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A survey of the Paleocene and Eocene deposits of Jylland and Fyn

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Arne Dinesen, Olaf Michelsen and Kirsten Lieberkind

I kommission hos C. A. Reitzels Forlag . København 1977

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Contents

Abstract

Existing data from boreholes in Jylland and on Fyn have been used to produce contour maps showing the surfaces of the Eocene, Peleocene, and limestone/chalk (Danian, Senonian) formations, and an isopach map of the series from the top of the limestone/chalk to the top of the Eocene. Brief descriptions of the corresponding formations accompany the maps, together with a map showing the formation thickness in selected boreholes.

Foreword

In June 1975 a working party under the Danish Atomic Energy Commission approached the Geological Survey of Denmark (DGU) with a request for a report on the non-permeable formations of the Lower Tertiary succession, to be used by the working party in its deliberations concerning the practicability of geologic disposal of high-radioactive waste in Denmark. This survey of the Paleocene and Eocene Formations in the Jylland–Fyn area, with accompanying maps of the depth and thicknesses of the deposits, was presented to the working party in August 1975 as part of the Geological Survey's response to this assignment. The material was later published as a supplement to a report by the Ministry of Commerce (Affald fra Kernekraftværker, Handelsministeriet, april–maj 1976, ISBN 87–503–1975–2). Apart from the introdoctory remarks, this English version of the survey is essentially a direct translation of the original Danish report.

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Introduction

With the exception of the limestone strata of the Danian stage and the sandier Oligocene deposits, sticky impermeable clay and marl sediments of marine origin are almost universal throughout the Lower Tertiary of Denmark. This report attempts to give a survey of the Paleocene and Eocene formations, and to describe their main depositional features in the Jylland–Fyn area.

In spite of an exceptionally large quantity of data originating from boreholes and natural or artificial exposures, knowledge of the composition and spatial extent of the formations is incomplete. A number of unsolved problems exist concerning identification of the rock types and the delimitation of the formations one from another. Mapping is furthermore hindered by the glacial disturbances undergone by the formations in a number of localities. This report, with its accompanying maps, was produced at very short notice, which gave little opportunity for verifying the numerous questions of interpretation presented here. In particular it must be stressed that the maps showing the depths and thicknesses of the formations have not been corrected and adjusted with the aid of the structural information that can be obtained from analysis of existing geophysical data.

With these reservations, which are discussed more fully in the following text, we hope to present here a usable picture of the deposits under consideration. The correlation diagram, plate 1, is provided to give a general view of the schematic subdivision into formations used in the text; it presents profiles for a few relatively welldocumented boreholes in Jylland.

The Paleocene and Eocene formations

The Paleocene–Eocene stratigraphic series consists of marine sedimentary clay-dominated deposits that have been laid down under conditions varying widely both geographically and temporally. Partly because of the variation in clay types and partly because of the scattered nature of the available observations, it has up to now only been possible to a limited degree to determine the spatial extent of the formations. The following subdivision of the formations is thus of a schematic nature.

Danskekalk (Danian limestone) (Lower Paleocene)

Type locality: Stevns Klint and Fakse.

The Danian limestone, earlier regarded as still belonging to the Upper Cretaceous, consists in Jylland and on Fyn chiefly of bryozoan and coccolithic limestones, silicified in places and with flints. The degree of permeability varies, deriving partly from pores and partly from fractures (particularly in hardened strata). In plate 4 the Danian limestone is mapped together with the White Chalk (Upper Cretaceous), since the Danian limestone and the Upper Cretaceous chalk are to be regarded as the "basement rocks" in the context on this report. Similarly, the Danian limestone is *not* included in the Paleocene–Eocene series in plate 5.

Lellinge Greensand (Middle Paleocene)

Type locality: Skovhusvænget at Lellinge, near Køge.

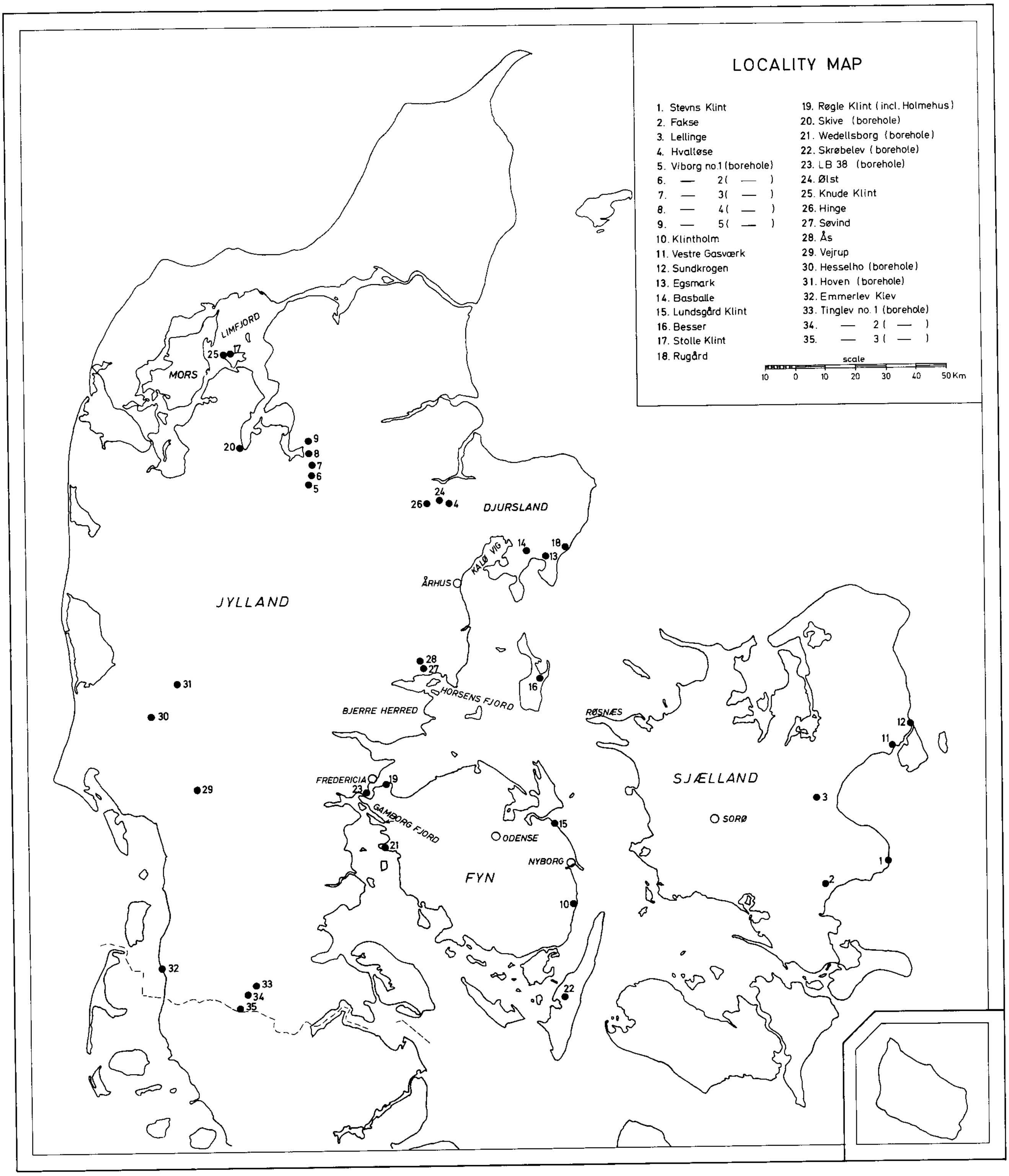
References: Gry (1935), Sorgenfrei (1957a).

This formation is well-developed in eastern Sjælland (thickness 5–10 m) and consists of limestone and marl in varying degrees of hardening (partly silicification). There are varying sand (predominantly redeposited chalk grains) and clay components, and a large glauconite component. Larger, redeposited chalk fragments (conglomerate) are found in places at the base of the formation. Conglomerate and greensand are only sparsely developed further west (North Jylland: Hvalløse, Viborg No. 5), and the formation appears to be absent in large areas of Jylland, Fyn (e.g. Klintholm), and the most westerly parts of Sjælland.

Unnamed formation, with dark grey to black clay or marl (Middle Paleocene)

Type locality: not designated.

Dark grey to black clays or marlstones, rich in pyrites and poor in sand, are found embedded in the Greensand at Lellinge, and resting on the Greensand in the



LOCALITY MAP
1. Stevns Klint
2. Fakse
3. Lellinge
4. Hvalløse
5. Viborg no.1 (borehole)
6. — 2(—)
7. — 3(—)
8. — 4(—)
9. — 5(—)
10. Klintholm
11. Vestre Gasværk
12. Sundkrogen
13. Egsmark
14. Basballe
15. Lundsgård Klint
16. Besser
17. Stolle Klint
18. Rugård
19. Røgle Klint (incl. Holmehus)
20. Skive (borehole)
21. Wedellsborg (borehole)
22. Skrøbelev (borehole)
23. LB 38 (borehole)
24. Ølst
25. Knude Klint
26. Hinge
27. Søvind
28. Ås
29. Vejrup
30. Hesselho (borehole)
31. Hoven (borehole)
32. Emmerlev Klev
33. Tinglev no. 1 (borehole)
34. — 2 (—)
35. — 3 (—)
scale
10 0 10 20 30 40 50 Km
LIMFJORD
MORS
DJURSLAND
KALØ VIG
ÅRHUS
JYLLAND
HORSENS FJORD
BJERRE HERRED
RØSNÆS
FREDERICIA
GAMBORG FJORD
ODENSE
NYBORG
FYN
SJÆLLAND
SORØ

Copenhagen area (e.g. at Vestre Gasværk and Sundkrogen). Corresponding rocks are also known from Djursland at Egsmark (black clay embedded in light grey marl) and Basballe. Investigations by Hofker (1966) of the foraminifera in samples from localities in Jylland and from the oldest strata in Lundsgård Klint near Kerteminde (Fyn) point to the presence of biozones intermediate between those of the Lellinge Greensand and the Kerteminde Marl. This can be taken as supporting the suggestion (see Rasmussen 1967) that a distinct formation can be distinguished at this point in the stratigraphic series. However, since the facies appear to alternate, with strata of both Greensand and Kerteminde Marl, the limits of this formation would appear to be difficult to define.

