

Sustaining heat flow from Triassic sandstones for deep geothermal energy - HotTrias

Publieke samenvatting / Public summary

Aanleiding

Deep geothermal energy (>1500m) in the Netherlands is a prime source of sustainable energy to replace hydrocarbons. Geothermal exploitation is increasingly feasible in areas where hydrocarbon activities provided data and knowledge. Excellent examples are the multiple projects targeting the Nieuwerkerk Formation in the Westland area. However, deep geothermal exploitation carries a high risk for targets that have insufficient deep subsurface data available (Masterplan Aardwarmte, 2018). The recent attempt to include very deep Triassic sandstones in a geothermal project provides a good example of the risks involved as the targeted reservoir proved to be impermeable. Geothermal initiatives are often single doublet stand-alone projects based on a tight budget. Consequently, risks of failure can be high due to insufficient available data. While the risks and uncertainties during hydrocarbon exploration can be offset by the net present value of a successful project (ratio 80/20), deep geothermal energy exploration carries a higher required success rate due to the smaller scale of operations. This substantiates the importance of fundamental applied research during the planning phase.

Doelstelling

The objective of this project is to quantify the reservoir properties of Triassic sandstones in Southern Netherlands at depths beyond 1500m in order to assess uncertainty and reduce the risks for future deep geothermal operations. Many Westland

Projectinformatie / Project information

Projectnummer / Project number
TGE0118004

Subsidiebedrag / Grant amount
€ 299.529,00

Algemene informatie / General information

Penvoerder / Secretariat
Technische Universiteit Delft

Publicaties en materialen / Publications and attachments

- 31.10.2024

Eindrapport TGE0118004

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geothermal projects at depths between 1500 and 2500m are successful. However, the Triassic reservoirs are geologically much older and therefore have a higher chance of complicating histories. The TRIAS Westland core (NLW-GT-01) analyses show that Triassic sandstone diagenesis is hampering water flow by a reduced permeability in layers at 4200m depth. It shows that to successfully predict heat production there is insufficient knowledge of these sediments, their mineralogy, local structural characteristics, spatial heterogeneity and diagenesis. We propose an innovative integrated sedimentary, structural and diagenetic study to assess, quantify and map their suitability for deep geothermal exploitation in the southern Netherlands. This work should substantiate if and where new deep geothermal projects in the Roer Valley Graben will be economically feasible.

Korte omschrijving

We benefit from the availability of the newly drilled NLW-GT-01 core, the newly produced 2D seismic data, and rediscovered Triassic cores. This makes this integrated study timely and feasible. Sediment petrography will be performed on all available cores and well log data to reconstruct sediment provenance, basin configuration, depositional environment and paleo-flow directions. In addition, analysis of the core fracture density and fracture style in relation to effective permeability and their role during the diagenetic process will be carried out. These data will be related to larger-scale fault patterns recognized on the seismics to evaluate a possible relation. This knowledge, combined with the detailed paleotopographic and provenance analysis, depositional environment and basin fill analyses of the Roer Valley Graben area supplemented by numerical forward modelling tools, will be the foundation of effective porosity and permeability probability maps for the Lower Triassic reservoirs using state-of-the-art geomodeling software. These maps will be the basis for future geothermal exploration to produce dynamic heat flow models.

Resultaat

The results will consist of an elaborate report and digital geomodel that include the spatial distributions of grain characteristics, mineralogy, diagenesis, including associated uncertainties. From that, a conceptual depositional model coupled to a sensitivity analysis of allogenic controls on deposition will be developed. Furthermore, we will deliver a structural and fault seal model as well as a discrete fracture model of the relevant formations. From these results we will derive effective porosity and permeability predictions which result in a static and dynamic map of the heterogeneities of the Lower Triassic sandstones in the Southern Netherlands focussed on the southern flank of the Roer Valley Graben. Finally, we will provide a synthesis and a recommended multidisciplinary workflow for deep geothermal reservoir characterisation, doublet design and accurate prediction of heat production related to Lower Triassic sandstones in the Netherlands.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.

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