The Gambia's Petroleum Prospectivity
The Geological story

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Presentation outline

- Introduction
- Location of The Gambia
- The MSGBC Basin
  - Basin Evolution
  - Regional Successful Plays
- The Gambia's Prospectivity
  - Blocks
  - Seismic Database

Introduction

- The Gambia's geological story is very much part of the MSGBC Geological evolution
- We will look at the Evolution of the MSGBC and how this knowledge helps in reducing the ever high exploration risk,
- It is common knowledge that exploration is a risky business but Geological and geophysical knowledge can significantly reduce this risk and make a huge difference between success and failure in an exploration project,
- Intensification of exploration efforts over the past few years have boosted the understanding and knowledge of the subsurface of the MSGBC.

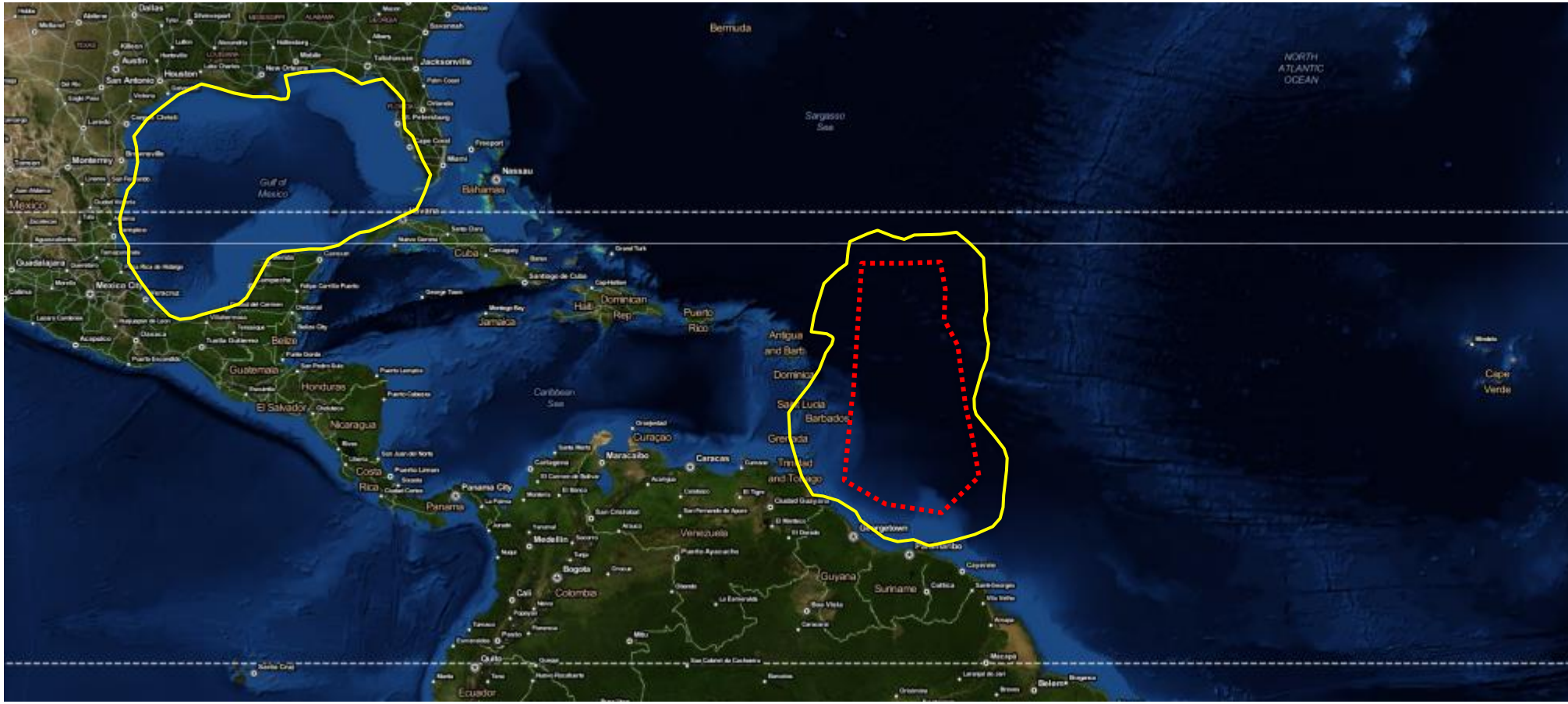
Where is the Gambia?

- Location: North West Africa, bounded to N, S and East by Senegal and West by Atlantic
- Size: 11,300 km^2
- Population: about 2 million
- Government: Democratic
- Official Language: English
- Geologically it is located in the MSGBC Basin

What is the MSGBC Basin?

Mauritania, Senegal, Gambia, Bissau, Conakry (MSGBC) Basin

MSGBC Basin Extent

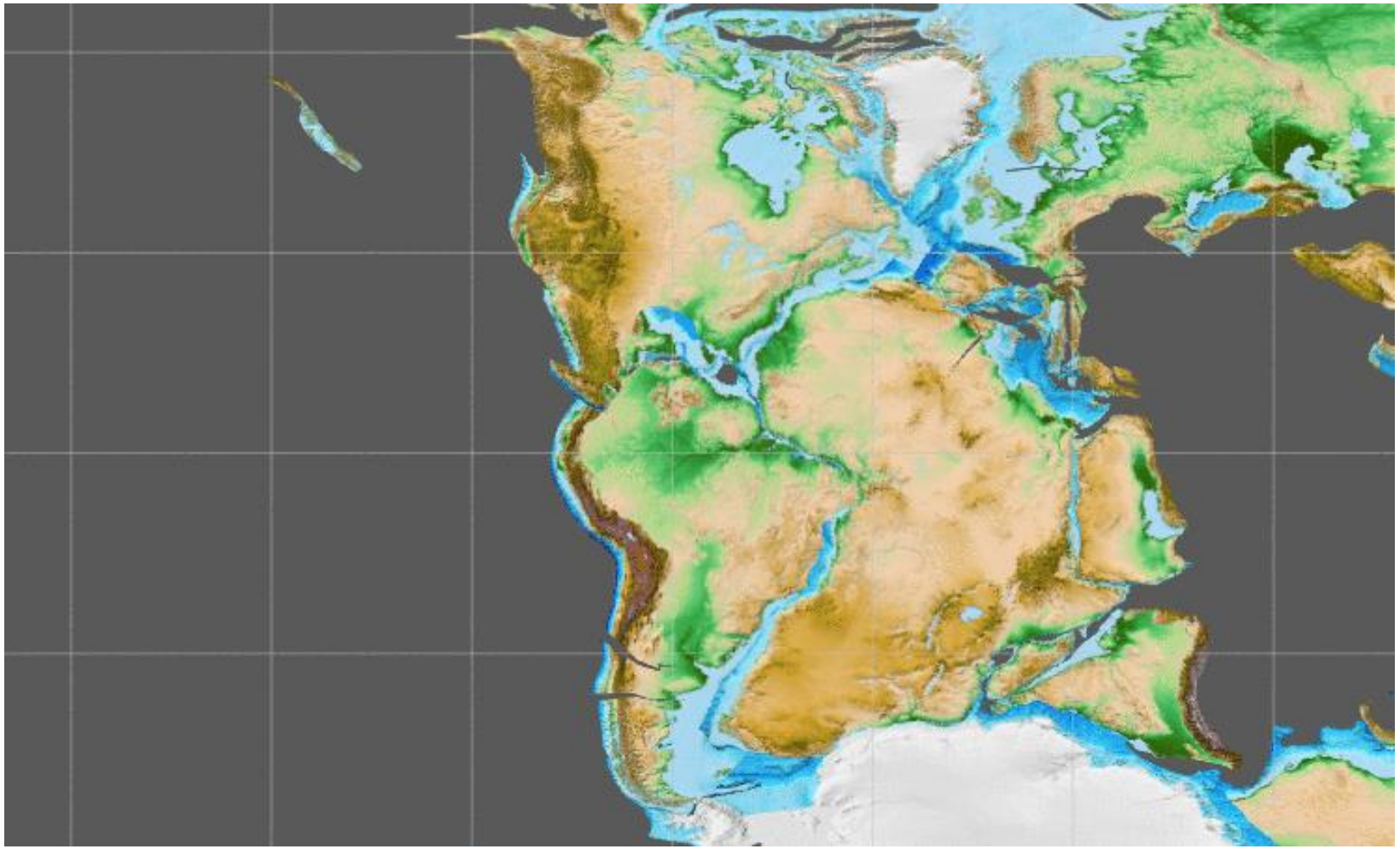


Why: MSGBC

- Highly under explored, with under 300 exploration wells drilled it is truly a frontier for exploration
- Established working Petroleum System

Basin Evolution

Plate Reconstruction

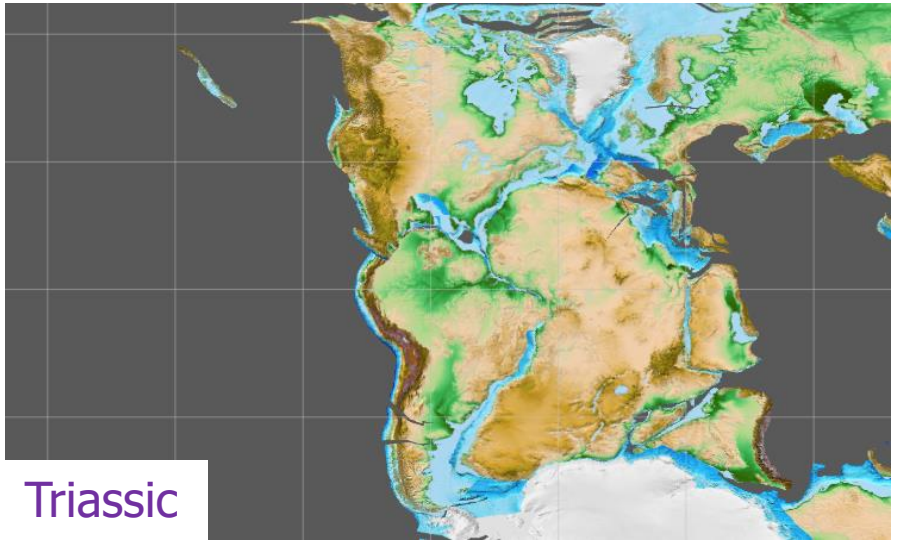


Adapted from outputs from Gplates - EarthByte Research Group, School of Geosciences, The University of Sydney, Australia

