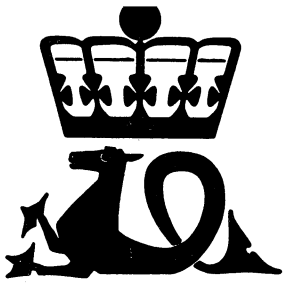

NPD-BULLETIN NO 4

A lithostratigraphic scheme for the Mesozoic and Cenozoic succession offshore mid- and northern Norway

Edited by
A. Dalland, D. Worsley and K. Ofstad

Amendments to NPD-Bulletin No 4

page 0: Read lithostratigraphic for lithostrategraphic

page 1: Read Chronostratigraphic for Cronostratigraphic

page 24: Column 2, line 2: read 61 m for 65 m

page 27: Column 2, line 22: read 12 m for 14 m

Fig. 26: The base of Lyr Fm: read 3836 m for 3835 m

ISBN 82–7275–241–9

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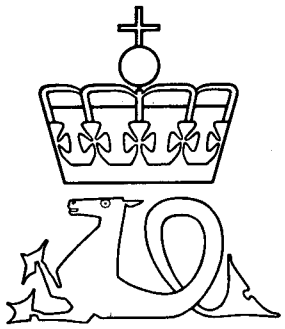
Januar 1988



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CONTENTS

INTRODUCTION

Background

The first wells drilled on Haltenbanken and Tromsøflaket in 1980 are released, and Norwegian shelf areas north of 62°N are extensively documented by well-data (Fig.1). Stratigraphic information based on data from exploration wells has been presented in a series of papers in the two Norwegian Petroleum Society volumes edited by Spencer *et al.* (1984, 1986). Although informal stratigraphic units are in use, the need for a formal lithostratigraphic framework in these areas is now acute.

A working group appointed by the geology and geophysics committee of OKN (Operators' Committee North of 62°N) presented informal alphanumerically based sequences of units for both Haltenbanken (e.g. H1, H2 etc.) and Tromsøflaket (e.g. T1, T2 etc.) to the Northern European Margins Symposium in Trondheim, May 1983. These proposals were not followed by a formal presentation in the ensuing conference volume (Spencer 1984), although two units from Tromsøflaket – the Stø and Nordmela formations – were described in that work (Olaussen *et al.* 1984). This informal scheme was then used by the petroleum industry on completion logs and in unpublished reports, without any accepted definition of units. Geographically based formation and group names later came into use, using names from coastal areas of mid- and northern Norway. This step was particularly unfortunate as several of the names adopted were already in use for established units on mainland Norway. Initiatives were therefore taken in 1986 to establish a formal lithostratigraphical scheme and a new working group consisting of representatives from Norsk Hydro, the Norwegian Petroleum Directorate, Saga Petroleum and Statoil is responsible for the present proposals.

Participation

The first informal scheme was developed by a working group consisting of V.W. Jacobsen (the Norwegian Petroleum Directorate), W. Karlsen (Saga Petroleum), O. Skarpnes (Statoil) and S. Solheim (Norsk Hydro).

The present working group was organised in two subcommittees:

Mid-Norway:
A. Dalland (Statoil, chairman), H.O. Augedahl (Saga Petroleum), K. Bomstad (Norsk Hydro), K. Ofstad (the Norwegian Petroleum Directorate).
J. E. Tellefsen and A. Lycke (Norsk Hydro) contributed to the work on Cretaceous and Tertiary sequences.
Northern Norway:
D. Worsley (Saga Petroleum, chairman), S.E. Kristensen (Norsk Hydro), R. Johansen (Statoil), F. Riis/R. Olsen (the Norwegian Petroleum Directorate).

Proposals from both subcommittees have been edited and co-ordinated by A. Dalland, D. Worsley and K. Ofstad, with invaluable help and constructive criticism from P.R. Waddams and especially from J.P. Nystuen on behalf of the Norwegian Committee on Stratigraphy.

Procedure

In the present work, existing informal lithologic units are refined and formally defined and the type and reference sections are illustrated by well logs. In addition some new units are defined. For the Upper Jurassic to Tertiary succession of mid-Norway and the Neogene of Tromsøflaket we suggest that the evidence for continuity and lithological similarity to the northern North Sea area is strong enough to allow use of the North Sea nomenclature at the group level. The Mid-Norway Subcommittee propose an entirely new stratigraphic name scheme and the Northern Norway Subcommittee retain only two of the existing formational units. In line with recommendations from the Norwegian Committe on Stratigraphy (Nystuen 1986), names directly linked to shelf areas have been chosen to avoid confusion with mainland stratigraphy. The major reason for this decision is that several of the informal names used earlier are already well established and formally defined for mainland geological units. Furthermore, new definitions in some cases differ from the boundary criteria in use for the informal units. There will inevitably be a transitional period with some confusion. However, these proposals are acceptable to the Norwegian Committee on Stratigraphy and to the Norwegian Petroleum Directorate and all users are urged to implement them as soon as possible.

Presentation of data

Well logs are presented in one of three vertical scales (1:500, 1:1000, 1:2000). The logs show lithology together with gamma ray, density, neutron and sonic logs, with lithological symbols defined in Figure 2. Text descriptions of unit boundaries are presented stratigraphically, viz. with upwards variation in log response across a boundary. All depths cited are metres relative to KB.

CHRONOSTRATIGRAPHIC FRAMEWORK

Ages referred to in the text are at stage level, and more precise ranges are not attempted. Age designations for the different units are based on unpublished consultant and in-house reports. Nomenclature in general corresponds to the time scale scheme of Harland *et al.* (1982), including the division of the Lower Triassic Scythian Series into 4 stages using the units proposed by Tozer (1967). However, Boreal terminology is adopted around the Jurassic/Cretaceous transition, using the Volgian as the final Jurassic stage and the Ryazanian as the initial Cretaceous stage.

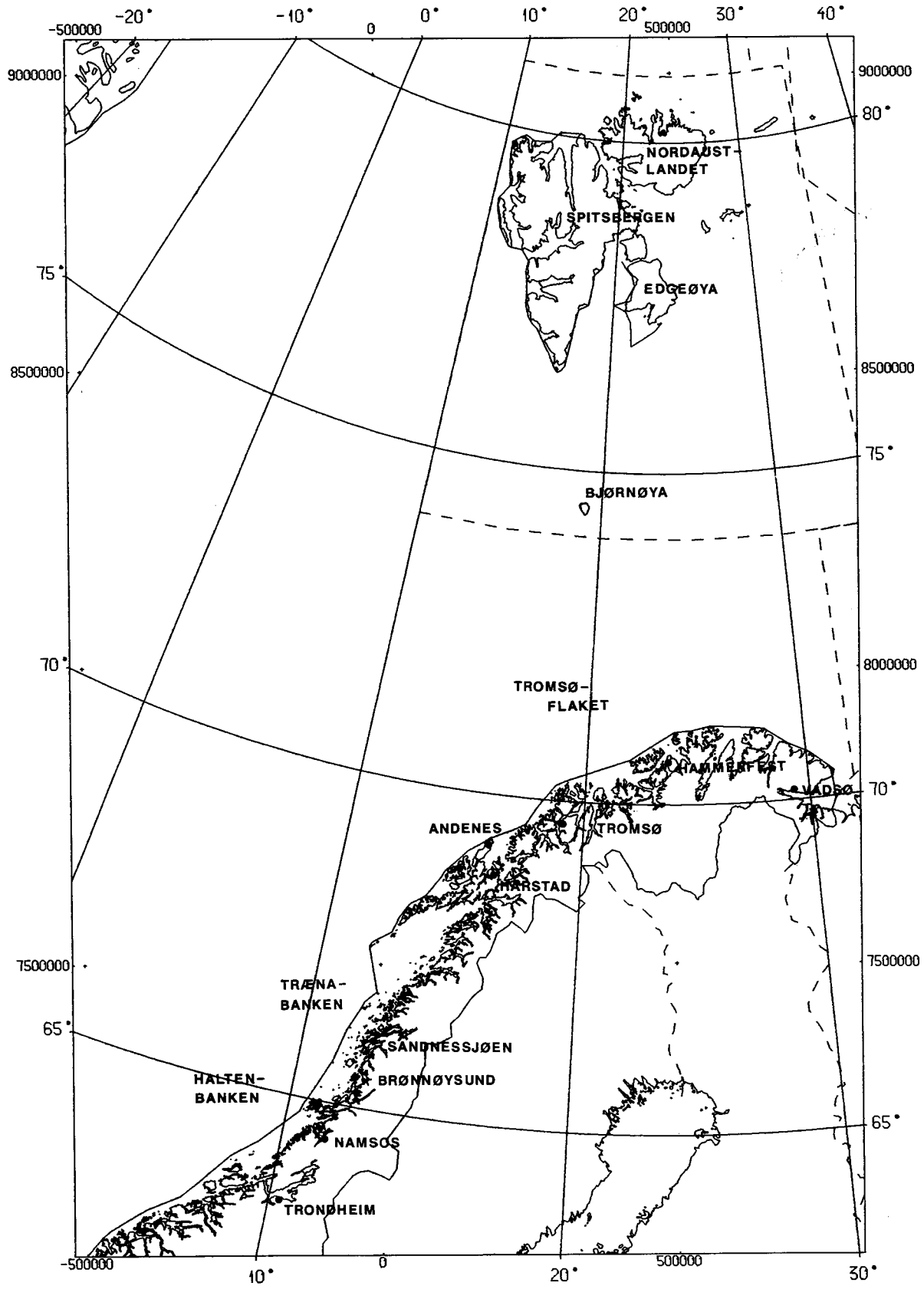


Fig. 1 Norwegian shelf areas north of 62° N

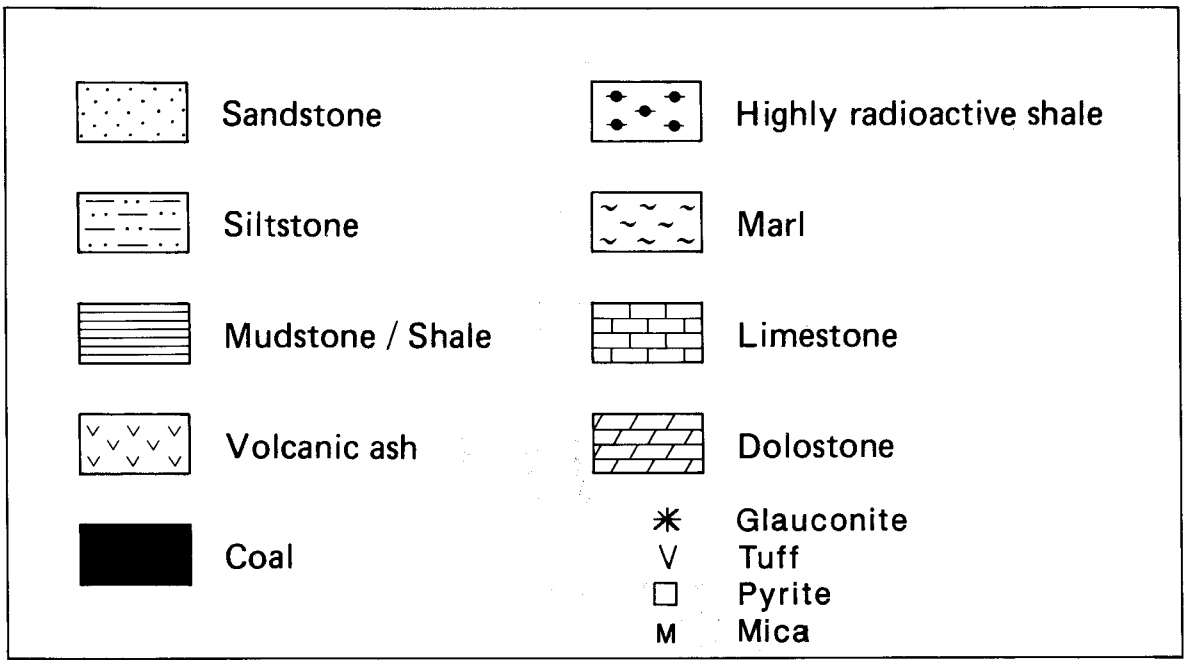


Fig. 2 Lithologic symbols used in the illustration of type and reference sections

THE POST-TRIASSIC SUCCESSION OF THE MID-NORWEGIAN SHELF

by

A. Dalland, H. O. Augedahl, K. Bomstad and K. Ofstad

INTRODUCTION

As the first hydrocarbon discoveries were being made in the Norwegian North Sea, the existence of large sedimentary basins offshore mid-Norway was documented by geophysical studies (Eldholm 1970, Åm 1970, Grønlie and Ramberg 1970, Talwani and Eldholm 1972). These early studies gave a crude picture of sediment thicknesses and internal seismic velocities but little information about lithology.

Further investigations in the 1970s included sea-bottom sampling of pre-Quaternary sedimentary rocks along the eastern margins of the shelf basins, and seismic tie-lines to wells in the northern North Sea. Papers which presented stratigraphic information in the area include: Sellevoll (1975), Bugge *et al.* (1975), Rønnevik and Navrestad (1977) and Jørgensen and Navrestad (1979).

Exploration drilling offshore mid-Norway started in 1980 with well 6507/12–1 (operator: Saga Petroleum). This well provided the first detailed information about the lithology of the sedimentary succession in the Haltenbanken area. Since then additional stratigraphic information has been obtained from more than 50 wells drilled in the area between 64°15′ and 66°45′N (Fig. 4). The well data give good coverage of the uppermost Triassic through Tertiary sequence. Much less information exists for the older parts of the sedimentary succession as only a few wells have penetrated the pre-Triassic. The Quaternary sediments are also poorly documented.

The main structural elements of the mid Norwegian shelf area were defined by Gabrielsen *et al.* (1984). The structural geology of the area has also been discussed by Jørgensen and Navrestad (1979, 1981), Aanstad *et al.* (1981), Price and Rattey (1984), Mutter (1984) and Bukovics and Ziegler (1985) and in various contributions to the conference volumes edited by Spencer *et al.* (1984 and 1986).

Stratigraphic information from the continental shelf east of the Haltenbanken-Trænabanken area is available through work by the Norwegian Continental Shelf Institute (IKU). A summary of this work was presented by Bugge *et al.* (1984). Data were obtained by sampling and shallow drilling Mesozoic and Tertiary outcrops at or near the sea bottom. In some cases the only known core sections through formation boundaries are from these IKU investigations. However, this material is unsuitable as type material since basin margin successions are commonly very thin and incomplete and not representative of lithologic units occurring in more central parts of the basin. Also lithostratigraphic correlation in the Haltenbanken-Trænabanken area has to be based on well logs.

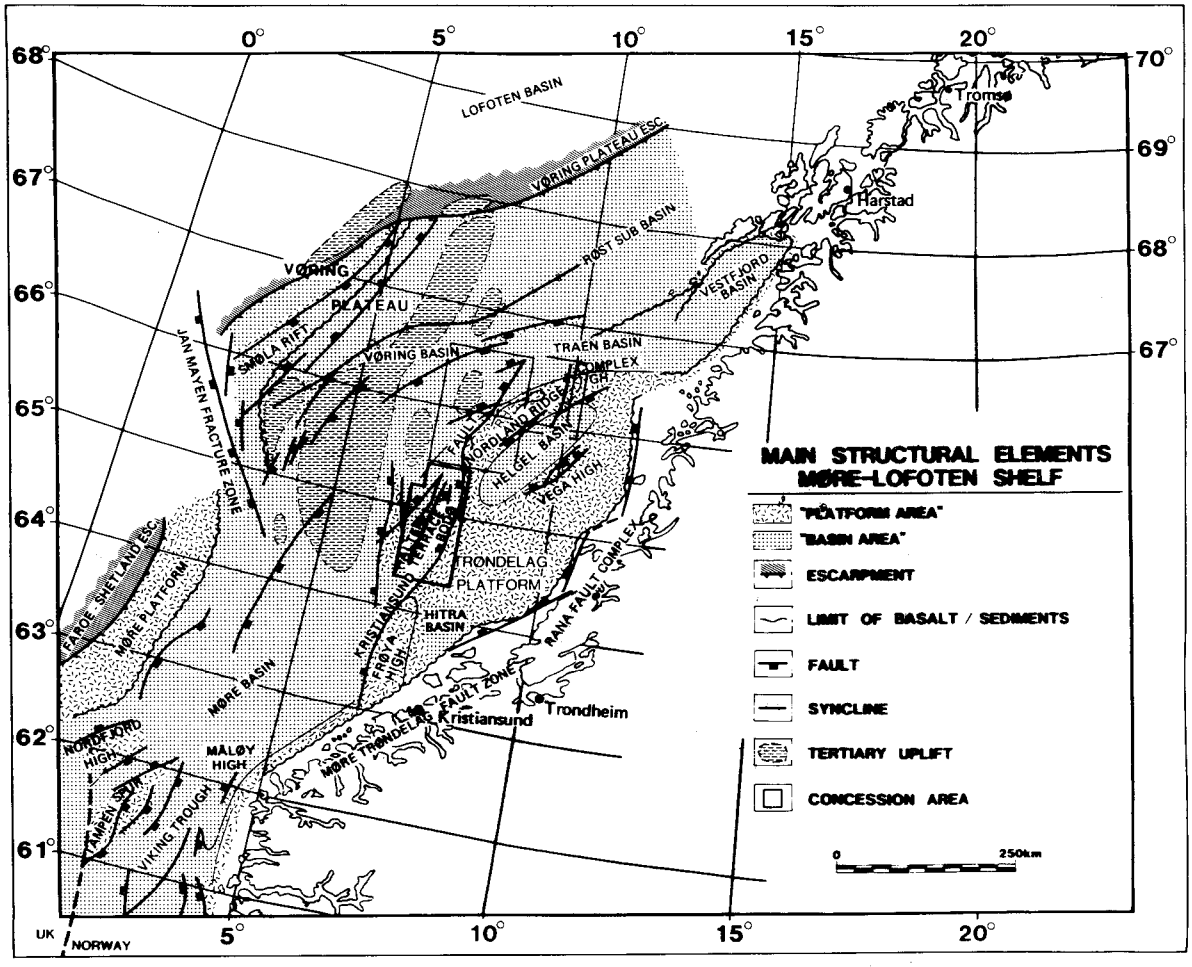


Fig. 3 Main structural elements of the mid Norway continental shelf (Modified from Gabrielsen et al. 1984)

LITHOSTRATIGRAPHY

The definitions of lithostratigraphic units are based on well data from the Haltenbanken area (the Halten Terrace and the western margin of the Trøndelag Platform, Fig. 3). In some units major changes in lithology occur towards the basin margins and along interbasinal highs such as the Nordland Ridge. Thus it will be necessary to modify the lithostratigraphic scheme presented here as more data become available. The proposed nomenclature (apart from group names adopted from the North Sea area) is based on Norwegian words connected to sea life and boats (Figs. 5 and 6).

Båt Group (Båtgruppen)

Name:
Norwegian name for boat. The Båt Group comprises the lower and middle parts of the earlier used informal Halten group (H1).

Type area:
The transition from the Halten Terrace to the Trøndelag Platform in Blocks 6507/11 and 6507/12.

The group's development is illustrated by the type section of its basal unit in well 6507/12-1 (Saga Petroleum), coordinates 65°07′01.62″N, 07°42′42.61″E from 2920 m to 2213 m (Fig. 7), and in the reference well 6407/1-2 (Statoil), coordinates 64°47′50.61″N, 07°02′23.76″E from 4548 m to 3907 m (Fig. 8).

Thickness:
707 m in well 6507/12-1 and 641 m in well 6407/1-2.

Lithology:
The Båt Group consists of alternating sandstone and shale/siltstone units, with sandstone as the dominant lithology.

Basal Stratotype:
The base of the Båt Group is defined by the base of the Åre Formation as described herein.

Lateral extent and variation:
The Båt Group is present in most of the wells drilled to date on Haltenbanken and Trænabanken, with maximum thicknesses in excess of 700 m. The upper part of the succession is

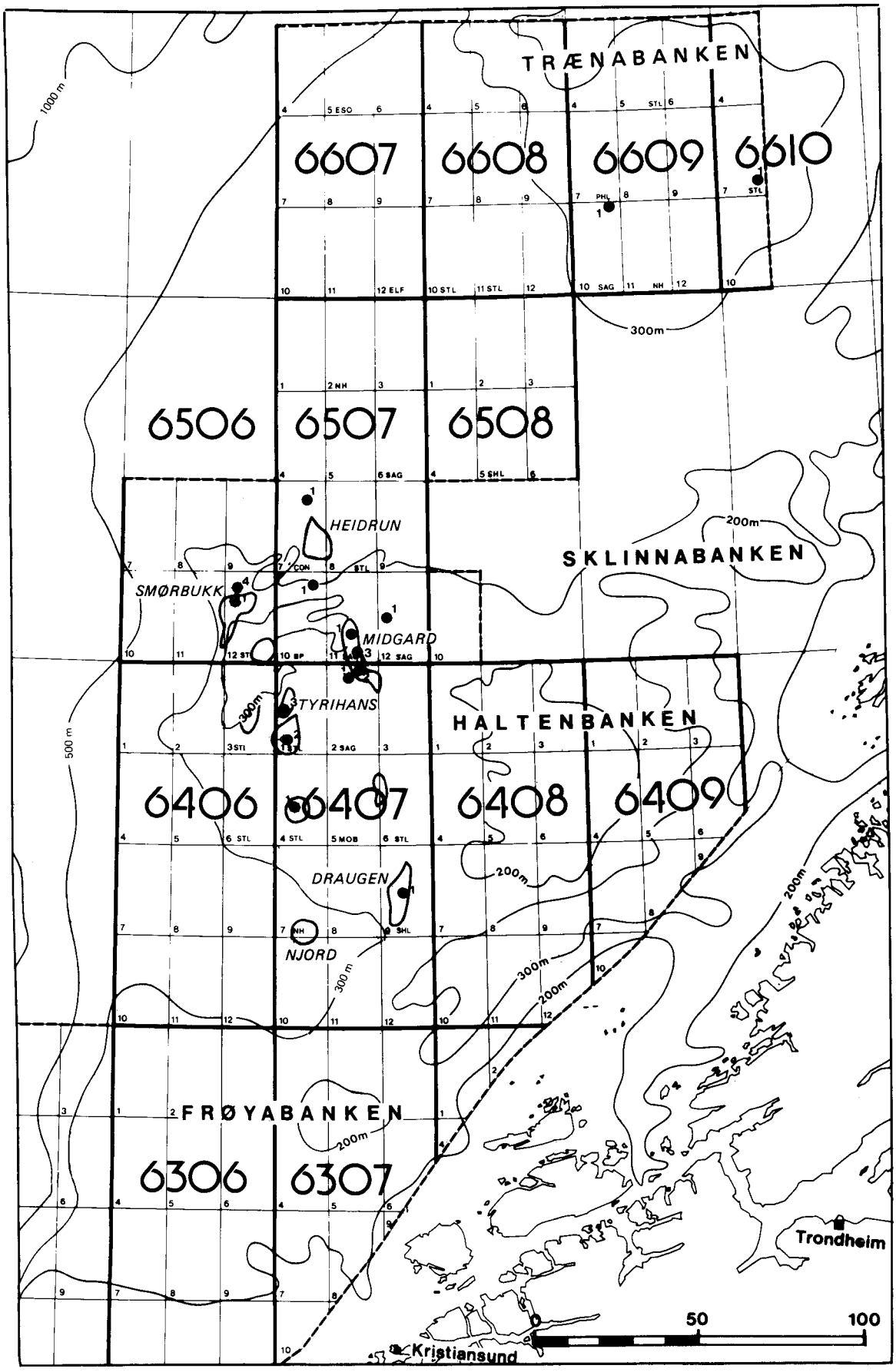


Fig. 4 Location of wells (black dots) used as type or reference sections in the Haltenbanken-Trænabanken area

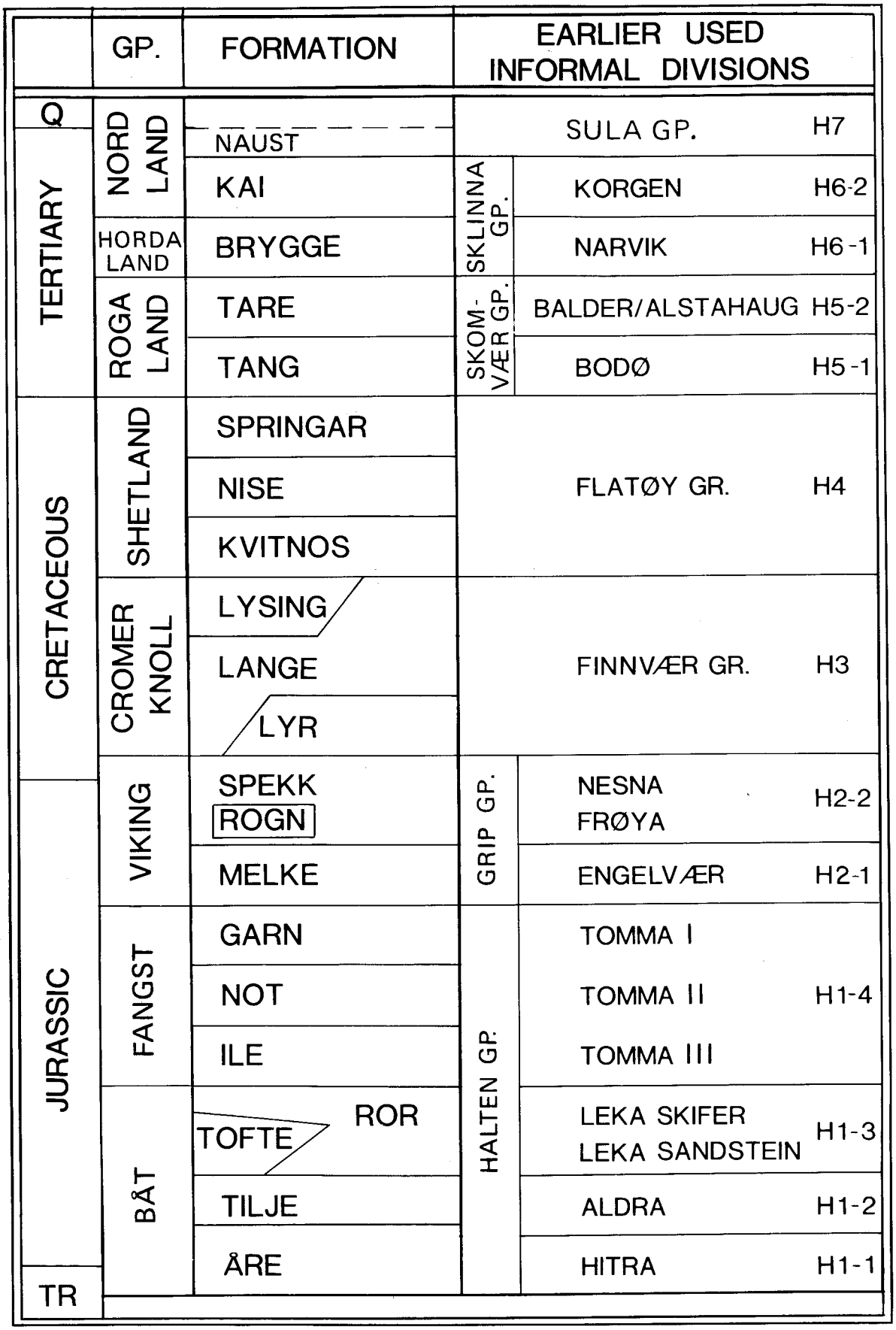


Fig. 5 Comparison between the new lithostratigraphic units and the earlier informal units used in the Haltenbanken area

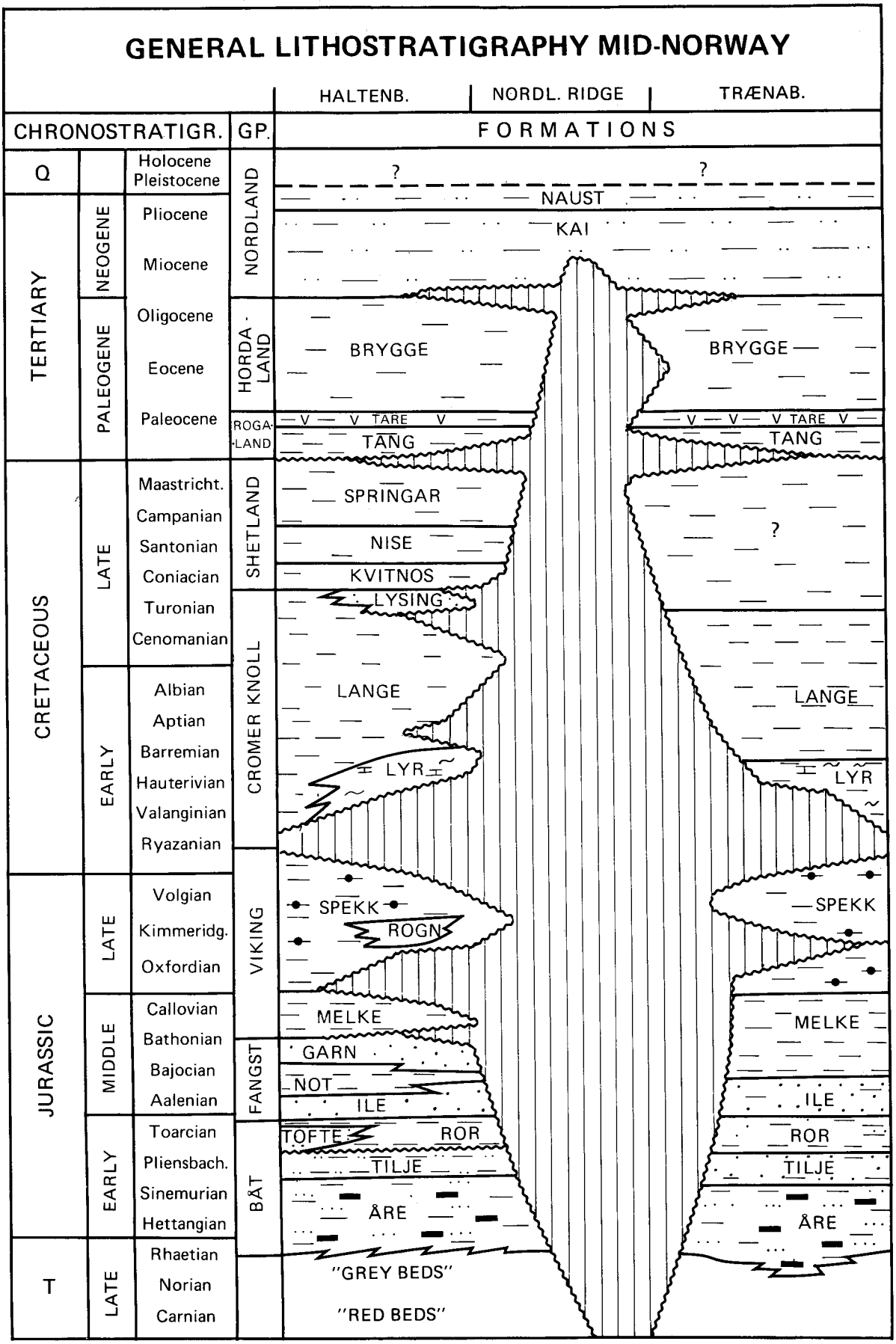


Fig. 6 Generalized time- and lithostratigraphic section from the Halten Terrace to the Trænabanken area

progressively truncated towards the crestal part of the Nordland Ridge and the whole group is absent on the highest parts of the ridge. Shallow boreholes off the Trøndelag coast (Bugge et al. 1984) indicate that the Åre Formation may be absent and younger strata within the Båt Group onlap directly on Precambrian basement.

Age:
Rhaetian to Toarcian.

Depositional environment:
Shallow marine to deltaic environments dominated during deposition of the group.

Correlation:
The group corresponds to the mid-Fruholmen to mid-Stø Formation sequence in the Realgrunnen Group of the Hammerfest Basin. The group is also partially equivalent to the Statfjord Formation and the Dunlin Group of the North Sea.

Subdivision:
The group comprises four formations (Figs. 7 and 8) all of which are defined herein.

Åre Formation (Åreformasjonen)

Name:
From the Norwegian word for oar. This formation corresponds to the informal term Hitra formation ("the coal sequence" or H1–1) together with the lower part of the Aldra formation (H1–2).

Well type section:
6507/12–1 (Saga Petroleum), coordinates 65°07'01.62"N, 07°42'42.61"E from 2920 m to 2412 m (Fig. 7). Two cores, 26.2 m recovery.

Well reference section:
6407/1–2 (Statoil), coordinates 64°47'50.61"N, 07°02'23.76"E, from 4548 m to 4221 m (Fig. 8). No cores.

Thickness:
508 m in the type well. Generally between 300 m and 500 m.

Lithology:
Alternating sandstones and claystones are interbedded with coals and coaly claystones. The claystones are grayish or locally red brown and noncalcareous to very calcareous. The sandstones are grayish, very fine to coarse-grained and predominantly moderately to poorly sorted. The coals in the type well are dark brown to black, vitreous, brittle and locally pyritic.

Basal Stratotype:
The base is defined directly underneath the lowermost coal bed identified on the sonic log. In the type well the resistivity log increases slightly and changes to a somewhat less nervous pattern at the transition into the Åre Formation.

Lateral extent and variation:
The formation is present in all areas drilled in the Haltenbanken – Trænabanken region but seismic data indicate that it is truncated in positive areas such as the Nordland Ridge. The upper part of the formation contains a laterally continuous mudstone interval; this has a generally uniform thickness, but thins slightly to the north.

Age:
Rhaetian to Pliensbachian.

Depositional environment:
Costal plain to delta plain deposits with swamps and channels pass upwards into marginal marine facies. Individual coals can be up to 8 m thick. More proximal lithofacies contain less coal and coarser sandstones. Shallow drilling to the east shows conglomerates which are probably laterally equivalent to the Åre Formation (Bugge et al. 1984).

Correlation:
The formation is partially equivalent to the Statfjord Formation in the North Sea, to the combined upper Fruholmen, Tubåen and Nordmela formations in the Hammerfest Basin and to the Kap Stewart Formation of eastern Greenland. The Åre Formation has a lower sand content than the Statfjord Formation in the northern North Sea.

Tilje Formation (Tiljeformasjonen)

Name:
The Norwegian word for a boat's decking. This unit corresponds to the upper part of the informal Aldra formation (H1–2).

Well type section:
6507/11–1 (Saga Petroleum), coordinates 65°04'43.82"N, 07°29'23.33"E, from 2596 m to 2498 m (Fig. 9). Five cores (33 m recovery) were taken through the upper part of the formation.

Well reference section:
6609/10–1 (Saga Petroleum), coordinates 66°14' 42.27"N, 09°14'59.50"E, from 1733 m to 1642 m (Fig. 10). One core (11.5 m recovery) was taken uppermost in the unit.

Thickness:
98 m in the type well, 91 m in the reference well.

Lithology:
Very fine to coarse-grained sandstones are interbedded with shales and siltstones. The sandstones are commonly moderately sorted with a high clay content and most beds are bioturbated. Shale clasts and coaly plant remains are common. Pure shale beds are rare; most of the finer grained interbeds are silty or sandy.

