Insights into the Geology and Prospectivity of the Joint Development Zone (JDZ)

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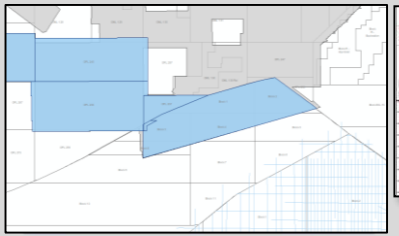
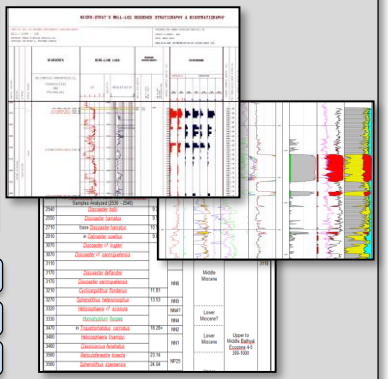
New Ventures Africa PGS

Executive summary – JDZ MC3D prospectivity review

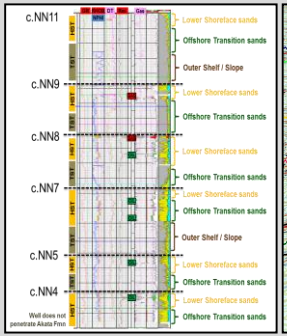
1. PGS have a comprehensive dataset within the JDZ.

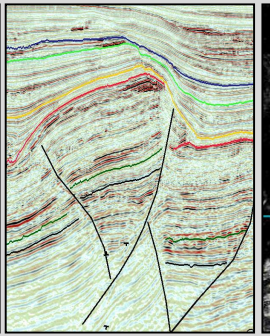


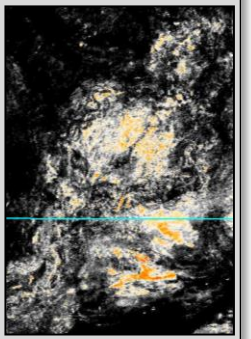


MC3D	Biostrat	Deviation Data
Well Reports	Mud Logs	Cuttings
Well CPI's	Gas Logs	Checkshots

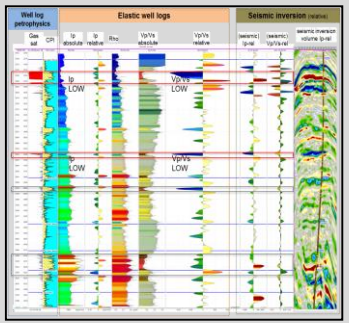
2. Well log and seismic interpretation show pro-delta reservoir facies within structural and stratigraphic traps.

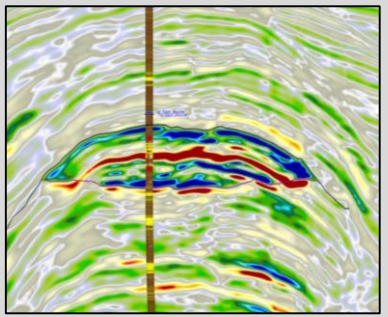




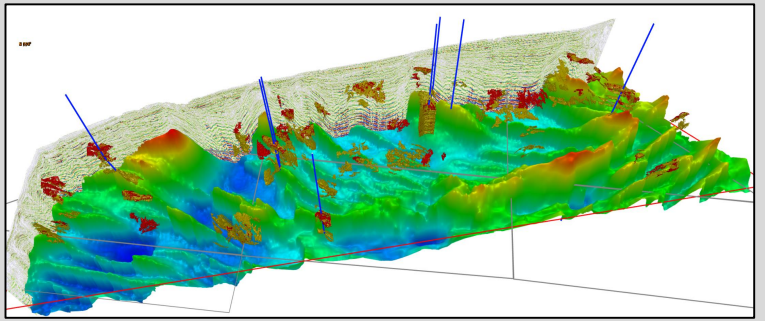


3. Quantative Interpretation work shows that hydrocarbon charge of reservoirs can be identified & calibrated.





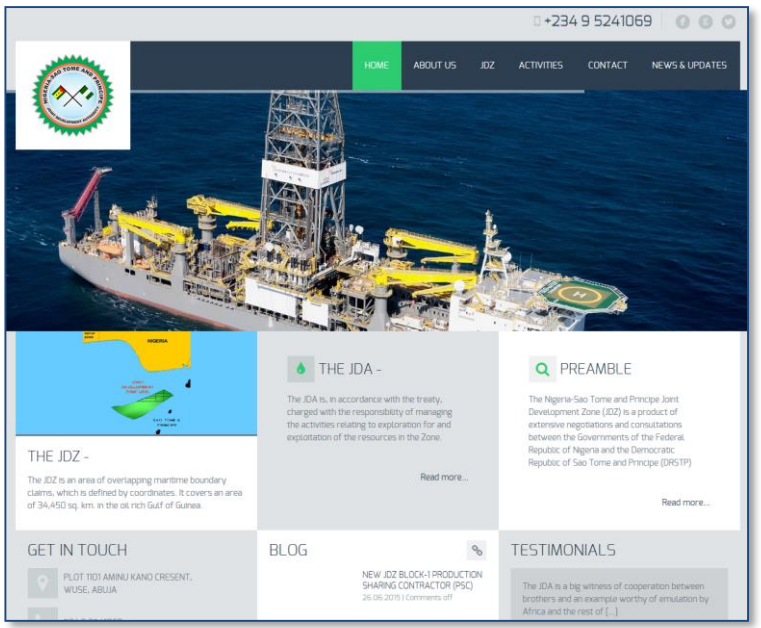
4. The study shows that there are undrilled leads calibrated to 8 drilled wells

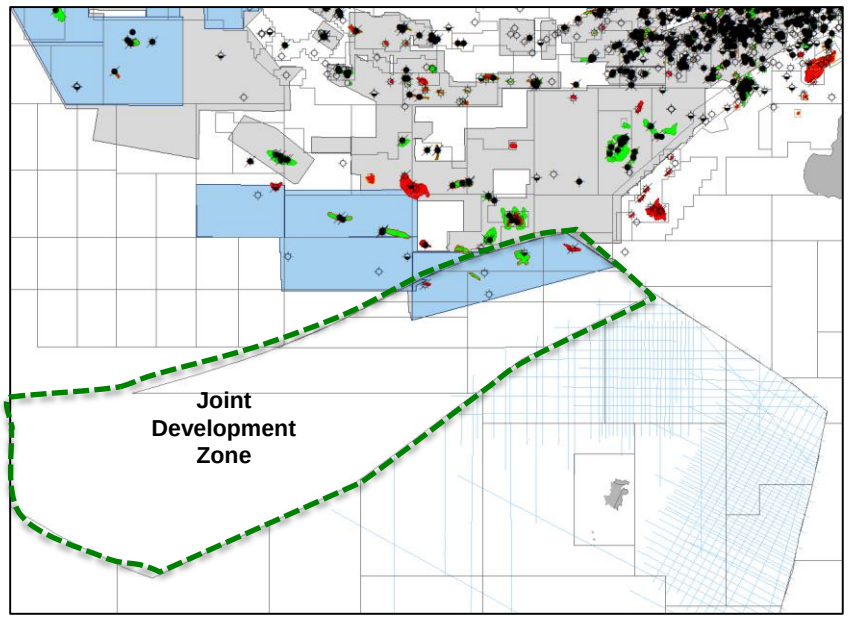


The JDZ and the JDA

- In 2001 a treaty was signed between Nigeria and São Tomé & Principé which defined the Joint Development Zone (JDZ).

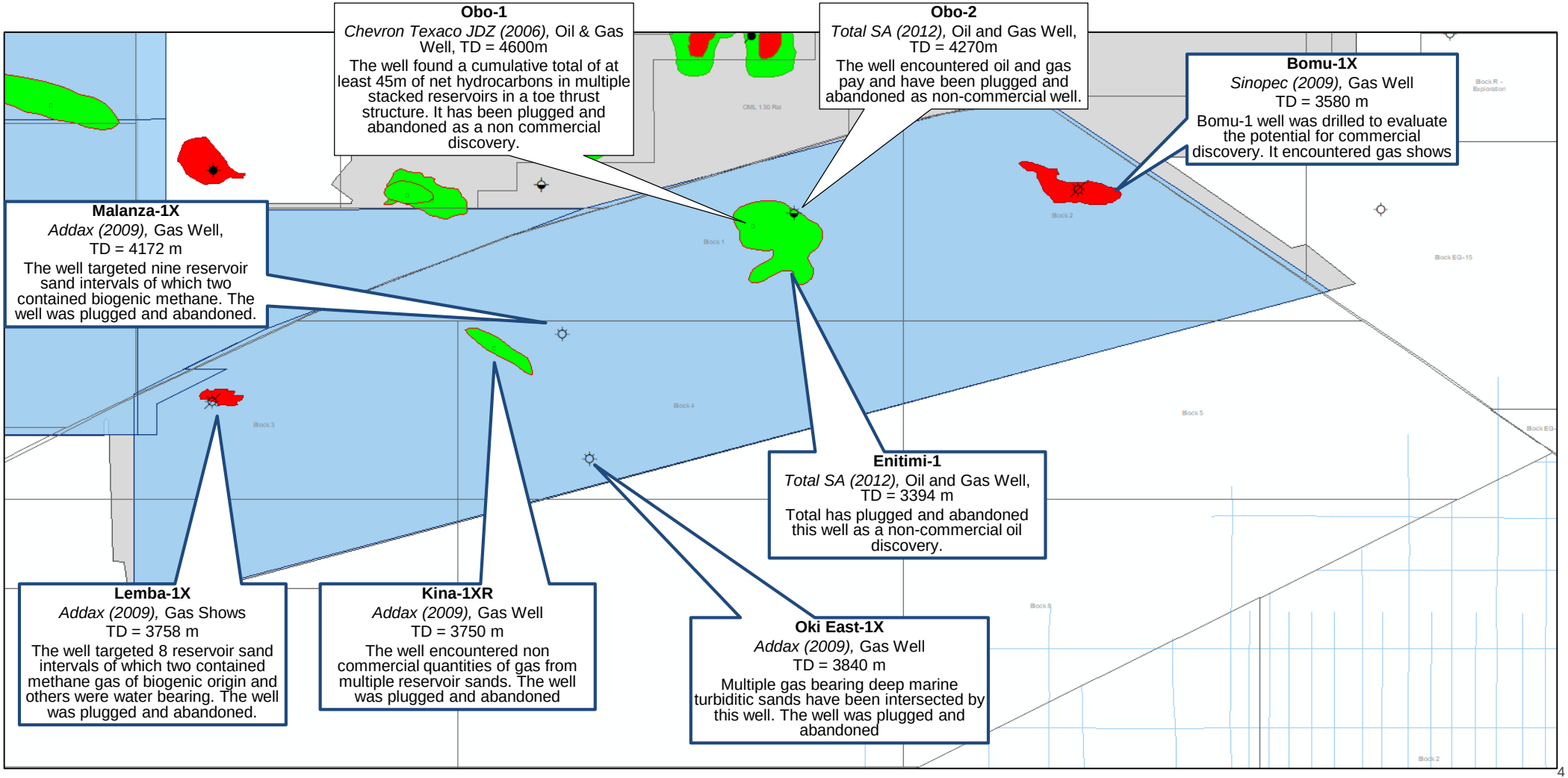
- The Joint Development Authority (JDA) was established to manage the activities relating to exploration for and exploitation of the resources of the JDZ, including the issuance of permits and licenses.





