Oil & Gas Outlook for Sierra Leone

‘Building Upon Strong Foundations’
Sierra Leone - Background Information

• LOCATION: West Africa bordering the North Atlantic between Guinea and Liberia

• CAPITAL: Freetown

• POPULATION: 7.1 Million (2016 census)

• LANGUAGES: English (Official) – Spoken by 20% of population, Temne (North), Mende (South), Creole (English-based lingua franca spoken/understood by 95% of population)

Sierra Leone declared Ebola free on 17th March 2016 by WHO
Sierra Leone - Background Information

- AREA: 71,740 Sq. km.
- COASTLINE: 402 km.
- GOVERNMENT: Constitutional Democracy – President Elected for 5 – year terms (not more than 2 terms)
- Climate: Hot, Humid with 2 seasons
  - Rainy Season (May – Dec)
  - Dry Season (Dec – April)
- GDP: $12.8 billion (2014 est.)
- GDP PER CAPITAL: 2,100 (2014 est.)
- REAL GDP GROWTH RATE: 7.1% (2014 est.) – Dip in GR due to Ebola Outbreak with slowed down economic activity
- KEY NATURAL RESOURCES: Iron Ore, Diamonds, Titanium, Bauxite and Gold
PDSL - What we do

Pursuant to executive powers conferred by H.E the President, Dr. Ernest Bai Koroma, the Director General of the Petroleum Directorate administers the Petroleum Exploration and Production Act (PEPA), 2011 and reports directly to H.E the President.

The Petroleum Directorate under PEPA 2001 has a statutory responsibility for regulating the upstream oil and gas sector, and ensuring that all Operators conducting petroleum operations comply with the applicable Petroleum Legislation and any other regulation(s) or guideline(s) governing upstream oil and gas operations in Sierra Leone.
Our Mission is to:

“facilitate the optimal exploration and development of Sierra Leone’s Potential Petroleum Resources for the long term benefit of its people, through the development of regulatory guidelines and monitoring contract compliance, having due regard for the economy, the environment, safety, technology, as well as balancing the interests of the nation and investor”

The Petroleum Directorate’s Vision is:

“To become a functionally and fiscally independent high-reliability regulatory agency capable of delivering its mission in a sustained way”
Regulatory Framework

• All Petroleum Rights are vested in the State

• The Petroleum Directorate (PD) was created as successor to the PRU by Petroleum Exploration and Production Act (PEPA) – 2011

• The PD is mandated to:
  – Regulate and promote petroleum exploration, development and production
  – Administer the licensing and participation of commercial entities in the sector
  – Encourage, monitor and enforce the standards of operation and code of practice for petroleum operations
  – Ensure efficient and safe petroleum operations
Petroleum Legislation- Update

• Following last bid round in July 2012, there has been considerable interest in onshore exploration

• Hence, review of current Petroleum Legislation is at an advanced stage

• Aim of the review is to establish the legal framework for onshore exploration and subsequently merge these provisions with the offshore legislation.

• New Law will provide for a detailed and competitive fiscal regime

• New environmental provisions cover detailed standards and environmental principles of compliance and safety, and include issues of decommissioning of infrastructure, including wells and restoration of land.
Petroleum Legislation- Update

- The law provides for a new licensing regime and clear rules for acquisition of licences.

- New environmental provisions will cover detailed standards and environmental principles of compliance and safety, and include issues of decommissioning of infrastructure, including wells and restoration of land.

- There are also detailed provisions relating to the conduct of well operations, steps for field development approval, assignment of petroleum interests, local content and the management of data.

- There are also available in the new law, a range of ancillary licences, permits and authorities. These cover reconnaissance, scientific investigations, access, infrastructure, drilling operations and pipelines.
Regional Setting

• Forms part of the West African Transform Margin

• Formed during the initial stages of rifting

• Basin development associated with the opening of the South Atlantic Ocean during the Early Cretaceous

• Basin segmented by transform faults
Stratigraphy

### Geological Events

- **Syn-Rift-1**
  - Passive Margin
  - On Set Spreading
- **Syn-Rift-2**
  - Gravitational Faulting/Sliding
  - Uplift & Erosion

### Stratigraphy

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### Sediments

- Pre-rift Jurassic/Triassic sediments
- Early cretaceous rifting (Aptian-Albian)
- Late Cretaceous to recent drift sequence of clastic deep water turbidites
Petroleum System

SOURCE ROCK

- Aptian to early Cenomanian lacustrine shales (HI 795-482 & TOC of 20-4%). Geochemical analysis has confirmed the good quality and high potential of this source zone.

- Late Cretaceous, Cenomanian-Turonian shales (HI approx. 560 & TOC approx. 5%)

- Both source rocks have reached both the oil/gas window (0.8 to 1.2)

RESERVOIR

- Potential reservoir sequences include the Aptian, Albian, Cenomanian, Maastrichtian and Paleocene to Eocene.

- The total net sand thickness is estimated at 1500m for all sequences. The average porosity of the sandstone series is expected to exceed 15%.
Petroleum System

TRAP
- Stratigraphic, structural or a combination exists before the Paleocene which is ideal for generation & expulsion of HC time or Turonian & Oligocene Cretaceous source beds.

SEAL
- The seal can be lateral, transformational shales or regional hemipelagic shales.
Exploration History

• Exploration began in the early eighties

• Initial work focused on shallow waters with 2D seismic & gravimetric surveys offshore

• Subsequent drilling of 2 offshore wells encountered some Oil (Hydrocarbon) shows.

