sck cen
Belgian Nuclear Research Centre

Koen Beerten, Alberto Casillas-Trasvina, and VOGERA team members - 23/06/2020

Groundwater at the receiving end: taking into account deep subsurface activities

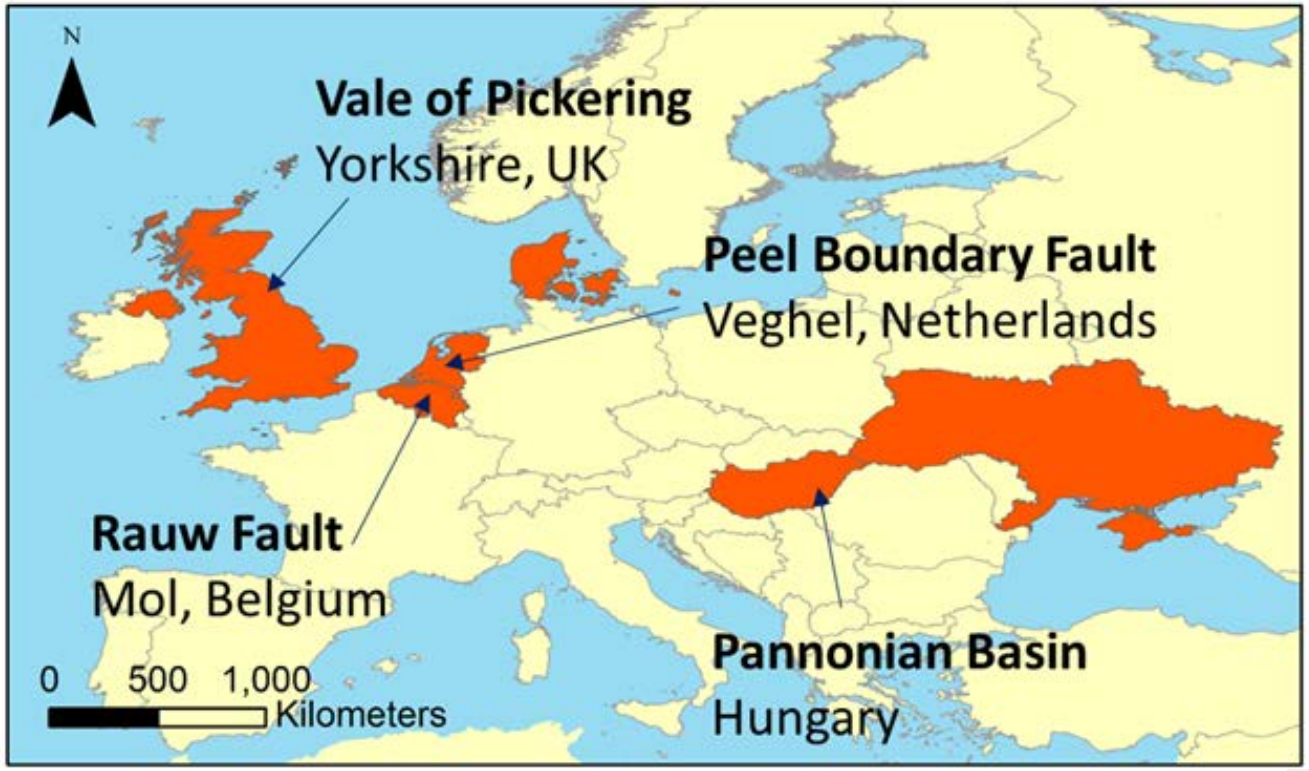
VoGERA
Vulnerability Of shallow Groundwater resources to deep sub-surface Energy Related Activities

Aims

- Improve scientific understanding of the vulnerability of shallow groundwater (e.g. potable water, water for other human uses and water supporting ecosystems) from deep sub-surface industrial energy-related activities.
- Develop a consistent approach to assessing a range of sub-surface energy activities including:
  - Conventional oil and gas
  - Geothermal energy
  - Unconventional oil and gas
  - Storage (e.g., energy, gas)
  - Waste disposal

