



SENEGAL SEDIMENTARY BASIN

Exploration Potential and new opportunities



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Outline



I. THE COUNTRY

II. THE SEDIMENTARY BASIN

III. EXPLORATION & PRODUCTION HISTORY

IV CURRENT EXPLORATION ACTIVITIES

V. OIL AND GAS DEVELOPMENT PLANS

VI NEW ACREAGES

VII LEGAL and FISCAL TERMS

VII. CONCLUSIONS



SENEGAL



- ❑ **Official Name** : Republic of Senegal.
- ❑ **Capital** : Dakar.
- ❑ **Official Language**: French.
- ❑ **Area** : 196 722 km²
- ❑ **Population** : About 15 millions
- ❑ **Density** : 51 persons/km²
- ❑ **Main Rivers** : Senegal River
 - Gambia River
 - Casamance River



THE SENEGAL SEDIMENTARY BASIN



SENEGAL BASIN



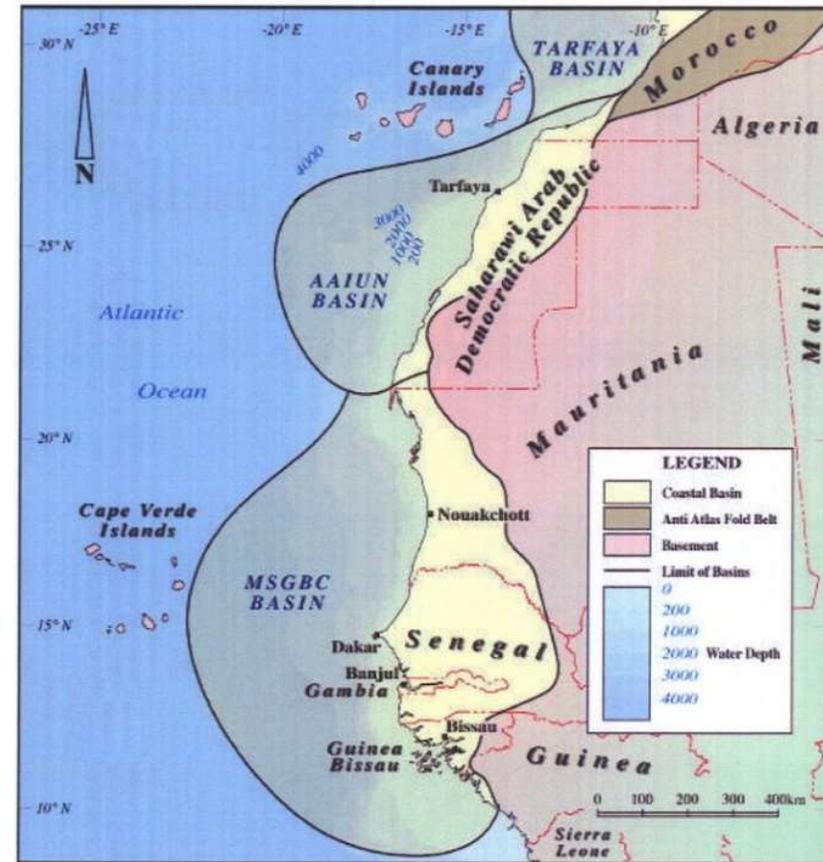
❑ The Senegal Sedimentary Basin occupies the central part of NW African coastal basin called the **MSGBC** (Mauritania-Senegal-Guinea-Bissau and Conakry Basin)

❑ ~230 000 km² (~90 000 Km² are offshore)

❑ **Mesozoic- Cenozoic Passive margin Basin**

- overlying a **Paleozoic basin**

❑ With **Major Oil & Gas opening basin discoveries since 2014**



LITHOSTRATIGRAPHIC COLUMN OF SENEGAL BASIN

STRATIGRAPHY		LITHOSTRATIGRAPHY	THICKNESS (m)	LITHOLOGY	
CENOZOIC			300-1000	LIMESTONE, SANDSTONE, SHALE	
MESOZOIC	CRETACEOUS	POST - RIFT	200-1250	SANDSTONE, SHALE & SAND	
			100-450	SHALE & SAND	
			150-1000	SANDSTONE	
			50-150	SHALE	
			150-950	LIMESTONE, SANDSTONE SHALE & SAND	
			200-1200	LIMESTONE, SANDSTONE SAND & SHALE	
			150-1400	ANHYDRITE, LIMESTONE SANDSTONE, SAND & SHALE	
	300-1200	LIMESTONE & SHALE			
	JURASSIC		SYN - RIFT	1 - 2000 ?	LIMESTONE & DOLOMITE
				200-1500	SALT & ANHYDRITE
200-1500 ?				SHALE & SANDSTONE	
PALEOZOIC	TRIASSIC		350	SANDSTONE, SLTSTONE & SHALE	
	PERMIAN		350	SHALE & SAND	
	DEVONIAN		300-1000	CONGLOMERATE, SANDSTONE & QUARTZITE	
	SILURIAN		500-3000	SANDY CONGLOMERATE	
	ORDOVICIAN		2000 - 4000	CONGLOMERATE, SHALE SANDSTONE, LIMESTONE & DOLOMITE	
PROTEROZOIC					
ARCHEAN				BASEMENT	

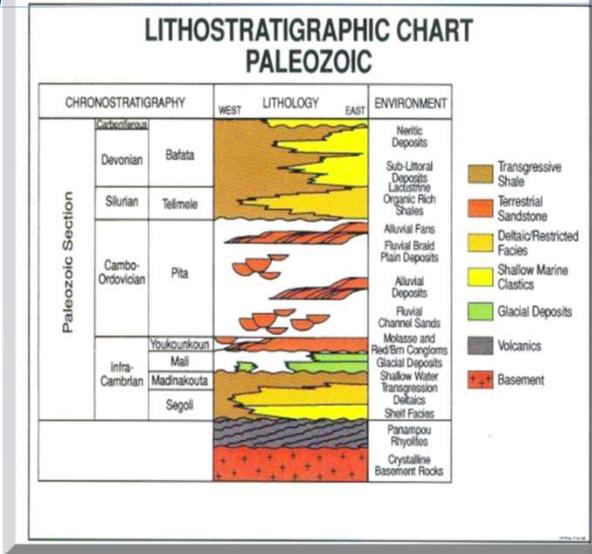
Post-rift stage
Mid Jurassic-Actual

Syn-rift stage
Permian- Triassic- Early Jurassic

Pre-rift stage
Upper Proterozoic- Palaeozoic
Archean basement



RESERVOIRS & SEALS



❑ **Ordovician sandstones** : no primary porosity, but very fractured, good secondary porosities having excellent deliverability

❑ **Devonian sandstones** : fine to coarse grained, often oolitic with porosities ~ 15% - 20%.

