

# SENEGAL SEDIMENTARY: PETROLEUM POTENTIAL





# Outline



- ☐ **PRESENTATION OF PETROSEN**
- ☐ **THE SEDIMENTARY BASIN & EXPLORATION AND PRODUCTION HISTORY**
- ☐ **OIL & GAS DISCOVERIES**
- ☐ **OFFSHORE AND ONSHORE OPEN BLOCKS POTENTIAL**
- ☐ **WHY INVEST IN SENEGAL**



# SENEGAL NATIONAL OIL COMPANY « PETROSEN »

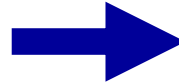




# PETROSEN



Creation in 1981



Since 1994

## MISSIONS

### Upstream

- ☐ Periodic Evaluation of the Petroleum Potential of the Basin;
- ☐ Promotion of this potential to the International Oil & Gas Market;
- ☐ Participation with the companies to E&P activities ;
- ☐ Technical Control of Petroleum Operations.

### Downstream

- ☐ Participation in joint venture to the Downstream Activities.



# THE SEDIMENTARY BASIN EXPLORATION & PRODUCTION HISTORY



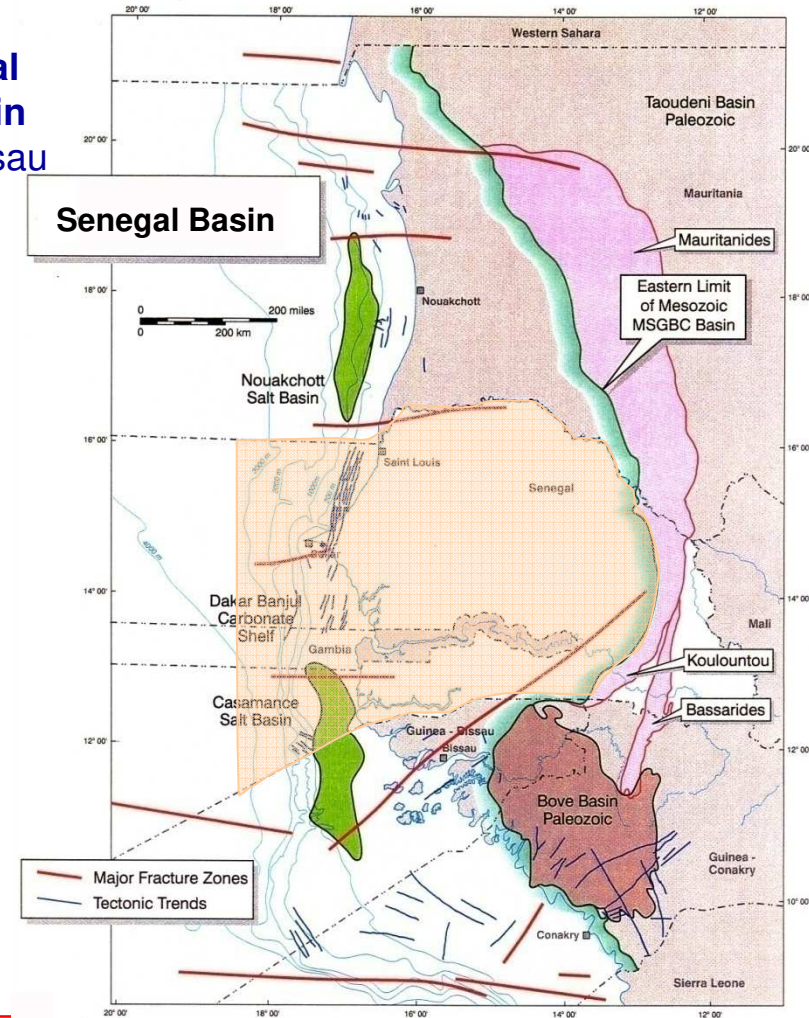
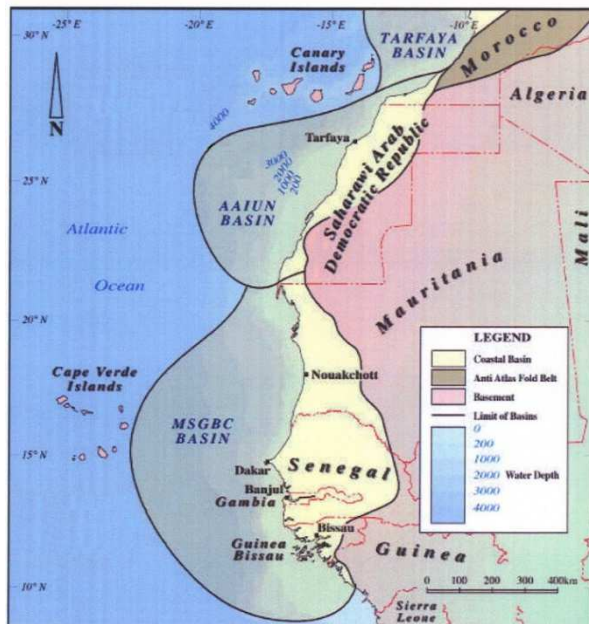


# MSGBC Basin



The Senegal sedimentary basin occupies the central part of the large North-Western African coastal basin called **MSGBC** (Mauritania – Senegal – Gambia – Bissau – Conakry), which extends from Reguibat shield in its Northern limit to Guinea fracture zone to the South.

