EGS in the Permian of the North German Basin, Europe:

a borehole doublet utilizing a former exploration well

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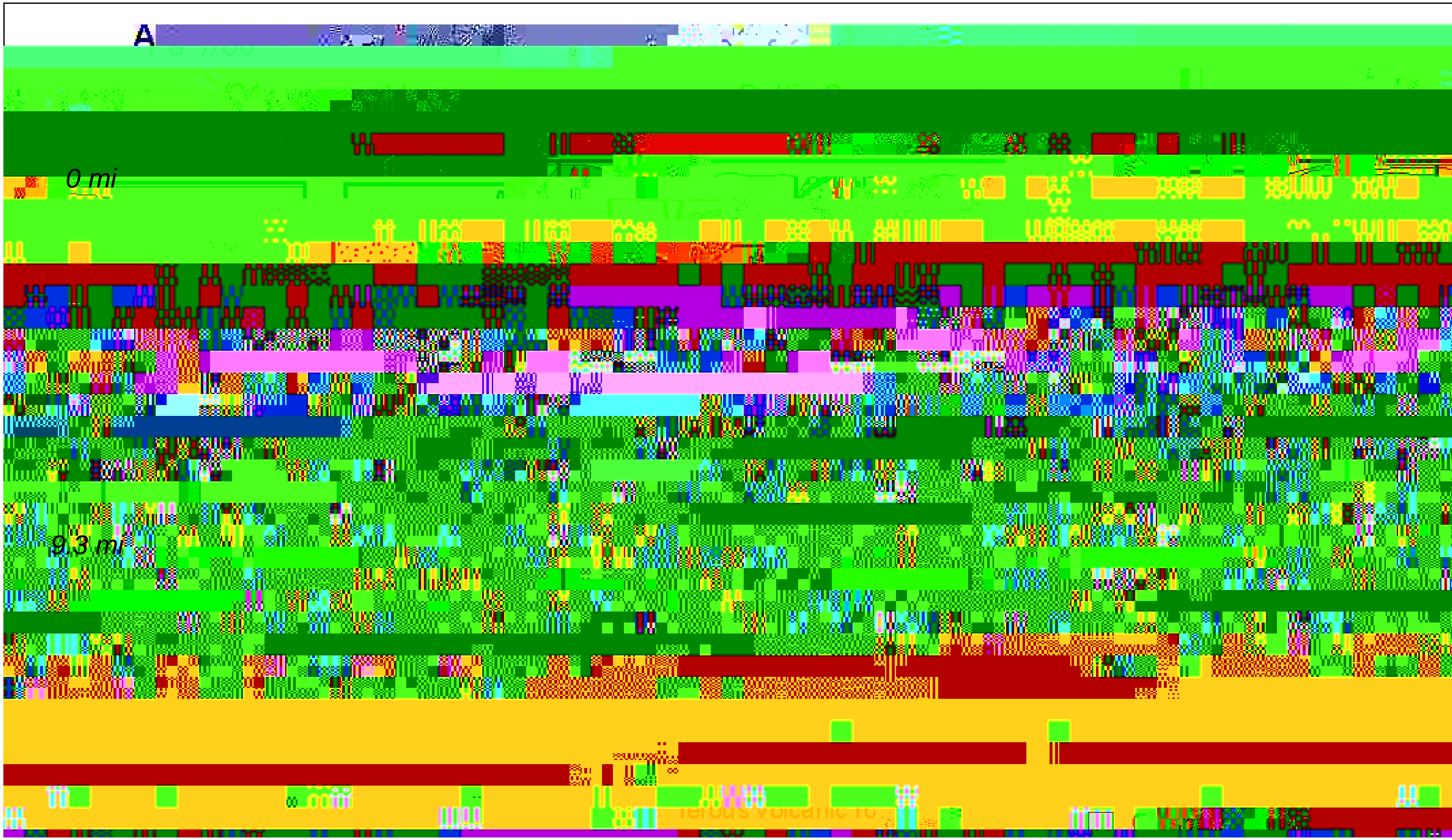
Commercial | **Potentially commercial**

