



Economic risk reduction of geothermal energy projects: Case study of the Delft Sandstone

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Study objective

Reduce economic risks for geothermal projects

Reduce uncertainties of reservoir characteristics

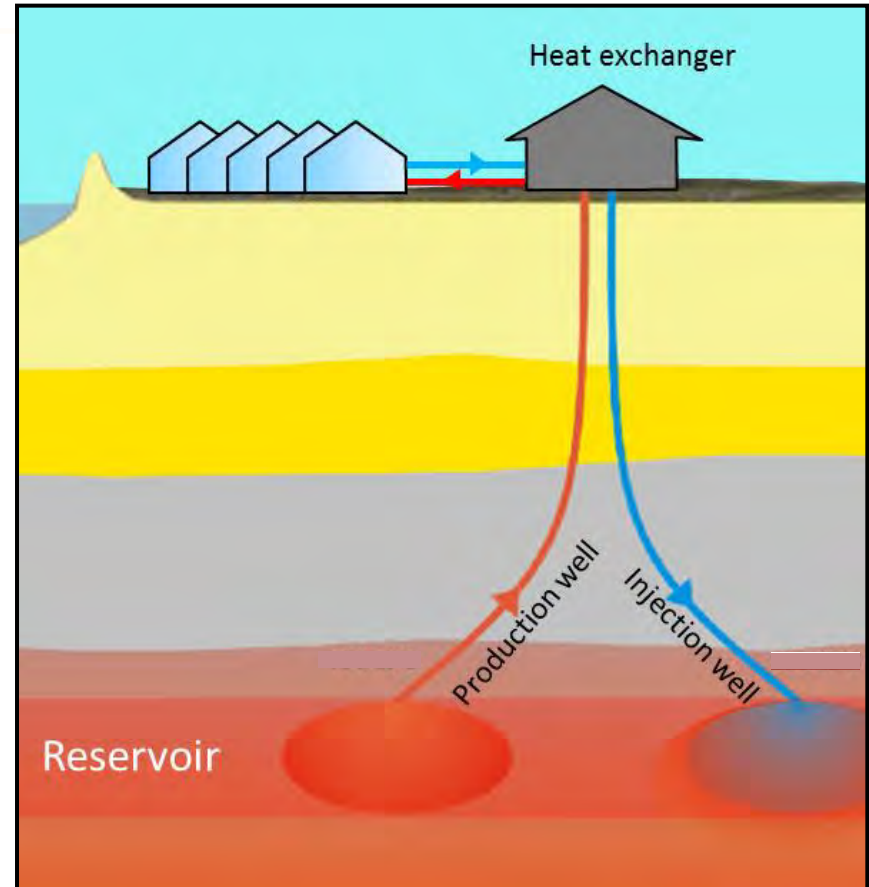


Conclusions

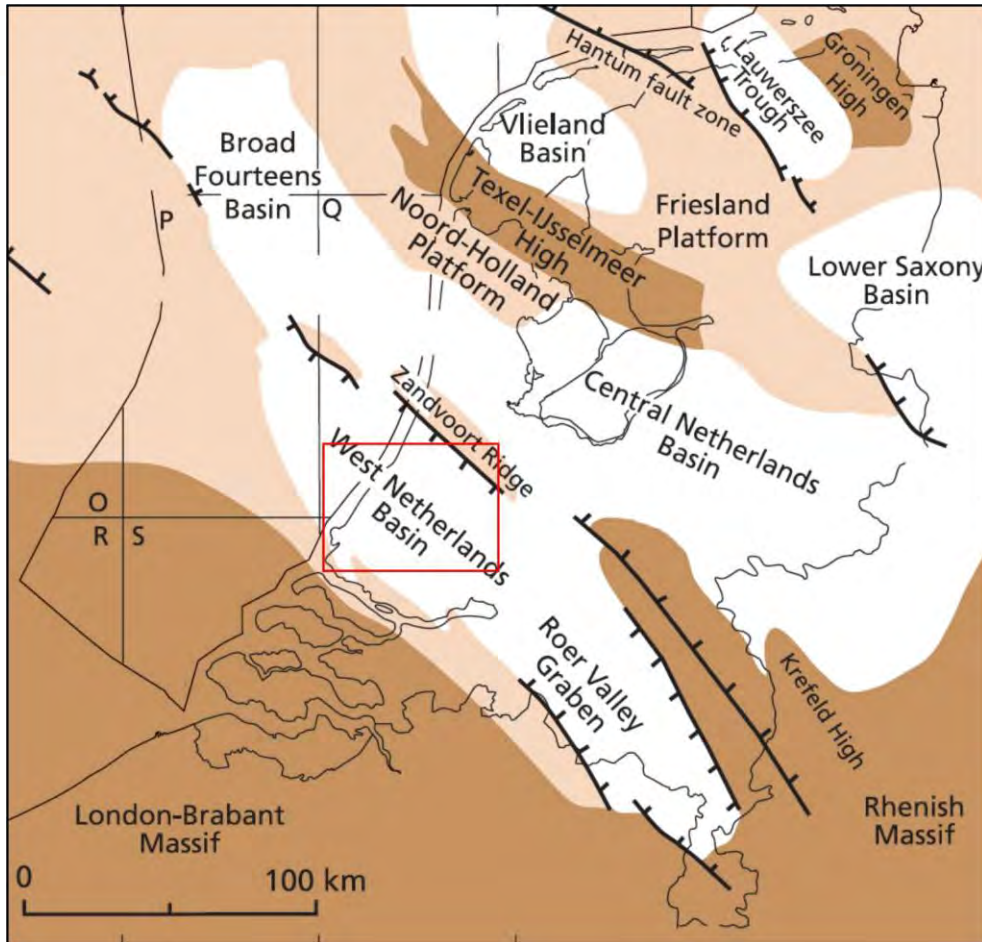
- Better model to predict sand bodies, in depth and space
 - No one Delft Sandstone
 - Sand 1 deeper than Sand 2
- Use reservoir characteristics for specific targeted sand
- Placement of doublets in NW-SE direction