Kerteminde Marl (Middle Paleocene)

Type locality: Lundsgård Klint.

References: Gry (1935), Sorgenfrei (1957a).

At the type locality, which is an erratic body in the glacial strata, the predominating rock is a light grey, quite sticky marl ($CaCO_3$ content approx. 50–70 %), poor in glauconite. Silicified zones occur in the marl; according to Gry (1935) these represent intercalations of more sandy deposits. The formation is thickest in western Sjælland (at least 156 m at Sorø). In several boreholes quite large variations in the content of $CaCO_3$ have been observed from layer to layer, and the less calcareous strata have been referred to as Kerteminde Clay. However, this term has also been used (e.g. by Sorgenfrei and Berthelsen (1954), Sorgenfrei (1957)) for the slightly calcareous Upper Paleocene clay discussed below. Permeability seems particularly to be associated with fractures in zones of hardening.

Unnamed formation, with grey, slightly calcareous clay (Upper Paleocene)

Type locality: not designated.

References: Bøggild (1918), Gry (1935), Flagler (1940).

In some borings (e.g. at Besser on Samsø, and Viborg Nos. 1, 4 and 5) quite thick deposits of grey clay, slightly calcareous and often only slightly silty, are found above the Kerteminde Marl. The fossils in this clay consists only of stratigraphically uncharacteristic microfossils (including agglutinating foraminifera) but it can probably be referred to the Upper Paleocene on the basis of its position between the Kerteminde Marl and the Clay with Volcanic Ash. This grey, slightly calcareous clay can be seen exposed at Stolle Klint on the island of Fur, and a rather sandier facies has previously been exposed at Rugård on Djursland. The sand grains in the Upper Paleocene clay consist to a major extent of quartz (in contrast to the calcareous sand in the Lellinge Greensand), and the glauconite content is considerable (in contrast to the Kerteminde Marl). Hardened, silicified zones occur (probably with associated fracturing and higher permeability). Delimitation of the boundary with the Kerteminde Clay presents difficulties and is unclear in a number of cases.

A section in the middle of the grey, slightly calcareous clay in the Viborg boreholes Nos. 1 and 3, and above the grey clay in Viborg No. 4, consists of greenish to brownish clay, resembling the "Holmehus Clay" mentioned below.

"Holmehus Clay" (Upper Paleocene?)

Type locality: Possibly at Holmehus, Røjle Klint.

References: Bøggild (1918), Dinesen (1965).

In borehole LB 38 at the Lillebælt an approximately 12 m thick section of greenish and red-brown, sticky, plastic clay, slightly calcareous, is found beneath strata containing volcanic ash. This section may be collated with Bøggild's report of the possible occurrence of Paleocene, plastic clay near Holmehus on Røjle Klint (Bøggild 1918), and with the abovementioned occurences of green clay in the grey, slightly calcareous clay in the Viborg boreholes. Furthermore, data from boreholes at Skive (Jylland), Wedellsborg (West Fyn) and Skrøbelev (Langeland) (Gry 1935) indicate the presence of sticky plastic clays beneath the Clay with Volcanic Ash. It is thus likely that a separate formation can be distinguished from the grey, slightly calcareous, Upper Paleocene clay mentioned above. However, it cannot be excluded that the clay contains the "negative" ash strata (see below), which simply have not been visible in the LB 38 borehole, and that the formation is more closely related to the basal Eocene than so far has been supposed.

Clay with Volcanic Ash (Lower Eocene)

(In the Limfjord region: Mo Clay with Volcanic Ash)

Type locality: The north coast of Mors (Mo Clay).

References: Bøggild (1918), Andersen (1937a), Flagler (1940), Sorgenfrei (1957a), Gry (1964).

The lower part of the ash-bearing formation in the Limfjord area consists of an approx. 30 m thick section, in which ash layers No. –39 to –20 are intercalated with dark, sticky, rather diatom-poor clay, and ash layers –19 to –1 are intercalated with diatom-rich clay (Mo Clay). The upper part consists of an approx. 25 m thick section in which ash layers +1 to +140 are intercalated with Mo Clay, but where ash layers +1 to +118 are strongly predominant at the expense of the Mo Clay. In the negative ash series the ash layers comprise only about 2 % of the total thickness, while the ash layers in the positive series make up about 15 % of the thickness. Hardened zones or lumps occur, partly formed by silicification but particularly formed by lime precipitation (cementstone).

Outside the Mo Clay area the ash layers may be followed over wide areas of the North Sea basin. As a rule the ash is embedded in dark sticky clay, reminiscent of the clay poorer in diatoms lowermost in the Mo Clay area. In the Viborg boreholes the negative ash series is partly associated with a characteristic laminated shaly claystone which can clearly be distinguished from the grey, slightly calcareous, Upper Paleocene clay. In borehole LB 38 at the Lillebælt, an approximately 1 m thick silt ("Lyngsodde Silt") containing inclusions of green clay is found at the base of the ash-bearing series (Dinesen 1965).

In Denmark the Paleocene/Eocene boundary has traditionally been placed at the base of the ash-bearing series. No real proof has been presented for this delimitation, and it should be pointed out that, according to newer investigations, at least some of the ash layers that have been found in the Lower Tertiary in numerous North Sea boreholes must be regarded as Paleocene.

Røsnæs Clay (Lower Eocene)

Type locality: Røsnæs.

References: Bøggild (1918), Mertz (1928), Ødum (1936), Flagler (1940), Sorgenfrei (1957a), Dinesen (1965, 1972).

The typical Røsnæs Clay, which in the type locality occurs as erratics in the glacial strata, consists of brick-red, red-brown or yellow-brown, calcareous, very sticky, plastic clay, in places with concretions. Minor greenish or greyish, less calcareous layers or zones occur, especially near the base. In borehole LB 38 at the Lillebælt some of the basal green clay has been redeposited lowermost in the typical Røsnæs Clay. Green clay has also been found at the base of the formation in the profile at Ølst, where it has been interpreted as a glauconitic layer (Andersen 1937), and as a 2 m thick layer in Viborg No. 5 (Flagler 1940). Røsnæs Clay of typical appearance may be seen deposited on top of the Mo Clay Formation at the easterly end of Knudeklint on the island of Fur.

The thickness of the Røsnæs Clay is recorded as being rather variable (10–40 m according to Sorgenfrei 1957a). It is likely, however, that the typical calcareous Røsnæs Clay reaches a maximum thickness of 12–15 m (as in borehole LB 38), and that records greater than this are due to inclusion in the calculation of layers interpreted here (see below) as transition strata between Røsnæs Clay and Lillebælt Clay.

Transition strata, Røsnæs Clay/Lillebælt Clay (Lower-Middle Eocene)

Type locality: not designated.

References: Dinesen (1965, 1972).

In an approximately 20 m thick section beneath the typical Lillebælt Clay and above the typical Røsnæs Clay in borehole LB 38 near Lillebælt is found a sticky, plastic clay, slightly calcareous, varying in colour between greenish, olive-grey, brownish and red-brown. Similarly, Flagler (1940) records that the lowermost 10 m (approx.) of the Lillebælt Clay in Viborg No. 1 must be regarded as a transitional section to the Røsnæs Clay. In many surface exposures (e.g. Røjle Klint, Hinge) a violent colour contrast occurs between Lillebælt Clay-resembling and Røsnæs Clay-resembling deposits, and these are often explained as arising from "mixing" of the clays by glacial disturbances, or from caving, or (in claypits) from the method of excavation. However, the observations from the above-mentioned boreholes indicate that these alternations of colours can also be "primary" (although perhaps diagenetically influenced) in surface exposures.

The transition strata are normally poor in fossils, although remains of a number of plants and fishes may occur (particularly in one or more layers of black clay), and the so-called pyritized fossils (crinoids etc.) occasionally washed up on beaches in the Lillebælt area also seem to derive from these strata. The lowermost transition strata contain quite large quantities of foraminifera, however; in borehole LB 38 a calcareous fauna is found and in borehole Viborg No. 1 an unusually rich fauna of agglutinating types occurs.

Concretions, e.g. of barytes, also occur in the transition strata.

Lillebælt Clay (Middle Eocene)

Type locality: the northern Lillebælt area.

References: Bøggild (1918), Mertz (1928, 1937), Ødum (1936), Flagler (1940), Sorgenfrei (1957a), Dinesen (1965, 1972).

Some uncertainty exists as to the usage of the formation name Lillebælt Clay, which by definition refers to a greenish to olive-grey, sticky, plastic clay, slightly calcareous. This uncertainty is partly due to the fact that the clay occurs downwards in layers alternating with layers reminiscent of the Røsnæs Clay (a section recorded here as the transition strata Røsnæs Clay/Lillebælt Clay), and upwards merges with a lighter, more calcareous variety, which lithologically is hard to distinguish from Søvind Marl (in a section recorded here as the Lillebælt Clay/Søvind Marl transition strata). A precisely-defined type stratum is lacking, since the upper strata of plastic clay in the Lillebælt area, e.g. in the boreholes at both the old (Mertz 1937) and the new (Dinesen 1965, 1972) Lillebælt bridges, are represented by the more calcareous facies.