❑ **Upper Devonian shales**

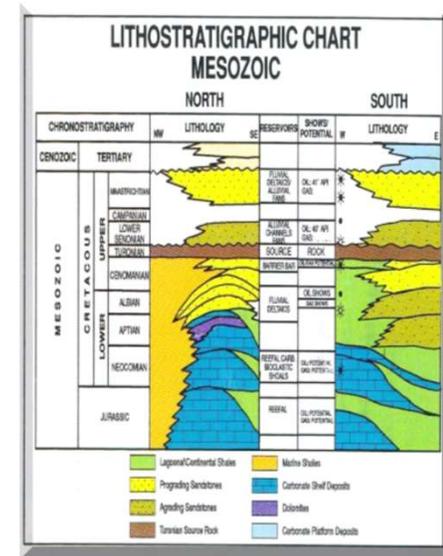
❑ Upper Tertiary shaly sequences

❑ Lower Tertiary clastics and carbonates

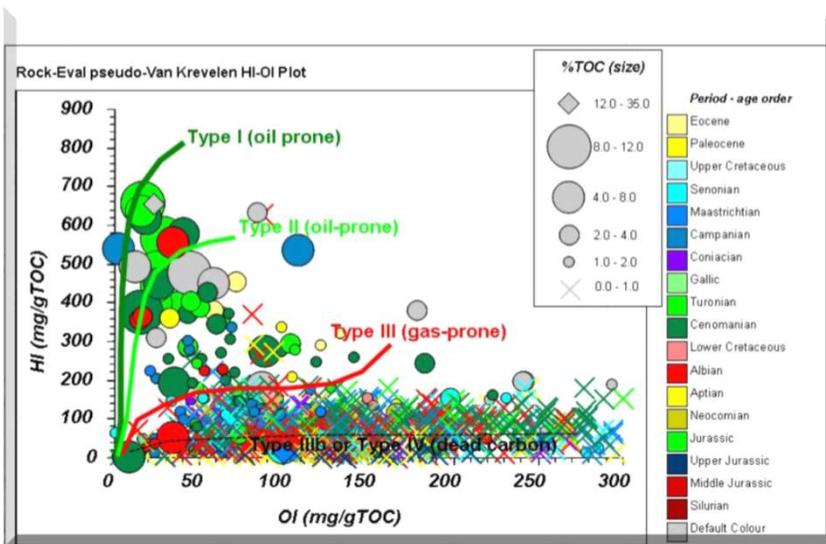
❑ Late Cretaceous sands and shale sequences

❑ Early Cretaceous sands and shale sequences

❑ Jurassic –Early Cretaceous carbonate platform



Mesozoic-Cenozoic section



Well samples analysis

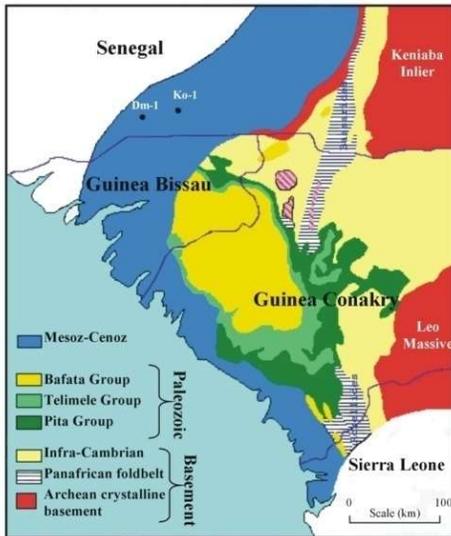
□ Best source rocks **Cenomanian- Turonian**

□ and secondary **Albian**

- in **CM-7 well**
Cenomanian level at 2608m
with
TOC = 8.72 %
HI = 660 mg/g
- in **CM-10 well**
Turonian level at 2554 m with
TOC = 5.25 %
HI = 638 mg/g

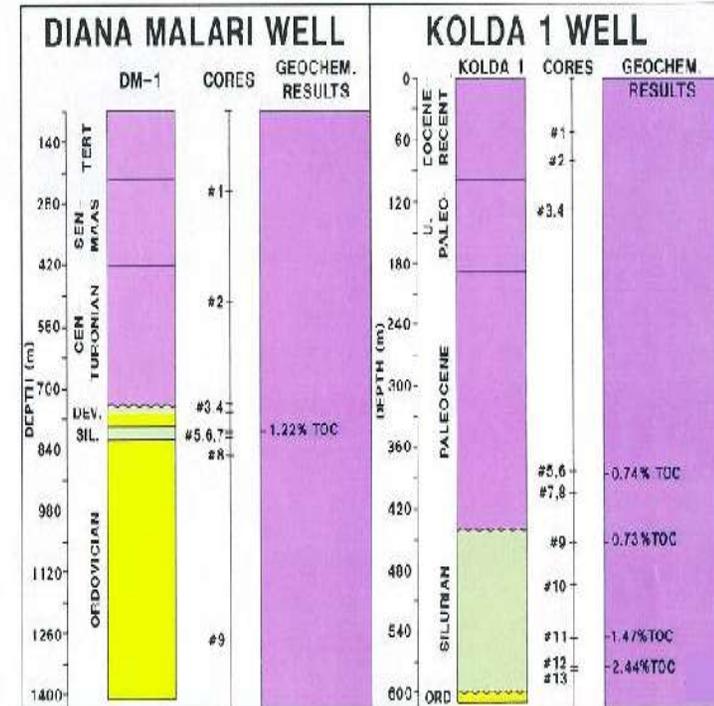
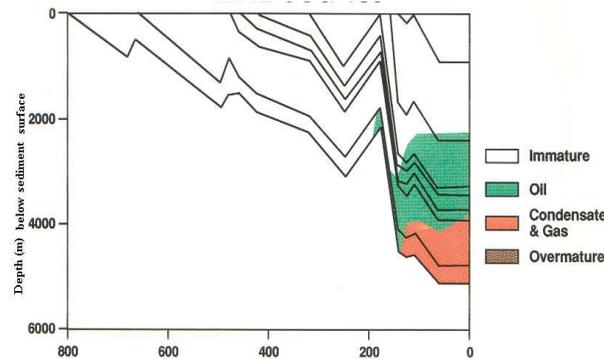


