Accelerating Granite-Hosted Geothermal

- Lessons from Fervo for Europe
- Andrew Douglas – SPE Aberdeen 2026

Well Guidance

EDS EUROPEAN DRILLING SERVICES

  - The Granite Suite
  - The Granite City
  - Talking about drilling through…

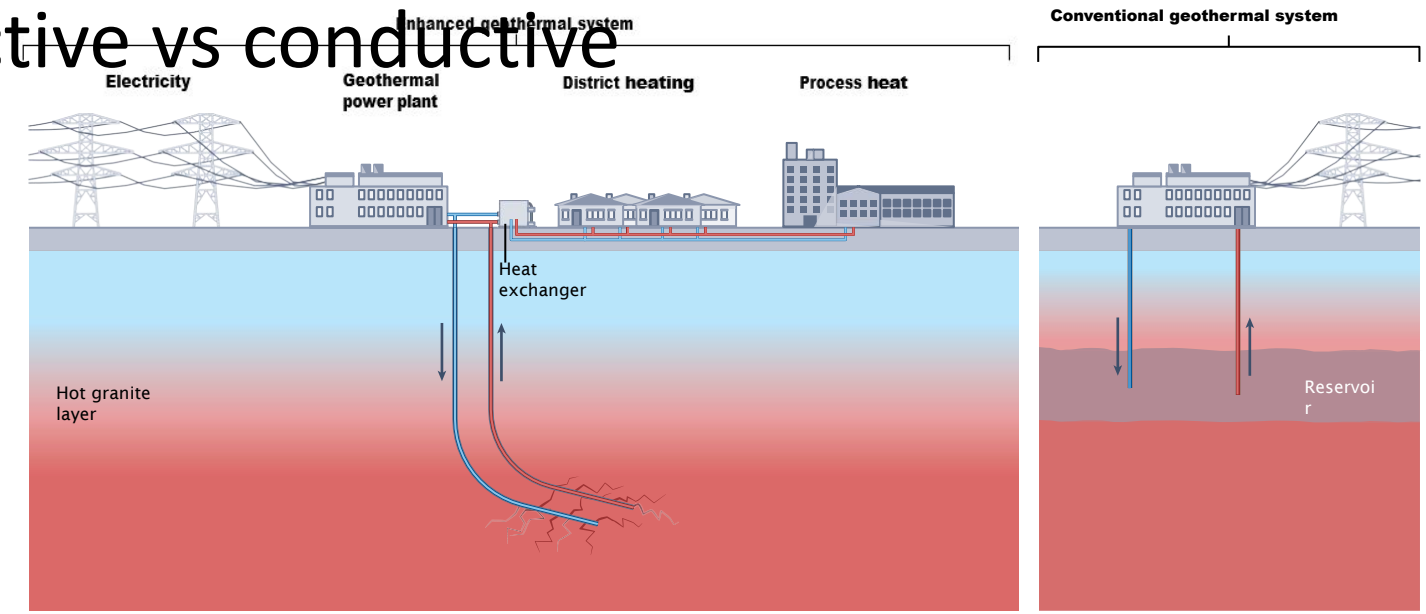
GEOTHERMAL 2026

SPE International Aberdeen Section

Solutions. People. Energy.℠

What is EGS?

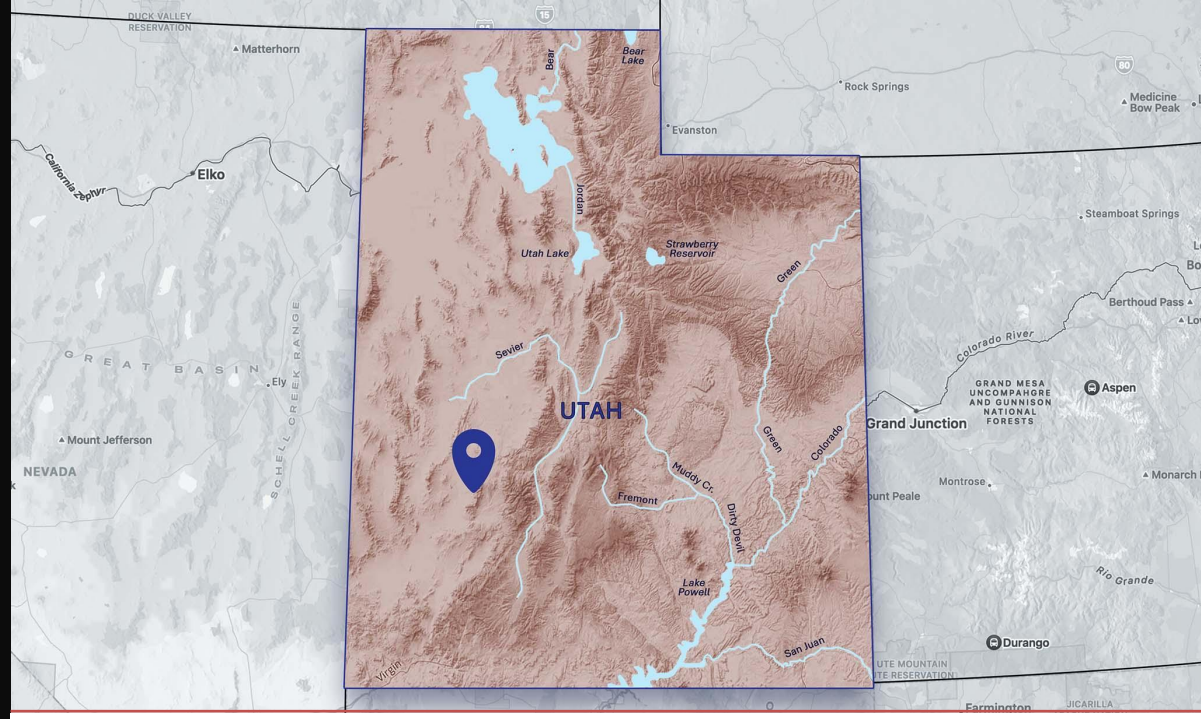
- - Injection & production wells
- - Engineered fracture network
- - Heat exchange
- - Convective vs conductive

