Lithology and lithostratigraphy of the Harre borehole, Denmark.

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ABSTRACT

Based on lithologic descriptions of the core material, on wireline logs and on spectral natural gamma-ray measurements of the cores and some individual samples, a lithostratigraphic subdivision of the cored section of the Harre borehole is performed and the depths of the lithostratigraphic boundaries are established. The following lithostratigraphic units of Tertiary age are identified: Vejle Fjord Formation from 9.75-67.5 m.b.s. (meters below surface), the Branden Formation from 67.5-119.45 m.b.s., the Viborg Formation from 119.45-177.5 m.b.s., the Lillebælt Clay Formation, from 177.5-186 m.b.s., the Røsnæs Clay Formation from 186-190.88 m.b.s., the Ølst and Fur Formations from 190.88-222 m.b.s., the Holmehus Formation from 222-229.9 m.b.s., the "grey slightly to non-calcareous clay" from 229.9-244.5 m.b.s. and the Kerteminde Marl from 244.5-256.9 m.b.s.. Below 256.9 m.b.s. Danian Limestone is found. There are distinct stratigraphic gaps between the Røsnæs- and Lillebælt Clay Formations and between the Lillebælt Clay Formation and the Viborg Formation. The Fur- and Ølst Formations are here demonstrated to be interfingering, with gradual transition between the two different but contemporaneous formations.

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INTRODUCTION

The locations of the Harre borehole and other important localities are shown in Fig. 1 in the introductory chapter.
The cored section of the Harre borehole (Fig. 1) can readily be divided into major units and correlated to the established lithostratigraphy. The Paleocene/Eocene lithostratigraphy has recently been revised by Pedersen & Surlyk (1984), Nielsen, Baumann, Zhang, Heilmann-Clausen & Larsen (1986) and Heilmann-Clausen, Nielsen & Gersner (1985), while Larsen & Dinesen (1959) and Christensen & Ulleberg (1973 & 1974) have established the Oligocene-Lower Miocene lithostratigraphy.

A resistivity and gamma log was produced by Terraqua (Fig. 1).
The following lithostratigraphical units were recognized from the core descriptions:

0-9.75 meters below surface (m.b.s.)	Not cored. Quaternary sediments ?
9.75-67.5 m.b.s.	Vejle Fjord Formation
67.5-119.45 m.b.s.	The Branden Formation
119.45-177.5 m.b.s.	The Viborg Formation
177.5-186 m.b.s.	The Lillebælt Clay Formation
186-190.88 m.b.s.	The Røsnæs Clay Formation
190.88-222 m.b.s.	The Ølst and Fur Formations
222-229.9 m.b.s.	The Holmehus Formation
229.9-244.5 m.b.s.	"Grey slightly to non-calcareous clay"
244.5-256.9 m.b.s.	The Kerteminde Marl
256.9->284.75 m.b.s.	The Danian Limestone

The depths of the lithostratigraphic boundaries are mainly taken from the informations given by the drill-company. These depths differ in the lower part slightly from what can be interpreted from a comparison between the wireline gamma-log and the gamma measurements performed in the laboratory on cores and on individual samples. These measurements include 25 cores and 20 samples and are performed with gamma-ray detectors (NaI and Ge) enabling distinction between gamma-rays from potassium-40, uranium-238 and thorium-232, and the decay products of the latter two. In Table 1. the samples analysed and the results are listed. The depths indicated by the cores are, below 216 m.b.s. reduced by 1.5 m and below 223.5 m.b.s. by 3 m in order to produce the best fit between the lithology and the gamma measurements.
The gamma-log was run with a logging speed of 0.7 meter per min., and the time constant of the plotter was 25 sec. This means that the fluctuations due to counting statistics have had only minor influence on the gamma-log. The low logging speed ensures that almost all significant variations in gamma-ray intensity have been recorded. Only layers with a thickness of less than approximately 20 cm could be overlooked. Further the choosen time constant and the low logging speed ensures that boundaries are detected with an insignificant time lag. Sharp boundaries are shifted 0.2 m upwards only.

TABLE 1.

m.b.s.	Formation	Th(ppm)	U(ppm)	K%	UR-units
113.1	Branden	9.8	2.3	2.41	8.0
114.8	Branden	8.9	1.9	2.24	7.2
116.1	Branden	14.0	2.5	3.46	10.7
118.2	Branden	12.2	1.9	2.90	9.0
121.0	Viborg	10.3	2.0	2.17	7.7
122.9	Viborg	10.0	2.0	2.19	7.6
123.3	Viborg	9.6	1.7	2.10	7.1
125.5	Viborg	9.3	1.7	1.98	6.9
126.5	Viborg	11.0	2.1	2.30	8.2
198.0	Fur	6.2	2.7	1.05	6.0
213.0	Fur	5.5	1.8	0.99	4.7
214.0	Fur	4.9	1.5	0.89	4.1
216.0	Fur	6.1	6.7	0.98	9.8
218.5	Ølst	4.8	7.1	0.90	9.7
219.0	Ølst	7.0	9.1	1.50	13.0
222.3	Holmehus	8.7	1.7	2.19	6.8
223.1	Holmehus	9.9	2.1	2.40	7.9
223.6	Holmehus	7.7	2.9	1.76	7.3
225.8	Holmehus	9.2	1.3	1.71	6.2
226.8	Holmehus	6.4	0.7	1.06	4.0