Fig. 7 TRIASSIC - JURASSIC WELL 6507/12-1

TYPE SECTION BÅT GROUP, TYPE SECTION ÅRE FORMATION
REFERENCE SECTION FANGST GROUP
1:2000

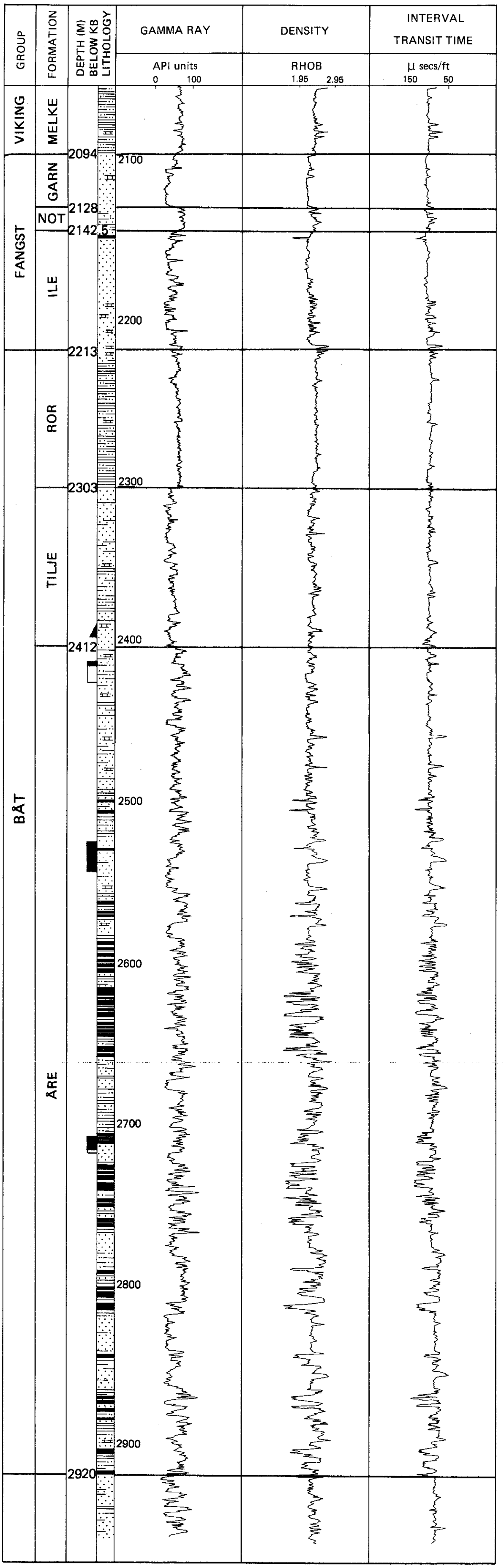


Fig. 8 TRIASSIC - JURASSIC WELL 6407/1-2

REFERENCE SECTION BÅT GROUP

1:2000

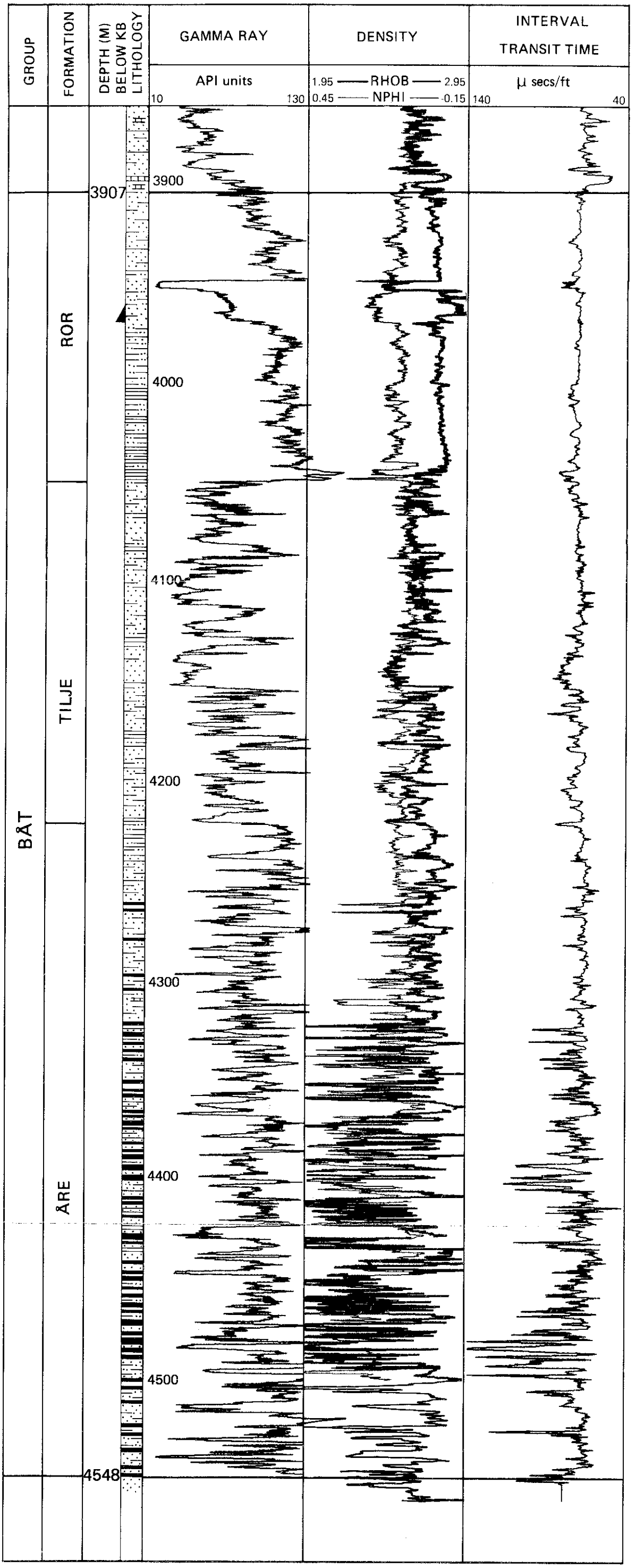
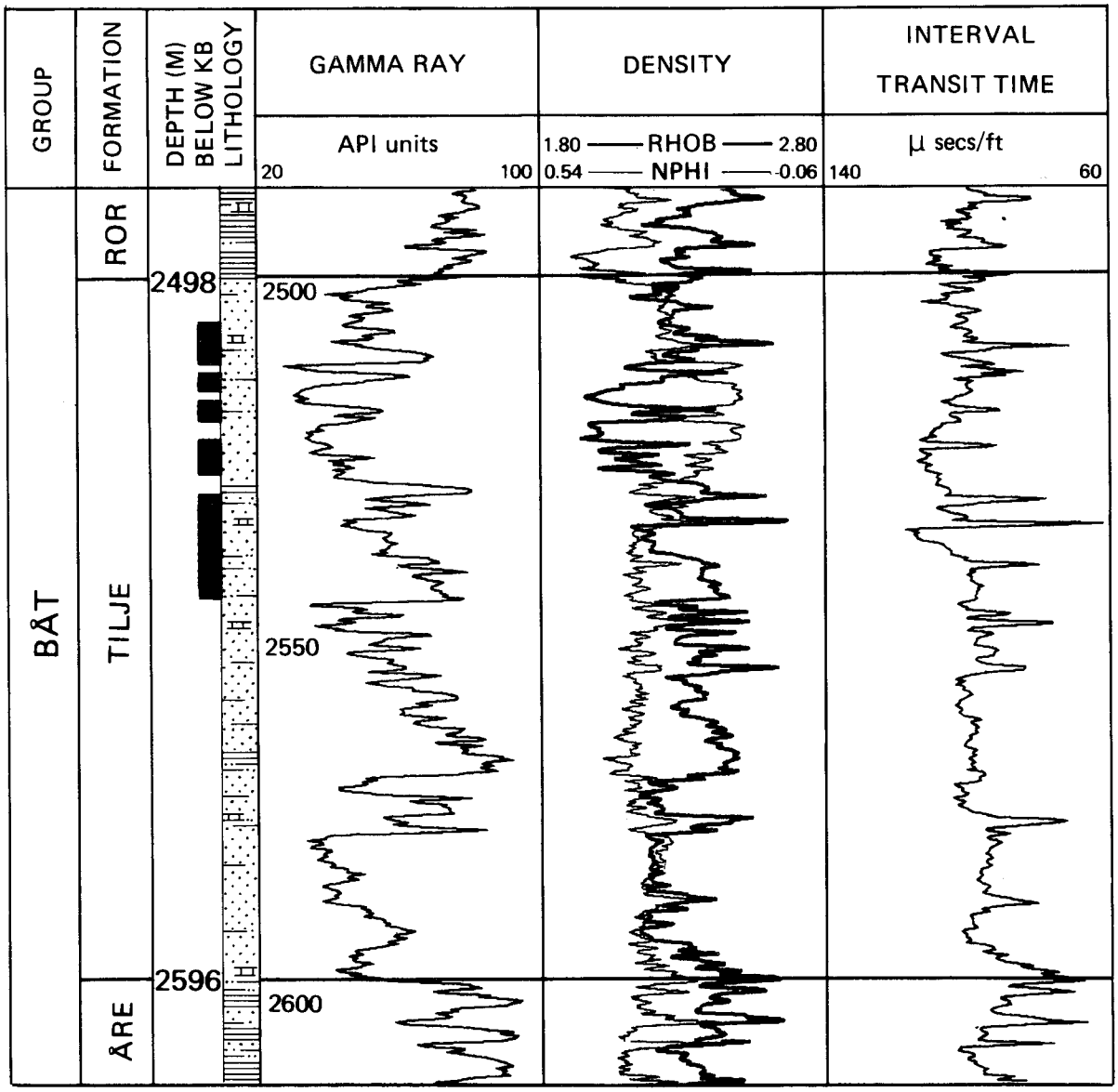


Fig. 9 JURASSIC WELL 6507/11-1

TYPE SECTION TILJE FORMATION

1: 1000



Basal Stratotype:
The base of the Tilje Formation is defined at the top of a mudstone interval recognized in most wells on Haltenbanken. The overlying sequence shows a markedly higher sand content and a greater average thickness of individual sandstone bodies. The gamma ray log shows a shift to generally lower values and a slightly more blocky pattern over the boundary.

The mudstone interval is most pronounced on the Halten Terrace, but is often difficult to pick further east on the Trøndelag Platform. Coal beds are here developed at higher stratigraphic levels than on Halten Terrace, and the top of the highest coal bed is recommended as the formational boundary.

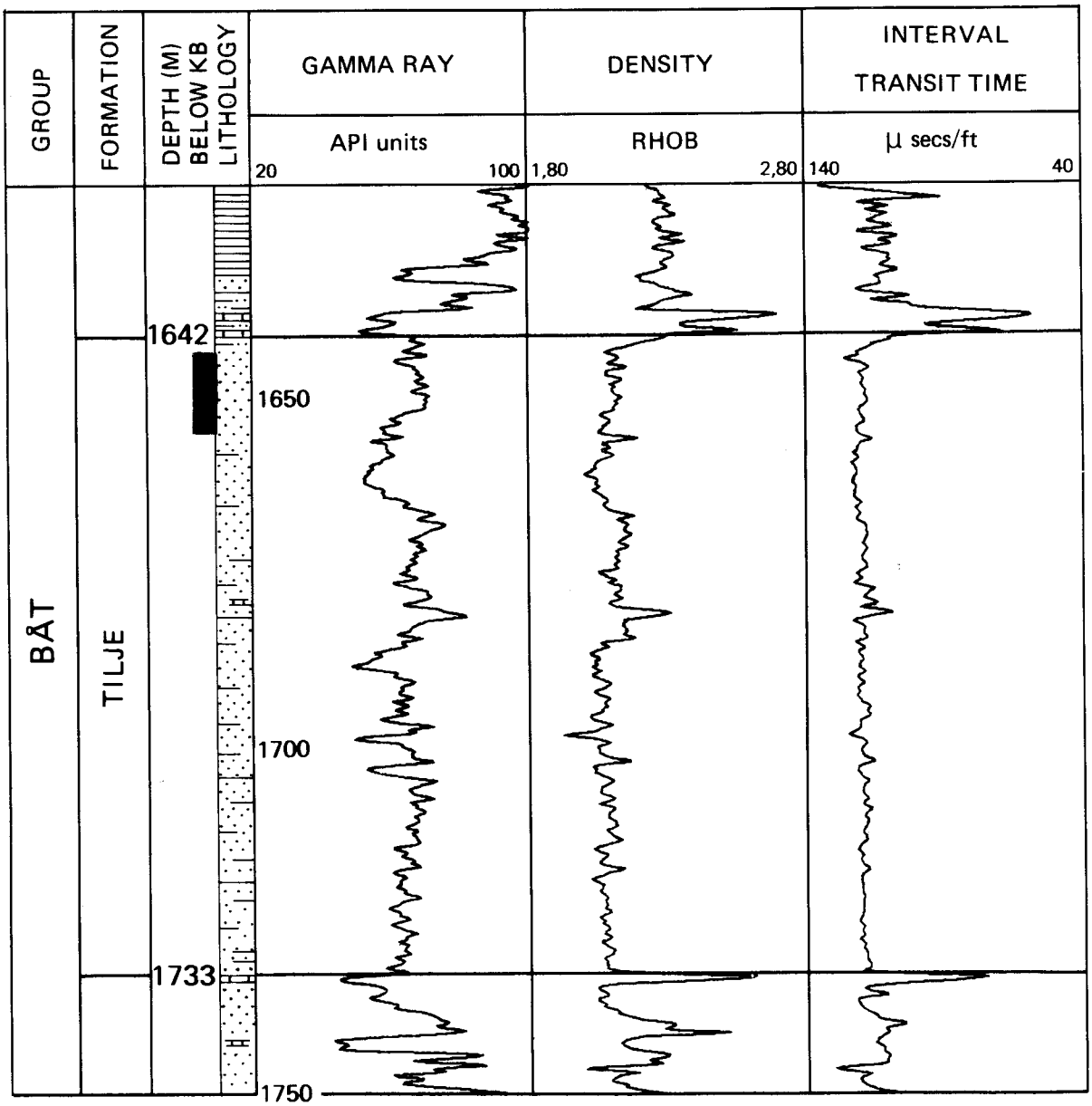
In the reference well from Trænabanken the formational base is taken at an upward shift in the gamma ray log from relatively irregular, high amplitude variations to more uniform, low amplitude and generally lower readings. Limestone interbeds are common below the boundary and much less frequent above in this area.

Lateral extent and variation:
The formation is present both on Haltenbanken and Trænabanken, although it is locally

Fig. 10 JURASSIC WELL 6609/10-1

REFERENCE SECTION TILJE FORMATION

1: 1000



absent on the Nordland Ridge due to erosion. The formation is uniformly developed throughout the Halten Terrace where it is from 100 m to 150 m thick, but it thins northeastwards to less than 100 m on the Trøndelag Platform. Shallow drilling close to the coast (Bugge *et al.* 1984) indicates time equivalent deposits dominated by coarse-grained clastics.

Age:
Sinemurian to Pliensbachian.

Depositional environment:
Nearshore marine to intertidal environments are typical of the formation. Subcrops near the coast (Bugge *et al.* 1984) indicate a gradual transition to continental environments eastwards.

Correlation:
The Tilje Formation is comparable in age and lithology to the Neill Klinter Formation of East Greenland and to the lower part of the Stø Formation in the Hammerfest Basin.

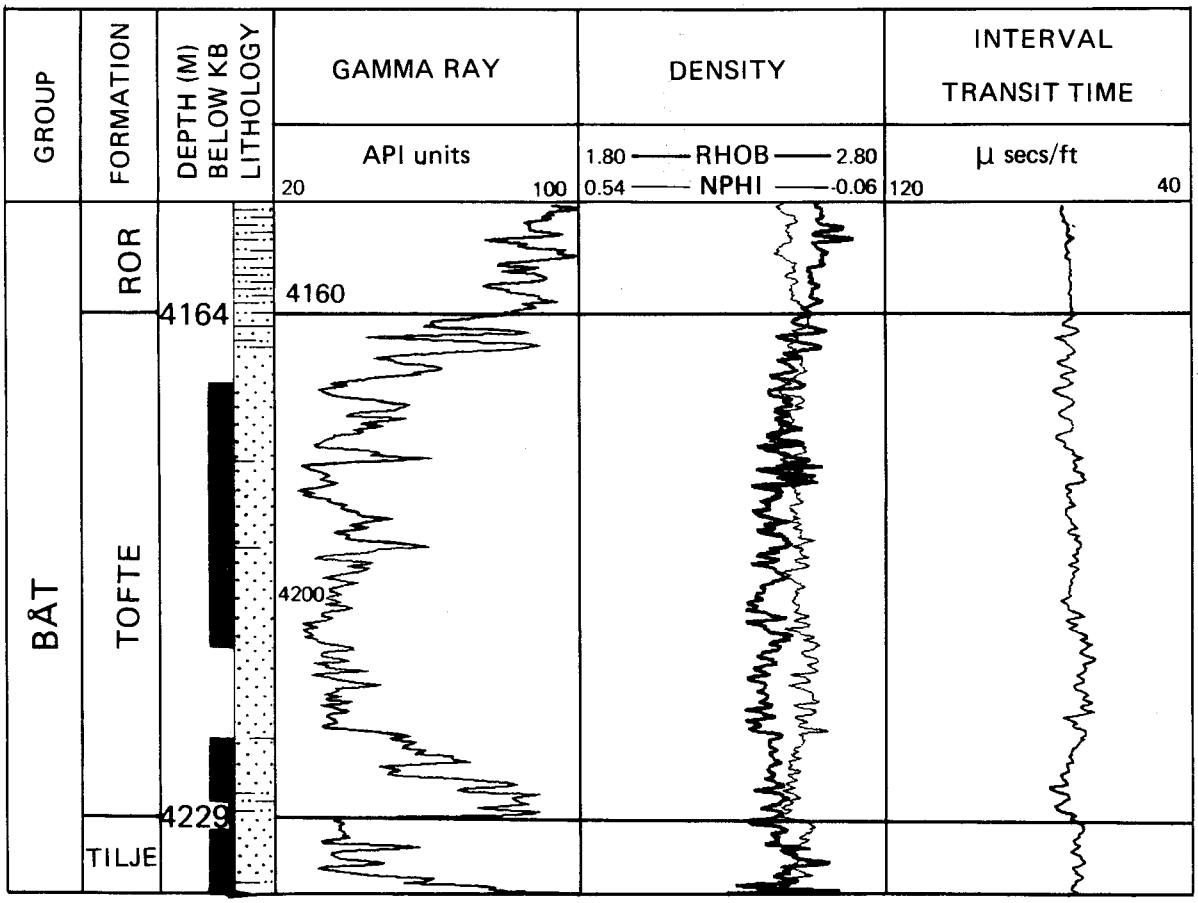
Tofte Formation (Tofteformasjonen)

Name:
Norwegian word for thwart. The unit has informally been called the Leka sandstone (within H1–3).

Fig 11 JURASSIC WELL 6506/12-1

TYPE SECTION TOFTE FORMATION

1:1000



Well type section:
6506/12–1 (Statoil), coordinates 65°10′07.58″N, 06°43′44.07″E, from 4229 m to 4164 m (Fig. 11). Three cores (41 m recovery), including the base and middle part of the unit.

Well reference section:
6407/4–1 (Statoil), coordinates 64°35′45.36″N, 07°08′42.17″E, from 4208,5 m to 4150 m (Fig. 12). Approximately 40 m of the section belongs to the Tofte Formation, the rest comprises fine-grained deposits of the interfingering Ror Formation.

Thickness:
65 m in the type well, approximately 40 m in the reference well. The formation thins rapidly eastwards across the Halten Terrace.

Lithology:
The Tofte Formation consists of moderately to poorly sorted coarse-grained sandstones which often show large-scale cross bedding. In the type section the quartz content is generally higher than 90%, although the sediment is texturally immature. Bioturbation occurs throughout the cored intervals, especially in zones of very poor sorting and high clay content.

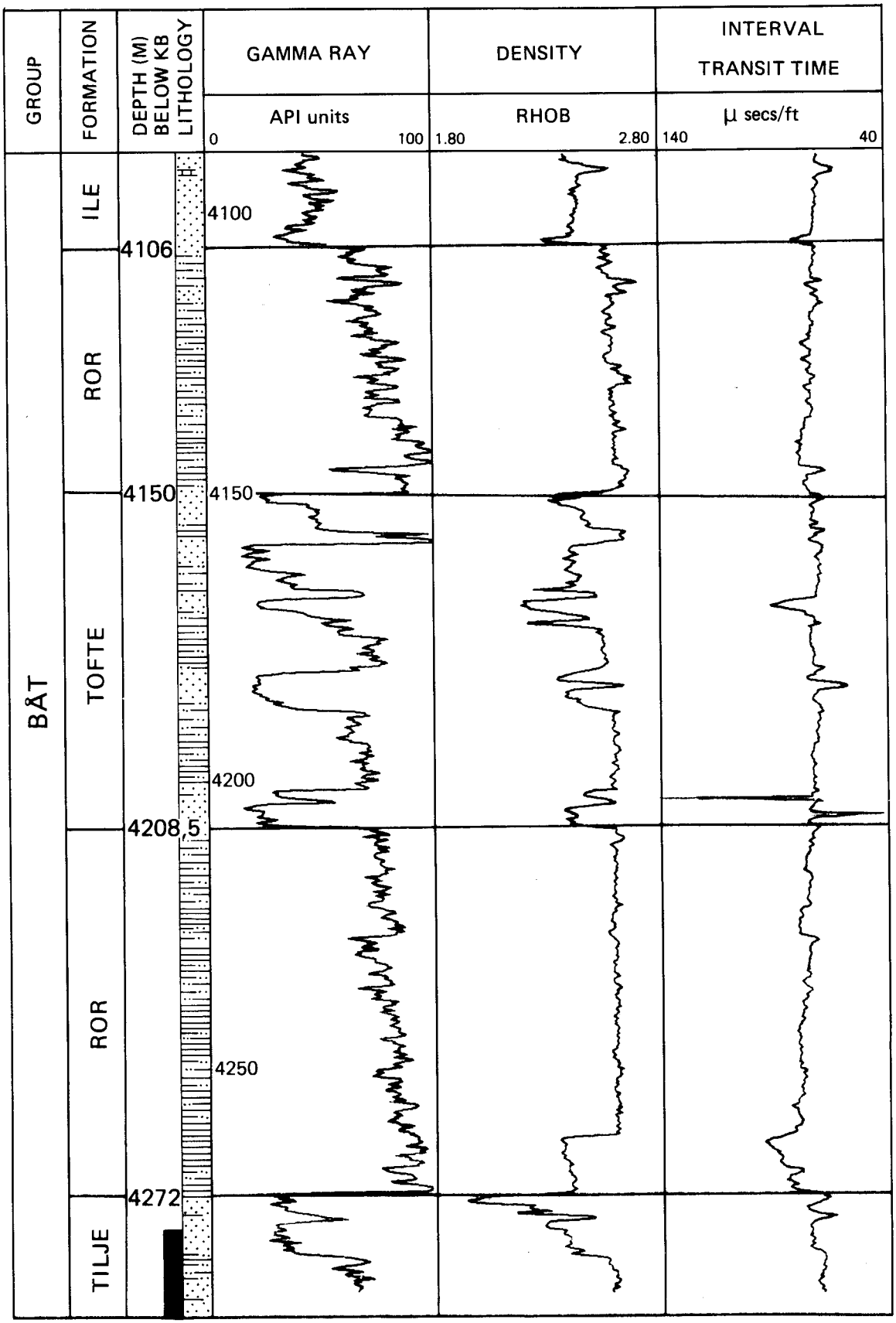
Basal Stratotype:
In the type well the lower boundary of the Tofte Formation occurs at the base of an upwards coarsening sequence. Fine-grained heavily bioturbated sandstones rest on medium-grained sandstones of the Tilje Formation and the gamma ray log shows a marked increase. In wells further to the south and east the Tofte Formation overlies mudstones and shales of the Ror Formation. The transition is there associated with a marked decrease in gamma ray response.

Lateral extent and variation
The Tofte Formation is only recognized on the western part of Halten Terrace, where it consists of a continuous succession of coarse-grained sandstones. The sandstones wedge out eastwards and interfinger with the Ror Formation. Reference well 6407/4–1 (Fig. 12) shows a relatively distal development of the formation where lateral interfingering occurs.

Fig 12 JURASSIC WELL 6407/4-1

REFERENCE SECTION TOFTE AND ROR FORMATIONS

1:1000



Age:
Pliensbachian to Toarcian.

Depositional environment:
The sandstones were deposited by eastwards prograding fan deltas which reflect tectonic uplift to the west.

Correlation:
No known time-equivalent lithostratigraphic units in surrounding areas are similar to the Tofte Formation.

Ror Formation (Rorformasjonen)

Name:
Norwegian word for rudder or helm. The previous informal unit was the Leka formation (H1–3).

Fig 13 JURASSIC WELL 6407/2-1

TYPE SECTION ROR FORMATION

1: 1000

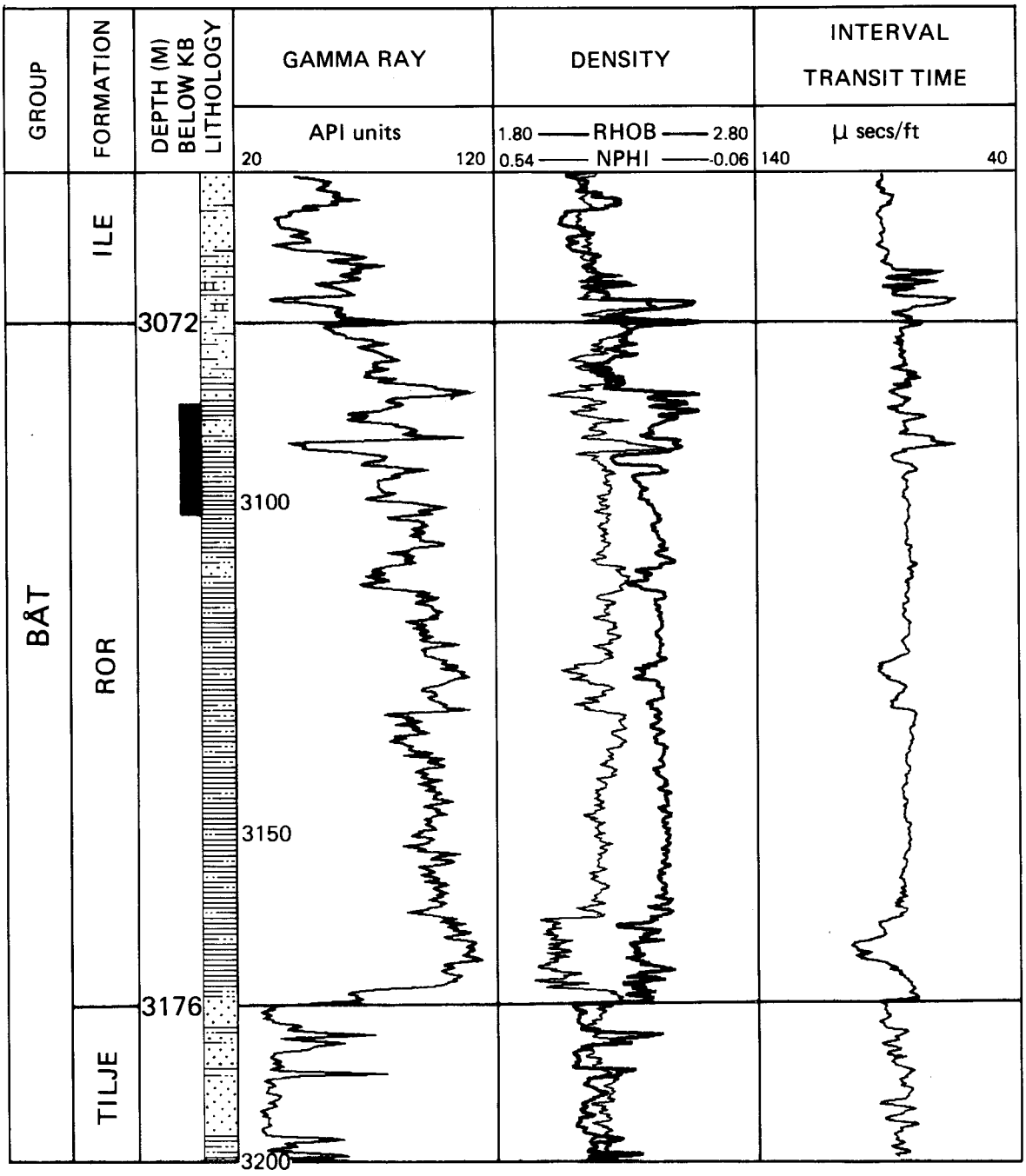
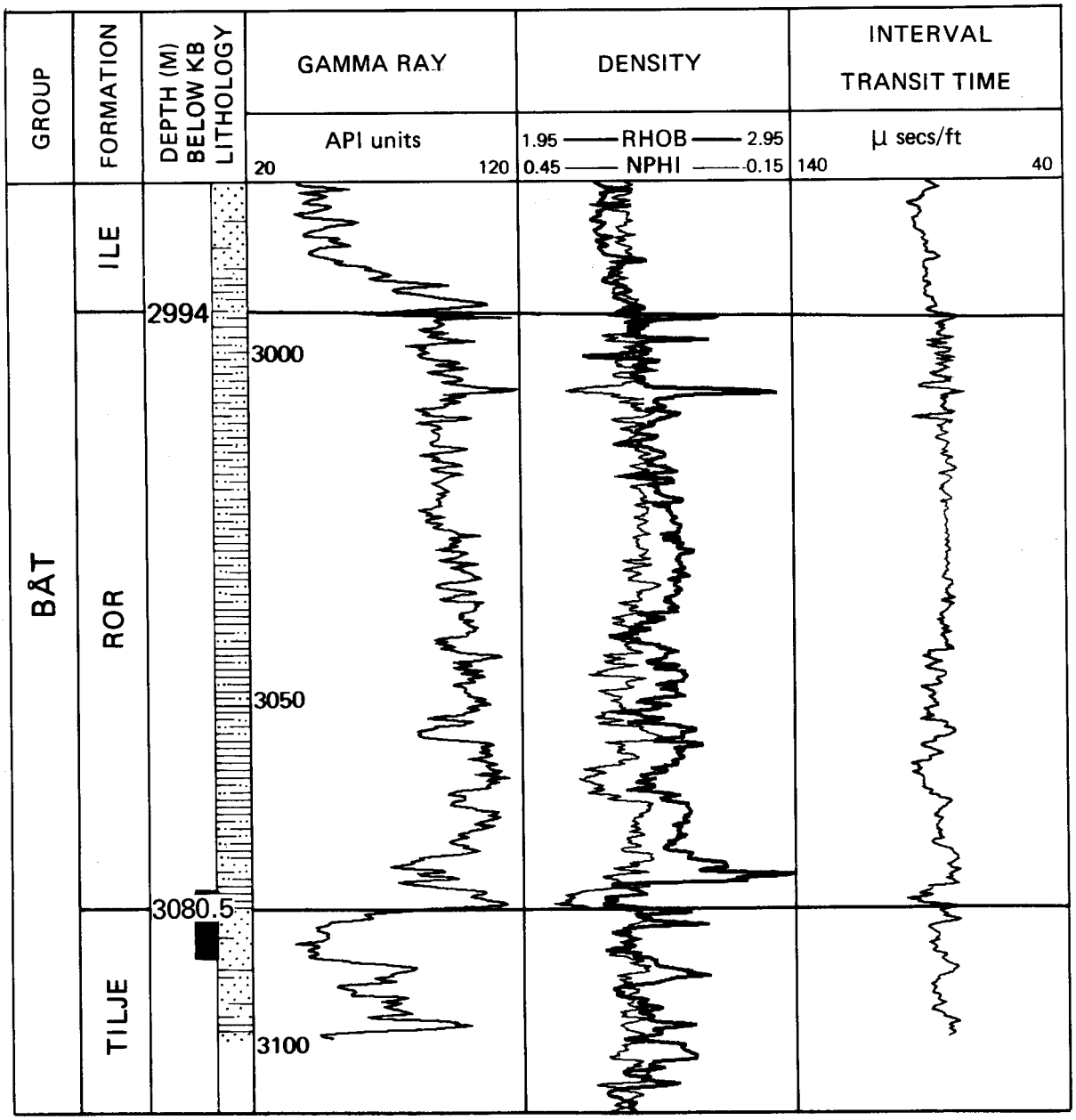


Fig 14 JURASSIC WELL 6507/10-1

REFERENCE SECTION ROR FORMATION

1: 1000



Well type section:
6407/2–1 (Saga Petroleum), coordinates 64°58′04.97″N, 07°28′28.11″E, from 3176 m to 3072 m (Fig. 13). One core (14.5 m recovery), from the upper parts of the formation.

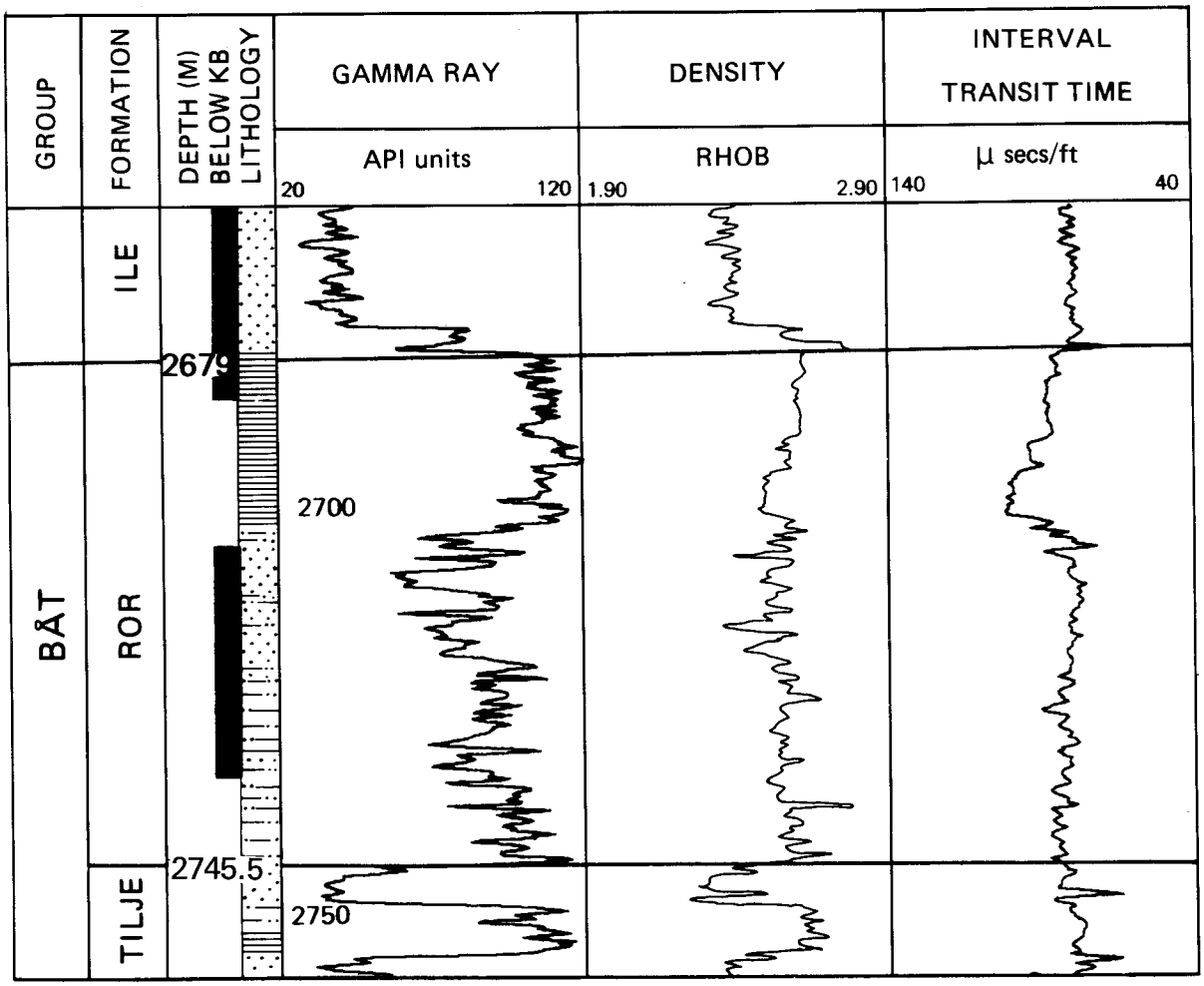
Well reference section:
6507/10–1 (BP), coordinates 65°13′10.75″N, 07°14′00.47″E from 3080.5 m to 2994 m (Fig. 14). One core covers the base and 3.5 m of the lower part of the unit. 6407/4–1 (Statoil), coordinates 64°35′45.36″N, 07°08′42.17″E, from 4272 m to 4106 m (Fig. 12). The section includes approximately 40 m of interbedded Tofte Formation. 6610/7–1 (Statoil), coordinates 66°17′32.82″N, 10°16′52.92″E, from 2745.5 m to 2679 m, (Fig. 15). Two cores, 28 m recovery, cover both the middle and upper parts of the unit.

Thickness:
104 m in the type well, from 66.5 m to 160.5 m in the reference wells.

Fig 15 JURASSIC WELL 6610/7-1

REFERENCE SECTION ROR FORMATION

1: 1000



Lithology:
Dominant grey to dark grey mudstones contain interbedded silty and sandy coarsening upwards sequences, commonly a few metres thick. Such sequences become more frequent towards the top of the formation, giving the unit an overall coarsening upwards trend over most of Haltenbanken.

Basal Stratotype:
The base is defined by the abrupt transition from sandstones of the Tilje Formation into mudstone. The break is well defined in most Haltenbanken wells and is easily picked on the gamma log. Well correlation indicates an erosional contact, at least in parts of the area.

In the northwesternmost Haltenbanken wells (e.g. 6506/12–1, Fig. 11) the Tofte Formation rests directly on the Tilje Formation, with no fine-grained succession in between. The mudstones overlying the Tofte Formation there are equivalent to the upper part of the Ror Formation in its type area.

