

Paleo Residual Gas in Columbus Basin: Examples from TSP Oil/Gas Field*

Giovanni Medouri¹, Reece Ramsingh¹, Candido Gomez¹, Javier Oviedo¹, and Luis Roncero¹

Search and Discovery Article #20322 (2015)**

Posted October 13, 2015

*Adapted from oral presentation given at AAPG Latin America and Caribbean Region, 20th Caribbean Geological Conference 2015, Port-of-Spain, Trinidad & Tobago, West Indies, May 17-22, 2015

**Datapages © 2015 Serial rights given by author. For all other rights contact author directly.

¹Repsol Trinidad & Tobago (roncero.blazquez.luis@repsol.com)

Abstract

One of the main problems in volume of hydrocarbon estimation in Columbus basin is the uncertainty of the seismic and petrophysical data when there is presence of Paleo Residual Gas (PRG) in the formations. Several examples in TSP's oil and gas producing fields that Repsol currently operates will be presented in order to show the difference of prediction of hydrocarbon accumulations and real results after drilling a well when there is presence of PRG.

In this paper, PRG is defined as the low gas saturation (approx 15-35%) that remains in water when paleo-traps leak. It is very important to identify this type of gas because it may result in erroneous hydrocarbon fluid determination or contacts in the reservoir. This study will show how seismic data can lead to error in the prediction of fluid contacts. Gas saturation greater than 5% all look the same on seismic data.

Several inconsistencies have been observed between proposed and actual hydrocarbon distribution. Seismic anomalies that did not match with fluid contacts were identified by drilling. Understanding the limitation of the use of seismic /well data in the estimation of OOIP/OGIP is crucial to reduce the risk and uncertainty when prospects are evaluated. The extraction of different seismic attributes will help to predict a more accurate depth for fluid contacts. In addition, a more integrated petrophysical analysis will be used to define the fluid type and contact. Formation pore pressure measurements have been the key tool to validate the type and depth of the fluids in the reservoir.

The analysis of PRG is crucial because it will affect directly in the economics of a project and ultimately its success or failure.

Paleo Residual Gas in Columbus basin Examples from TSP oil/gas field



20th Caribbean Geological Conference

Giovanni Medouri, Reece Ramsingh, Candido Gomez, Javier Oviedo, Luis Roncero

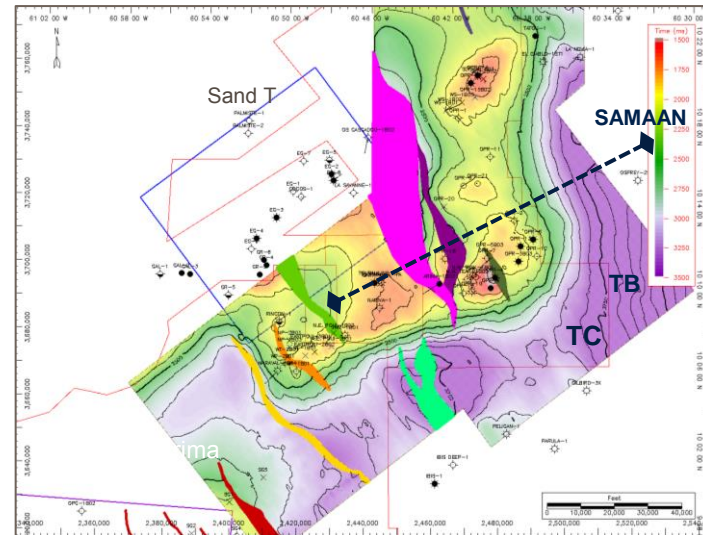
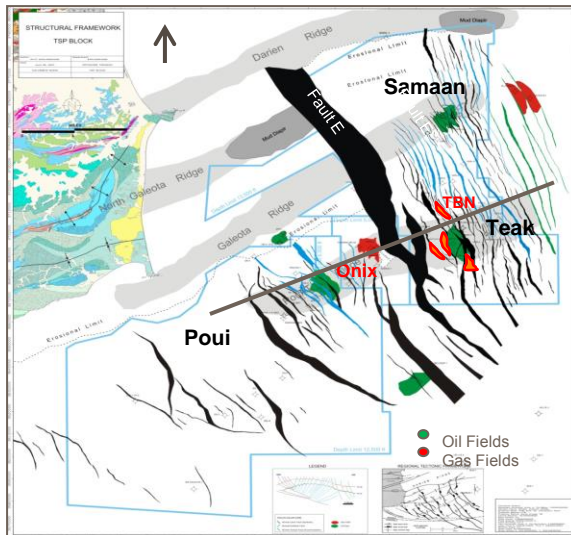
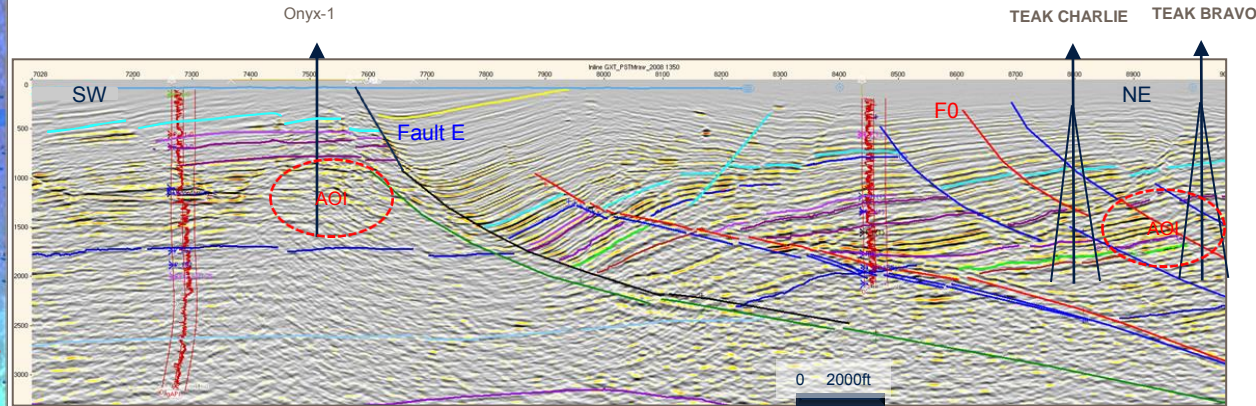
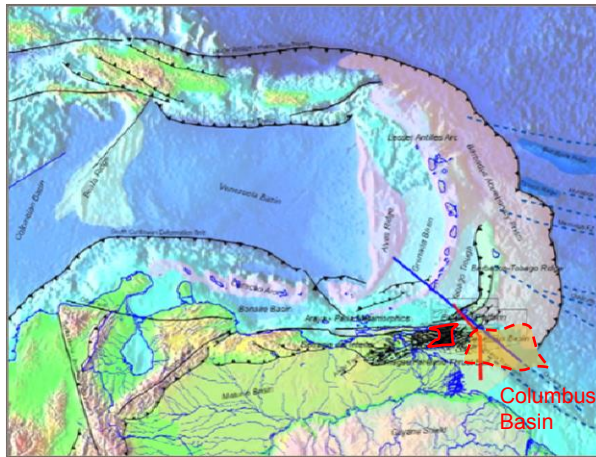
OUTLINE



- REGIONAL FRAMEWORK
- PALEO RESIDUAL GAS IN TRINIDAD OFFSHORE
 - ONYX (G&G, Petrophysics, Reservoir Engineering)
 - TBN (G&G, Petrophysics, Reservoir Engineering)

