

Offshore East Africa-where is all the oil?

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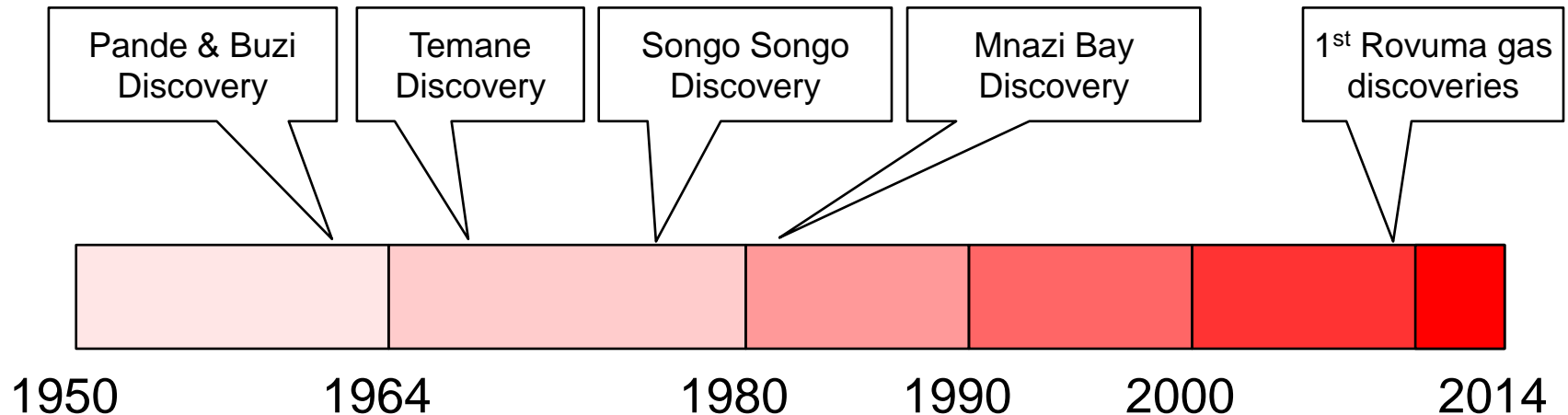
Introduction

- Offshore East Africa, only gas has been found in commercial volumes
- Oil discoveries onshore Uganda, Kenya, Mozambique and Madagascar – along with numerous seeps along the coast – encourage the continued pursuit of the elusive offshore oil.

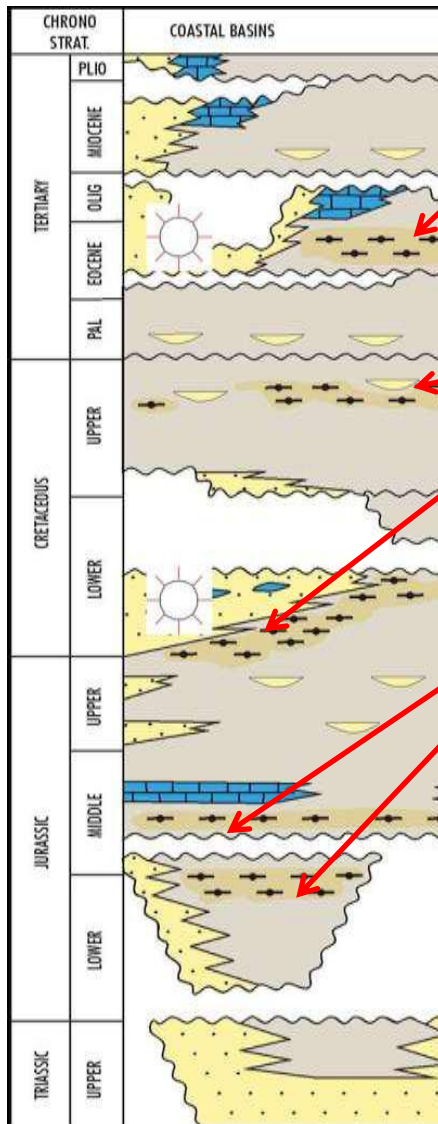


History of Exploration

- 1950-1964 Majors perform geological studies and the petroleum system is proven.
- 1964-1980 Seismic surveys shot and 5 wells drilled. AGIP discover Songo Songo Gas field. Gulf Oil discover Pande & Buzi Gas fields.
- 1980-1990 Increased drilling period. ENI discover Mnazi Bay gas field.
- 1990-2000 Exploration efforts wane due to prediction of gas-prone source rocks.
- 2000-2009 First gas produced Songo Songo and Mnazi Bay.
- 2009-2014 Renewed exploration with intensive drilling campaigns resulting in multiple multi-TCF gas discoveries in Mozambique and Tanzania.



Postulated Source Rocks



Paleogene-Neogene:

Restricted to localised pro-delta environments and rarely attained sufficient thermal maturation.

Post mid-Jurassic – Cretaceous:

Likely to be gas prone due to paucity of oil-prone kerogens at the time.

Lower-Middle Jurassic:

Generally deeply buried. Widespread Miocene inversion thought to have flashed much of the oils to gas.

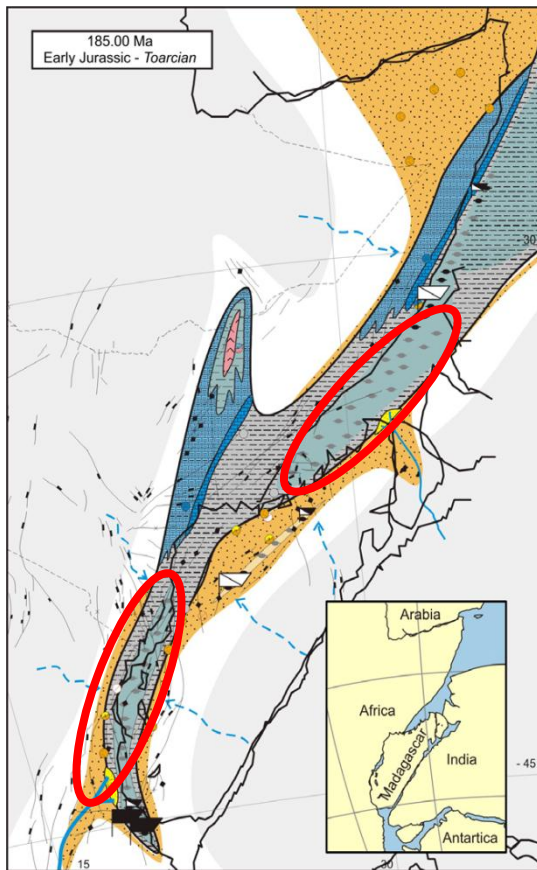
Triassic:

Likely to be over-mature.