Project partners and pilot sites

- BGS (UKRI) - UK
- TNO - NL
- VMM - B
- SCK CEN - B
- MBFSZ - H
- Geoinform - UA
- GUES - DK



Total budget: € 433782

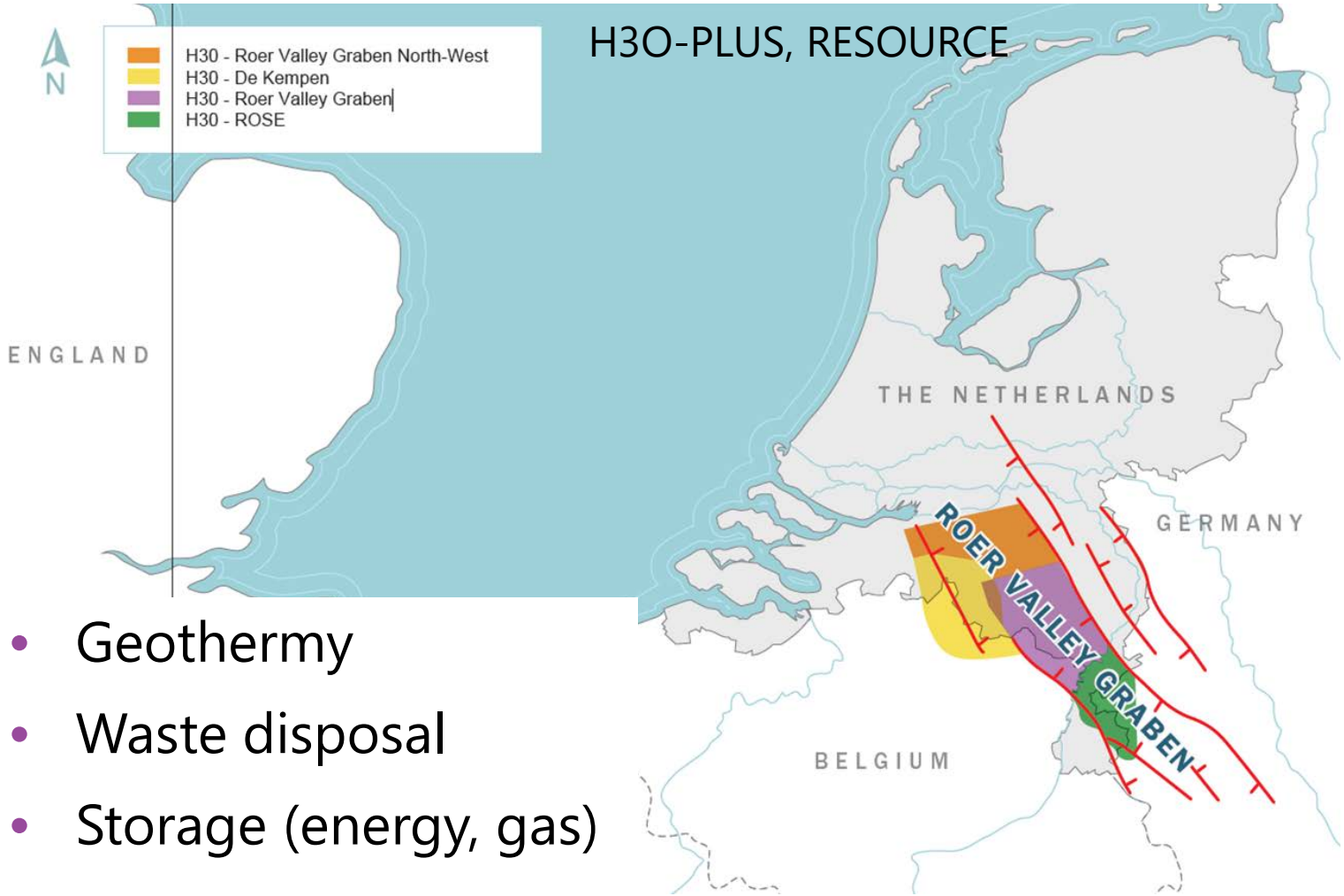
Approach

- (1) Develop conceptual models of the sub-surface activities with possible pathways of contamination to groundwater
- (2) Use evidence to assess possible pathways (e.g. fault zones/abandoned wells) at pilot locations such as:
  - Stable isotopes
  - Dating/residence time indicators
  - Temperature
  - Hydraulic head
  - Groundwater flow data
  - 3D geological models
- (3) Develop framework for assessing vulnerability of shallow groundwater from the energy-related activities:
  - That can be applied across a range of European hydrogeological settings
  - Than can be used as a tool for regulators and decision makers
- (4) Test vulnerability framework at pilot sites and modify according to results

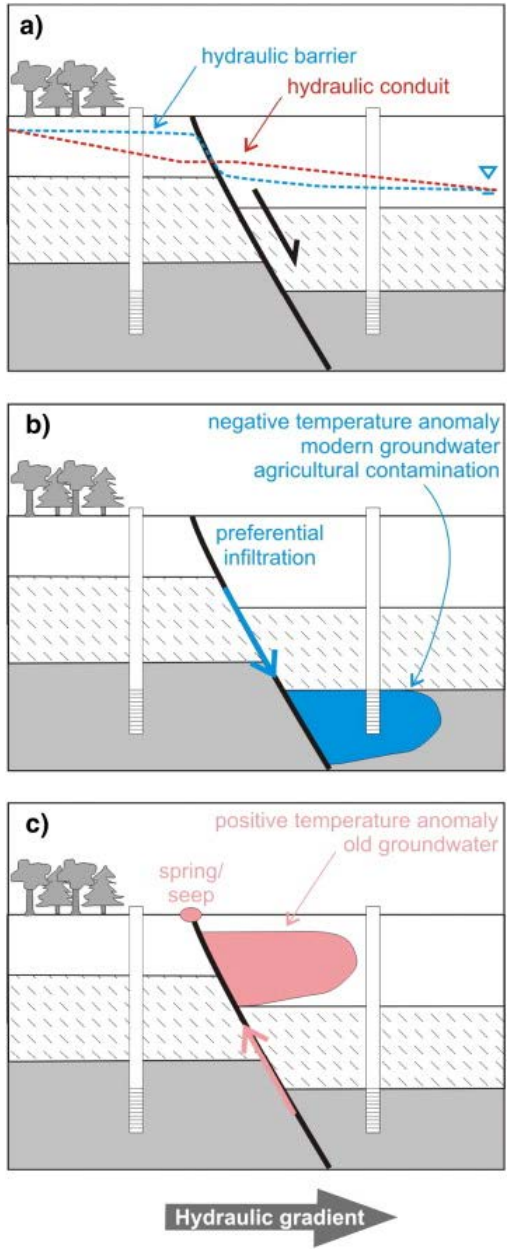
Expected outcomes

- Improved understanding of groundwater vulnerability to a range of energy related activities
- Improved sub-surface spatial planning and decision making
- Consistent approach for assessing groundwater vulnerability across Europe

