Breda Formation – target for shallow geothermal exploration

J.G. Veldkamp[1], E. Peters[1], J. Foeken[1], F. Smit[2], K. Geel[1]
[1]hans.veldkamp@tno.nl TNO Geological Survey of the Netherlands P.O. Box 80015 3508 TA UTRECHT, [2]freek.smit@aardyn.nl

Poster presented at the European Geothermal Workshop, 8-9 November 2023, Utrecht, the Netherlands

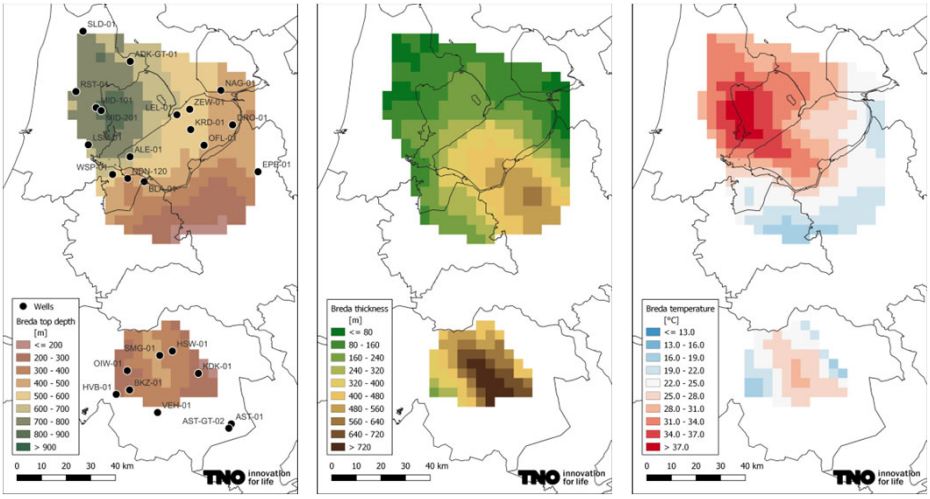
INTRODUCTION

The Miocene Breda Formation is the oldest and therefore deepest unit in the Upper North Sea Group. Because of its relatively shallow burial (top depth between 0 and 600m) and therefore low temperature, it has not yet been considered as a target for geothermal exploration. However, in the Roer Valley Graben (RVG) and the Zuiderzee Low (ZZL), the depth of the base exceeds 1000 meter. This corresponds to temperatures of more than 40°C which makes the unit a potential target.

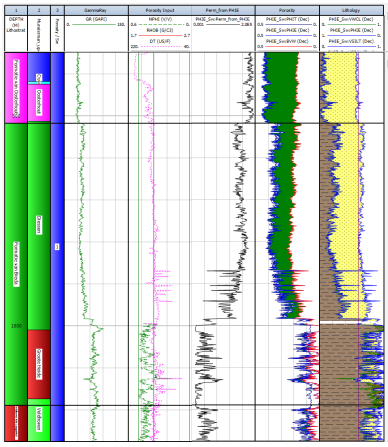
The geology of the depth range of ~200-1200 meter has long been overlooked because it is too deep for groundwater studies, and too shallow for O&G exploration. The REGIS model (REgional Geohydrological Information System) suggests that the Breda is only sandy in the southern part of the Netherlands around the RVG (BRz1 unit), but there is little well data to support the sand distribution. Large uncertainty exists about the top, thickness and especially lithological composition.

MAPPING THE GEOMETRY

The ZZL and RVG areas were depocenters during the deposition of the sediments of the Breda Formation. A hypothesis was formulated that the lithological composition of the Breda in the ZZL may also dominantly comprise sand. In the ZZL area the top and bottom as well as an internal unconformity which splits the Breda Formation into the yet informal underlying Groote Heide and overlying Diessen units could be interpreted on seismic. For a part of the RVG, a similar seismic interpretation was performed within the H3O NW project.



The top and thickness were mapped using previously unused seismic data. The temperature was calculated from a 3D temperature model



Petrophysical evaluation of the Broekzijde-1 well

SAND OR CLAY?

Lithological descriptions of the deep Breda Fm. are rare. Cuttings from 5 deep wells were evaluated. The cuttings reveal that, in the ZZL, the Breda Formation is sandy, although it is difficult to establish the fines content and therefore the flow potential.

