



Ministry of Mines & Energy

"promoting Namibia's mineral, geological and energy resources"

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NAMIBIA EXPLORATION WELLS ANALYSIS: "Lessons learned"

Presented by:

Maggy Shino
Petroleum Commissioner

**AAPG 2019
Buenos Aires, Argentina**





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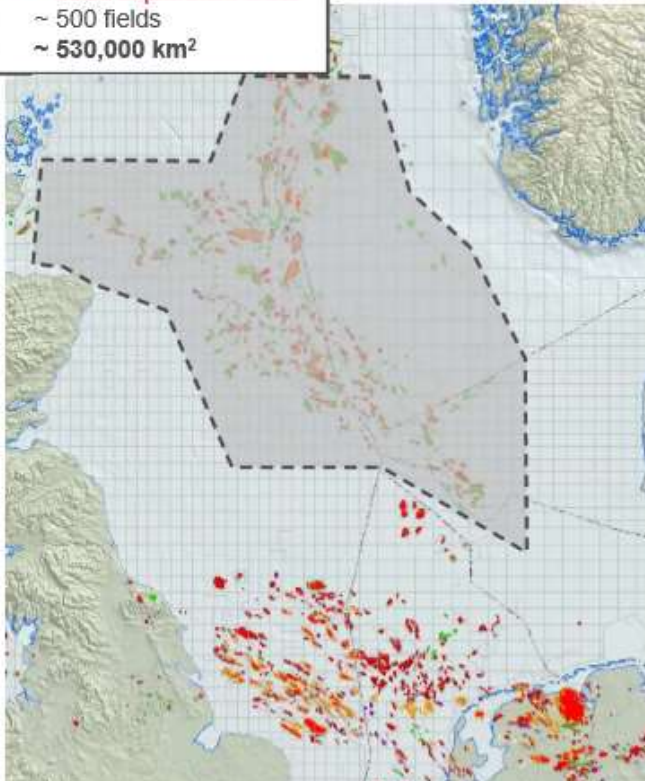


Size of area: Namibia vs the North Sea for scale

North Sea

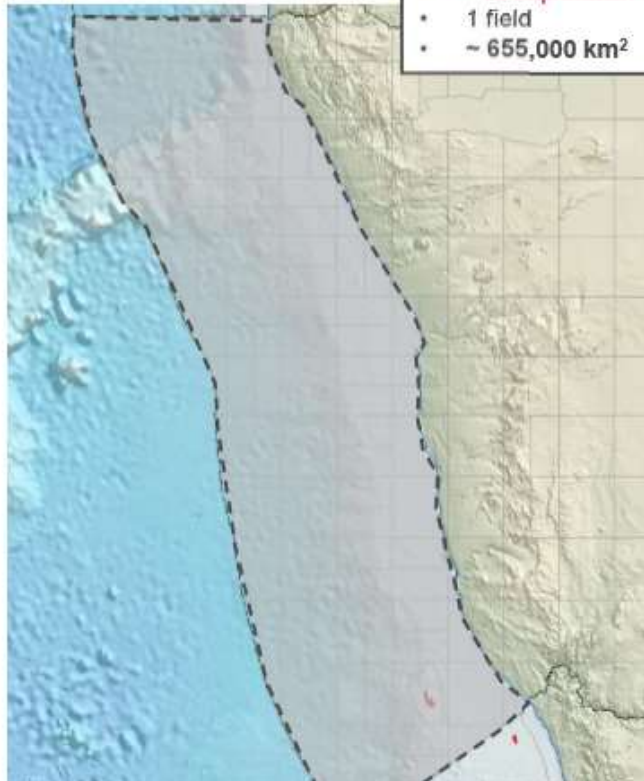
- Very mature basin
- ~ 3800 exploration wells
- ~ 500 fields
- ~ 530,000 km²

Maps to same scale



Namibia offshore

- Virtually unexplored
- ~18 exploration wells
- 1 field
- ~ 655,000 km²





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Two main basin systems developed in the south Atlantic margins:

- Central South Atlantic Aptian salt basin system, and;
- Southern South Atlantic Aptian anoxic basin system.

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Paleogeographic Reconstruction of the South Atlantic during the Late Aptian



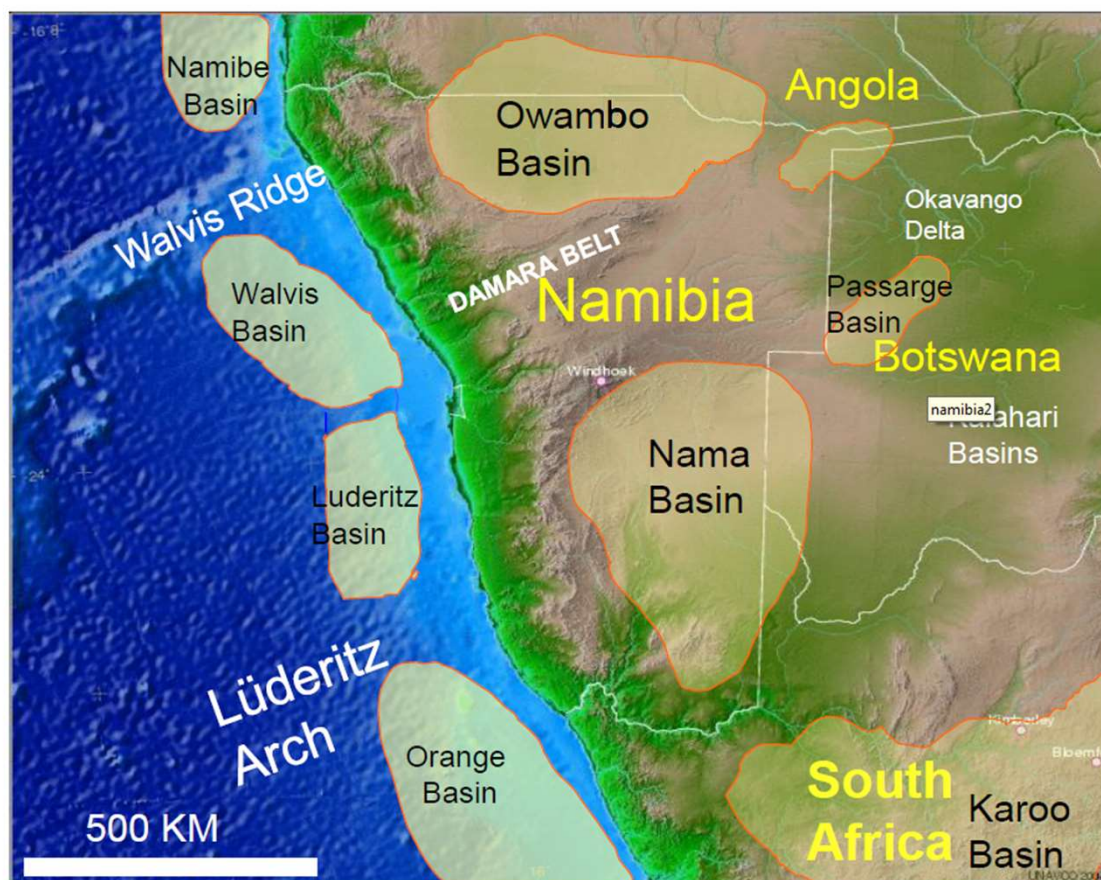
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Namibia Onshore & Offshore Petroleum Basins