**Total surface area: 230 000 square kilometers**







# Exploration : from 1952 to Present

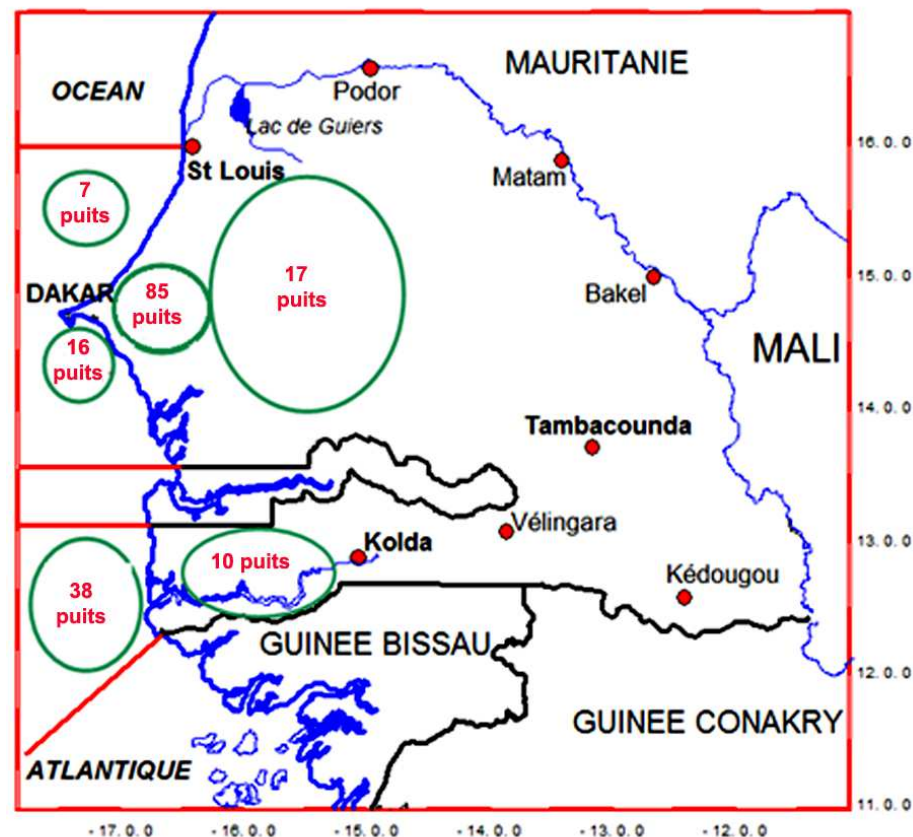


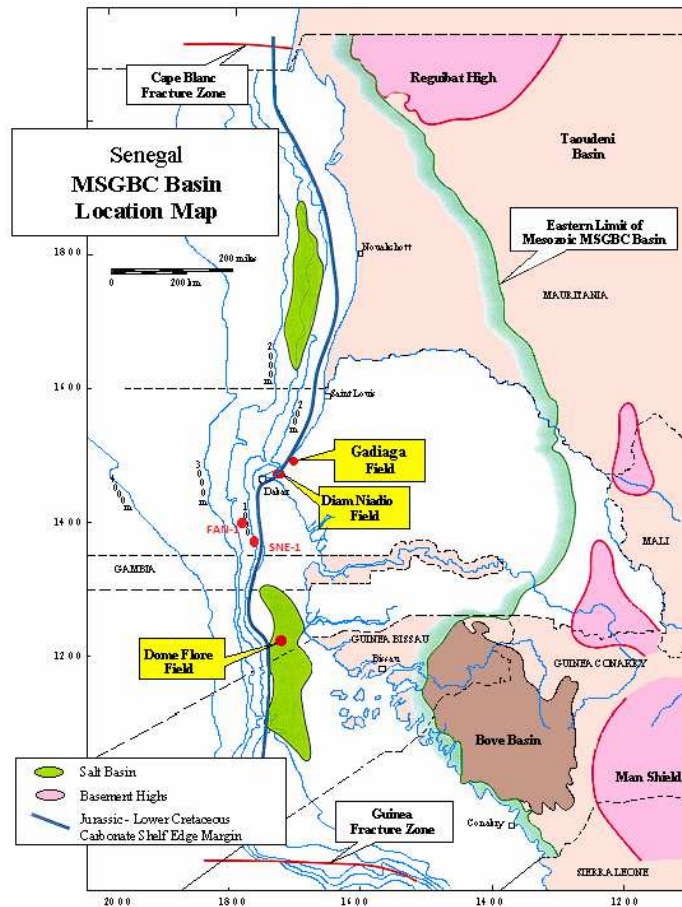
## Seismic Acquisition

- ❑ 60 900 km of 2D seismic
- ❑ 27 150 km<sup>2</sup> of 3D seismic

## Exploration Wells

- ❑ A total of 173 exploration & Appraisal wells (most of the wells are drilled in the Dakar/Thies area and offshore south)
- ❑ The basin is under explored





## Diam Niadio in 1961

Many small oil and gas fields in the Maastrichtian section

## Dome Flore & Gea in 1967

About 1 billion barrels of heavy oil in the Oligocene limestone

## Gadiaga in 1976 / 1997

Very important gas reserves in Campanian and Senonian sandstones.

## Sangomar Offshore Profond in 2014, 2017

4 oil & gas discoveries in the Cenomanian & Albian.

