

Probing the Limits of the Economic Basement in NW Europe

F.F.N. van Hulten

Energie Beheer Nederland BV (EBN)

Heerlen - The Netherlands



Probing the Limits of the Economic Basement in NW Europe

Outline

- Introduction
 - The Silesian and the Pre- Silesian in the Netherlands
- Pre Dinantian
- Dinantian
 - Dinantian - Setting the scene
 - Comparison with Canada
 - Seismic



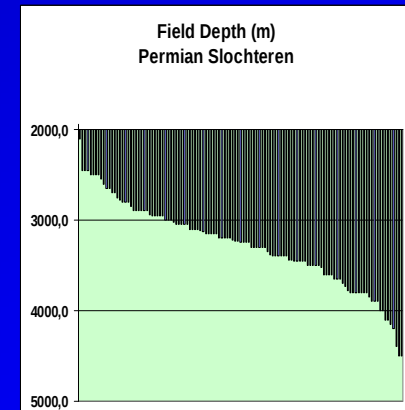
Paleozoic	Permian		
	Carboniferous	Silesian	Stephanian
			Westphalian
			Namurian
		Dinantian	
Devonian			

Cenozoic	Tertiary	Neogene	
		Paleogene	
	Mesozoic	Cretaceous	Upper Cretaceous
Lower Cretaceous			
Jurassic		Upper Jurassic	
		Middle Jurassic	
		Lower Jurassic	
Triassic		Upper Triassic	
		Middle Triassic	
		Lower Triassic	
Paleozoic	Permian	Upper Permian	
		Lower Permian	
	Carboniferous	Silesian	Stephanian
			Westphalian
			Namurian
	Dinantian		
	Devonian	Fammenian	
		Frasnian	
		Givetian	
Eifelian			

Introduction

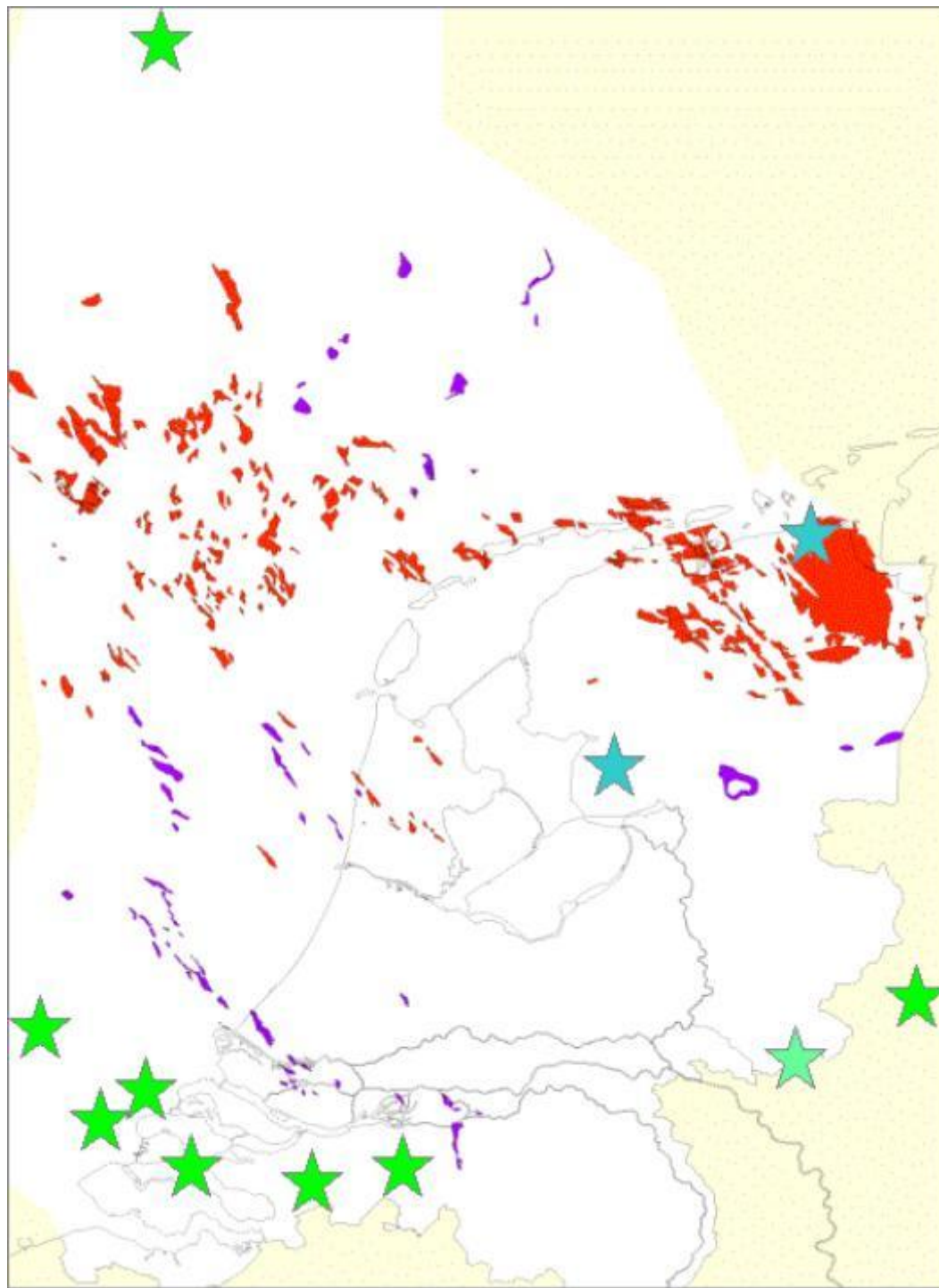
Exploration in the Netherlands

- Exploration Onshore and Offshore
- Mature - a limited number of plays
 - Successful – No creaming
 - Mainly Permian and Triassic
 - Outside Rotliegendes fairway less explored
 - Limited “Other Plays”
 - Chalk
 - Lower Cretaceous
 - Upper Jurassic



Is the Westphalian the economic basement?





