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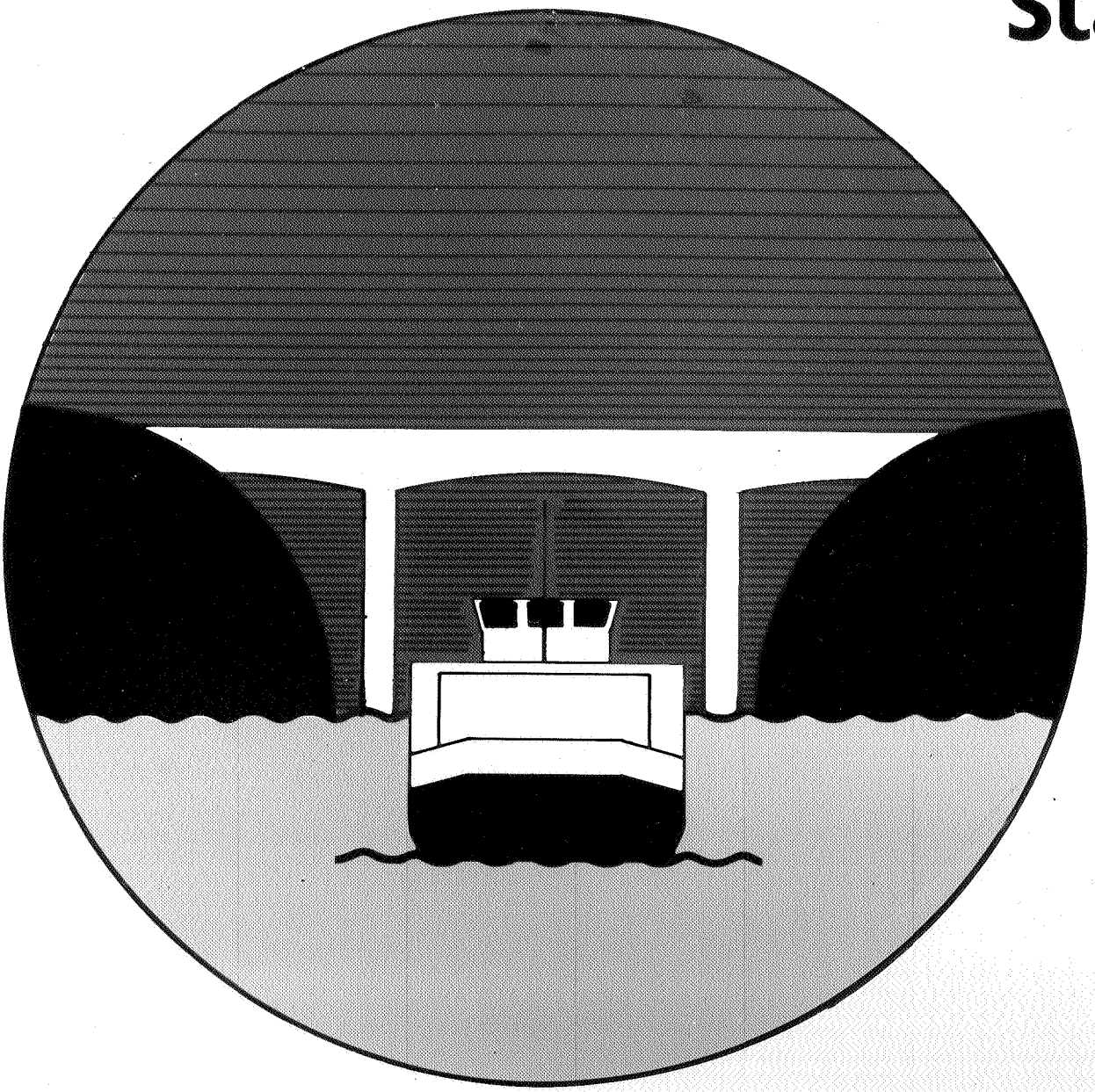

EXPLORATION & PRODUCTION DIVISION

COMPLETION REPORT
Well 6406/3-2

PL 091 STATOIL,MOBIL,SAGA

LET/K

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Title/Subtitle

PL 091
COMPLETION REPORT
WELL 6406/3-2

Activity/Keywords

Requested by
PL 091

Org. unit

Contract No./Project No.	Report No./Revision

Prepared by
Exploration Dept., Kristiansund, Lennart Jensen
Exploration Dept., Kristiansund, Trygve Øvrehus
Drilling Dept., Oddmund Theodorsen

No. of pages	No. of encl.	No. of copies	Textoperator
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LET-K	Kristiansund N., MAY 1987
Approved by: O.J. Aga, UND	Signature
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PL 091

