
NIGERIAN ASSOCIATION OF
SINCE
1975
PETROLEUM EXPLORATIONISTS

The Past is the Key to The Future: The Regis Field 2022 New Oil Campaign Experience

Abidemi Belgore, Nnaemeka Umeh, Christabel Chidiebere, Timi Jenakumo, Oluwaseyi Adekoya, Somime Oguntola and Jaume Hernandez
Shell Nigeria Exploration and Production Company Limited (SNEPCo)

ABSTRACT

The Regis field is a deepwater brown field in the Gulf of Guinea, and like most brown fields, has its own fair share of late life development challenges. These challenges ranges from poorer reservoir properties, low drilling margin, poor well performance and so on. These challenges were heightened during the 2018 drilling campaign, and necessitated a look back, going back to basics and adopting a learner's mindset on how to get better results from future opportunities; especially from postmortem of what went wrong. A combination of new oil improvement initiatives born out of the look back was adopted for 2022/23 drilling campaign. These initiatives include: Reservoir geobody mapping of individual discrete sand bodies, to highlight extent, orientation, shape, and isolation/connectivity. Net-Sand/V-Shale maps from seismic inversion (absolute impedance data) and Near angle stack OBN seismic as proxy for lithology distribution. Further velocity model update incorporating recent well data for structural uncertainty management. Single Velocity model build to process all seismic volumes. Alternative Geological Scenarios. The focus of this paper is on how the Netsand derived map and Geobody mapping was used to achieve optimum well results.

Keywords: Learner's Mindset, After Action Review, Netsand derived Maps, Geobody Mapping, well placement.

INTRODUCTION

Results of Regis 2018/19 "New Oil" campaign clearly showed that Regis is currently dealing with "Late stage (Life) field development realities" with objective reservoirs much thinner, more baffled, limited in lateral extent and productivity/injectivity challenges. Sequel to an "After Action Review (AAR)" of the campaign, a detailed improvement plan was adopted with an end-to-end delivery plan to address the key challenges encountered in the areas of Net Sand Prediction, Well Placement, Drilling practices, Borehole Stability, Sand-face completion failure and Effective filter Wellbore Clean Up.

Based on recommendations from the AAR, the Regis project team, in a bid to ensure effective Net Sand Prediction and well placement in future wells, carried out net sand prediction from NTG inversion on seismic volumes.

METHODOLOGY

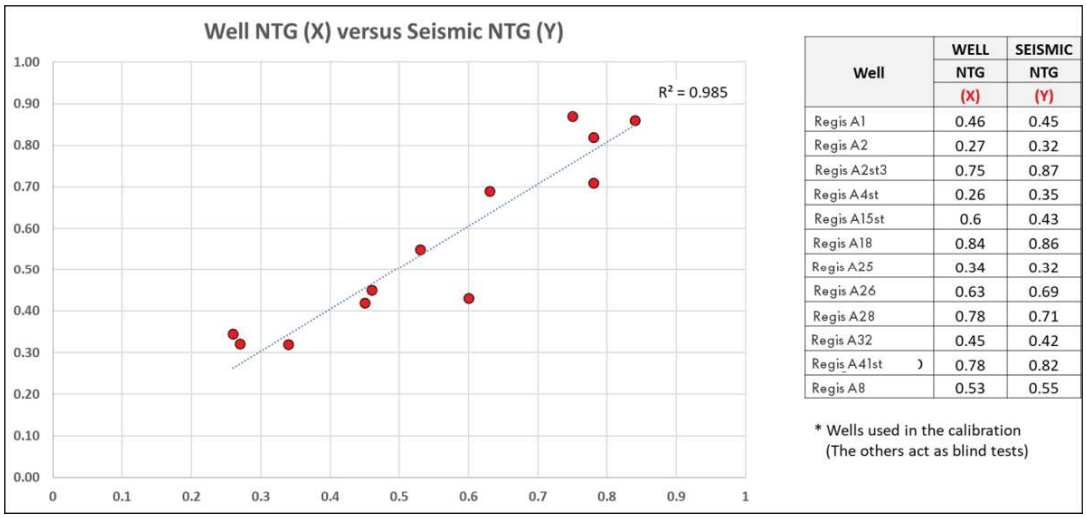
A new AVO inversion for NTG was derived from available 3D seismic data set. The inversion volume results were then calibrated with actual well data, until reasonable match was achieved; (R2 of 0.985). This was used to produce net sand maps where detailed geobody mapping was carried out on the target reservoirs which underpinned all new well proposals for the Regis 2022/23 drilling campaign.

