

Geothermal Energy of the Triassic

By Floris Veeger

9:45 - 10:15

Geotechnical developments in Triassic geothermal projects

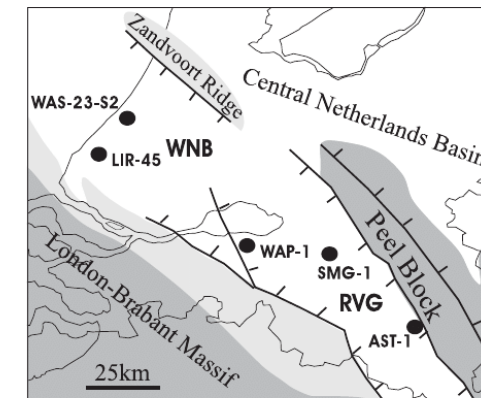
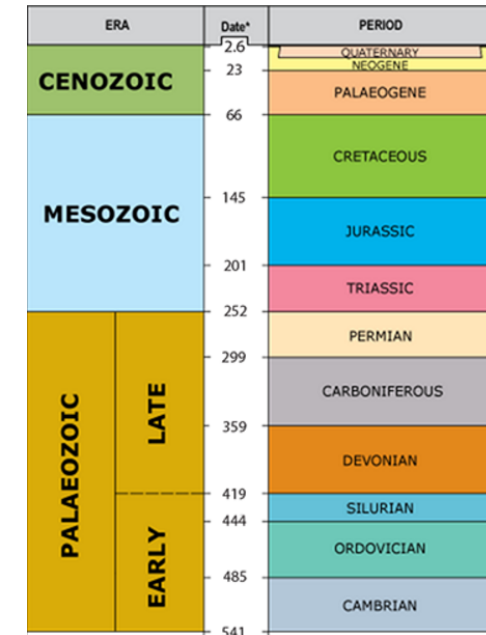
Another play, another challenge