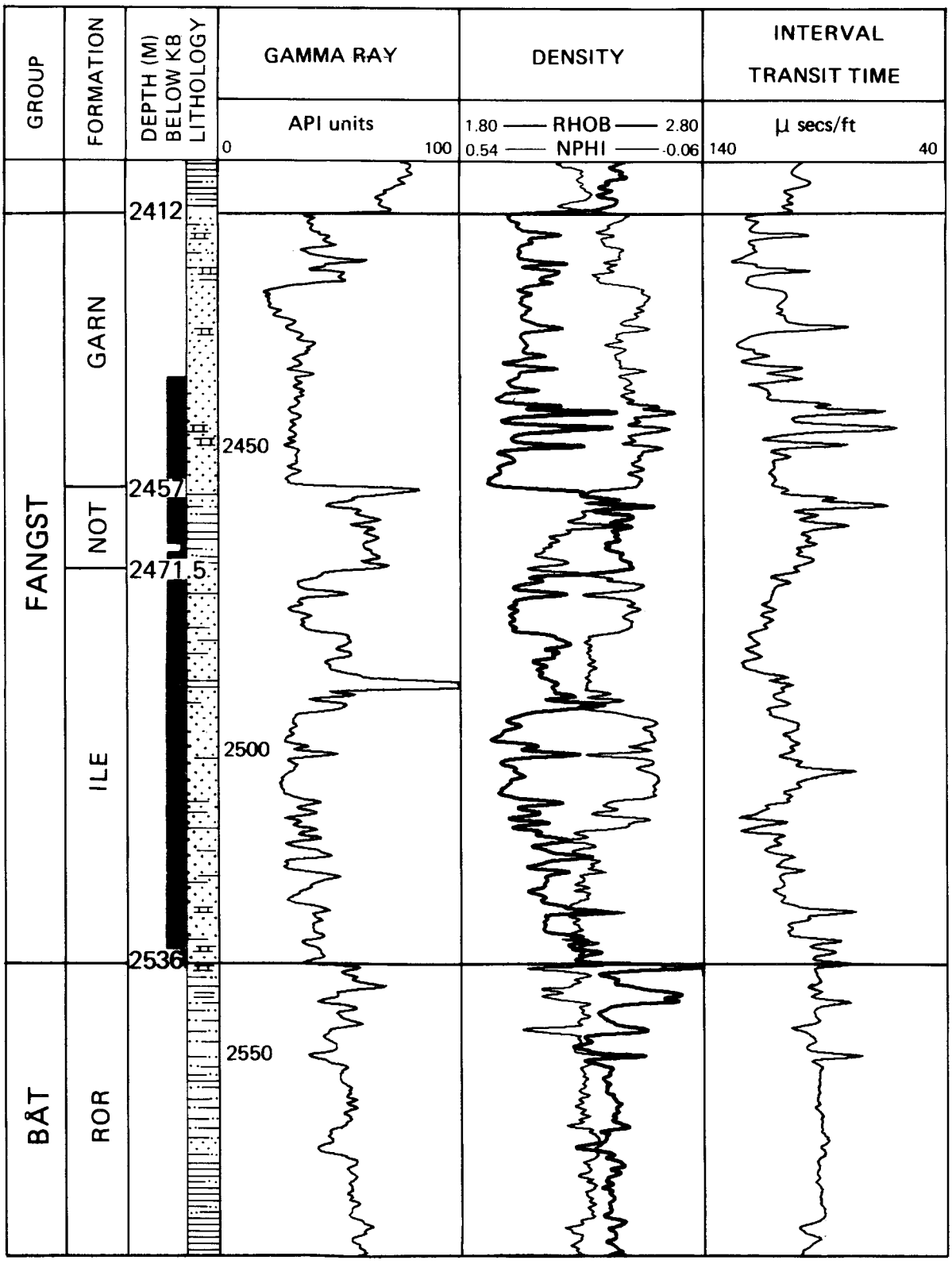
Lateral extent and variation:
The formation is present in all wells on Haltenbanken, where it varies from 70 m to 170 m thick – generally thinning to the northeast. To the west it interfingers with sandstones of the Tofte Formation (Fig. 12), and the oldest part of the Ror Formation is often absent. The Ror Formation is also present in some Trænabanken wells (e.g. Fig. 15), but has been removed by erosion over large areas of the Nordland Ridge.

Age:
Pliensbachian to Toarcian.

Depositional environment:
The formation was deposited in open shelf environments, mainly below wave base. The coarsening upwards trend reflects ongoing shallowing and storm-generated sands are common in the unit's upper part. Sand input from the west indicates synsedimentary tectonic uplift along the western margins of the basin.

Fig 16 JURASSIC WELL 6507/11-3

TYPE SECTION ILE AND NOT FORMATIONS,
FANGST GROUP
1:1000



Fangst Group (Fangstgruppen)

Name:
Norwegian name for catch. Previous informal name was the Tomma formation (H1–4).

Type area:
The Halten Terrace. The group's development is illustrated by the type section of its basal unit in well 6507/11–3 (Saga Petroleum), coordinates 65°01′59.8″N, 07°30′42.34″E, from 2536 m to 2412 m (Fig. 16). Reference wells for the group are 6407/1–2 (Statoil), coordinates 64°47′50.61″N, 07°02′23.76″E, from 3907 m to 3658.5 m (Fig. 17), and 6507/12–1 (Saga Petroleum), coordinates 65°07′01.62″N, 07°42′42.61″E, from 2213 m to 2094 m (Fig. 18).

Fig 17 JURASSIC WELL 6407/1-2

REFERENCE SECTION FANGST GROUP

1:2000

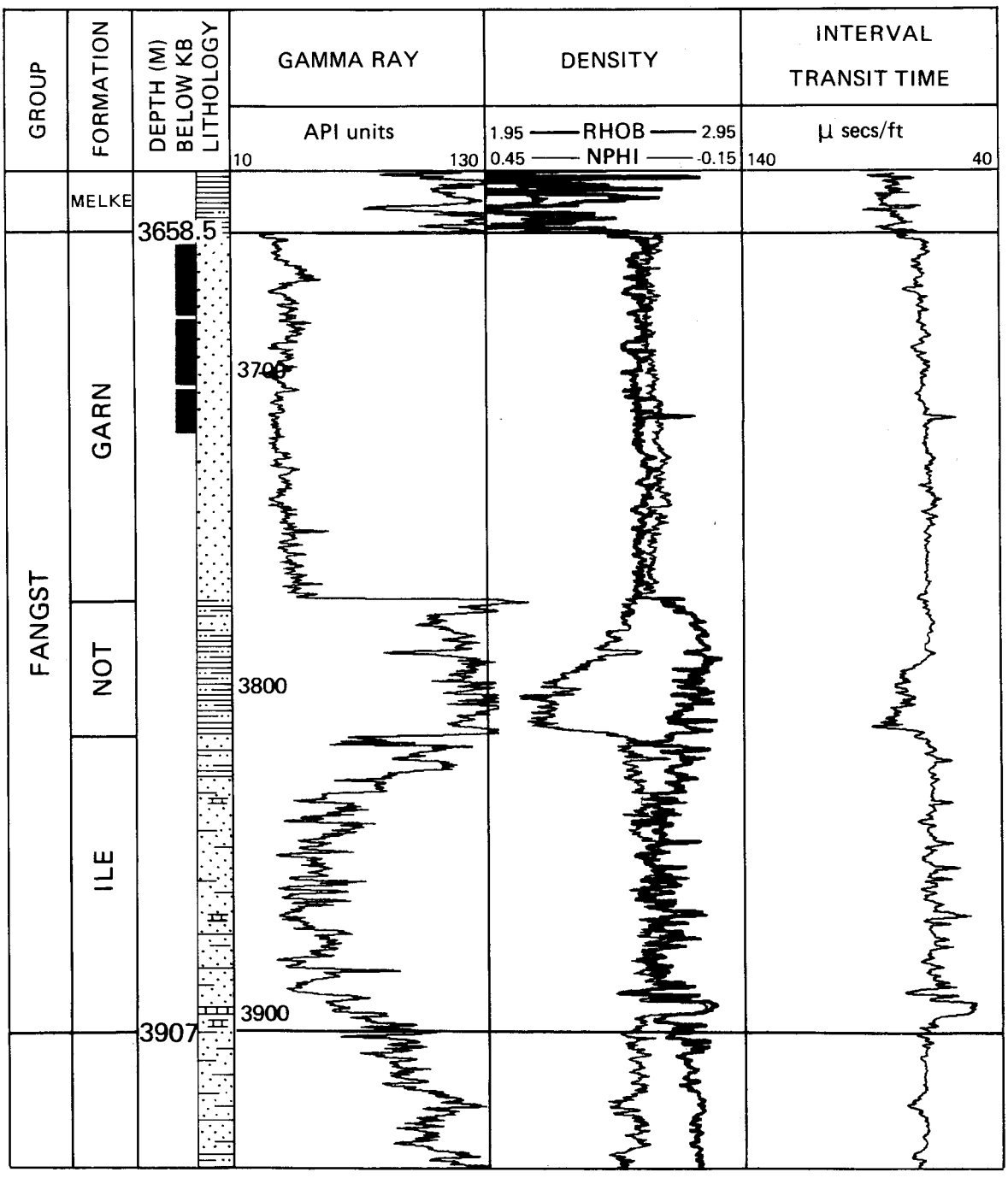
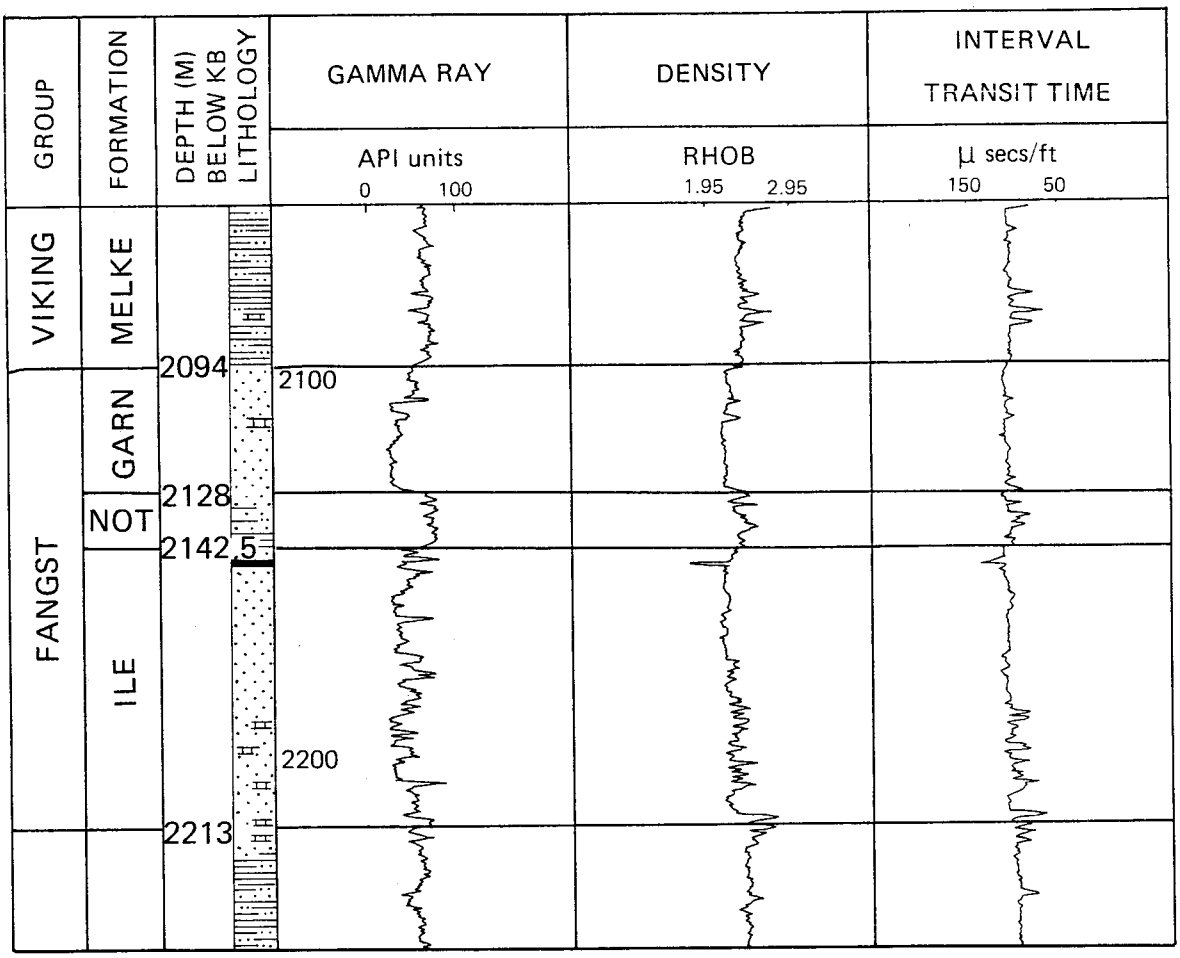


Fig 18 JURASSIC WELL 6507/12-1

REFERENCE SECTION FANGST GROUP
1:2000



Lithology:
The Fangst Group typically comprises three lithological units: a lower fine to medium-grained sandstone with numerous shaly interbeds, a middle mudstone, and an upper relatively massive fine to coarse-grained sandstone. Each of these units are defined as formations herein.

Basal Stratotype:
The base of the group is defined by the base of the Ile Formation as described below.

Lateral extent and variation:
The Fangst Group is represented in most of the Trænabanken – Haltenbanken area except on the highest parts of the Nordland Ridge where its constituent units have been eroded. Time-equivalent sandstone-dominated sequences subcrop on the sea-floor along the inner part of the Trøndelag Platform (Bugge *et al.* 1984) and outliers of Middle Jurassic sediments are present east of the Froan islands and beneath Beitstadfjorden in Trøndelag. The latter probably represent a continental facies equivalent to the dominantly marine Fangst Group.

Along the southern margin of the Nordland Ridge (e.g. the Heidrun Field) the succession is much thinner than on Halten Terrace and the threefold lithologic division is not so obvious. Further north the Trænabanken wells show a lateral facies change to marine mudstone of the Viking Group and only the lower unit of the Fangst Group (the Ile Formation) is recognized.

Age:
Late Toarcian to Bathonian.

Depositional environment:
Shallow marine to coastal/deltaic facies dominate sequences on the Halten Terrace. Increasing continental influence is inferred towards the Trøndelag Platform to the east, especially in the lower part of the group. Upper parts interfinger with marine shales to the northeast in the Trænabanken area.

Correlation:
The Fangst Group corresponds generally to the Brent Group in the North Sea and to the

Stø Formation on Tromsøflaket. However, the basal part of Stø Formation is older and the base of the Brent Group is slightly younger than the Fangst Group.

Subdivision:
Although three formations are described herein it is clear that increasing knowledge will lead to the establishment of a more varied framework to reflect the lateral facies changes seen in the area.

Ile Formation (Ileformasjonen)

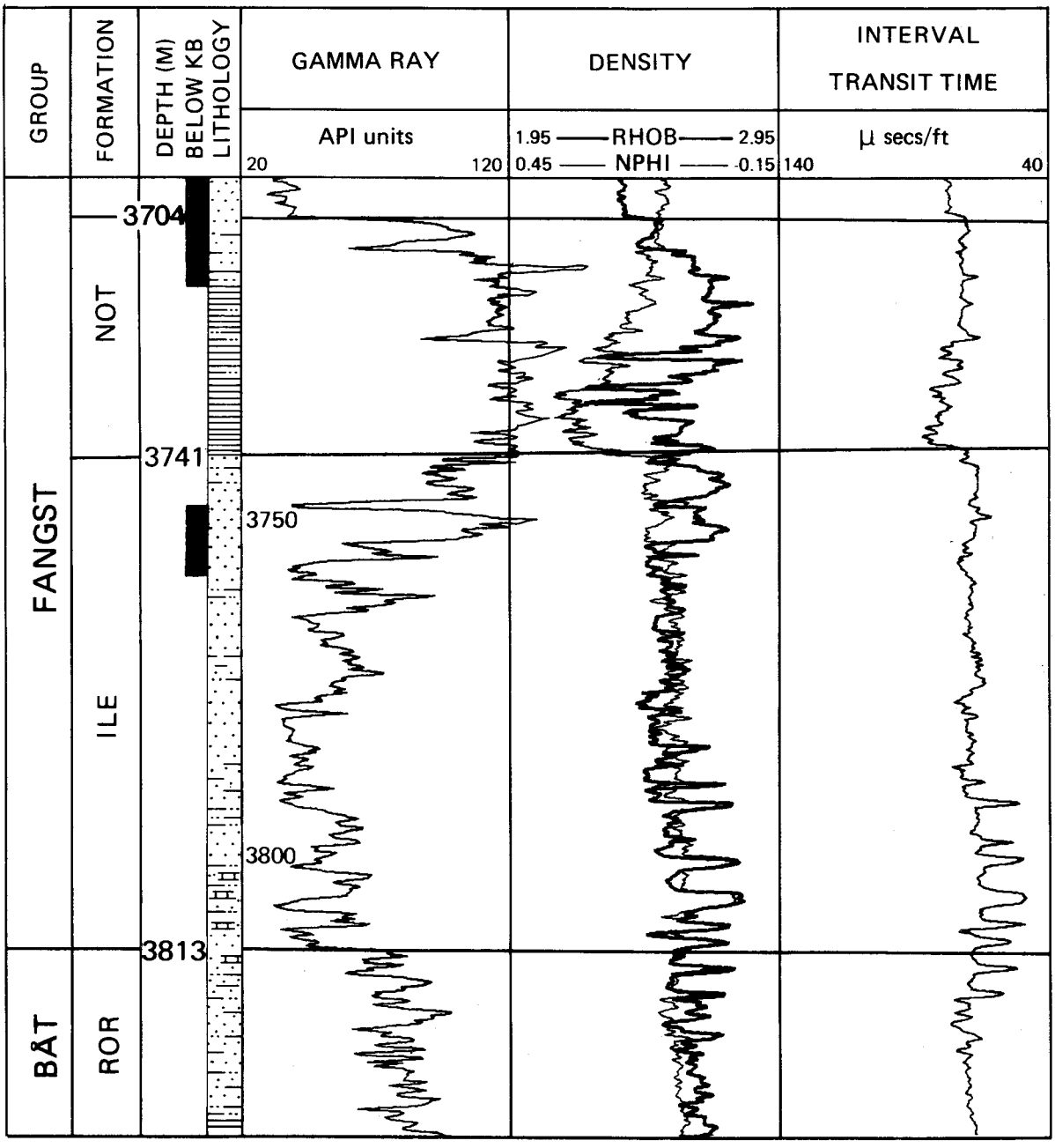
Name:
From the Norwegian word for a stone sinker or a drag. The unit corresponds to the lower part of the informal Tomma formation (H1–4) or "Tomma III".

Well type section:
Well 6507/11-3 (Saga Petroleum), coordinates 65°01'59.8"N, 07°30'42.34"E, from 2536 m to 2471.5 m (Fig. 16). The entire formation is cored except for the basal 2 m.

Fig 19 JURASSIC WELL 6407/1-3

REFERENCE SECTION ILE AND NOT FORMATIONS

1: 1000



Well reference section:
Well 6407/1–3 (Statoil), coordinates 64°52′25.48″N, 07°02′53.47″E, from 3813 m to 3741 m (Fig. 19). One core (10 m recovery), from the upper part of the unit.

Thickness:
64.5 m in the type well and 72 m in the reference well.

Lithology:
Fine to medium and occasionally coarse-grained sandstones with varying sorting are interbedded with thinly laminated siltstones and shales. Mica-rich intervals are common. Thin carbonate-cemented stringers occur, particularly in the lower parts of the unit.

Basal Stratotype:
The lower boundary is defined at the base of a generally upwards coarsening sequence visible on the gamma ray log. In wells where this coarsening trend is not evident on logs, the base of the formation may be picked where the overall lithology changes from siltstone to sandstone. Often this transition is associated of one or more carbonate-rich beds.

Age:
Late Toarcian to Aalenian.

Depositional environment:
The formation represents various tidal-influenced delta or coastline settings.

Lateral extent and variation:
The Ile Formation generally varies from 50 m to 100 m over most of Haltenbanken, with a general thickening to the west and a marked thinning to the northeast. It is also encountered in wells on Trænabanken. Sandstone-dominated successions of similar age have been located by sea bottom sampling and shallow drilling on the eastern part of the Trøndelag Platform. (Bugge et al. 1984).

Correlation:
No distinct comparable time equivalent formations are known from the North Sea area. In the Hammerfest Basin the middle part of the Stø Formation may be correlated to the Ile Formation.

Not Formation (Notformasjonen)

Name:
From the Norwegian word for a sweep net. The unit corresponds to the middle part of the informal Tomma formation (H1–4), or "Tomma II".

Well type section:
Well 6507/11–3 (Saga Petroleum), coordinates 65°01′59.8″N, 07°30′42.34″E, from 2471.5 m to 2457 m (Fig. 16). The entire unit is cored, including the base.

Well reference section:
Well 6407/1–3 (Statoil), coordinates 64°52′25.48″N, 07°02′53.47″E, from 3741 m to 3704 m (Fig. 20). One core, 10 m recovery, including the top.

Thickness:
14.5 m in the type well and 37 m in the reference well.

Lithology:
Claystones with micronodular pyrite coarsen upwards into bioturbated fine-grained sandstones which are locally micra-rich and carbonate cemented.

Basal Stratotype:
The lower boundary is defined by an abrupt increase to a steady high gamma ray response. In the type well this occurs immediately above a thin matrix-supported conglomerate.

Age:
Aalenian to Bajocian.

Depositional environment:
The basal part of the formation reflects a semi-regional transgression which led to the development of lagoons or sheltered bays. The upper part of the unit consists of prograding deltaic or coastal front sediments.

Lateral extent and variation:
The formation is recognized over the entire Haltenbanken area, if not eroded. The thickest development (<50 m) is seen on the southwestern part of the Halten Terrace and the unit generally thins eastwards on the Trøndelag Platform. On Trænabanken a time equivalent succession dominated by mudstone is assigned to the Viking Group.

Correlation:
In the Hammerfest Basin the middle part of the Stø Formation is thought to correlate with the Not Formation. No similar unit is recognized in the North Sea.

Garn Formation (Garnformasjonen)

Name:
From the Norwegian word for a net. The unit corresponds to the upper part of the Tomma formation (H1–4) of informal usage, or "Tomma I".

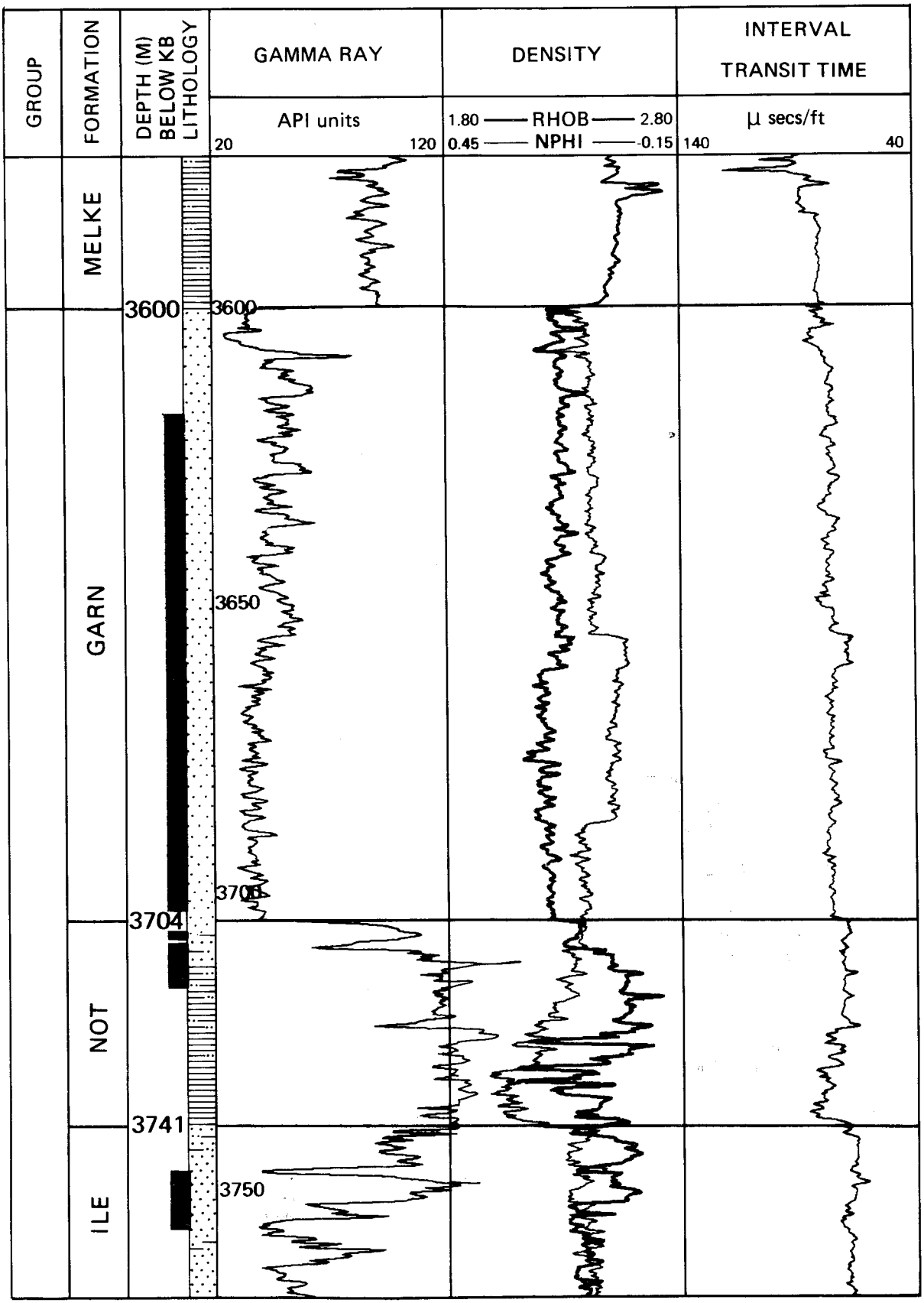
Well type section:
Well 6407/1–3 (Statoil), coordinates 64°52′25.48″N, 07°02′53.47″E, from 3704 m to 3600 m (Fig. 20). The lower 84 m of the unit are cored, including the base.

Well reference section:
Well 6507/11–3 (Saga Petroleum), coordinates 65°01′59.8″N, 07°30′42.34″E, from 2457 m to 2412 m (Fig. 16). The lower 29 m of the unit are cored, including the base.

Fig 20 JURASSIC WELL 6407/1-3

TYPE SECTION GARN FM. - REFERENCE SECTION NOT FM.

1:1000



Thickness:
104 m in the type well and 45 m in the reference well.

Lithology:
The Garn Formation consists of medium to coarse-grained, moderately to well-sorted sandstones. Mica-rich zones are present. The sandstone is occasionally carbonate-cemented.

Basal Stratotype:
The lower boundary is defined by a drop in gamma ray response. In the type well this coincides with an erosional contact at the base of a thin conglomerate.

Age:
Bajocian to Bathonian.

Depositional environment:
The Garn Formation may represent progradations of braided delta lobes. Delta top and delta front facies with active fluvial and wave-influenced processes are recognized.

Lateral extent and variation:
The Garn Formation is encountered across most of Haltenbanken. It may be over 100 m thick on the Halten Terrace, but in structurally high positions the entire unit may be eroded. In the Trænabanken area shaly sediments are lateral equivalents of the Garn Formation sandstones.

Correlation:
The Garn Formation is time equivalent to parts of the Brent Group in the North Sea, to the lower part of the Vardekløft Formation in East Greenland and to the upper part of the Stø Formation in the Hammerfest Basin.

Subdivision:
The formation is not subdivided at present although two different units may be identified in the western part of Haltenbanken.

Viking Group (Vikinggruppen)

Name:
Named by Vollset and Doré (1984) in the northern North Sea. Present usage on Haltenbanken corresponds to the informal Grip group (H2).

Type area:
The type area is the northern North Sea, north of 58°N and east of the East Shetland Platform boundary fault. In this report the following wells are used to illustrate the local development of the Viking Group: 6506/12–4 (Statoil), coordinates 65°12′46.97″N, 06°43′30.37″E, from 3979.5 m to 3855 m (Fig. 21) and 6407/9–1 (Shell), coordinates 64°21′55.39″N, 07°47′21.76″E, from 1673 m to 1612 m (Fig. 22).

Thickness:
124,5 m in well 6506/12–4 and 65 m in 6407/9–1. Thicknesses of up to 1000 metres are indicated by seismic data in restricted down-faulted areas.

Lithology:
The Viking Group is totally dominated by shales and mudstones on Haltenbanken. Thin beds of carbonate and scattered sandstone stringers are minor constituents. Only in the Draugen Field area is sandstone a significant component.

Lateral extent and variation:
The Viking Group is present in most wells on Haltenbanken and Trænabanken, but with only a thin partial development on the Nordland Ridge. The group extends to the basin margin on the eastern part of the Trøndelag Platform where it has been sampled just beneath the sea-floor at several locations (Bugge *et al.* 1984, Aarhus *et al.* 1986).

Age:
Bajocian-Ryazanian.

Depositional environment:
Marine, mainly below wave base on Haltenbanken.

Subdivision:
The Viking Group contains three formations, the Melke, Spekk and Rogn formations (Figs 21 and 22), all of which are formally described in this paper.

Melke Formation (Melkeformasjonen)

Name:
The Norwegian word for milt or soft roe. This unit corresponds to the informal Engelvær formation (H2–1).

Well type section:
6506/12–4 (Statoil), coordinates 65°12′46.97″N, 06°43′30.37″E, from 3979.5 m to 3863 m (Fig. 21). One core, 8 m recovery, including formational base.

Well reference section:
6407/2–2 (Saga Petroleum), coordinates 64°59′39.64″N, 07°31′53.08″E, from 2461 to 2417 m, (Fig. 23). One core, 2 m recovery, including the base.

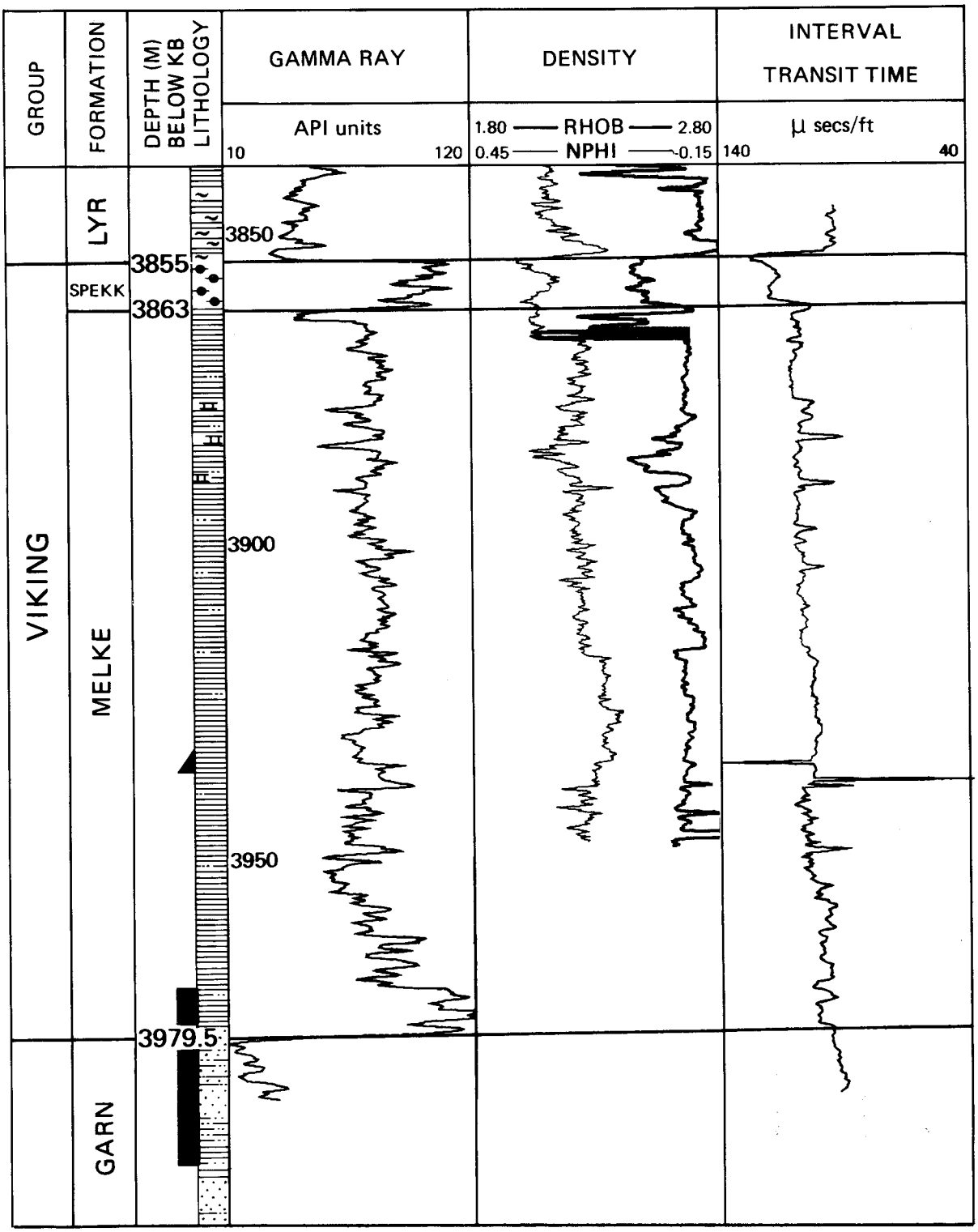
Thickness:
116.5 m in the type well, 44 m in the reference well.

Lithology:
Dominantly claystone, with siltstone and limestone interbeds and stringers of sandstone. The claystone is dark grey to dark brown and slightly calcareous.

Fig 21 JURASSIC WELL 6506/12-4

TYPE SECTION MELKE FORMATION
REFERENCE SECTION VIKING GROUP

1: 1000

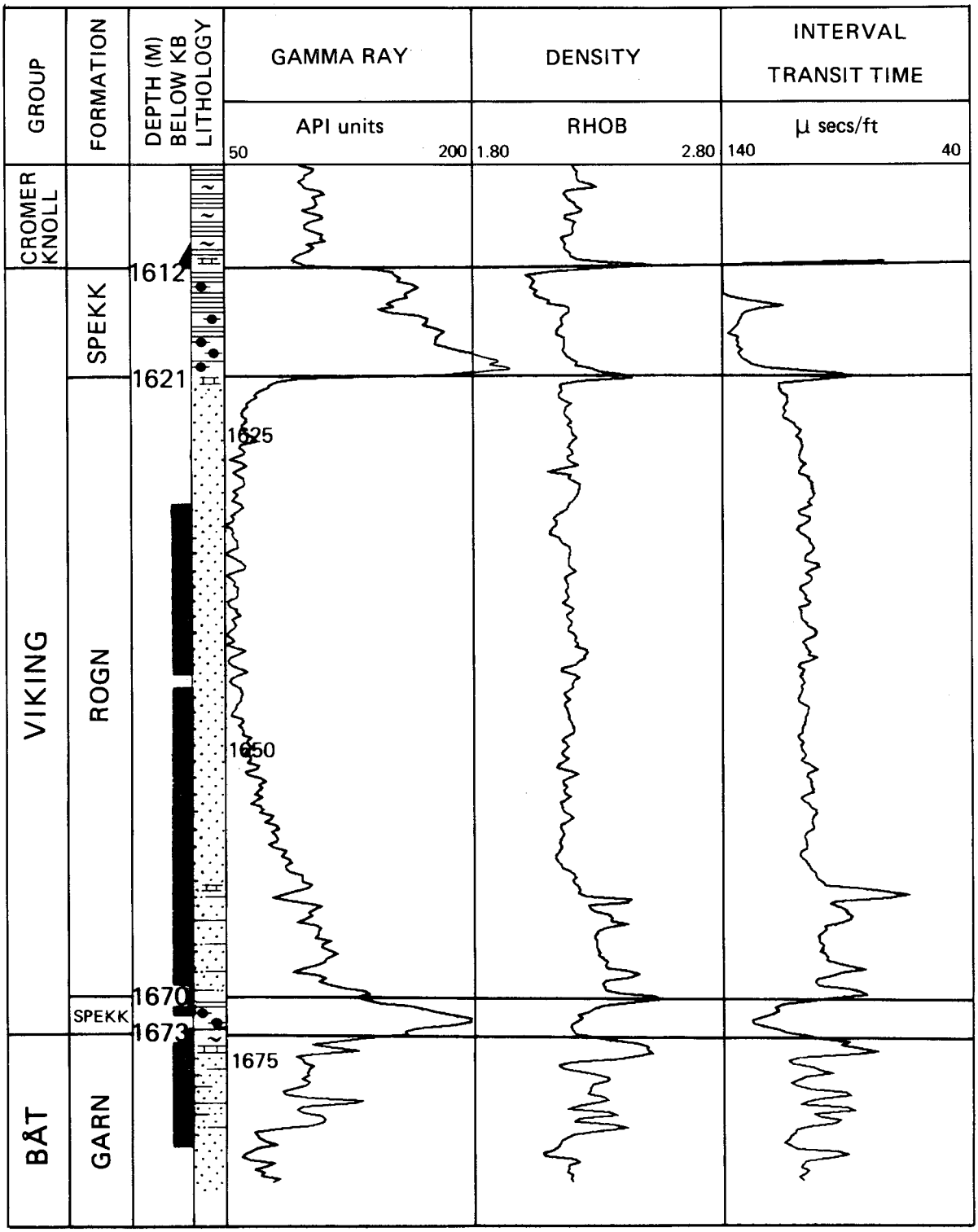


Basal Stratotype:
The base is defined by a sharply increasing gamma ray response at the contact between the underlying sandstones of the Garn Formation and the claystones of the Melke Formation.

Fig 22 JURASSIC - CRETACEOUS WELL 6407/9-1

TYPE SECTION ROGN FM. -
REFERENCE SECTIONS VIKING GROUP AND SPEKK FM.

1: 500



Lateral extent and variation:
The formation was deposited throughout the Haltenbanken-Trænabanken area and is locally absent on structural highs. The formation may attain thicknesses of several hundred metres in down-flank basinal situations. The formation also shows lateral variation in lithology, being more silty or having more fre-

quent limestone beds in some areas. Deposition of the unit's mudstones commenced earlier on Trænabanken than elsewhere (Fig. 6).

The unit subcrops beneath the Quaternary on the eastern part of the Trøndelag Platform as evidenced by several shallow cores (Bugge *et al.* 1984).

Age:
Bajocian to Oxfordian.

Depositional environment:
The Melke Formation was deposited in an open marine environment.

Correlation:
The Melke Formation is comparable to the Heather Formation of the North Sea. The upper parts of the Melke Formation are time equivalent to the Fuglen Formation in the Hammerfest Basin.

Rogn Formation (Rognformasjonen)

Name:
The Norwegian word for spawn or hard roe. The formation corresponds to the informally used Frøya formation.

Well type section:
6407/9–1 (Shell), coordinates 64°21′55.39″N, 07°47′21.76″E, from 1670 m to 1621 m (Fig. 22). Three cores, recovery 35.5 m, including the base.

Thickness:
49 m in the type well.

Lithology:
The formation shows a coarsening upward sequence from siltstones and shales to sandstones which constitute the bulk of the unit.