## Saint Louis offshore Profond in 2015, 2016, 2017

3 great gas discovery in the Cenomanian & Albian



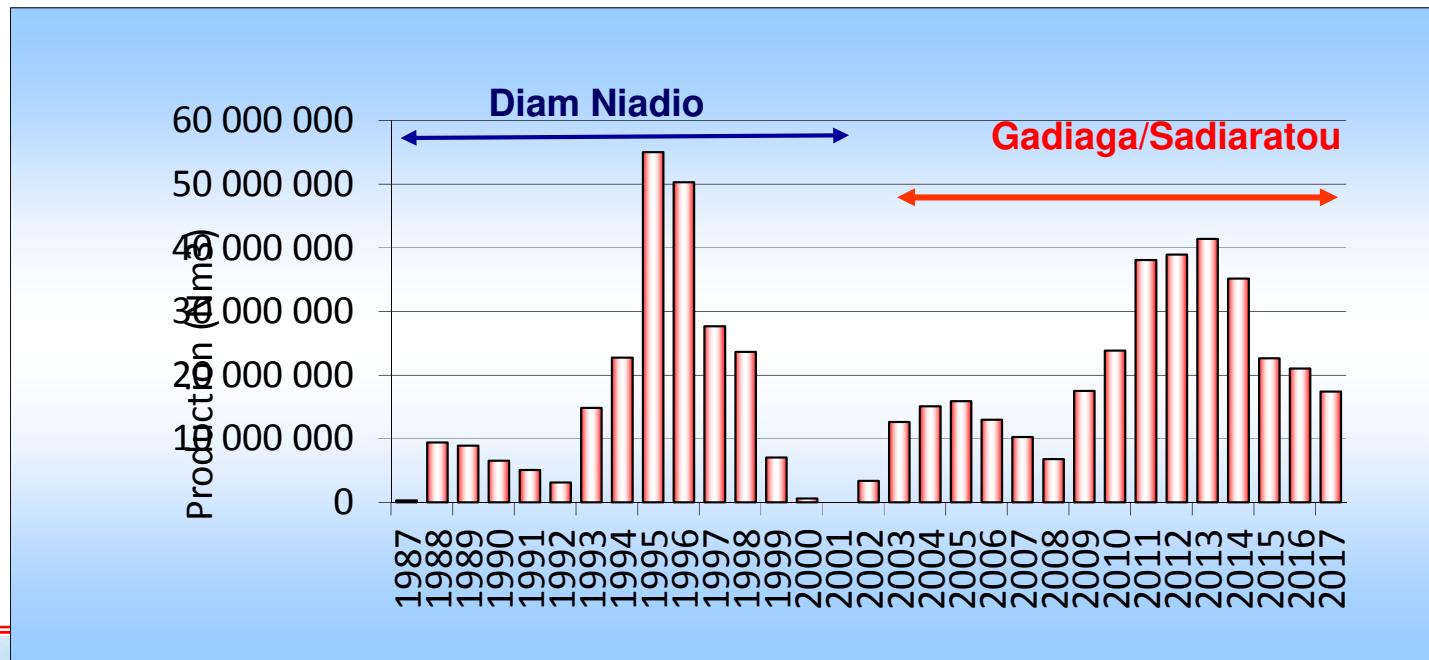


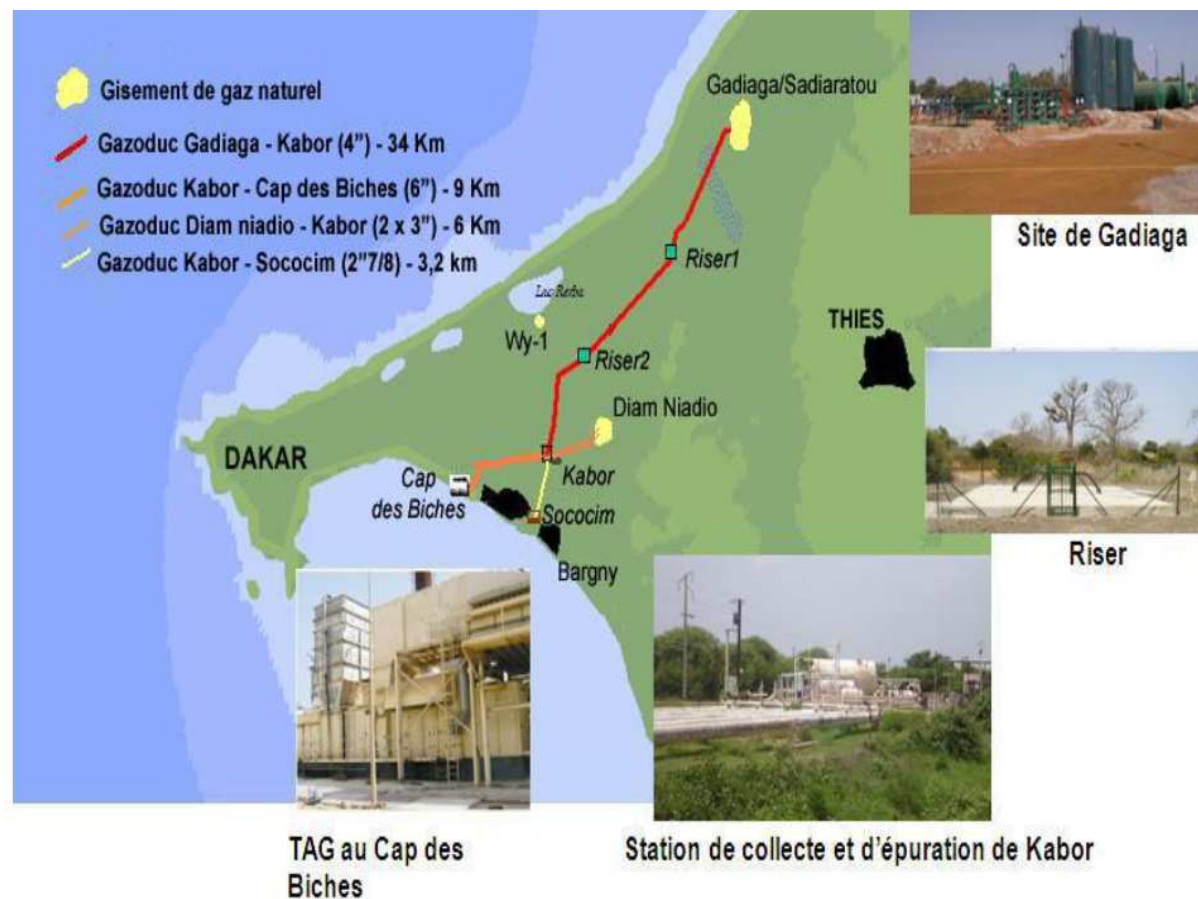
# Hydrocarbons Production



## Diam Niadio

- ❑ 62 500 barrels of crude oil (34° API)
- ❑ 35 600 barrels of condensate
- ❑ Diam Niadio : 235 000 000 Nm3 of natural gas (8.8 BCF) from 1987 to 2000
- ❑ Gadiaga/Sadiaratou : 333 172 649 Nm3 of natural gas (12 BCF) from october 2002 to 2017



