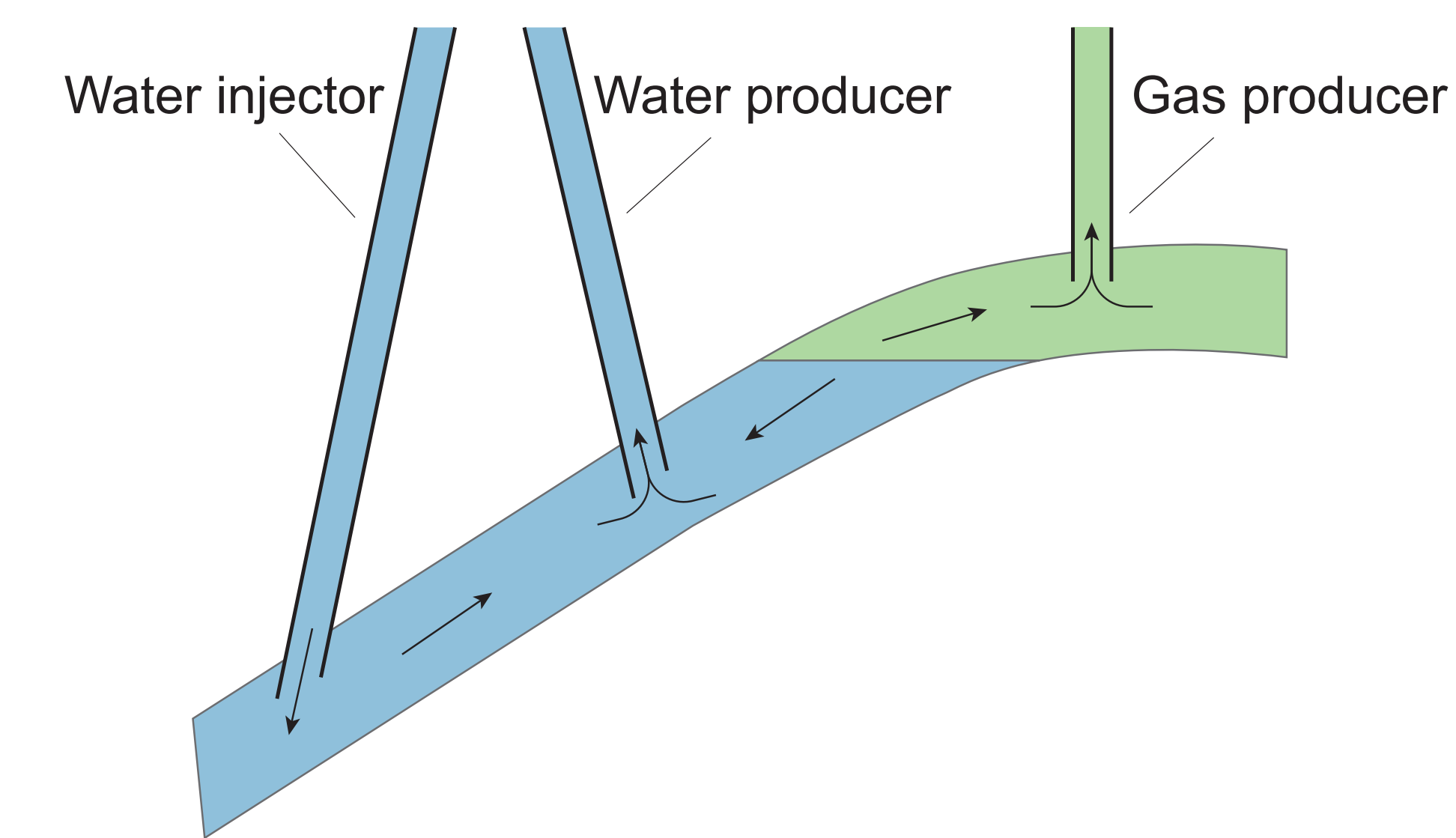


# Synergy in Gas Field Development