Pilot sites: Roer Valley Graben faults



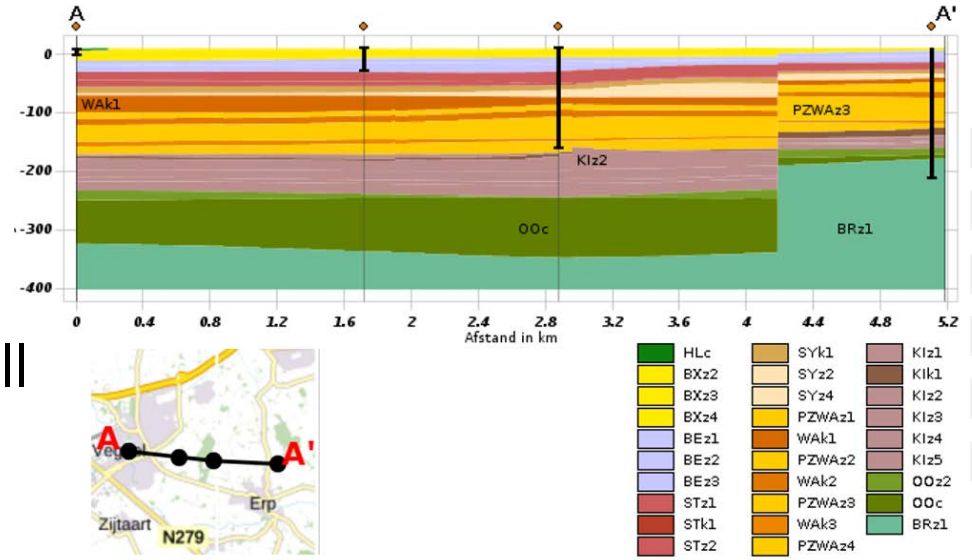
- Geothermy
- Waste disposal
- Storage (energy, gas)