- Offshore Basins – Passive continental Margin
- Onshore Basins – Proterozoic oldest sediments

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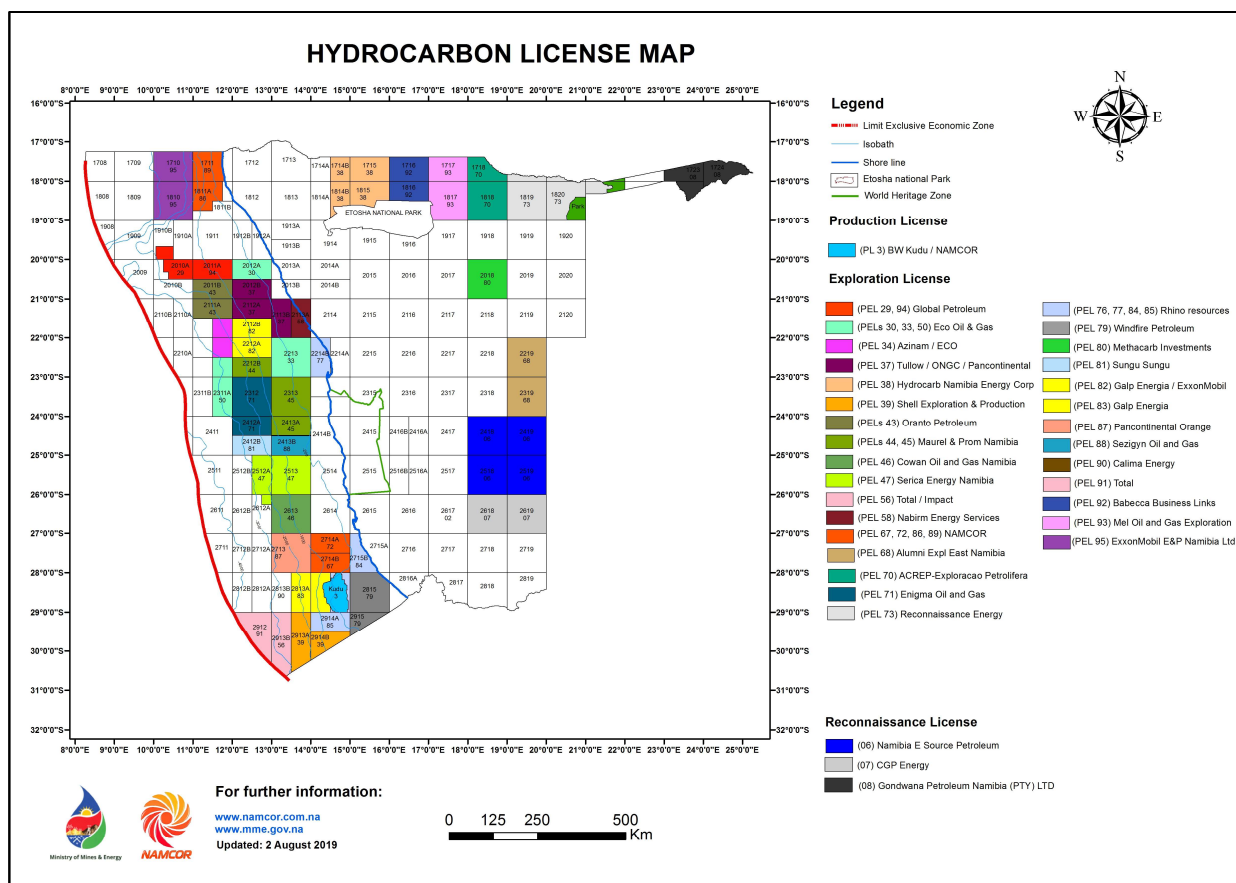
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Current Exploration Status

- Namibia currently has 43 active petroleum exploration Licenses
 - 33 offshore PELs
 - 7 onshore PELs
- 1 Production License
 - Kudu Gas Field
- 3 Reconnaissance Exploration License
 - All onshore

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Presence of major oil companies such as Total, ExxonMobil, Shell, Tullow, Galp Energia, etc.

