

Essential elements and processes of the oil and gas systems in the Netherlands

Databases, maps and integrated basin modelling



Figure 1 Location map showing structural elements in onshore and offshore Netherlands

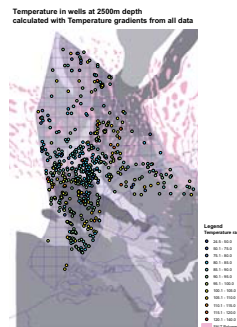


Figure 2 Calculated temperatures at 2500 m depth derived from geothermal gradients. These geothermal gradients were calculated at more than 600 well locations using Bayesian least squares on approximately 7000 temperature measurements of different origin and quality

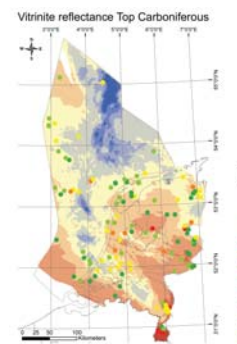


Figure 3 Maturity at Top Carboniferous. The maturity map is based on in-house measured vitrinite reflectance values of the Carboniferous at 115 well locations

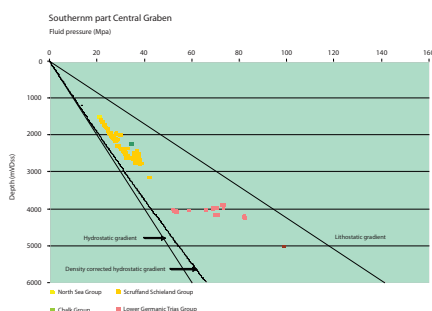


Figure 5 Multiwell plot of pore fluid overpressure versus depth in the southern part of the Dutch Central Graben. All stratigraphic units from the Lower North Sea Group and older are overpressured. Very large variations in overpressure occur in the Triassic units

Introduction

TNO applies two approaches to increase the knowledge on essential elements and processes of the petroleum systems in the Netherlands:

1. Regional mapping;
2. Detailed mapping and 3D basin modelling.

Regional mapping

The TNO thematic mapping programme of the deep subsurface of Netherlands onshore and offshore aims to compile, analyse and map temperatures and rock and fluid properties (fluid = oil, gas, water) derived from released data from oil and gas wells.

In 2007 focus was on analysing and mapping:

- Temperature and geothermal gradients (Figure 2)
- Maturity of Carboniferous source rocks (Figure 3)
- Geochemical composition of natural gas accumulations (Figure 4).

Detailed mapping and 3D modelling

As part of the TNO detailed mapping programme of sub-areas, special attention is paid to analysing and interpreting rock and fluid parameters. We use 3D basin modelling for the integrated interpretation of the wealth of data obtained in the detailed mapping project with the aim to increase the understanding and knowledge of the petroleum systems. The deliverables for the Terschelling Basin and the southern part of the Dutch Central Graben include:

- Visualisation and analysis of rock and fluid parameters
- 3D burial histories
- Petroleum system analysis.

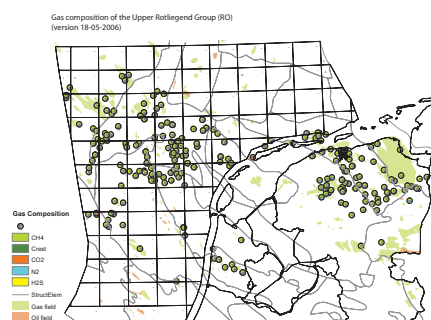


Figure 4 Geochemical composition of natural gas in the Upper Rotliegend Group.

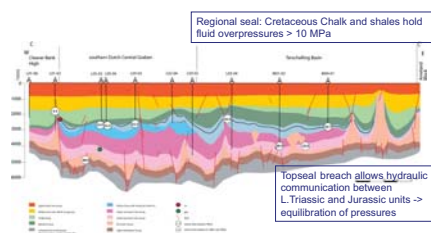


Figure 6 W-E cross-section through the southern part of the Dutch Central Graben and the Terschelling Basin showing the distribution of pore fluid overpressures.

Figures 5 and 6 present examples of the pressure versus depth plots and cross-sections used to characterise the fluid pressure conditions in the area. Figures 7, 8 and 9 show selected results of the 3D basin modelling.

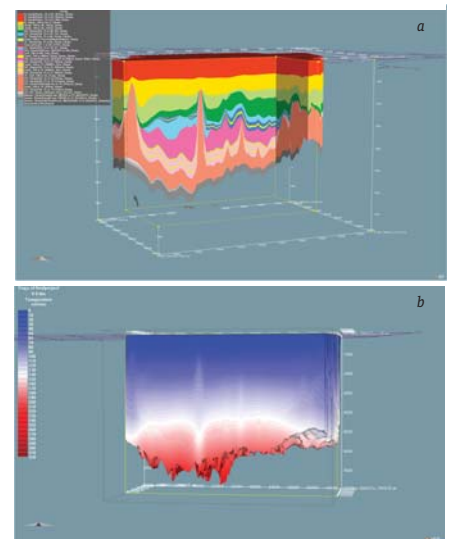


Figure 7a) 3D geological model of the Terschelling Basin and southern part of the Dutch Central Graben
 Figure 7b) Simulated present-day temperature: results from 3D basin modelling of the Terschelling Basin and the southern part of the Dutch Central Graben (using PetroMod Version 10.0 of IES). Note the influence of salt diapirs on the temperature distribution

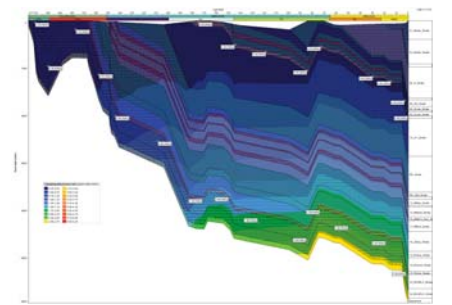


Figure 8 Simulated maturity history (1D extraction of 3D simulation run)

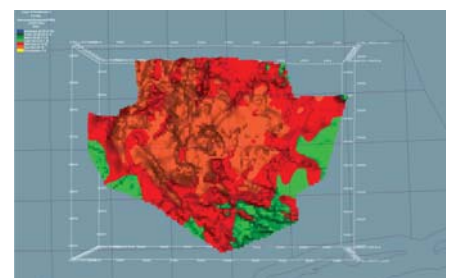


Figure 9 Top view of simulated present-day maturity at the Top Carboniferous in the Terschelling Basin and the southern part of the Dutch Central Graben (results from 3D basin modelling)