UR-Units= U(ppm) + 0.36xTh(ppm) + 0.92xK(%)
The formula for the UR-units is based on a gamma probe with a 25 mm * 25 mm NaI-crystal. 27 UR-units is approximately equal to 200 API-units. The UR-unit does, however, take into account the size of the detector, and the energy discrimination of probe, which the API-unit does not take into account. Thus the UR-unit is a better measure of the gamma activity of the formation experienced by a gamma probe in a borehole.

DESCRIPTION OF THE LITHOSTRATIGRAPHIC UNITS

The Vejle Fjord Formation from 9.75-67.50 m.b.s..
Age: Late Oligocene
General lithology:
This part of the sequence is developed very homogeneously as **micaceous, sandy and clayey silt.**
There is a general decrease in grain-size downwards to 58.25 m.b.s., where glauconite is introduced into the sediment as sand-sized grains giving the clayey and silty sediment a sandy appearence. Down to 18 m.b.s. fine-grained sand lenses and layers occur. From 18 to 58.25 m.b.s. the sediment appears very homogeneous. Pyrite is conspicuous, especially in the lower part of the interval. Macrofossils (up to cm-large molluscan shells) are found throughout the interval, sometimes numerous.
Burrows have been observed at a few levels, especially in the lower part, where also more general bioturbation is observed. The basal 25 cm are laminated.
The colour of fresh samples is monotonously brown (greyish brown, 5 YR 3/2), but alters quickly on oxidation to a blackish brown colour. Below 54 m.b.s. there is some variation in colours ranging from olive black to yellowish brown. In the glauconitic part (below 58.25 m) the bulk sediment may be greenish in colour due to the glauconitic sand grains, whereas the fine-grained matrix is brownish or olive black.
Stratigraphy:
The lithological development of this interval with a basal sandy, glauconitic clay superposed by gradually upwards coarsening clay and silt with a high content of organic matter is very similar to that of the Vejle Fjord Formation (Larsen & Dinesen, 1959). Yet, the members of this formation are much thinner and less fine-grained.
The lithological succession is general for Upper Oligocene/?Lower Miocene deposits of Jutland, and this part of the Harre section is therefore referred to the Vejle Fjord Formation, although the geographical extension of this formation outside the Vejle Fjord area is not fully known. There are no other formally defined lithostratigraphical units applicable to these sediments although they probably correspond to the Sofienlund Formation of Christensen & Ulleberg (1973). They also correspond to sediments known in older literature as Cilleborg Clay, a lithounit not defined in terms of formal lithostratigraphy.
No samples or cores from the Vejle Fjord Formation have been measured for gamma-ray emission.
There is a rather good correlation between the depth of the formation boundaries indicated by the cores and the wireline logs (Fig. 1). The uppermost 10 m contain more sand and show a lower gamma response, while the lowermost 10 m contain glauconite and correspondingly show a greater gamma response.

The Branden Formation from 67.5-119.45 m.b.s.
Age: Late Oligocene
General lithology:
This unit consists of **fine-grained, silty clay** of very homogeneous appearence. It is slightly micaceous, and pyrite occurs abundantly as small stems or rods.
At a few places pyrite is concentrated in concretions or in well-defined thin layers. Macrofossils are pre-