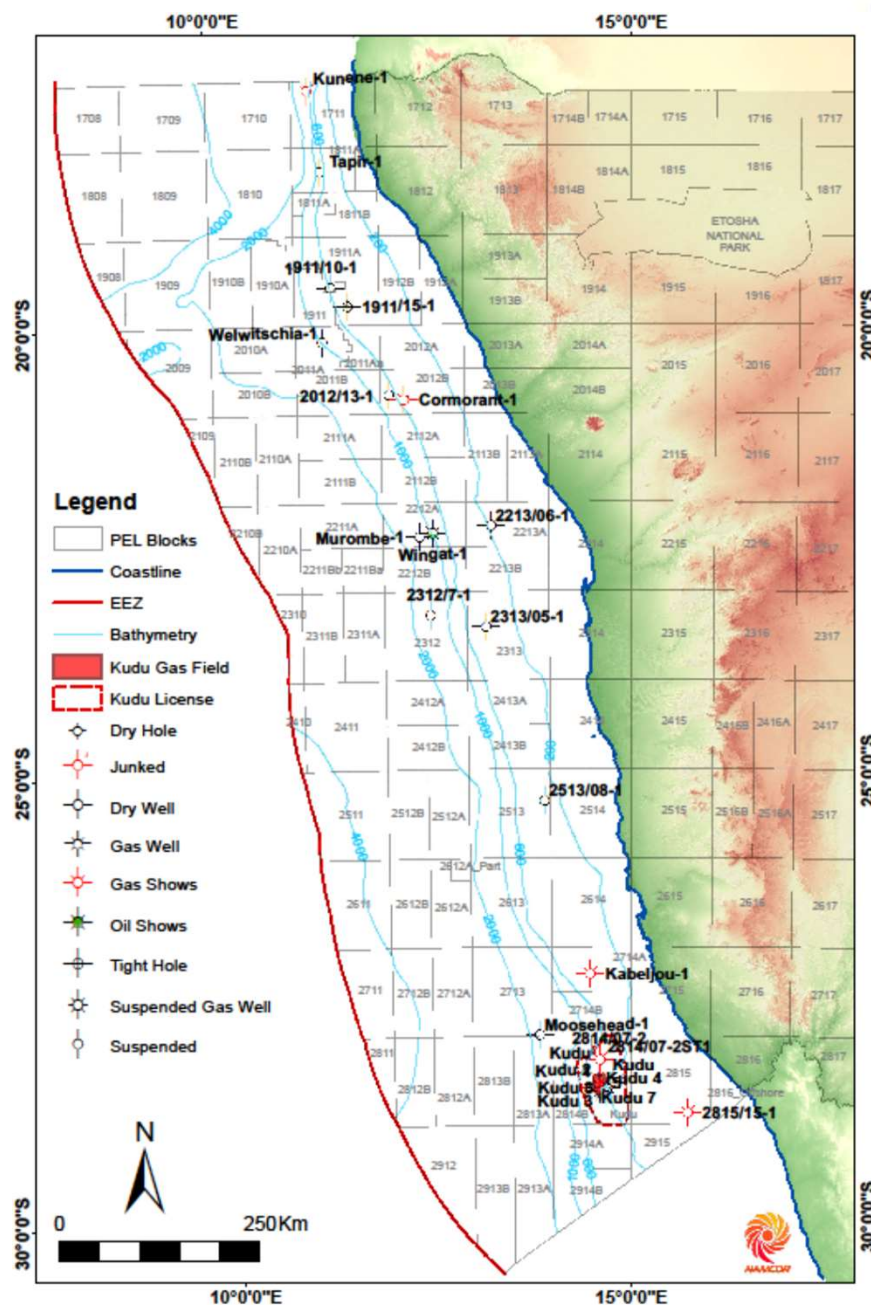


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Wells

- Total of 21 Wells drilled offshore
- 15 Exploration & 7 Appraisal wells (Kudu)
- Latest wells drilled by Tullow and Chariot in Walvis Basin



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NON COMMERCIAL OIL DISCOVERY

SUMMARY OF WINGAT WELL

SOURCE ROCK: QUARTET POTENTIAL SR (GOOD – EXCELLENT)

1. PROVEN EARLY APTIAN SR
2. LOWERMOST APTIAN SR
3. BARREMIAN SR
4. CAMPANIAN SR

MATURITY: EARLY MATURE – PEAK MATURE

1. TOP THERMAL MATURITY UP TO CAMPANIAN

MIGRATION: POSITIVE – VERTICAL - LATERAL

1. Shows within Aptian
2. C3-C5 Gas Background up to Campanian
3. TESTED RESULT → OIL

RESERVOIR: MODERATE TO GOOD

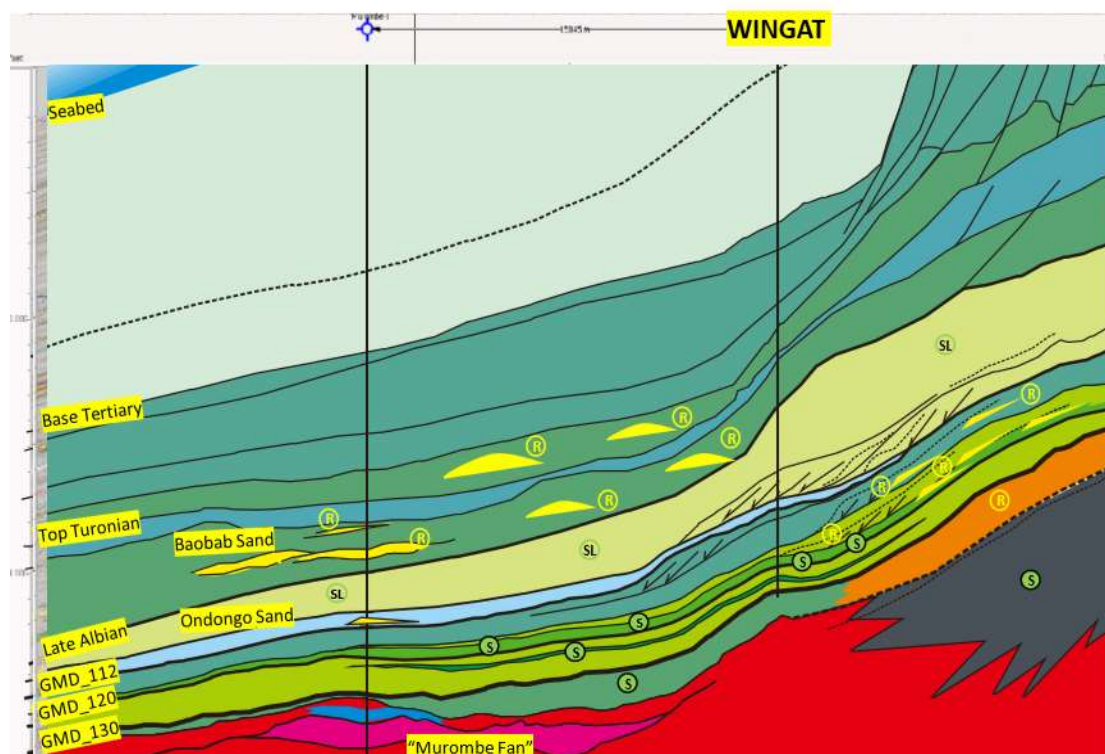
1. ALBIAN PROGRADING CARBONATE AS MAIN OBJECTIVE INDICATED TIGHT → SILTSTONE IN DEPTH TARGET
2. ALL LIMESTONE WITHIN LOWER CRETACEOUS INDICATED TIGHT → UNTESTED
3. GOOD – MODERATE RESERVOIR WHICH PENETRATED ARE:
 - EARLY APTIAN SHALLOW MARINE SAND → PROGRADING SHOREFACE BAR? → DISTAL LOBE? → TESTED → OIL → 41° API → GROSS THICKNESS 36 m → NETT 10.6 m → 10 % POROSITY
 - LATE ALBIAN SANDSTONE → THIN → UNTESTED → AVERAGE PHI 12%