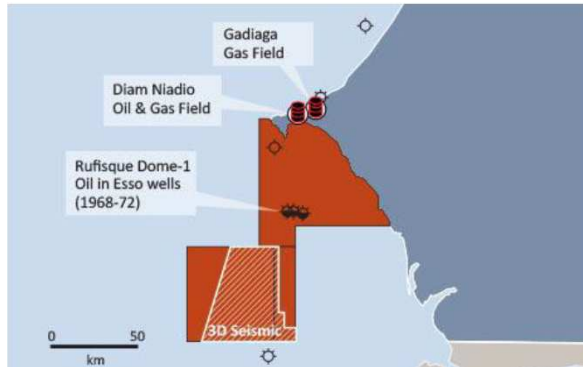


# OIL & GAS DISCOVERIES





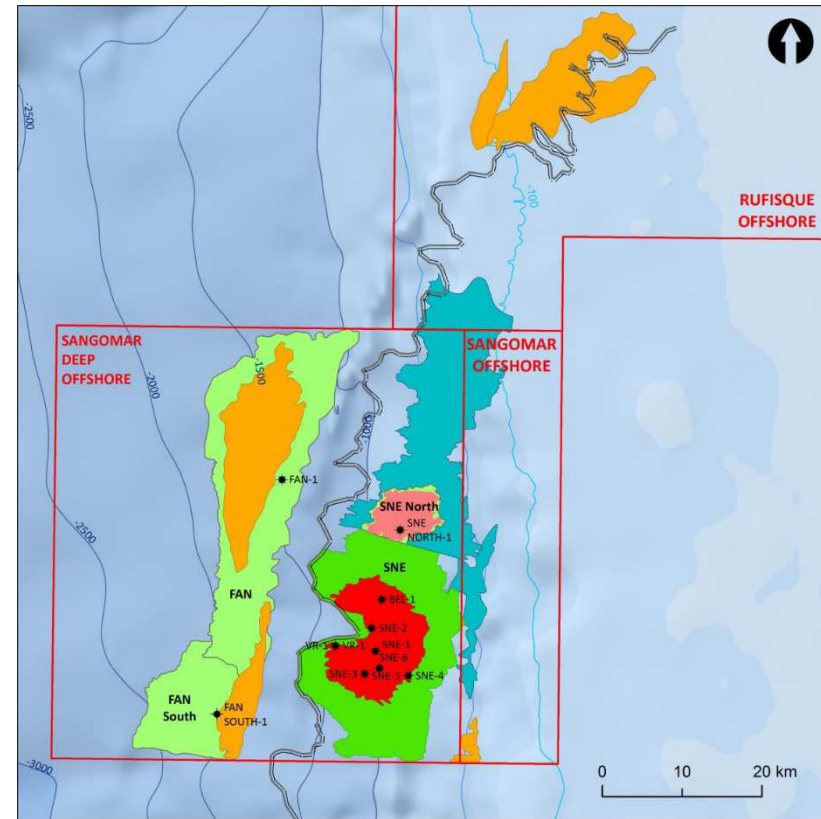
# Sangomar Offshore Profound Block Discoveries



Location of the License

## Rufisque Offshore, Sangomar Offshore & Sangomar Offshore Profound License

- ❑ 2014 exploration wells : FAN-1 and SNE-1
- ❑ Appraisal wells : SNE-2, SNE-3, SNE-4, BEL-1, SNE-5, VR-1 and SNE-6
- ❑ Reserves Estimate (2C) : 563 MMSTB oil + 2,3 tcf gas associated and non associated
- ❑ Oil 31° API
- ❑ First oil : 2021 – 2023
- ❑ FAN South Discovery : 152 millions barrels
- ❑ SNE North discovery : ~83 millions barrels and 378 Bcf of gas



Discoveries, Prospects and Leads Map





## Saint Louis & Cayar Offshore Profond Discoveries



### Grand Tortue/Ahmeyin (GTA)

- 3 wells drilled: Tortue-1 (Aymeyin-1) et Aymeyin-2 in Mauritanie and Geumbeul-1 in Senegal

**Gas reserves : About 20 trillion cubic feet (TCF)**

### Téranga-1 (Cayar Offshore Profond block)

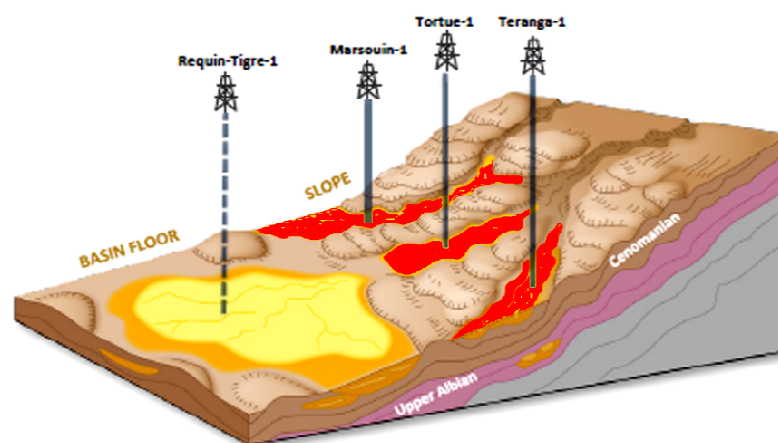
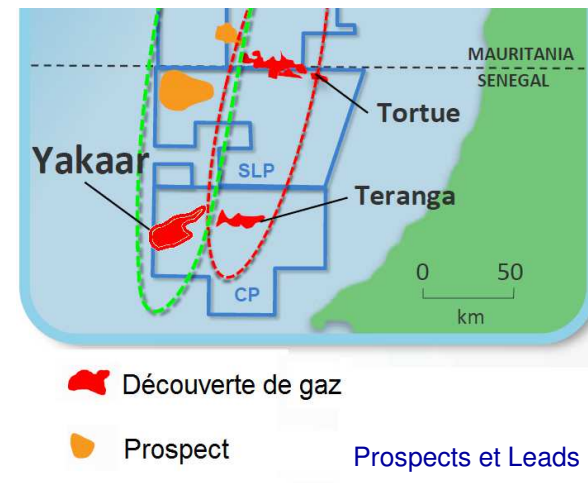
Drilled between end March to May 2016