Permo-Carboniferous:

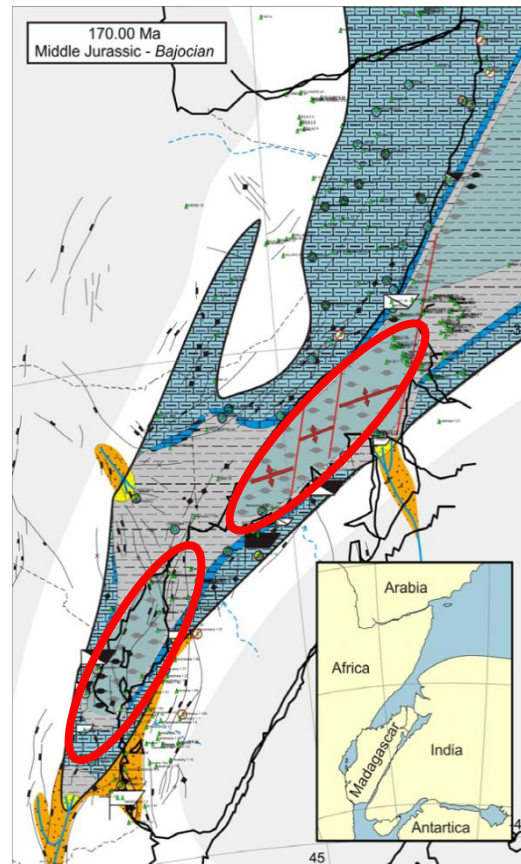
Compositionally prone to be gas bearing.

Palaeogeography



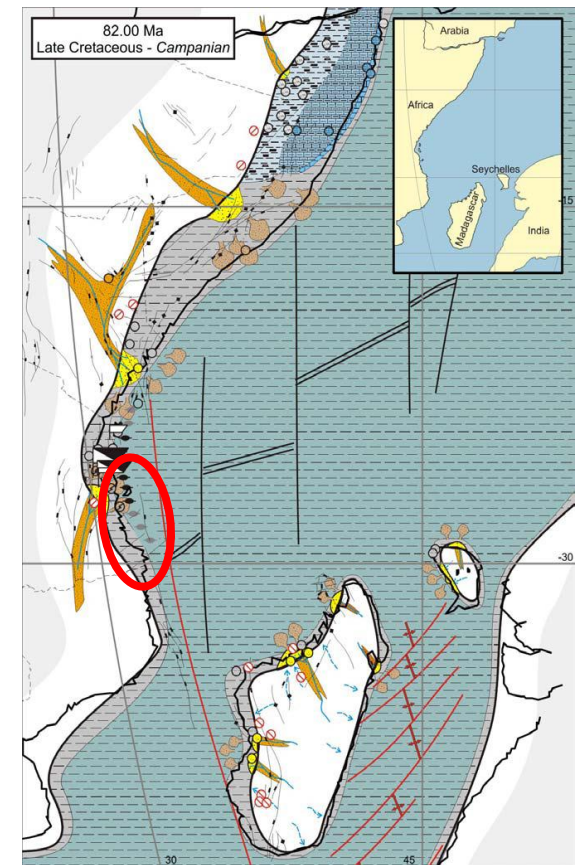
Early Jurassic

Transition between Permo-Triassic rifting and sea-floor spreading. Thermal doming between Tanzania and Madagascar



Mid-Late Jurassic

Madagascar begins southerly drift along Davie Fracture Zone. Source rocks deposited in semi-restricted settings.