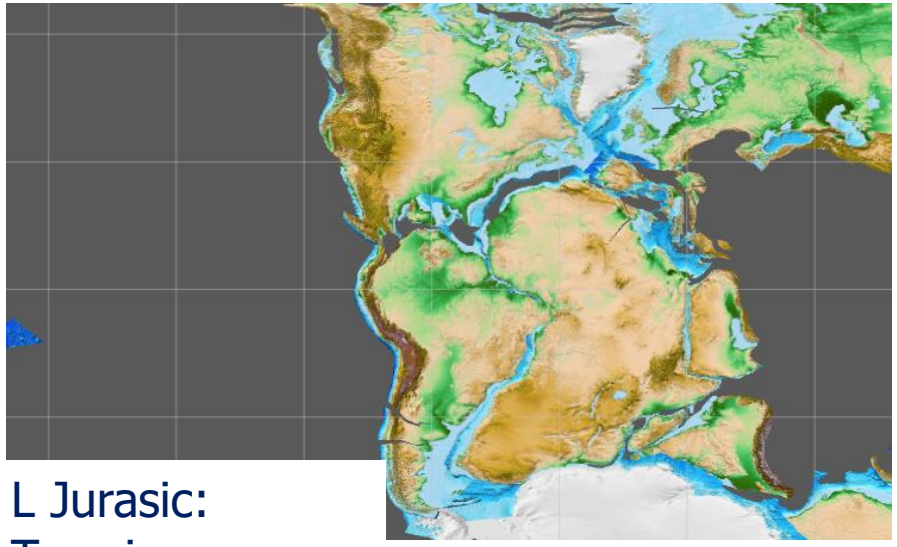
The Basin has undergone a complex history that can be divided into 3 main stages of development:

- the pre-rift (Precambrian to Paleozoic)
- syn-rift (Permian to Early Jurassic)
- post-rift (Middle Jurassic onwards)

