Schweizer Kompetenzzentrum für
Tiefengeothermie Zur
Strom- und Wärmeproduktion

GEO ENERGIE SUISSE

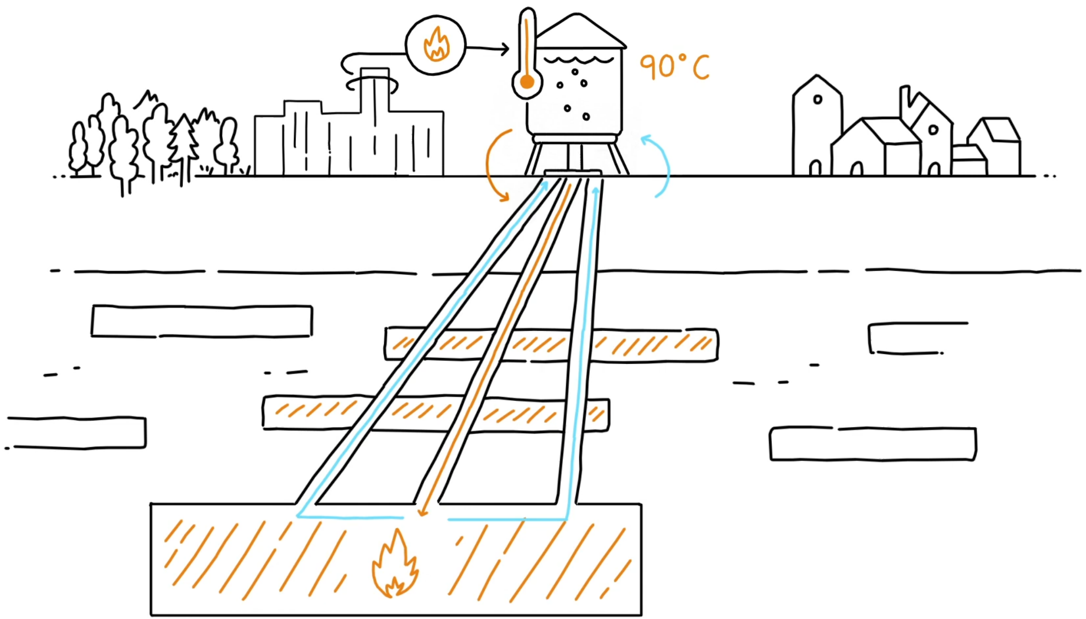
Status Heatstorage Project in Bern
(work in progress)

IEA ATES Workshop Hoorn 20.4.2023

Peter Meier

aet ebl EOS HOLDING ewb ewz GVM Gasverbund Mittelland AG iwb

Heat storage concept



Objectives:

Seasonal storage of 15 GWh_{th} heat from the waste heat in the summer months out of the Bern power plant (EZF)

www.ewb.ch/geospeicher

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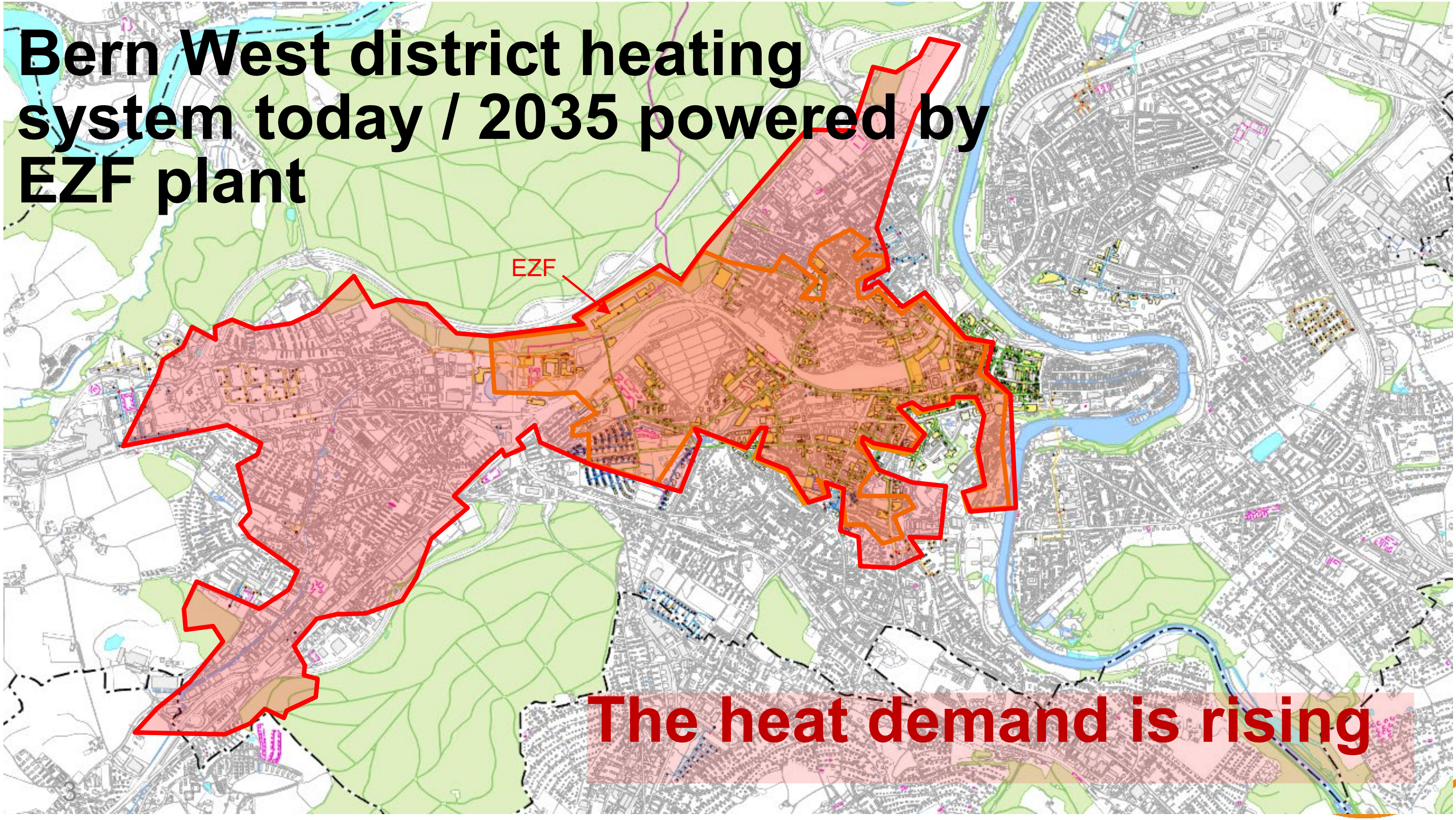
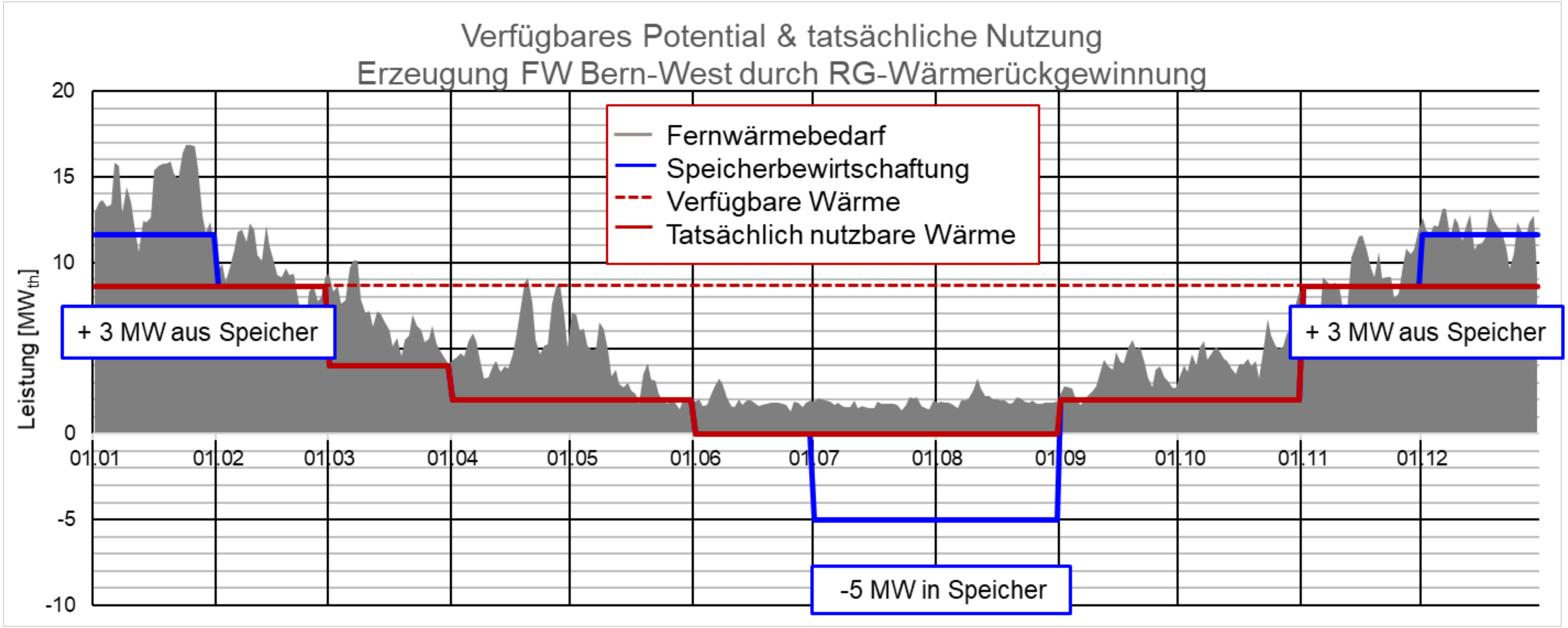
Bern West district heating system today / 2035 powered by EZF plant



