The Cygnus play
Opportunity for a Dutch equivalent of the Cygnus Field (UK)
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Outline

1) Introduction

2) Cygnus field concept

3) An equivalent of the Cygnus Field in the Dutch offshore and its potential

4) Conclusions
Introduction
The Rotliegend Fm

The Rotliegend formation:

- Prolific reservoirs
- Significant fraction of Dutch gas production
- Well known
All producing fields are located at the southern edge of the Southern Permian Basin.

How about the Northern fringe?

New Rotliegend play concepts:

- 1959 – Groningen
- 1976 - Feather edge
- 1993 - Golden Fairway
- 2013 – ‘Ruby’ play

Modified after Doornenbal et al. (2010)
Cygnus field concept
Facts

Location:
- UK southern North sea
- Blocks 44/11 & 44/12

Current operator: Neptune

Estimated UR: 21.25 BCM (760 BCF)
Missed-pay

Initial target reservoir:
• Upper Carboniferous Westphalian C Ketch formation

Tight

But... with shows in the Leman Sst Fm.

Producing reservoirs:
1. Permian Rotliegend Leman Sandstone formation
2. Upper Carboniferous Westphalian C Ketch formation

Largest field discovered in the UK SNS in the last 30 yrs

= Lower Leman sst. (~Lower Slochteren sst.)

Discovery of Cygnus Field

1988

2016

First gas
Missed-pay

The Lower Leman sst. (Rotliegend) was in this area not recognised as potential reservoir.

Was conceived non-productive:

- Tight
- Thin
The importance of data acquisition

Discovery of Cygnus Field

Well 44/21-1
Target: Carboniferous
Result: DC - Low RF
LS - Minor gas shows, tight

Second well

Well 44/11-2
Target: Carboniferous
Result: DC – Low RF
LS - Minor gas shows, tight


Full extend of field could be mapped
Block: Q44/11 and Q44/12

Well 44/12-2
T: Leman
R: LS – HC, tight

Well 44/12a-3
T: Leman
R: LS – HC, tight, thin

Well 44/12a-4
R: LS – HC, good

Well 44/11a-4
R: LS – HC, good

Well 44/12a-5
R: LS – HC, good, thick

Well 44/12a-6
R: LS – HC, moderate
Initial depositional model

Modified after Doornenbal et al. (2010)

Modified after Otaru (2009)
The importance of data acquisition

- **Discovery of Cygnus Field**
  - Well 44/21-1
    - Target: Carboniferous
    - Result: DC - Low RF
    - LS - Minor gas shows, tight
  - **Unknown**
  - 2002
  - **2006**
  - +/− 2010
  - 2012
  - 2014
  - 2016

- **Engie recognized the missed-pay potential.**
- **Second well**
  - Well 44/21-1
    - Target: Carboniferous
    - Result: DC – Low RF
    - LS - Minor gas shows, tight
  - **1989**

- **Well 44/11-2**
  - Target: Carboniferous
  - Result: DC – Low RF
  - LS - Minor gas shows, tight
  - 1988

- **Well 44/12-2**
  - Target: Carboniferous
  - Result: DC – Low RF
  - LS - Minor gas shows, tight
  - 1988
The importance of data acquisition

Reservoir quality of the Lower Leman Sandstone:

- **Good**
- **Moderate**
- **Thight**
- **Unknown**

Modified after Catto et al. (2017)

Completion of Appraisal drilling program

<table>
<thead>
<tr>
<th>Well</th>
<th>Result:</th>
<th>Reservoir quality</th>
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<tbody>
<tr>
<td>Well 44/12-2</td>
<td>No HC</td>
<td>R: LS – HC, tight</td>
</tr>
<tr>
<td>Well 44/12a-3</td>
<td>No HC</td>
<td>R: LS – HC, tight, thin</td>
</tr>
<tr>
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<td>R: LS – HC, good</td>
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Extended field could be mapped
Block: Q44/11 and Q44/12

Well 44/21-1
Target: Carboniferous
Result: DC
LS
- Minor gas shows, tight

Well 44/11-2
Target: Carboniferous
Result: DC
LS
- No HC
LS
- Minor gas shows, tight

Well 44/12a-6
Result: HC, moderate
The impact of 3D seismic data

Average amplitude strength across the Lower Leman Sandstone

Modified after Catto et al. (2017)
Cuesta model

Modified after Mijnlief et al. (2009)

