Zechstein Carbonates revisited
new insights and new changes for an old play

- Established petroleum play in NW Europe including NL
- A new Zechstein-2 carbonate distribution and facies map for the Dutch northern offshore has resulted from a review of well and seismic data
- Several undrilled Zechstein buildups have been identified, combine with other targets
- There are positive indications for the presence of mature source rocks in Zechstein and below
- Analysing outcrops in UK and NL production data helps in predicting reservoir quality and productivity in undrilled structures

- MSc research at EBN by Jan Schneider (‘13-'14) and Sjoerd Tolsma (‘12-'13)
- Prospectivity screening by EBN, excursion to outcrops (‘13-'15)
- EBN partner in Integrated Zechstein Project by Durham University / GRL (‘15-'16)
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Zechstein carbonates in the Southern Permian Basin

E&P and UGS in these reservoirs across / around the basin

Zechstein-2 carbonate distribution and facies map from Geluk (2007)
Zechstein-2 carbonates depositional model
wells indicate presence of carbonate buildup in large part of study area

Diagram after Geluk (2007) and Słowakiewicz et al. (2013)
Zechstein in seismic – E02-02 buildup

presence of several carbonate buildups in DEFAB area confirmed in seismic
New map for Zechstein-2 carbonates distribution as a result of integrating well review and seismic interpretation.
**Time to explore – petroleum play elements**

**focus on Zechstein-2 carbonates – differences between areas**

### Onshore Netherlands, Germany, Poland at southern fringe of SPB

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<thead>
<tr>
<th>Trap</th>
<th>carbonate platform / slope &amp; fault-dip closures</th>
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### Offshore Netherlands, Mid North Sea area at northern fringe of SPB

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# Zechstein carbonates

petroleum play elements in the Mid North Sea area - reservoir

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When lacking well data...

- Look at analogues in literature
- Look at relevant outcrops
Reservoir quality – many controlling factors...
Diagenesis & fractures – examples from producing Drenthe area (onshore NL)

Recent work on nearby similar german fields presented by Schoenherr et al. (2014)

Diagenetic model for proximal slope Zechstein-2 carbonates, from Reijers (2012)

Productivities of Drenthe ZeZ2C wells (Q50 test at 50 bar drawdown), from Frikken (1999)

EBN MSc thesis research on relation between productivity and fractures & facies ongoing, Coen Paulides (TUD)
Reservoir quality – many controlling factors...

Diagenesis & fractures – examples from producing Drenthe area (onshore NL)

But this may be different in Mid North Sea area!

- Very much dependant on burial and heatflow history, faulting
- These will be different throughout the basin
- Impact of facies & fractures
- Limited analysis on fractures

Productivities of Drenthe ZeZ2C wells (Q50 test at 50 bar drawdown), from Frikken (1999)

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Little fieldtrip to Durham Province (NE England)
outcrops show diagenetic features impacting reservoir quality

Tertiary uplift and exhumation caused Ze-1 anhydrite to dissolve, overlying Ze-2 carbonates collapsed. Outcrops show large-scale collapse of Roker Fm, forming breccia.

residue Hartlepool Anhydrite (cm’s)
Trow Point Bed (microbial, 10 cm)

slide plane
Little fieldtrip to Durham Province (NE England)
outcrops show diagenetic features impacting reservoir quality

Tertiary uplift and exhumation caused Ze-1 anhydrite to dissolve, overlying Ze-2 carbonates collapsed. Outcrops show large-scale collapse of Roker Fm, forming breccia.

Breccia pipes and de-dolomitisation developed in fault zones.
Similar processes and effects may be expected in the MNS area which was also uplifted and exhumed after deposition.

Zechstein lithostratigraphy and depositional sequences for Durham Province, from Catuneanu et al. (2011) after Tucker (1991)

Seismic section through E02-02 build-up
DEF seismic courtesy Spectrum SA
Zechstein carbonates
petroleum play elements in the Mid North Sea area – source & charge

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- Positive indications for source rock potential and recent charge, see presentation *Source rock potential of the Dutch northern offshore*
- Zechstein intra-platform source rock potential:
  - Zechstein-2 carbonate proven SR for oil and condensate in SPB
  - Facies determines SR potential; seafloor, lower slope, lagoonal facies. See Slowaciewickz (2013)
  - Location in the basin matters; for instance salinity, oxygen, tidal activity impact SR (preservation) potential
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