The heat demand is rising

Objective: 3 MW seasonal heat storage for western Bern district



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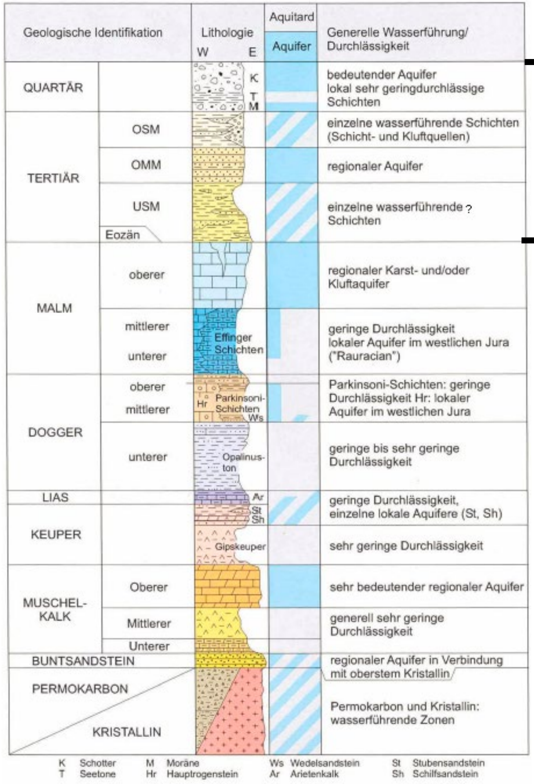
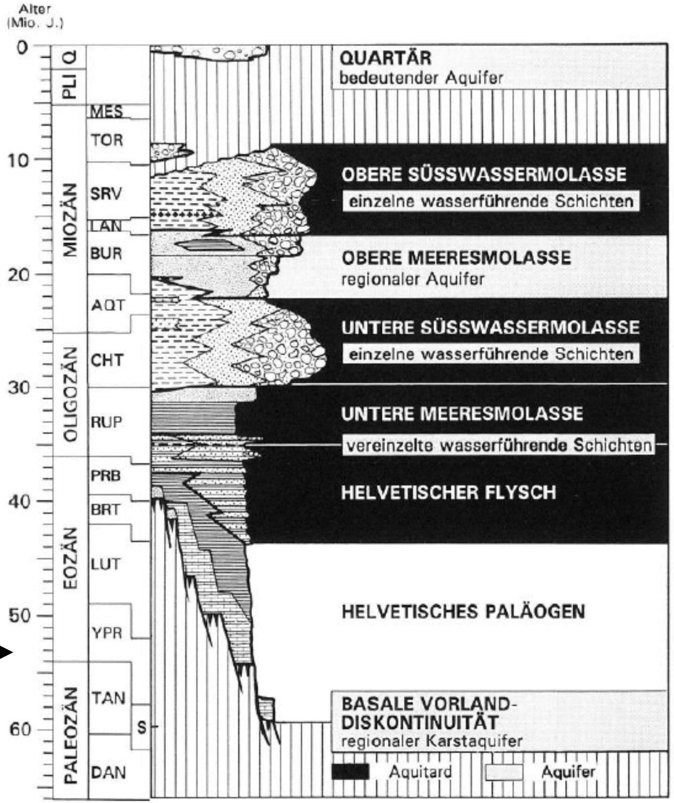
Geology: target upper fresh water molasse (USM)





Sedimentology of the lower fresh water molasse

	Architektur-Element	Beschreibung
RG	Rinnengürtel	Mittel- und Grobsandsteine
DFR	Durchbruchsfächer und –rinnen	Mittel- und Feinsandsteine
UW	Uferwälle und distale Überschwemmungssande	Sandsteine und Grobsiltsteine
UPS	Überschwemmungsebene mit Paläoböden und Sümpfen	Schlammsteine und Mergel
LAK	Lakustrische Ablagerungen	Mergel, Süsswasserkalke, lokal Gips

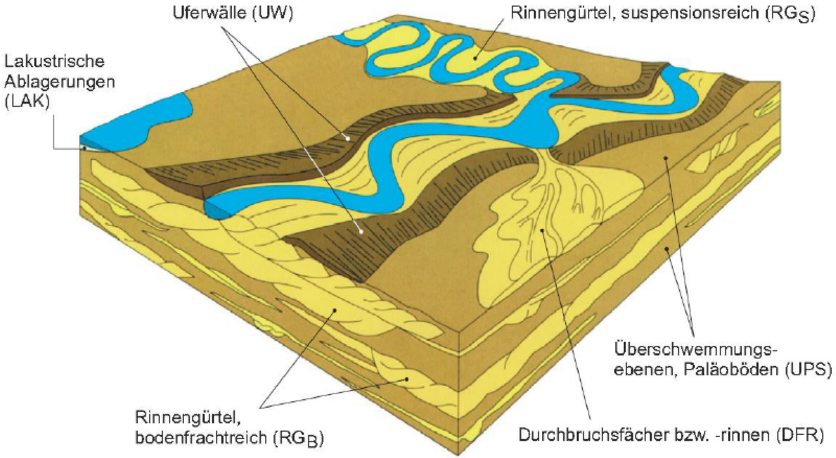


Abbildung 10: Faziesmodell der distalen (alpenfernen) Unteren Süsswassermolasse (Keller et al., 1990).

