

DeepGeo

29-01-2021
Mats Egard

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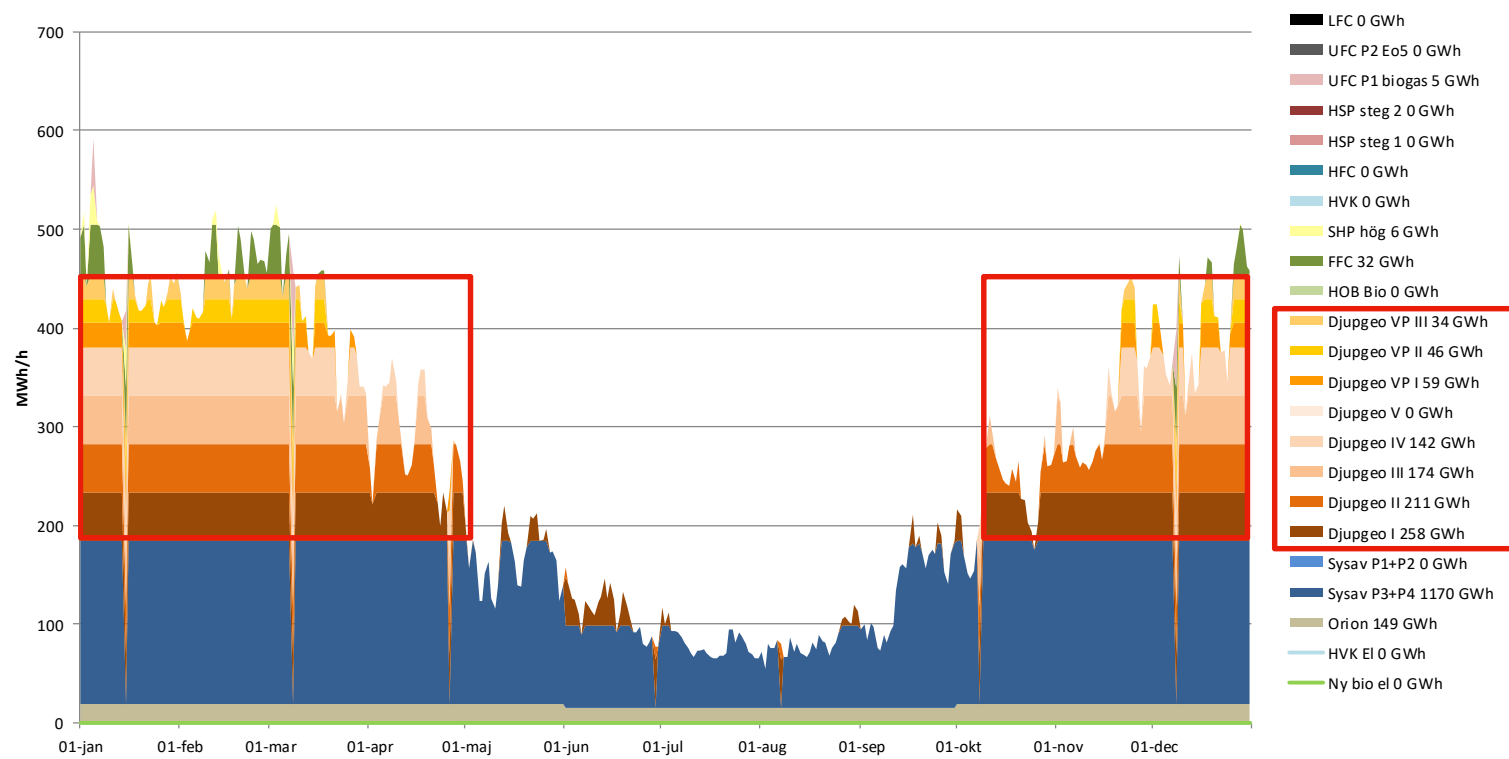
Background - EON 's District Heating Business in Malmö

- 10 000 customers
- 90 % of the apartment buildings are connected to DH
- We connect >95% of new building areas in Malmö
- c. 2200 GWh/year sold volume
- c. 22 GWh/year annual growth
- **Great interest in Renewable District Heating**

- We need to replace old, ageing plants, either by biomass or geothermal



Possible Scenario 2030 - Deep Geothermal (EGS)