Cretaceous

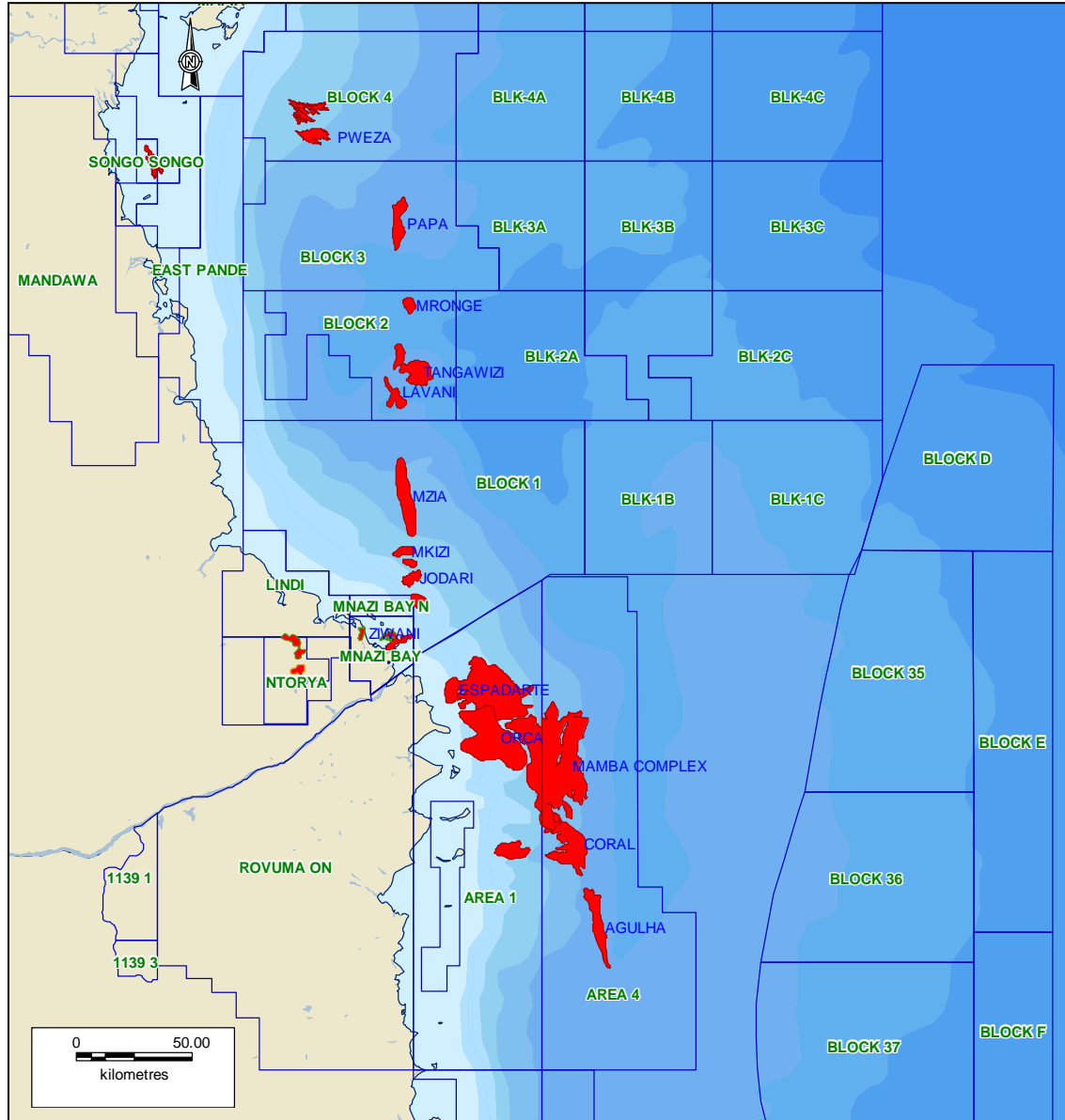
Continued drift of Madagascar. Major deltas begin to form in coastal basin.

Natural Gas assets in East Africa

Source Intervals

- An Early-Mid Jurassic marine shale is thought to source much of the gas in offshore Tanzania and Mozambique.
- This source rock has not yet been directly sampled.
- Is gas being generated because?
 - The source rock predominantly lies within the gas window.
 - Some areas of this source rock had high gas-prone terrigenous input

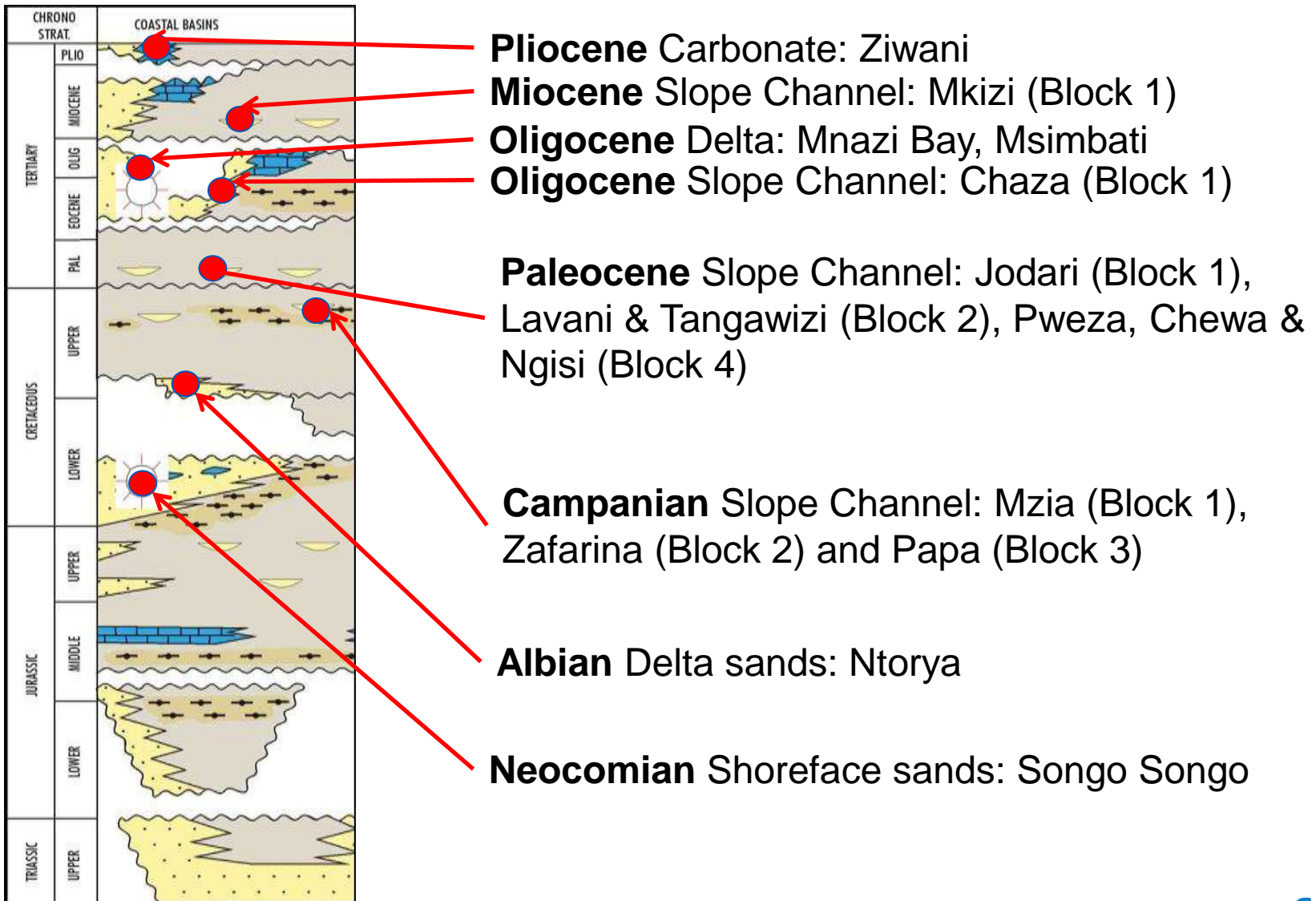
Gas Discoveries - Mozambique and Tanzania