The USM has a large potential in the densely populated areas of Switzerland

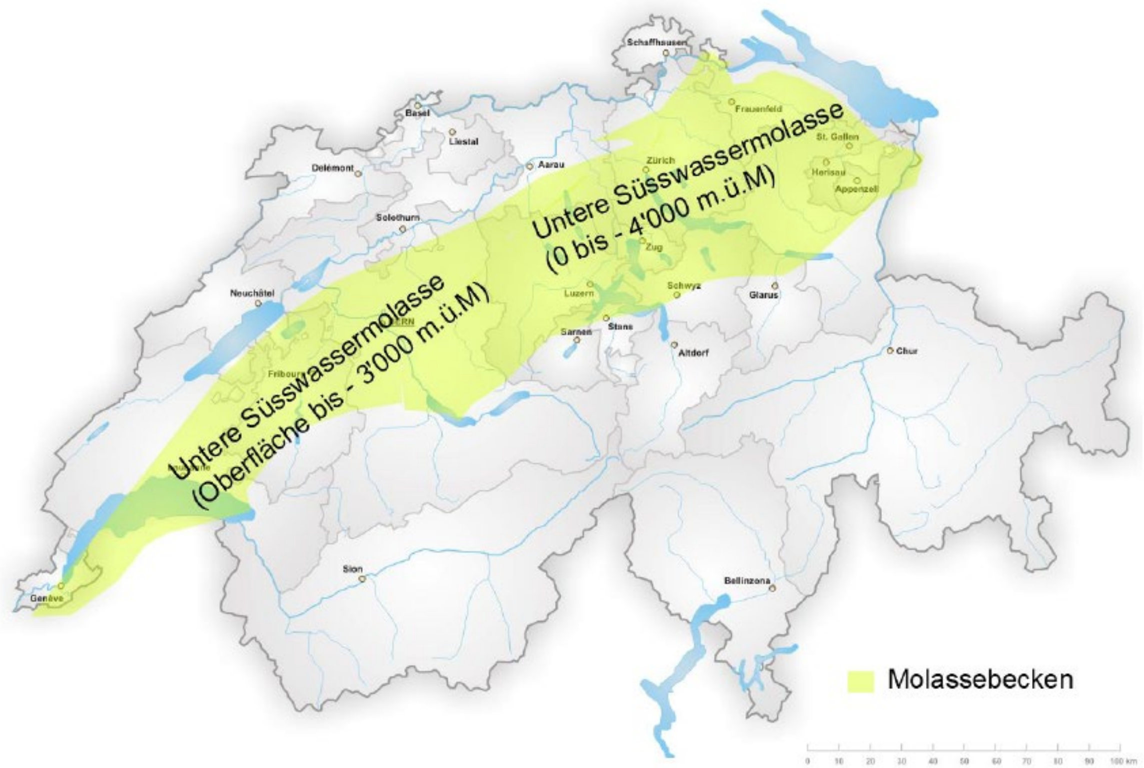
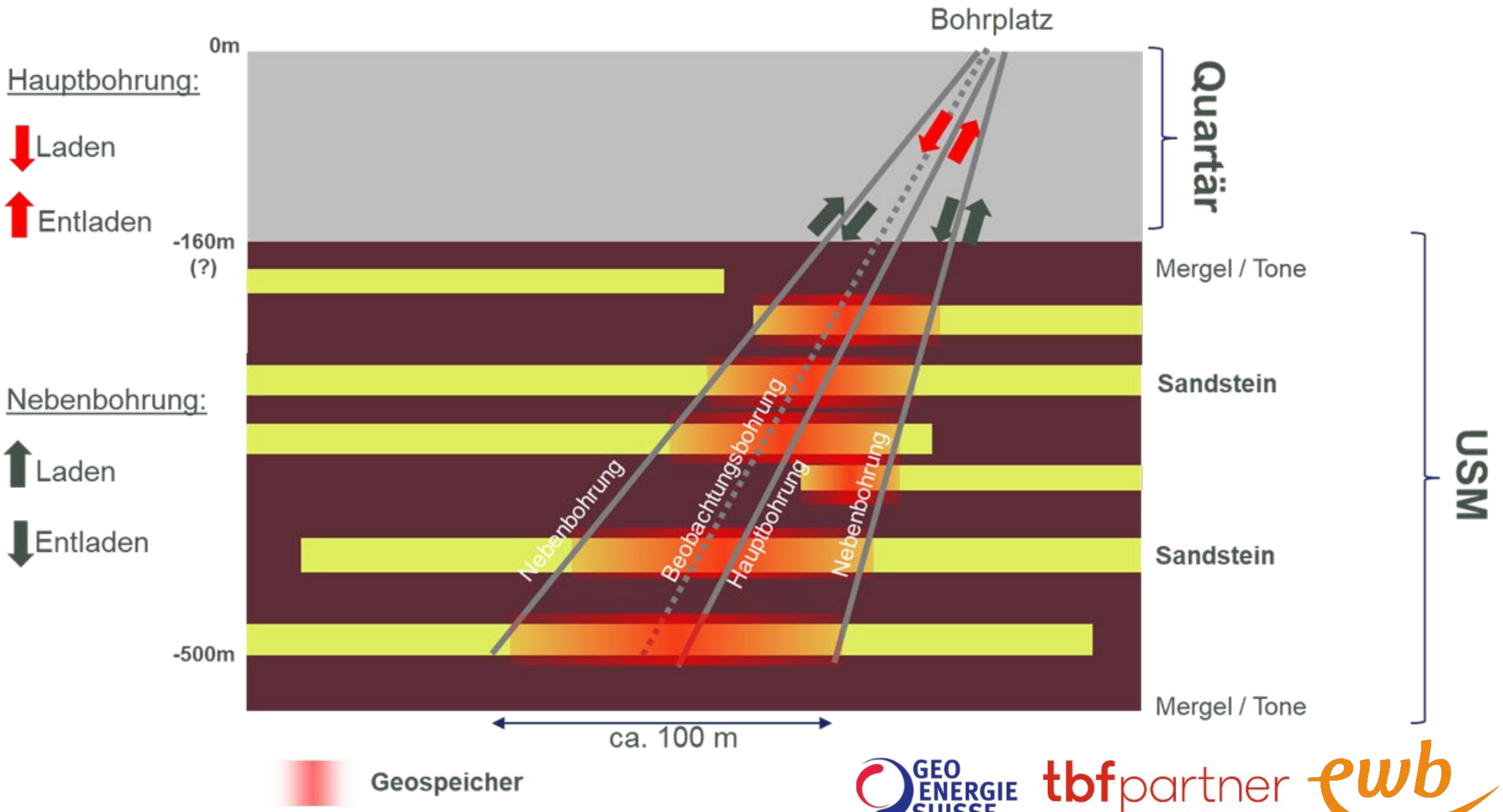
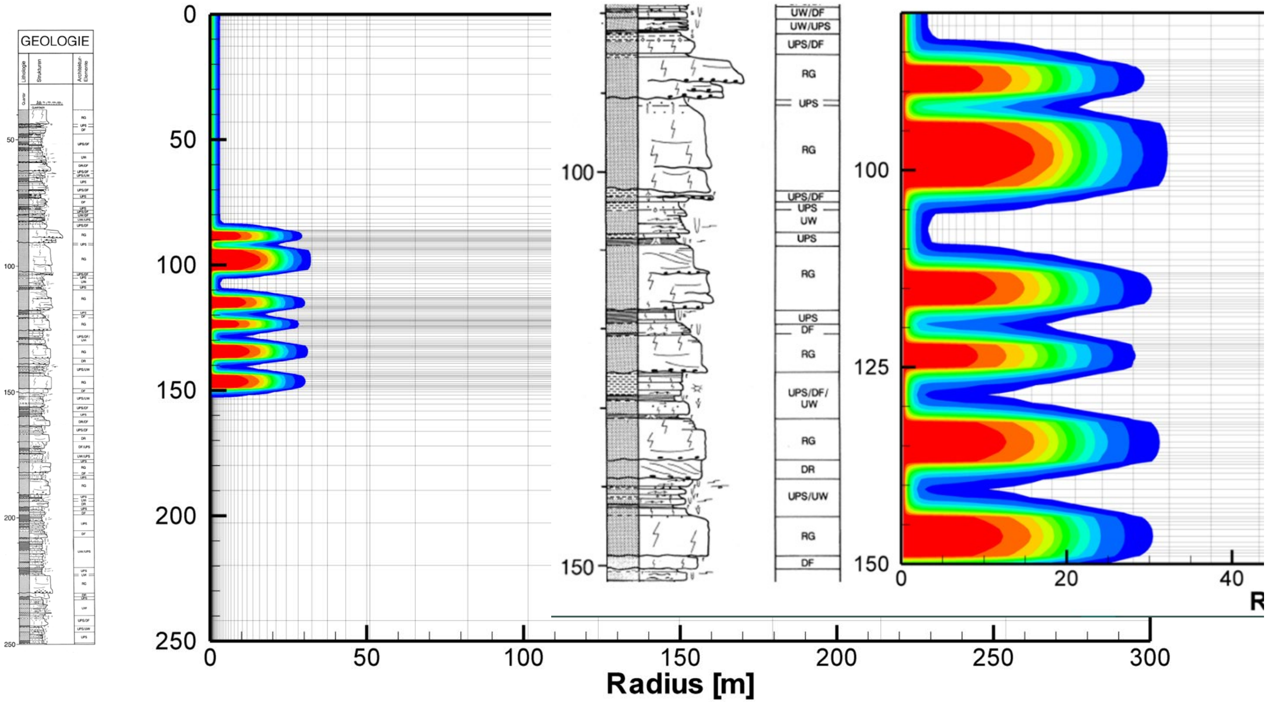


Abbildung 19: Nutzungs- und Anwendungspotential der Unteren Süsswassermolasse in der Schweiz unter Angabe der Tiefenlage in m.ü.M.