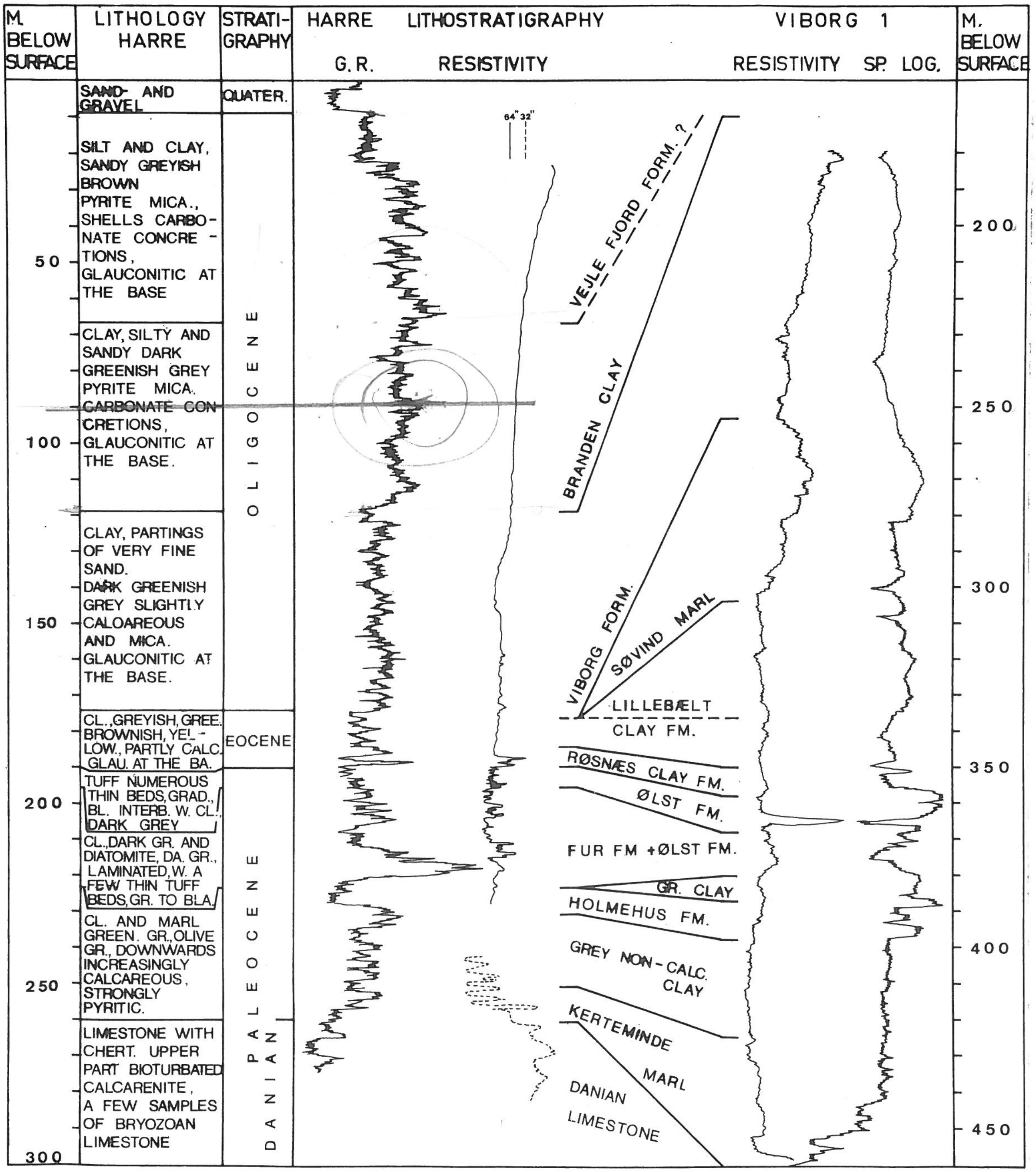

Fig. 1. Wireline logs lithostratigraphy and lithology. Correlation to Viborg 1.

sent as small molluscan shells, generally less than 1 cm in size.

Below 111 m.b.s. the sediment contains glauconite in large proportions, and the bulk character of the sediment varies between glauconitic, fine-grained clay, and more or less clayey greensand. Small burrows (diameter ca. 1 mm) are observed at three levels between 75 and 80 m.b.s..

The colour of the sediment is dark greenish grey (5 GY 4/1) on fresh and moist samples. When dry the colour becomes light grey. In the basal part of the unit, colours are generally darker with an olive black matrix and a bright greenish tint from the sand-sized glauconitic grains.

The upper boundary is situated between two core-sections.

The lower boundary is very sharp and marked by a 1 cm thick, very light-coloured clay layer, which contrasts strongly to the superposing glauconitic clay and sand, and to the underlying silty clay.

Stratigraphy:

Due to lithological characters of the unit as well as its position in the sequence, the sediments are referred to the Branden Formation (as provisionally defined by Christensen & Ulleberg, 1973). The Branden Clay (sensu Christensen & Ulleberg, 1973) has by Flagler (1940) been referred to the Upper Oligocene. The age is most probably Late Oligocene (for discussion see Christensen & Ulleberg, 1973).

5 cores and 4 samples of the Branden Formation have been subject to gamma-ray measurements (see Fig. 2 and Table 1). The gamma response and the contribution from thorium, uranium and potassium is similar to other measurements on sediments of the Branden Formation (Engell-Jensen, Korsbech & Madsen, 1984). The response defines a level slightly higher than in the underlying Viborg Formation despite the coarser texture of the Branden Formation. The higher content of glauconite, compared to the Viborg Formation, is probably the main reason for this.

The Viborg Formation from 119.45-177.5 m.b.s.

