

# Assessing the vulnerability of shallow groundwater resources to deep subsurface energy activities (VoGERA)

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

- Increasing energy demand, global environmental sustainability, decarbonisation of the power sector, and public concerns have increased the pressure on deep sub-surface energy related activities in Europe



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# Energy related activities in the sub-surface

1. Conventional oil and gas
  2. Shale gas
  3. Coal bed methane
  4. Geothermal (low/high enthalpy)
  5. Energy and gas storage
- induce physical and chemical changes in the subsurface
  - introduce new chemical substances
  - cause the movement of pre-existing fluids (brine, hydrocarbons)



**Impact on groundwater quality?**



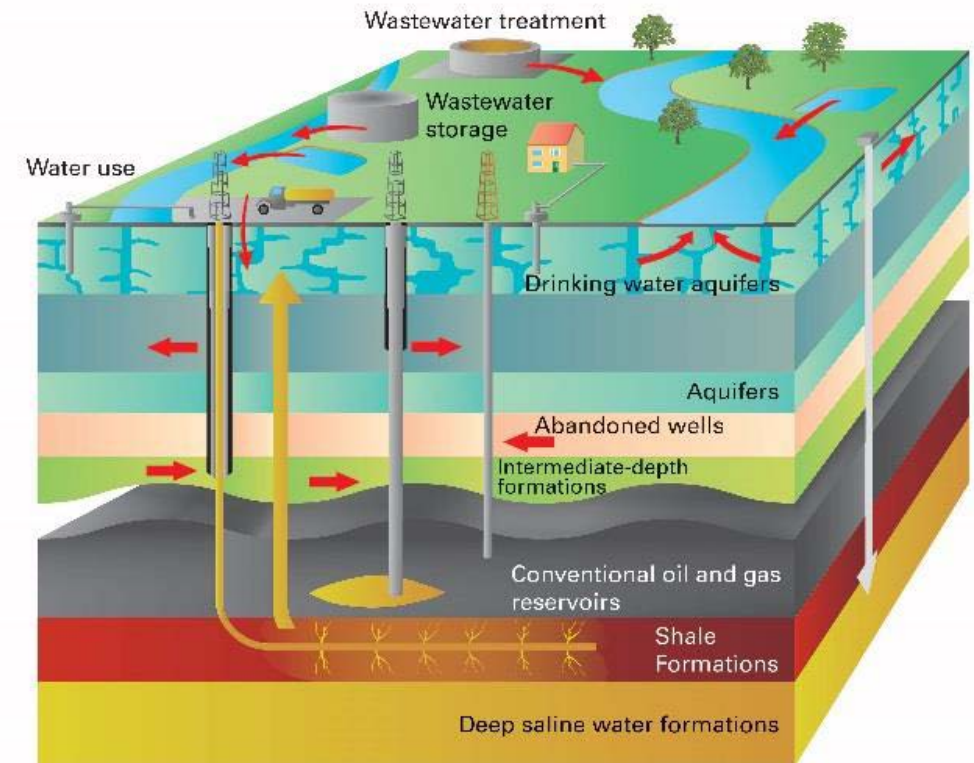
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# Aim of the VoGERA project

To improve scientific understanding of the vulnerability of shallow groundwater from deep sub-surface energy-related activities.

- Protect vulnerable groundwater
- Allow informed and responsible use of the deep sub-surface
- European-wide approach
- Consistent across energy activities



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Groundwater contamination occurs when there is a **pathway** connecting a **source** of pollutants to a **receptor**

### Objectives of the VoGERA project :

- 1) develop SPR conceptual models for each activity
- 2) develop a groundwater vulnerability approach
- 3) test the approach at 4 pilot sites across Europe

