



THE UNIVERSITY *of* EDINBURGH
School of GeoSciences

Quintessa

Mine water: a sustainable renewable energy resource?

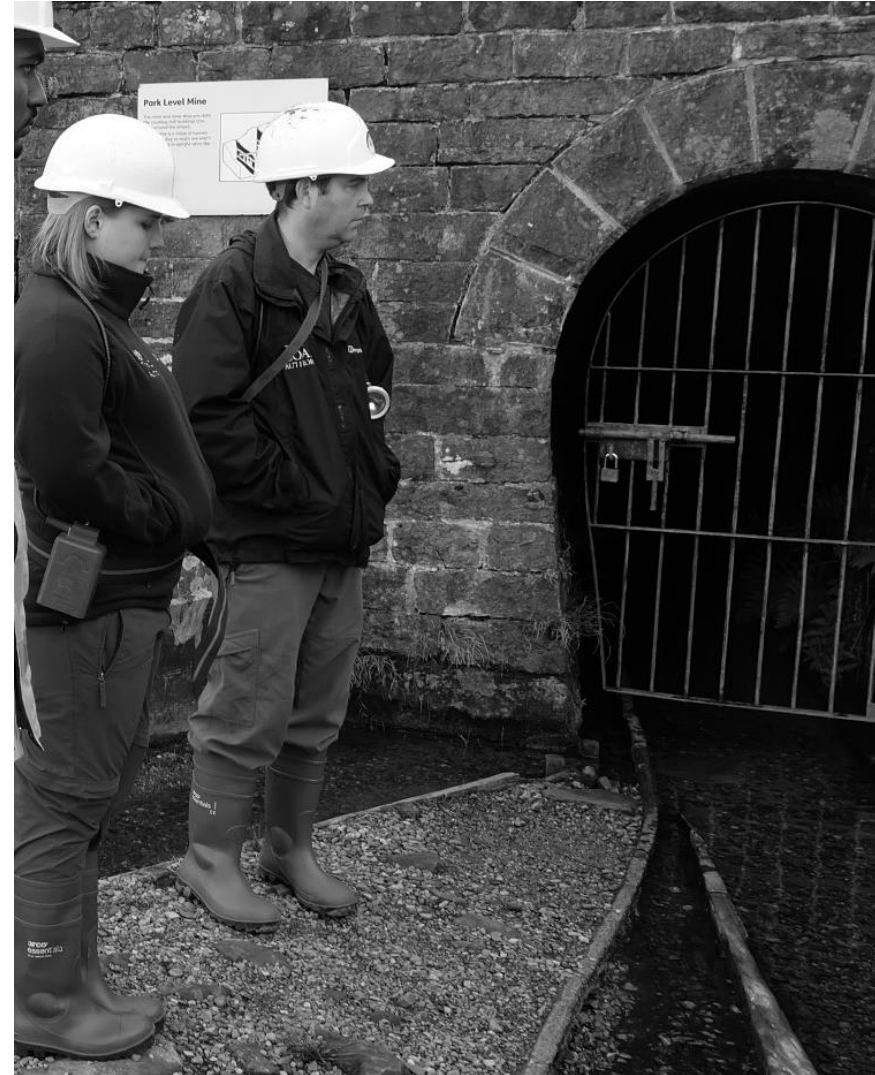
Supervisors: Dr Chris McDermott, Dr Andrew Fraser Harris, Dr Stuart Gilfillan (UoE) and Dr Alex Bond (Quintessa)