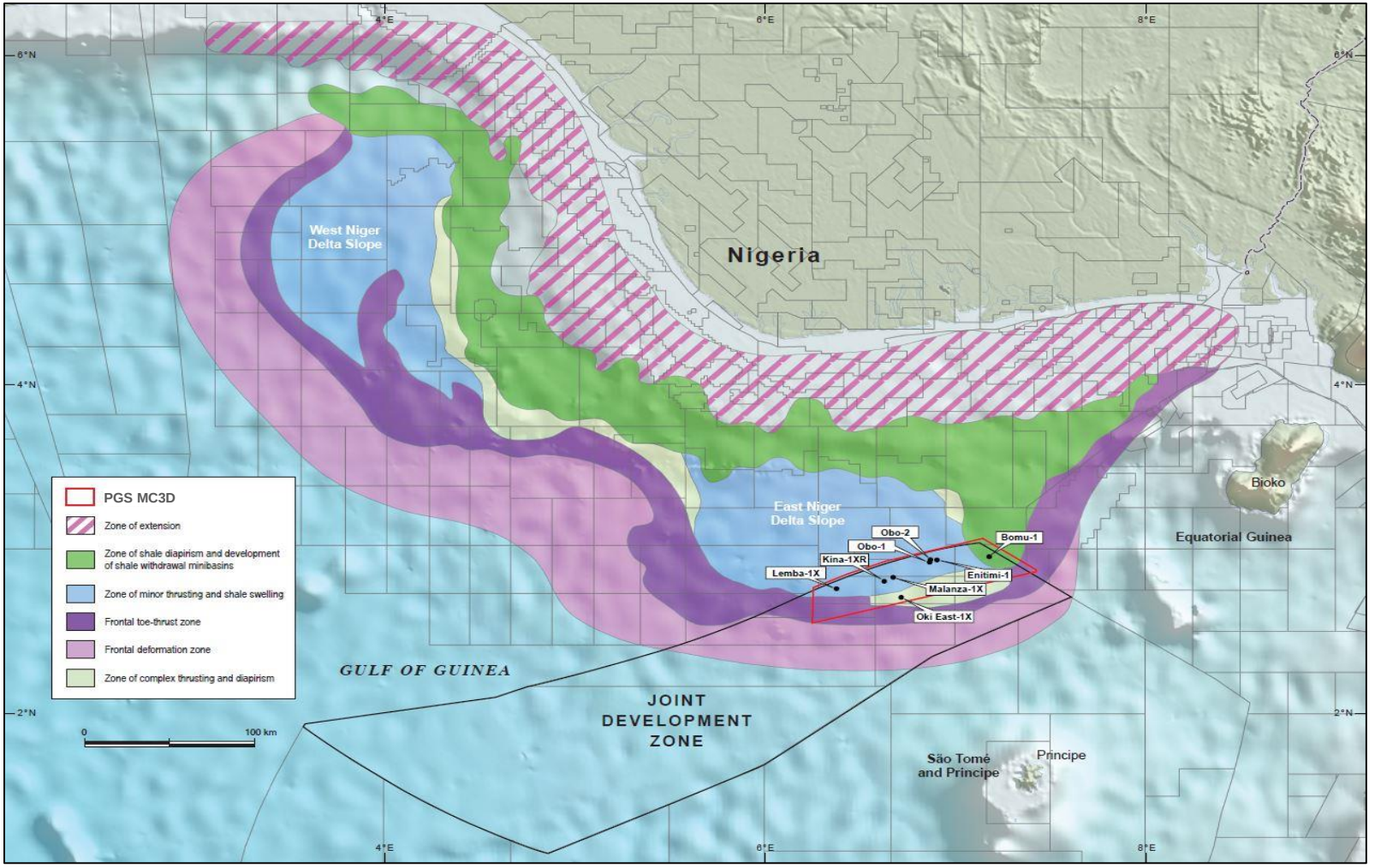
PetroView

Wells and Fields

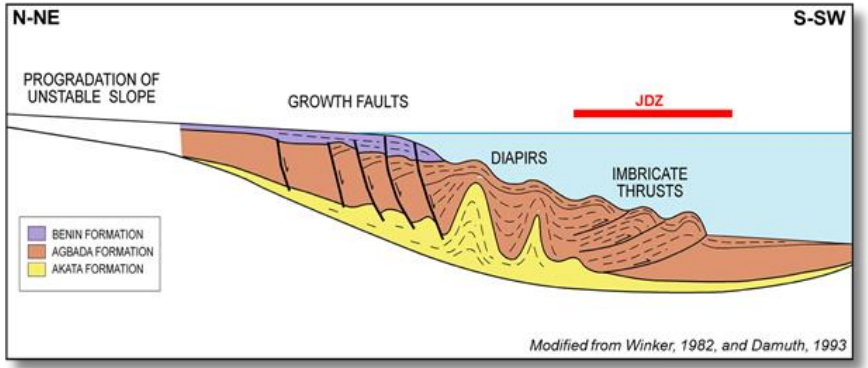


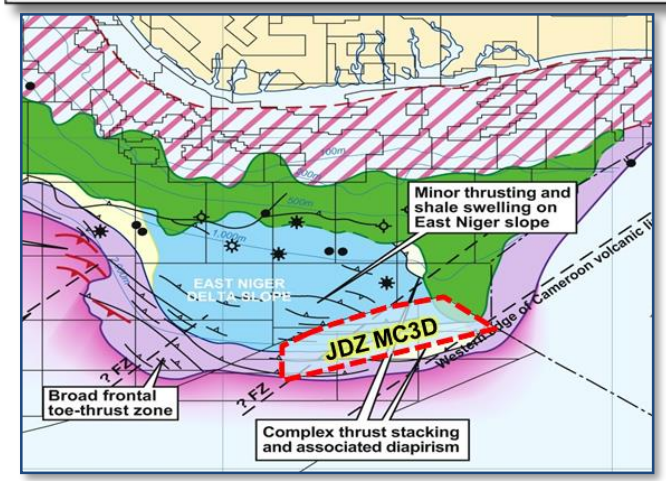
Regional Geology

Niger Delta tectonic setting

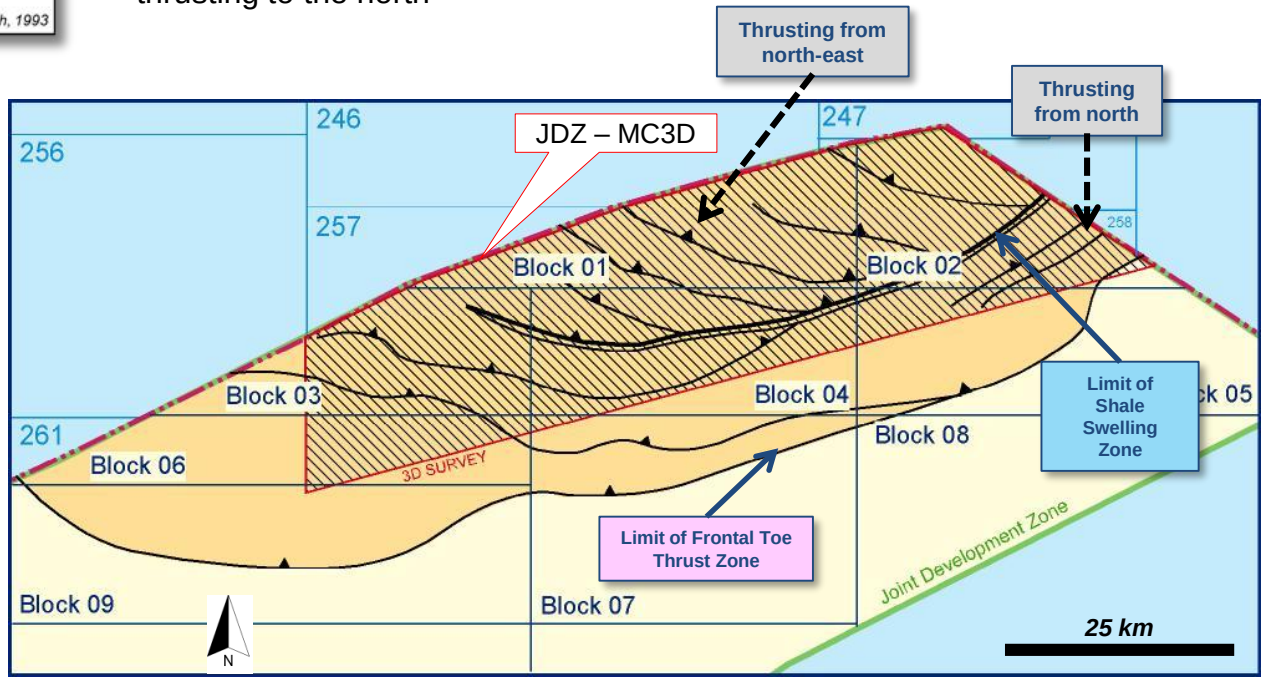


Thrusting in JDZ study area





- JDZ lies on 2 depobelts - Shale swelling and Frontal toe trust zones
- The Shale Swelling Zone is typically associated with E-W trending toe thrusts, apparent within the Agbada Formation and detaching within the Akata mobile shales
- Akata shales have been injected up the fault planes isolating fault blocks
- The Frontal Toe Trust Zone is associated with NE–SW fault trends controlled by thrusting to the north