Since opinion is devided as to what the term Lillebælt Clay covers, correlation of the existing profiles presents difficulties. As an example, reference may be made to the diagram in plate No. 1, where the non-calcareous section in borehole LB 38, with purer greenish to grey clay between approximate depths −47 to −72 m, is termed Lillebælt Clay. To judge from the foraminifera occurring in this section, however, the Lillebælt Clay of LB 38 corresponds to strata in Viborg No. 1 interpreted by Flagler (1940) as a transition zone *above* what he terms Lillebælt Clay. As mentioned above, Flagler interpreted the lowermost 10 m of the Lillebælt Clay in Viborg No. 1 as a transition zone to Røsnæs Clay. On the basis of the original core description, according to which traces of reddish-brown clay are found immediately below the top of Flagler's Lillebælt Clay (at depth −288,5 m), it is probable that the Lillebælt Clay in Viborg No. 1 can be correlated with the transition strata Røsnæs Clay/Lillebælt Clay in LB 38.

Precipitated concretions (of $CaCO_3$ and $FeCO_3$) occur regularly in the slightly calcareous Lillebælt Clay. Observations of borings at the new Lillebælt bridge suggest that certain strata are particularly rich in concretions. In Viborg No. 5 the Lillebælt Clay is replaced by a rock rich in siliceous organisms (e.g. radiolarians).

Transition strata, Lillebælt Clay/Søvind Marl (Middle-Upper Eocene)

Type locality: not designated (well-represented in the Lillebælt area).

References: Mertz (1928, 1937), Flagler (1940), Dinesen (1965, 1972).

These transition strata consist of lighter, olive-grey, calcareous, sticky, plastic clay or marl, which in some cases appears to alternate downwards with less calcareous Lillebælt Clay, and is difficult to distinguish lithologically from the overlying Søvind Marl. The Søvind Marl has a generally higher content of $CaCO_3$, however, there is a distinct difference in the foraminifera and coccolith content when the transition strata and the Søvind Marl are compared. Concretions occur, but appear to be rarer than in the typical Lillebælt Clay.

In the most easterly part of Jylland, from Bjerre Herred southwards to Als, these transition strata are the uppermost Eocene formation, the Søvind Marl being absent. The three finding places of the brachiopod *Terebratulina nysti,* discussed by Ødum (1936), and which have played an important part in the evaluation of the age of the Søvind Marl, are located in this area, where apparently only the transition strata are represented.

Søvind Marl (Upper Eocene)

Type locality: Søvind and Ås, north of Horsens Fjord.

References: Ødum (1936), Andersen (1937b), Flagler (1940), Sorgenfrei (1957a), Dinesen (1965, 1972).

The Søvind Marl, found in the type locality as glacially disturbed bodies, is a light olive-grey to almost white, sticky rock, generally highly calcareous (at Søvind ca. 50–70 % $CaCO_3$, although as low as 5 % in thin clay zones). Concretionary precipitates occur but are not very common. Some glauconitic zones, found particularly in boreholes, are less calcareous. In Viborg No. 5 Flagler (1940) noted that the marl is characterised by a more varied colour composition than normal found in the Søvind Marl. According to Flagler the marl in Viborg No. 5 may represent a northerly marginal facies.

Investigations both of foraminifera and coccoliths show the presence of younger biozones in Viborg No. 1 than known from the type area. It is extremely likely that in northern Jylland the formation contains strata deposited later in the Upper Eocene than the type strata. Since *Terebratulina nysti,* as previously mentioned, is not associated with the true Søvind

Marl, their age cannot be estimated by means of this fossil. The microfossils, however, seem to indicate that the entire formation is Upper Eocene throughout (and not Lower Oligocene as assumed by Ødum 1936).

These remarks concerning the geographic distribution of the Søvind Marl and the transition strata with the Lillebælt Clay imply that the youngest Upper Eocene strata are absent at Horsens Fjord, and that south of here even more of the Upper Eocene strata are missing, either because they were never deposited, or as a result of denudation after their deposition. When the overlying younger Tertiary strata are taken into consideration, it may be seen that the unconformity between the older (Paleocene–Eocene) and younger (Oligocene – Miocene) Tertiary sediments generally becomes more restricted from south to north (presumably as a result of a relative elevation over the Ringkøbing–Fyn High). In southern Jylland the lowermost strata above the gap are Upper Oligocene or Lower Miocene, while the lowermost strata above the break in the Viborg area are from the Middle Oligocene (according to observations on coccoliths by Mikkelsen (1975) they are perhaps even Lower Oligocene).

Additional sources of information concerning the sediments

In the descriptions of the formations, reference has primarily been made to publications of importance for the definition and delimitation of the formations. These publications – in particular Gry (1935), Bøggild (1918) and Mertz (1928, 1937) – also contain much information concerning the characteristics of the rocks, the circumstances of their deposition, and diagenetic processes.

Additional information concerning the deposits and their physical and chemical characteristics may be found in the following works: Wirtz (1939), Bettenstaedt (1949), Illies (1949), and Gripp (1964) all four of which discuss the corresponding deposits in north-western Germany, and of which Illies in particular presents data and theories (e.g. on movement of pore water and formation of concretions) which are of interest for the comprehension of the Danish Eocene sediments.

Of newer Danish publications the following may be mentioned: Tank 1963 (with clay mineralogical analyses), Bonde 1973 (with a model for the formation of the Mo Clay), Petersen 1973 (with chemical analyses of ash layers, concretions and Eocene clays from Røsnæs) and Nielsen 1973 & 1974 (with analyses of corresponding sediments from Ølst).

In the present context it is also worth mentioning that geotechnical investigations have produced much data that may be of value for a more detailed analysis of e.g. the characteristics of plastic clay.

Remarks to the maps

The data used have been obtained from the Well Record Department at the Geological Survey, taking the areas with Tertiary deposits on Fyn, Jylland, and neighbouring islands west of the Storebælt.

The boreholes have been made for greatly differing purposes (e.g. oil exploration, stratigraphical investigation, water well drilling, geotechnical investigation). The spacing and quality of the samples are usually good for the stratigraphic and geotechnical borings, while sample material from oil and water boreholes is very variable in character, depending to a great extent on the method of drilling.

The reliability of the data in the Well Record Department is furthermore very dependent upon the effort expended on registration while work is in progress and on investigation of the sample material. In the course of producing this survey a need was found in numerous instances for supplementary investigations which would be able to reduce the element of "estimate" that has been necessary in the evaluation of the data.

Boreholes were chosen from the archive material which penetrate to Eocene, Paleocene, or older strata. Details of the archive number, ground level, depth and elevation of the relevant strata (and their nature where necessary) were then off-listed.

In a number of cases boreholes in which the relevant strata are represented had to be omitted because the position of the site was not sufficiently accurately recorded. Boreholes have been included only when the ground level is recorded with an uncertainty of less than 1 m.

Boreholes in which deposits from the Lower Tertiary or limestone/chalk deposits occur as erratics in the glacial strata have been omitted where possible. However, a significant source of error in the data selection process is these glacial disturbances and influences on the pre-Quaternary strata and on the "original" surface of these strata. Some of the boreholes included here may have stopped in erratics, while others may penetrate glacially disturbed but still "rooted" deposits, which with greater justice can be counted as in situ formation.

It has only been possible to a limited extent to take into account the numerous boreholes stopping in younger Tertiary or Quaternary strata, and this is a definite weakness in the maps. Such boreholes have been used chiefly in regions where there are no, or only few, borings reaching Eocene or older strata. Systematic utilization of all data from boreholes and surface exposures will of course be necessary for the construction of detailed maps, but for practical reasons this could not be attempted here.

The boreholes that have been used are marked with position and archive number on a base map of scale 1:500,000. These positions have been transferred to new maps indicating the surface elevations for the Eocene, Paleocene, and limestone/chalk (Danian, Senonian) formations respectively. Contours showing the surface of these deposits have been drawn in to produce the appended relief maps. Finally, a map indicating the thickness of the combined Eocene–Paleocene formation has been constructed on the basis of the points of transection of the Eocene surface and limestone/chalk surface contours (subtracting the numerical value of the Eocene contour from that of the limestone/chalk contour), taking into account the thicknesses actually measured in the boreholes. The thicknesses of the Eocene and Paleocene formations at each boring have also been marked.

In some areas (e.g. Århus, Fredericia, Lillebælt, Odense and Nyborg) the boreholes lie so close to each other that it has not been possible to record them individually on the maps. A combined record (square, triangle or dot) has been made in these cases, indicating the variation in elevation and thickness in the various strata within such areas.

Contour maps, plates 2–4

The suggested erosion boundaries show in broad outline the present geographical extent of the different deposits. Certain details have been omitted from the map, and the boundaries should be adjusted using observations from outcrops, etc. The regional boundary between the Senonian and Danian in northern Jylland, and the boundaries on Sjælland and Lolland–Falster have been drawn from previous maps (Sorgenfrei 1954).

Problems arising from glacial disturbances have been mentioned in the previous section. The dislocations are thought to be most extensive in the easterly and northerly "marginal areas" of the Eocene and Paleocene, where sticky rock-types lie relatively high, and where the contour maps may be expected to show levels which generally lie considerably higher than the surface of the "well-rooted" or "undisturbed" strata. An example can perhaps be seen north of Kalø Vig, where the Eocene strata are found relatively high up, while the chalk lies relatively deep a little further to the north. Even very large erratics of several metres thickness can be partially or completely underlain by glacial strata. Erratics of Eocene sediments are found in some places in West Jylland (Vejrup, Hesselho, Hoven, Emmerlev Klev). The counterpart to formation of erratics is erosion, which can be very deep in places, creating "windows" in the pre-Quaternary strata. For example, at Gamborg Fjord, south of Middelfart, a deep erosional valley of this sort is found, in which the glacial strata rest directly on the Senonian White Chalk. In Viborg No. 3 glacial erosion extends down into the deeper-lying Eocene; according to Flagler (1940) the glacial deposits rest directly on Clay with Volcanic Ash at depth −273 m (see plate 1).