Armed with these geobody maps, the placement of Regis A3 (injector)/A8 (producer) well pair and Regis A4 (producer)/A6 (injector) well pair were designed to ensure that producer-injector pairs were placed within high net areas in the same geobody or in geobodies with direct connectivity to mitigate compartmentalization within the reservoir. Well A3 was a replacement well for A57 which was found to be drilled in a compartmentalized body that could not provide injection support for A8.

In a similar vein, the A4 and A6 well pair were originally planned in a Field Development Plan based on the RMS amplitude in Figure 4A; where we had assumed a more connected body, hence a single-phase development was planned.

On further investigation using Geobody extracted from an impedance seismic data, the team optimized the well positions for optimum landing and connectivity as seen in Figure 4B.

The authors acknowledge the contributions of reviewers/assurers who brought clarity to the work and paper. Special thanks to SNEPCo and CoV partners for the permission to present and publish this paper.



Well	WELL NTG (X)	SEISMIC NTG (Y)
Regis A1	0.46	0.45
Regis A2	0.27	0.32
Regis A2st3	0.75	0.87
Regis A4st	0.26	0.35
Regis A15st	0.6	0.43
Regis A18	0.84	0.86
Regis A25	0.34	0.32
Regis A26	0.63	0.69
Regis A28	0.78	0.71
Regis A32	0.45	0.42
Regis A41st	0.78	0.82
Regis A8	0.53	0.55

* Wells used in the calibration
(The others act as blind tests)

Figure 1: Plot of well NTG (X) vs Seismic NTG (Y).

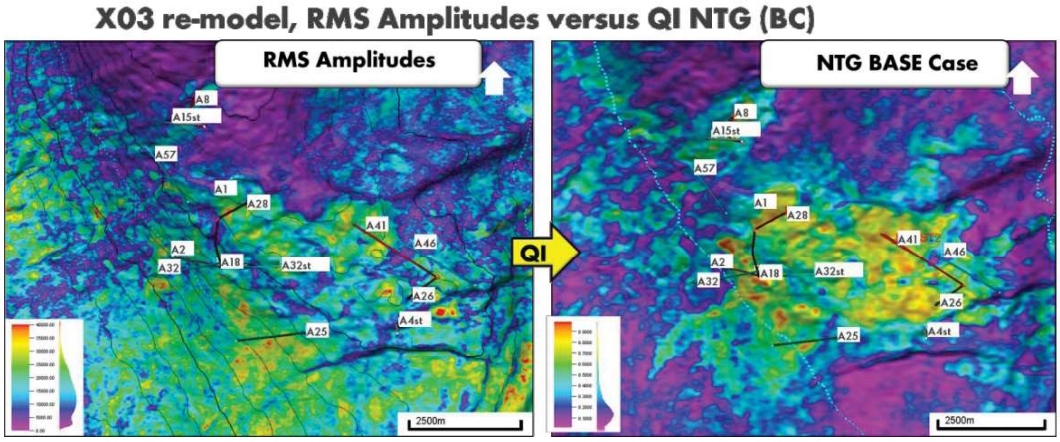


Figure 2: Close Match between RMS attributes extracted on the X03 Reservoir and Inversion generated NTG on same level.

