Lessons Learned in Otaniemi St1 Deep Heat project

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Preparation, preparation, preparation

- Do the work in advance to make sure you understand the geology and ground conditions as well as possible
  + Ground work in the surrounding area by geologists to asses major fault lines etc.
  + Geological mapping with novel techniques like aerial scanning from drones
  + Geophysical mapping with ground installed geophones and vibro-trucks
  + Drill test holes
  + Log test holes with all possible techniques
- All the money you spend at this stage helps you to asses the needs for deep well drilling
  + One logging run for the test hole that provides critical information on rock types and fractures can cost you as low as half a day worth a drilling rig time

Drilling the Deep Holes

- Plan the site and do the site preparations together with the selected drilling company
- Drill pilot/initial holes with local piling drilling company
- Plan the all the drilling steps in advance and make a plan B for each step
- Plan the casing works in advance and order the casing material well in advance
- Use only good reputation contractors for casing works, cementing works, directional drilling contractor, logging works etc.
- Prepare for surprises
- Remember that each new meter of drilled hole is more expensive than the previous one -> the cost to go deeper is not linear it is logarithmic
- Decide the maximum depth where to stop and do not try to overcome that
- Decide in advance when to kill the project if everything goes wrong

Stimulating the bedrock

- Design and install so vast geophone network in 300 – 2000m boreholes that you are able to detect < M -2,0 microearthquakes
- Design and install couple of hydrophones (if lake or sea present) as well as high accuracy microphones in selected locations like underground bomb shelters or other places with no daily traffic
- Make a proper stimulating plan and traffic light system and get an acceptance for those by Department of Earth Sciences at Uppsala Uni (SNSN operator)
- Communicate the stimulation works in advance to press, authorities and citizens
- Select a trustworthy stimulation company
- Be prepared for audible microearthquakes and the fuss that those create in the media
- Start slowly and take time on stimulation even if it is costly. You have to learn how to read the signs of the bedrock micro movements beneath your feet

Surface works after drilling

- Do a flow test on the wells with airlift or similar rental equipment
- Do your final plant design and equipment dimensioning based on flow test results
- Purchase the equipment (ESP pump, injection pumps, heat exchangers, filters etc.) based on these final designs
- Analyse the ground water composition and buy correct steel grades based on that with a reasonable margin. Most likely high alloy steels are needed
- Take your time on the commissioning this will be another “stimulation” event for the bedrock