In other cases these "windows" must be assumed to have a structural background. This is definitely the case for the indicated North Jylland salt diapirs, which are confirmed by boreholes.

In all three maps the contours have been drawn in solely on the basis of the depth figures for the boreholes. Clearly, the course of the contours ought to be more finely influenced by local structural conditions, which either are already known, or for which details can be obtained using geophysical data, in particular seismic data. Seismic data would be particularly suitable for improving the contour map of the limestone/chalk surface, which seismically is very reflective. However, the seismic techniques used in oil prospection would not contribute to any great improvement of the Eocene and Paleocene surface contours – except through an adjustment to match the topography of the surface of the limestone/chalk – since these strata are insufficiently reflective.

An obvious weakness of the maps is that they do not indicate the position and extent of structures and faults. It may be taken for granted that some faults "throw through" the Eocene and Paleocene deposits, but knowledge of these is extremely sparse. One of the reasons for this is the difficulty of finding a usable reference surface in the glacially disturbed strata in areas where the borings are grouped closely enough to permit geological detection of faults. Indications of faults can perhaps be seen in the slickensides regularly observed in sample material e.g. of the Eocene clays, but the phenomenon may have an alternative explanation, since a non-uniform rate of consolidation, possibly also in connection with the formation of concretions, may be the cause (Illies 1949). The surest evidence of faulting through

Eocene strata seems to be found in Viborg No. 4, where according to Flagler (1940) the Oligocene has "normal" thickness above a greatly reduced Eocene series (see plate 1).

Isopach map, plate 5

The map has been produced as explained above, by subtracting the Eocene surface contours from the limestone/chalk surface contours, taking into consideration the actual thicknesses found in the various borings. The accuracy, of cource, is very dependent on the accurary of the contour maps. The procedure results in the production of contour-enclosed areas with an indicated thickness not necessarily confirmed by data from boreholes. In particular, doubt exists as to the correctness of the assumption of very pronounced thicknesses in the Silkeborg area; local structures may be influencing the picture in this area.

Eocene formations, plate 6

This map depicts the thicknesses of the Eocene formations in the deep boreholes (oil test wells and stratigraphical research boreholes). As mentioned in the discussions of the formations, there is ambiguity in the definition and delimitation of the individual formations, arising from the transition strata between the Røsnæs Clay and Lillebælt Clay, and between the Lillebælt Clay and Søvind Marl.

In this map the traditional, simplified subdivision of the Eocene into the formations Clay with Volcanic Ash, Røsnæs Clay, Lillebælt Clay, and Søvind Marl (the Plastic Clay Group *sensu* Sorgenfrei 1957a) has been retained. An attempt has been made to make the formational units comparable – as far as has been possible to judge from the available data – by taking the term Søvind Marl to include the transition strata between Lillebælt Clay and Søvind Marl, and by taking the term Lillebælt Clay to include the transition strata between Røsnæs Clay and Lillebælt Clay. This means that there is a fair probability that the depicted formations are approximately synchronous. On the other hand it must be borne in mind that within the formations Lillebælt Clay and Søvind Marl there is geographical variation with respect to the time of deposition. It is probable, therefore, that the "Søvind Marl" in southern Jylland is chiefly represented by the transition strata between Lillebælt Clay and Søvind Marl.

The map also indicates the known extent of the Mo Clay formation in the Limfjord region.

Explanations of the signatures on plate 1

Correlation diagram for some Tertiary boreholes in Jylland.
Istidsaflejringer: glacial drift
Ler: clay (Miocene, Oligocene)
Silt, sand: silt, sand
Søvindmergel: Søvind Marl
Overgangslag: transition strata (Lillebælt Clay/Søvind Marl)
Lillebæltler: Lillebælt Clay
Overgangslag: transition strata (Røsnæs Clay/Lillebælt Clay)
Røsnæsler: Røsnæs Clay
Ler m. Vulkansk Aske: Clay with Volcanic Ash
Lerskifer, lamineret: shale, laminated
Holmehusler: "Holmehus Clay"
Gråt kalkfattigt ler eller Kertemindeler: greyish, slightly calcareous clay or Kerteminde Clay
Kertemindemergel: Kerteminde Marl
Kalk(sten): limestone

Dansk sammendrag

Kortlægning af paleocæne og eocæne aflejringer i Jylland og på Fyn

Fede, lavpermeable ler- og mergelaflejringer af marin oprindelse er – når der ses bort fra danien etagens kalkstenslag og fra de mere sandede indslag i oligocæn – næsten enerådende i Danmarks ældre tertiær. Den foreliggende rapport tilstræber at give en oversigt over de paleocæne og eocæne formationer og at gøre rede for hovedtrækkene i formationernes lejringsforhold i Jylland–Fyn området.

På trods af en særdeles omfangsrig datamængde, stammende fra boringer og fra naturlige og kunstige blotninger, er kendskabet til formationernes sammensætning og rumlige udbredelse mangelfuldt. Der er knyttet en række uløste problemer til identifikationen af bjergarterne og til formationernes indbyrdes afgrænsning. Kortlægningen vanskeliggøres endvidere af de glaciale forstyrrelser, som flere steder har ramt formationerne. Rapporten med tilhørende kort er udarbejdet inden for en snæver tidsramme, og der har kun været ringe lejlighed til at efterprøve den mangfoldighed af fortolkninger, som indgår i fremlæggelsen. Det må i særlig grad betones, at kortene over formationernes dybdemæssige placering og mægtighedsforhold ikke er søgt justeret ved hjælp af sådanne strukturelle oplysninger, som kan aflæses af foreliggende geofysiske data.

Med de nævnte forbehold, håber vi hermed at præsentere et brugbart billede af de omhandlede aflejringer. Til støtte for den skematiske formationsinddeling i nedenstående oversigt henvises til korrelationsdiagrammet, tavle 1, hvor profiler for enkelte, forholdsvis veloplyste boringer fra Jylland er angivet.

Danskekalk (nedre paleocæn)

Typelokalitet: Stevns Klint, Fakse kalkbrud.

I Jylland og på Fyn udgøres Danskekalken hovedsagelig af bryozokalk og kokkolitkalk med flint og forkislede partier.

På tavle 4 er Danskekalken kortlagt sammen med det senone skrivekridt, idet kalk/kridtserien må opfattes som basisaflejringer i den foreliggende sammenhæng. Danskekalken er ikke medregnet i mægtigheden af eocæn–paleocæn aflejringerne på tavle 5.

Lellinge Grønsand (mellem paleocæn)

Typelokalitet: Skovhusvænget ved Lellinge nær Køge.

Formationen består af kalksten og mergel med et stort indhold af glaukonit, med vekslende indhold af sand (omlejrede kalkkorn), og med et konglomerat ved basis (omlejrede kalkbrokker).

Sort ler eller mergel (mellem paleocæn)
Ubenævnt enhed.

Typelokalitet: Ikke udpeget.

Indlejret i grønsandet ved Lellinge og hvilende på grønsandet i København området findes mørkegrå til sorte, pyritrige ler- og mergelbjergarter. Tilsvarende bjergarter kendes også fra Egsmark og Basballe på Djursland.

Facielle vekslinger både med lag af Lellinge Grønsand og Kerteminde Mergel vanskeliggør en lithostratigrafisk afgrænsning.

Kerteminde Mergel (mellem paleocæn)

Typelokalitet: Lundsgård Klint syd for Kerteminde.

Består af lysegrå, ret fed og glaukonitfattig mergel. Forkislede partier forekommer og repræsenterer mere grovkornede aflejringer (Gry 1935).

Størst mægtighed findes i det vestlige Sjælland.

Enkelte lag er mindre kalkholdige og har været betegnet Kerteminde Ler, – en betegnelse der imidlertid også har været anvendt for det nedennævnte øvre paleocæne ler.

Gråt, kalkfattigt ler (øvre paleocæn)
Ubenævnt enhed.

Typelokalitet: Ikke udpeget.

Ret tykke lag af gråt, meget kalkfattigt og ofte svagt finsandet ler, der findes mellem Kerteminde Mergel og Ler med Vulkansk Aske. Sandkornene består af kvarts, og glaukonitindholdet er betydeligt.

Kendes bl.a. fra boringer ved Besser på Samsø og ved Viborg, og fra Stolle Klint på Fur.

"Holmehus Ler" (øvre paleocæn?)

Typelokalitet: Muligvis ved Holmehus, Røjle klint.

I boringen LB 38 ved Lillebælt findes ca. 12 m grønligt og rødbrunt, kalkfattigt, fedt plastisk ler under lag med vulkansk aske, der kan sammenholdes med den af Bøggild (1918) omtalte, mulige forekomst af paleocænt plastisk ler nær Holmehus ved Røjle klint. Formation menes desuden truffet i boringer ved Viborg og Skive, samt på Vestfyn og Langeland.

Det kan ikke udelukkes, at leret indeholder "negative" askelag, og at det dermed er nærmere knyttet til det basale eocæn end foreløbigt antaget.

Ler med Vulkansk Aske (nedre eocæn)

Typelokalitet: Nordkysten af Mors.

Formationen består af moler eller ler med askelag.

I Limfjord området består den overvejende del af formationen af diatomérigt ler (moler) med 179 nummerede askelag (fra −39 til +140). Hærdnede zoner forekommer grundet forkisling eller kalkudfældning (cementsten).

Askelagene kan følges over udstrakte områder i Nordsø bækkenet, og de er som regel indlejret i mørkt, fedt ler.

I Danmark placeres grænsen eocæn/paleocæn traditionelt ved basis af den askeførende serie. Der er ikke ført egentlig bevis herfor, og ifølge nyere udenlandske undersøgelser af lagserien i Nordsø boringer bør en del af serien måske henføres til paleocæn.