- +/- 1995 - Featheredge
- 2013 – ‘Ruby’ play
Cuesta depositional model

Modified after Otaru (2009)

Modified after Mijnlief et al. (2009)
Cuesta depositional model

Modified after Catto et al. (2017)
The importance of data acquisition

- **Discovery of Cygnus Field**: 1988
- **1989**: Second well
  - Well 44/11-1
    - Target: Carboniferous
    - Result: DC – Low RF
    - LS - Minor gas shows, tight

- **Engie recognized the missed-pay potential.**
- **Unknown**: Start of Appraisal program of six wells
- **+/- 2010**: Development sanctioned
- **2002**: 3D Seismic survey
  - Extend of field could be mapped
- **2006**: Multi-client survey
  - Block: Q44/11 and Q44/12

- **2012**: Completion of Appraisal drilling program
- **2014**: Multi-client survey
- **2016**: First gas
  - Well 44/11-2
    - Target: Carboniferous
    - Result: DC – Low RF
    - LS - Minor gas shows, tight

Well 44/12-2
- R: LS – HC, tight

Well 44/12a-3
- R: LS – HC, tight, thin

Well 44/12a-4
- R: LS – HC, good

Well 44/11a-4
- R: LS – HC, good

Well 44/12a-5
- R: LS – HC, good, thick

Well 44/12a-6
- R: LS – HC, moderate
A new play concept

**Trap:**
Broad, anticlinal low-relief, faulted structure comprising a series of terraced, tilted fault blocks

**Seal:**
Shales of the Silverpit Fm.

**Reservoir:**
1) Permian Rotliegend Leman Sandstone formation
2) Upper Carboniferous Westphalian C Ketch formation

**Source rock & Charge:**
- Carboniferous Westphalian A/B
- Namurian
The potential of the Cygnus play in the Dutch Northern offshore
Dutch potential

Main production is from the South side of the SPBA.

The Cygnus field proves the presence of a Northern sediment source.

Study
- **TNO**: New Petroleum Plays in the Dutch Northern Offshore (TKI project – to be released)

Data:
- **Wells**: Limited
- **Seismic**: Varying quality
The play elements of the Cygnus play

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**Source rock & Charge:**
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- Namurian
Sand distribution

Upper Rotliegend (RO2) Lithological map

Well E12-03

Modified after de Bruin et al. (2015)
Reservoir potential

Modified after de Bruin et al. (2015)
Setting in the Dutch Northern offshore
A Dutch equivalent of the Cygnus field

Undersampled area

... with Potential

Modified after Doornenbal et al. (2010)
Which elements do we need?

<table>
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<tr>
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<td>Presence</td>
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<td>Efficiency</td>
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- Presence
- Efficiency

- Fault
- Zechstein Fm.
- Carboniferous
- Rotliegend
Conclusions and way forward

Conclusions:

• The Cygnus field confirms the presence and efficiency of a viable Lower Leman (~Slochteren) sst. play fairway on the northern feather edge of the Southern Permian Basin.

• There is opportunity for a Dutch equivalent of the Cygnus Field.

• The Cygnus reservoir potentially present in the Northern offshore is waiting to be unlocked.

Way forward:

EBN will continue to work on this play to confirm prospectivity in the Dutch Northern offshore.

The timeline of the Cygnus field follows the same stages as the ‘Ugly duckling’ fairytale.
1988
Discovery of Cygnus Field

The Ugly Duckling is pushed away because he doesn't fit in. He struggles through the winter, but is friendship just around the corner?

1989
Primary target: Carb. Caister Formation (minor shows).

1989
At the pond, Mummy Duck guided her ducklings into the water. Splish, splish, splish they went as they hopped in. SPLASH! went the big, grey duckling.

2002
Engie recognized the missed-pay potential.

2014
Completion of Appraisal drilling program

The little, fluffy, yellow ducklings swam very nicely. But the big, grey duckling was the best swimmer of all! “Well done!” quacked Mummy Duck, proudly.

The grey duckling grew even bigger than the other ducklings. “Big feet!” teased his brother.

“Fuzzy feathers!” snapped his sisters.

“Ugly Duckling!” they all squawked at him. “You don’t belong with us.”

1988
The Ugly Duckling
Valuable support in following publications by TNO and Neptune.
References