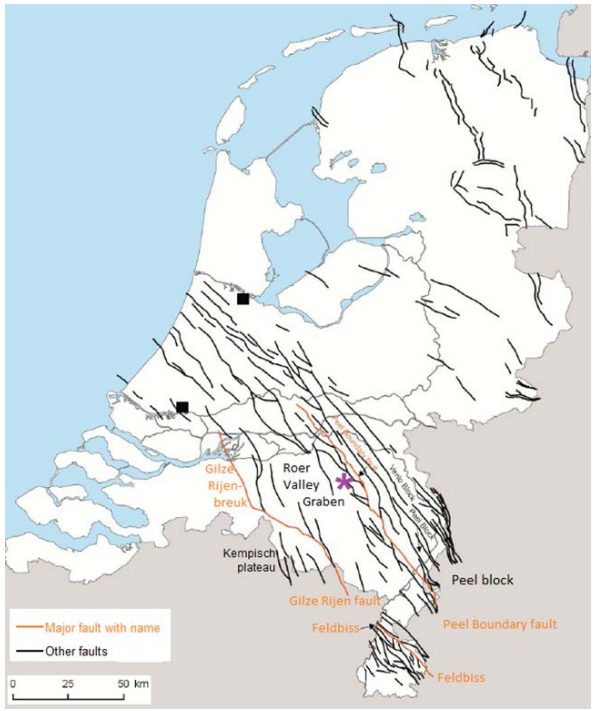


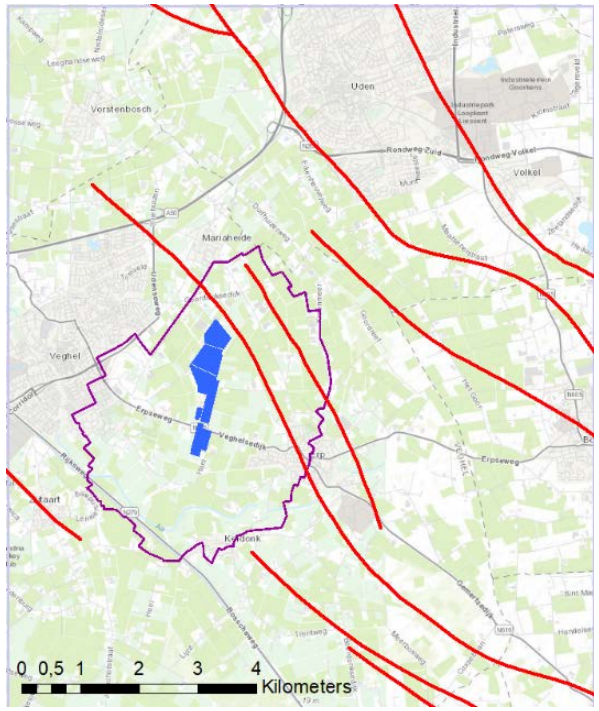
Bense et al. Earth Science Reviews 2013

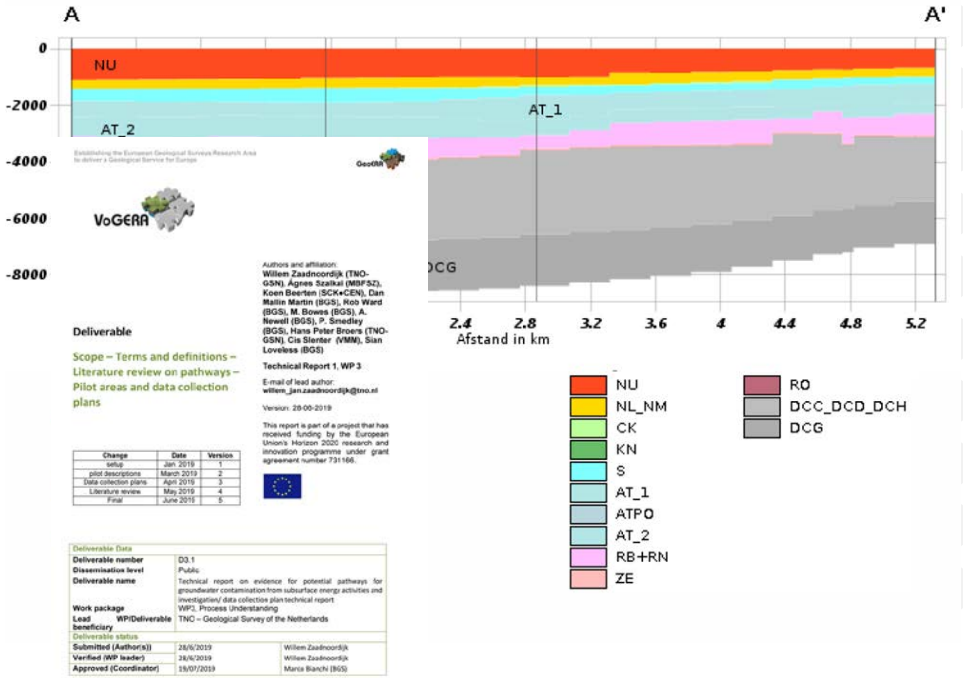
Peel Boundary Fault near Veghel (NL)

- Currently no deep subsurface activities
- One abanonded hydrocarbon exploration well
- Drinking water abstraction