Geothermal energy

- Doublets
- Closed system
- Injection and production well



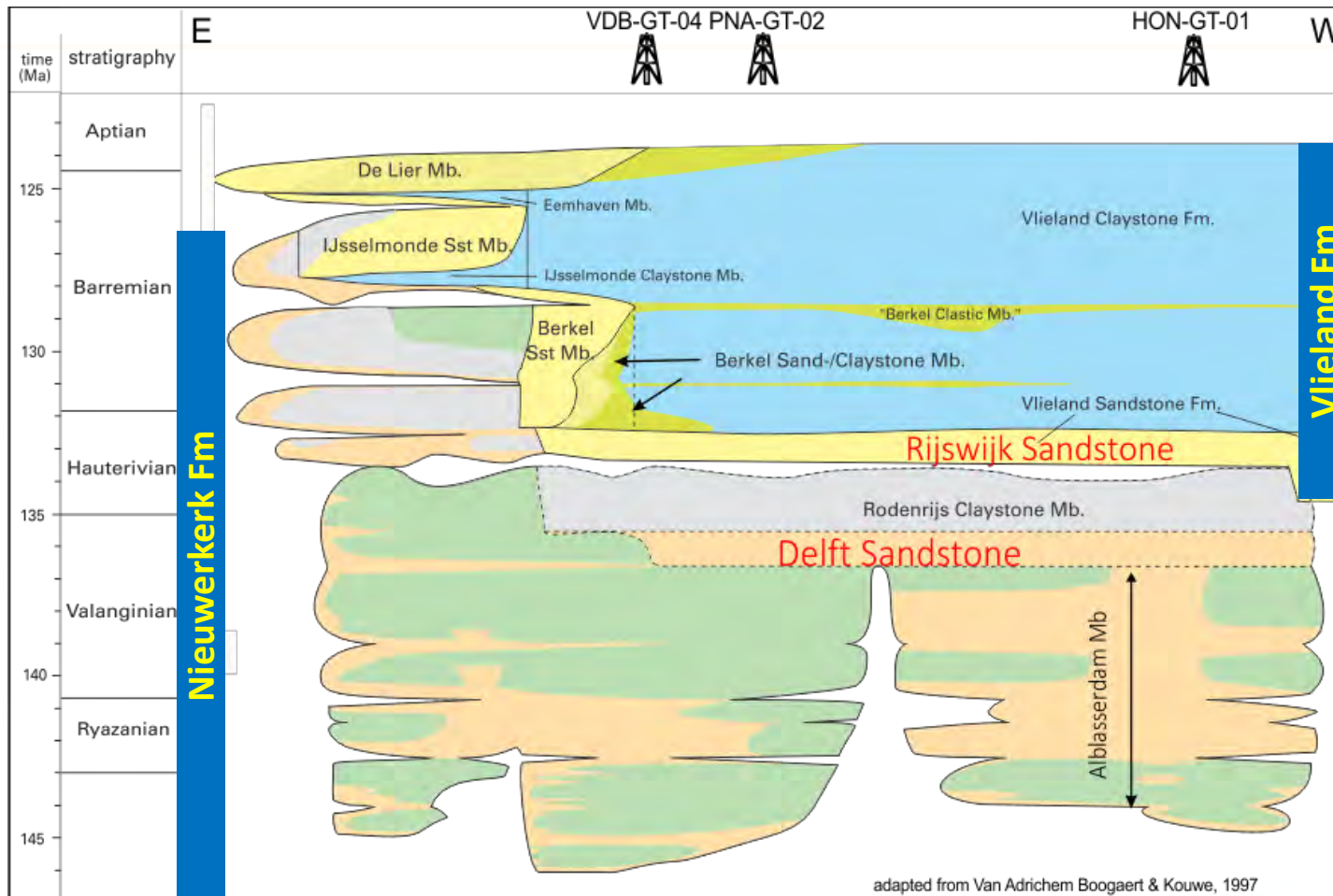
West Netherlands Basin



Modified after Herngreen and Wong, 2007

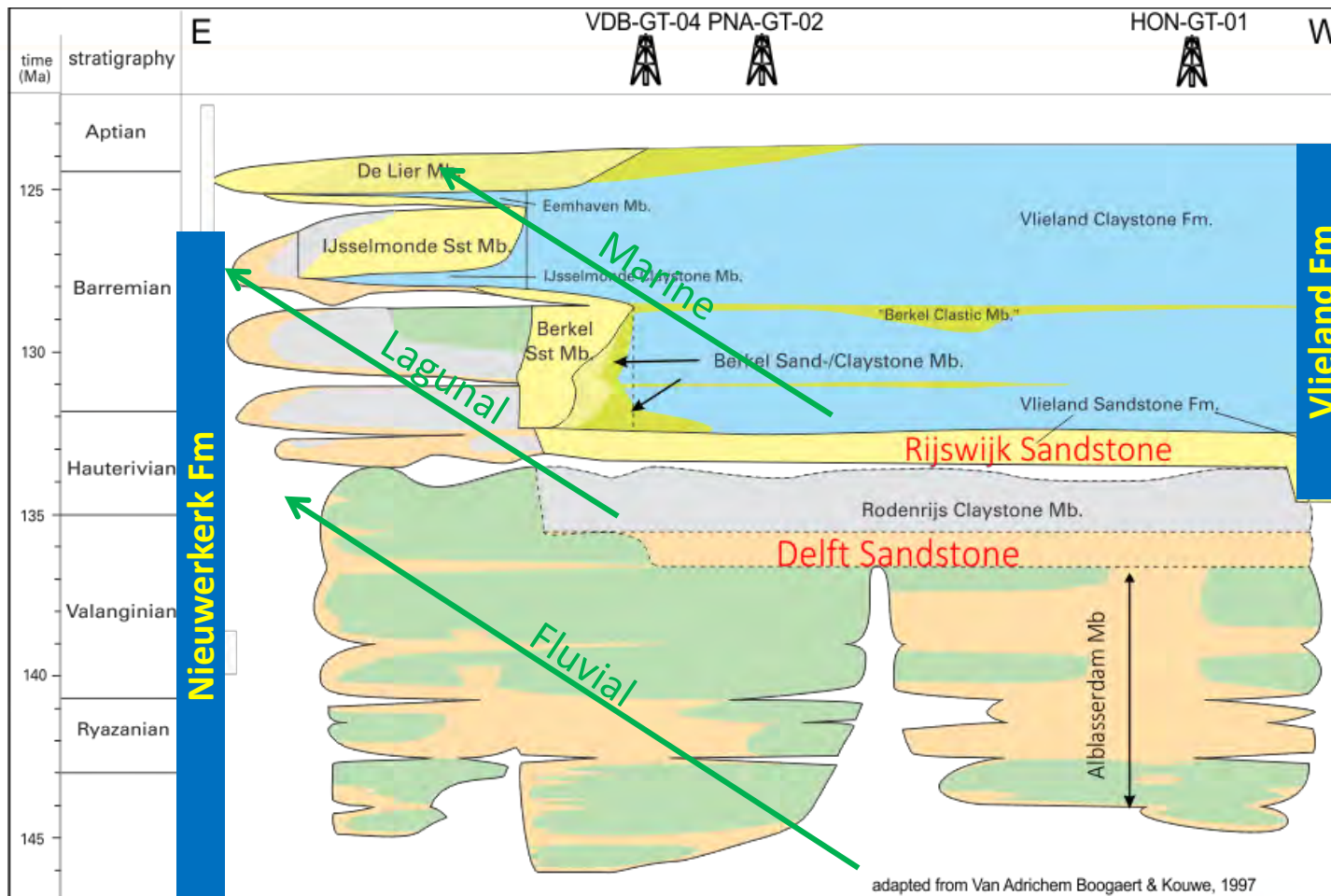
- First doublet
- Cretaceous reservoir rocks
- Late Jurassic rifting
- Late Cretaceous inversion

Stratigraphic scheme West Netherlands Basin



- Four important members
- Delft Sandstone main target
- In whole WNB a dominant sandstone