Fiona Todd

ETP annual conference 29/10/18

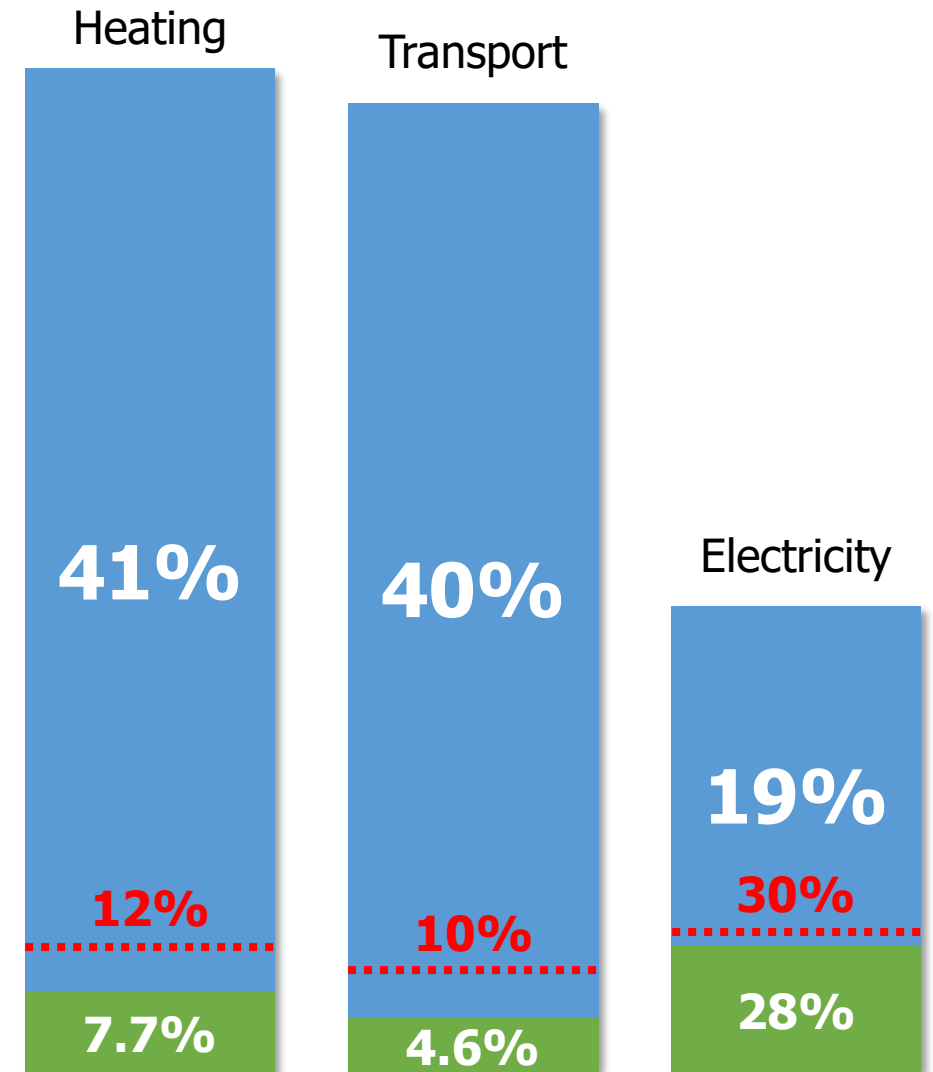
Overview

- Context
- Research aims
- Modelling results
- Next stages



Context

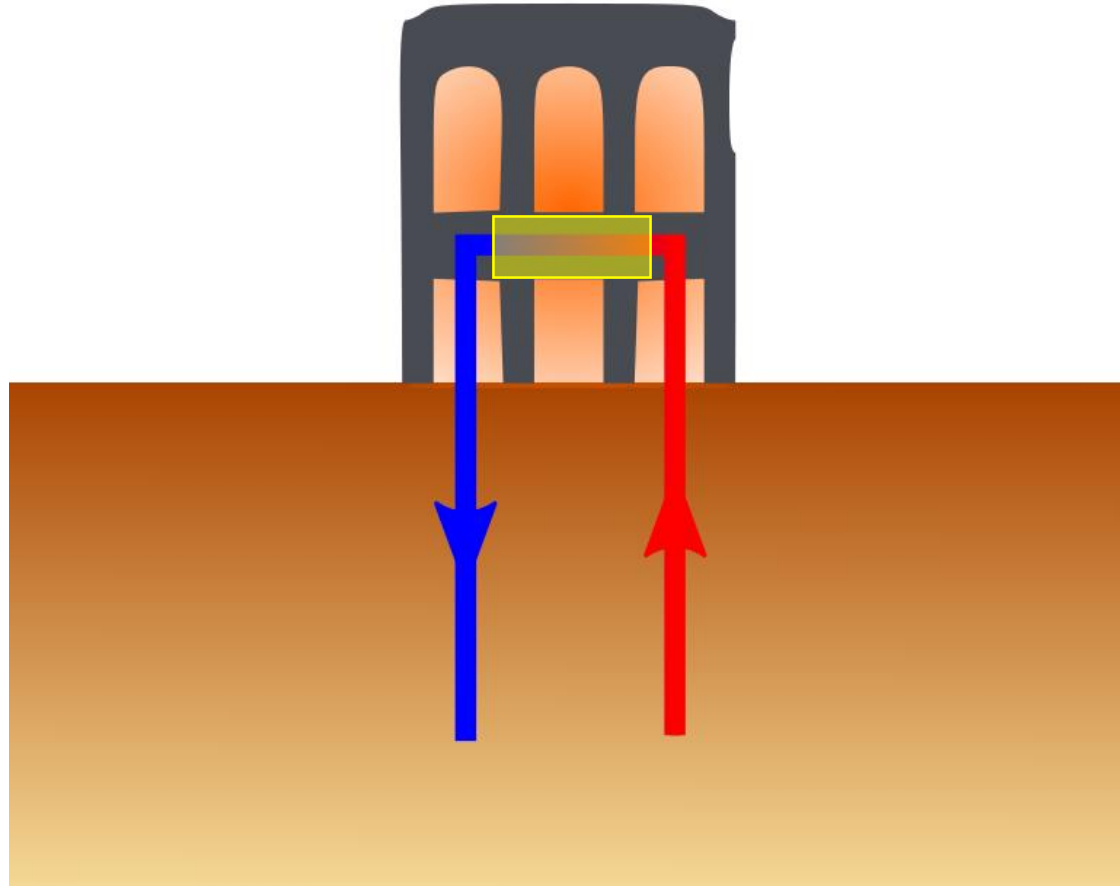
- Decarbonisation goals
 - Legally binding renewable targets
 - 2016 progress
- 1/3 Scotland's heat demand from shallow geothermal*



