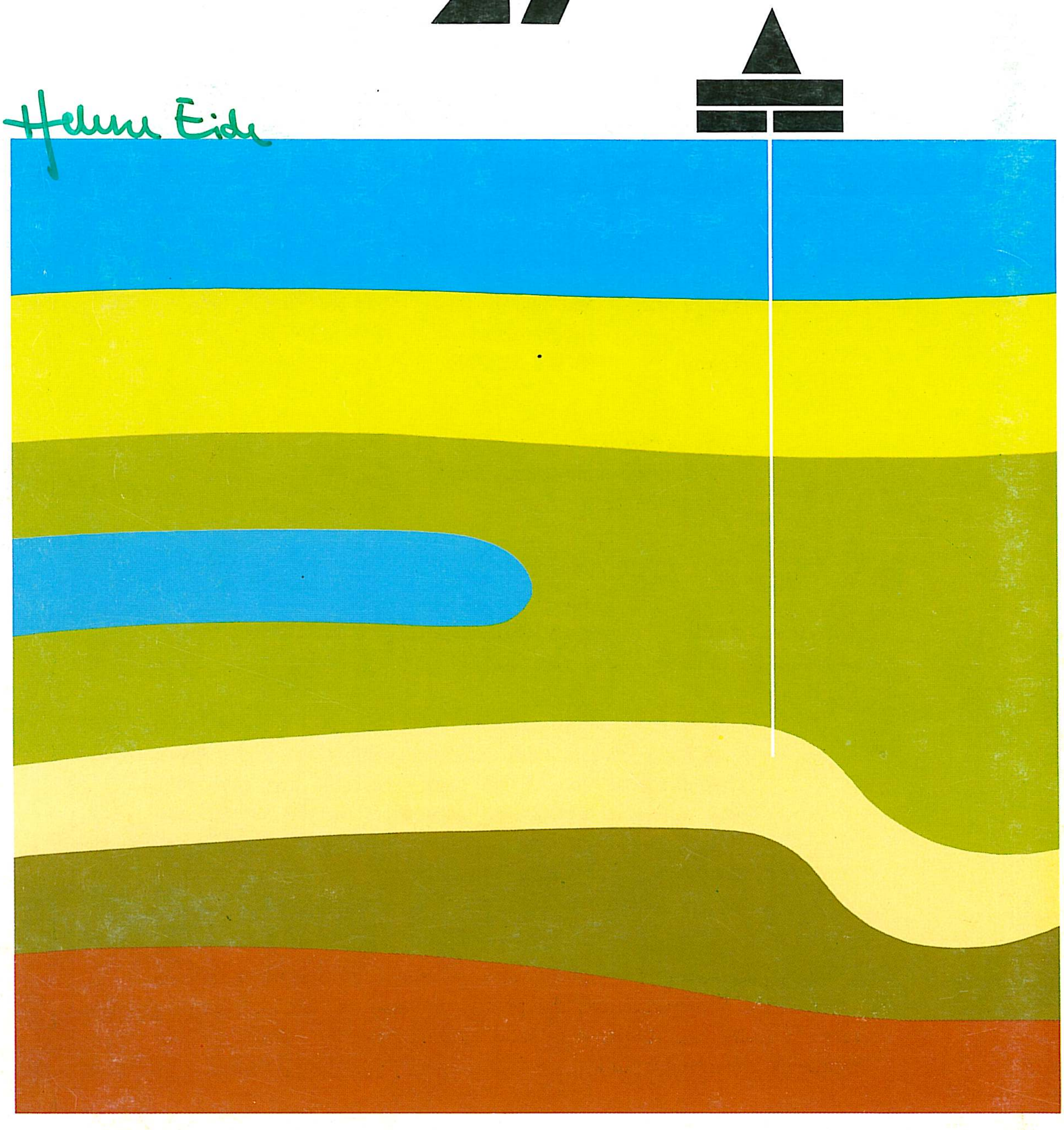
OLJEDIREKTORATET
NORWEGIAN PETROLEUM DIRECTORATE
NPD PAPER NO. 27

Helene Eide



Lithology. Well No. 9/12-1

427 Stavanger 1980

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This is a part of the responsibility of the Resource Management Department in the Directorate and the present publication series is meant to partially fulfill this object. It is named NPD Papers and issued as consecutively numbered volumes.

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Lithology. Well 9/12-1

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4 Figures
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NPD Paper No. 27
Randi Chr. Olsen
ISBN 82-7257-039-4

Preface

The Norwegian Petroleum Directorate has, among its duties, the responsibility for publication of releasable data connected to petroleum activities on The Norwegian Continental Shelf.
In this connection it has been decided to make a standardized description of drill bit cuttings as well as cores.
The sample descriptions are based on the «Standard Legend — Exploration and Production Department of the Royal Dutch/Shell group of companies». The Directorate much appreciates the Royal Dutch/Shell companies and A/S Norske Shell Exploration and Production's permission to use their legend.

The samples and the wire line logs from the herein described well are released to scientific institutions, companies and other interested organizations for futher studies.
The material pertinent to the well can be examined in the Directorate. For practical reasons an application must be made in each case.
The application should state what material is to be examined, what kind of examination will be made, and the purpose of the studies. It should be addressed to:

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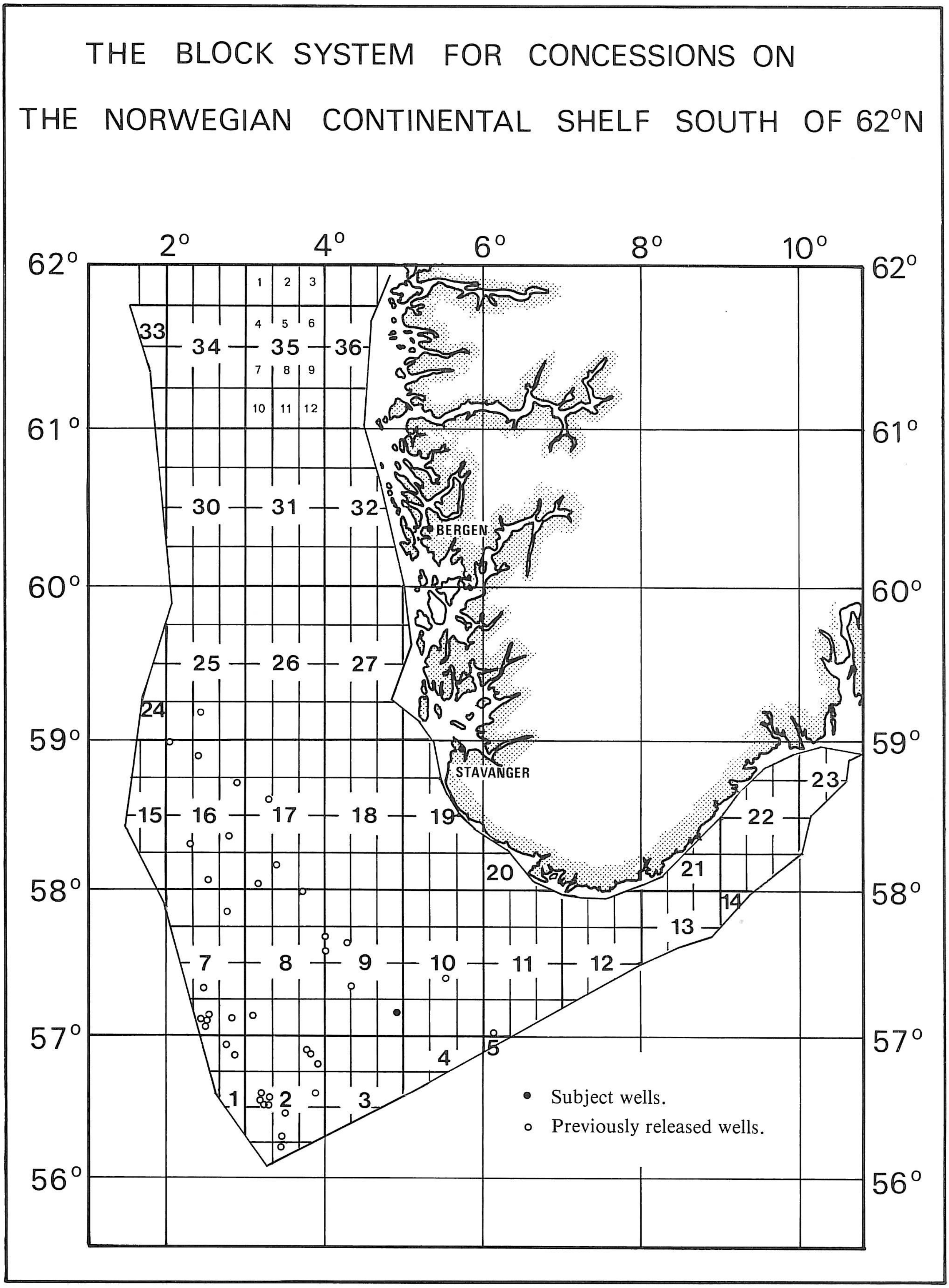
Acknowledgements

The tables were compiled by Helene Eide and Per Brandshaug. The drafting was done by Torill Rosland. Other colleagues have contributed during discussions on geological interpretations.


THE BLOCK SYSTEM FOR CONCESSIONS ON
THE NORWEGIAN CONTINENTAL SHELF SOUTH OF 62°N
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Subject wells.
Previously released wells.

Fig. 1

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LITHOLOGY. WELL 9/12-1

Introduction

Licence 012, which covers the blocks 9/12, 10/7 and 10/9 on the Norwegian Continental Shelf, was in 1965 assigned to A/S Norske Shell Exploration and Production. Well 9/12-1, drilling permit No. 24, was spudded 28 March 1969 and abandoned 6 May 1969.

The location of the drill site is 57°11'40" N, 04° 57' 21" E, and the position of the well is shown in Fig. 1. The objective of the well was to test the Tertiary and Mesozoic sequences. No hydrocarbon bearing sections were encountered.

The 9/12 block was relinquished in 1974.

Drilling operations

Well 9/12-1 was drilled with the semi-submersible rig Sedneth I at a mean water depth of 61 m (201'). The kelly bushing elevation was 26 m (85'). All depths in the following text and on the appended lithology log are referred to the kelly bushing. The total depth (TD) of the well is reported to be 2697 m (8850').

The casing programme is given in Table 1. The 36" hole was drilled to 133 m (434') and the 30" casing was run to 131 m (429'). An 18 1/2" hole was drilled to 403 m (1321'), and two joints of 20" casing were hung from the 30" housing before the 13 3/8" casing was set at 395 m (1296'). Sea water was used as drilling fluid in the 36" and 18" holes and the returns were to the sea floor.

After the setting of the 13 3/8" casing the mud system was converted to a Spersene/XP-20 sea water mud which was used to TD. The mud programme and mud additives are given in Tables 2a and 2b.

Available material

Wire line logs and drill bit cuttings from well 9/12-1 are stored at the Norwegian Petroleum Directorate. The 68 sidewall cores which were recovered, are in the possession of the operator. No conventional cores were cut in this well, and there are no wet samples.

The log runs with their corresponding depth intervals and scales are listed in Table 3. 620 drill bit cuttings samples were sampled between 408 m (1340') and 2697 m (8850'), sample intervals and average weights are given in Table 4a. The depths of the sidewall cores are listed in Table 4b.

Geology

GENERAL

Lithological descriptions and wire line log interpretations made in the Norwegian Petroleum Directorate have been used as the main basis for comments on environments of deposition and lithostratigraphy.
The lithostratigraphic nomenclature used in the text and on the appended log, is based on the joint work of the UK/Norwegian lithostratigraphic committees (Deegan & Scull 1977). The lithology is described in intervals according to lithostratigraphic groups. In the Norwegian—Danish Basin, however, no subdivision of the Jurassic and Triassic sedimentary sections have been given group status. The main units are formations and the corresponding subunits are members (Deegan & Scull 1977).
Description and classification of lithology are based on Shell's Standard Legend 1976 (Shell Internationale Petroleum Maatschappij B. V. 1976). This Legend is based on Wentworth's scale for grain size (Wentworth 1922) and Dunham's classification for carbonates (Dunham 1962).
Colours are described according to the Rock-Color Chart (Geol. Soc. Am. 1970) and are based on dry samples.

GEOLOGICAL SETTING

The position of well 9/12-1 relative to the main structural features, is shown at the top of the appended log. The well is located in the Norwegian—Danish Basin west of the Lista Nose (Rønnevik et al. 1975).
Well 9/12-1 was drilled near the crest of a salt induced anticlinal feature, Fig 2.
Well 9/12-1 is very similar to the 9/8-1 well (Myhre 1977a), although the various geological units are somewhat thinner in 9/8-1. This may be because well 9/8-1 sits on top of a salt structure which may have had its growth during the Mesozoic and early Tertiary.