Age: Early Oligocene (Rupelian)

General lithology:

The unit consists of **fine-grained silty clay**. It is slightly micaceous and calcareous. Pyrite occurs in small amounts at a few levels. Partings or very thin laminae of silt and fine sand occur with varying frequency throughout the interval. Macrofossils occur in the entire interval, generally as small shells (a few mm). Apart from the silty and sandy partings, a distinct interlamination of brownish clay laminae was observed at a few levels. Only very few burrows were observed in this interval.

The colour is generally dark greenish grey (5 GY 4/1) The basal 25 cm of the unit is strongly glauconitic and contains glauconite-impregnated molluscan shells.

4 cores and 5 samples of the Viborg Formation have been subject to gamma-ray measurements (see Fig. 2 and Table 1). The gamma response is similar to other measurements on sediments of the Viborg Formation (Engell-Jensen *et al.*, 1984). The gamma response on the wireline log (Fig. 1) is fairly constant and slightly below the response of the overlying Branden Formation and above the underlying Eocene sequence.

Stratigraphy:

Based on the lithology and the lithological succession this unit can be correlated with the Viborg Formation as defined by Christensen & Ulleberg (1973). The thickness of the Viborg Formation at the type-locality in the Viborg 1 Borehole is 85.8 m (Christensen & Ulleberg, 1973) and exceeds that at Harre by 30 m. The age of the sediments is most likely Early Oligocene (Rupelian), see Christensen & Ulleberg (1973) and Flagler (1940).

The Lillebælt Clay Formation from 177.5-186 m.b.s.

Age: Middle Eocene

General lithology:

The unit consists of **fine-grained clay**, mostly homogeneous dark greenish grey (5 GY 4/1). The uppermost 1.35 m is brownish grey to olive grey (5 YR 4/1-5 Y 4/1) followed by 7.15 m of greenish grey clay. Carbonate is absent except for concretions. The clay is laminated and contain scattered white sand-sized particles probably foraminifers, in some intervals. At the transition from the brownish layer to the underlying greenish clay burrows with glauconite occur. Glauconitic grains are also present close to the base of the unit.

No cores or samples have been subjected to spectral natural gamma-ray measurements, but the total gamma response (Fig. 1) has a level within the expected range.

Stratigraphy:

Based on the grain-size, the colour and its variation, and the absence of carbonate and pyrite and the presence of glauconitic horizons it is most likely that the unit belongs to Bed L5 of the Lillebælt Clay Formation (Heilmann-Clausen *et al.*, 1985). The younger part of the Lillebælt Clay Formation and the Søvind

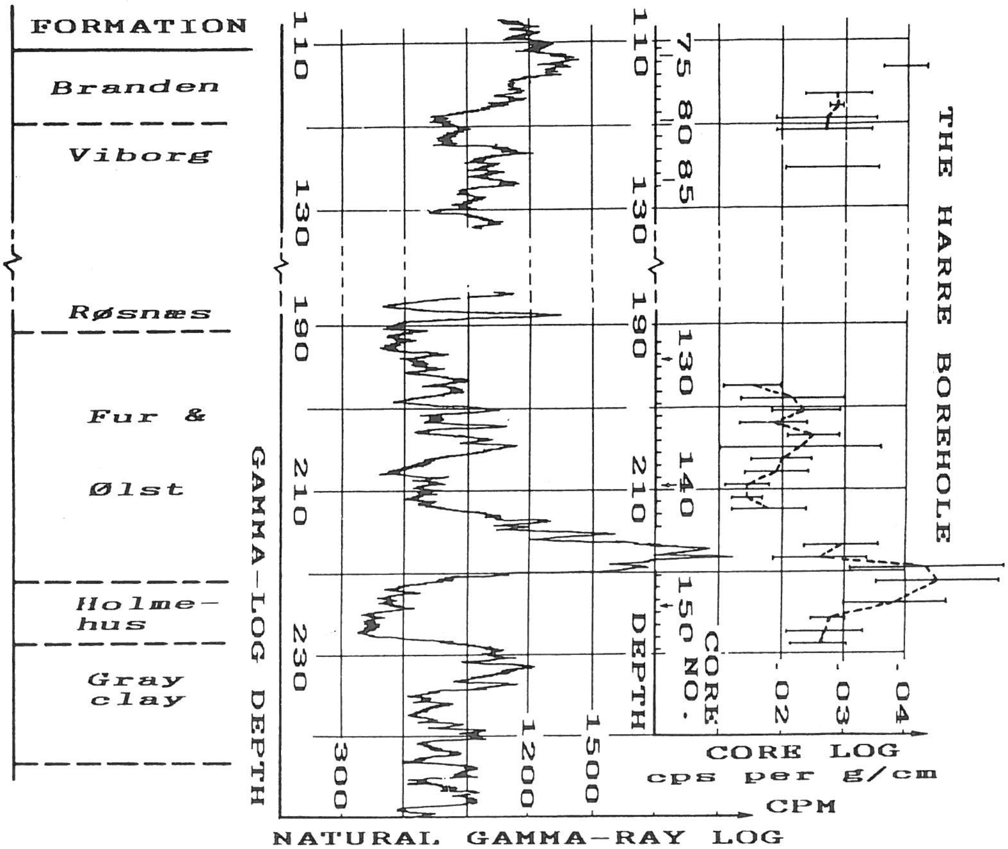

Fig. 2. The correlation between the wireline gamma-log and the Spectral Natural Gamma-ray measurements of cores. Note the discrepancy below approximately 212 m.b.s..