Source: Digest of UK energy statistics (BEIS 2017)

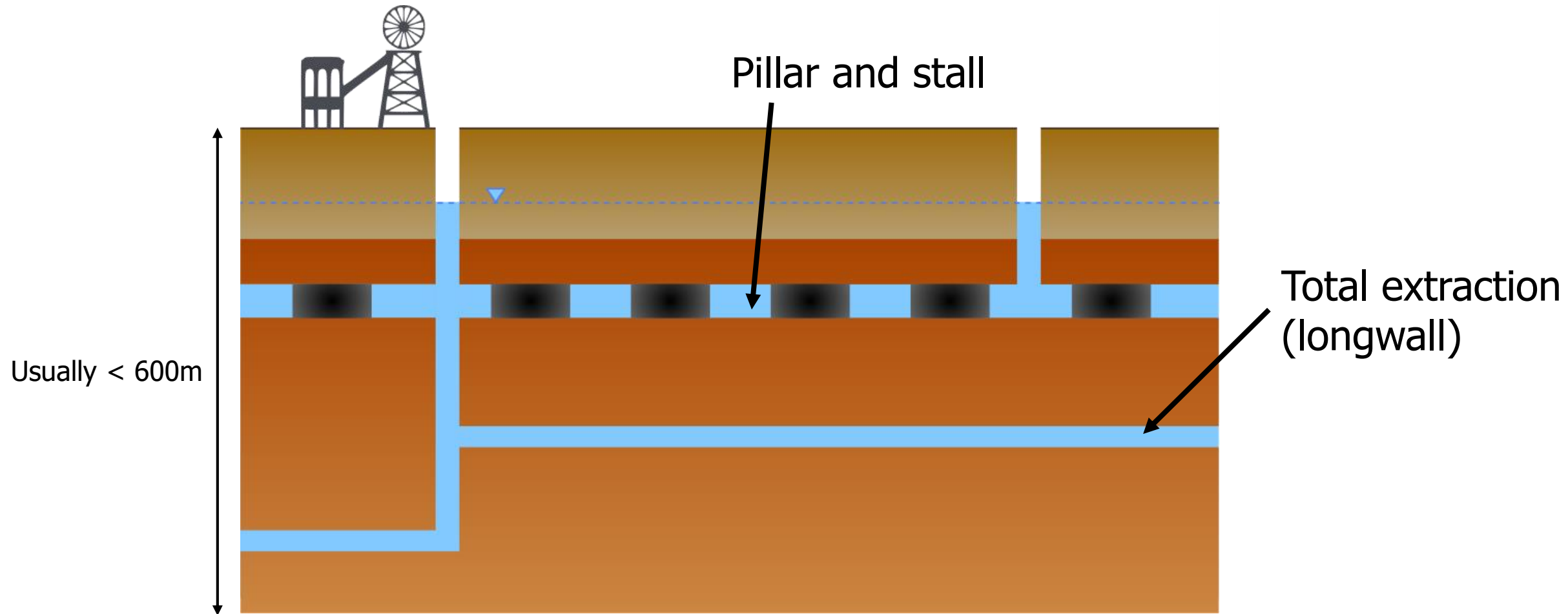
*BGS 2013 Study into potential for deep geothermal energy in Scotland

Geothermal?