Gasfields in the Netherlands

Triassic (Purple)

– Bunter

Permian (Red)

– Rotliegend **Slochteren**

Pre Silesian well control

★ Older Wells

★ Confidential



Cenozoic	Tertiary	Neogene	
		Paleogene	
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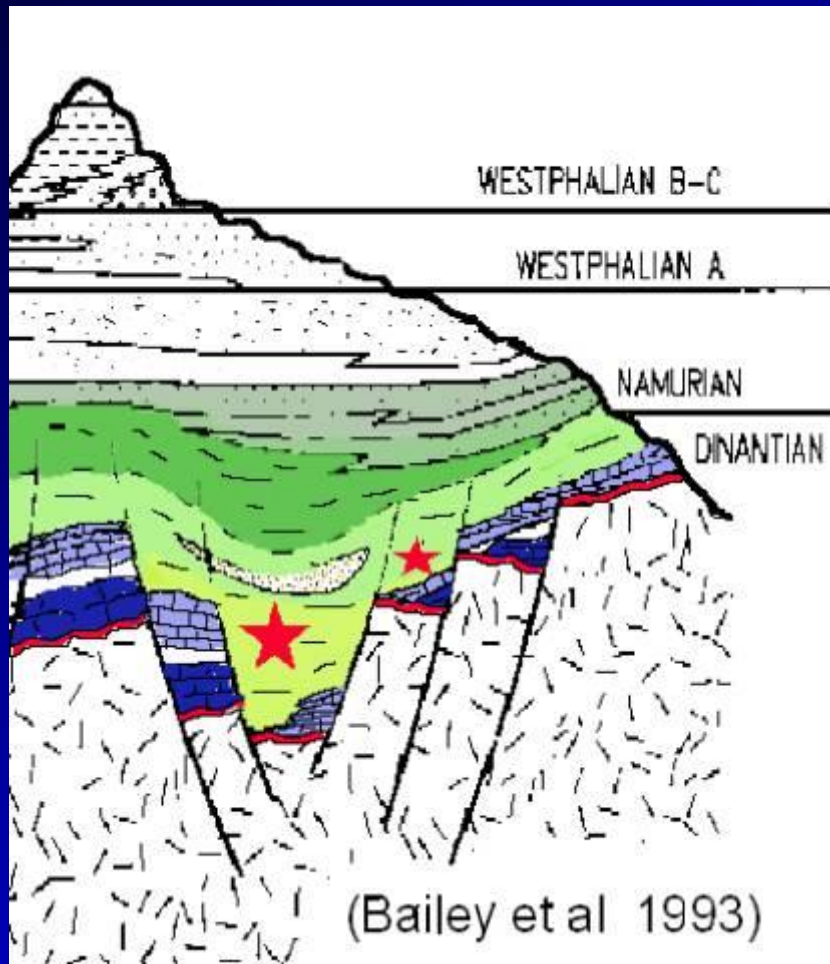
Introduction

Petroleum Systems in the Netherlands

- Tertiary
- L. Cretaceous Delfland/Wealden
- **Jurassic** – type II: Posidonia, Sleean/Aalborg, Kimmeridge
- Permian – Kupferschiefer
- **Westphalian**
Coals, shales



Pre Silesian Charge



Basal Silesian

- *Bowland/Geverik type II shales*

Below Silesian???

- *Dinantian?*
- *Devonian?*

Below Caledonian Unconformity

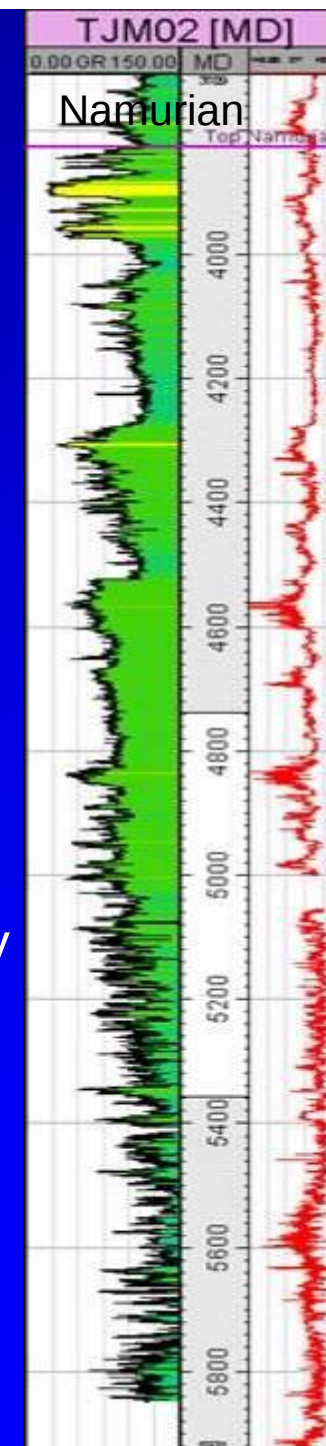
- *Light metamorphic – no source*
 - Baltic vs Belgium: Difference



Silesian - Seal



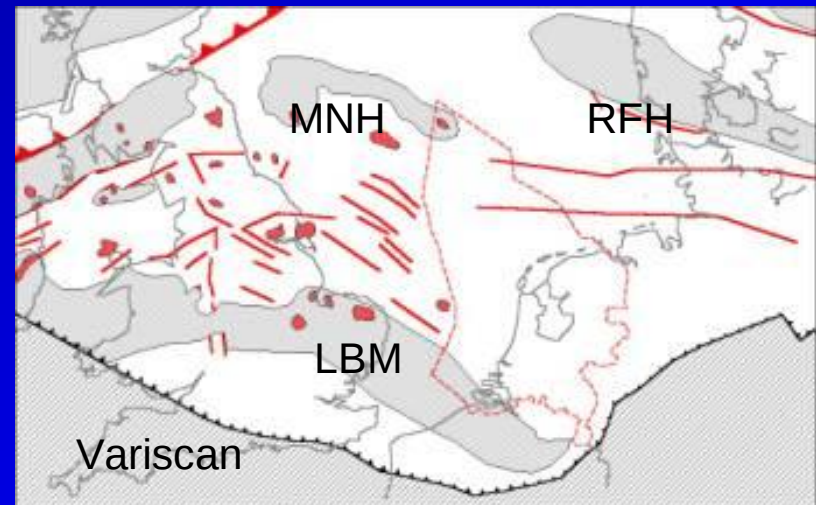
- Silesian (Westphalian and Namurian age)
 - Clastic Limburg Group
 - Original sediment thickness of over 5000 m?
 - Foreland basin fill – overall regressive, later **truncated**
 - Partly eroded
 - The top units Westphalian: frequently continuous parallel reflections, clay, coal and sands
 - The basal units Namurian: low frequency reflections, mainly shale, hardly any coal
 - Widespread
 - **Seal** potential
 - Geverik (Bowland) high TOC shale in basin areas, base Namurian



Pre Silesian envelope

The Base - The Caledonian unconformity *The technical “economic basement”*

- Generally hidden because of depth and undrilled
- Knowledge in simple terms, speculative
 - In surrounding countries
 - Complex events
- Sutures and Massifs
 - Elements of the Late Paleozoic geography
 - NW structural accretion: Caledonian
 - Highs
 - Micro Craton
 - Batholiths (in Red)