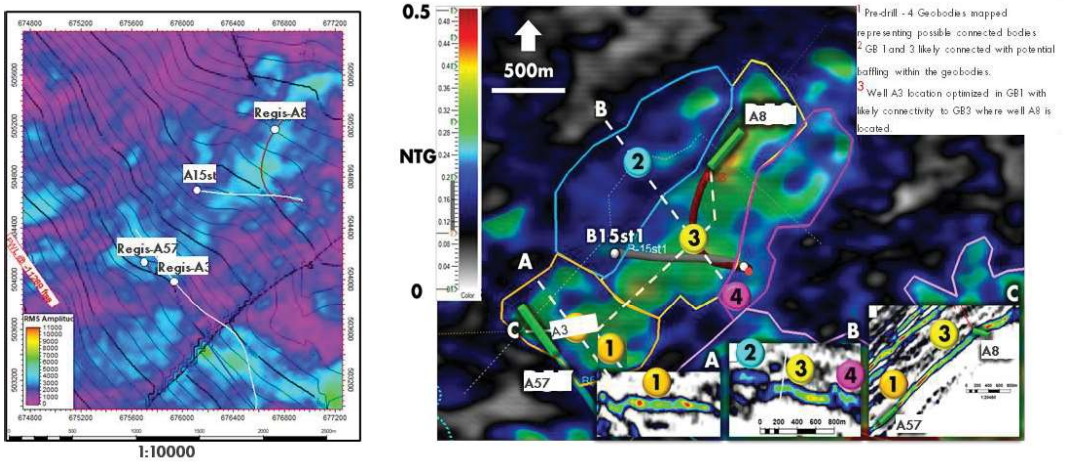


Figure 3A: Zoom Section on RMS attributes extraction (X03), which shows all bodies are connected, hence not adequate for proper injector producer well placement; Figure 3B: Geobody mapping polygon on Extracted Impedance Volume (X03), which shows discrete Geobody used for well placement optimization.

RESULTS AND DISCUSSION

This was the turning point for these wells because despite the limitation (and in some cases failure of the Wells A4 and A6 pressures trend with A1 while A2, A16 & A11 trend is ~13.6 psi higher. This suggest likely compartments within the X14 reservoir.

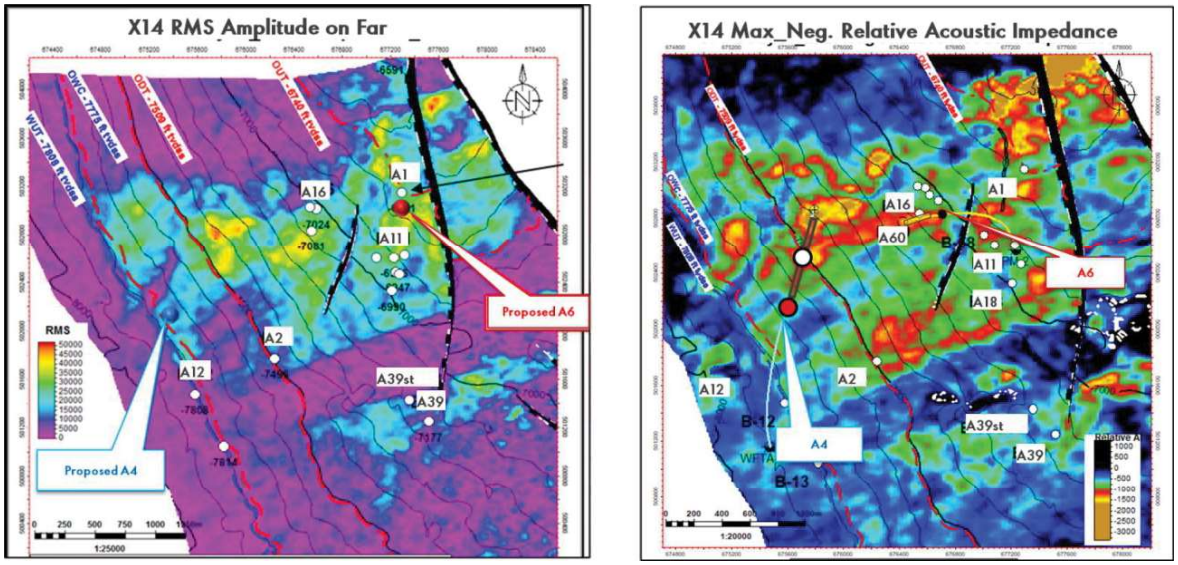


Figure 4A: Reservoir Development Plan as per FDP: A Single Producer – Injector Well Pair to develop ca. 20.7MMbbls in X14 reservoir (which shows all bodies are connected, hence single-phase development planned); Figure 3B: AI map delineating Geobodies in X14 reservoir, which shows discrete Geobody used for well placement optimization (phased development of 2 producer-injector pairs).