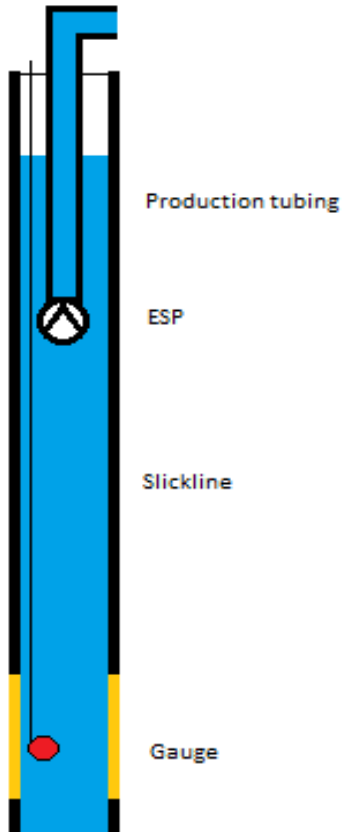
15 March 2017 – Floris Veeger

Presentation content

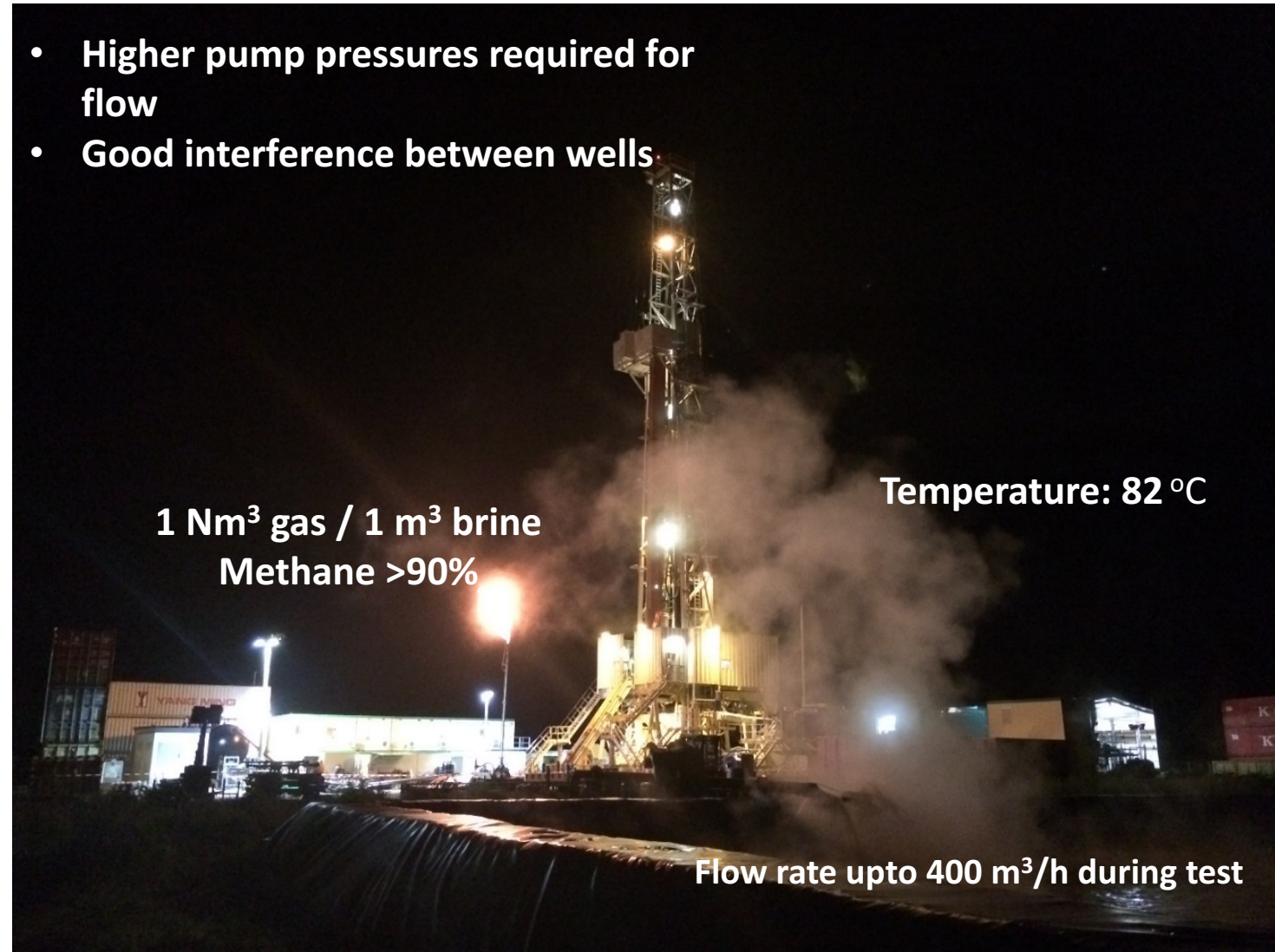
- Aardwarmte Vierpolders
 - Start-up & Injection problems
 - Clogging investigation
 - Cleaning job
 - Adjustments of operation
- Next Triassic projects Hydreco
 - Geothermie Brabant
 - Trias Westland



