The Netherlands represent a mature area for hydrocarbon exploration, and only less obvious targets are left for finding more oil and gas. One of these targets is the Chalk Group. To support the E&P industry to target the Chalk, particularly in the Netherlands, a multidisciplinary joint industry research project is proposed. For this purpose, petrophysical log interpretations, new biostratigraphical analysis and seismic fault interpretations will be combined with high resolution analyses of existing geological, geophysical and fluid dynamic data on the Chalk. The project aims to develop and apply a new stratigraphic trap model and migration/charge model for the Chalk in The Netherlands. The result of this comprehensive approach is of direct importance for establishing prospectivity of the Chalk in the Netherlands.
The Chalk Group includes important hydrocarbon reservoirs in the UK, Norwegian and Danish sectors of the North Sea, and it is extensively studied from the '70s onward (Surlyk et al., 2003). These studies show that the chalk is a micritic limestone mainly composed by fine algae and in a minor part also by larger organisms such as Foraminifera, Ostracods, fragments of bivalves, echinoids and Bryozoa. Deposition of the chalk occurred from shelf to bathyal paleodepths. The deposition in different paleoenvironmental settings, combined with a complex structural configuration and tectonic history are responsible for creating a wide range of differences, not only on a regional scale but also locally. The reservoir-quality Chalk is generally characterized by high porosity and low permeability. Tilted hydrocarbon-water contacts in the reservoir-quality Chalk and regional overpressure gradients indicate dynamic basin-wide conditions (Dennis et al., 2000; Moss et al., 2003). Most of the Chalk fields produce from the uppermost part of the Chalk (Maastrichtian and Danian). In contrast, the lower part of the Chalk Group, and the Lower Cretaceous shales, are considered to act as a regional seal restricting fluid and gas flow and often preserving high overpressures in underlying units (e.g. Winefield et al. 2005). Recently, the porosity-permeability characteristics of this non-reservoir part of the Chalk have also been assessed quantitatively (e.g. Mallon et al. 2005). Faulting and fracturing of the Chalk near salt structures may locally influence the pressure and the fluid migration conditions and, thus, may provide vertical pathways for oil and gas to enter and move through the Chalk.

### Challenge

Despite the fact that major parts of the Chalk Group are probably of non-reservoir quality, the hydrocarbons managed to migrate through the Chalk and charge the reservoirs in the uppermost part of the Chalk in the UK, Norwegian and Danish parts of the Central Graben. In fact, several fields are successfully drilled in Denmark already from 1966 onwards. In the Netherlands, the only producing oil field is the Hanze Field, which was discovered in 1996 in Block F2. Here, the early Paleocene Ekofisk and, to a minor degree, Maastrichtian Ommelande/Tor Formations constitute the reservoirs. The only gas field known to date is the onshore Harlingen field.

The present-day knowledge about the properties and distributions of potential stratigraphic traps (Bramwell et al. 1999), regional seals and leak points/migration paths in the Chalk Group in The Netherlands is meager. In 2004, Van der Molen completed a study on the sedimentary development, seismic stratigraphy and burial compaction of the Dutch Chalk. More recently, a preliminary integrated regional study revealed that differences in sedimentary and burial history of the Dutch Chalk and resulting differences in seismostratigraphic build-up, thickness and porosity of the Chalk correspond to different fluid migration conditions in the Chalk (Verweij, 2006).
Project aim

To enhance the knowledge and understanding of the Chalk in The Netherlands, the project will build upon the published information available on the UK, Norwegian and Danish Chalk, using recently completed Dutch studies on the Chalk in combination with the wealth of data, information and knowledge on the Dutch subsurface available at TNO. In addition, the study aims to apply innovative approaches and state-of-the-art tools (e.g. basin modeling) to analyze and interpret this information and data. Apart from this more regional approach, the project intends to carry out a detailed comparison between successfully drilled reservoirs in the Danish sector with Chalk conditions in The Netherlands. The comparison will focus on the biostratigraphy and paleoenvironmental characteristics, on the associated compaction and permeability, and on the migration and charging conditions. The regional approach and the detailed comparison study will be used to develop a new stratigraphic trap model and migration/charge model for the Chalk in The Netherlands.

The project ultimately aims to answer the following interrelated questions:
1. Where are the sweet spots?
2. What are the sealing characteristics of the Chalk and how do they vary in space?
3. What is the role of the Chalk (regional barrier to migration, local leak points) on the prospectivity of the Triassic in platforms and highs?

Successful reservoirs prediction cannot be achieved without detailed chronostratigraphic and biofacial models as support for the stratigraphic trap model. This would also allow developing a detailed biostratigraphic frame of this interval which could be useful for biosteering during drilling operations. The budget costs for this Phase I is estimated at EUR 80.000 and the run-time is approximately 6 months.

Project outline

The project will be executed in 2 phases: a pilot study based on available data and samples, and a second phase to develop an exploration model. Progress meetings will be regularly organized to discuss the results and to determine the follow-up.

Phase I

- **Pilot project on the southern Part of the Dutch Central Graben:**

  This phase provides the general basis for the project.

  1. Compilation of (publicly) available data, information and maps (Chalk specific information, such as depth and thickness, intra-Chalk seismostratigraphy, faults, burial anomalies, biostratigraphy, petrophysical, hydrocarbon shows; regional 3D geological model, information on pressures, mudweights, leak-off pressures, temperature, salinity);

  2. Time-depth conversion of seismostratigraphic subdivision of the Chalk assessed by Van der Molen (2004); verification of seismostratigraphy with well information and biostratigraphic interpretations; incorporation of the seismostratigraphy in existing 3D-depth stratigraphic and fault model of the study area;

  3. Log analysis (petrophysical, lithological) to determine porosities, clay/silt content;

  4. Biostratigraphic interpretation of samples from the Hanze field in order to define biostratigraphic and facial properties of a producing field;

  5. Regional integrated analysis, including application of simulation of 1D-2D burial histories (Petromod);

  6. Concept development (development stratigraphic trap & migration/charge model).

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**Phase II**

- **Creation of an innovative exploration model.**

  The approach and results of the pilot will be extended to other Chalk occurrences in the Netherlands offshore. An initial regional overview will be followed by a more detailed study on a selected promising area (selection in cooperation with partners of project). This phase includes workpackages 1-5 of the pilot project, and

6. Creation and application of the stratigraphic trap and migration/charge model in selected areas;

7. Identification and mapping of play areas, involving stratigraphic traps, regional seals and leak points in the Chalk Group in selected areas.

The budget costs for this Phase II are estimated at EUR 120,000 and the run-time is approximately 9 months.

**Sponsoring opportunities**

With a total project budget of EUR 200,000, it is intended to finance the project through sponsorship by companies with interest in the North Sea Chalk. To signify your potential participation and interest in the project, please contact the address below. A detailed project plan, including in-company presentation can be provided to you upon request.

**References**