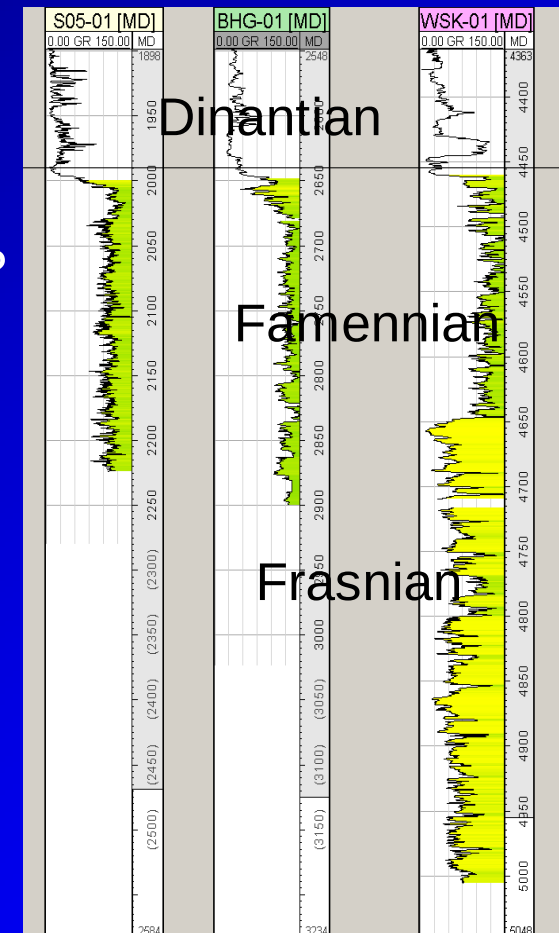
LBM= London Brabant Massif
MNH=Mid North Sea High
RFH= Ringkøbing-Fyn High



Devonian

- Well control sparse
 - First sedimentation after Caledonian Orogeny
 - Old Red in UK
 - Marine basin over large parts of the Netherlands?
 - Reef in Belgium south of the Brabant Massif
 - Limestone in Loenhout-Heibaart to the north
 - Limestone in Münsterland-01 (Germany)
 - Wells Winterswijk-1 (NL) vs. Münsterland-01
 - Sands vs. Limestone same age
 - Famennian no hot shales
- Not clear on seismic
- Distribution conjectural
 - No indications (yet) for a separate Devonian petroleum system like in Canada
 - Paleo-geographic highs and lows comparable to Dinantian?