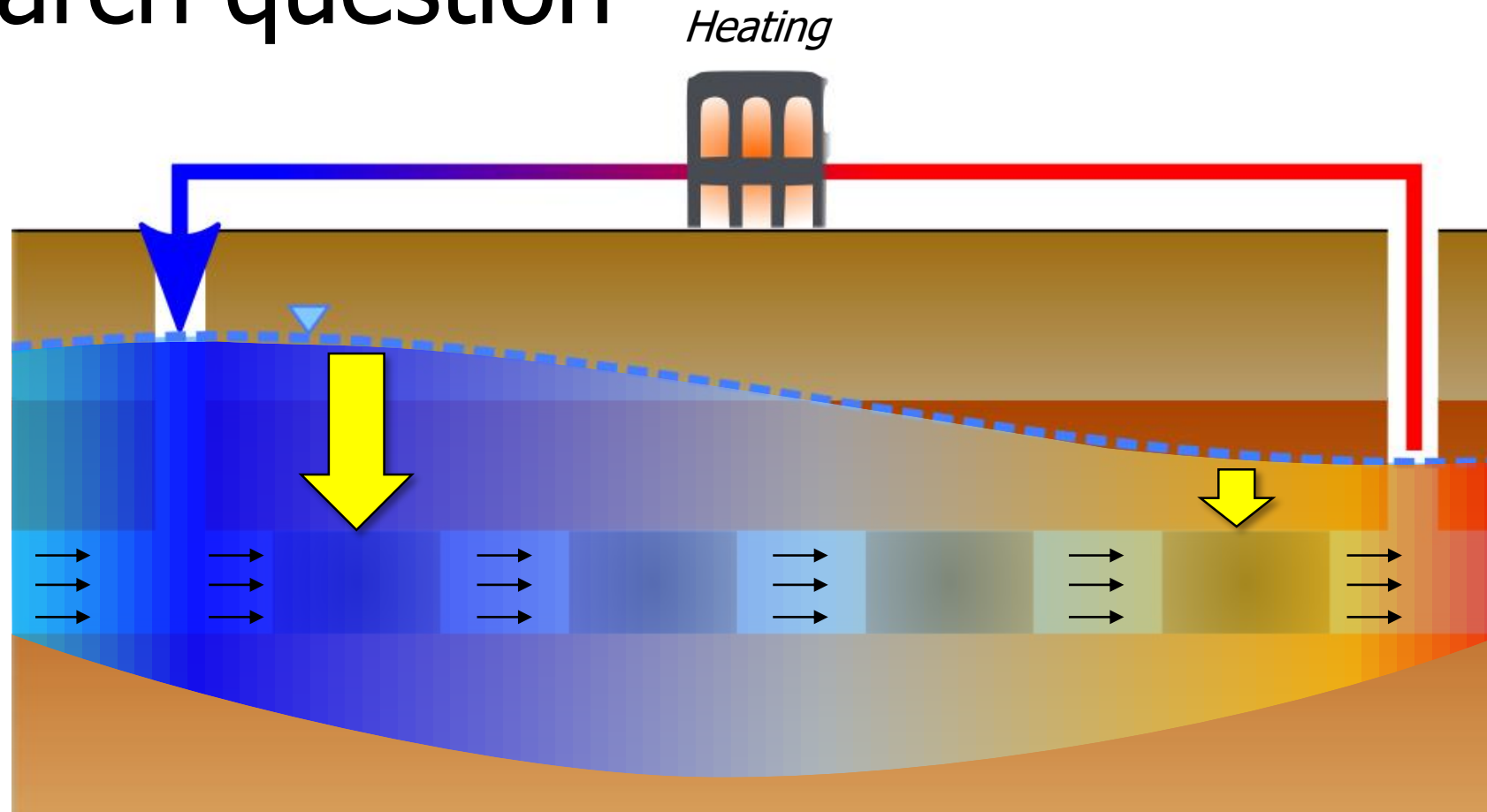


- Low temperature – direct use
- Ground source heat pumps
COP = 4
- Highly connected network
- Elevated temperature