STATOIL/MOBIL/SAGA

COMPLETION REPORT

WELL 6406/3-2

ALPHA

LETK87212035R

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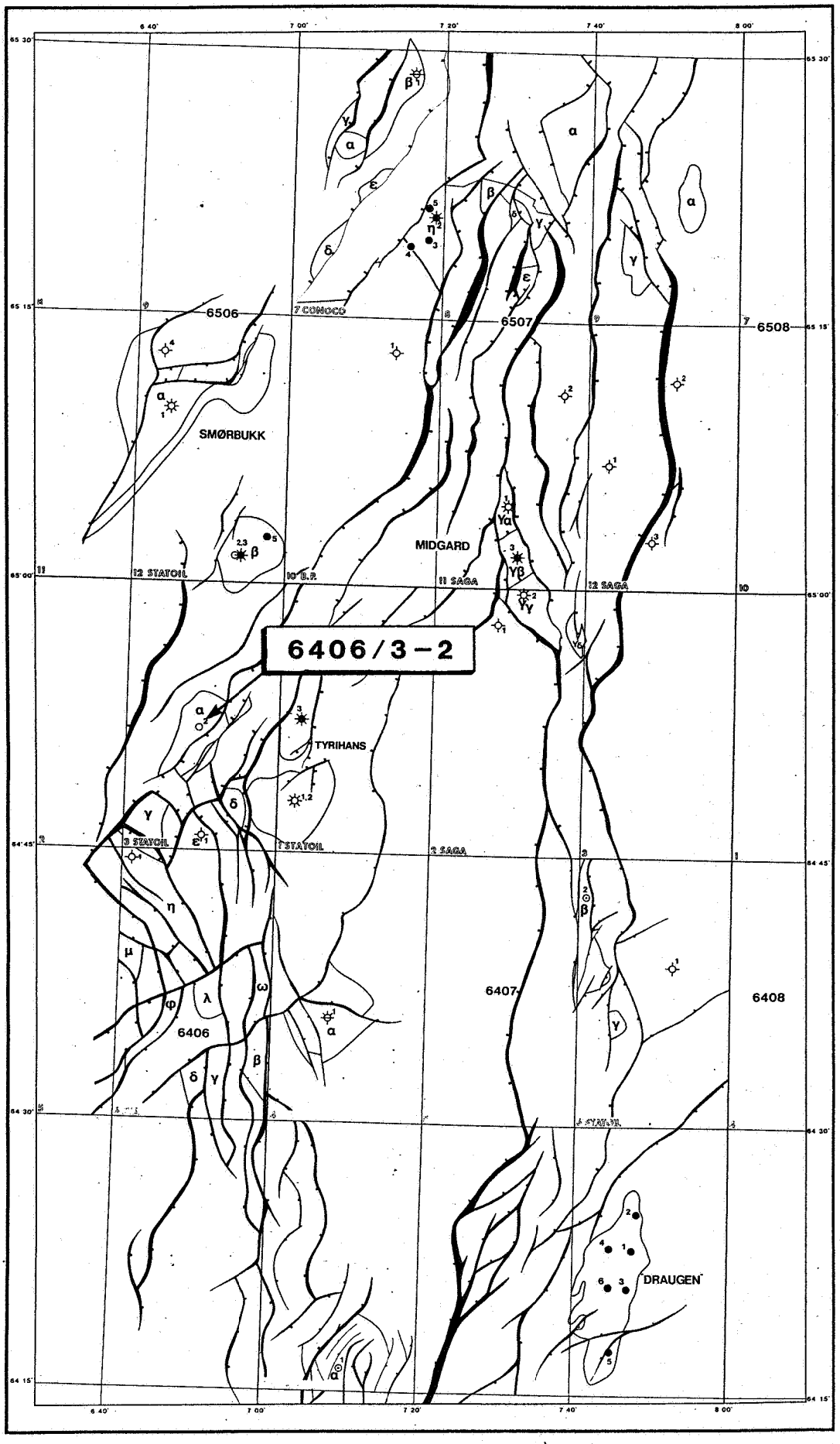
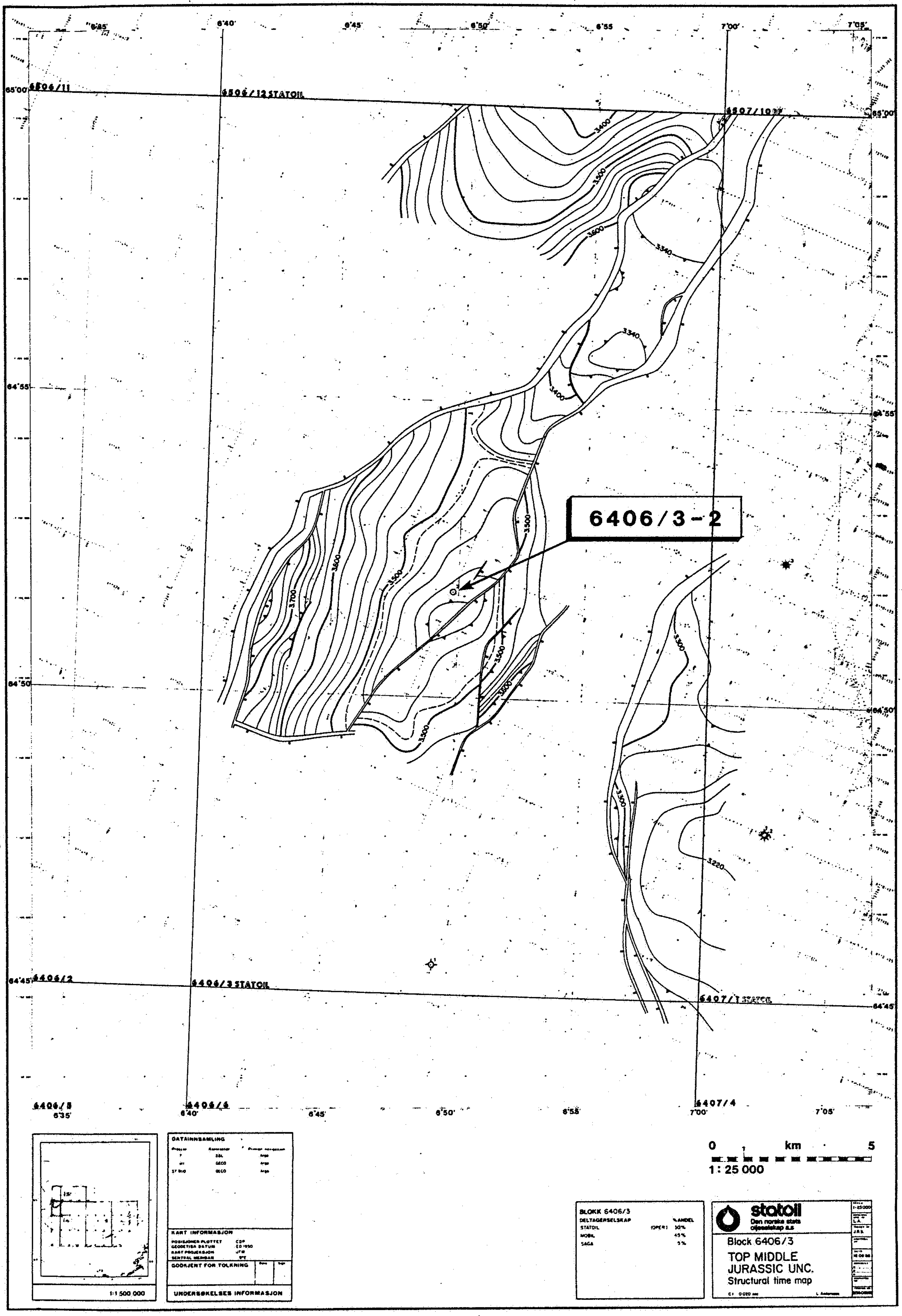
HALTENBANKEN

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%ANDEL
STATOIL (OPER.) 50%
MOBIL 45%
SAGA 5%
statoil
Den norske stats oljeselskap a.s
Block 6406/3
TOP MIDDLE
JURASSIC UNC.
Structural time map
1:25000
L.A.
J.R.S.