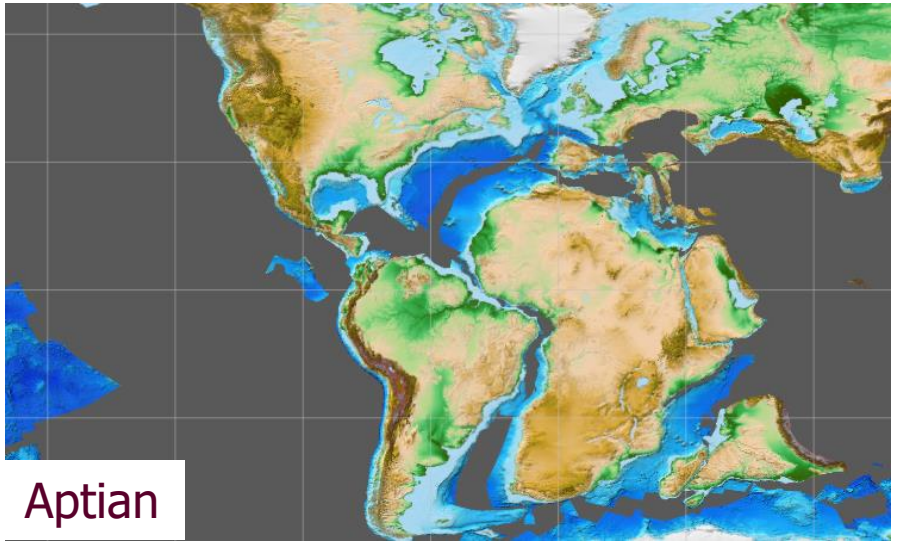
Plate Reconstruction



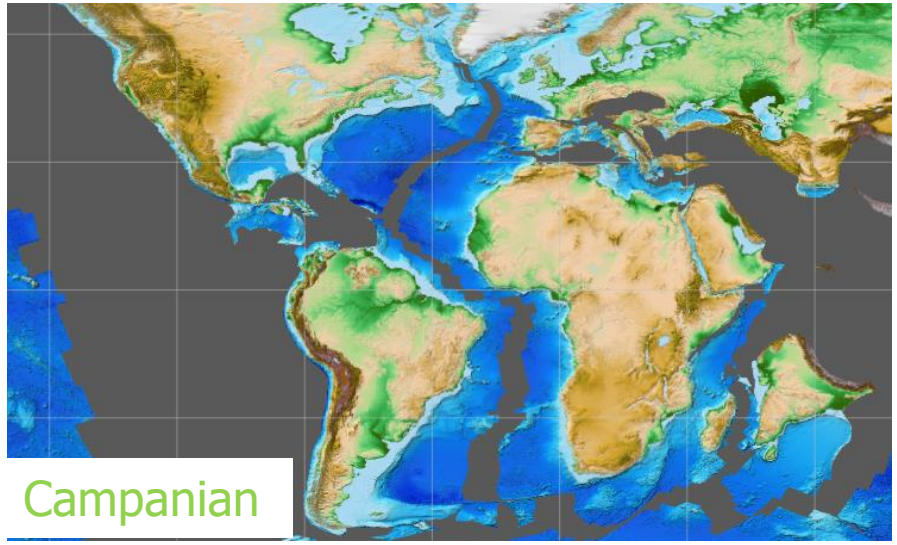
Triassic



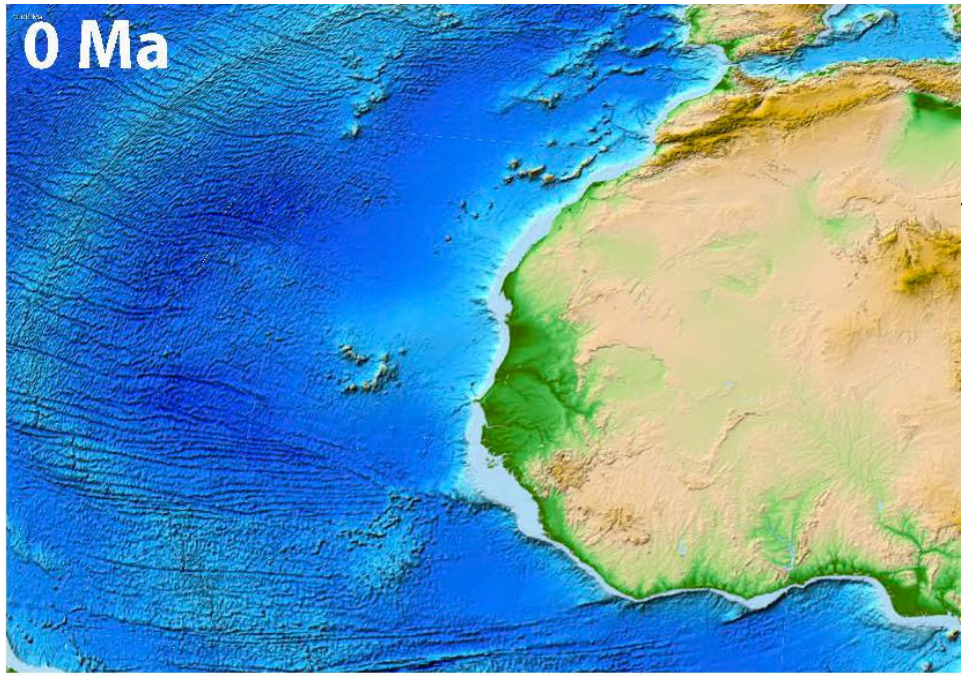
L Jurasic:
Toarcian



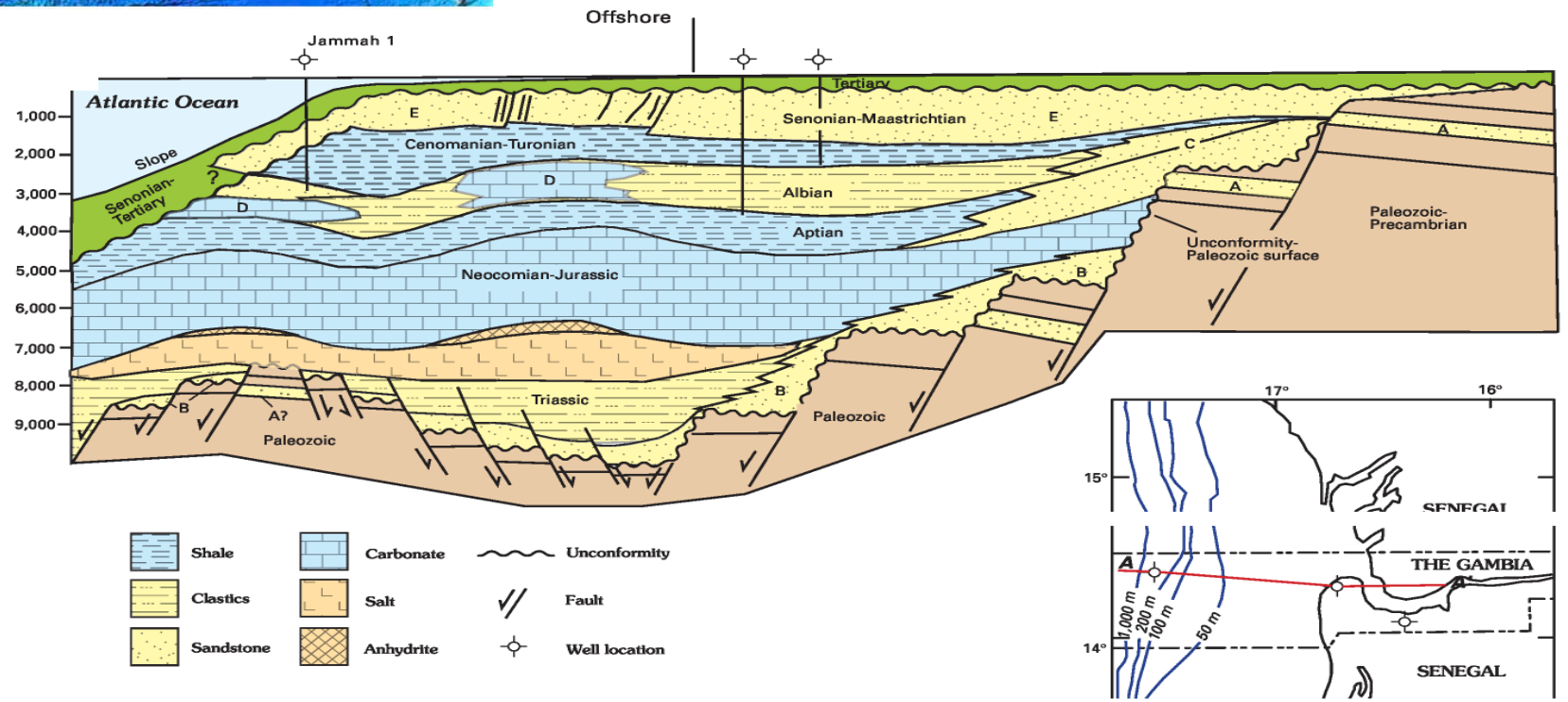
Aptian



Campanian

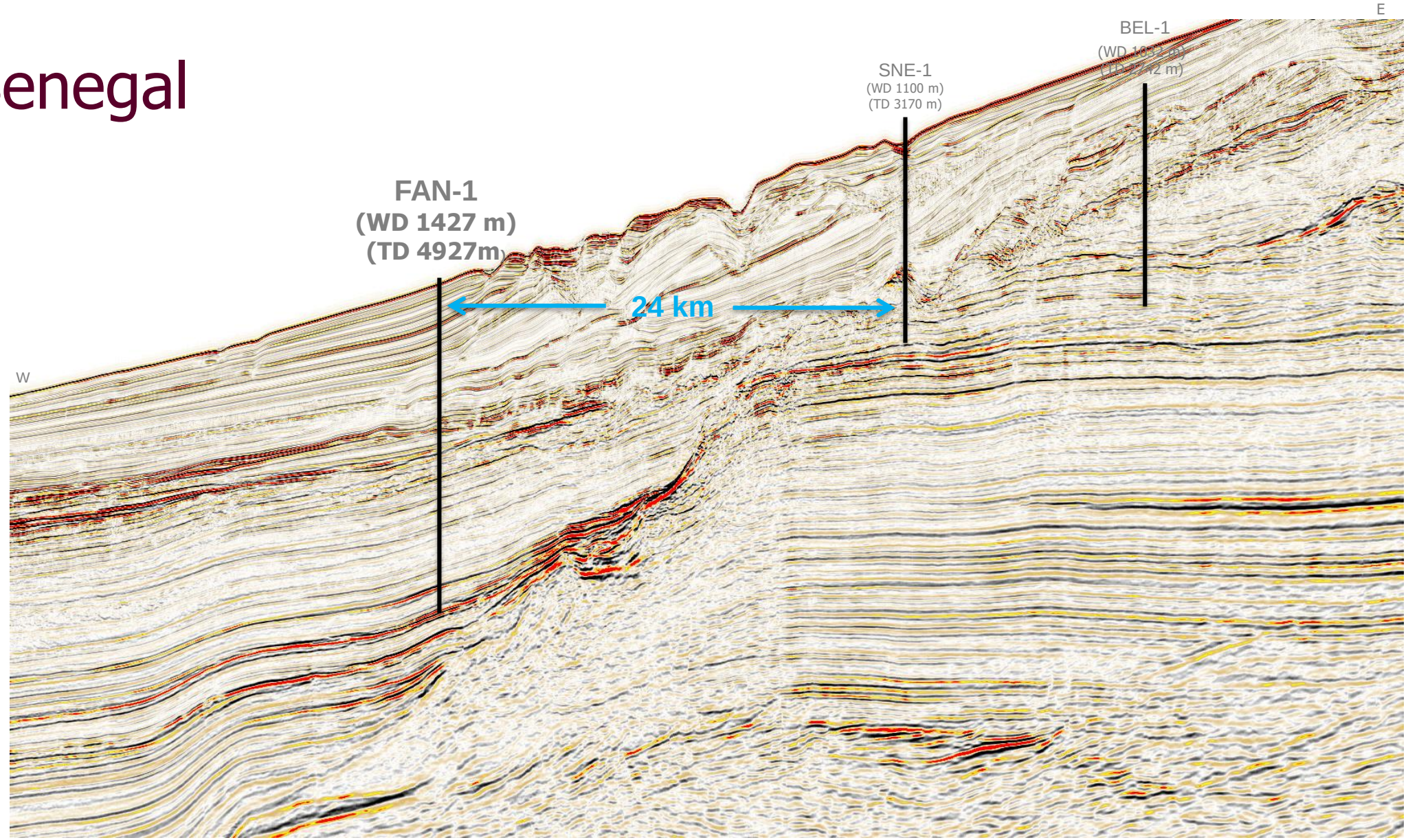


Consequent:
Extensively faulted Basin with grabens and normal faults forming sub basins



Regional Success

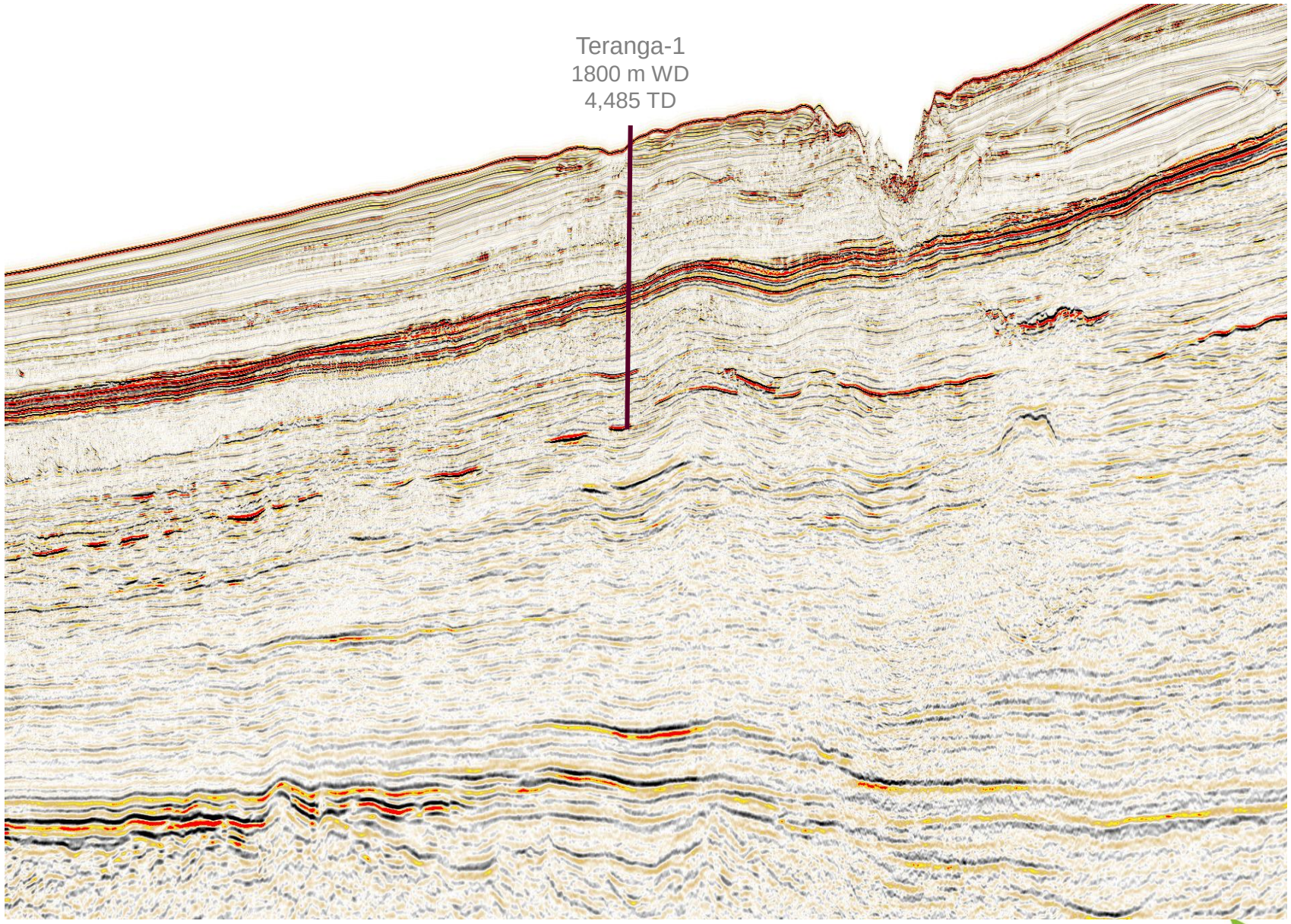
Senegal



- FAN-1 set of stacked fans 100 km offshore
- P50 reserves of 950 mmbbls with distinct oils ranging from 28° and 41°API
- Aptian Source? Albian reservoir

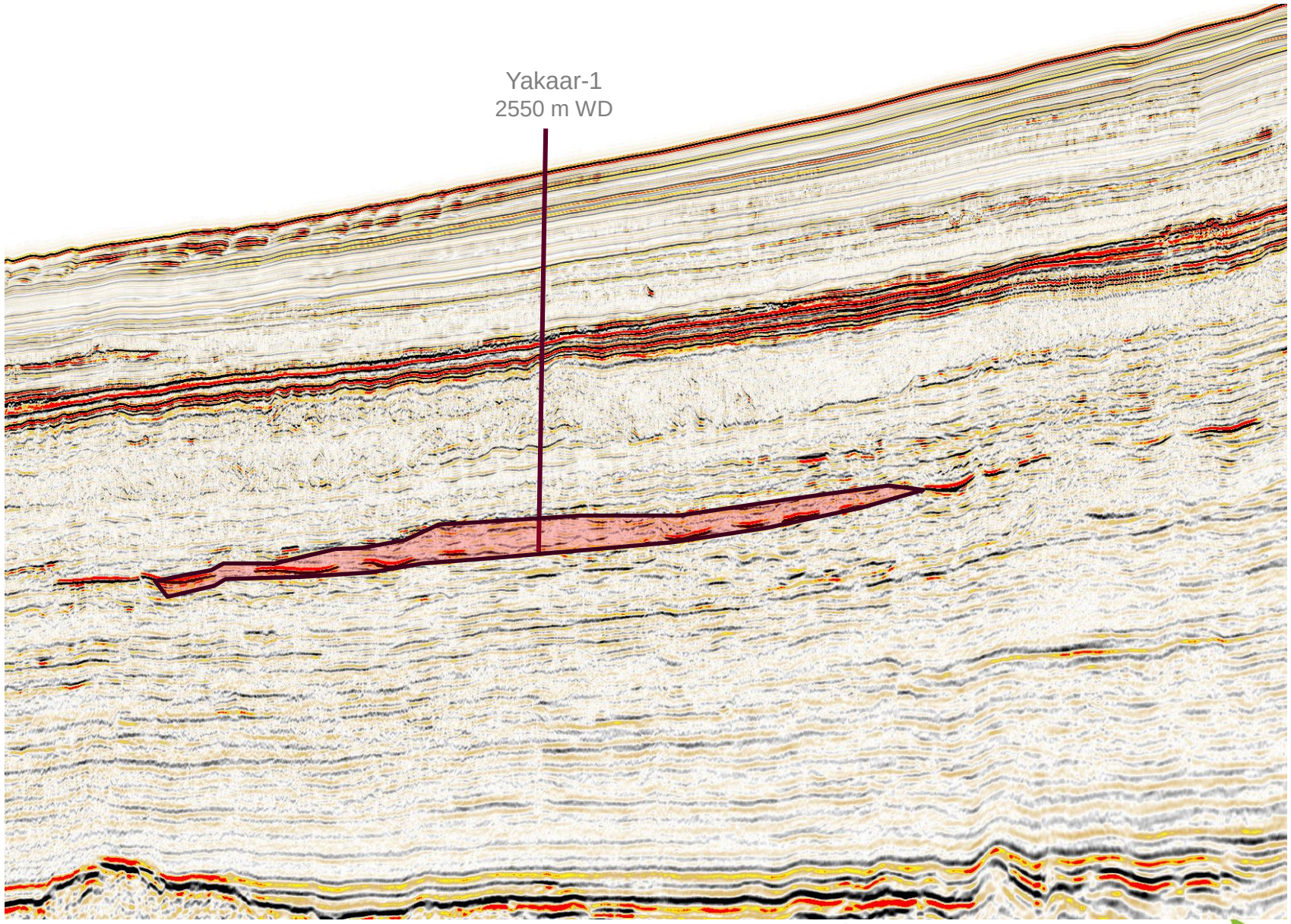
Senegal

- Drilled (May 2016) north SNE
- NET 31m gas column in Lower Cenomanian good quality reservoir.
- Thick, stacked reservoir sands over a very large area with good porosity and permeability.
- Inboard play fairway estimates raised to 50 Tcf



Senegal

- Drilled (May 2017)
- Stacked Lower Cenomanian basin floor fairways fans.
- Thick, stacked reservoir sands over a very large area with good porosity and permeability.
- Gross gas column of 120 m. NET 45m
- Estimates of 15 Tcf.