LITHOLOGY AND LITHOSTRATIGRAPHY

Hordaland Group, 408—988 m
Since the upper part of the well, from sea floor to 400 m, was not sampled, the lithology in this interval has not been differentiated. Very little can be inferred from the GR log because of its inaccuracy in large holes, 18 1/2" in this case. The uppermost cuttings samples show brownish black to olive black clay with glauconite and fragments of greyish limestone. From 460 m there is a 90 m thick interbedded sequence of clay and sandstone with limestone stringers. The clay is mainly brownish grey, silty and micaceous. The sandstone is greyish, very fine to fine grained, sorted, and it has a calcareous cement.
The sandy unit is underlain by about 220 m of olive grey clay, which becomes sandy in the lower part. From approximately 775 m to 910 m a very argillaceous sand unit was penetrated. The sand is mostly very fine grained, silty and glauconitic. Below the sand, down to 988 m, there is mainly light olive grey clay. In the very lower part of the interval a greenish grey, slightly tuffaceous claystone appeared together with some brownish, glauconitic siltstone.
It seems probable that when the sampling of this well commenced at 408 m, the upper boundary of the Hordaland Group had already been penetrated, since brownish clays and limestone fragments were found in the samples. These are common criteria for the presence of the Hordaland Group.

Rogaland Group, 988—1167 m

There is a marked change in the composition of the cuttings samples from 988 m on due to the appearance of tuffaceous material. The tuffs are mostly greenish grey to olive grey with white speckles, but they also occur as black, fine grains in a calcareous matrix.

At 1011 m a greyish sandstone appears. It is mostly very fine grained, very argillaceous, friable and glauconitic. The interval from 1042 m and for about 100 m downwards is dominated by greyish, silty claystones. In the upper part of this interval there are also greenish grey and dark grey claystones, which seem to be tuffaceous. Limestone stringers are present, and the sediments are calcareous. Around 1140 m the sediment turns into a light grey marl.

Within the Rogaland Group it is possible to recognise five formations, the Balder, Fiskebank, Sele and Lista Formations and the marly equivalent to the Maureen Formation.

The Balder Formation comprises the main tuffaceous unit in the interval 988—1011 m. Its top and base are defined by the logs, especially by the GR response which shows a marked reduction in this interval.

The top of the Fiskebank Formation in this case coincides with the base of the Balder Formation. The base of this sandstone unit is picked at 1042 m, where there is an increase in interval transit time. The Fiskebank Formation is easily distinguishable on the SP log.

The partly tuffaceous claystones in the interval 1042—1085 m most likely constitute the Sele Formation. This interval gives a higher GR response and a higher interval transit time than the adjacent formations.

The top of the homogeneous claystones of the Lista Formation is picked at 1085 m where there is a distinct reduction in the GR response and a steplike decrease in interval transit time. These log shifts reflect an increase in the content of calcareous material in the claystones.

The next steplike decrease in the interval transit time and likewise decrease of the GR response occur at 1139 m. This is taken to be the top of the marly equivalent of the Maureen Formation.

Chalk Group, 1167—1552 m

The sediments in this interval are limestones with thin marl and shale interbeds, especially in the very upper and in the lower part. Chert is frequent in the upper part. The limestones are soft mudstones, mostly of a white or very light grey colour. The marls and shales are light greenish grey.

The lithostratigraphic breakdown of the Chalk Group in this well is based on log motifs and correlations with other wells in the Norwegian—Danish Basin. The group may be separated into five formations of which the upper one, the Ekofisk Formation, probably extends down to 1225 m. At this depth there is a slight shift on the GR log which is taken to be the top of the Tor Formation. This boundary is rather tentative because of the partial lack of logs in the interval immediately above. The top of the Hod Formation is picked at 1300 m. This is the top of a sequence with very smooth log readings. The slightly disturbed log responses around 1450 m indicate a less clean limestone in this interval.

The presence of the Plenus Marl and Hidra Formations is uncertain. However, there are distinct log shifts at 1527 m, and argillaceous limestone and traces of shale were found in the samples from this depth. A thin Plenus Marl Formation is therefore suggested around 1530 m with the Hidra Formation below it down to 1552 m.

Cromer Knoll Group, 1552—1910 m

This sequence is predominantly made up of shales and clays which are variably calcareous. In the upper part there are reddish brown marls and varicoloured claystones. The main marl unit extends from 1618 m to 1634 m. It passes into a uniform clay/shale sequence with scattered limestone stringers.

Around 1780 m there are several thin sandstone streaks. The sandstone is very fine grained, calcareous and glauconitic.

The Cromer Knoll Group can be subdivided into the Rødby Formation and the Valhall Formation. The top of the Rødby Formation is picked at 1552 m where the sharp log breaks demonstrate the passage from limestone to marl and claystone. The basal marl unit of the Rødby Formation gives characteristic log motifs with a decrease in GR response and interval transit time.

The base of the Rødby Formation is set below the main marl unit at 1634 m, in accordance with previous practice. Thereafter the succession passes into the uniform clay/shale sequence of the Valhall Formation.

Deegan and Scull (1977) have chosen well 2/11-1 (Myhre 1977b) as type section and reference section for the Valhall and Rødby Formations. In this well the top of the Valhall Formation is set at the top of a particularly pure shale unit which in well 9/12-1 may compare to the clay/shale unit which starts at 1650 m below the upper marl unit. Also in well 2/11-1 there is a lower pale reddish brown marl unit with distinct log motifs, but in this instance it is included in the Valhall Formation. A correlation to well 9/12-1 might imply that the boundary between these two formations should have been set further up, and that only the upper marl unit should have been included in the Rødby Formation.

Bream Formation, 1910—2038 m

This is mainly a dark coloured shale section. In the upper half the shale is rather silty and sandy, and it contains glauconite and shell fragments. Also belemnite fragments were found. There are also minor dark grey siltstone and fine grained clear sandstone. Below approximately 1975 m, the shale is dark greenish grey, and in the very lower part it is black with abundant plant remains.

For the most part the sediments and the log patterns of the Bream Formation in this well correlate well with 9/4-1 which is the type well for the formation and described by Deegan & Scull (1977). The Fredrikshavn Member constitutes the upper half of the Bream Formation. It is distinguishable on the logs due to its content of silt and sand particles.