**Ressources en place : 5 Tcf**

### Yakaar-1 (Cayar Offshore Profond block)

Drilled between end March to May 2016

**Ressources en place : 15 Tcf**



KOSMOS, 2017



# Offshore & Onshore Open Blocks Potential

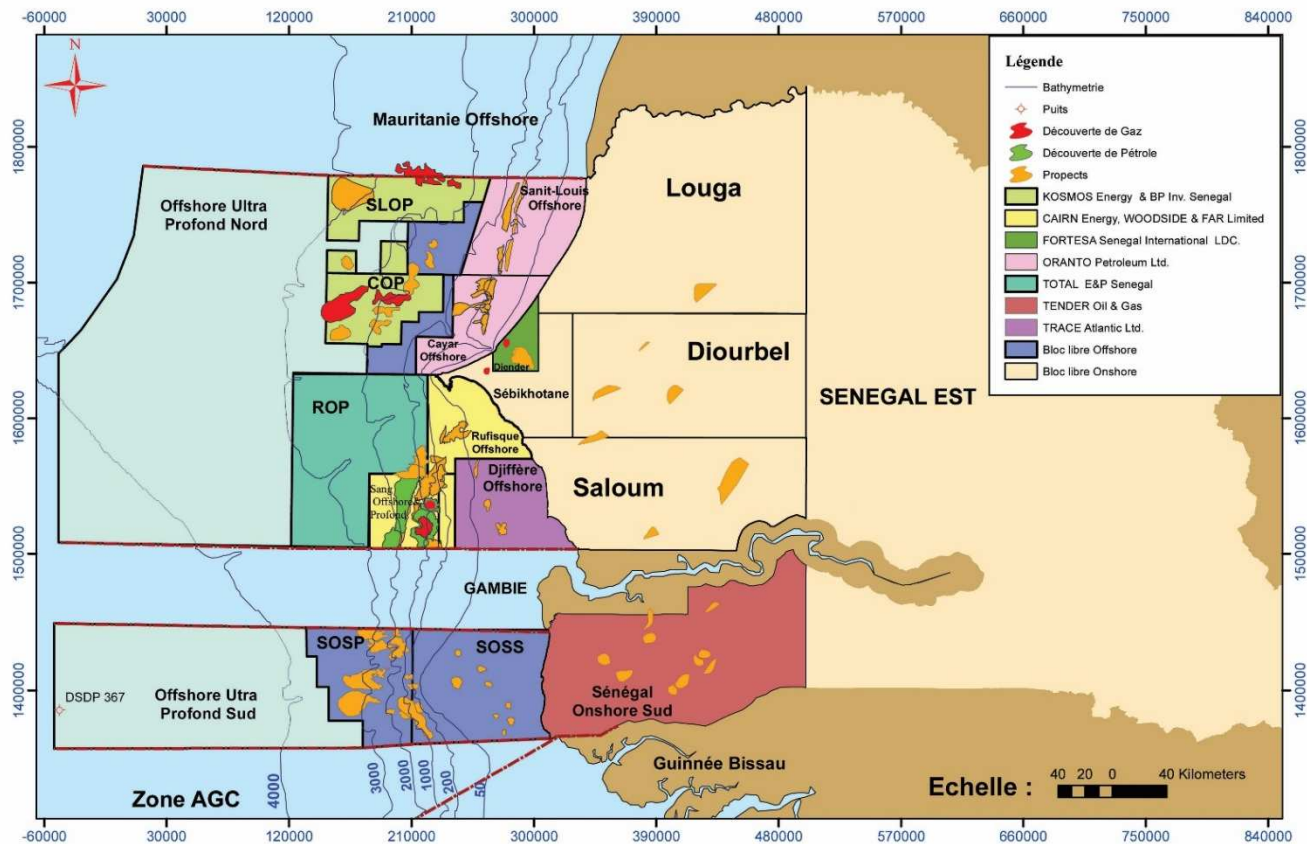




# Open Blocks



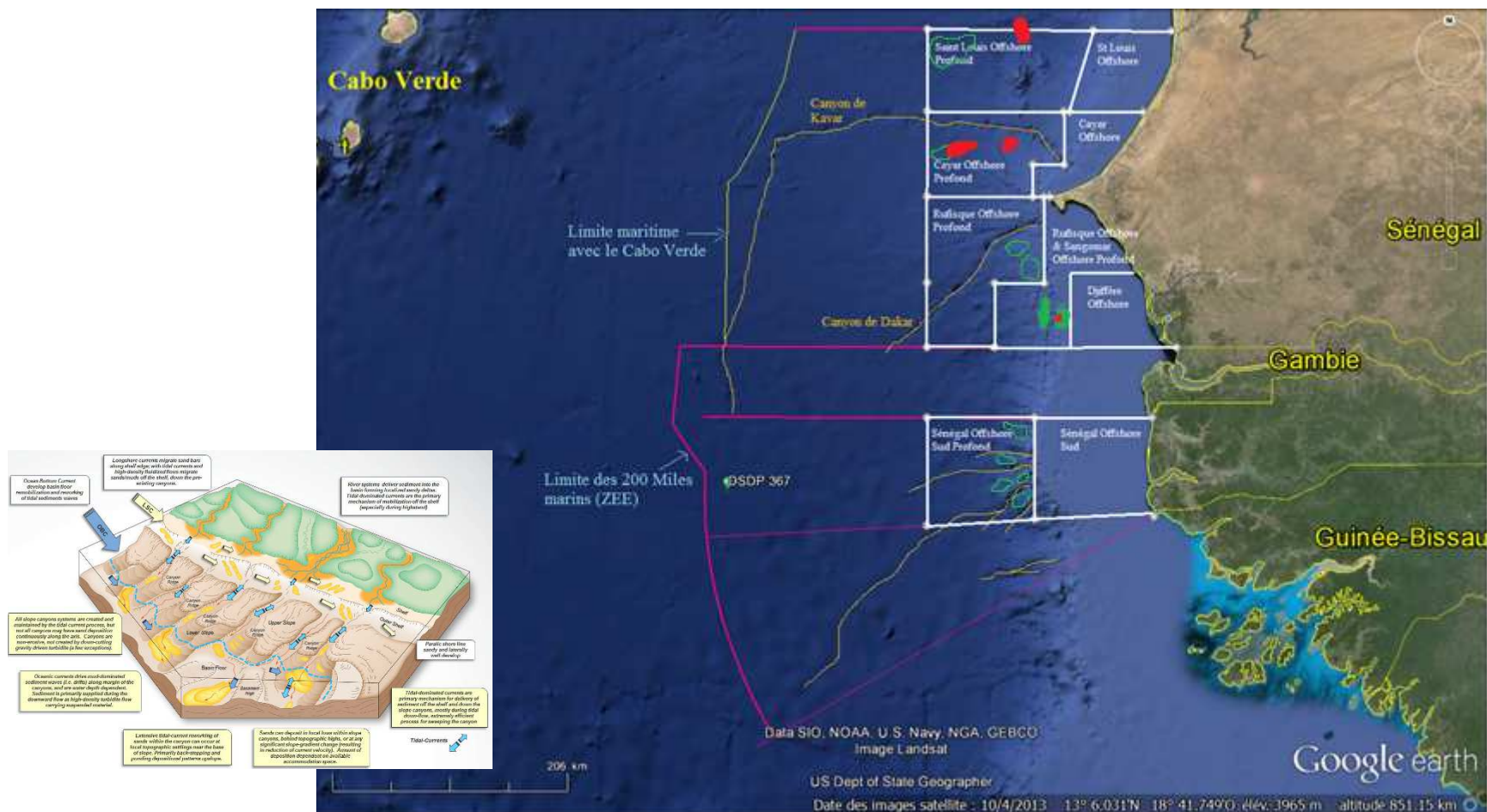
- ❑ Onshore Open Blocks with Paleozoic potential
- ❑ Offshore and Ultra Deep petroleum potential (available next year)
- Many leads and prospects identified