GEOLOGICAL FRAMEWORK - LOCATION

PROSPECTS AND STRUCTURAL SETTING

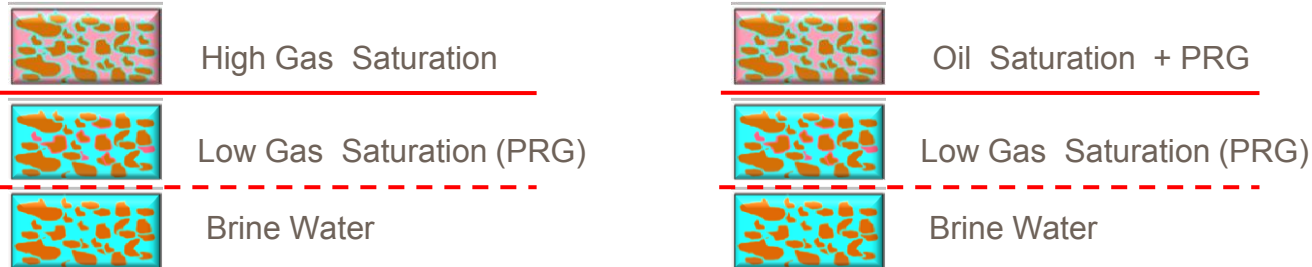


PALEO RESIDUAL GAS IN TRINIDAD OFFSHORE CONCEPT - RISKS

PALEO RESIDUAL GAS

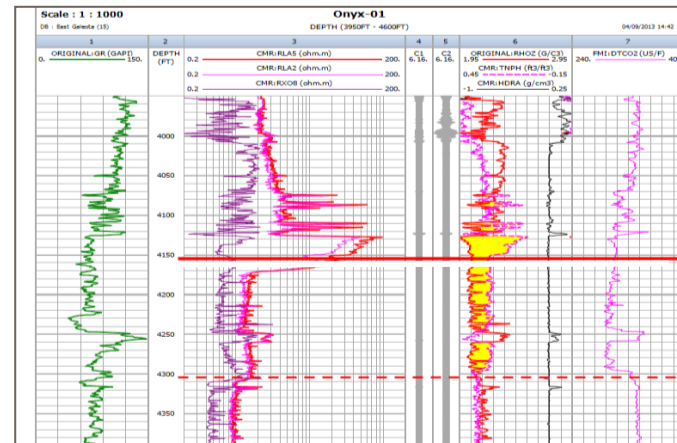
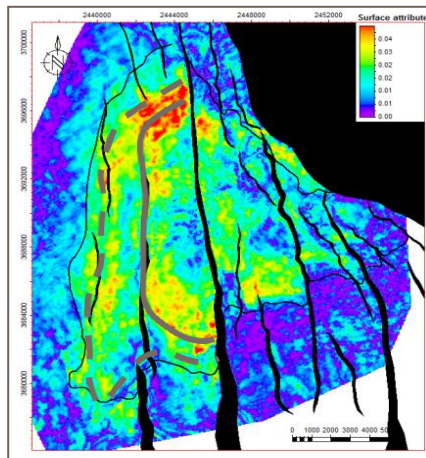
Definition:

Low Gas Saturations (15-35%) in water and oil that remain in the formations.



Risks:

- SEISMIC: Gas saturations > 5% all look the same in seismic data. False Direct Hydrocarbon Indicator
- LOGGING: Uncertainties in the responses with different logging tools.



RISK IN EXPLORATION- DEVELOPMENT SUCCESS

Hydrocarbon Indicators vs Uncertainties



SEISMIC DATA

- Bright spots, Flat spots, Amplitude Anomalies.
- AVO

DRILLING WELL DATA

- Mud Log
- HC shows
- Fluorescence

LOGGING WELL DATA

- Sonic
- Resistivity,
- Neu-Dens

RESERVOIR WELL DATA

- Pressure Points
- Fluid Samples
- DST

SEISMIC DATA

- Lithology (Arima)
- Quality of seismic

DRILLING WELL DATA

- Small accumulations or just Migration of HC (OPR)

LOGGING WELL DATA

- Lithology-interbedding
- PRG

RESERVOIR WELL DATA

- Validation of type and depth of fluids

-

Reliability

+

RISK IN EXPLORATION- DEVELOPMENT SUCCESS ONYX-1

ONYX-1

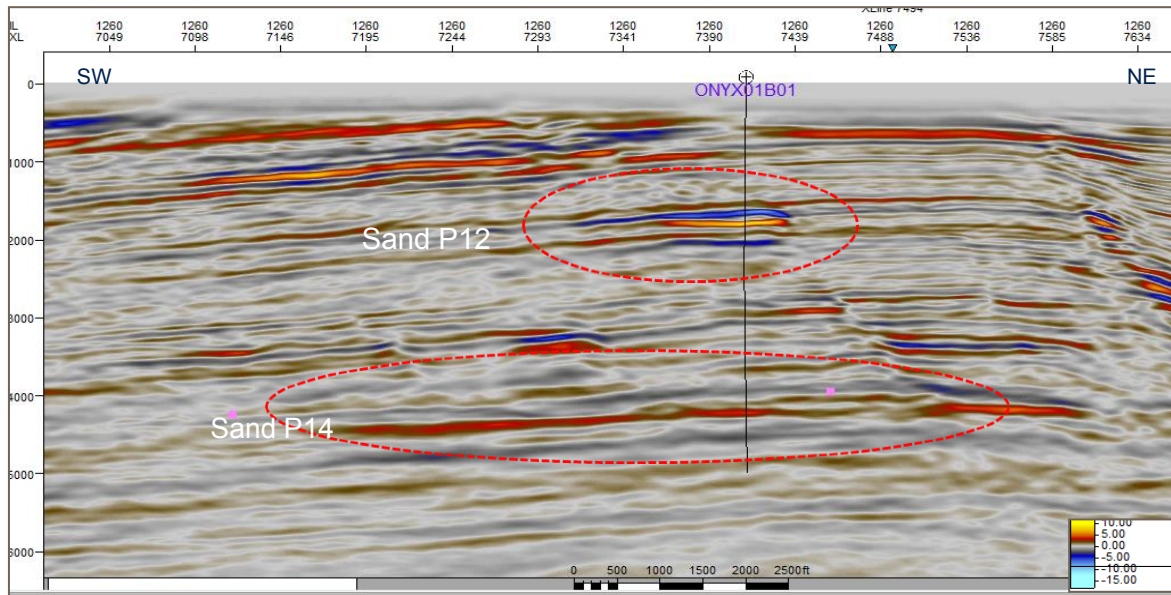


Sand P12

Seismic:

Trough with Bright spot. Top of Sandstone with potential HC.

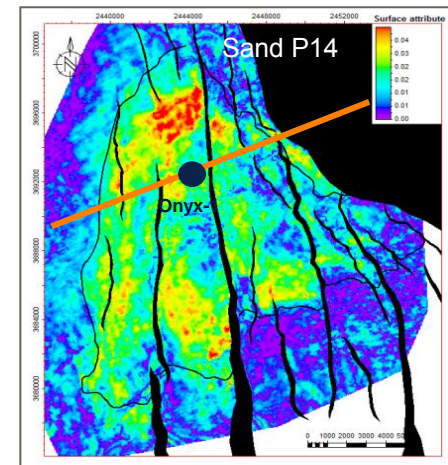
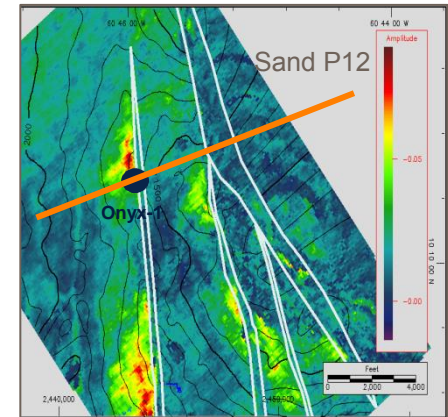
Pick with Flat spot. Sandstone with potential HCWC @ -1760 ft.



Sand P14

Seismic: Trough without Bright spot in center of structure, due to energy absorbed from the shallow bright spot and AI contrast not so strong.

Pick with Flat spot. Sandstone with potential HCWC @ 4230 ft.