The lower half of this section belongs in the Børglum Member. Its very lower part is characterized by a higher radioactivity.

Haldager Formation, 2038—2085 m
and a tentative
Gassum Formation, 2085—2105 m

This section is composed of sandstones with only thin interbeds of claystone, shale and coal.

Especially in the upper part of the section the cuttings samples are contaminated by caved material. The logs indicate a fairly clean sand in this part, but very little of it was actually seen in the samples. However, traces of a light grey, mostly very fine grained loose sandstone with possible glauconite was observed.

Further down in the section various types of sandstone were found. The sandstones are mostly greyish coloured, very fine to fine grained and moderately sorted. The porosity of the sandstones is fair to good. Dypvik and Vollset (1979) describe secondary quartz overgrowth and kaolinite and calcite cements from this section. Framboidal pyrite was found to be common, and also glauconite was observed.

Although black, brittle coal is found throughout, it seems from the logs to be restricted to the interval between 2047 m and 2075 m. Some of the sandstones were found to be very carbonaceous. The claystone is light grey and brownish grey.

Around 2085 m there is a very coarse grained, poorly sorted and friable sandstone. Also loose, granule sized fragments were found. In addition there is a yellowish grey to olive grey, very fine to medium grained, sorted sandstone. The shale, which was found in the lower part, is greenish grey.

The top of the Haldager Formation is picked at the sudden reduction in GR response and rapid decrease in interval transit time at 2038 m associated with the change from shale to sandstone. The lower boundary is somewhat tentative. There is a conceivable change in the composition of the sediments in the lower part of the section from around 2085 m to 2105 m. Also the log responses change across this interval. They seem to be gradational from the section above 2085 m to the section below 2105 m. It is possible that this lower part constitutes the Gassum Formation, at least this possibility cannot be exluded.

Skagerrak Formation, 2105—2420 m

Sandstone is the dominating lithology in this section. In the upper part a loose, clear sandstone seems to alternate with greenish grey and reddish brown sandstones. The clear sandstone is mostly poorly sorted. Around 2175 m it is very coarse and well rounded. The greenish grey and reddish brown sandstones are fine to very fine grained, moderately sorted and calcareous in the upper part. Below 2200 m sandstones are interbedded with siltstones and claystones. All the sediments seem to be heavily oxidized from this depth on, and they are very rich in muscovite.

The incoming of reddish brown clay and sandstone at 2105 m marks the top of the Skagerrak Formation.

The base of the formation is gradational, however, it is set at 2420 m at the top of a more argillaceous section.

Smith Bank Formation, 2420—2697 m

The claystones of this section are mostly dark reddish brown, but greyish red towards TD. In addition some greenish grey and dusky purple shales were observed.

The thin sandstones of this formation are very similar to the sandstones above. Also a yellowish grey, fine to medium grained, calcareous sandstone was noted around 2425 m.

The base of the Smith Bank Formation was not penetrated in this well.

DISCUSSION

The 9/12-1 well penetrated nearly 600 m of red beds. The base of the Triassic sequence was not seen in the well. From the seismic section (Fig . 2) it is evident that the well was terminated in the upper portion of a thick series with discontinuous reflectors. The thickness of this series is in this area in the order of 2—3000 m. These facts point to a continental Triassic succession. From the seismic section it is further evident that this series overlies a section which just north of the well rises to an anticlinal feature. This is probably Permian salt, and the well was drilled near the crest of the salt induced structure.

During the Triassic alluvial sediments filled the subsiding northern Permian basin and gradually overstepped the basin edges (Ziegler 1977 & 1978). The clastics were mainly shed from the Fennoscanidan shield. The argillaceous Smith Bank Formation probably represents an extensive outwash plain. In the course of the Triassic it was overidden by coarser material, the Skagerrak Formation, as the fringing alluvial fans prograded over this vast plain.

There is a major hiatus to the overlying sandstone sequence, the Haldager Formation, as microfossils indicating a Middle Jurassic age have been reported from this sequence. As the section consists of interbedded sandstones, shales and coals, it is probably deltaic in origin. Since both coal and glauconite have been observed, the sands were most likely deposited in a marginal marine position. Perhaps the upper 10 m thick massive sand body with a box shaped log pattern represents a transgressive unit. As observed by Al-Kasim et al. (1975), the Middle Jurassic on the whole was a period of regional regression whereas the uppermost Middle Jurassic marks the onset of a general transgression.

Also in the 9/8-1 well (Myhre 1977a), which shows a very similar development throughout its geological succession to that of 9/12-1, there is a Middle Jurassic deltaic sequence.

As the transgressive phase continued, the Middle Jurassic sands were overlain by Late Jurassic shales. These shales, the Børglum Member, are rich in carbonaceous detritus and show a high radioactivity although not as high as found in wells further to the west. According to Ziegler (1977) the Kimmeridgian shales lose their source rock potential southward from the Egersund Basin into the Danish Embayment.

Both in the 9/12-1 well and the 9/8-1 well (Myhre 1977), the carbonaceous shales directly overlie the Middle Jurassic sandstones. Further north, e.g. the 9/4 wells (Frodesen 1977), a noncarbonaceous shale unit, the Egersund Member, is found in between.

The overlying Fredrikshavn Member is widely distributed in this part of the Norwegian—Danish Basin. The passage to the Cretaceous seems to be continuous in this area without a major break in sedimentation. The boundary may be associated with small shifts on the logs at 1875 m.

The Early Cretaceous was essentially a period of transgression, and only fine grained material was deposited. The reddish coloured marls found near the top of this sequence in well 9/12-1 are very widespread and may have been deposited in association with an Aptian rifting phase (Vail et al. 1977, Ziegler 1978).

Available paleodata indicate the presence of a continuous Early Cretaceous sequence with relatively rich foraminiferal faunas.

The boundary to the Upper Cretaceous limestones is rather abrupt and marks the change from sedimentation of dominantly clays to carbonates. Coccolith lime muds were deposited below the wave base of a vast shelf sea (Selley 1975), and the sea inundated most of the fringing highs.

In well 9/12-1 the Upper Cretaceous is represented by 375 m of limestones. At the close of the Cretaceous and early Paleocene times there was widespread regression and renewed tectonic activity. The carbonate depositional regime came to an end. In the subject well this is seen as the passage from the pure lime muds of the Tor Formation, through the somewhat impure limestones of the Ekofisk Formation to the marls which constitute the equivalent of the Maureen Formation. An entirely clastic regime was reached in the course of the Paleocene, and deposition of clay prevailed.