Paleozoic section



- Silurian shales :
best regional source rocks
TOC ~ 5%
Ro ~ 0.95 - 1.3

- Oil windows should occur
between 1850/2400 m to 3400/4000
m



EXPLORATION and PRODUCTION HISTORY: 1952 - 2017



Seismic Data Acquisition

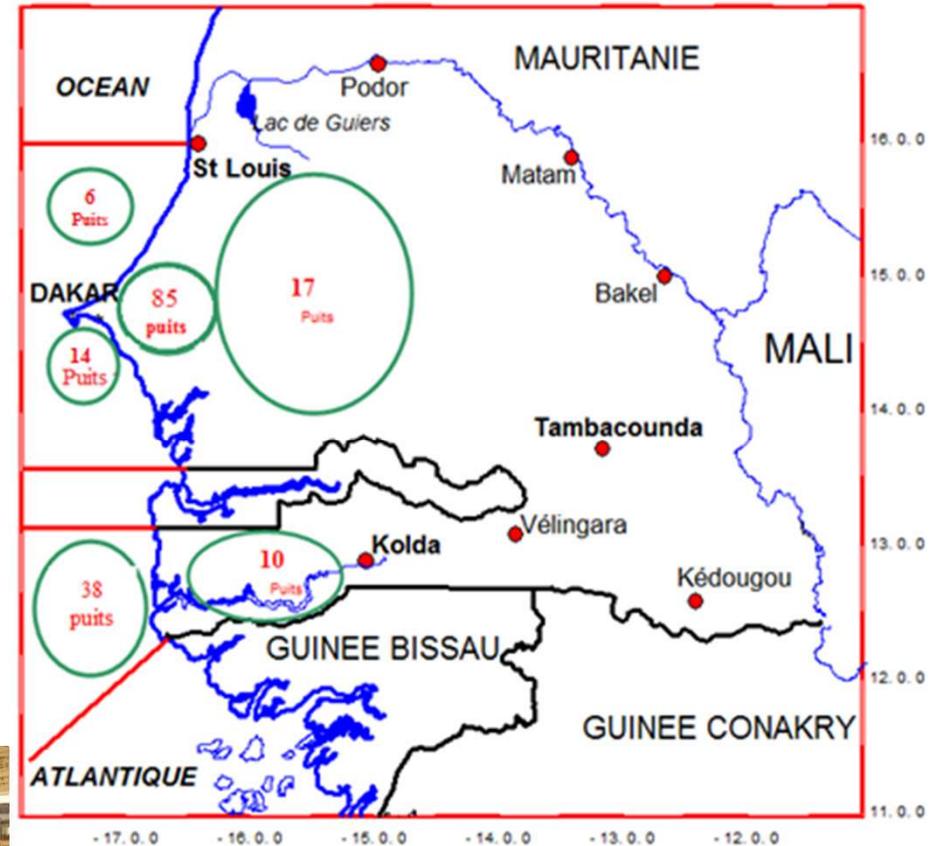
- 60 900 km of **2D** seismic
- More than 12 200 km² of **3D** seismic
- Good offshore coverage, but poor in onshore
- New ultra deep 2D data in 2017

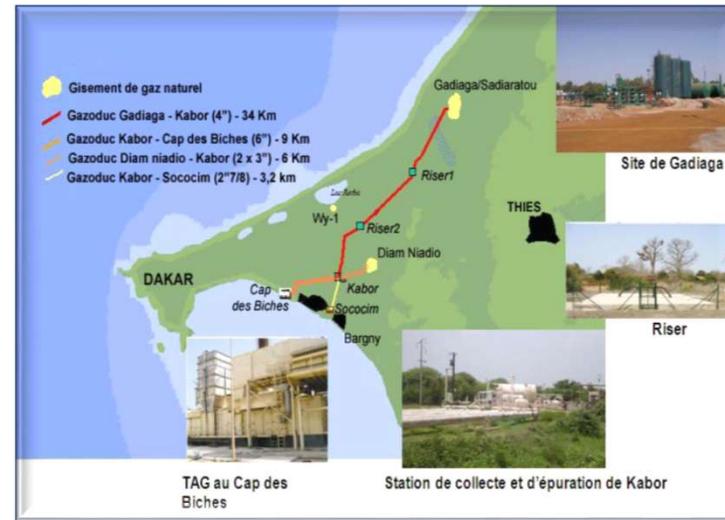
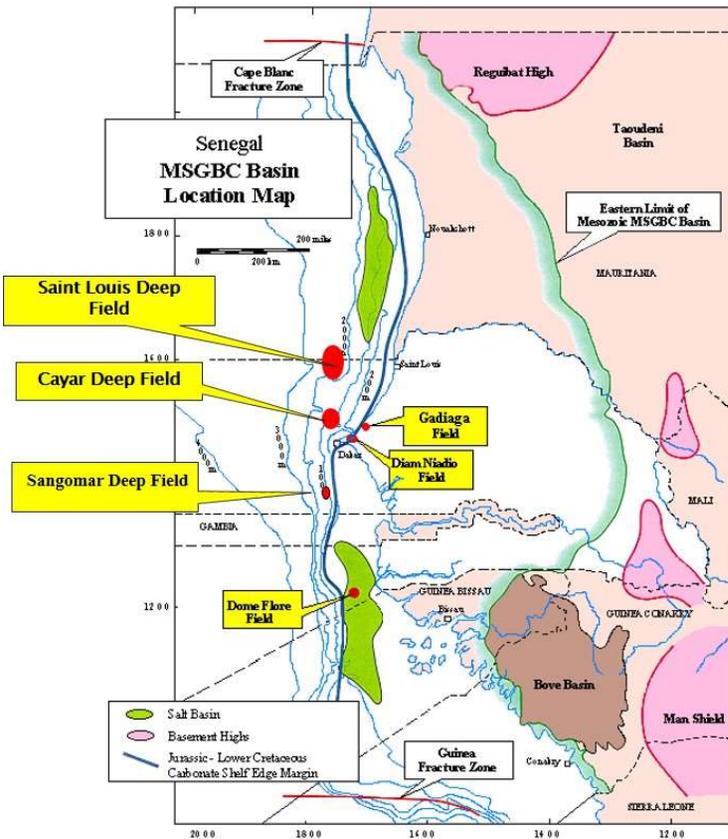
Wells

- 172 Exploration Wells;
- 1 well per 1337 km²**;
- with an organized database



- It is an **under explored basin.**





□ DIAMNIADIO field

- produced Oil & Gas (1987-2000)
- 8 BCF of gas,
- 100000 bbl. light Oil 34° API & condensate