- 20-30 TCF discovered offshore Tanzania

- 120-150 TCF discovered offshore Mozambique

Ages of Gas Discoveries in Tanzania



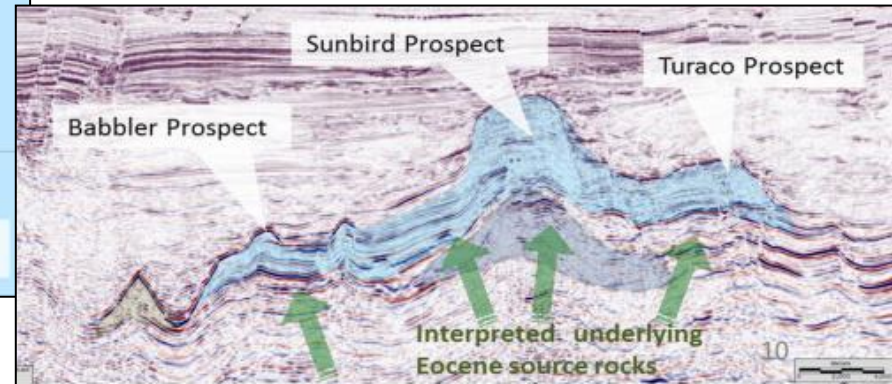
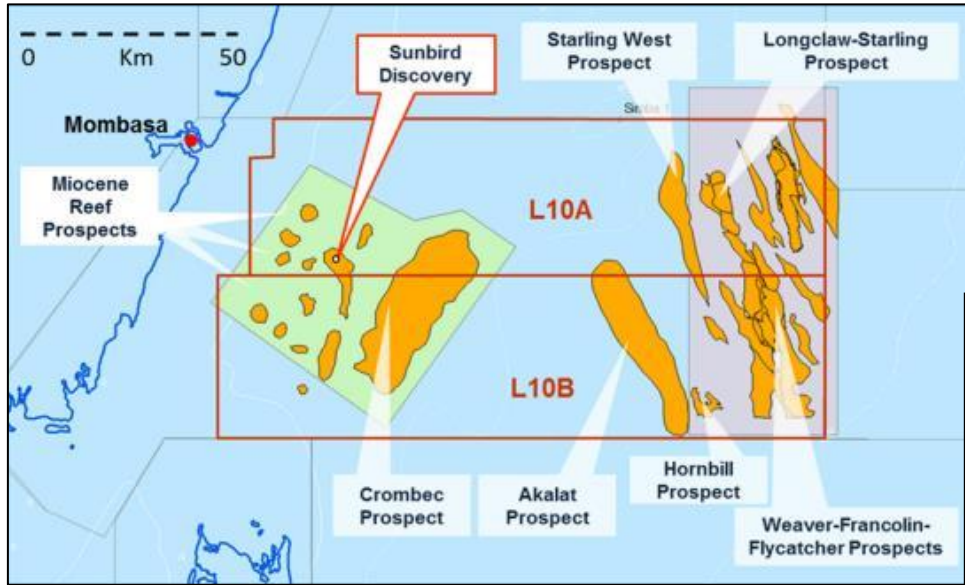
Source: TPDC

Other oil play factors - Crustal Type

- The nature of the crust which underlies the East African margin is subject to current debate.
- Geochemistry of the Grand Comore lavas indicate an oceanic crustal signature to the Comoros islands - a useful Eastward constraint upon the location of the crustal boundary.
- Gravity and magnetics data over the area is also subject to debate, as seafloor topography associated with the Davie fracture zone and Rovuma delta make the interpretation more difficult.
- Attempts have been made to pick a distinct crustal boundary on 2D seismic

Offshore Oil Discoveries?