SEALS: CONCLUSIVE GOOD

1. INTRAFORMATIONAL WITHIN APTIAN → DISCOVERY OIL

TRAP: CONCLUSIVE GOOD

1. STRATIGRAPHY TRAP WITHIN APTIAN → DISCOVERY OIL

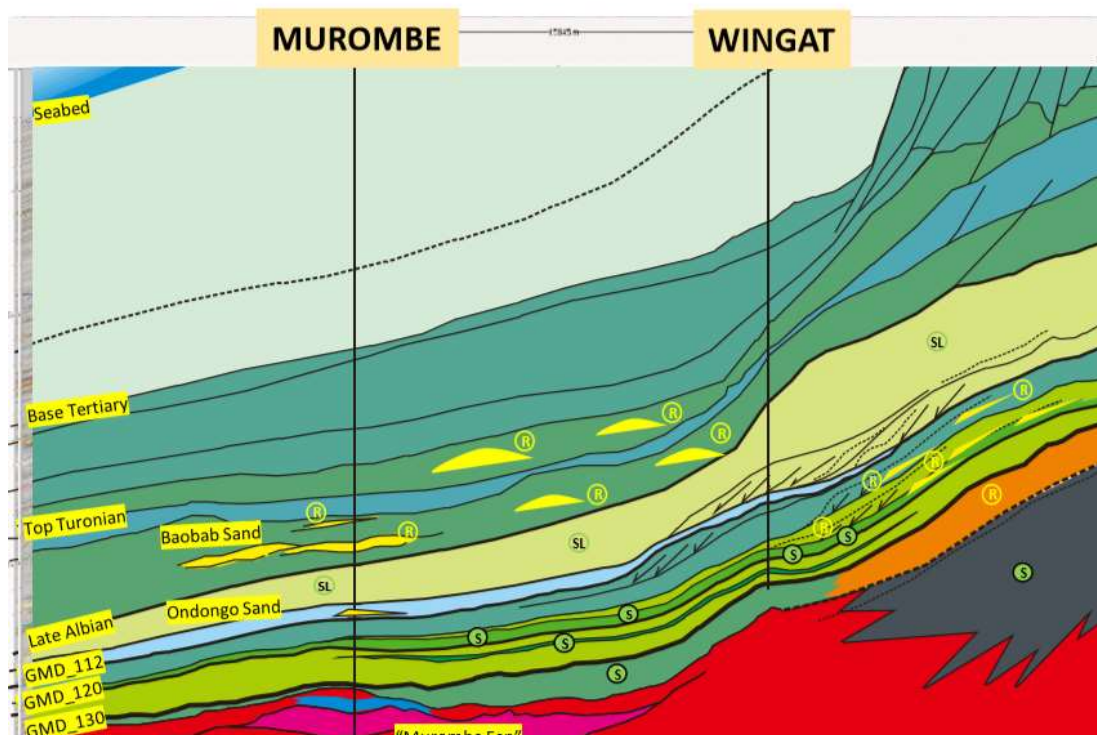




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SUMMARY OF MUROMBE WELL

TIGHT RESERVOIR WITHIN MATURE SR ZONE – WATER BEARING WITHIN CENOMANIAN RESERVOIR (CONCLUSIVE DRY)



SOURCE ROCK: TRIPLE POTENTIAL SR (GOOD – EXCELLENT)

1. PROVEN EARLY APTIAN SR
2. LOWERMOST APTIAN SR
3. BARREMIAN SR

MATURITY: EARLY MATURE – PEAK MATURE

1. TOP THERMAL MATURITY UP TO LATE APTIAN
2. POSSIBLY PEAK MATURE FOR LOWER MOST APTIAN - BARREMIAN

MIGRATION: POSITIVE – VERTICAL - LATERAL

1. NO Indication of HC show
2. First C3 → ALBIAN
3. First NC4 → LATE APTIAN

RESERVOIR: - GOOD - EXCELLENT

1. MUROMBE MAIN OBJECTIVE IS FAILED TO PROVED → MUROMBE FAN → BARREMIAN VOLCANIC
 2. BARREMIAN – APTIAN CARBONATE INDICATED TIGHT
 3. MODERATE – EXCELLENT SR ARE:
 - ALBIAN SST (ONDONGO SST) → 12% AVERAGE PHI
 - CENOMANIAN BFF (BAOBAB SST) → UP TO 24 % PHI
1. NO TEST WERE RUN, PETROPHYSIC REPORT SUGGESTED WATER WET WITHIN BAOBAB SAND

SEALS: INCONCLUSIVE / POSSIBLY GOOD

1. INTRAFORMATIONAL LATE ALBIAN → ONDONGO PLAY
2. TURONIAN – SANTONIAN → CENOMANIAN PLAY

TRAP: INCONCLUSIVE/ POSSIBLY GOOD

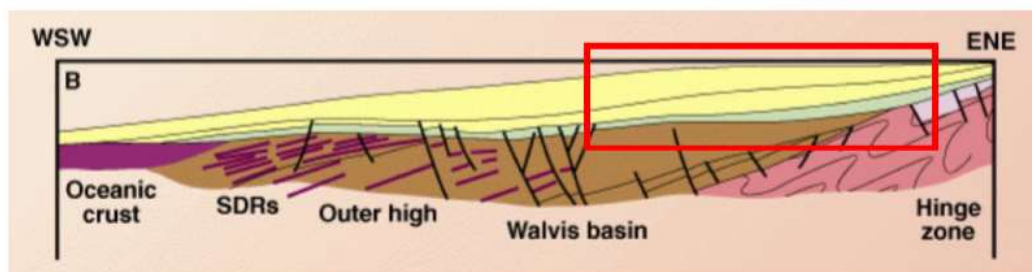
1. STRATIGRAPHY
2. NO TEST



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SUMMARY OF 2012/13-1 AND CORMORRANT WELLS

MIGRATION HC / ACCESS TO MATURE SOURCE ROCK (CONCLUSIVE DRY)



SOURCE ROCK: TWIN EXCELLENT SOURCE ROCK

1. CENOMANIAN – TURONIAN
2. POSSIBLY CONTINUATION OF APTIAN SR ??? → REGIONAL PALEOGEOGRAPHY TREND DURING APTIAN WITHIN WALVIS BASIN INDICATING SHALLOWING TOWRD TO THE NORTH → CARBONATE DEVELOPMENT

MATURITY: - EARLY MATURE

1. TOP THERMAL MATURITY UP TO CENOMANIAN

MIGRATION: - POSITIVE (VERTICAL)

1. C3-C4 Gas background up to Coniacian → bellow reservoir target → MAASTRICHTIAN – BASE TERTIARY → **INDICATED NO ACCESS TO MATURE SOURCE ROCK → FOR 2213/13-1**
CORMORANT WELL HAS BEEN DESIGNED TO PENETRATED BASIN FLOOR FAN IN SOURCE ROCK ZONE (EARLY MATURE, WITH MIGRATION INDICATION) → CENOMANIAN/ALBIAN

RESERVOIR: - GOOD - EXCELLENT

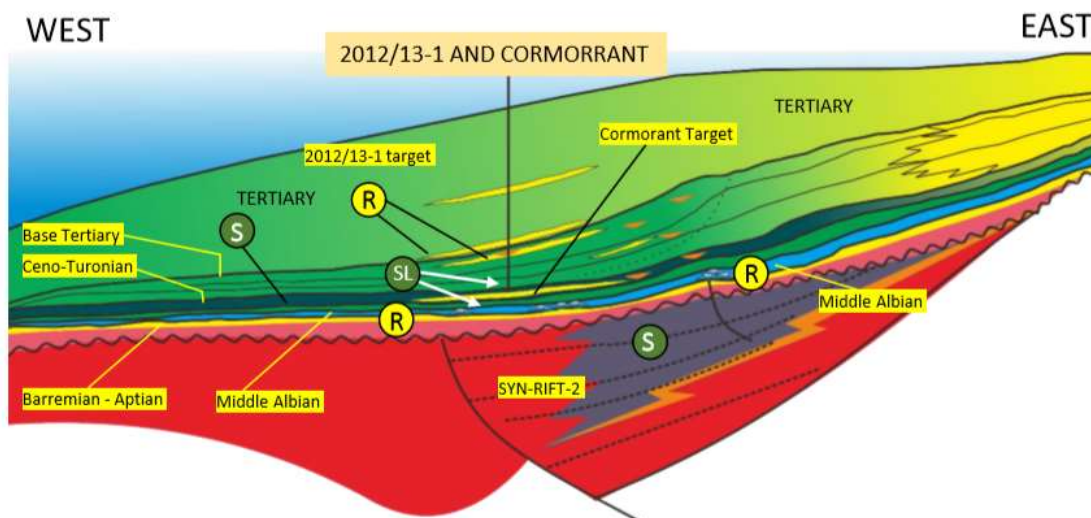
1. MAASTRICHTIAN – BASE TERTIARY BASIN FLOOR FAN → 20% AVERAGE POROSITY → TESTED → WATER → MAIN TARGET OF 2012/13-1 WELL
2. CENOMANIAN BASIN FLOOR FAN → TARGET FOR CORMORANT → UP TO 25% POROSITY → WELL HAS BEEN REPORTED AS DRY