□ GADIAGA – SADIARATOU Gas field

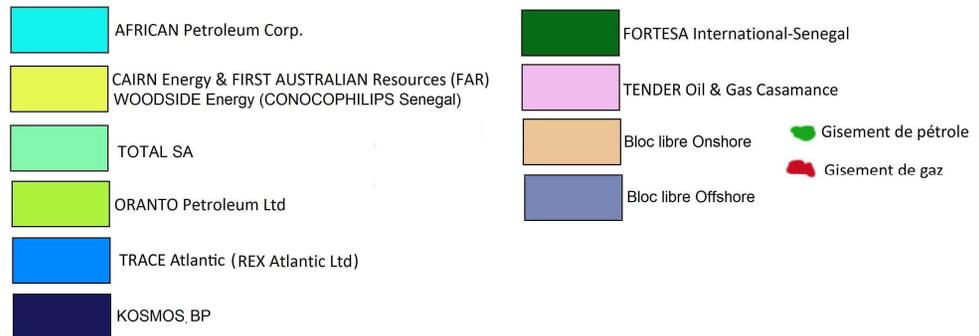
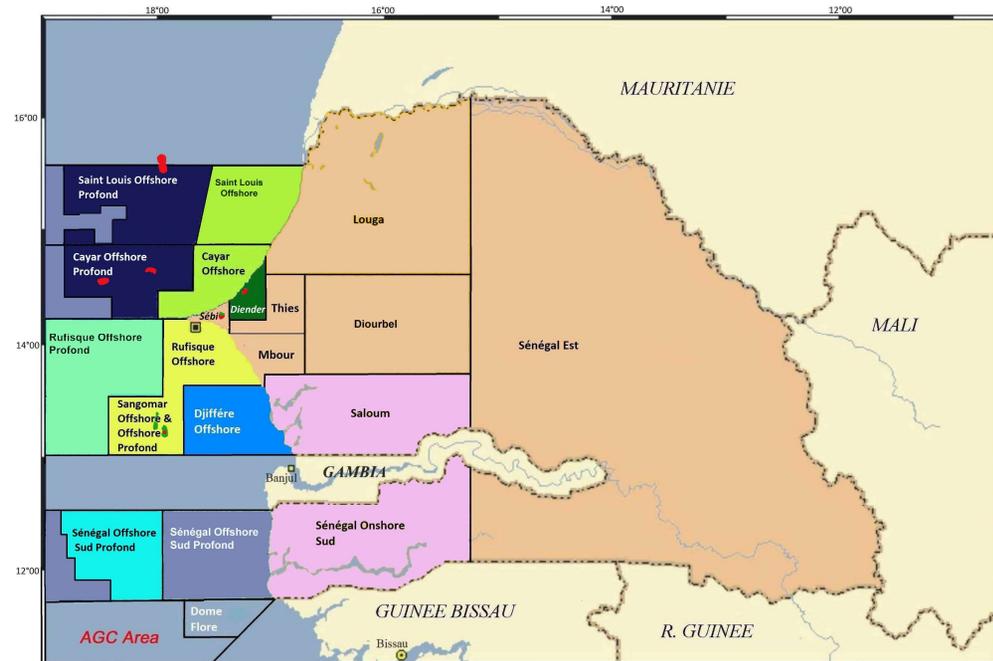
- ~ 13 BCF of natural gas and condensate since 2002
- With Oil shows



CURRENT EXPLORATION ACTIVITIES



- ❑ 8 offshore PSC (AGC not included)
- ❑ 3 onshore PSC
- ❑ 10 Companies
- ❑ 3 open onshore block
- ❑ One open offshore



SAINT LOUIS OFF. DEEP & CAYAR OFFSHORE DEEP BLOCKS



Play Concept : Upper Cretaceous structural stratigraphic

1st Exploration Phase – Inboard Basin Central Anticline Trend

SAINT LOUIS OFFSHORE DEEP License

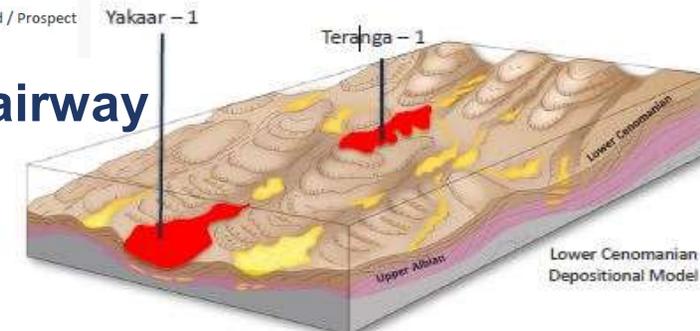
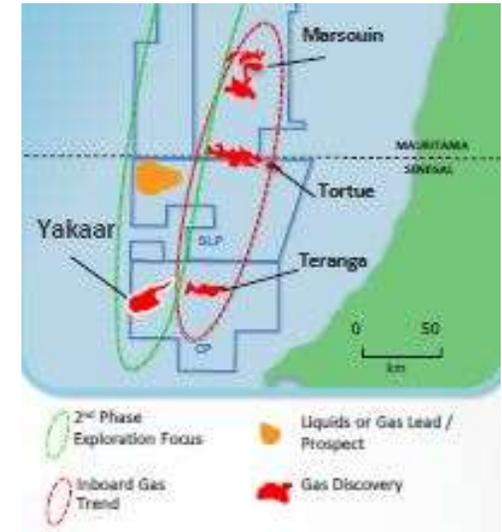
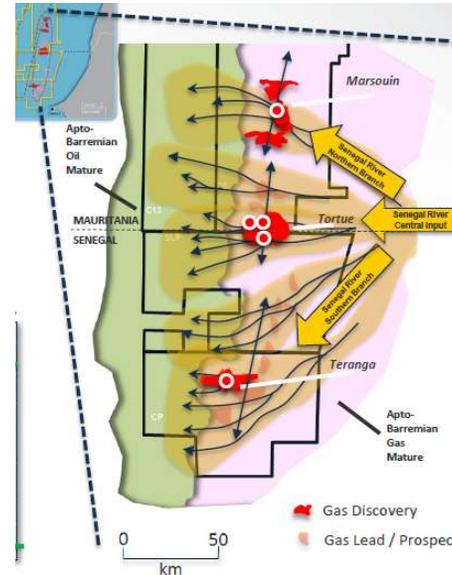
Greater Tortue/Ahmeyin (GTA)

- 3 Wells drilled:
- ✓ Tortue-1 (Aymeyin-1) & Aymeyin-2 in Mauritania
- ✓ Geumbeul-1 in Senegal
- ✓ 100% success with 20 Tcf of natural gas discovered

CAYAR OFFSHORE DEEP License

- ✓ Téranga-1 well drilled in 2017
- 5 Tcf of natural gas was discovered

- 25 Tcf of discovered gas resources along the inboard Senegal River fairway of northern Senegal and southern Mauritania



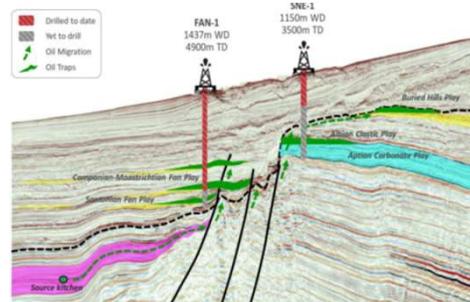
2nd Exploration Phase – Outboard Basin Floor Fan Fairway

- ✓ Yakaar-1 is the world largest hydrocarbon discovery of 2017
- Ressources in place : 15 Tcf
- ✓ DST on Tortue-1 flow 200 mmscf/day
- ✓ Requin tigre-1 well drilled in 2017 was dry



