Abstract

I discuss our team's story on opening new oil basins and show there is a pattern of discovery. Tullow Oil is focused on finding oil and then selling it in the ground or through the pipe. We are focused on low-cost of supply, light oil which flows naturally. We are conventional oil finders and our exploration covers two continents – Africa and South America. Africa is the continent in which Tullow Oil began doing business, and where we see considerable future exploration potential. South America presents us with exciting new opportunities and a chance to replicate the exploration success we have had in Africa. Our “off-limits” exploration filters help us focus on high-margin light oil in onshore rifts in East Africa, simple offshore settings on the African and South America continental margins and in our production heartlands of West Africa, particularly in Ghana.
Opening New Oil Basins: A Pattern of Discovery

Angus McCoss, Exploration Director, Tullow Oil plc
Oil finding focus

18 Countries
102 Licences
147 Geoscientists
1.2Bboe Reserves & Resources
78-85k bopd YE est 2017

JAMAICA
Walton Morant (100%)
2D Seismic

MAURITANIA
C3 (90%), C-10 (76.5%)
3D Seismic

KENYA
Block 12A (50%)
2D Seismic
Block 10BB/13T (50%)
3D Seismic
South Lokichar Basin (50%)
4 + 4 well programme

GUYANA
Kanuku (30%)
3D Seismic
Orinduik (60%)
3D Seismic

SURINAME
Block 54 (30%)
Araku wildcat

GHANA
Jubilee (35.5%)
4D Seismic
TEN (47.2%)
3D Seismic

URUGUAY
Block 15 (35%)
3D Seismic

URUGUAY
PEL 30 & PEL 37
Multiple leads being matured

ZAMBIA
Block 31 (100%)
Airborne Gravity Gradiometry
Block 31 (100%)
Passive Seismic
“Chronostratigraphy” of Tullow Oil

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Transformational discoveries open four new oil provinces.

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Cumulative net mmboe

Net 2C additions to YE’16

NAS: 2013/14
South Lokichar: 2012
TEN: 2010
Lake Albert: 2008
Jubilee: 2007
Frontier exploration de-risked

- Proven petroleum system on shelf
- Class 2 AVO fits structure, albeit on two vintage 3D surveys with “risky” gap
- Geological Goldilocks zone 40% N/G

Jubilee present & future

- 4D dual-azimuth seismic complete
- Dynamic sub-surface data integration
- Iterative updates of reservoir model

Jubilee: Progressive exploration & development in Ghana
Tweneboa-Enyenra-Ntomme

- High quality 3D seismic proved essential
- Extended Elastic Impedance “patterns” learned from Jubilee
- However, thinner reservoirs complicated the EEI “pattern”
- Bold 5 km outstep appraisal wells - could have been 15 km!
Pattern of exploration success in Tano Basin, Ghana

Insights & Lessons

- Paradigms challenged - industry over-focused on Cenozoic turbidites
- Proven working petroleum system reduces exploration risk when opening a basin
- Understand & adapt to limitations of geophysical methods
- Good quality seismic data during the exploration phase enhances impact & efficiency
- Aligned partners enabled acceleration of Jubilee & T.E.N. exploration to production (in 40 months)

Quick to “follow golden threads” – prioritized for high-return investment
Hunting for another Jubilee along the African margin

Geophysical analogues - over-emphasized
- High profile industry campaign in Cote d’Ivoire, Sierra Leone & Liberia
- Strikingly similar seismic, supported by AVO and EEI
- Paon, Venus, Mercury & Jupiter discoveries - up to 31 m net pay

Geological Goldilocks zone - too shaley
- Reservoir quality and N/G quickly identified as issues
- Limited well control, stratigraphic knowledge incomplete
- Under-appreciation of erosion impact - trap breach

Over-confidence in stratigraphic traps
French Guiana: Jubilee twin across the Atlantic?

**Giant Cingulata Turbidite Fan Complex**

- EEI predicts sand presence but not quality
- Class 1 AVO - limited fluid response
- Tullow’s most complex deep-water well

**Geological Goldilocks zone - too sandy**

- Maastrichtian & Santonian 72m net oil pay discovered below thick mudstone seals
- Hasty appraisal: back-to-back rig-driven programme

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**AAPG 2017**
Insights & Lessons

• Wells drilled during significant sector cost escalation – minimum commercial field size trebled
• Compressed timelines due to licence deadlines added significant pressures
• Need to properly understand consequences of data quality
• Uncalibrated drilling complexity in frontier exploration
• Geophysics alone does not provide full de-risking
• Holistic play analysis essential
• Goldilocks zone = 40% N/G (Jubilee)
Uganda: finding oil from first principles

Attracted to oil seeps
- First wildcats drilled on 2D seismic, guided by geological fieldwork
- Darcy permeability reservoirs identified

Strategic geophysics & wildcatting
- 2007 basin-wide 2D seismic acquisition
- Kasamene discovery opens Victoria Nile play
- 2009 FTG acquired: pseudo-3D survey
- 3D seismic acquired 2011 for appraisal phase

Wells tested at 1,100 - 14,000 bopd
32° API Oil
Kenya exploration campaign shaped by Ugandan “patterns”

Regional approach to onshore Africa exploration
- Loperot-1 legacy well proved working petroleum system
- Legacy 2D plus Tullow FTG generates significant inventory
- Ngamia-1 opens basin & 2D seismic firms up next prospects
- Several other basins tested with wildcats

South Lokichar Basin exploration & appraisal
- Early 3D seismic for appraisal & development
- 20 untested prospects in 1Bbo upside potential
- 2017 E&A wells drive basin towards 2018 FID

World class source rock: 10/12 success ratio
Pattern of exploration success in East African Rift Basins

**Insights & Lessons**

- Paradigms challenged - industry over-focused on dormant rifts
- First mover advantage, ~100,000 sq km acreage position
- World class source rocks in oil windows - seeps indicated active petroleum province
- FTG reduced our footprint, time & cost
- Wildcats on sparse 2D seismic data + FTG (pseudo-3D)
- Imagination, geoscience & perseverance
- Prioritized for value build
Araku: Testing new patterns in Guyana-Suriname basin

High-impact, high-reward prospect from portfolio refocus

- AVO supported, multiple flat spots, 4-way closure
- Simple well design, moderate water depths
- 500mmbo, high impact, follow on potential
- De-risked by Liza-1 oil discovery in the basin

Material low-cost new play in de-risked oil province