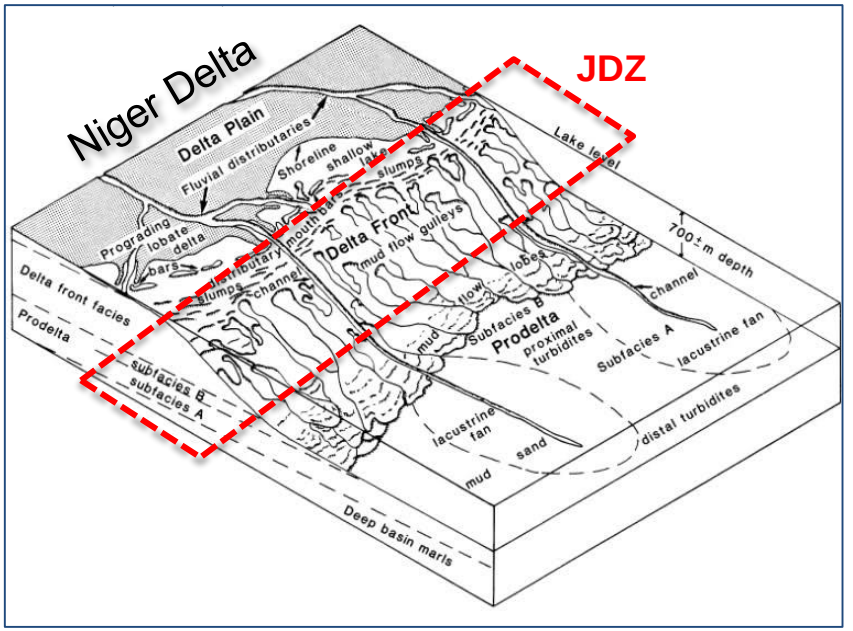


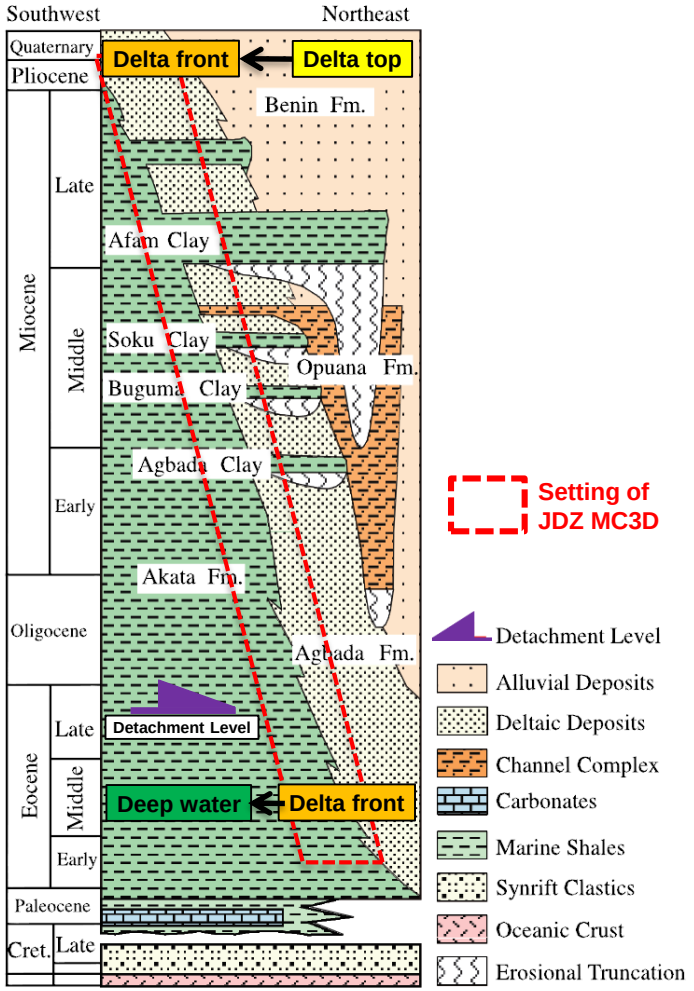
Regional stratigraphy of the Niger Delta

The Tertiary section of the Niger Delta is divided into 3 diachronous formations, representative of broad depositional setting:

- *Benin Formation* – representative of alluvial deposits
- *Agbada Formation* – representative of deltaic deposits
- *Akata Formation* – representative of deep water muds

The area of the JDZ MC3D dataset is located in a delta front to deep water setting and is dominated by Agbada Formation delta front deposits that is detached from underlying Akata shales



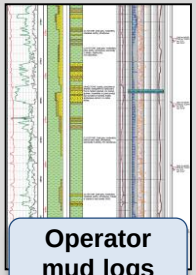


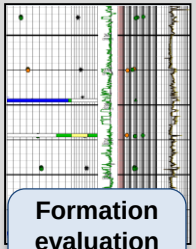
From Freddy et al., 2005

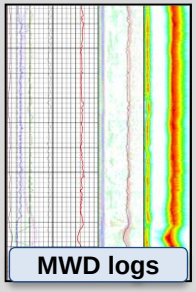
PGS Data Package

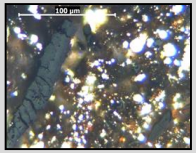
Available data package

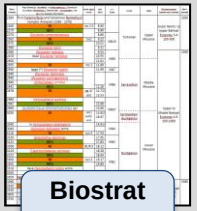
Well data available for brokerage

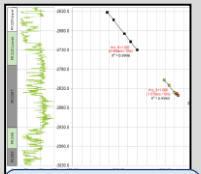

Operator mud logs

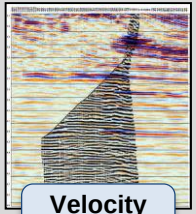

Formation evaluation logs

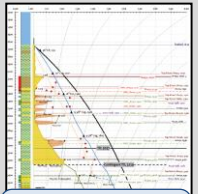

MWD logs

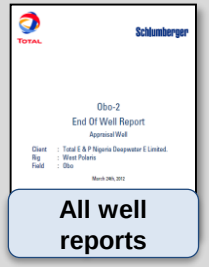

Vitrinite reflectance


Biostrat data

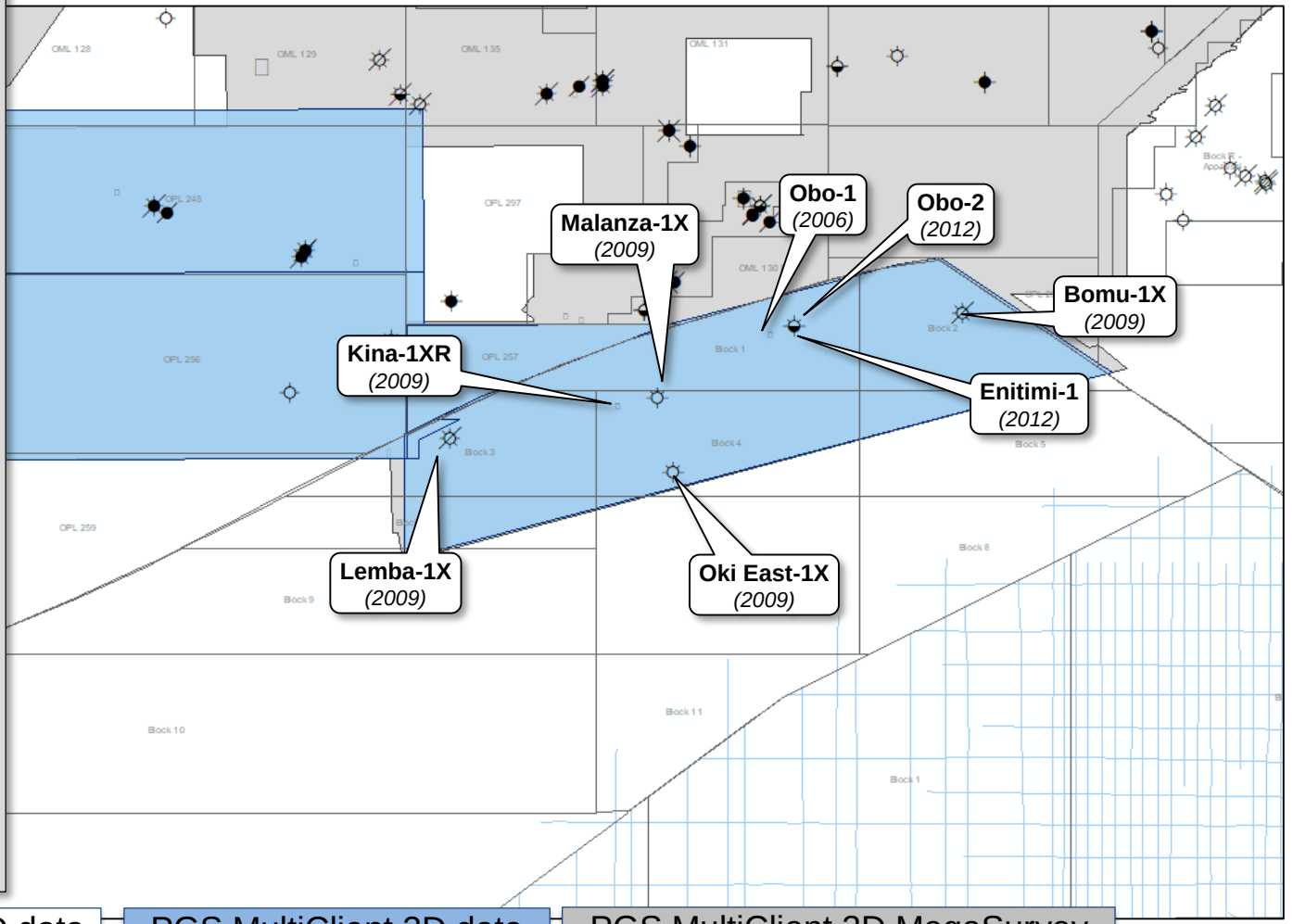

Bottom hole temperature


Velocity data


Pore pressure data



All well reports

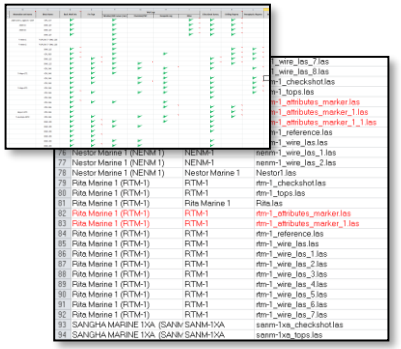


PGS MultiClient 2D data | PGS MultiClient 3D data | PGS MultiClient 3D MegaSurvey

