TNO Bouw en Ondergrond

Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek / Netherlands Organisation for Applied Scientific Research

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Notitie

Rotliegend dataset: Marginal notes

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1. Introduction

This document aims to add some short informative notes with the release of a (Petrel) dataset of a large-scale 3D-facies modeling study of the Upper Rotliegend Formation in the Netherlands. The aim of the study was to integrate data and models into one platform to build a 3D-model of the Slochteren and Silverpit Formations. These aims are directly related to the need, of especially the AGE group of TNO, to have a better grip or even a predictive tool on the distribution of reservoir productivity. A productivity attribute to fields, prospects and aquifers at any given location in the Dutch subsurface is a prerequisite of present and future policy support and advises to the MEA.

The project was executed in 2008-2009 and resulted in a 3D grid mimicking the lithostratigraphic subdivision of the Rotliegend in the Netherlands. The step to fill the "sand facies" with environment and permeability attributes is postponed. It was felt other parties may find the preliminary dataset and results beneficial for in-house studies. Therefore, a release of the project file in Petrel format is now available on request through www.nlog.nl.

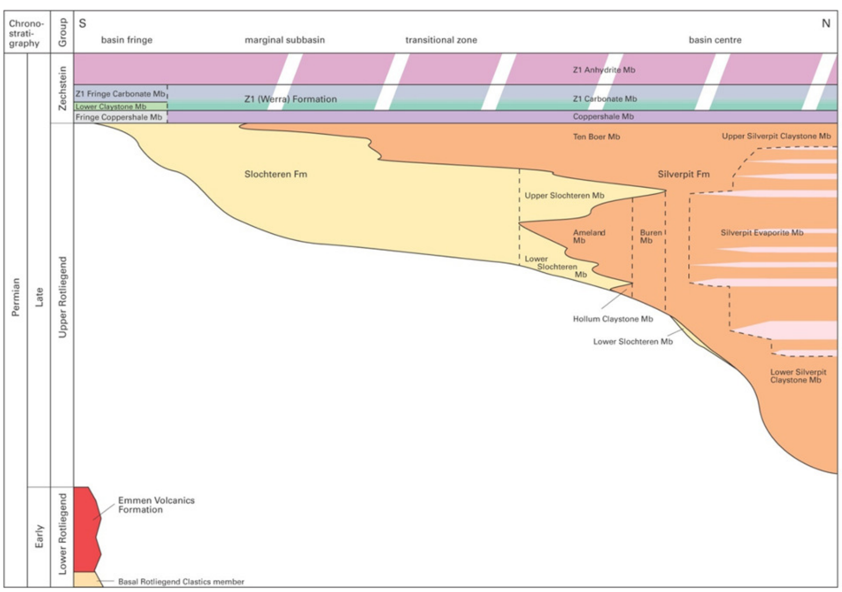

Figure 1 Litho-chronostratigraphic cross section of the 'Early' Permian through the central and eastern Netherlands. Vertical scale is not linear (Van Adrichem Boogaert and Kouwe, 1994).

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The main stratigraphic split in the Rotliegend of the Dutch subsurface is the distinction between the Slochteren Formation and the Silverpit Formation, which are commonly represented by respectively primarily sand or clay lithology. As these different members interfinger with each other, there is no unique solution on picking this boundary between both formations on the Dutch on-and offshore (see figure 1).

A pilot study (Beglinger, 2006) pointed out that productivity is primarily dependent on sedimentary facies. Because of this relation a start was made in 2007, to make a conceptual model of the distribution of the Rotliegend facies (Van Dienst, 2007). It was further extended in 2008 (Pezzati, 2008 and (Mijnlieff & Pezzati 2009). A conclusion was that the compilation of a 3D-facies model for the Rotliegend was possible, to map the most important production parameter: facies. The aims for 2008 were to enlarge the dataset of 2007 and 2008 to a dataset for the whole of the Netherlands and to make a 3D-facies model. Apart of the essential datasets with sedimentary, productivity- and petrographic data, model-hypotheses were made for the distribution of the sediments (Mijnlieff et al, in prep.).

