Centre of Excellence in Geoscience and Petroleum Engineering
University of Benin

INTEGRATED FIELD DEVELOPMENT STRATEGY OF F5000 AND G8000 RESERVOIRS IN OBOM FIELD.

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OUTLINE

- Field Overview
- Data review/ Study workflow
- Stratigraphic correlation/ Facies identification
- Sequence Stratigraphic Framework
- Conceptual model
- Fault interpretation/ Horizon interpretation
- Structural modelling
- Upscaled logs/ Facies model
- Petrophysical Modelling
- Reservoir Volumetrics
- Development Opportunities
- Conclusion

PROJECT OBJECTIVES AND DELIVERABLES

Business Objective

- To carry out detailed QA/QC and interpretation of all available subsurface data from the field.
- To identify key subsurface uncertainties and their respective impacts on static volumes.
- Estimate the potential of F5000 and G8000 reservoirs.
- Integrate with other disciplines and Identify production opportunities

Key Deliverables

- Re-interpreted 3D Seismic
- Build new static models for G8000 and F5000 reservoirs

FIELD OVERVIEW

Location	East Niger Delta
Area	Onshore, Land
Discovery History	1965 by OBOM-001

Drilled Wells

14 wells

Structural Geology

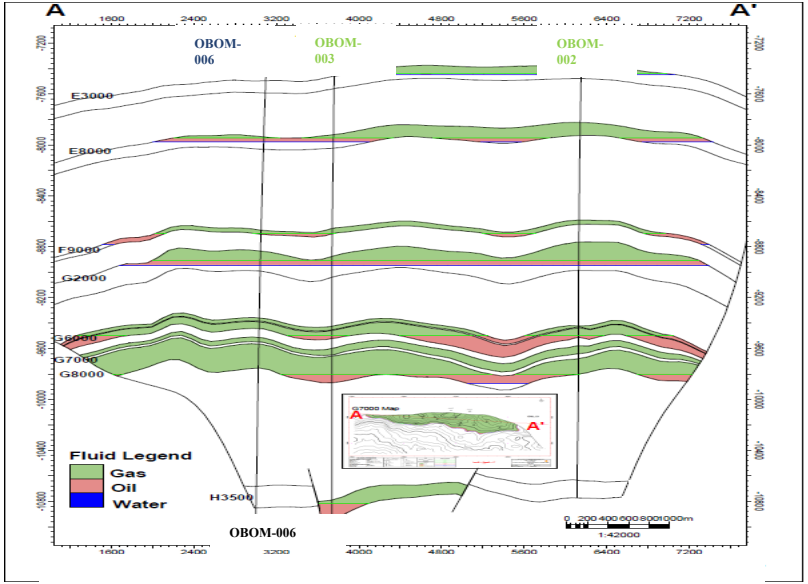
The field is a simple rollover structure elongated in the east-west direction, and bounded by a curved growth fault in the north-west and south-east direction. The trap mechanisms are dip closures for shallow reservoirs and dip assisted fault closures for deeper ones.

Field Description

Environment of deposition: The field is made of stacked paralic sequence of sand, silt and shale. The field has a total of 42 stacks of reservoirs penetrated between 6400-12900ftss.

Production Highlights

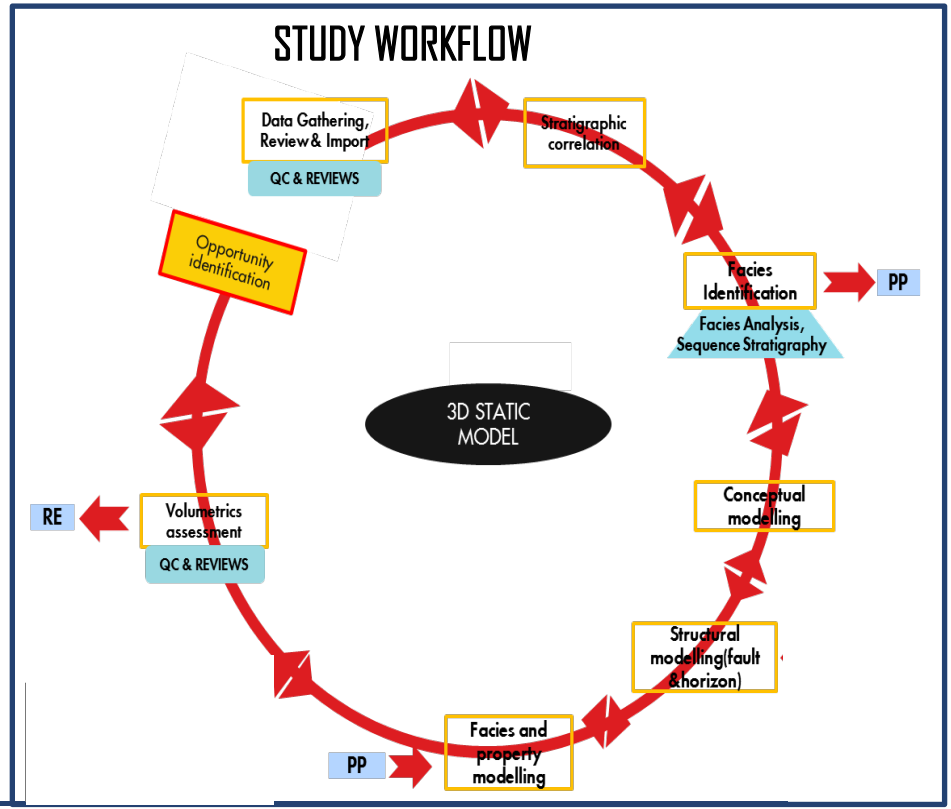
Only two wells are currently producing from the reservoirs in the field.