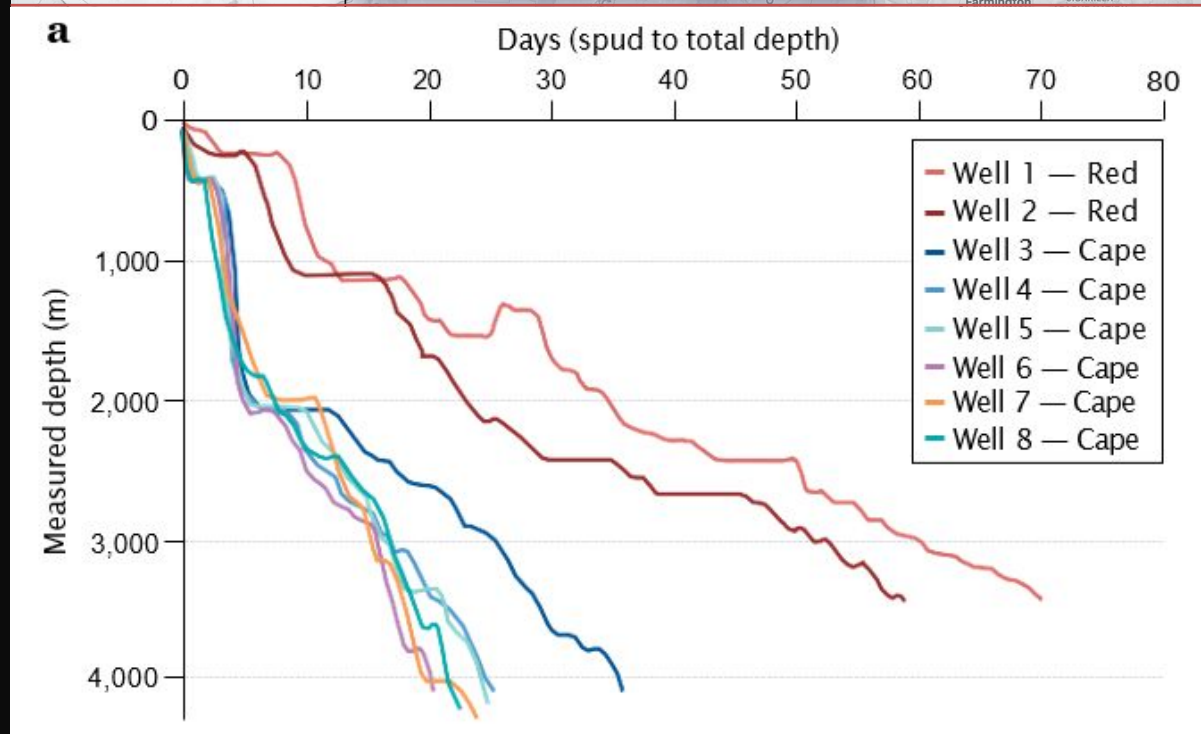


(Horne, Genter et. al 2025)

Fervo: Proof of Concept

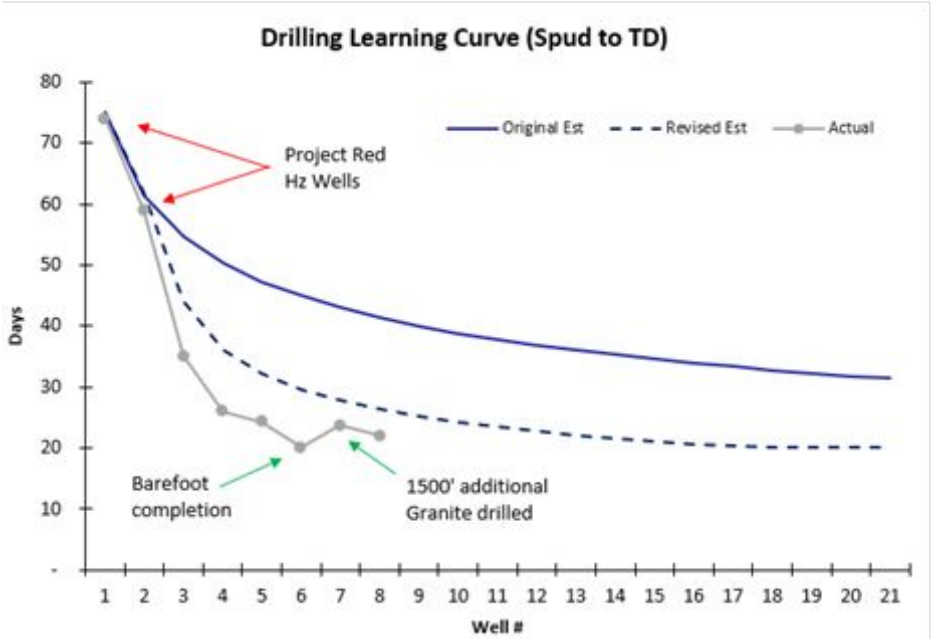
- - Record drilling speed
- - Horizontal EGS wells
- - Commercial flow & temperature
- - Rapid learning curve





How Fervo Did It

- Drilling Rig & Drilling Fluids
- Optimised bits & BHAs
- MSE monitoring
- Performance Trials



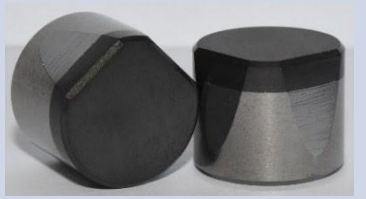
Powerful Drilling Rig Deployed - H&P 492

- **Rig Type:** H&P FlexRig® (Walking, highly mobile).
- **Power System:** Electrified (grid-powered) with Grid Sync system to convert utility power for drilling operations.
- **Power Generation (Alternative):** Capable of using 4x diesel generators, with 1-2 units typically running.
- **Environmental Impact:** 25% lower noise, 96% reduction in NOx, and significant CO2 reduction due to electrification.
- **Primary Application:** Geothermal drilling, including horizontal wells with long laterals.
- **Capabilities:** Equipped to handle high-temperature, hard-rock drilling conditions.