GENERAL INFORMATION

Well Data Record

a) Designation : 6406/3-2

b) Classification : Exploration - Plugged and Abandoned.
Oil discovery

c) Location:

i) Country : Norway offshore
Norwegian Sea

ii) Area : Haltenbanken

iii) Licence : PL 091 Statoil (operator) 50 %
Mobil 45 %
Saga 5 %

iv) Latitude : 64° 51' 46.78"N
Longitude : 06° 49' 51.87"E
Final location was 40 m,N 001°E from proposed location

v) Intersection of seismic lines 911430 and ST 8403-401

vi) Prospect : Alpha

vii) Water depth : 300 m

d) Rig data

i) Rig name : West Vanguard

ii) Drilling Draft: 20 m maximum

iii) KBE : 22 m

Table: Lithostratigraphy 6406/3-2

GROUP/FORMATION	Depth (mMSL)	Thickness (M)	TWT (s)
SULA GROUP	300	1171	0.408
SKLINNA GROUP	1471	816	1.480
KORGEN FORMATION	1471	477	
NARVIK FORMATION	1948	339	
SKOMVÆR GROUP	2287	128	2.239
ALSTAHAUG FORMATION	2287	71	
BODØ FORMATION	2358	57	
FLATØY GROUP	2451	682	2.355
FINNVÆR GROUP	3097	722	2.895
GRIP GROUP	3819	89	
NESNA FORMATION	3819	26	3.379
ENGELVÆR FORMATION	3845	63	3.397
HALTEN GROUP	3908	593+	
TOMMA FORMATION	3908	197.5	3.433
TOMMA I	3908	87	
TOMMA II	3995	52	
TOMMA III	4047	58.5	
LEKA FORMATION	4105.5	157.5	3.524
LEKA I	4105.5	50.5	
LEKA II	4156	25.5	
LEKA III	4181.5	81.5	
ALDRA FORMATION	4263	211+	3.600
HITRA FORMATION	4474	27+	3.703
TD	4501		3.717

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REPORTS ON WELL 6406/3-2

Summaries

Log Evaluation Report	Statoil
RFT Summary Report	Statoil
Test Report	Statoil
Final Well Report	Anadrill
DLWD Final Well Report	Exlog
ADT Well Report	NPS

Seismic

Site Survey at location 6406/3-2	Geoteam
VSP, Final Report	(Geco) GWS

Coring

Conventional Core Analysis	Geco
Core Photographs	Geco
Core Gamma Log	Geco
Thin Section Photographs	Geco
Quality control and Routine Core Analysis	Geco
Final P/K Report	Exlog

Biostratigraphy

Biostratigraphy/Kerogen Analysis 6406/3-2	Robertson Research Ltd.

Geochemistry

Report on Stable Isotops	IFE
Geochem. as a Method to define OWC	Statoil

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DNLL Steamtesting

Well Testing Report DST 1+2	Flopetrol Johnsen
Computer Report DST 1	Flopetrol Johnsen
PVT-Analysis	Statoil/Prolab
Sampling and Analysis of Trace Components	Petrotech
PVT-Samling from Separator/Bottomhole	Petrotech

Processed Data

Playbacks	ISF/LSS/MSFL/GR	Schlumberger
	LDL/CNL/GR	Schlumberger
	NGS	Schlumberger
	MSD	Schlumberger

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Well History

a) General

i) Spud Date : 28.06.86

ii) Rig released : 23.11.86

iii) Status : Plugged and Abandoned - Oil Discovery

b) Contractors

Drilling platform	: West Vanguard
Drilling Contractor	: Smedvig Drilling
Cementing	: B.J. Hughes
Casing	: Nor-Casing
Electric Logging	: Schlumberger
Mud	: International Drilling Fluids
Mudlogging	: NPS
MWD	: Exlog
Rig Positioning Contractor	: Decca/Geoteam
Bottom Survey Contractor	: Geoteam
Supply Boats	: Statoil Supply Boat Pool
"Stand by boats"	: Statoil Supply Boat Pool
Diving	: Scandive
Helicopters	: Helikopter Service A/S
Coring	: Diamond Boart

c) Casing

30" shoe at 433 m KB

20" shoe at 951 m KB

13 3/8" shoe at 2283 m KB

9 5/8" shoe at 3913 m KB

7" liner shoe at 4377 m KB

SUMMARY OF BIOSTRATIGRAPHICAL RESULTS 6406/3-2

Consultants: Robertson Research Int. Ltd.

Intervals	Age
440 - 650	Pleistocene - ?Pliocene (Top not seen)
650 - 1610	Pliocene
1610 - 1880	Upper - Middle Miocene
1880 - 1940	?Upper Oligocene
1940 - 1970	Upper Oligocene
1970 - 2000	Lower Oligocene
2000 - 2030	?Upper Eocene
2030 - 2210	Upper Eocene
2210 - 2270	Middle Eocene
2270 - 2309	Lower Eocene
2309 - 2436.5	Upper Paleocene
2436.5 - 2451	Upper Campanian
2451 - 2619	Lower Campanian
2619 - 2781	Upper Santonian
2781 - 2991	Middle Santonian
2991 - 3125	Middle Santonian - Coniacian
3125 - 3233	Coniacian
3233 - 3361.5	Coniacian - Turonian
3361.5 - 3450	Turonian
3450 - 3480	Upper Cenomanian
3480 - 3510	Middle - Lower Cenomanian