Vierpolders - well tests 2015



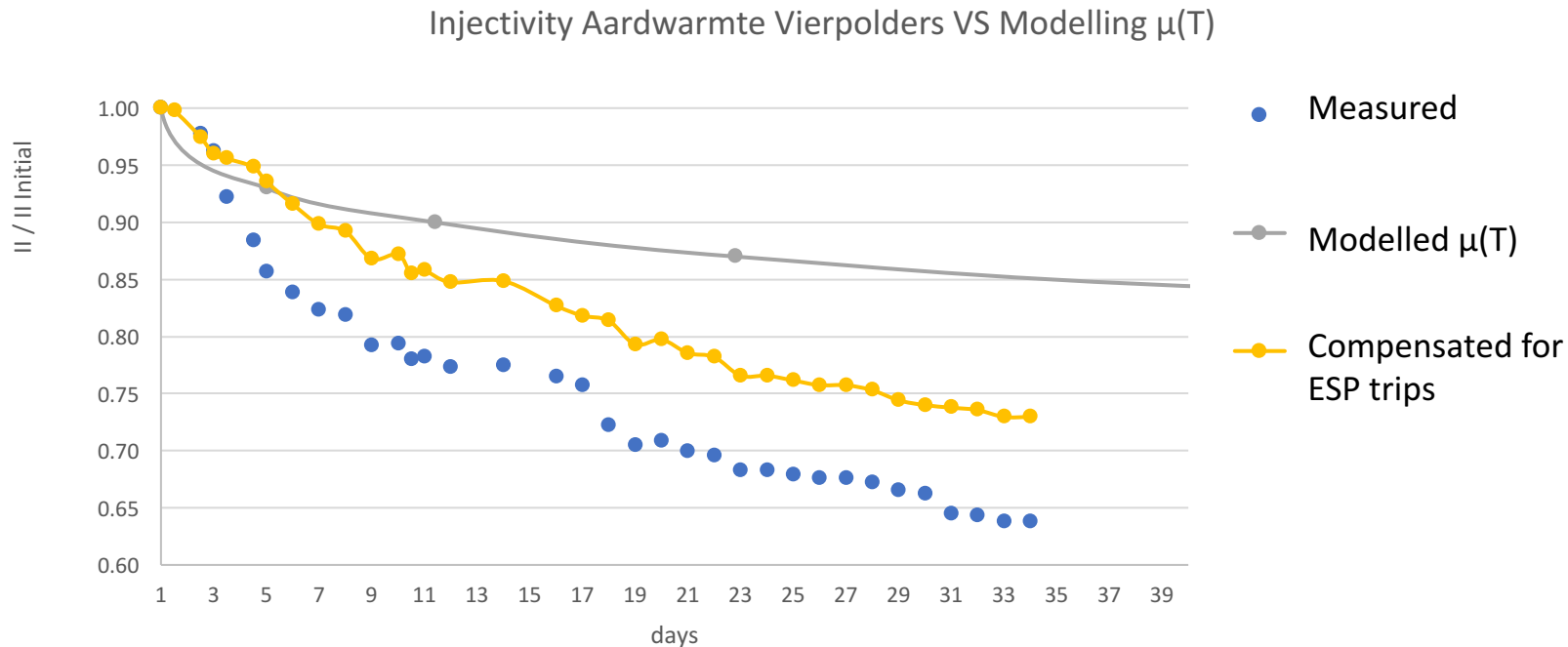
- Higher pump pressures required for flow
- Good interference between wells



Vierpolders - Startup

Long term testing unsuccessful

- Injectivity decreased continuously
- Procedure checks
- Injection pressure limitations



Clogging investigation



Wireline
BRI-GT-02
Geothermal
Injector

Targets:
1. Check well
integrity
2. Investigate
well clogging



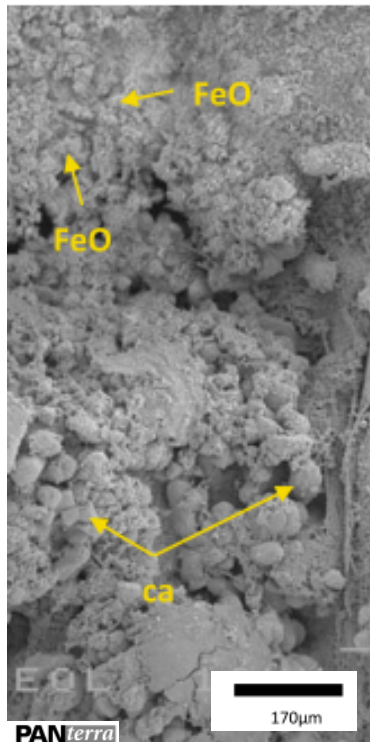
22 April 2016

Activities:
1. Camera run
2. Bailer run

Extensive sample analysis

Sample analysis (XRD, SEM and EDX):

- | | | |
|--------------------------|-------------------------------|---------------------------|
| • Ironoxides | Fe_3O_4 (6%) | |
| • Chalcopyrite | FeCuS_2 (6%) | |
| • Iron sulphide / pyrite | FeS_2 (1%) | |
| • Calcium Carbonate | CaCO_3 | Scales & Reservoir grains |
| • Quartz | SiO_2 | Reservoir grains |