Research



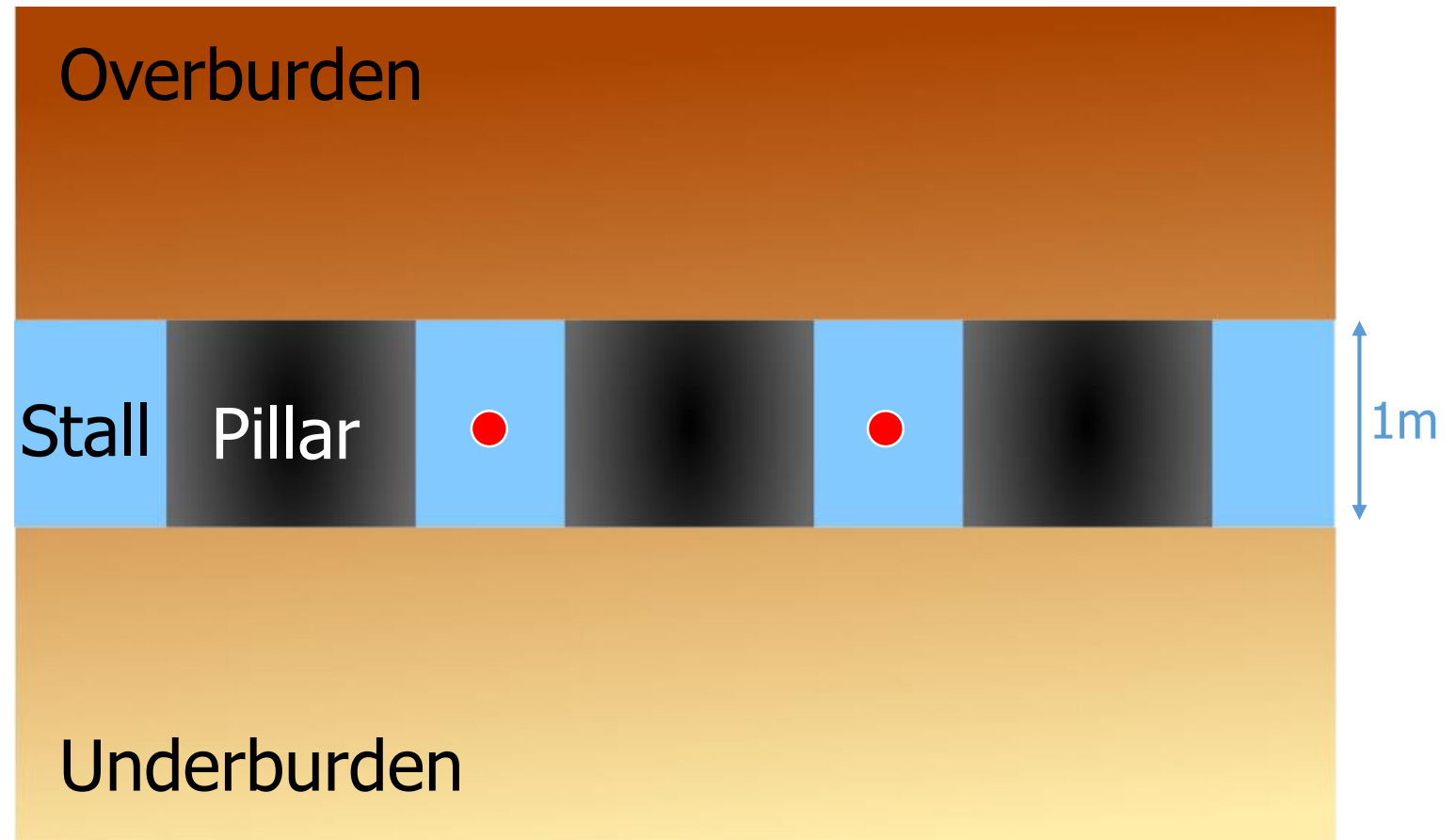
Research question



Fluctuations in pressure, temperature and flow will impact pillar integrity and cause ground stability issues

2D modelling

- Geometry
 - 50m overburden
 - Pillar 10m
 - Stall 6m
- 3 materials
- 2 source terms