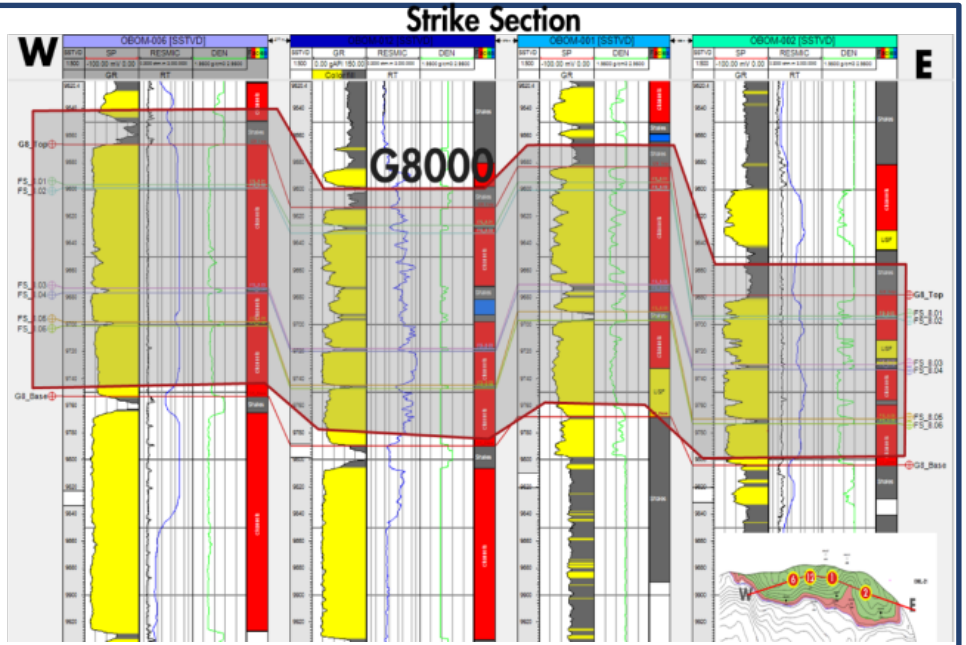
Reservoir	OIIP (MMstb)	GIIP (Bscf)	URo (MMstb)	URg (Bscf)	Np (MMstb)	Oil Reserves (MMstb)	Gas Reserves (Bscf)
F5000	-	19.00	-	11.59	-	-	11.59
G8000	44.20	240.70	18.00	146.83	15.13	2.87	146.80

DATA REVIEW/ STUDY WORKFLOW

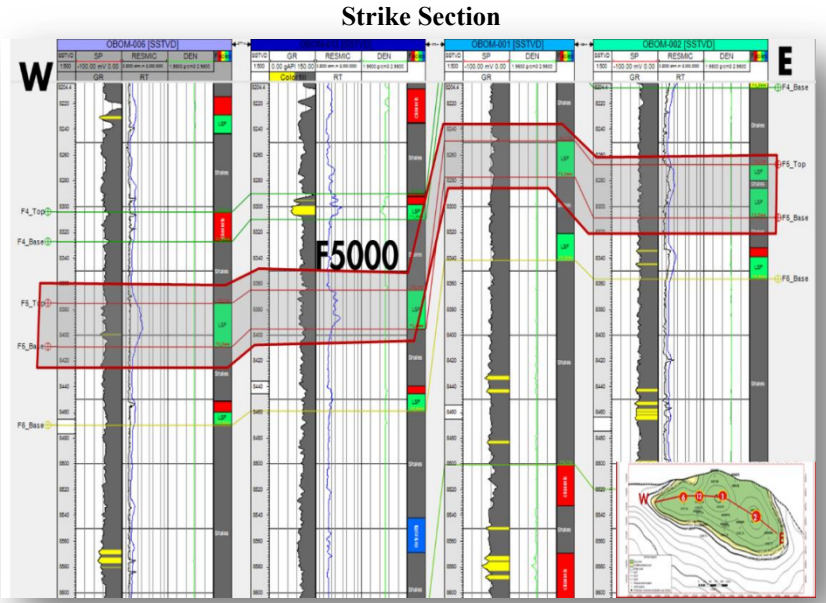
Well	GR	SP	CAL	RES	NEU	DEN	CORE	SWS
OBOM-001	Y	Y	Y	Y	N	N	N	N
OBOM-002	Y	Y	Y	Y	Y	N	N	Y
OBOM-003	Y	Y	Y	Y	N	Y	N	Y
OBOM-004	Y	Y	Y	Y	Y	N	N	Y
OBOM-005	Y	Y	Y	Y	Y	Y	N	Y
OBOM-006	Y	Y	Y	Y	N	N	N	N
OBOM-007	Y	Y	Y	Y	N	Y	N	Y
OBOM-008	Y	Y	Y	Y	N	Y	N	Y
OBOM-009	Y	Y	Y	Y	Y	Y	N	N
OBOM-010	Y	N	Y	Y	Y	N	N	Y
OBOM-011	Y	N	Y	Y	N	Y	N	Y
OBOM-012	Y	N	Y	Y	N	Y	N	N
OBOM-013	Y	Y	Y	Y	N	Y	N	N
OBOM-014	Y	Y	Y	Y	Y	Y	Y	N



STRATIGRAPHIC CORRELATION/FACIES IDENTIFICATION



- Correlation of OBOM wells on west – east direction(W-E) along strike showing the lateral continuity of reservoir.
- Dip: Depositional story



- Correlation of OBOM wells on west – east direction(W-E) along strike showing the lateral continuity of reservoir.
- Dip: Depositional story

Note: The F5 reservoir sand are likely a radioactive sand that could not be delineated with Gamma-ray hence SP, RT and Density logs were utilized. Its facies Identification was analyzed SWS description.