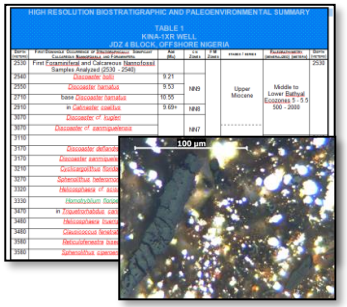
Well Log processing workflow for JDZ

1. Well data collection and management

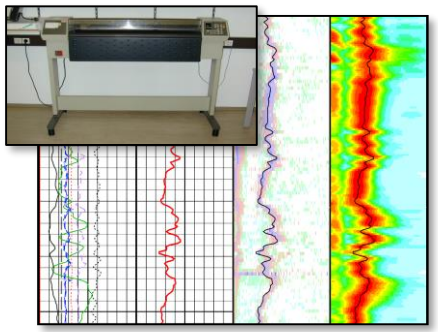
2. Well data cataloguing



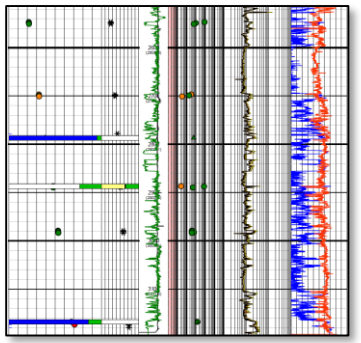
3. Collation of operator data



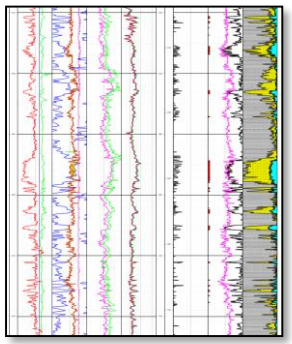
4. Well log scanning & digitising



5. Well log QC, splicing & environmental corrections.

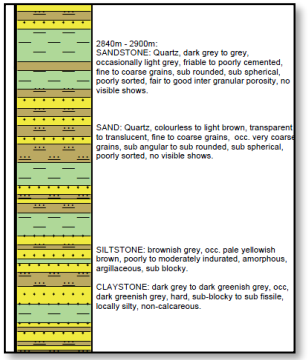


6. Workstation Ready Log Suite (WSR)

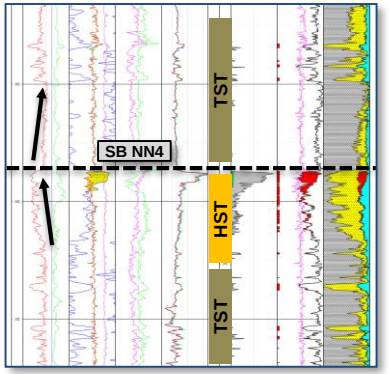


Well Log interpretation workflow for JDZ

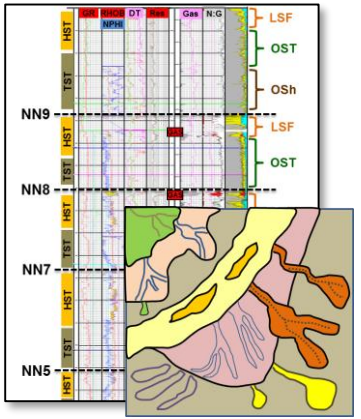
7. Lithological interpretation



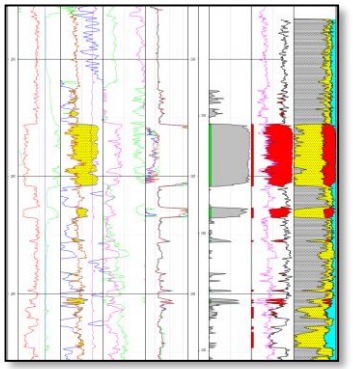
8. Sequence stratigraphic interpretation



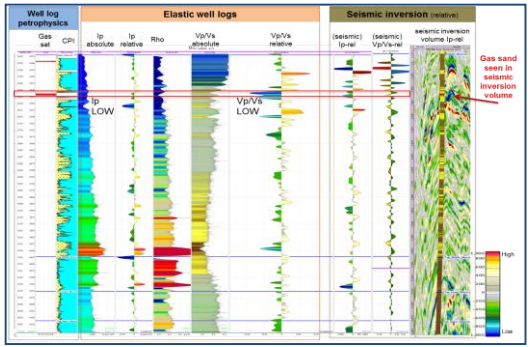
9. Depositional Environment and Facies Interpretation



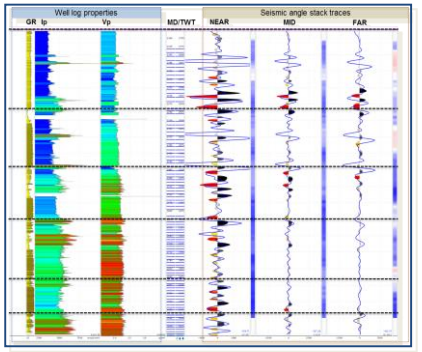
10. Petrophysical analysis (CPIs).



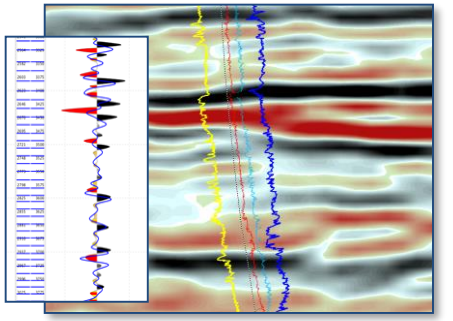
11. Reservoir fluid elastic attribute analysis



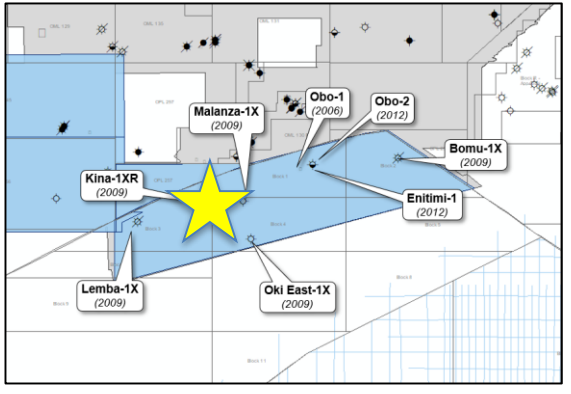
12. Acoustic attribute to pre-stack trace calibration



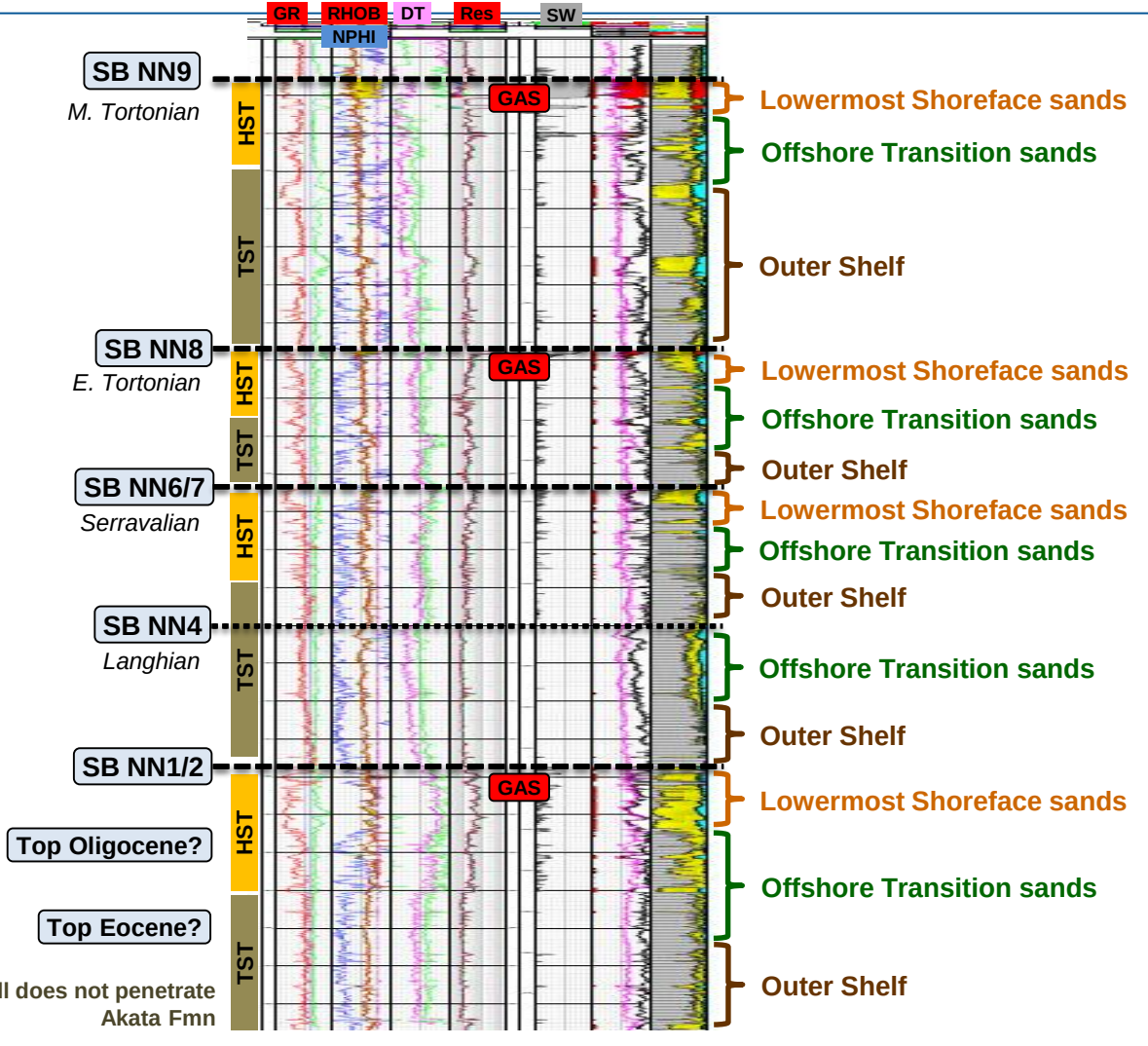
13. Well to seismic tie using checkshot, VSP & synthetics



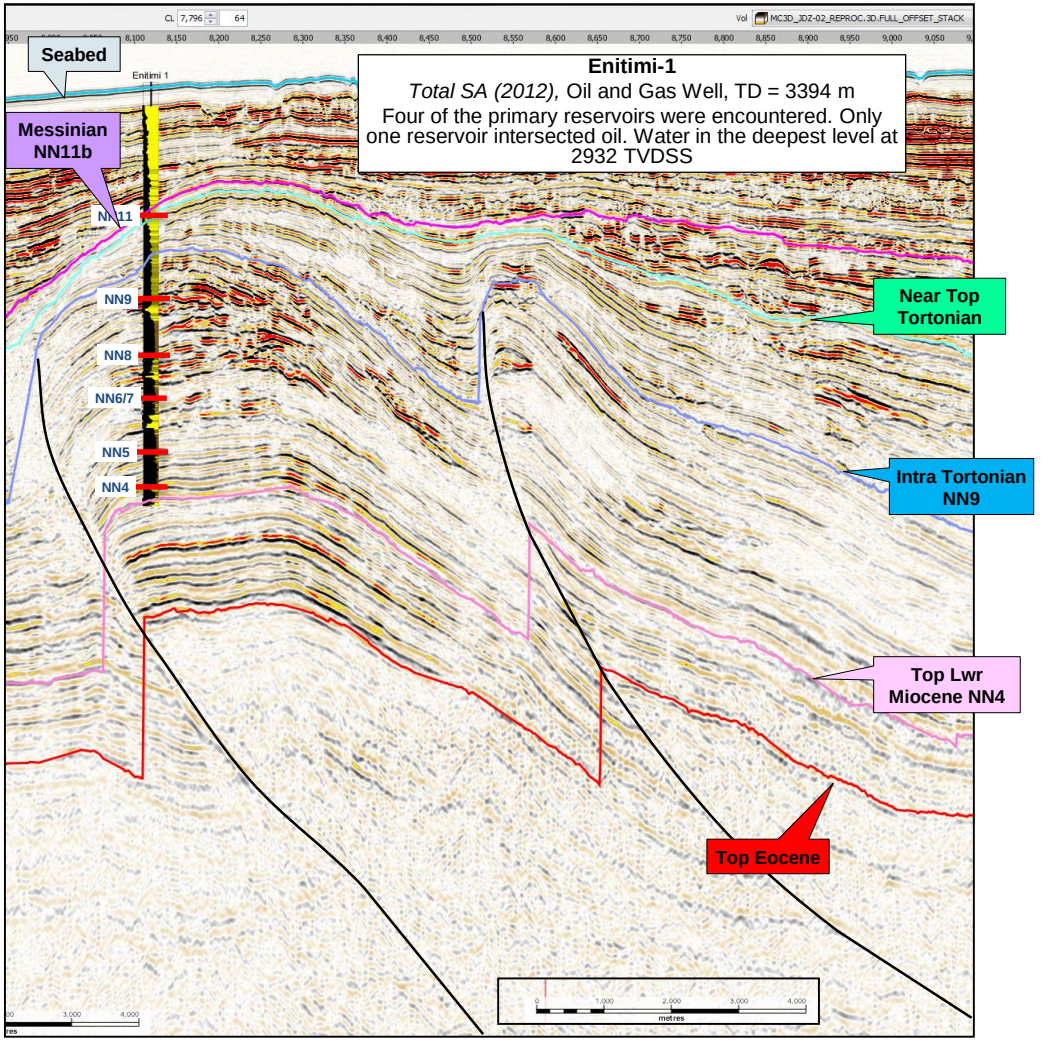
Well sequence and depositional environment interpretation – Kina-1XR