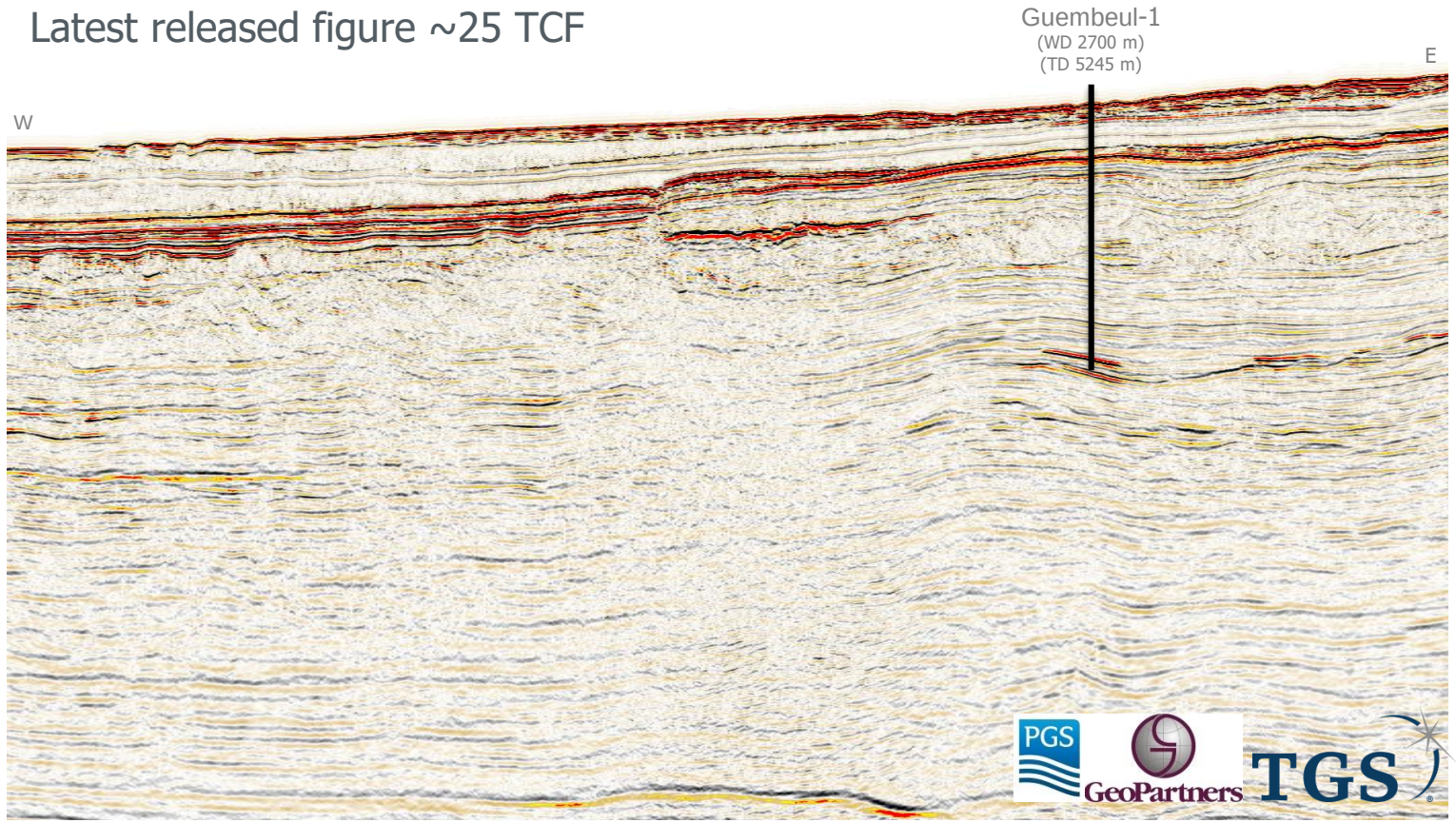


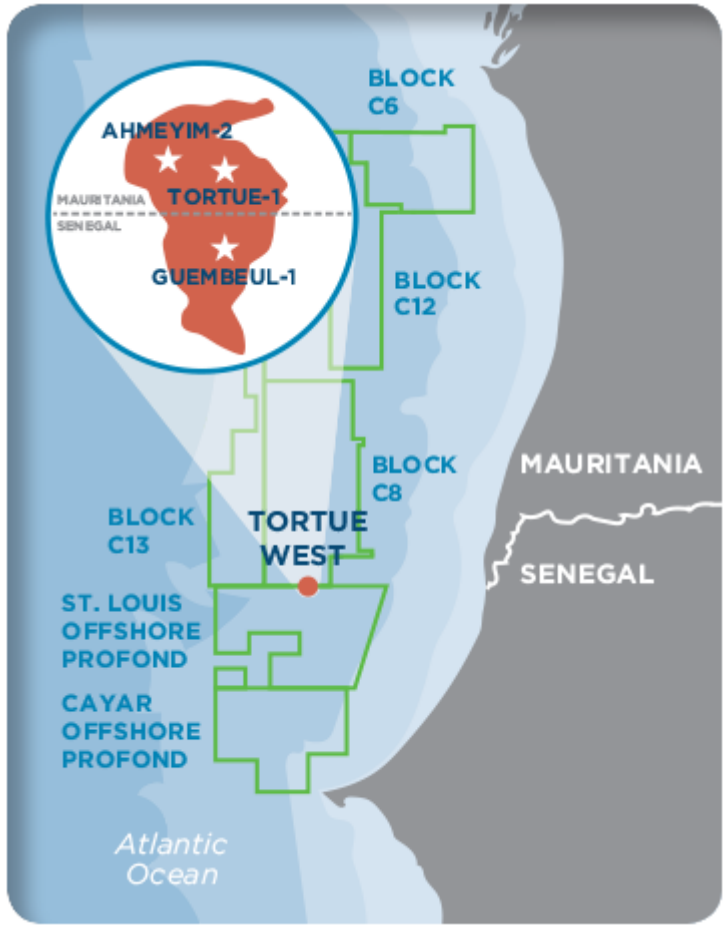
PGS GeoPartners TGS

GNPC

Senegal - Mauritania

- Guembeul-1 found 101 m of net gas pay in same reservoirs as Tortue-1 - including 56 meters in the Lower Cenomanian and 45 meters in the underlying Albian
- Static pressure communication with Tortue-1 suggests single large accumulation
- Latest released figure ~25 TCF

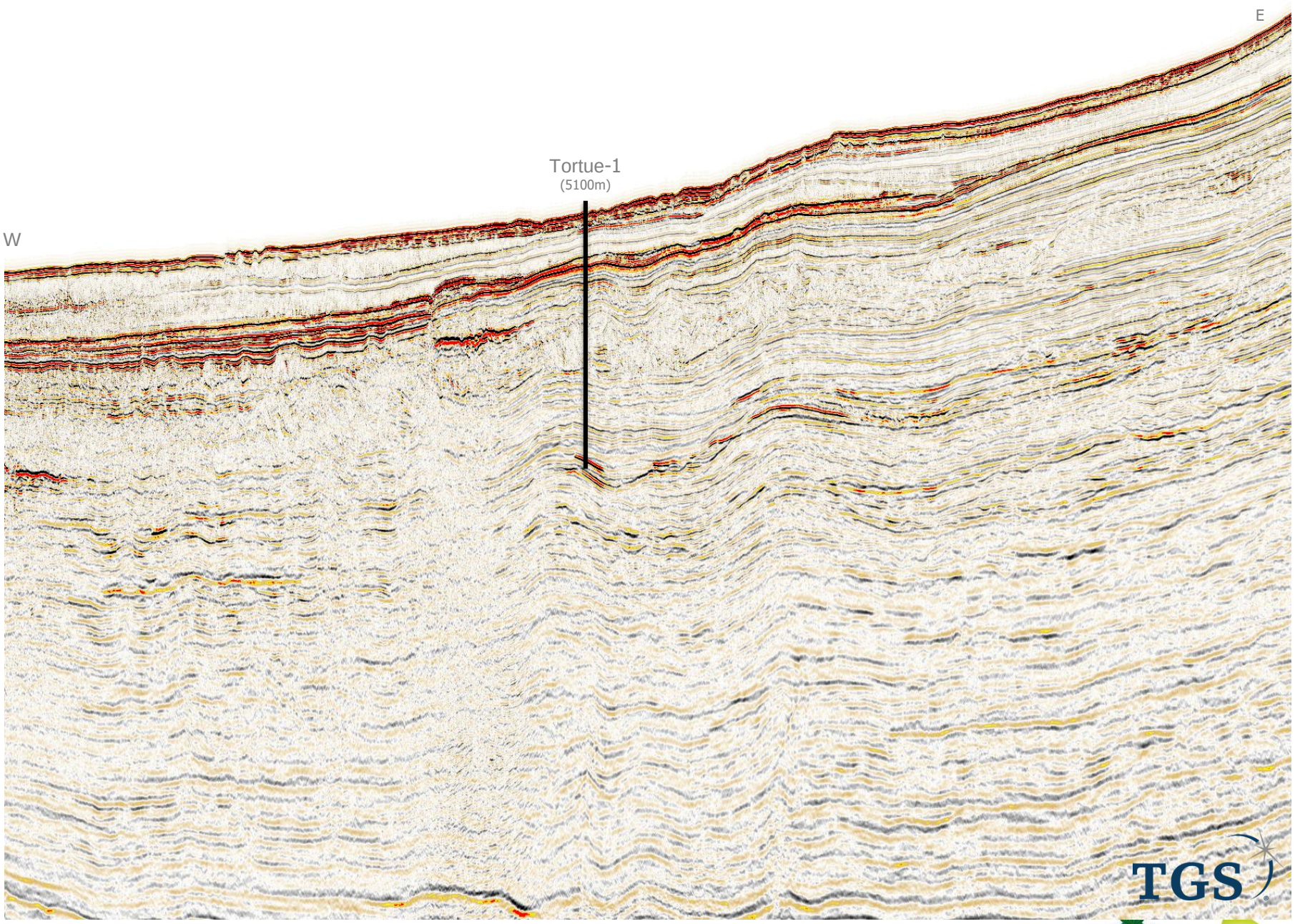




GNPC

Mauritania

- Tortue-1 found 117 m of net gas pay in excellent poro-perm Cenomanian & Albian reservoirs
- Slope/channel reservoirs in structural /stratigraphic trap
- 5-8 TCF