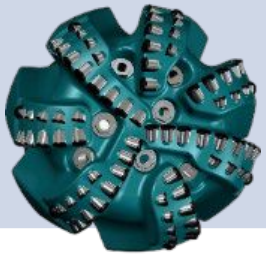
Drill Bits

PDCs – Polycrystalline Diamond Compact

Changes in Cutter Design



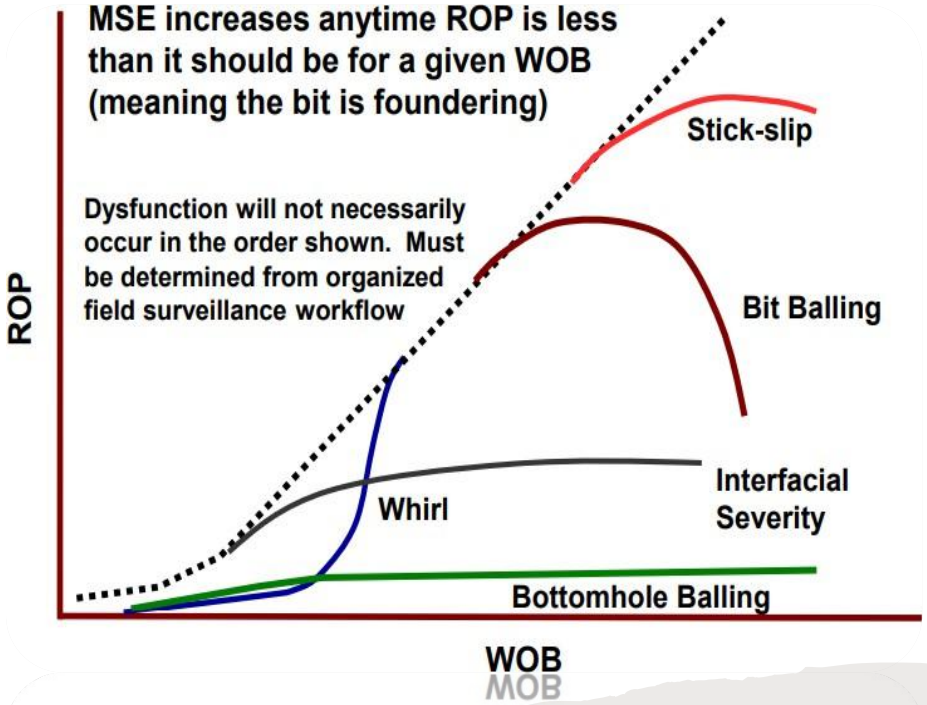
Increased Durability

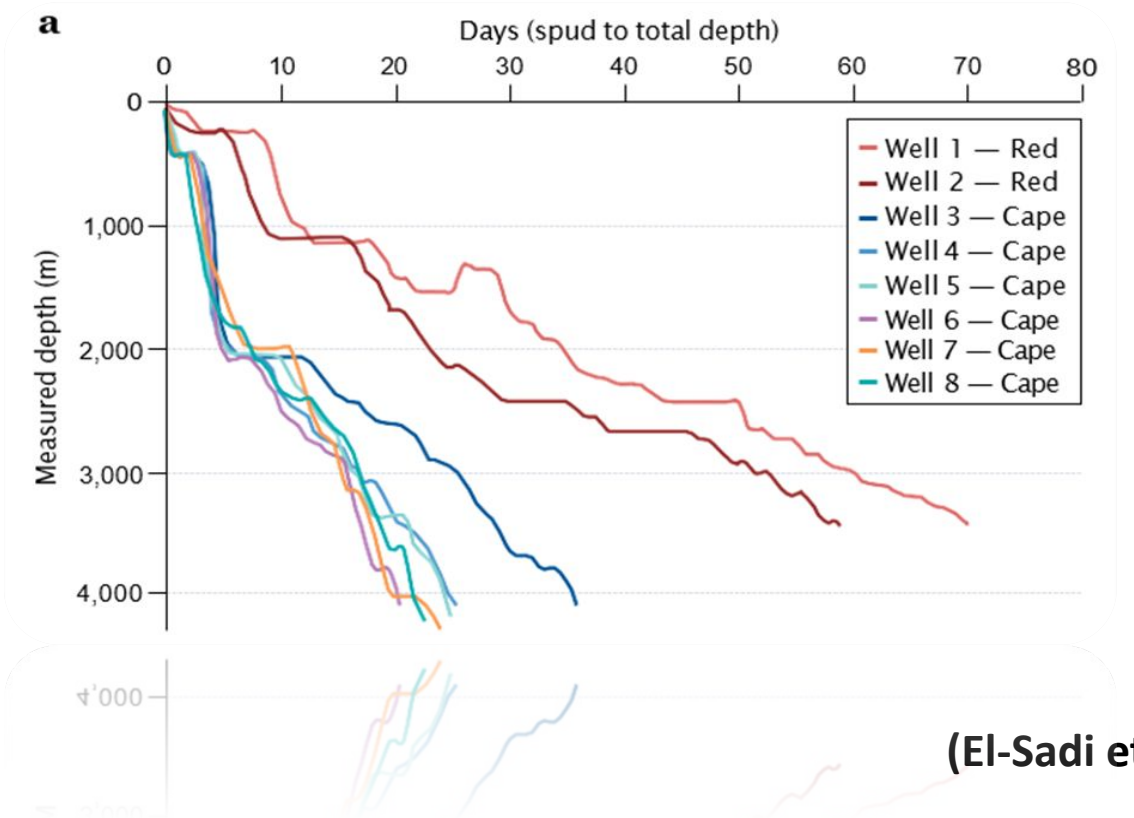


MSE monitoring

$$MSE_{psi} = \frac{480 \times TOR \times RPM}{Dia^2 \times ROP} + \frac{4 \times WOB}{\pi \times Dia^2}$$