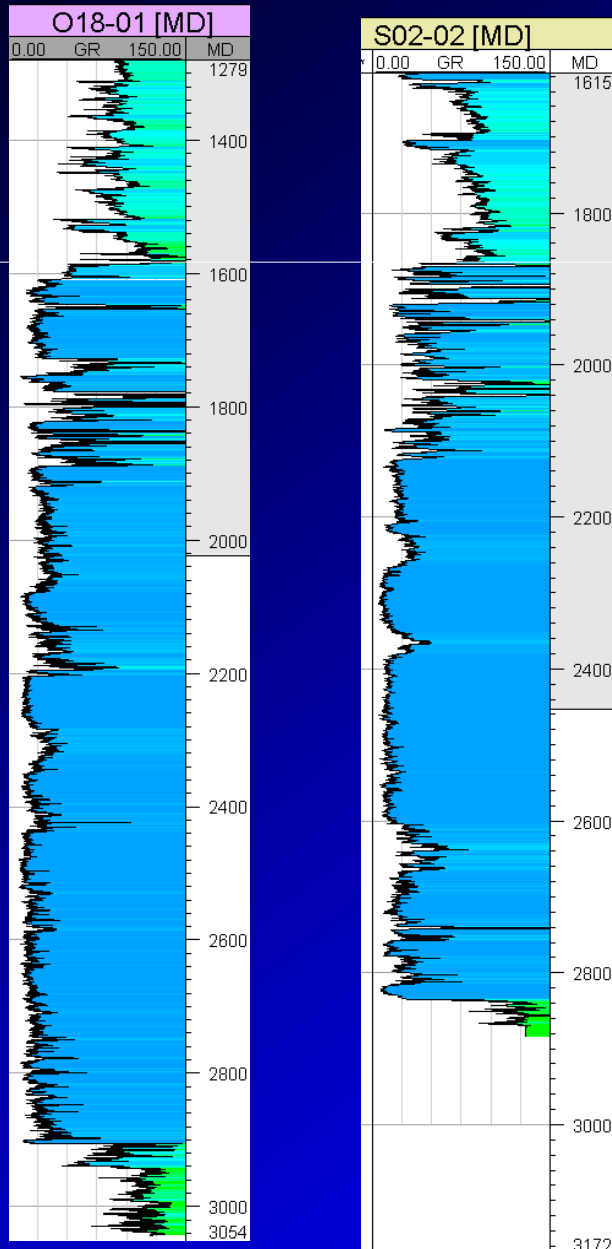
S5-1 BHG-1 WSK-1



O18-01

S2-02

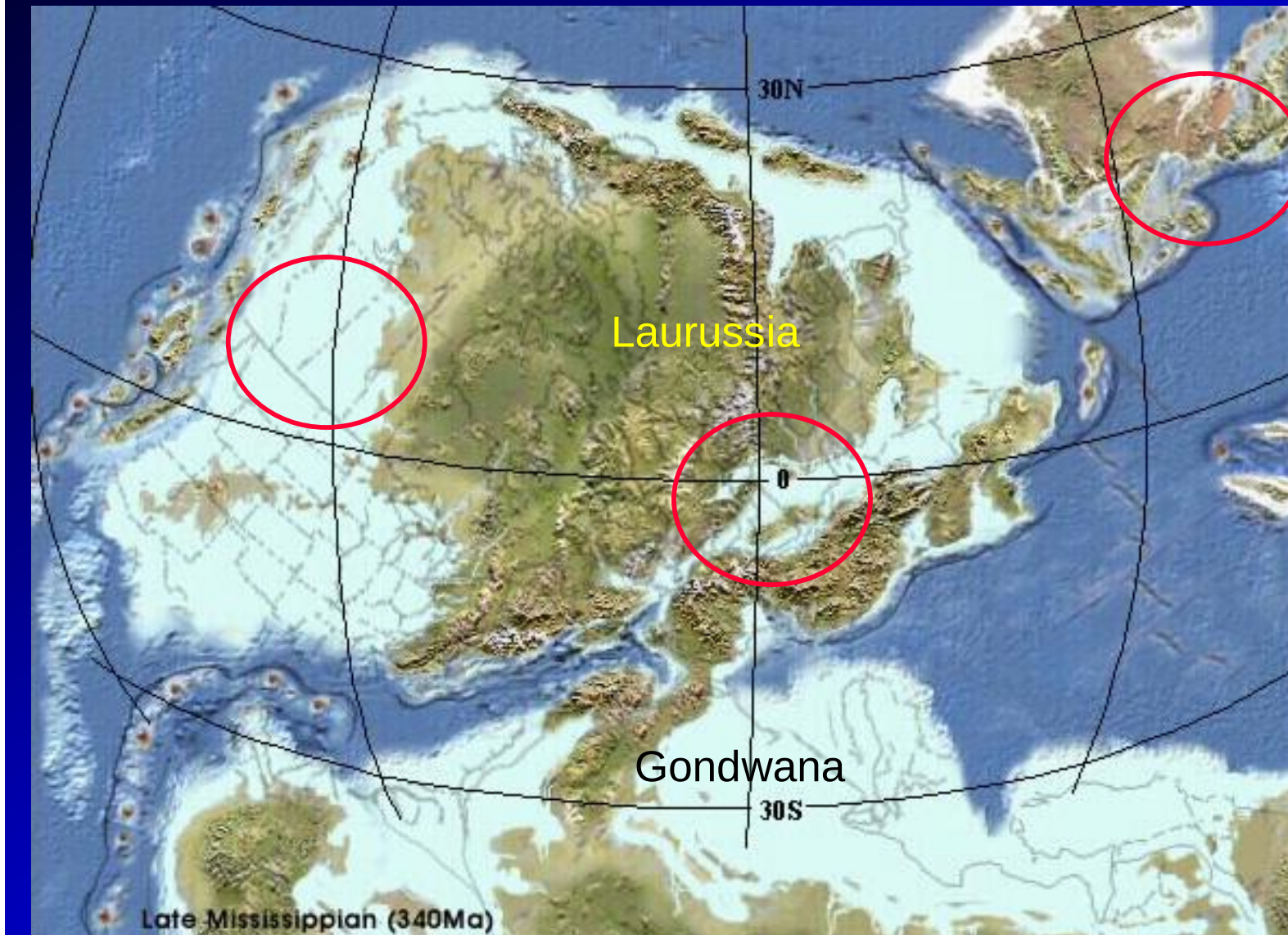
Dinantian



- Carbonate Platforms
 - Zeeland Formation
 - Brown and black limestones
 - Grey dolomites
 - 900 – 1400 m
 - Widespread
 - Comparable to Belgium, UK
 - Platform and ramp carbonates
 - Interplatform seaways
- New finds in the Caspian Sea
 - Tengiz, Kashagan
- Canadian examples

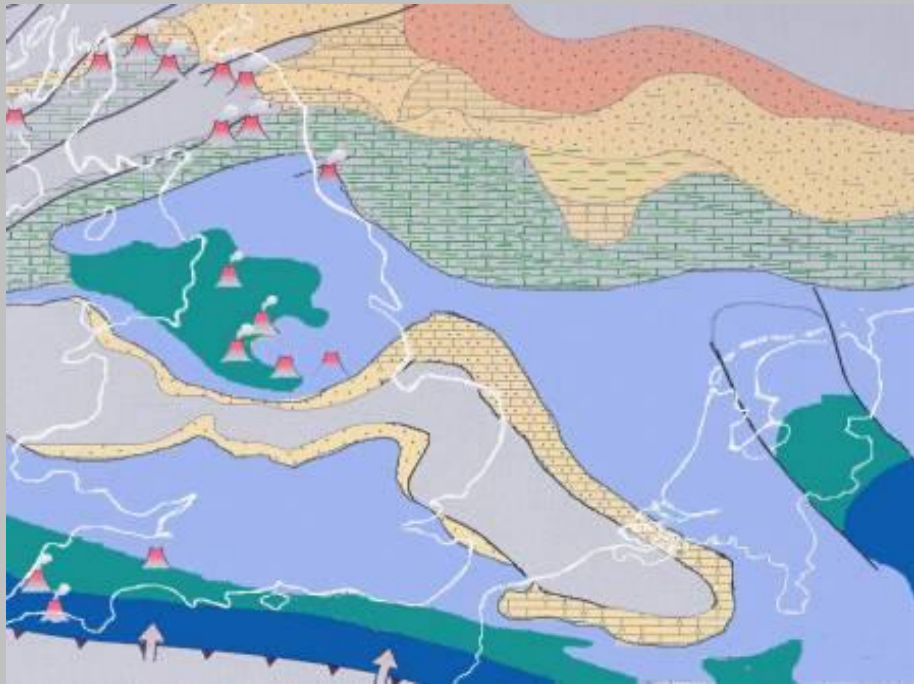


Dinantian Global Paleogeography

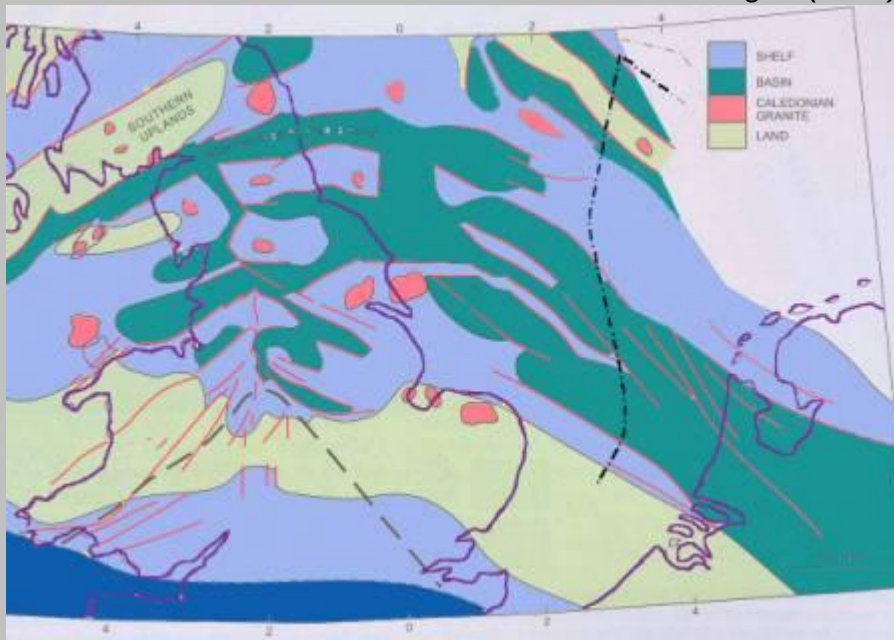


Dinantian Paleogeography

- Progradational limestone wedges from Paleozoic highs
- Back arc extension - gradual crustal collapse North of London Brabant Massif
- Series of arc shaped **blocks** and **basins** over Central Northern England
 - Extending over the Netherlands