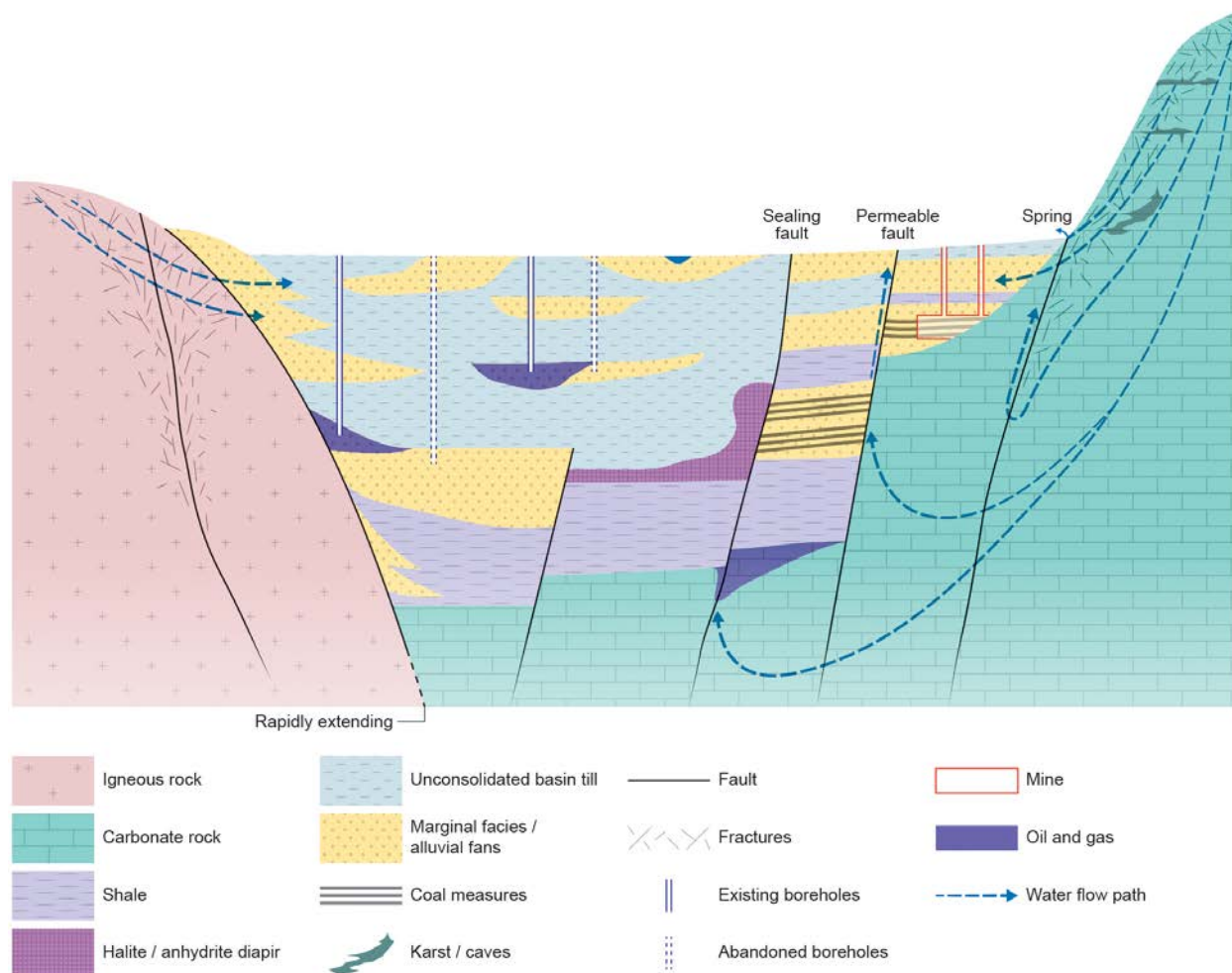


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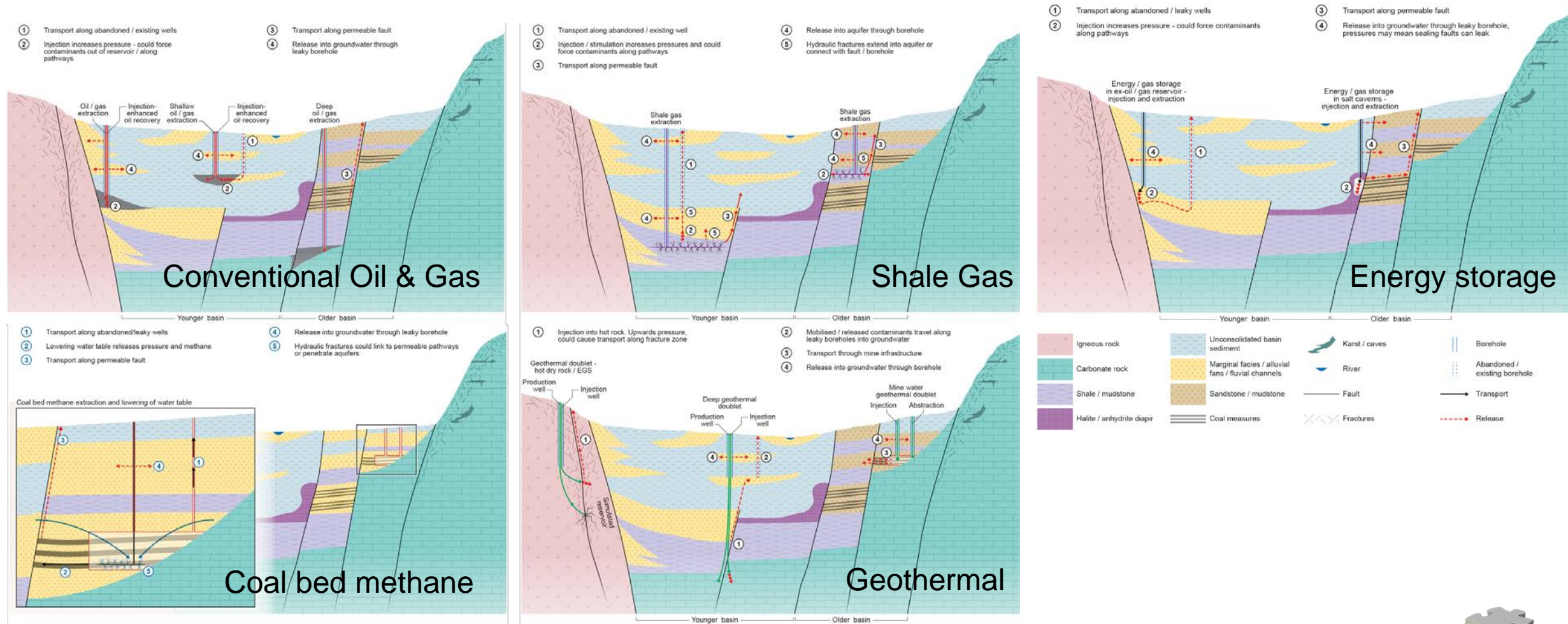