- Mechanical Specific Energy (MSE)
  - WOB
  - RPMs
  - Torque
  - ROP





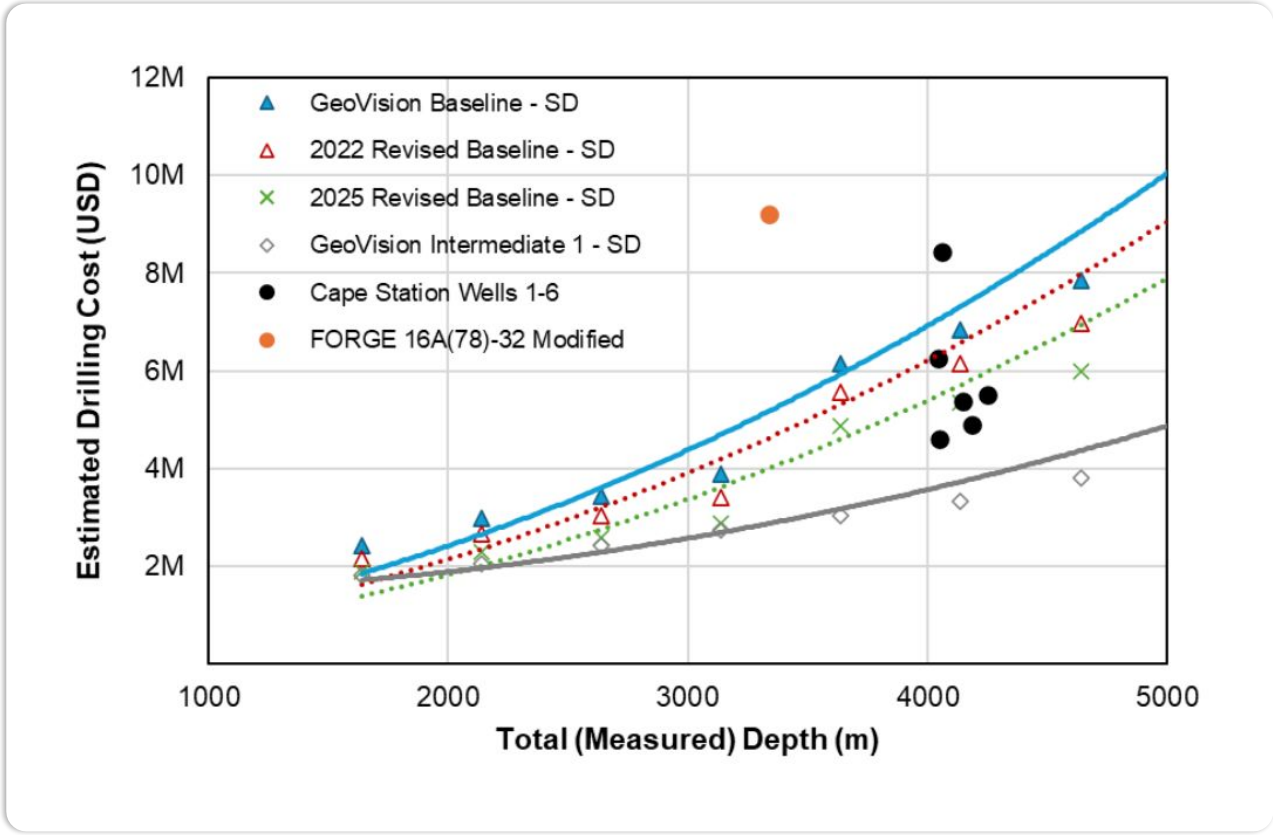
Project	Well	Days	TD (m)	Drilling rate (m/day)	Cost ($/ft)	Cost ($/m)
Project Red	1	71	3,420	48.2	994.62	3263.15
Project Red	2	58	3,417	58.9	1,106.74	3630.99
Cape Station	3	33.75	4,059	120.3	633.45	2078.22
Cape Station	4	25.91	4,045	156.1	471.59	1547.19
Cape Station	5	24.26	4,146	170.9	395.71	1298.25
Cape Station	6	20.1	4,051	201.5	346.45	1136.63
Cape Station	7	23.71	4,252	179.3	394.08	1292.90
Cape Station	8	22.27	4,186	188.0	357.36	1172.43

(El-Sadi et al. 2025)

Performance & Cost Outcomes – Project Red / Cape Station

Why Speed = Economics

- - Drilling dominates cost
- - Fewer days = lower CAPEX
- - Learning curves
- - Bankability