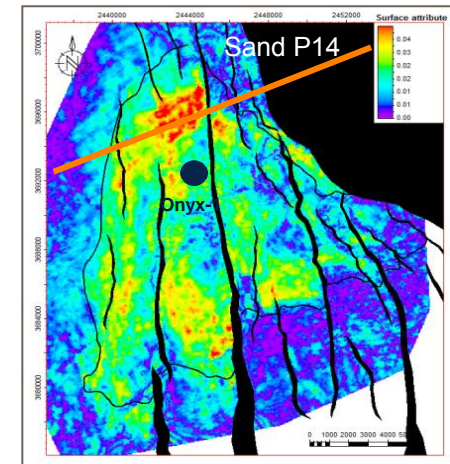
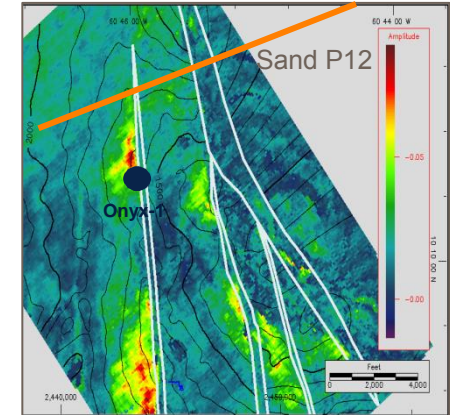
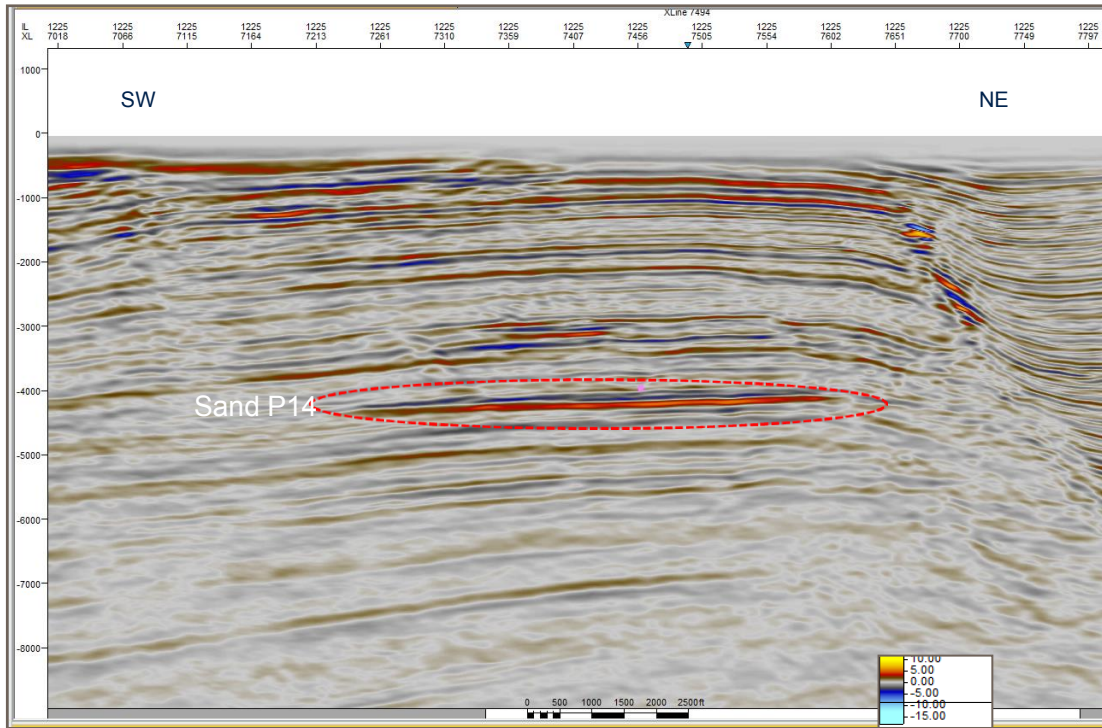


Flat spot at 4230 ft tvdss

ONYX-1



Sand P12 Out of structure.



Flat spot at 4230 ft tvdss

Sand P-14

Seismic: Trough with Bright spot in the sides of the structure, no energy absorbed from the shallow bright spot and Highest Acoustic Impedance contrast in top of P-14 reservoir.

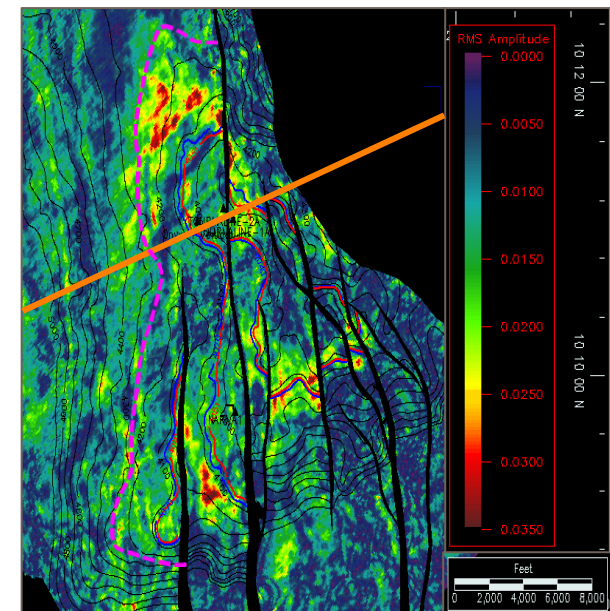
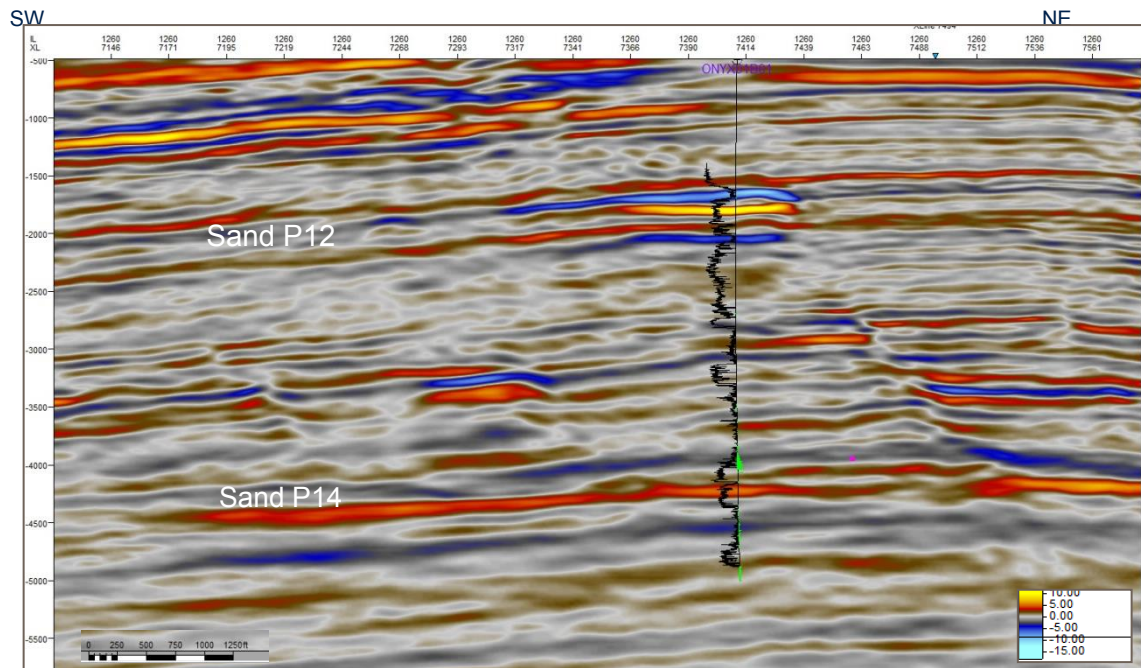
Top of Sandstone with potential HC

Pick with Flat spot. Sandstone with potential HCWC @ 4230 ft.

ONYX-1



P12 Well data: Wet sand.
 Seismic: Trough with Bright spot. Top water bearing Sandstone with PRG.
 Pick with Flat spot. PRG – Water contact.