Productive hydrothermal | *Enhanced geothermal* | *Hot dry rock*

*** Hydrofracture, targeted injection, acid leaching, directional drilling, etc.**

Oil and Gas Exploration in NE Germany

Distribution map of the sedimentary Rotliegend
(Lower Permian) in North Europe

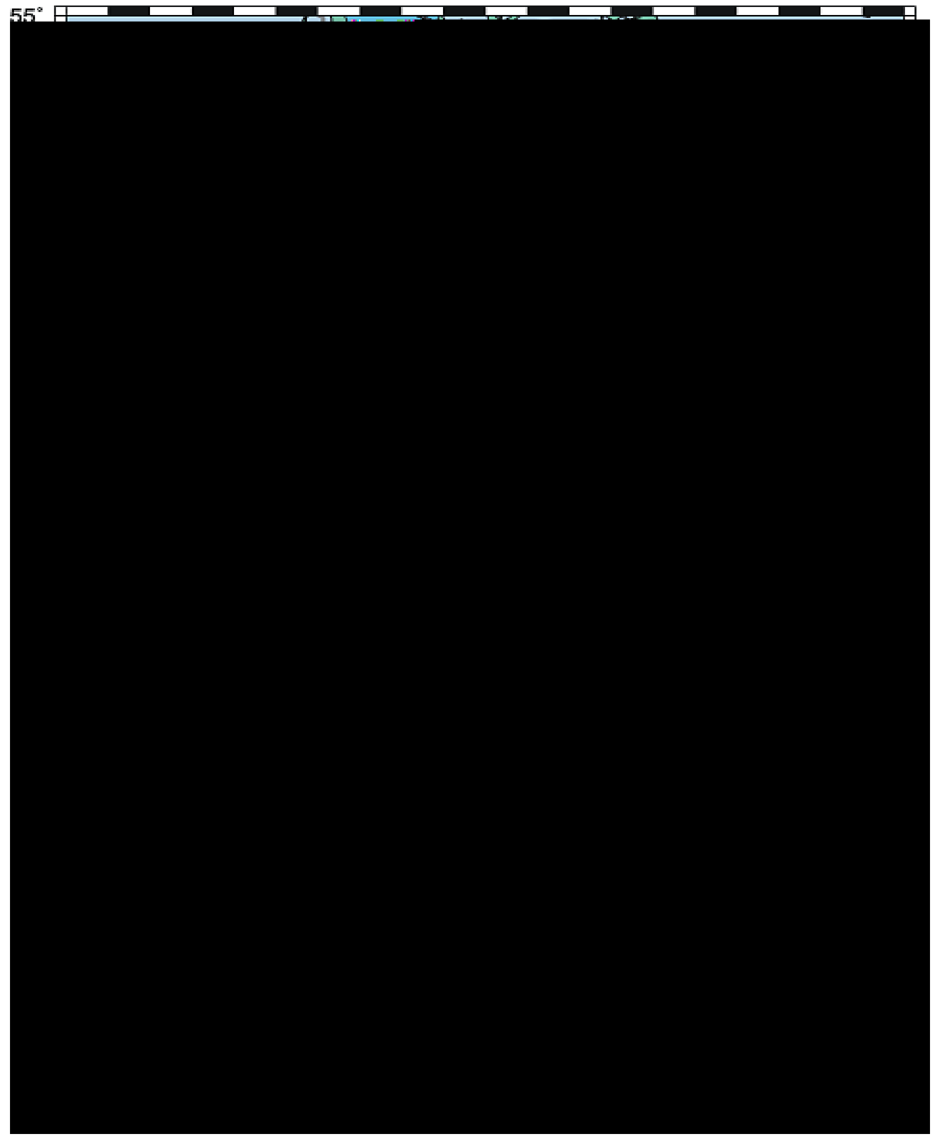


A
0 mi
9.3 mi

Temperature map of Germany

Temperature distribution in 3000 m depth

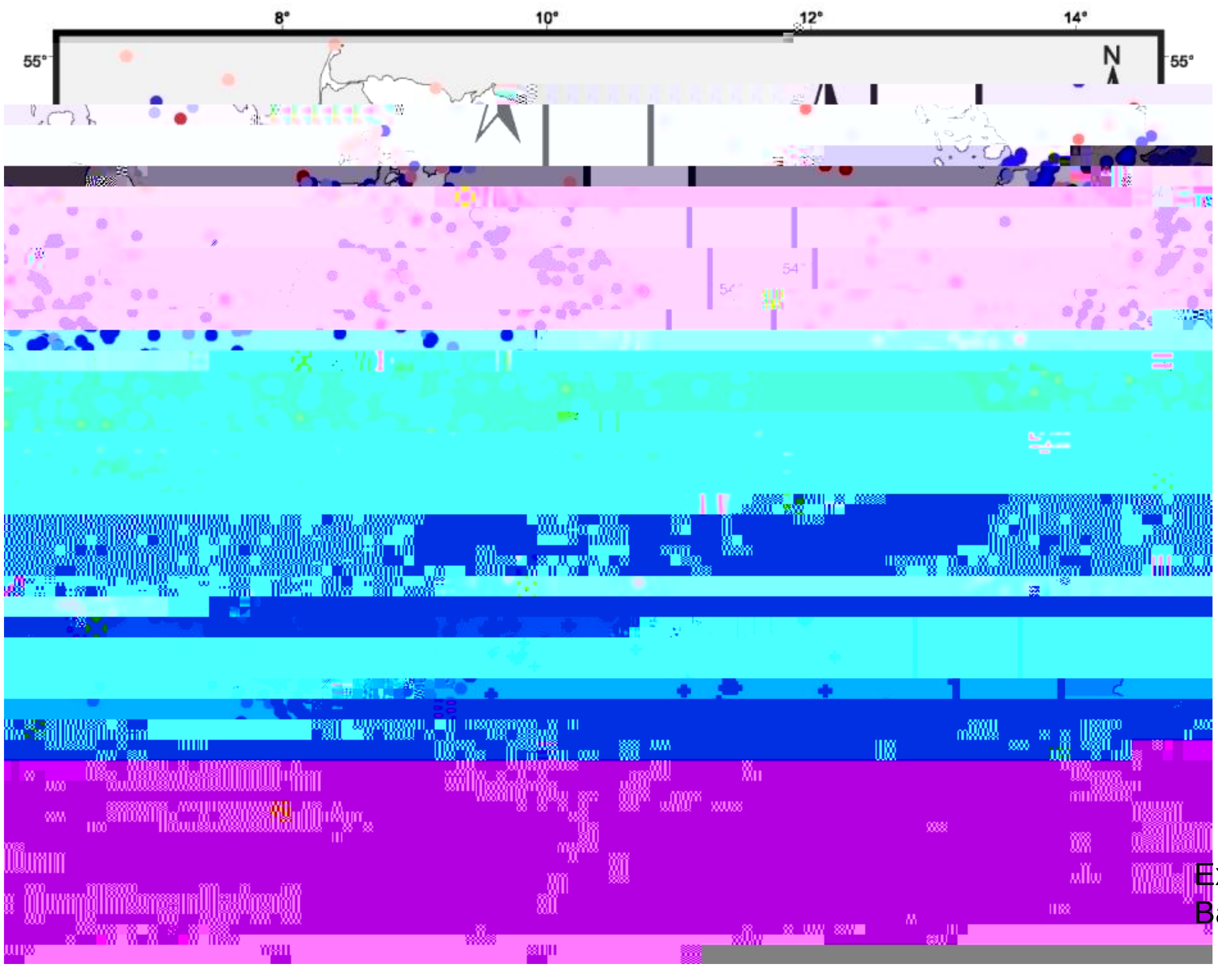
At most sites are low to moderate enthalpy reservoirs. These reservoirs can be efficiently used by enhancing the permeability.