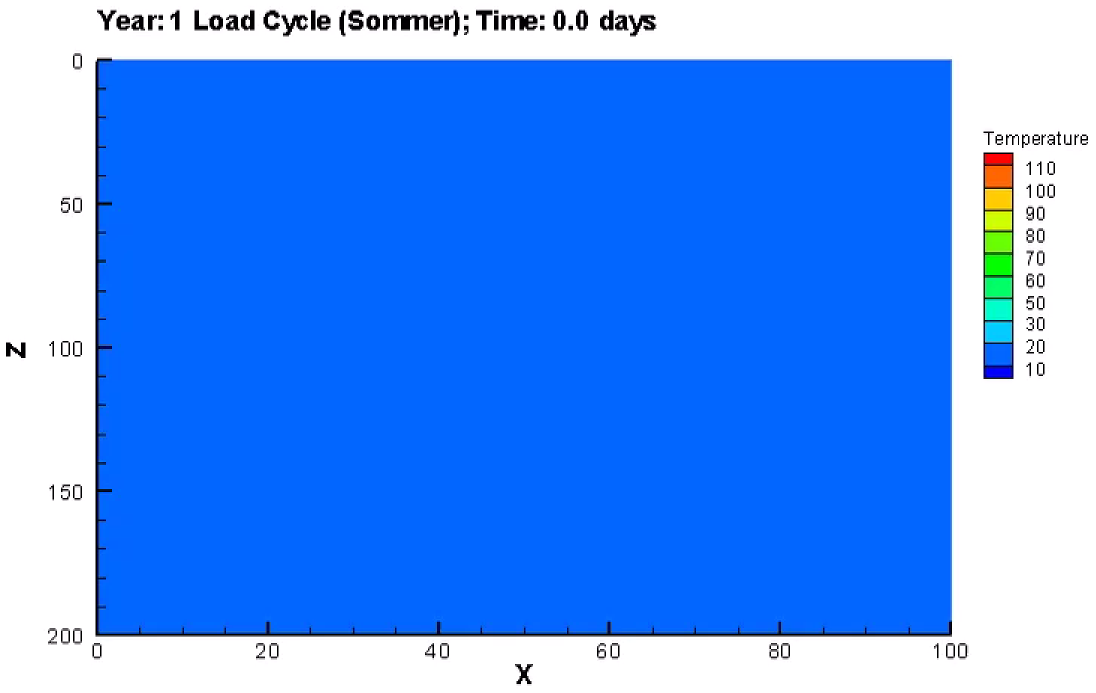
Expected conceptual reservoir model



Modelling sedimentary layers



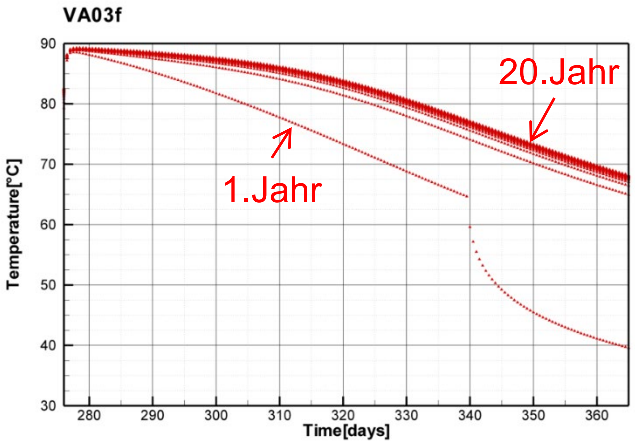
Modelling sedimentary layers



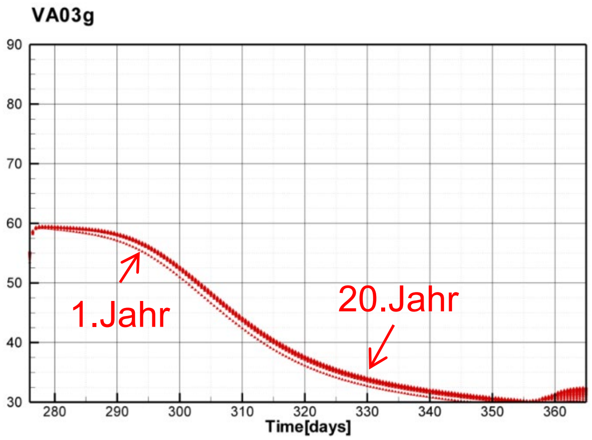
Geospeicher

Temperture unloading

Without heat pump, T_{inj} = 90°C



With heatpump, T_{inj} = 60°C



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Situation

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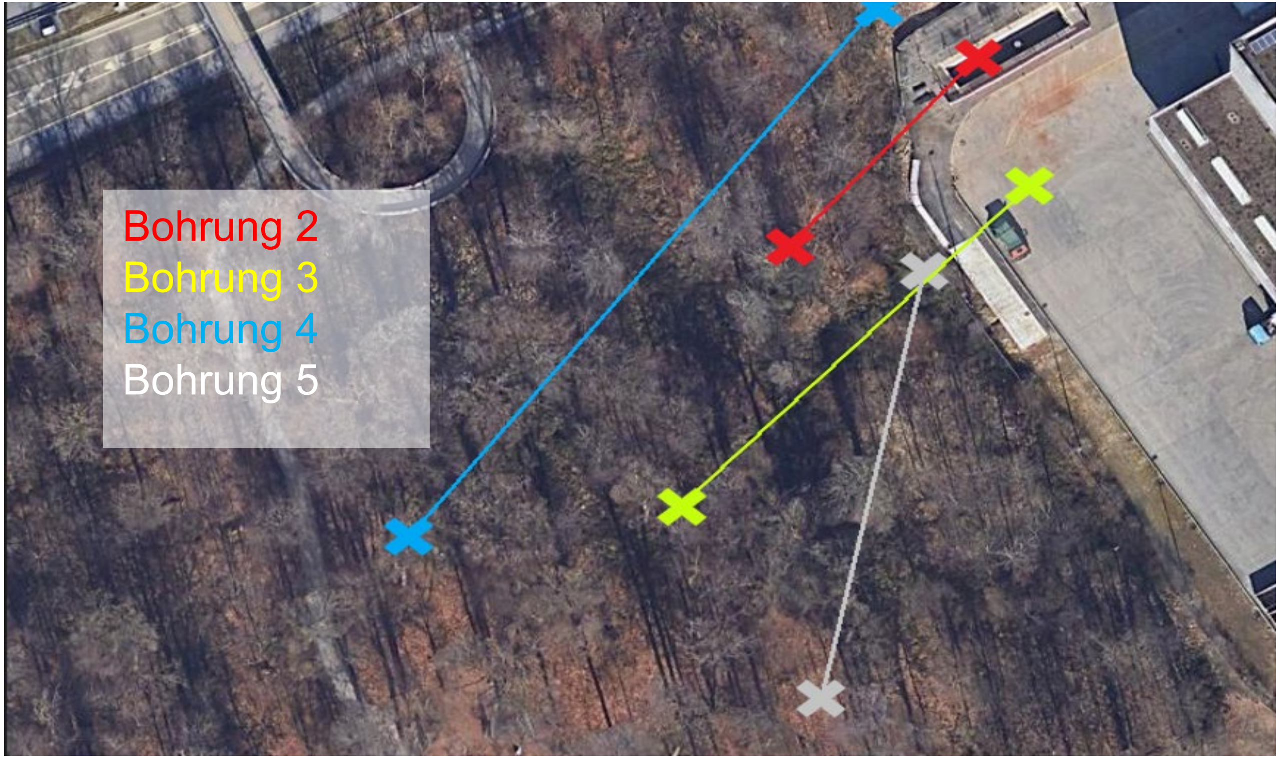
Landing points boreholes 2-5



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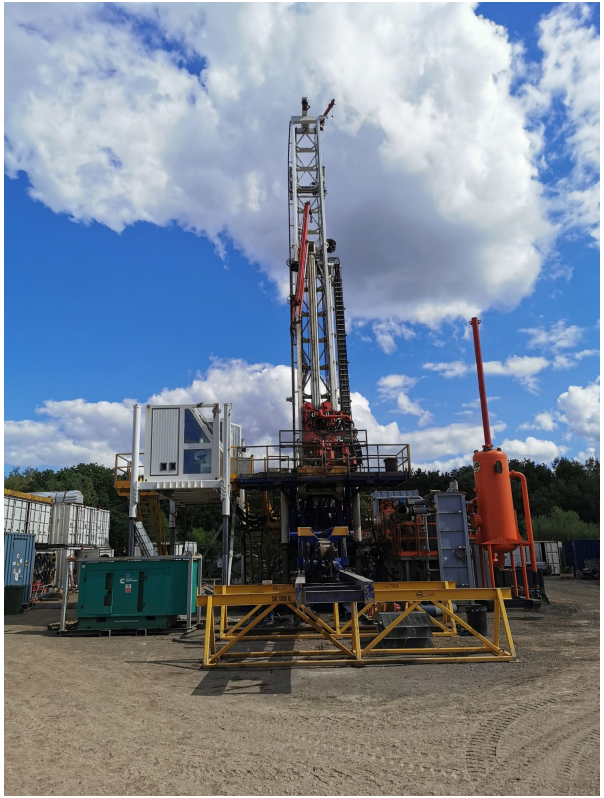
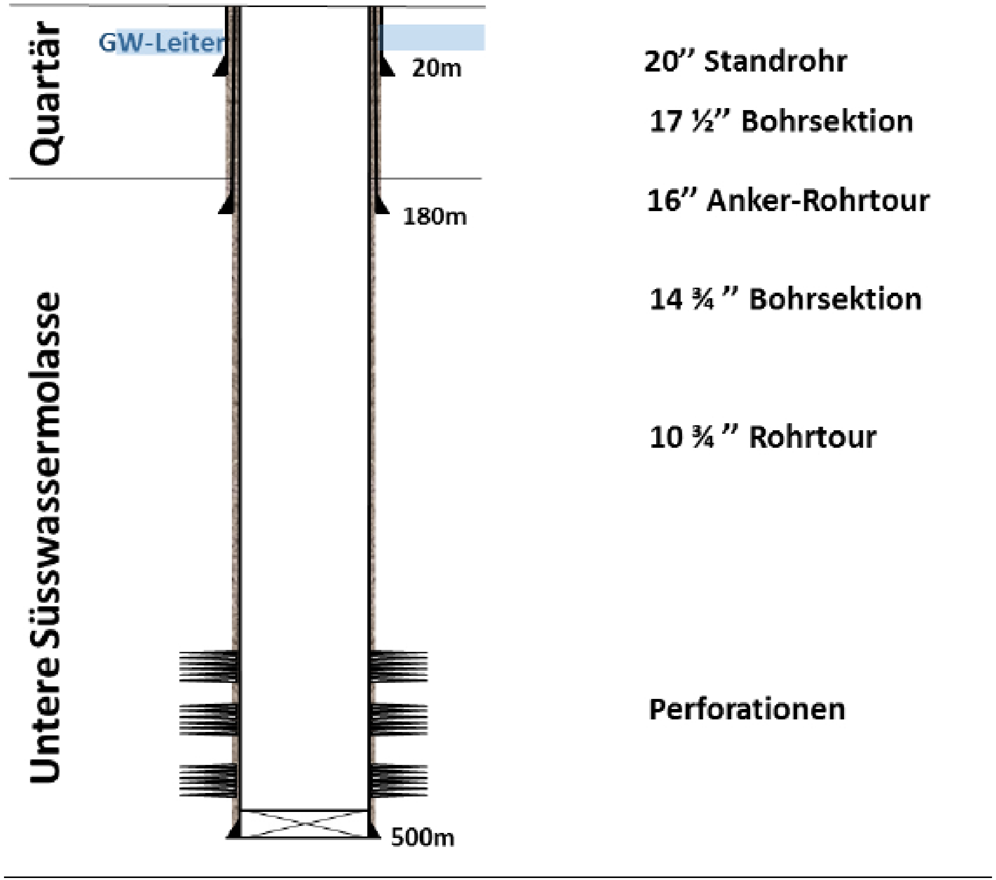
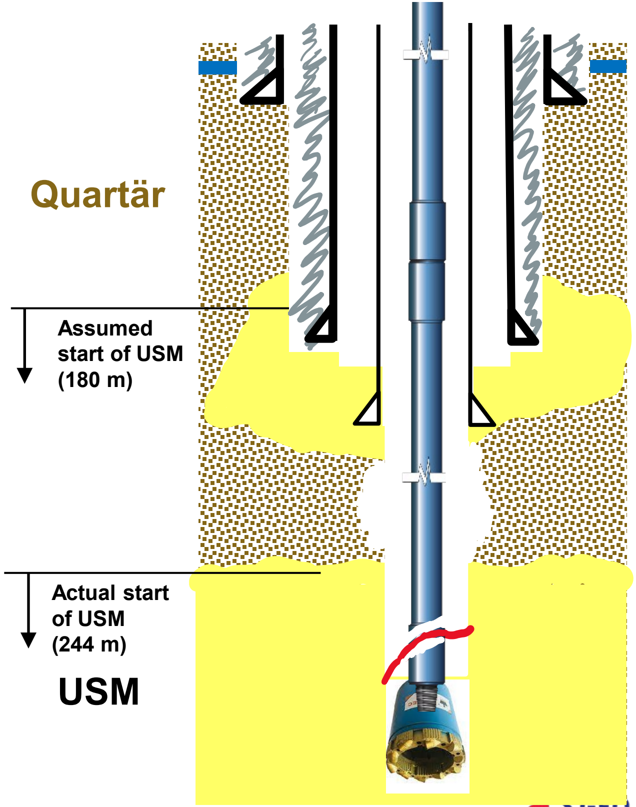
Marriott Rig 18