Basal Stratotype:
The Rogn Formation is developed within the Spekk Formation in the type well. The lower boundary is defined at the base of a gradual decrease in the gamma ray log and at a sharp decrease in interval transit time shown by the sonic log (Fig. 21).

Lateral extent and variation:
The formation is developed in the Draugen Field area, where it thins laterally away from the type well.

Age:
Oxfordian to Kimmeridgian.

Depositional environment:
The formation's sandstones are interpreted as shallow marine bar deposits.

Correlation:
There are no known comparable units in surrounding areas.

Spekk Formation (Spekkformasjonen)

Name:
The Norwegian word for blubber. The unit corresponds to the informal Nesna formation (H2–2).

Well type section:
6407/2–1 (Saga Petroleum), coordinates 64°58′04.97″N, 07°28′28.11″E, from 2908 m to 2842,5 m (Fig. 24).

Well reference section:
6407/9–1 (Shell), coordinates 64°21′55,39″N, 07°47′21.76′′E, from 1673 m to 1612 m (Fig. 22). This section includes 49 m of the Rogn Formation. The lowermost part, including the base is cored, but the atypical development of the succession in the Draugen Field makes this well unsuitable as type section.

Thickness:
65,5 m in the type well, 14 m in the reference well.

Lithology:
The formation consists of dark brown to dark grey shale. The shale is predominantly noncalcareous. Parts of the unit may be silty. The organic content (mainly of type II kerogen) is very high.

Basal Stratotype:
The formation has a characteristic high gamma log response and the sonic log shows high interval transit times. The base is defined by a sharp increase in the gamma ray response and a drop in sonic log readings. High velocity limestone stringers close to the base of the formation may complicate the basal pick on the sonic log.

Lateral extent and variation:
The formation was probably deposited throughout the Haltenbanken-Trænabanken area, but may now be absent from the Nordland Ridge and other structural highs. Unusually thick sections may be present in structural lows.

Age:
Oxfordian to Ryazanian.

Depositional environment:
The unit's shales were deposited in marine anoxic bottom water conditions.

Correlation:
The Spekk Formation has a higher, more uniform gamma ray response than the partially time equivalent Draupne Formation in the northern North Sea. The two formations are lithologically similar with dark claystones and high organic contents. The Spekk Formation is time equivalent to the Hekkingen Formation in the Hammerfest Basin.

Fig 23 JURASSIC WELL 6407/2-2

REFERENCE SECTION MELKE FORMATION

1:500

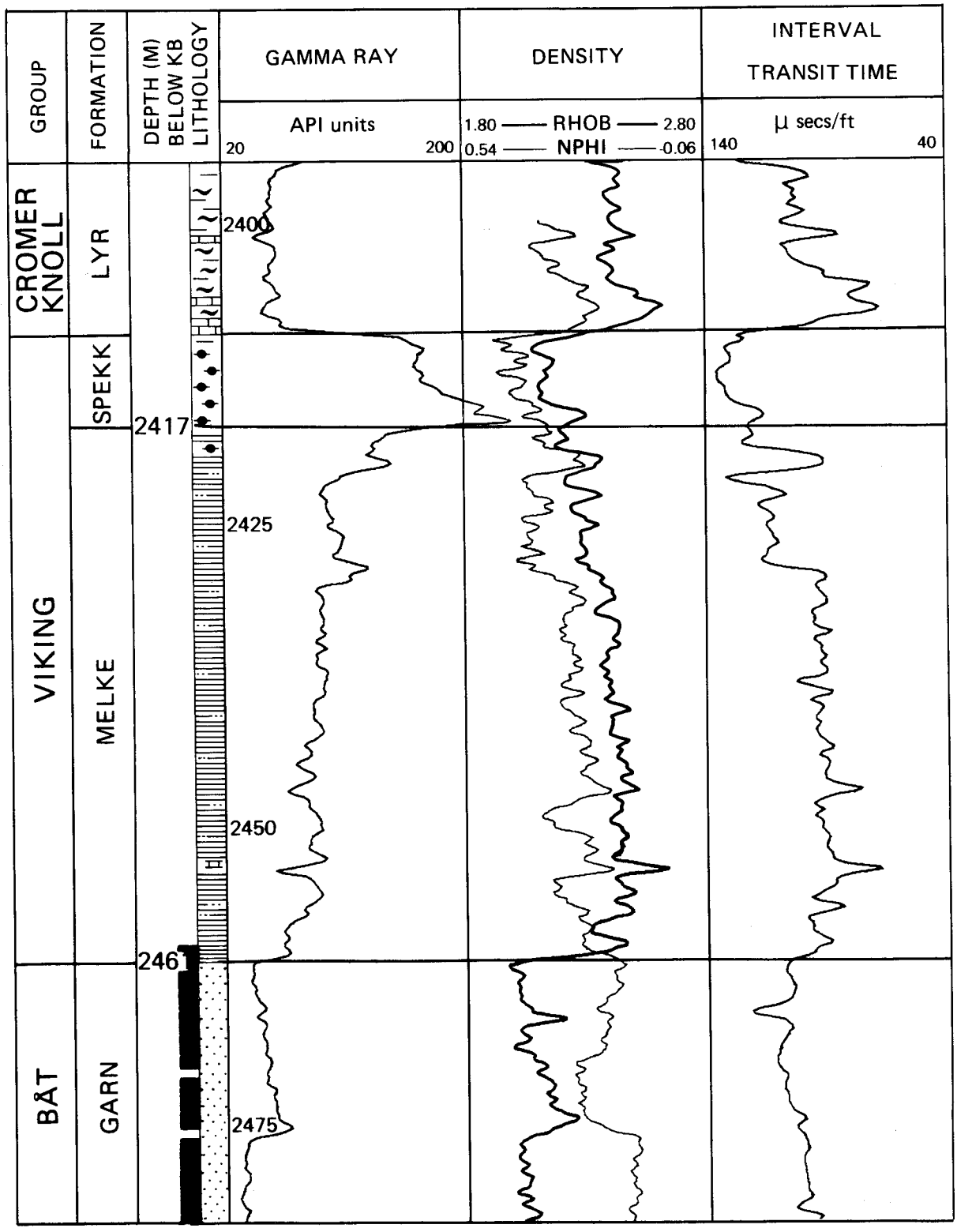
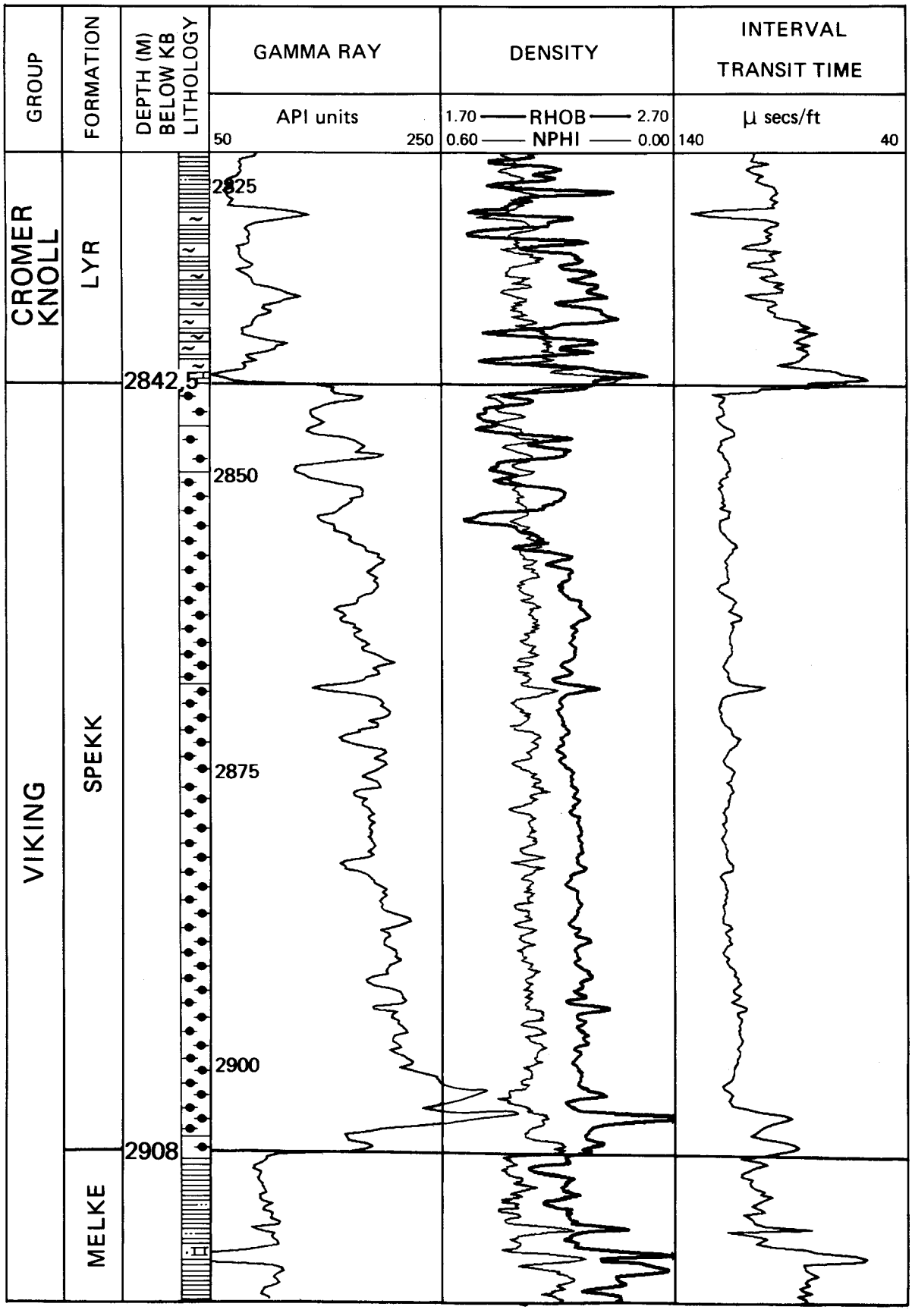


Fig 24 JURASSIC - CRETACEOUS WELL 6407/2-1

TYPE SECTION SPEKK FORMATION

1:500



Cromer Knoll Group (Cromer Knollgruppen)
Name:
Named by Rhys (1974) in the southern North Sea and extended in use to the northern North Sea by Deegan and Scull (1977). The group as now used off mid-Norway corresponds to the informal Finnvær group (H3).

Type area:
Southern North Sea Basin. In this report the following wells are used to illustrate the local development of the group: 6506/12–4 (Statoil) coordinates 65°12′46.97″N, 06°43′30.37″E, from 3855 m to 3132.5 m and 6506/12–1 (Statoil) coordinates 65°10′07.58″N, 06°43′44.07″E, from 3835 m to 3175 m (Figs. 25 and 26).

The base of the Lyr Formation marks the lower boundary of the Cromer Knoll Group on Halten Terrace. In basinal areas to the west the Lange Formation is expected to rest directly on shales of the Viking Group (Figs. 5 and 6).

Thickness:
722.5 m in well 6506/12–4 and 660 m in well 6506/12–1.

Lithology:
On Haltenbanken, the group consists of calcareous and non-calcareous claystones interbedded with marls and stringers of carbonates and sandstones. Sandstones are more common in the upper part of the group.

Lateral extent and variation:
The group's representatives are found throughout the Halten Terrace and in basinal areas to the west. There is little lateral variation apart from a gradual increase in sandstone content to the north. The sequence is generally several hundred metres thick on the Halten Terrace and within the Helgeland Basin, but it is much thinner and locally absent on the Trøndelag Platform. The group is not preserved on parts of the Nordland Ridge nor on local highs along the western flank of the Trøndelag Platform.

Age:
Ryazanian to Turonian.

Depositional environment:
The sediments were deposited in shallow to deep marine environments.

Subdivision:
The Cromer Knoll Group comprises three formations in the area (Figs 25 and 26), all of which are formally described herein.

Lange Formation (Langeformasjonen)
Name:
From the Norwegian name for the fish species *Molva molva* (ling).

Well type section:
Well 6506/12–1 (Statoil), coordinates 65°10′07.58″N, 06°43′44.07″E, from 3812.5 m to 3190 m (Fig. 26). No cores.

Well reference section:
Well 6506/12–4 (Statoil), coordinates 65°12′46.97″N, 06°43′30.37″E, from 3835 to 3150 m (Fig. 25). The uppermost 7 m are cored.

Thickness:
622.5 m in the type well and 685 m in the reference well.

Lithology:
Dominant light/medium grey to green and brown claystones contain stringers of carbonates and sandstones. Claystones in the Barremian-Aptian interval are often reddish-brown and are occasionally interbedded with tuffs.

Basal Stratotype:
The base is generally marked by a distinct drop in gamma ray response and a decrease in interval transit time shown by the sonic log. In the type well and on Halten Terrace and Trøndelag Platform marls of the Lyr Formation underlie the Lange Formation. In this case the boundary is defined by a gradual decrease in the gamma ray response and a slight but sharp decrease in interval transit times. The boundary has been sampled in shallow cores from the eastern part of the Trøndelag Platform (Bugge *et al.* 1984), but logs and detailed descriptions of these are not yet available.

Lateral extent and variation:
The formation is only absent from parts of the Nordland Ridge and on local highs along the western flank of the Trøndelag Platform. The early Cenomanian interval shows a sandstone-rich development in well 6507/7–1. Sandstones are also expected along the western flank of the Nordland Ridge.

A thin sequence of claystones of Hauterivian to Barremian age subcrop along the eastern part of the Trøndelag Platform. Red-brown oxidized silty claystone found there is also commonly encountered in wells further offshore. Similar sequences are exposed on Andøya and on East Greenland.

Age:
Ryazanian to Turonian.

Depositional environment:
The formation was deposited in a marine environment, possibly shallower on the Halten Terrace area and deeper in the basins to the west.

Correlation:
The lower part of the Lange Formation may be correlated with the Valhall Formation defined in the central North Sea (Deegan and Scull 1977).

Fig 25 CRETACEOUS WELL 6506/12-4

REFERENCE SECTION CROMER KNOLL GROUP AND LANGE FORMATION

1:2000

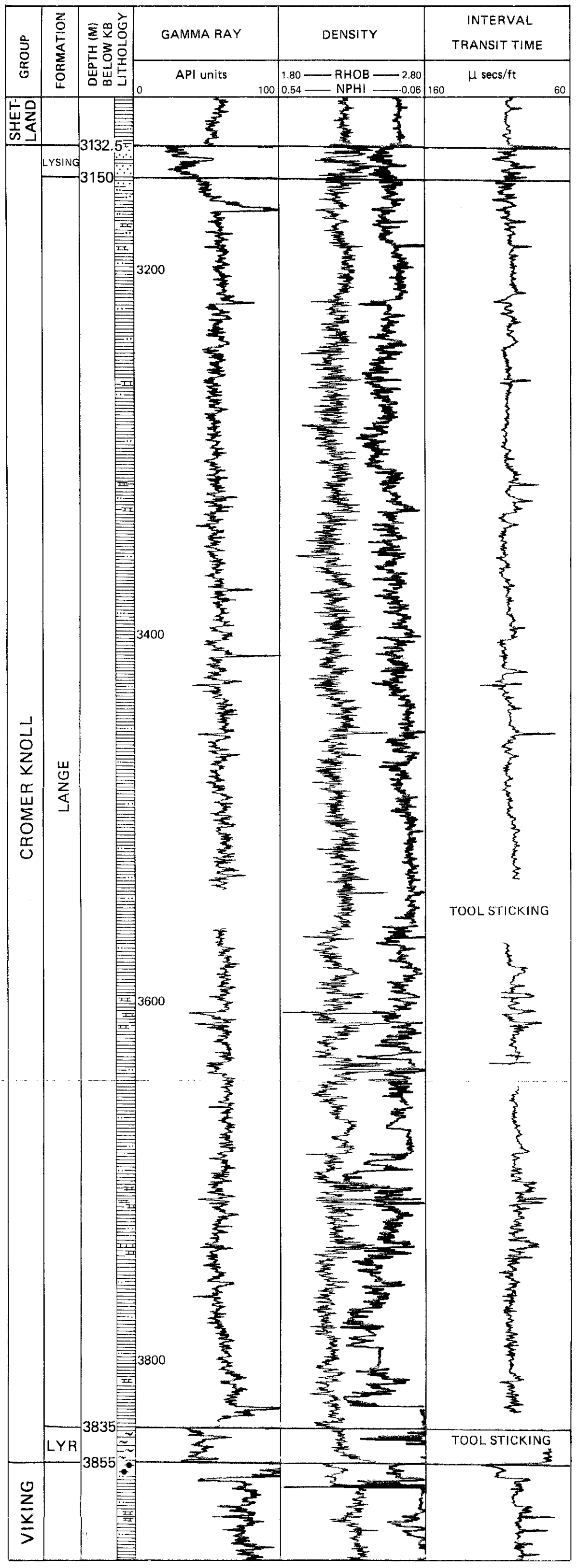
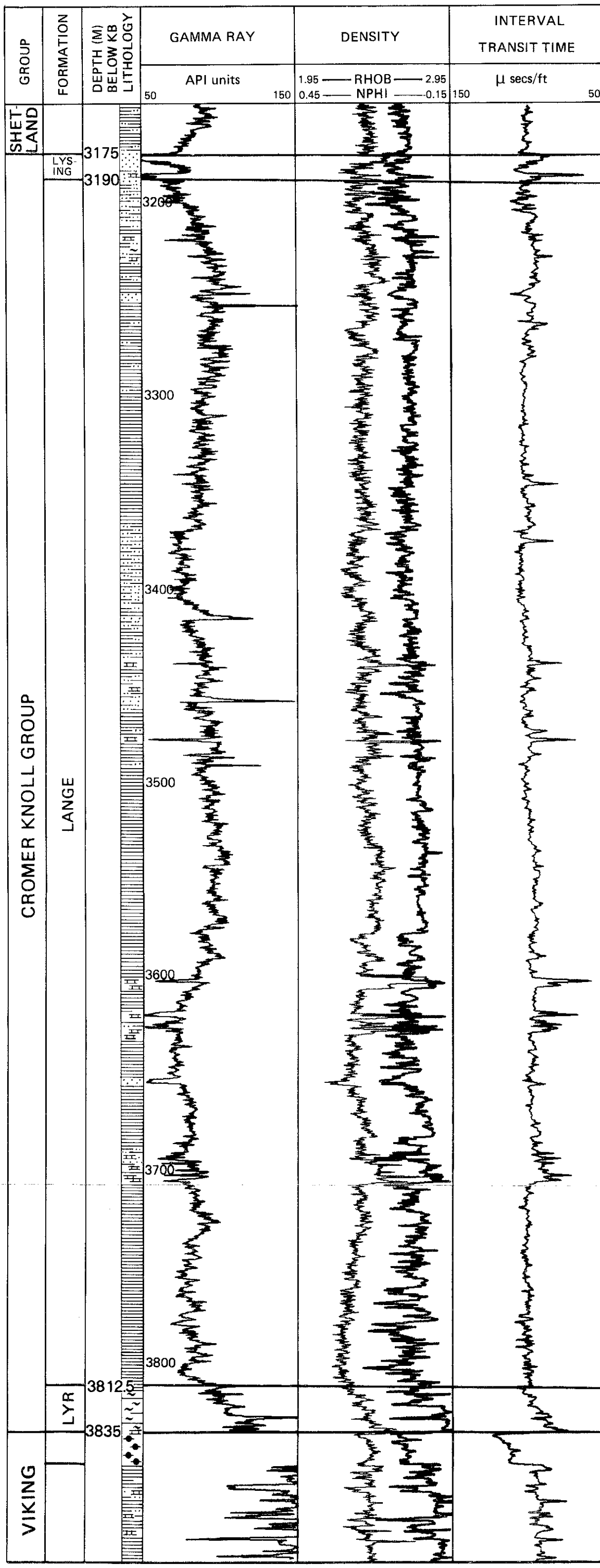


Fig 26

CRETACEOUS WELL 6506/12-1

TYPE SECTION LANGE FORMATION
REFERENCE SECTION CROMER KNOLL GROUP

1:2000



Lyr Formation (Lyrformasjonen)

Name:
From the fish species *Pollachius pollachius* (pollack).

Well type section:
Well 6506/12–1 (Statoil), coordinates 65°10′07.58″N, 06°43′44.07″E, from 3836 m to 3812.5 m (Fig. 27). No cores.

Well reference section:
Well 6407/1–2 (Statoil), coordinates 64°47′50.61″N, 07°02′23.76″E, from 3526 m to 3510 m (Fig. 28). No cores.

Thickness:
23.5 m in the type well and 16 m in the reference well.

Lithology:
The formation consists of light/medium grey to light greyish-green marls with interbedded carbonates.

Basal Stratotype:
In the type well the base is defined by a decrease of interval transit times shown by the sonic log. The gamma ray and the resistivity responses also decrease.

The base has been sampled in shallow cores from the eastern part of the Trøndelag Platform (Bugge *et al.* 1984), but logs and detailed descriptions are not yet available.

Lateral extent and variation:
The formation is encountered in all wells on Halten Terrace, but is absent on the Nordland

Fig 27 CRETACEOUS WELL 6506/12-1

TYPE SECTION LYR FORMATION

1:500

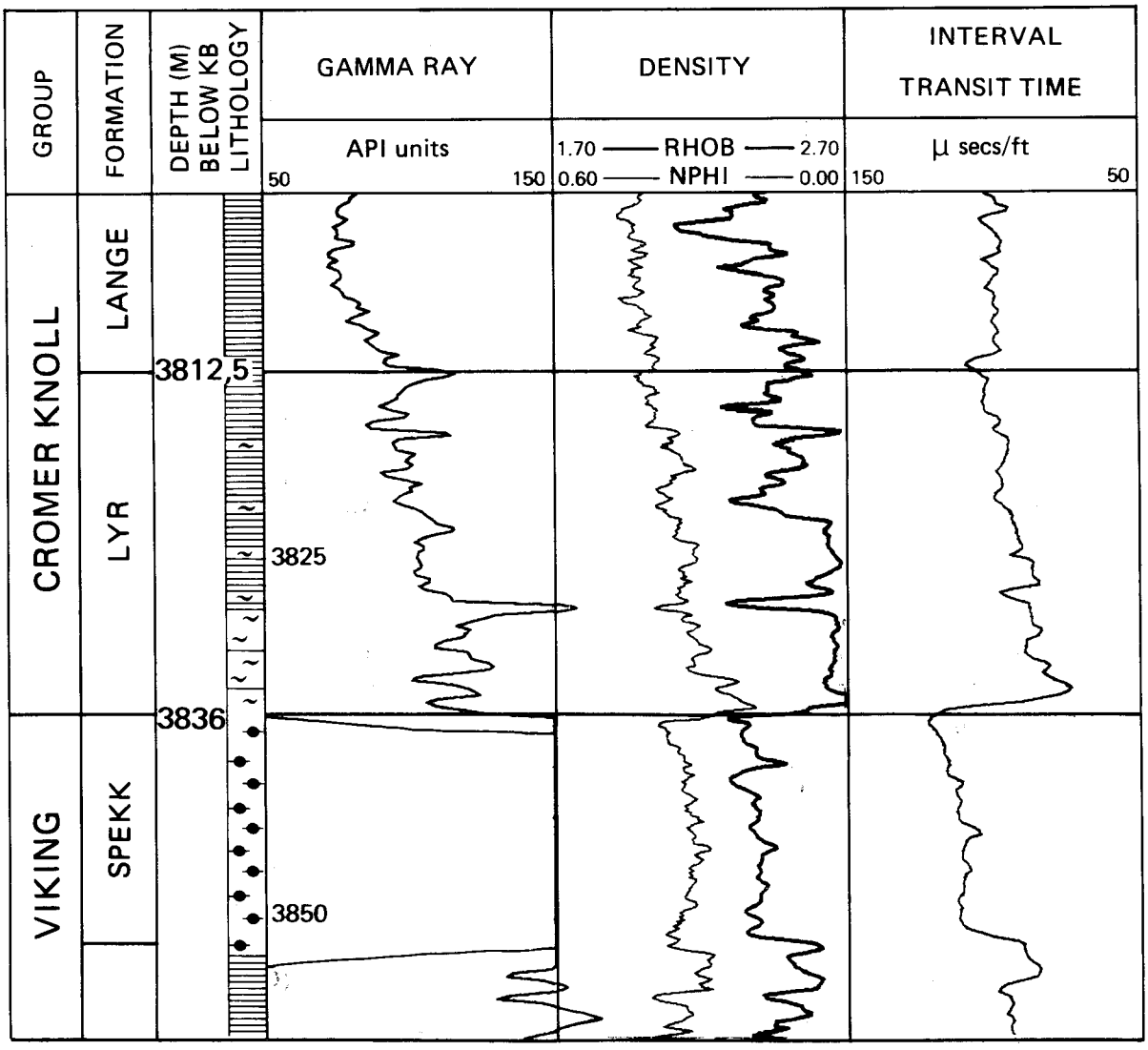
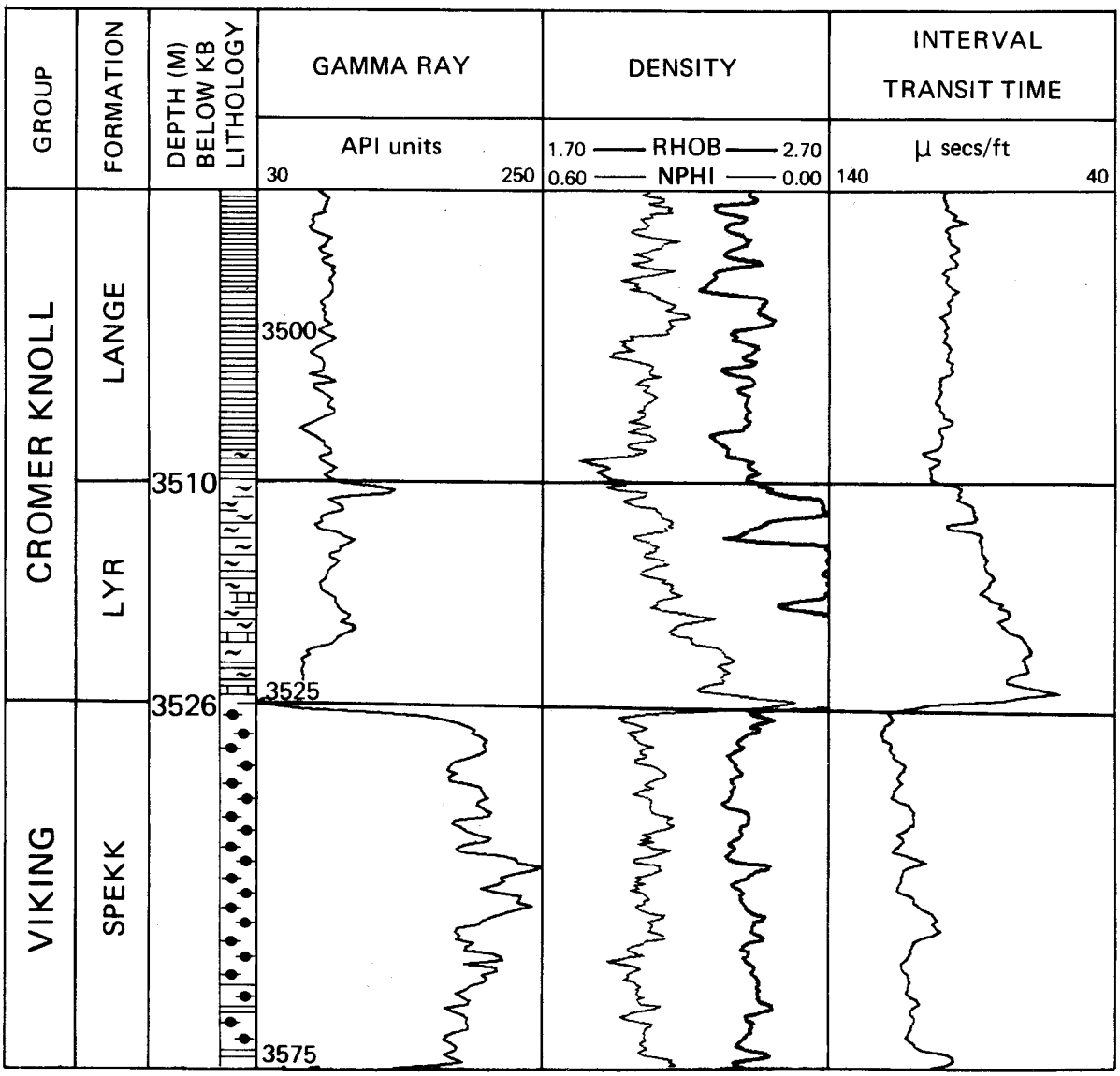


Fig 28 CRETACEOUS WELL 6407/1-2

REFERENCE SECTION LYR FORMATION

1:500



Ridge and on structural highs on the Nordland Ridge and the Trøndelag Platform. The carbonate content is expected to decrease to the west in the Møre and Vøring Basins. The formation consists of very thin limestones with intraformational conglomerates on the eastern part of the Trøndelag Platform (Bugge *et al.* 1984).

Age:
Valanginian to Early Aptian.

Depositional environment:
The formation was deposited under open marine conditions.

Correlation:
The Lyr Formation is comparable to the Valhall Formation (Deegan and Scull, 1977) in the central North Sea. It is also equivalent to the Leira Member on Andøya (Dalland, 1979).

Lysing Formation (Lysingformasjonen)

Name:
From the fish species *Merluccius merluccius* (hake).

Well type section:
Well 6507/7–1 (Conoco), coordinates 65°27'16.7"N, 07°12'52.6"E, from 3000 m to 2926 m (Fig. 29). No cores.

Fig 29 CRETACEOUS WELL 6507/7-1

TYPE SECTION LYSING FORMATION

1:500

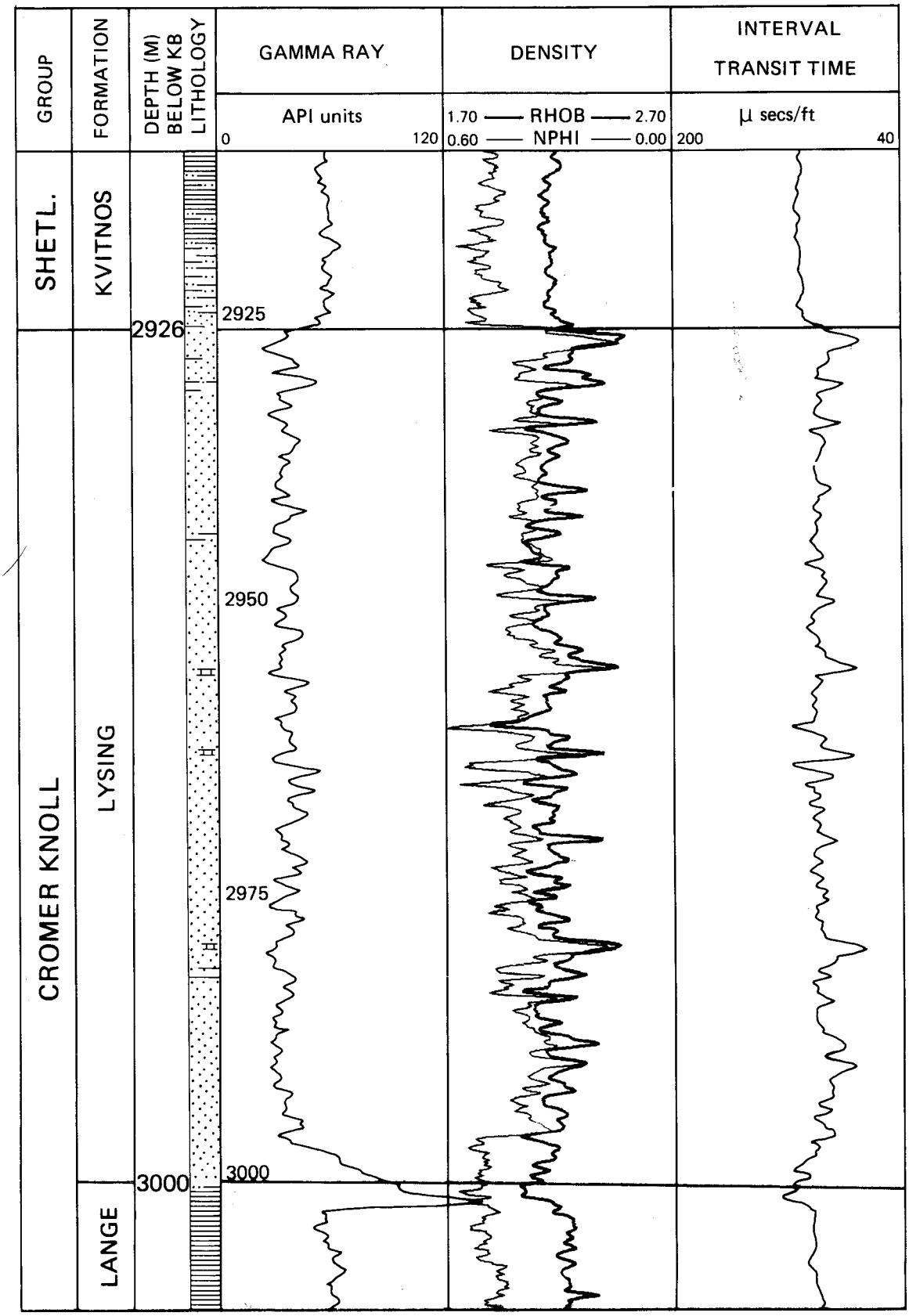
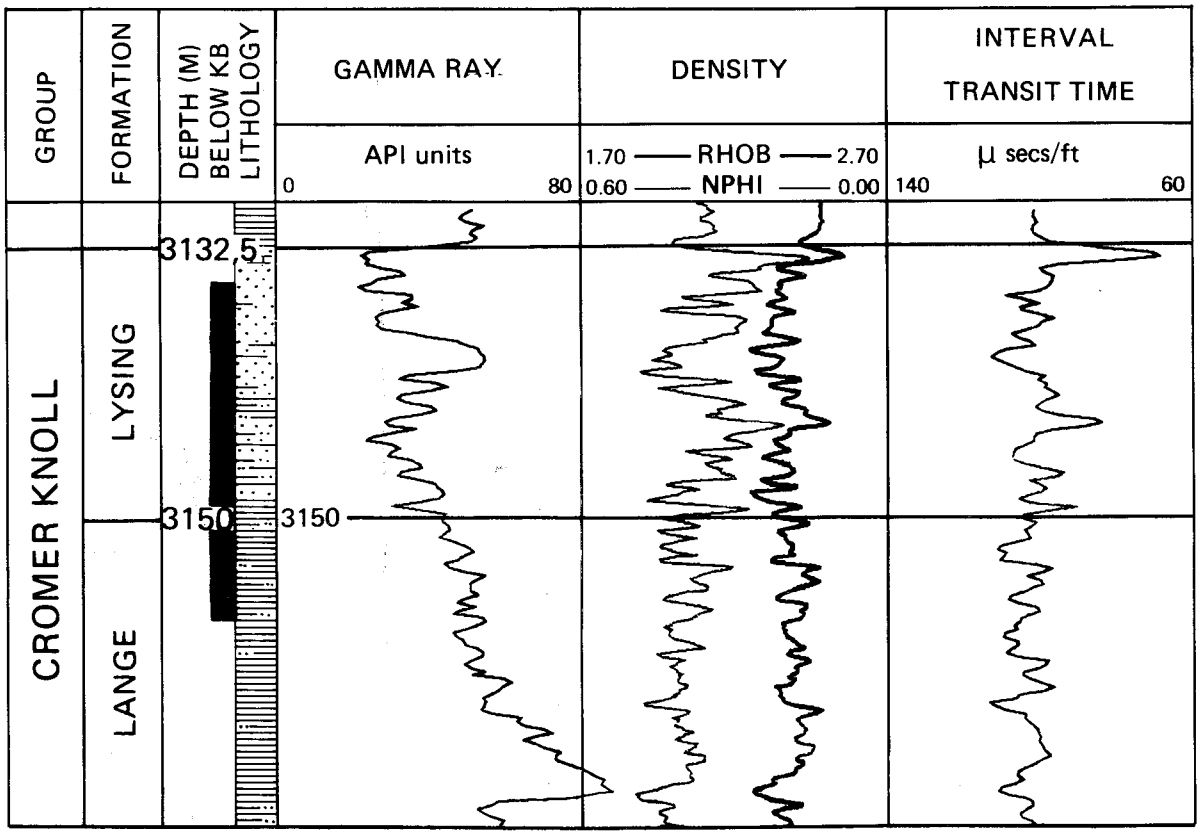


Fig 30 CRETACEOUS WELL 6506/12-4

REFERENCE SECTION LYSING FORMATION

1: 500



Well reference section:
Well 6506/12–4 (Statoil), coordinates 65°12′46.97″N, 06°43′30.37″E, from 3150 m to 3132.5 m,(Fig. 30). The lower 15 m of the formation are cored, including the base.

Thickness:
74 m in the type well and 17.5 m in the reference well.

Lithology:
Predominantly fine to medium, occasionally coarse grained, white-grey sandstones, partly carbonate-cemented and interbedded with shales.

Basal Stratotype:
The base is defined by a gradual decrease in the gamma ray log response and by the onset of a more nervous pattern on the resistivity and sonic logs.

Lateral extent and variation:
The formation is widely distributed over the Halten Terrace, but is absent on the Trøndelag Platform. It thins to the south and north of the type well.

Age:
Late Cenomanian to Turonian/Coniacian.

Depositional environment:
Interpretations vary from shallow to deep marine, possibly as submarine fan deposits.

Shetland Group (Shetlandgruppen)

Name:
Named by Deegan and Scull (1977). Use of the group off mid-Norway corresponds to the informal Flatøy group (H4).