Geothermal technology

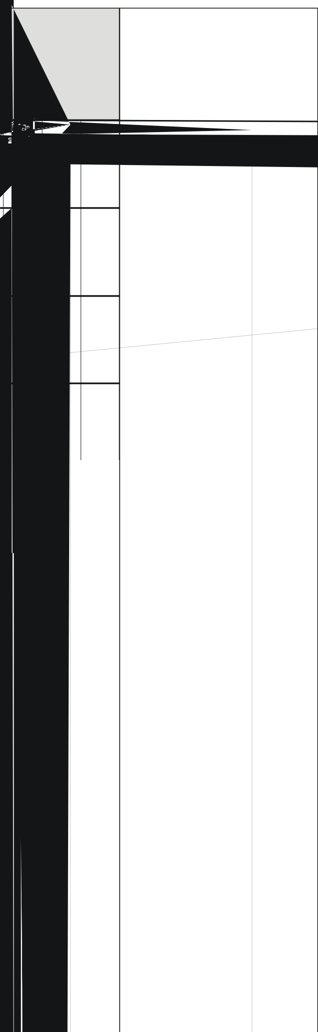
The key site in the NE German Basin – Groß Schönebeck

Re-using an existing gas exploration well

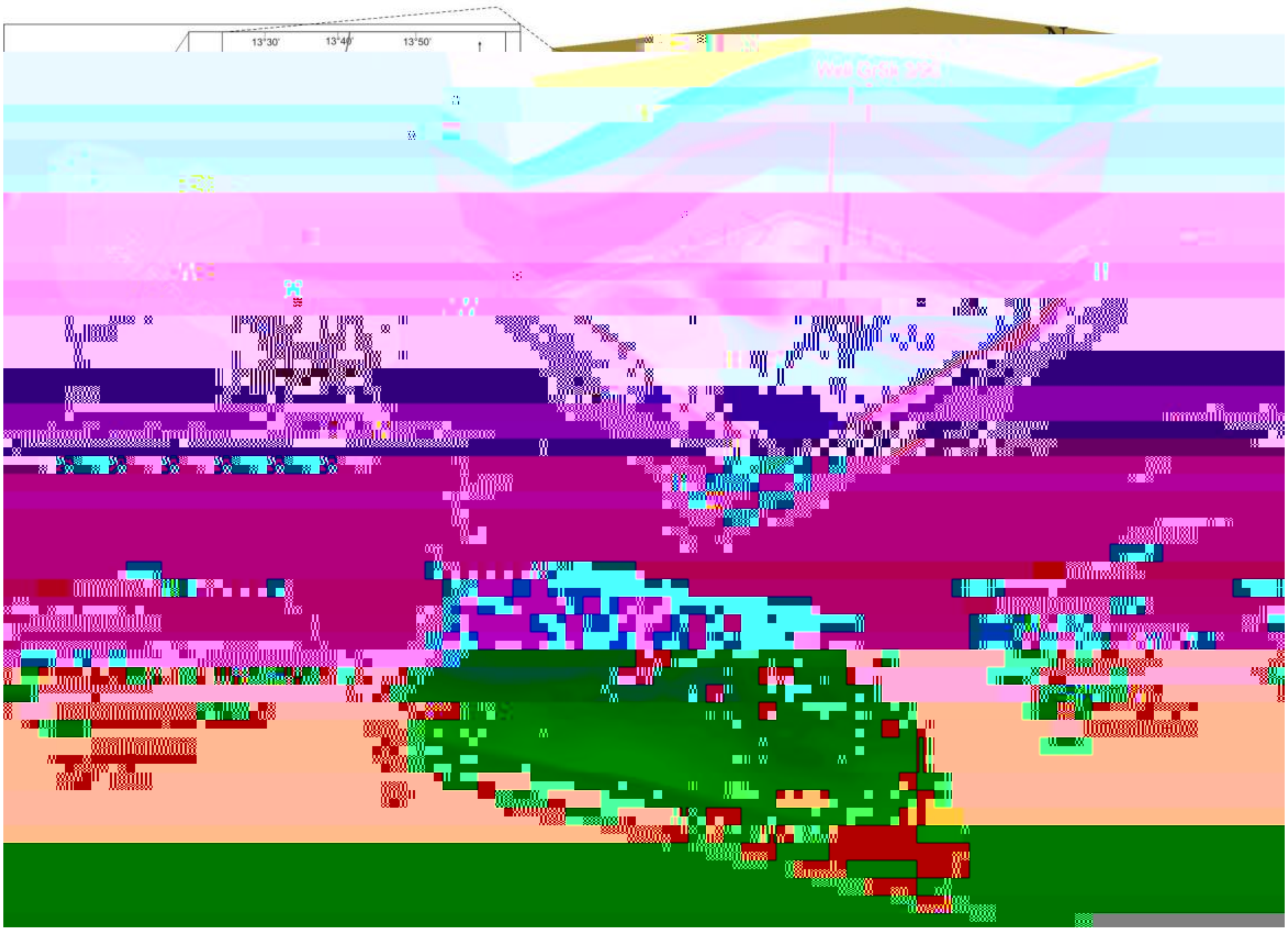


Existing HC wells in the North German Basin

erpretation from the existing well



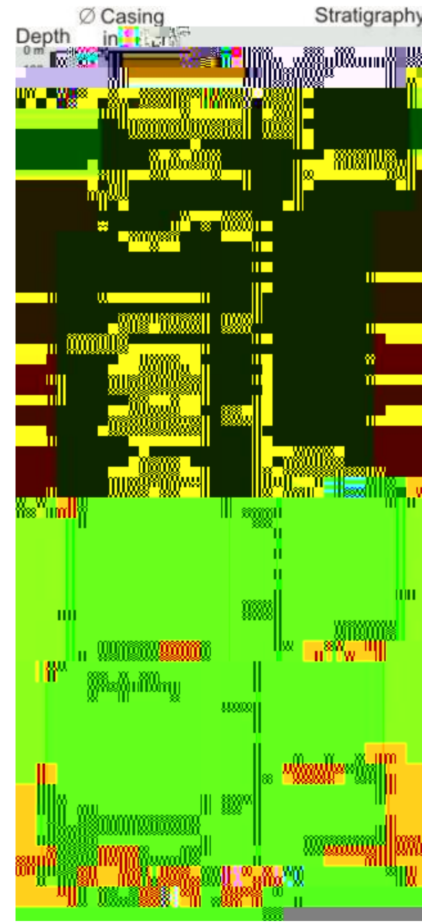
Re-using seismic and well data for new 3D Modelling



Thermal-Hydraulic simulation

Installation of a well doublet II

Planning and drilling a new geothermal well



Requirements on geothermal wells

- large diameters
- directional drilling
- near-balanced drilling in the reservoir

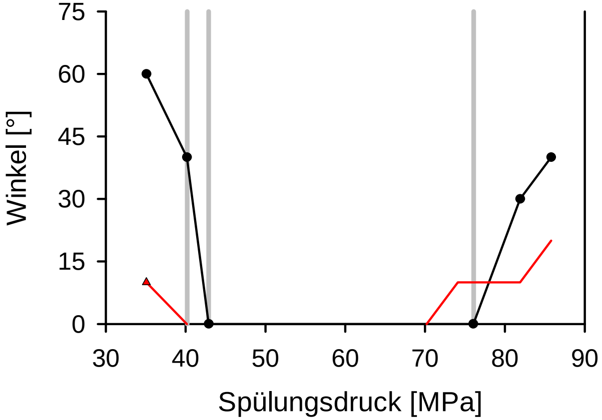
Well controll and mitigation of formation damage