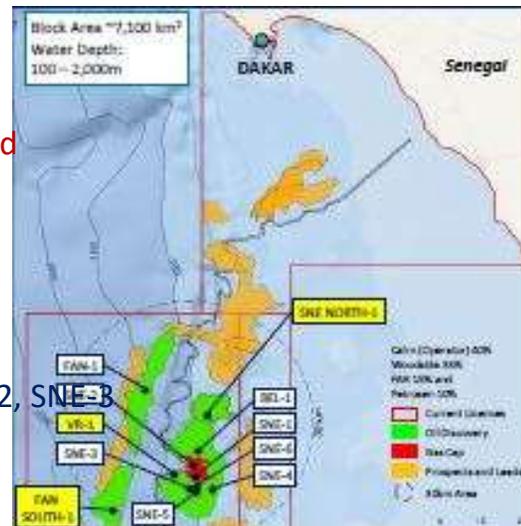
First Phase of Exploration Drilling

- ❑ Two major oil discoveries in 2014
 - FAN-1 (Oil)
 - SNE-1 (Oil & Gas)



Second Phase of Exploration Drilling Complete

- ❑ SNE Field Characterisation
 - Water depth (WD) 650 - 1,400 metres
 - Following discovery, seven further wells completed
 - Two distinct reservoir horizons:
 - S400 Upper Reservoirs
 - S500 Lower Reservoirs
 - Eight DSTs completed in four separate wells (SNE-2, SNE-3, SNE-5 & SNE-6)



Third Phase of Exploration

Drilling Commenced 2017

- ❑ VR-1 exploration
- ❑ FAN SOUTH-1 discovery follow on to FAN-1 discovery
- ❑ SNE NORTH-1 Northern test of SNE field play & has **Discovered** separate accumulation to SNE
 - Demonstrates potential for additional finds in basin
 - Remaining Exploration Potential within 30km of SNE
 - Prolific source rock, excellent reservoir development and good working seal





SANGOMAR OFFSHORE DEEP



40 % WOODSIDE 35 %



FIRST AUSTRALIAN RESOURCES 15 %



10 %



SNE Field DEVELOPMENT & PRODUCTION CONCEPT



☐ PHASED DEVELOPMENT

- Targeting production rates of **75,000-125,000** barrels of oil per day (bopd)
- **With 1 – 2 mmbbls FPSO oil storage**
- Initial well count up to **25** wells planned (**oil producers, water and gas injectors**)

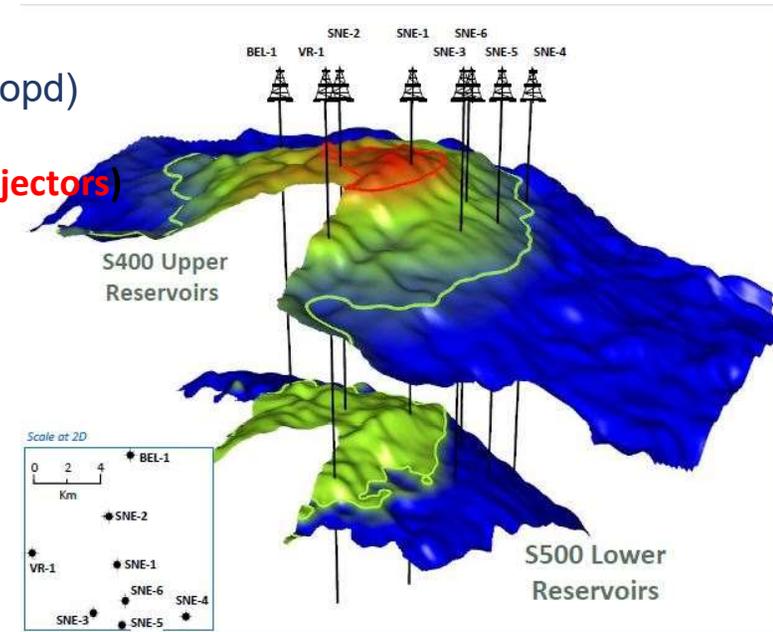
☐ THE OIL RESOURCES

- First development phase
- ✓ targeting **~240 mmbbls** principally in **S500 lower reservoir** + S400 Upper Reservoirs Core area
- Subsequent development phases
- ✓ to **target resource base in S400 upper reservoirs**
- ✓ S400 Additional **Areas Further Subsea infrastructure + Wells**

☐ UPDATED GROSS CONTINGENT RESOURCES (mmbbls) *

August 2017 1C 346 **2C** **563** 3C 998

(19% contingency resources growth)

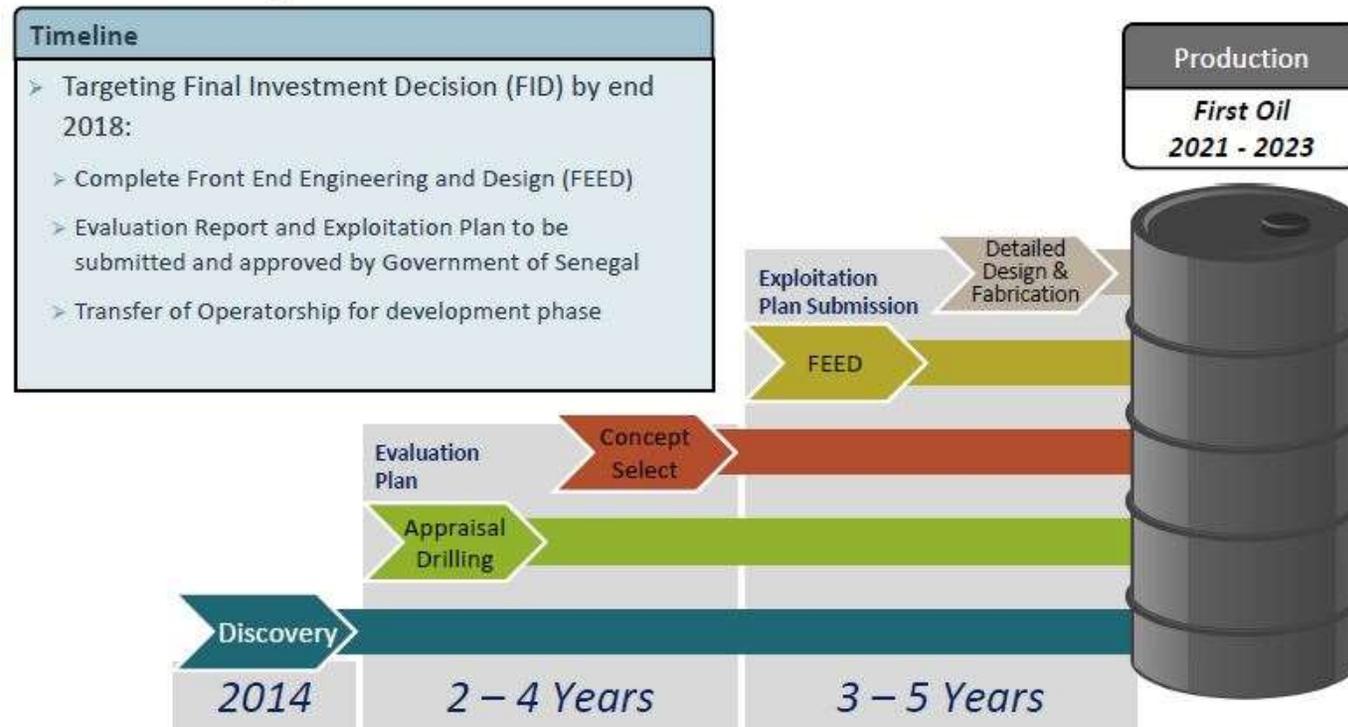


*ERC Equipoise Limited (ERCE) estimate august 2017

Economic field size (gross) **>=200 mmbbls** for foundation development project



SNE Development



- ❑ **FINANCE**
- Life of field development capex: ~\$12/boe (~60% development drilling)
- Capex to first oil: ~\$2.3bn (~16 wells pre-drilled)