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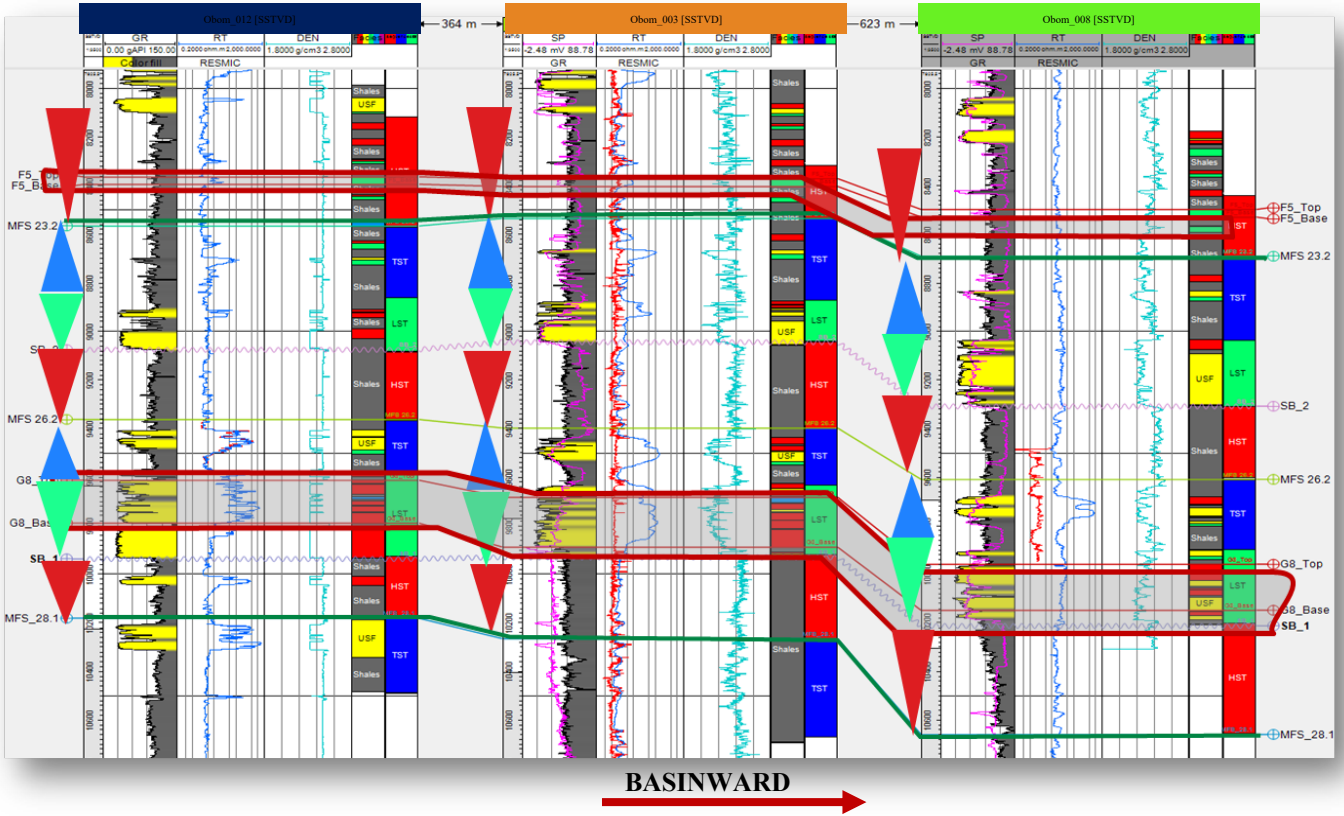
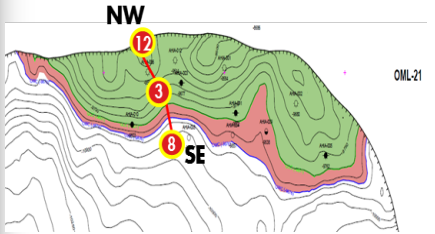
FRAMEWORK

