Tern Oil Field: Investment in Brownfield Data Acquisition

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Outline

- History
- Regional Structure
- Seismic Interpretation
- Tracer Study
- Conclusions
**Tern History**

- Discovered in 1975 with Well 210/25-1
- Reservoir: Middle Jurassic Brent Group

- Production commenced 1989
  - Currently 17 producers, 4 injectors
  - STOOIP: 594 mmstb
  - Production (end 2010): 271 mmstb
  - Recovery Factor: 45%
Structural Setting: East Shetland Basin

3D Image of Top Brent (ft)

Tern

Cormorant

Hudson

Brent

Pelican
Tern Seismic Data

ESB-09

TE-95

Tern

SW NE
Regional Faulting: The Influence on Tern

- Pobie Fault
- E Edge of Tern-Eider Ridge
- Basement controlled fault

Basement Fault

Brent TWTT
Transfer Zone

- Transfer Zone is very subtle
  - small throw: few ms or up to 25 ft
  - shows up well on attributes
  - possible extension of basement fault
- Key factors
  - shooting direction: with the fault trend
  - increase in data quality due to HD3D
Tern Faults

- Dip of main intra-field faults shows two distinct trends
  - southern faults dip towards southwest
  - northern faults dip northeast
- Series of small faults: Transfer Zone
  - parallel to the Pobie Fault
  - divide the field into two
Tracer Study

- Water injection started in 1989
  - Same year as production
- Both injection and formation water is produced
- Classic sweep pattern adopted
- Chemical tracer injected February 2010
- Immediate sampling in all 17 Brent producers
- No preconceptions with results for quantity or timing

Initial observations:
- All producers detected tracer from at least 1 injector
- Tracers were detected within days
Tracer Study Results

**TA18S5**
- Closest injector to producers
- Tracer detected in all wells

**TA22S1**
- Detected after a few days in the far north
- Large shadow in centre of field

Filled circle: tracer recovered
Hollow circle: no tracer recovered
Tracer Study Results

TA27S3
- Several wells at crest did not see tracer
- Some wells in centre registered tracer

TA28S3
- Similar pattern at crest
- Patchy recovery in centre

Filled circle: tracer recovered
Hollow circle: no tracer recovered
Tracer Study Interpretation

- Water is flowing in all directions
- Transfer fault acting as a flow barrier and conduit
  - Centre of the reservoir is receiving poor support
- Layered reservoir:
  - Juxtaposition of reservoir layers at faults creates multiple paths

Tracer Detected

- TA22S1: 22
- TA28S3: 28
- TA27S3: 27
Conclusion

Information from a tracer study and seismic data has increased the understanding of the reservoir and provided data for ongoing field development.

Major improvements in ESB-09 seismic survey
- Fault map more regionally consistent
- Identification of transfer zone

Tracer study given insight into the dynamic, complex reservoir
- Identified shadow zones
- Explained under pressured layers

- Combination of both studies is required to understand the field
  - Supported production and injection targets

- Investment in brown field data acquisition does pay off