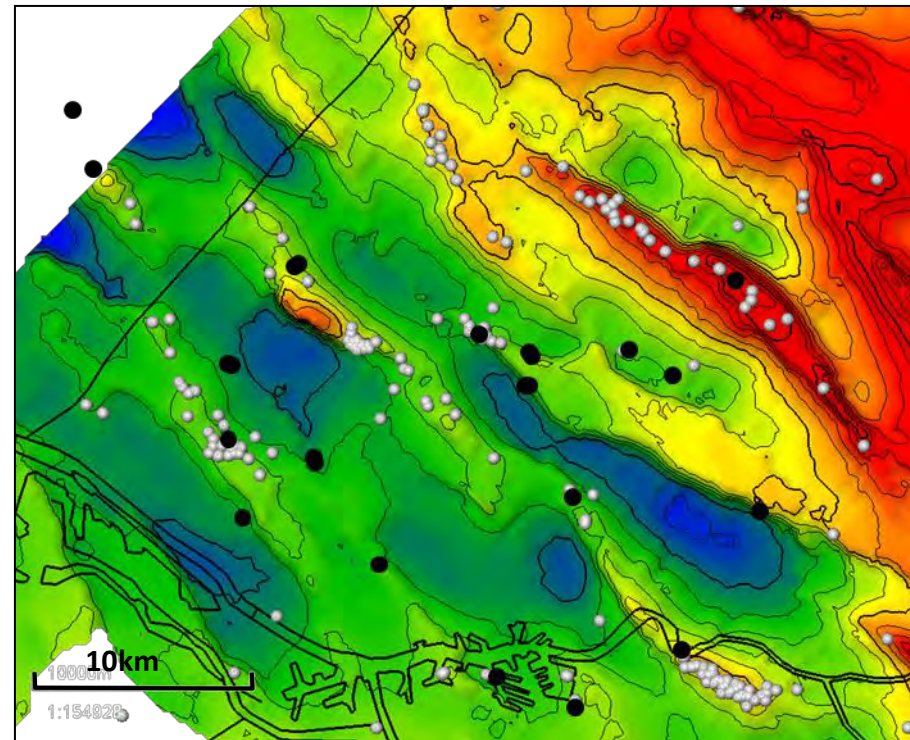
Stratigraphic scheme West Netherlands Basin



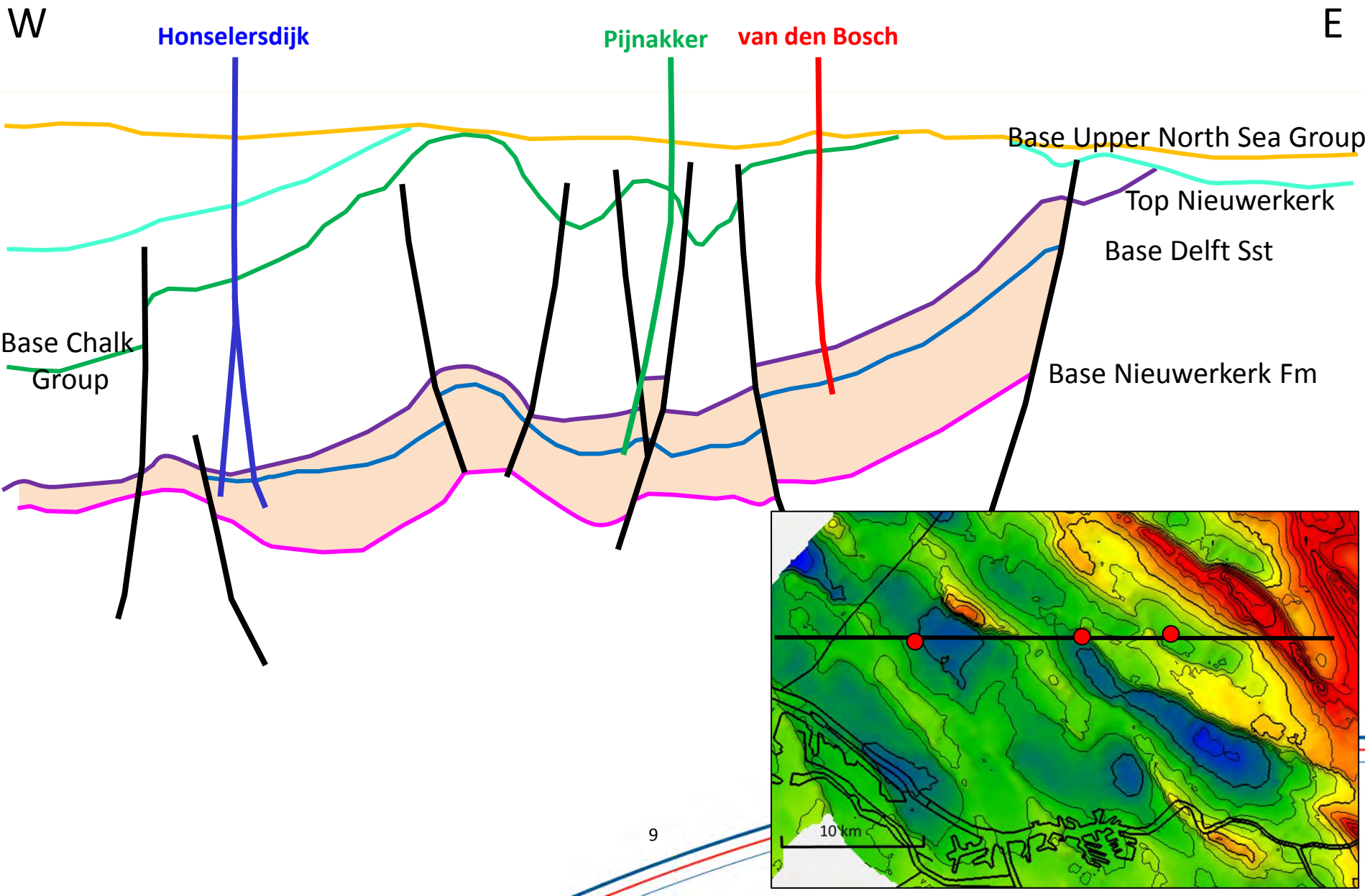
- Four important members
- Delft Sandstone main target
- In whole WNB a dominant sandstone

Nieuwerkerk Fm

- Fluvial deposits
- NW-SE trend
- Constrained by fault activity
- Occurs throughout the WNB