SEALS: FAIR TO GOOD

1. PALEOGENE – PALEOCENE SEAL : → MODERATE (DUE TO SANDY FORMATION)
2. CONIACIAN – SANTONIAN SEALS FOR CENO-TURONIAN PLAY → GOOD → BOUNDED MIGRATION (C3-C4 IS STOP IN CONIACIAN) → 500 M shale section between Maastrichtian/Tertiary reservoir to Mature SR
3. LATE ALBIAN FOR MIDDLE ALBIAN → INCONCLUSIVE → UNPENETRATED

TRAP: STRATIGRAPHY, HIGH RISK

1. LEAKING POSSIBILITY WAS NOTED IN POST DRILL REPORT EVALUATION OF 2012/13-1 FOR MAASTRICHTIAN – BASE TERTIARY BASIN FLOOR FAN PLAY → GENTLE STRATIGRAPHY CLOSURE
2. THIS NOTED COULD BE POSSIBLE HAPPEN IN CORMORANT





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SUMMARY OF TAPIR SOUTH WELL

**SEAL CAPACITY PROBLEM FOR LOWER CRETACEOUS PLAY,
POSSIBILITY OF BYPASS ZONE FOR UPPER CRETACEOUS PLAY
(INCONCLUSIVE DRY WELL)**

**SOURCE ROCK: - NO POTENTIAL SOURCE ROCK PENETRATED BY
WELL (POOR TOC) → SITUATED AT "HIGH"**

1. APTIAN – PROXIMAL FACIES OF CARBONATE / LAGOON
2. CENOMANIAN - TURONIAN

MATURITY: - MATURE – EARLY MATURE @WELL

1. TOP THERMAL MATURITY UP TO CAMPANIAN @WELL → SHOULD BE SIMILAR TO THE KITCHEN

MIGRATION: - POSITIVE (VERTICAL – LATERAL)

1. C3-C4 Gas background up to CAMPANIAN

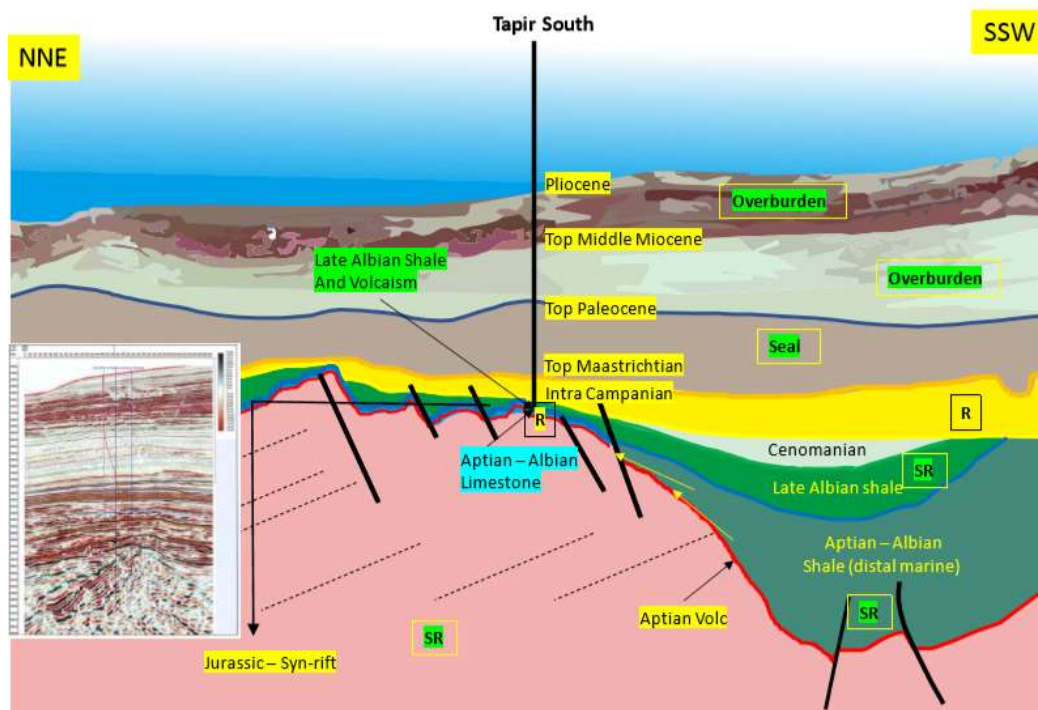
RESERVOIR: - GOOD - EXCELLENT

1. UPPER CRETACEOUS – BASE TERTIARY MTC AND SUBMARINE FAN → 20% AVERAGE POROSITY → TESTED (WATER) → POSSIBLY BYPASS ZONE
2. ALBIAN LIMESTONE → NOTE OF DOLOMITE PRESENCE → 14.7 POROSITY → UNTESTED