Ziegler (1990)



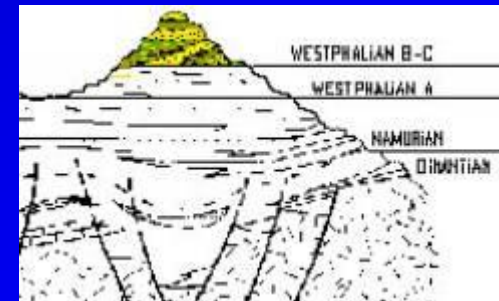
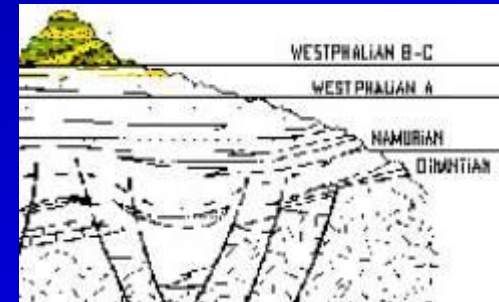
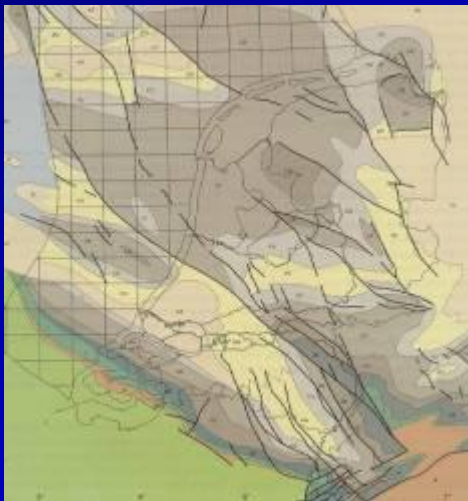
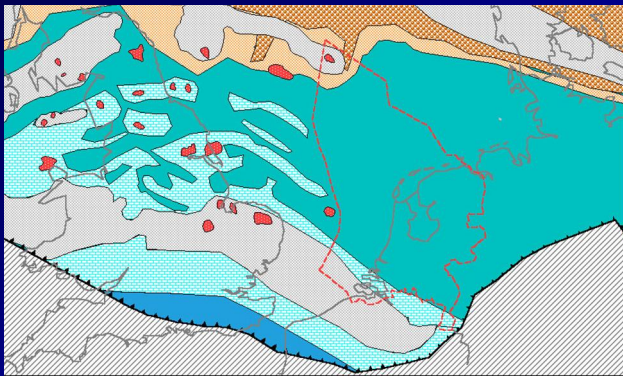
Glennie (2001)



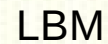
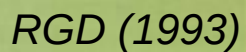
Dinantian

