

# Rise and Fall, the role of thermal uplift in the formation of Jurassic basins in the Dutch subsurface

## Publieke samenvatting / Public summary

### Aanleiding

The Middle Jurassic Central North Sea thermal doming is best known from its effect on the Dutch Central Graben and surrounding highs of the Central North Sea, where it caused km-scale uplift and erosion of the highs while, interestingly, sedimentation in the basins continued. Furthermore, stratigraphic and uplift data show that the Middle Jurassic thermal doming affected a much wider area and lasted longer than currently assumed, with the regional uplift being observed beyond the Lower Saxony Graben and into the Upper Jurassic (Kimmeridgian). The wide-spread uplift of highs and coeval continuous sedimentation in basins during the Upper Jurassic is not compatible with the currently assumed simple model of basin formation by extension, uplift of basement highs that border the basins, or by a combination of both. Therefore, a new mechanical model of basin formation is required to explain the observed effects.

### Doelstelling

We propose to study the vertical motions, thermal perturbations and sediment redistribution in the Netherlands and surrounding areas of the South Permian Basin. The aim is to determine the relative roles of the Middle Jurassic thermal doming and Late Jurassic rifting on the formation of Jurassic basins and highs in the Netherlands subsurface. The project will create a know-how basis for the Upper Jurassic of the Netherlands, integrated across basins and highs, based on crustal- to well-scale data and state-of-the-art tectonic and geodynamic concepts.

#### Projectinformatie / Project information

**Projectnummer / Project number**  
TKITOETKI2018-05-GE

**Subsidiebedrag / Grant amount**  
€ 251.789,00

#### Algemene informatie / General information

**Penvoerder / Secretariat**  
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In contrast with existing ideas of mechanical rifting, we propose a new concept of basin formation driven by uplift of highs. This project adds value to the program line "Basin Analysis" by improving understanding of the Dutch subsurface and developing improved understanding of its multi-phase tectonic evolution, and its bearings on spatial and temporal evolution of vertical motions, thermal and deformation history and architecture of basin sediments. This assists in building more robust conceptual models for hydrocarbon and geothermal energy exploration, and facilitates in extending the resource base.

### **Korte omschrijving**

The project will start with a detailed compilation and mapping of uplift/ erosion and subsidence/ sedimentation in between and across the different basins and highs at the scale of the Dutch subsurface. Areas with the highest data density will be studied first so further analysis can start before the compilation and interpolation across basins and highs for the entire study area is completed. Recent compilations including the publically available results of the TKI FOCUS and COMMA projects will be taken into account. Further analysis will include the quantification of tectonic subsidence and uplift as well as forward modelling (e.g. multi 1D) to test the concept of plume related underplating and its spatial and temporal evolution. Optional activities include 3D potential field and numerical modelling studies and a detailed sediment routing analysis. This concept will be studied by onshore and offshore observations and will be tested by means of state of the art modelling techniques, readily available at Utrecht University. Active engagement with sponsor interests will be effectuated through internships of master students, a methodology with well proven past success.

### **Resultaat**

A spatio-temporal compilation of distribution of deposition and erosion (in the form of digital maps and tables) will be a prime result. Data interpolation across basin will allow for the comparison of vertical movements between highs. Tectonic and seismo-

stratigraphic interpretation across basins and basement highs will be made along key cross-sections. The tectonic and thermal evolution will be calculated by multi 1D modelling, translating the compilation of vertical movements (and erosion) to tectonic subsidence and uplift. Public data of wells from NLOG will be available to the project by collaboration with EBN . A proof of concept of basin formation by thermal uplift of inter-basin highs will be provided by means of the multi 1D thermal models, laboratory experiments and, also possible, by a thermomechanical and potential field modeling study.

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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Voor meer informatie over de TSE / Energie-Innovatie regelingen die RVO aanbiedt, ga naar [www.rvo.nl/tse](http://www.rvo.nl/tse).