Type area:
Northern North Sea. In this report the following wells are used to illustrate the local development of the group: 6506/12–4 (Statoil) coordinates 65°12′46.97″N, 06°43′30.37″E, from 3132.5 m to 2211 m and 6506/12–1 (Statoil) coordinates 65°10′07.58″N, 06°43′44.07″E, from 3175 m to 2279 m (Figs 31, 32, 33 and 34).

Thickness:
921.5 m in well 6506/12–4 and 896 m in well 6506/12–1.

Fig 31 CRETACEOUS WELL 6506/12-4

TYPE SECTION KVITNOS FORMATION

1:2000

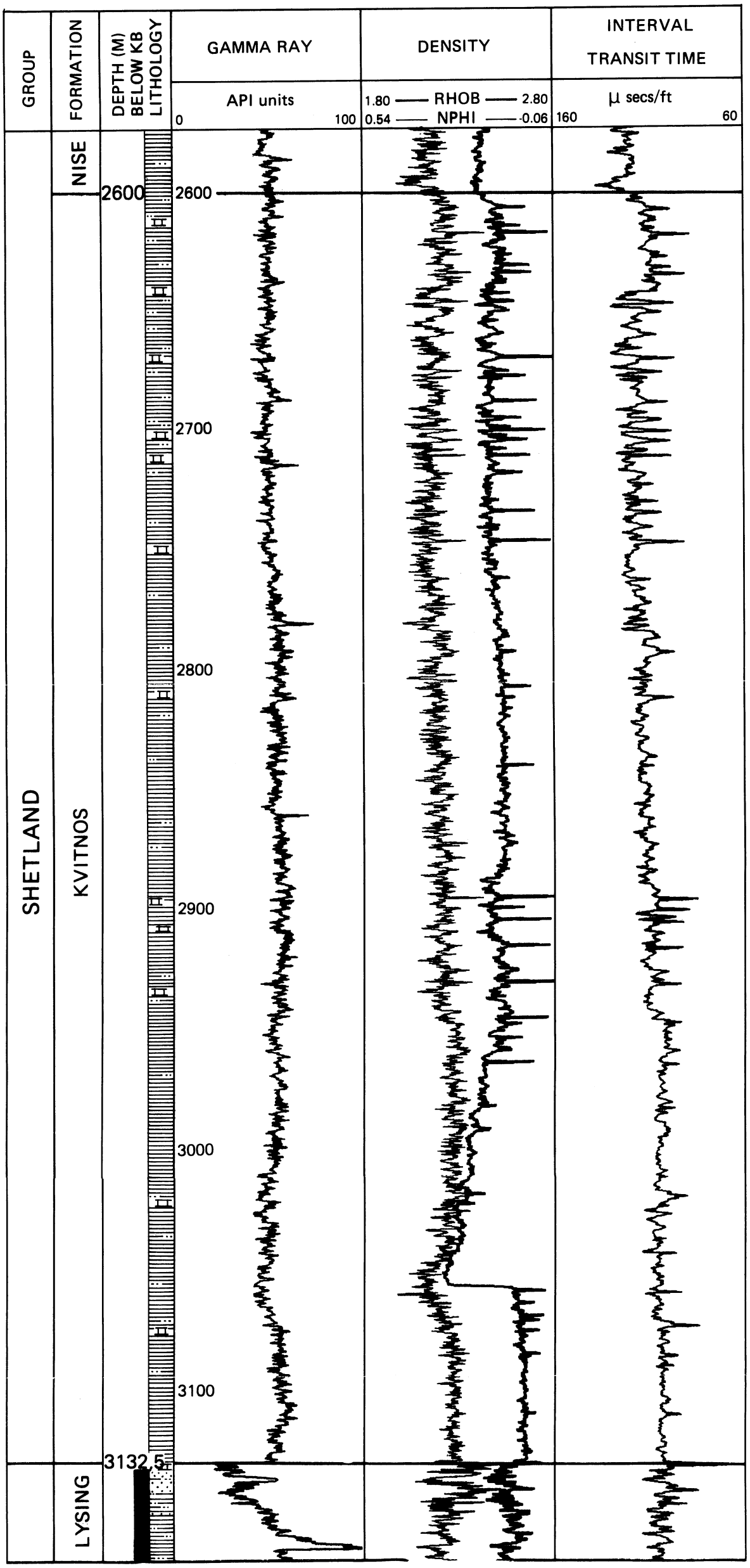
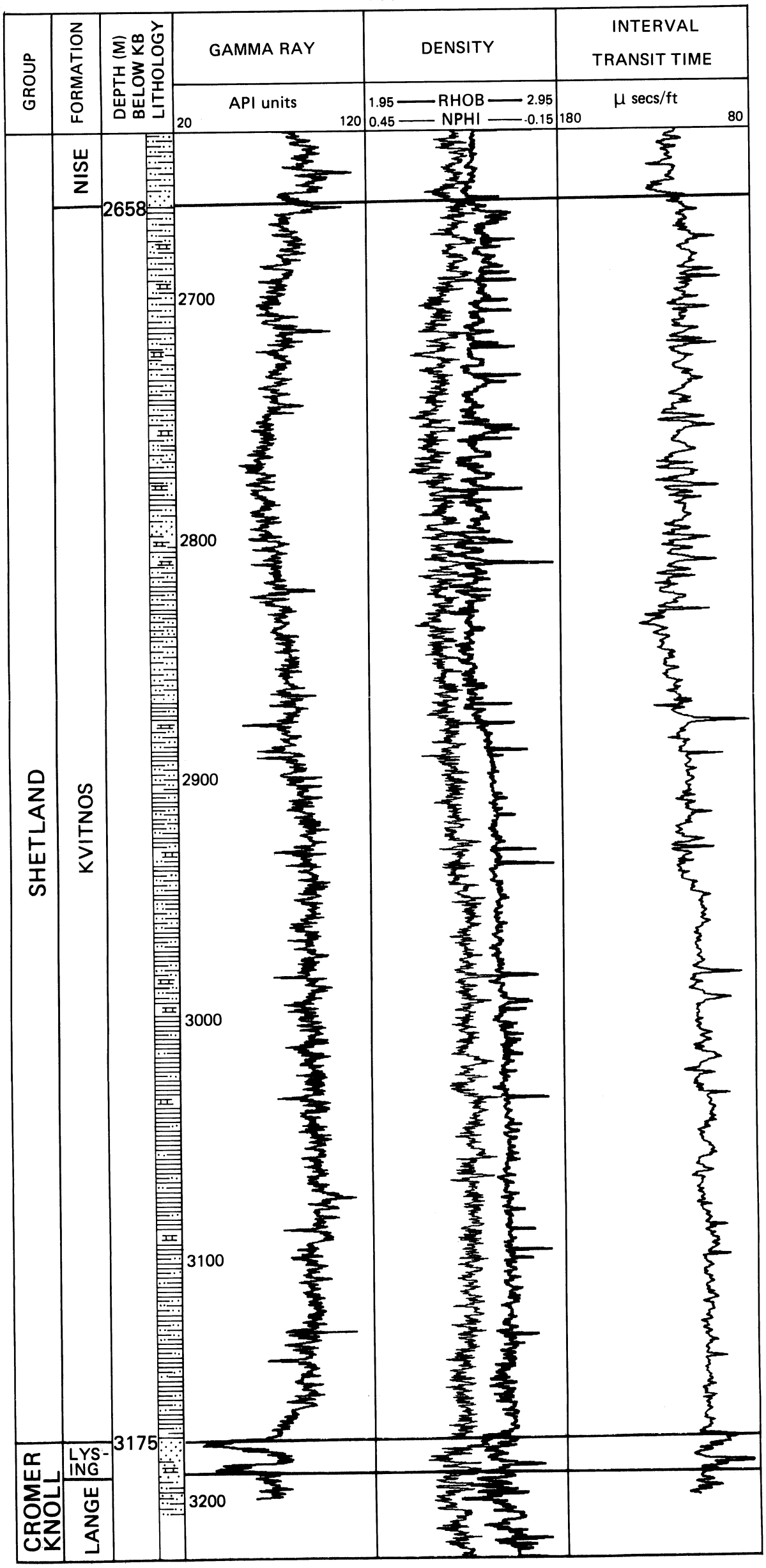


Fig 32 CRETACEOUS WELL 6506/12-1

REFERENCE SECTION KVITNOS FORMATION

1: 2000



Lithology:
On Haltenbanken the group consists of claystones interbedded with minor amounts of carbonates and sandstones.

Lateral extent and variation:
The Shetland Group's representatives occur throughout the Mid-Norwegian shelf and are only absent over parts of the Nordland Ridge. The sequence is usually very thin on the Trøndelag Platform.

Age:
Turonian to Maastrichtian.

Depositional environment:
Open marine.

Subdivision:
The Shetland Group is represented by three formations in the area, all of which are described herein.

Kvitnos Formation (Kvitnosformasjonen)
Name:
From the whale species *Lagenorhynchus albirostris.*

Well type section:
Well 6506/12–4 (Statoil), coordinates 65°12'46.97"N, 06°43'30.37"E, from 3132.5 m to 2600 m (Fig. 31). No cores.

Well reference section:
Well 6506/12–1 (Statoil), coordinates 65°10'07.58"N, 06°43'44.07"E, from 3175 m to 2658 m (Fig. 32). No cores.

Thickness:
532.5 m in the type well and 517 m in the reference well.

Lithology:
Grey and greyish green calcareous claystones with carbonate and sandstone stringers.

Basal Stratotype:
The base is defined by a marked increase in the gamma ray log, an increase in the interval transit time on the sonic log and a decrease in the resistivity log readings.

Lateral extent and variation:
The formation is laterally continuous. It is missing on parts of the Nordland Ridge and on local highs along the western flank of the Trøndelag Platform; otherwise it is very thinly developed on the platform.

Age:
Turonian to Santonian.

Depositional environment:
Open marine.

Nise Formation (Niseformasjonen)
Name:
From the whale species *Phocoena phocoena.*

Well type section:
Well 6506/12–4 (Statoil), coordinates 65°12'46.97"N, 06°43'30.37"E, from 2600 m to 2380 m (Fig. 33). No cores.

Well reference section:
Well 6506/12–1 (Statoil), coordinates 65°10'07.58"N, 06°43'44.07"E, from 2658 m to 2446 m (Fig. 34). No cores.

Thickness:
220 m in the type well and 212 m in the reference well.

Lithology:
Dominant grey and greyish-green claystones interbedded with carbonate and sandstone stringers.

Basal Stratotype:
The base is defined by a log break giving an increase in interval transit time and a weak decrease in resistivity from the calcareous claystones of the Kvitnos Formation into the less calcareous claystones of the Nise Formation.

Lateral extent and variation:
The formation is regionally extensive but is absent on parts of the Nordland Ridge and on local highs along the western flanks of the Trøndelag Platform.

Age:
Santonian to Campanian.

Depositional environment:
Open marine.

Springar Formation (Springarformasjonen)
Name:
A Norwegian collective name for small whales.

Well type section:
Well 6506/12–4 (Statoil), coordinates 65°12'46.97"N, 06°43'30.37"E, from 2380 m to 2211 m (Fig. 33). No cores.

Well reference section:
Well 6506/12–1 (Statoil), coordinates 65°10'07.58"N, 06°43'44.07"E, from 2446 m to 2279 m (Fig. 34). No cores.

Thickness:
169 m in the type well and 167 m in the reference well.

Lithology:
Predominantly greyish-green claystones interbedded with stringers of carbonates and sandstones.

Fig 33 CRETACEOUS WELL 6506/12-4

TYPE SECTION SPRINGAR AND NISE FORMATIONS

1:2000

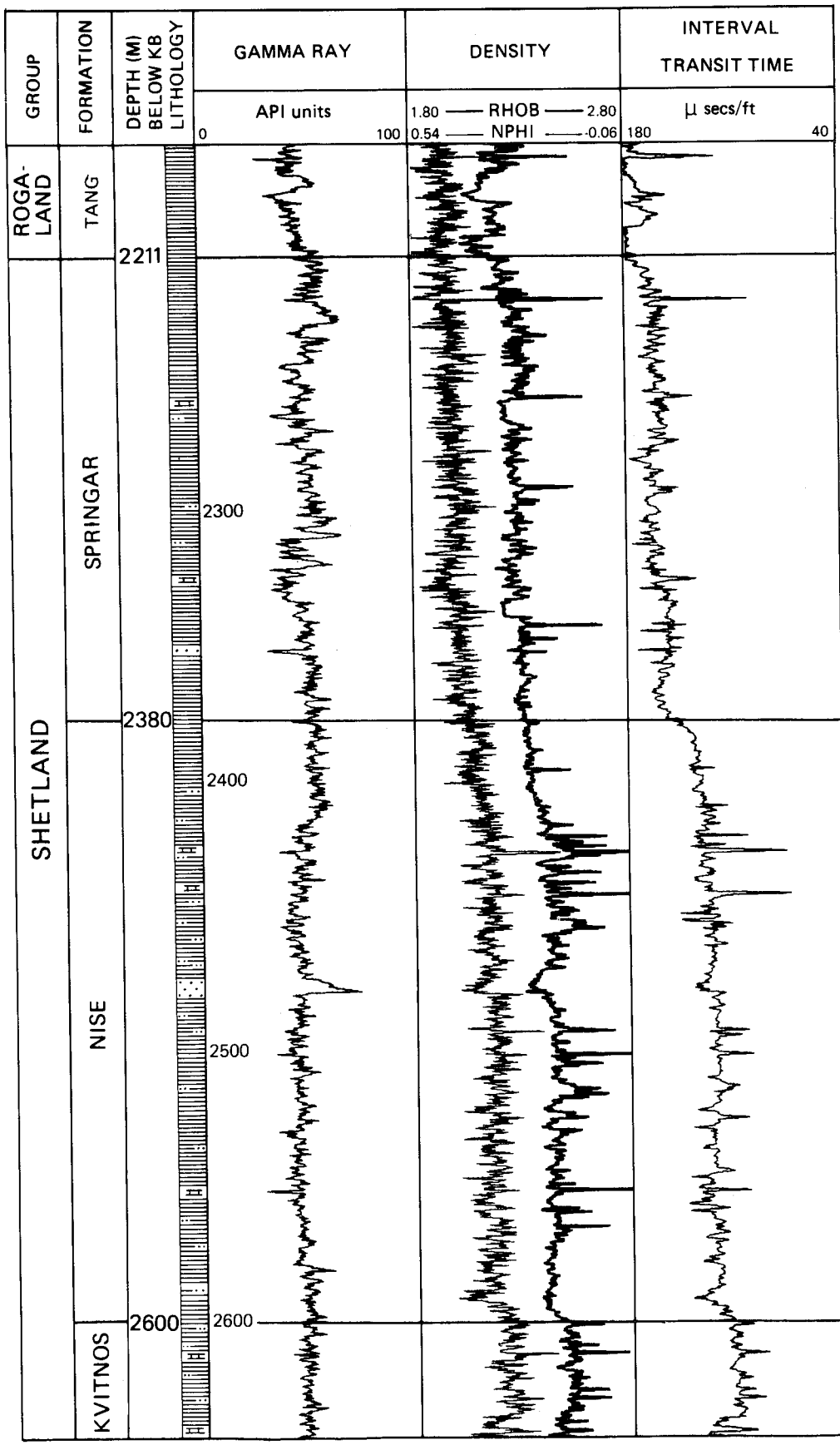
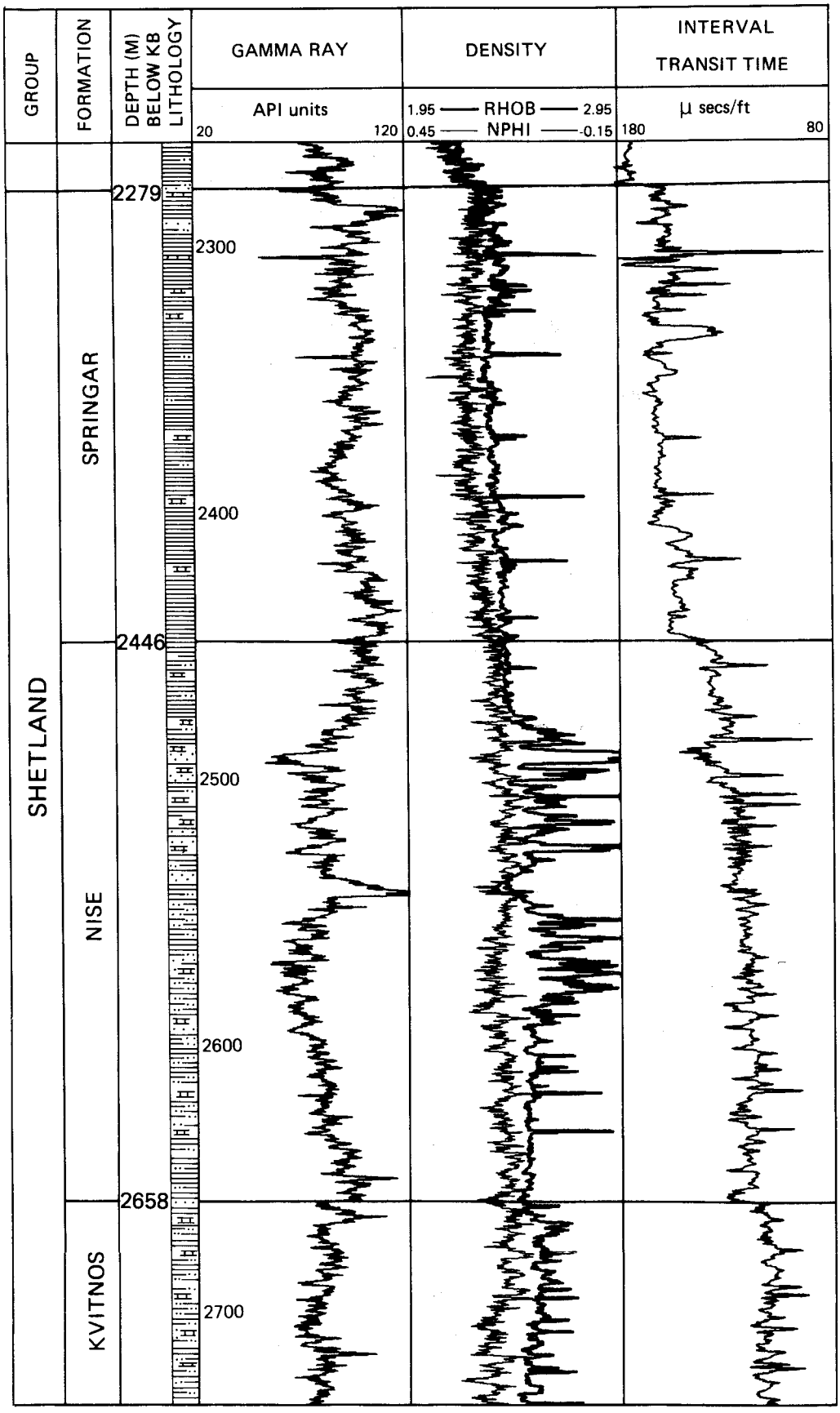


Fig 34 CRETACEOUS WELL 6506/12-1

REFERENCE SECTION SPRINGAR AND NISE FORMATIONS

1: 2000



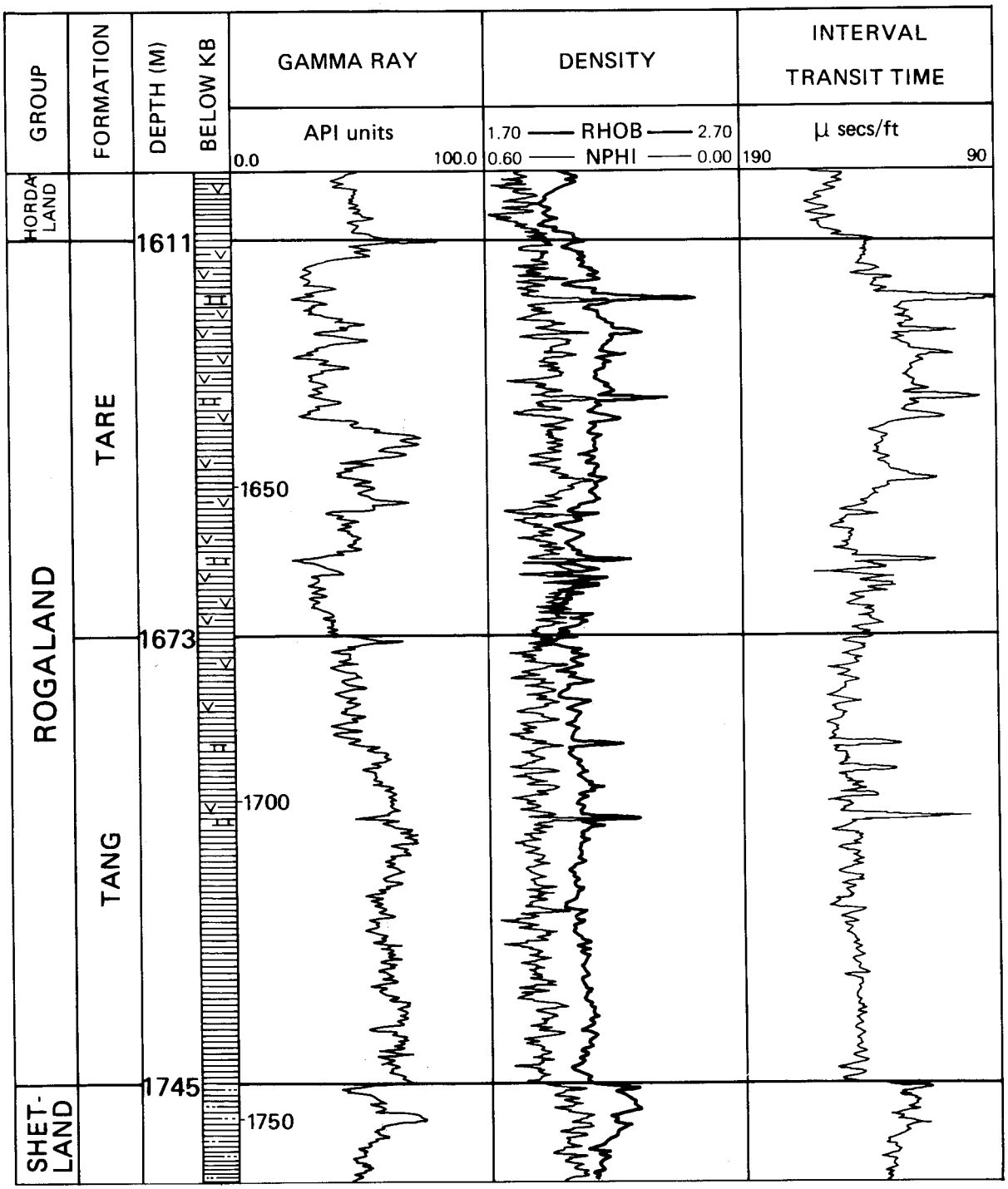
Basal Stratotype:
The base is defined by a marked increase in interval transit time shown by the sonic log from the underlying Nise Formation into the Springar Formation.

Lateral extent and variation:
The Springar Formation is regionally extensive and is absent only on parts of the Nordland Ridge.

Fig 35 TERTIARY WELL 6407/6-1

TYPE SECTION TANG FORMATION,
REFERENCE SECTION ROGALAND GROUP AND TARE FORMATION

1 : 1000



Age:
Campanian to Maastrichtian.

Depositional environment:
Open marine.

Rogaland Group (Rogalandgruppen)

Name:
Named by Deegan and Scull (1977). As used herein the group corresponds to the informal Skomvær group (H5).

Type area:
Central and northern North Sea. In this report, well 6407/6–1 (Statoil) coordinates 64°38′29.62″N, 07°52′31.53″EE, from 1745 m to 1611 m, is used to illustrate the group's local development (Fig. 35).

Thickness:
134 m in well 6407/6–1.

Lithology:
On Haltenbanken the group consists of claystone with minor local siltstone. Tuff is common in the upper part.

Lateral extent and variation:
The lower part of the group is not present in the northeastern part of the Haltenbanken area. The upper tuffaceous part is ubiquitous, except for the crest of the Nordland Ridge. The tuff content varies.

Age:
Danian to Late Paleocene.

Depositional environment:
The sediments were deposited in a deep marine environment.

Subdivision:
In the Haltenbanken area the Rogaland Group comprises the Tang and Tare formations.

Tang Formation (Tangformasjonen)

Name:
From the Norwegian name for seaweed. The formation corresponds to the informal Bodø formation (H5–1).

Well type section:
Well 6407/6–1 (Statoil), coordinates 64°38′29.62″N, 07°52′31.53″E, from 1745 m to 1673 m (Fig. 35). No cores.

Thickness:
72 m in the type well.

Lithology:
Dark grey to brown claystone with minor sandstone and limestone.

Basal Stratotype:
The base is defined by an increase in interval transit time on the sonic log and a decrease in density and resistivity log readings.

Lateral extent and variation:
The formation thins towards the northeast. It is not present on the Nordland Ridge.

Age:
Danian to late Paleocene.

Depositional environment:
The sediments were deposited in a deep marine environment.

Tare Formation (Tareformasjonen)

Name:
From the Norwegian name for algae or sea tangle. The formation corresponds to the informal Alstahaug formation or H5–2.

Well type section:
Well 6507/12–1 (Saga Petroleum), coordinates 65°07′01.62″N, 07°42′42.61″E, from 1884 m to 1826 m (Fig. 36). No cores.

Thickness:
58 m in the type well.

Lithology:
Dark grey, green or brown claystones with some thin sandstone stringers show a variable content of tuff.

Basal Stratotype:
The base is defined by an increase in tuff content. Consequently the sonic log shows a decrease in interval transit time and an increase in density log readings.

Lateral extent and variation:
The Tare Formation is ubiquitous except near the crest of the Nordland Ridge. The tuff content decreases southwards.

Age:
Late Paleocene.

Depositional environment:
These sediments were deposited in a deep marine environment.

Correlation:
The Tare Formation is similar in both age and lithology to the Balder Formation (Deegan and Scull, 1977) in the North Sea.

Hordaland Group (Hordalandgruppen)

Name:
Named by Deegan and Scull (1977). As used herein the group's local develoment corresponds to the lower part of the informal Sklinna group (H6).

Fig 36 TERTIARY WELL 6507/12-1

TYPE SECTION TARE FORMATION

1: 1000

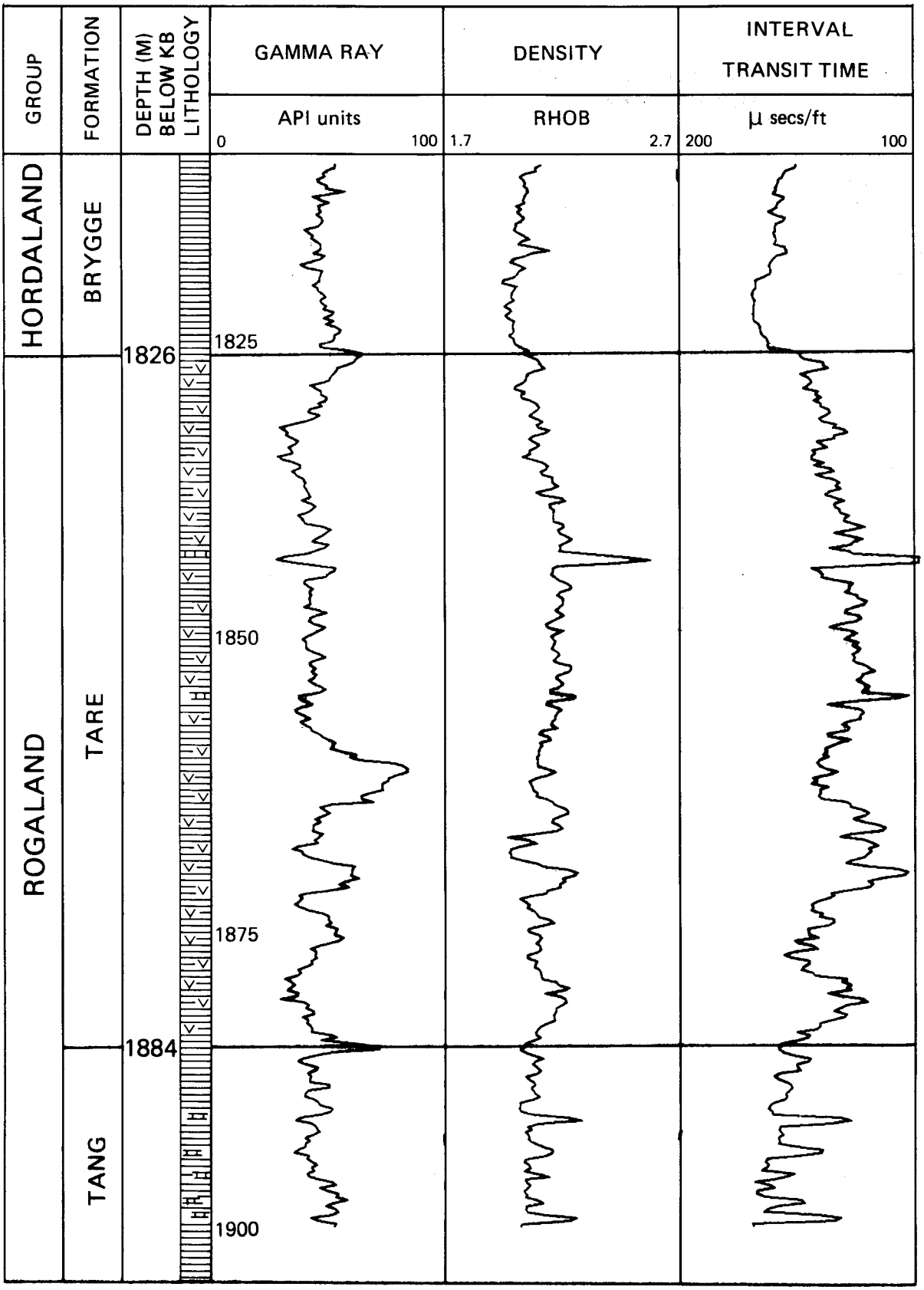
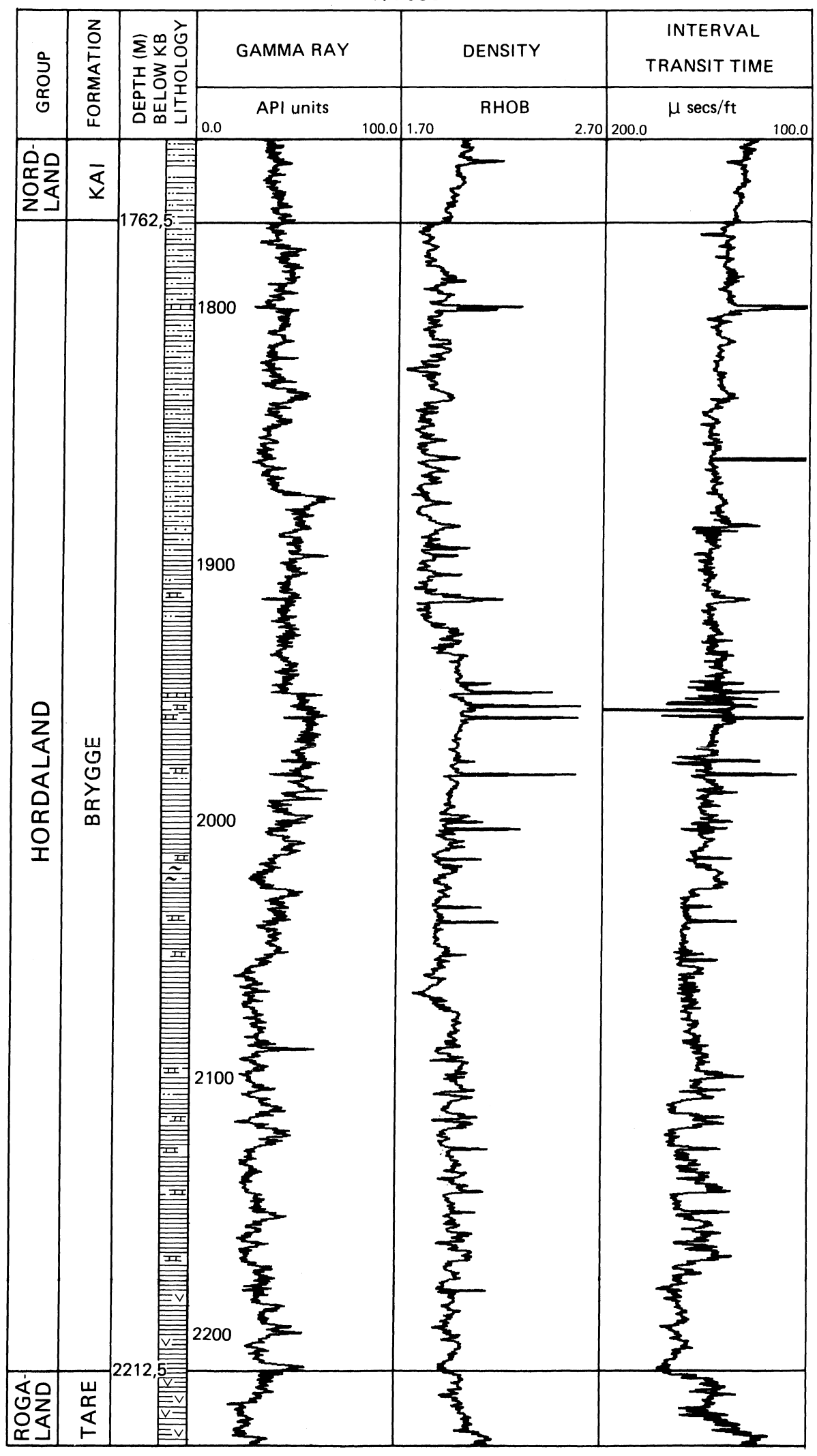


Fig 37 TERTIARY WELL 6407/1-3

TYPE SECTION BRYGGE FORMATION,
REFERENCE SECTION HORDALAND GROUP

1:2000



Type area:
North Sea Tertiary Basin. In this report, well 6407/1–3 (Statoil), coordinates 64°52′25.48″N, 07°53′47″E, from 2212.5 m to 1762.5 m, is used to illustrate the local development of the group (Fig. 37).

Thickness:
450 m in the reference well.

Lithology:
In Haltenbanken the Hordaland Group consists of claystones and minor sandstones, herein assigned to the Brygge Formation. The sandstone content increases to the east.

Lateral extent and variation:
The Hordaland Group occurs throughout Haltenbanken. It thins eastwards and is eroded on the Nordland Ridge. Close to the coastline the group comprises a sandy sequence informally termed the Røyrvik formation (Askvik and Rokoengen 1985).

Age:
Eocene to Early Miocene.

Depositional environment:
The sediments are marine, mainly deposited in deep water.

Subdivision:
The Hordaland Group comprises the Brygge Formation on Haltenbanken at present. Lateral facies changes and breaks in the sequence may form the basis for future subdivision.

Brygge Formation (Bryggeformasjonen)
Name:
From the Norwegian name for wharf or quay. The formation corresponds to the informally used Narvik formation (H6–1).

Well type section:
Well 6407/1–3 (Statoil), coordinates 64°52′25.48″N, 07°02′53.47″E, from 2212.5 m to 1762.5 m (Fig. 37). No cores.

Thickness:
450 m in the type well.

Lithology:
Mainly claystone with stringers of sandstone, siltstone, limestone and marl. Pyrite, glauconite and shell fragments are seen in the sandstones.

Basal Stratotype:
The base is defined by a decrease in interval transit time shown on the sonic log and by an increase in the density log readings.

Lateral extent and variation:
The Brygge Formation is ubiquitous across Haltenbanken, but it is absent on the crest of the Nordland Ridge. A sand-dominated succession of Oligocene age, termed the Røyrvik formation, has been mapped (but not formally defined) off the Møre-Trøndelag coast (Askvik and Rokoengen, 1985). The Røyrvik formation probably interfingers with the fine grained Brygge Formation to the west.

Age:
Early Eocene to Early Miocene.

Depositional environment:
The sediments were deposited in marine environments.

Nordland Group (Nordlandgruppen)
Name:
Named by Deegan and Scull (1977). As used herein the group corresponds to the upper part of the informal Sklinna group and to the Sula group (H6 and H7).

Type area:
North Sea Tertiary Basin. In this report, well 6407/1–2 (Statoil), coordinates 64°47′50.61″N, 07°02′23.76″E, from 1690 m to 302 m, is used to illustrate the local development of the group (Fig. 38).

Thickness:
1388 m in well 6407/1–2.

Lithology:
Alternating claystone, siltstone and sandstone.

Lateral extent and variation:
The Nordland Group is present throughout the Mid-Norwegian shelf, but the lower part is not present on the crest of the Nordland Ridge. The sand content may vary locally, but there is no significant regional variation.

Age:
Early Miocene to Recent.

Depositional environment:
The Nordland Group was deposited in a marine environment in a rapidly subsiding basin characterised by major westerly prograding wedges. The upper part is of glacial to glaciomarine origin.

Subdivision:
The Nordland Group consists of the Kai and Naust formations in the Haltenbanken area.

Kai Formation (Kaiformasjonen)
Name:
The Norwegian word for quay. The formation corresponds to the informal Korgen formation (H6–2).

Well type section:
Well 6407/1–2 (Statoil), coordinates

64°47'50.61"N, 07°02'23.76"E, from 1690 m to 1419 m (Fig. 38). No cores.

Thickness:
271 m in the type well.

Lithology:
Alternating claystone, siltstone and sandstone with limestone stringers. Glauconite, pyrite and shell fragments are common.

