The Upper Cretaceous – Danian chalk may be considered to be the economically most important rock type in Denmark. Onshore it constitutes an important groundwater aquifer and it is also quarried for e.g. building materials and paper production. Offshore the chalk reservoirs contain more than 80% of the oil and gas produced in Denmark (Fig. 1).

During the last few years efforts have therefore been made to map this important succession in the Danish and adjoining areas (Vejbæk et al. 2003). The stratigraphic interval mapped comprises the Chalk Group of Cenomanian to Danian ages and its stratigraphically equivalent units (Fig. 2). The north-eastern limit of the Chalk Group is determined by Neogene erosion. The limits of the map to the west and south were mainly determined by the amount of available data.

**Data base**

The comprehensive data base comprises high-resolution and conventional 2-D and 3-D reflection seismic data as well as published maps (e.g. Britze et al. 1995; Hommel 1996; Ottesen et al. 1997; Jensen 1998; Kramarskiej 1999; Baldschuhn et al. 2001; Stoker 2005). More than 500 deep wells and numerous onshore water wells have provided control for the mapping. This is especially relevant for the mapping where the Top Chalk is immediately overlain by the Neogene (Fig. 3). In these areas in particular, mapping was based on high-resolution seismic data.

**Depth conversion**

Depth conversion was undertaken by using depth-dependent velocity functions, where the velocity $V$ at depth $z$ is given by:

$$V = V_0 + dV + K \times z$$

where $V_0$ is the surface velocity, $dV$ is a variation of the surface velocity and $K$ is the gradient of velocity increase with depth (Table 1; e.g. Japsen 1998, 1999). The surface velocity variation is typically mapped on the basis of well data and may reflect lateral facies changes, burial anomalies or excess fluid pressures.
The Cenozoic velocity model consists of a single layer onshore Denmark and two layers offshore. The division between the two layers is taken at the ‘near Top Middle Miocene marker’ that corresponds approximately to the top of the over-pressured section (Upper and Lower Post Chalk Group in Table 1). The parameters for these layers were taken from Britze et al. (1995) and Japsen (1999, 2000) who derived a similar but segmented model for the Chalk Group. Since the parameters are based on a large well data base from the entire North Sea (e.g. Japsen 2000), they are applicable to most of the North Sea.

Notes about the maps

In some areas where the Neogene lies directly on the Top Chalk seismic horizon, the erosional truncation of the Chalk Group is negligible. This occurs around Copenhagen, in northern Sjælland and in south-western Scania, where minor outliers of Sellean deposits document the former extent of the Chalk Group. The occurrence of Palaeogene sediments offshore Poland also indicates that erosion of the Chalk Group is generally not very deep in the western Baltic outside the main inversion zones (Fig. 3).

In Norwegian waters, however, extensive Neogene erosion has occurred. The erosion in these areas is sufficiently deep for Lower Cretaceous deposits to subcrop the base of the Neogene. Outside these areas the Chalk Group generally has a larger areal extent than the Lower Cretaceous. (Fig. 3).

A general increase in thickness of the Chalk Group is found west of the Sorgenfrei–Tornquist inversion zone. A north-eastward increase in thickness is also found in the areas unaffected by Neogene erosion offshore southern Norway, suggesting the presence of similar depocentres on the flanks of inversion zones. Thus, inversion may also have occurred in the south-western coastal areas of Norway.

Table 1. Parameters for depth conversion

| Unit                     | \( V_0 \) (m/sec) | \( K \) (sec\(^{-1}\)) | Source               |
|--------------------------|-------------------|--------------------------|----------------------|
| Upper Post Chalk Group   | 1725              | 0.4                      | Britze et al. 1995   |
| Lower Post Chalk Group   | 1517.2            | 0.6                      | Japsen et al. 1999   |
| Chalk \( z < 900 \) m    | 1550              | 1.3                      | Japsen 2000          |
| Chalk \( 900 \) m < \( z < 1471 \) | 920              | 2.2                      | Japsen 2000          |
| Chalk \( 1471 \) m < \( z < 2250 \) | 1950              | 1.3                      | Japsen 2000          |
| Chalk \( 2250 \) m < \( z < 2875 \) | 2625              | 1.3                      | Japsen 2000          |

Facing page: Fig. 3. Simplified structure maps of the Chalk Group and equivalent deposits. A. depth to top Chalk Group, B. depth to base Chalk Group and C. isopach. Grey shadings in A and C indicate where the Lower Cretaceous subsurfaces Quaternary sediments (i.e. where the Chalk Group has been totally removed by erosion). Cph. Copenhagen.

PDF versions of the maps with more detail are available from www.geus.dk/publications/bull/no13/index-uk.htm
Hydrocarbon aspects

The Chalk Group in the Central Graben area is an important reservoir and migration path for oil and gas. It is the most important oil-producing interval in Denmark and is also a major contributor to oil and gas production in Norway and the Netherlands, while production from the Chalk Group is still insignificant in the UK sector (Fig. 1). Traps within the Chalk Group range from inversion-generated anticlines (e.g. the Valhall, Roar, Tyra and South Arne fields), over salt domes with some degree of inversion overprint (e.g. the Dan, Eko-fisk and Svend fields) to salt diapirs (e.g. the Skjold and Harald fields). Stratigraphic traps may also play a major role (e.g. the Halfdan and Adda fields). These traps owe their existence to a combination of over-pressuring and early hydrocarbon invasion to preserve the quality of their reservoirs despite the great depths to which they have been buried (e.g. Anderson 1999; Vejbæk in press). Their position directly above the main Upper Jurassic source rock also seems to be a necessary condition for their existence (e.g. Anderson 1999; Surlý et al. 2003), since the generally very low permeability of the chalk precludes long-distance migration and even keeps accumulations in hydrodynamic disequilibrium (e.g. Dennis et al. 2005; Vejbæk et al. 2005).

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