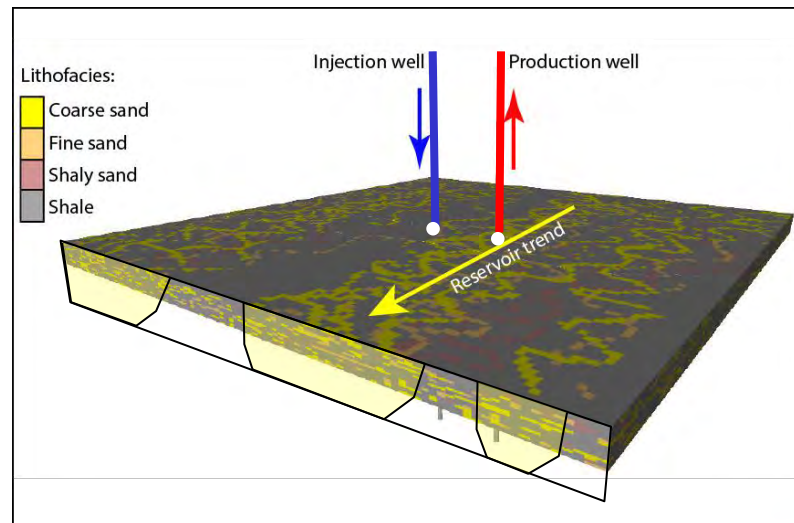


Cross section



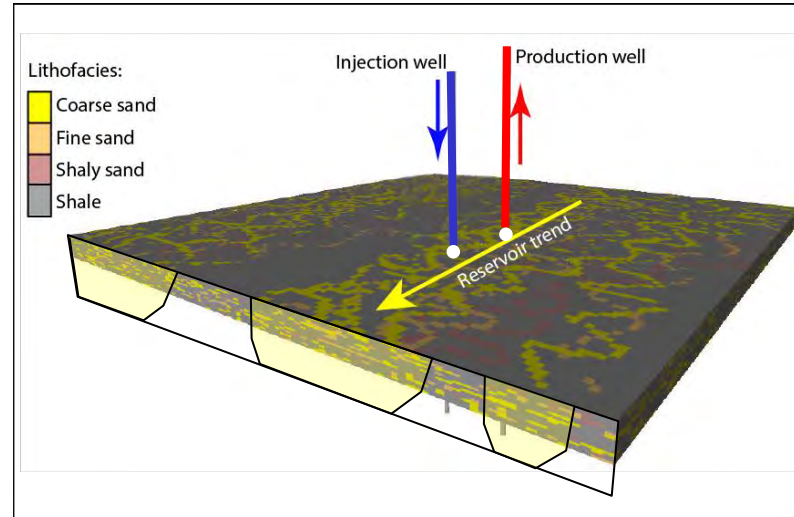
Problem statement

- Current knowledge from structural highs
- Architecture of the fluvial Delft Sandstone reservoir is difficult to predict
- Economic risk depends on well placement



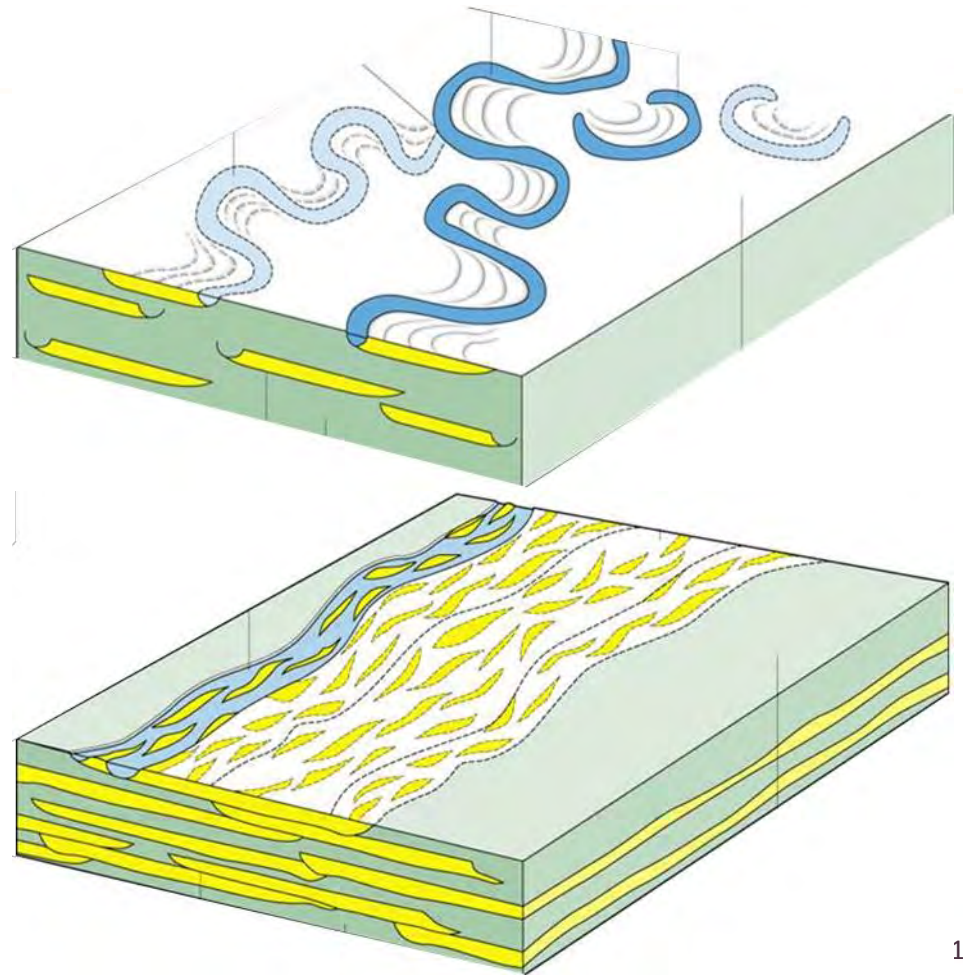
Problem statement

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Reservoir Challenges

- Presence
- Thickness
- Continuity
- Geological model



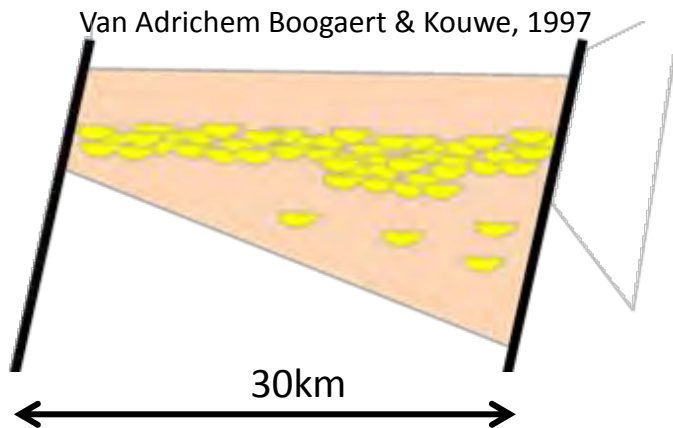
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Stratigraphic correlations