A petrophysical analysis was carried out for 9 wells in the RVG and 16 in the ZZL. The petrophysical evaluations for both areas shows that the permeability ranges from ~100 to ~3000 mD. The upper Diessen has better aquifer properties than the lower Groote Heide. This is roughly in line with a well test result from the sandy parts of the Breda Formation in the Naarden-120 well located at the southern border of the ZZL and at the same time the northernmost occurrence of the REGIS Brz1 unit. The calculated permeabilities is about 300 mD.

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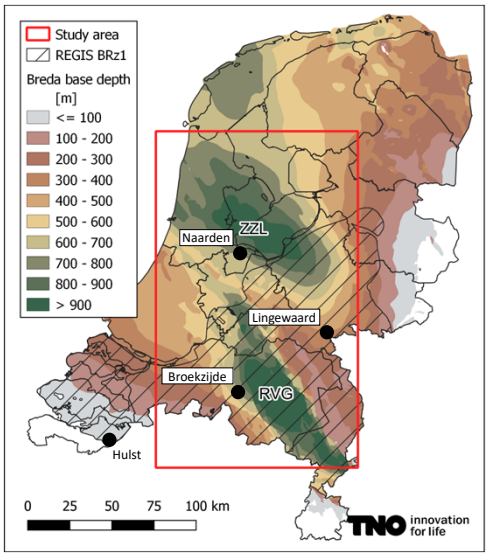
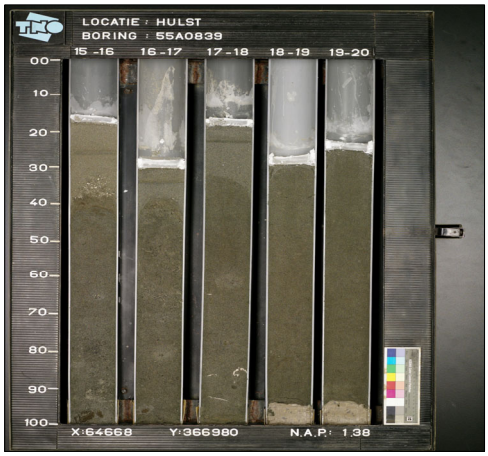
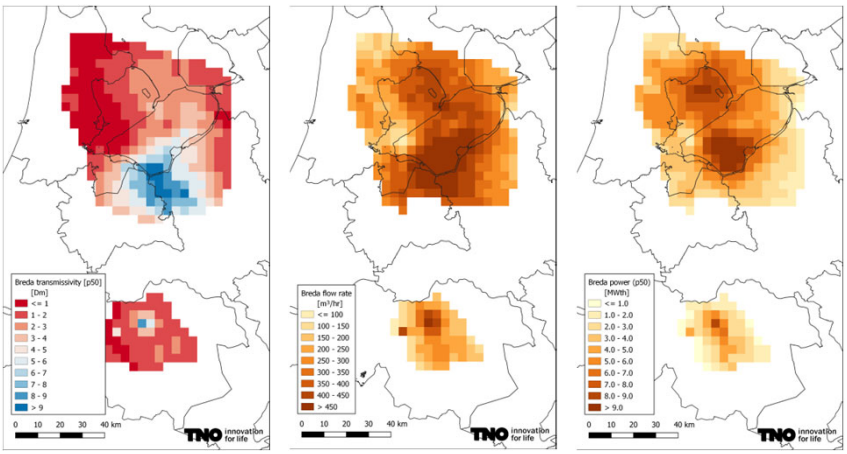


The base Breda is located at a large depth in ZZL and RVG



Cored Breda sand from Hulst well (lower), and clay cuttings with shell fragments from Lingewaard well (upper)



Transmissivity (Dm), flow rate (m³/hr) and potential power (MWth)

GEOTHERMAL POTENTIAL

The geothermal potential was calculated using the ThermoGIS approach (www.thermogis.nl). The power that can be produced may be up to about 9 MW_{th} in both the Zuiderzee Low and the Roer Valley Graben if the full unit is completed. This may however not be the ideal situation given the poorer aquifer quality of the lower Groote Heide. Alternatively, better production rates and power may be achieved using an optimized well design and/or a heat pump.

CONCLUSION

From a study of seismic and well data that were previously not used to its full extent, it is concluded that the upper part of the Breda Formation is thick and has favourable aquifer properties for geothermal production. The geothermal potential of the unit is higher than previously thought, and extends over a large area.

ACKNOWLEDGEMENTS

This project was carried out as part of the WarmingUP Innovation Plan. This was made possible in part by a subsidy from the Rijksdienst voor Ondernemend Nederland (RVO) in the context of the Meerjarige Missiegedreven Innovatie Programma's (MMIP) subsidy scheme, known at RVO under project number TEUE819001.