Basal Stratotype:
The base is defined by a decrease in interval transit time on the sonic log and an increase in the density log readings.

Lateral extent and variation:
The formation is present throughout the Haltenbanken area apart from the crest of the Nordland Ridge. The sand content varies locally.

Age:
Early Miocene to Late Pliocene.

Depositional environment:
The formation was deposited in marine environments with varying water depths.

Naust Formation (Naustformasjonen)

Name:
From the Norwegian word for a boathouse. The formation corresponds to the informal Sula group (H7).

Well type section:
Well 6507/12–1 (Saga Petroleum), coordinates 65°07'01.62"N, 07°42'42.61"E, formational base at 1342 m (Fig. 39). No cores.

Thickness:
The base of the overlying, dominantly glaciomarine deposits is not yet defined. Precise thicknesses are therefore unknown, but generally the Naust Formation is several hundred metres thick in the Haltenbanken — Trænabanken area.

Lithology:
Interbedded claystone, siltstone and sand, occasionally with very coarse clastics in the upper part.

Basal Stratotype:
The base is defined by a decrease in interval transit time and gamma ray response and an increase in the resistivity log readings.

Lateral extent and variation:
The Naust Formation is laterally continuous across the Mid-Norwegian Shelf.

Age:
Late Pliocene.

Depositional environment:
The formation was deposited in a marine environment. A transition to glaciomarine environments occurs in the upper part, but this transition is poorly documented by the exploration wells.

THE MESOZOIC AND CENOZOIC SUCCESSION OF TROMSØFLAKET

by
D. Worsley, R. Johansen and S.E. Kristensen

INTRODUCTION

Background

The first regional surveys in the Barents Sea showed that the area was underlain by thick sedimentary sequences (Eldholm and Ewing 1971, Sundvor 1974, Renard and Malod 1974, Eldholm and Talwani 1977, Hinz and Schlüter 1978, Rønnevik 1981).

The first wells were drilled on Tromsøflaket in 1980. To date 31 pre-11th Round wells have been drilled, most of these (24) in the Hammerfest Basin, 1 on the Troms – Finnmark Platform, 1 in the Tromsø Basin, 2 on the Senja Ridge and 3 on the Loppa High (Fig. 40).

Only a few wells have penetrated the pre-Mesozoic sequence. It is therefore premature to introduce a formal lithostratigraphic scheme for that part of the succession, especially as most of these wells have tested regionally anomalous positive structures such as the Loppa High. Similarities to the Permian and Carboniferous successions of Svalbard are however striking.

Major structural features in the area are illustrated in Figure 40. Terminology follows that of Gabrielsen *et al.* (1984).

LITHOSTRATIGRAPHY

The definitions of lithostratigraphical units herein (Fig. 41) are based mainly on well data from the Hammerfest Basin, but also taking into account data from the other structural provinces drilled to date. It is clear however that as drilling activity now moves into new areas as a result of the 11th and strategic licensing rounds the present scheme will need revision. Names presented herein are based on marine fauna of Norwegian waters together with coastal or offshore geographic names.

Ingøydjupet Group (Ingøydjupgruppen)

Name:
From a deep to the north of Sørøya at 71°30'N, 22°30'E. The present concept of the group does not differ from that of T1 or the Lofoten group of informal usage.

Fig 38 TERTIARY WELL 6407/1-2

TYPE SECTION KAI FORMATION,
REFERENCE SECTION NORDLAND GROUP

1 : 2000

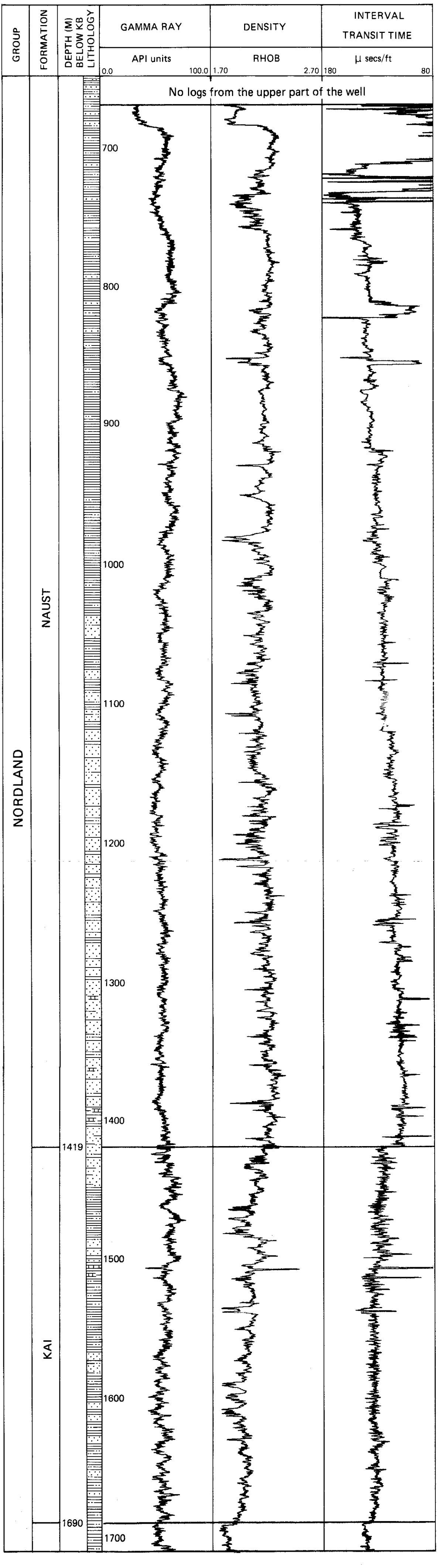
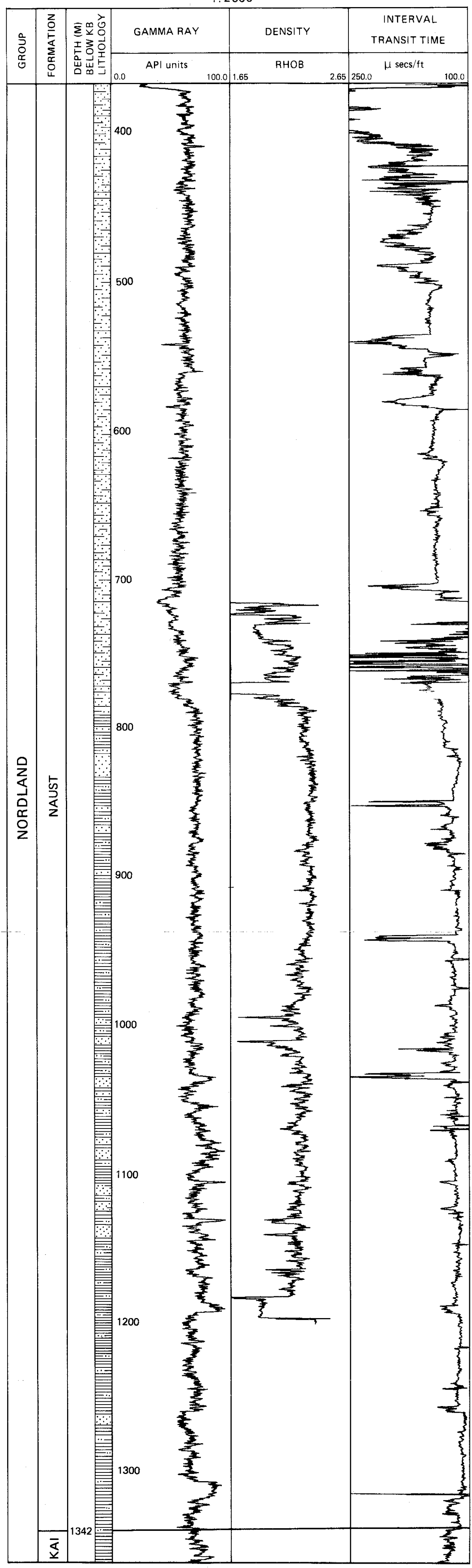


Fig 39 TERTIARY WELL 6507/12-1

TYPE SECTION NAUST FORMATION

1:2000



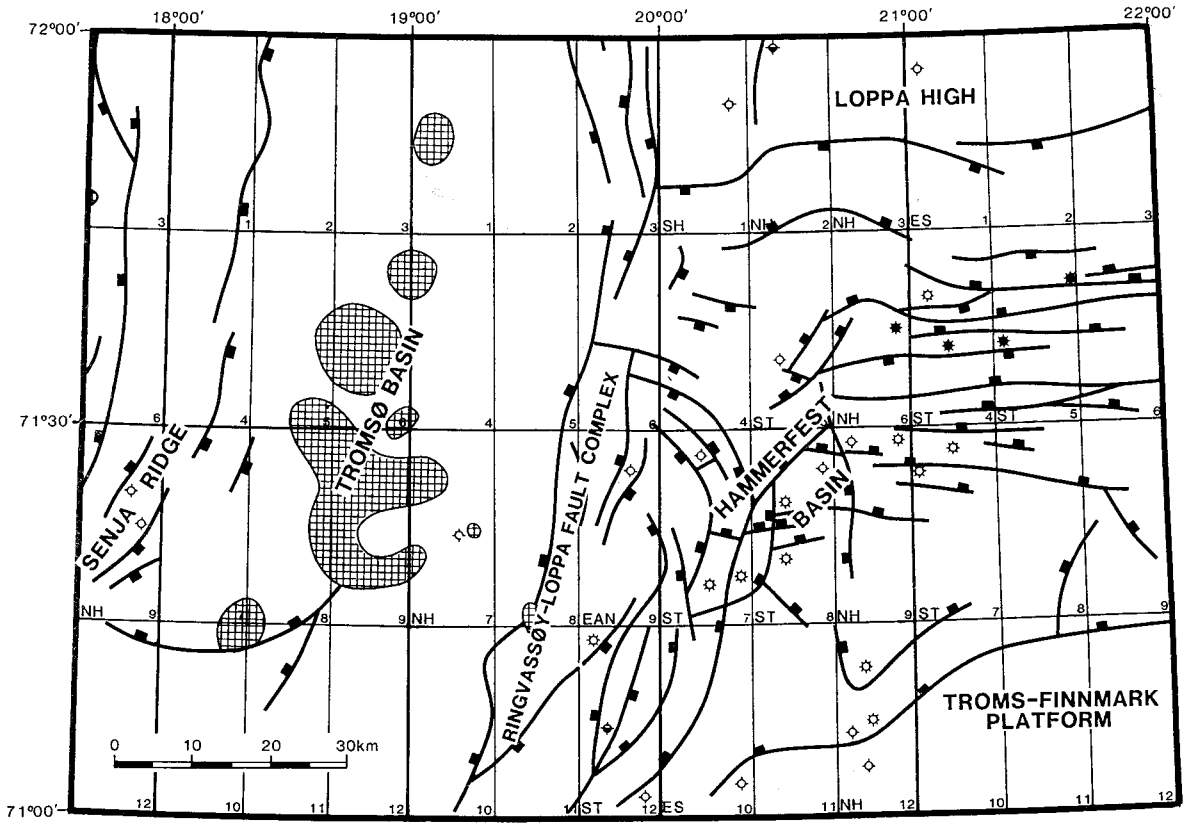


Fig 40 Tromsøflaket, main structural features and well coverage

Type area:
Block 7120/12, where parts of the group are penetrated in four wells. Both base and top are seen in 7120/12–2, but approximately 400 m of the upper part are faulted out in that well. This missing sequence is displayed in 7120/12–1.

Reference area:
Lateral variation is illustrated in Block 7120/9.

Thickness:
Approximately 1700 m thick in the type area, thickening northwards to 2400 m in 7120/9–2.

Lithology:
Grey to black shales and claystones dominate, but thin grey siltstones and sandstones are also significant components, especially in the upper part. Minor carbonate and coal interbeds also occur.

Basal Stratotype:
The base of the lowermost Havert Formation is defined by changes in gamma ray, sonic and density log responses.

Lateral extent and variation:
The group is thick throughout the Hammerfest Basin, with an attenuated lower part onlapping the crest of the Loppa High to the north. The upper parts have been eroded from the Troms-Finnmark Platform.

Age:
Griesbachian to early Norian.

Correlation:
Internal sequences and general development show great similarities to the Sassendalen Group and lower parts of the Kapp Toscana Group on Svalbard (c.f. Mørk *et al.* 1982, Jacobsen and van Veen 1984).

Depositional environment:
Marine environments in the lower parts of the group suggest coastlines to the south and southeast of the Hammerfest Basin and progressive onlap of the Loppa High to the north. The upper parts reflect northwestwards deltaic progradation over an extensive, low relief depositional basin.

Subdivision:
The group comprises four formations, with names based on different seals found in northern waters.

Havert Formation (Havertformasjonen)

Name:
From the seal species *Halichoerus grypus:* The unit corresponds to unit T1–1 or the Svolvær formation of earlier informal usage.

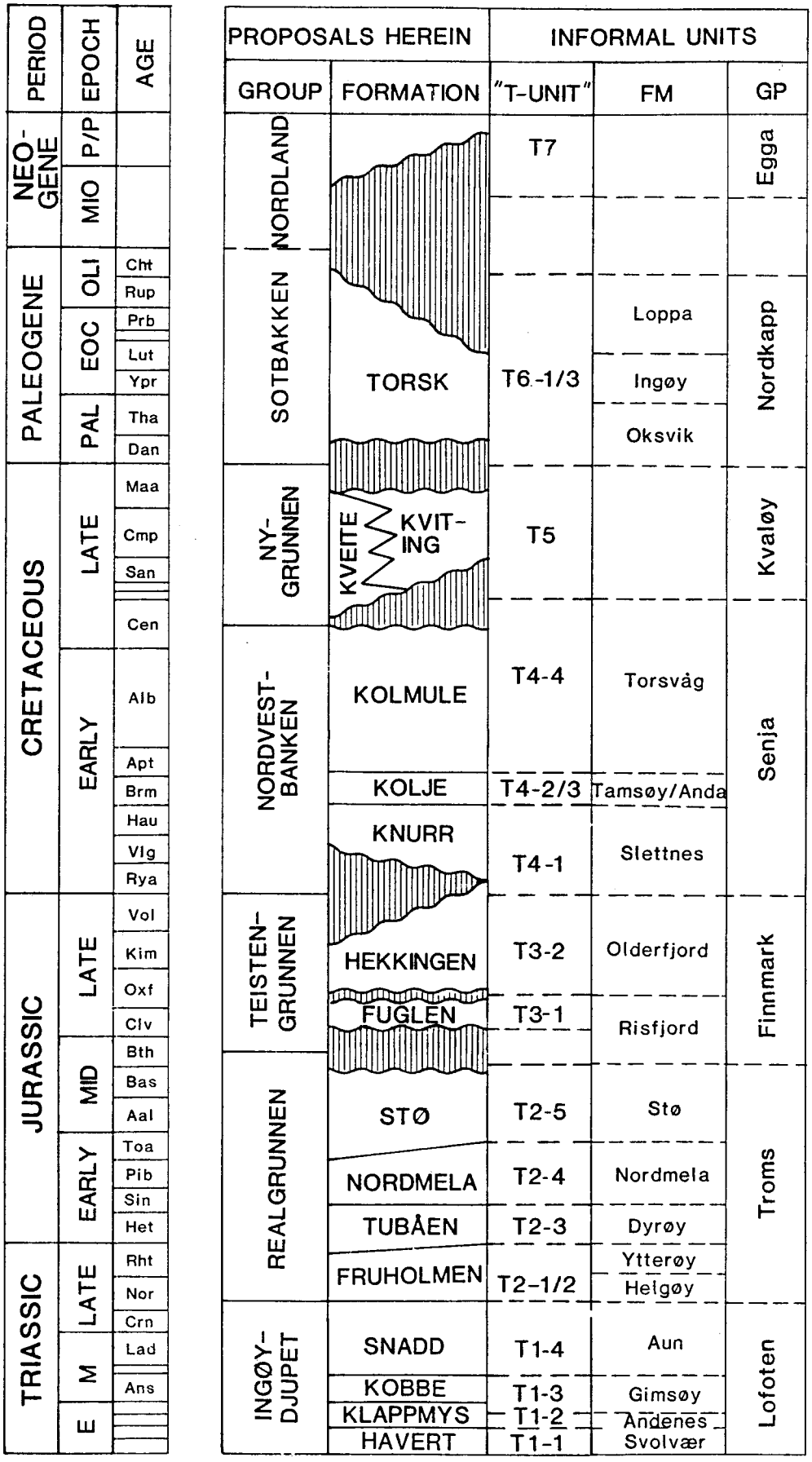


Fig 41 Lithostratigraphical scheme

TRIASSIC

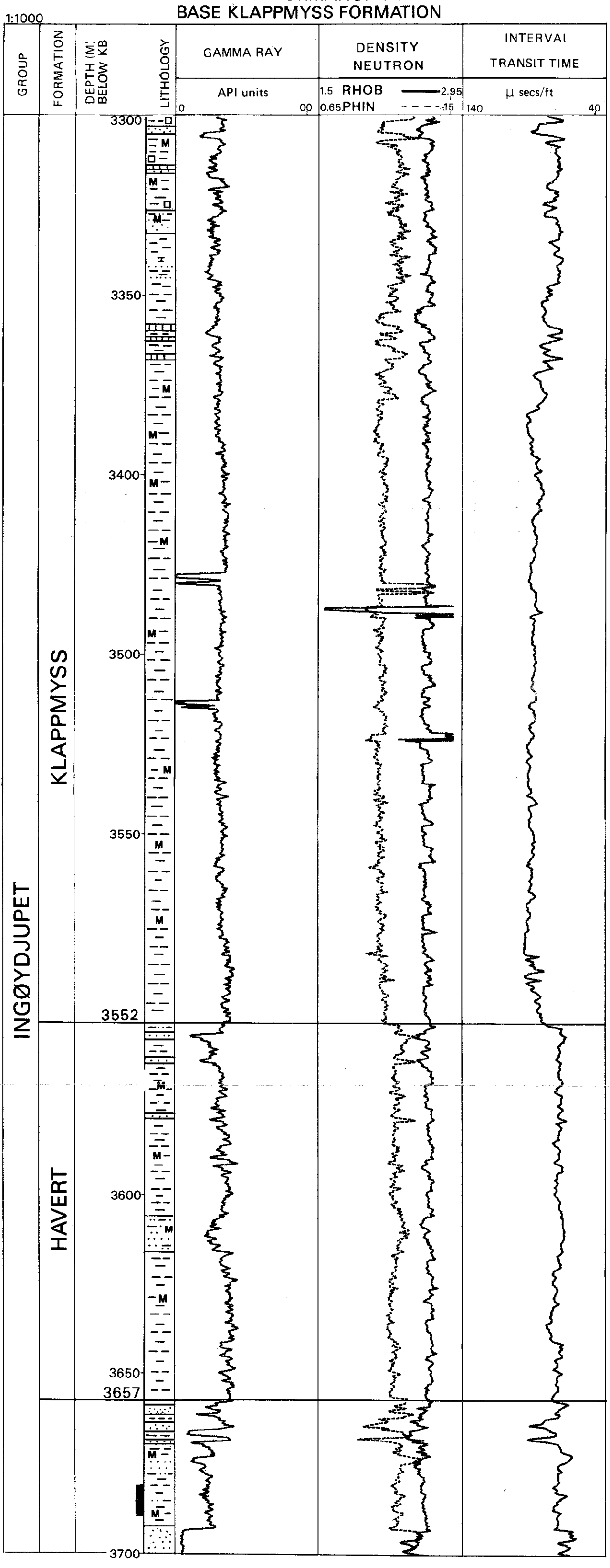
WELL 7120/12-2

TYPE SECTION

Fig 42

HAVERT FORMATION AND BASE KLAPPMYSS FORMATION

1:1000



TRIASSIC

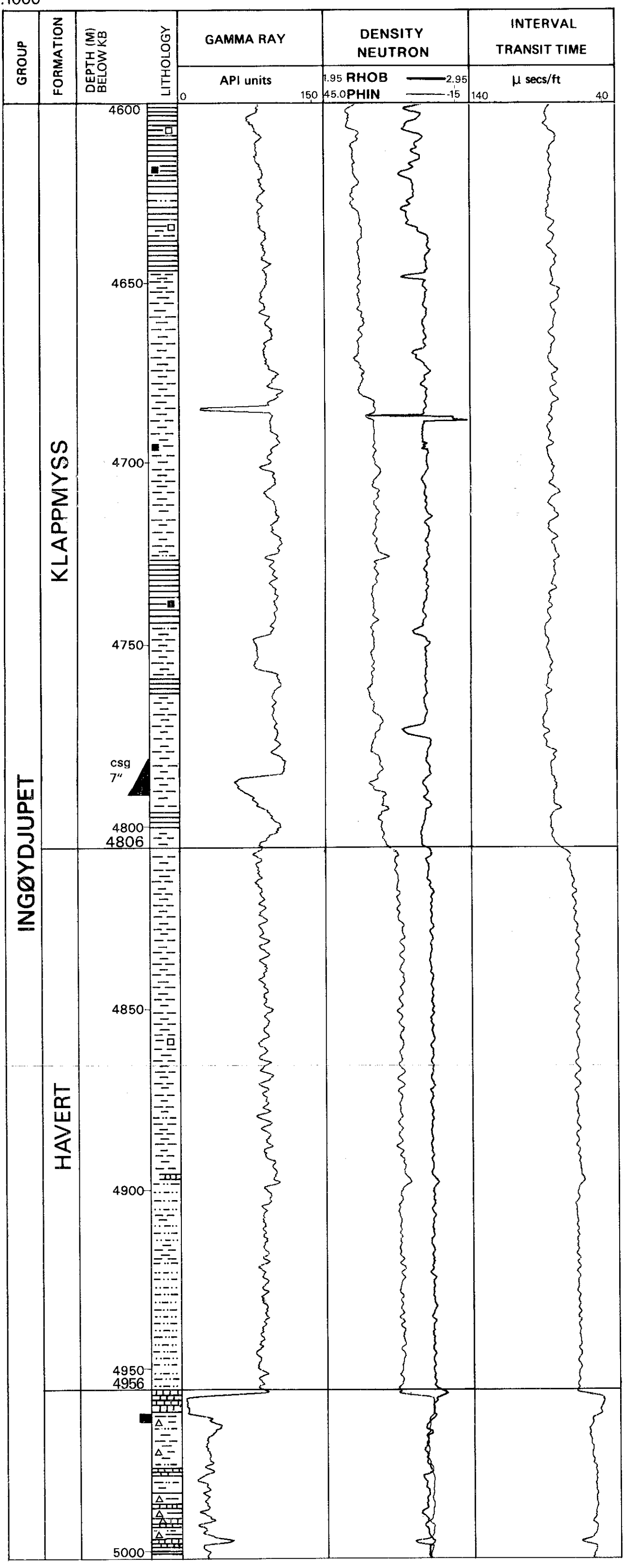
WELL 7120/9-2

REFERENCE SECTION HAVERT

Fig 43

FORMATION AND BASE KLAPPMYSS FORMATION

1:1000



Well type section:
Well 7120/12–2 (Norsk Hydro), coordinates 70°7'30.03"N, 20°48'19.00"E, from 3657 m to 3552 m (Fig. 42).

Well reference section:
Well 7120/9–2 (Norsk Hydro), coordinates 71°29'40.81"N, 20°42'05.38"E, from 4956 m to 4806 m (Fig. 43).

Thickness:
105 m in the type well and 150 m in the reference well.

Lithology:
In the type well the formation consists of medium to dark grey shales with minor interbedded pale grey siltstones and sandstones comprising two generally coarsening upwards sequences. The reference section further north in the Hammerfest Basin shows a more monotonous silty shale sequence with only a very weak upwards coarsening trend.

Basal Stratotype:
The base is defined by increasing gamma ray and decreasing density responses above underlying mixed clastic and carbonate sequences. In the reference well the base is also easily recognised as basal silty shales directly overlie a 6 m thick limestone bed.

Lateral extent and variation:
Present information suggests a fining trend from the southern margins of the Hammerfest Basin northwards. Thicknesses are moderate and show no marked trends.

Age:
Palynomorphs suggest a Griesbachian to Dienerian age.

Depositional environment:
The formation was deposited in marginal marine to open marine settings with coastal environments to the south and southeast.

Correlation:
Palynofloras and sequence development show similarities to the Vardebukta Formation of western Spitsbergen.

Klappmyss Formation (Klappmyssformasjonen)

Name:
The formation's name is derived from the seal species *Cystophora cristata*. The formation corresponds to T1–2 and the lower parts of T1–3 (Andenes and lower Gimsøy formations) of earlier informal terminology.

Well type section:
Well 7120/12–2 (Norsk Hydro), coordinates 71°7'30.03"N, 20°48'19.00"E, from 3552 m to 3095 m (Fig. 42).

Well reference section:
Well 7120/9–2 (Norsk Hydro), coordinates 71°29'40.81"N, 20°42'05.38"E, from 4806 to 4245 m (Fig 43).

Thickness:
457 m in the type well and 561 m in the reference well.

Lithology:
Medium to dark grey shales pass upwards into interbedded shales, siltstones and sandstones in the type well. The reference well shows a similar trend, but with more shale throughout.

Basal Stratotype:
The base is defined by clear log breaks, with increasing gamma ray, interval transit time and neutron porosity readings. This represents an important sequence boundary throughout the area, reflecting an early Smithian transgressive pulse.

Lateral extent and variation:
The formation thickens and fines northwards from the southern margins of the Hammerfest Basin.

Age:
Palynofloras suggest a Smithian to Spathian age.

Depositional environment:
Marginal to open marine environments are indicated, with renewed northwards coastal progradation following the early Smithian transgression.

Correlation:
The unit is equivalent to the Tvillingodden Formation of western Spitsbergen.

Kobbe Formation (Kobbeformasjonen)

Name:
From the Norwegian collective name for several seal species common in arctic waters. The unit corresponds to upper T1–3 or upper Gimsøy formation of earlier informal usage.

Well type section:
Well 7120/12–2 (Norsk Hydro), coordinates 71°7'30.03"N, 20°48'19.00"E, from 3095 to 2927 m (Fig. 44).

Well reference section:
Well 7120/9–2 (Norsk Hydro) coordinates 71°29'40.81"N, 20°42'05.38"E, from 4245 m to 3962 m (Fig. 45).

Thickness:
168 m in the type well and 283 m in the reference well.

Lithology:
A basal 20 m thick shale unit passes up into

interbedded shale, siltstone and carbonate cemented sandstone.

Basal Stratotype:
The formation is defined by upwards increasing gamma ray, interval transit time and neutron porosity responses into the basal shale. Log responses show much more variation above this unit.

Lateral extent and variation:
This unit shows a coarser proximal facies development, along the southern margin of the Hammerfest Basin and fines towards the basin axis. The formation thickens northwards from 140 m on the Troms – Finnmark Platform. Thicknesses vary more from platform to basin than in the underlying units.

Age:
An Anisian age is suggested by palynomorphs, with a probable break in deposition in the early and/or late Anisian.

Depositional environment:
A transgressive pulse marking the base of the unit was followed by renewed buildout of clastic marginal marine regimes from southern coastal areas.

Correlation:
The base of the formation is a clear regional marker, which elsewhere (on Svalbard and in the Sverdrup Basin) marks the onset of deposition of phosphatic organic rich shales. This facies, well displayed by the Botneheia Member of the Barentsøya Formation in central and eastern Svalbard, has not yet been encountered in the Hammerfest Basin. The Kobbe Formation shows greater similarities to the Bravaisberget Formation of western Spitsbergen.

Snadd Formation (Snaddformasjonen)

Name:
From the seal species *Pusa hispida.* The present formation corresponds to unit T1–4 or Aun formation of earlier informal terminology.

Well type section:
Well 7120/12–2 (Norsk Hydro) coordinates 71°07'30.03"N, 20°48'19.0"E, from 2927 m to 2354 m (Fig. 44).

Well reference sections:
Well 7120/12–1 (Norsk Hydro), coordinates 71°06'48.7"N, 20°45'20.1"E, from 3474 m to 2535 m. Well 7120/9–2 (Norsk Hydro) coordinates 71°29'40.81"N, 20°42'05.38"E, from 3962 m to 2552 m (Fig. 45).

Thickness:
The formation thins from 1410 m in 7120/9–2 to 944 m in 7120/12–1. An apparently anomalous thin development of 573 m in 7120/12–2 reflects faulting out of approximately 400 m of the middle and upper parts of the unit.

Lithology:
Basal grey shales coarsen up into shales with interbeds of grey siltstones and sandstones. Limestones and calcareous interbeds are relatively common in the lower and middle parts of the unit, while thin coaly lenses are developed locally further up. Distinctive dusky red-brown shales occur near the top of the unit. Lateral and vertical lithological variations may provide the basis for 2 to 4 member subdivisions or for the establishment of several formations.

Basal Stratotype:
The base represents a clear log break at the base of a 60 m shale interval above the mixed lithologies of the underlying unit. This is marked on logs by a sharp increase to a more uniform response in gamma ray, interval transit time and neutron porosity readings.

Lateral extent and variation:
High rates of deposition occurred throughout the area and there was little differentiation between earlier negative and positive structural elements. The unit contrasts with under- and overlying sequences in terms of palaeogeographic controls on sedimentation patterns, perhaps reflecting updoming of northern shelf margins.

Age:
A Ladinian to early Norian age is suggested. Correlations around the Ladinian/Carnian transition suggest earlier deposition of coarse clastics in central than in southern parts of the Hammerfest Basin.

Depositional environment:
The Ladinian sequence represents relatively distal marine environments in all wells, following a major transgressive pulse which submerged all structural highs and platform areas in the region. Input of storm-derived silts and sands from southern sources is indicated. The Carnian is marked by large-scale progradation of deltaic systems over the entire region.

Correlation:
The Snadd Formation shows great similarities in age and development to the lower and middle parts of the Kapp Toscana Group of Svalbard (the Tschermakfjellet and De Geerdalen formations).

Realgrunnen Group (Realgrunngruppen)

Name:
From a local fishing bank around 71°N and 20°E, to the NW of the island of Sørøya. The present group concept corresponds to T2 or the Tromsø group of earlier informal usage.

TRIASSIC

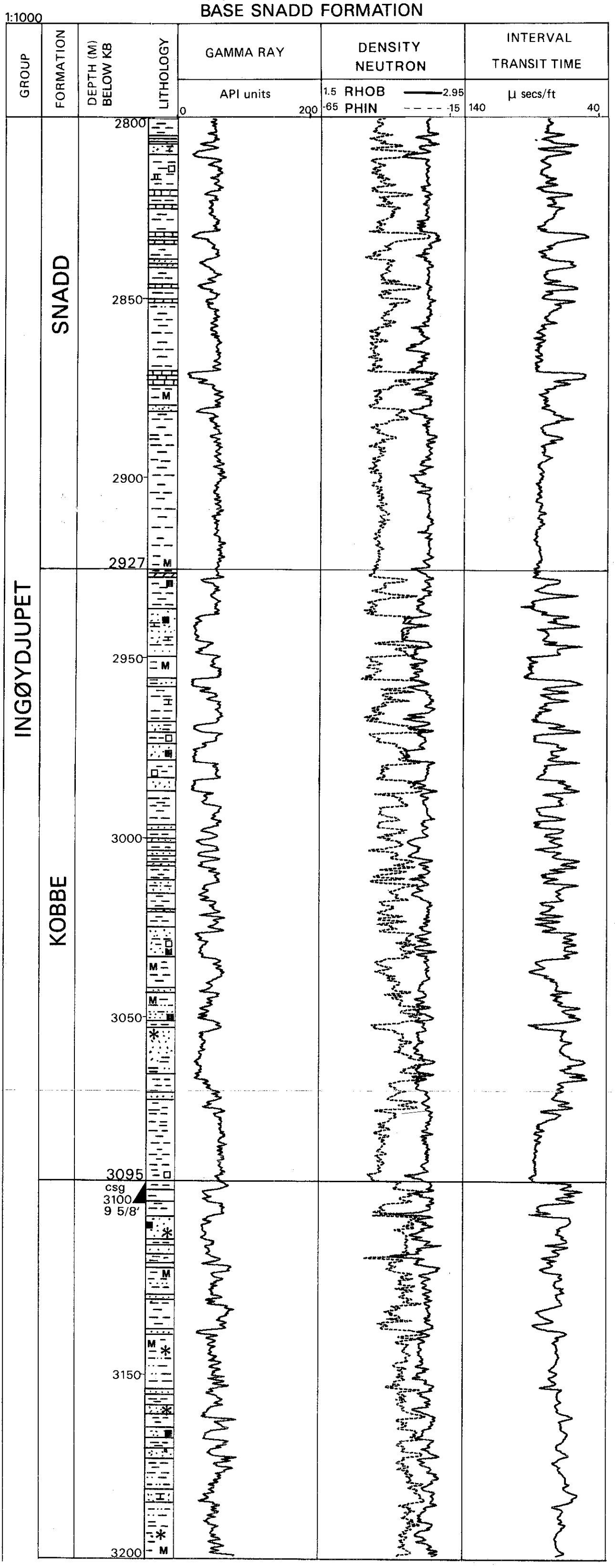
WELL 7120/12-2

TYPE SECTION

Fig 44

KOBBE FORMATION AND
BASE SNADD FORMATION

1:1000



Type area:
Block 7121/5 where the entire group is penetrated in well 7121/5–1.

Reference area:
Block 7119/12 for the upper, and 7120/12 for the lower parts of the group.

Thickness:
425 m in well 7121/5–1, 490 m in block 7120/12.

Lithology:
Pale grey sandstones dominate the group, especially in its middle and upper parts. Shale intervals are most common in the lower parts, where thin coals also occur.

Definition:
The lower boundary is defined by the basal shales of the Fruholmen Formation. This represents an important transgressive episode which produced a sequence boundary traceable throughout the European and American Arctic from Tromsøflaket to the Sverdrup Basin (c.f. the Barrow Formation of Embry 1982).

Lateral extent and variation:
The group is present throughout the Hammerfest Basin, and probably thickens markedly into the Tromsø Basin (although not yet penetrated in wells there). The upper parts of the group contain seismic markers which can be followed over large areas of the Barents Sea. At least parts of the group were probably also originally deposited on the Loppa High and Troms-Finnmark Platform, but were subsequently eroded from these areas during Kimmerian movements.

Age:
Preserved sections through the group are dated as early Norian to Bajocian; condensed sequences uppermost and a locally erosive top reflect Kimmerian uplift.

Depositional environment:
Following initial transgression in the early Norian, the remainder of the late Triassic saw the development of prograding deltaic systems over the southern parts of the Hammerfest Basin. Coastal marine environments became established in the course of the early Jurassic. The main reservoir sandstones of the Stø Formation were deposited in a variety of shoreface, barrier and tidal inlet regimes (c.f. Olaussen *et al.* 1984, Berglund *et al.* 1986).

Correlation:
The group is generally time-equivalent and shows a similar development to the Wilhelmøya Formation of eastern Svalbard and to the Båt and Fangst groups of the mid-Norwegian shelf.

Subdivision:
As used herein, the group comprises 4 formations, with names taken from small settlements on the islands of Andøya and Langøya in Vesterålen, and from lighthouses in northern Norway. This procedure is adopted as the terms Stø and Nordmela are now well entrenched in the literature: furthermore the presentation of these units by Olaussen *et al.* (1984) is regarded as satisfying standards set for definition of lithostratigraphical units.

Fruholmen Formation (Fruholmformasjonen)
Name:
From a lighthouse on a skerry north of Ingøy in Finnmark. The present formational concept embraces the two units T2–1 and T2–2 (Helgøy and Ytterøy formations) of earlier informal usage.

Well type section:
Well 7121/5–1 (Statoil), coordinates 71°35′54.88″N, 21°24′21.78″E, from 2793 m to 2572 m (Fig. 46).

Well reference section:
Well 7120/12–1 (Norsk Hydro), coordinates 71°06′48.7″N, 20°45′20.1″E, from 2535 m to 2337 m (Fig. 47).

Thickness:
From 221 m in the type well to 198 m in 7120/12–1.

Lithology:
Basal grey to dark grey shales pass gradually upwards into interbedded sandstones, shales and coals. Sand dominates in the middle of the formation in several wells, while the upper part is more shaly, prompting a tripartite subdivision into (ascending order) the Akkar (Squid) Reke (Prawn) and Krabbe (Crab) members. The extent of these members in the type and reference wells are shown in Figs 46 and 47.

Basal Stratotype:
The base of the formation (and of the Akkar Member) is defined by a marked increase in gamma ray and neutron porosity logs, but often more moderate increases in interval transit time and bulk density readings.

The middle Reke Member is characterized by a lower gamma ray response, but its base can be best defined by a carbonate bench above which the separation between density and porosity logs decreases markedly. This separation increases again at the base of the uppermost Krabbe Member. A characteristic feature of the Reke and Krabbe members are funnel-shaped gamma ray responses.

Lateral extent and variation:
No marked trends in lateral variation are suggested by present data, although few wells have yet penetrated the entire formation; the

thickest sequence (262 m) is seen in well 7120/9-2. The unit may be represented in its entirety further to the north in the Hammerfest Basin by the more shaly marine lithofacties of the Akkar Member passing up into sands of the overlying Tubåen Formation.

Age:
The base of the formation is early Norian. The top corresponds in general to the Triassic/ Jurassic transition, but available data indicate that it is somewhat diachronous.

Depositional environment:
Open marine shales of the Akkar Member pass up into coastal and fluvial sandstone dominated sequences of the Reke Member. These represent northward fluviodeltaic progradation with a depocentre to the south. As the main deltaic input shifted laterally, most of the central and southern parts of the basin became the site of flood-plain deposition, with more marine environments to the north.

Subdivision:
Present information suggests subdivision into three members as described above.

