REVIEW OF WALVIS BASIN PROSPECTIVITY: SIMILARITIES AND DIFFERENCES TO THE ORANGE BASIN

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Stamper Oil & Gas

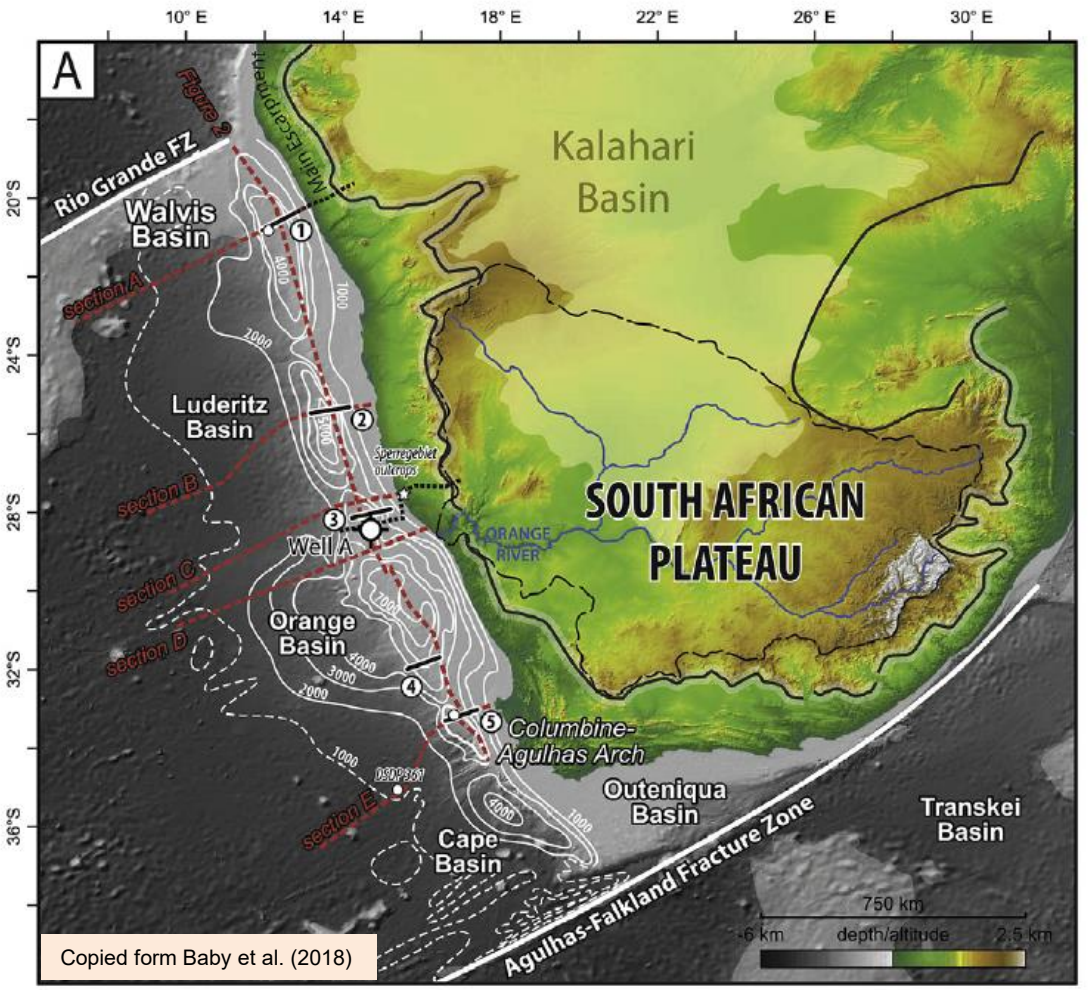
Introduction

Guiding Questions

- Which plays work in the Orange Basin and why?
- Which conditions are similar between the Walvis and Orange Basin?
- Which conditions are markedly different between both basins?
- What are the critical unknowns?

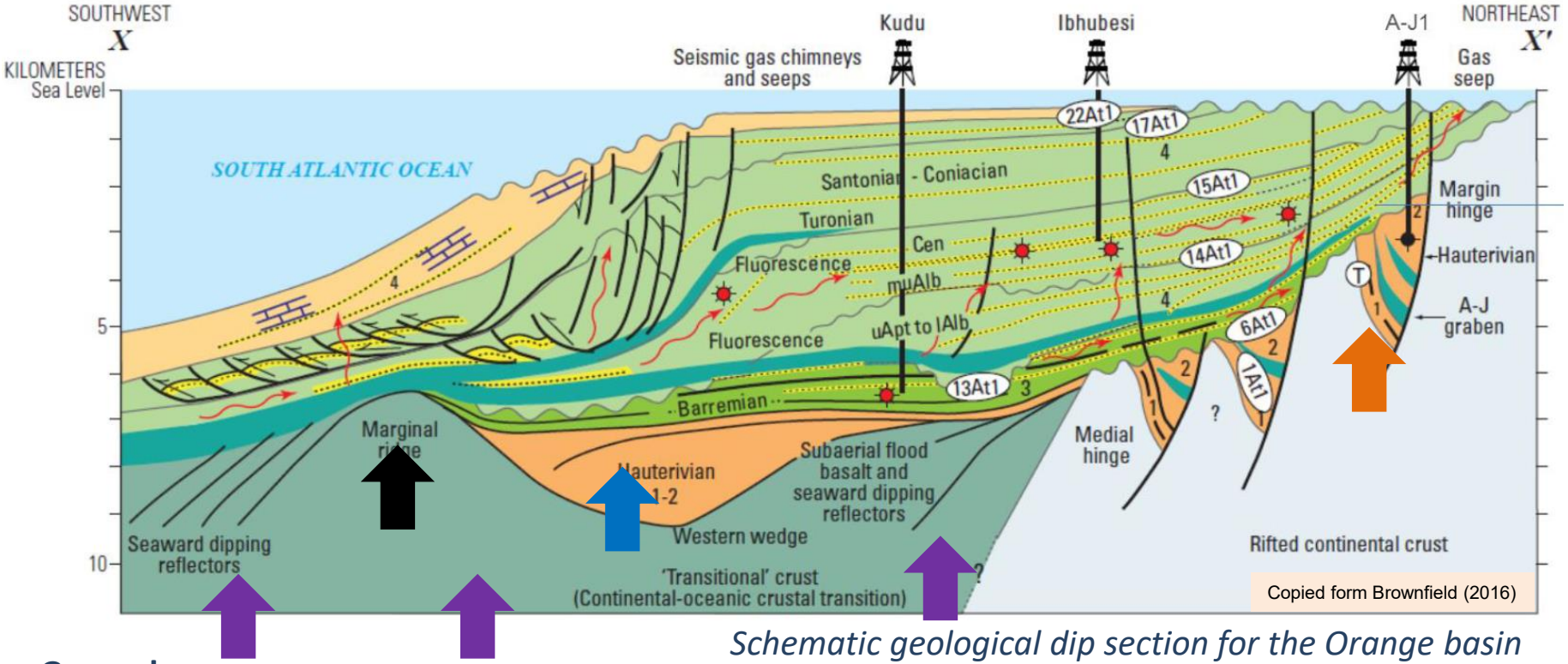
Key Elements

- Structural Framework and Sediment Distribution
- Sediment Provenance and Reservoir Quality
- Source Rock presence, quality and maturity
- Charge access and trapping

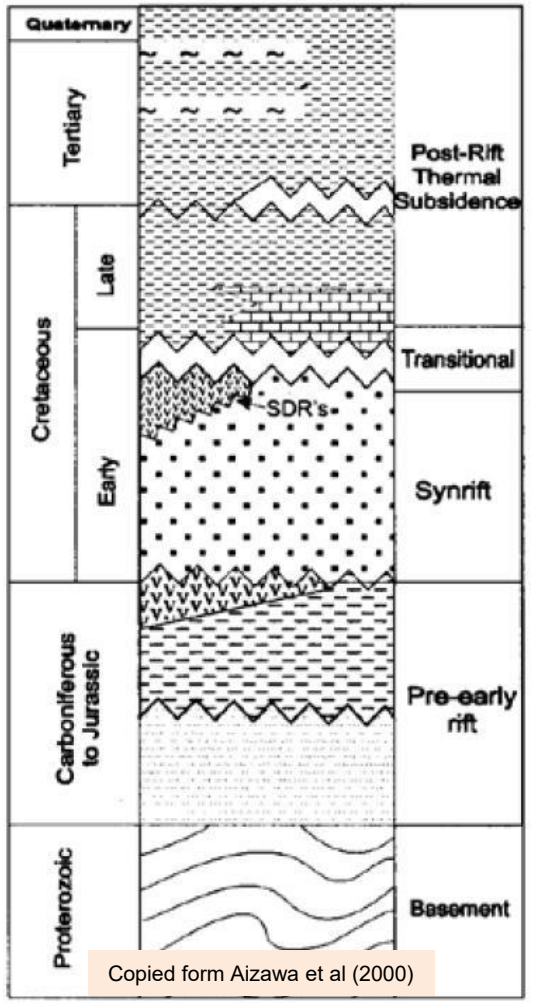


Copied form Baby et al. (2018)

