

# **Modeling of high temperature, high pressure geothermal energy production system**

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**Silje Bordvik, NTNU**  
**Sturla Sæther, Statoil**

# Modeling of high temperature, high pressure geothermal energy production system

- High Temperature and High Pressure (HTHP) geothermal has the potential to reduce investments compared to conventional geothermal
- HTHP geothermal are related to area with volcanic activity
- High production rates per well and long lasting reservoirs by heat influx from magma plumes
- The concept may be applicable for resources on-shore as well as off-shore. Large potential
- Basic knowledge of geofluid is required to succeed
- Ph-d study important to investigate

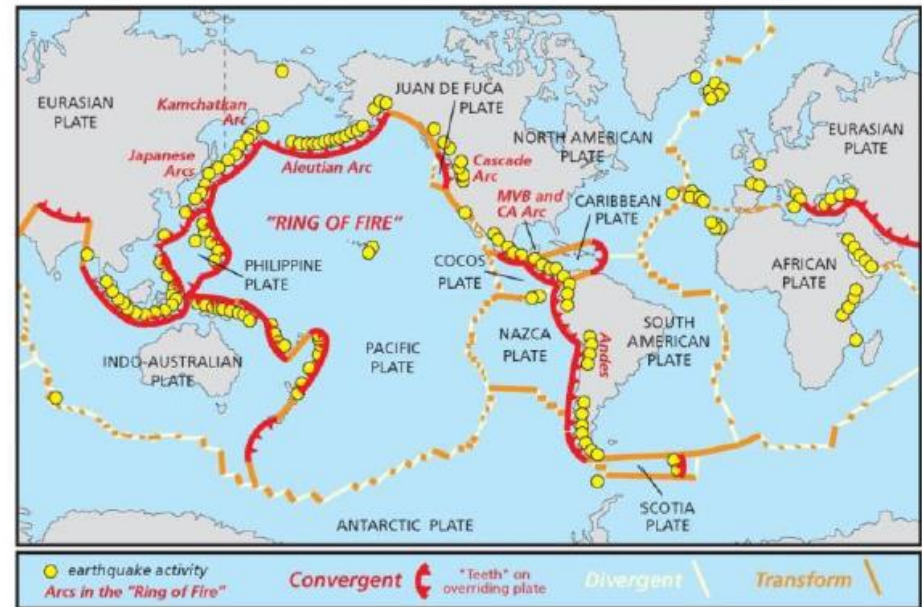


Figure 3 Worldwide areas with tectonic activity (Ref 5)

# Goal for PhD study

- The primary goal for the project is to determine whether problems related to precipitation like scaling, fouling, clogging and erosion are treatable with conventional technologies in the given application and with the given well stream data.
- It is necessary to predict how the geothermal fluid behaves as a function of pressure and temperature. The project will also aim to determine where scaling could be harmful in the process and to simulate and test methods of mitigation.
- The secondary goal is to recommend which system solution and what components are most suitable for the application. The aim is to in a broader perspective determine the overall feasibility and to evaluate technology gap compared to conventional technology and life cycle cost compared to energy potential for the energy plant, taking into account known characteristics for the system and fluid in question.
- The study is planned for year 2018-2020