SEALS: HIGH RISK → POSSIBLY LEAKING

TRAP: STRUCTURAL – HIGH RISK

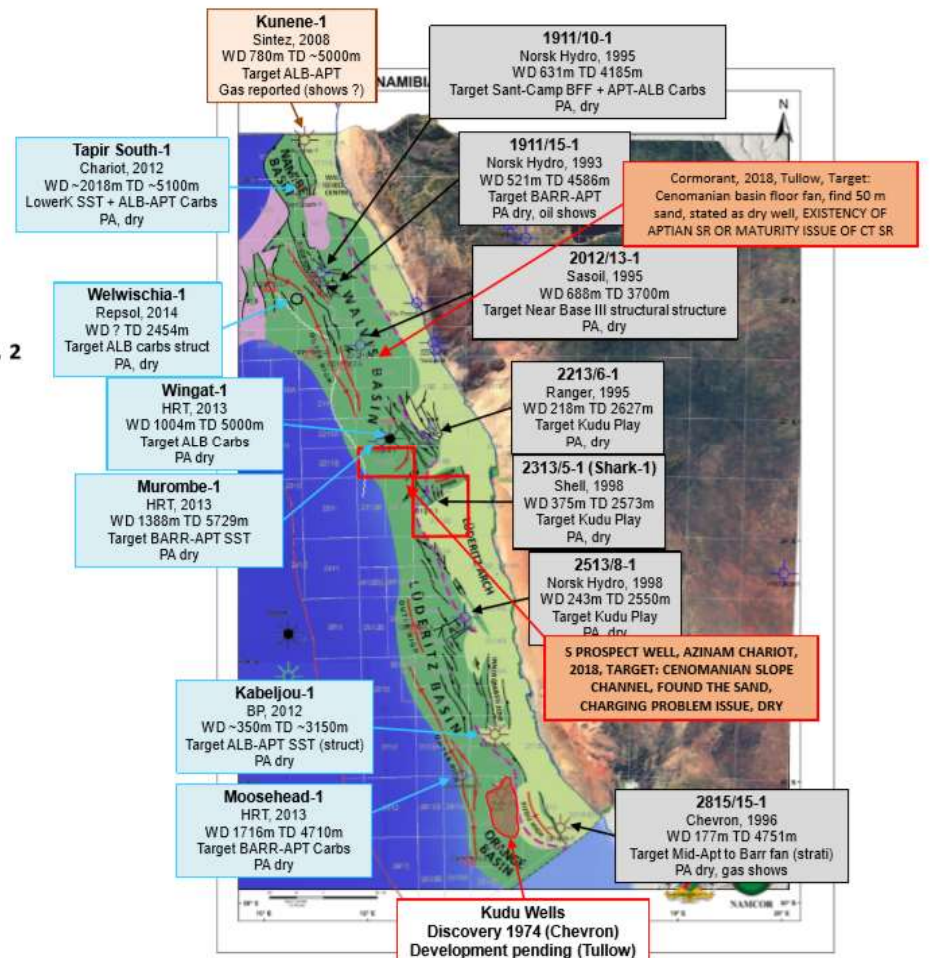
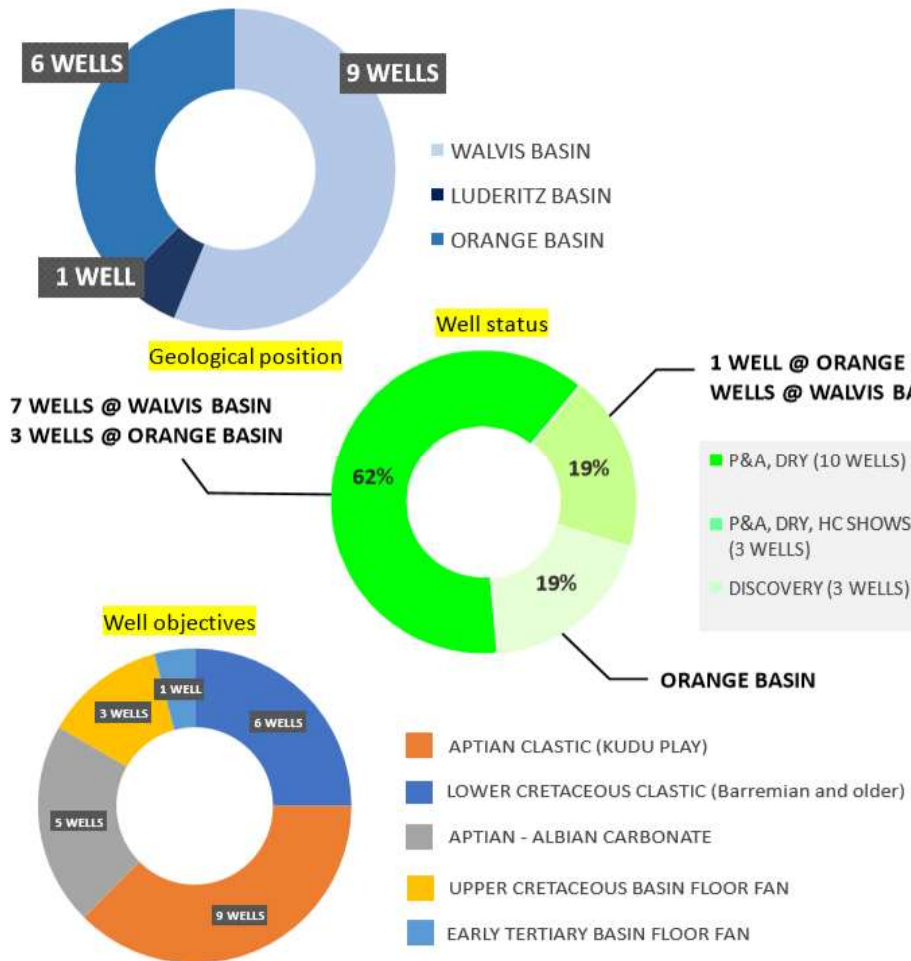
- ALBIAN PLAY → HIGH RISK DUE TO YOUNGER STRUCTURIZATION → REACTIVATED
- PALEOCENE → SEAL RISK → SAND RICH