# Offshore Ultra-deep



Ultra Deep : Channel and turbidite deposits



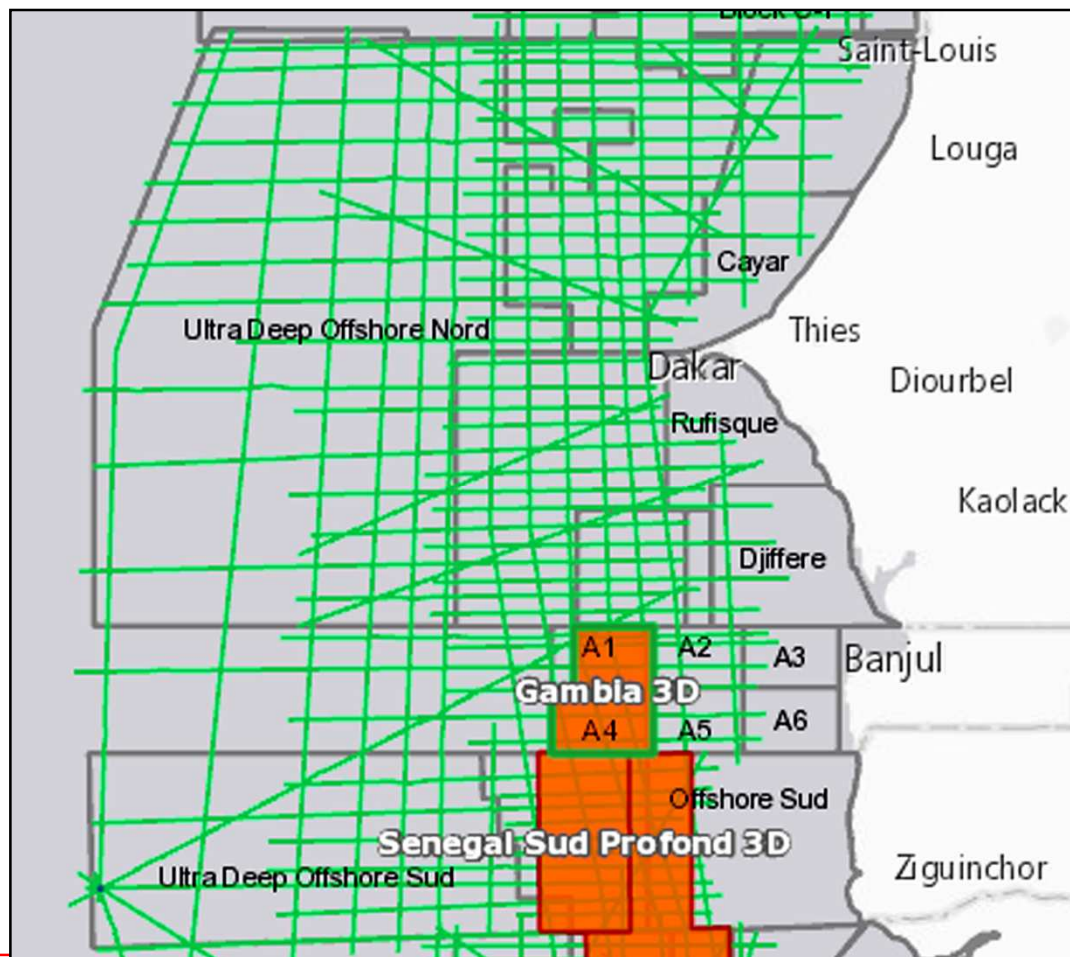
AAPG Cape Town - November 2018



# New Area of exploration



2D MultiClients seismic survey – 2017 by TGS and Geopartners



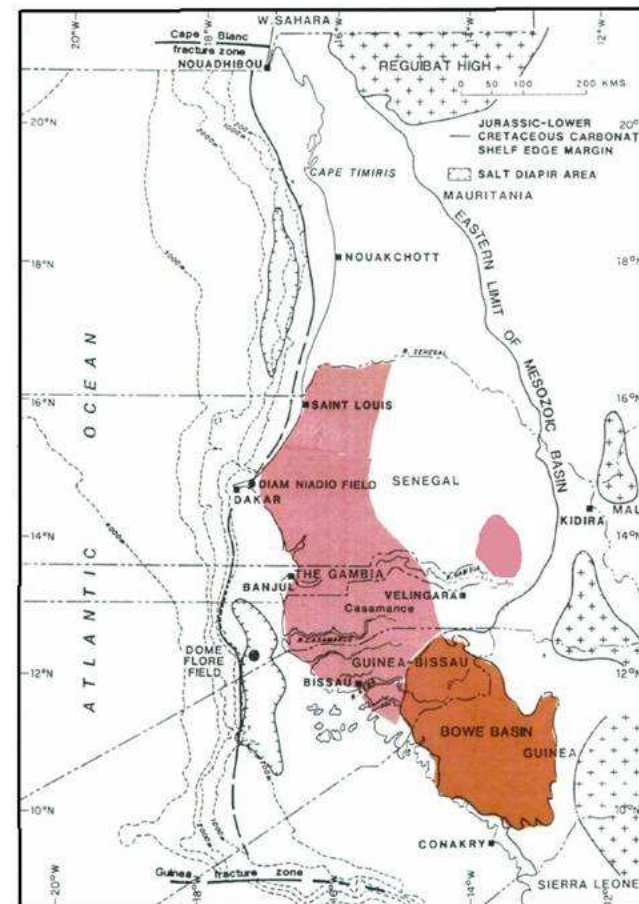
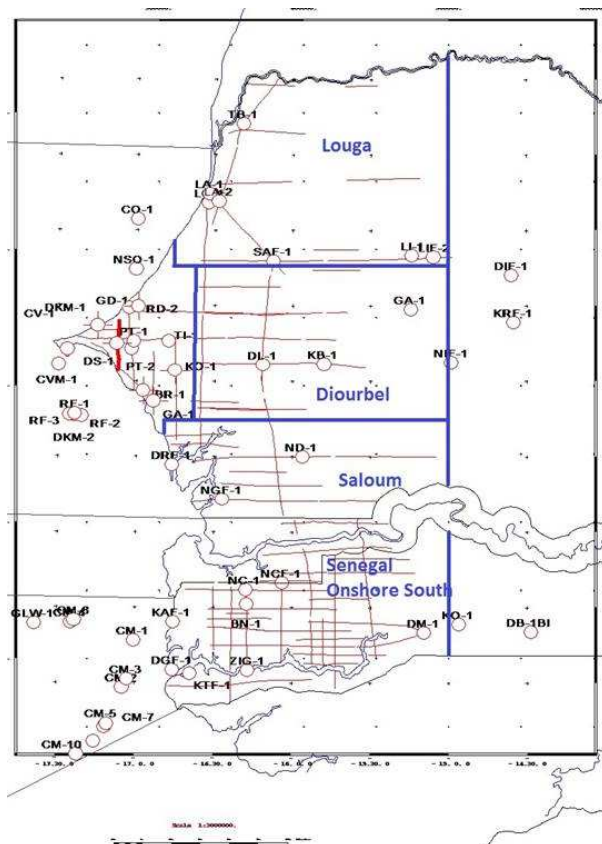
AAPG Cape Town - November 2018



# Paleozoic Basin



- Surface : About 60 000 km<sup>2</sup> covering Louga, Diourbel, Saloum and Senegal Onshore Sud Blocks
- Two sub-basins in Senegal East Area



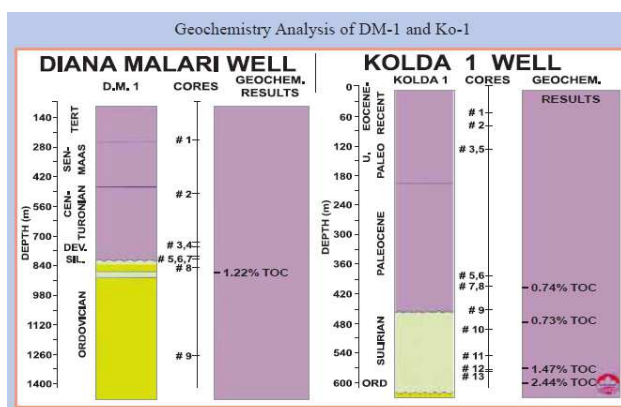


# Paleozoic Basin : Source rocks & reservoirs



## Source Rocks

- **Silurian black shales** with TOC between 1 to 3% and vitrinite reflectance between 0.95 to 1.3



| Gas Shale Field                             | Depth (m)     | Sediment                              | TOC (%)   | Vitrinite: Ro (%) |
|---|---------------|---------------------------------------|-----------|-------------------|
| Antrim (Michigan – USA)                     | 228.5 – 914   | Devonian Shales                       | 0.3 – 8   | 0.6               |