# Generic hydrogeological model



- Base case scenario representing the range of hydrogeological settings across Europe

# Conceptual models



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# Pathways

Pathway	Activity			
	conventional oil & gas	unconventional gas & oil	coalbed methane	geothermal energy
Release of contaminants into groundwater through leaky borehole	X	X	X	X
Transport along abandoned/existing wells into formations with groundwater	X	X	also through mine infrastructure	
Injection increases pressures and forces contaminants out and along other pathways	in case of enhanced oil recovery, injection of water steam, or CO2 into reservoir			injection into permeable zone, such as fault
Injection/stimulation to increase permeability (e.g. hydraulic fracturing) can increase reservoir pressures and force contaminants out of reservoir and along other pathways		X		
Transport of contaminants along permeable faults	X	X	X	
Transport of contaminants through mine infrastructure				X
Lowering of water table releases pressure and methane			X	
Mobilization/release of contaminants which travel along leaky boreholes into groundwater				X
Fractures could extend into aquifer or connect with a permeable fault		Hydraulic fractures	Hydraulic fractures	Sheared fractures



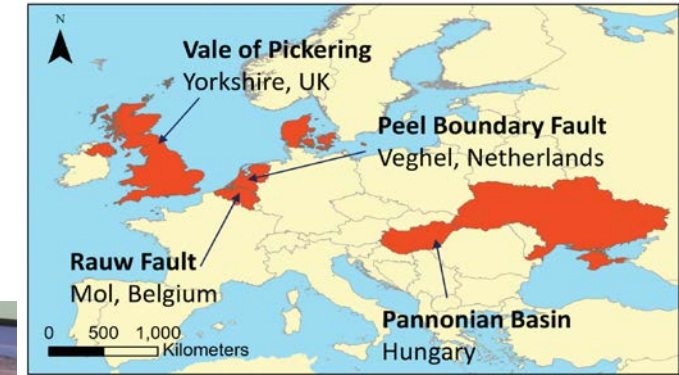
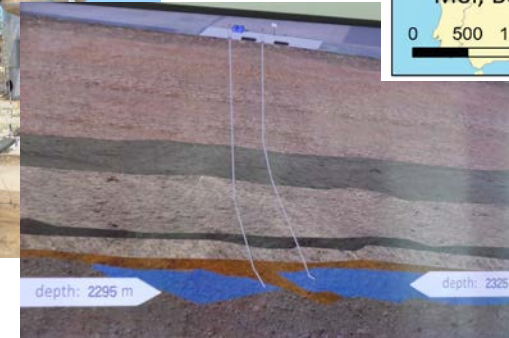
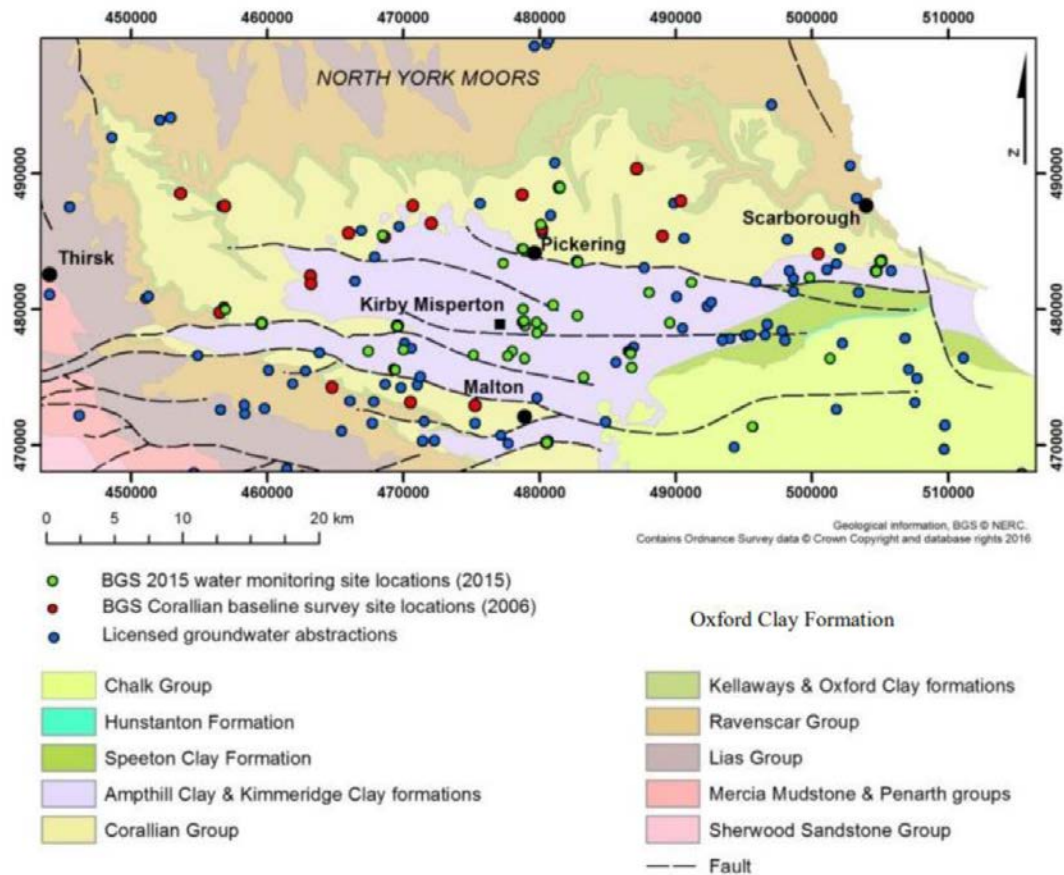
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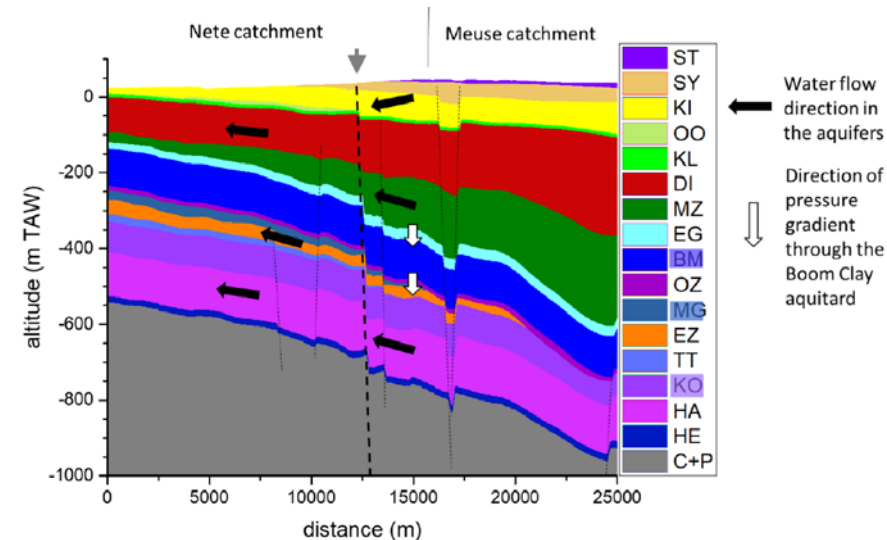


# Pilot sites

## Shale gas



## Geothermal



## Radioactive waste + Geothermal



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# Anticipated outcomes

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



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# Thank you for your interest

Further details can be obtained from: Rob Ward ([rswa@bgs.ac.uk](mailto:rswa@bgs.ac.uk))

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