Casing scheme



1. Borehole



Quartär
Untere Süsswassermolasse

Broken drillstring

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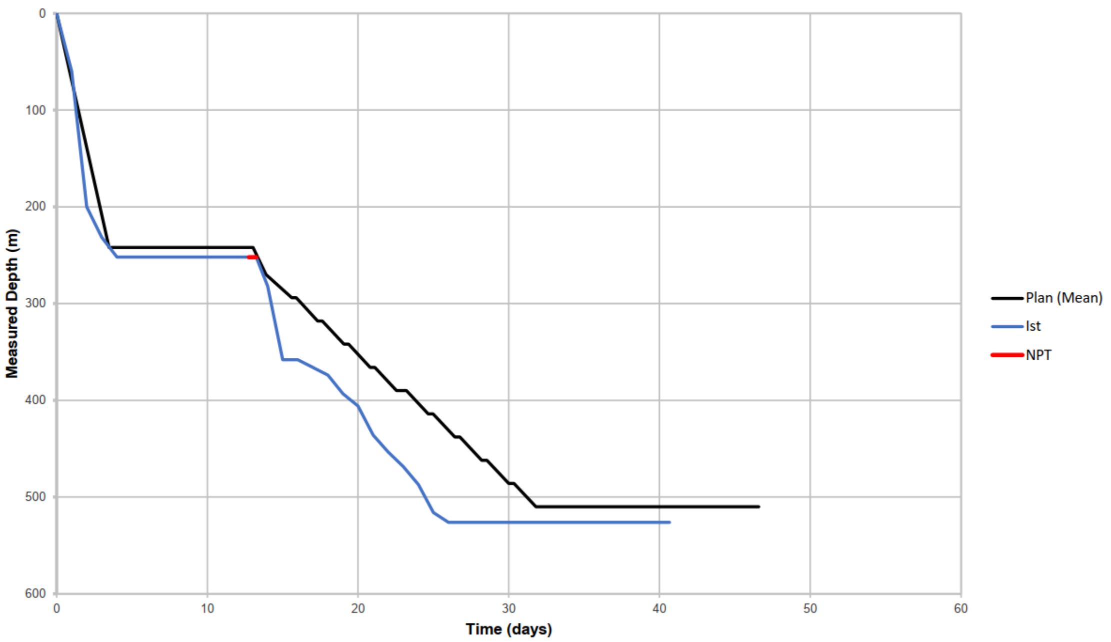
2. Second borehole



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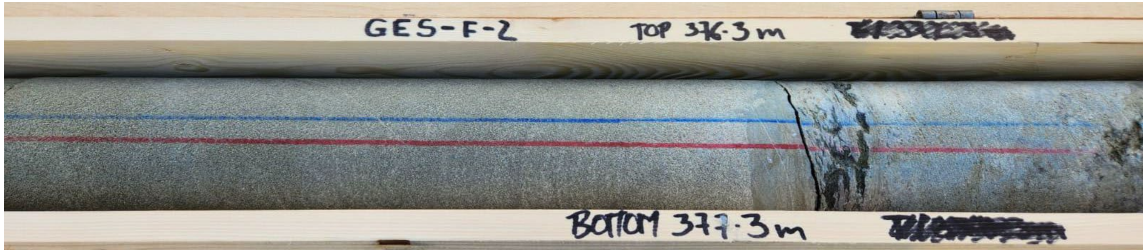
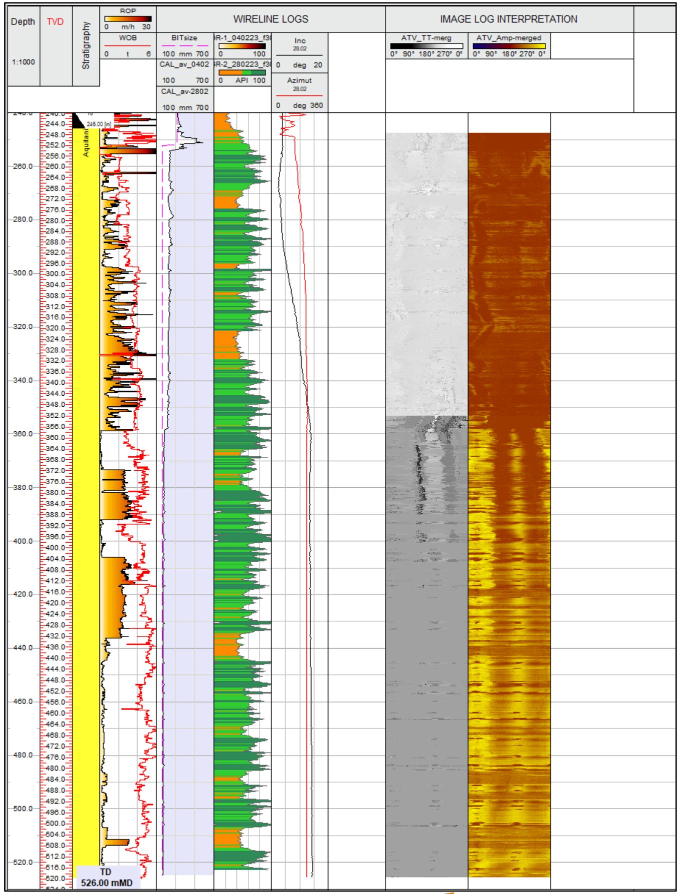
2. Borehole - Geology