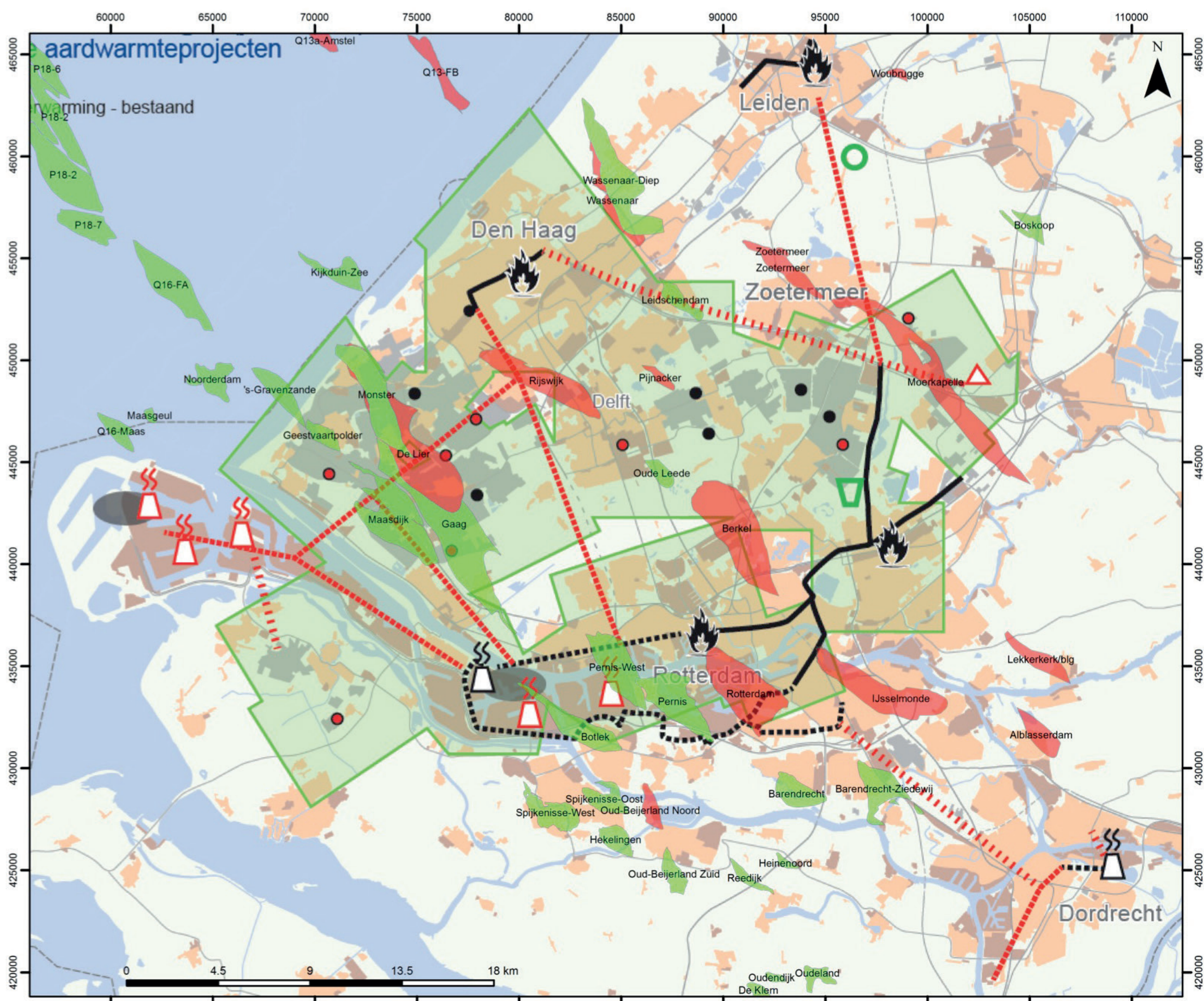
## Dual heat and gas production strategy