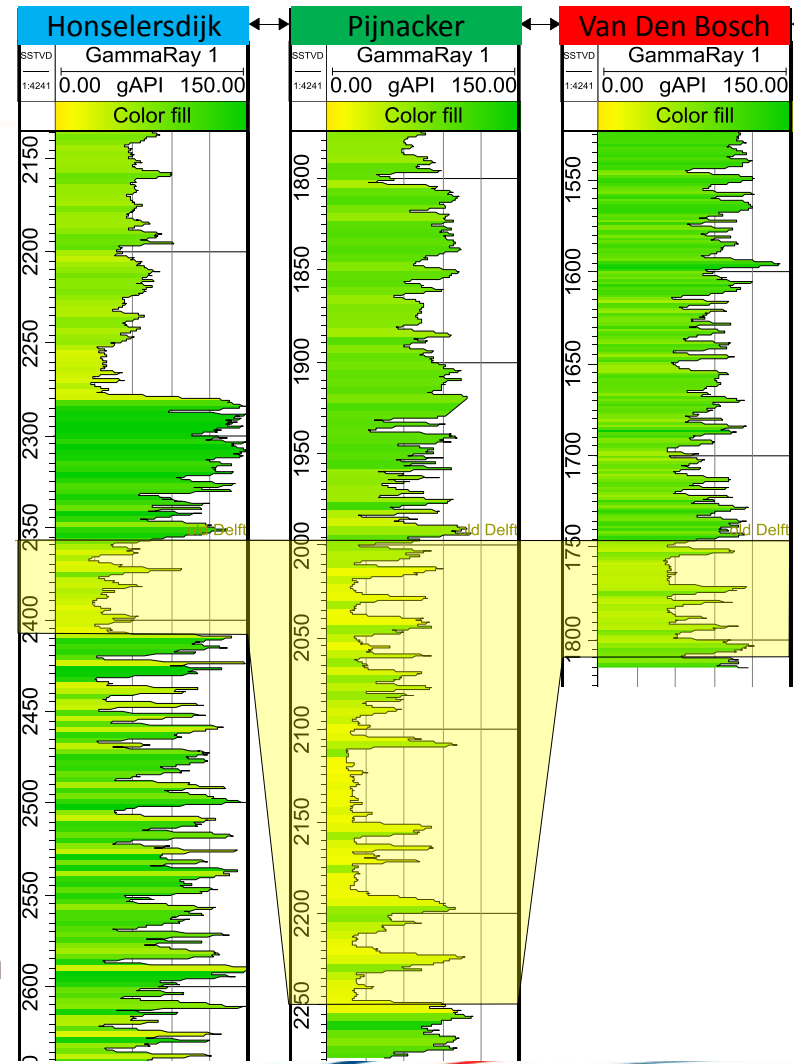
- Biostratigraphical correlation:
 - Age
 - Depositional environment
- Well correlations
- Seismic correlations