- ca. 35 m of sandstone





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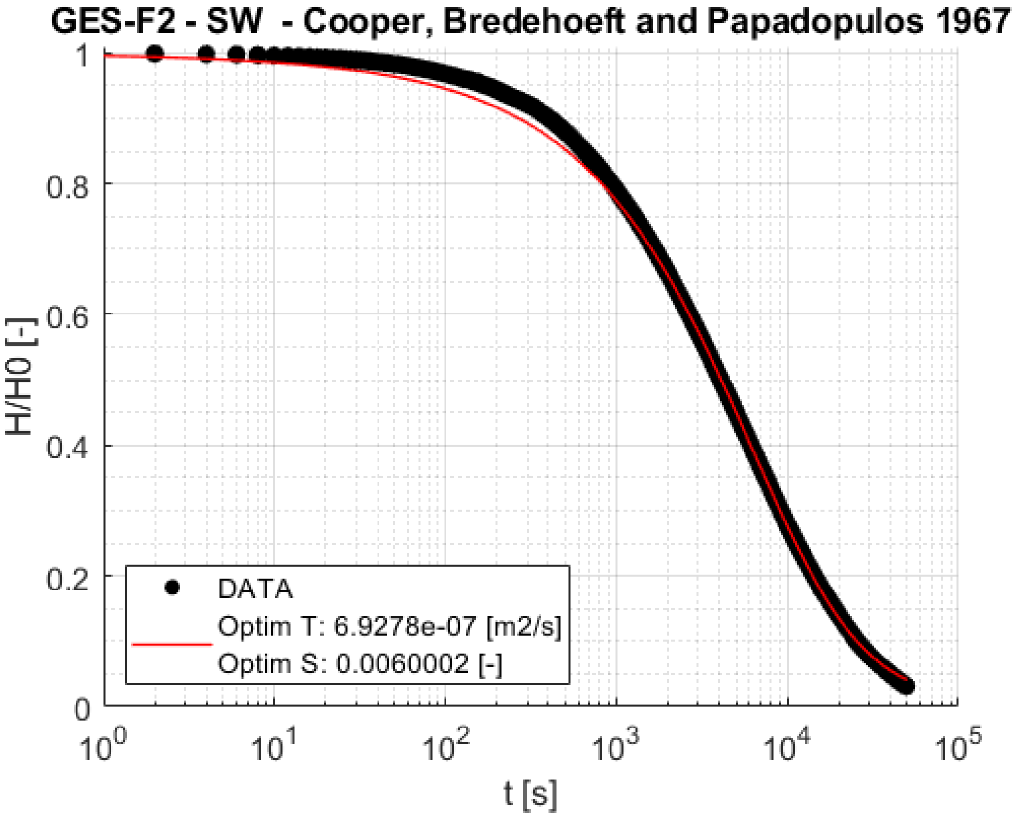
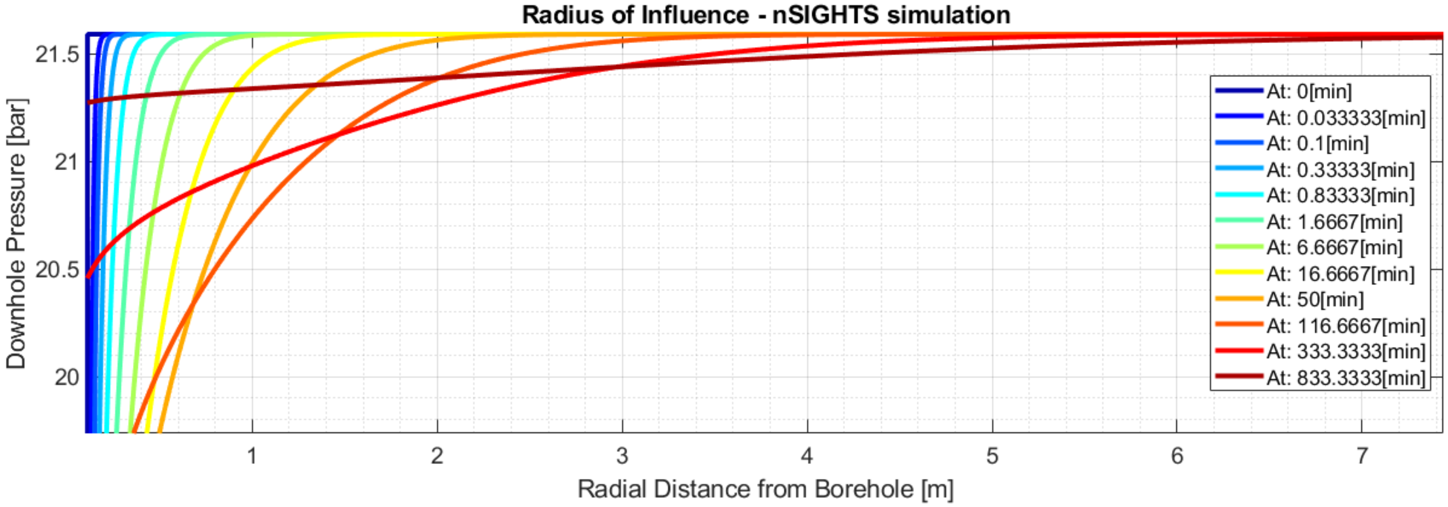
Hydraulic testing: Slug test entire borehole section



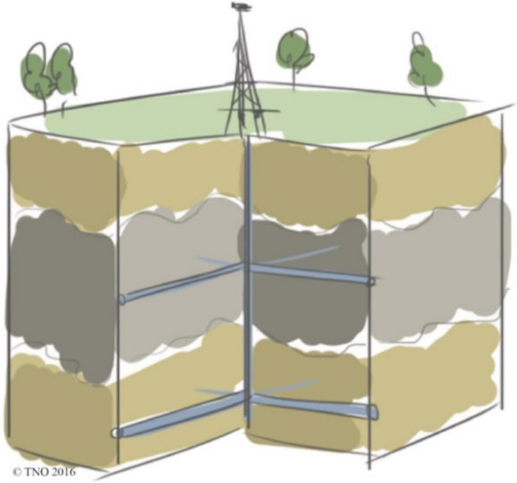
T = 6.9E-7 [m2/s]

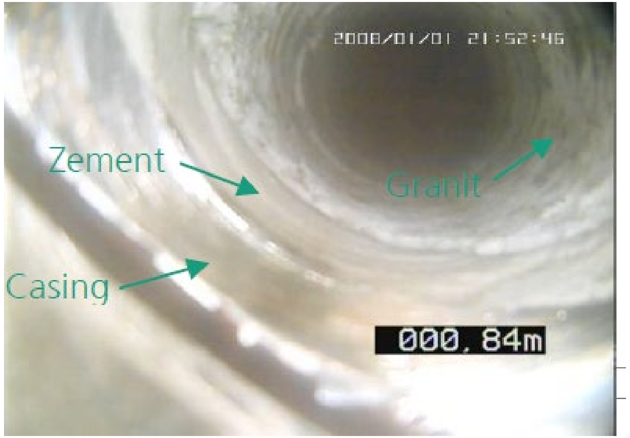
S=6E-3 [-]

Hydraulic radius of investigation of slug tests



Innovation: Radial Jet Drilling and Micro-Drilling





Jetting-Test USM-core (Fraunhofer Bochum)

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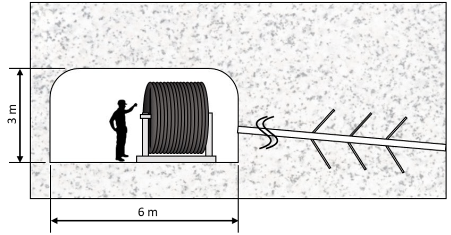
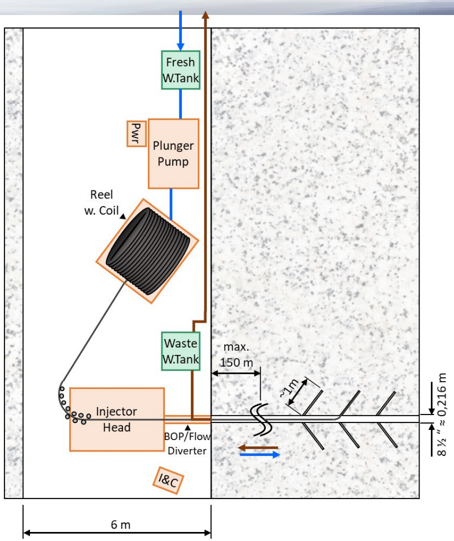
WP2 Notching / jetting/ micro drilling at Bedretto (1)





Deflector shoe

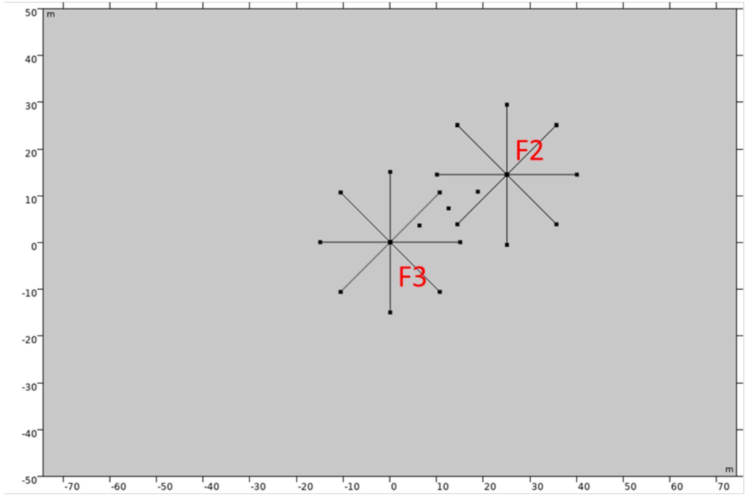
Microturbine with bit

High pressure pump

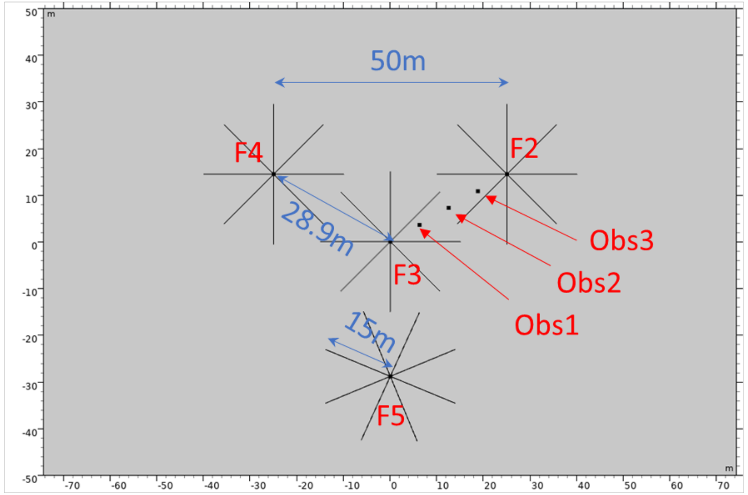
Jetting not enough powerful in granite,
But the deployment worked => strongly recommeded for softer rocks