| Barnett (Texas – USA)                       | 1981 – 2438   | Devonian Mississippian Mudrock Shales | 3 – 5     | 0.6 – 2.1         |
| Woodford (Oklahoma – USA)                   | 1829 – 3657.6 | Miss/Devonian Shales                  | 1 – 14    | 0.8 – 4.7         |
| Fayetteville (Arkansas – USA)               | 609.6 – 1981  | Devonian Mississippian Shales         | 1 – 5     | 1.3               |
| Bossier-Haynesville (Texas/Louisiana – USA) | 3048 – 4876.8 | Jurassic Shales - Mudstone            | 0.3 – 4.5 | 0.9 – 2.6         |
| Tanezzuft - ALGERIA                         | 1200 – 1600   | Silurian shales                       | 0.8 – 8   | 1.1 – 1.75        |
| Tanezzuft - ALGERIA                         | 800 – 1200    | Middle to Upper Devonian Shales       | 2 – 8     | 1.1 – 1.3         |
| SENEGAL Onshore South Block                 | 543 – 789     | Silurian shales                       | 1 – 3     | 0.95 – 1.3        |

## Reservoirs

- The **Ordovician quartzitic sandstones**, interspersed with shales. Their porosity and permeability are almost nil but they are generally highly fractured, which gives them a good secondary porosity.