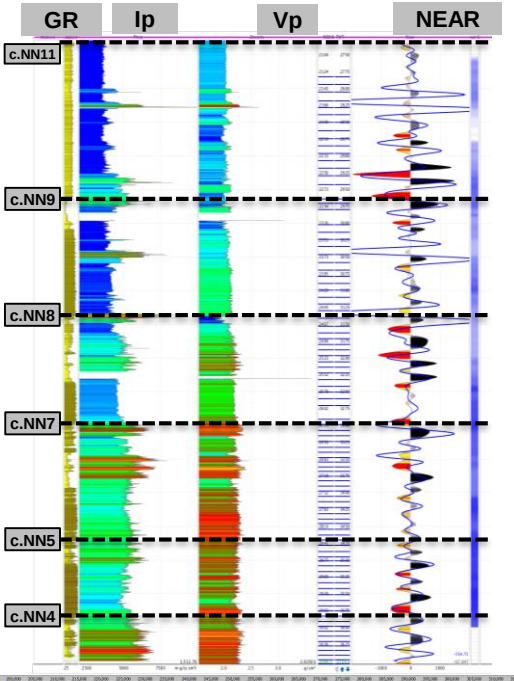


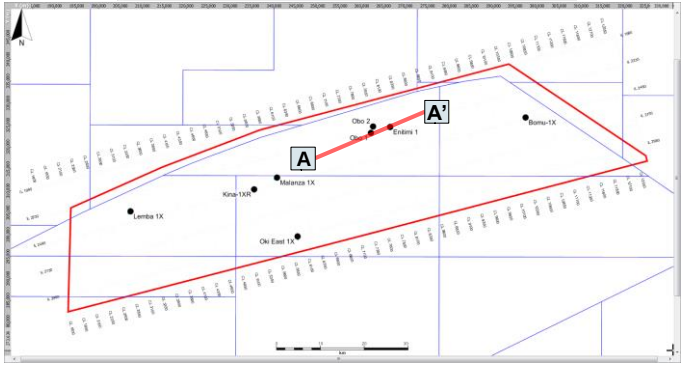
Biostrat data	☑
Operator shows	☑
H/C from CPI	Gas @ 2575m, 2940m, 3120m, 3480m,
Check shot	☒