This phase was interrupted by the supply of the fine grained sands of the Fiskebank Formation. Deegan & Scull (1977) suggest that this is a basin margin deposit. The formation appears to be extensive in the vicinity of field 9. Well 9/11-1 (Deegan & Scull 1977) is the type well for the section, and it is also recorded in the 9/4 wells (Frodesen 1979). The formation is evident from cuttings samples and log patterns in well 9/12-1, and quite similar log patterns are found in well 9/8-1 (Myhre 1977a). The source for these sediments probably was to the northeast along the Fennoscandian border line.

The tuffaceous Balder Formation, which is found just above the Paleocene sand in 9/12-1, is the result of volcanic activity at the time of the transition from Paleocene to Eocene. Volcanism occurred along the Rockall—Faeroe rift (Ziegler 1978), and it is also thought to have occurred in the Skagerrak (Åm 1973). As a result volcanic detritus was scattered over most of the North Sea area.

From the Eocene on mostly fine grained material was shed into the basin. Also more sandy units are present, probably due to the relative proximity to the Fennoscandian border zone.

Summary

Well 9/12-1 is situated in the Norwegian Danish Basin close to the Lista Nose. The well was drilled near the crest of a salt induced structure to test the Teriary and Mesozoic sequences. The well encountered both Triassic and Jurassic sandstones, but they revealed no hydrocarbons. The well was plugged and abandoned as a dry well.

The Triassic is represented by about 600 m of continental red beds. There is a major unconformity to the overlying 65 m thick Middle Jurassic sandstones which represent a marginal marine, deltaic environment. The Upper Jurassic consists of 165 m of mainly dark shales. During the Early Cretaceous in excess of 300 m of shales were deposited in the area while the Late Cretaceous is represented by 375 m of carbonates.

From the Tertiary on the sedimentation turned to a clastic regime. Deposition of fine grained sediments prevailed although this was interrupted by the deposition of more sandy units. The Tertiary is made up of about 1200 m of sediments in this well.

S Fig. 2: Interpreted seismic record. Line: 310. Shot point: 1692.