Malmö

DeepGeo in the City of Malmö

- ✓ **Test Hole** aiming to show that there is possibility to build an EGS - ongoing
- ✓ Planning and designing an **EGS** with 6,5 km deep wells – ongoing
- ✓ The target is Sweden's first deep geothermal plant delivering heat directly to the district heating network, by 2024
- ✓ A possible game-changer that was previously impossible with our challenging geophysical conditions and in non volcanic areas

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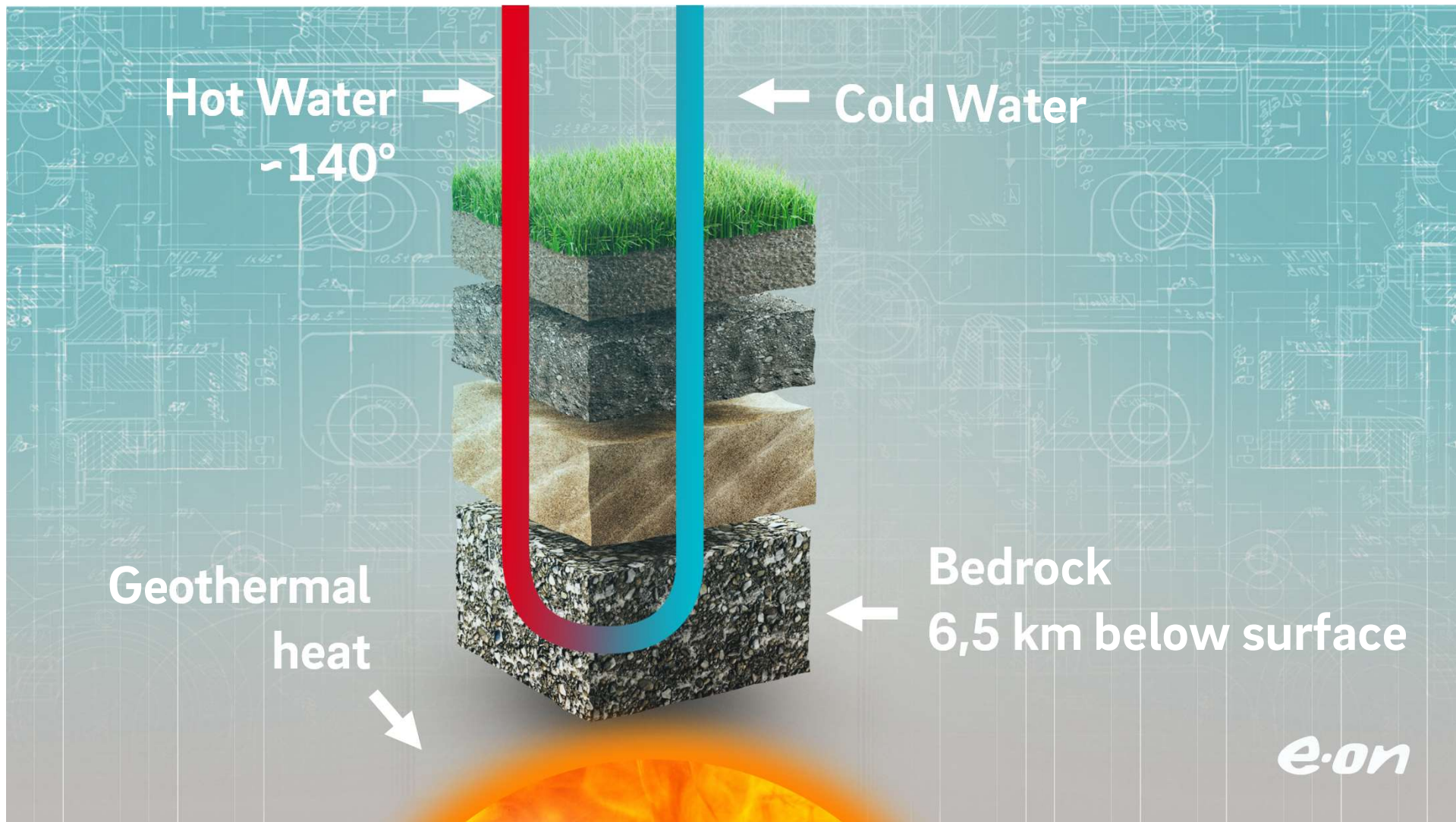
Hot Water →
~140°