- ❑ **MARKET**
- Domestic Market
- Regional and International market





SAINT LOUIS OFFSHORE DEEP BLOCK



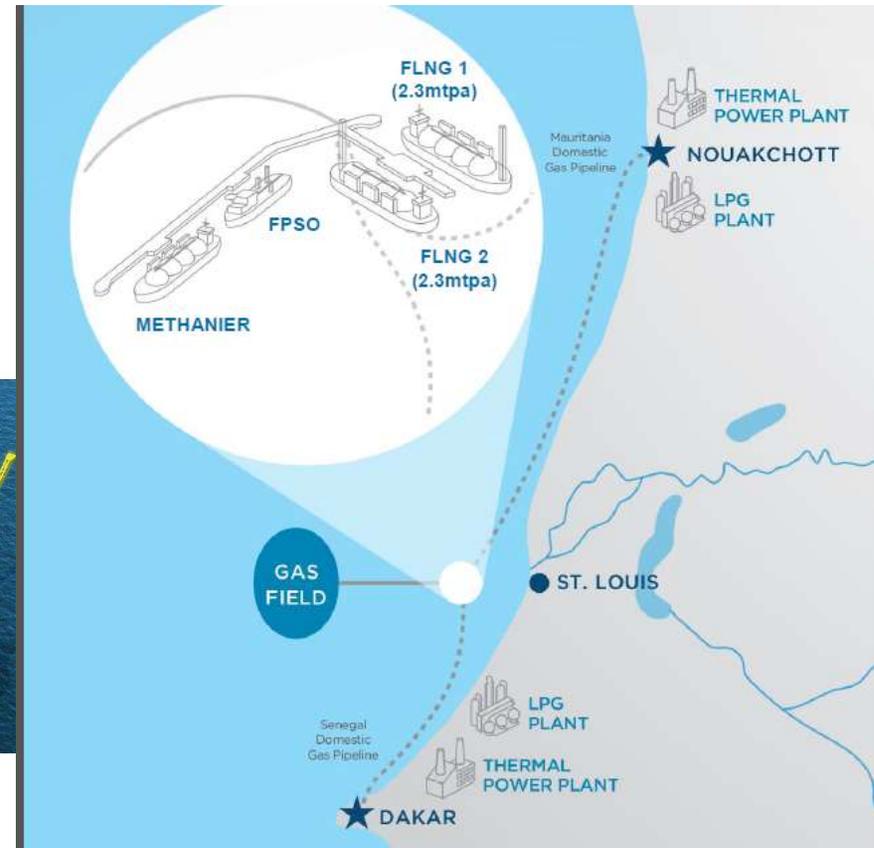
32.51%

BP 32.51%



10 %

GREATER TORTUE/AHMEYIN (GTA) DEVELOPMENT PLAN



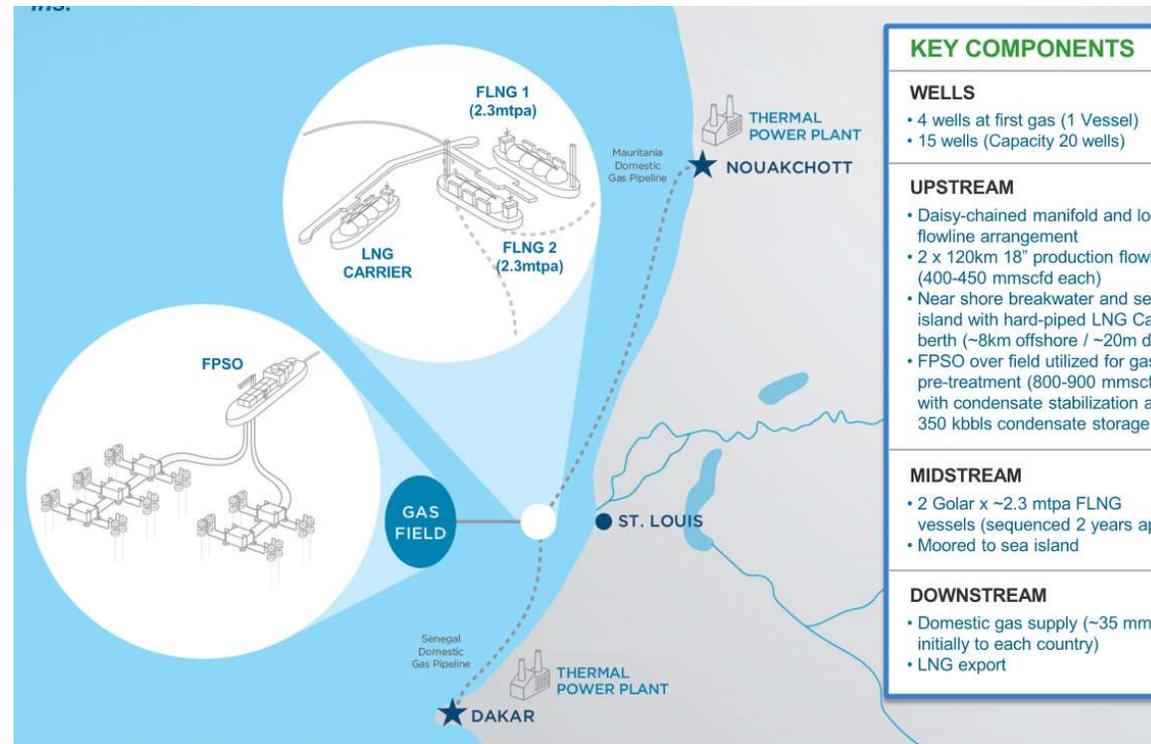
Conceptual Development Plan

Competitive **near-shore LNG** concept :

- Tortue being one of the lowest cost green-field LNG projects in the world
- **First phase *Train 1 (2.3 mtpa)***
Train 2 (2.3 mtpa)
- **potential expansion up to 10 mmpa,**

Quality resources

~ 40 trillion cubic feet of gross natural gas resource discovered between Senegal and Mauritania





TORTUE TIMELINE



- From 2017, BP operates the Development of Tortue project targeting FID by 2018
- In early 2018, the governments of Mauritania and Senegal signed **an Inter-Governmental Cooperation Agreement (ICA)** which enables the development of the cross- Tortue natural gas field.