Original hypothesis

One continuous Delft Sst. in the WNB

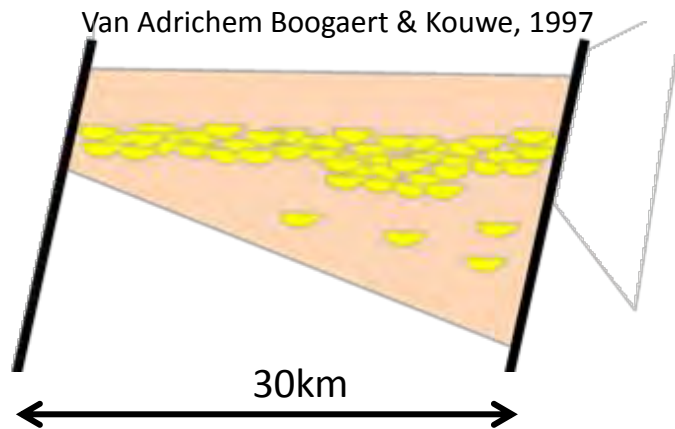


Lithostratigraphic Correlation

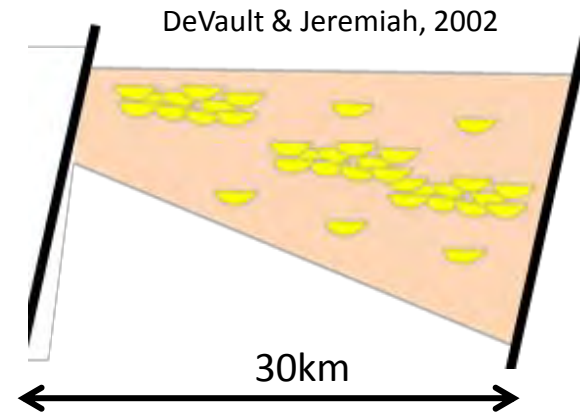


Original hypothesis

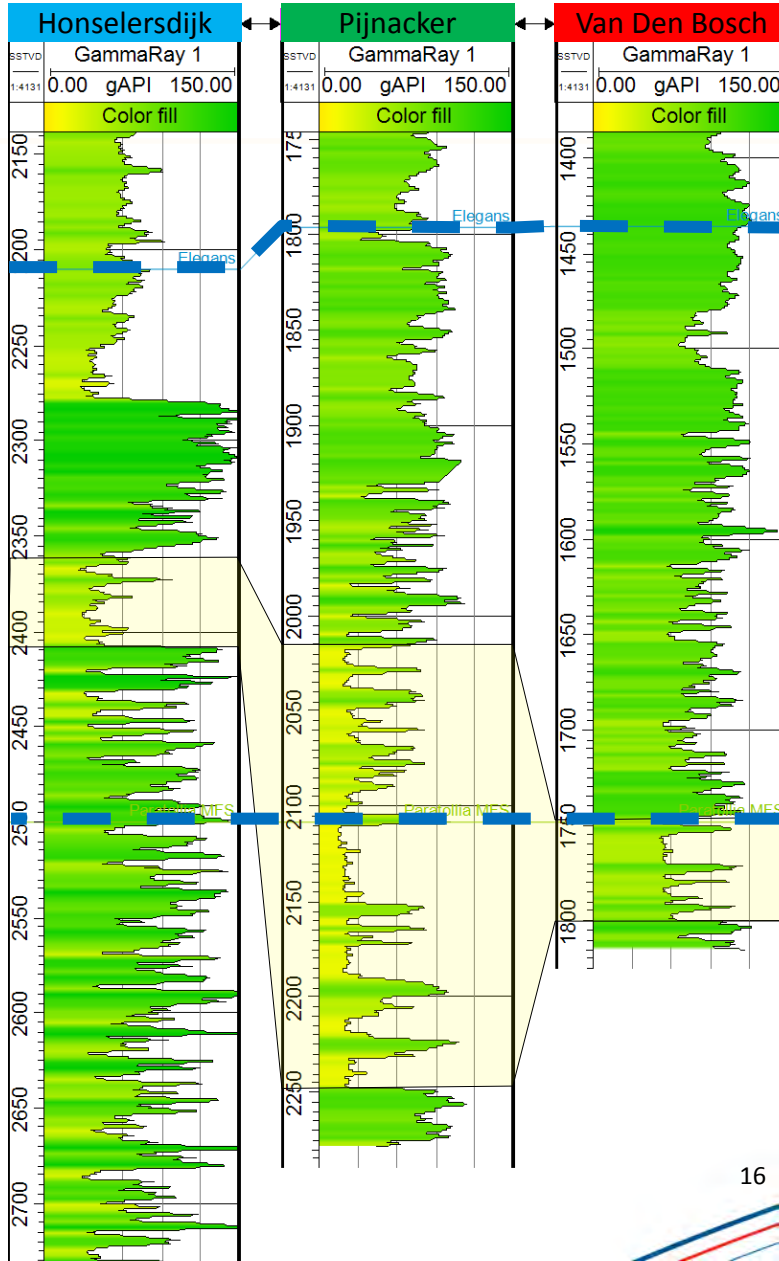
One continuous Delft Sst. in the WNB



No Delft Sst.
Thick, stacked channel complexes
in the WNB