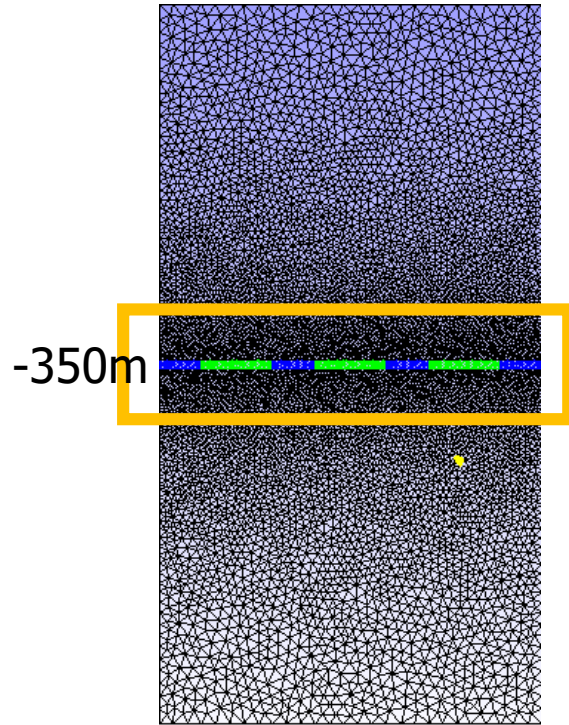


Pillars

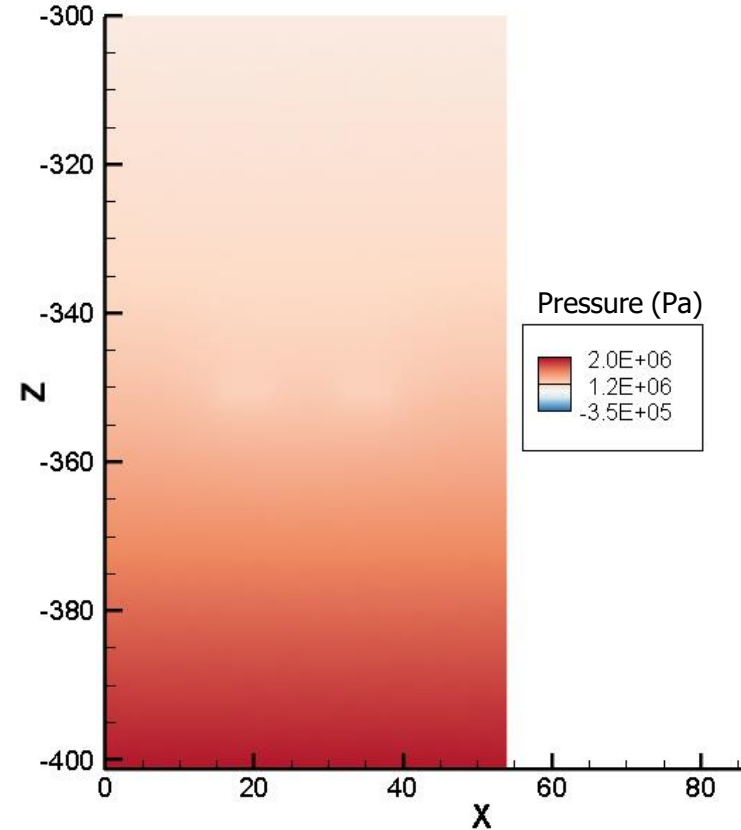


Source: AditNow Photography by lampwort

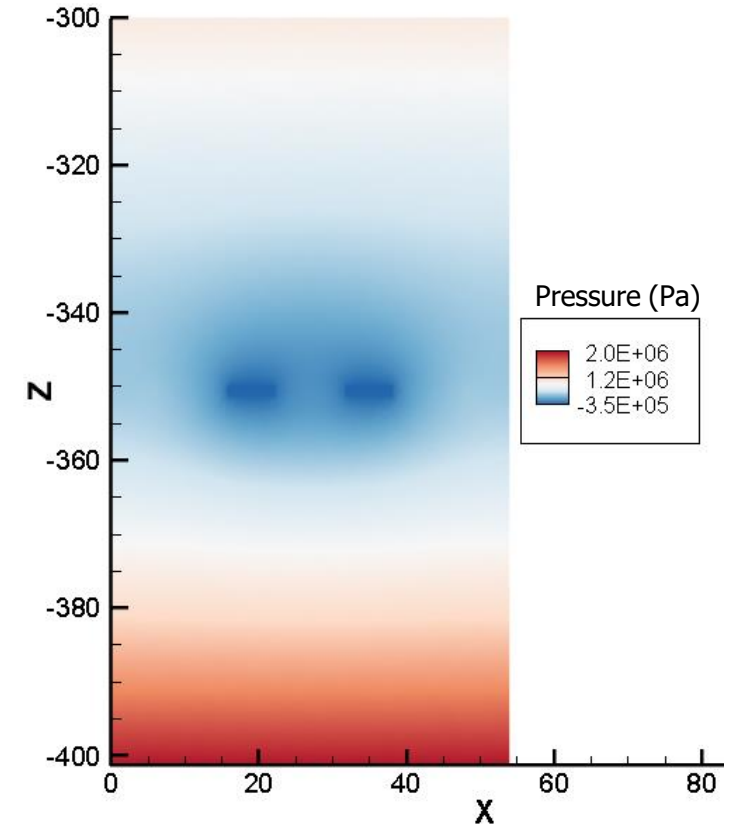
2D modelling: hydraulic flow



Model mesh



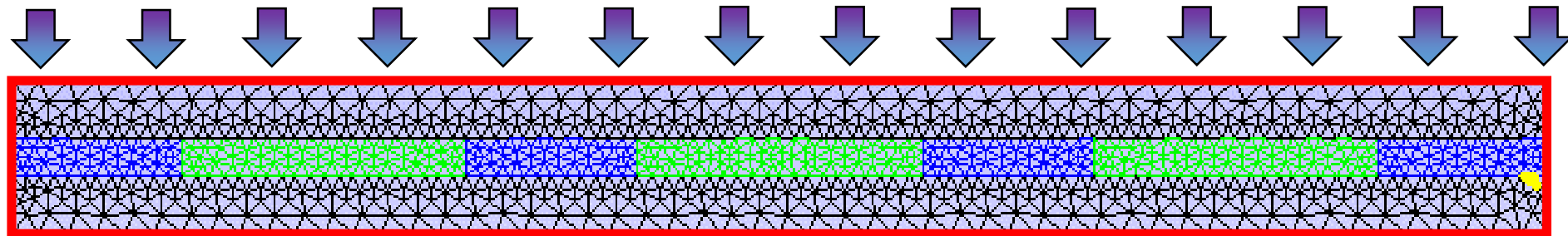
Low abstraction



High abstraction

2D modelling: geo-mechanics

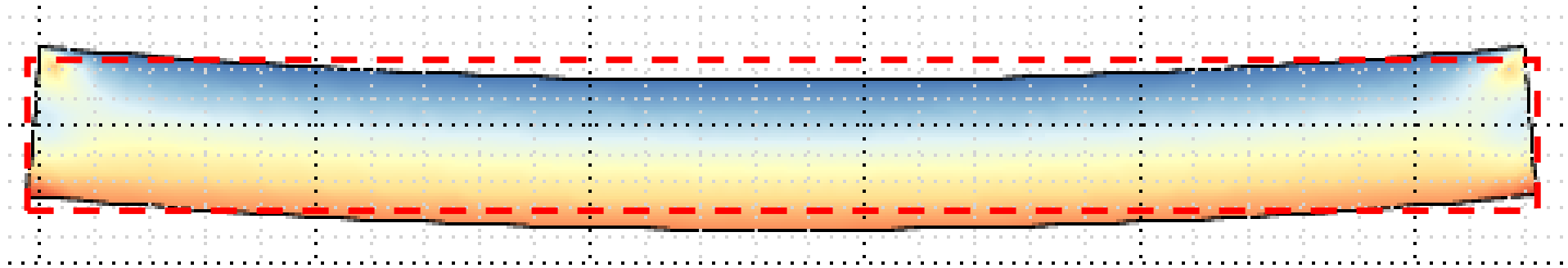
Model mesh



Boundary conditions?
Source term?