# Direct Steam and Binary Power Plant options

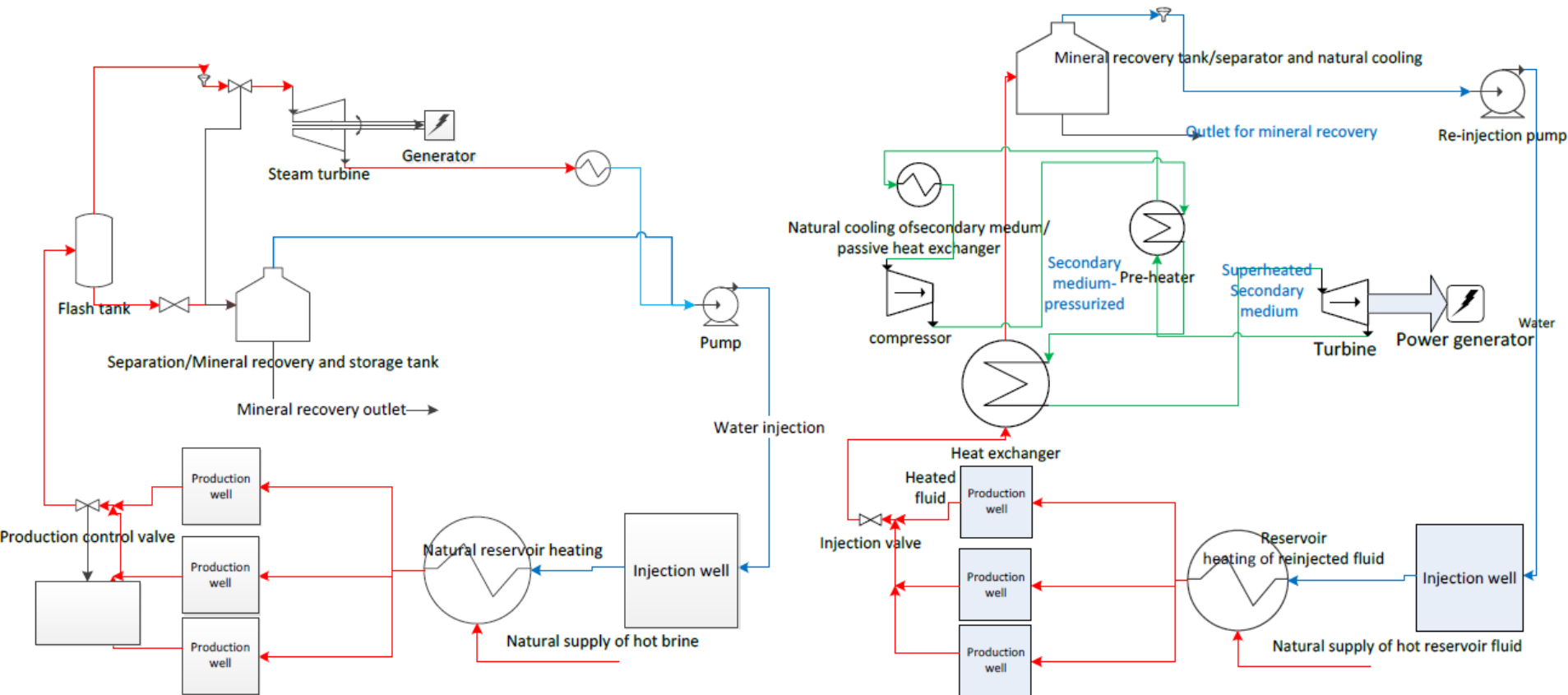


Figure 4 a) Direct steam power plant, b) Binary power plant

# Main activity, objectives and deliverables

## 1 Modelling and simulation

- Establishing necessary modelling tools
- Analysis of input data from IDDP
- Create input calculation models to improve simulation
- Optimize system model
- Evaluation of results and further optimization of model
- Reporting and communicating results

## 2 Laboratory testing to verify model

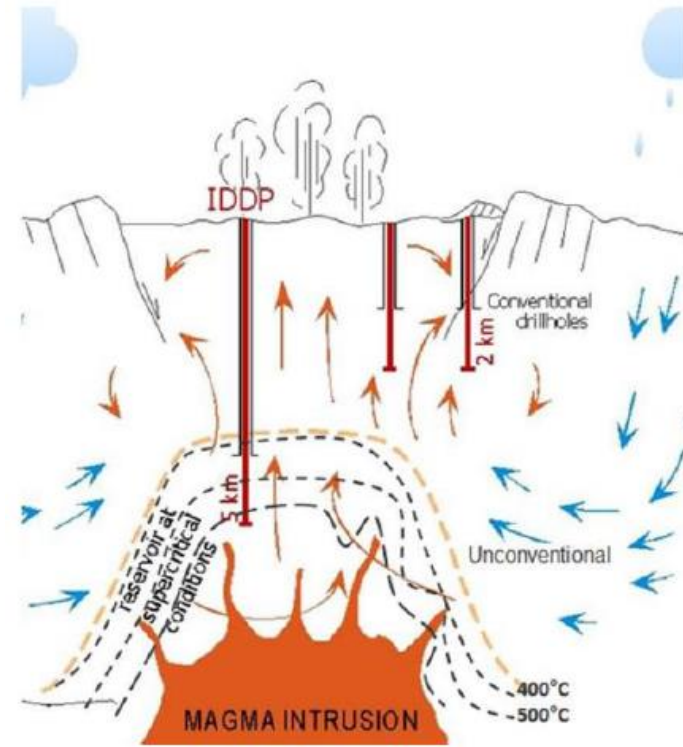


Figure 2 Illustration of GeoMagma concept from Iceland Deep Drilling Project (Ref 20)

# Research tasks

The research can be divided into the following subtasks:

- i. Analysis of steam samples from typical high enthalpy geothermal well (Input from IDDP2 well planned drilled in 2016) and likely variations in different relevant conditions
- ii. Process modeling and simulation of direct system and binary systems with different refrigerants to determine where precipitation will occur. Evaluate viability of existing simulation tools and create additional calculation models and input files to improve the analysis tool where necessary
- iii. Estimation of consequences and possible mitigating actions to manipulate process conditions to avoid identified problem
- iv. Verify model by lab testing
- v. Use analysis from i) to determine suitable steam treatment through modeling and simulation. Estimate effect on process efficiency and equipment robustness
- vi. Evaluate valve performance with regard to the above estimated erosion and corrosion potential
- vii. Compare identified requirements to conventional technology to define residual technology gap for high regularity and high robustness required for equipment
- viii. Suggest further work to optimize equipment for the required service
- ix. Perform an analysis of energy potential versus investment and life cycle cost of the system
- x. Perform an evaluation of future application of technology in light of status on known challenges and necessary further work