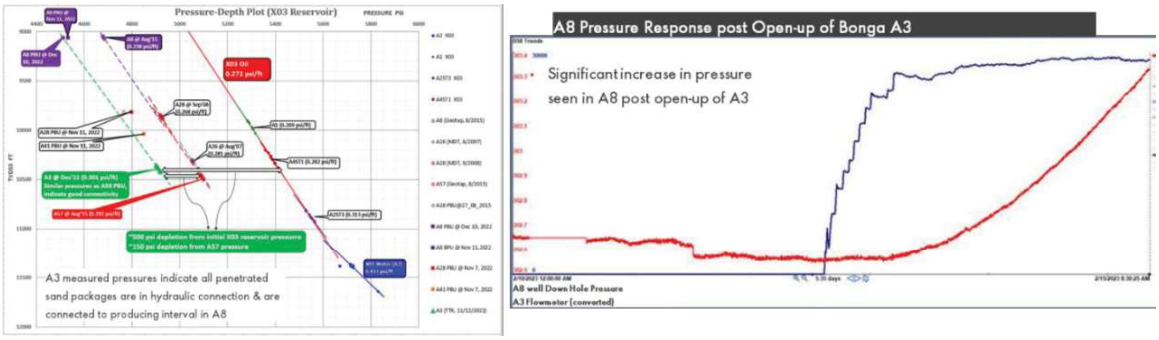


Figure 5: Pressure Depth Plot of X03 Reservoir and A3/A8 Pressure - Response post start up.

Geosteering tool), the team was able to exceed the base net sand for each of these wells by >15%, as well as drill the longest fishhook and horizontal section well in Regis field. Pressure data acquired from the wells suggest connectivity between the well pairs. Regis A8 (producer for Regis A3) which has since been confirmed as evidenced in the clearly observed pressure support response on the producer well. The Regis A8 well has since been beaned up with 600% increase seen and with potential for further bean-up in line with reservoir management strategy.

Finally, the pressure data taken in the newly drilled well pair (A4/A6), line up, suggesting connectivity between the well pair (see pressure plot insert: Figure 6). Deepest ODT for reservoir X14 now encountered in well A6

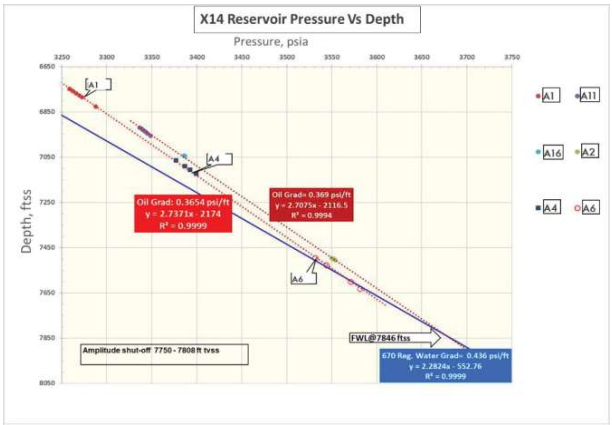


Figure 6: A4 & A6 Formation Pressure Results.

CONCLUSIONS / BUSINESS IMPACT

New Oil campaigns have been vital to sustaining Regis production since 2014; contributing over > 48% of Production since 2014. The 2022/23 new oil campaign is expected to develop additional 15% in UR over base plan from result of the campaign & reduce field production decline from ca. 12 - 14% to ca. 5 - 7% over the next 4 years. Learnings from this recent campaign are currently being synthesized and documented for future improvements on the well delivery process.

REFERENCES CITED

Adel, A. A. (2013). Seismic Attributes Techniques to delinate channel complex inpliocene age, North Abu Qir, Nile Delta; . Eygpt Journal of applied science Research 10 (2), 4255-4270.

Aizebeokhai, K. D. (December, 2015). Seismic Attributes Analysis For Reservoir Characterization; Offshore Niger Delta. Petroleum & Coal 57(6), 619-628.

Ajisafe, Y. A. (2013). 3-D Seismic Attributes for Reservoir Characterization of "Y" Field Niger Delta, Nigeria. Journal of applied Geology and Geophysics (IOSR-JAGG), PP 23-31.

Andrew, B. (2013). 3D seismic attributes analysis in Reservoir Characterization. Journal of Geology, 2 (3),, 112-117.