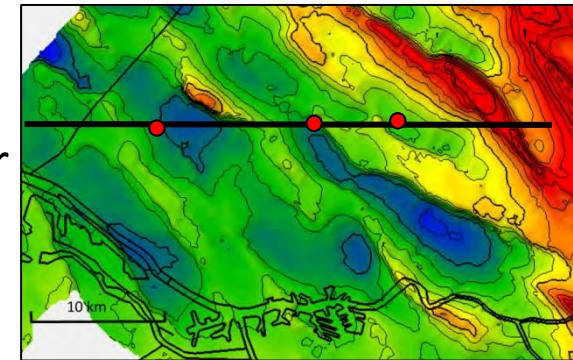


Results biostratigraphy

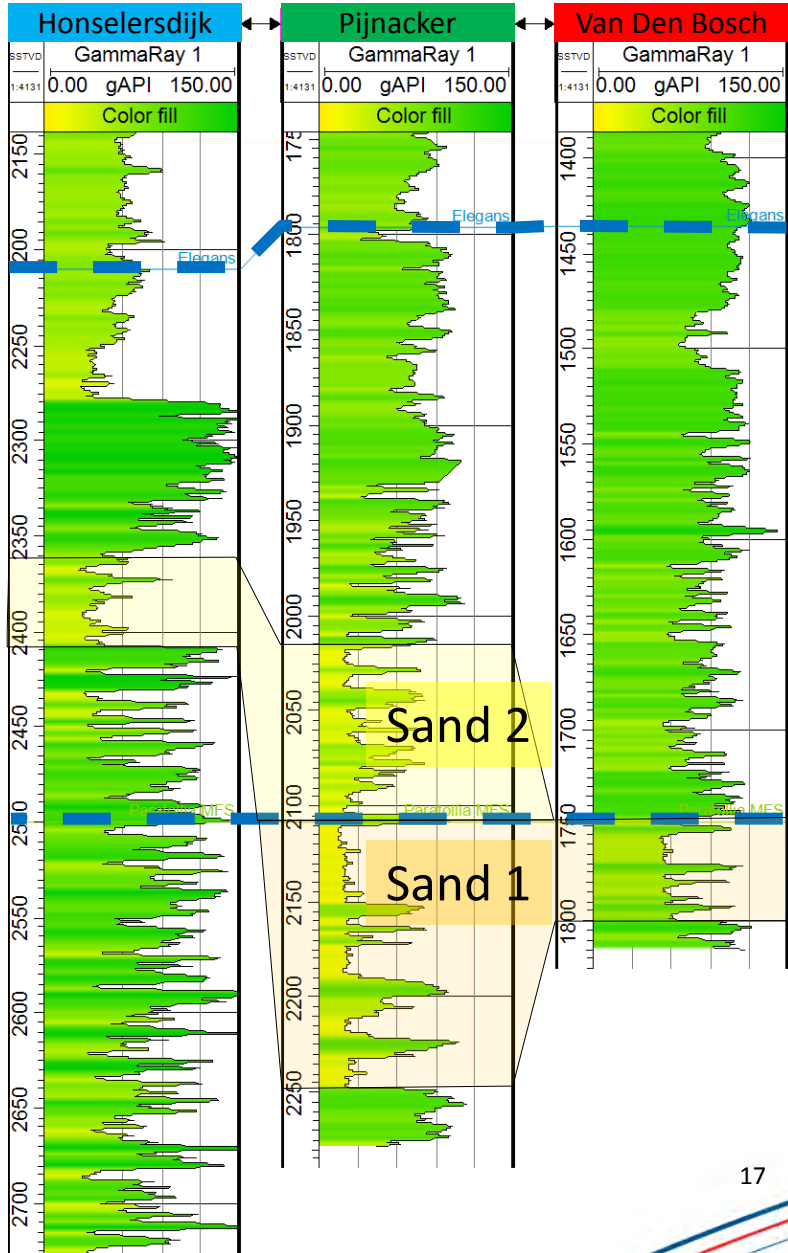


Elegans marker

Paratolia marker

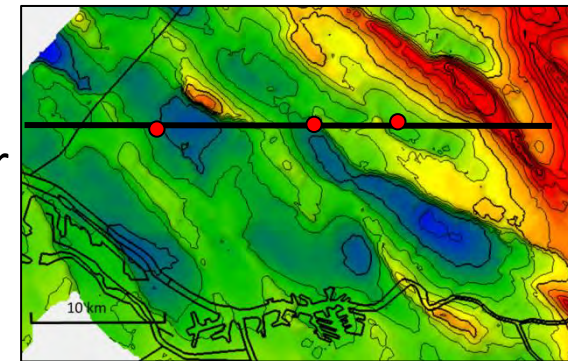


Results biostratigraphy

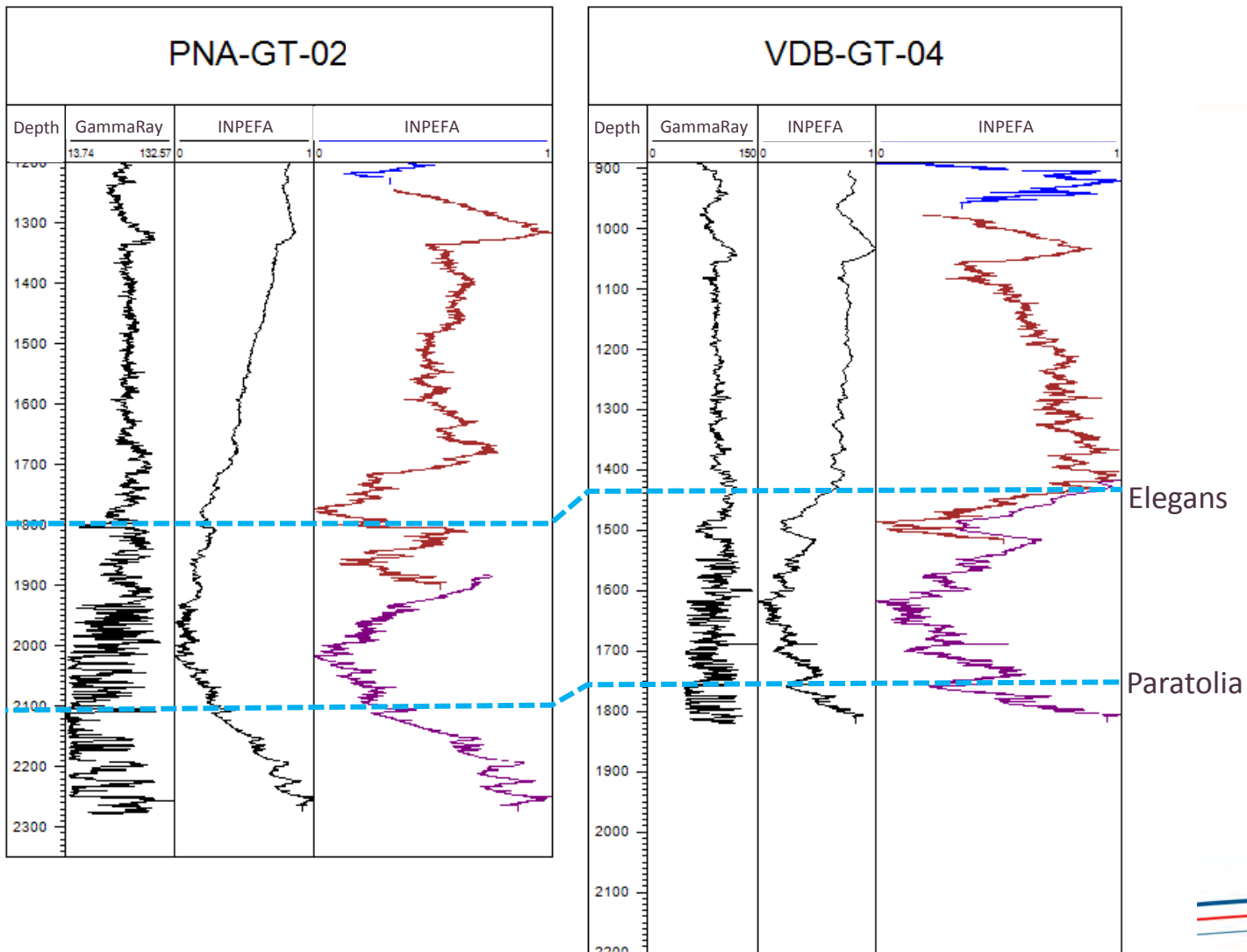


Elegans marker

Paratolia marker

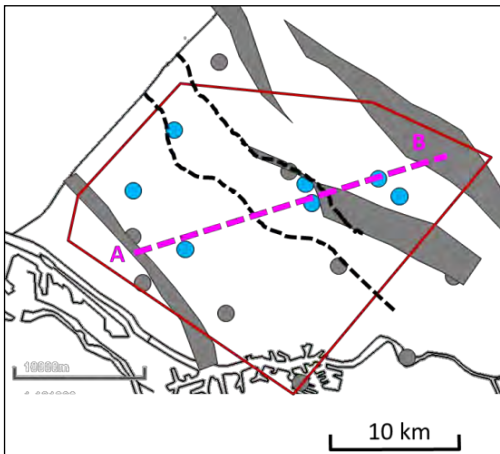
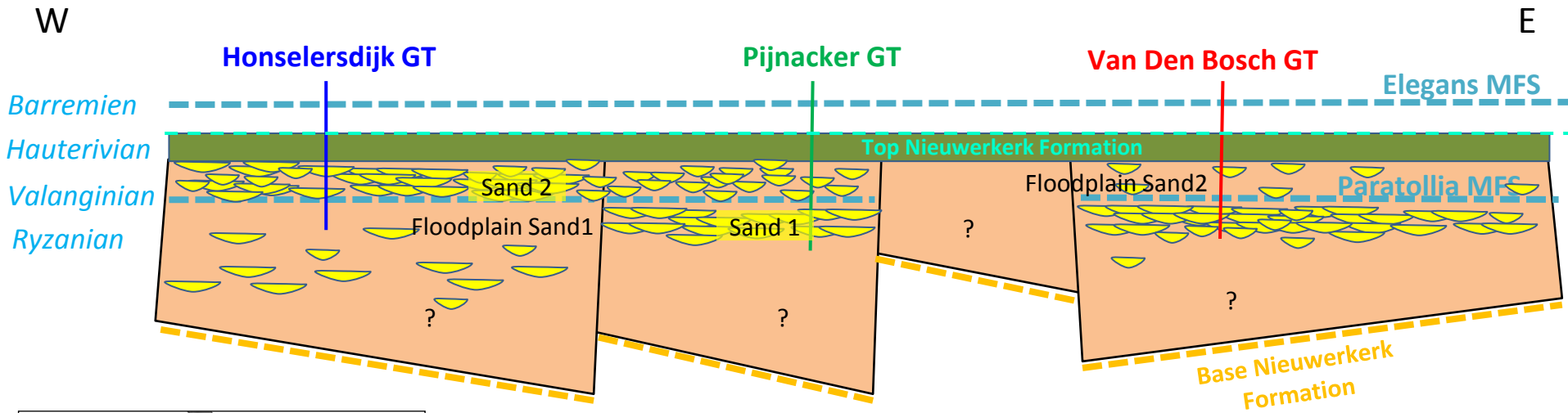