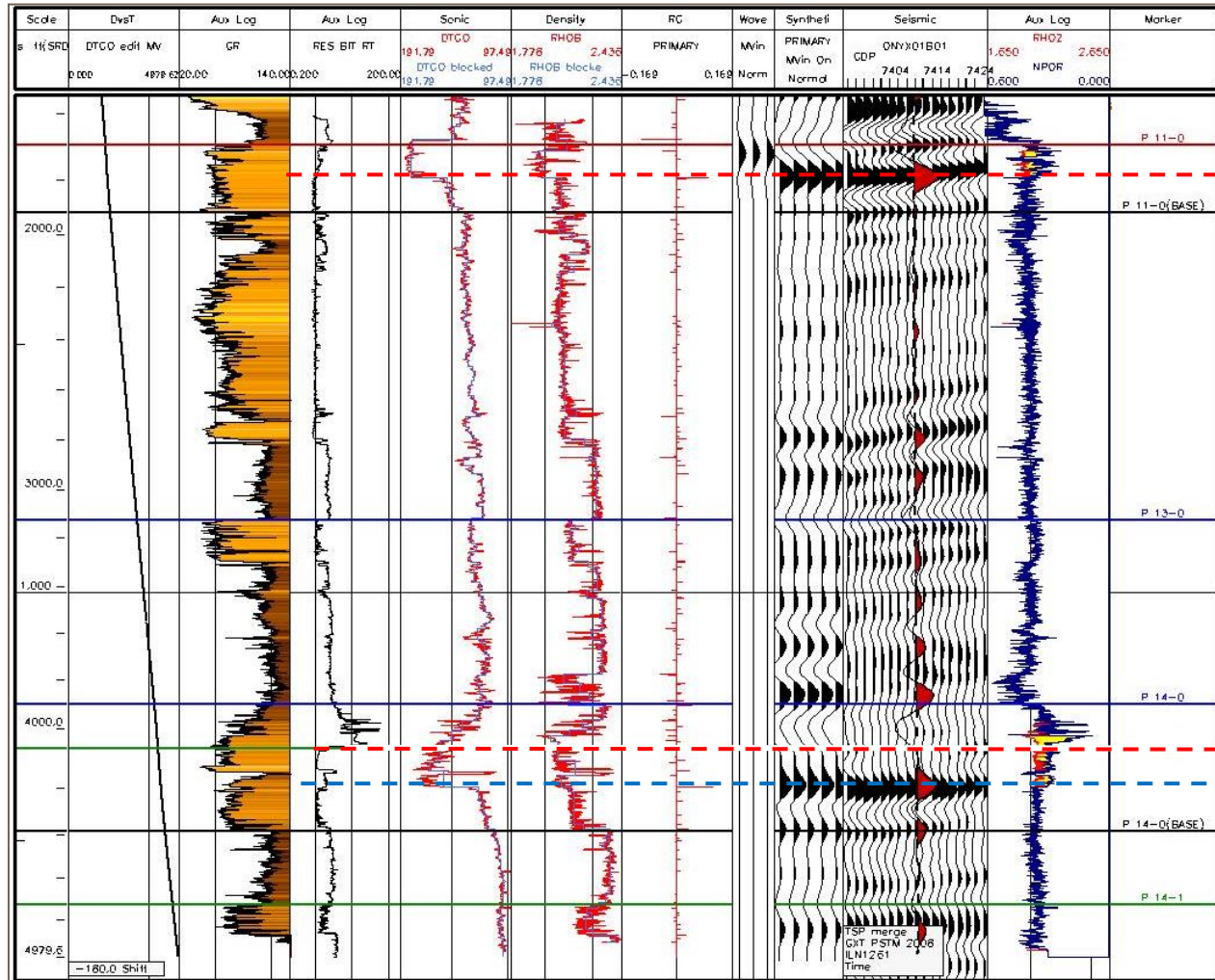


Flat spot at 4230 ft tvdss

P14 Well data: Gas-Oil bearing sand.
 Seismic: Trough without Bright spot in center of structure, due to energy absorbed from the shallow bright spot and AI contrast not so strong.
 Pick with Flat spot. Sandstone with HCWC.

ONYX-1

Seismic –well data integration



Wet sand from Resistivity log.

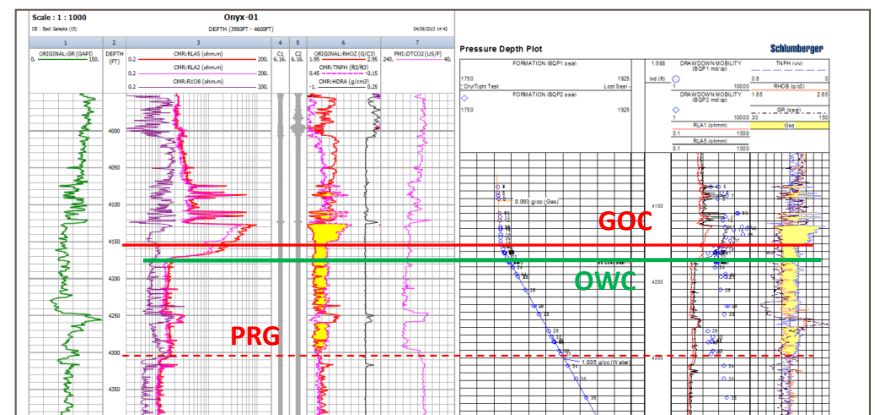
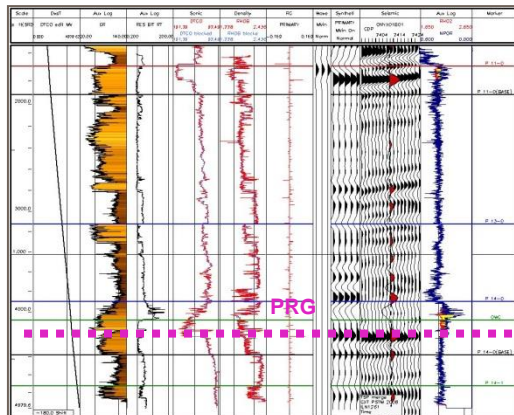
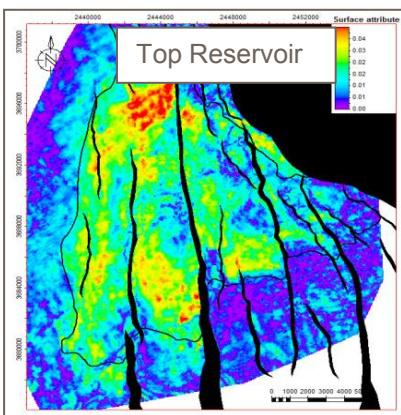
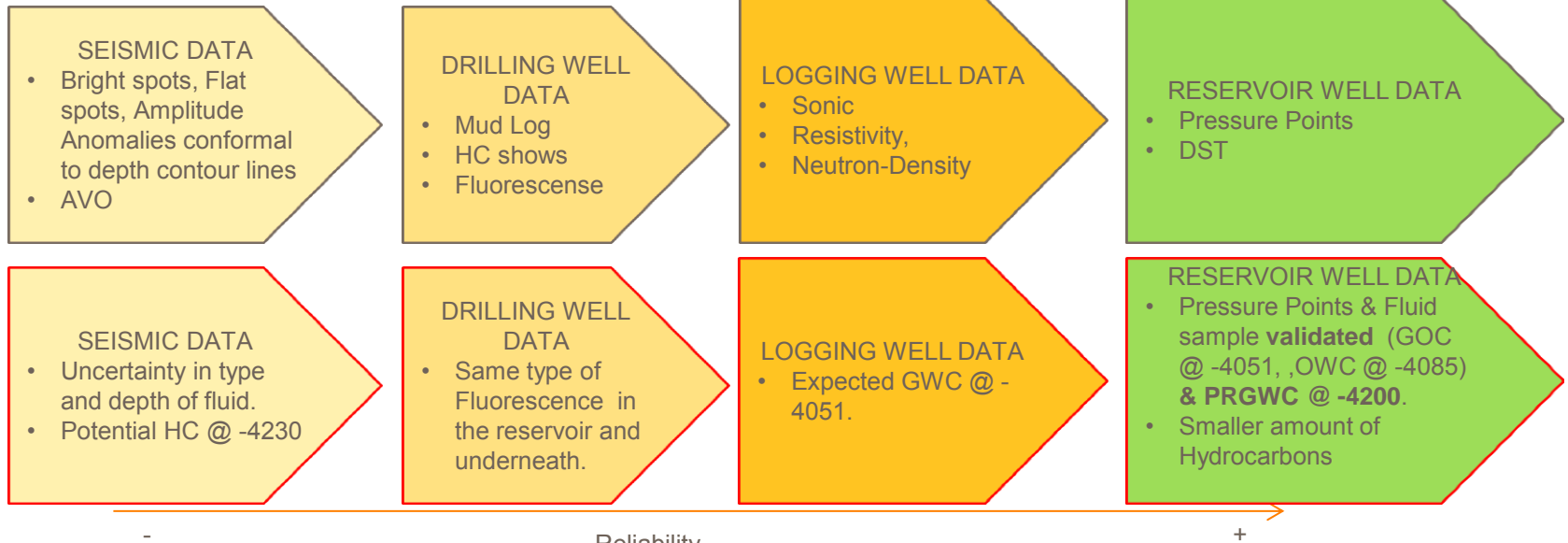
PRG- water contact from N-D and Flat Spot @ -1760 ft.