Bello, R., Igwenagu, C. L., & Onifade, Y. (Sept, 2005). Cross plotting of Rock Properties for Fluid and Lithology Discrimination using Well. Journal of Applied Science, Environnment and Manage, 539-546.

Chambers, R. L. (2002). Quantitative Use of Seismic Attributes for Reservoir Characterization. . CSEG Recorder,, pp. 14 - 25, June Issue.

Chopra, S. A. (2005). Seismic Attribute for prospect identification and reservoir characterization. SEG Geophysical Development Series No. 11, 464 p.

Chopra, S. A. (2005). Seismic Attributes; A Histoical Perspective. Geophysics 70 (5), 3-28.

Daukoru, C. M. (1994). Northern delta Depobelt portion of the Akata-Agbada Petroleum system, Niger Delta, Nigeria, Petroleum Association System, AAPG memoir 60. American Association of Petroleum Geologists, Tulsa (AAPG),, 598-616.

Ekweozor CM, a. D. (1984). Petroleum source-bed evaluation of Tertiary Niger Delta; discussion and reply,. AAPG Bulletin, Vol. 68,, p. 387-394.

Enwenode, O. (2014). Seismic Data Analysis Techniques in Hydrocarbon Exploration. Marine and Petroleum Geology 5(6), 229-237.

Evamy BD, H. J. (1978, Vol. 62). Hydrocarbon habitat of Tertiary Niger Delta. APG Bulletin, p. 1-39.

Fatoke, O. A. (2010). Sequence stratigraphy of the Pliocene-pleistocene strata and shelf - Margin deltas of the Eastern Niger Delta, Nigeria, University of Houston. . Spectroscopy (4), 267-277.

Hampson, D. R. (1997,). Multiattribute seismic analysis:. The Leading Edge, 16, 1439-1443.

Hart, B. S. (2008). Channel detection in 3-D seismic data using sweetness. . AAPG Bulletin, 92(6),, 733-742.

Hua-wei, Z. (2018). Introduction to Seismic Data and processing (2nd edition). Cambridge University Press, 38.

Jonny, H. a. (1997). Seismic Attributes Analysis in Structural Interpretation of the Gullfaks Field, University of Bergen. Petroleum Geosciences 3(41), 13-26.

K. C. Chiadikobi et al. (2012). Seismic Attributes of BETTA Field, Onshore Niger Delta, Southern Nigeria. International Journal of Science and Emerging Technologies, 71-81.

Koson et al. (2014). Seismic attributes and seismic geomorphology. Bulletin of Earth Sciences of Thailand Vol. 6,, No. 1, 1-9.

Limited, S. (1972). Schlumberger Log Interpretation. New York Schlumberger, l.

Lowrie, W. (2007). Fundamentals of geophysics. London: Cambriodge University Press .

Perveiz, K. N. (2016). An Integrated Seismic Interpretation and Rock Physics attributes analysis for pore fluid discrimination. Arabian Journal for Geoscience and Engineering, 41(1), 191-200.

Rachel, A. (2013). Seismicity and its effect in parts of North West India. Marine and Petroleum Geology, 46(2), 36-50.

Raef, A. E. (2015). Application of 3D Seismic Attributes in hydrocarbon prospect identification and evaluation, . Marine and Petroleum Geology, 73 (14), 21-35.

Ralph Daber et al. (2009). Interpreter's Guide to Seismic Attributes. Schlumberger.

Sanhasuk Koson, P. C. (2014). Seismic Attributes and Their Applications in Seismic Geomorphology . Bulletin of Earth Sciences of Thailand ol. 6, No. 1,1-9.

Stewart, D. G. (1996). 3D Seismic Attribute. CREWES Research Report-Volume 8, 45-1 - 45-30.

Taner, M. T. (1979). Complex seismic Trace Analysis . Geophysics Texas, 44,, 1041-1063.

Ude, A. T. (Geophysical 5(7)). Integrated Seismic Attribute Analysis for production optimization of an offshore field, Niger Delta Basin, . Nigerian 9th NAPE-NMGS Mini-Conference for Teritary Institution, Emerging Energy Challenges , 112-121.

Weber, K. J. (1975). Petroleum Geolo