Tubåen Formation (Tubåformasjonen)
Name:
From a fishing bank off the northern point of Sørøy (Finnmark). The present formational concept corresponds to T2–3 or the Dyrøy formation of earlier informal usage.

Well type section:
Well 7121/5–1 (Statoil), coordinates 71°35'54.88"N, 21°24'21.78"E, from 2572 to 2507 m. The entire upper part of the formation (from 2542 m) is cored in this well (Fig. 46).

Well reference section:
Well 7120/12–1 (Norsk Hydro), coordinates 71°06'48.7"N, 20°45'20.1"E, from 2337 to 2250 m (Fig. 47).

Thickness:
The formation is relatively thin in its type and reference wells (65 m and 87 m respectively).

Lithology:
The formation is dominated by sandstones with subordinate shales and minor coals. Coals are most abundant near southeastern basinal margins, and die out to the northwest. The formation generally has a tripartite development, with a lower and upper sand-rich unit separated by a more shaly interval. Shale content increases towards the northwest where the Tubåen Formation may intercalate with a lateral shale equivalent.

Definition:
The base is taken on gamma ray logs at the first significant sand with blocky to bell-shaped response patterns above the more irregular high responses of the underlying unit. There is also a marked change in the separation pattern between the neutron porosity and bulk density logs.

Lateral extent and variation:
Greatest thicknesses, in the order of 150 m, are seen in the Askeladden area (blocks 7120/7 and 8), and isopachs appear to follow a WSW-ENE trend. The formation is expected to have a distribution subparallel to the Troms – Finnmark Fault Complex. It appears to shale out towards the northwest.

Age:
The formation base is of late Rhaetian to early Hettangian age; the unit may locally extend upwards into the Sinemurian.

Depositional environment:
The unit's sands are thought to represent a stacked series of high energy marginal marine (tidal inlet dominated barrier complex and/or estuarine) deposits. Marine shales reflect more distal environments to the northwest, while coals and shales to the south-east were deposited in protected back-barrier lagoonal environments.

Nordmela Formation (Nordmelaformasjonen)
Name:
Nordmela is a small community on the west coast of Andøya. Our use of the term corresponds to the description by Olaussen *et al.* (1984) and to the informal term T2–4.

Well type section:
Well 7121/5–1 (Statoil), coordinates 71°35'54.88"N, 21°24'21.78"E, from 2507 to 2445 m. The entire formation is cored in this well (Fig. 48).

Well reference section:
Well 7119/12–2 (Statoil), coordinates 71°00'51.81"N, 19°58'20.81"E, from 1719 m to 1517 m. All but the basal 31 m are cored in this well (Fig. 49).

Thickness:
62 m in the type well and 202 m in the reference well.

Lithology:
The formation consists of interbedded siltstones, sandstones, shales and claystones with minor coals. Sandstones become more common towards the top.

Basal Stratotype:
The base is defined by a sharp increase in gamma ray response to high, irregular, patterns in contrast to the cylindrical, blocky to bell-shaped pattern of the underlying unit. This shift is accompanied by an increase in bulk density readings.

TRIASSIC

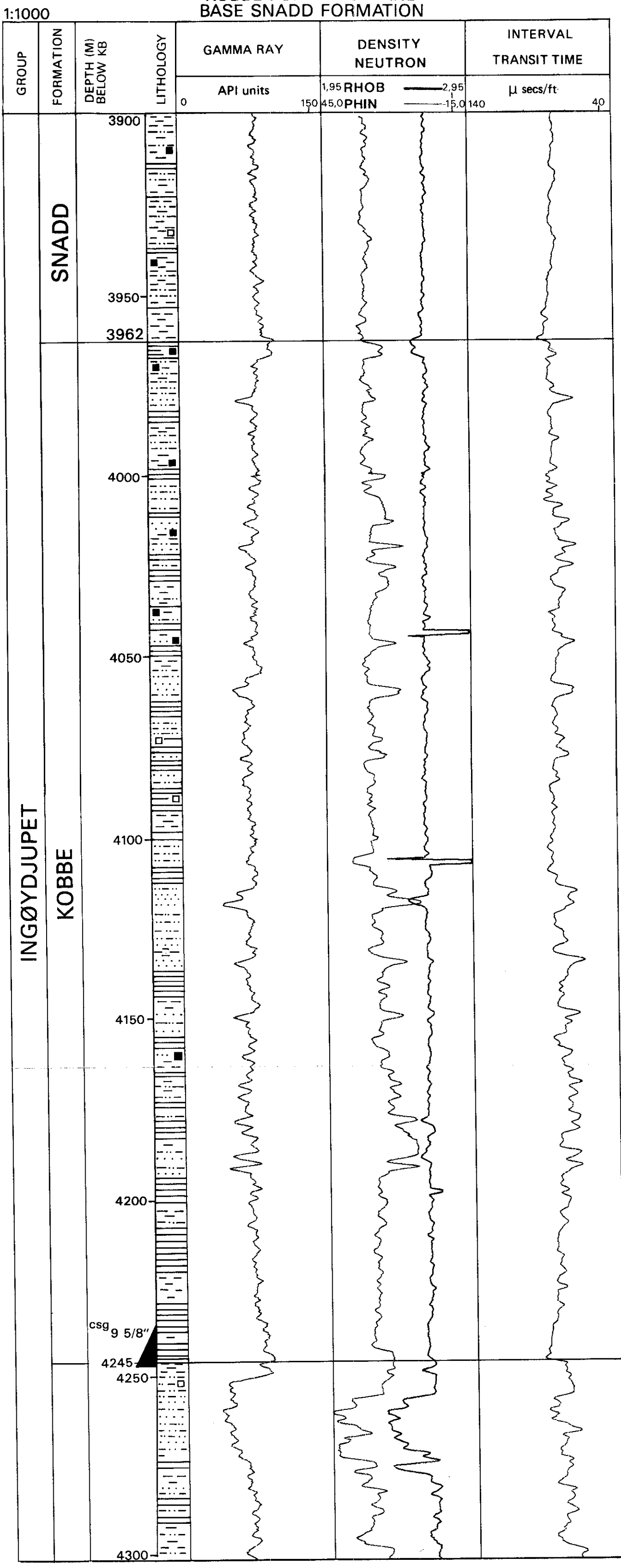
WELL 7120/9-2

REFERENCE SECTION

Fig 45

KOBBE FORMATION AND
BASE SNADD FORMATION

1:1000



JURASSIC

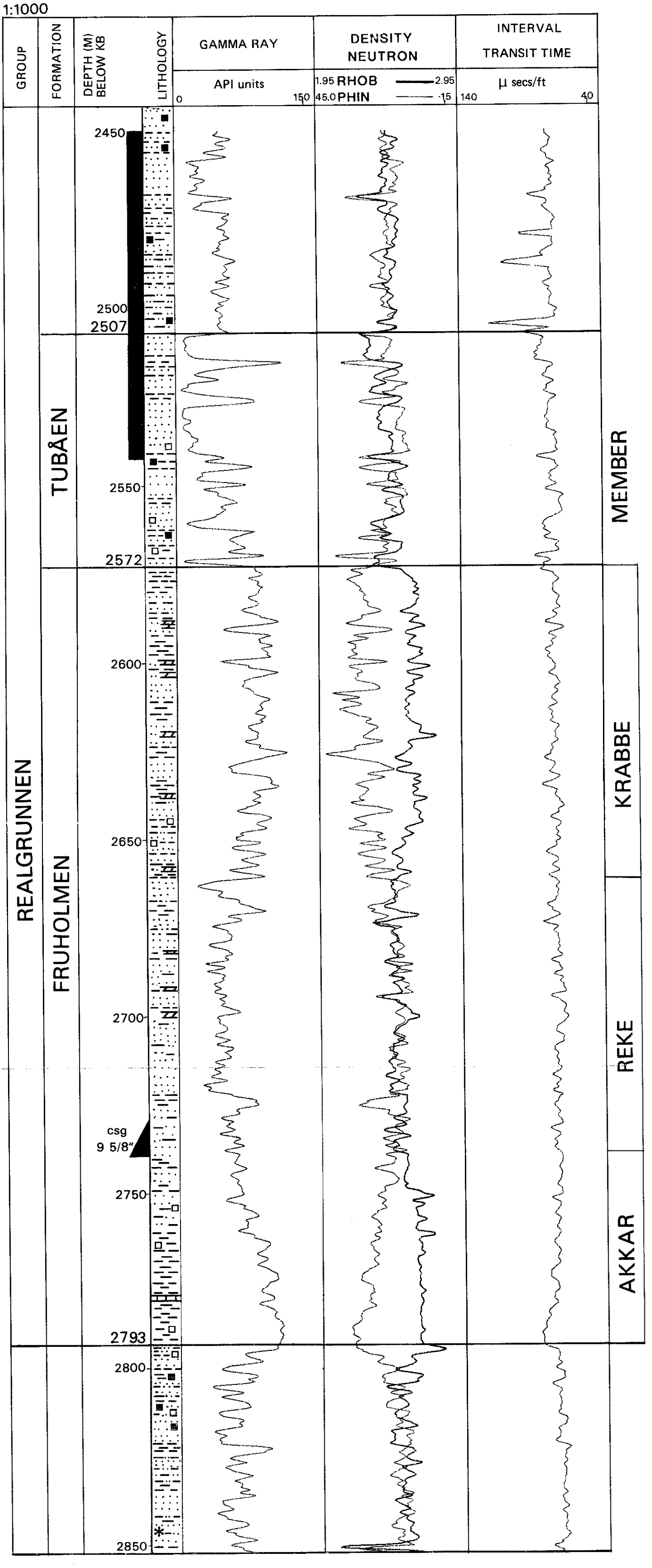
WELL 7121/5-1

TYPE SECTION

Fig 46

FRUHOLMEN AND TUBÅEN FORMATIONS

1:1000



JURASSIC AND TRIASSIC

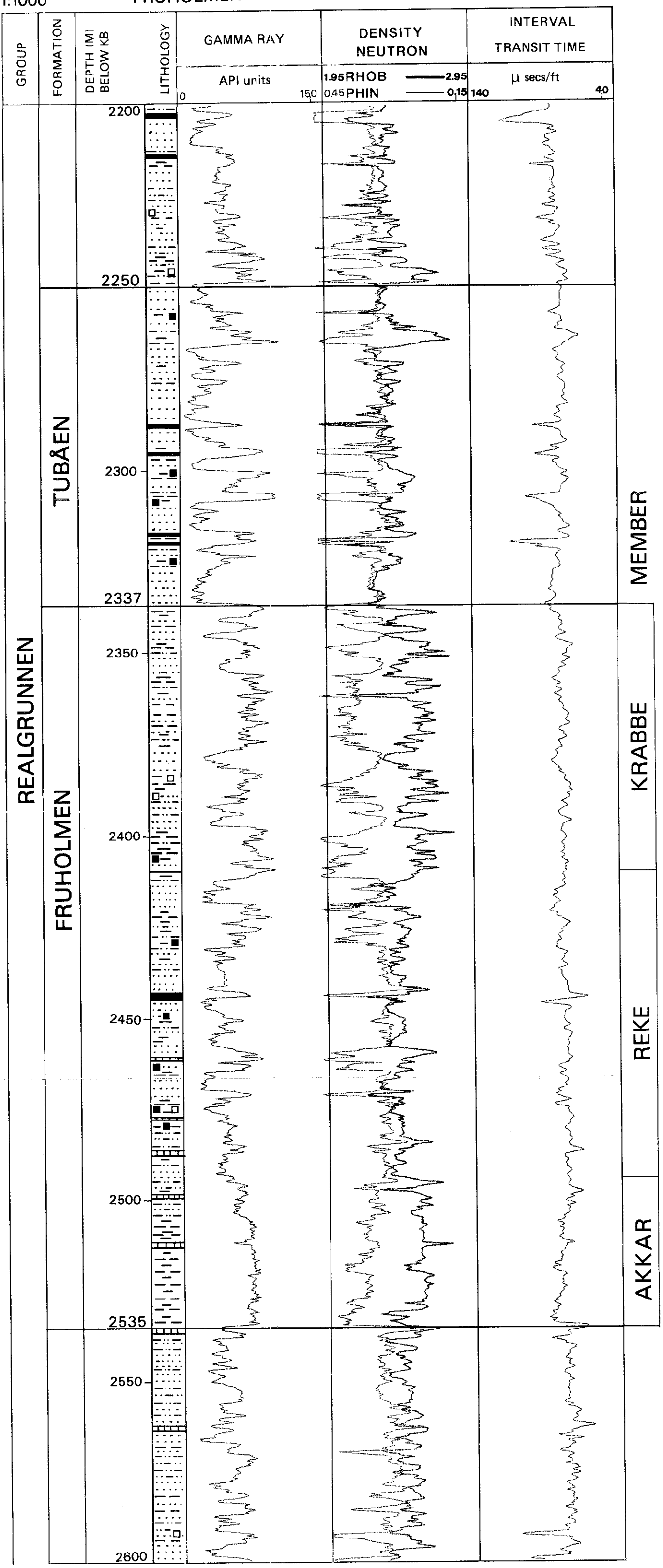
WELL 7120/12-1

REFERENCE SECTION

Fig 47

1:1000

FRUHOLMEN AND TUBÅEN FORMATIONS



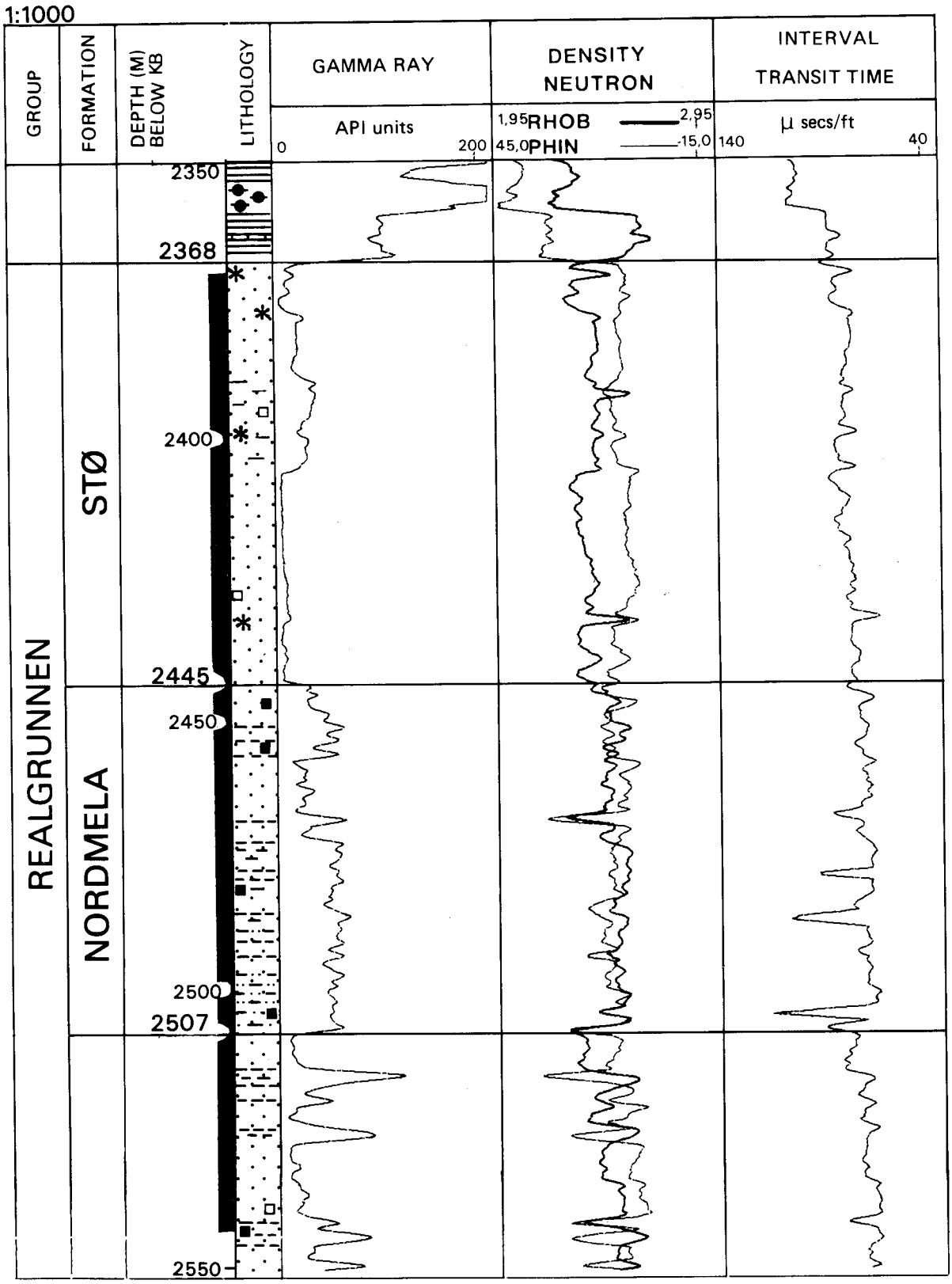
JURASSIC

WELL 7121/5-1

TYPE SECTION

Fig 48

STØ AND NORDMELA FORMATIONS



Lateral extent and variation:
Thickness variation between the type and reference wells clearly illustrates a southwest thickening wedge. This is in marked contrast to the underlying Tubåen Formation. Westwards thickening may be the result of early Kimmerian subsidence over the site of the Ringvassøy – Loppa Fault Complex.

Age:
The formation extends from the Sinemurian to the late Pliensbachian in the reference area. Its top may be diachronous, younging eastwards into the Toarcian in the type section.

Depositional environment:
The formation was deposited in tidal flat to flood plain environments. Individual sandstone sequences represent estuarine and tidal channels which dissected this lowlying area.

Stø Formation (Støformasjonen)

Name:
Stø is a farm on the northern coast of Langøya in Vesterålen. Our use of the term corresponds to the description by Olaussen *et al.* (1984) and to the informal term T2–5.

Well type section:
Well 7121/5–1 (Statoil), coordinates 71°35′54.88″N, 21°24′21.78″E, from 2445 m to 2368 m. All but the uppermost 3 m of the formation are cored in this well (Fig. 48).

Well reference section:
Well 7119/12–2 (Statoil), coordinates 71°00′51.81″N, 19°58′20.81″E, from 1517 m to 1372 m. Most of the lower and upper thirds of the formation are covered by cores, although base and top are not represented (Fig. 49).

Thickness:
77 m in the type well and 145 m in the reference well.

Lithology:
Moderately to well-sorted and mineralogically mature sandstones are dominant. Thin units of shale and siltstone are clear markers; phosphatic lag conglomerates occur in some wells, especially in upper parts of the unit.

Basal Stratotype:
The base is defined by the sharp transition from regular and serrated gamma ray patterns of the underlying unit to the blocky to smooth cylindrical patterns of this sequence. Density readings decrease upwards over the boundary, but this change is more gradual.

Lateral extent and variation:
The formation is thickest in southwestern wells, thinning generally eastwards. This pattern corresponds to that of the underlying Nordmela Formation. The entire unit may be divided into 3 depositional sequences, with bases defined by transgressive episodes. The basal sequence is only present in the western parts of the Hammerfest Basin. The middle (late Toarcian/Aalenian) sequence represents maximum transgression in the area. The uppermost Bajocian sequence is highly variable owing to syndepositional uplift and winnowing and to later differential erosion.

Age:
A late Pliensbachian to Bajocian age is indicated by present data. The base is apparently diachronous, younging from west to east in the Hammerfest Basin.

Depositional environment:
The sands in the formation were deposited in prograding coastal regimes, and a variety of linear clastic coast lithofacies are represented. Marked shale/siltstone intervals represent regional transgressive pulses in the late Toarcian and late Aalenian.

Teistengrunnen Group (Teistengrunngruppen)

Name:
The group is named after a fishing bank to the north of Ringvassøy around 70°45′N and 18°E. The group corresponds to unit T3 or the Finnmark group of earlier informal usage.

Type area:
In the northern parts of Block 7120/12 near the southern margins of the Hammerfest Basin.

Thickness:
The group shows great variations in thickness, from over 300 m immediately north of the Troms – Finnmark Fault Complex to approximately 60 m on the structural highs in the centre of the Hammerfest Basin. This reflects the effects of Kimmerian movements defining these highs as positive features.

Lithology:
Shales and claystones contain minor thin interbeds of marly dolomitic limestone and only rare siltstones or sandstones.

Basal Stratotype:
The base is defined by the transition from the sands of the underlying Stø Formation into the calcareous mudstones of the Fuglen Formation.

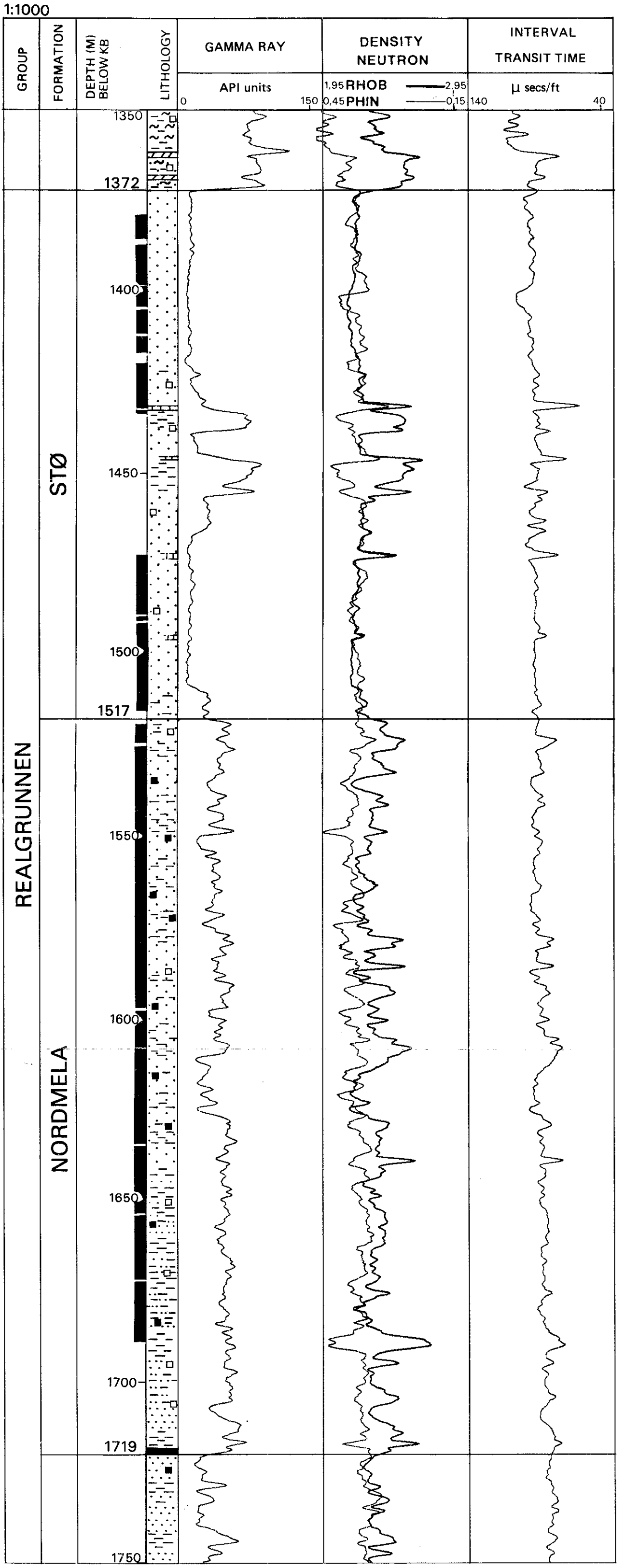
Lateral extent and variation:
The group is present in all wells in the Hammerfest Basin. The Troms-Finnmark Platform as probably emergent during deposition in the basin.

Age:
Late Callovian to Ryazanian in most wells; the late Bathonian/early Callovian interval may be present locally.

JURASSIC
WELL 7119/12-2
REFERENCE SECTION
STØ AND NORDMELA FORMATIONS

Fig 49

1:1000



Depositional environment:
Deposition occurred in relatively deep and quiet marine environments.

Correlation:
The unit is similar to the Agardhfjellet Member of the Janusfjellet Formation on Svalbard, and to the Grip Group of the mid-Norwegian shelf.

Subdivision:
The group comprises two formations. Formational names are taken from lighthouses on the coast of northern Norway.

Fuglen Formation (Fuglenformasjonen)
Name:
Fuglen lighthouse is situated on the western tip of Sørøy at 70°40'N and 21°55'E. The unit corresponds to T3–1 or Risfjord formation of earlier informal schemes.

Well type section:
Well 7120/12–1 (Norsk Hydro), coordinates 71°06'48.7"N, 20°45'20.1"E, from 2047 m to 2019 m (Fig. 50). The lowermost 5 m and the contact with the underlying Stø Formation are cored in this well.

Well reference section:
Well 7119/12–1 (Statoil), coordinates 71°06'08.00"N, 19°47'40.29"E, from 2658 to 2610 m (Fig. 51).

Thickness:
28 m in the type well and 48 m in the reference well.

Lithology:
Pyritic mudstones with interbedded thin limestones give characteristic gamma, sonic and density log responses. The shales are dark brown and the limestones white to brownish grey.

Basal Stratotype:
The lower boundary is marked by sharp increases in gamma ray and density responses and by an accompanying decrease in interval transit time.

Lateral extent and variation:
The formation is thickest in southwestern parts of the Hammerfest Basin, thinning to less than 10 m on the central highs in the basin; these areas are characterized by rare, thin limestones and by pyritic shales.

Age:
Late Callovian to Oxfordian.

Depositional environment:
The formation was deposited in marine environments during a highstand with ongoing tectonic movements. Coarse clastic sources were not emergent, but local block structures were the sites of low sedimentation rates.

Hekkingen Formation (Hekkingenformasjonen)
Name:
The formation name is taken from Hekkingen Lighthouse at 69°30'N and 17°40'E on the northern tip of Senja. The formation corresponds to T3–2 or Olderfjord formation of earlier usage.

Well type section:
Well 7120/12–1 (Norsk Hydro), coordinates 71°06'48.7"N, 20°45'20.1"E, from 2019 m to 1660 m (Fig. 50). Two short cores have been taken between 1661 and 1668 m and between 1702.6 and 1707.6 m.

Well reference section:
Well 7119/12–1 (Statoil), coordinates 71°06'08.00"N, 19°47'40.29"E, from 2610 to 2497 m (Fig. 51).

Thickness:
359 m in the type well and 113 m in the reference well.

Lithology:
The formation consists of brownish-grey to very dark grey shale and claystone with occasional thin interbeds of limestone, dolomite, siltstone and sandstone. These minor clastic components are most common towards basinal margins. Lower parts of the formation show especially high gamma ray readings. This is used to differentiate the lower Alge from the upper Krill Member in the formation (Figs 50 and 51).

Basal Stratotype:
The base is defined by the transition from carbonate cemented and pyritic mudstones to poorly consolidated shales, producing a sudden increase in interval transit time and an abrupt decrease in bulk density values.

Lateral extent and variation:
The formation is thickest in its type well. It thins northwards to less than 100 m towards the axis of the Hammerfest Basin. This pattern reflects the development of semigrabens along basin margins while doming was active along the basin axis.

Age:
Palynomorphs suggest an age span of late Oxfordian/early Kimmeridgian to Ryazanian. There are local breaks in deposition at the base and top, probably most developed near the basinal axis.

Depositional environment:
Marine, deep water with anoxic conditions resulted from the formation of local barriers to circulation by Kimmerian movements.

Nordvestbanken Group (Nordvestbankgruppen)

Name:
From a local fishing bank around 70°20′N, 18°30′E, NE of the island of Vannøy. The present group concept is the same as that of unit T4 or the Senja group of earlier informal usage.

Type area:
Block 7119/12, where the group is penetrated by three wells. Base and top are seen in well 7119/12–1. A complete sequence seen in northern parts of 7120/12 illustrates lateral variation in the group.

Thickness:
1440 m in the type well, thinning to 918 m in the reference well.

Lithology:
Dark grey to grey-brown shales and claystones dominate, with thin interbeds of grey to grey-brown siltstone, limestone and dolomite.

Basal Stratotype:
The base of the lowermost Knurr Formation is defined on changes in gamma ray, sonic and density log response.

Lateral extent and variation:
The group shows little lithological variation throughout the Ringvassøy-Loppa Fault Complex and Hammerfest Basin. Along the western margins of the basin it thickens towards the fault complex. Thickness variations within the Hammerfest Basin itself are more closely related to basin-parallel main phase Kimmerian structures. The thinnest sequences are seen over the central dome, and the group thickens both north- and southwards before wedging out in onlap sequences against both the Loppa High and the Troms-Finnmark Platform.

Age:
Valanginian to Cenomanian.

Subdivision:
The group comprises three formations, with names based on different fish found in Norwegian waters. Four formations were recognized in earlier informal usage. The middle two of these units are now combined in the Kolje Formation because of basic lithological similarities. However, a break in deposition in the middle of the unit may be used to designate two member units.

Depositional environment:
Marine environments throughout the group are dominated by distal conditions with periodic restricted bottom circulation. Clastic fans built out from the emergent Loppa High, but the Troms-Finnmark platform was a much less marked feature.

Correlation:
The group correlates to the upper parts of the Adventdalen Group of Svalbard. However, the Adventdalen Group shows effects of repeated deltaic progradations in the early Cretaceous, and youngest sequences exposed in Svalbard are of Albian age. Southern shelf areas were more remote from the updoming shelf margins responsible for the Svalbard development, and show more continuous fine-grained deposition.

Knurr Formation (Knurrformasjonen)

Name:
From the fish species *Eutrigla gurnardus* (grey gurnard). The formation corresponds to T4–1 or Slettnes formation of earlier informal terminology.

Well type:
Well 7119/12–1 (Statoil), coordinates 71°06′08.00″N, 19°47′40.29″E from 2497 m to 2441 m (Fig. 51).

Well reference section:
Well 7120/12–1 (Norsk Hydro), coordinates 71°06′48.7″N, 20°45′20.1″E, from 1660 to 1375 m. A core was taken between 1535 and 1546 m in this well (Fig. 50).

Thickness:
56 m in the type well and 285 m in the reference well.

Lithology:
In the type well the formation consists of dark grey to greyish brown claystone with thin limestone and dolomite interbeds. Thin sandstones are also seen in the unit's lower parts, but these disappear laterally into the Hammerfest Basin. Red to yellow brown claystone generally occurs in the upper parts of the formation.

Basal Stratotype:
The base is defined by decreasing gamma ray response and by the sonic log showing decreasing interval transit time. In the type well the density log response shows a slight decrease in an otherwise increasing trend across the boundary. However, the general pattern in most wells is an increase in the density log response accompanying the sonic log response. The base is marked by a thin sandy limestone in the reference well.

Lateral extent and variation:
Present data suggest similar lithologies in all wells which penetrate the formation. The sand content is somewhat higher close to the Troms-Finnmark Fault Complex (e.g. well 7120/12–1). Most complete sequences are seen along basin margins.

Age:
Dinoflagellates and foraminifera suggest a

JURASSIC

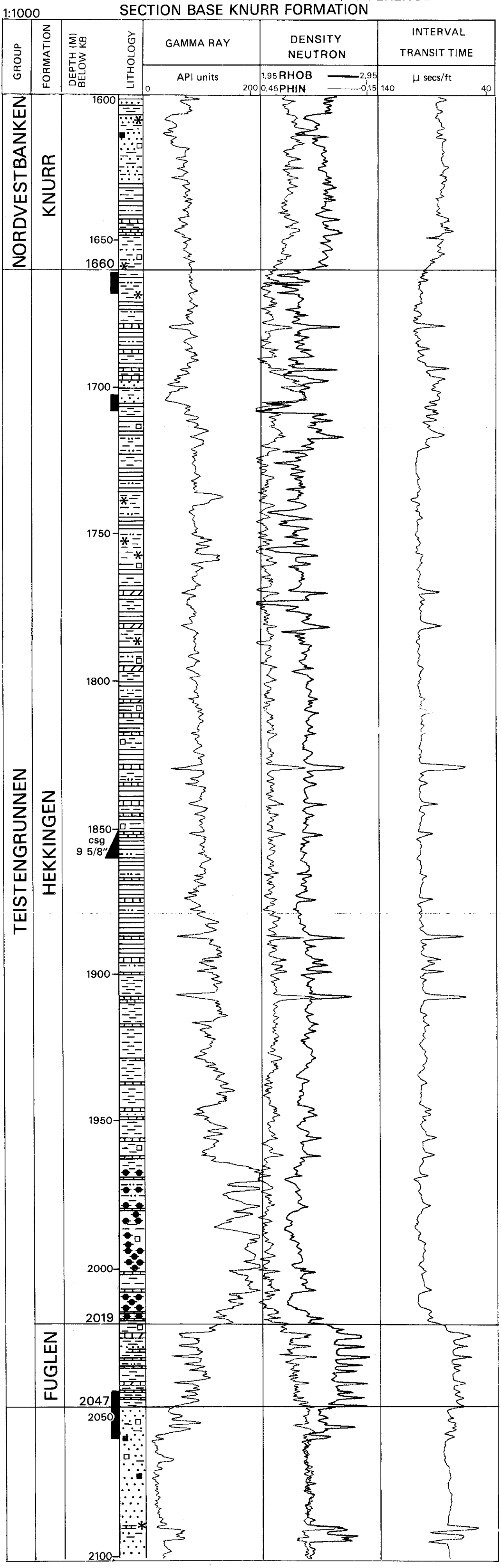
WELL 7120/12-1

TYPE SECTION

Fig 50

FUGLEN AND HEKKINGEN FORMATIONS, REFERENCE SECTION BASE KNURR FORMATION

1:1000



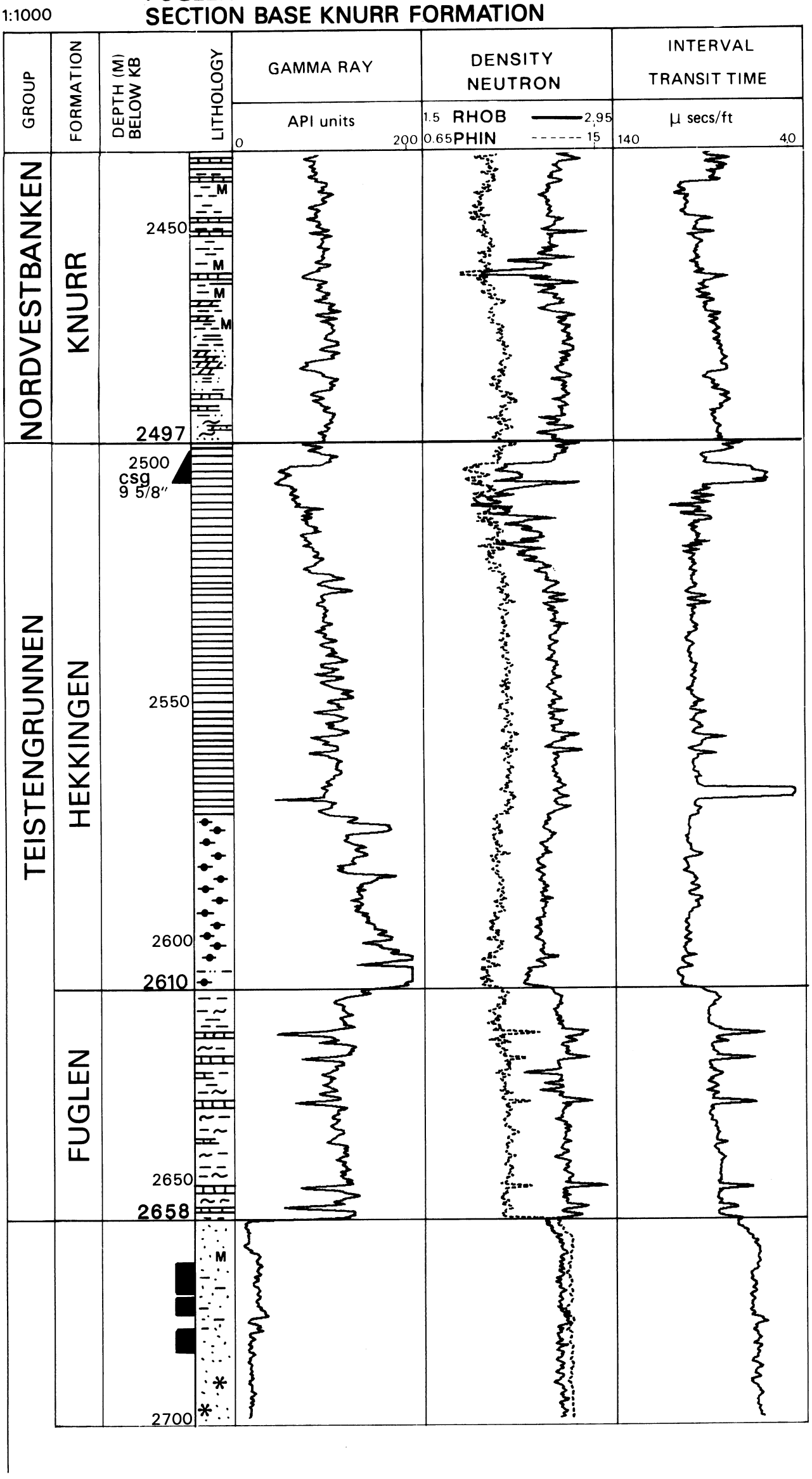
JURASSIC

WELL 7119/12-1
REFERENCE SECTION

Fig 51

1:1000

FUGLEN AND HEKKINGEN FORMATIONS, TYPE SECTION BASE KNURR FORMATION



Ryazanian/Valanginian to early Barremian age.

Depositional environment:
The formation was deposited in open and generally distal marine environments with local restricted bottom conditions.