← Cold Water

Geothermal
heat

← Bedrock
6,5 km below surface

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Test Hole Project - The Plan

2 x Existing wells
2100 m deep through
sedimentary layers,
ending at top of
basement

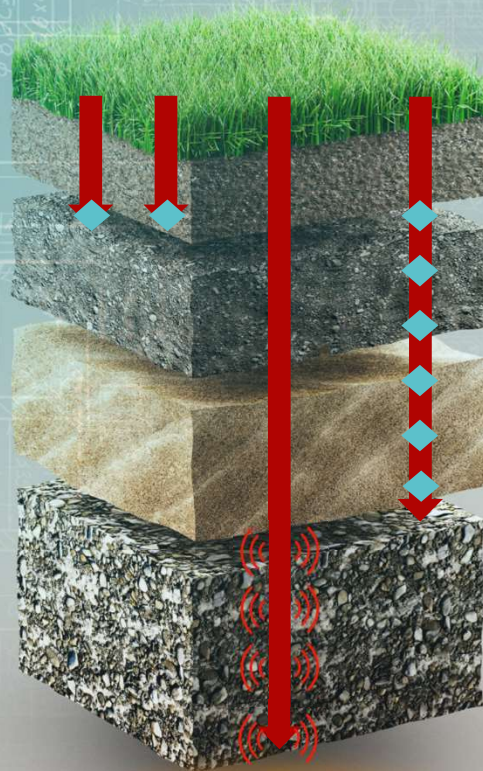


Demonstration and development of:

- ✓ Air hammer drilling in basement
 - ✓ Air-hammer seismics
 - ✓ 3D-modelling of basement
- To give vital information on possible faults, thermal properties, fracture zones, bedrock types, conditions for drilling and hydraulic properties

Test Hole Project - Planned Scope

2 x Geophone hole
750 m



1 x Geophone array



1 x Test hole
4000 m



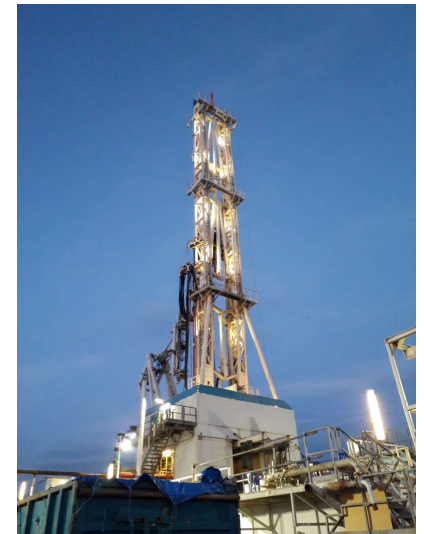
Test Hole Project - Results

- Air hammer drilling as a method has been tested
- It worked very well when there was no water in the hole.
- ROP in basement: 10-20 m/h.
- There was too much water leaking into the hole
- We drilled 90 m with air hammer



Test Hole Project - Results

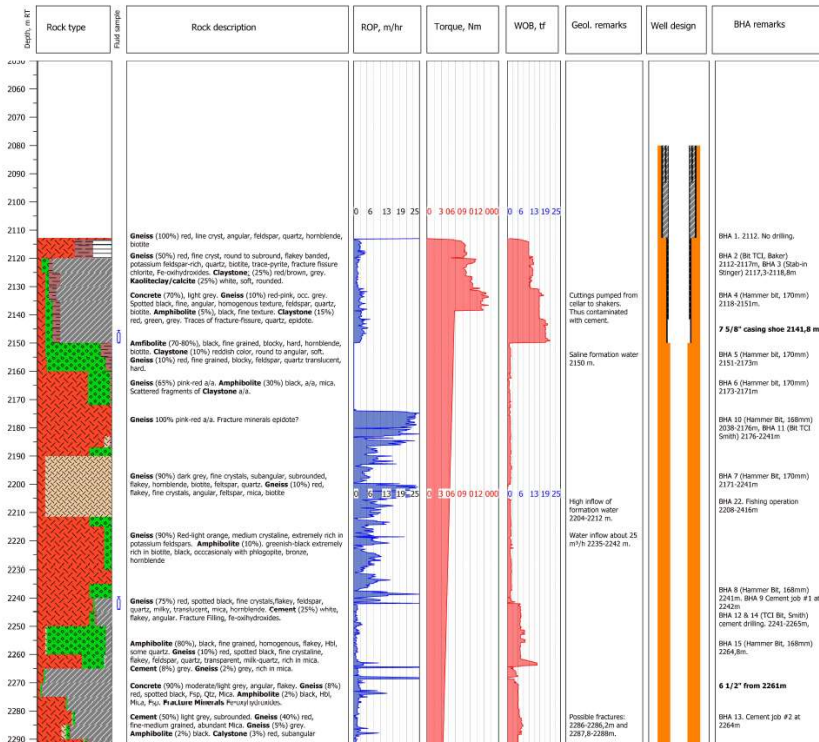
- Rotary drilling methods have been evaluated.
- 2-3 m/h.
- Different bits and drilling parameters tested and evaluated
- We drilled 900 m rotary drilling