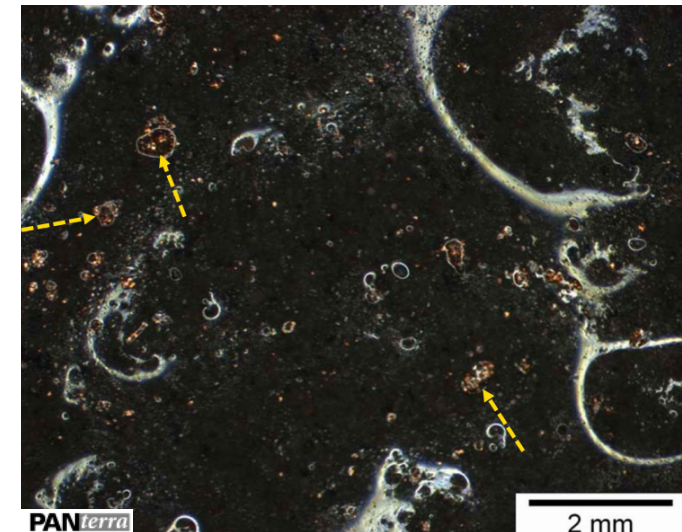
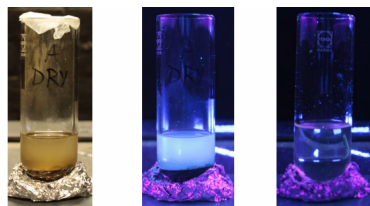


Microbiological analysis

- Upto 3,5 bilion archea/gram
- Small amount of SRB's
(Sulphate Reducing Bacteria)

Solubility tests

Desk studies & 2nd opinions



Cleaning job



- 2 stage coil tubing cleanout with 15% HCl and gaslift
- Micro biological treatment
- High rate cleanout with ESP
- H₂S complexity
- **Resulted in almost clean well (Skin >30 to Skin of 4)**

Adjustments of operation

Treatments

- Downhole corrosion polymer
- Annulus anti-scaling polymer
- CO₂ compensation
- Micro biological treatment (batch)