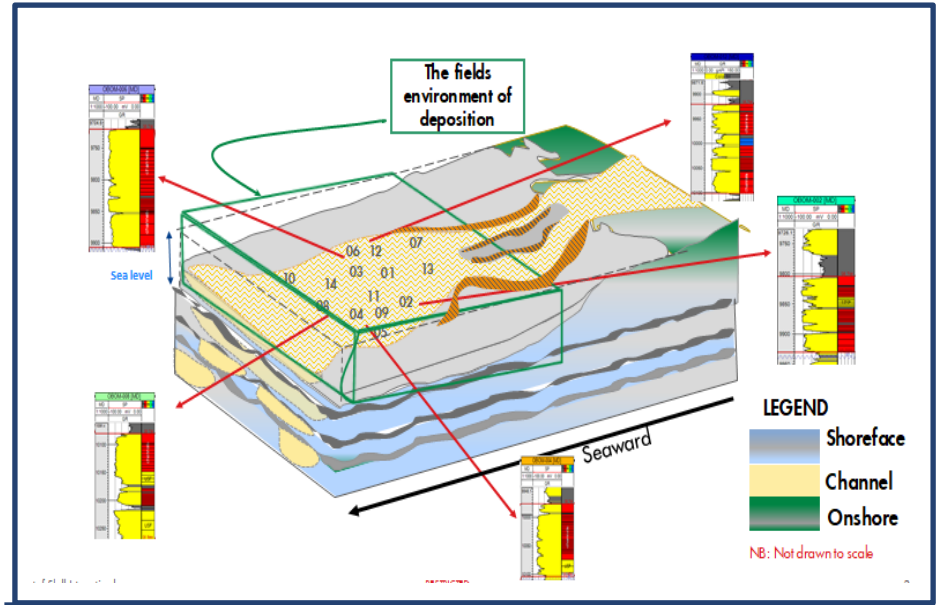


Two 3rd order depositional cycles occurred from the G8000 sands to the F5000 sands with a retrogradation sequence

