Future giant discovery in the Outeniqua Basin, offshore South Africa

Anongporn Intawong & Neil Hodgson
Talk Outlines

• Structural framework & Evolution of the South Atlantic

• Structural architecture of Cape fold Belt – Pre existing fabric in the Outeniqua Basin

• Petroleum system

• Proven plays - Analogues

• Giant prospects - To be tested

• Summary
Structural Framework

(Modified after Roux et al., 2003)

Recoverable Reserves:

- Ga-A 85 MMboe
- E-M/F-A 314 Mmboe
- Oribi/Oryx 55 MMboe
- Sable 50 MMboe

(Source: NOAA)
Evolution of the South Atlantic

Mid Jurassic:
- After Gondwana break-up: India-Madagascar – E. Africa separation

Late Jurassic – Valanginian South Atlantic Rifting divided S. America & Africa along the South Atlantic ridge

Hauterivian - Barremian:
- Beginning seafloor spreading in the southern South Atlantic
- AFFZ accommodated strike-slip motion between Africa & S. America

Turonian - Coniacian:
- Seafloor spreading propagated northward and connected with the Central Atlantic and the mid oceanic ridge south of the AFFZ

Eocene:
- Ridge jumped toward the African plate (~60 Ma) ended the strike-slip motion of the AFFZ

(Gaina et al., 2013)
Structural Architecture of Cape Fold Belt – Pre-existing fabric in the Outeniqua Basin

- Onshore geology dominated by E-W trending Permian-Triassic fold belt (Cape Super Group)
Petroleum System

Main source rocks:

- Syn-rift Late Jurassic lacustrine mudstone
- Hauterivian – Barremian restricted marine mudstone
- Aptian-Albian anoxic restricted marine mudstone (source rock of made discoveries in the Orange basin): TOC 2.8% - >5% (locally), HI 450-600

(Source: IHS, 2012)
Reprocessed 2016 (Blue) & All Data Available to Reprocess in S. Africa (Grey)

- Modern PreSTM imaging sequence
- Phase and amplitude matched
Proven Plays - Analogues

• **Bredasdorp Sub-basin**
  - Basin floor fan and channel (e.g. Sable, Oribi and Oryx)

• **Platmos Sub-basin**
  - Fractured & sub-aerial quartzite Table Mountain Fm. (Ordovician - Devonian Cape Super Group) – GA-A1
  - Draped sands on syn-rift structural high – GA-A1
Bredasdorp Sub-basin: Sable BFF & Channel Plays

Sable (1990)

oil & gas (Reserve 50 MMboe)

Stacking Early Aptian – Barremian BFF fan & channel lobe system – 100% stratigraphic trap (Socker, 1997)

Hauterivian – Barremian restricted marine source (2.5 – 3 s)

Syn-rift Late Jurassic source? (3 - 4 s)
Albian turbidites sand pinch outs:
- 27 m net
- Porosity 13-24%
- Permeability 500 mD - 2 D

2D Repro 2015  35 km line

E-BT1 (1990) oil & gas (Reserve 41 MMboe)
Large Syn-rift structural trap, BFF & Channel in Platmos Sub-basin

GA-C-1 gas show (fault breach)

Undrilled Early Cretaceous basin floor fan & channel – **Sable & Oribi analogue**

Undrilled rollover structure

Hauterivian – Barremian restricted marine source (2.5 - 3 s)

Syn-rift Late Jurassic source (3.5 - 4 s)

Cape super Group Pre-rift/ Basement

Line length 75 km

[Image of a geologic cross-section showing various geological features like traps, sources, and structural traps.]
Platmos Sub-basin: Pre-rift Fractured & Sub-Aerial Plays & Drape on Structure High

Gas & Cond in syn-rift Early Cretaceous marginal marine sands draped on structure high (porosity 10 – 30 %, K 30 – 1,000 mD)

Gas in Table Mountain Fm. Ordovician-Devonian pre-rift: Fractured & sub-aerial quartzite

Syn-rift Late Jurassic source (4 s)

2D Repro 2015 25 km line
Fractured & Sub-aerial Quartzite Table Mountain Fm. Play

Sub-basins of the Outeniqua Basin
- B – Bredasdorp
- P – Pletmos
- G – Gantoos
- A – Altoa
- S – Southern Outeniqua

Legend:
- Green: Oil Field
- Red: Gas Field
- Yellow: Onshore Mesozoic Basin
- Orange: Shallow Basement in Offshore Areas
- Purple: Depth to Basement (kms)
- Black: Major Fault
- Blue: 200m Isobath in Metres
- Green: Margin of the Karoo Basin
- Yellow: Outeniqua Basin

‘Table Mountain Fm.’

(Cawthra, 2014)
What remains to be tested?
Syn-rift Fault Block Rotation Play in Algoa Sub-basin

Fault block rotation
Late Jurassic - Early Cretaceous syn-rift play

High amplitude - soft kick

Syn-rift Late Jurassic source (2-3 s)

Ordovician – Devonian Cape Super Group Pre-rift

Source rk

2D Repro 2015 25 km line
Large Syn-rift Structures & BFF in S. Outeniqua

SW

Draped sands on structure high

Aptian restricted marine source (2 s)

Hauterivian – Barremian restricted marine source (2.5 – 3 s)

Syn-rift Late Jurassic source (2.5 - 4 s below the mud line)

Cape Super Group Pre-rift /Basement

L. Jurassic – E. Cretaceous Syn-rift

2D Repro 2015 135 km line
Large Basin Floor Fan – S. Outeniqua

High amplitude Basin floor fan with positive AVA

L. Jurassic – E. Cretaceous Syn-rift

2D Repro 2015, 67 km line
Large Basin Floor Fan & Channel Plays – S. Outeniqua

Flat spots

L. Jurassic – E. Cretaceous Syn-rift

High amplitude Basin floor fan & channel with positive AVA

Strike Repro 2015, 35 km line

L. Jurassic – E. Cretaceous Syn-rift

(UltraFar-Near) * UltraFar

Dip Repro 2015, 20 km line

TWT (s)

TWT (s)
Summary Prospectivity

- Fractured & sub-aerial Quartzite Table Mountain Fm. play in the shallow pre-rift basement highs

- Large syn-rift structures: fault block rotation, roll-over anticline & drape sands on structural high

- Large basin floor fan & channel plays with high amplitude supported by AVA analysis
New Petroleum Laws to be approved in mid-year 2017 – more favourable to oil company.