Røsnæs Ler (nedre eocæn)

Typelokalitet: Røsnæs

Teglrødt, rødbrunt eller gulbrunt, kalkholdigt, meget fedt, plastisk ler, stedvis med konkretionære dannelser. Underordnede grønlige eller grålige, kalkfattige lag eller partier indgår, især ved basis.

Overgangslag Røsnæs Ler/Lillebælt Ler (nedre–mellem eocæn)

Typelokalitet: Ikke udpeget.

Ca. 20 m kalkfattigt, fedt, plastisk ler, der i farve veksler mellem grønligt, olivengråt, brunligt og rødbrunt findes i boringen LB 38 ved Lillebælt mellem Røsnæs Ler og Lillebælt Ler. Tilsvarende lag er iagttaget i boringen Viborg 1 og i daglokaliteter. Sidstnævnte forekomster har ofte været tolket som blandingsbjergart grundet glaciale forstyrrelser eller udskridninger, men observationerne i boringerne tyder på forekomst af en primær dannelse.

Lillebælt Ler (mellem eocæn)

Typelokalitet: Det nordlige Lillebælt område.

Kalkfattigt, grønlig til olivengrå, fedt, plastisk ler. Der hersker nogen usikkerhed om afgrænsningen af formationen grundet forekomsten af de over- og underliggende overgangslag, ligesom der savnes en præcis angivelse af et typelag, idet de øvre lag i Lillebælt området er repræsenteret ved en kalkrigere varietet.

Overgangslag Lillebælt Ler/Søvind Mergel (mellem–øvre eocæn)

Typelokalitet: Ikke udpeget.

Består af lysere olivengråt, kalkholdigt, fedt, plastisk ler eller mergel, som nedefter i nogle tilfælde synes at veksle med det kalkfattige Lillebælt Ler, og som vanskeligt kan skelnes fra den overliggende Søvind Mergel. Sidstnævnte er dog oftest mere kalkholdigt. Foraminifer- og kokkolitindholdet udviser tydelig forskel.

Søvind Mergel (øvre eocæn)

Typelokalitet: Søvind og Ås, nord for Horsens Fjord.

Merglen er fed, lys olivengrå til næsten hvidlig, og indeholder underordnede lerlag og glaukonitrige zoner.

Fremgangsmåde ved kortfremstillingen

De anvendte data er fremskaffet ved en gennemgang af D.G.U.'s borearkiv indenfor området vest for Storebælt. Der er foretaget en vurdering af arkivmaterialet, men ikke af prøvematerialet. Fra arkivmaterialet er udvalgt boringer, som når ned i eocæne og ældre lag, hvorimod kun få særlig dybe boringer, der stopper i yngre lag er anvendt. Ved en konsekvent udnyttelse af samlige boringer vil en bedre detaljekortlægning kunne opnås. En anden fejlkilde er at enkelte af de udvalgte boringer kan være stoppet i glaciale flager, selvom der ved udvælgelsen er søgt at undgå sådanne boringer. Endelig skal der gøres opmærksom på, at der kun i begrænset omfang er taget hensyn til forekomster kendt fra daglokaliteter og at lokale strukturelle træk kendt fra seismiske undersøgelser ikke er indgået som grundlag for tegning af kurver og erosionsgrænser for de enkelte lagserier.

Kortet over mægtighed af eocæn–paleocæn lagserien er fremstillet ved subtraktion af eocæn overfladen fra kalkoverfladen. Kortets nøjagtighed er naturligvis afhængig af de to konturkorts nøjagtighed, og også her kan lokale strukturforhold (som ikke er indkalkuleret i konturkortene) ændre billedet på visse punkter.

Literature

Andersen, L. J. 1958: Nye forekomster af eocæne askelag ved Randers. – Meddr dansk geol. Foren., 13, pp. 449–470.

Andersen, S. A. 1937a: De vulkanske Askelag i Vejgennemskæringen ved Ølst og deres Udbredelse i Danmark. – Danm. geol. Unders., II række, 59.

Andersen, S. A. 1937b: Oligocænet ved Aas. – Meddr dansk geol. Foren., 9, pp. 218–223.

Andrup, G. O. 1960: Odense-egnens vandforsyning i relation til de geo-hydrologiske forhold i Fyn. – Odense.

Berthelsen, O. 1962: Cheilostome bryozoans in the Danian Deposits of East Denmark. – Danm. geol. Unders., II række, 83.

Bettenstaedt, F. 1949: Paläogeographie des nordwestdeutschen Tertiär mit besonderer Berücksichtigung der Mikropaläontologie. *In:* Erdöl und Tektonik in Nordwest-Deutschland, pp. 143–172. – Hannover.

Bonde, N. 1973: Fiskefossiler, diatomiter og vulkanske askelag. – Dansk geol. Foren., Årsskrift for 1972, pp. 136–143.

Bøggild, O. B. 1918: Den vulkanske Aske i Moleret samt en oversigt over Danmarks ældre Tertiærbjergarter. – Danm. geol. Unders., II række, 33.

Christensen, L. & Ulleberg, K. 1974: Sediments and Foraminifers of the Middle Oligocene Viborg Formation, Denmark. – Meddr dansk geol. Foren., 23, pp. 109–117.

Dinesen, A. 1965: Boringen LB 38 på Lyngs odde. Geologisk rapport. – Danm. geol. Unders., unpubl. report.

Dinesen, A. 1972: Foraminiferselskaber fra de jyske eocæne formationer. – Dansk geol. Foren., Årsskrift for 1971, pp. 70–78.

Flagler, C. W. 1940: Report on the Stratigraphy and Foraminifera of the Viborg Core drill profile, Mid-Jutland, Denmark. – Danish American Prospecting Co., unpubl. report.

Gripp, K. 1964: Erdgeschichte von Schleswig-Holstein. – Neumünster.

Gry, H. 1935: Petrology of the Paleocene Rocks of Denmark. – Danm. geol. Unders., II række, 61.

Gry, H. 1940: De istektoniske Forhold i Molerområdet. – Meddr dansk geol. Foren., 9, pp. 586–627.

Gry, H. 1964: Furs geologi. – Dansk Natur – Dansk Skole, årsskrift, pp. 45–55.

Hansen, K., Heller, E. & Larsen, G. 1960: Sedimentary and Economic Geology of Denmark. – Ekskursionsguide, Int. Geol. Congr. XXI session. København.

Harder, P. 1922: Om Grænsen mellem Saltholmskalk og Lellinge Grønsand. – Danm. geol. Unders., II række, 39.

Hofker, J. 1966: Maastrichtian, Danian and Paleocene Foraminifera. – Paleontographia, Supplement-Bd., 10. Stuttgart.

Illies, H. 1949: Die Lithogenese des Untereozäns in Nordwestdeutschland. – Mitt. Geol. Staatsinst. Hamburg, 18, pp. 7–44.

Madsen, V., Ødum, H. & Gry, H. 1935: Boringerne ved Langbrogaard ved Sønderborg. – Danm. geol. Unders., II række, 55.

Mertz, E. L. 1928: Lillebeltsler og London Clay. – Danm. geol. Unders., II række, 51.

Mertz, E. L. 1937: Geologiske Profiler gennem danske Sunde og Fjorde. Danm. geol. Unders., II række, 60.

Mikkelsen, N. 1975: Marine Lower Oligocene sediments in Denmark as indicated by coccoliths in the Viborg Formation. – Bull. geol. Soc. of Denmark, 24, pp. 83–86.

Nielsen, O. Bjørslev 1973: Eocæne aflejringer i Ølst-området og deres indpasning i områdets Kvartærgeologi. – Dansk geol. Foren., Årsskrift for 1972, pp. 100–110.

Nielsen, O. Bjørslev 1974: Sedimentation and Diagenesis of Lower Eocene Sediments at Ølst, Denmark. – Sedimentary Geology, 12, pp. 25–44.

Petersen, K. Strand 1973: Some features in Clay with Tuffbeds from Lower Eocene on Røsnæs, Danmark. – Danm. geol. Unders., Årbog 1972, pp. 69–78.

Rasmussen, L. Banke 1960: Geology of North Eastern Jylland, Denmark. – Ekskursionsguide, Int. Geol. Congr. XXI session. Kbhvn.

Rasmussen, L. Banke 1967: Tertiærperioden. *In:* Danmarks Natur, 1, pp. 161–198. København.

Rasmussen, L. Banke 1972: Oversigt over dybdeboringerne på dansk landområde 1965–1968. – Dansk geol. Foren., Årsskrift for 1971, pp. 41–48.

Rasmussen, L. Banke et al. 1971: Dybdeboringen Rønde nr. 1 på Djursland. – Danm. geol. Unders., II række, 39.

Rasmussen, L. Banke et al. 1973: Dybdeboringen Nøvling nr. 1 i Midtjylland. – Danm. geol. Unders., II række, 40.

Sorgenfrei, T. 1951: Oversigt over prækvartærets topografi, stratigrafi og tektonik i området Fyn–Sydsjælland–Lolland-Falster–Møn. – Meddr dansk geol. Foren., 12, pp. 166–171.

Sorgenfrei, T. 1952: Geologiske og hydrologiske erfaringer fra Randers og omegn. – Vandteknikeren (februar), pp. 1–7.

Sorgenfrei, T. 1954: Undergrundskort. – Danm. geol. Unders.

Sorgenfrei, T. 1956: (Odense amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 5, pp. 8–12.

Sorgenfrei, T. 1957a: Lexique Stratigraphique International, 1, fasc. 2d, Danemark. – Paris.

Sorgenfrei, T. 1957b: (Svendborg amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 5, pp. 520–526.

Sorgenfrei, T. 1958: (Landet). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 1, pp. 17–28.

Sorgenfrei, T. 1960: (Hjørring amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg. 6, pp. 14–20.