Investor Presentation
August 2017



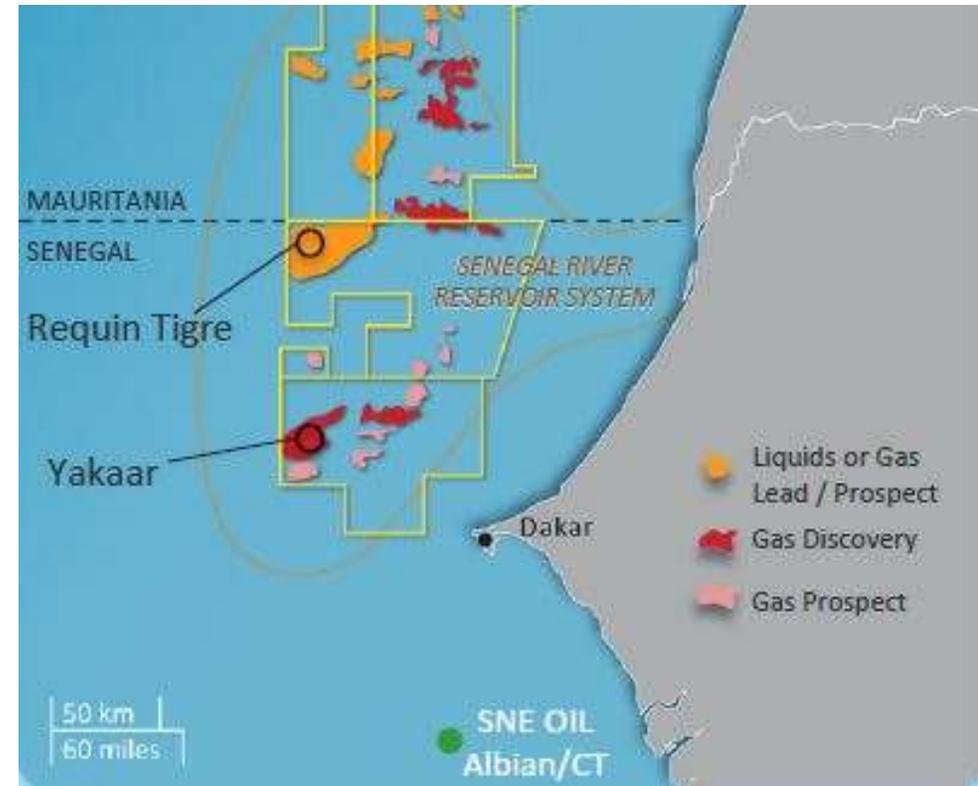
FURTHER DEVELOPMENT OPPORTUNITIES



- ❑ **Yakaar-1, combined with Teranga-1**, discovered **20 Tcf** Pmean gas resource in Cayar Offshore block
- ❑ creating the **opportunity for a second cost competitive LNG Hub in Senegal**

❑ GAS TO POWER

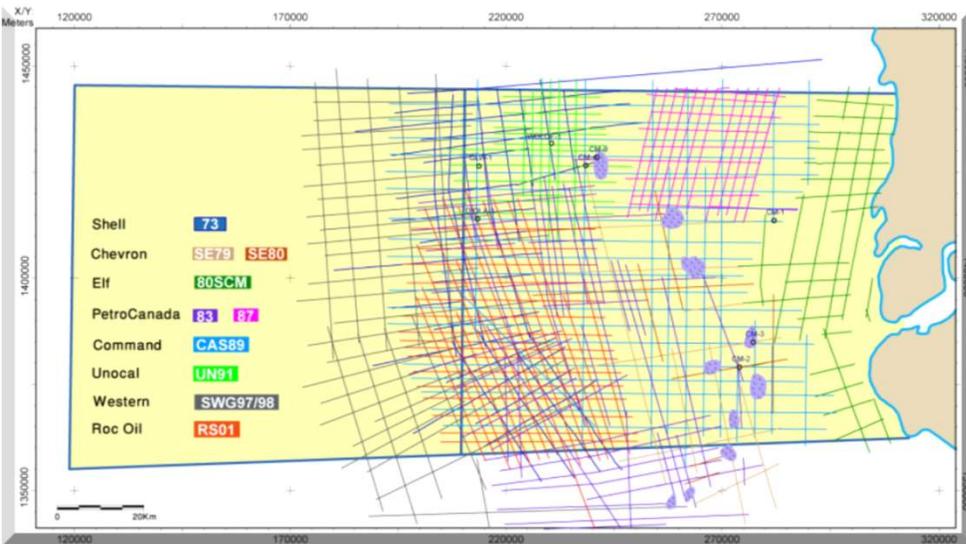
- Domestic market
- Regional market



OPEN BLOCS



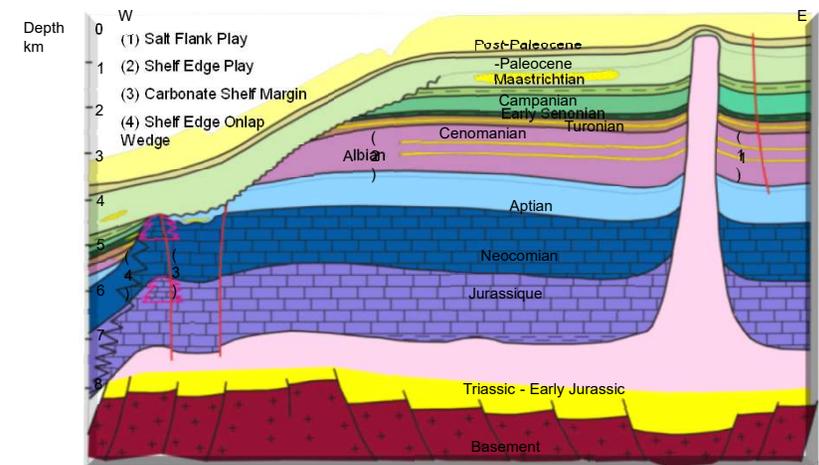
SENEGAL OFFSHORE SOUTH BLOCK



Senegal offshore South Seismic basemap

- About 10 000km of 2D from 1973 to 2001
- 8 wells
- 7 Salt Dome sub parallel to the coastline along a narrow trend approximately 400 km long and 30 km wide
- Many leads and prospects identified