Kenya - Sunbird-1



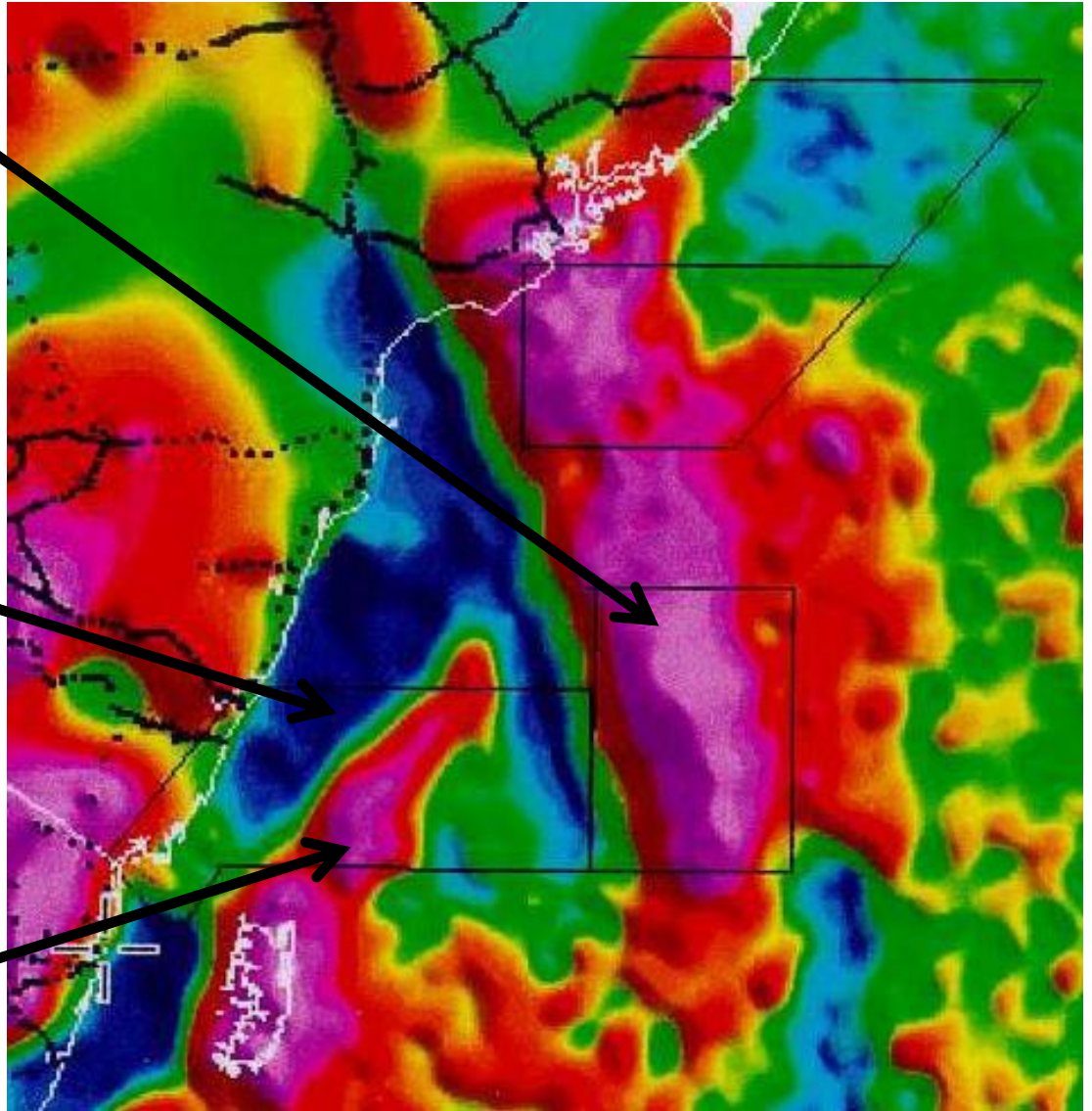
- The well was completed in the March 2014.
- Water depth 723m
- ~900m of overlying sediment
- “. . . gross 29m gas column overlying a gross 14m (9.2m net) oil column” in a Miocene Pinnacle Reef.