Sorgenfrei, T. 1961: (Thisted amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 6, pp. 440–447.

Sorgenfrei, T. 1961: (Ålborg amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 6, pp. 768–773.

Sorgenfrei, T. 1962: (Viborg amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 7, pp. 8–14.

Sorgenfrei, T. 1963: (Randers amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 7, pp. 516–523.

Sorgenfrei, T. 1963: (Århus amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg, 8, pp. 4–9.

Sorgenfrei, T. 1964: (Skanderborg amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 8, pp. 365–368.

Sorgenfrei, T. 1964: (Vejle amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 8, pp. 750–759.

Sorgenfrei, T. 1965: (Ringkøbing amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 9, pp. 5–13.

Sorgenfrei, T. 1965: (Ribe amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 9, pp. 591–590.

Sorgenfrei, T. 1965: (Haderslev amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 10, pp. 58–62.

Sorgenfrei, T. 1966: Strukturgeologischer Bau von Dänemark. – Geologie, 15, pp. 641–660.

Sorgenfrei, T. 1966: (Tønder amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 10, pp. 389–400.

Sorgenfrei, T. 1967: (Åbenrå amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 10, pp. 766–774.

Sorgenfrei, T. 1967: (Sønderborg amt). Dybgrundens geologi. *In:* Trap: Danmark, 5. udg., 10, pp. 1032–1038.

Sorgenfrei, T. & Berthelsen, O. 1954: Geologi og Vandboring. – Danm. geol. Unders., III række, 31.

Sorgenfrei, T. & Buch, A. 1964: Deep tests in Denmark 1935–1959. – Danm. geol. Unders., III række, 36.

Spjeldnæs, N. 1975: Paleogeography and Facies Distribution in the Tertiary of Denmark and Surrounding Areas. – Norges geol. Unders., 316, pp. 289–311.

Stenestad, E. 1972: Træk af det danske bassins udvikling i Øvre Kridt. – Dansk geol. Foren., Årsskrift for 1971, pp. 63–69.

Tank, R. W. 1963: Clay Mineralogy of some Lower Tertiary (Paleogene) Sediments from Denmark. – Danm. geol. Unders., IV række, 9.

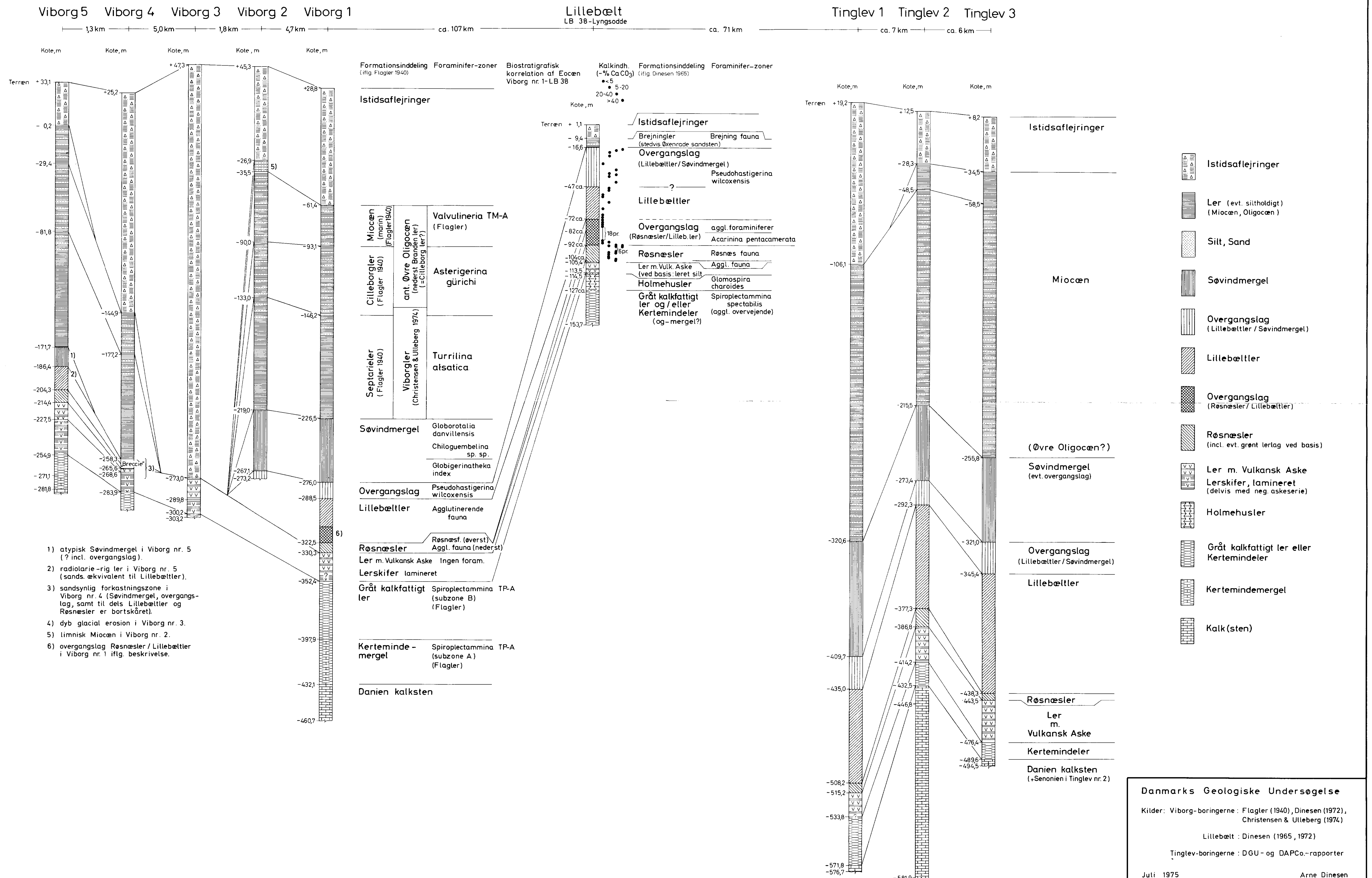
Thomsen, E. 1974: Maastrichtian and Danian facies pattern on the Ringkøbing-Fyn High, Denmark. – Meddr dansk geol. Foren., 23, pp. 118–123.

Wirtz, D. 1939: Das Alttertiär in Schleswig-Holstein. – Neues Jahrb. für Mineralogie etc., Beil.-Bd. 81, Abt. B, pp. 215–297.

Ødum, H. 1926: Studier over Daniet i Jylland og på Fyn. – Danm. geol. Unders., II række, 45.

Ødum, H. 1936: Marint Nedre Oligocæn i Danmark. – Meddr dansk geol. Foren., 9, pp. 88–90.

Korrelationsdiagram for nogle jyske tertiær-boringer



1) atypisk Søvindmergel i Viborg nr. 5 (? incl. overgangslag).
2) radiolarie-rig ler i Viborg nr. 5 (sands. ækvivalent til Lillebæltler).
3) sandsynlig forkastningszone i Viborg nr. 4 (Søvindmergel, overgangslag, samt til dels Lillebæltler og Røsnæsler er bortskåret).
4) dyb glacial erosion i Viborg nr. 3.
5) limnisk Miocæn i Viborg nr. 2.
6) overgangslag Røsnæsler / Lillebæltler i Viborg nr. 1 iflg. beskrivelse.

Danmarks Geologiske Undersøgelse

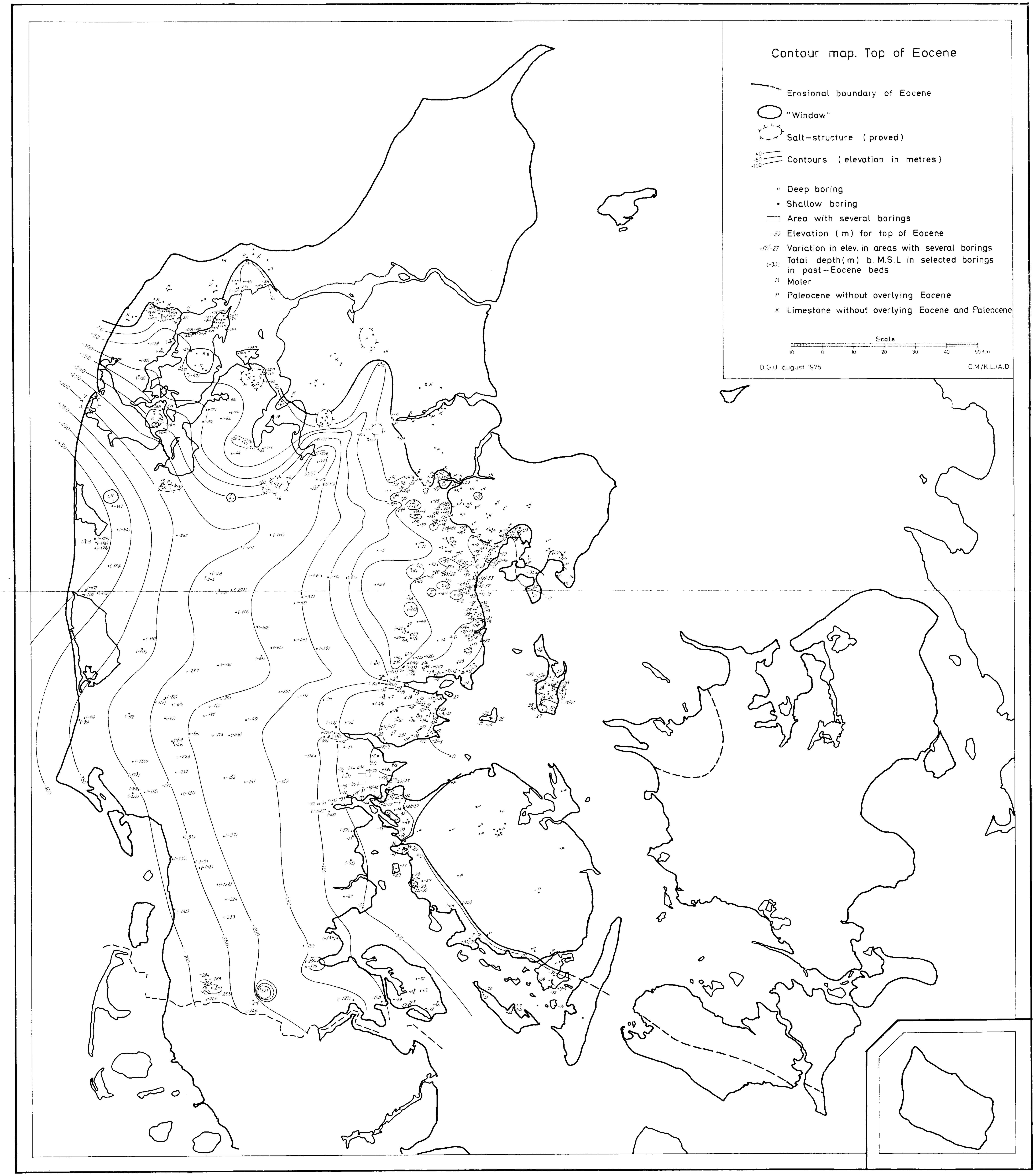
Kilder: Viborg-boringerne: Flagler (1940), Dinesen (1972), Christensen & Ulleberg (1974)