General Structural Framework



Schematic geological dip section for the Orange basin

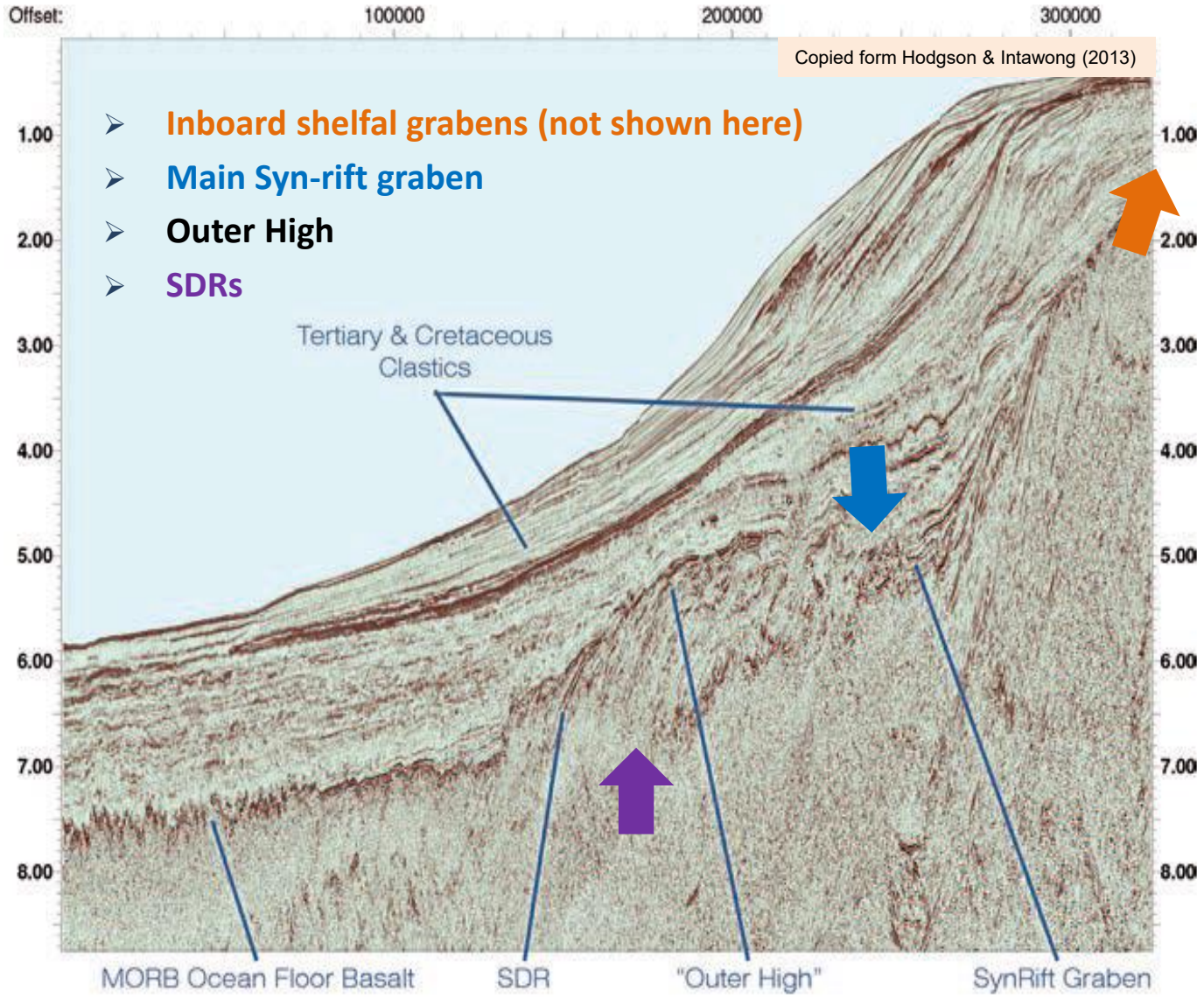


General Namibian margin Tectonostratigraphy

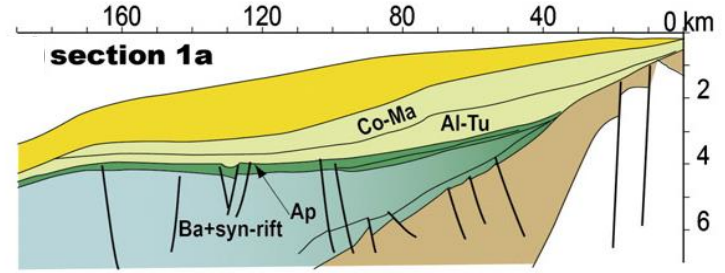
General commons

- **Passive volcanic margin hosting classical rift-drift sequence**
  - Hauterivian - Barremin Syn-rift: volcanic, mixed volcanic and lacustrine clastic
  - Early Cret. (Late Barremian - Aptian) transitional sequence: argillaceous and arenaceous clastics, ? platform carbonates)
  - Late Early Cretaceous - Cainozoic Post-rift / drift sequence: shales, turbidites, contourites
- **Inboard shelfal grabens** (local, e.g., A-J1 in Orange Basin)
- **Main Syn-rift graben(s)** flanked by Outer High and "Medial Hinge line" (Hauterivian-Barremian fill)
- **Outer High** / Marginal Ridge (established since the Aptian)
- **SDRs** (Mostly Barremian; distinction between Inner and Outer SDRs)

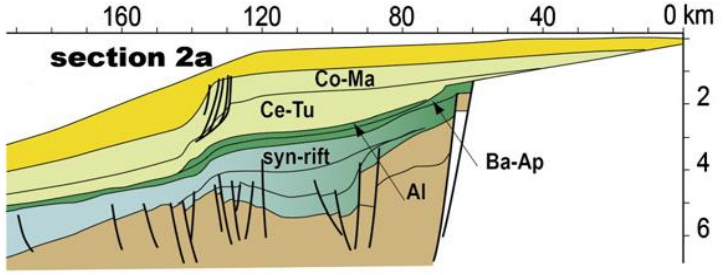
General Structural Framework



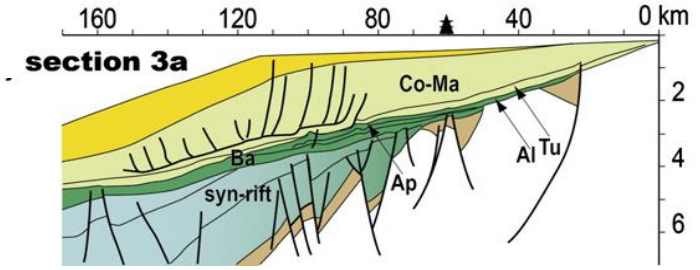
A typical WSE-ENE dip line showing the consistent structures on the Namibian margin. This line is 320 km long.