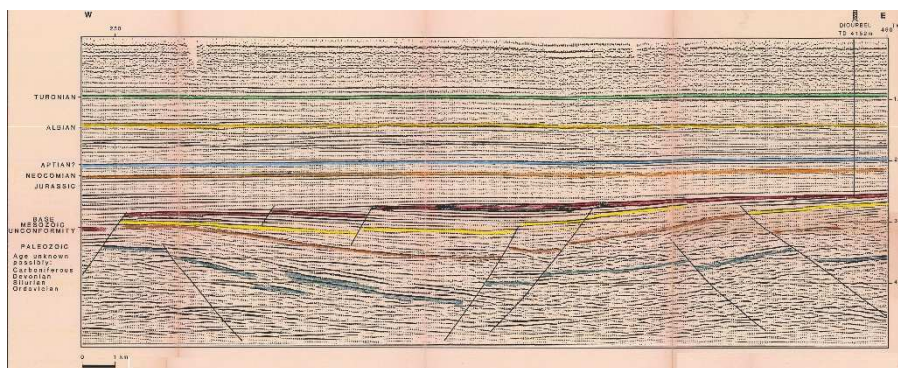
The seal for these reservoirs could be represented by interspersed shales or by overlying Silurian shales

- The **Devonian sandstones** can constitute important reservoirs of hydrocarbon generated by Silurian shales and sealed by argillaceous formations of the upper Devonian

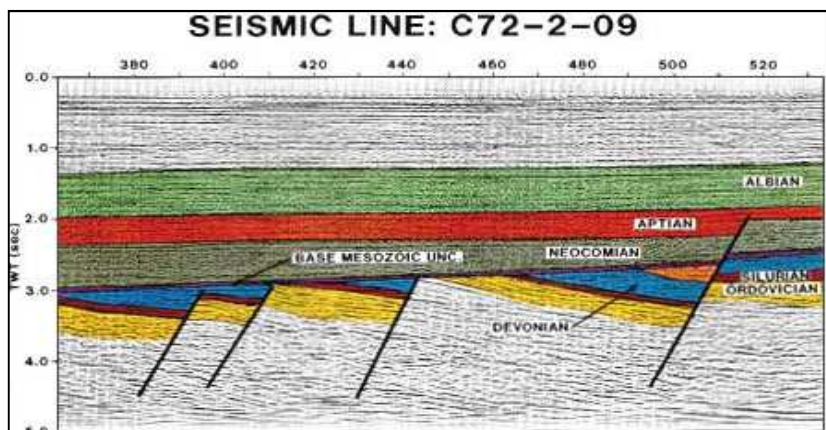




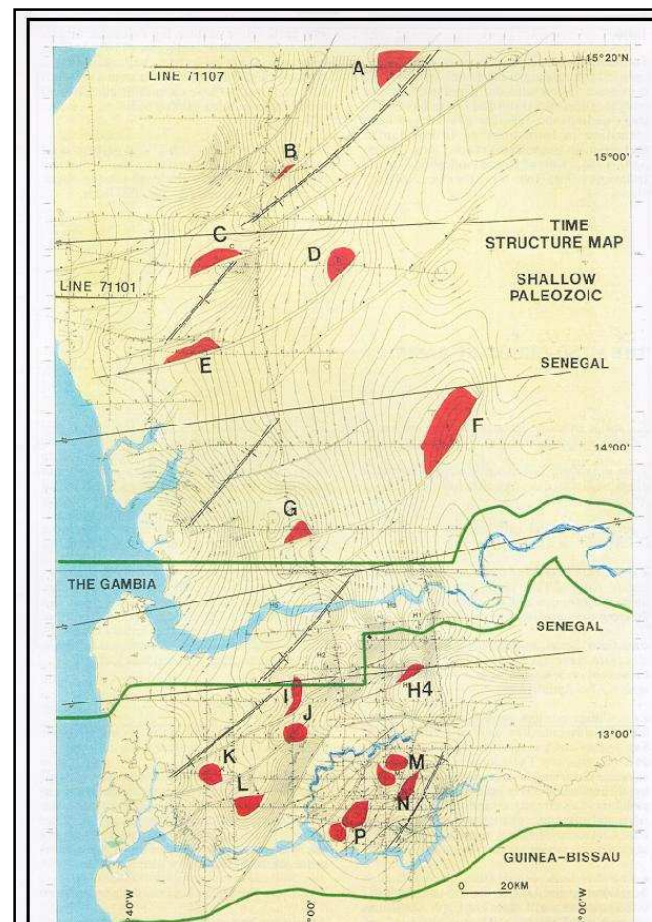
*Many structures were mapped onshore*



E-W seismic line through Diourbel block



E-W seismic line through Senegal Onshore sud block



Top Paleozoic Structural map





# Why Invest in Senegal



- ☐ Oil and Discoveries :Diam Niadio, Gadiaga, Dôme Flore, Sangomar offshore profond, Saint Louis offshore profond et Cayar offshore profond)
- ☐ Mature source rocks: (Turonian, Cenomanian, Albo-Aptian & Silurien)
- ☐ Many Leads and prospects identified in the offshore shallow and deep
- ☐ Few structures mapped in the onshore



## 7 REASONS TO INVEST (APIX)

- ❑ A Stable and Open Country
- ❑ Modern Key Infrastructures
- ❑ Healthy and Competitive Economy
- ❑ Quality Human Resources
- ❑ Legal and Tax Incentive
- ❑ Privileged Access to Regional and International Markets
- ❑ An exceptional Quality of Life



# THANKS