Fracture mechanical failure modell to understand borehole stability

Near-balanced drilling in the reservoir

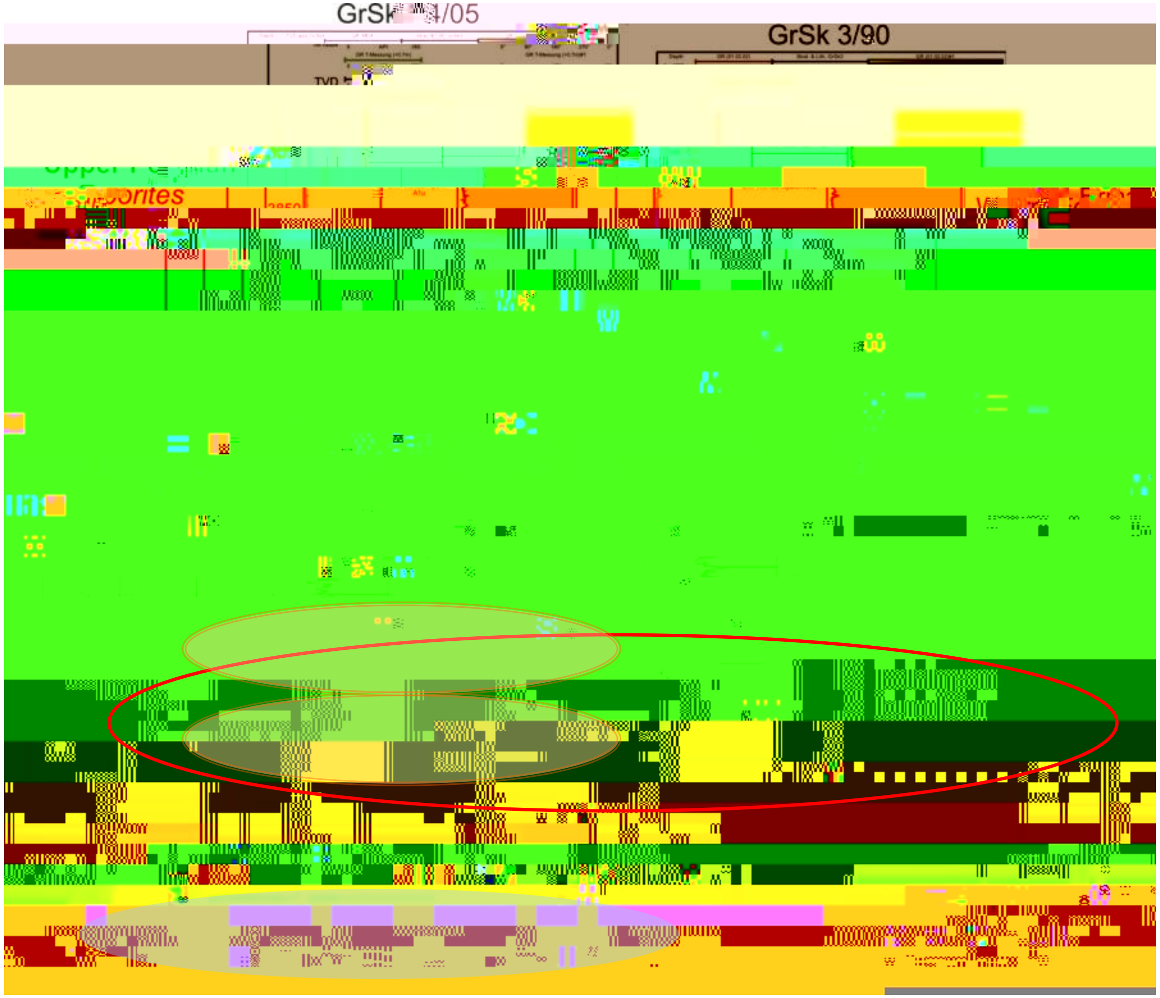
Analysis of borehole breakouts in 4100 m depth

Fracture mechanical analysis of initiation and growth of breakouts, using data from LOTs, FMI and core testing



(*Moeck et al. 2007, Backers & Moeck, submitted*)