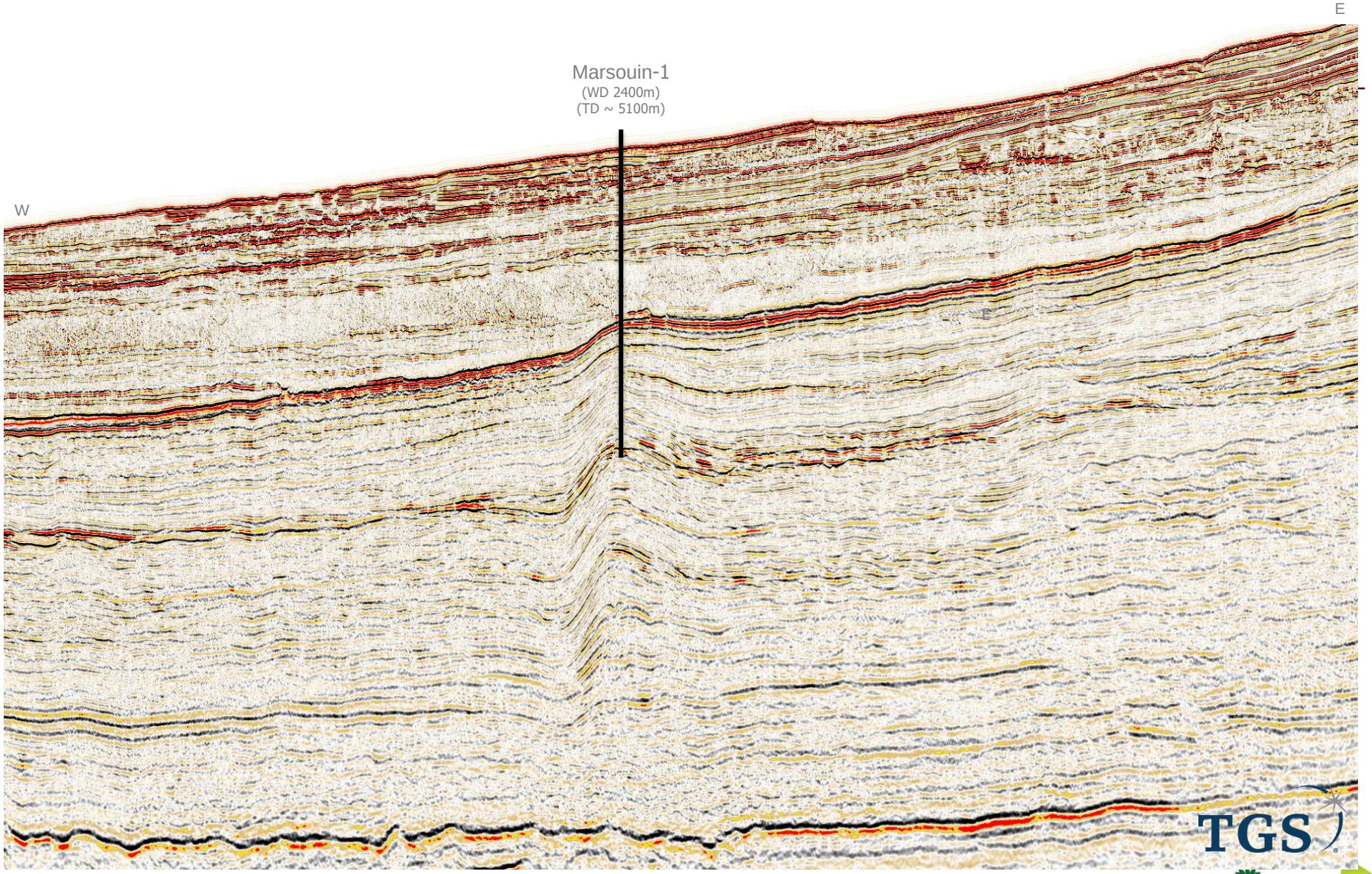


Largest global thermogenic discovery of 2015

GNPC

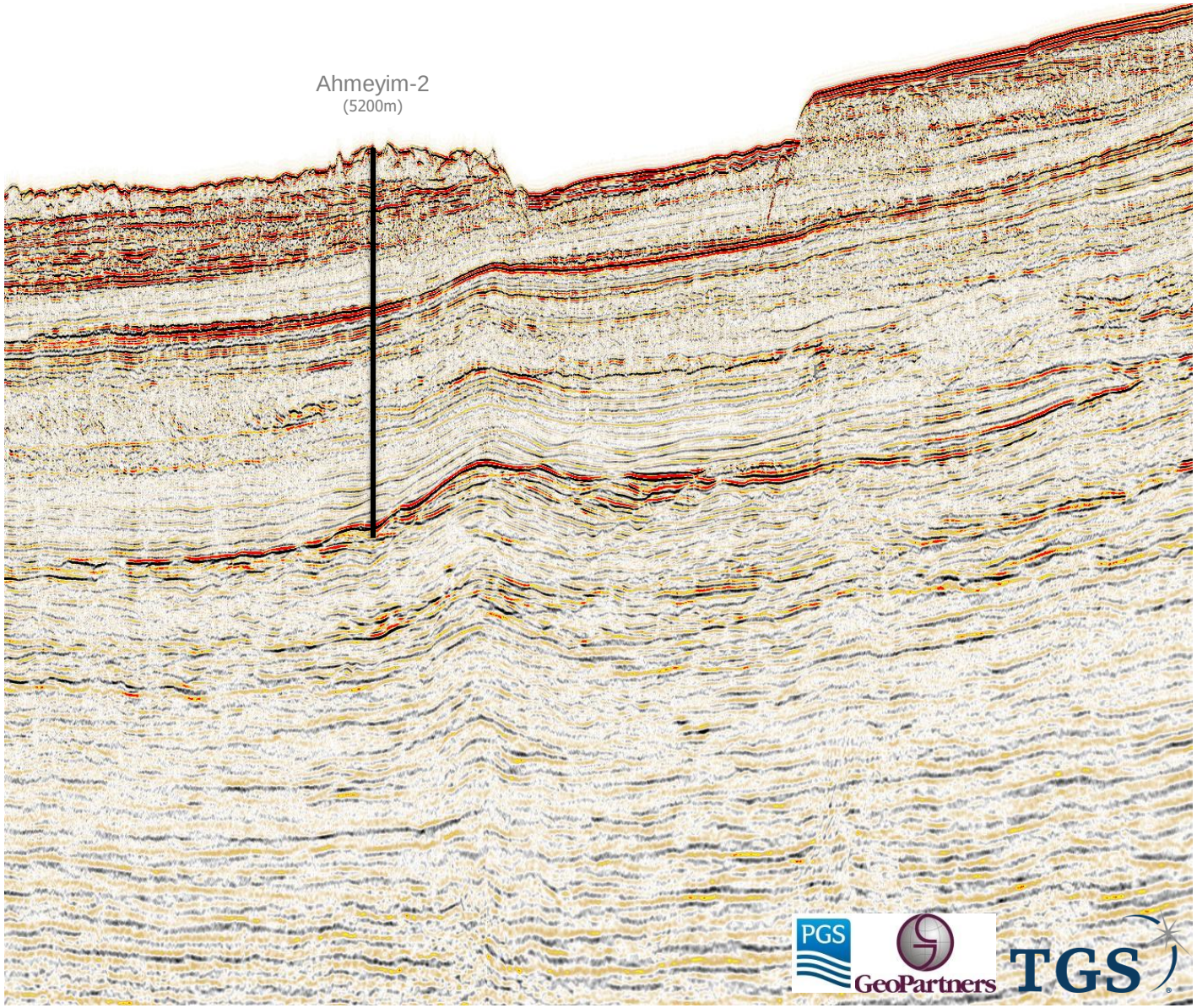
Mauritania

- Marsouin-1 found 70 m of net gas pay in excellent poro-perm Upper and Lower Cenomanian reservoirs
- 60 km north of Tortue
- ~5 TCF gas