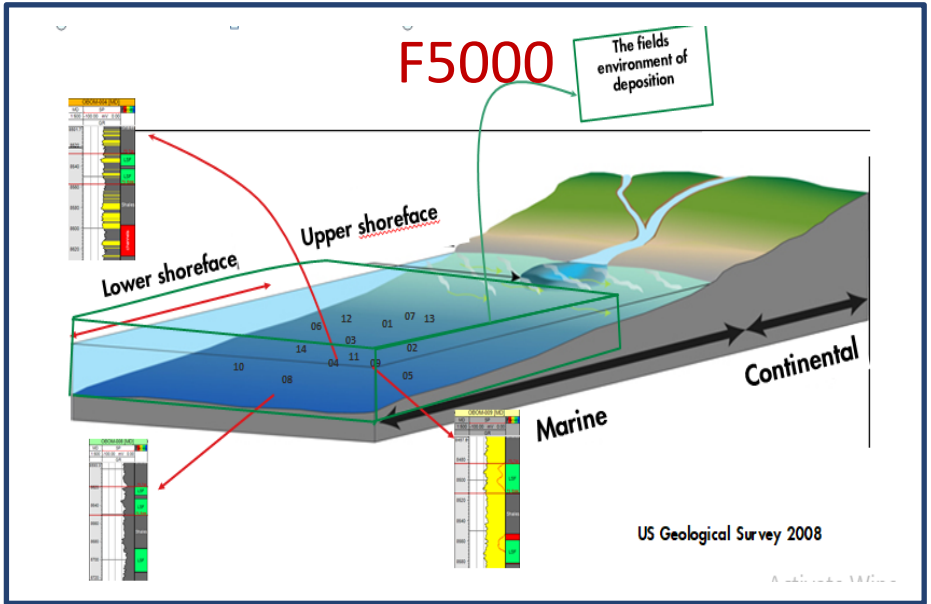


Highstand systems tract	
Transgressive systems tract	
Lowstand systems tract	

F5 MODELS

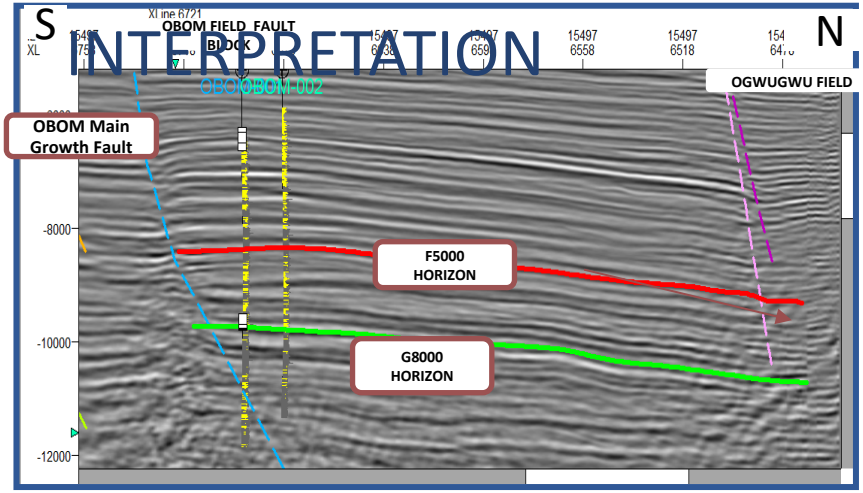


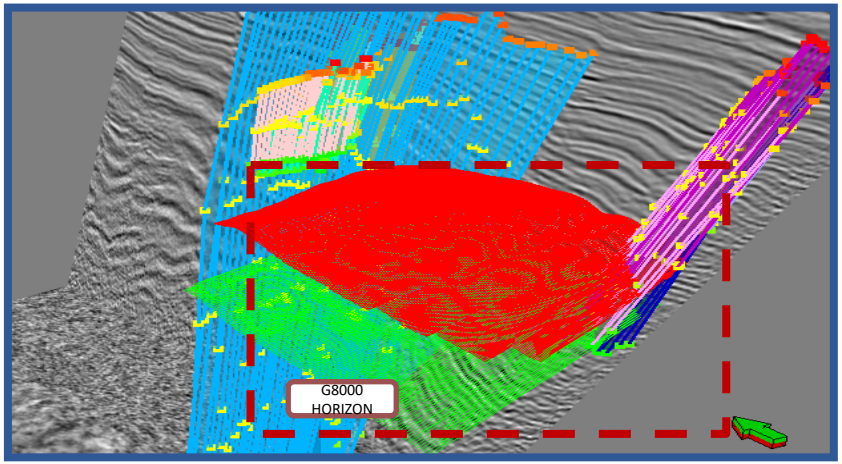
- Evidence from well log correlation, SWS description and Sequence Stratigraphy indicates that the G8000 sand was deposited in a channelized shoreface environment in the late Oligocene age.
- Facies association identified include channel sands, Upper shoreface, heteroliths and shales.

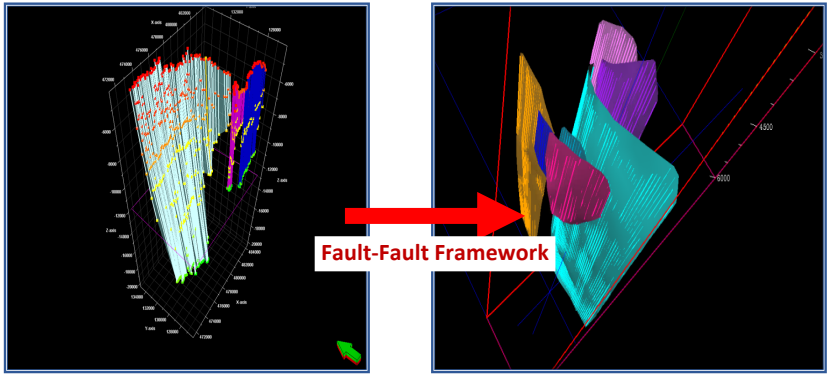


- Evidence from well log correlation, SWS description and Sequence Stratigraphy indicates that the F5000 sand was deposited in a Lower shoreface environment in the early Miocene age.
- Facies association identified include lower shoreface, and shales.

FAULT/HORIZON INTERPRETATION







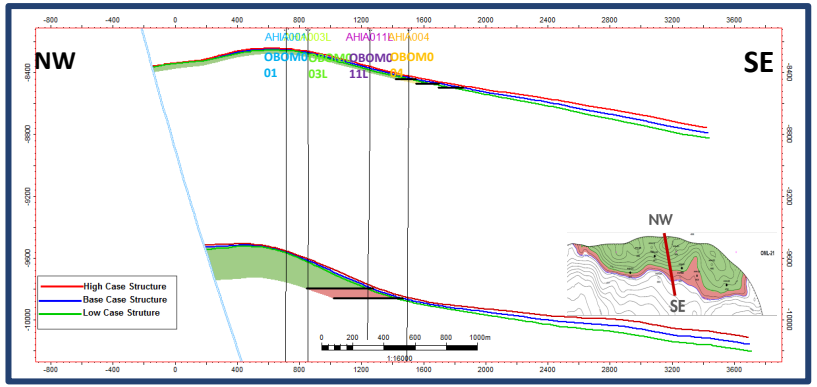
Notes

- Horizons were interpreted by picking event on a grid of 4inlines & 4xlines sections
- Faults were interpreted every 5lines (125m intervals) in the inline direction from West to East flank of the OBOM survey(AOI)
- Semblance slice volume was used to QC fault picks, the existence of fault and the geometry of faults from shallow (1.0ms) to deeper level(2.8ms)

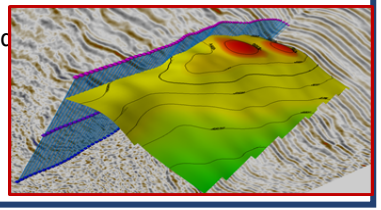
Result:

- Interpreted F5000 horizon (shallow reservoir) and G8000 horizon (deeper reservoir)
- Both Horizons showed Roll-over anticlinal structure on the Main growth fault
- Total of 8 faults interpreted within the AOI. The Major fault of interest is the growth fault (Cyan).
- Fault –to fault framework built for structural framework building & input for understanding aquifer drive direction

STRUCTURAL MODELLING

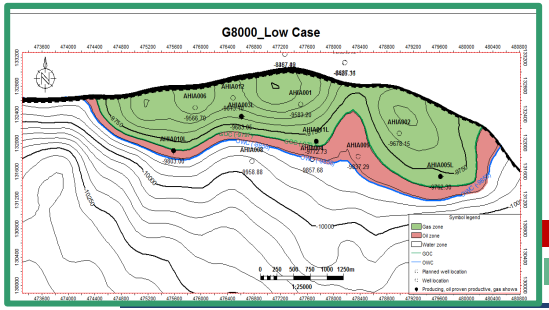


- Structural model were built to capture the trapping mechanism of the OBOM field in 3D. One major growth fault was modelled in the OBOM Field.
- Faults were modelled to best represent the subsurface using seismic volume and semblance slice as QC.
- Using a depth uncertainty of 34ft for the F5000 and realizations were made for the two reservoirs.