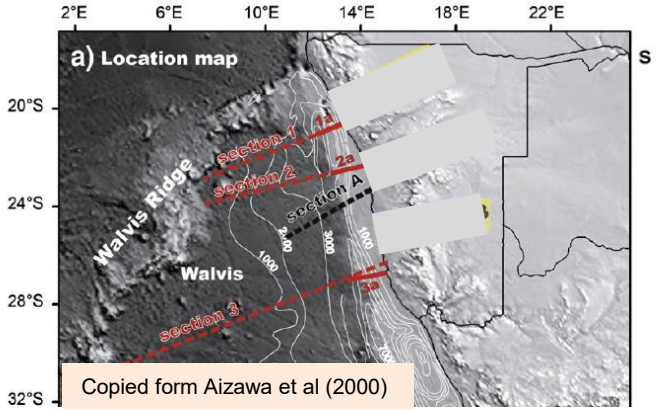
Northern Walvis Basin

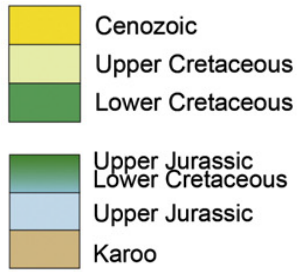


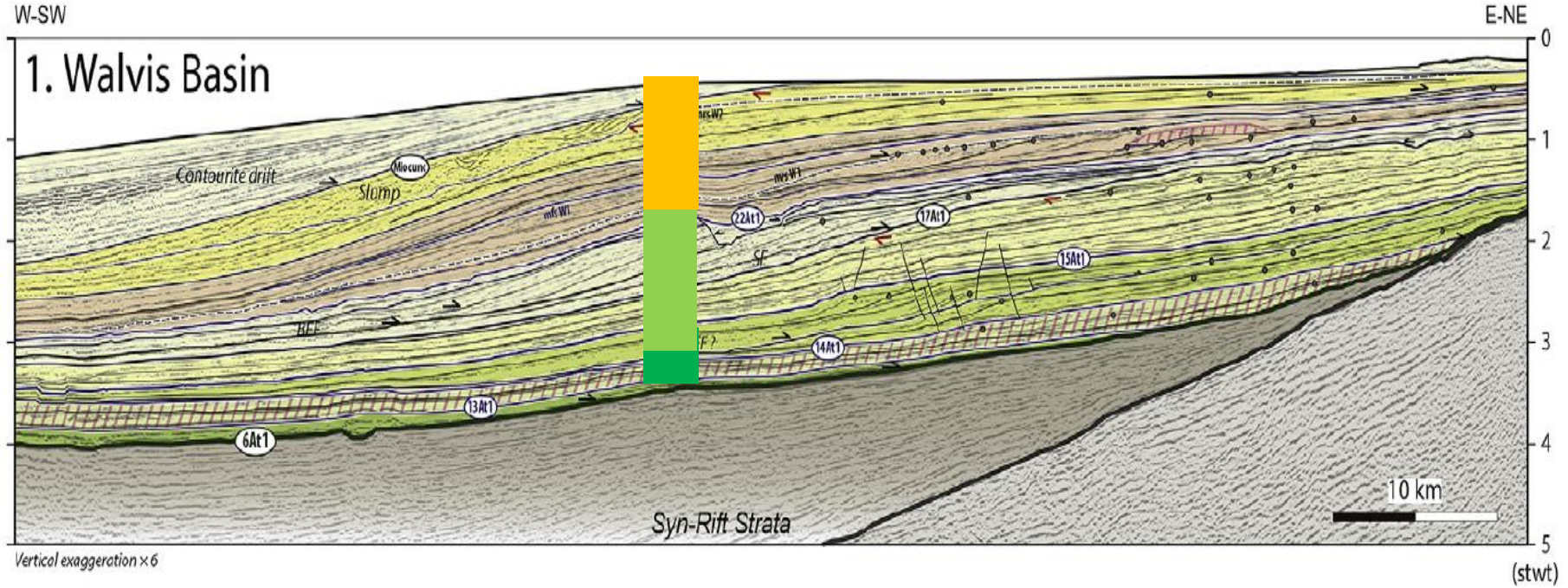
Southern Walvis Basin

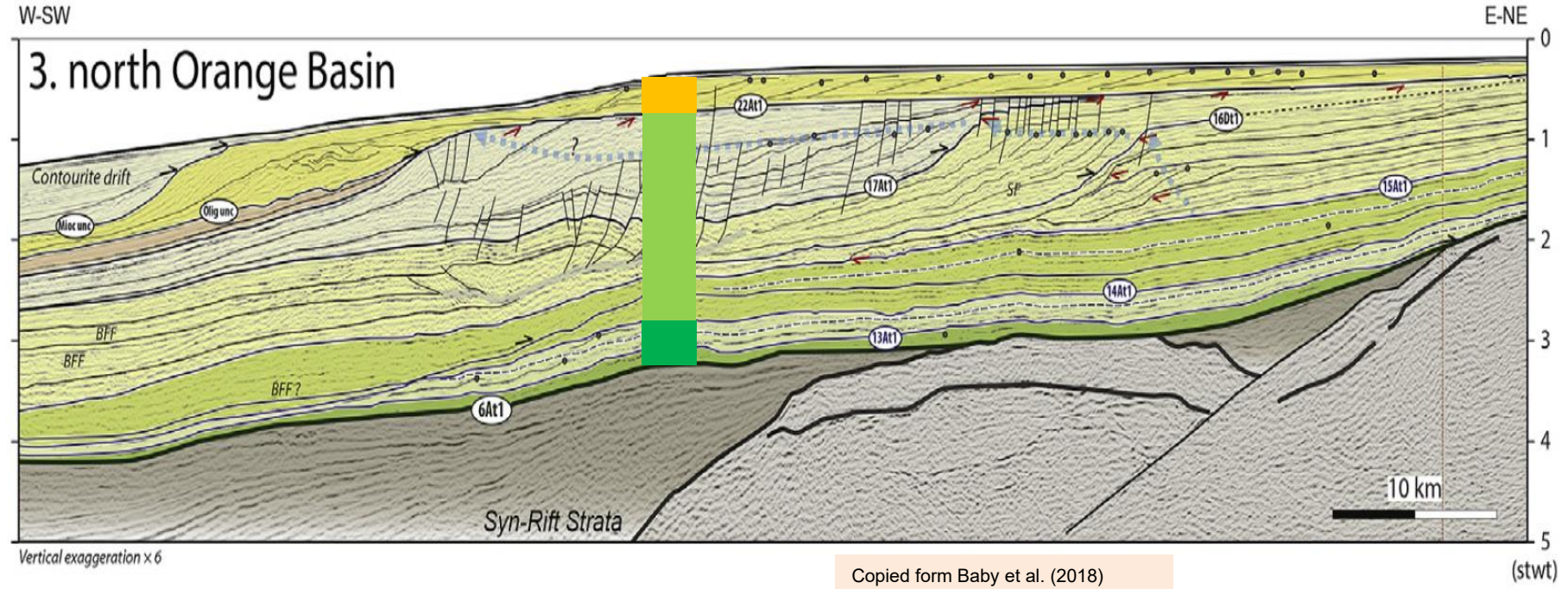


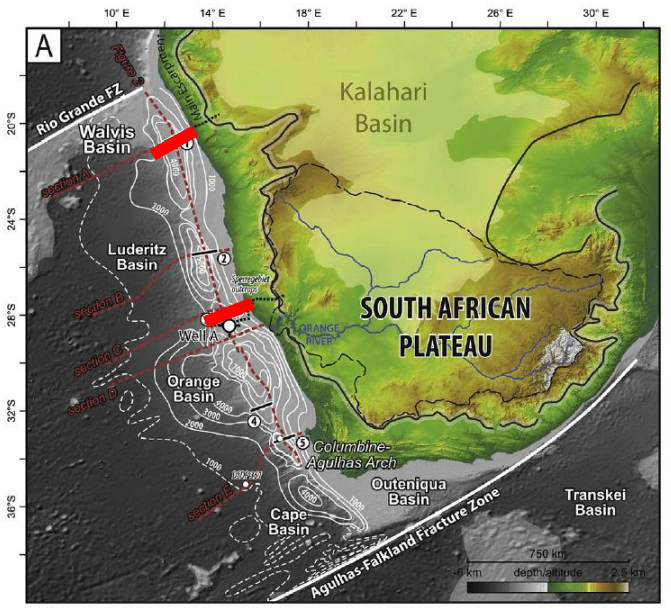
Northern Orange Basin











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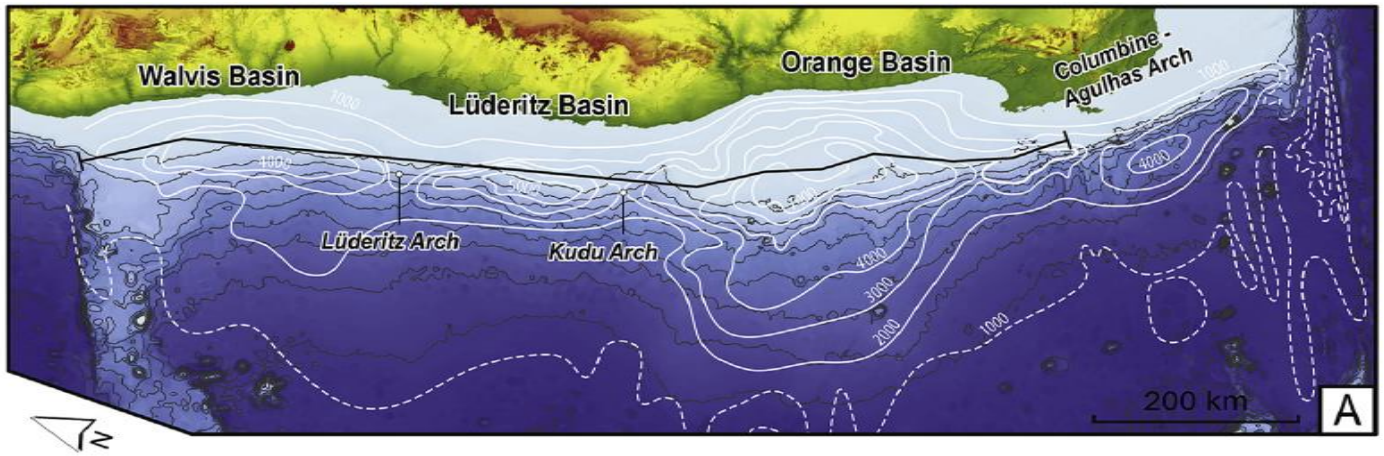
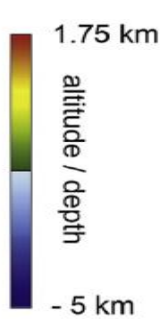
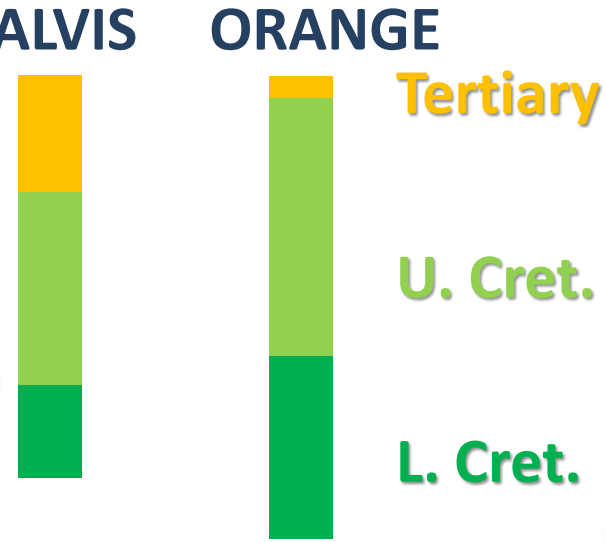
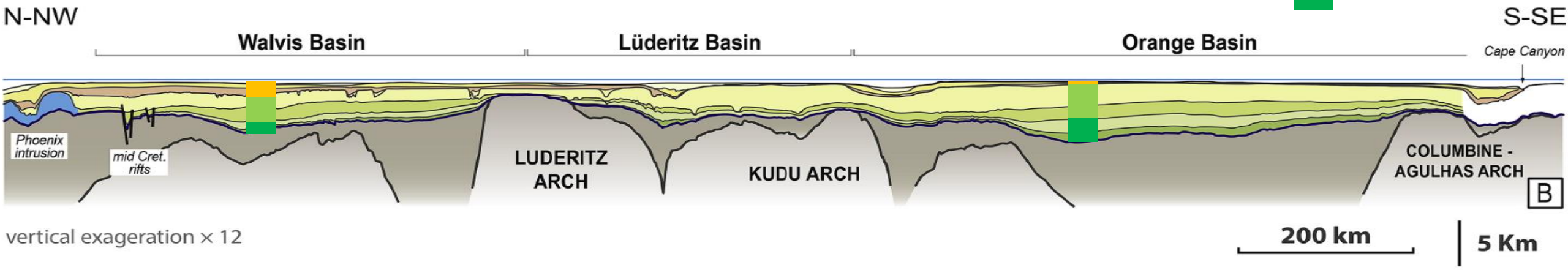
Sediment Distribution









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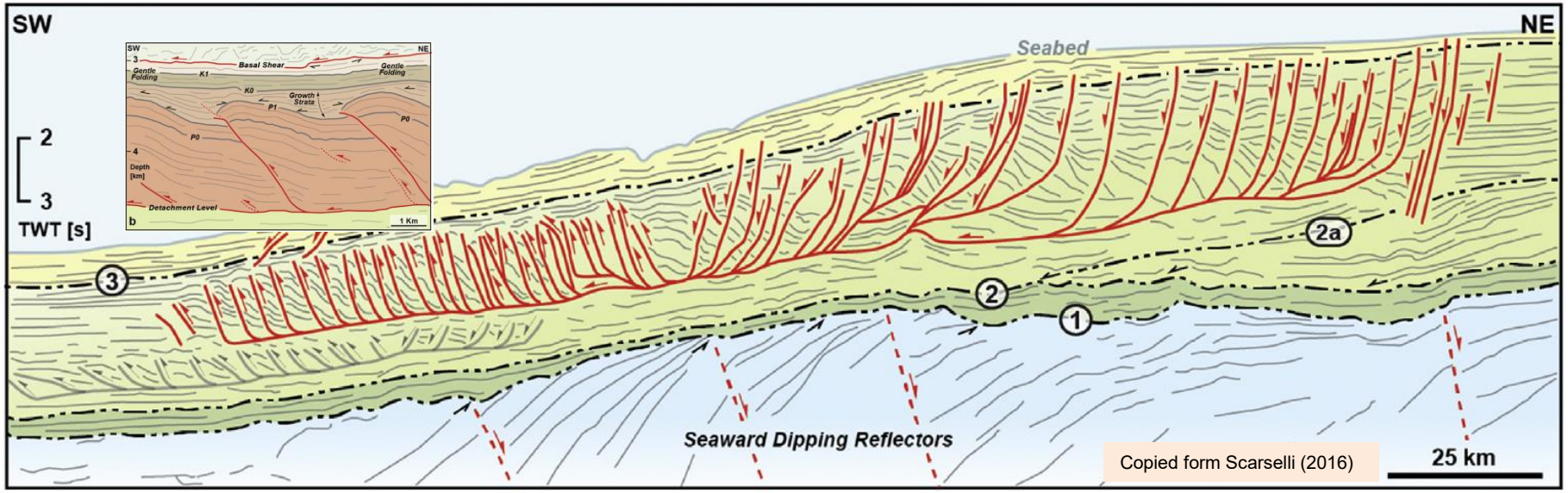
Orange Basin

Distinct Orange Basin Feature: Upper Cretaceous Gravity Systems



Sequence II
Barremian to Aptian

Sequence IV
Cenozoic

Sequence I
Upper Jurassic to Lower Cretaceous

Sequence III
Aptian to Maastrichtian

③ Reflector 3
Base Cenozoic (~66 Ma)

2a Reflector 2a
Turonian (~90 Ma)

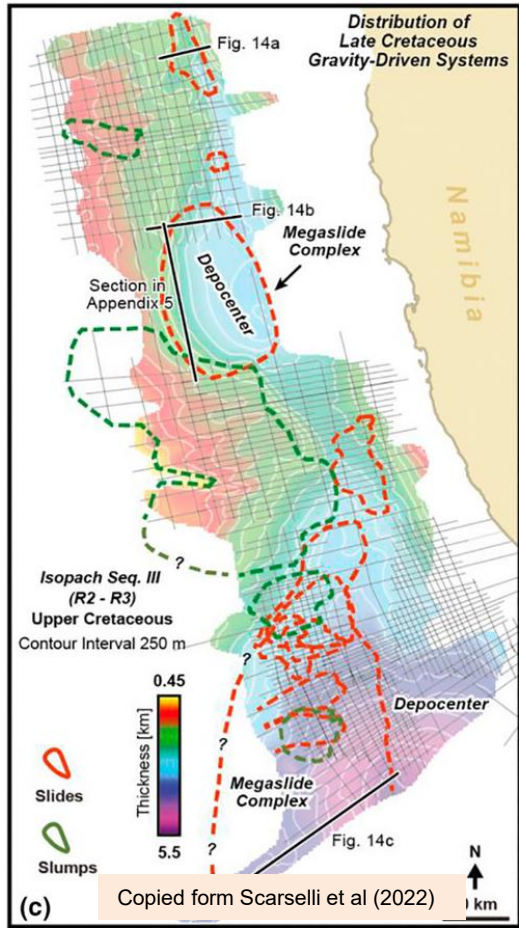
② Reflector 2
Aptian (~115 Ma)