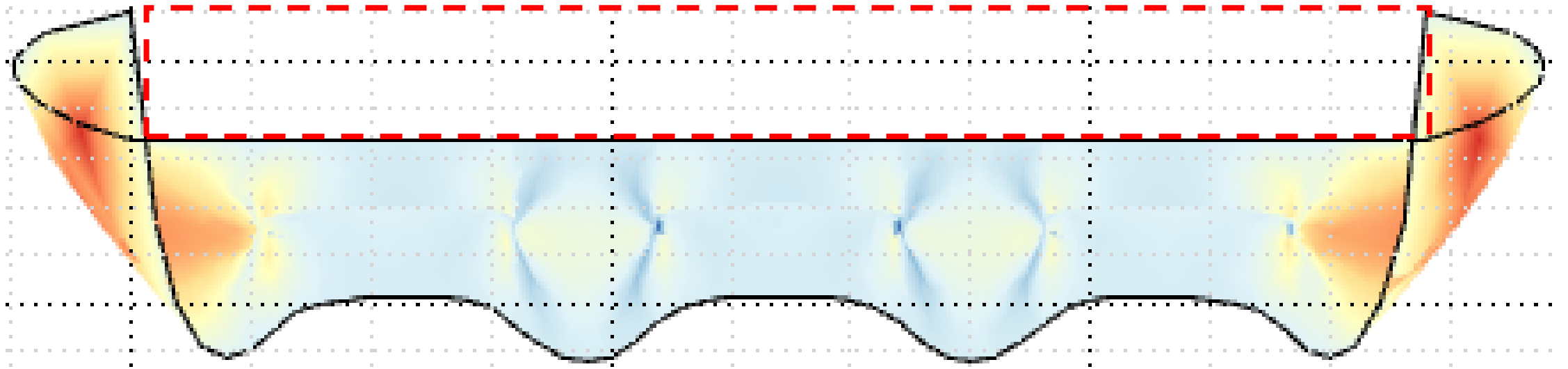
2D modelling: geo-mechanics

Boundary condition issue

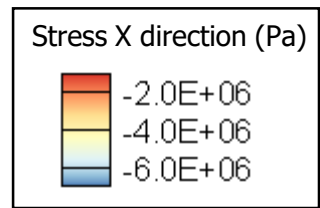


2D modelling: geo-mechanics

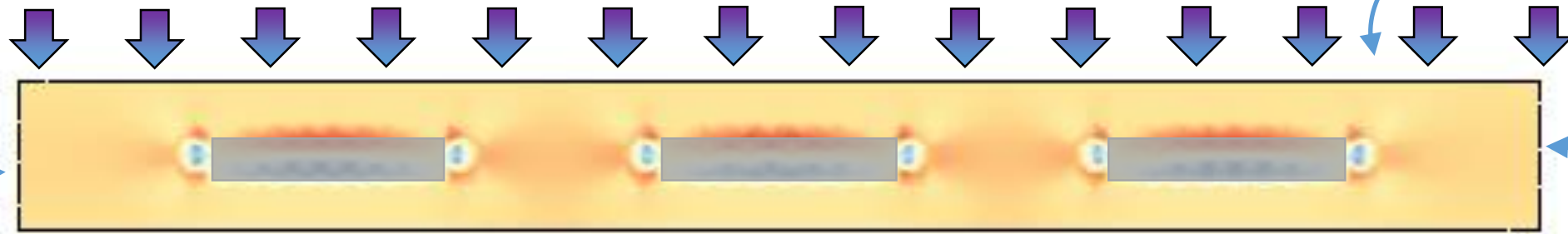
Source term issue



2D modelling: geo-mechanics



$9 \times 10^6 \text{ Pa} \approx 350\text{m overburden}$

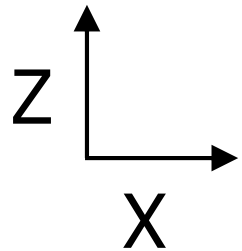


No movement in X
direction

No movement in X
direction

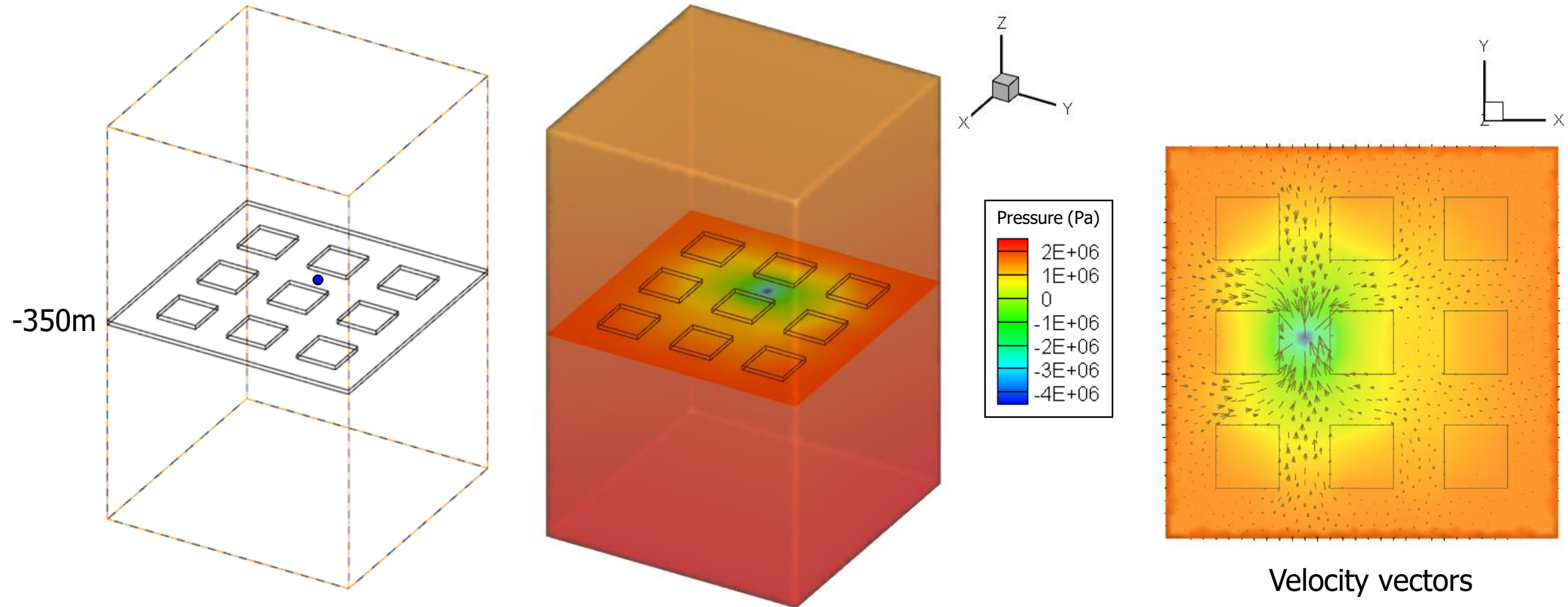
Static

No movement in X
direction



Two material groups

3D model: hydraulic flow



Next stages

- Couple thermal-hydraulic-geomechanical processes