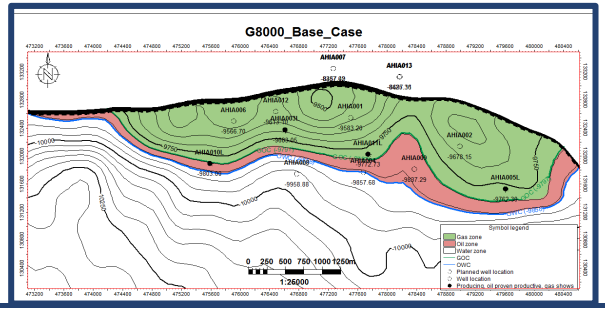


Structural Realizations For G8000 Reservoir

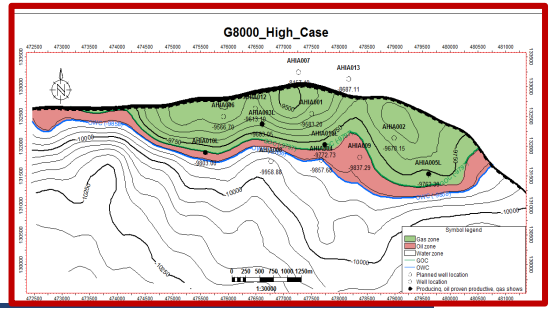
Low Case; GRV = 177300 acre.ft



Base Case; GRV = 191,930 acre.ft



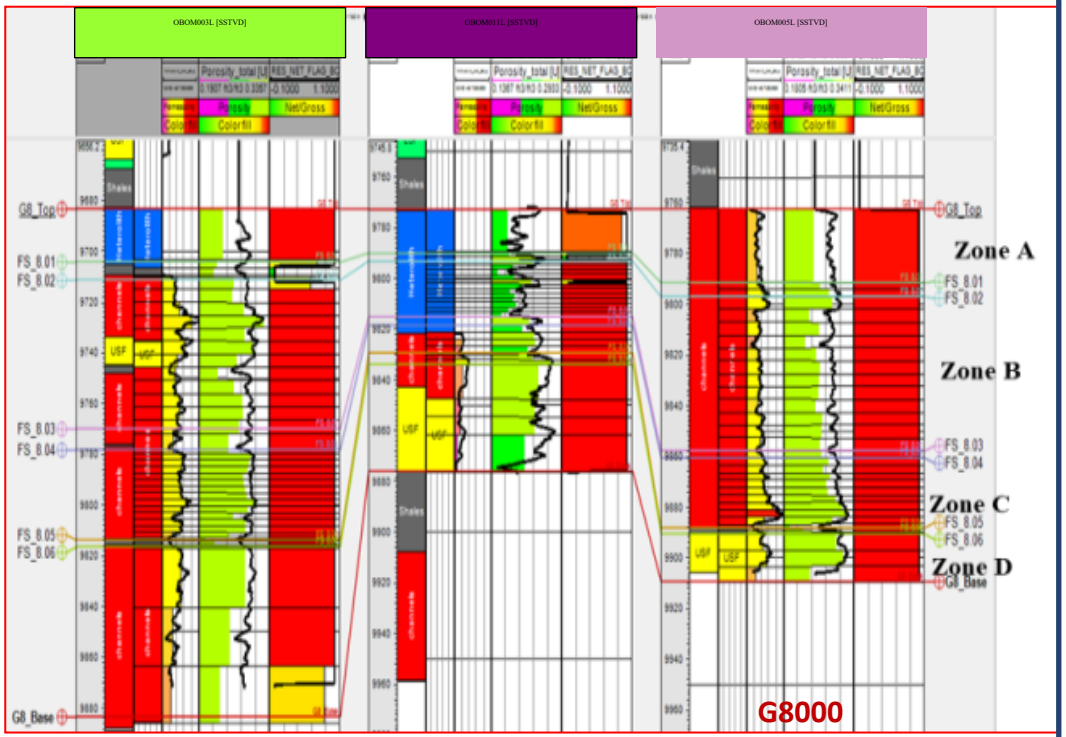
High; GRV = 209,150 acre.ft

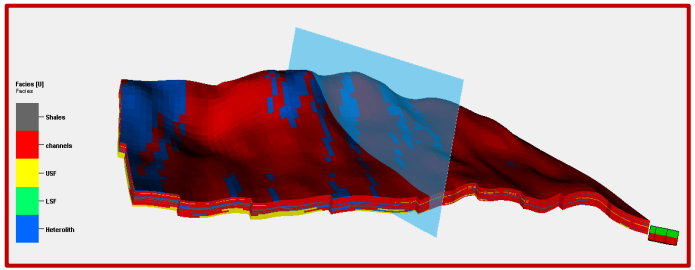


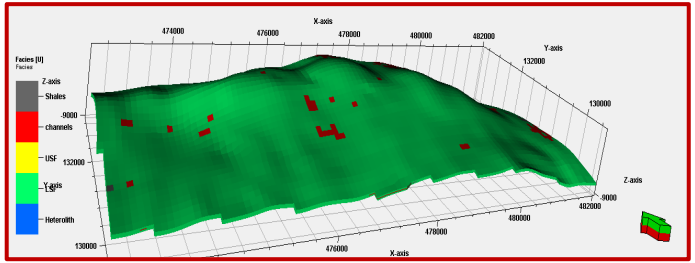
Oil

Gas

UPSCALE LOGS/FACIES MODEL

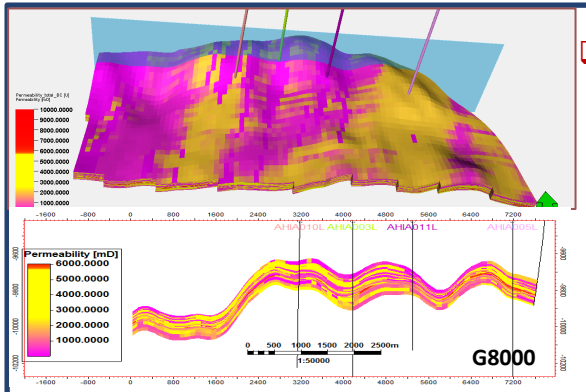






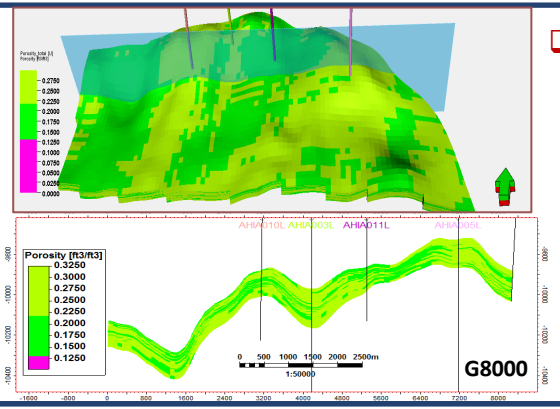
- The facies model was built using Sequential Indicator Simulation algorithm.
- To capture flow units the G8000 reservoir model is subdivided into 4 zones
- To further capture reservoir heterogeneities the flow units were subdivided into layers. A total of 32 layers for G8000 and 4 layers for F5000