① Reflector 1
Early Barremian (~129 Ma)

Unconformity

Erosional Truncation

Downlap/Onlap



Prominent Gravity Driven Systems

- Slides / Mega-Slides, Slumps
- Updip extensional Slope Domain,
- Downdip Fold and Thrust Belt
- Regional detachment mostly in Turonian shales
- Drape and growth geometries over rotated blocks

Orange Basin Sediment Provenance and RQ

Sediment Source

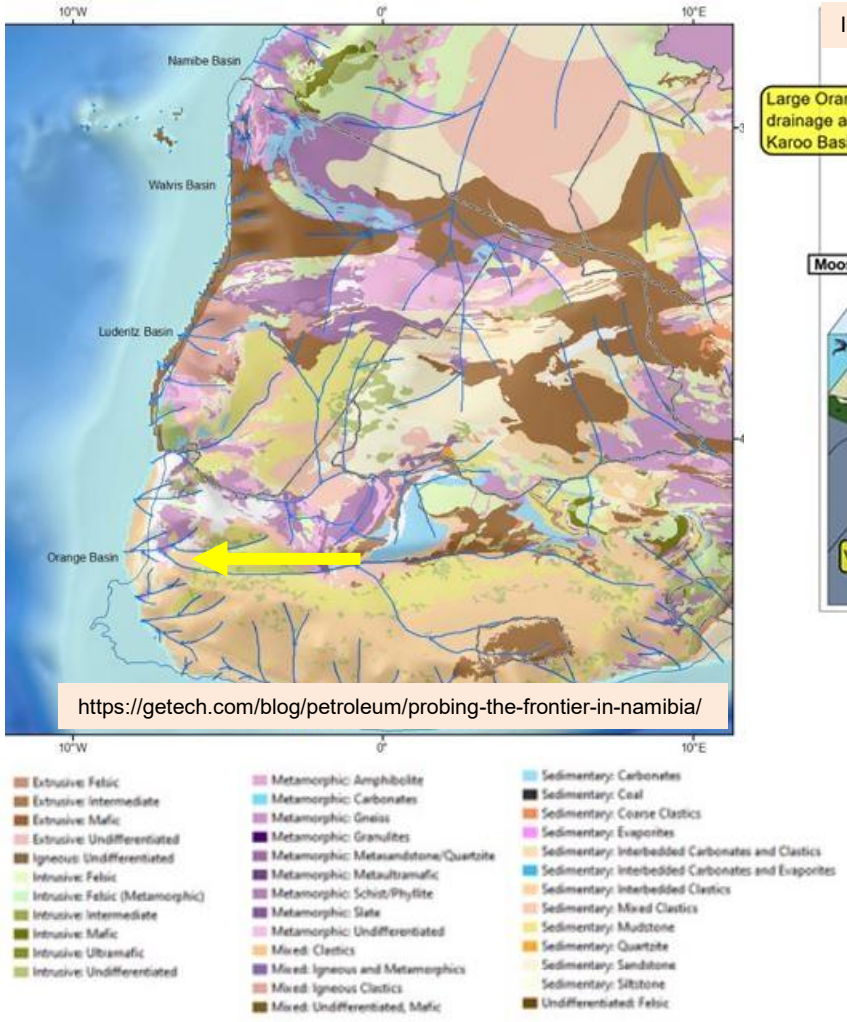
- Sediment supply from continental interior – large catchment area
- Mixed igneous and metamorphic basement rocks, various sedimentary rocks

Basin Entry

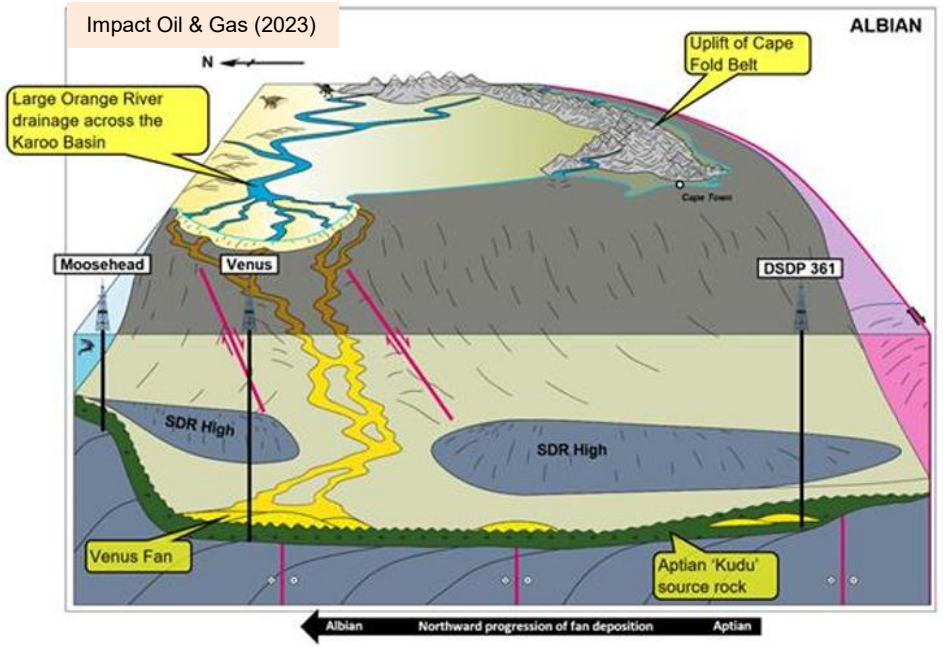
- Relatively stationary Orange and Olifants River

Reservoir Quality

- Excellent to limited, depending on amount of unstable minerals and diagenetic modifications
  - Kudu sands with excellent RQ: well sorted sands, textural and mineralogical mature
  - Graff RQ: Poro-Perm influenced by chlorite (probably deriving from alteration of unstable minerals)
- Contourite drift could help improving RQ northwards – contourite features seen from late Lower Cretaceous



Albian palaeosurface geology



Deposition of the Albian-aged Venus Fan in the outer Orange Basin directly on to the Aptian aged "Kudu Shale" source rock. Sediment drainage from across the Karoo basin.

Orange Basin Plays

1) OUTER HIGH.

2) MIXED VOLCANICS (FLOOD BASALTS) AND CONTINENTAL SEDIMENTS (MAY ALSO CONTAIN LOWER CRETACEOUS SOURCE ROCK).

3) HAUTERIVIAN PLAY: PINCH OUT OF THE SYN-RIFT LACUSTRINE, FLUVIAL AND DELTAIC SANDSTONES.

4) KUDU DISCOVERY: PINCH OUT OF BARREMIAN FLUVIAL FACIES.

5) ALBIAN-CENOMANIAN PROGRADING CLASTIC WEDGE.

6) ALBIAN SHELF FLUVIAL CHANNEL SYSTEM.

7) MOPANE DISCOVERY: STACKED SLOPE CHANNEL COMPLEX.

8) OCEANIC MORB (MID OCEAN RIDGE BASALTS).

9) APTIAN SOURCE ROCK.

10) VENUS DISCOVERY: BASIN FLOOR FAN SITS ON APTIAN SOURCE ROCK. NOTE COUNTER-REGIONAL DIP

11) MANGETTI DISCOVERY.

12) TRUNCATED SDR'S FIRST MARINE TRANSGRESSION ERODES SDR'S.

13) GRAFF DISCOVERY: CHANNELS TRUNCATED BY GRAVITY. DRIVEN STRUCTURE. SIMILAR MODEL FOR JONKER, ENIGMA, LA RHONA, LESEIDI.

14) TURONIAN SOURCE ROCK.

15) EXTENSIONAL PART OF GRAVITY DRIVEN FOLD AND THRUST BELT (GDFTB).

16) CONTRACTIONAL PART OF GDPTB: TOE TRUST.

17) UNDRILLED TRAP BEYOND FIRST THRUST OF GDFTB.

18) TRANSLATED PART OF GDFTB.

19) MTD.

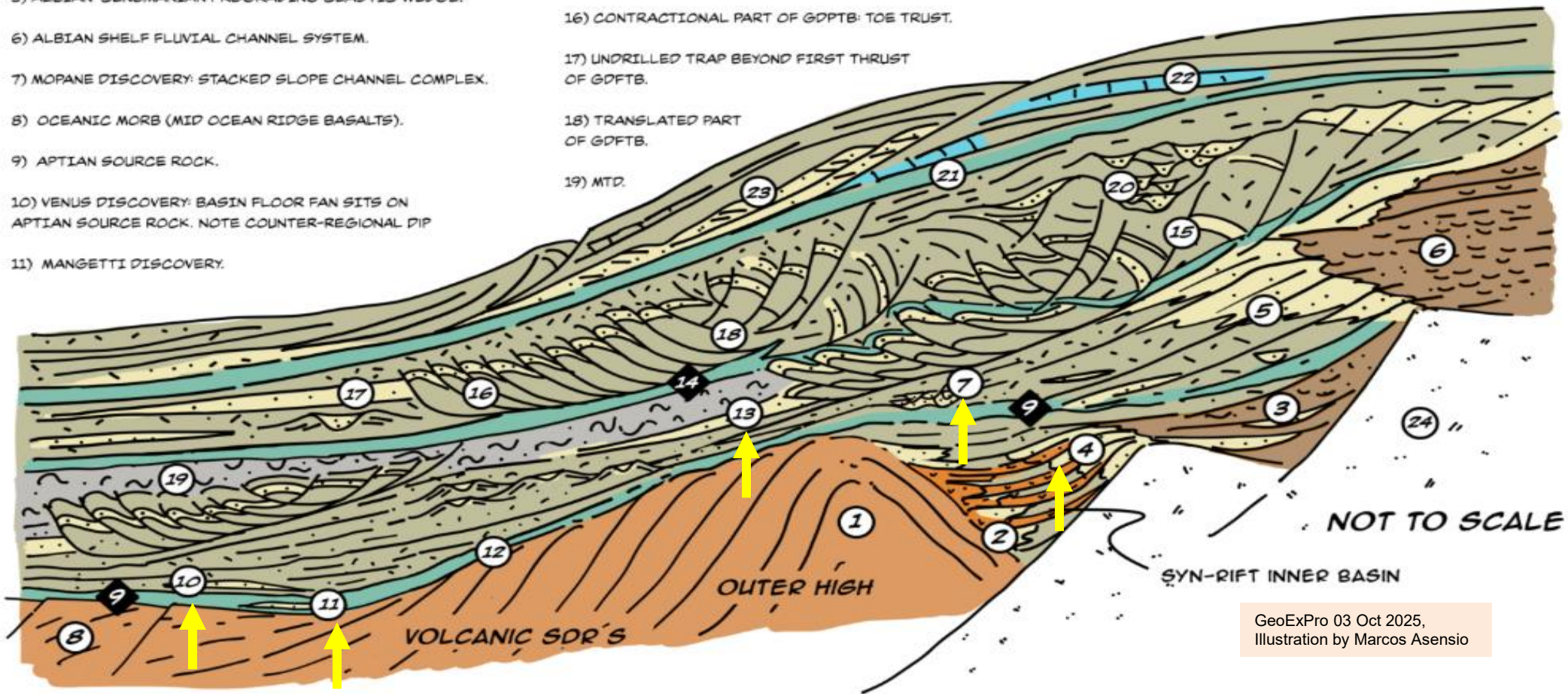
20) SANTONIAN-CONIACIAN SLOPE CHANNEL COMPLEX.