Possible GWC from Resistivity, N-D Log @ -4051 ft

PRG- water contact from N-D and Flat spot @ 4230 ft tvdss

RISK IN EXPLORATION- DEVELOPMENT SUCCESS

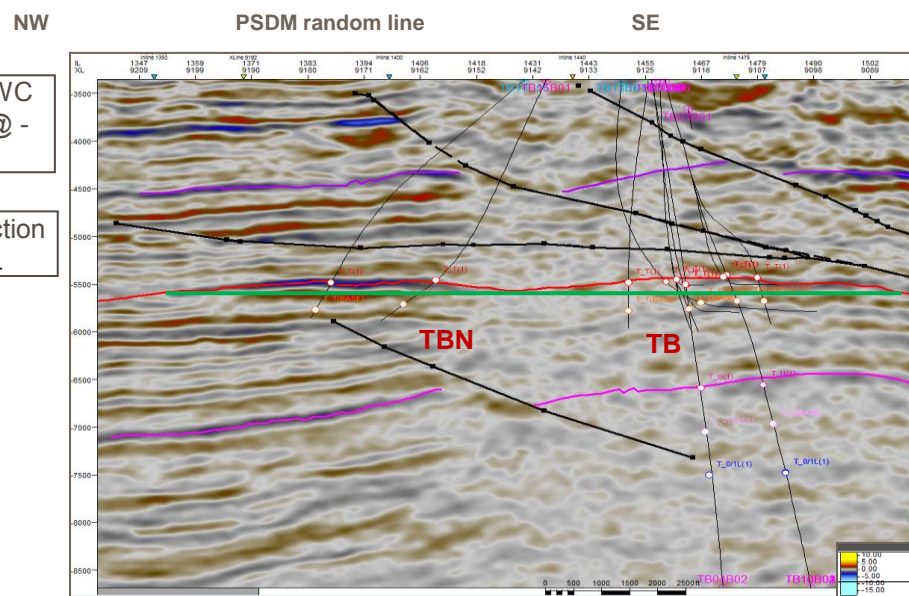
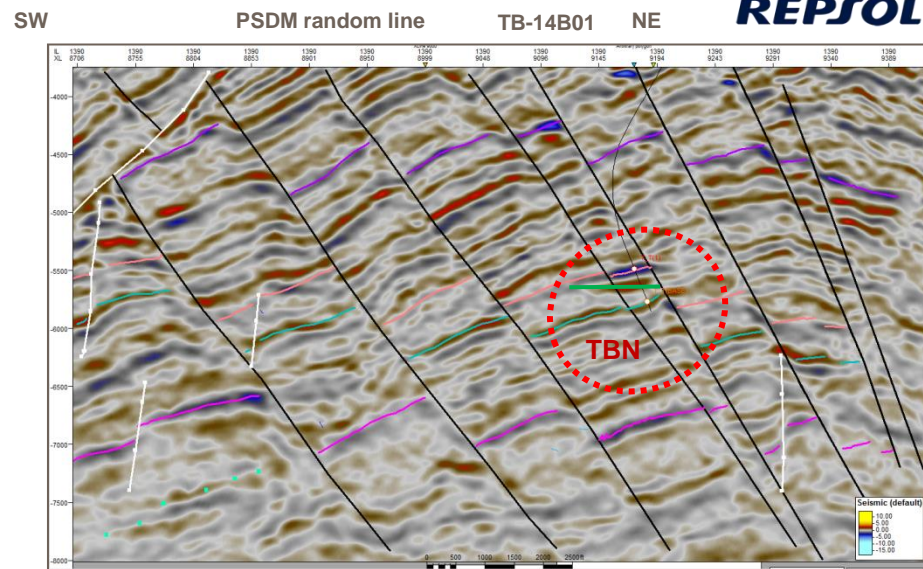
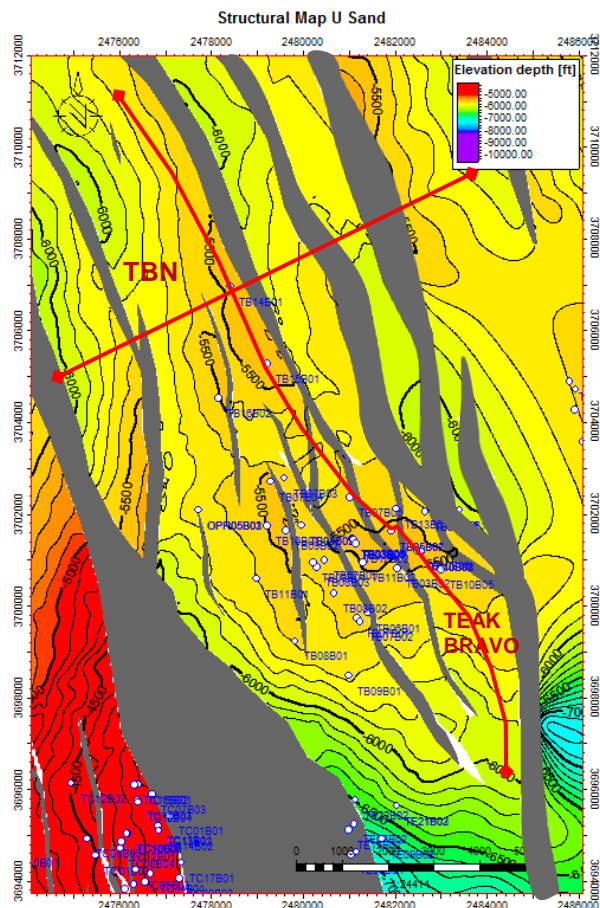
Hydrocarbon Indicators vs Uncertainties



RISK IN EXPLORATION- DEVELOPMENT SUCCESS TBN

TBN

STRUCTURE. SEISMIC ANOMALY

**REPSOL**

Teak Bravo OWC
and Flat Spot @ -
5591 ft.

Possible connection
of structures.