Source: NREL

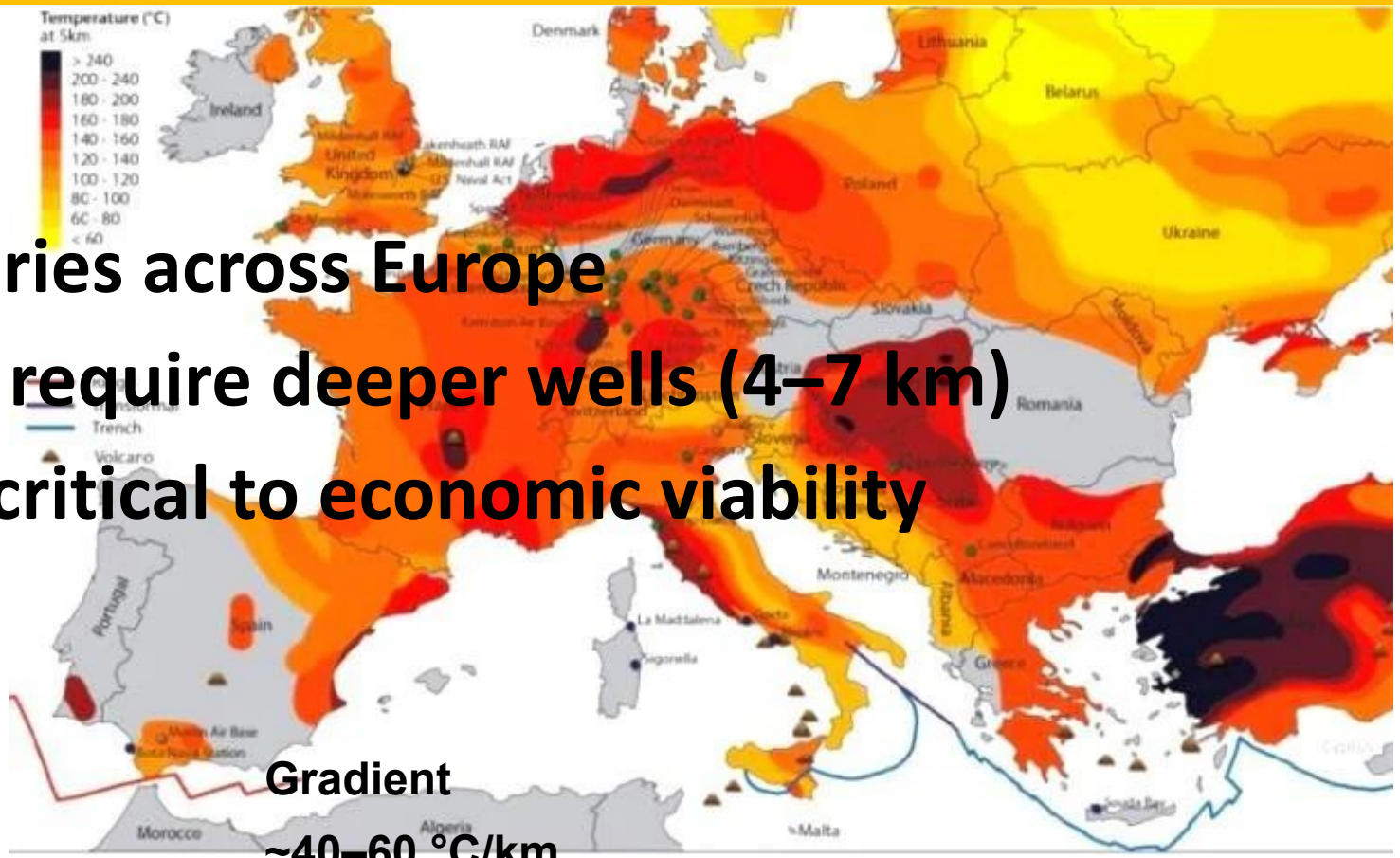
Translating to Europe

- - Stress regime
- - Depth to heat
- - Faulting
- - Permitting
- - Supply chain

European Granite

- **Control of the fracture orientation & stimulation geometry**
- **European granites may behave differently from Basin-and-Range EGS systems (such as in Utah)**
- **Norway:** high-strength, durable, and stable granites, with types like Blue Antique exceeding 200–250 MPa.
  - fractures may be more horizontal
- **Sweden:** strong granites such as Red Bohus (112–158 MPa) and various types in Central Sweden ranging around 127–205 MPa.
  - fractures may be more horizontal
- **Finland:** Known for high-quality, durable stone, with types like Kuru Grey typically ranging from 179 to 201 MPa and others from 150 to 220 MPa.
- **UK:** Commonly >200 MPa
- **Germany/France:** compressive strength range of 100–250 MPa.
  - Normal faulting but with complex fault systems
  - increased induced seismicity risk.

Depth to heat in Europe



- **Geothermal gradient varies across Europe**
- **Some granite provinces require deeper wells (4–7 km)**
- **Drilling performance is critical to economic viability**

Typical gradients:

Region	Gradient
Basin & Range (Utah/Nevada)	~40–60 °C/km
Upper Rhine Graben	~35–45 °C/km
Nordic Shield granites	~20–30 °C/km

Permitting

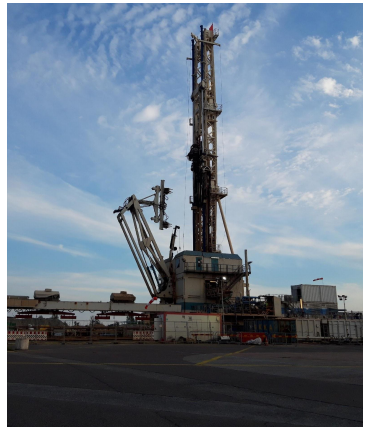
- Permitting timelines vary significantly.
- Approximate comparison:

Region	Typical timeline
US geothermal states	1–3 years
Germany / France	3–6 years
Nordics	2–4 years

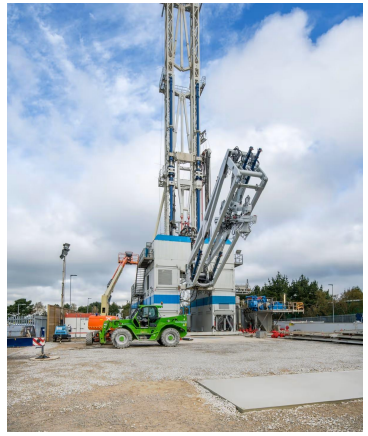
Supply Chain

- Drilling rigs capable of deep high-temperature wells
- Rotary Steerable Tools
- High-temperature MWD/LWD
- Stimulation Equipment
- Experienced drilling teams