21) MAASTRICHTIAN TRANSGRESSIVE SURFACE.

22) TERTIARY MARLSTONE-CARBONATE.

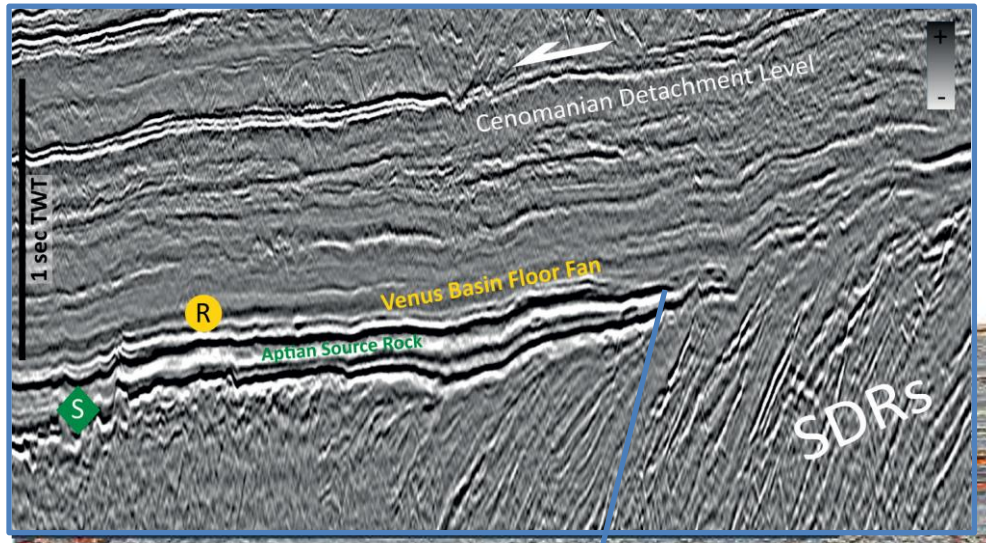
23) COUNTOURITE DRIFT.

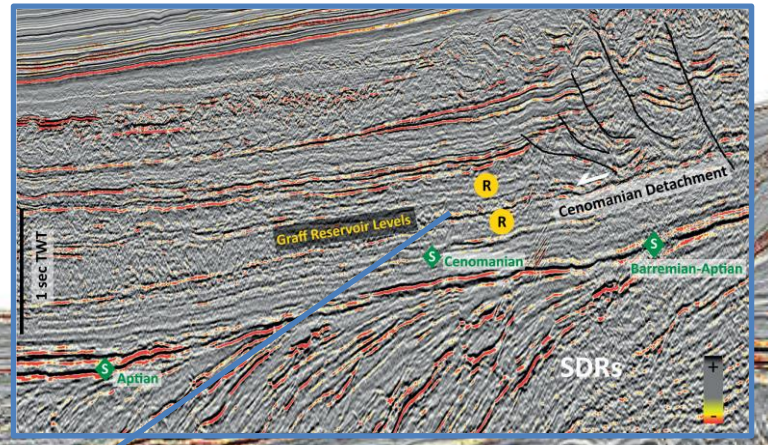
24) RIFTED CONTINENTAL CRUST.



GeoExPro 03 Oct 2025,
Illustration by Marcos Asensio

Orange Basin Plays





Late Cretaceous Toe-thrust and Roll-over R

R

Late Cretaceous Turbidites

R

Late Cretaceous Sub-thrust Fans

R

2 km Depth

Early Cretaceous Basin Floor Fans

R

Early Cretaceous Build-ups

S

Barremian-Aptian

S

Aptian

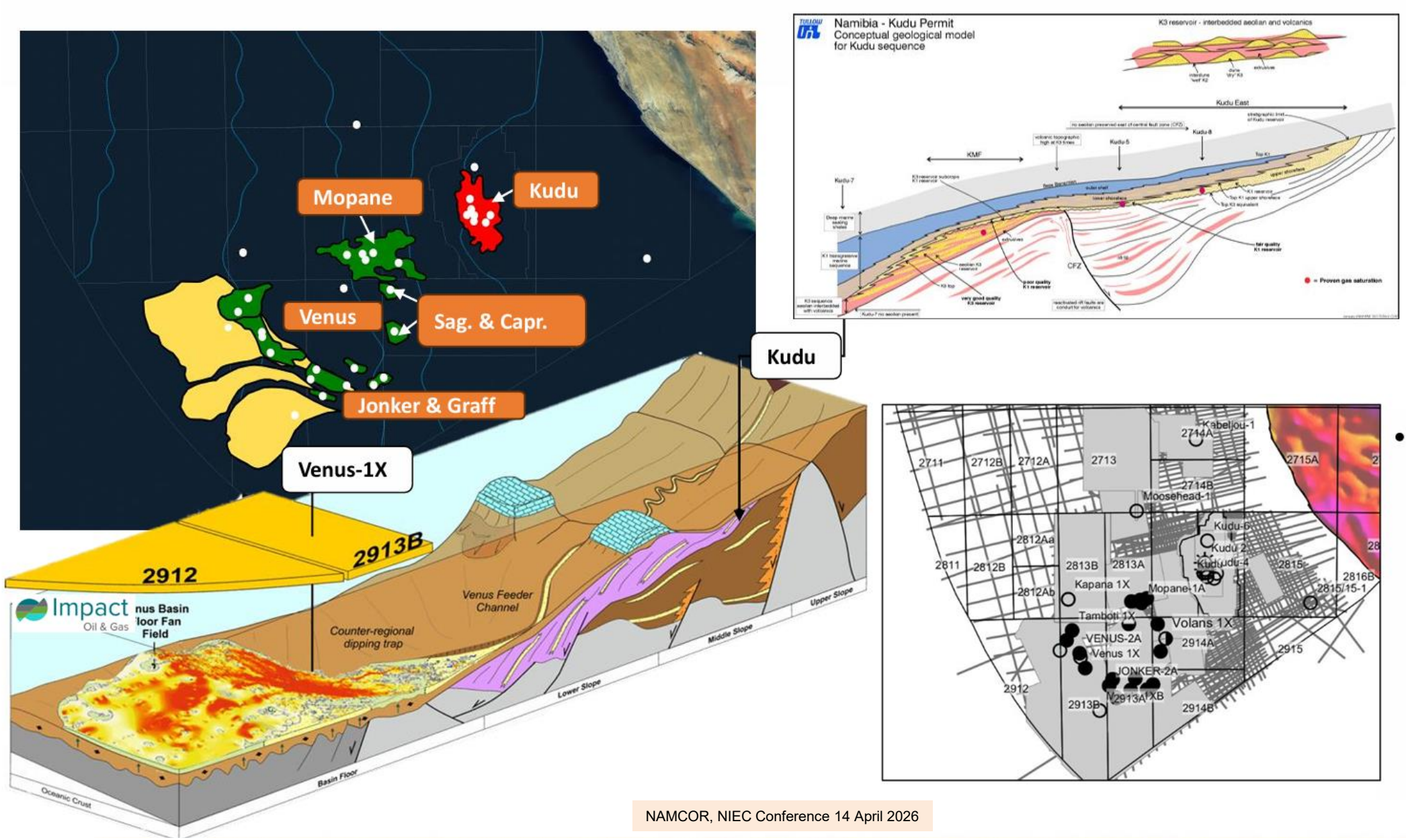
Outer Sub-basin

Outer Regional High (SDRs)