Log correlation with existing and new well



Geothermal aquifer
150°C, 10-100 mD
vertical thickness: 80 m

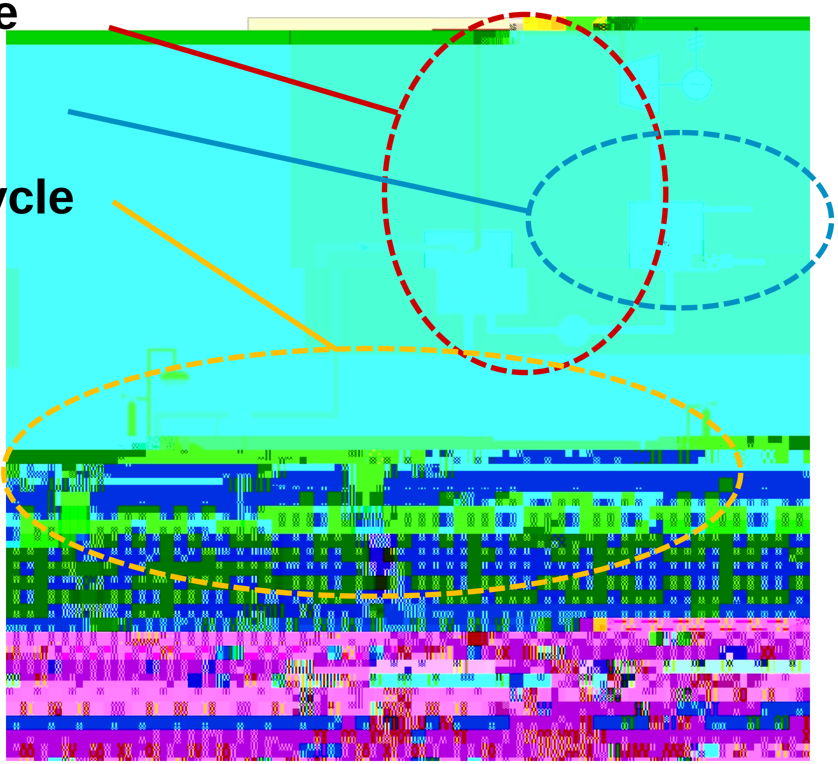
Gel/Proppant fracs

Outlook

Process engineering

Generation of energy

- Power plants serve for net power production
- Net power = gross power - auxiliary power
- Auxiliary power
  - **conversion cycle**
  - **cooling cycle**
  - **thermal water cycle**