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Test Hole Project - Results

- Investigations done of cuttings – created a log



Test Hole Project - Results

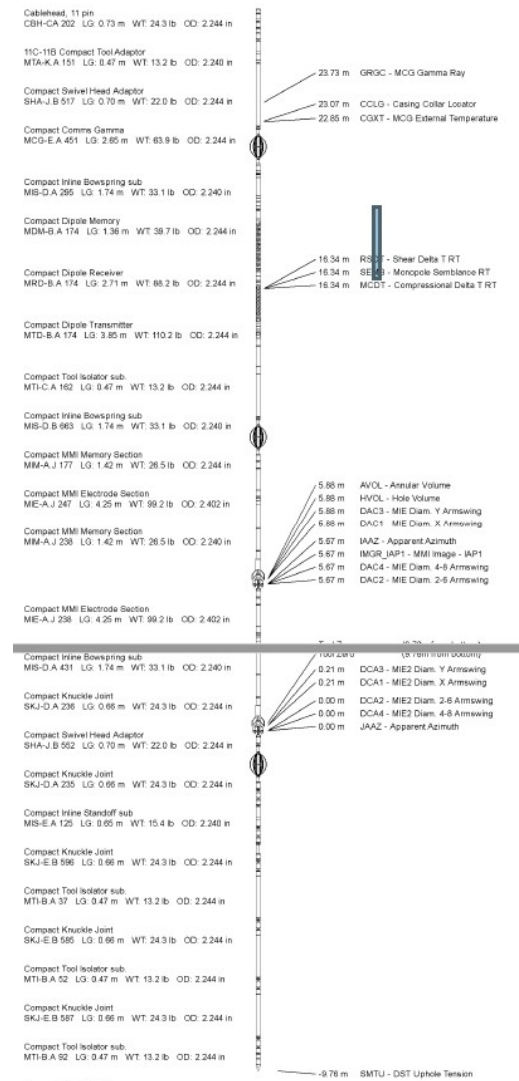
- A geophone array has been tested in place in the existing well FFC2 in the sedimentary layers
- The array could not "hear" the echoes from the hammer
- Very low seismicity in the area. Occurrence interval for a natural M2 earthquake within 10 km is 50-250 years.
- Geophone array results indicate that there are water filled cracks in the bedrock



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Test Hole Project - Results

- Wireline logging was done 24-25/11.
- Data is currently being analysed. Report end January.



Test Hole Project - Results

- Gamma ray, caliper, resistivity, sound velocity, temperature, pressure etc
- Data is currently being analysed