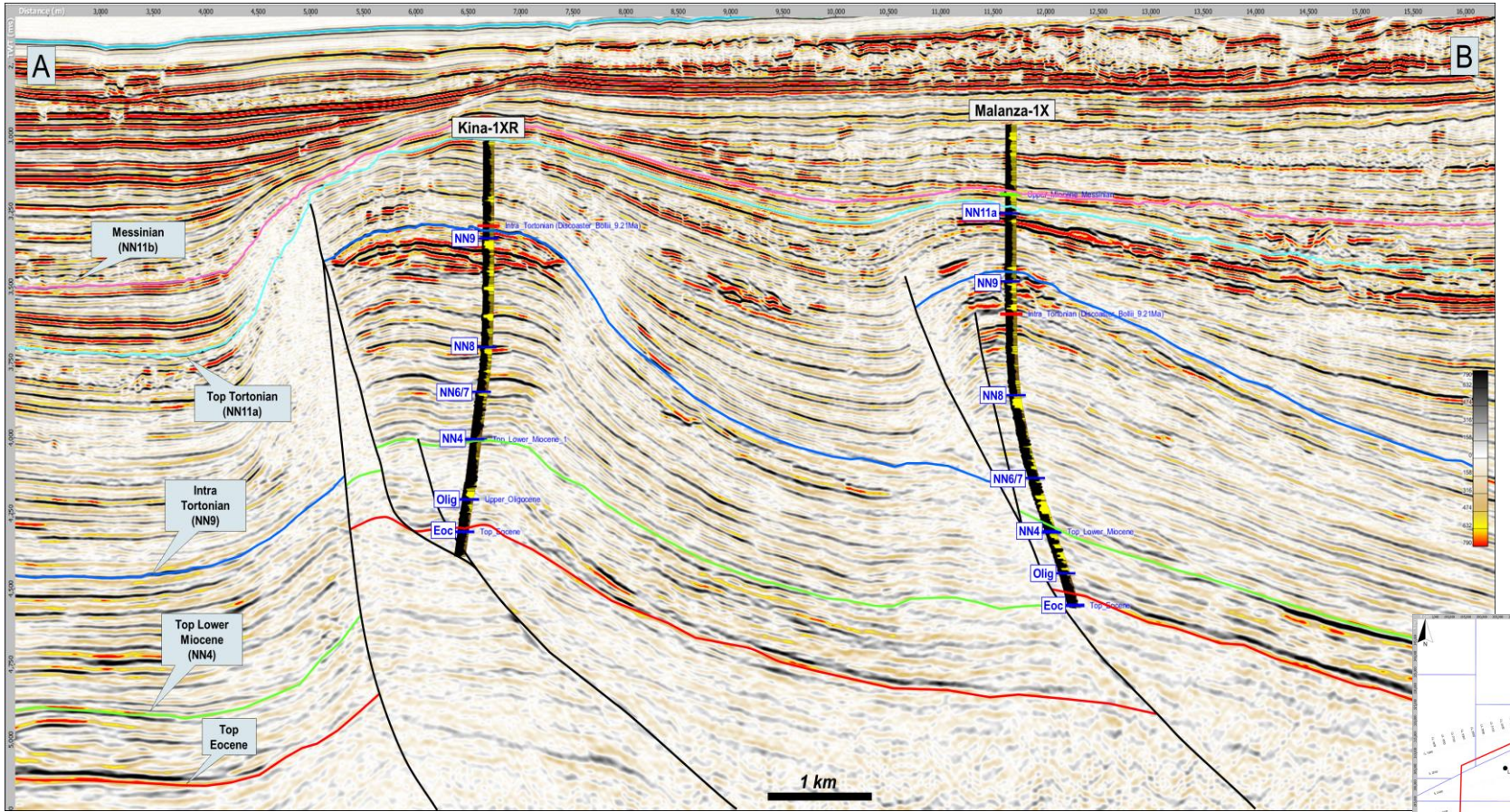
Well to seismic tie - Enitimi

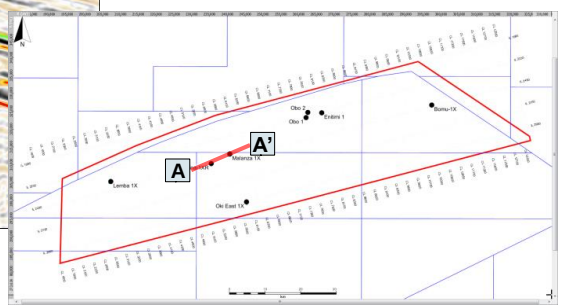




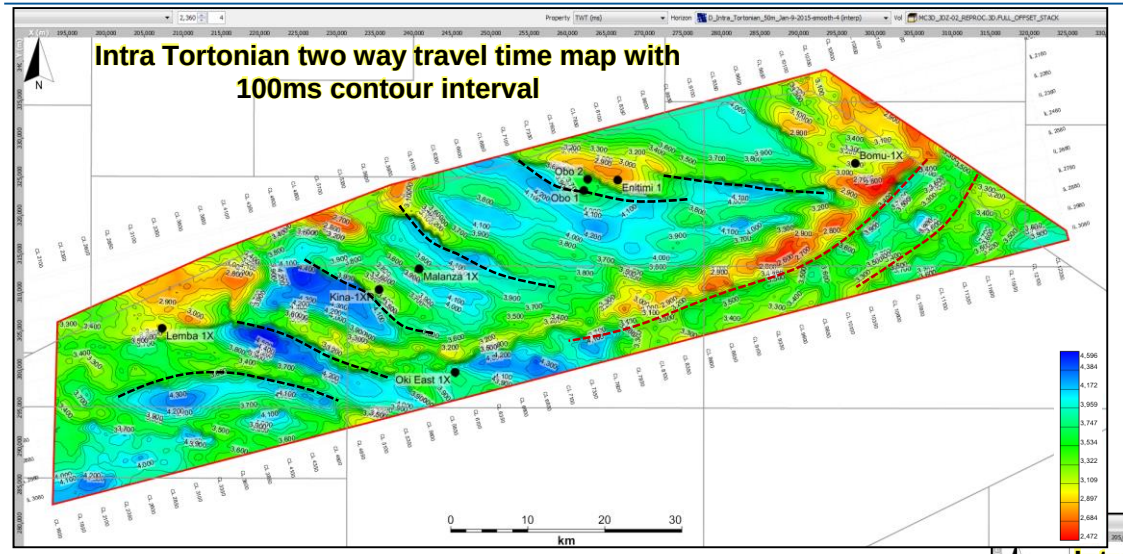


Build and interpret sequence framework in 3D dataset



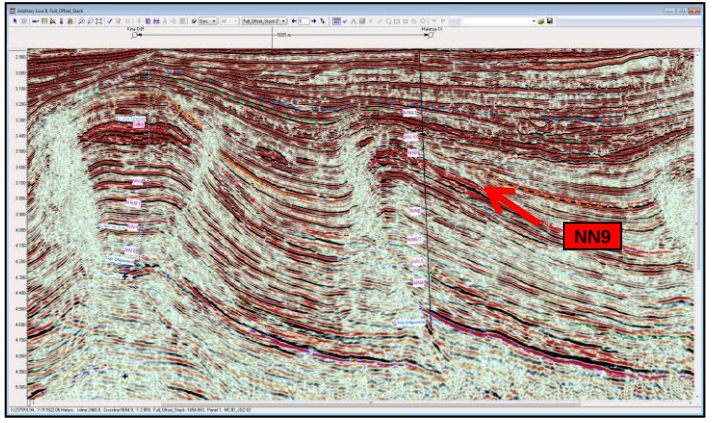


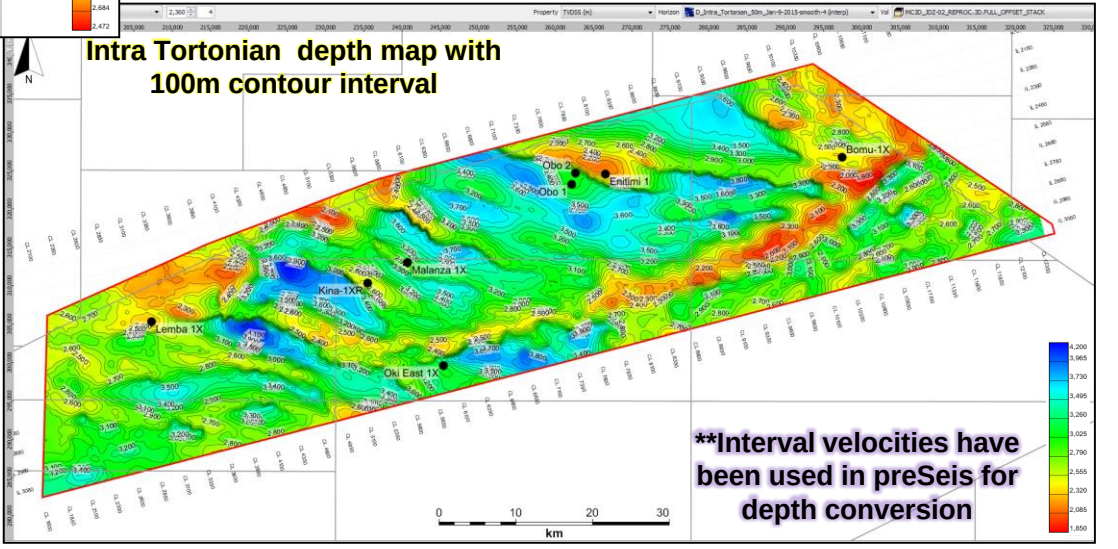
Example time and depth structure maps



Faulting associated with Shale Swelling Zone

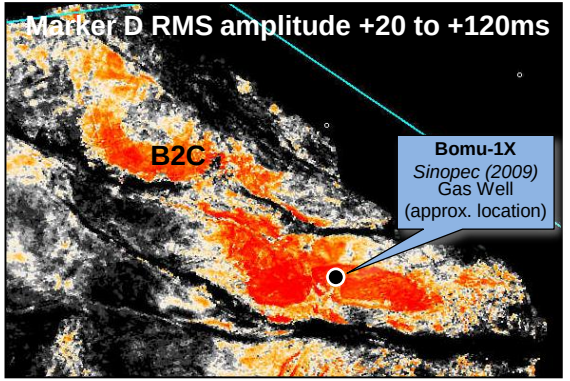
Faulting associated with Frontal Toe Thrust Zone





**Interval velocities have been used in preSeis for depth conversion

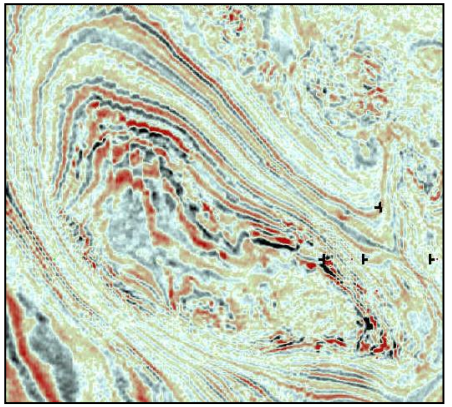
Play analysis - an example of a structural lead

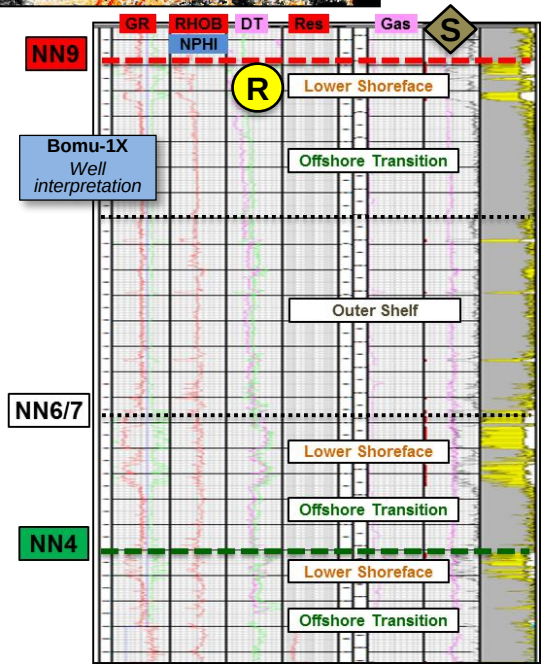


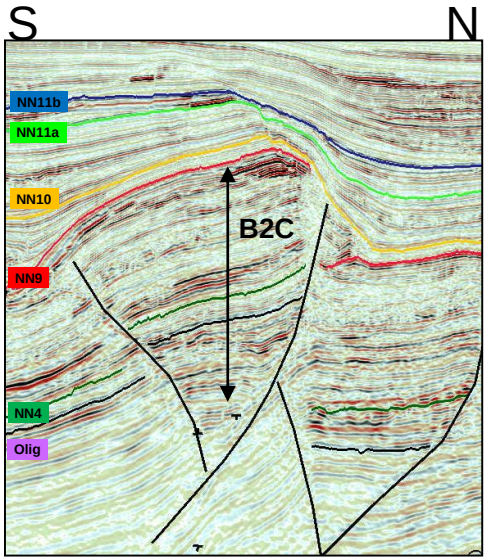
Structural Lead:

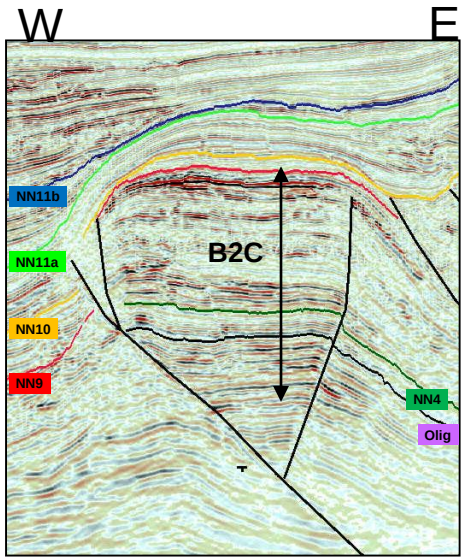
Closure within a toe thrust, very bright amplitudes at crest

Reservoir: likely to be Lower Shoreface sands
Seal: likely to be intra-formational TST transgressive muds.

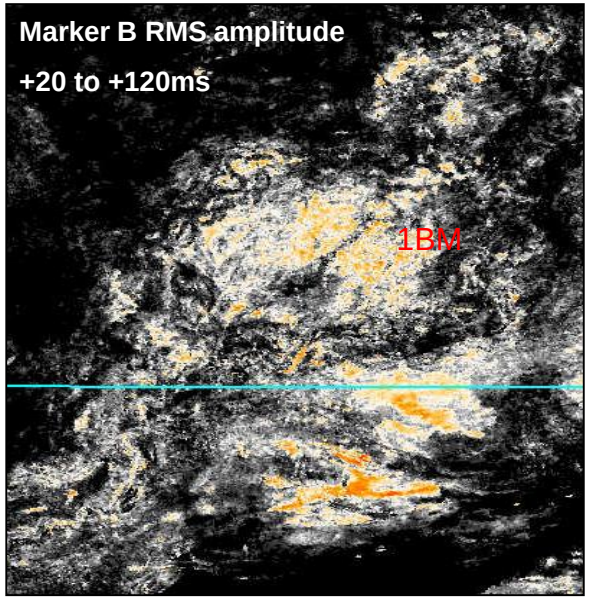


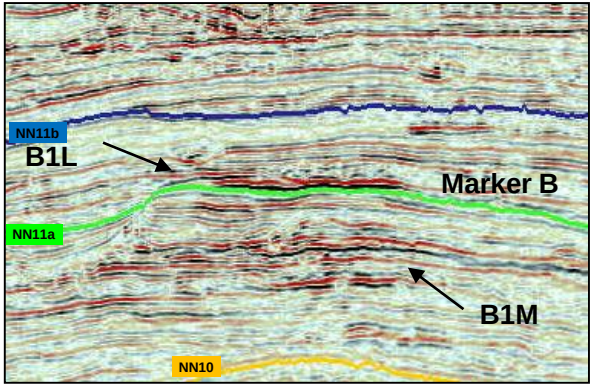






Play analysis - an example of a stratigraphic lead

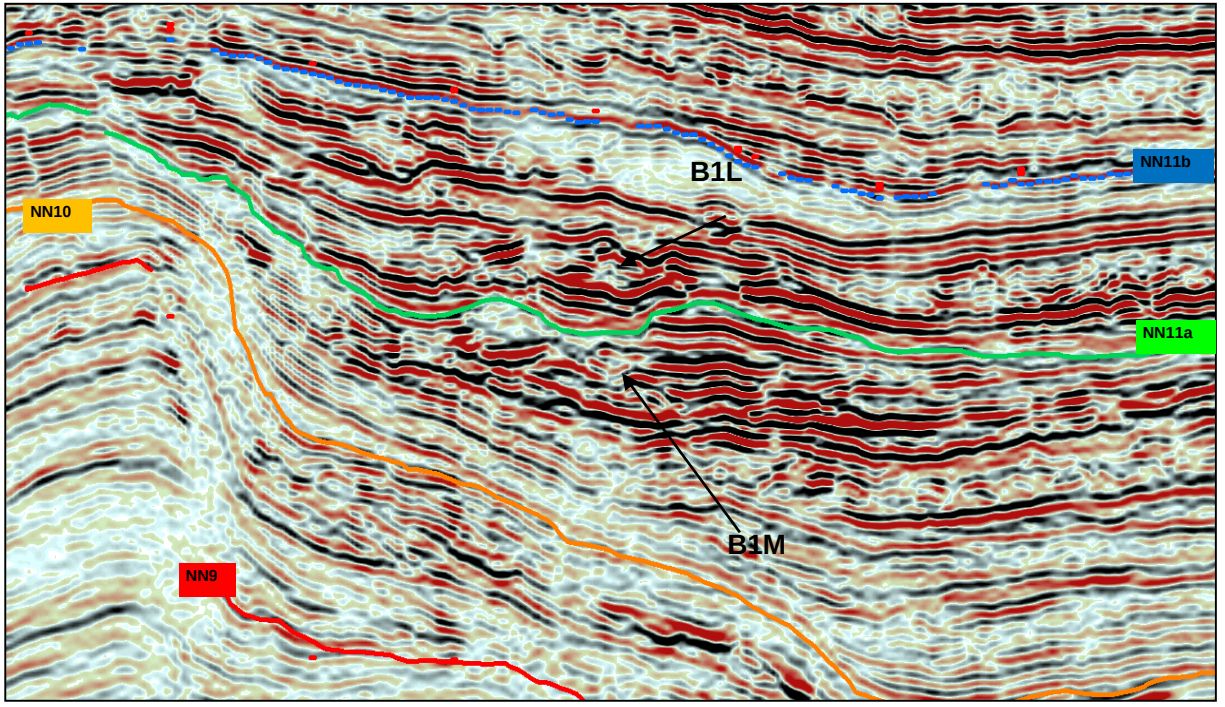




Stratigraphic Lead:

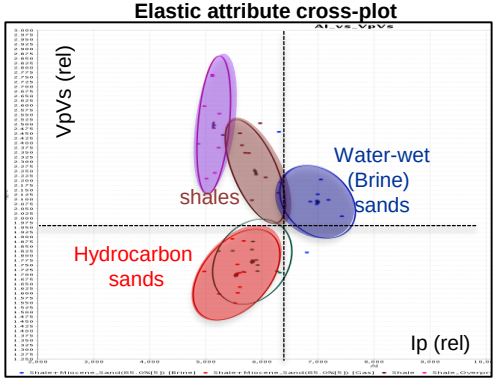
Sand prone body pinching out against thrust fault.