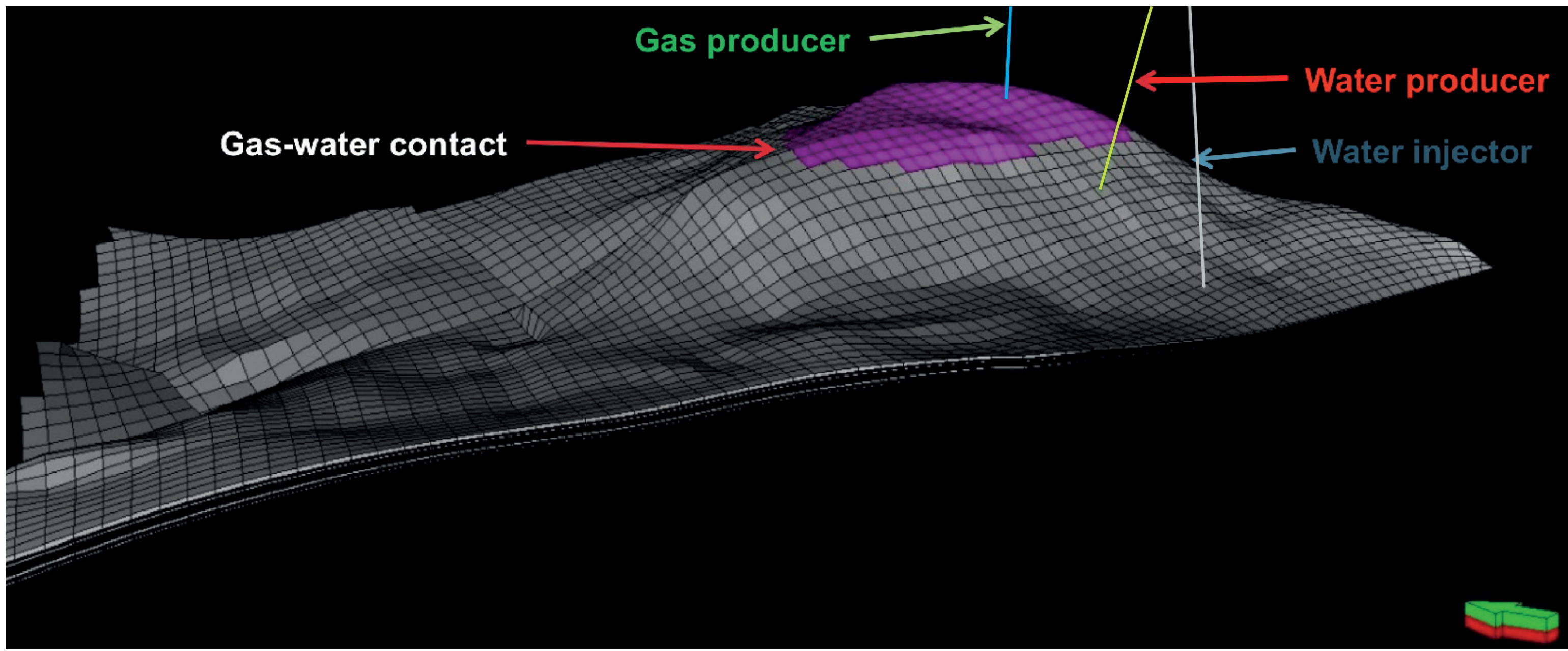
- Interference between gas- and geothermal production can occur when hydraulic communication exists.
- With clever placing of the geothermal wells with regard to the producing gas wells it is possible to create synergy between both systems.
- Water production by a geothermal doublet near the gas producers postpones water breakthrough in gas wells; the Roden study (Peters et al, 2014) showed a gas recovery factor (RF) increase of 3.3%.
- In the western Netherlands there is a large potential for geothermal energy. A number of greenhouse farmers already have a geothermal installation in production. There is also a number of stranded gas fields in this area. To investigate the possibility of synergy between both subsurface energy resources a case study has been performed to answer the following questions:
  - Is significant gas RF increase achievable elsewhere?
  - Can synergy in an onshore stranded gas field trigger field development?
  - What are the critical elements for synergy?