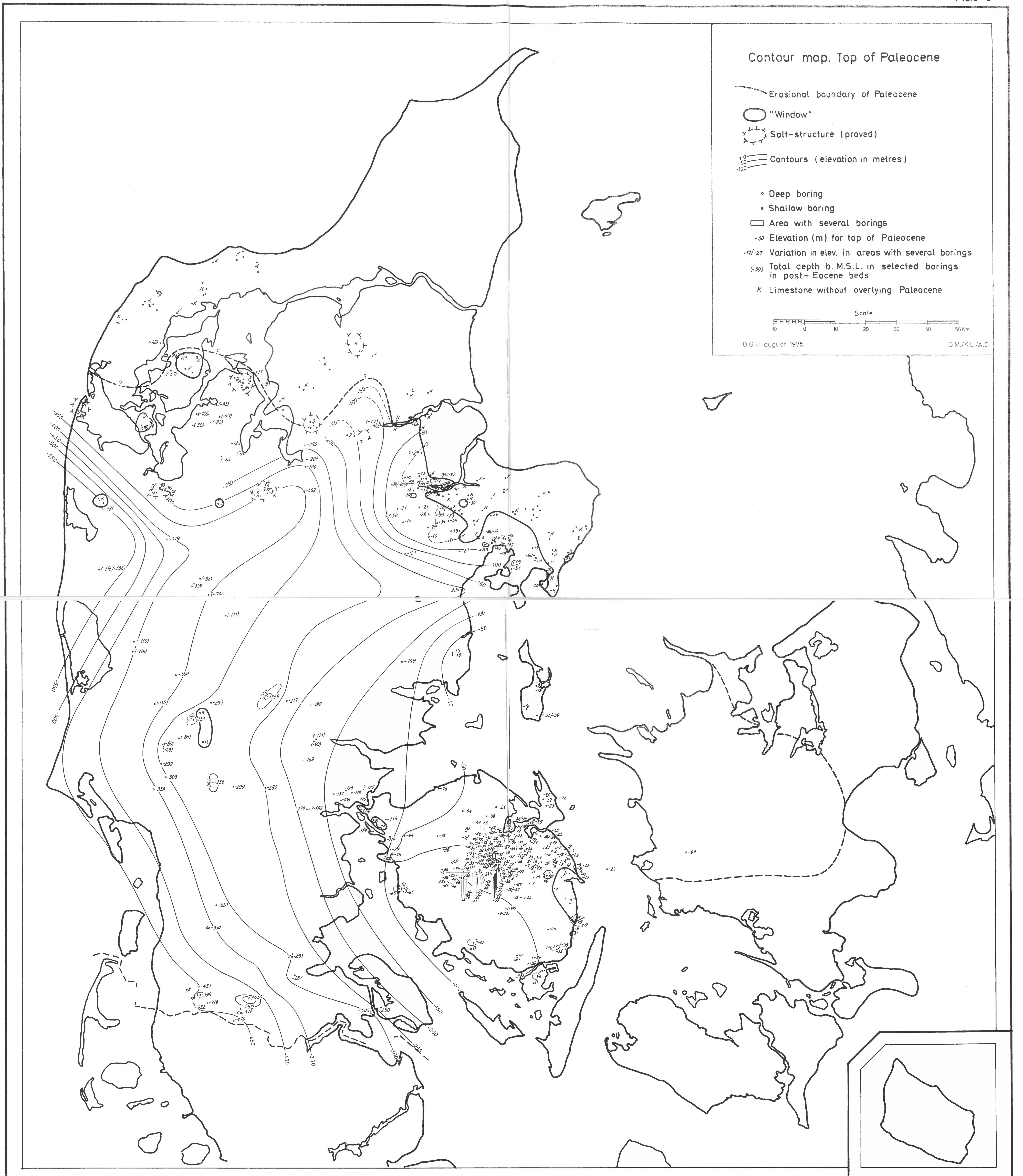
Lillebælt: Dinesen (1965, 1972)

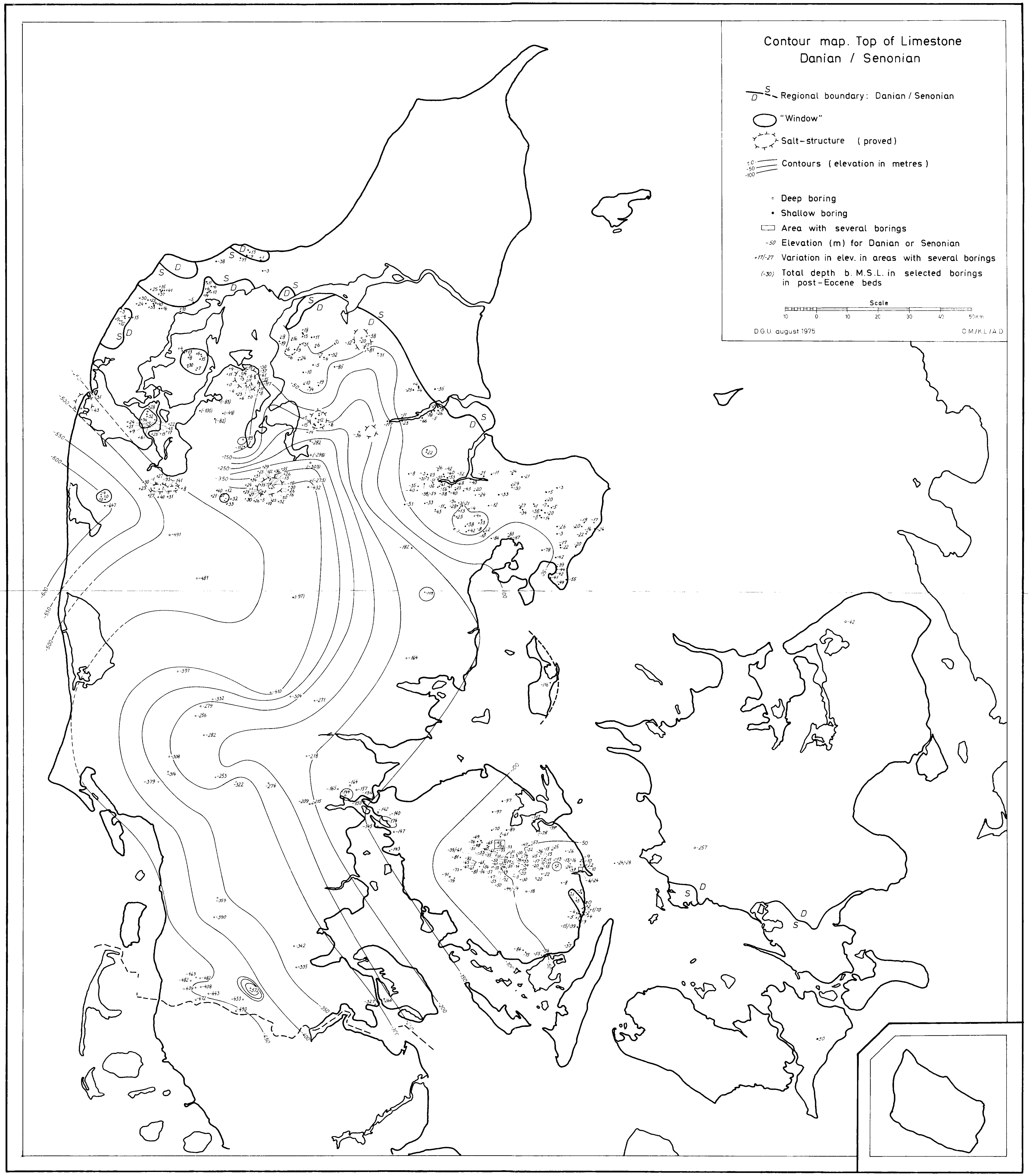
Tinglev-boringerne: DGU- og DAPCo.-rapporter