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Intervals:	Age:
3510 - 3555	Upper - Middle? Albian
3555 - 3735	Lower Albian - Aptian
3735 - 3825.8	Upper - Middle Barremian
3825.8 - 3834	Lower Barremian
3834 - 3840.5	Upper Hauterivian
3840.5 - 3867.5	Lower Volgian - Kimmeridgian
3867.5 - 3894	Lower Oxfordian? - Callovian
3894 - 3918	Lower Callovian - Bathonian
3918 - 3930	Lower Bathonian
3930 - 3988.3	?Middle - Lower Bajocian
3988.3 - 4216	Middle - Lower Bajocian
4216 - 4399.8	Toarcian
4399.8 - TD	Pleisbachian - Sinemurian

RFT PRESSURE LISTING
(RUN NUMBER 4B)

DEPTH (mRKB)	HYDROSTATIC PRESSURE SGP (KPA)	FORMATION PRESSURE HP (KPA)	SGP (KPA)	REMARKS
3942	48586	41228	41062	good perm
3960	48786	-	41441	good perm
3975	48855	41400	41297	very good perm
3990	49097	41476	41379	very good perm
4000	49345	41593	41476	low perm
4010	49621	41614	41497	very good perm
4045	50103	-	-	tight
4073	50262	-	-	tight
4101.5	50614	47000	46703	low perm
4125	50862	46993	46814	low perm
4201	51814	-	-	tight
4257	52448	-	-	tight
4282	52772	-	-	tight
4286.5	52814	-	-	tight
4287	52841	-	-	tight
4301.5	52966	-	-	tight
4311	53103	-	-	tight
4321	53255	-	-	tight
4331	53414	-	-	tight
4343	53448	51841	51772	mod perm
4368.5	53793	-	-	tight
4371.5	-	-	-	tight

MWD/ELECTRICAL LOGGING

MWD services including gamma ray,resistivity and directional survey data were performed by Exlog from below the 30" casing to 4380 m KB.
Wireline logging was performed by Schlumberger.

Type of Log	Run no.	Logged Interval (mKB)
ISF-LSS-MSFL-SP-GR	1A	315 - 965
(4D BHC-sonic)	2B	950 - 2297
	3C	2283 - 3926.5
	4D	3913 - 4381
	5E	4382 - 4524.5
LDL-CNL-GR	4A	3913 - 4382
	5B	4382 - 4526
DLL-MSFL-GR	4A	3913 - 4378
CST-GR	3A	3233 - 3865
	5B	4385 - 4518.5
CBL-VDL-GR	3A	320 - 2282.5
	5B	3768 - 4381
	6C	3980 - 4711.5
SHDT	4A	3913 - 4382.5
TEMP.LOG	3A	340 - 3875

CORE SUMMARY:

CORE	INTERVAL (m)	CUT (m)	REC (m)	REC o/o
1	3931 - 3934	4	2.94	73.5
2	3935 - 3952	17	17.0	100.0
3	3952 - 3965	13	12.25	94.0
4	3965 - 3983	18	16.5	91.7
5	3983 - 4001	18	18.0	100.0
6	4001 - 4027.5	26.5	26.0	98.0
7	4027.5 - 4048	20.5	20.5	100.0
8	4048 - 4056.5	8.5	8.5	100.0
9	4067 - 4094	27	27.0	100.0
10	4094 - 4121	27	25.8	95.6
11	4121 - 4149	28	27.3	97.5
12	4282 - 4298.5	16.5	14.0	85.0
13	4298.5 - 4308.5	10	10.0	100.0
14	4308.5 - 4336	27.5	27.0	98.2
15	4336 - 4345.5	9.5	4.9	51.6
16	4345.5 - 4363	17.5	15.4	88.0
17	4363 - 4377.5	14.5	12.35	85.0

Purpose of the well

The well was the second in block 6406/3 where the drilling obligation is 3-1 well.

The primary purpose of the well was to drill a commitment well on the Alpha structure and to find hydrocarbon accumulations of significant amounts in the Middle Jurassic sandstone reservoir.

Secondary objectives were hydrocarbon accumulations in the Lower Jurassic sandstone, and to verify the geophysical and structural interpretation and improve the geological, paleontological and geochemical understanding of the area. Total depth was to be in rocks of Triassic age or 4000 m in order to satisfy the licence commitment.

Results of the well

The well was drilled to a total depth of 4523 m KB into sediments of Sinemurian age (Lower Jurassic). The Middle Jurassic sandstones were penetrated at 3930 m and were found to be HC-bearing.

The well was logged, plugged and abandoned as an oil discovery. A table of detailed reports generated from the well is enclosed.

DST SUMMARY 6406/3-2

TEST NO	FORMATION	PERF. INT. MRKB	FLOW PERIOD	DURATION MIN	CHOKE MM	OIL RATE SM^3/D	GAS RATE SM^3/D	GOR SM^3/SM^3	WATER RATE TOT. SM^3	OIL DENSITY KG/M^3	GAS REL. AIR	WELL HEAD PRESS. KPA	WELL HEAD TEMP. ^0C	BOTTOM HOLE PRESS. KPA	RESERVOIR PRESSURE KPA ****
1		4302-	1											***	
		4336		438	12.7	0	0	-	4.5	-	-	177	9.7	37500	50500
			1	* 95	VARIABLE	-	-	-	-	-	-	-	-	-	-
				* 603	38.1	-	-	-	-	-	-	-	-	-	-
		3937		590	22.225	550	91500	166	-	825	0.790	4130	50	*** 24000	40300
2		3995													
			2	695	11.11	327	59000	180	-	830	0.814	8550	25	** 30150	40300
			3	628	OPEN CHOKE MANIFOLD	645	130000	202	-	828	0.855	2130	53	** 24500	40300

*) CLEAN UP FLOW
**) PRESS. DATA FROM MUST
***) PRESS. DATA FROM LASALLE GAUGES IN GAUGE CARRIER
****) RESERVOIR PRESSURE FROM TESTANALYSIS

NB! WATER DATA FROM TEST NO 1: DENSITY: 1060 KG/M^3, CHLORIDES: 51000 MG/L, PH: 6.0

I

GEOLOGICAL SUMMARY

1 GEOLOGICAL SUMMARY

SULA GROUP: 322 - 1493 m KB

Age: Quaternary: Pleistocene
Tertiary : Pliocene

The Quaternary is interpreted to be 255 m thick, and can be divided into four units as defined in the site survey. This division places the Pleistocene - Pliocene boundary at the base of unit IV at 577 m.
The sample descriptions start at 440 mKB, lithology above this depth is based on the log interpretation.

