

Contribution of borehole image for the understanding of Heterogeneous geomechanical properties and cooling in a sandstone geothermal reservoir

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Understanding the impact of long-term injection on geothermal reservoir properties is critical for sustainable energy production. Within the Dutch national innovation program *Geo4all*, we investigated geomechanical heterogeneities and thermal cooling in a siliciclastic geothermal reservoir located in the Middenmeer Geothermie license area, operated by Ennatuurlijk Aardwarmte. In 2025 a replacement production well (MDM-GT-11-S2) was drilled adjacent to an injector well that was active for a decade; several well log data, including a borehole image, were acquired in the replacement well with the intent of comparing predicted cooling models with measured temperature profiles and to assess reservoir properties before and after prolonged injection.

Measured temperatures were compared to modelled temperatures, conventional petrophysical logs were analyzed to derive porosity, permeability and elastic moduli, fractures (interpretation by SLB) and facies were interpreted on the image log (fig 1) and calibrated to cores from the same reservoirs in a different well.

The results of such analyses show that thermal cooling was concentrated within approximately one-third of the reservoir thickness. Well log analysis revealed significant variability in elastic moduli and reservoir properties and image log analysis revealed variability of sedimentological facies and fracture type and density along the borehole. The integration of these analyses has allowed to establish the existence of a link between cooling patterns, facies and fracture distributions, identifying facies more affected by cooling and facies where cooling inducing fractures seem more likely to develop.

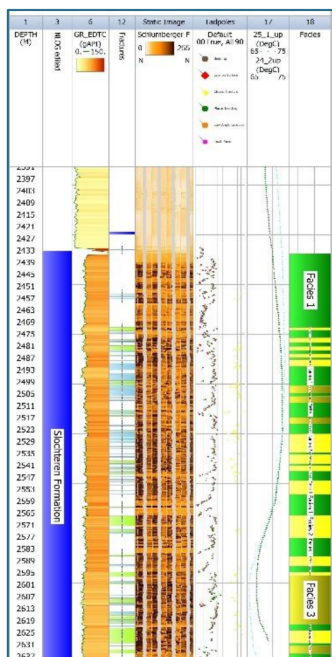


Figure: image log interpretation and temperature data from MDM-GT-11-S2

Angela Pascarella, geologist, PhD in Earth Science and oil industry professional with more than 17 years of international experience in well logs acquisition and interpretation within high-profile corporations. Angela has started her career at wellsite acquiring wireline data and over time she has specialized in borehole image processing and interpretation and petrophysical interpretation. Currently she works at the geological survey of the Netherlands part of TNO (the Netherlands Organisation for Applied Scientific Research) as reservoir geologist/petrophysicist.