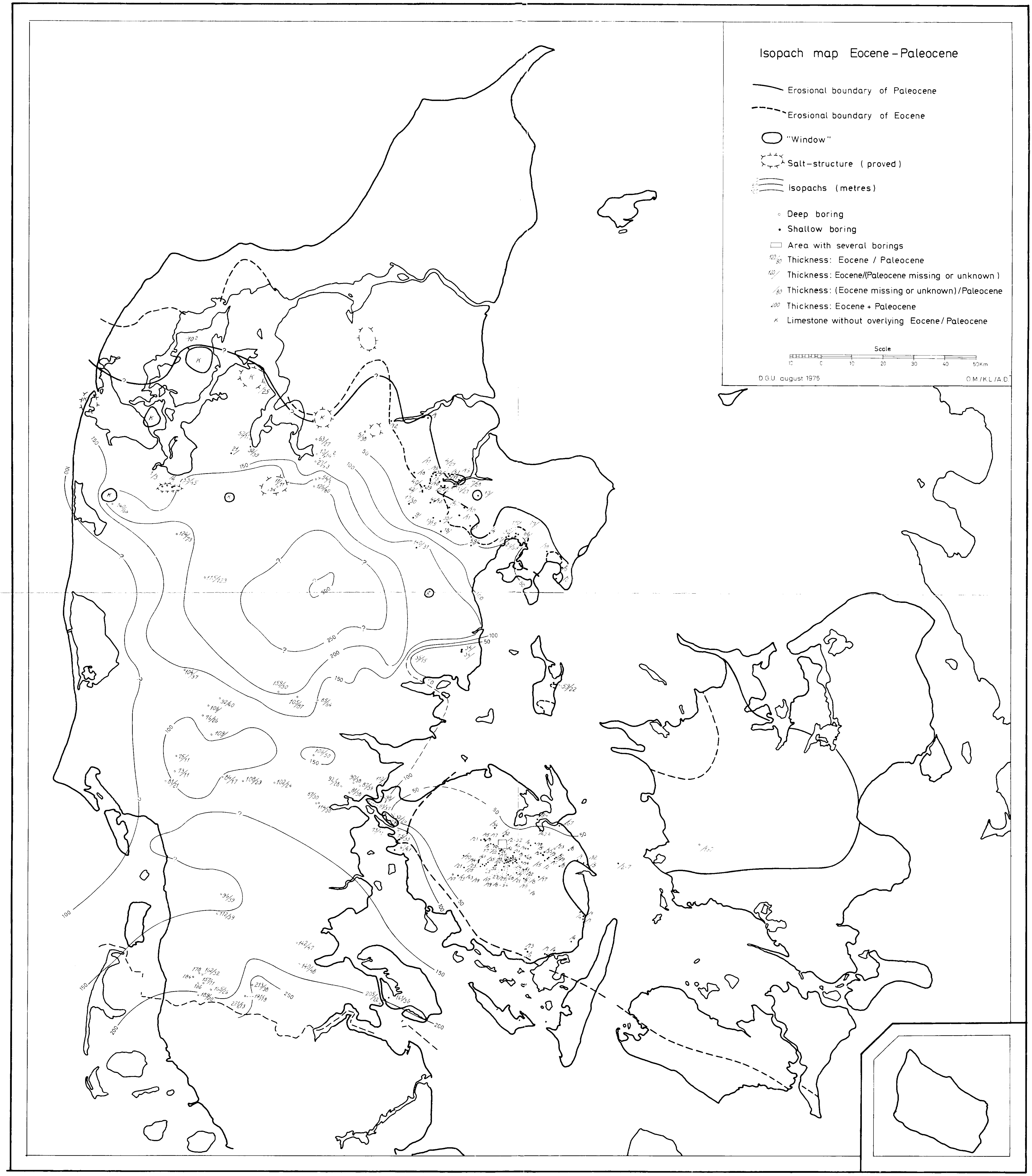
Juli 1975 Arne Dinesen

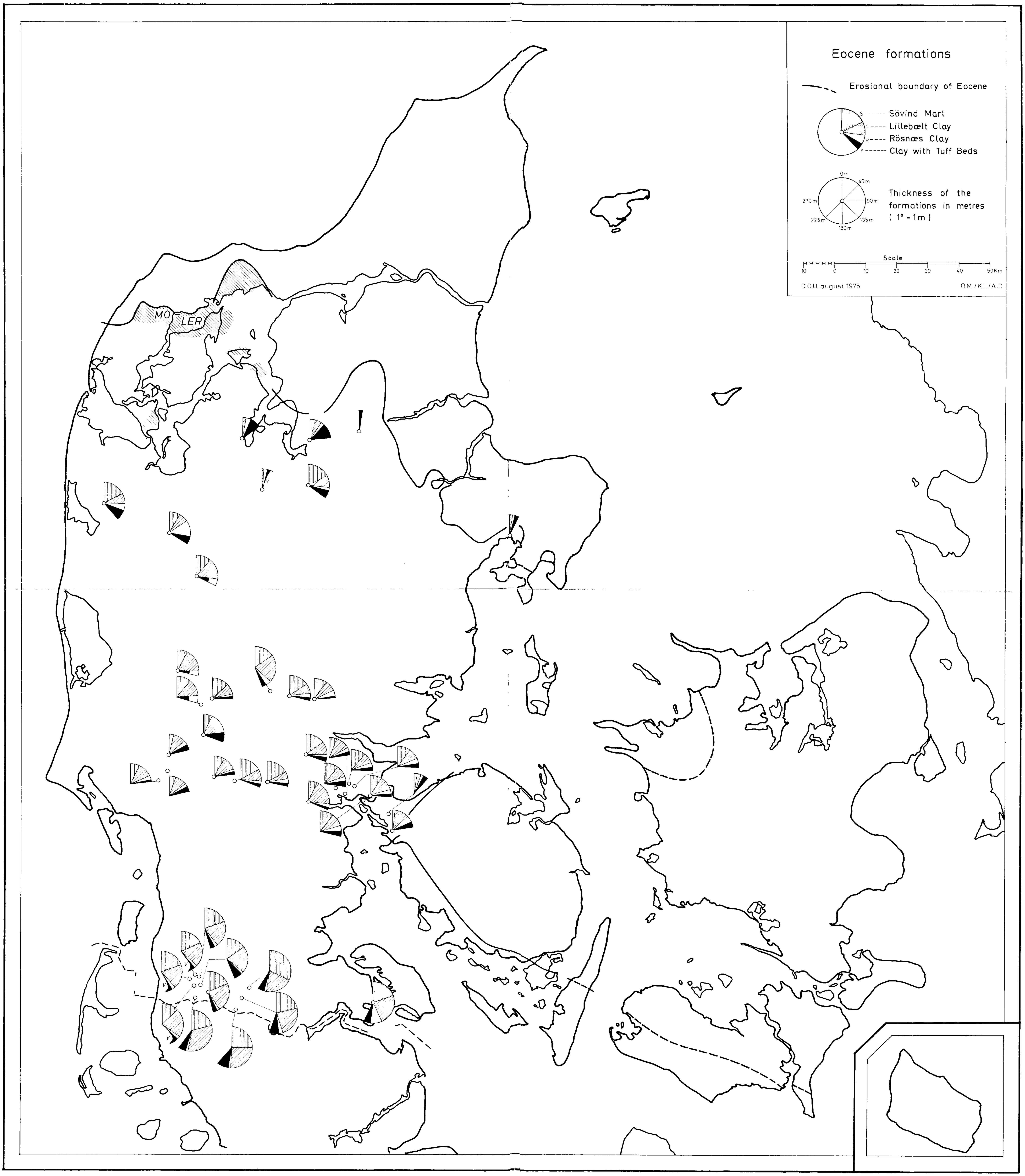
1975-47


Contour map. Top of Eocene
Erosional boundary of Eocene
"Window"
Salt-structure (proved)
Contours (elevation in metres)
Deep boring
Shallow boring
Area with several borings
Elevation (m) for top of Eocene
Variation in elev. in areas with several borings
Total depth (m) b. M.S.L in selected borings in post-Eocene beds
Moler
Paleocene without overlying Eocene
Limestone without overlying Eocene and Paleocene
Scale
10 0 10 20 30 40 50 Km
D.G.U. august 1975
O.M/K.L/A.D.


Contour map. Top of Paleocene
Erosional boundary of Paleocene
"Window"
Salt-structure (proved)
Contours (elevation in metres)
Deep boring
Shallow boring
Area with several borings
-50 Elevation (m) for top of Paleocene
+17/-27 Variation in elev. in areas with several borings
(-30) Total depth b. M.S.L. in selected borings in post-Eocene beds
K Limestone without overlying Paleocene
Scale
10 0 10 20 30 40 50Km
DGU august 1975
O.M./K.L./A.D


Contour map. Top of Limestone
Danian / Senonian
Regional boundary: Danian / Senonian
"Window"
Salt-structure (proved)
Contours (elevation in metres)
Deep boring
Shallow boring
Area with several borings
-50 Elevation (m) for Danian or Senonian
+17/-27 Variation in elev. in areas with several borings
(-30) Total depth b. M.S.L. in selected borings in post-Eocene beds
Scale
10 0 10 20 30 40 50 Km
D.G.U. august 1975
O.M./K.L./A.D.


Isopach map Eocene - Paleocene
Erosional boundary of Paleocene
Erosional boundary of Eocene
"Window"
Salt-structure (proved)
Isopachs (metres)
Deep boring
Shallow boring
Area with several borings
Thickness: Eocene / Paleocene
Thickness: Eocene/(Paleocene missing or unknown)
Thickness: (Eocene missing or unknown)/Paleocene
Thickness: Eocene + Paleocene
Limestone without overlying Eocene/Paleocene
Scale
10 0 10 20 30 40 50Km
D.G.U. august 1975
O.M./K.L./A.D.


Eocene formations
Erosional boundary of Eocene
Sövind Marl
Lillebælt Clay
Rösnæs Clay
Clay with Tuff Beds
0m
45m
90m
135m
180m
225m
270m
Thickness of the formations in metres (1° = 1m)
Scale
10
0
10
20
30
40
50Km
DGU august 1975
O.M./KL./A.D.
MO
LER