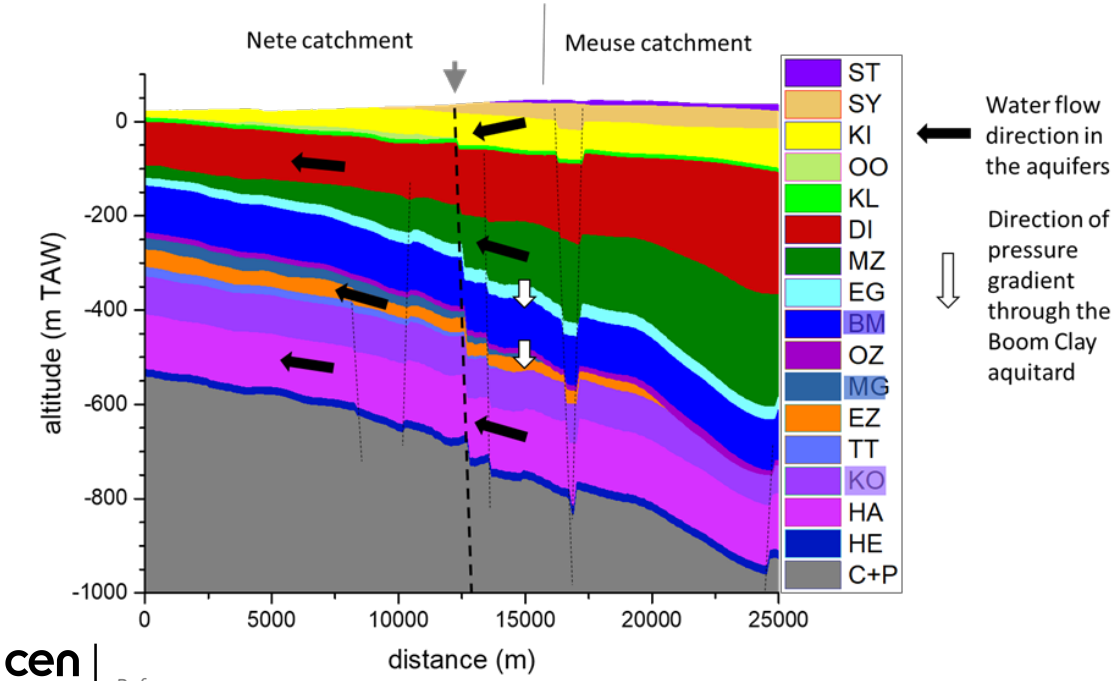


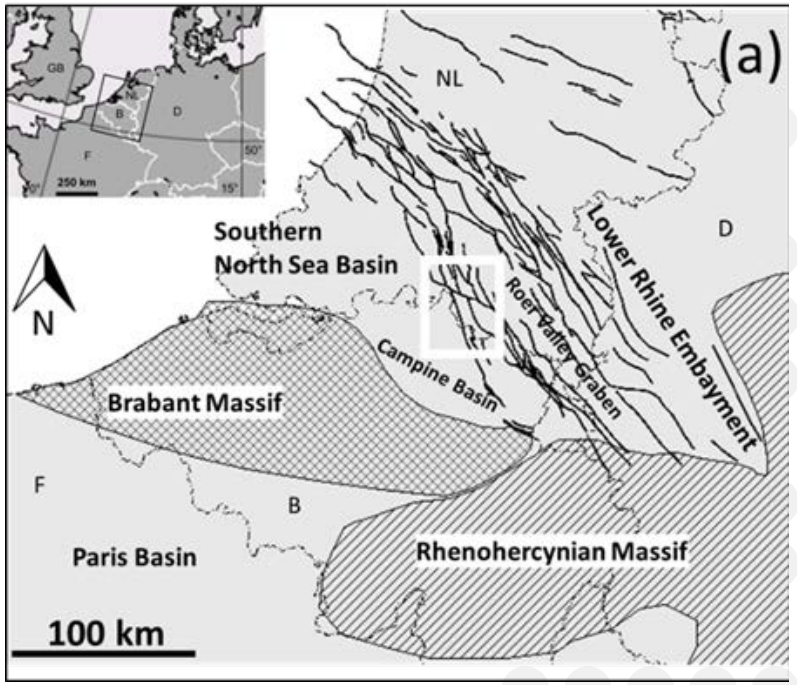


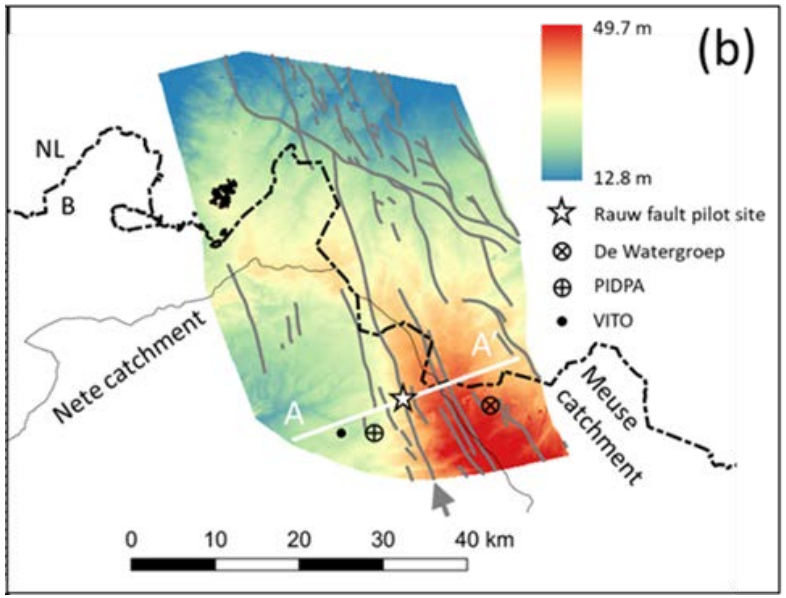


The Rauw Fault near Mol (B)

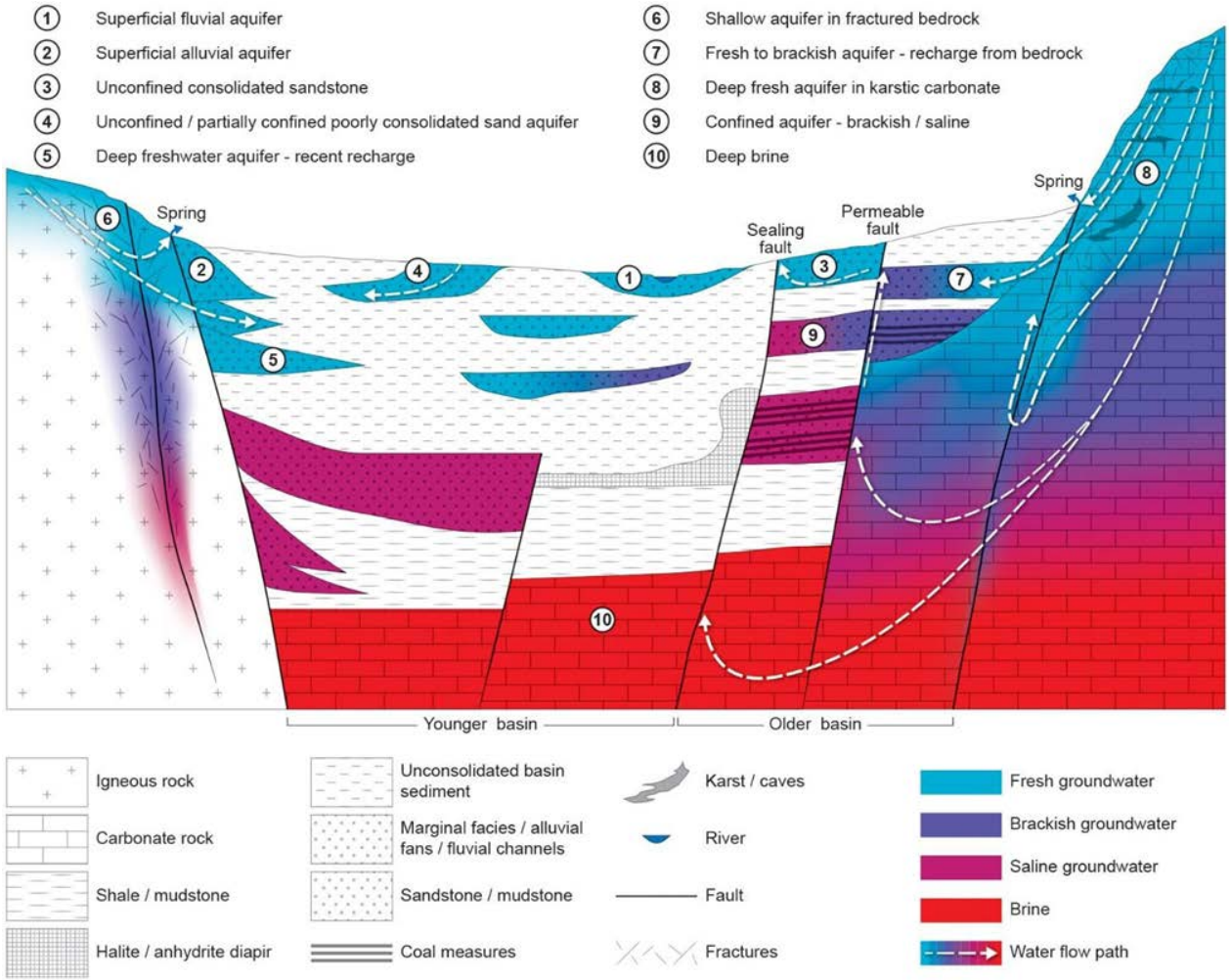
- Geothermal well
- Planned activities
- Drinking water abstraction