Reservoir: likely to be Offshore Transition mass flow or Lower Shoreface
Seal: likely to be intra-formational TST transgressive muds.

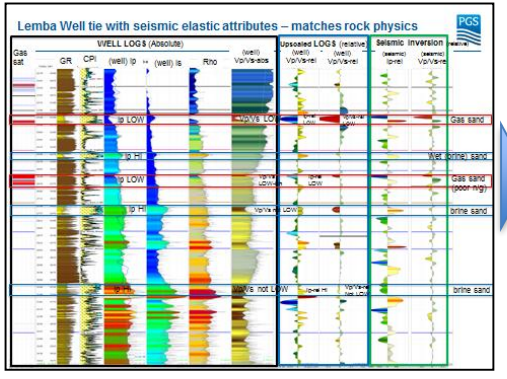


Quantitative Interpretation

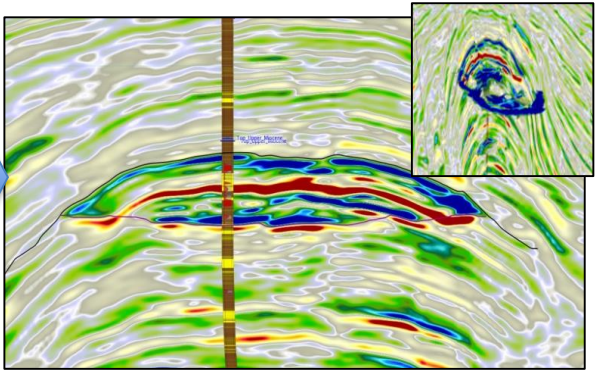
Reservoir analysis - quantitative interpretation workflow



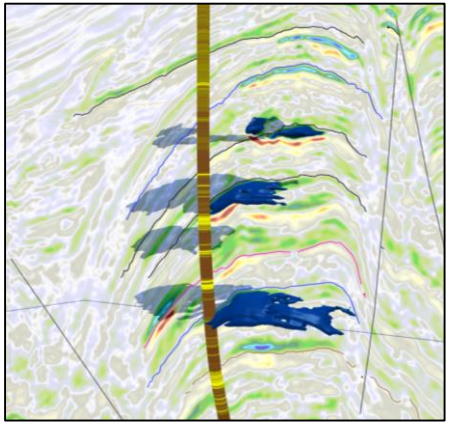
Rock physics shows elastic attributes can discriminate shale – brine sand – HC sand



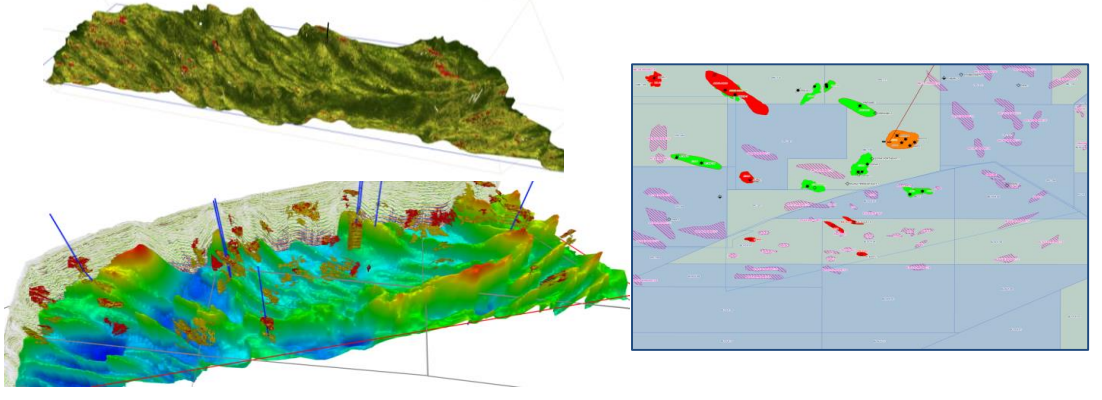
Well log elastic attributes discriminate lithology & fluid (shale – brine sand – HC sand). This pattern is consistent with the seismic elastic attributes (Ip and Vp/Vs)



Seismic sections of elastic attributes clearly show the difference between – shale, brine sand & HC sand with strong changes at hydrocarbon water contacts

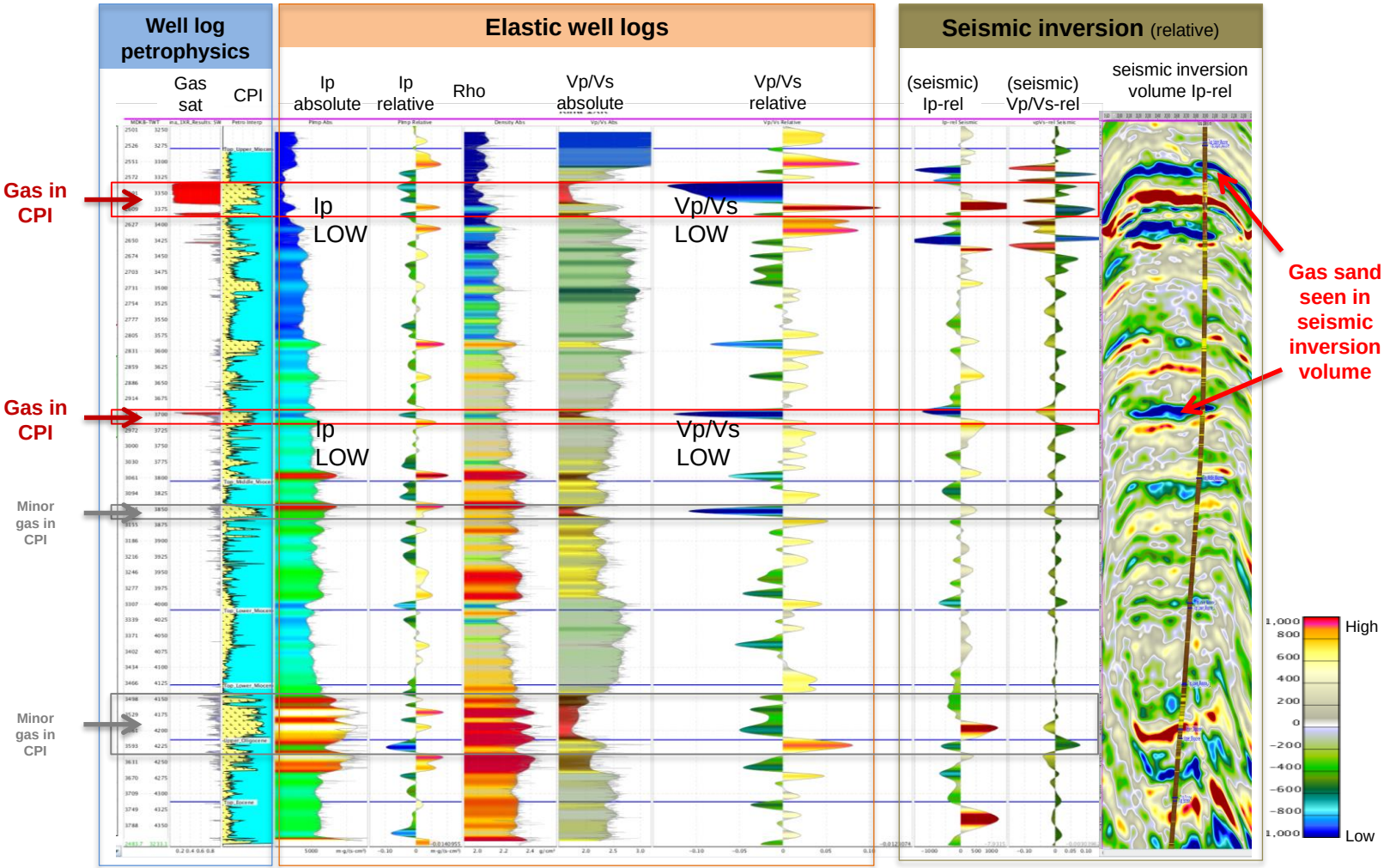


We have mapped the top or base of anomalies in leads and discoveries to understand the relationship between HC fill and structural closure / fill

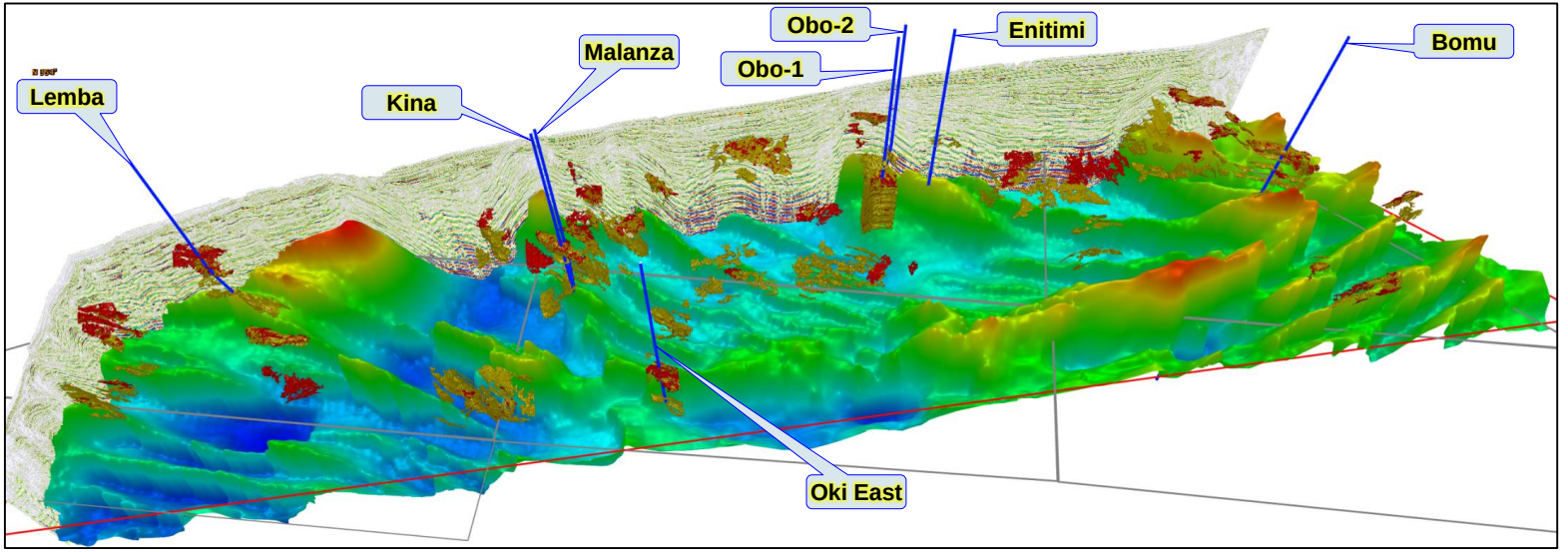


With such a clear pattern in elastic attributes we can auto-detect areas of specific values (low Ip and/or Vp/Vs) as 'geobodies'.
These are calibrated to well log reservoir properties and identify many untested leads