• A-1 in 1982 (Mobil) and A1-2 in 1985 (Amoco) were drilled in the country’s inner shelf, in water depths of <100m

• The wells penetrated significant thickness of reservoir quality Sandstone – Late Jurassic to Late Cretaceous.

• Wells provided evidence of enough sedimentary cover and source rock types to spur on further exploration

• More exploration work followed with the acquisition of speculative 2D data (5,800 Sq. km.) by TGS-NOPEC between 2000 – 2001, which sparked the current cycle of exploration

• Sierra Leone’s offshore coast was divided into 7 exploration blocks following acquisition of this data.
Exploration History Continued

- 2001: PEPA 2001 passed by Parliament to govern petroleum operations. Established the Petroleum Resources Unit (PRU) to regulate and monitor petroleum operations.

- 2003: First Bid Round held. 4 offshore exploration blocks were offered and awarded to bidding Companies.


- 2006: 1 exploration block awarded through Direct Negotiation.

- Appraisal and subsequent relinquishment by all companies except African Petroleum Corporation (APC) in mid-2015.


- APC entered second exploration phase in December 2015.

- A total of 8 wells have been drilled, (6 wells between 2009 to 2013 with 4 discoveries).
Sierra Leone - Current Activity
Sierra Leone 3D Seismic & Wells 2016

Legend

- [Legend description]

- [Data source and details]

- [Map scale and legend items]
Multi Client Seismic Data- TGS

2D seismic: 15,780 line km
3D seismic: 9,976 km²
Well data: 8 wells available
Interpretation reports
Current & Recent PDSL Projects

• Drilling campaigns of 2009-2013 proved Sierra Leone as a petroleum basin, with abundant prospectivity

• World Bank Capacity Building Project recently undertaken to analyse all geotechnical data in Sierra Leone and build capacity in Seismic Interpretation and Prospectivity

• Step change in IT infrastructure in Freetown offices

• National Data Archive

• Additional capacity building in GIS, Petrophysics and Seismic Interpretation currently being undertaken
Recent Infrastructure Advancements

- 24/7 power backup installation
- Server purchase and setup
- Security and Network upgrade
- Cloud hosted email rollout
- G & G workstation setup
- Kingdom License Server Installation
- NAS Storage-12tb for technical team
National Data Archive

Collection and collation of all Petroleum data in Sierra Leone
Seismic Interpretation & Prospecivity Review
GIS Capacity Building

- Installation of ESRI ArcGIS software and licenses
- Collation of all PDSL GIS data
Prospectivity- Overview

• Undeveloped oil discoveries
  – Four Cretaceous Oil Discoveries

• Onshore
  – Tilted fault blocks
  – Rumoured seeps on Sherbro Island

• Shallow water
  – Cretaceous tilted fault blocks
  – Two wells drilled in 1980’s by Amoco & Mobil (oil shows)

• Deep water
  – Structural plays associated with Sulima plateau
  – Cretaceous pinch out play
Undeveloped Discoveries

**Venus – B1 (2010, License Block SL-07)**
Water Depth: 1800m, TD: 5636m in Albian
Hydrocarbons: ~14m of pay in Cretaceous
good reservoir quality sand (channel/fan), penetrated several source rock intervals, and several good reservoir quality intervals all way down to TD.

**Mercury – 1 (2011, SL License Block SL-07)**
Water Depth: 1600m, TD: 4862m in Albian
Oil in two Cretaceous fan systems, 34.7m of 34° – 42° API oil in the primary objective and 6.4m of 24° API oil in a shallower secondary objective.

**Savannah-1X (2013, License Block SL05/11)**
Water Depth: 2153, TD 4737m
The well intersected ~3m oil pay in the primary objective and encountered an OWC

**Jupiter-1 (2012 License Block SL-07B-11)**
Water Depth: 2,199m, TD: 6465m
The well intersected 30m of hydrocarbon pay in the primary Upper Cretaceous objective and did not encounter a hydrocarbon water contact.
Onshore Prospectivity

- The present day shelfal area lies inboard of the Atlantic rift margin on a continental mobile belt.

- These shelfal areas contain Palaeozoic rift basins and sediments formed before rifting of the Atlantic.

- Palaeozoic petroleum systems produce oil onshore North West Africa suggesting the shelfal area of Sierra Leone is also likely to be prospective.
Aeromagnetic Survey

Fault block geometries visible in Aeromag data
The 2013 Sierra Leone aeromagnetic survey is 24,000 km².

The survey was shot partly over land and partly over the offshore.

The offshore present day shelf has water depths of up to 150m.

Prolongations of the Sierra Leone FZs onto the shelf and onshore are clearly visible as ridges in the high pass filtered magnetic merge.
Shallow Water Prospectivity

Rifted fault blocks present in proximal offshore of Sierra Leone

Fault block Leads in Shallow Water

Targets are up dip of deep water discoveries & provide significant prospectivity with reduced drilling costs
Deep Water Prospectivity

- Proven hydrocarbons in deep water Cretaceous turbidite plays
- Structural and stratigraphic plays identified in deep water by PDSL
- Abundant remaining potential
Sierra Leone offers good exploration opportunities:

– Good prospective acreage available (from onshore, shallow water to deep water)
– Favourable legal, regulatory and fiscal framework
– Political stability

Sierra Leone offers good investment opportunities:

– The socio-economic indicators are steadily growing after Ebola Outbreak
– GDP growth has slowed due to Ebola crisis, but is on rise again
– The fiscal incentives for foreign investment are attractive
– The infrastructures such as roads, telecommunications are improving substantially
Thank you from Sierra Leone!

Please come visit us at our booth in Safari Hall