- Validate model with surface uplift data as water rises
- Overburden properties

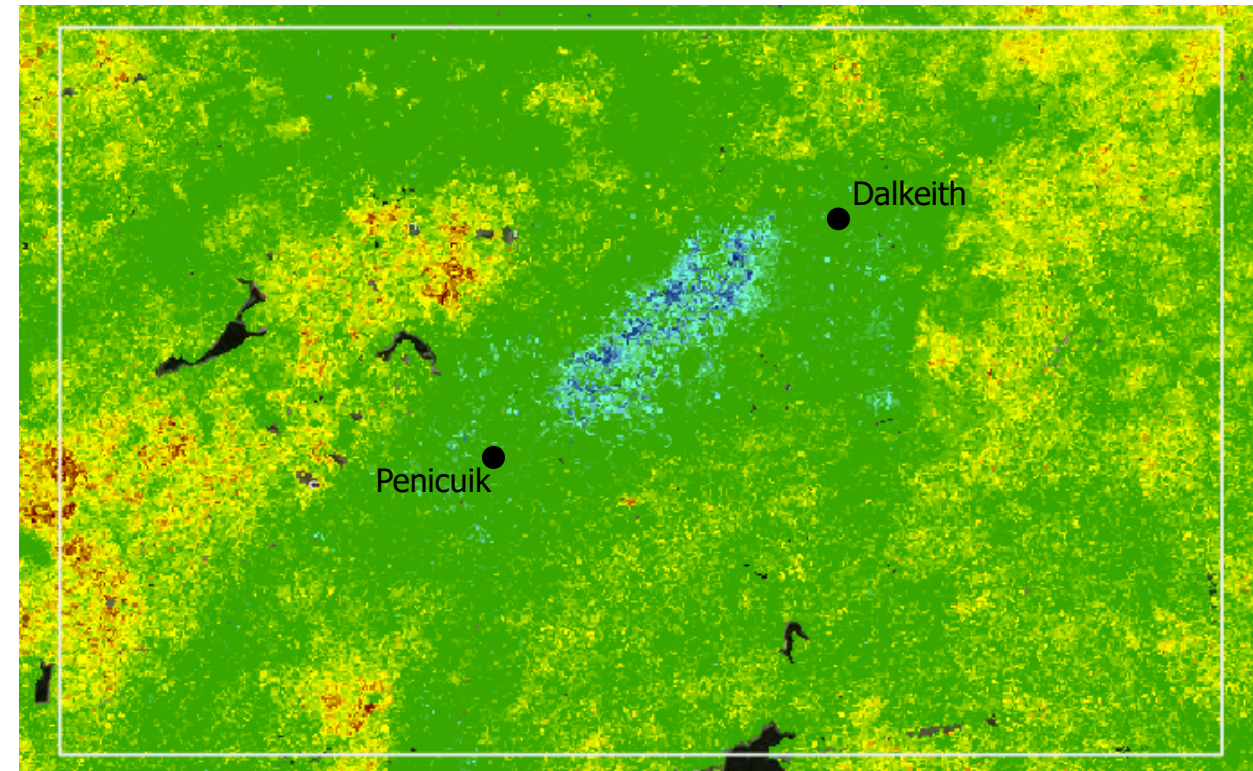


Image obtained from: <https://www.geomaticventures.com/uk-map>

Research output

- Overburden geology vs deformation risk
- Risk map/matrix?



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Conclusions

- Alternative sources are required for decarbonisation of heating sector
- Mine water is a renewable energy source which could contribute significantly to heat demand
- Important to understand how the potential associated risks can be managed