Example well tie with seismic elastic attributes



3D view of wells and leads: Geo-bodies extracted from Ip & Vp/Vs

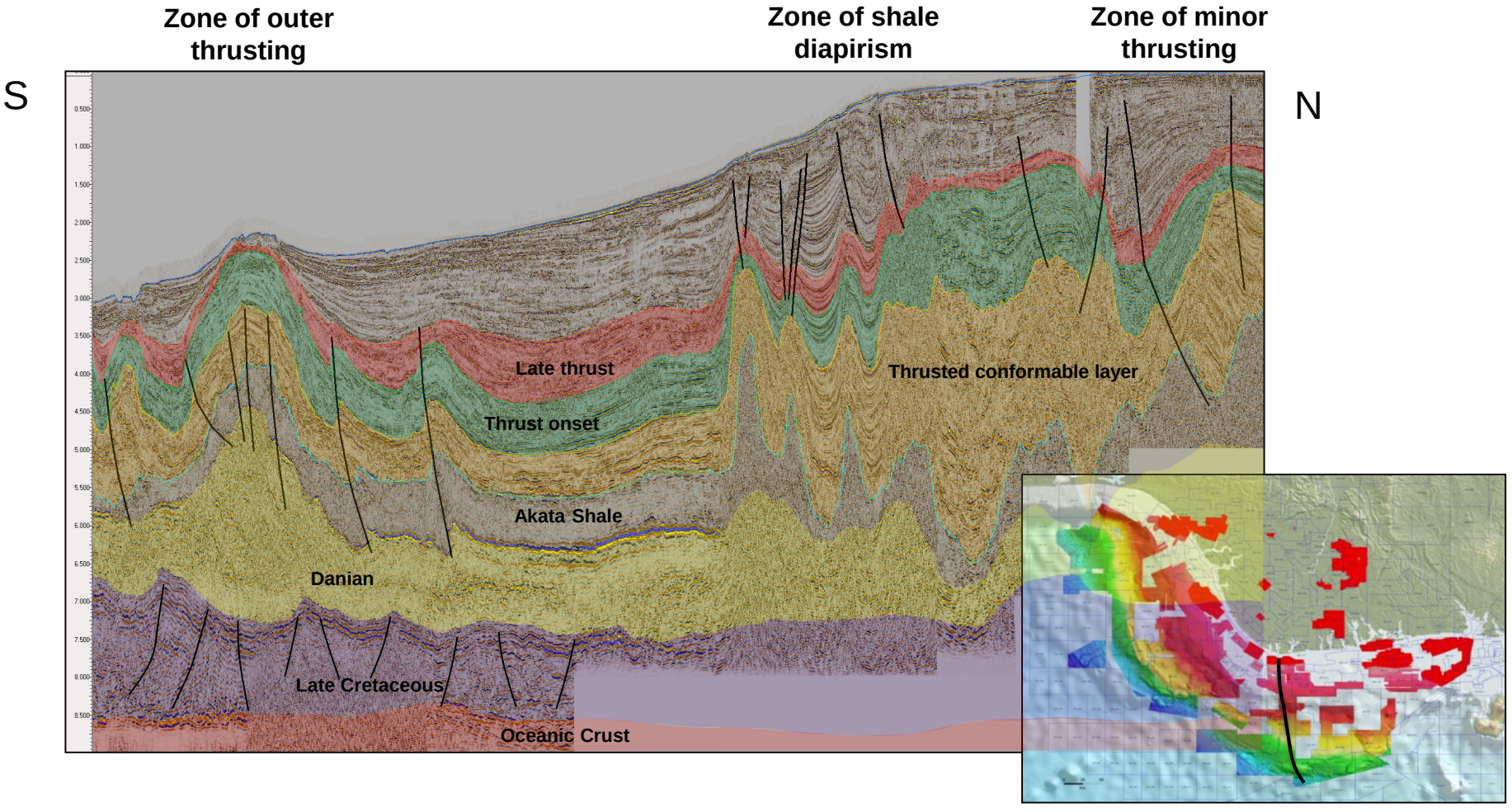


Basin Modelling

Sub Akata Prospectivity

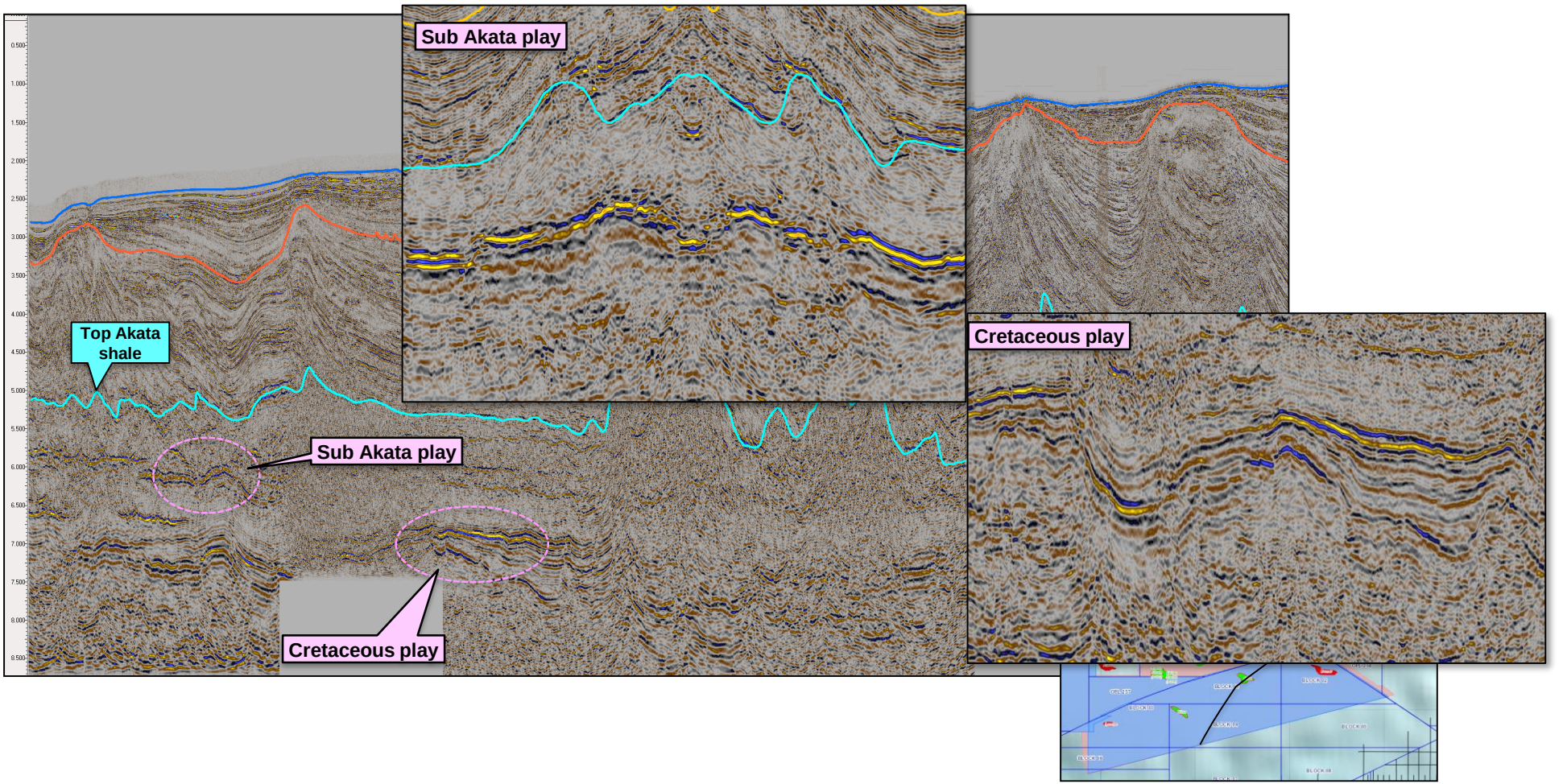
PGS Discovery Webinar – Deeper Insight into the Niger Delta

Tectonic domains through southern Niger Delta



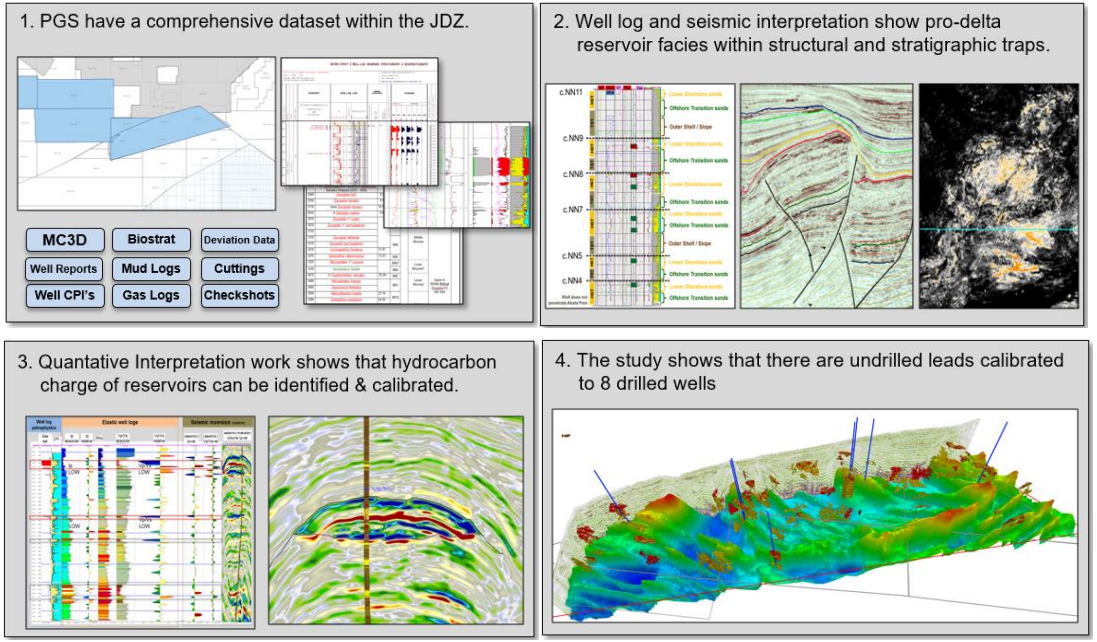
PGS Discovery Webinar – Deeper Insight into the Niger Delta

The South-eastern front – sub-Akata opportunities



Conclusions

- JDZ is significant hydrocarbon prone area. All the elements of working petroleum system have been identified and evaluated
- 8 wells have been drilled with both oil and gas discovered
- Depositional sequence interpretation shows that reservoirs are lowermost shoreface sands and pro-delta mass-flow sands (channels, fans and lobes)
- The sub-Akata section may be provide a secondary petroleum system
- Quantitative interpretation is an important tool for derisking
- Opportunities to develop discoveries and drill stacked reservoirs



Thank You

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