Marl as well as the older part of the Lillebælt Clay Formation is not present in this borehole.

The Røsnæs Clay Formation from 186-190.88 m.b.s.
Age: Early Eocene
General lithology:
The upper part (3 m) consists of dark yellowish brown (10 YR 4/2) or moderate brown (5 YR 3/4-4/4) **fine-grained clay**, mostly carbonate-free, with well defined thin bioturbated layers of greenish to blueish grey clay layers, probably argillized volcanic ash layers. This part is equivalent to R4 of Heilmann-Clausen *et al.* (1985). The interval from 189-190.35 m.b.s. consists of a carbonate rich, *Zoophycos* bioturbated, yellowish grey (5 Y 7/2) clay, equivalent to R3 of Heilmann-Clausen *et al.* (1985). From 190.35-190.88 m.b.s. the clay is mostly carbonate-free and greenish grey. In some layers glauconitic grains occur. One more coarse grained layer, 0.75-1.5 cm in thickness, of volcanic origin is present in this interval. No cores or samples have been analysed for spectral natural gamma-ray measurements, but on the wireline gamma-ray log (Fig. 1) the glauconitic basal part of the Røsnæs Clay Formation is marked by a distinct peak.
Stratigraphy:

The glauconitic basal part is equivalent to R1 of Heilmann-Clausen *et al.* (1985). R2 is not demonstrated with certainty, but R3 and R4 are present. The uppermost beds of the Røsnæs Clay Formation, the calcareous brownish and greyish clays, R5 and R6, are not identified, and probably a hiatus is present between the Røsnæs- and Lillebælt Clay Formations. It has not been possible to distinguish between Bed R4 of the Røsnæs Clay Formation and Bed L1 of the Lillebælt Clay Formation, so it is possible that all the brownish clay above Bed R3 of the Røsnæs Clay Formation belongs to Bed R4, and consequently that L1 is absent in the Harre borehole.

The Ølst- and Fur Formations from 190.88-222 m.b.s.
Age: Late Paleocene/Early Eocene
General lithology:
The sequence consists of **clay with numerous volcanic ash layers.**
The clay down to 196.50 m.b.s. is more or less laminated light olive gray (5 Y 6/1) to greenish grey (5 GY 6/1) carbonate free with scattered greenish sand sized particles. In the lower part of this interval the clay gradually becomes less dense, like the mo-clay of the Fur Formation. Bioturbation occurs in some limited intervals, but is mostly absent. The clay between the ash layers in these upper 5.62 m is similar to that of many wellknown outcrops to the south, both with respect to appearence and to the thickness of the layers, but differs from the mo-clay as it is known in outcrops to the north.
This unit contains the volcanic ash layers numbered with positive numbers (Bøggild, 1918). The ash layers (Fig. 3) are generally slightly thicker than at the outcrops at Ølst (Fig. 1, Nielsen, 1974), and they are mostly dark grey to black sandy silt, many with graded bedding and with sharp boundaries. Most of the ashes can be referred to the established ash stratigraphy of Bøggild (1918).
From 196.50 to 218.5 m.b.s. the appearence and the thickness of the clay layers between the ashes are similar to the mo-clay of the Fur Formation (Pedersen & Surlyk, 1984), and is thus referred to this formation. The colour varies from light grey, olive gray to almost black, presumably caused by a variation in the ratio diatoms/clay particles and in the content of organic carbon. A carbonate-rich interval is found between 200.23 and 200.38 m.b.s.. Based on lamination the clay between 196.5 and 218.5 m.b.s. is subdivided into 3 types with a very complex and interfingering stratigraphic position.

Type 1: extremely well laminated, generally light grey, presumably a very diatom-rich clay

Type 2: poorly laminated clay, generally dark grey to grey, partly with distinct bioturbation

Type 3: intermediate laminated, varying in colour and probably in clay content, often with a very alternating degree of hardening or silicification.