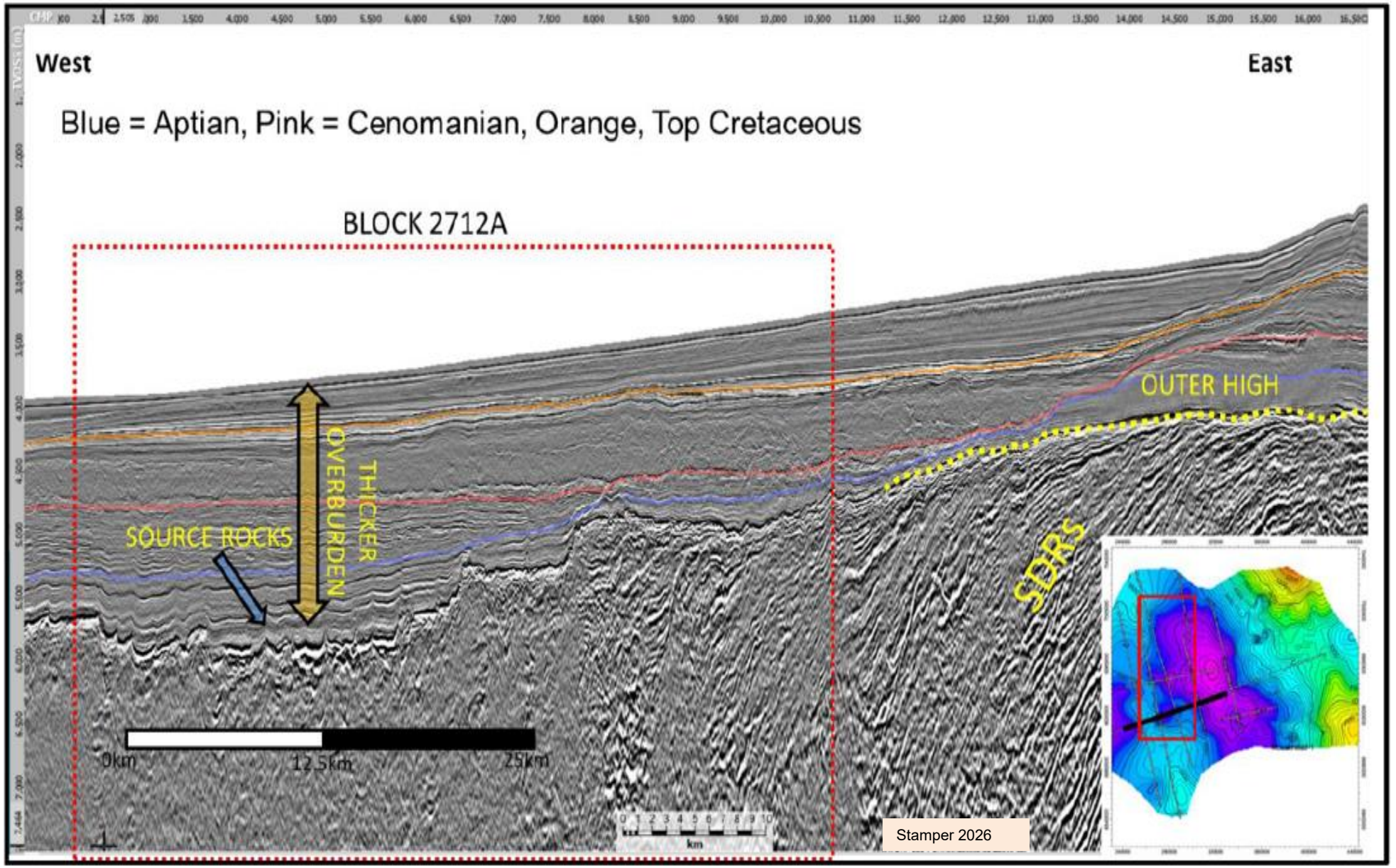
Inner Sub-basin

Hedley et al 2022

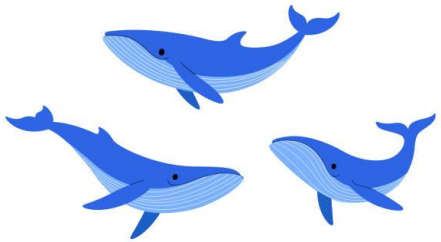
Orange Basin Plays



Orange Basin Plays

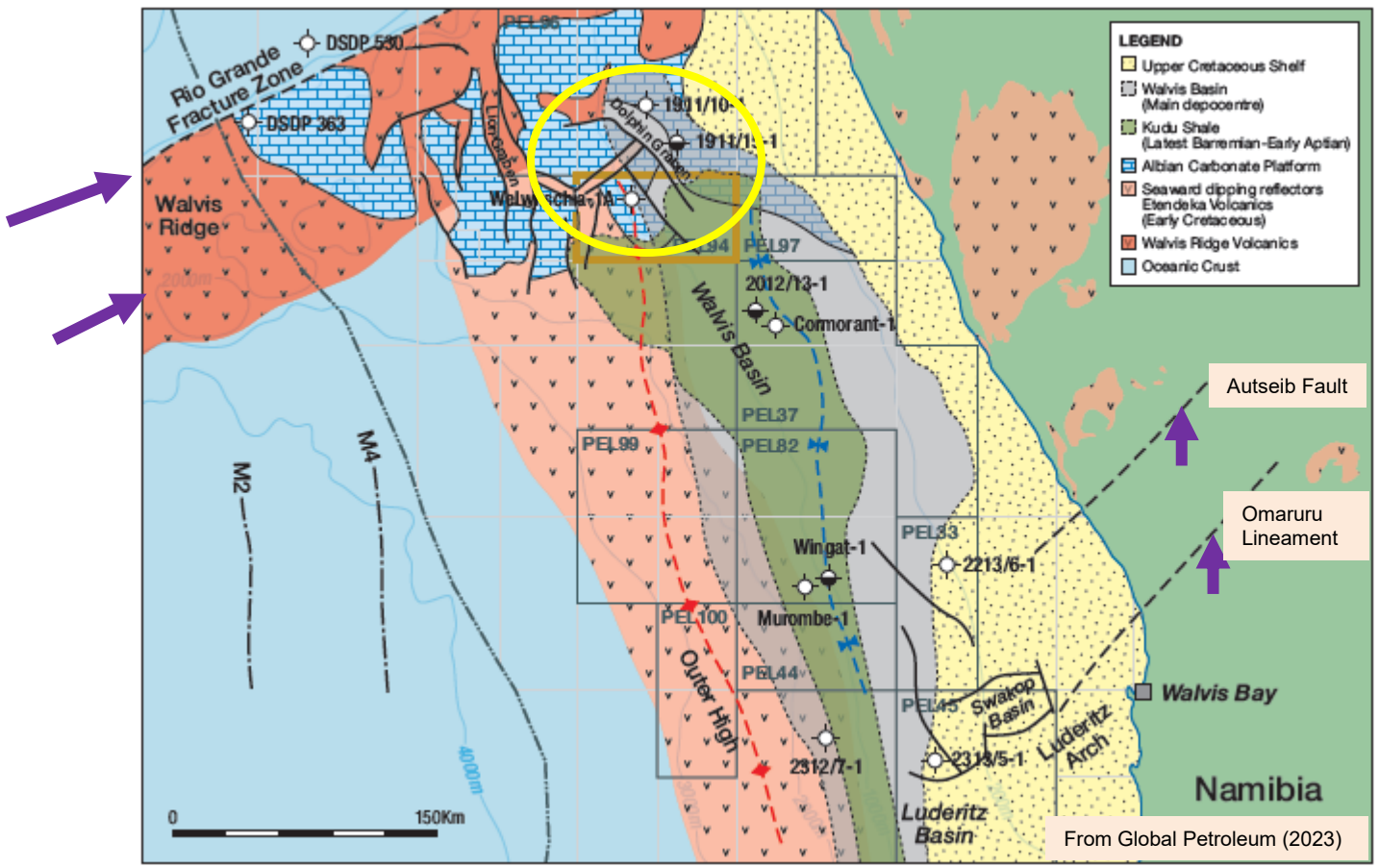


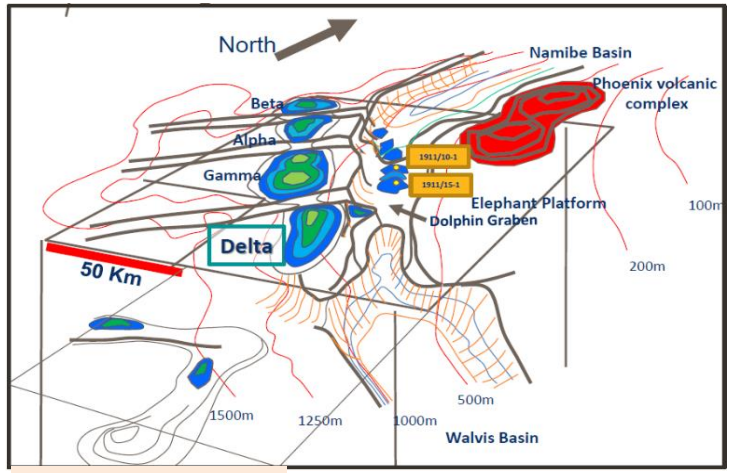
More Venus lookalikes along strike northwards?



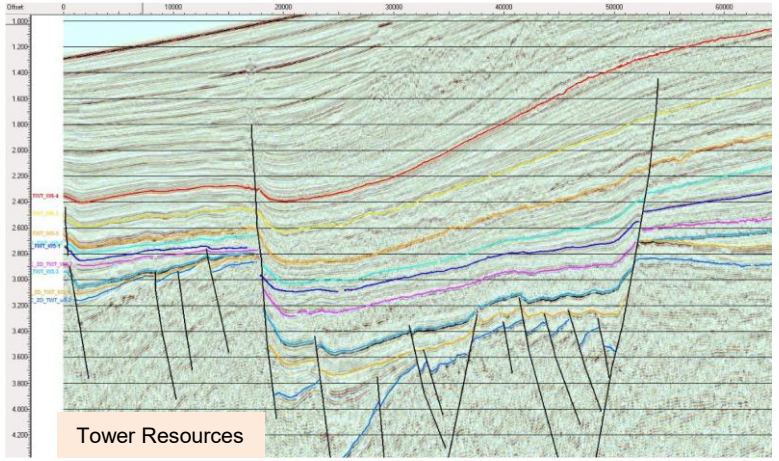
Walvis Basin

Distinct Walvis Basin Features: Dolphin Graben, SW-NE structural elements





Tower Resources (2020)



Tower Resources

Distinct structural elements

- Dolphin Graben: possible mature syn-rift SR, as well as Aptian SR
- Rio-Grande Fracture Zone and Walvis Ridge delineating basin geometry
- SW-NE transfer faults extending deep onshore (e.g. Omaruru lineament, Autseib Fault), forming shelfal sub-basins

Walvis Basin Sediment Provenance and RQ

Sediment Source

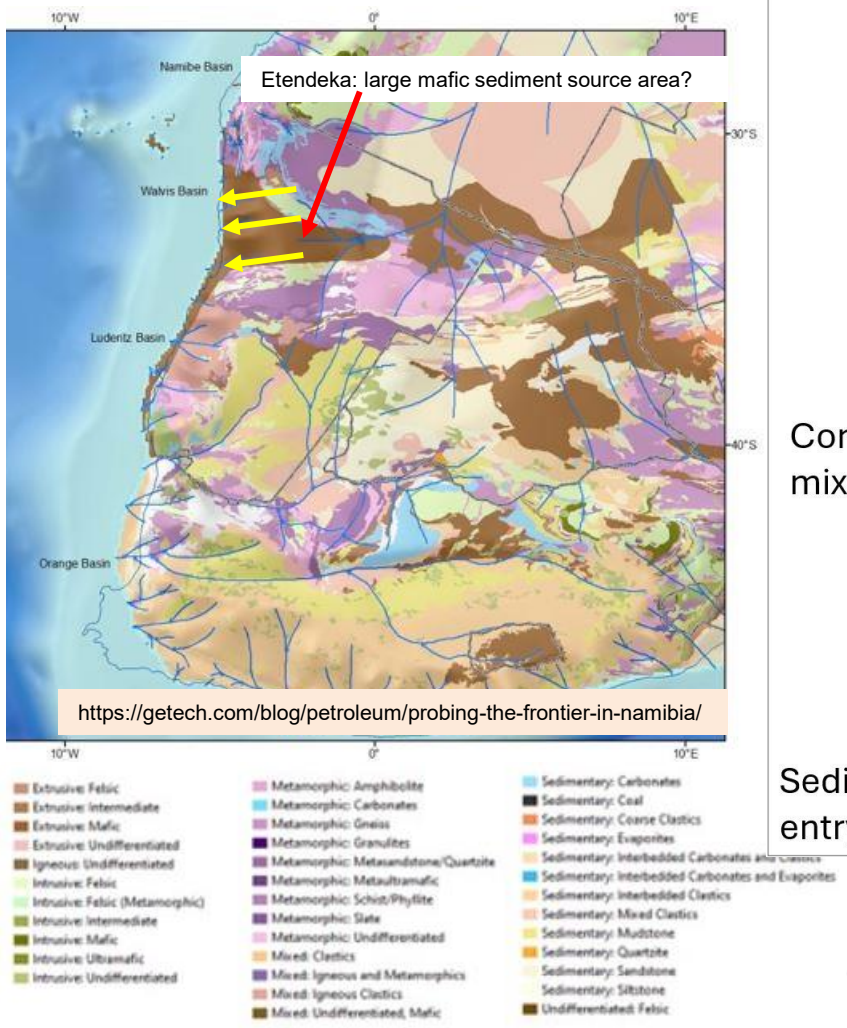
- Sediment supply from rather short trunk rivers (precursors of Swakop, Ugab, Huab)
- Mixed metamorphic basement rocks, Karoo shales and sandstone, volcanics