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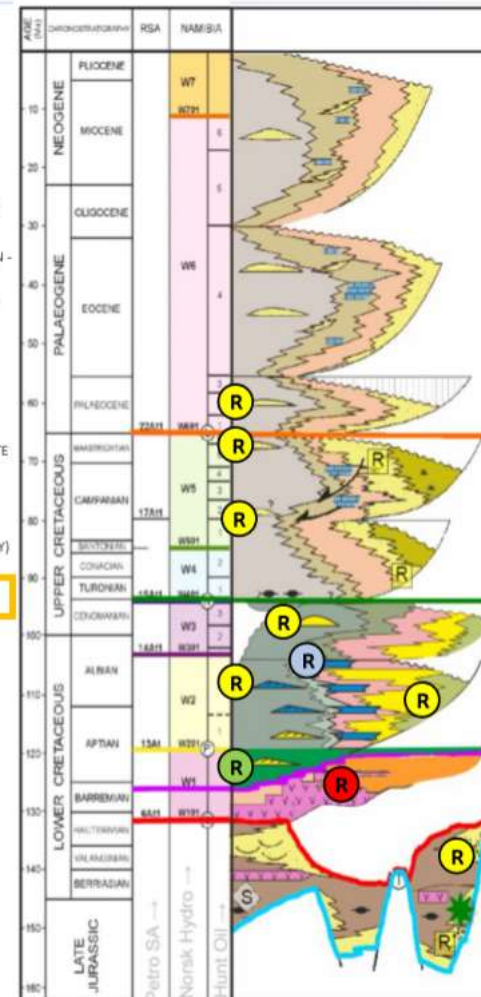
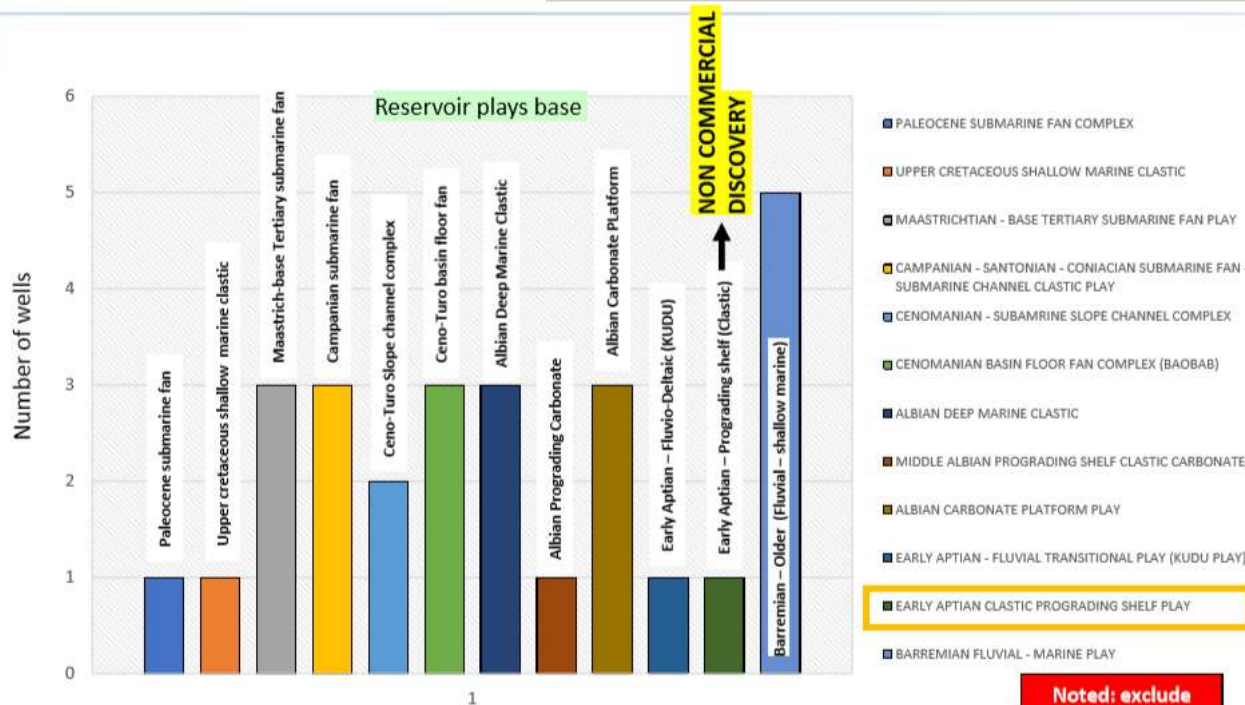
WELL STATUS (LOCATION, WELL STATUS, OBJECTIVES)



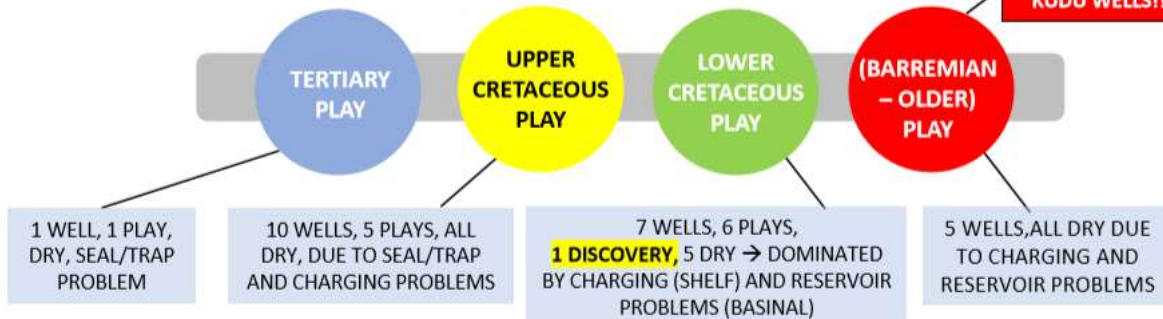


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WALVIS BASIN SUMMARY OF WELL POST MORTEM – 2018 – PLAY SUMMARY



Noted: exclude KUDU WELLS!!!



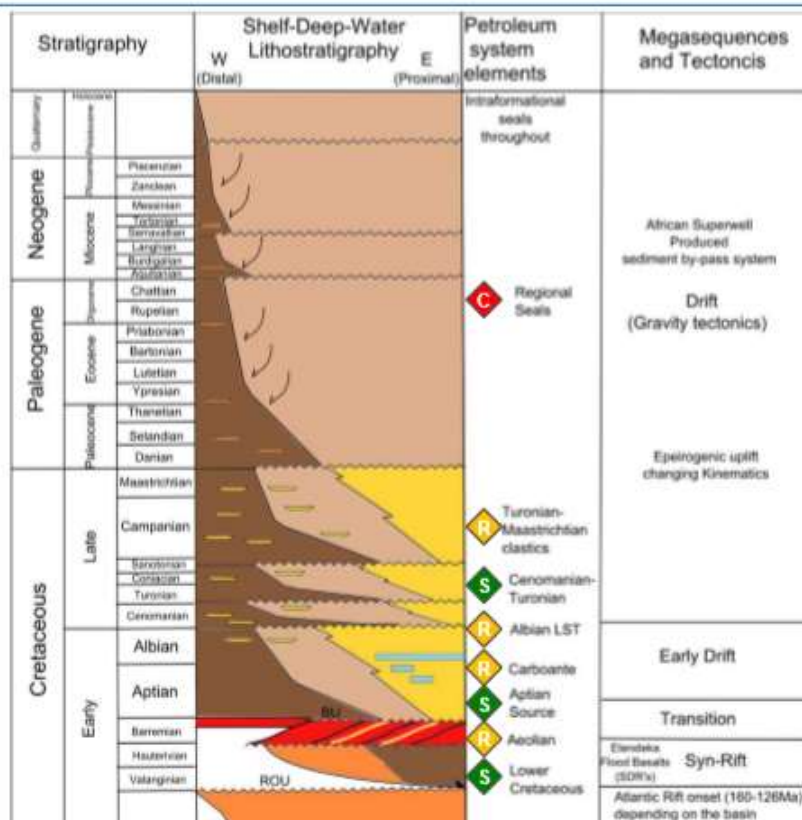


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Petroleum systems Summary



Key seal intervals

C

- Intraformational Shales
- Palaeocene Shale

Key reservoir intervals

R

- Palaeocene - Miocene sands } Post-rift
- Albian – Maastrichtian sands }
- Aptian – Albian Carbonates }
- Barremian aeolian sands } Pre/Syn-rift
- L.Cretaceous – fluvial sands }

Key source rocks

S

- Cenomanian-Turonian marine } Post-rift
- Base Aptian marine }
- Neocomian lacustrine? } Pre/Syn-rift