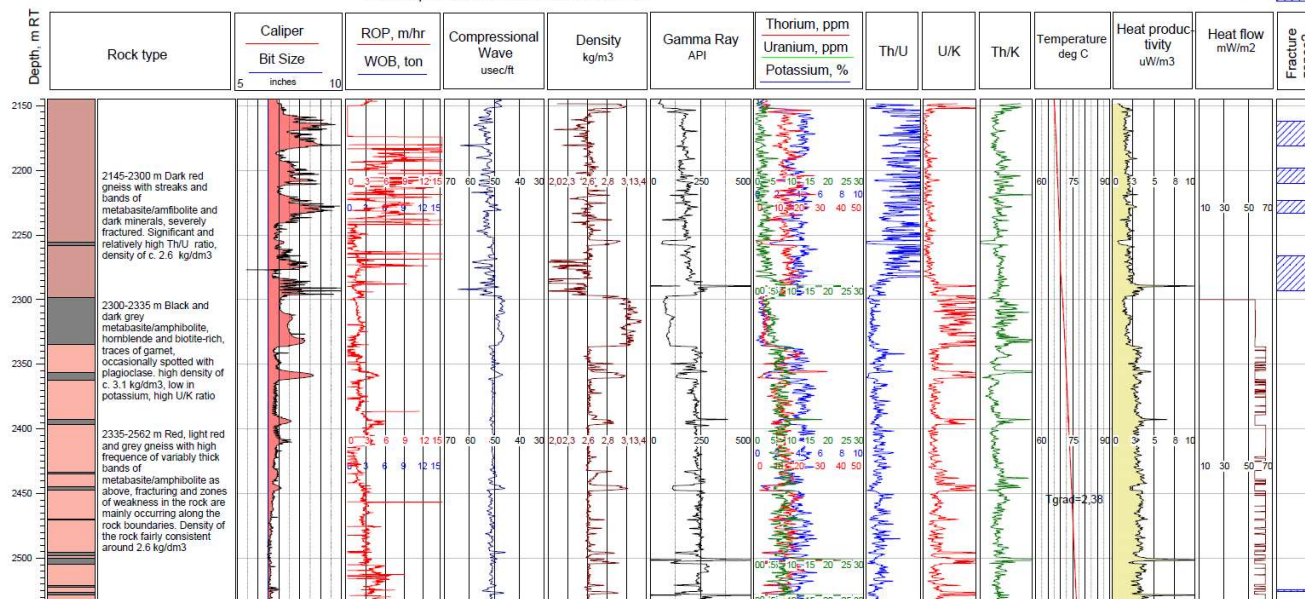
FFC-1- composite well log- basement section

Compiled by : Mikael Erlström
Wire-line logging operations: Weatherford

Location: 55 37'57.811"N/13 00'51.997"E
Reference level (drill floor): 12.0 m above seal level
Total depth: 3133 m below reference level

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DeepGeo-Testhole

Preliminary data on fracturing
Relative high frequency
of foliation and fracturing
in the imager log
Fracturing indicated by
Caliper data, density, sonic