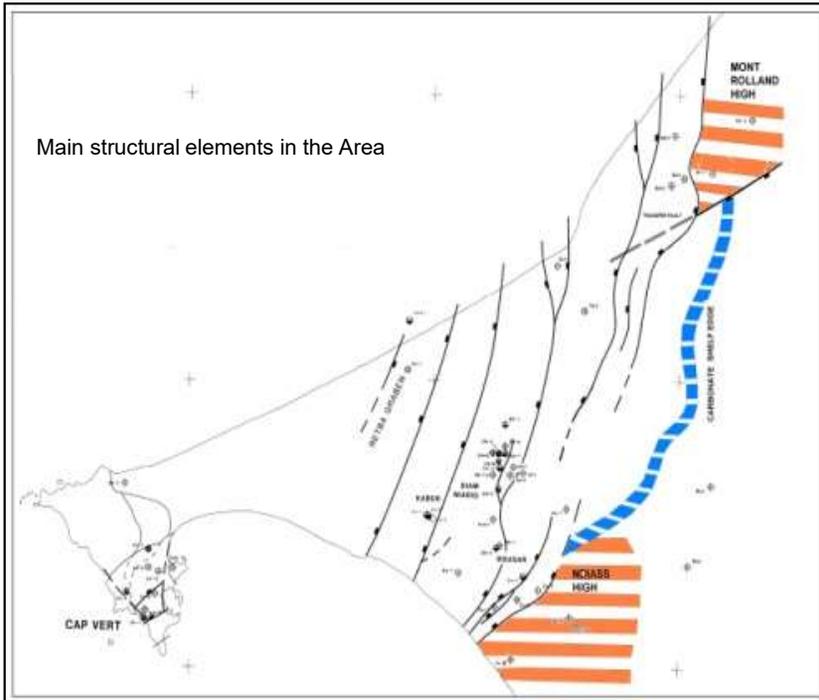
- Play types**
- ✓ Salt Flank play
- ✓ Shelf Edge play
- ✓ Carbonate Shelf Margin
- ✓ Shelf Edge Onlap Wedge



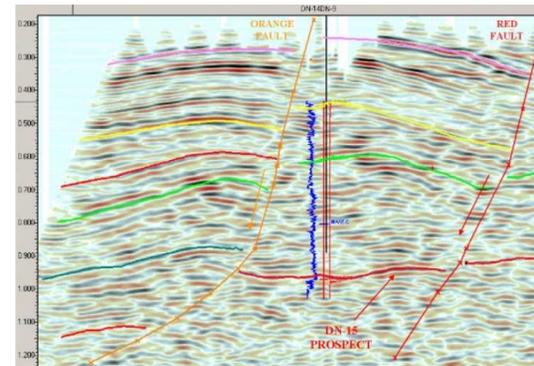
NEW SEBIKHOTANE BLOCK



Main structural elements in the Area



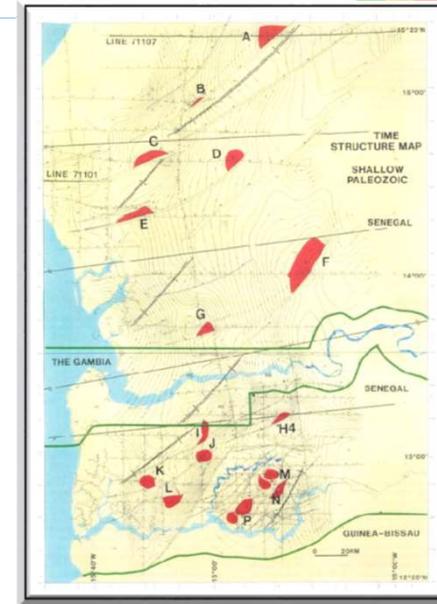
- Produced Oil, Gas and Condensate in **Diamniadio, Kabor and Ndoyenne onshore fields** from 1986 to 2000
- Shallow reservoir in **Maastrichtian sandstone**
- Play Types:** Roll Over, Rover Anticline
- Big Potential in Deeper targets (Albian)** non explore yet
- Sebikhotane block is the onshore extension of the Sangomar Offshore Deep play**



PALEOZOIC BASIN



- ❑ Prospective area: East Meridian 15°
- ❑ Acreage ~ 60000 km²
- ❑ Two sub-basins East of Meridian 15°
- ❑ Covers 4 blocs form witch 2 open blocs north of Gambia:
 - Louga bloc
 - Diourbel
 - Saloum
 - Senegal Onshore South
- ❑ Many Leads

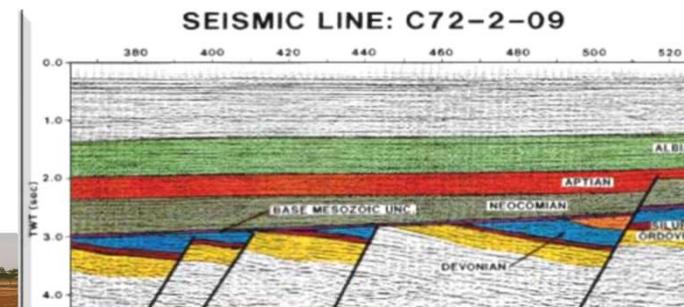
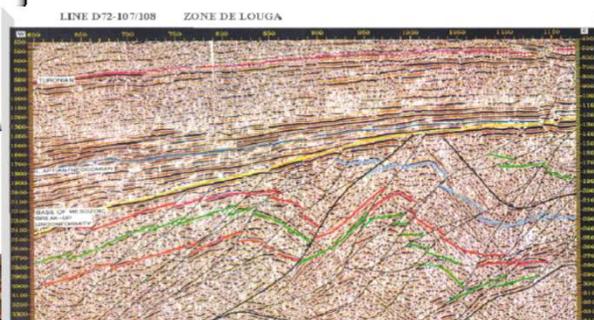


Paleozoic Leads

TECTONIC REGIME

❑ **Compressional** system in the rest of the Senegal basin

❑ **Extensional** system in Senegal onshore South



LAW N° 98-05 of January 1998 (PETROLEUM CODE)

❑ PRODUCTION SHARING CONTRACT (PSC)

➤ EXPLORATION PERIOD

- Initial Period: 1-3 years
- Renewal Periods: 2-3 years

➤ EXPLOITATION PERIOD

- Initial Period: 25 years
- Extension Periods: 10+10 years

➤ PETROSEN PARTICIPATION

- Exploration phases: PETROSEN Carried Interest of 10 %

- After Commercial discovery: Working Interest up to 20 %

➤ **FISCAL REGIME** Thirty per cent (30%) **Income Tax**
(applied on net profit)





CONCLUSION

- ❑ The Senegal Basin has generated oil and gas in Diamniadio, Gadiaga onshore fields and in the offshore blocks Casamance Dome Flore, Sangomar Offshore Deep, Saint Louis Deep and Cayar Deep fields,
- ❑ Big hydrocarbon potential in the offshore Ultra Deep open to tender in the near future,
- ❑ Potential for **shale gas** in the onshore Palaeozoic underexplored basin and open blocks
- ❑ **The Word class opening basin Oil & Gas Discoveries** has open lots of opportunities for local and international companies & challenges in governance strategy and monetizing
- ❑ Competitive legal and fiscal terms,
- ❑ **Stable country and economy in constant growth of ~7% per year**

MANY THANKS