Age: Quaternary - Pleistocene

Unit I (322 - 407 m KB)

This unit consisted of hard, poorly sorted clay with a certain gravel content. Scattered boulders may be present in the entire section. The analog sparker indicated that the unit might be seperated by an erosional surface covered by a thin layer of sand. Irregularity in the unit may be caused by glacial deformation.

Unit II (407 - 479 m KB)

The top of the unit is represented by a major reflector which might be assosiated with a gascharged sand layer. The analog sparker indicated four interval reflectors. The unit is interpreted as interbedded silt and clay.

Samples from the lower 20 m of the unit contain a lot of sand and clay. The sand was described as very coarse to granules, occasionally fine, poorly sorted quartz grains with abundant lithic fragments. The clay was light grey, soft and sticky. Good traces of foraminifera, shell fragments and microfossils were also observed. Also slight traces of milky white to clear, hard, microcrystalline limestone were described.

Unit III (479 - 515 m KB)

An irregular reflector defined the top of Unit III. The unit consisted of layered sand and clay, with the same description as above in Unit II.

Unit IV (515 - 577 m KB)

This unit consisted of layered clay and sand. The clay was described as light grey to medium grey, soft, sticky, soluble, silty/sandy and non calcareous. The sand was predominantly loose, medium to coarse, occasional very fine to fine, clear to translucent quartz, also abundant lithic fragments.

The lower boundary of Unit IV was represented by a slightly irregular reflector. In places the reflector splits to show a thin layer of sand on erosion surface. No change was indicated by the electrical logs at this level.

Tertiary - Pliocene

The Tertiary sequence from 577 to 1493 m KB was described as predominantly light to dark grey claystone becoming more silty, occasionally grading to siltstone from 1300 m KB and downwards. The most prominent sand layer was at 675 m KB.

The gas level was generally low, less than 1 %, in the whole Sula Group except for one peak at 980 m (2.4 %).

The clay was described as light to dark grey, soft, sticky, soluble, non to slightly calcareous and micromicaceous. The sand was predominantly clear to translucent quartz, very fine to medium, occasionally coarse to very coarse down to 600 m KB, angular to subangular and loose. Shell fragments, microfossils, glauconite, lithic grains, pyrite and mica occur as abundant accessories. Fragments of carbonaceous material occur frequently as accessories in the upper part of the unit.

SKLINNA GROUP: 1493 - 2312 m KB

Age: Lower Pliocene - Lower Eocene

Sklinna Group was further divided into two formations, (Korgen and Narvik) by an unconformity at 1970 m, marked by a clear break in both resistivity and sonic log.

Korgen Fm: 1493 - 1970 m KB

Age: Lower Pliocene - Upper Oligocene

Korgen Formation consisted predominantly of interbedded silt and clay layers with stringers of sand, with most silt in the lower part. The formation was described as mainly silty to sandy clay, dark to medium dark greenish gray, amorphous to blocky, soft, sticky and calcareous to very calcareous. The sand was clear to smokey quartz, fine to coarse, poorly sorted, subrounded to subangular and slightly calcareous cemented.

Narvik Fm: 1970 - 2312 m KB

Age: Lower Oligocene - Lower Eocene

The Narvik Formation consisted mainly of claystone with stringers of limestone and dolomite. The claystone was light grey to grey and medium brown grey, silty, occasionally grading to argillaceous siltstone, firm, occasionally moderately hard, non to slightly calcareous, micromicaceous and glauconitic. The dolomite stringers were light brown to yellowish brown,

argillaceous, hard, and microcrystalline and blocky in shape. The limestone was described as light brown to white, hard, microcrystalline, occasionally crystalline and sandy in part. The lower part of the Narvik Formation, from 2278 to 2312, is informally referred to as the "Red Brown Claystone Unit".

"Red Brown Claystone Unit" 2278 - 2312 m KB

Age: Lower Eocene

Claystone of this unit was brick red brown, occasionally subfissile, moderately firm to soft, sticky and swelling and non calcareous. The unit is mainly made up by smectite type clays.

SKOMVÆR GROUP: 2312 - 2436 m KB

Age: Upper Paleocene

This group is divided into two formations. The Alstahaug Formation representing claystone with tuffaceous layers and the Bodø Formation consisting of claystone with occasional interbedded limestone and with traces of tuffaceous influence.

Alstahaug Fm: 2312 - 2374 m KB

Age: Upper Paleocene

The claystone was described as medium grey, slightly silty, blocky, in part platy, hard, subfissile and slightly calcareous. The tuffaceous layers were light blue grey with light green and cream spots, silty, firm and non calcareous.

Bodø Fm: 2374 - 2436 m KB

Age: Upper Paleocene

The formation consisted predominantly of light greenish grey claystone, firm, blocky, subfissile, slightly silty in part and non to slightly calcareous.

FLATØY GROUP: 2436 - 3028 m KB

Age: Upper Campanian - Middle Santonian/Coniacian

The lithology consisted of clay/claystone of different colours, interbedded claystone/very fine sandstone and a marl sequence at the top.

Flatøy Group can be divided into three informal units:

Unit I	: Marl Unit	2436 - 2476 m KB
Unit II	: Clay/Claystone Unit	2476 - 2567 m KB
Unit III	: Interbedded Claystone and Sandstone	2567 - 3028 m KB

"The Marl Unit" 2436 - 2476 m KB

This unit consisted of marl, claystone and interbedded limestone stringers. Marls were pale blue grey to dusky creamy grey, soft and waxy. The claystone occured in various shades of grey and was slightly silty to silty and non calcareous. The limestone was grey white to dusky grey, firm to hard and microcrystalline.

"The Clay/Claystone Unit" 2476 - 2567 m KB

The clay/claystone was mainly light greenish grey to greenish grey, soft, sticky and slightly calcareous. Limestone occured in thin stringers and pyrite was a common accessory.

"Interbedded Claystone and Sandstone " 2567 - 3028 m KB

This unit varies from the above by the increased differentiation of the sediments into claystone and sandstone. Whilst claystone predominates, both sandstone and siltstone were common as thin interbeds. Some limestone stringers were also encountered.