### Case study

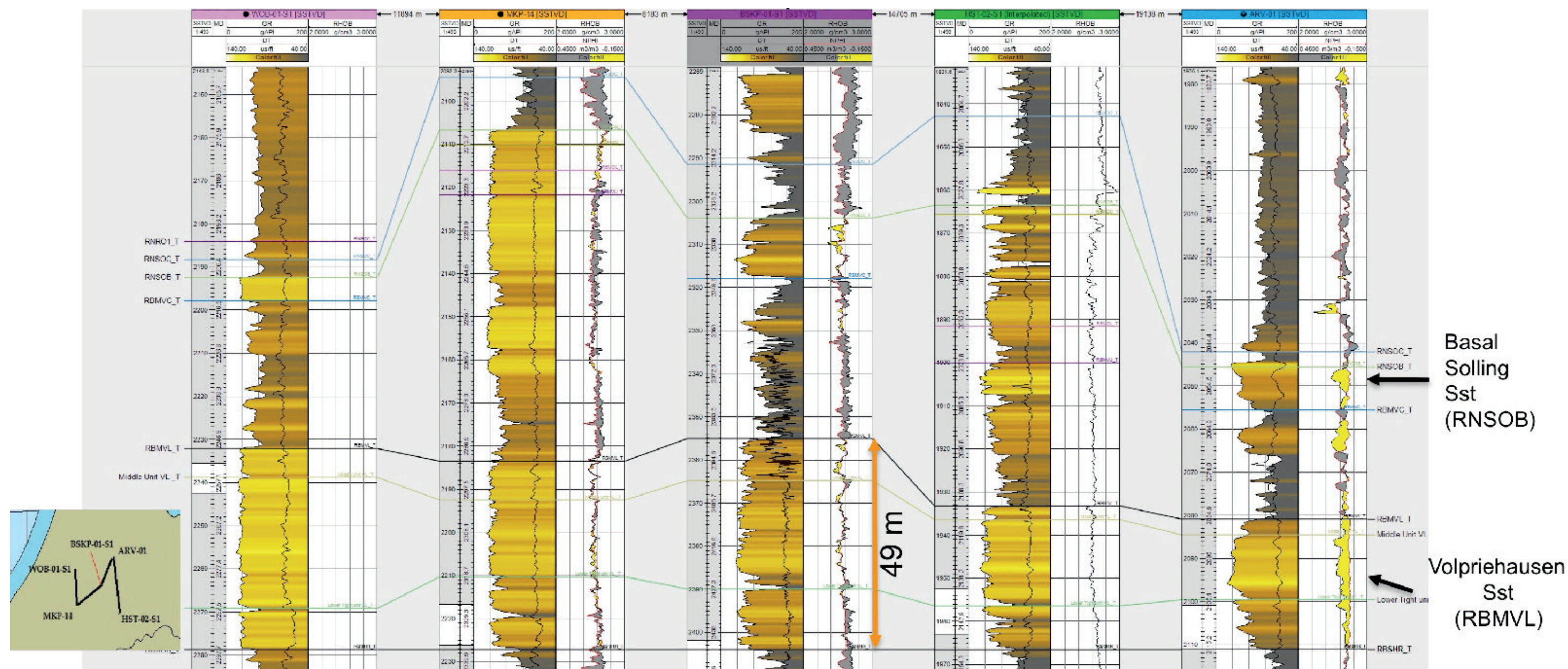
- A reservoir model was constructed for the stranded gas field and the connected geothermal reservoir.
- The well log panels on the right show multiple reservoir intervals being tested.
- Several parameters have been tested, such as the effect of permeability, the geothermal flow rate and the aquifer strength.



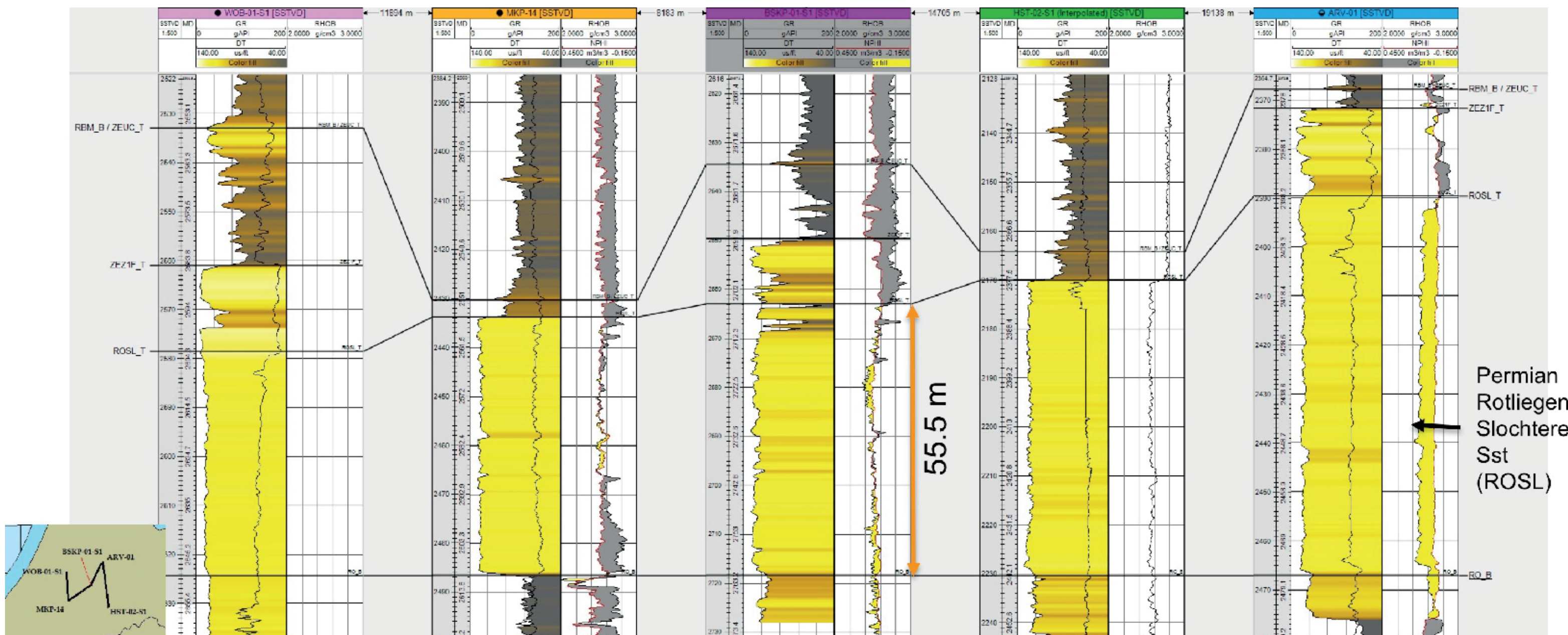
Map of the western Netherlands with its geothermal licenses and the (future) heat grid.