Paleogeography

Based on Carboniferous Subcrop



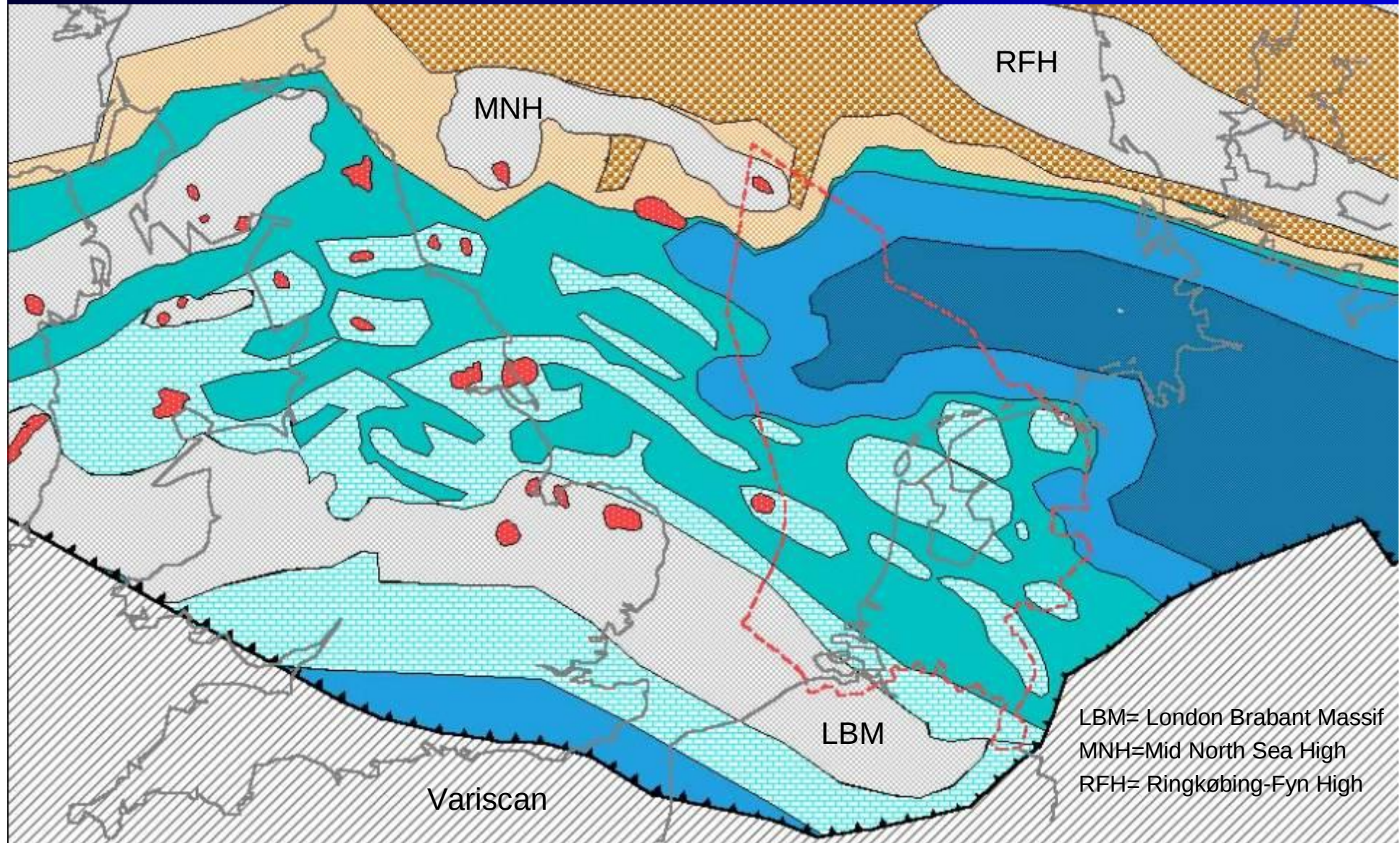
Based on Carboniferous Subcrop



Campine

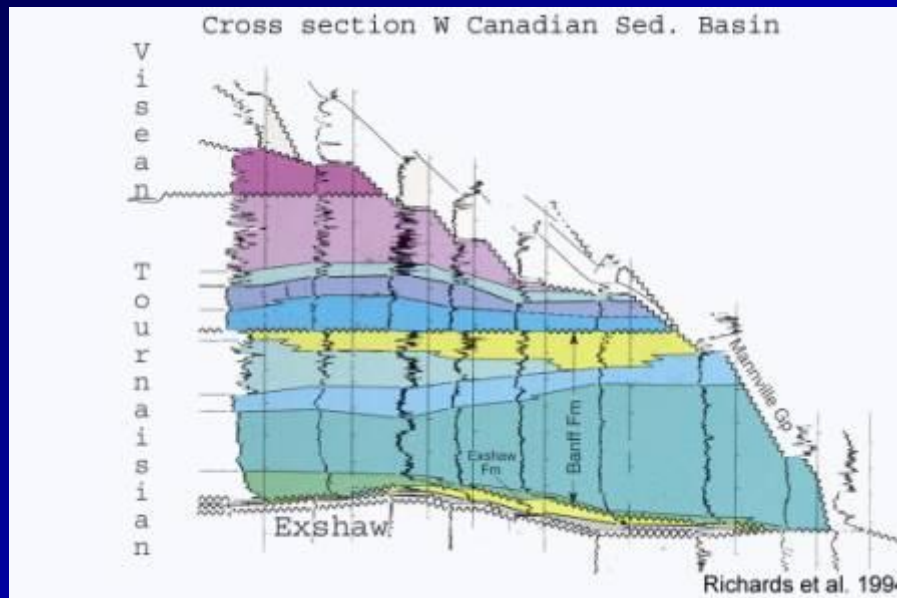
Dinantian

Paleogeography - NW Europe



Comparison with Canadian Dinantian

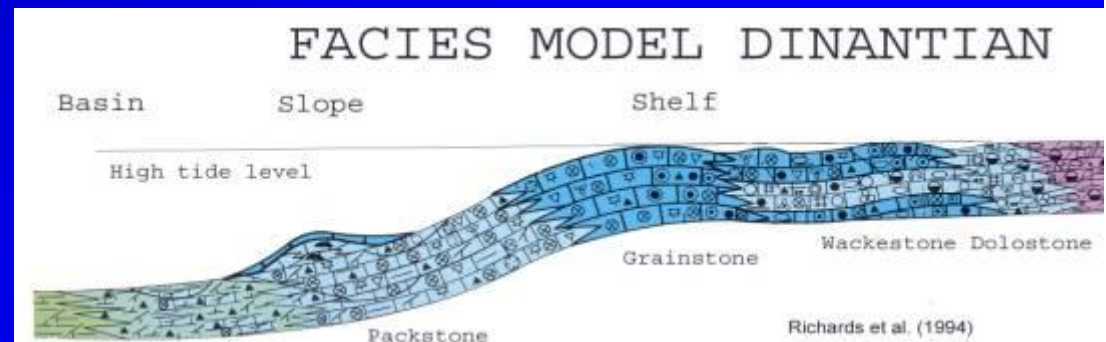
Carbonates of Viséan and Tournaisian age
Platform, slope and basin facies



- Important hydrocarbon reservoir interval for West Canadian Basin – good wellcontrol
- Comparison relevant because of similarities
- Useful for play models

Differences:

- Canada much shallower
- Exshaw source
- Less subcrop erosion

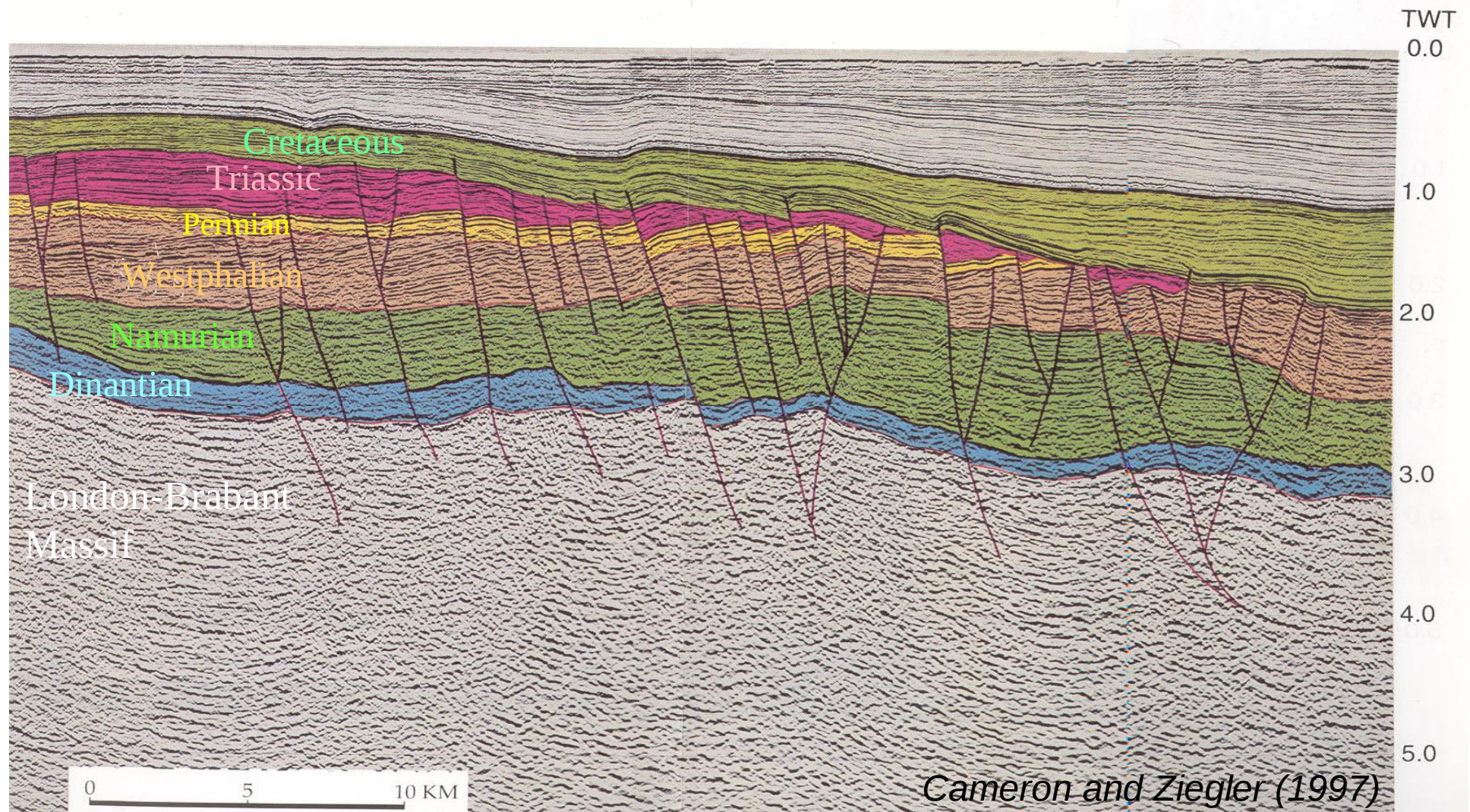


Pre Silesian

Southern North Sea SW-NE seismic section (PGS NOPEC)