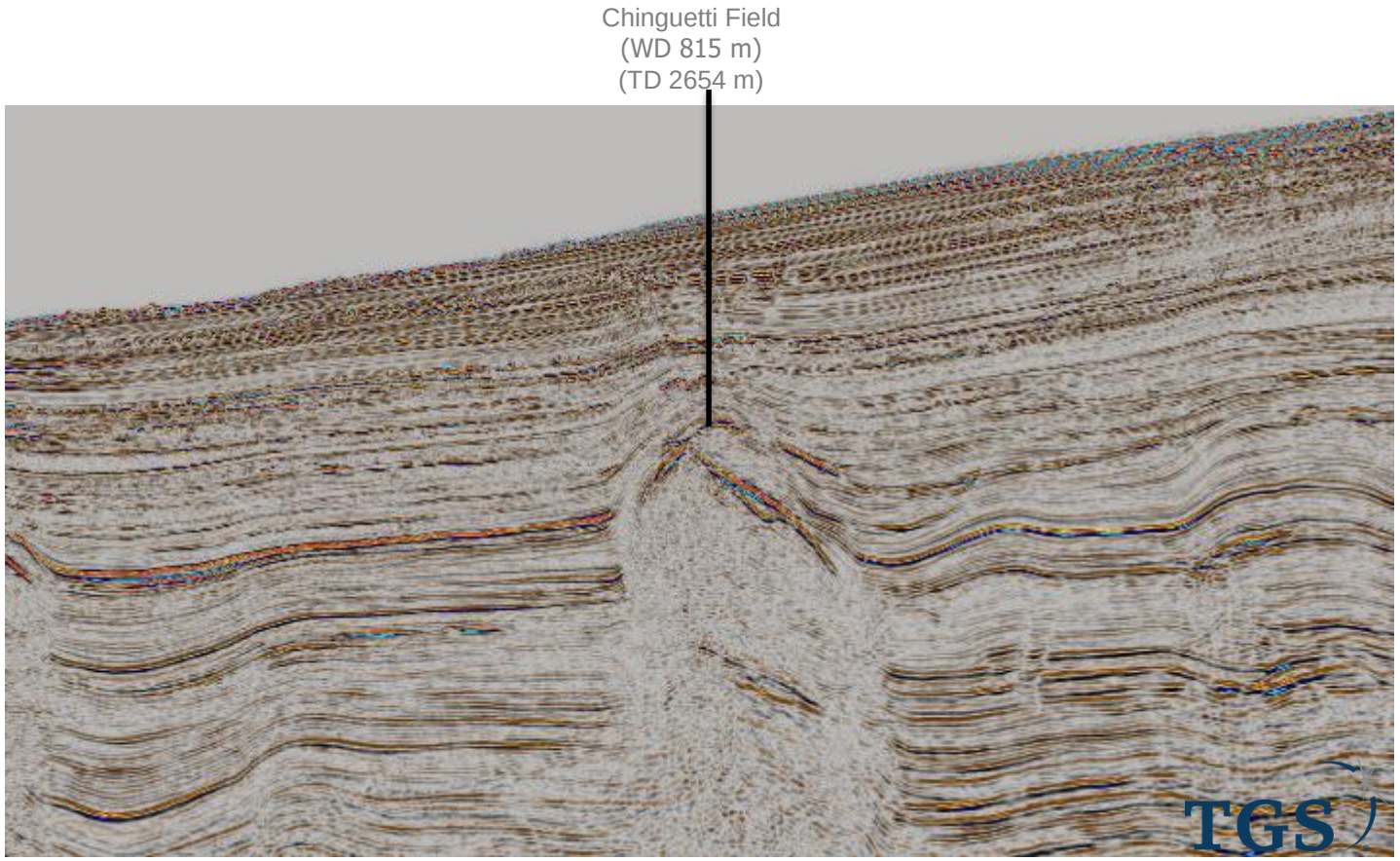


Mauritania

- Ahmeyim-2 found thickening of gross reservoir sequences with excellent quality Cenomanian & Albian reservoirs.
- Defined the field limit and extended the productive field area from approximately 50 km^2 → 90 km^2

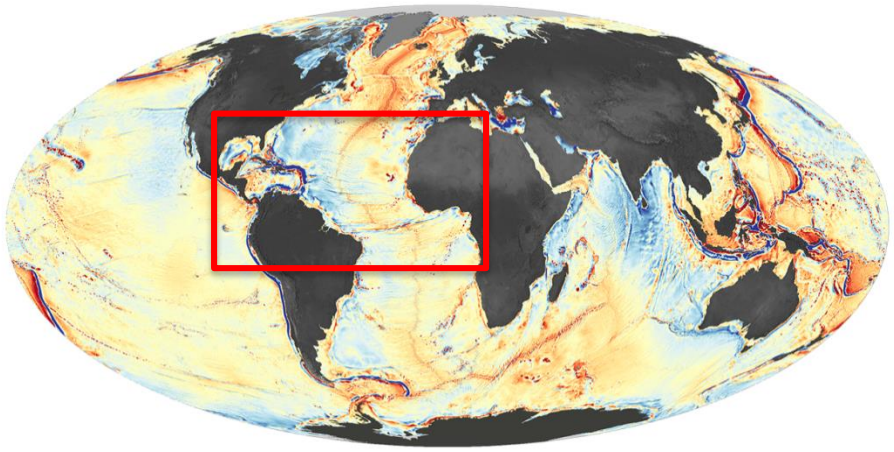


Only production offshore in Mauritania

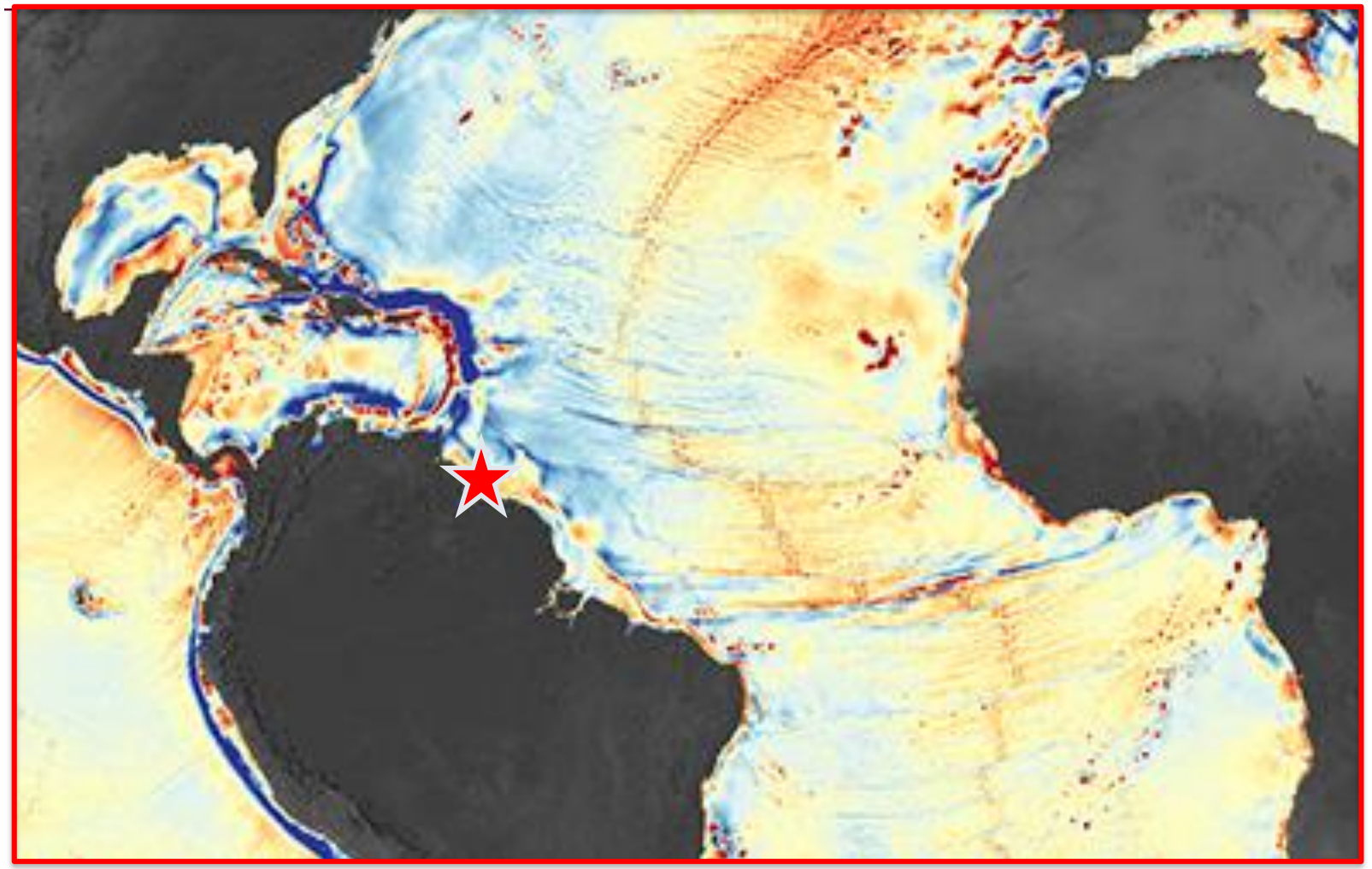


- Discovered by Woodside in 2001 ~ 34 MMBOE (2P reserves)
- 80 km offshore Mauritania – 12km^2 closure
- Currently being produced by Petronas at about 6,000 bpd from Tertiary Sandstones
- Production declining – decommissioning looming

Conjugate Success

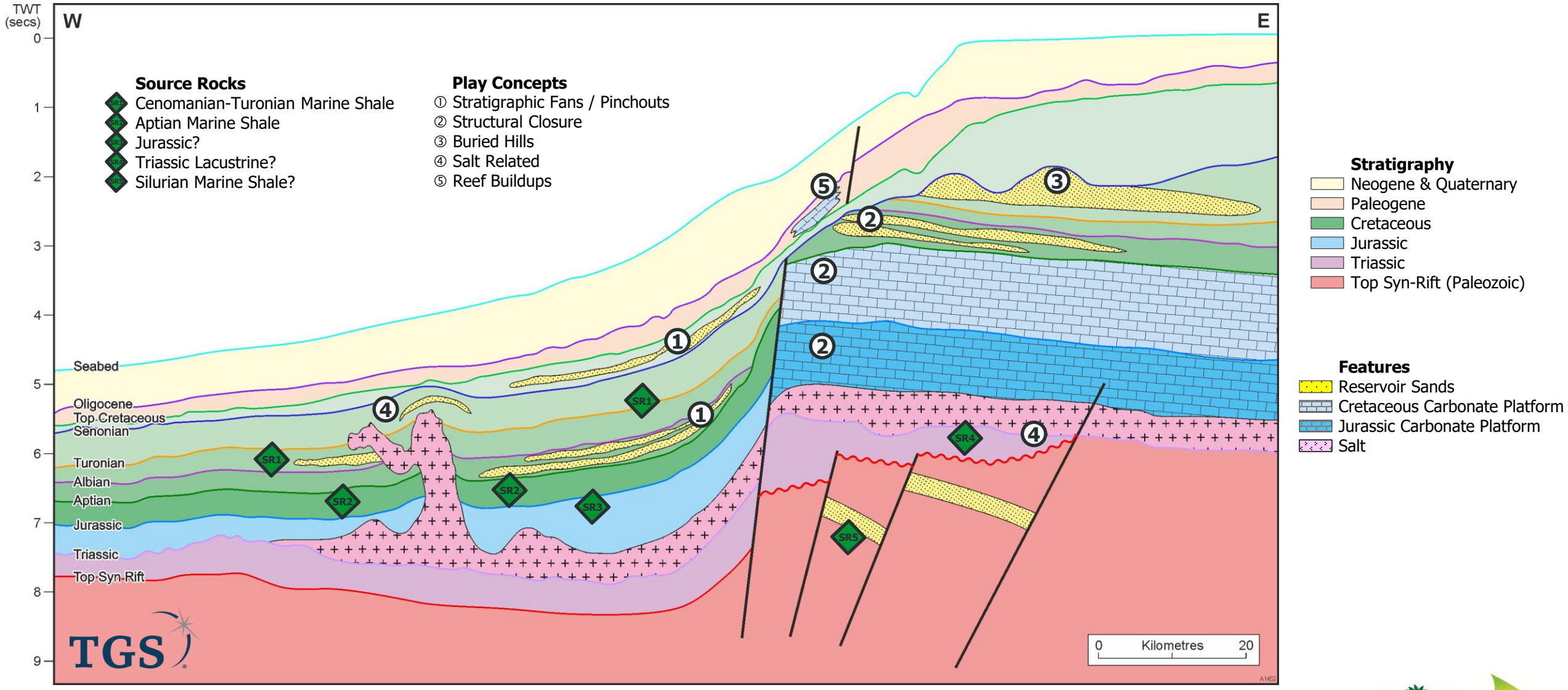


ExxonMobil continues with its successful exploration campaign offshore Guyana with the discovery of Turbot. This shows that deepwater can still be attractive. ExxonMobil's Liza and Payara complex approach the 2 billion barrel mark in commercial reserves!!!
Expect around 350,000-400,000 b/d of oil production by 2026