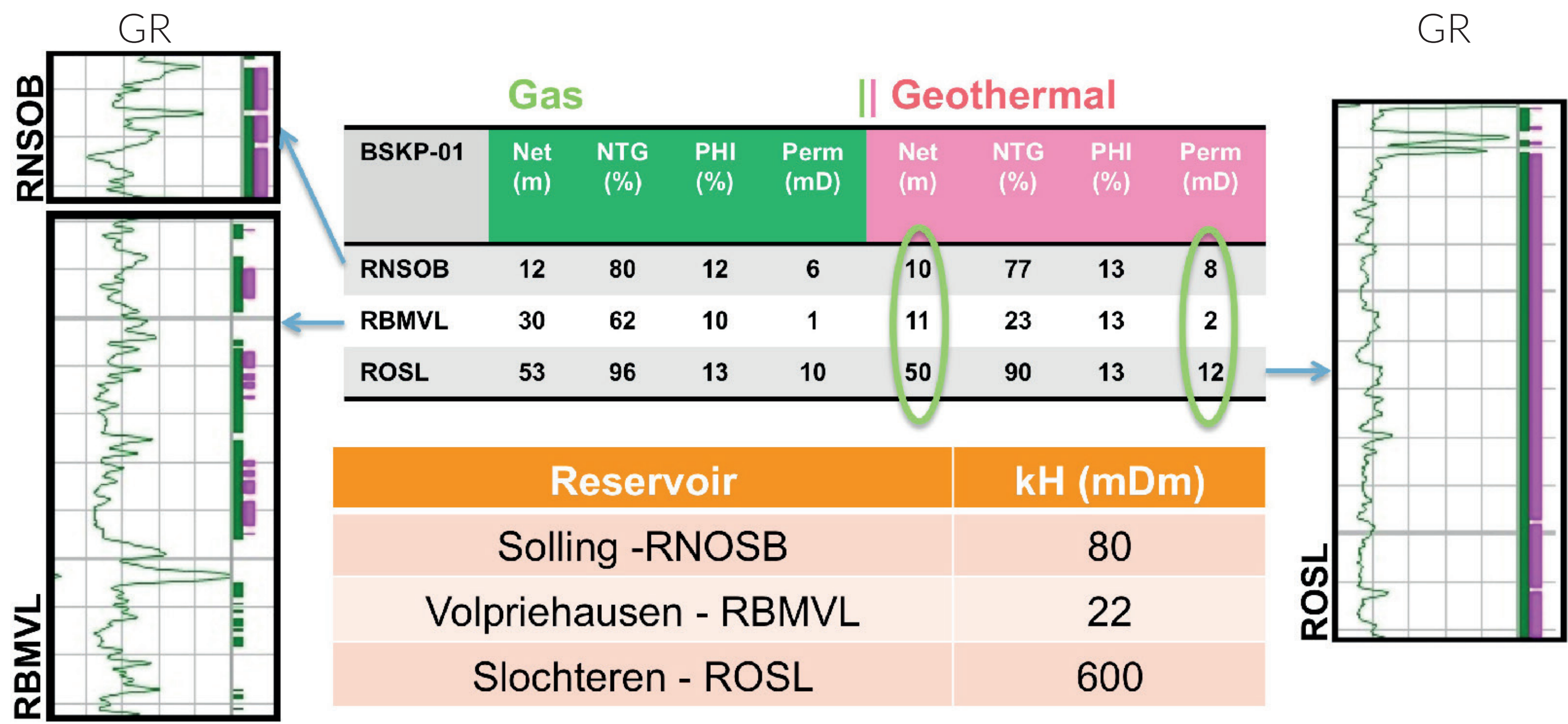
Reservoir model of the stranded gas field.