Basin Entry

- Multiple entry point, possibly stationary as fault controlled

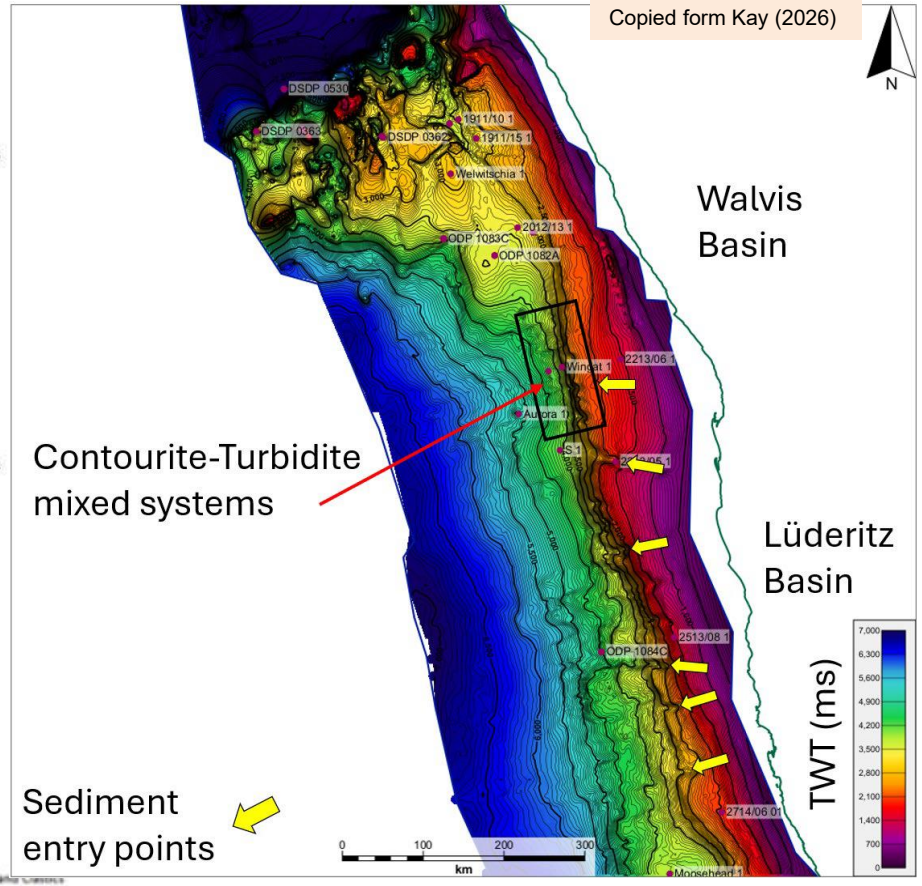
Reservoir Quality

- Excellent to limited
  - Chariot Prospect S – Upper Cretaceous excellent, deeper sands lower RQ; only limited impact of unstable minerals on RQ (Fox & Wallace 2025)
- Contourite drift may help improve RQ (active from Albian)
- Remark: little volcanic detritus in modern river bed sediments



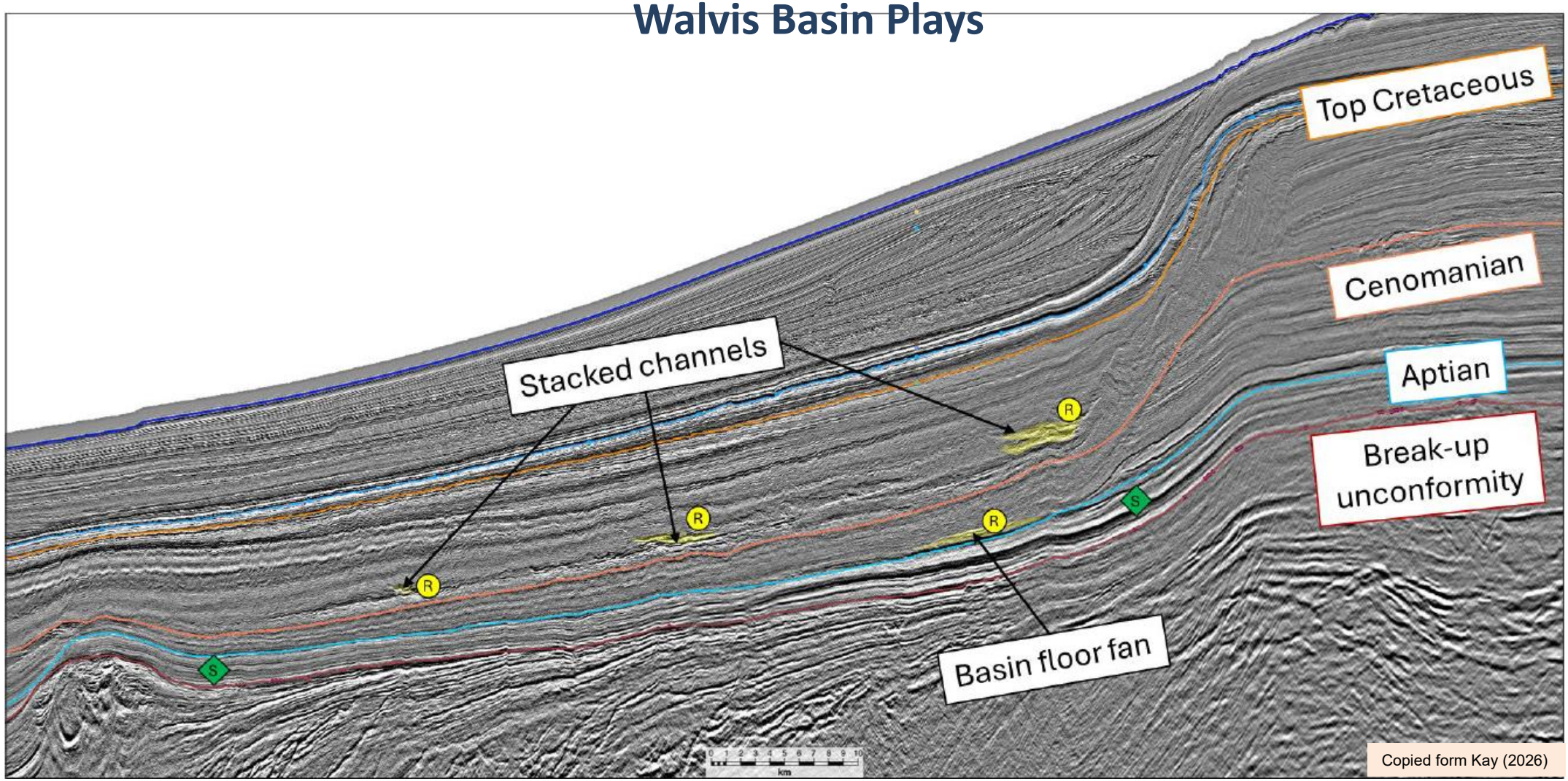
Albian palaeosurface geology

Copied form Kay (2026)



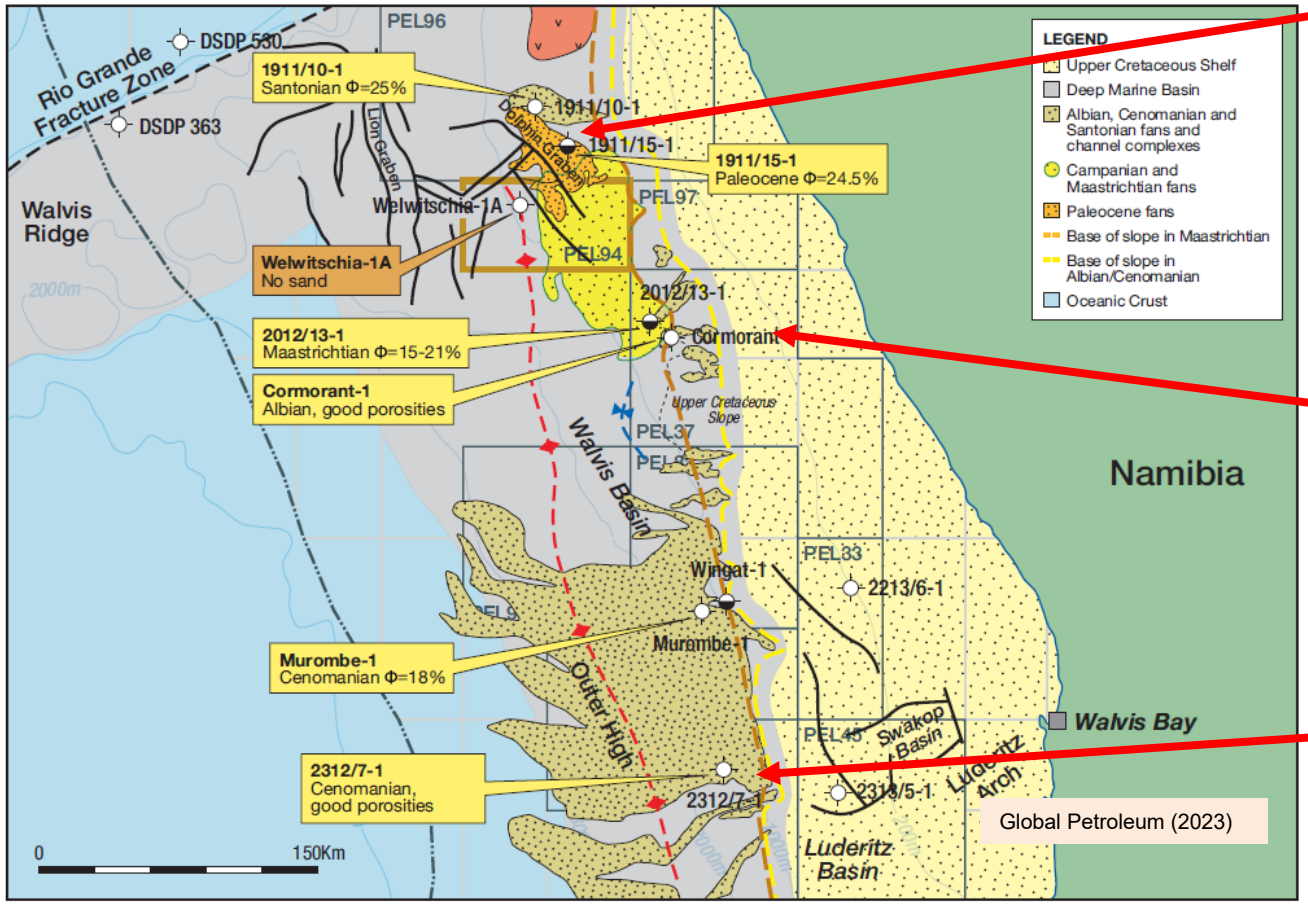
Top Cenomanian TWT map showing sediment entry points on the shelf and highlighting the presence of a mixed contourite-turbidite system along-strike of the Wingat-1 well