Modelling the effects of radial drillings

2-well configuration



Triangle configuration



Main parameters: $T_{sandstone}$ = 5E-7 m^2/s; T_{jets}=1E-2m^2/s

Flow regimes: convergent (i.e., pumping at auxiliar wells) and “natural” (no pumping)

Injection scheme: 8 months load + 4 months unload

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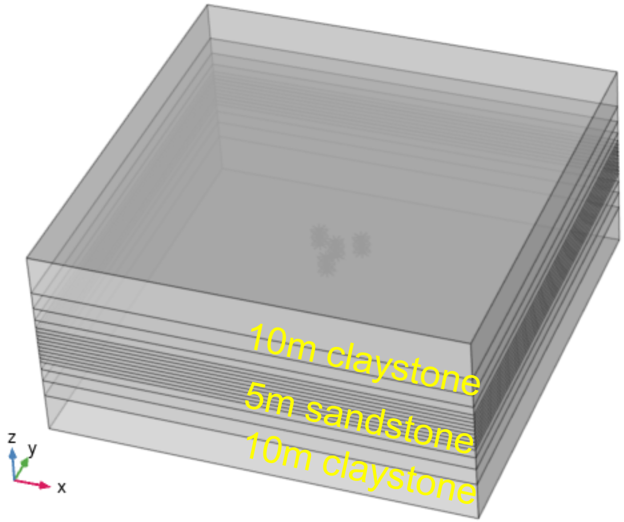
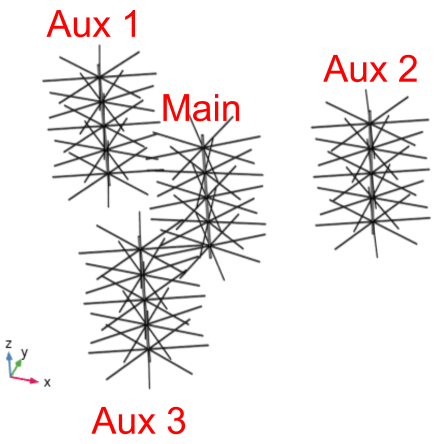
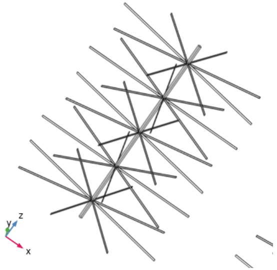
The synthetic model in a nutshell







- 5 crowns with 8 jets each (1m spacing)
- "Rotating" azimuth of jets
- Length jets = variable (0,5,10,15m)
- Radius jets = 2cm
- Radius boreholes = 20cm

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Impact of flow and thermal regime: comparison forced vs unforced

- **Forced:**
  - Load cycle: injection 5 kg/s, T=90C at main well and pumping of either 5/3 kg/s at Aux1 to 3 or 5 kg/s at Aux2
  - Unload cycle: pumping of 5 kg/s at main well and injection with T=60C of either 5/3 kg/s at Aux1 to 3 or 5 kg/s at Aux2
- **Unforced:**
  - Load cycle: injection 5 kg/s, T=90C at main well (no pumping at aux wells)
  - Unload cycle: pumping of 5 kg/s at main well and injection with T=60C of either 5/3 kg/s at Aux1 to 3 or 5 kg/s at Aux2

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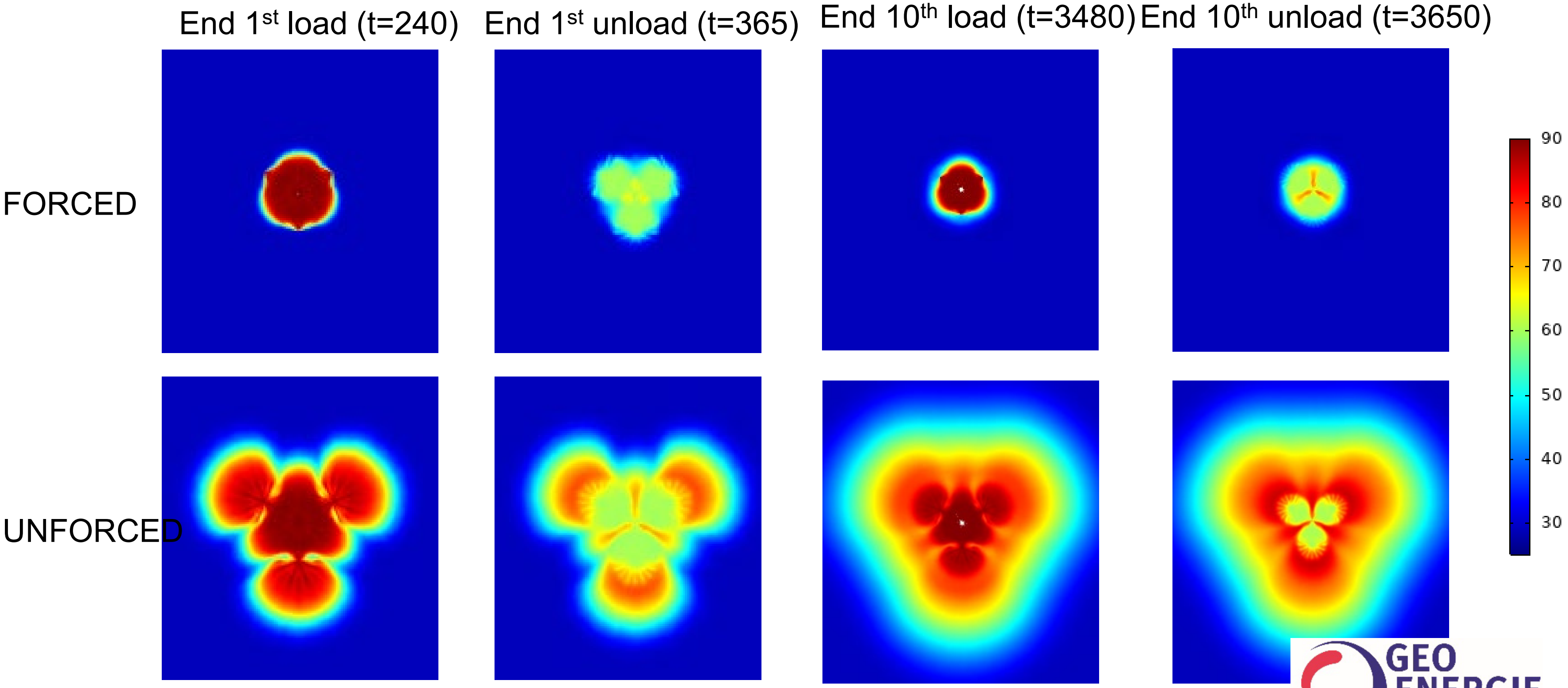
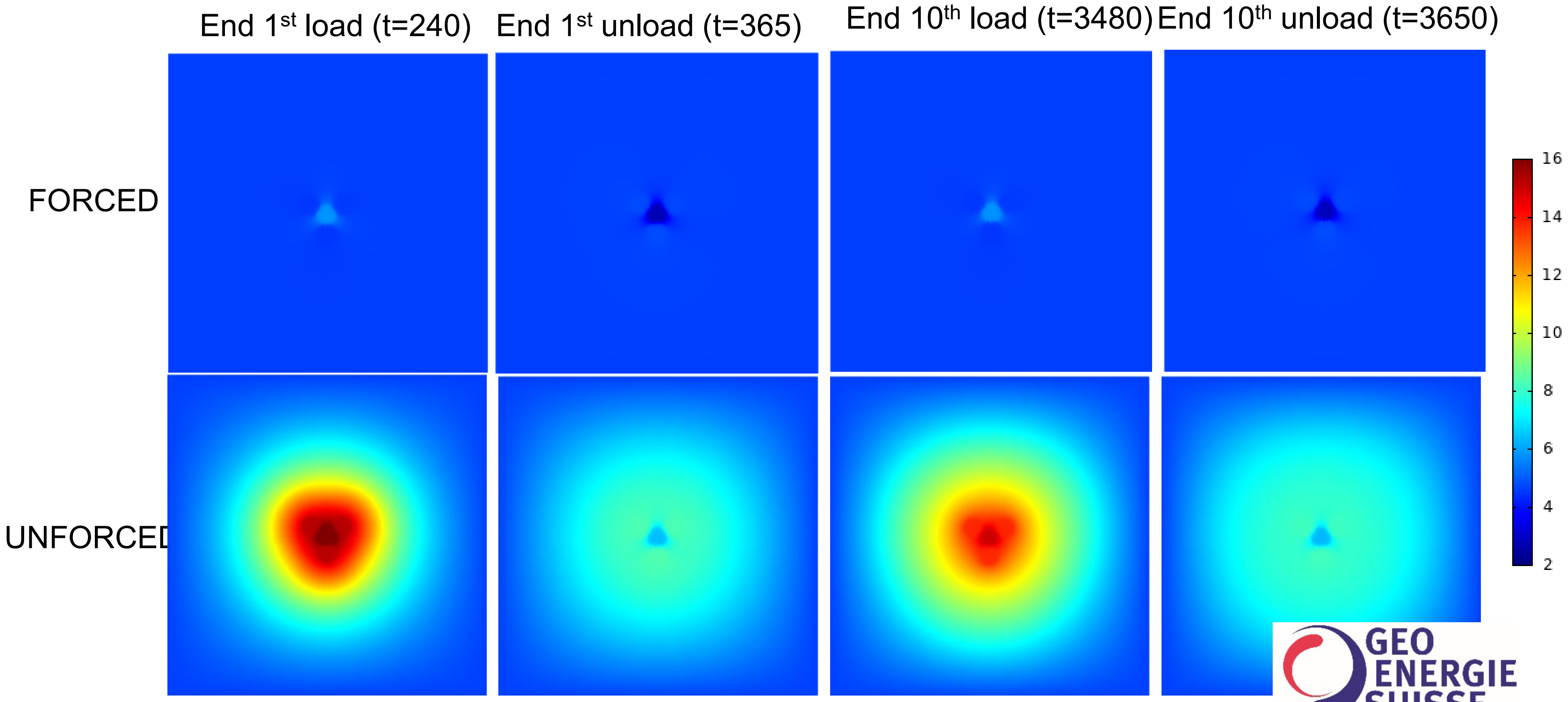
**Impact of flow and thermal regime: comparison forced vs unforced. Triangle configuration.
2D horizontal slice at Drains 3 (Center). Temperature**