Log panel across the study area, focusing on Triassic stratigraphy.



Log panel across the study area, focusing on Permian stratigraphy.



Reservoir properties.

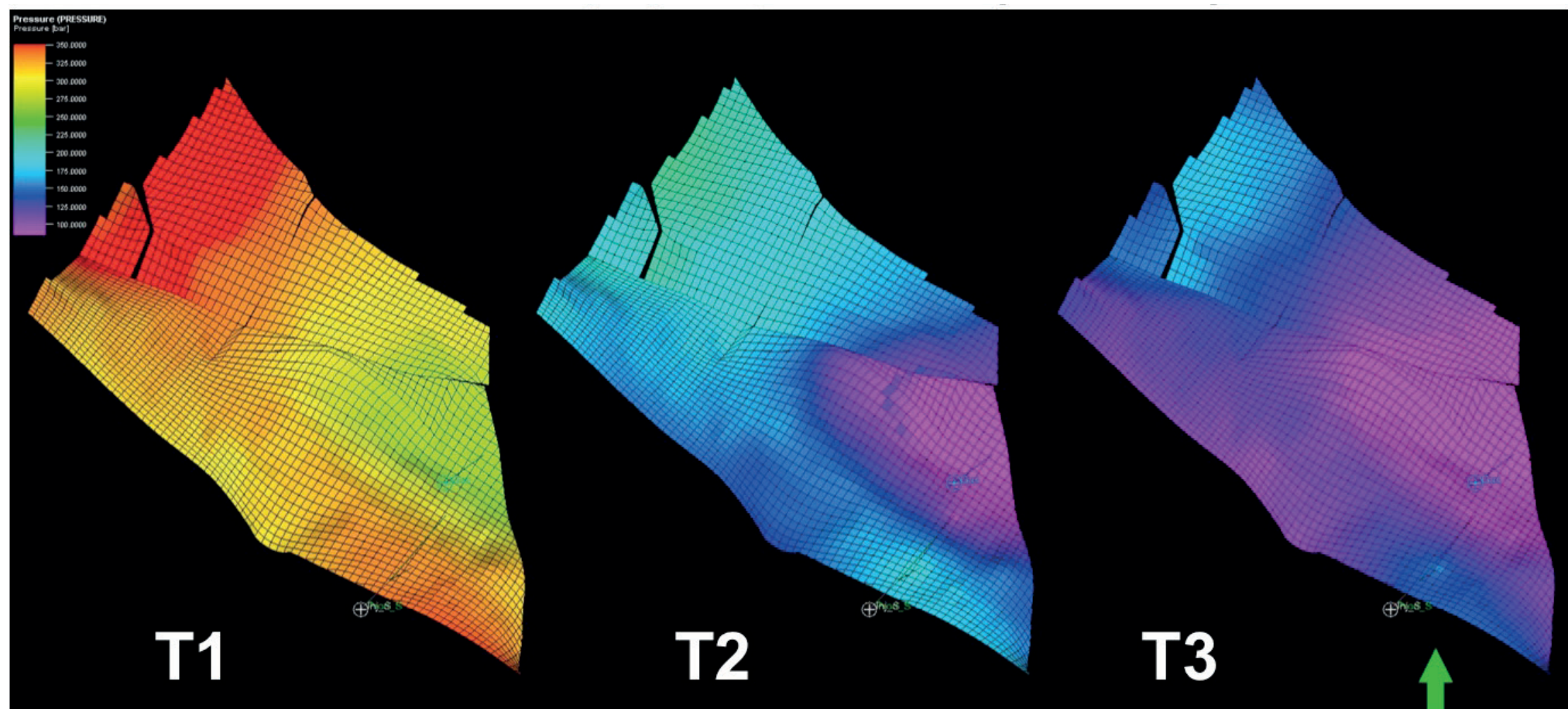
The results of the case study are that the **critical elements** for synergy are:

- High **permeability thickness**
- High **water flow rate** at geothermal wells
- Strong **active aquifer** for pressure support

**Slight recovery factor increase** due to synergy at studied stranded field, but not significant due to lack of critical elements. Locations that do fit the critical elements however, will see an increase in recovery factor as the Roden study (Peters et al, 2014) demonstrated.

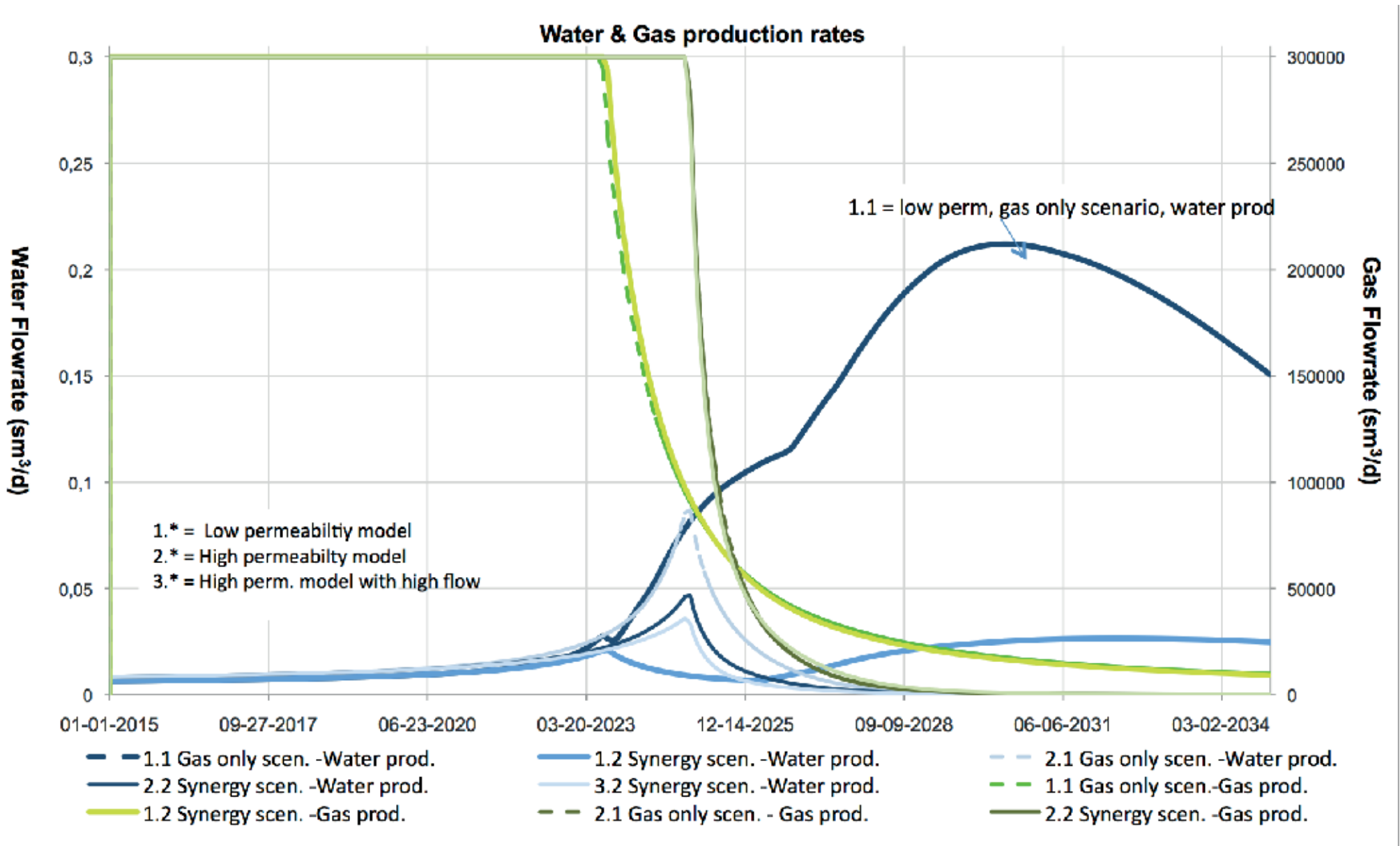