The claystone is described as various shades of grey, mainly light to dark grey, firm, with variable calcite content from slightly to very calcarous. The sandstones were generally in thin beds and described as clear to light grey, very fine to fine grained and moderately hard. The limestone was dusky white, occasionally translucent, blocky, firm, in part hard and microcrystalline.

FINNVÆR GROUP: 3034 - 3841 m KB

Age: Coniacian - Upper Hauterivian

The lithology consisted of claystone, sandy in the upper part, with a section of tuffaceous claystone in the middle part and a section of marl at the very bottom. Stringers of limestone/dolomite occur throughout the Finnvær Group.

The Finnvær Group can be devided into two informal units:

Unit I	: Clay/Claystone Unit	3034 - 3805 m KB
Unit II	: Marl Unit	3805 - 3841 m KB

The Clay/Claystone Unit: 3034 - 3805 m KB

This unit consisted of claystone with frequent stringers of sand down to about 3100 m, a section of claystone with stringers of tuffaceous claystone between 3520 - 3550 m KB, and a section of claystone with stringers of limestone/dolomite down to the marl unit.

The claystone was described as olive grey to black, occasionally dark brown, soft to firm, blocky to subfissile and with a varialbe silt and carbonate content. The sand stringers in the upper part consisted of white to clear, very fine to fine quartz sand. The sand stringers were mostly well calcareous cemented. The tuffaceous claystone was described as medium light grey to light olive grey, firm to crumbly and non calcareous. Finely disseminated pyrite was also observed.

The section between 3550 and 3805 m KB consisted of claystone as described above with stringers of white to grey, and yellowish white, firm to hard, crystalline, sparry and occasionally fibrous limestone/dolomite. Traces of pyrite and glauconite occured throughout the whole unit.

"The Marl Unit" 3805 - 3841 m KB

The lithology was described as dark grey brown, light to medium grey, occasionally red brown, moderatly to very calcareous claystone. The marl was also silty with traces of mica and pyrite.

GRIP GROUP: 3841 - 3930 m KB

Nesna Fm: 3841 - 3867 m KB

Age: Lower Volgian - Kimmeridgian

This formation displayed typical Upper Jurassic shale characteristics. The claystone was described as predominantly dusky yellowish brown to medium greyish brown, occasionally silty/sandy, fissile, micaceous, non to slightly calcareous and carbonaceous. The high gamma ray and transit time were also typical of the Upper Jurassic "hot shale".

Engelvær Fm: 3867 - 3930 m KB

Age:Lower Oxfordian ? - Lower Bathonian

The formation consisted of claystone with limestone stringers, becoming silty claystone at the bottom. The claystone was described as greenish grey, occasionally various brown and green shades, blocky to subfissile, moderately hard to firm, in part silty to sandy, non to slightly calcareous, with micromica and pyrite as accessories.
The limestone stringers were described as light grey to light yellowish orange, blocky, crystalline, hard occassionally argillaceous and dolomitic.
The silty claystone at the bottom had mostly the same colour as the claystone above, however, it was more friable, softer and occasionally sandy.
The base of the formation was an abrupt lithological break into a major sandstone unit at 3930 m.

HALTEN GROUP: 3930 - 4523 m KB

Age:Middle Bajocian - Sinemurian

The Halten Group is the most important group in the Haltenbanken area. It includes the major potential reservoir sandstones and probable source rock (the coal unit) for the area.

The Halten Group is divided into four major formations:

Tomma Formation
Leka Formation
Aldra Formation
Hitra Formation.

The Hitra was the eldest formation penetrated in this well.

Most of the Tomma Fm and the upper part of the Aldra Fm were cored (see also core description). The summary below provides a general lithological description and description of hydrocarbon shows.

<u>Tomma Fm: 3930 - 4127.5 m KB</u>

Age: ? Middle - Lower Bajocian

The Tomma Fm is divided in three informal units:

Tomma I Unit
Tomma II Unit
Tomma III Unit

Unit I and III consist predominantly of sandstone and Unit II of claystone/sandstone.

Tomma I Unit: 3930 - 4017 m KB

The top of Tomma I Unit was marked by an abrupt drilling break. The resistivity increased sharply and the gamma ray decreased at the transition from the Engelvær Fm to the Tomma Fm. Except for the upper 6 m, the whole of Unit I was cored (see also core description). Core recovery was between 73.5 - 100 %.

The lithology in Unit I was predominantly fine to coarse, occasionally very coarse sandstone. The sandstone was brownish grey, clear to translucent, occasionally light olive grey, subangular to angular, moderately to well sorted, occasionally poorly sorted, with an argillaceous matrix and was moderately to well silica cemented, moderately hard to hard and occasionally friable. There were good traces of mica throughout the unit with some pyrite, and shale laminae in the upper part. Between 3987 and 4017 m abundant streaks of carbonaceous (coal) material were observed. The sandstones have fair to good, occasionally poor visible porosity.

All cores have a strong hydrobarbon odour and the cores were sweating or bubbling apparent light oil from the intervals with good porosity. The fluorescence was patchy to even, bright to dull yellow with occasional yellow gold spots. Moderate to fast streaming/blooming, occasionally instant blue white to yellow white cut was observed in all cores. The visible residual fluorescence was bright yellow white to blue white.

Tomma II Unit: 4017 - 4069 m KB

The Tomma II Unit consisted of sandstone - shaly sandstone grading to claystone with some sandstone at

4050 m down to 4069 m. The gamma ray starts increasing at 4017 m. Tomma I Unit was observed both on the logs and in the cores. At the bottom of the unit there was a shift in the gamma ray and sonic transit time response. This, in addition to a sharp drilling break and a change in the lithology represent the boundary to the Tomma III Unit.

The lithology in the Tomma II Unit was described as very fine to fine grained sandstone with layers and lenses of claystone/silstone down to 4050 m. The sediment was partly bioturbated. The sandstone was very light grey, subrounded to angular, moderately sorted with an argillaceous matrix. The sandstone was also hard, well silica cemented and silty with poor to nil visible porosity. Abundant streaks of coal and mica were observed. There was a very weak orange brown fluorescence but no cut in the upper part. In the rest of Tomma II Unit there were no shows.

