

Seismicity Potential Dinantian geothermal reservoirs – implications of case study Balmatt

Publieke samenvatting / Public summary

Aanleiding

The Dinantian carbonates are considered as a target for production of geothermal energy in the Netherlands. Geological characteristics of these reservoirs are quite different from the 'conventional' sandstone reservoirs. A wide spectrum of geological characteristics and settings exists amongst the Dinantian reservoirs. Their tectonic setting, reservoir properties, karstification and fractured nature will affect flow, heat transport and geomechanics, and thereby the seismic potential of the Dinantian rocks. Two geothermal doublets have been operated in the Dinantian in the southeast of the Netherlands. During operations a limited number of seismic events were recorded, which have led to the cessation of the geothermal doublet operations. Unambiguous conclusions on the relation between operations and seismic events are hampered by the lack of data and understanding of causal mechanisms. These relations are crucial for designing operations to minimize risks of induced seismicity. Data, models and experience from the Balmatt geothermal doublet in Mol (Belgium) can underpin relations between geology, operations and seismicity for the Dinantian carbonates in the Netherlands.

Doelstelling

Ambitions to accelerate development of geothermal energy production as outlined in the 'Masterplan Aardwarmte' require development of new geothermal targets, such as the Dinantian carbonates. Geothermal projects targeting the

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Dinantian carbonates in the Netherlands have been mostly successful in terms of heat production, but induced seismicity has proven to be a showstopper. A better mechanistic basis underpinning relations between operations and seismicity can help managing seismic risks of such projects. Modelling approaches are required that provide quantitative forecasts of stress changes and associated induced seismicity. The Balmatt geothermal project provides an unique dataset of the relation between doublet operations targeting Dinantian carbonates and induced seismicity. The aims of this project are (1) to use the Balmatt data to develop and validate induced seismicity models, (2) to establish a mechanistic basis underpinning relations between operations and seismicity, and (3) to assess implications for Dinantian carbonates targets in different parts of the Netherlands taking into account experiences in the Californië Wijnen Geothermie project (CWG).

Korte omschrijving

Based on available geological and reservoir engineering data and models from the Balmatt geothermal site, TNO and VITO will set up a coupled reservoir - geomechanical model to assess the effects of geothermal operations on changes in pressure, temperature, fault stresses and associated seismic response of the fault(s). Model data, the catalogue of seismic events and results of seismological studies available from the Balmatt site are used to inform and validate the geomechanical and seismicity models. In addition, seismic monitoring at Balmatt will provide a data set to evaluate the predictability (forecasting) of the models. The sensitivity of model forecasts to several key factors will be determined to capture some of the variation in geological characteristics and settings for the Dinantian reservoirs in the Netherlands. A review of relevant (experimental) data on rock properties will be performed, and extended with some additional experiments to constrain model input parameters. Existing data and experience obtained in the CWG project will be combined with recent reviews to assess differences in key factors between Balmatt and Californië

geothermal projects.

Resultaat

The integrated research activities are used to improve the understanding, model capabilities and assessment of coupled thermo-hydro-mechanical processes that determine critical conditions for fault reactivation and induced seismicity during geothermal operations in Dinantian carbonate reservoirs. The project will result in insights into mechanisms and key factors of fault reactivation and induced seismicity in Dinantian rocks, based on data, models and 'lessons learned' from Balmatt geothermal site. A practical modelling approach will be developed that quantifies the effects of temperature and pressure changes on fault stability and seismicity in Dinantian carbonate reservoirs. The model forecasts will be validated against the operational and seismicity data from Balmatt. The validated model approach will aid in managing seismic risks by optimizing doublet design and operations in future projects targeting the Dinantian carbonate reservoirs in the Netherlands. The results will also underpin differentiation and qualitative ranking of key factors and mechanisms that control the seismicity potential for Dinantian reservoirs in other regions 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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