Layers of type 3 are mostly found as thin individual layers in the interval from 217.3 to 220 m.b.s., and they have an appearence similar to the "Skifferserien" ('shaleseries') as defined by Bøggild (1918). They are sporadically present in the whole sequence. (See Fig. 3).
This unit contains only few and thin ashes, which have been difficult to correlate with specific numbered ashes as defined by Bøggild (1918). Some of the ashes are black, but most of them are grey to light grey. A 7.5 cm thick very light grey layer is probably the very distinct ash no. -33.

The lowermost part from 218.5 to 222 m.b.s. consists of clay layers similar to the uppermost part and is consequently referred to the Ølst Formation. Some clay layers in this interval are silicified. This unit contains 4 very thin light grey ash layers. In the lower part of the Ølst/Fur Formations two core liners were empty, and in a few others, the material was somewhat disturbed and the cores were incomplete. This indicates that the depths calculated by the number of cores might be uncertain.
The boundary between the Ølst Formation and the Holmehus Formation is seen in the cores at a depth of 225 m.b.s.. On the wireline logs (Fig. 1) the characteristic decrease in the gamma signal at the transition from the Ølst- to the Holmehus Formation is seen at 222 m.b.s., i.e. 3 m above the position indicated from the cores. The transition from the Holmehus Formation to the "grey slightly to non-calcareous clay" is thus seen 3 m lower in the cores than indicated by the gamma response (Fig. 1). Measurements of the gamma emission on cores (Fig. 2) and on samples (Table 1) were used to test which of the two depth indications was correct; the one calculated from the cores or the one interpreted from the wireline log. It is evident from these analyses that there is a discrepancy between the wireline gamma response and the corresponding signal from core measurements