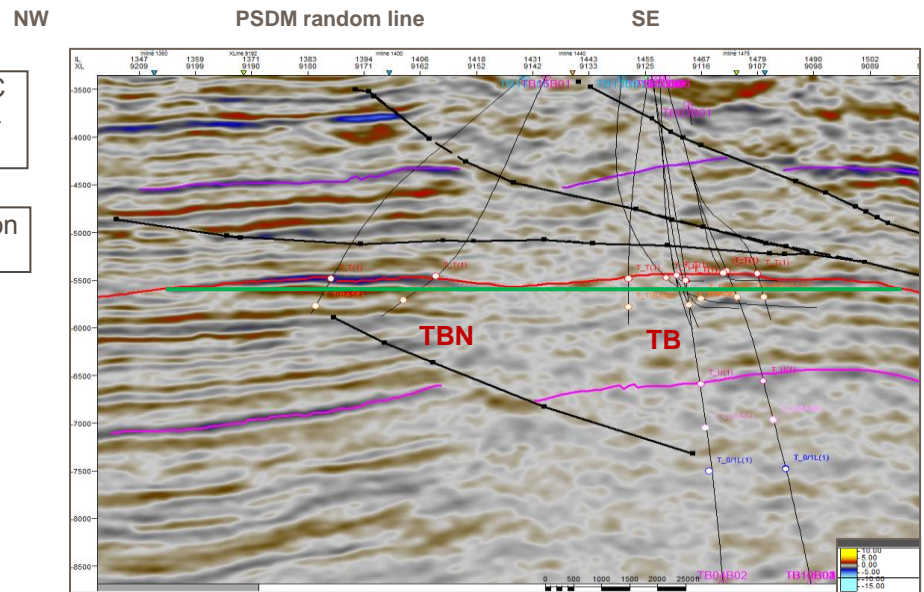
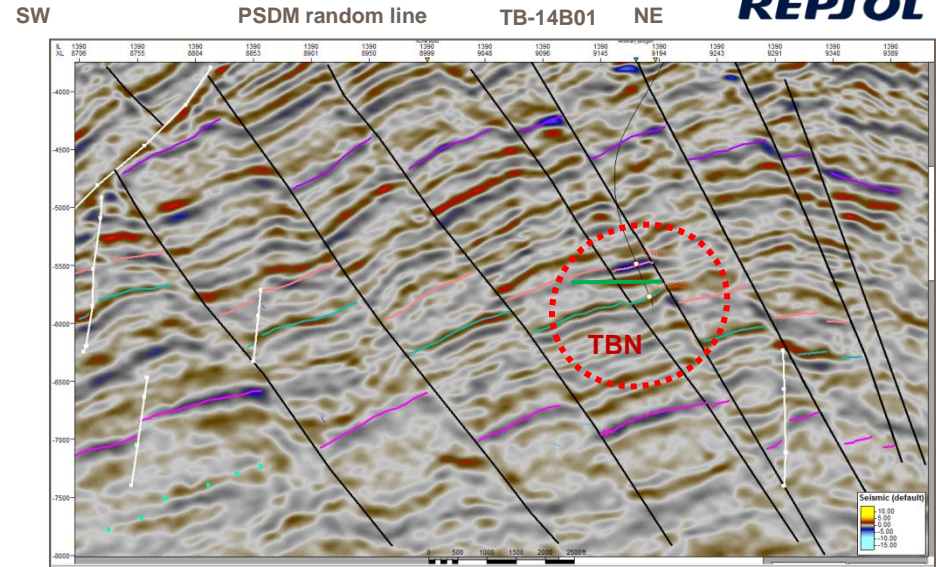
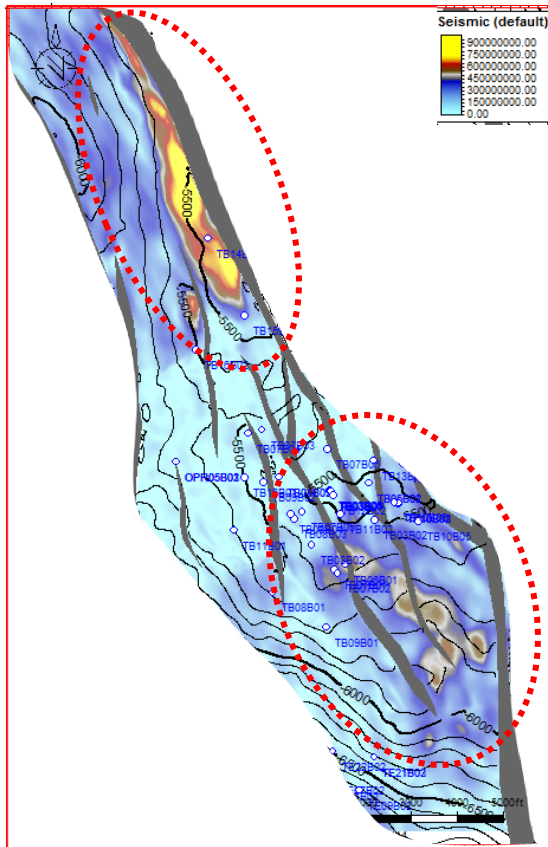
TBN STRUCTURE. SEISMIC ANOMALY



REPSOL

Seismic anomaly

Structural Map U Sand



Teak Bravo OWC
and Flat Spot @ -
5591 ft.

Possible connection
of structures.

TBN SEISMIC AMPLITUDES

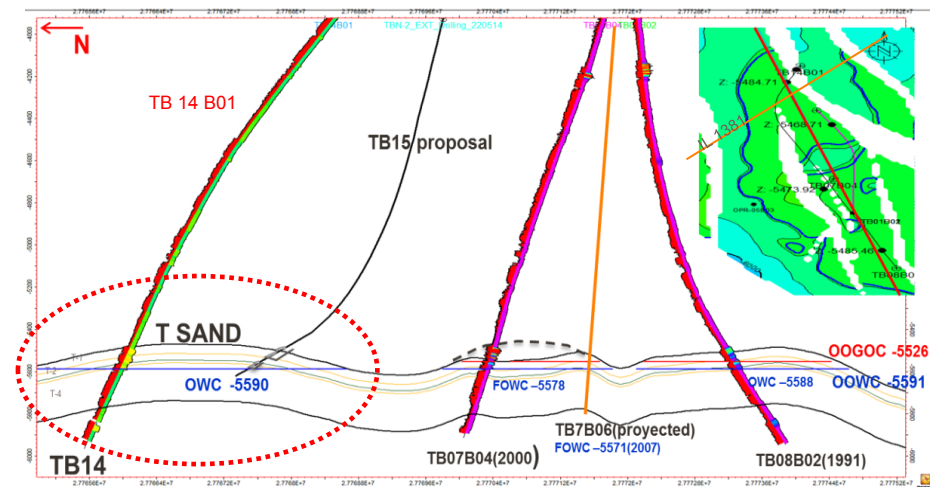
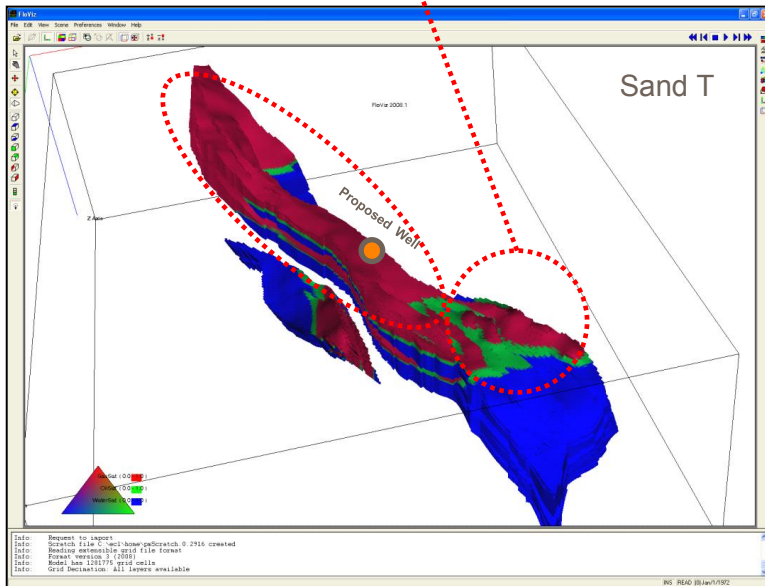


Teak Bravo Field

- About 10 MMBO of Oil and 50 BCF of Gas and 20 MMBW already produced over last 40 years.
- The OOIP –OGIP do not fit with the accumulative production.
- We are missing several bcfs of Gas & few million barrels of Oil from production in T sand.
- Is the structure connected to the TBN??