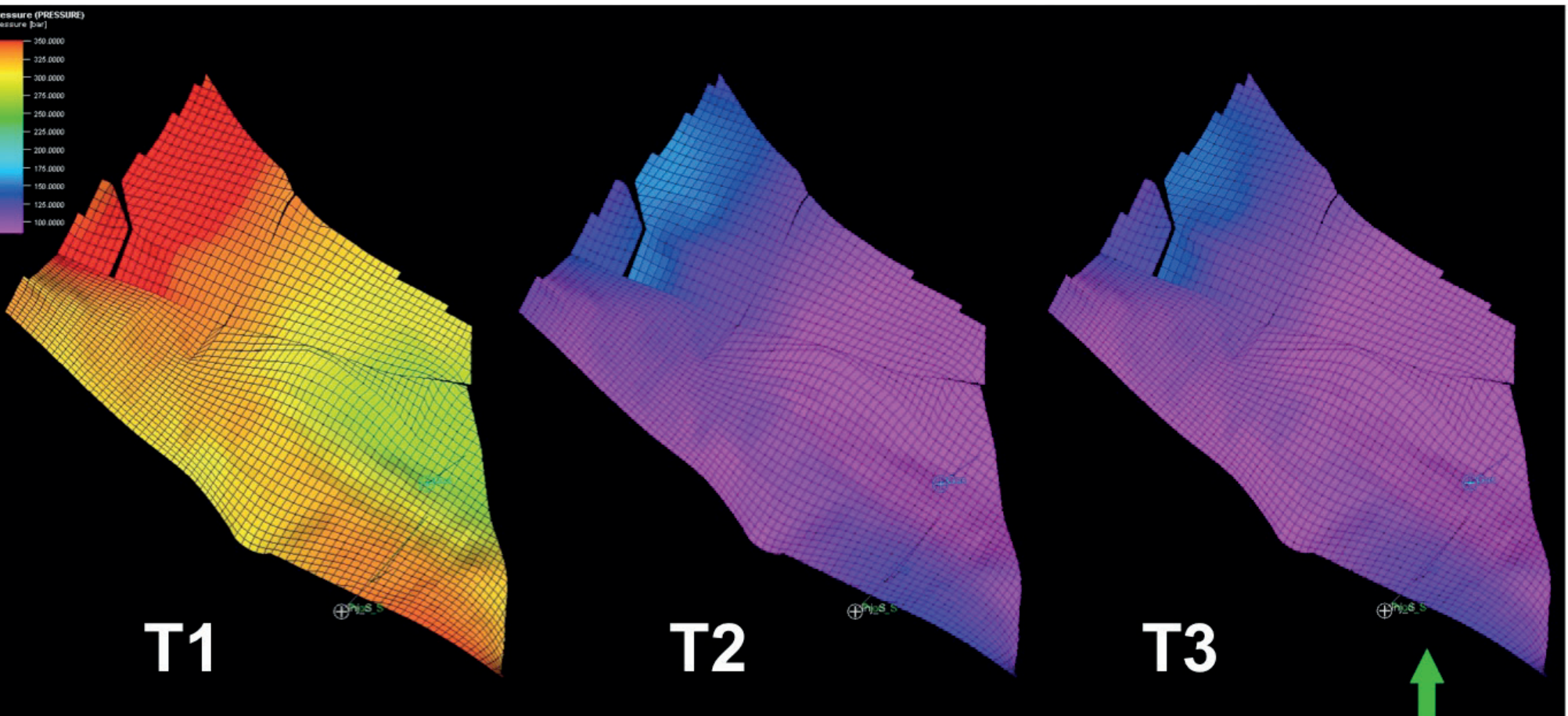
Reference: Peters et al, 2014; van der Meulen et al, 2016; van der Molen et al, in prep.

Case 1 - Determined properties (10 mD)



Simulated pressure distribution using a low and high permeability case.

Case 2 - High permeability (90 mD)



Water and gas production profiles for the synergy scenario.