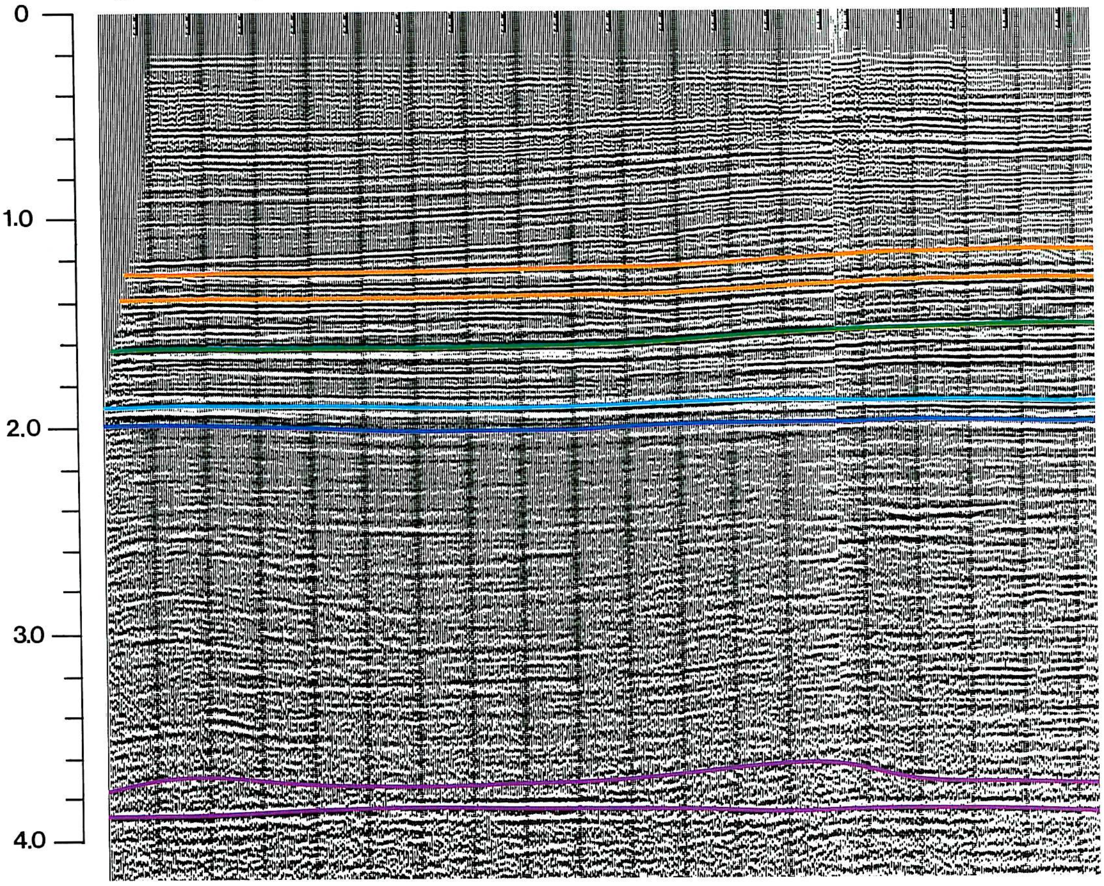
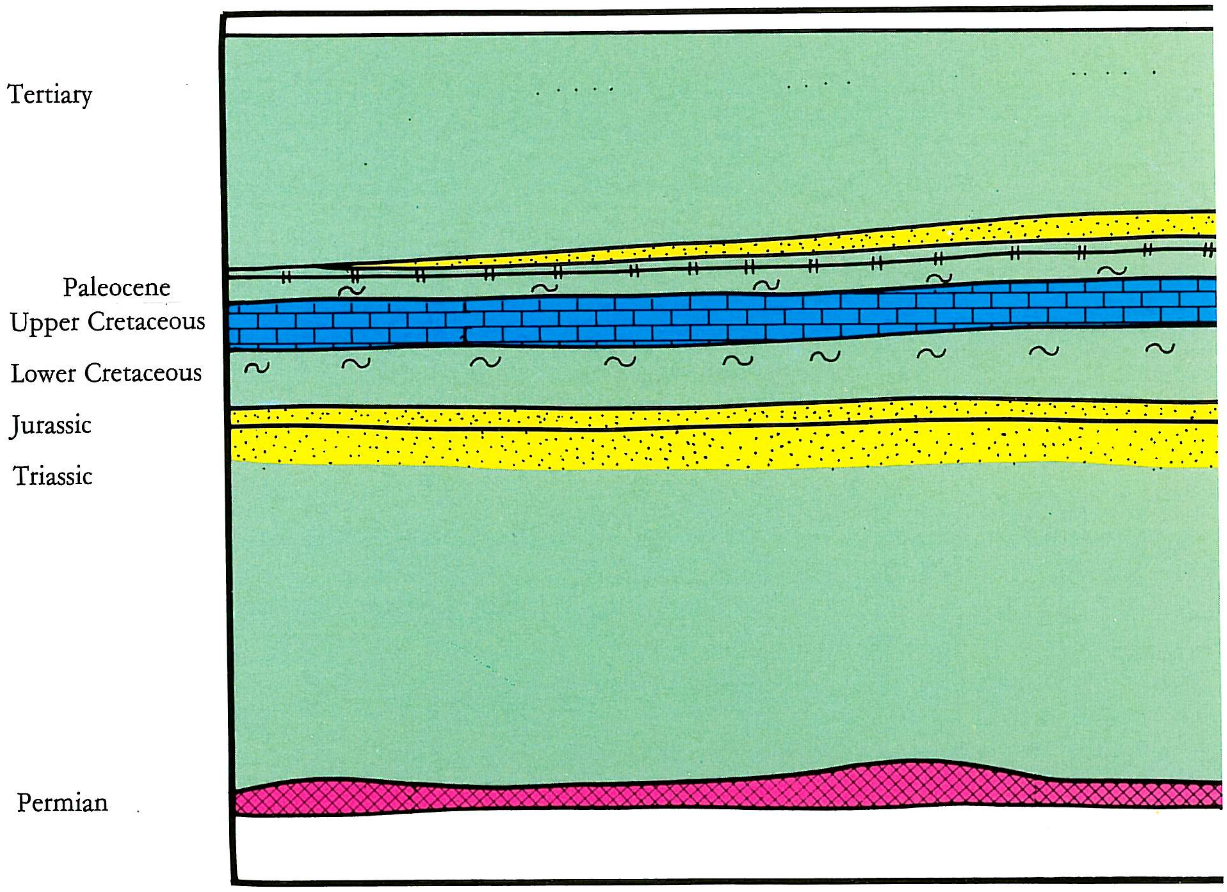
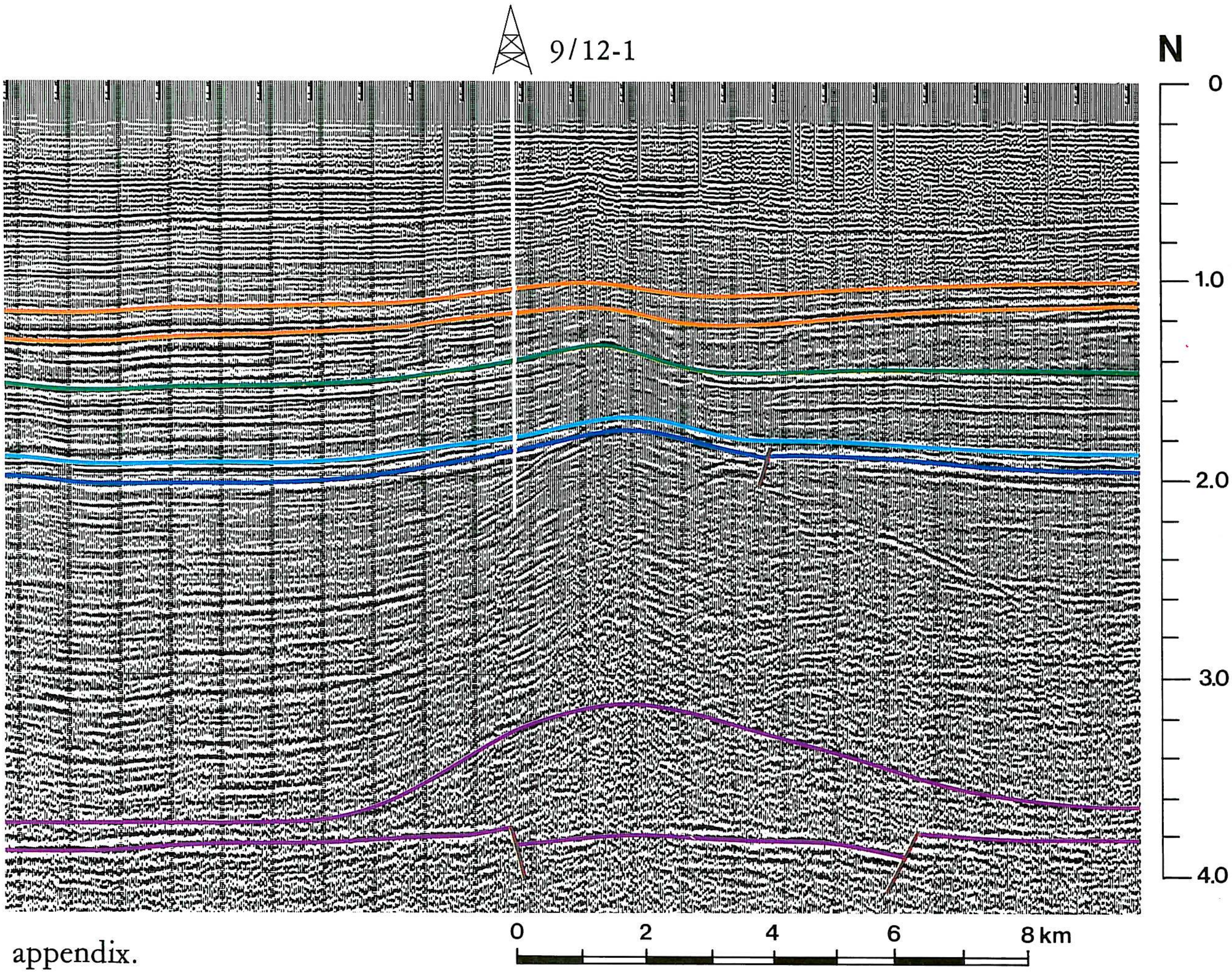
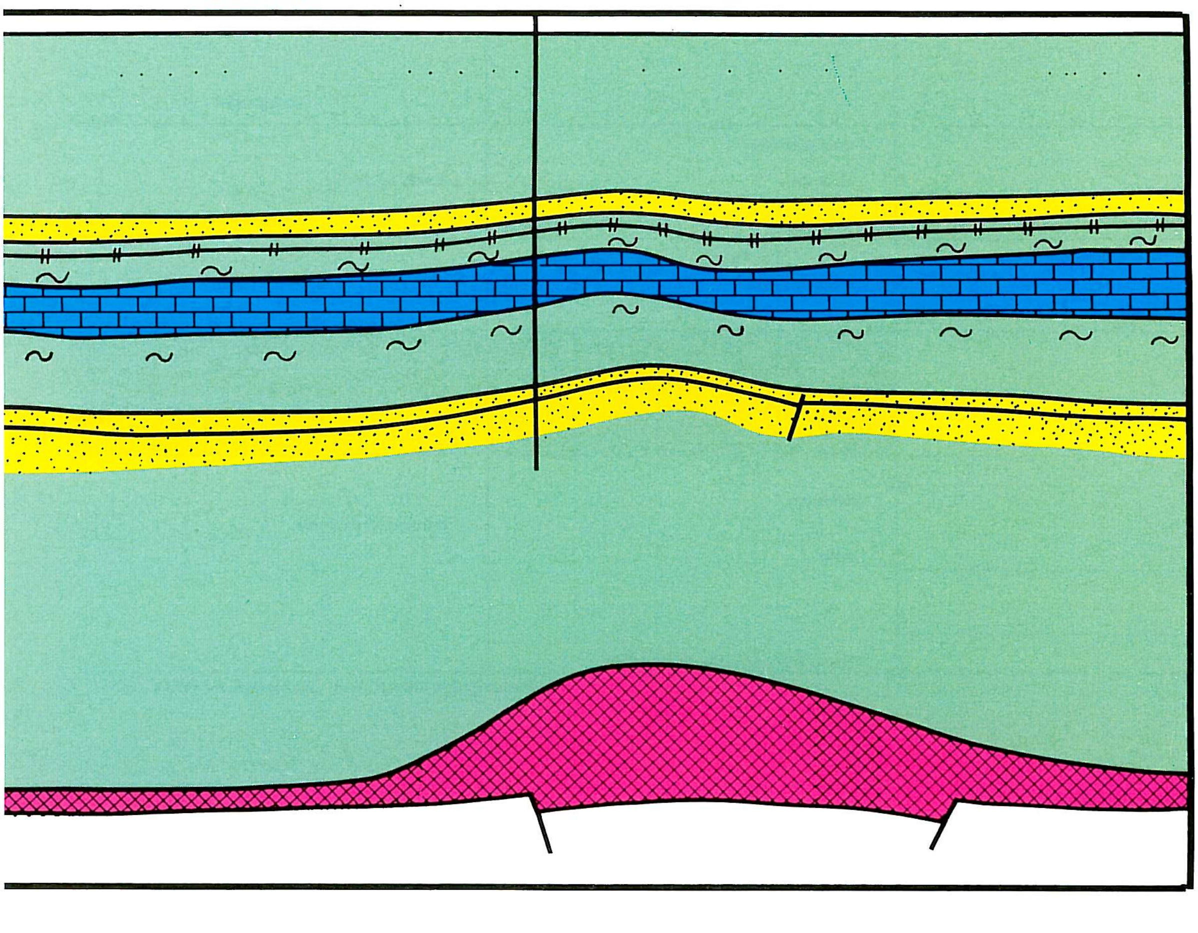