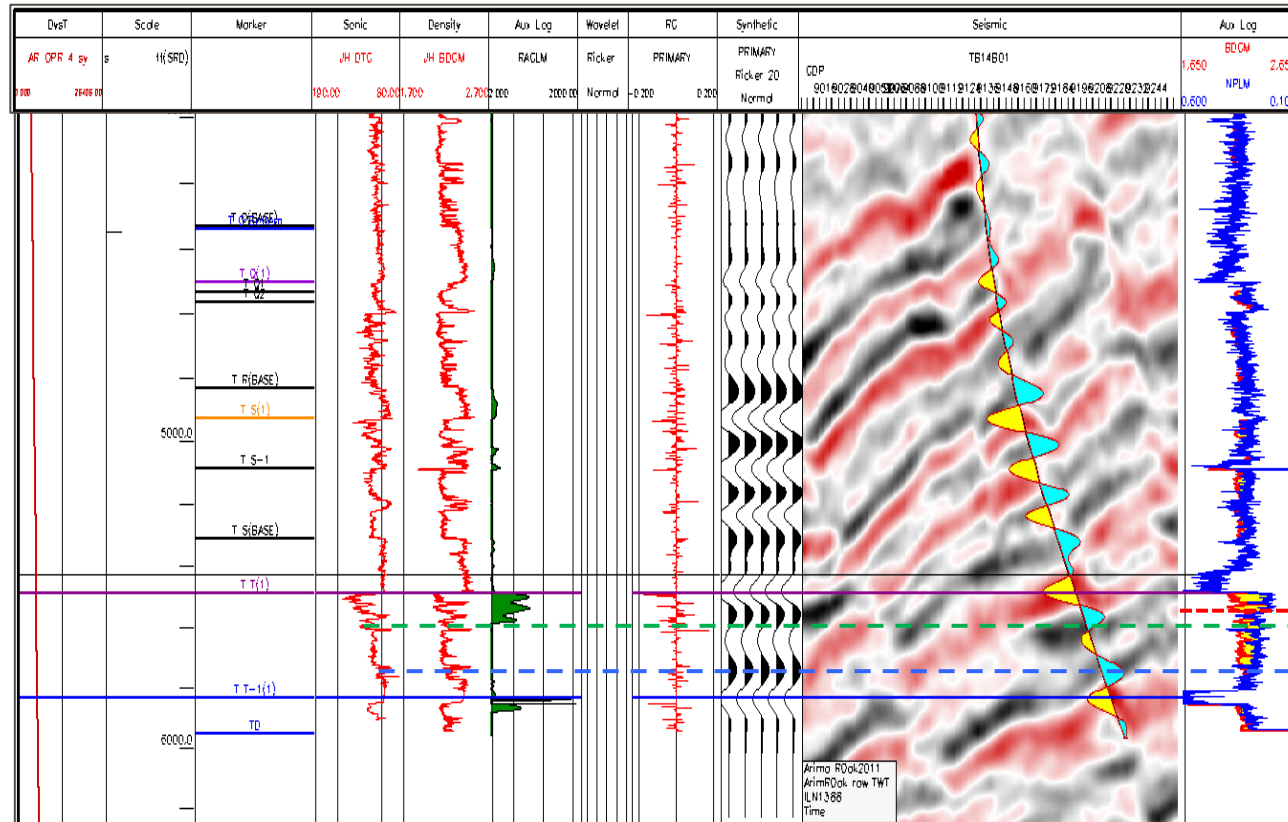
Teak Bravo North

The same contacts are expected to be in TBN.
GOC @ -5526 ft
OWC @ -5591 ft.



TB14B01 synthetic

Seismic –well data integration



From Resistivity and N- D Possible
GOC @ -5550 ft & OWC @ 5591 ft.
Bright and flat spot @ -5591.

PRG water contact from N-D @ -
5725 ft tvdss.
Not flat spot due to the absorption of
energy of the Gas and Oil in sand T.

T and T-1: Low acoustic impedance sandstones
(low velocity, low density)
Top of the reservoir: trough reflexion

TBN

Well correlation. PRG in other wells.