Pathways and receptors



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Deliverable

D4.1 Expanded diagrams of conceptual models identifying potential pathways for energy activity in the deep sub-surface and shallow groundwater vulnerability

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Report 1, WP 4

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Change	Date	Version
Final v1	10/07/2019	1

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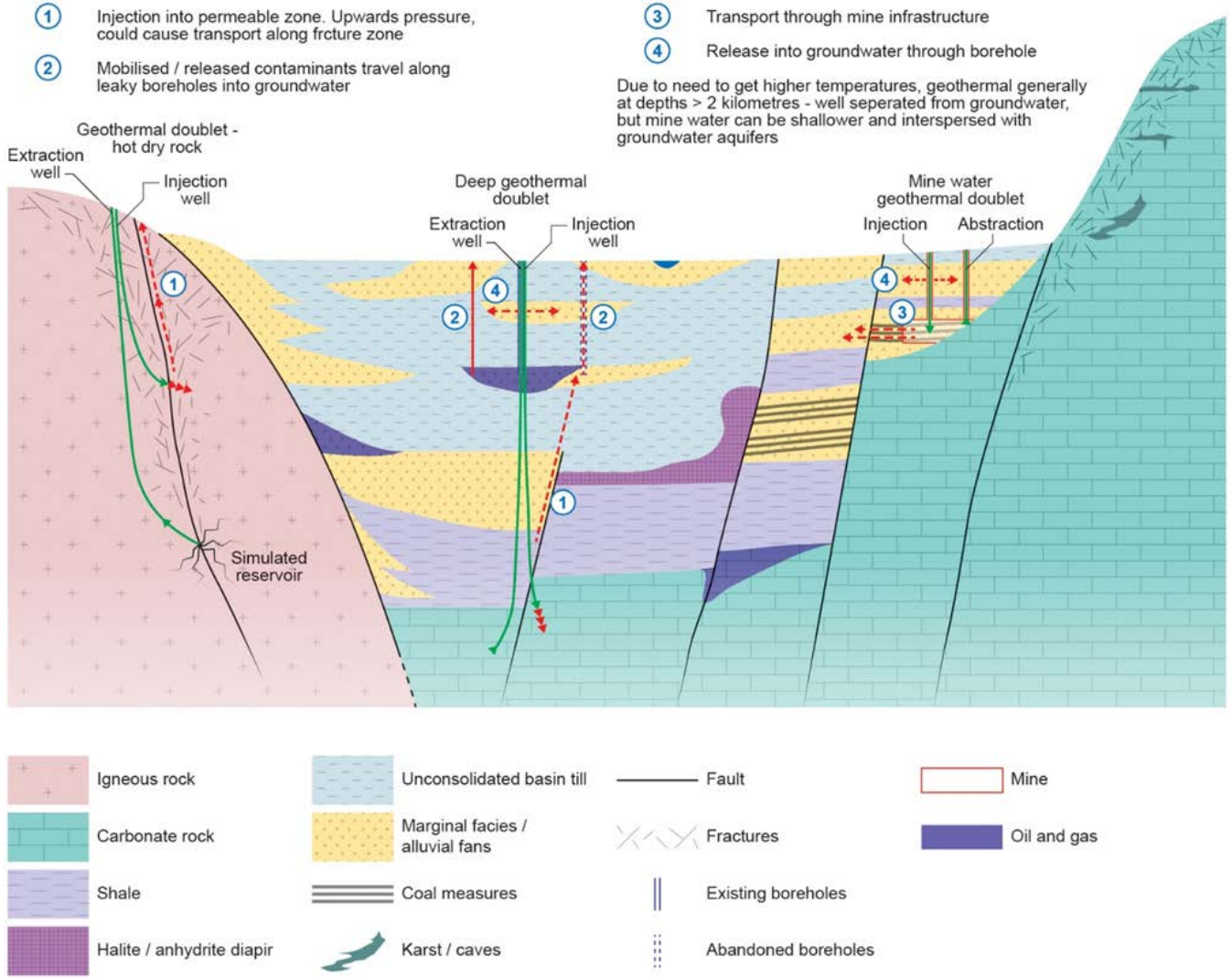
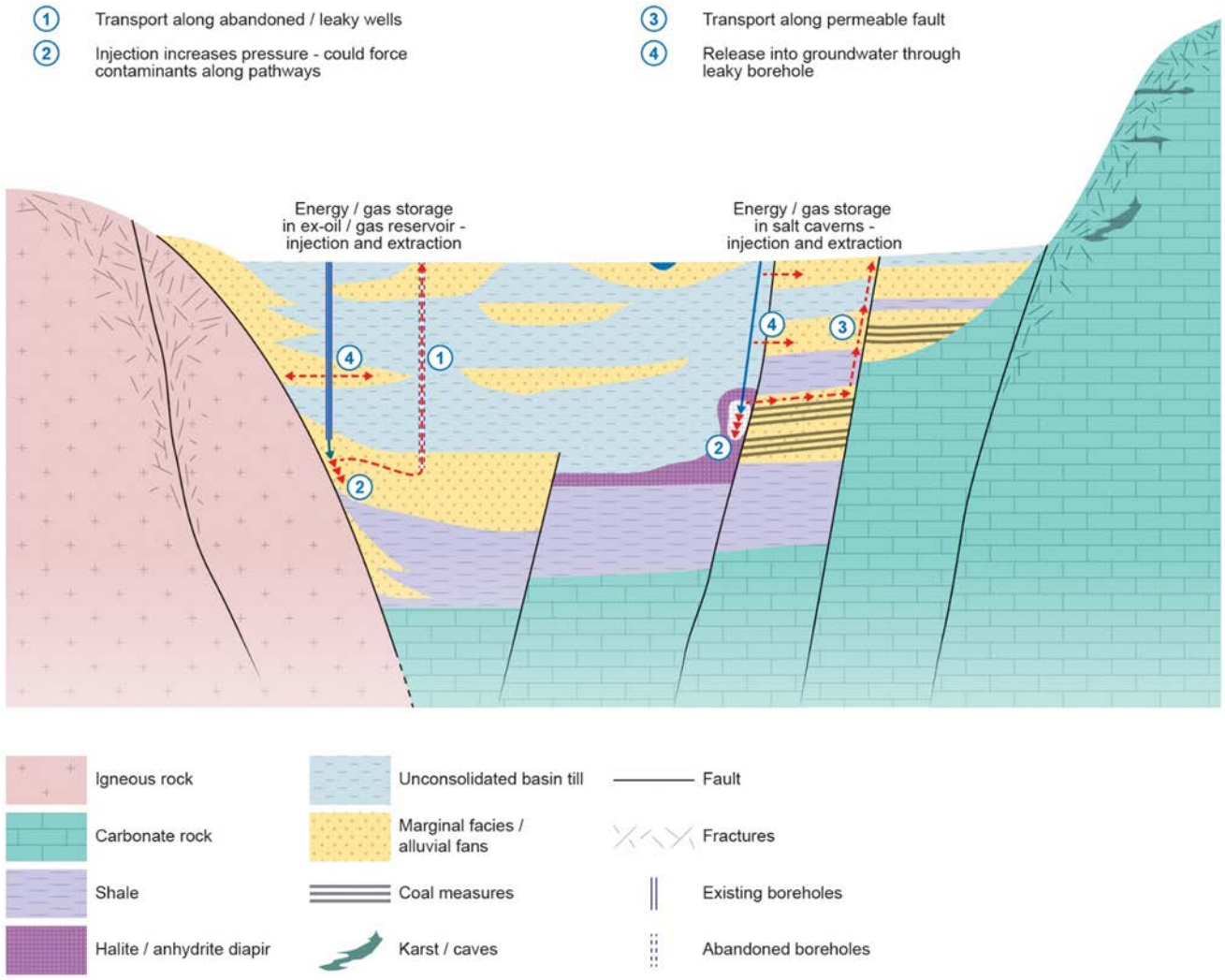
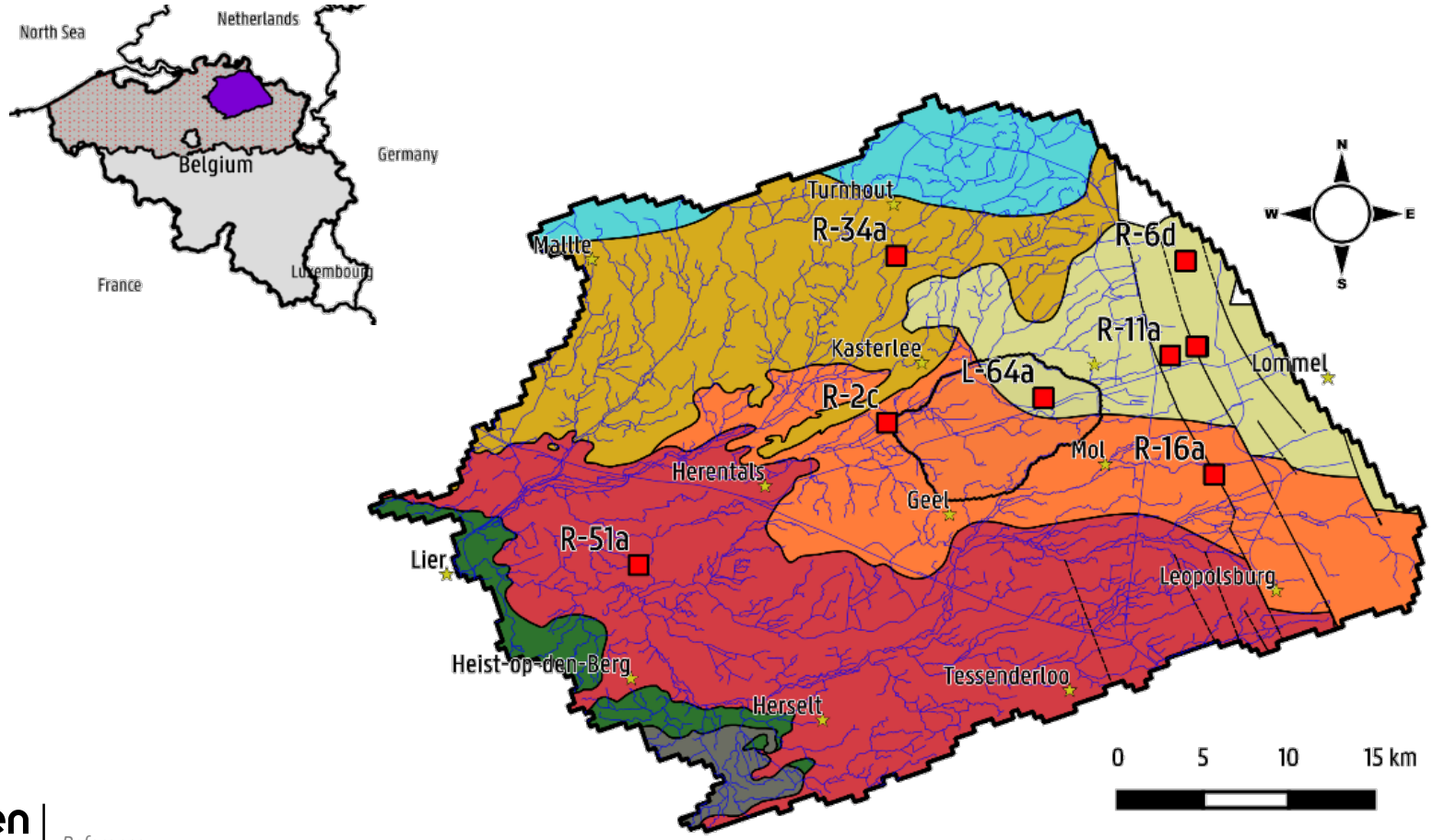
Geothermal energy