Fig. 3: Summary of interpreted seismic record and lithology. Index: See





appendix.



Summary chart

The main rock types and depositional environments as seen in well 9/12-1.

Stratigraphic classification		mill. years	Rock type (not represented)	Sedimentary environments and geological events
QUATERNARY		0		
TERTIARY	PLIOCENE			
	MIOCENE			
	OLIGOCENE		clay (sand)	marine
	EOCENE		sand	
		50	tuff	volcanic activity
	PALEOCENE		claystone, sandstone marl	marine
	DANIAN		limestone	regression
CRETACEOUS	LATE		limestone	open marine
	EARLY	100	marl clay marl shale	open marine transgression
JURASSIC	LATE	150	shale (siltstone) black shale	restricted marine transgression
	MIDDLE		sandstone (coal)	deltaic, shallow marine
	EARLY			erosion / non deposition
TRIASSIC	LATE	200	sandstone shale	continental (alluvial)
	MID.			
	EAR	230	The well bottomed in Triassic shale.	

Chronostratigraphy after: F. W. B. van Eysinga, 3rd Edition, 1975.

TABLES 9/12-1

CASING

Casing	30" m	20" m	13 3/8" m	9 5/8" m	Total depth m
depth	131	117	395	1211	2697

Table 2

MUD PROGRAMME

Mud properties							
Depth below KB m	ft	Weight ppg	Weight g/cc	Funnel visc sec	Filt. loss cm^3	Remarks	Mud components
395	1296	Sea water					Down to a depth of 395m (1296') the hole was drilled with sea water. From this depth to TD a Spersene/sea water mud system was used.
429	1406	12.1	1.45	48	4.0		
736	2415	12.2	1.46	46	4.8		
1207	3660	12.8	1.53	49	5.0	200 bbls mud lost due to balled up reamer between 1151m and 1166m	
1213	3979	12.4	1.48	42	5.0		
1273	4177	11.4	1.36	47	8.1		
1309	4295	11.4	1.36	46	5.0		
2108	6915	11.4	1.36	45	2.9		
2162	7094	11.4	1.36	45	2.8	Tight hole at 2162m. Reamed and washed between 1664m and 2162m.	
2162	7094	11.7	1.40		4.2	Mud weight raised to facilitate logging.	
2201	7220	11.4	1.36	55	3.0		
2697	8850	11.4	1.36	47	3.0		

Table 2a

MUD ADDITIVES

Function	Product*
Bactericides	(Lime), (Caustic Soda)
Calcium Removers	Soda Ash, (Caustic Soda)
Corrosion Inhibitor	(Lime)
Defoamer	Magconol
Emulsifier	(Drilling Detergent)
Lubricants	Bit Lube, (Lime)
Filtrate Reducers	CMC, (Magcogel), (Spersene), (XP-20)
pH Control	Lime, Caustic Soda, (Soda Ash)
Shale Control Inhibitors	XP-20, (Lime)
Surface Active Agent	Drilling Detergent
Thinners, Dispersants	Spersene, XP-20
Viscosifiers	Salt Gel, Magcogel, (CMC)
Weighting Material	Barite

*Additives in parentheses signify a secondary function.