Cyclolog

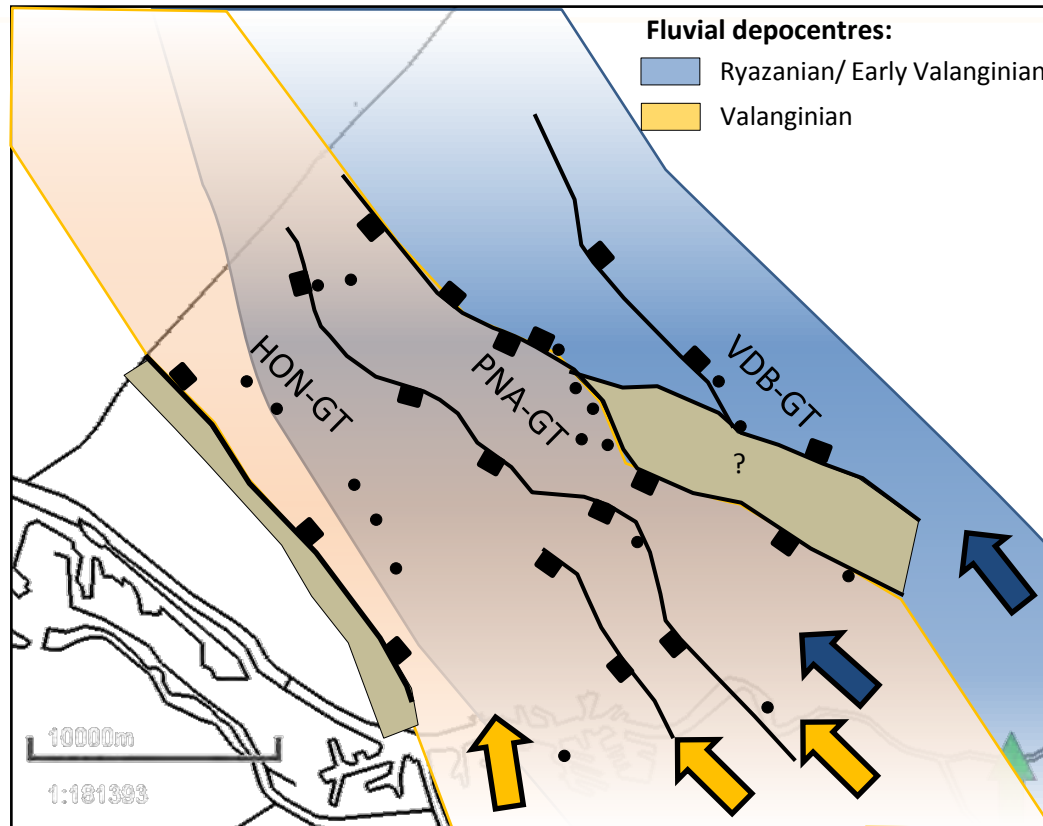


Conclusion - hypothesis

- Not one Delft Sandstone
- Fluvial system moved from east to west

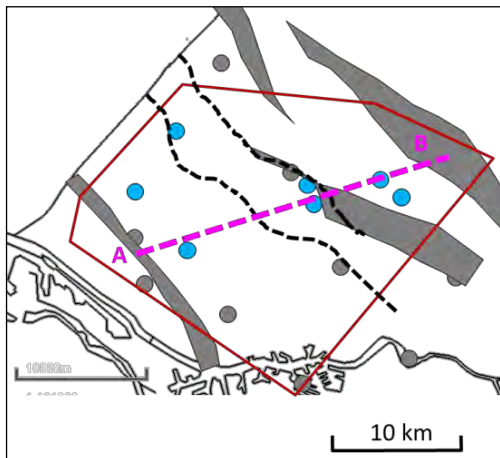
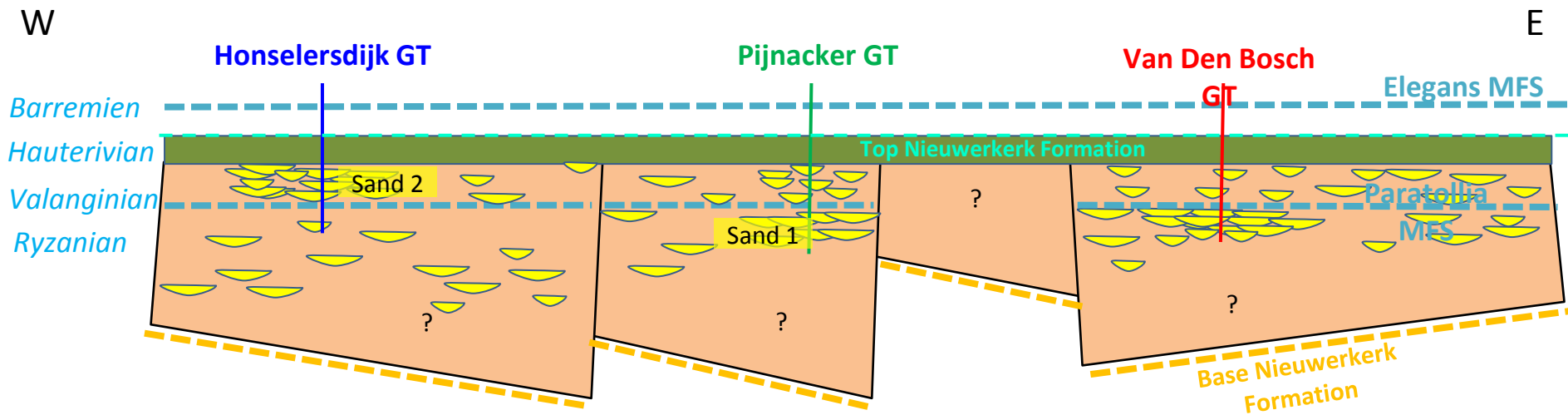


Conclusion - hypothesis

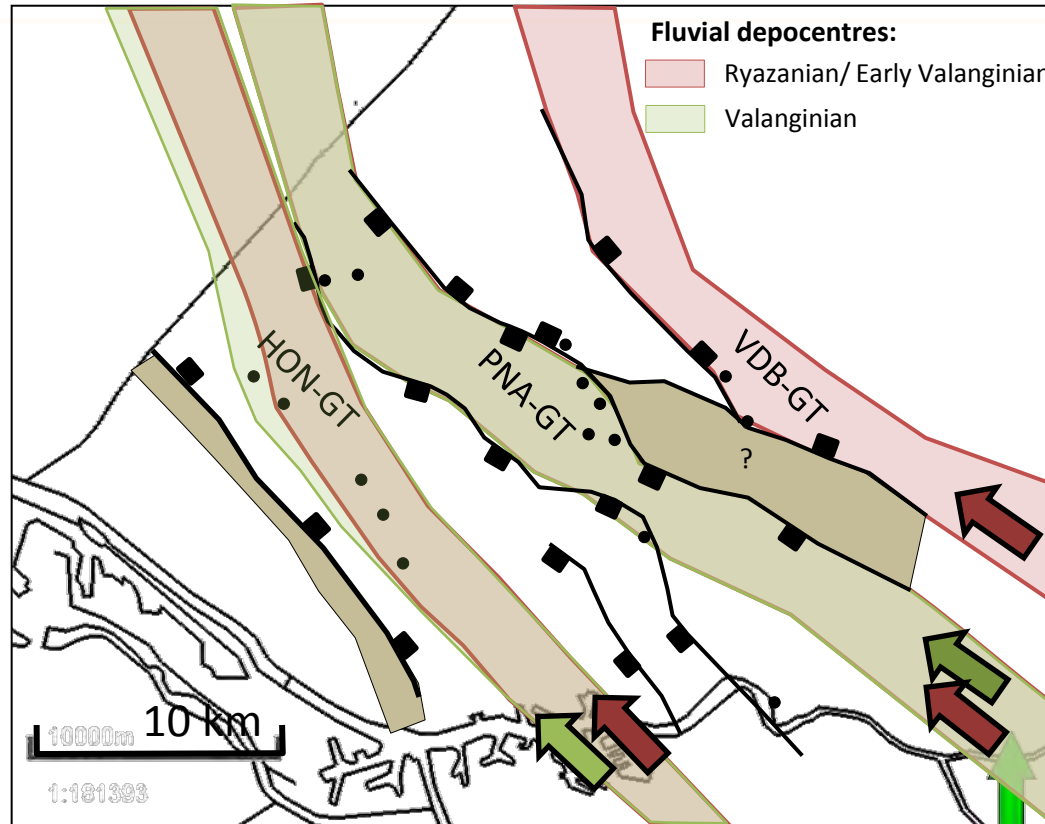


Conclusion - hypothesis

- Sand distribution

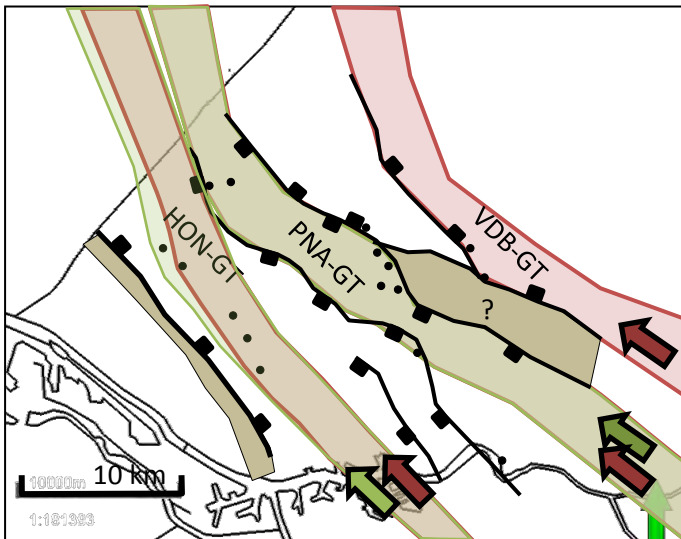


Conclusion - hypothesis



Geothermal implications

- Reduced uncertainties in reservoir characteristics important for economic risk reduction
 - Better model to predict sand bodies, in depth and space
 - No one Delft Sandstone
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Thank you