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Test Hole Project - Results

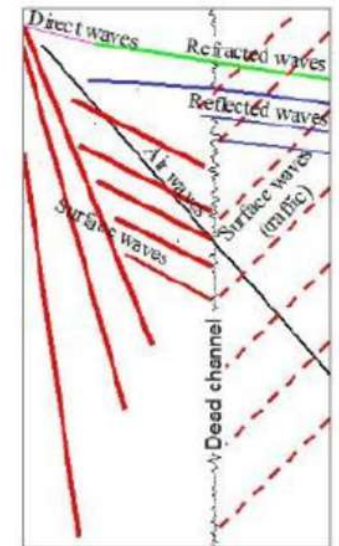
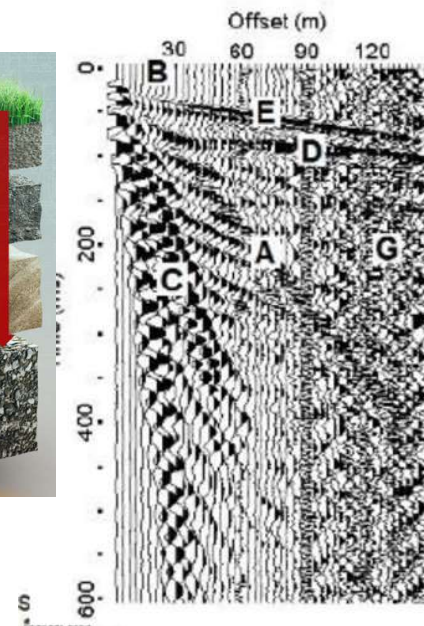
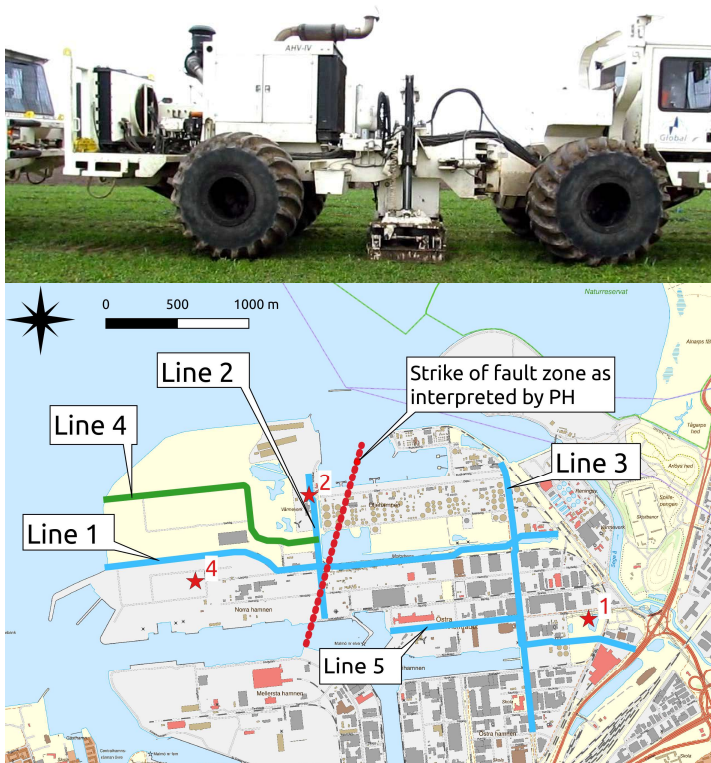
- Learnings how to handle and clean water
- 750 m³ water produced from the well
- Cleaning the water was a challenge.
Contains salts, drilling mud, sludge, cuttings chemicals.
Solids is the biggest problem.
- Several methods tested
- New method in operation right now



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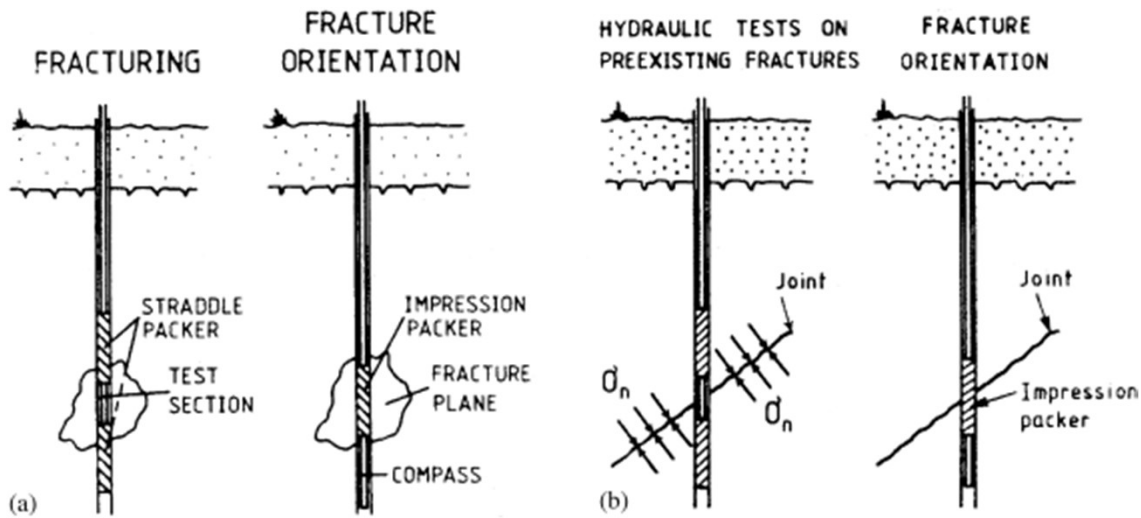
Test Hole Project - Remaining Activities

- **Vibrator seismics** with array in FFC1 and geophones on ground to be done in May 2021.
Aim to exclude any vertical faults and to identify possible reservoir