European Opportunities

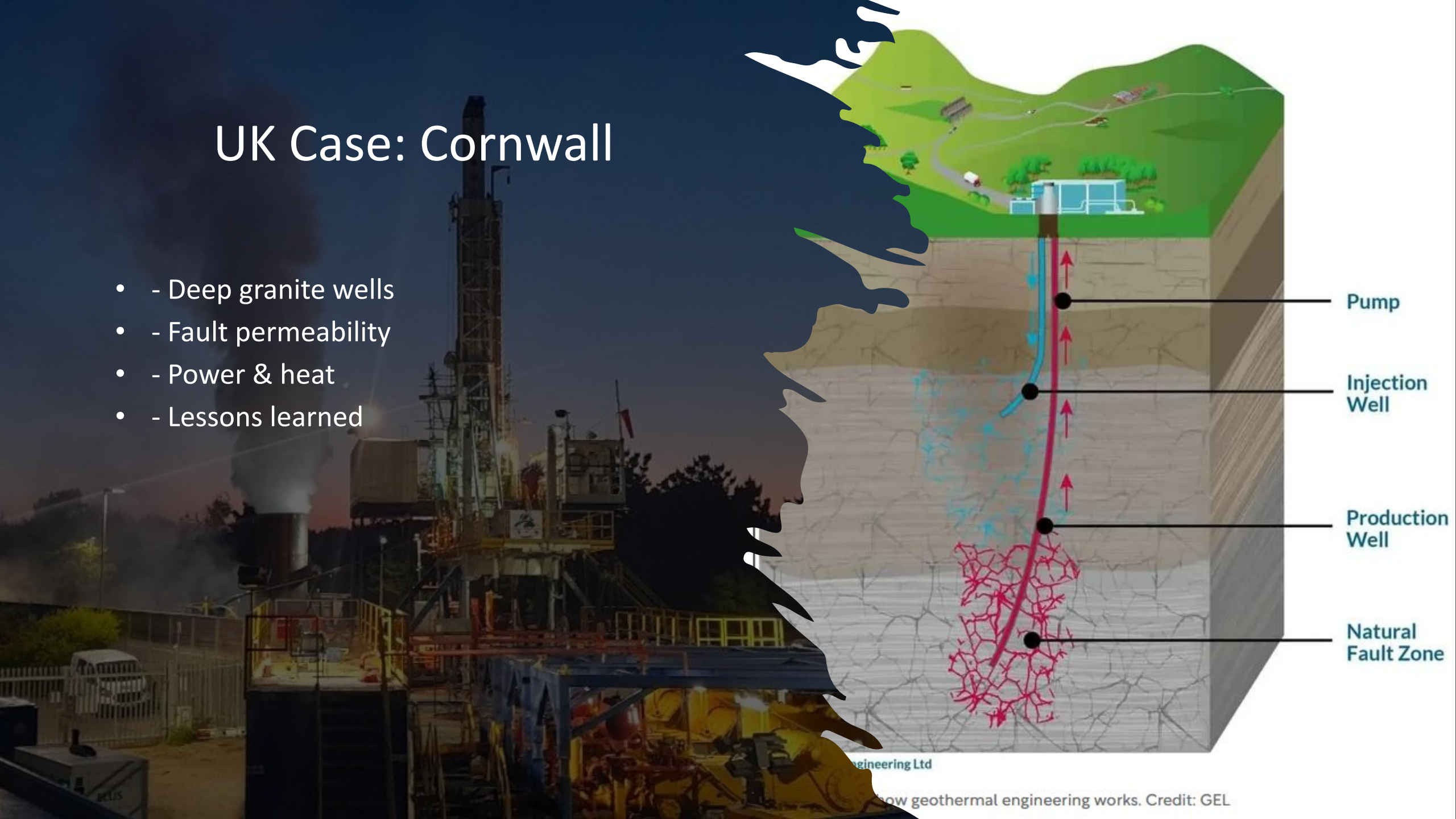


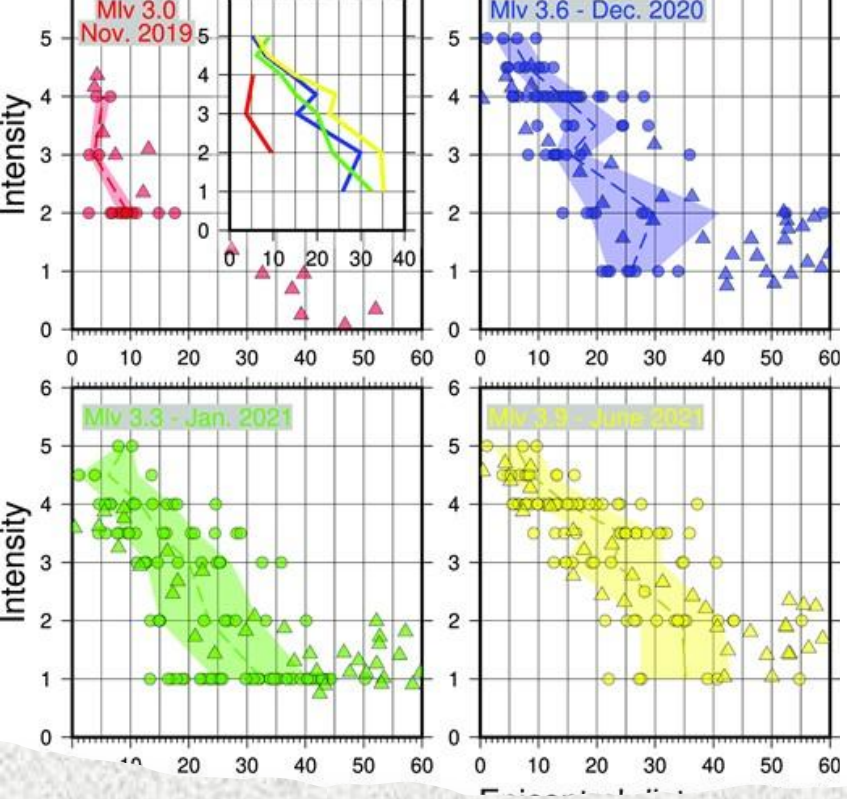
- - UK: Cornwall & Scotland
- - Germany/France
- - Finland/Sweden
- - Norway