Correlation:
The formation is a lateral equivalent of the dark shale dominated Rurikfjellet Member of the Janusfjellet Formation on Svalbard.

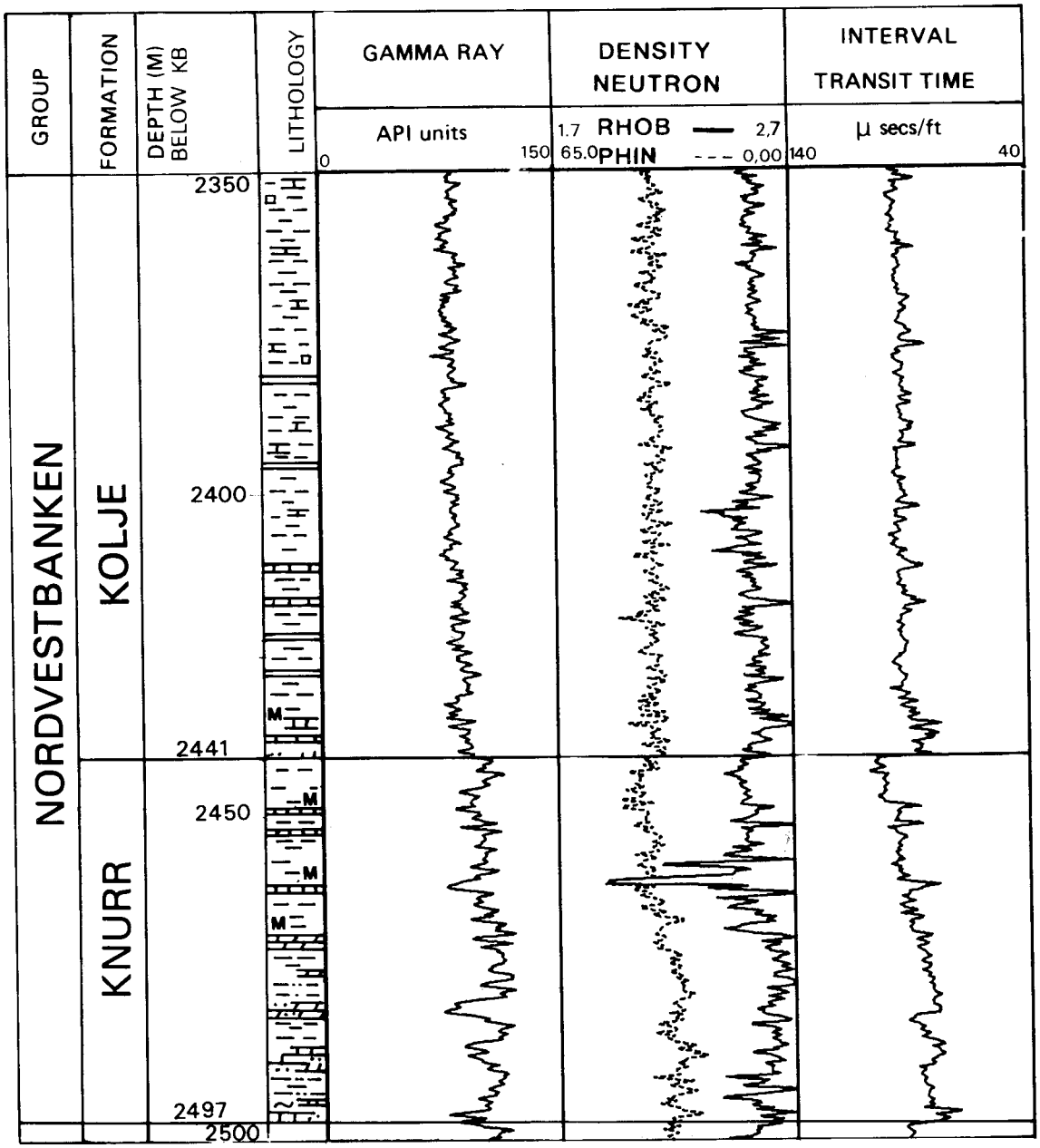
CRETACEOUS

WELL 7119 /12-1

TYPE SECTION

KNURR AND KOLJE FORMATIONS

Fig 52



CRETACEOUS

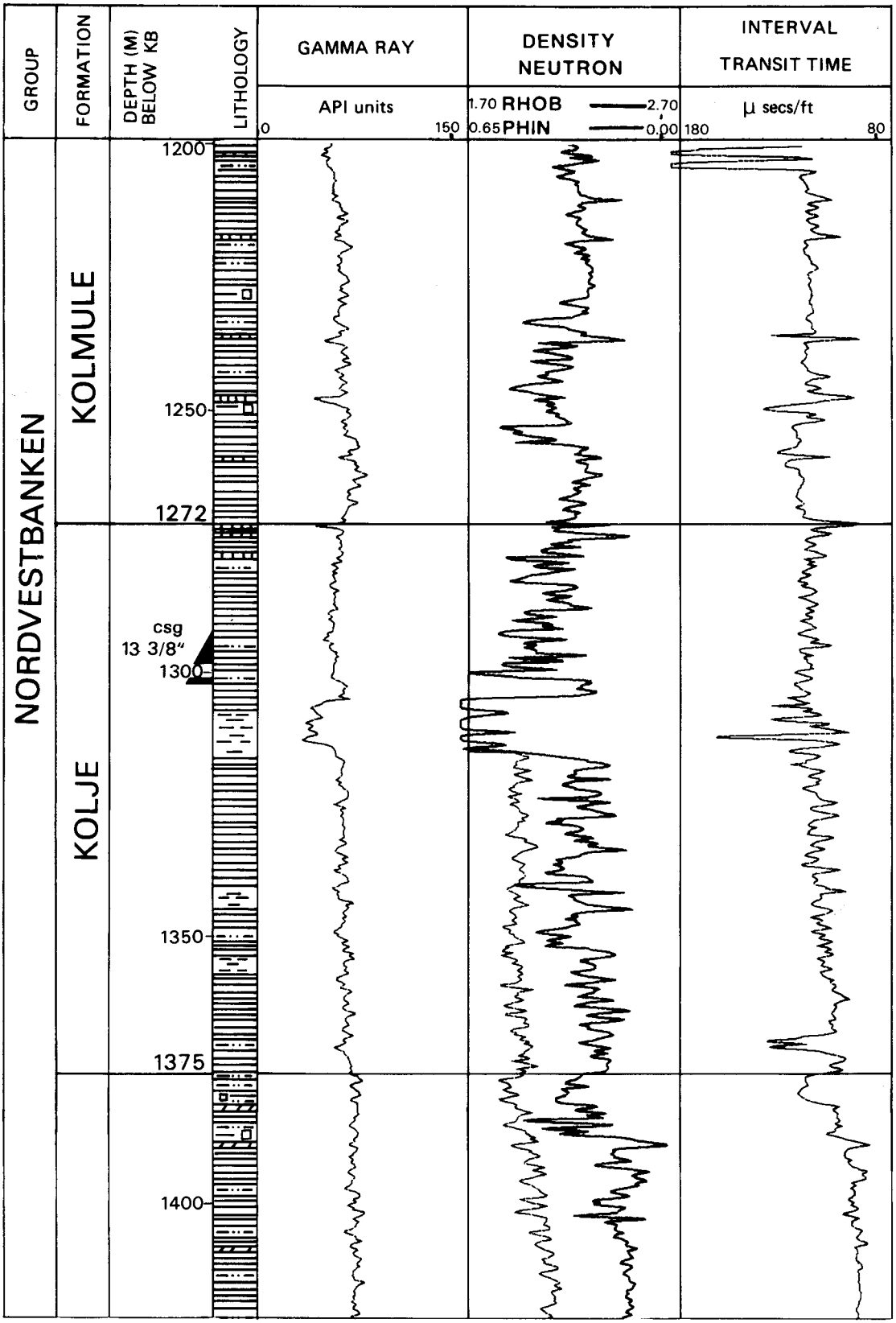
WELL 7120/12-1

REFERENCE SECTION

Fig 53

1:1000

KNURR AND KOLJE AND
BASE KOLMULE FORMATIONS



Kolje Formation (Koljeformasjonen)

Name:
From the fish species *Melanogrammus aeglefinus* (haddock). The formation corresponds to T4–2 and T4–3, the Tamsøy and Anda formations of earlier informal terminology.

Well type section:
Well 7119/12–1 (Statoil), coordinates 71°06'08.00"N, 19°47'40.29"E from 2441 m to 2004 m (Fig. 52).

Well reference section:
Well 7120/12–1 (Norsk Hydro), coordinates 71°06'48.7"N, 20°45'20.1"E, from 1375 m to 1272 m (Fig. 53).

Thickness:
437 m in the type well and 103 m in the reference well.

Lithology:
Dark brown to dark grey shale and claystone dominate, with minor interbeds of pale limestone and dolomite. The upper part of the formation also has thin interbeds of light grey-brown siltstone and sandstone. The reference well displays similar lithologies.

Basal Stratotype:
The base is marked by gradually decreasing gamma ray, decreasing interval transit time and increasing density log responses.

Lithology:
Dark brown to dark grey shale and claystone dominate, with minor interbeds of pale limestone and dolomite. The upper part of the formation also has thin interbeds of light grey-brown siltstone and sandstone. The reference well displays similar lithologies.

Basal Stratotype:
The base is marked by gradually decreasing gamma ray, decreasing interval transit time and increasing density log responses in the type well. However, in the central part of the Hammerfest Basin the density log response shows a decreasing trend at the formation base. A marker in the middle part of the formation (boundary between unit T4–2 and T4–3 of earlier informal terminology) shows an increase in density in parts of the Hammerfest Basin. An increasing gamma log response is associated with this log break westwards. The log breaks at the base and in the middle parts of the formation are thought to reflect condensed intervals providing important regional seismic markers.

Lateral extent and variation:
The formation thickens westwards but thins towards the central part of the Hammerfest Basin. There are no marked regional variations in lithology.

Age:
An early Barremian to late Barremian/early Aptian age is suggested.

Depositional environment:
The formation was deposited in distal open marine conditions, with good water circulation, but also with periodic restricted environments.

Correlation:
The formation is a lateral equivalent of the Helvetiafjellet Formation, a distinctive sand-dominated unit on the Svalbard Platform.

Kolmule Formation (Kolmuleformasjonen)

Name:
From the fish species *Micromesistius poutassou* (blue whiting). The formation corresponds to T4–4 (Torsvåg formation) of earlier informal terminology.

Type well:
Well 7119/12–1 (Statoil), coordinates 71°06'08.00"N, 19°47'40.29"E, from 2004 m to 1059 m (Fig. 54).

Reference well:
Well 7120/12–1 (Norsk Hydro), coordinates 71°06'48.7"N, 20°45'20.1"E, from 1272 m to 742 m (Fig. 53).

Thickness:
945 m in the type well and 530 m in the reference well.

Lithology:
Dark grey to green claystone and shale, silty in parts with minor thin siltstone interbeds and limestone and dolomite stringers. Traces of glauconite and pyrite occur. The reference well has the same lithology.

Basal Stratotype:
In the type well the base is defined by sharply increasing interval transit time and neutron porosity readings and a slight decrease in gamma log response. The reference well shows a similar sonic and neutron log trend, although with a gradually increasing gamma ray log response.

Lateral extent and variation:
The formation thickens towards and into the Tromsø Basin and shows a slight increase in thickness eastwards in the Hammerfest Basin. Lithologies are laterally continuous.

Age:
Aptian to mid-Cenomanian.

Depositional environment:
Open marine environments are indicated.

CRETACEOUS

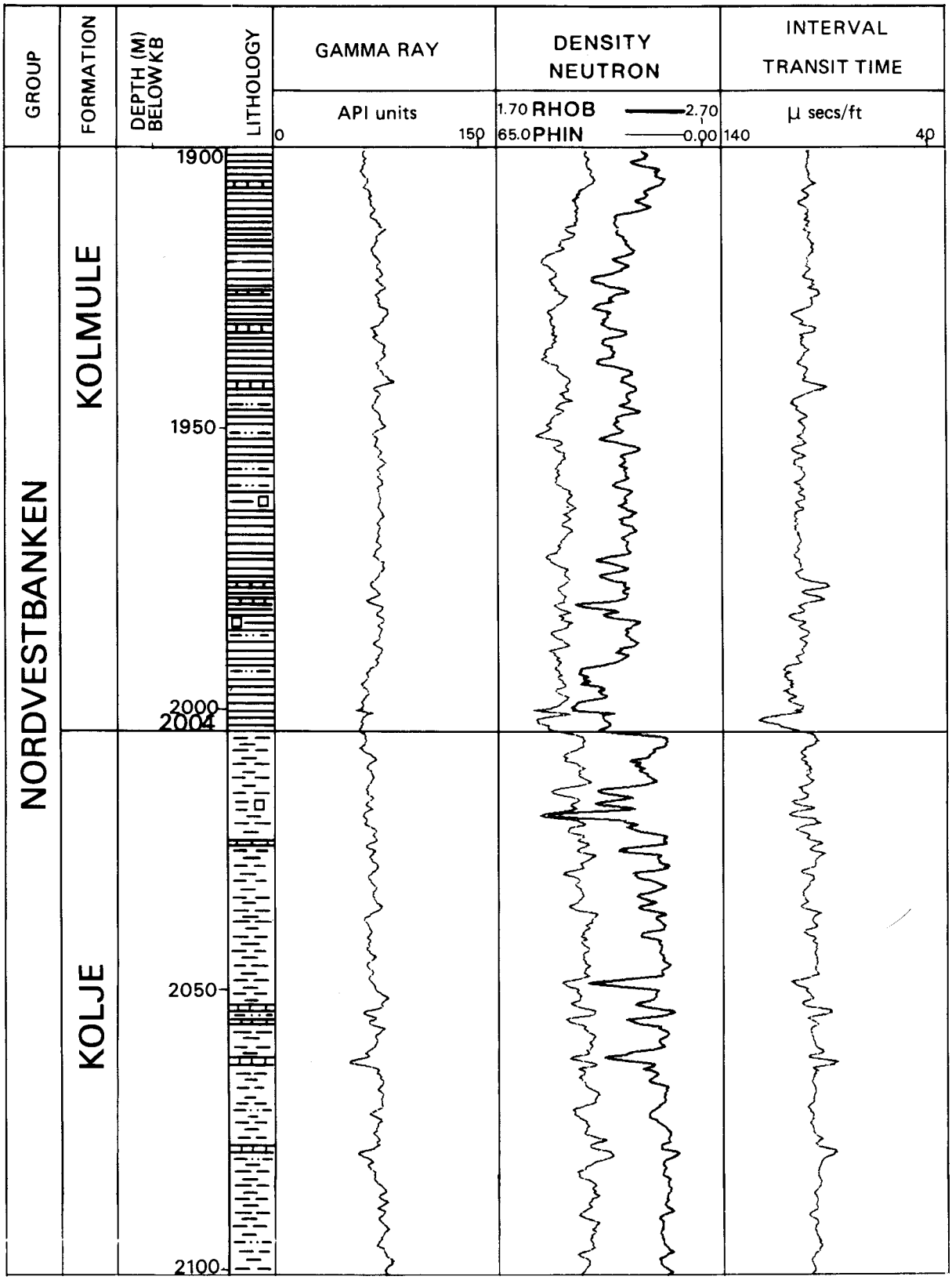
WELL 7119/12-1

Fig 54

1:1000

TYPE SECTION

BASE KOLMULE FORMATION



Correlation:
The lower parts of the formation correlate to the prodeltaic to open shelf deposits of the Carolinefjellet Formation on the Svalbard Platform. The base of the unit marks a regionally significant transgressive pulse; its top is eroded by the Cretaceous uplift of northern shelf margins. The youngest beds preserved onland Svalbard are of Albian age.

Nygrunnen Group (Nygrunngruppen)
Name:
The group is named after a fishing bank to the NW of Sørøya, around 71°N and 21°E. The unit corresponds to T5 or the Kvaløy group of earlier usage.

Type area:
The most complete sequence seen in the Hammerfest Basin is in Block 7119/12. Blocks 7121/5 and 7120/12 show a thinner development more typical of central and southeastern basin areas.

Thickness:
The group thins eastwards in the Hammerfest Basin from approximately 250 m in the type area to less than 50 m in easternmost wells and in locations near the southern margins of the basin. The only well drilled to date in the Tromsø Basin penetrated a 1200 m thick development assigned to the group, while wells on the Senja Ridge show a thin sequence, reflecting late Cretaceous structuring of the area.

Lithology:
Greenish grey to grey claystones with thin limestone intervals in the Tromsø Basin and western parts of the Hammerfest Basin pass eastwards and southeastwards into more calcareous (7121/5–1) or sandy (7120/12–1) condensed sequences. The claystones are here assigned to the Kveite Formation, the condensed sequences to the Kviting Formation. Central wells on Tromsøflaket, e.g. in the 7120/9 area, show a transitional development with a lower Kviting limestone passing up into a Kveite shale. Further exploration may show the need for differentiation between sandy and calcareous units, but there is insufficient data at present.

Age:
The group appears to represent remnants of a depositional sequence with an age span from late Cenomanian to Maastrichtian. The Tromsø Basin was a depositional centre throughout most of this period. Areas further east were either only transgressed at times of maximum sea level and/or display only condensed sections of the original sequence. The Campanian seems to be the most widespread age represented in wells.

Depositional environment:
Open marine, deep shelf environments in the west passed into shallower starved shelf regimes (uplifted at times) in the east.

Correlation:
This unit is not represented on Svalbard. The equivalent Shetland Group in mid-Norway shows a more complete development, reflecting continuous subsidence over large areas.

Kviting Formation (Kvitingformasjonen)
Name:
From the fish species *Merlangius merlangus* (whiting). The formation has not been differentiated previously.

Well type section:
Well 7120/12–1 (Norsk Hydro), coordinates 71°06′48.7″N, 20°45′20.1″E, from 742 m to 725 m (Fig. 55).

Well reference section:
Well 7121/5–1 (Statoil), coordinates 71°35′54.88″N, 21°24′21.78″E, from 1036 m to 1005 m (Fig. 56).

Thickness:
17 m in the type well. 31 m in the reference well.

Lithology:
The type section shows calcareous sandstones with interbedded sandy and glauconitic mudstones. Limestones in the reference well are interbedded with, and grade up into, sandy claystones.

Basal Stratotype:
The base is defined in the type well by log breaks showing a sharp fall in gamma response and interval transit time, and increasing density.

Lateral extent and variation:
The unit is apparently restricted to central and eastern parts of the Hammerfest Basin.

Age:
Campanian.

Depositional environment:
Deep to shallow shelf environments with normal circulation are indicated.

Kveite Formation (Kveiteformasjonen)
Name:
From the fish species *Hippoglossus hippoglossus* (halibut). The formation has not previously been differentiated.

Well type section:
Well 7119/12–1 (Statoil), coordinates 71°06′08.00″N, 19°47′40.29″E, from 1059 m to 810 m (Fig. 57).

CRETACEOUS

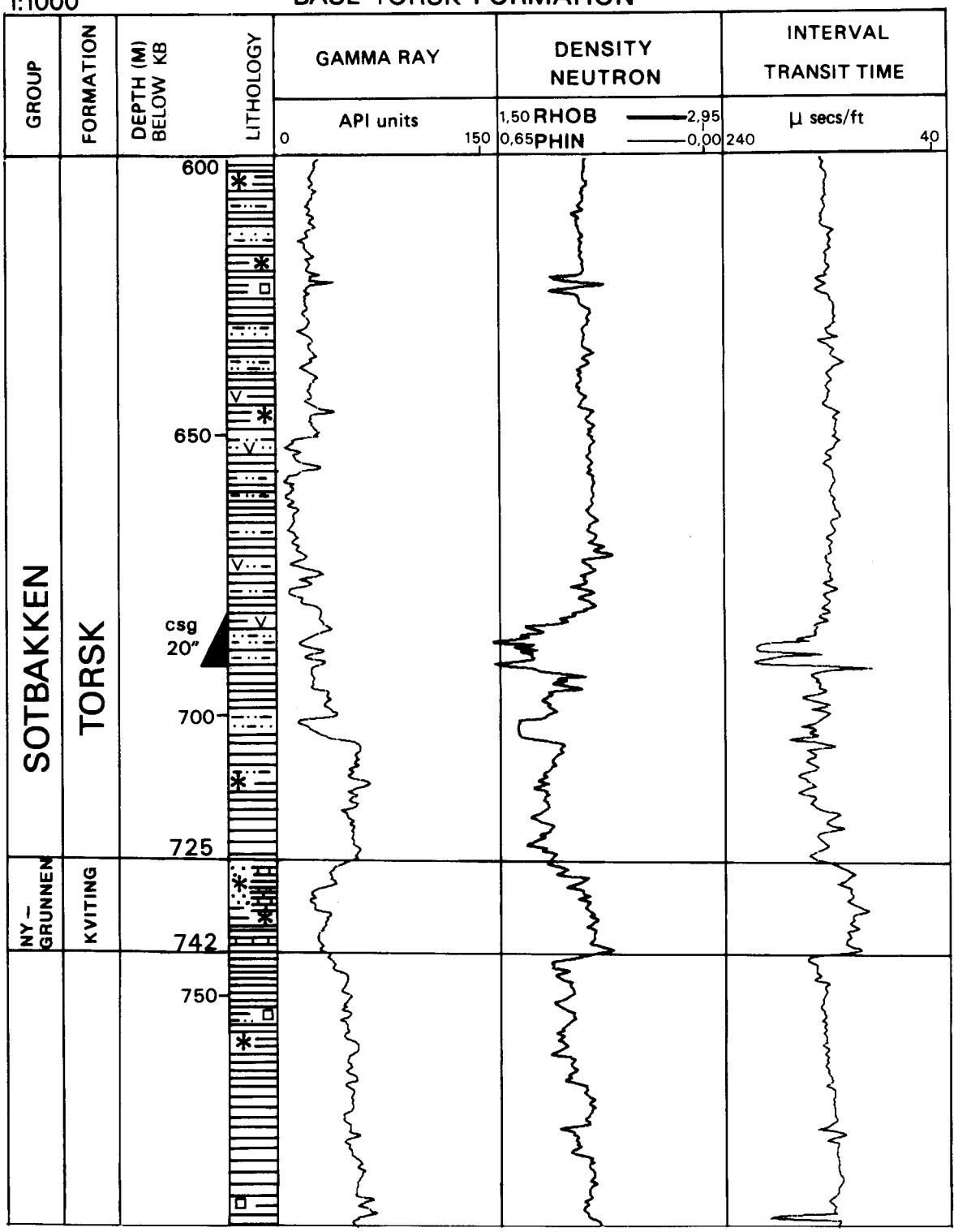
WELL 7120/12-1

TYPE SECTION

Fig 55

KVITING FORMATION AND REFERENCE SECTION
BASE TORSK FORMATION

1:1000



CRETACEOUS

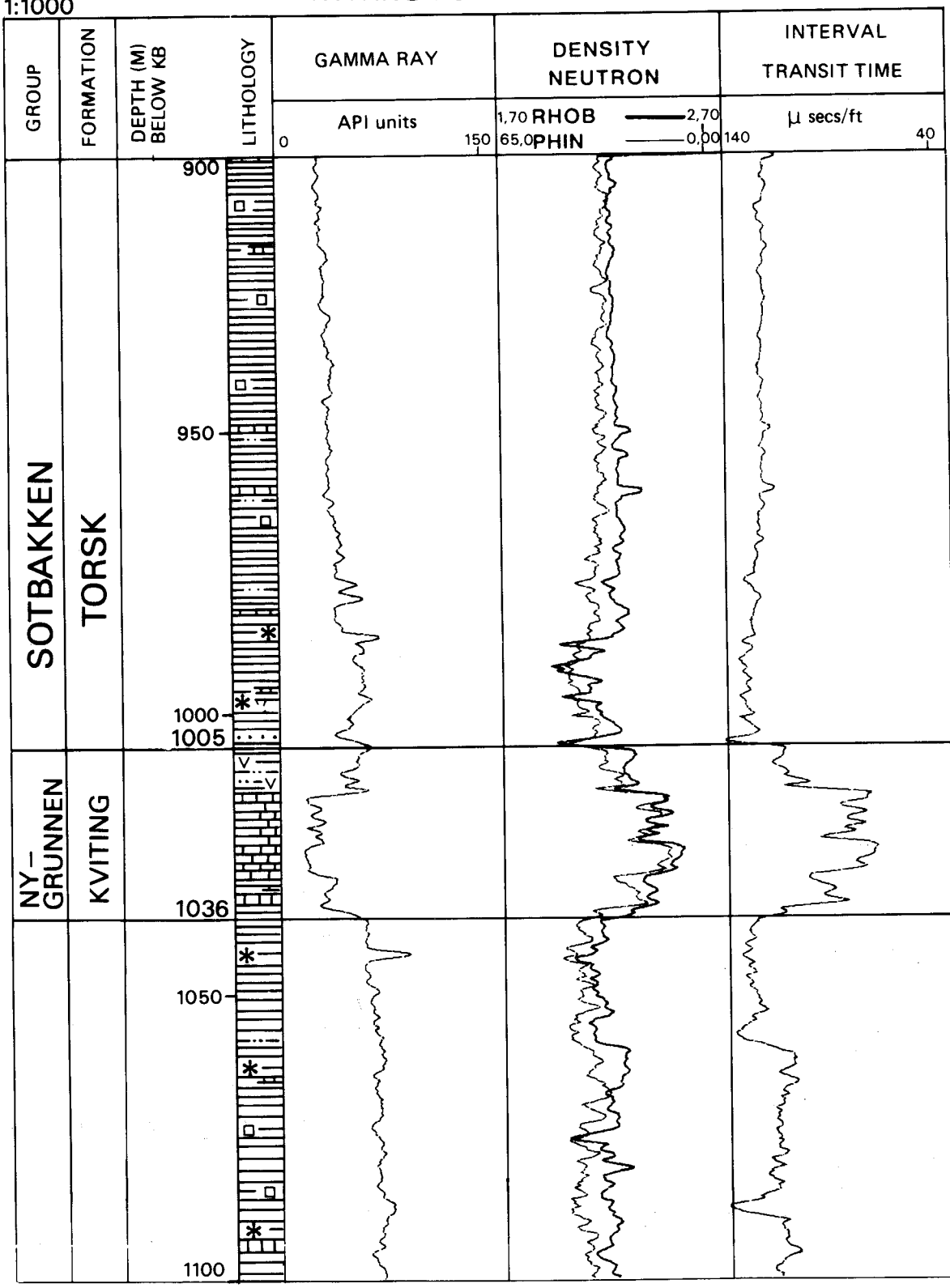
WELL 7121/5-1

REFERENCE SECTION

Fig 56

KVITING FORMATIONEN

1:1000



Well reference section:
Well 7119/7–1 (Norsk Hydro), coordinates 71°23'42.40"N, 19°15'18.43"E, from 2529 m to 1331.5 m.

Thickness:
Approximately 1200 m in the reference well, thinning eastwards to 249 m in the type well.

Lithology:
Greenish-grey to grey shales and claystones show thin interbeds of limestone and siltstone. A tuffaceous and/or glauconitic component is reported from several wells.

Basal Stratotype:
The formation is characterized by a lower gamma response and higher interval transit time than the underlying unit. A basal sand in the type well gives a marked break in both these logs. The boundary in this well is also marked by a sudden increase in bulk density readings above a generally decreasing trend, but the formation as a whole shows a highly variable and irregular density response.

Lateral extent and variation:
The formation appears to be characteristically developed in the Tromsø Basin and across the Ringvassøya – Loppa Fault Complex into the Hammerfest Basin, thinning eastwards and passing into the sands and carbonates of the Kviting Formation.

Age:
Total span appears to be late Cenomanian to early Maastrichtian.

Depositional environment:
Deep open shelf with normal circulation.

Sotbakken Group (Sotbakkgruppen)

Name:
From a submarine slope north of Vannøy around 70°40'N, 19°40'E. The unit corresponds to T6 or Nordkapp group of earlier usage.

Type area:
Block 7119/12.

Thickness:
The group shows a general increase in thickness from approximately 300 m near the southern margins of the Hammerfest Basin, to approximately 1 km in the most northwestern wells in the basin.

Lithology:
The group is dominated by claystones, with only minor siltstone, tuffaceous and carbonate horizons.

Basal Stratotype:
The base of the constituent Torsk Formation is defined by changes in sonic and density log responses. The basal contact is unconformable and represents an important depositional break in the latest Cretaceous and early Paleocene throughout the Tromsøflaket area.

Lateral extent and variation:
Due to a shift in tectonic regime in the middle Oligocene, large areas of the Barents Shelf east of the Senja Ridge were uplifted and subjected to erosion, which lasted until the early Pliocene. The erosional products were deposited west of the ridge. As a result of this post-depositional erosion, the upper part of the Sotbakken Group is not preserved in the eastern parts of Tromsøflaket. The lower parts are probably present throughout the Barents Shelf, but younger sequences are only preserved over the Ringvassøy – Loppa Fault Complex and in the Tromsø Basin (c.f. Spencer *et al.* 1984).

Age:
Preserved sequences show a late Paleocene (Thanetian) to early/middle Eocene (Ypresian/Lutetian) age in central and eastern parts of the Hammerfest Basin. Oligocene seqüences may also be present in western wells.

Depositional environment:
The whole Barents Shelf was transgressed in the mid-Paleocene and a uniform sequence of outer sublittoral to deep shelf claystones were deposited.

Correlation:
The group is time-equivalent to the van Mijenfjord Group on Svalbard; however, the van Mijenfjordenen Group shows a much more marginal marine development with intercalated coarse and fine clastic units.

Subdivision:
At present only one formation is recognized within the group.

Torsk Formation (Torskformasjonen)

Name:
From the fish species *Gadus morhua* (cod)

Well type section:
Well 7119/12–1 (Statoil), coordinates 71°06'08.00"N, 19°47'40.29"E, from 810 m to 465 m (Fig. 57).

Well reference section:
Well 7120/12–1 (Norsk Hydro), coordinates 71°06'48.7"N, 20°45'20.1"E, from 725 m to 462 m (Fig. 55).

Thickness:
345 m in the type well, 263 m in the reference well.

CRETACEOUS

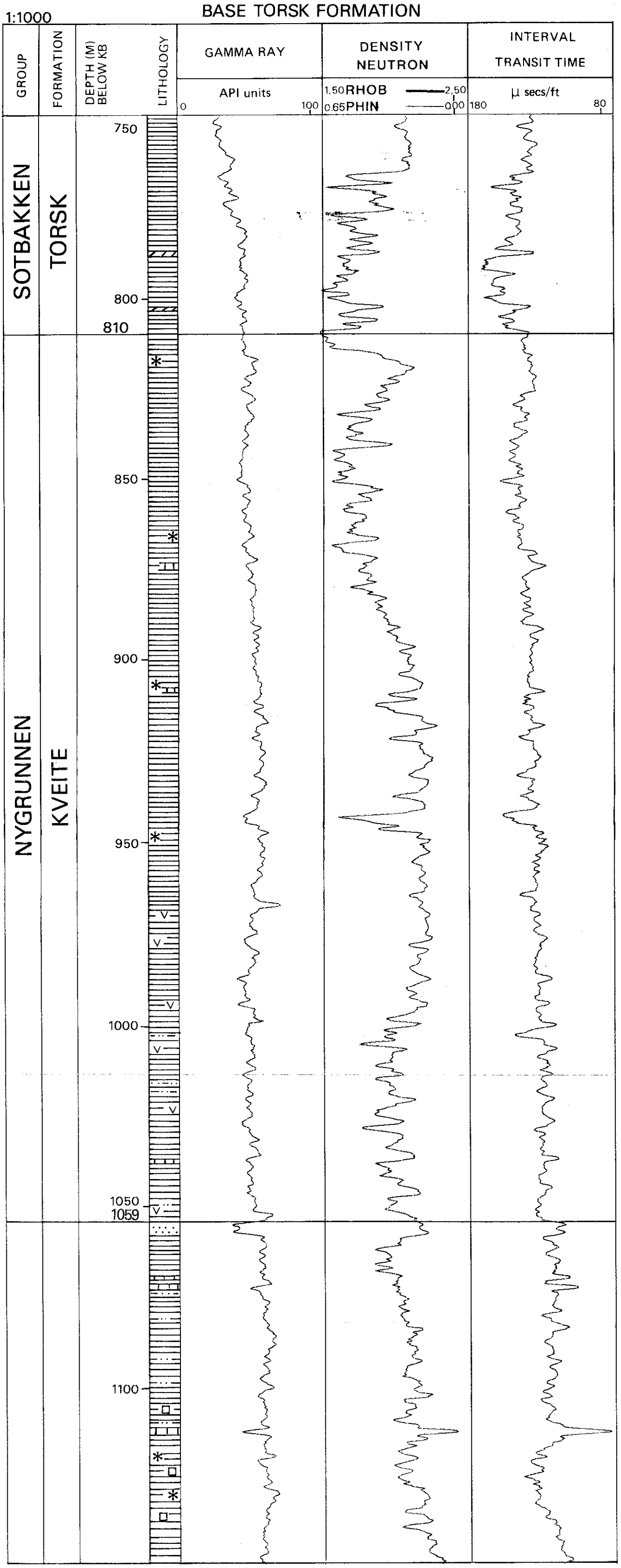
WELL 7119/12-1

TYPE SECTION

Fig 57

KVEITE FORMATION AND
BASE TORSK FORMATION

1:1000



Lithology:
Light to medium grey or greenish-grey generally non-calcareous claystones dominate in the type well. Rare siltstone/limestone stringers occur throughout the section, and tuffaceous horizons are often seen in the lower parts of the unit.

Basal Stratotype:
The base is defined by a sharp increase in interval transit time and decrease in density readings.

Lateral extent and variation:
The formation is recognized throughout Tromsøflaket with little lithological variation.

Age:
Late Paleocene to Oligocene.

Depositional environment:
Open to deep marine shelf with no significant coarse clastic supply.

Nordland Group

Name:
The group was first defined by Deegan and Scull (1977) in the North Sea. The sequence in the Hammerfest Basin is believed to belong to this laterally continuous unit, although only the younger parts of the group are represented in this area. The unit corresponds to T7 or Egga group of earlier usage.

Well reference section:
Well 7119/12–1 (Statoil), coordinates 71°06′08.00″N, 19°47′40.29″E, from 465 m to 225 m.

Thickness:
The group thins from approximately 250 m in southern wells to less than 100 m in northernmost locations in the Hammerfest Basin. Westernmost wells drilled over the Senja Ridge in Block 7117/9 show thicknesses of over 700 m.

Lithology:
Sands and clays grade into sandstones and claystones, the sand content increasing upwards. Cobbles and boulders of quartzite, granite and different metamorphic rocks occur with clay in the upper parts of the group. The clay is grey to greyish greeen, soft to firm, blocky, noncalcareous, and in parts silty.

The base of the group coincides with the Oligocene unconformity. In the reference well this is defined by a decrease in interval transit time and gamma ray readings, and a lithologic change from claystones in the underlying Sotbakken Group to the basal sand/sandstones of this group. In wells where claystones are found above the base, the boundary is not easily identified by wireline logs. In such cases, minor lithological variations have to be relied upon; the claystones of the Nordland Group are generally softer and darker than those of the Sotbakken Group.

The group is often drilled with returns to seabed only (seabed – 30″ casing). As a consequence, especially where there is no marked lithological variation, it is often difficult to pick the base of the group, particularly when it is thin and poorly developed. This is the case for most wells located north of 71°15′N and east of 20°20′E.

Lateral extent and variation:
The Nordland Group is represented over the whole of Tromsøflaket. The most continuous sequences should be found over and to the west of the Senja Ridge. Sequences in the Hammerfest Basin itself are mainly of glacial and post-glacial origin.

Subdivision:
No regional formational scheme has yet been presented, although several Quaternary and Holocene units have been defined (see e.g. Vorren *et al.* 1978, Hald and Vorren 1984).

Age:
Late Pliocene to Pleistocene/Holocene in the Hammerfest Basin, extending back to the mid-Oligocene along western shelf margins.

Depositional environment:
Bathyal to glacial marine.

LIST OF FIGURES

Fig. 41: Lithostratigraphical scheme for Tromsøflaket.

Fig. 42: Type section through Havert Formation and basal Klappmyss Formation, 7120/12–2.

Fig. 43: Reference section through Havert Formation and basal Klappmyss Formation, 7120/9–2

Fig. 44: Type section through Kobbe Formation and base Snadd Formation, 7120/12–2.

Fig. 45: Reference section, Kobbe Formation and base Snadd Formation, 7120/9–2.

Fig. 46: Type section through Fruholmen and Tubåen formations, 7121/5–1.

Fig. 47: Reference section through Fruholmen and Tubåen formations, 7120/12–1.

Fig. 48: Type section through Nordmela and Stø formations, 7121/5–1.

Fig. 49: Reference section through Nordmela and Stø formations, 7119/12–2.

Fig. 50: Type section through Fuglen and Hekkingen formations and reference section base Knurr Formation, 7120/12–1.

Fig. 51: Reference sections through Fuglen, Hekkingen formations and type section base Knurr Formation, 7119/12–1.

Fig. 52: Type sections through Knurr and Kolje formations, 7119/12–1.

Fig. 53: Reference sections through Knurr, Kolje and base Kolmule formations, 7120/12–1.

Fig. 54: Type section through base Kolmule Formation, 7119/12–1.

Fig. 55: Type section of Kviting Formation and reference section base Torsk Formation, 7120/12–1.

Fig. 56: Reference section through Kviting Formation, 7121/5–1

Fig. 57: Type section through Kveite Formation and base Torsk Formation, 7119/12–1.

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