

GEUS

Near-shore shallow-seismic geological mapping of the Danish North Sea Coast

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Introduction

The knowledge of the near-surface geology in the Danish part of the North Sea was until recently very general and sporadic. In 1998, the Geological Survey of Denmark and Greenland (GEUS) began a three-year survey programme in order to map the geology off the the Danish West Coast (Leth & Anthony, 1999). The project is a co-operation between GEUS and the Danish Coastal Authorities.

Methods

A seismic survey was carried out in fall 1998. The survey vessel was equipped with side scan sonar (EG&G DF-1000), sub-bottom profiler (EdgeTech X-STAR), echosounder and navigation (Sercel DGPS and EIVA NaviPac software). At the end of the survey, 25 six-meter vibrocores were collected.

The survey covered a rectangular area of approximately 500 km², see Fig. 1 and Fig. 2. The area was surveyed parallel with the axes in the UTM-system and with a mesh-size of 2 km. The mean depth in the survey area varied from approximately 10 to 25 m below sea level.

From the "Jupiter" database at GEUS, geological data from the coastal zone were extracted to extend the geological profile from the marine environment to on-shore. In addition to the existing land based cores, thirteen more cores were drilled at the beach - all to a depth of approximately 13 m.

Summary of Results from the 1998-survey

Geological profiles

Shore-normal as well as shore-parallel geological profiles were made on the basis of the survey. Fig. 3 shows an example of a shore-normal geological profile (W-E-oriented) and Fig. 4 shows an example of a shore-parallel geological profile (S-N oriented).

The geological boundaries are primarily based on seismic interpretation, correlated with the vibrocores.



Fig. 1. Location of the survey area.

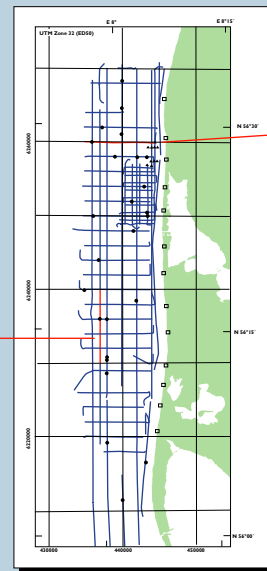


Fig. 2. Seismic survey lines and core positions.

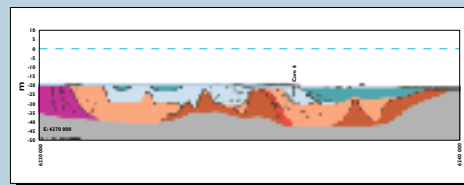


Fig. 4. S-N oriented geological profile (see legend in fig. 3).

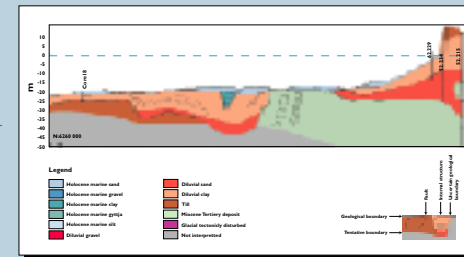


Fig. 3. W-E oriented geological profile.

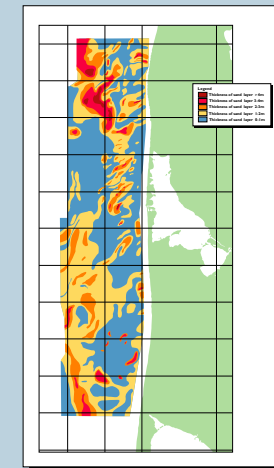


Fig. 5. Distribution and thickness of Holocene sand.

Isopack map of top sand layer

The thickness of the top sand layer has been derived from the geological profiles, to produce an isopack map, see Fig. 5. The erosional surface underlying the top sand layer - often armoured with stones and gravel, which generally is interpreted as Holocene transgression lag sediments - has a very gently sloping topography. The isopack map can therefore be viewed as a map showing the large-scale sand bodies, which generally is interpreted as large-scale subaqueous sand dunes. The sand dunes are not equally dispersed in the region, but are located in more or less well-defined regions. The relationship between the distributional pattern of the sand dunes, and the outline and geology of the coastline is ambiguous, and is not examined in detail yet.

Geology below the top sand layer

Below the transgression lag sediments, the vibrocores penetrated into diluvial sand and clay, glacial deposits, Holocene clay and silt as well as Tertiary sediments (Miocene clay and sand), see Fig. 3 and Fig. 4.

In the northern part of the survey area, the glacial deposits are of Weichselian age, and are closely connected to the terminal moraines found on land. Glacial deposits found in the southern part are probably of Saale age, or even older.

The Tertiary deposits overlying the Nissum salt diapir (Japsen & Langtofte, 1991), has partly been uplifted by diapirism, making the pre-quaternary deposits emerge at the seabed. Rim synclines seem to have developed during the Quaternary period, expressed by relatively thick Quaternary deposits at the margins of the salt diapir.

The diluvial sediments in the area are generally present in wide valleys, some places overlain by Holocene marine clays. The marine clay are assumed being deposited in a relatively calm lagoonal environment during the Holocene transgression, when a Saale landscape, seaward of the marine clays, still existed above sea level. The general orientation of the diluvial channels are for the present found to be North-South.

Further work

During 1999 and 2001 the area north and south of the 1998-area will be surveyed, and additional cores, both off-shore and on-shore, will be made. Moreover, GEUS will in general increase the effort to survey in the near-shore shallow zone.

References

- Japsen, P. & Langtofte, C. (1991): Geologisk kort over Danmark, 1:400 000, Det danske Bassin, 'Basis Kalk' og Kalk Gruppen, DGU Kortserie nr. 29.
- Leth, J.O. & Anthony, D. (1999): Geologisk kortlægning af Vestkysten, Regionalgeologisk tolkning af kystzonen mellem Sønderø og Bovbjerg, Geological Survey of Denmark and Greenland, Report 1999/31 (in Danish).