SW

NE

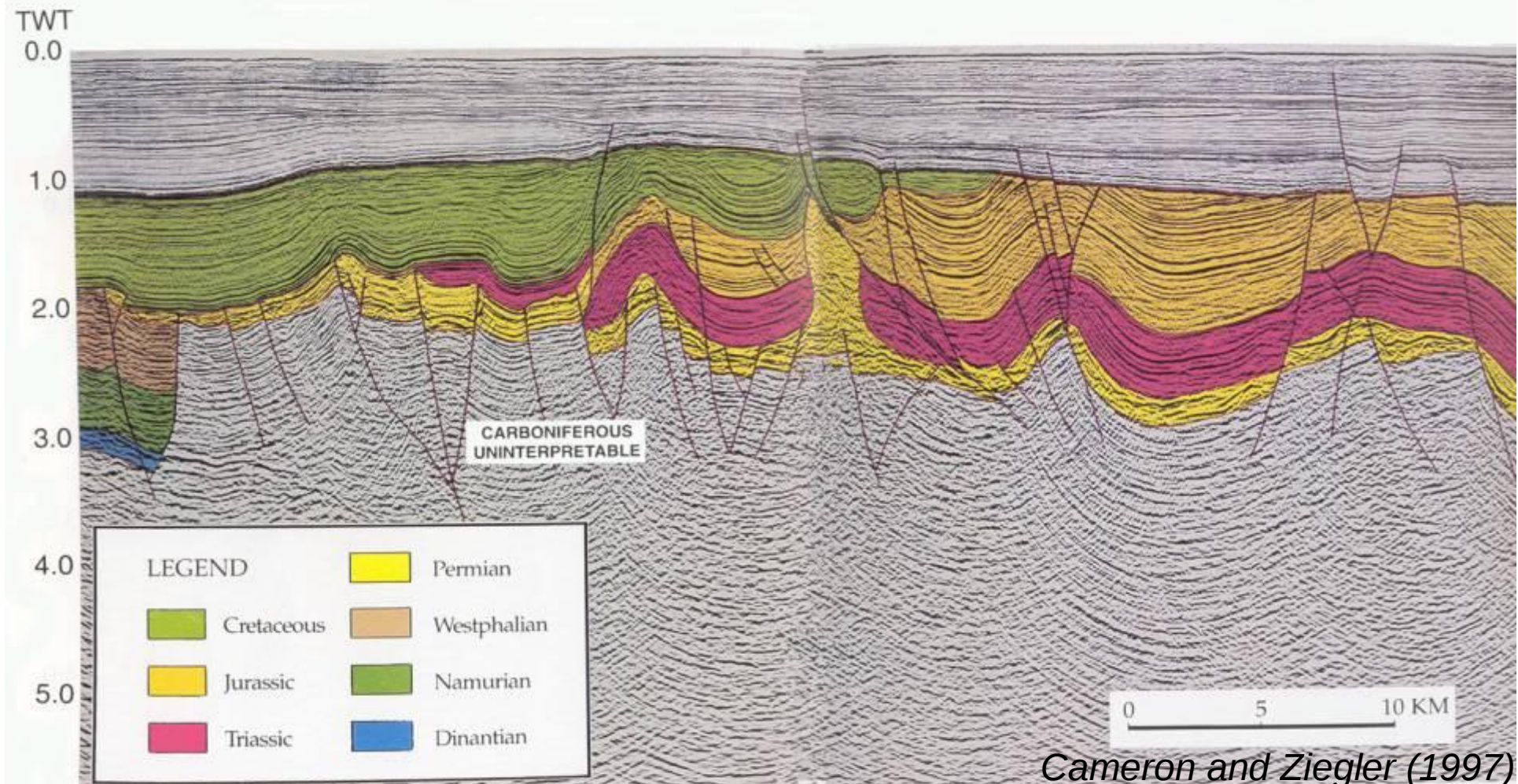


Uninterpretable Pre Silesian

Southern North Sea SW-NE seismic section
Continuation previous line

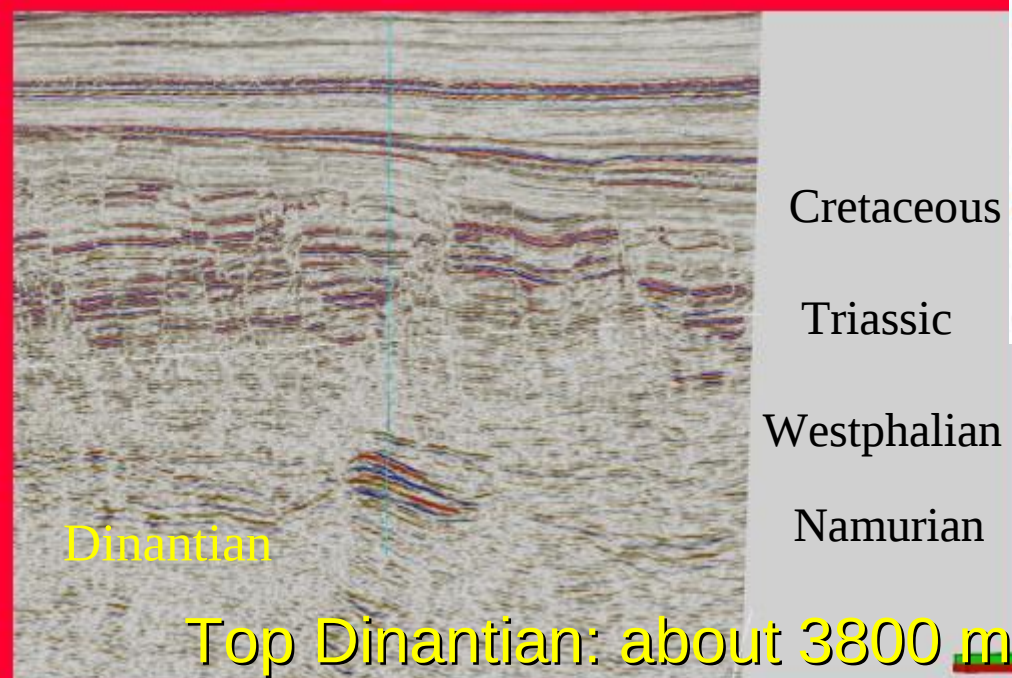
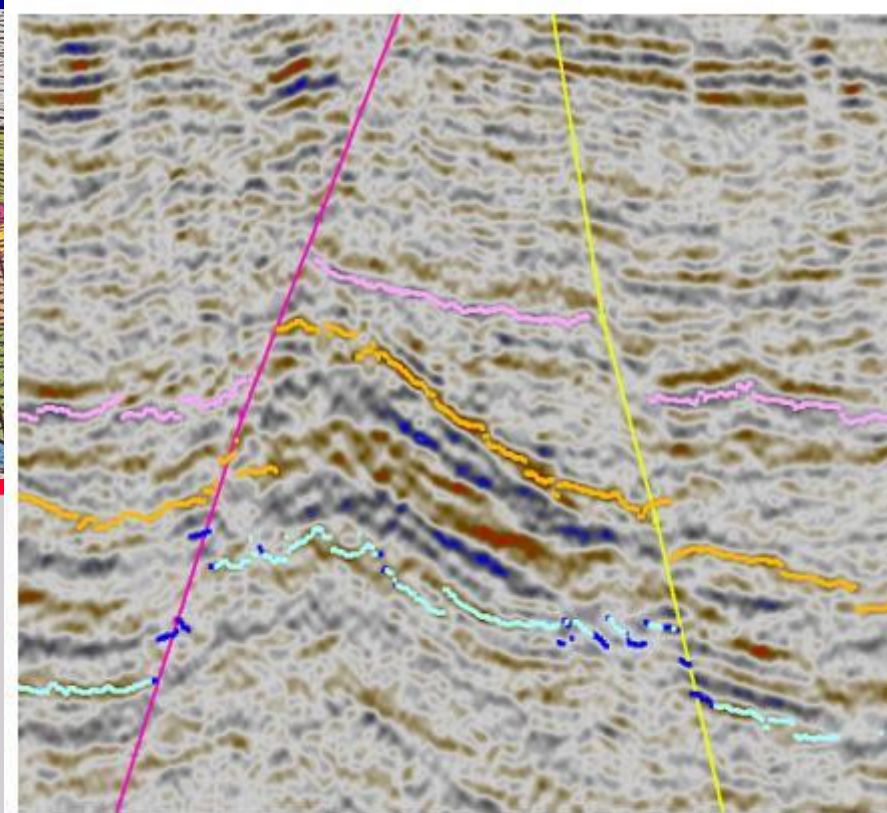
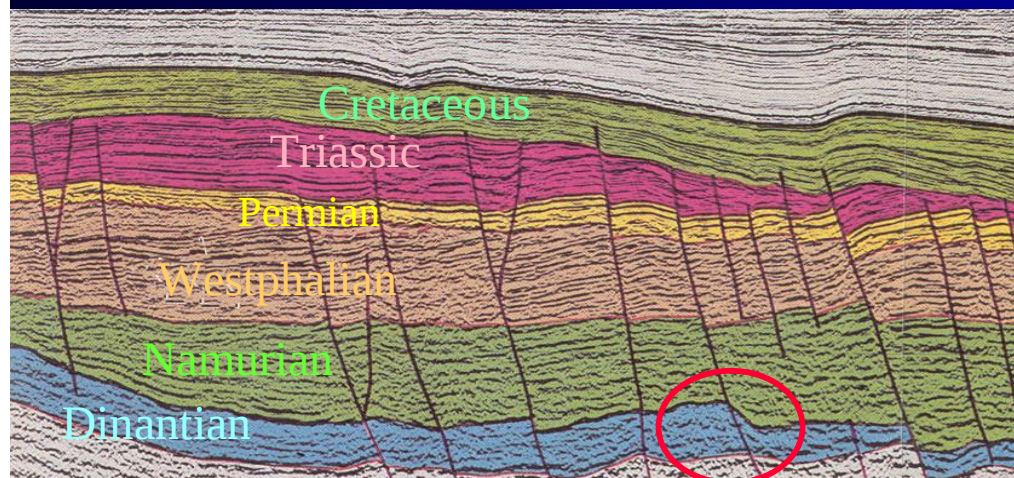
SW

NE



Dinantian

Southern North Sea - Dinantian Leads



Pre Silesian plays

Recent activity

Deep wells (*confidential*)

- Uithuizermeeden-2 (2002) [TD est. 5000 m]
- Luttelgeest-1 (2004) [TD est. 4500 m]

[scouting data]