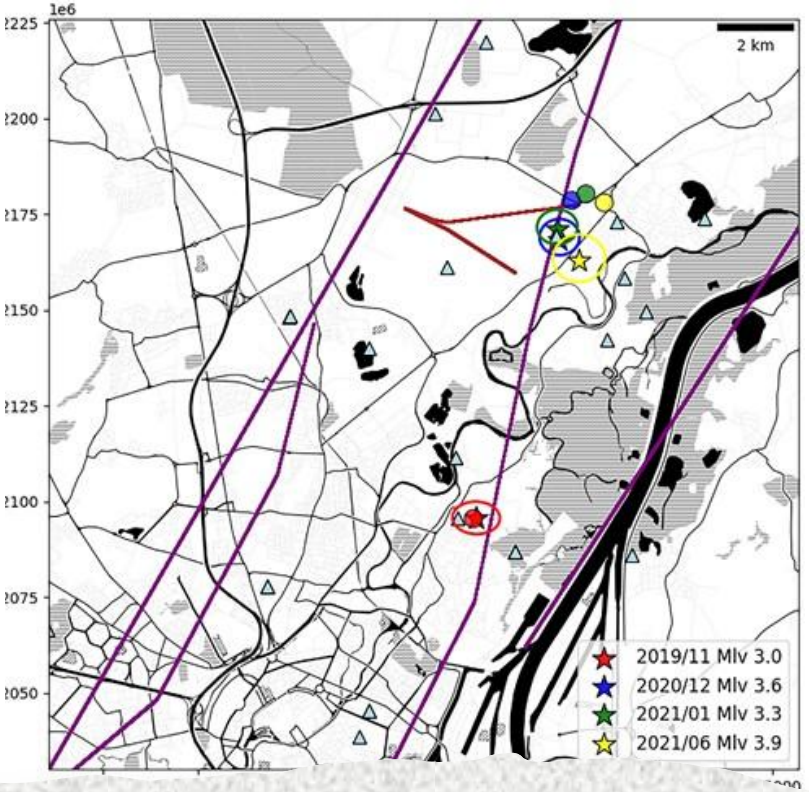


UK Case: Cornwall

- - Deep granite wells
- - Fault permeability
- - Power & heat
- - Lessons learned




Mlv 3.0
Nov. 2019
Mlv 3.6 - Dec. 2020
Mlv 3.3 - Jan. 2021
Mlv 3.9 - June 2021
Intensity
Epicentral distance


1e6
2 km
2019/11 Mlv 3.0
2020/12 Mlv 3.6
2021/01 Mlv 3.3
2021/06 Mlv 3.9


Wantzenau
Strasbourg
Kehl
Offenburg
Illkirch-
Graffenstaden
GERMANY
Esri, CGIAR, USGS


Wantzenau
Strasbourg
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Offenburg
Illkirch-
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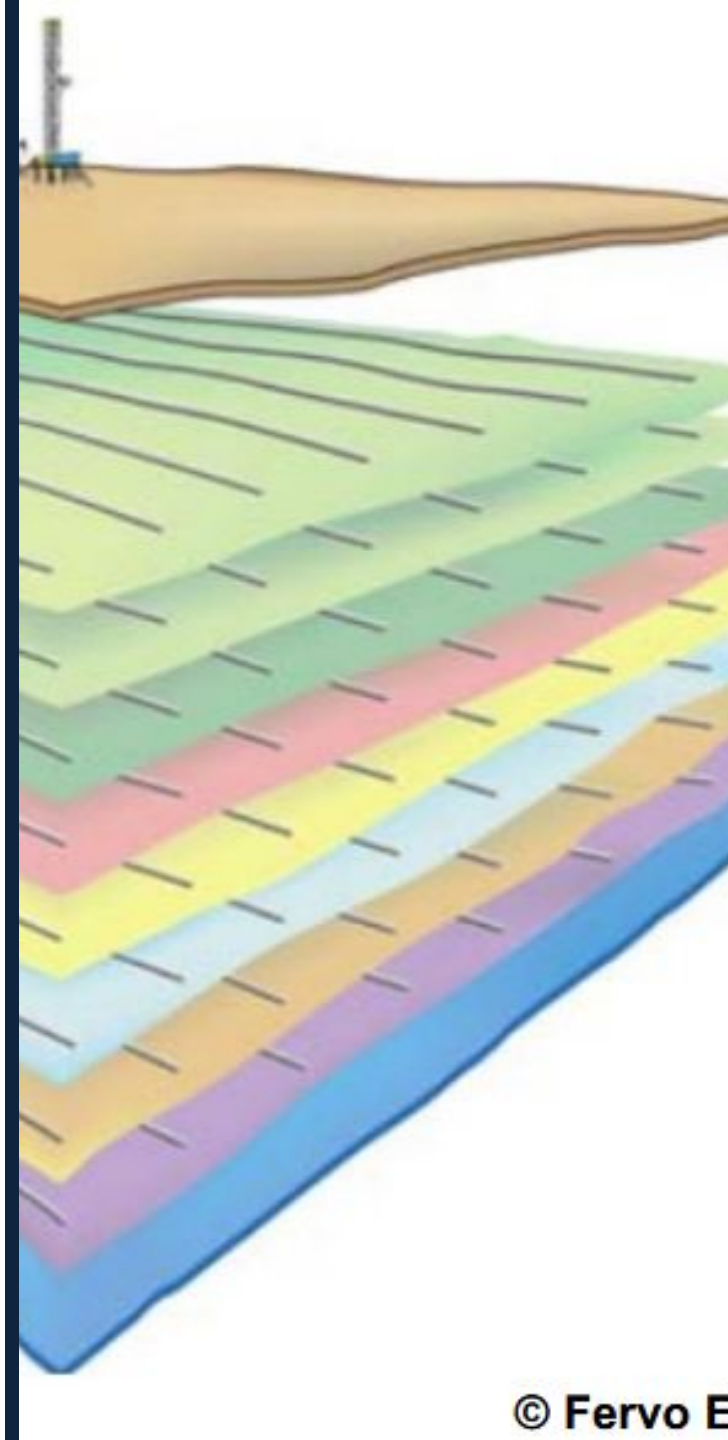
GERMANY
Esri, CGIAR, USGS