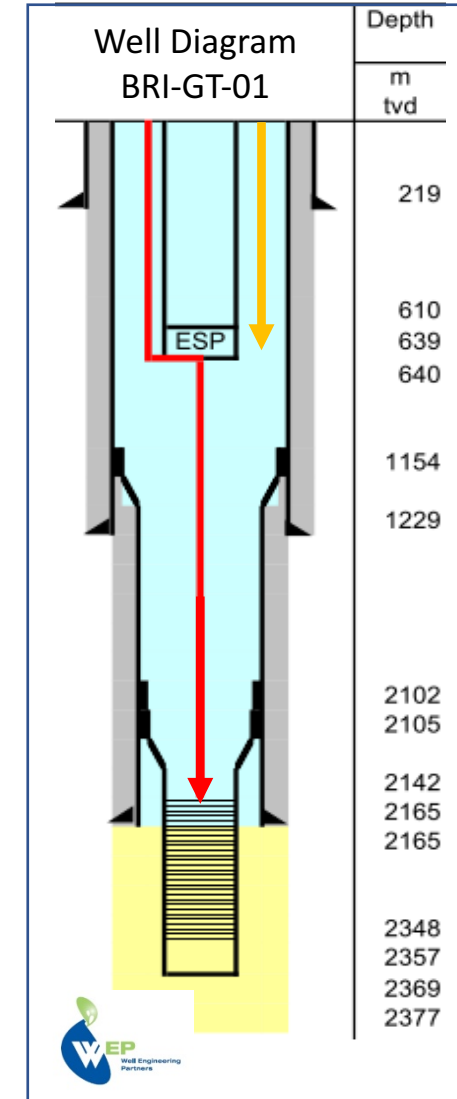
at injector



Extensive Monitoring & Tests programme

Microbiological research by kennisagenda

Result: 5 months of stable injection at 260 m³/h

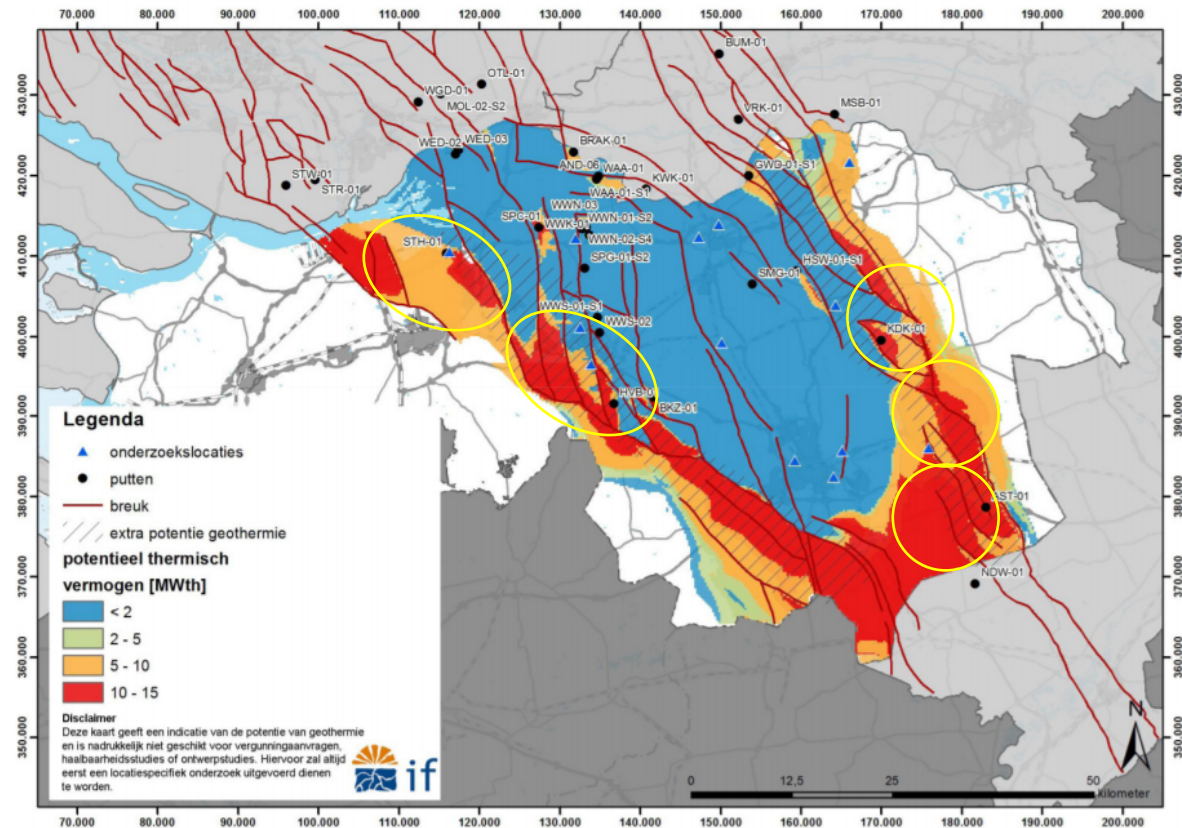


Vierpolders Greenhouses



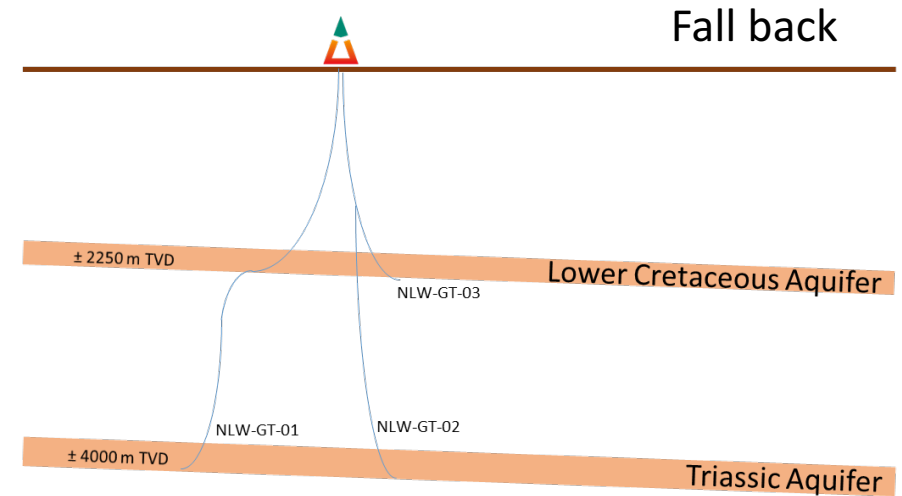
Geothermie Brabant B.V.

- Shareholders Hydreco and Energiefonds Brabant
- Portfolio of (minimal) 5 projects
- Greenddeal signed with ministry of Economic Affairs
- Goals: upscaling, upgrading and risk/cost-reduction
- Hydreco operator, long term perspective



Trias Westland

- Westland Infra, HVC, Royal FloraHolland
- Trias 140°C - 25 to 45 MW heat
- Geology uncertain
- Well design challenges
- 49 greenhouse contracts signed
- Start drilling: September 2017



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Another play, another challenge

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