TB14B01_Drill

DRL: 2014

TB07B04

DRL: 2000

0.07 MMBO

7.18 BCF

2000/06

TB08B02

DRL: 1991

0.38 MMBO

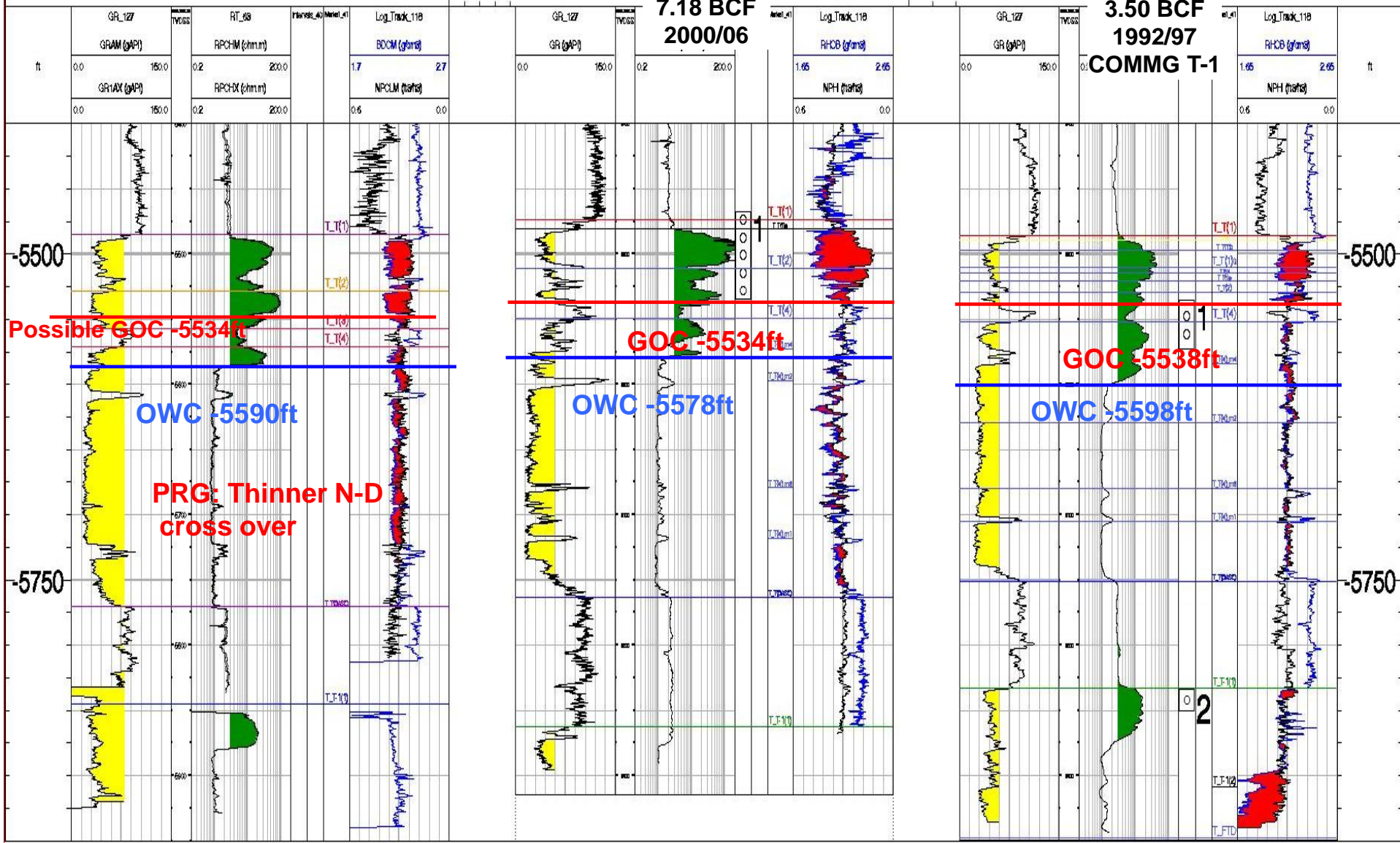
3.50 BCF

1992/97

COMM T-1

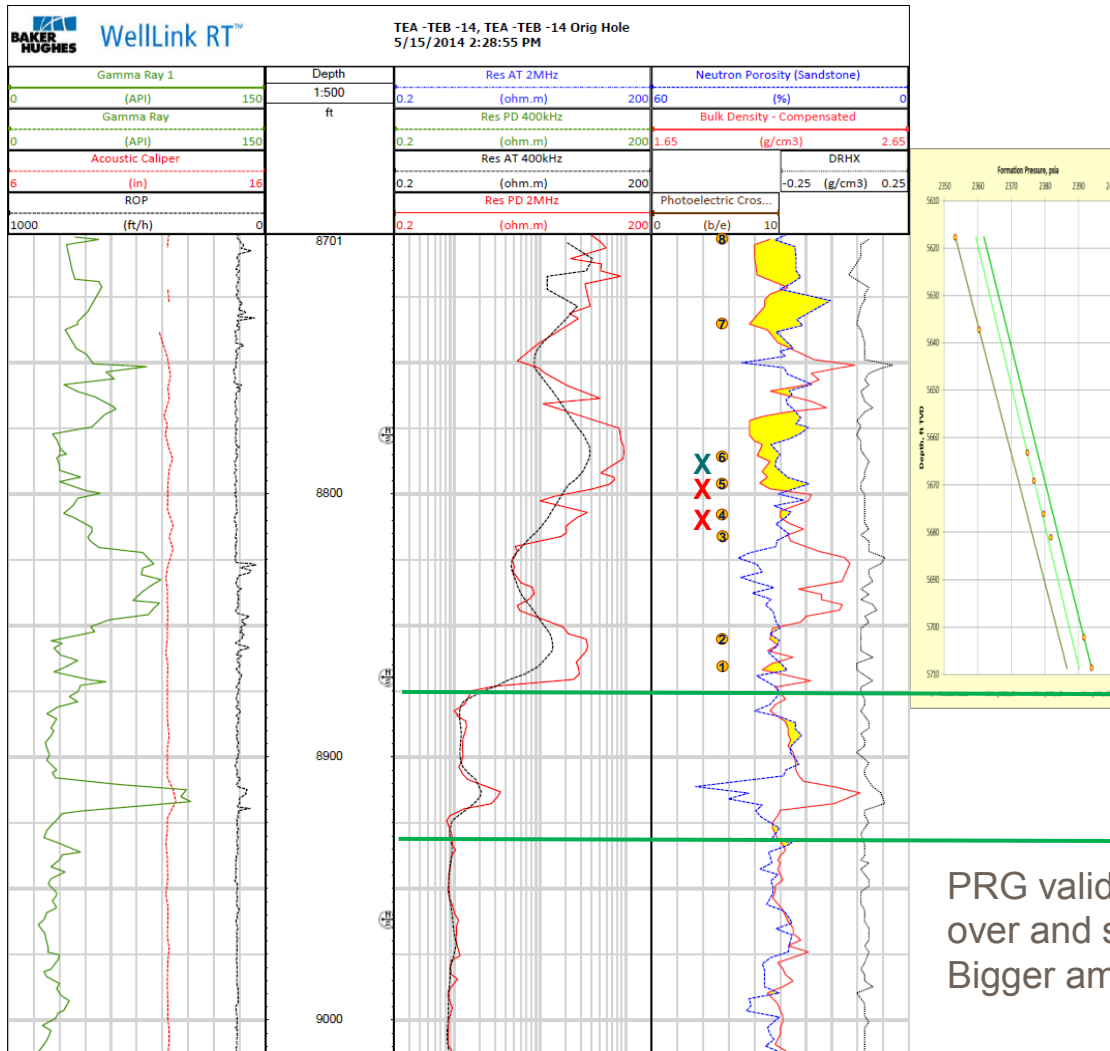
N

S



TBN

TB14B01. Fluid Identification: Formation Pressure Data

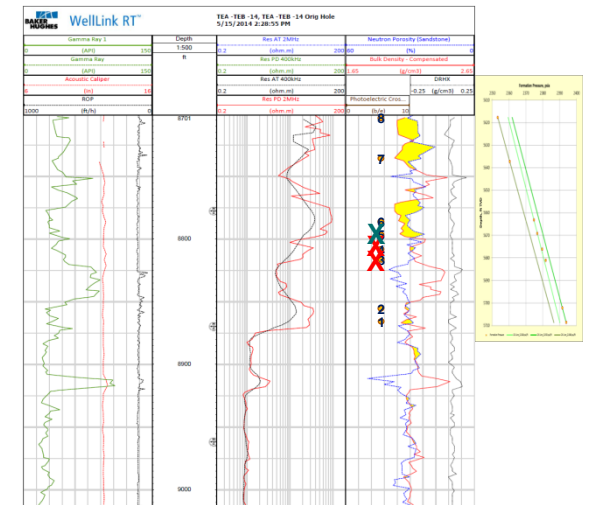
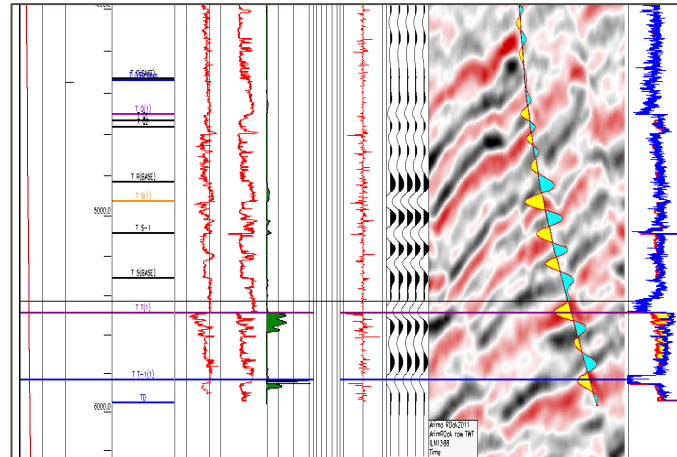
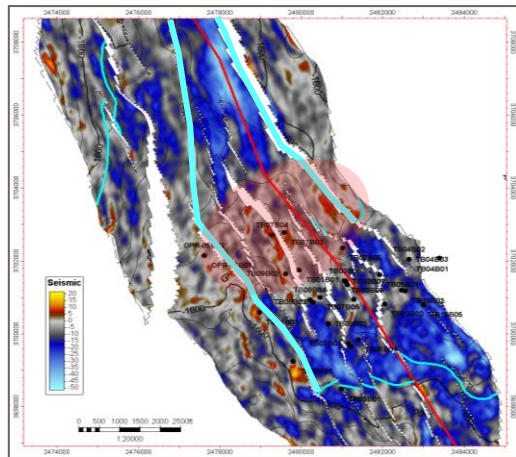
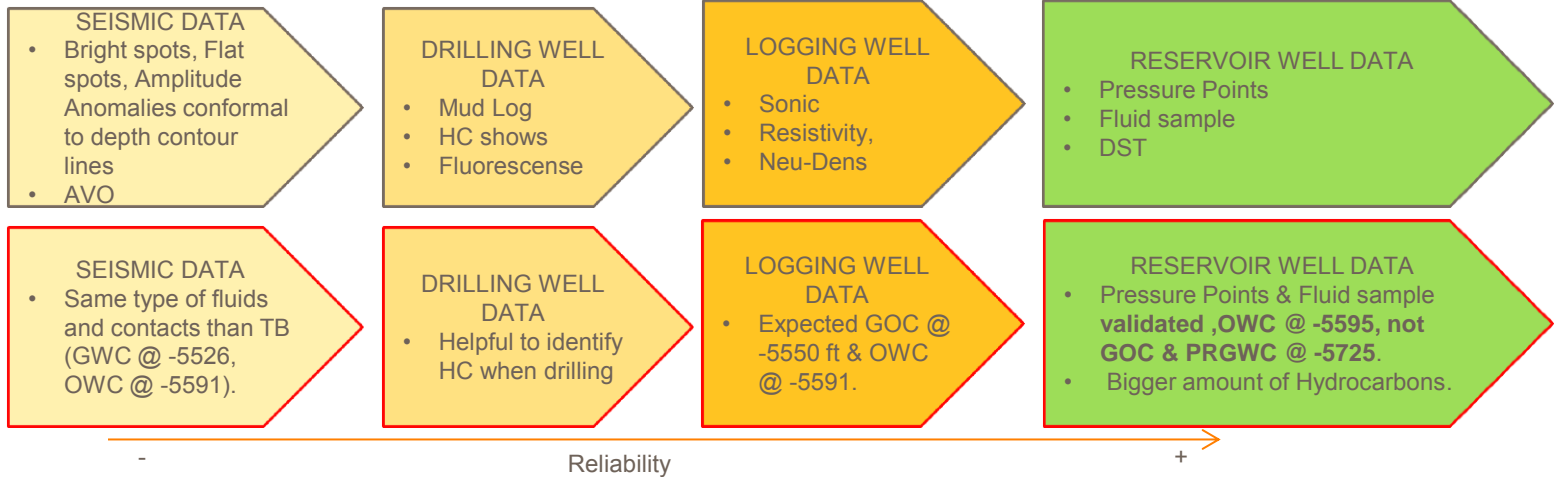


Pressure points validated
OWC @ 5591 ft, Not GWC

PRG validated @ 5725, Effect of N-D cross
over and seismic anomaly due to PRG.
Bigger amount of Hydrocarbons.

RISK IN EXPLORATION- DEVELOPMENT SUCCESS

Hydrocarbon Indicators vs Uncertainties



CONCLUSIONS



- Low Gas Saturations (15-35%) in water that remain in the formations is a risk when evaluating a prospect to drill. Seismic and Logging data have uncertainties, furthermore type and depth of fluid contacts will do as well.
- As we have seen, presence of PRG will affect your Hydrocarbons estimations.
 - Case 1 where GOC & OWC have been validated in a shallower position. So that, smaller amount of Hydrocarbons have been proved.
 - Case 2, TBN where the OWC has been validated in the expected position, but there were not GWC.
- Once this process is identified in an area, it is highly recommended to adjust the risk accordingly.
- The use of Reservoir data, such as pressure measurements, fluid sample and /or DST is crucial for validation of type and depth of fluid contacts.

Thank you very much to partners



PETROTRIN



NGC

GRACIAS