A Petrel project file has been produced, that incorporates all the necessary data to generate a facies grid. The facies grid would then serve as the basis for a productivity grid. However, the creation of a productivity grid is shelved for the time being. The focus diverted to define a project workflow for the compilation of a large 3D-facies grid in Petrel and to create an adequate facies grid. As a result of this decision the end products of this project are:

1. A Petrel project comprising a large selection of wells (including logs) that drilled through or into the Rotliegend in the Dutch subsurface.
2. A 3D-facies model, in which the lithofacies have been divided into sand, ‘waste’, clay and evaporates. The ‘waste’ component is defined by the lithology definition on the GR-log, which may be interpreted as clayey sand or sandy clay.

The hypothesis on the relation of sediment distribution and palaeotopography is used to explain distribution and thickness of the various lithostratigraphic units of the Upper Rotliegend. The basic assumption is 1) that topography dictates to a large extent the distribution and type of sediments (Mijnlieff and Geluk, in prep.) and 2) that the Rotliegend has an onlap configuration on its subcrop. The relation between relief and the sediment distribution is taken as primary guideline to propose predictive models on the distribution of the sandstones of Lower Slochteren Formation (Geluk & Mijnlieff, 2002; Mijnlieff & Pezatti, 2009). Previous workers like George and Berry (1997), Maynard & Gibson (2001) and Geluk (2007) have already described this relation for certain areas in and around the Netherlands.

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2. Dataset

The project inhibits the following components:

1. **Well logs**
   Including:
   a. Gamma Ray (GR)
   b. Sonic (DT)
   c. Density (RHOB; DRHO)
   d. Neutron (NPHI)
   e. Resistivity (LLD; LLS)
   f. Cores
   g. Permeability (Horizontal; Vertical)

2. **Well tops**
   The well tops represent the different members of the Rotliegend Formation:
   a. Upper Silverpit Claystone Member (ROCLU)
   b. Silverpit Evaporite Member (ROCLE)
   c. Lower Silverpit Claystone Member (ROCLL)
   d. Ten Boer Member (ROCLT)
   e. Buren Member (ROCLB)
   f. Ameland Member (ROCLA)
   g. Hollum Member (ROCLH)
   h. Upper Slochteren Member (ROSLU)
   i. Lower Slochteren Member (ROSLL)
   j. Akkrum Member (ROSLA)
   In some cases the Rotliegend has been identified, but the specific member was not specified. The represented well tops were then indicated by
   k. Silverpit (ROCL)
   l. Slochteren (ROSL)
   m. Rotliegend (RO)
3. **Surfaces**
   Including:
   a. Zechstein base
   b. Rotliegend base
4. **Rotliegend thickness map**
5. **Rotliegend 3D-model**

3. Model notes

Some notes should be taken, when working with and looking at the model:

- Cell thickness of the model is 25 meters. Sections with smaller clay and/or sand members will therefore not be visualized.
- Cell blocks have a dimension of 500x500 meters. In areas where the Rotliegend is thin, the model has difficulties to maintain the top and the base of the model on the same depths as the well tops.
- It’s difficult to pinpoint the base of the Rotliegend. Therefore, the bottom surface of the model was created by subtracting of the thickness map from the surface that represents the base of the Zechstein Formation.

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- Anomalies (such as spikes) have been removed as much as possible.
- To correlate the different facies, the Ordinary Kriging correlation method has been used. One of the disadvantages of this method is that it tends to blend local variances in the regional view.
- At the time of the project execution digital well logs from some 300 wells were available, of the approximate 1700 wells that penetrate the Rotliegend in the Netherlands.
- Although an effort has been made; it proved difficult to distinguish sands and evaporites from each other with the available logs and the bulk processing method. This is mainly the case in the northern part of the model.
- Model reliability depends on well density.
- It’s a conceptual model, which is still in progress.
- Data files on facies and petrography are not included in the released project, because they are still in the processing stage.

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