Impact of flow and thermal regime: comparison forced vs unforced. Triangle configuration.
2D horizontal slice at Drains 3 (Center). Absolute pressure



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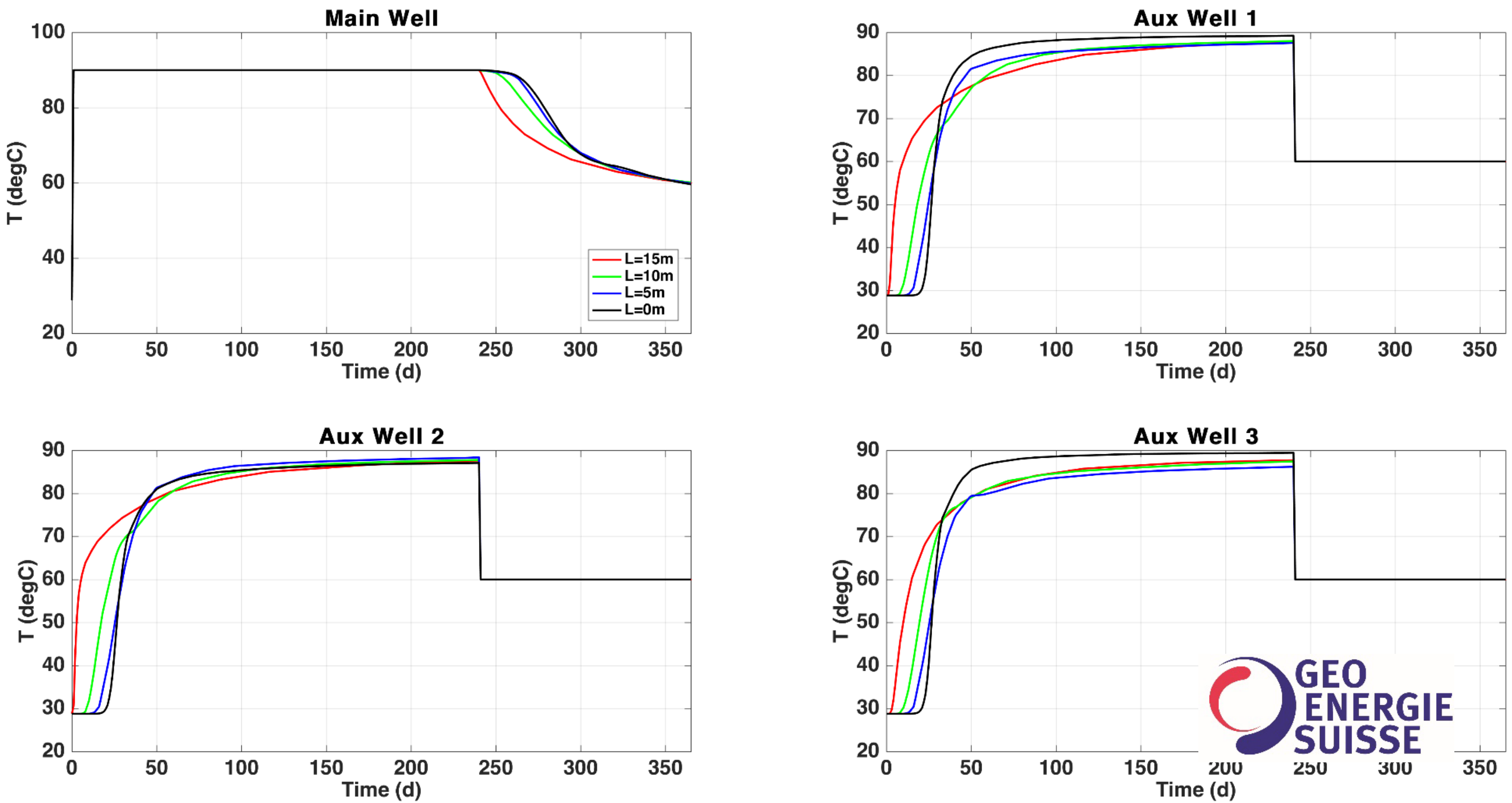
Impact of the length of jets. TRIANGLE forced regime. Temperature



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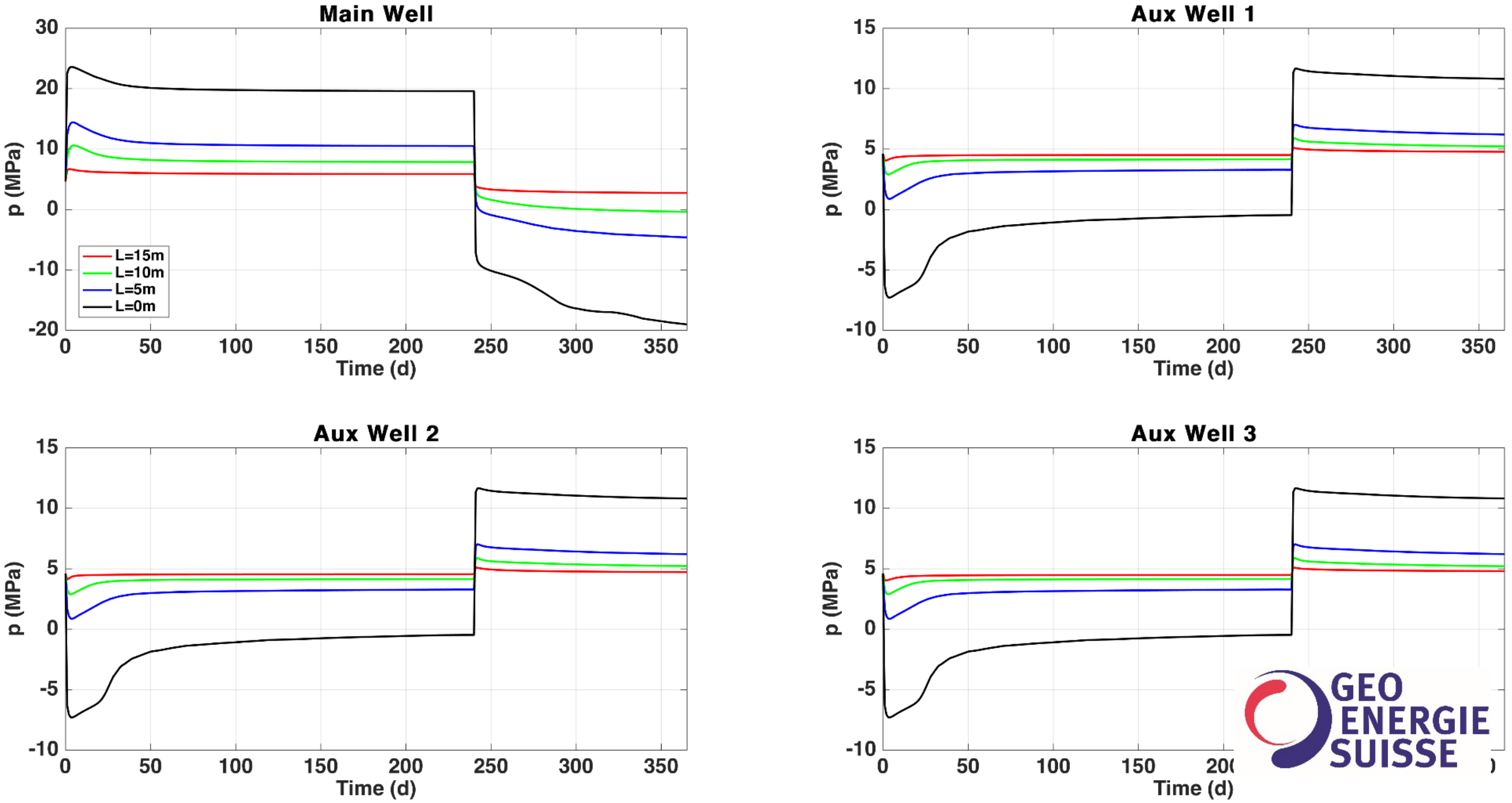
Impact of the length of jets. TRIANGLE forced regime. Pressure



Thank you for your attention