Table 3

AVAILABLE LOGS

Type of logs	Interval m	1/200	1/500
GR	85— 396	x	x
GR/BHC	396—2693	x	x
IES	395—2697	x	x
FDC	395—2696	x	x
LL-7	395—2697	x	x
MLL-ML	395—2697	x	x
SNP	1209—2697	x	x
CDM	395—2697		x
CDM ap	1208—2158		x
Dir	395—2697		x
T	30—1172		x
CBL	85—1209		x
SRS	518—2697		x
Mud	402—2697		x

Table 4

DRILL BIT CUTTINGS

PERIOD/ EPOCH	Depth interval Sample interval Remarks	
TERTIARY	408—1207m 6m 1207—1225m 3m	32
LATE CRETACEOUS	1225—1552m 3m	20
EARLY CRETACEOUS	1552—1910m 3m	32
LATE JURASSIC	1910—2038m 3m	25
MIDDLE JURASSIC	2038—2105m 3m	21
TRIASSIC	2105—2697m 3m	29

Abbreviations

ab	=	above
abn	=	abundant
amr	=	amorphous
ang	=	angular
Anhd	=	Anhydrite
arg	=	argillaceous
Bar	=	Barreimian
Bc	=	Breccia
bd	=	bedded
becom	=	becoming
BHC-Sonic	=	Bore Hole Dompensated — Sonic Log
BHP	=	Bottom Hole Pressure
BHC-C	=	Bore Hole Compensatred Sonic with Caliper Log
Biot	=	Biotite
Biv	=	Bivalve
bl	=	blue
Bld	=	Boulders
blk	=	black
Blm	=	Belemnite
brit	=	brittle
brn	=	brown
CAL	=	Caliper
Calc	=	Calcite
calc	=	calcareous
carb	=	carbonaceous
Cbl	=	Cobbles
CBL	=	Cement Bond Log
CDM	=	Continous Dipmeter
Cgl	=	Conglomerate
Chk	=	Chalk
Dhl	=	Chlorite
Cht	=	Chert
Cl	=	Clay
cl	=	clayey
Cist	=	Claystone
cmt	=	cement
col	=	colour(ed)
cont	=	contorted
conv	=	convolute
crs	=	coarse
crm	=	cream
cag	=	casing
DIR	=	Directional log
distr	=	distribute(ion)
dk	=	dark
dns	=	dense
Dol	=	Dolomite
dol	=	dolomitic
DLL	=	Dual Laterolog
disk	=	dusky
Ech	=	Echinoid
f	=	fine
FDC	=	Formation Density log
fib	=	fibrous
filt	=	filtration
fis	=	fissile
fl	=	floor
Fld	=	Feldspar
frag	=	fragment
fri	=	friable
Foram	=	Foraminifera
Fos	=	Fossils
Gast	=	Gastropode
glac	=	glacial
Glc	=	Glauconite
glc	=	glauconitic
Gn	=	Gneiss
gn	=	green
Gran	=	Granules
gran	=	granular
GR	=	Gamma Ray log
Gr	=	Granite
grd	=	graded
grns	=	grains
Gvl	=	Gravel
gvl	=	gravelly
gy	=	grey
Gyp	=	Gypsum
h	=	horizontal
hd	=	hard
HDT	=	Highe Resolution Dipmeter
hom	=	homogeneous
IES	=	Induction Electrical Survey
ig	=	Igneous
Ill	=	Illite
iner	=	increasing
intbd	=	interbedded
irreg	=	irregular
Kaol	=	Kaolin
KB	=	Kelly Bushing
Kimm	=	Kimmeridgian
lam	=	laminated
LCM	=	Lost Circulation Material
Lig	=	Lignite
lig	=	lignitic
lith	=	lithic
LL	=	Laterolog
lns	=	lens
lse	=	loose
lt	=	light
m	=	medium
matr	=	matrix
met	=	metamorphic
mdst	=	mudstone
mic	=	micaceous
mid	=	midlle
ML-C	=	Microlog - Caliper
MLL-C	=	Microlaterolog — Caliper
mod	=	moderate
Mrl	=	Marl
mrl	=	marly
mtl	=	mottled
Muse	=	Muscovite
NL	=	Neutron Log
nod	=	nodular
n.s.	=	no sample
o	=	oil
occ	=	occasional(ly)
olv	=	olive
orng	=	orange
pa	=	pale
Pbl	=	Pebble
pel	=	pellet
Pelc	=	Pelecypod
pkst	=	packstone
pk	=	pink
plast	=	plastic
Pleist	=	Pleistocene
por	=	porosity, porous
ppg	=	lb/gallon
predom	=	predominant
pres	=	pressure
psi	=	lb/sq.in
purp	=	purple
Pyr	=	Pyrite
pyr	=	pyritic
Qtz	=	Quartz
qtz	=	quartzitic
rec	=	recovery
red	=	red(dish)
Rk	=	Rock
rnd	=	rounded
S	=	Sand
s	=	sandy
sc	=	scattered
Sch	=	Schist
sec	=	second
sft	=	soft
Sh	=	Shale
Si	=	Silica
Sid	=	Siderite
Sks	=	Slickenside
Slt	=	Silt
slt	=	silty
Sltst	=	Siltstone
SNP	=	Sidewall Neutron Porosity
sph	=	sphericity
spic	=	spicules
SRS	=	Seismic Reference Survcy
srt	=	sorted
Sst	=	Sandstone
stnd	=	stained
strgs	=	strings
Styl	=	Stylolite
suc	=	sucrose(ic)
surf	=	surface
text	=	texture
TD	=	Total Depth
Tf.	=	Tuff
tf	=	tuffaceous
tot	=	total
trsl	=	translucent
trsp	=	transparent
TS	=	Temperature Survey
v	=	vertical
visc	=	viscosity
vn	=	vein
vy	=	very
w	=	with
wkst	=	wackestone
wh	=	white
xin	=	crystalline
yel	=	yellow

Examples of quantitative expressions: (for sand)
(s) - slightly sandy, s - moderately sandy, s - very sandy

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