University of Utrecht

Internship Report

The Role of Reservoir Geology and Reservoir Architecture on Geothermal Doublet Performance

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Chapter 1

Introduction

1.1 Geothermal Energy

With the increase in global energy consumption, the increase of global warming and rising energy prices there is a strong need for sustainable energy and diversification of energy production. Geothermal energy is a sustainable energy source which can be produced from the geothermal reservoirs in the earth. It has the advantages over other sustainable resources that is always available and not affected by external factors (seasons, wind, sun). In a geothermal system, heat is produced from a suitable aquifer, the reservoir. This reservoir rock contains geothermal energy (at sufficient depth) since the earth core is emitting heat to its crust constantly. The source of the geothermal heat is decay of radioactive isotopes like ^{40}K, ^{232}Th, ^{235}U and ^{238}U [3].

The potential of exploiting this heat led to a strong worldwide growth in the geothermal energy market. The installed thermal power for direct usage of geothermal energy is increasing with a compound rate of 12.3 % annually [16]. In the Netherlands, the governmental aim is to increase its share of renewable energy up to 14% by the year 2020 [25]. Geothermal energy production is considered a viable option because it can operate as a base load energy supply [15], unlike the majority of available sustainable energy sources.

In a geothermal doublet system the produced heat which is transported by the water, is extracted from the fluid with a heat exchanger on surface level. The cooled fluid is then subsequently injected back into the same reservoir via the injection well to retain pressure support. The reservoir rock typically must have high porosity and permeability in order to transmit and producer water (Figure 1.1).

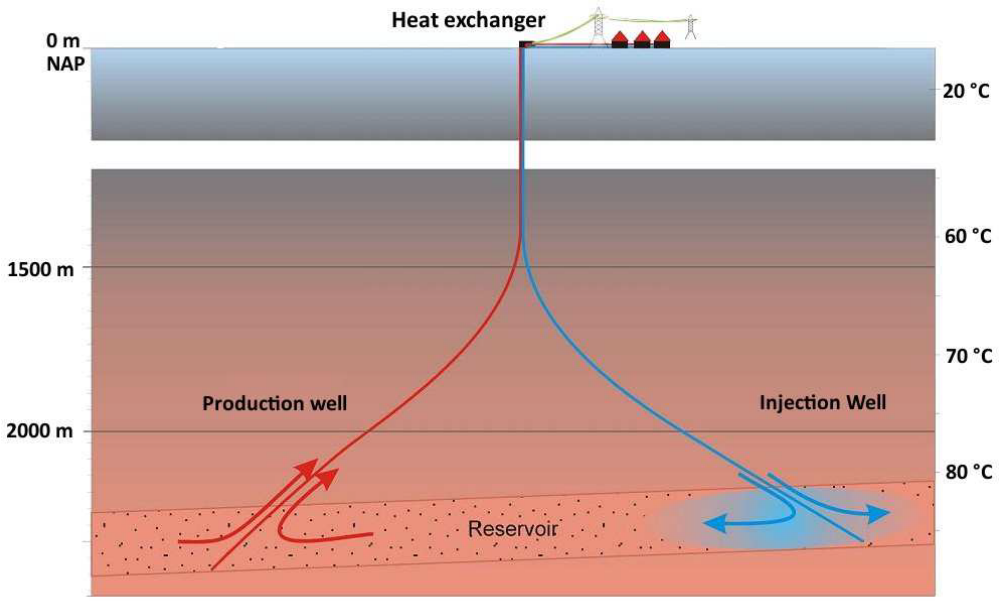

Figure 1.1: Schematic representation of a geothermal doublet ([23])

Despite the potential of geothermal energy, almost all geothermal projects in the Netherlands encountered lower than predicted well performance. In addition, geothermal projects are very expensive due to required deep well drilling. It is therefor important to perform extensive studies on the subsurface in order to achieve maximum thermal energy production.

The DAP (Delft Geothermal Project) is planned to be built in the Western part of the Netherlands on the premises of the Delft University of Technology (TU Delft) aiming for a Lower Cretaceous fluvial sandstone, the Delft Sandstone. A recent study by Gilding [12] shows that hole water temperature readings indicate a geothermal gradient of 3 °K/100m in the area surrounding the proposed DAP location. The DAP project was put in motion in 2007 by the department of Applied Earth Sciences in Delft with the main goal to develop geothermal system which could supply TU Delft with sustainable heat. Extensive research on the Delft sandstone, regarding the facilitation of the DAP project has lead to increased knowledge on the local reservoir and subsurface characteristics. Therefor this study uses the Delft Sandstone as a representative geothermal reservoir in an attempt to investigate some of the performance issues encountered so far in geothermal projects in th Netherlands.

The remainder of this report contains information that is (temporarily) confidential.