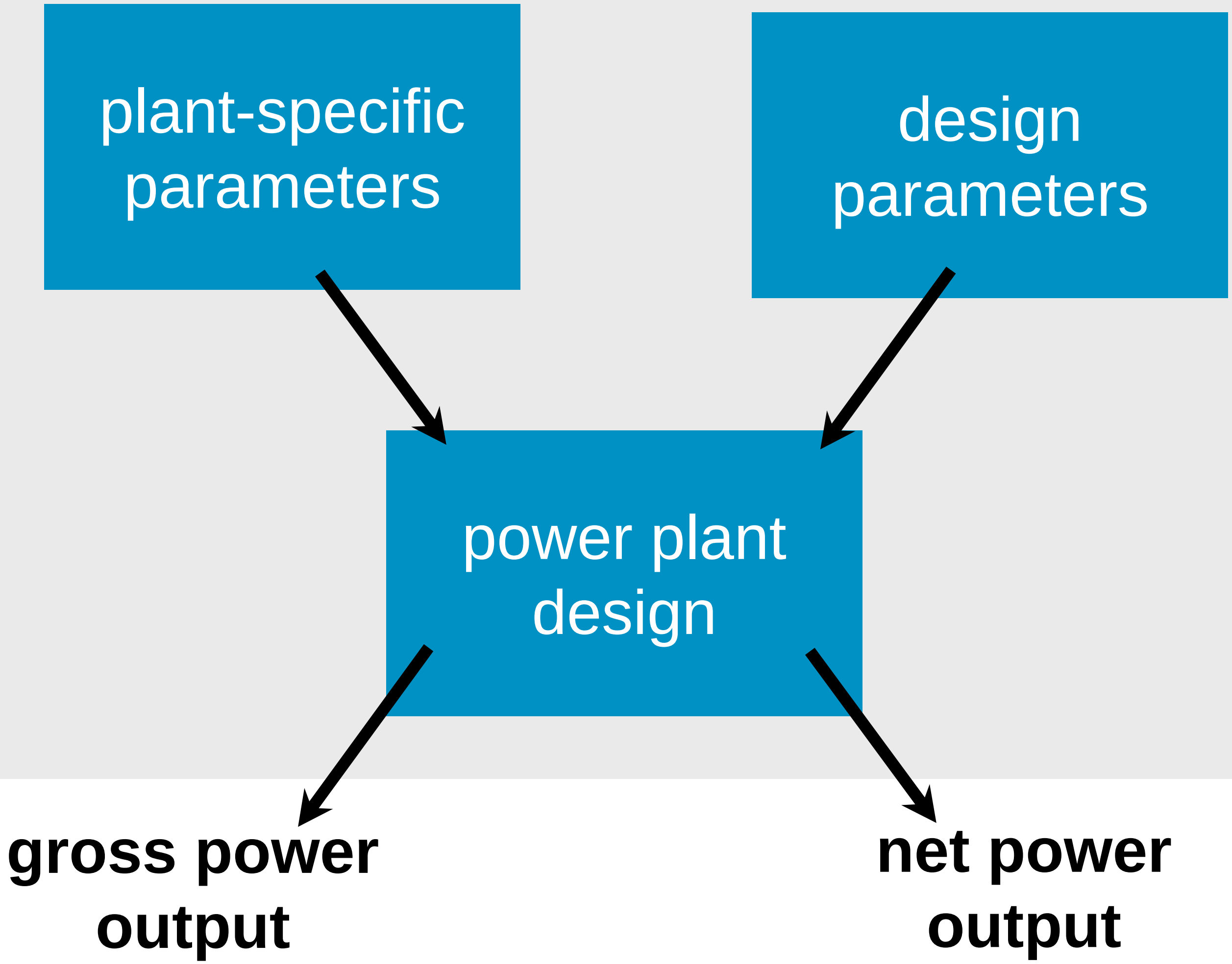


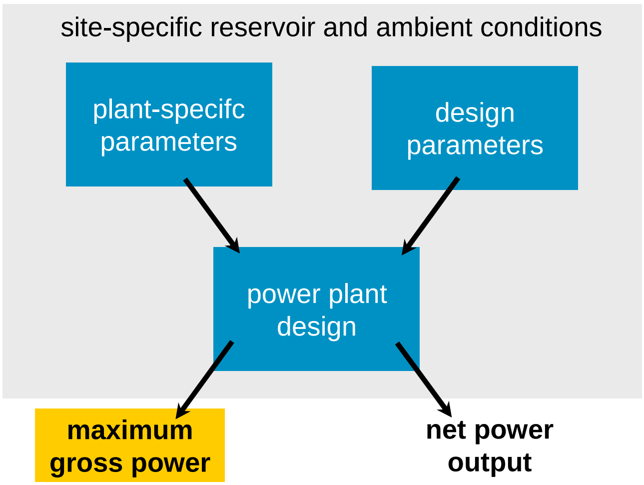
➡ A maximum net power output can't be reached by maximizing the gross power

➡ Geothermal power plant design needs a holistic approach

Approach to power plant design

site-specific reservoir and ambient conditions





	maximum gross power (wet cooling)	maximum net power (wet cooling)
reservoir conditions	T_{TW} = 150 °C, PI = 30 m³/(h MPa), $depth_{reservoir}$ = 4,500 m	
thermal water mass flow	56 kg/s (14.8 gps)	
th. water injection temp.	66 °C (151 °F)	
condensation temp.	30 °C (86 °F)	
gross power	1,8 MW	
net power	460 kW	

Plant-specific parameters, ambient conditions = const.

Conclusions

- Geothermal technology combines engineering and geosciences is therefore multidisciplinary
- Groß Schönebeck demonstrates the feasibility of power generation from low-enthalpy EGS systems under economic conditions
- Fitting the power plant type and processes to the geological reservoir characteristics requires a holistic approach
- Our learning curve allows the adaptation of profitable workflows to equivalent sites

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