Walvis Basin Plays



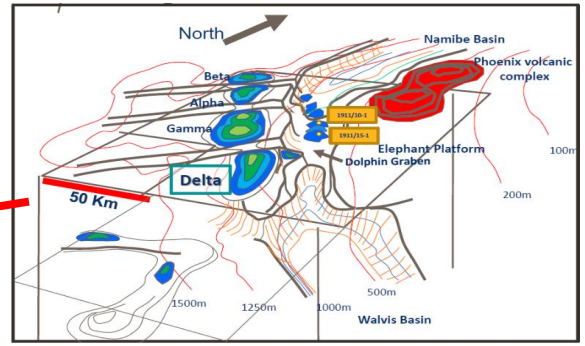
Dip example in TWT across the Walvis Basin showing play elements and potential stratigraphic traps in the Albian and Upper Cretaceous

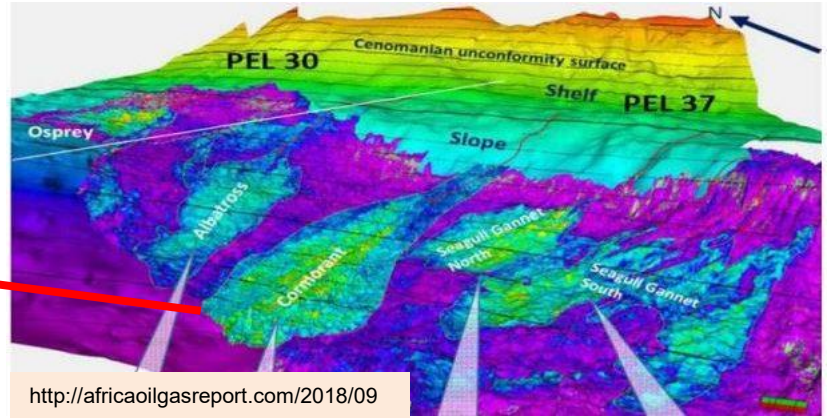
Walvis Basin Plays



Global Petroleum (2023)

Walvis Basin Cretaceous / Paleocene Facies and Reservoirs





http://africaoilgasreport.com/2018/09

Lower Slope Cretaceous Turbidite plays

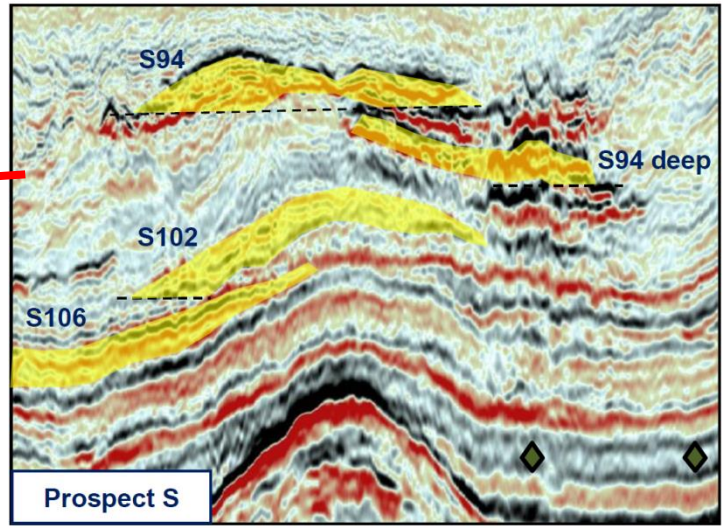


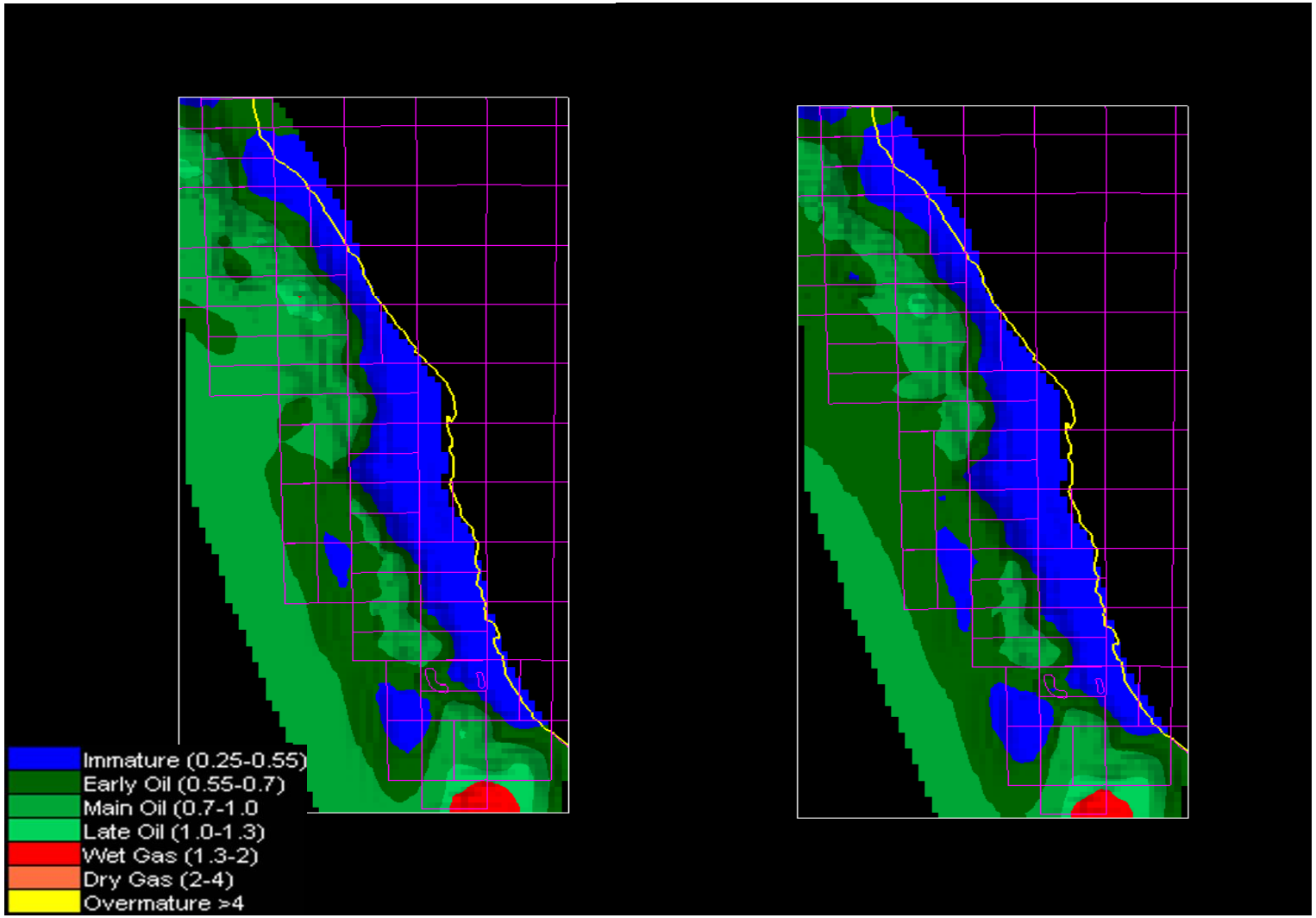
Image: Chariot Oil & Gas

Deep water Cretaceous Turbidite play over volcanic intrusion

Regional SR Maturity

General Trends

- Kudu shale and Albian SR main candidates of oil mature SRs - widespread
- Cenomanian-Turonian rarely reaching maturity (not shown here)
- Better oil-prone organofacies expected farther offshore (less dilution with clastic and lower vitrinite input)
- Venus prove that SR on oceanic crust can be mature (only approx. 2.5km overburden required)
- Orange Basin: high maturity – up into dry gas window (high sediment thickness, possible influence of Miocene Vema hot-spot)
- Walvis Basin: larger area of lower maturity, no or limited dry gas zones (attributed to lower sediment thickness, Early Cretaceous Tristan hot spot did not affect transitional and post rift deposit)
  - **Rather oil than gas potential in the Walvis**

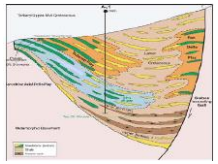


Super-regional model of simulated present-day maturity (%Ro) of two potential source rock intervals. Left: potential source rock interval of Barremian age ("Kudu Shale"?); right: potential source rock interval of Albian age. Study by H.A. Kemna.

Comparison and Conclusion

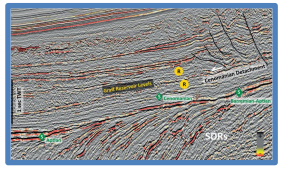
Orange Basin

Inboard Grabens – AJ-1



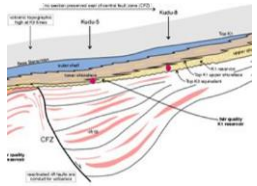
- Established in S-Africa

East of Outer High - Graff, Mopane, etc.



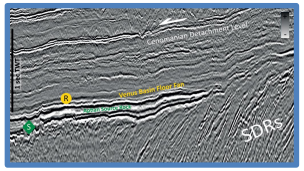
- Stacked slope-channel complexes
- Ponding against Outer High
- Fold and Thrust structures augment trapping configuration
- Charge access to deeper SR

Intra-volcanic - Kudu



- Excellent reservoir - mature sands
- Paleo-morphologic feature - Kudu High

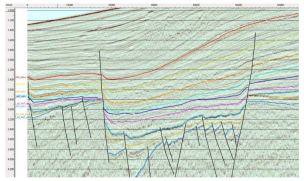
West of Outer High - Venus



- SR on oceanic crust, good heatflow
  (Influence of Vema hotspot?)
- Counter-regional dip and onlap against Outer High
- Short migration path (Reservoir directly on SR)
- Long sediment transport, possibly contourite drift improving RQ

Walvis Basin

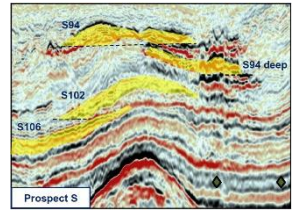
Inboard Grabens



- 2213/6-1 Dry
- Dolphin Graben further downdip, 1911 wells dry
  - Multiple opportunities remaining

East of Outer High

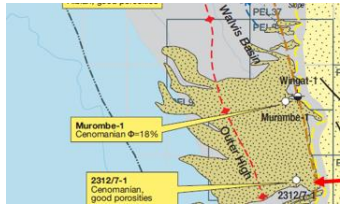
- Excellent RQ in stacked channels, indication of turbidite-contourite systems
- Drape over volcanic features (e.g. Wingat)
- Limited Cretaceous MTCs
- ? Charge access to deeper SR



Intra-volcanic

Unknown – possible within upper syn-rift graben (likely lower maturity source)

West of Outer High



- ? Warm transitional-oceanic crust as in Orange
- ? Counter-regional dip
- Reservoir likely present, fans extending west of Outer High mapped, indication of turbidite-contourite systems
- ? RQ of Albian sands