Kenya – Lamu Basin

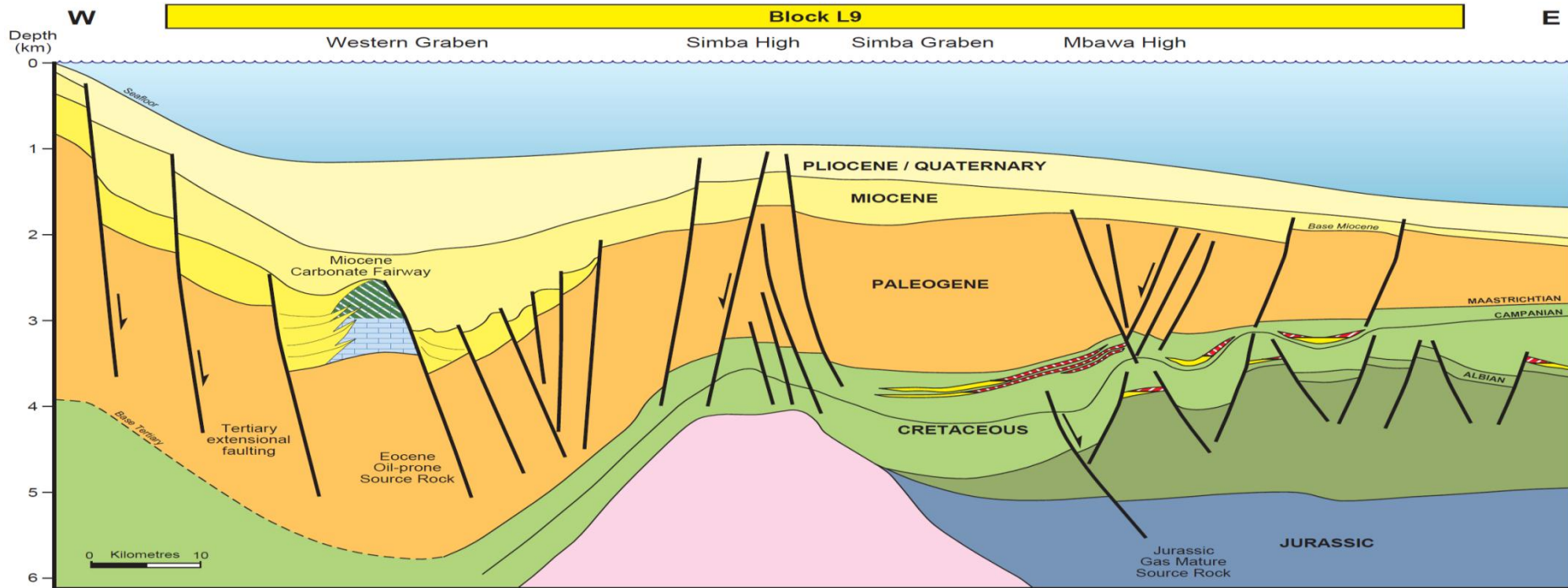
- Davie-Walu Ridge

- Tembo trough

- Simba High

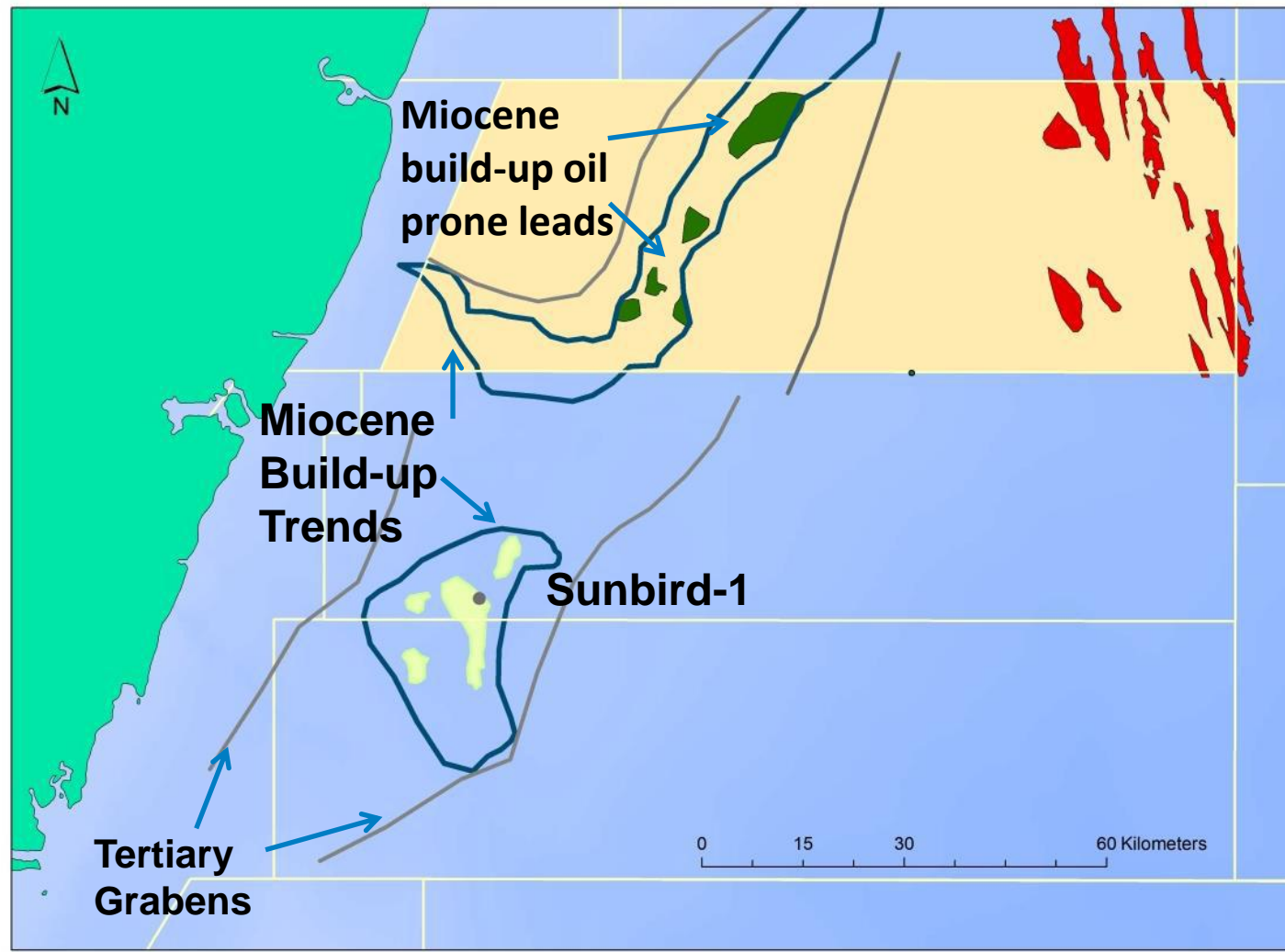


Kenya – Lamu Basin Reef Play



- Prognosed Eocene source
- East of the Simba High, Cretaceous age clastic play expected to be sourced by gas mature Jurassic.