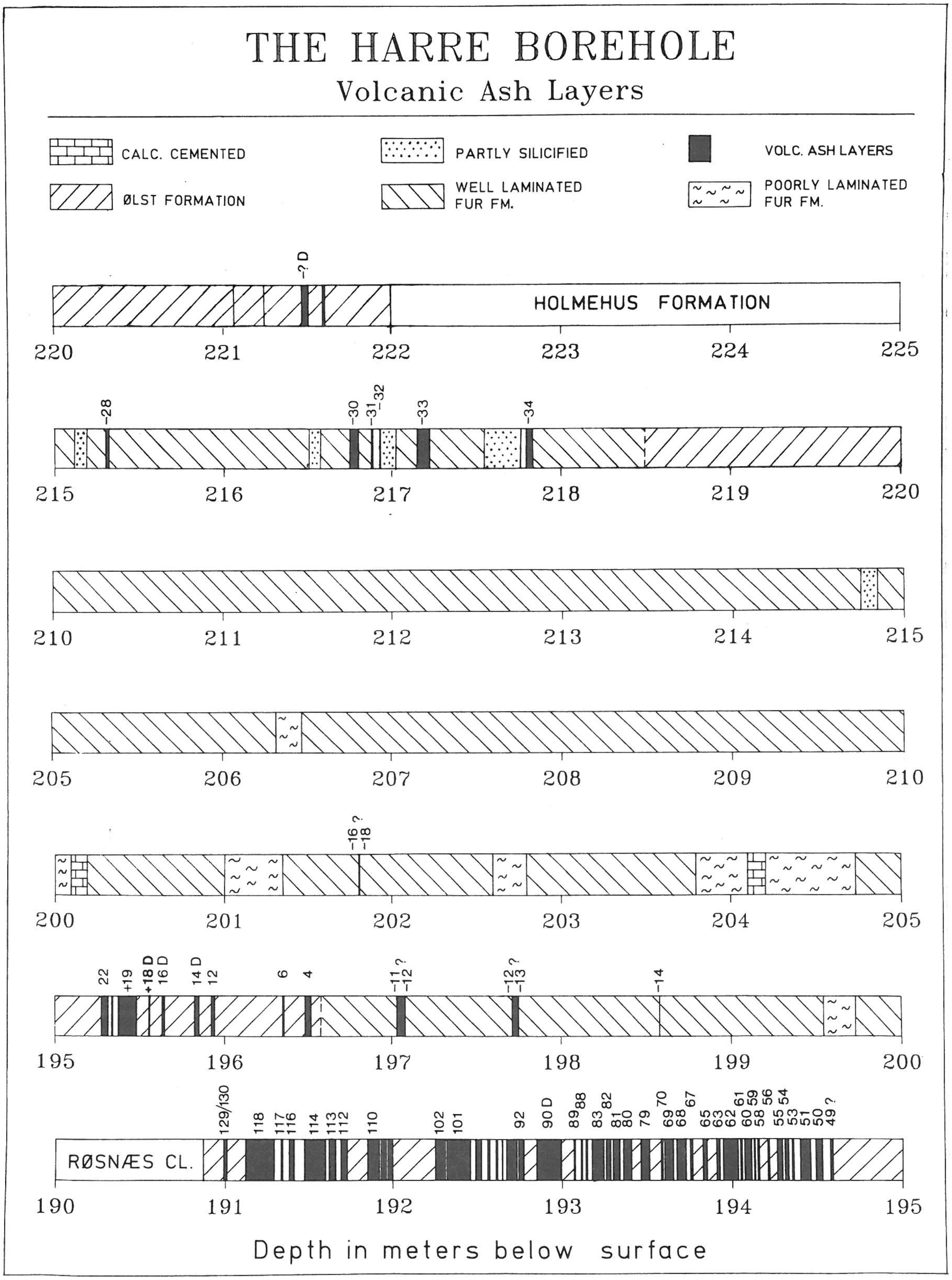

Fig. 3. Location, thickness and identity of volcanic ash layers from the Ølst/Fur Formations. Important lithologic features such as laminations, bioturbations, presence of calcareous and siliceous concretions are indicated.

from the lower part of the Ølst Formation and downcore. The discrepancy has a magnitude of 3 m, i.e the same magnitude as the difference between the depths calculated from the cores and the depths interpreted from the wireline logs.

Thus, there is a correlation between the expected and the measured gamma response from the cores and the lithology of the cores. Down to the lower Ølst Formation there is a correlation between the wireline gamma curve and the gamma results from core measurements and to the lithology, but belowe the interval where empty cores were found the depths from cores differ from the wireline data. It is therefore concluded that the wireline log is the most precise measure for depths, and consequently all depths from the lower Ølst Formation to the bottom are corrected.

The gamma log response in the upper part of the Ølst Formation is relatively low (Fig. 2) as would be expected. Detailed gamma logging of boreholes in East Jutland has shown that at the transition from the ash series with positive to negative numbers, the gamma response is distinctly increased. This does not seem to be the case here, although some fluctuations occur. The reason for this is believed to be the dominance of diatoms in the clay layers of the Fur Formation, which do not contain gamma-sources and therefore dilute the signal. At the transition to the less diatom-rich clay sediments of the lower Ølst Formation at 218.5 m.b.s., the gamma response increases very distinctly to a level known from non-diatomaceous lower Ølst Formation-lithologies in other boreholes.

16 cores and 8 samples from the Ølst/Fur Formations have been analysed for spectral natural gamma ray emission, and the results seem to correspond to the results from the gamma log when compensated for the depth discrepancy (Figs. 2, 3 and Table 1). The measurements on cores and samples reveal that the peak of the gamma-log at 216 to 220 m.b.s. is due to a high content of U.

The upper Ølst Formation has a lithology and a log response, which is similar to the Balder Formation of the North Sea (Deegan & Scull, 1977). The Fur Formation is not quite similar to the Sele Formation of the North Sea and its onshore Danish equivalent with respect to gamma response. The reason for the difference is believed to be the dominance of diatoms in large parts of the sequence. The lithology and gamma ray level in the lower Ølst Formation is more or less like that of the Sele Formation.

The Holmehus Formation from 222-229.9 m.b.s..
Age: Late Paleocene
General lithology:
The interval consists of greenish grey - dark greenish grey - greenish black (5 G 2/1 - 5 G 5/1) **very fine grained clays.** Scattered specks of pyrite and several white sand-sized particles, possibly of biogenic origin, give the unit a characteristic appearence. The clay is carbonate free, except for small amounts in thin intervals in the lower part, and laminated in a few thin zones, but usually burrows are present. The upper boundary to the Ølst Formation is located between two cores but is probably sharp. The lower boundary is relatively sharp.
Stratigraphy:
The interval has a appearence and a thickness which corresponds to the Holmehus Formation in other wells and outcrops (Heilmann-Clausen *et al.*, 1985) and is also similar to the Lista Formation in the North Sea (Deegan & Scull, 1977).

The gamma response of the Holmehus Formation onshore in Denmark is very low and therefore very characteristic for the unit. A similar low gamma level is not that distinct in the North Sea, but the reason for this is not yet quite understood. The pure smectitic composition and the almost absence of organic material and glauconite of the Holmehus Formation are the most probable reasons for this.

Five samples and 5 cores from the Holmehus Formation have been measured for spectral natural gamma emission (Fig. 3 and Table 1), and the results are in fairly good agreement with the wireline measurements when corrected with respect to the depth.

The "grey slightly to non-calcareous clay" (informal unit) from 229.9 to 244.5 m.b.s..
Age: Late Paleocene
General lithology:
This informal litho-unit consists of olive black (5 Y 2/1) **slightly silty clay,** non-calcareous in the upper part grading into calcareous in the lower part with a indistinct boundary to the underlying Kerteminde Marl. Sand-sized pyrite and glauconite particles are present in few intervals. Many thin intervals are cemented, mostly partly silicified.
Stratigraphy:
The boundaries of this informal unit are generally not well defined. At the upper boundary the greenish clays of the Holmehus Formation becomes gradually mottled and more and more greyish, while, at the lower boundary, the grey clay becomes gradually more

calcareous.
No samples or cores have been analysed for spectral gamma ray emission, but the wireline gamma log response is greater than in the Holmehus Formation and it varies in a rythmic way as also known from other boreholes, probably due to regular variations in the content of diagenetic silica (Opal CT).