PETROPHYSICAL MODELING FOR G8000



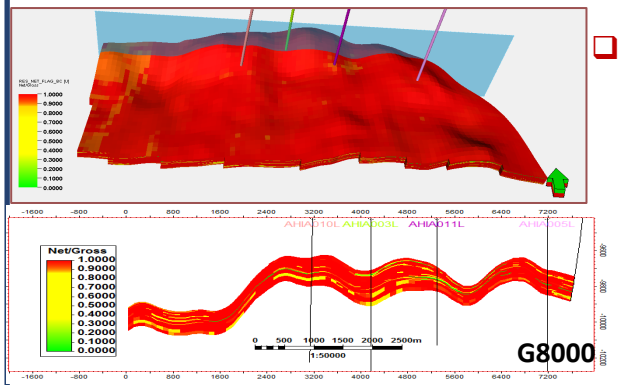
- Built using the Sequential Gaussian simulation algorithm and cokrigged to porosity. Average =2137mD

PERMEABILTY MODEL



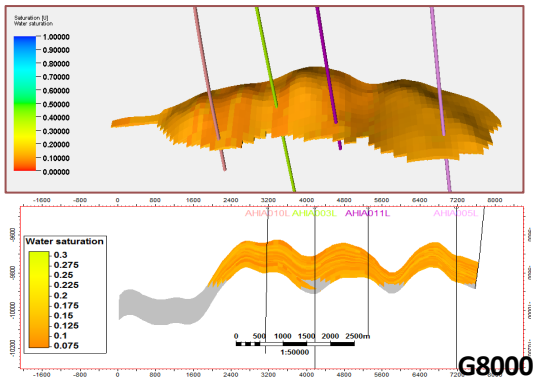
- Built using the Sequential Gaussian simulation algorithm Average = 0.23%

POROSITY MODEL



- Built using the Sequential Gaussian simulation algorithm Average = 0.92%

Net to Gross MODEL

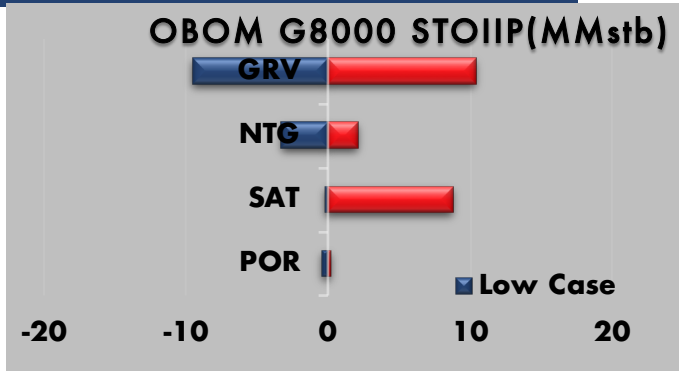


Saturation model was created for G8000 reservoirs using the SHF parameters from Saturation modelling by the PP

SATURATION MODEL

RESERVOIR VOLUMETRICS

- Using the different structural realizations resulting in different GRVs static volumes were estimated.
- Imported saturations from the Reservoir Engineer used to compute volumes.