22/01/2021 earthquake (3.3 MLv, Imax = V)
FRANCE
Haguenau
Baden-B.
Wantzenau
Strasbourg
Kehl
Offenburg
Illkirch-
Graffenstaden
GERMANY
Esri, CGIAR, USGS


26/06/2021 earthquake (3.9 MLv, Imax V)
FRANCE
Haguenau
Baden-B.
Wantzenau
Strasbourg
Kehl
Offenburg
Illkirch-
Graffenstaden
GERMANY
Esri, CGIAR, USGS

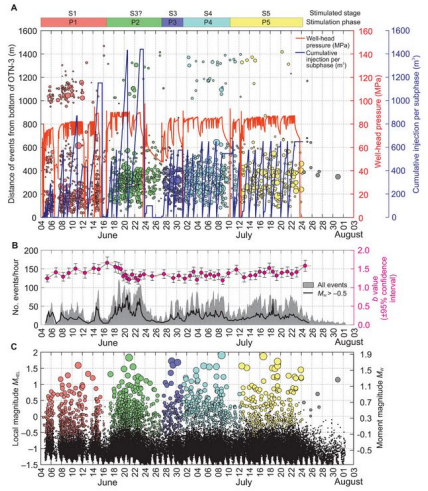
Deployment Roadmap

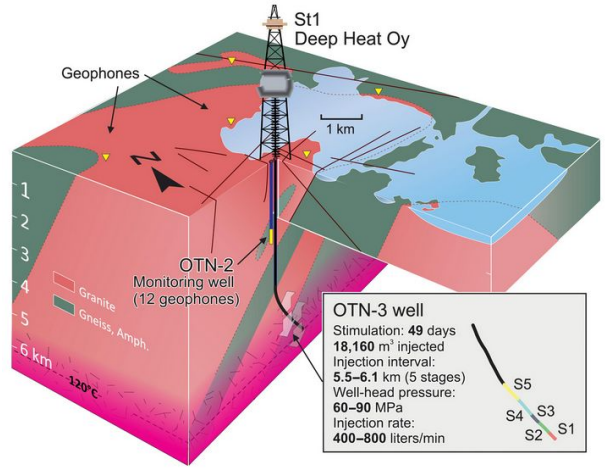
- **Pilot wells**
- **Standard well design**
- **Factory-style drilling**
- **Supply chain maturity**
- **Regulatory frameworks**
- **Commercial Results**

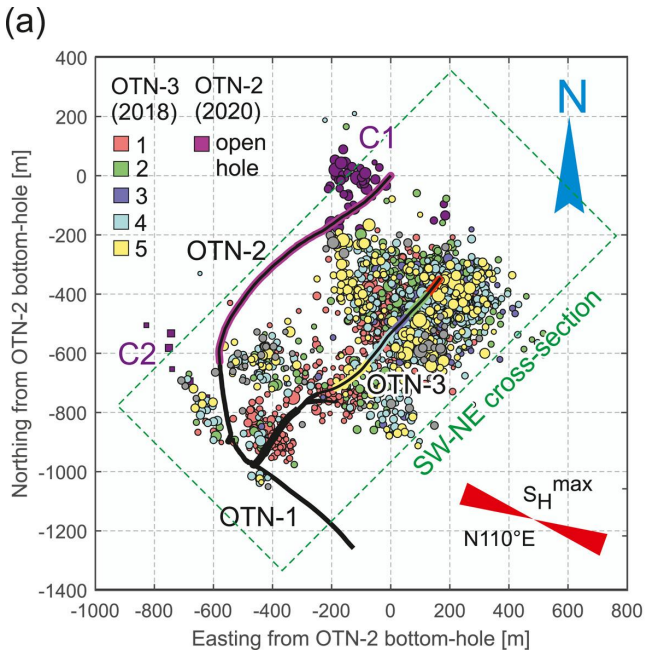


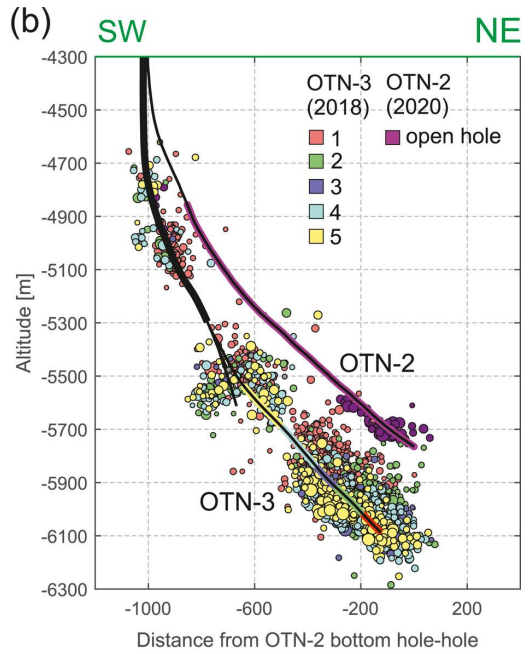
Remaining Gaps

- - Tool reliability
- - Stimulation
- - Seismic risk
- - Permitting









Conclusions

- - Granite EGS works
- - Drilling is key
- - Adapt Fervo model
- - ERS could be a future game changer
- ***“From pilot wells to standardised pad drilling, applying the Fervo model can turn European granite geothermal from experimental projects into a scalable energy infrastructure.”***
- - Time for pilots in Scotland