Energy (and gas) storage

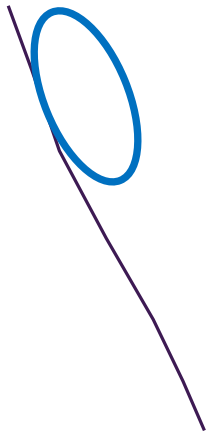


Assessment of Rauw Fault impact on local and regional hydrogeology using the Neogene Aquifer Model (NAM)



NAM modelled heads *without* Horizontal Flow Boundary (HFB)

Residual Obs = modelled minus measured

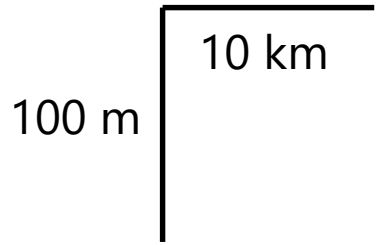


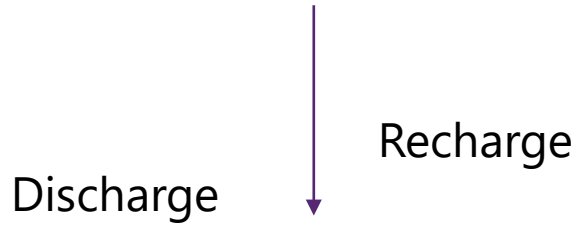
Mod > Meas

Mod < Meas

NAM modelled heads *with* Horizontal Flow Boundary (HFB)

Particle tracking





- Rauw fault causes upward flow
- Only the Rauw Fault acts as a HFB
- In modelling terms: only the K-value of the Rauw Fault proved to be sensitive

Summary

- Rauw Fault above Boom Clay is a horizontal flow boundary / hydraulic barrier
- In accordance with prevous observations along the Roer Valley Graben
- Needs to be confirmed by transport model (He-4 and C-14)
- Not clear yet whether the fault also acts as a vertical conduit
- Vulnerability assessment tool to be tested at this pilot site

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