The claystone laminae were described as dark grey to medium dark grey, silty in part, micaceous, hard and subfissile.

From 4040 to 4050 m there was a gradual increase of claystone laminae. An argillaceous sandstone with aboundant calcareous laminae was observed from 4047 - 4048 m. This layer was described as light olive grey to greenish grey, very fine to fine sandstone. The sandstone had an argillaceous to micaceous matrix, abundant sparry calcareous cement, and was very hard, with undulating carbonaceous micro lenses, no to very poor visible porosity and with slight traces of yellow brown fluorescence.

The lithology from 4050 to 4069 m was brown black to medium dark grey, hard to very hard, very micaceous and micromicaceous claystone. The claystone was also non calcareous and subfissile, with traces of pyrite.

Tomma III Unit: 4069 - 4127.5 m KB

The boundary between the Tomma II and III Unit is described above. The boundary between the Tomma III Unit and the Leka Fm is represented by a sharp increase in the gamma ray value. Except for the transition from Unit II to Unit III the whole unit was cored. The entire unit consisted of bioturbuted sandstone with claystone and mica laminae. The sandstone was light grey, occasionally light brownish grey, predominantly fine to medium, occasionally very fine, occasionally coarse, becoming predominantly medium to coarse from 4097 m and downwards, subangular to subrounded, moderately to well sorted, very hard, well silica cemented with occasional carbonaceous lenses (coal) and pyrite. The sandstone occasionally had a brown argillaceous matrix in the lower part. The porosity of the sandstone was variable but predominantly poor down to 4085 m, becoming fair to good down to the bottom of the unit.

The sandstone had very variable fluorescence and cut. In the upper part of the cored section down to 4078 there was predominantly even dull orange fluorescence and no cut except from a few points where oil was observed to bleed from the core. From 4078 - 4087 m an even to patchy yellowish white to yellow fluorescence with an instant to fast streaming white cut was observed. From 4078 m to top Leka Fm the shows were variable but generally weak, although both the fluorescence and cut became stronger towards the bottom of the unit.

Leka Fm: 4127.5 - 4285 m KB

Age: Middle/Lower Bajocean - Toarcian

The boundary between the Tomma and the Leka Formation is described above. The lower boundary to the Aldra Formation is marked by a sudden drop in the gamma ray values and a relativly abrupt change from claystone to sandstone. The uppermost part of the Leka Formation was cored.

The Leka Formation consisted of argillaceous sandstone in the upper part, a relatively clean sandstone with some clay layers from 4177 to 4205 m, and a silty, sandy claystone from 4205 to 4285 m.

The sandstone was described as very light grey to light brown grey, with clear to translucent, occasionally smoky quartz. The sand was coarse to fine and poorly sorted, becoming medium to fine and well sorted between 4177 to 4205 m. In the upper part it had a predominantly argillaceous matrix. The sandstone was predominantly well silica cemented, occasionally with calcareous cement. Good traces of mica, pyrite and specks of carbonaceous material were observed throughout the unit. The porosity was predominantly poor, occasionally fair.

The siltstone was light grey brown, brownish black, medium grey, firm, non calcareous and carbonaceous, occasionally grading to silty very fine sandstone and occasionally laminated and blocky to subfissile. The siltstone also contained mica and specks of carbonaceous material. The silty, sandy claystone was described as brown to black, dark grey, firm to hard, blocky to subfissile, micromicaceous to very micromicaceous, non

calcareous, in part carbonaceous and in part with disseminated pyrite.

Aldra Fm: 4285 - 4496 m KB

Age: Toarcian - Pleisbachian/?Sinemurian

The nature of the transition from the Leka to the Aldra Formation is described above and the lower boundary to the underlaying Hitra Formation was picked at the first major coal seam at 4496 m, where 5 % coal was described in the wellsite samples.

6 cores were taken from the top of the Aldra Formation down to 4377.5 m with 51.6 - 100 % recovery.

The cored section consisted of bioturbated sandstone with frequent laminae of shale/claystone and some lenses of coal.

The sandstone was predominantly fine to medium, occasionally very fine, becoming medium to coarse and occasionally very coarse between 4322 to 4332 m. The sandstone was generally medium to dark grey, occasionally clear to translucent, occasionally olive grey, generally moderately sorted, subangular to subrounded, with argillaceous/ carbonaceous matrix and silica cement with kaolinitic cement from 4329 m and was moderately hard to hard. The visible porosity varied from poor to good. The shale laminae were dark grey, grey to black, hard, subfissile, micromicaceous, carbonaceous, occasionally with local coal and occasionally silty, grading to siltstone. The coal lenses were black, occasionally dark brown, shiny, firm to moderately hard, brittle and displayed conchoidal fracture. There was a strong hydrocarbon odour and oil

bleeding from the core down to 4336 m. Below this the hydrocarbon odour was sporadic, occasionally fair, and oil bled from a few scattered points only.

Down to 4336 m an even to patchy, bright to dull yellow white to blue white fluorescence with good cut fluorescence was observed. Further down there was only a dull even to patchy orange brown fluorescence with no cut fluorescence.

From 4377.5 m down to top Hitra Fm the lithology consisted of sandstone with laminae and lenses of shale and coal. The sandstone was frequently grading to siltstone. The description of the lithology was the same as described above.

Hitra Formation: 4496 - 4523 m KB

Age: Sinemurian

The Aldra/Hitra boundary is described above. The base of the Hitra Formation was not penetrated . The Hitra Formation consisted primarily of argillaceous sandstone with laminae and lenses of shale and coal.

The sandstone was described as argillaceous, light olive grey, fine moderately to well sorted, silica cemented, moderately hard, micromicaceous and carbonaceous in part, with poor visible porosity.

The shale was olive to medium dark grey, platy, moderately hard and micromicaceous.

The coal was black, shiny brittle, moderately hard, occasionally silty and with accessory pyrite.

The well was drilled 27 m into the Hitra Formation to 4523 m KB (TD).

PORE PRESSURE GRADIENT

The pore pressure is evaluated using drilling parameters, sonic and resistivity measurements, measured test pressure (RFT) and drilling data from daily drilling reports.