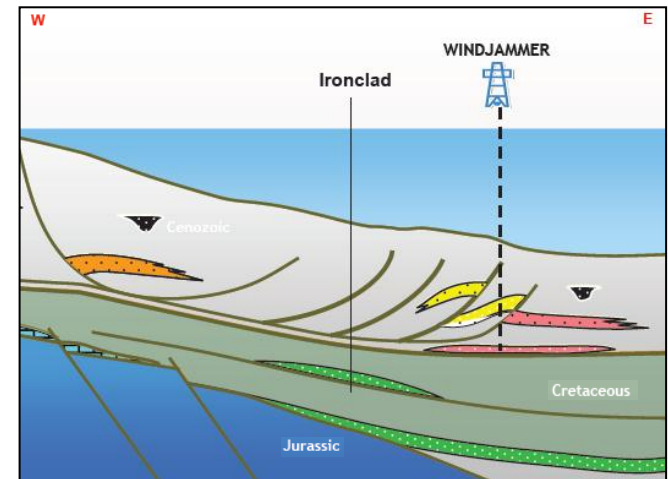
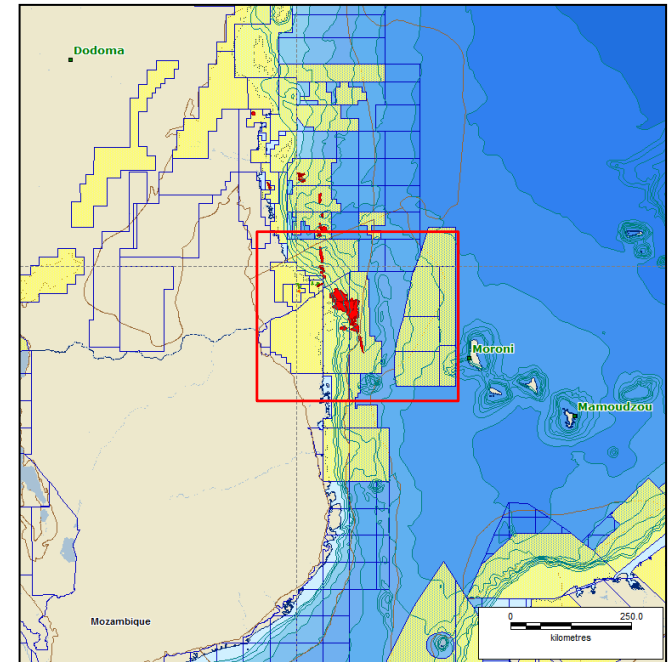
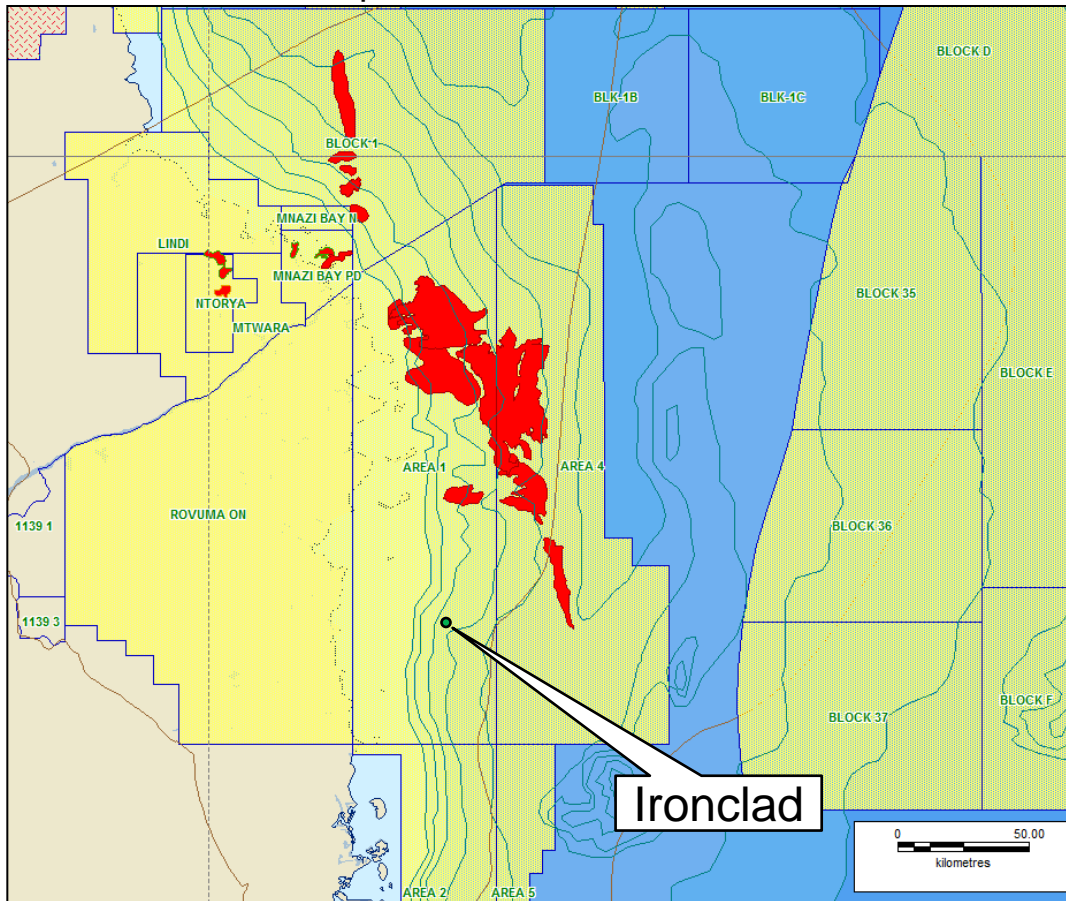
Further Lamu Basin oil leads



Offshore oil discoveries?

Mozambique - Ironclad

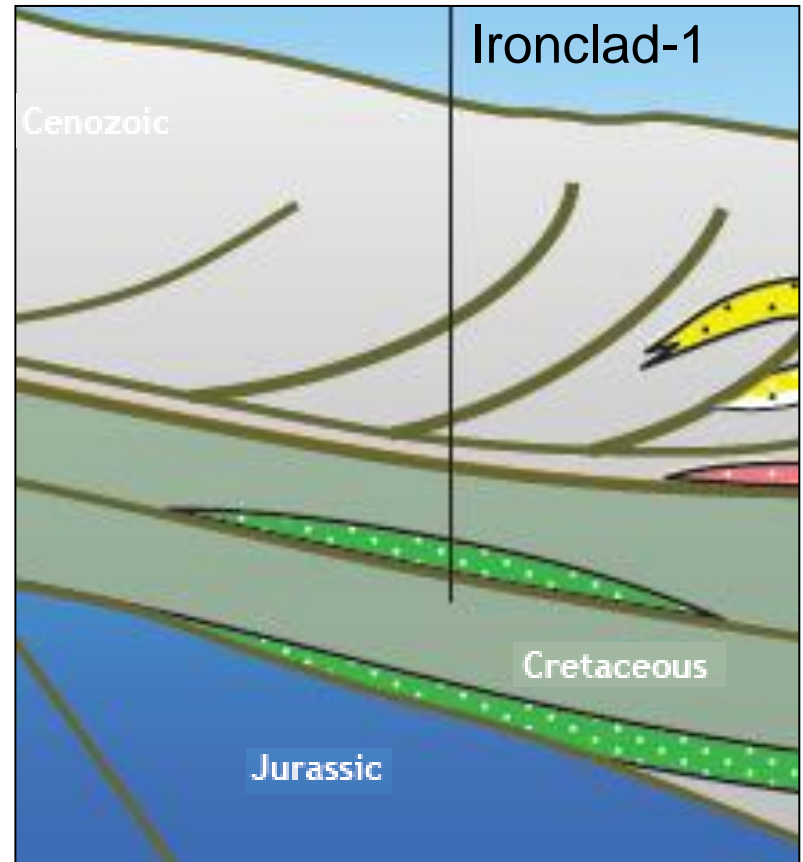
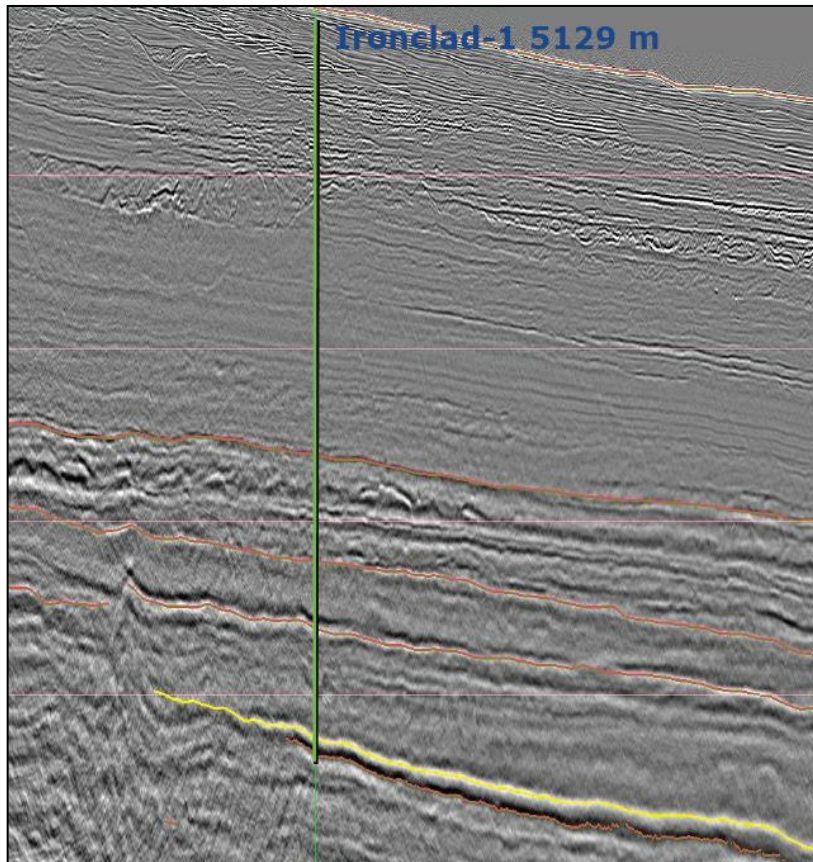
- Ironclad-1 drilled by Anadarko had oil (and gas) shows in tight Cretaceous deepwater fan sandstones in Area 1 offshore Mozambique. 2010.