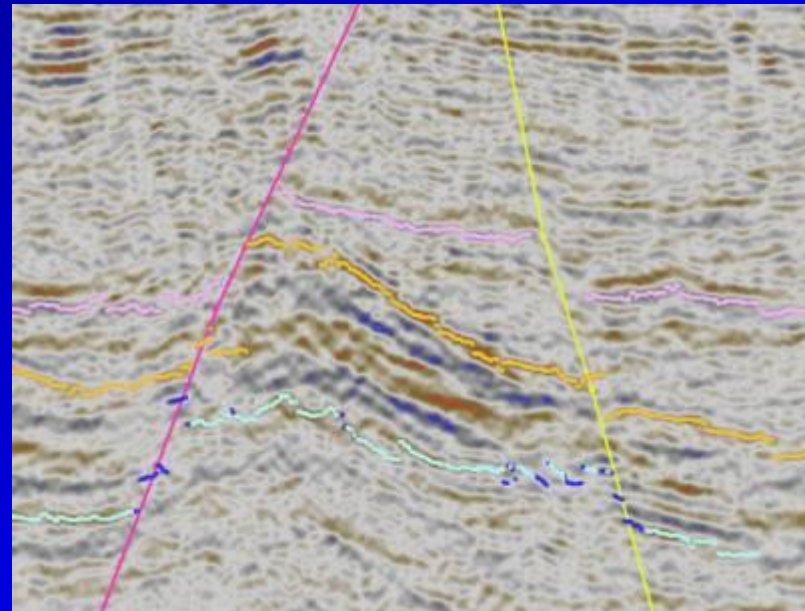
Pre Silesian plays

Conclusions

All elements are present
for Dinantian leads

- Seal
- Charge
- Reservoir

- Southern part of the Netherlands most interesting
- Depth offset by size



Pre Silesian plays

Conclusions

Pre Silesian Plays poorly constrained

- Some suggestions:
 - Need to rework all existing data
 - Including shallower layers
 - New look at the seismic
 - Regional and detailed
- More study work
 - Regional geophysical studies required
 - Basin modeling