AVERAGE PROPERTIES/VOLUMES												
Reservoir	Fluid Type	Contacts [ft]			Net to Gross			POR (%)	SAT (%)	Volumes		
		LC	BC	HC	LC	BC	HC			LC	BC	HC
G8000	Oil (MMstb)	OWC -9858	OWC -9858	OWC= -9858	0.92	0.97	0.99	23	4.7	40	47	52.8
G8000	Gas (Bscf)	GOC -9797	GOC -9797	GOC -9797	0.92	0.97	0.99	23	87	232	261	309
ARPR 2017 for oil										31.2	44	60.70
ARPR 2017 for gas										**172**	**240**	**320**
F5000	Gas (Bscf)	GDT= -8441	Midway= -8469.5	WUT= -8498	0.69	0.77	0.99	11	12.9	29.3	37.4	51.74
ARPR 2017										**19**		

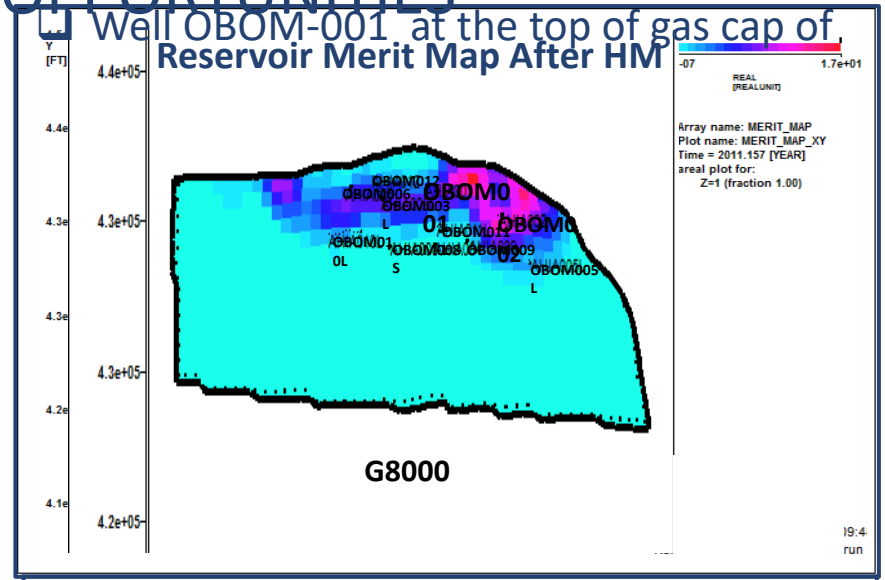
UNCERTAINTIES

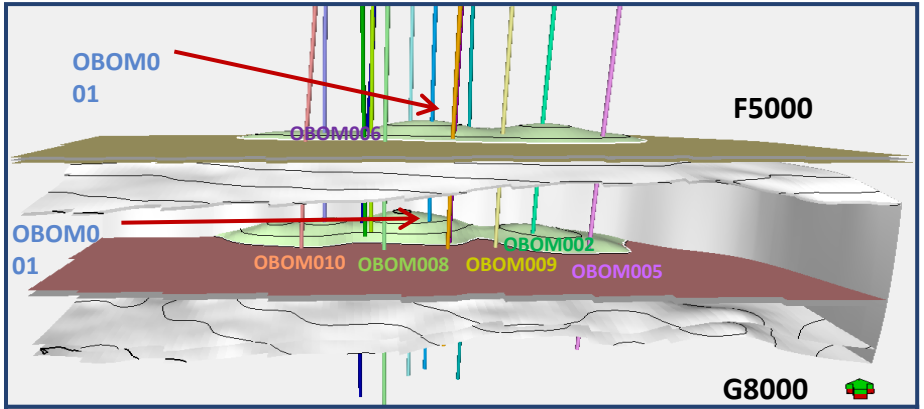
Key Uncertainty parameters used to calculate Low, Base and High case realisations are:

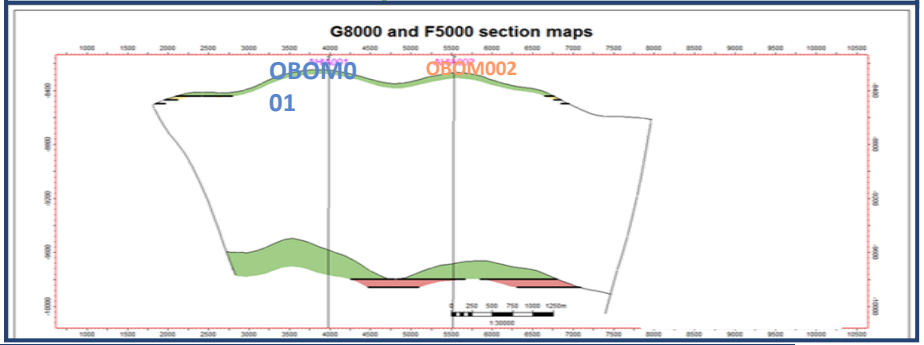
- Contacts
- Depth uncertainty
- NTG

DEVELOPMENT OPPORTUNITIES

- After Integrating with the Reservoir Engineer both reservoirs
- Well OBOM-001 at the top of gas cap of







Further oil development opportunities exist in OBOM002 as seen from the hydrocarbon saturation merit map.

CONCLUSION

- Deterministic Base case in-Place volumes of 261Bscf of gas and 47MMstb of oil for G8000 reservoir and 37.4Bscf of gas for F5000 reservoir.
- Depositional Environment: The G8000 reservoir was deposited in a channelized shoreface environment and the F5000 reservoir a Lower shoreface deposit.
- Key Impacting uncertainties are: Contacts, Net to Gross and Structure. The identified uncertainties have been managed by building realization to capture all possible outcomes.
- Optimum subsurface development concept for F5000 and G8000 reservoirs is one new vertical gas well (recompleted existing well) and the recompletion of OBOM002 in G8000 reservoir for oil production.

Thank you for listening