher OPEX/Bbl and the time value of money + financing issues
- Pre-Salt & Onshore Rifts
 - Super rich source rocks allied to very complex play concepts
 - Rapid vertical movements, lateral variations in seals and reservoirs
 - Improved rift imaging + imagination likely to yield many more "hidden gems"

Thank you for your attention

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