Offshore oil discoveries?

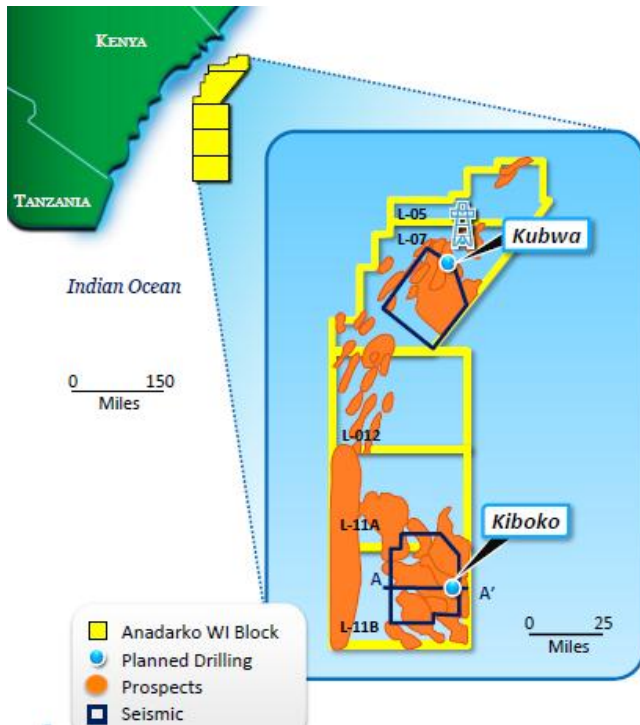
Mozambique - Ironclad

- Oil presumably sourced from less deeply buried Jurassic underlying the prospect.
- Cretaceous reservoir of poor quality, unlike the neighbouring Tertiary gas bearing sands

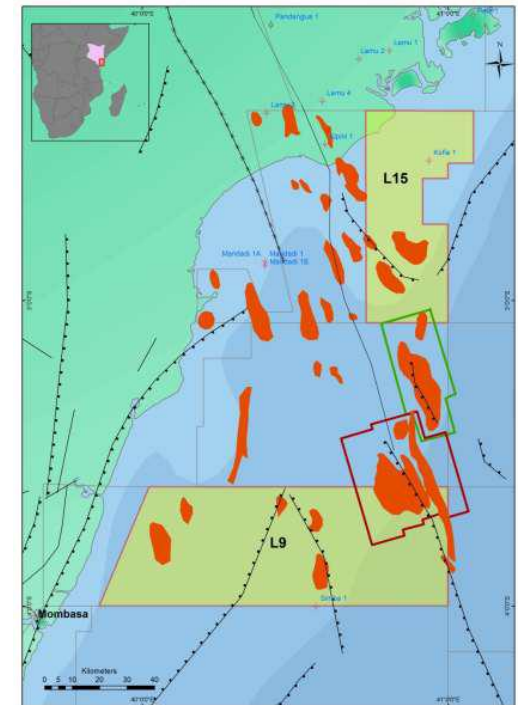


Offshore Kenya

Anadarko Kubwa well in the L-07 Block offshore Kenya, encountered non-commercial oil shows in reservoir-quality sands.



Ophir indicates that satellite slick studies suggest an oil-prone region offshore Kenya



Conclusions

- Oil in commercial quantities remains elusive offshore East Africa.
- The widespread Jurassic source rocks tend to be in the gas window.
- Less deeply buried Jurassic sources could perhaps exist:
 - Closer to shore,
 - In deeper water where there may be less overburden,
 - In sub-basins with different tectonic history
- Alternative (younger) oil mature source rocks may be developed in restricted sub-basins
- Any detailed source rock information from recent wells is proprietary.
- Recent Tanzania offshore license round had limited appeal (is more gas in deeper water further from the shore attractive?)
- But there were successful bidders. What do they think they know?
- GCA would be pleased to help you in this ongoing pursuit.

Thank you

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