Test Hole Project - Remaining Activities

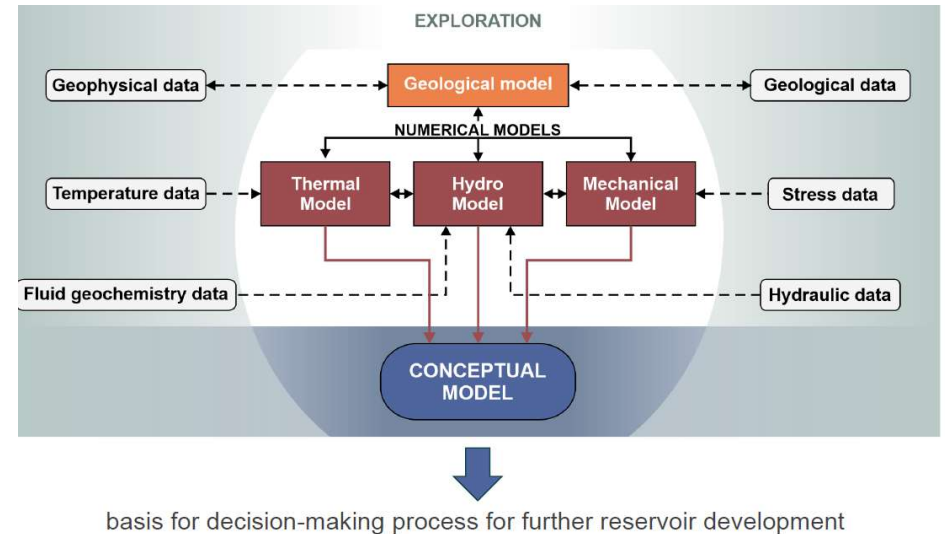
- **Rock tension measurements** to be done at the bottom of the hole in the summer of 2021.



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Test Hole Project - Remaining Activities

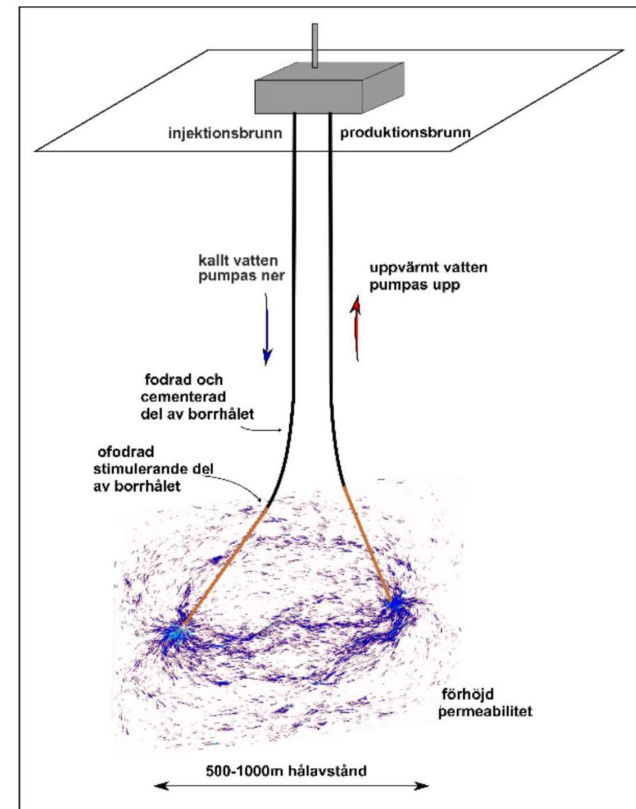
- Develop a model, simulating the heat exchanger in the bedrock – very complex task
- All geological, geophysical, seismic, rock tension data as input.
- Answer whether there are conditions in the underground under Malmö to create an EGS plant through hydraulic stimulation.
- Finished Q3 2020
- Next step is to continue designing the 6,5 km EGS



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The planned EGS-plant - DeepGeo#1

- The injection hole is drilled to the target depth, ~6500 m.
- The stimulation is done.
- Analysis of the crack formation after the stimulation with determination of the position of the reservoir
- The production hole is drilled into the reservoir.
- Another stimulation is done.
- Pressure and flow tests are done.



Principle for an EGS-plant

Estimated Milestones for EGS - DeepGeo#1

The permit application is planned to be submitted:	2021 April
Permit from MPD County Administrative Board:	2022 Q1-Q3
Construction start:	2022
District heating from the plant:	2024 Q1-Q3

If everything goes as planned 😊