Source: NASA Global Gravity Ocean Floor

MSGBC Basin Play Types



GNPC

Discovered MSGBC Volumes

- **BP / Kosmos Group**= Greater Tortue Complex is 25 TCF = 4.3 BBOE of C2 Reserves
- **CAIRN Group**= 0.6 -1.0 BBO of C2 Reserves
- **Dome Flore**= 1.3 BBO Heavy Oil in place, > 3.0 BBO generated

This means the MSGBC Basin is now a

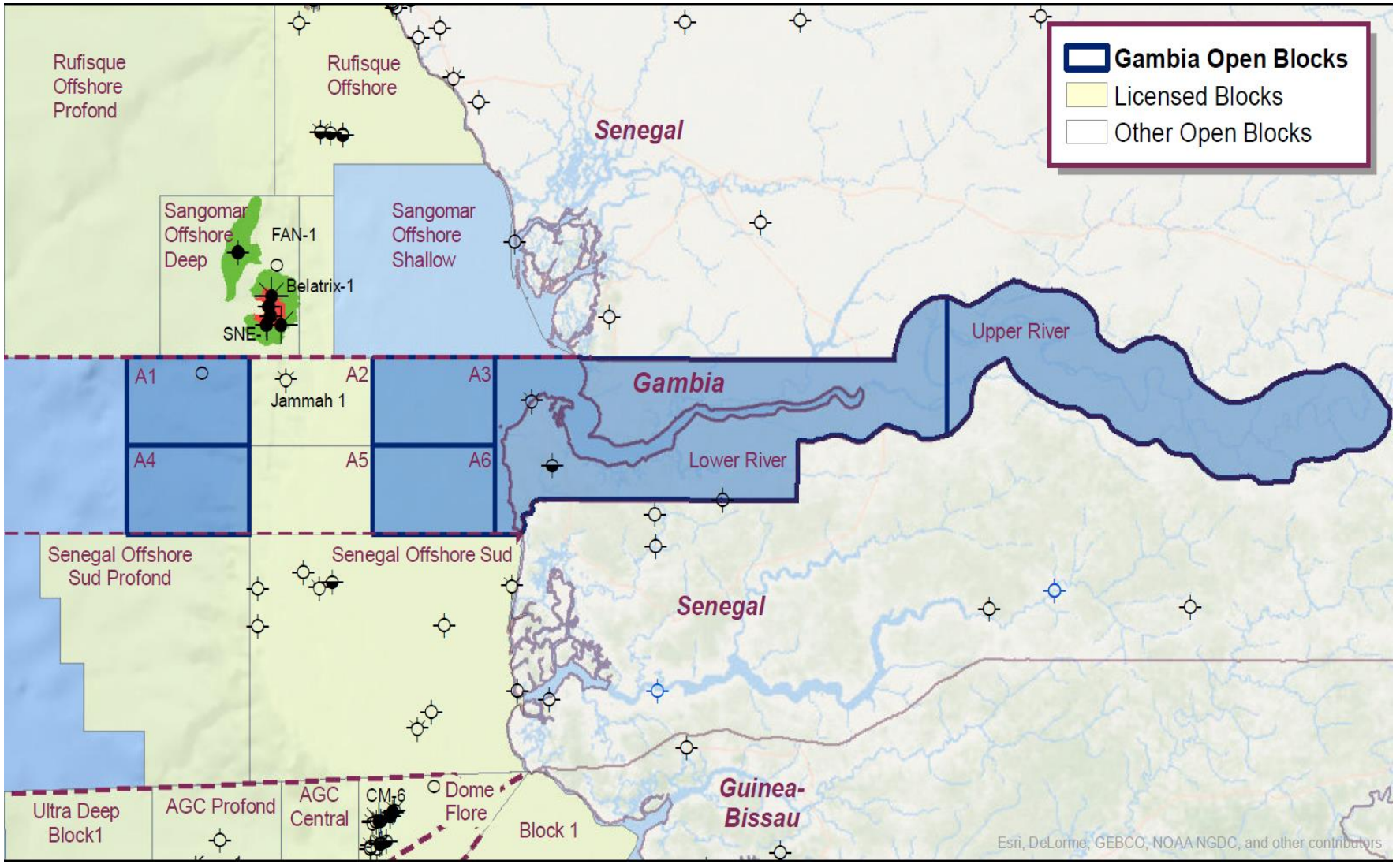
Supergiant Petroleum System

with more than 5 BBO (or oil equivalent)

reserves already discovered.

The Gambia's Prospectivity

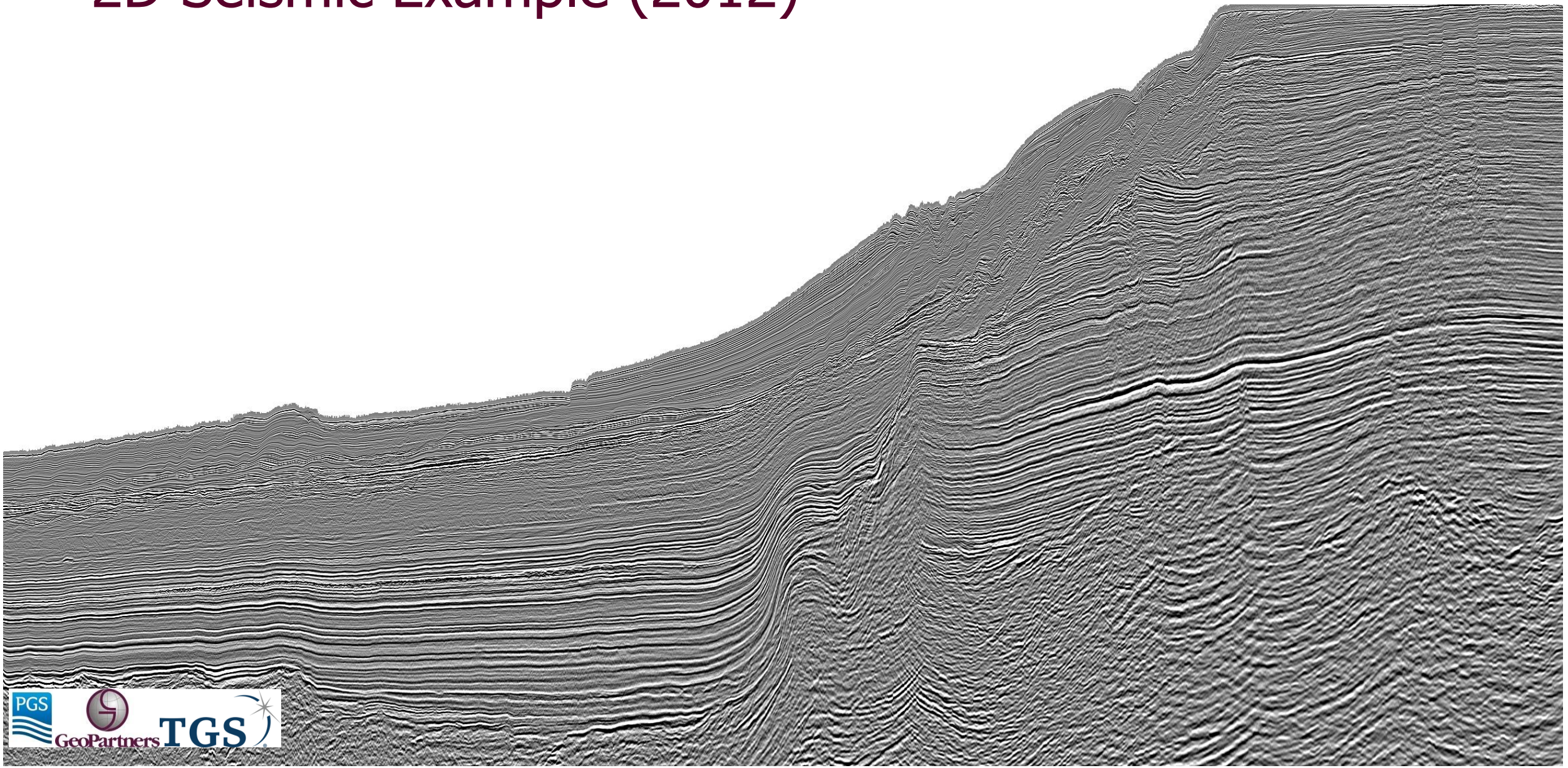
Block Map


Gambia Open Blocks
Licensed Blocks
Other Open Blocks
Rufisque Offshore Profond
Rufisque Offshore
Senegal
Sangomar Offshore Deep
FAN-1
Belatrix-1
SNE-1
Sangomar Offshore Shallow
Upper River
A1
A2
A3
Jammah 1
Gambia
A4
A5
A6
Lower River
Senegal Offshore Sud Profond
Senegal Offshore Sud
Senegal
Guinea-Bissau
Ultra Deep Block1
AGC Profond
AGC Central
CM-6
Dome Flore
Block 1
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors

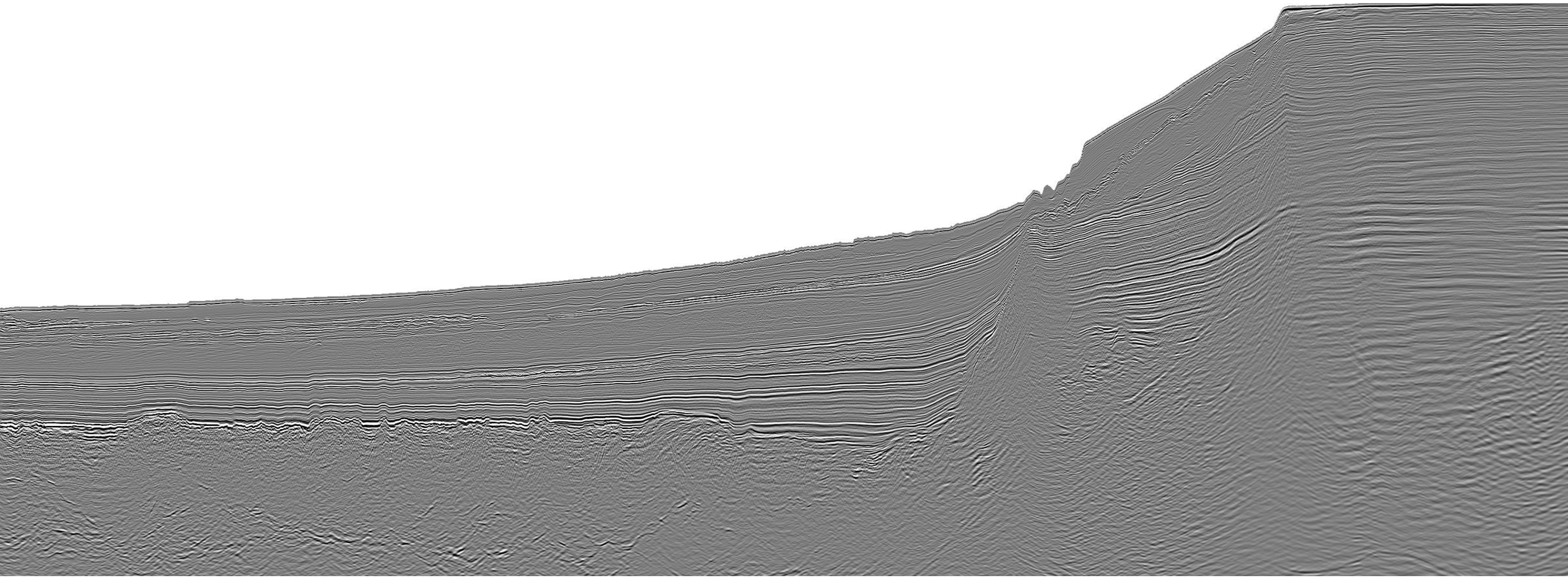
Recent Seismic Data Coverage

Vintage	Offshore		
	2D (km)	3D (km²)	
1999	1096		Multi-Client
1999	102		Multi-Client
2001	720		Multi-Client
2003		500	Gov't
2011	612		Multi-Client : TGS
2011		2566	Multi-Client : TGS
2015		1504	Multi-Client : GeoPartners/Polarcus
2017	1513		Multi-Client : TGS/PGS
TOTAL	4043 km	4570 km²	

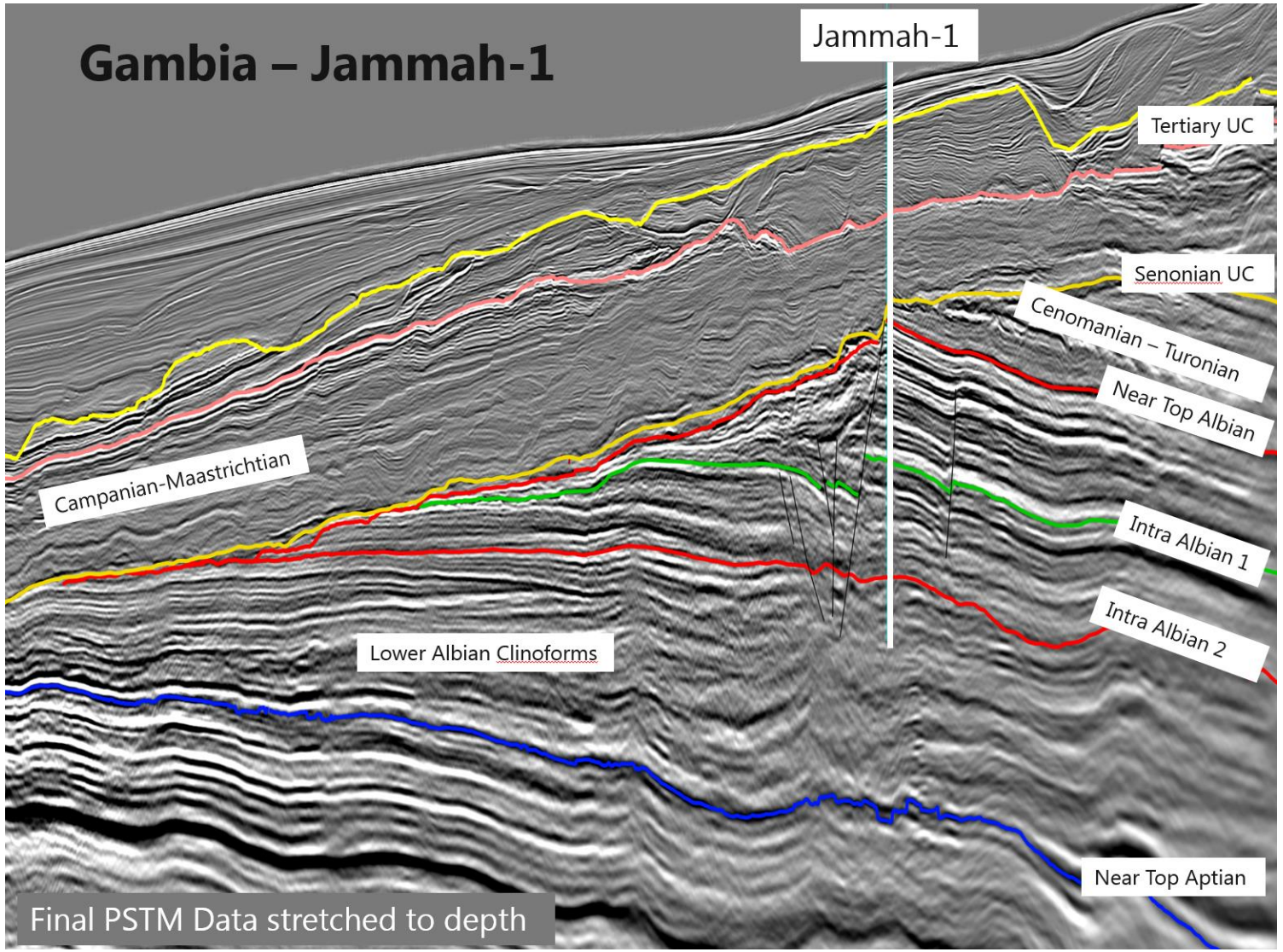
2D Seismic Example (2012)



2D Seismic Example (2017 Fast Track)



3D Seismic Example (A2/A5) thru Jammah-1



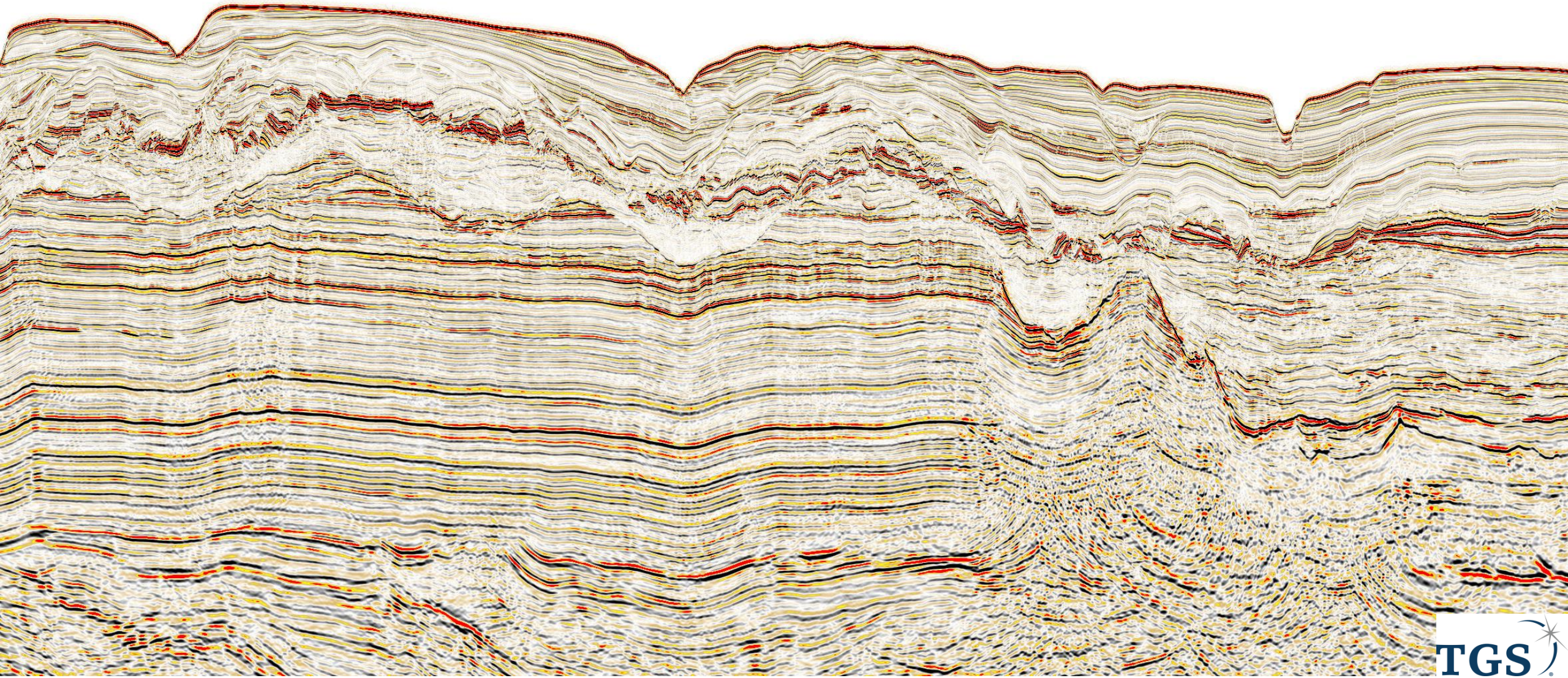
- The well targeted an Albian shelf-edge carbonate feature and encountered viable reservoir horizons but with only minor petroleum shows.
- The well was drilled on the basis of 2D seismic data and post well studies suggest the well was dry due to erosion of potential Turonian source rocks at the well location

GeoPartners

Polarcus

GNPC

3D Seismic Example (A1/A4) Strike



Conclusions

- **Source Rocks:**
- **PRIMARY**: Cenomanian-Turonian shales upto 150 meters thick
  - North: wells on shelf boundary with source rocks, up to 380 m thick,
  - South: Turonian interval contains bituminous shales believed to be the richest source rocks thickness up to 150 m
  - DSDP 367 and 368 identified potential Neocomian to Cenomanian source rocks
  - Minor source rocks within Senonian and Maastrichtian
- **SECONDARY**: Graptolitic Silurian shale appx 400m thick in south Senegal, equivalent to oil-rich Silurian Tanezzuft Formation, in N Africa & M East
- **TERTIARY:** Syn-rift inferred Upper Permian-Lower Triassic lacustrine rocks. Analogies in Morocco, NW Africa, North America and West Central Africa which contain clastic, lacustrine, and evaporite rocks. The Newark Basin of North America is one of these rift basins that contain lacustrine source beds

THANK YOU