The Kerteminde Marl from 244.5-256.9 m.b.s.
Age: Late Paleocene
General lithology:
The sediment of this unit is a olive grey (5 Y 3/1) **fine grained marl**, with a varying carbonate content, upcore grading into the almost non-calcareous clay above. The unit is strongly bioturbated with a varying content of silt sized material. The upper part is olive black, and also in the central part two 30-50 cm thick olive black intervals are present.
Stratigraphy:
The formation is lithologically very similar to the Maureen Formation of the North Sea (Deegan & Scull, 1977) and the North Sea Marl in the Danish Central Graben (Michelsen, 1982).
The gamma log response varyies probably due to variations in the carbonate- and organic C content.

The Danian limestone from 256.9 m.b.s.
Age: Early? Paleocene
General lithology:
The uppermost 1.1 m is cored and consists of alternating limestone and flint layers. The limestone is developed as a light olive grey (5 Y 6/1) **calcisiltite**, with molluscs, glauconite and is strongly bioturbated. From the underlying 22 m only scattered samples have been recovered, some of these consist of bryozoan limestone, some others , especially the lowermost one from 279 m.b.s., are rather clay rich.
Stratigraphy:
The precise stratigraphy of this unit is impossible to interpret from the very sparse available material.

CONCLUSION

The following lithostratigraphy has been established based on core descriptions: Vejle Fjord Formation from 9.75-67.5 m.b.s. (meters below surface), the Branden Formation from 67.5-119.45 m.b.s., the Viborg Formation from 119.45-177.5 m.b.s., the Lillebælt Clay Formation from 177.5-186 m.b.s., the Røsnæs Clay Formation from 186-190.88 m.b.s., the Ølst and Fur Formations from 190.88-222 m.b.s., the Holmehus Formation from 222-229.9 m.b.s., the "grey slightly to non-calcareous clay" from 229.9-244.5 m.b.s. and the Kerteminde Marl from 244.5-256.9 m.b.s.. Below 256.9 m.b.s. Danian Limestone is found. There are distinct stratigraphic gaps between the Røsnæs- and Lillebælt Clay Formations and between the Lillebælt Clay Formation and the Viborg Formation. The Fur- and Ølst Formations are here demonstrated to be interfingering with gradual transition between the two different but contemporaneous formations. Spectral natural gamma-ray measurements on cores and individual samples have enabled an important correction of the depths indicated by the cores and thus established a more logical relation between the lithostratigraphy based on core descriptions and the gamma response on the wireline log.
During the work with the core-descriptions it became evident that the present material, especially from Paleocene and Oligocene, was rather unique and that the borehole might act as a key-locality for these intervals. It was in particular considered to focus on the stratigraphical gaps, which seemed to be present, as they offered a possibility to elucidate the tectonic history of this region and the provenance of the sediments. It was therefore decided to try to perform a program containing intensive stratigraphic and compositional analyses by inviting international wellknown specialists to participate. The following papers represent the results of this work.

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DANSK SAMMENDRAG

På baggrund af lithologisk beskrivelse af kontinuerte kerner, af borehuls logs og af gamma målinger på udvalgte prøver og kerner er der foretaget en lithostratigrafisk inddeling af de tertiære sedimenter i Harre boringen. Boringen omfatter kontinuerte kerner fra ca. 10 meter under overfladen til ca. 256,5 m med ca. 95 % recovery, samt enkelte prøver til en dybde af ca. 280 m. Følgende enheder er identificeret:
Vejle Fjord Formationen fra 9.75-67.5 m u.t. (meter under terræn), Branden Formationen fra 67.5-119.45 m u.t., Viborg Formationen fra 119.45-177.5 m u.t.,

Lillebælt Ler Formationen fra 177.5-186 m u.t., Røsnæs Ler Formationen fra 186-190.88 m u.t., Ølst- og Fur Formationen fra 190.88-222 m u.t., Holmehus Formationen fra 222-229.9 m u.t., grå kalkfattig til kalkfri ler fra 229.9-244.5 m u.t. og Kerteminde Mergel fra 244.5-256.9 m u.t.. Under 256.9 m u.t. er Danian kalksten identificeret. Der er tydelige stratigrafiske gab mellem Røsnæs- og Lillebælt Ler Formationen og mellem Lillebælt Ler Formationen og Viborg Formationen. Lag fra Fur- og Ølst Formationen fingrer ind i hinanden, og der er gradvise overgange fra den ene til den anden af disse to samtidige formationer.

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