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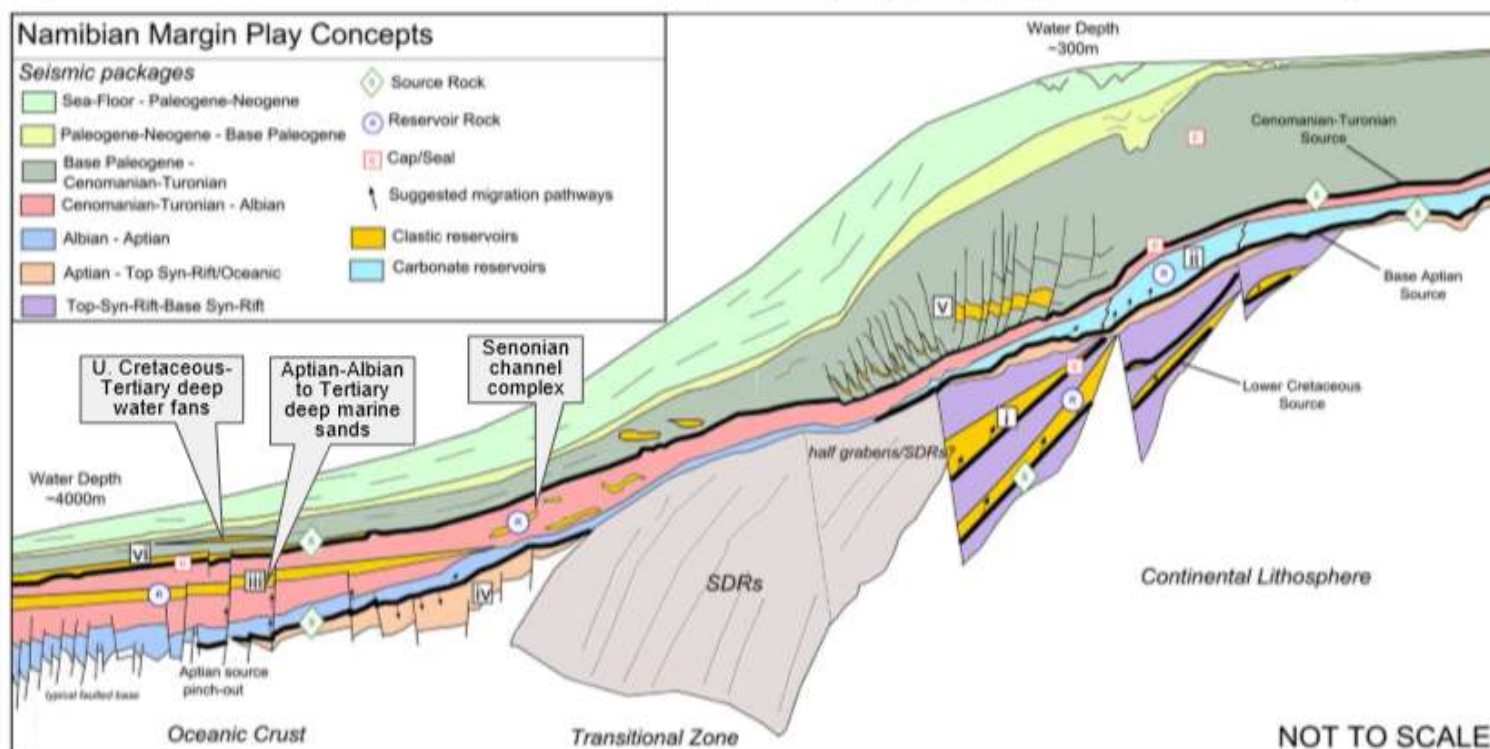
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Petroleum systems – Namibia Deep Water Play Concepts



Main area of deep water survey



M. Steventon MSc thesis (2014), work undertaken at PGS, unpublished.



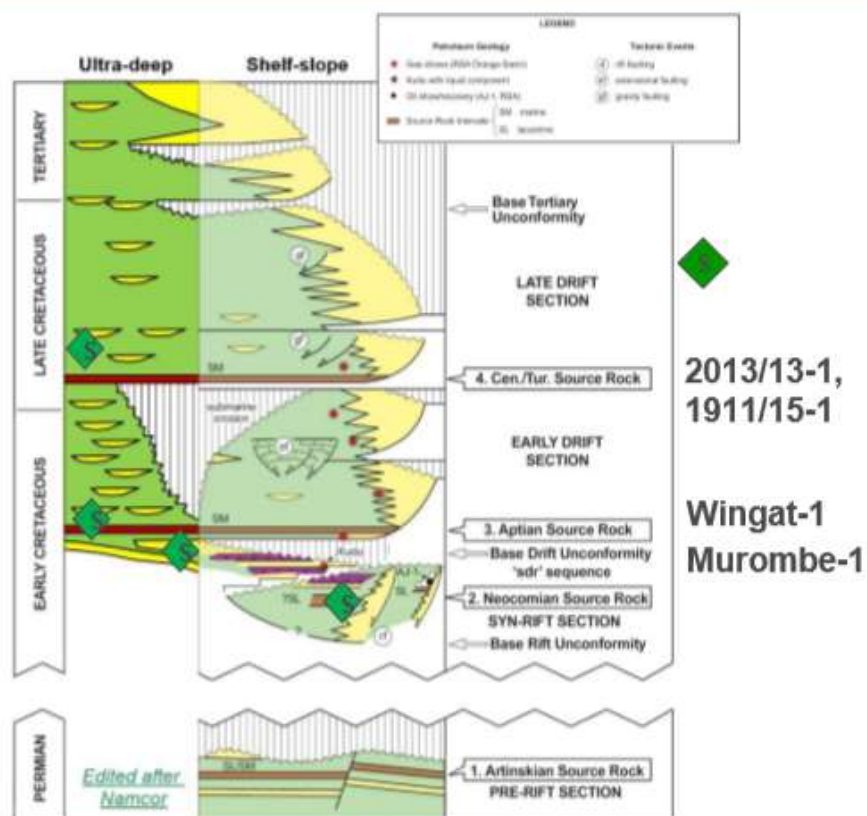
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Namibia Deep Water Area Potential Source Rocks



Barremian Source Rock

- Barremian Source Rock proposed but not proven
- Falklands Analogue ~7.5 wt % TOC

Aptian – Albian Source Rock

- Wingat-1, Murombe-1, Moosehead-1
- ~3.4 wt % TOC, 200 HI

Cenomanian – Turonian Source Rock

- 2013/13-1, 1911/15-1, Moosehat-1
- 2 – 6 wt % TOC, 150 – 500 HI
- Likely immature in deep water areas



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Conclusions

- Namibia remains one of the underexplored regions with considerable potential of hydrocarbon accumulations.
- Have seen entrance of oil majors such as Total and ExxonMobil acquiring acreages offshore Namibia.
- Multiple plays form existing exploration targets including clastic and carbonate plays.
- All the elements of the petroleum system have been tested, Wingat-1 well proved the presence of at least one active petroleum system capable of generating oil and not only gas.
- Upcoming drilling campaign aimed towards a commercial discovery





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