The pore pressure gradient is, as prognosed, equal to 1.03 g/cm^3 from the seabed down to the Upper Miocene unconformity as top Sklinna Group, at 1493 m. Across this unconformity, the background gas increased from an average 0.5 % to 1.5 %, although this was attributed to change in lithology rather than an increase in the pore pressure gradient.

An enforced bit change at 1509 m makes interpretation of drilling parameters directly below this unconformity rather difficult.

The first departure from a normal (hydrostatic) pore pressure gradient occurs around 1800 m in the lower part of the Korgen Formation of Middle Miocene age. In the lower part of the Miocene the gradient increases very rapidly before the increase becomes somewhat steadier from top Narvik Formation, Oligoene and reaches a maximum value in the Upper Paleocene. A maximum pore pressure of 1.71 g/cm^3 was reported at 2470 m, this based on drilling parameters. Subsequent calculations from sonic measurements confirmed this estimate. Although this estimate was correct, there were several indications that the quantative estimates were rather conservative in the transition zone. Rates of penetration were abnormally high, drag on connections

was relatively common and splintery pressure cavings were observed. These, and estimates based on sonic measurements would suggest that long sequences of this transition zone were in fact drilled underbalanced.

The lack of connection gases and relatively low and constant background gas, for whatever reason, make accurate quantative estimation difficult in this section.

There is a significant pressure drop in the Upper Cretaceous once the maximum has been reached and a stable gradient is established down to Lower Cretaceous where the pressure again increases slightly towards top Jurassic.

Quantative estimates within this interval are inaccurate as most of the interval was drilled utilising a turbine. Sonic measurements provide the best results and indicate a stable pore pressure gradient, approximating 1.30 g/cm^3.

A combination of factors including turbine drilling, bit changes and several unconformities made any reliable estimate of pore pressure from those parameters available impossible in the Lower Cretaceous. The pressure increase towards top Jurassic is based therefore on sonic data.

The mud weight was reduced once the presence of hydrocarbons in the Tomma Formation had been confirmed. Measured test pressures in the Tomma Formation indicated a pore pressure of 1.06 g/cm^3. Further measurements showed an equivalent pressure of 1.22 g/cm^3 at 4343 m, within the water bearing zone of the Aldra Formation. Further measurements were impossible as the

RFT tool became stuck at 4371 m. There is no evidence of any significant pressure increase between 4343 m and TD at 4523 m (RKB) and a stable pore pressure gradient, approximating 1.22 g/cm^3 is assumed.

Overburden Gradient

The overburden gradient is calculated from measured and calculated densities.

Down to seabed, a density of 1.03 g/cm^3 is assumed and used in the calculations.

Density measurements are only available from below the 9 5/8" casing shoe at 3913 m. No density log was run before this depth.

The prognosed overburden gradient is based on density measurements from wells 6407/1-2 and 6407/1-3. The density from seabed down to 9 5/8" casing shoe is calculated from the sonic data and this appears to conform well with the prognosed gradient.

The relationship used between sonic and density values is an empirical North Sea correlation and is not derived particularly for the Haltenbanken area. However, it is assumed that the accuracy is still within the accuracy of the rest of the calculation.

II

DRILLSTEM TESTING SUMMARY

Sequence of events, Drill Stem Test 1
(Perfs 4302.3 - 4336.3 m RKB)

08.October 1986

09:02 Started the Lasalle EMR-700 gauge no.70534.
09:03 Started the Lasalle EMR-700 gauge no.70535.
(Both gauges sensing point at 4192.09 m RKB.)
09:30 Installed gauges in the gauge carrier.
Pressure tested to 550 Bars, for 10 minutes.
11:40 Run in hole with the carrier.

09.October 1986

R.I.H. with the test string, and landed it.
21:03 Perforated the well.
21:11 Changed to a 12.7 mm (32/64") choke.
21:19 Shut the well in for the initial build-up test.
22:22 Opened the well for clean-up flow on a 12.7 mm (32/64") choke.

10.October 1986

06:40 Well shut in at the LPR-N valve, for the main build-up test.
19:11 Opened the LPR-N valve.
19:37 Opened the well on a adjustable choke, for sampling.
Started pumping.
20:32 Well shut in, at the choke manifold.
Started bullheading, and killing of the well.
Pulled the test string.

11.October 1986

Continued pooh with the test string.
17:00 Received gauges in carrier, at surface.
Unloaded data from gauge no.70534. OK.
Unable to unload data from gauge no.70535.

End of Drill Stem Test 1

Sequence of events, Drill Stem Test 2
(Perfs 3937.0 - 3995.1 m RKB)

06.November 1986

03:12 Started the Lasalle EMR-700 gauge no.70689.
03:16 Started the Lasalle EMR-700 gauge no.70534.
(Both gauges sensing point at 3785.42 m RKB.)
03:48 Installed gauges in gauge carrier on catwalk.
Pressure tested to 55000 Kpa, for 15 minutes.
07:04 Run in hole with gauge carrier.

07.November 1986

10:00 Sting into packer.
14:26 Pressured up tubing to 10000 Kpa.
14:33 Opened LPR-N valve.
14:40 Pressured up tubing to 48600 Kpa to activate guns.
14:45 Bled off tubing pressure.
PERFORATION and INITIAL BUILDUP
14:56 Perforated the well.
16:05 Closed lubricator valve.
16:06 Started Lasalle SWC gauge no.50125.
17:20 Started Lasalle SWC gauge no.50138.
18:13 Gauges in lubricator.
18:53 Commenced running in hole with gauges on wireline.
20:09 Land gauges in "F" nipple at 3827.71 m RKB.
20:11 Gauges released in "F" nipple.
CLEAN-UP FLOW
22:32 Opened well on 4.762 mm adj. choke to tank.
22:35 Increased to 6.350 mm adj. choke.
22:36 Increased to 7.937 mm adj. choke.
22:43 Increased to 9.525 mm adj. choke.
23:05 Increased to 12.700 mm adj. choke.
23:45 Gas to surface.
23:50 Choke plugged.
23:55 Changed to 12.700 mm fixed choke.

08.November 1986

00:04 Increased to 23.813 mm adj. choke.
00:05 Increased to 31.750 mm adj. choke.
00:07 Increased to 38.100 mm adj. choke.
10:10 Decreased to 31.750 mm adj. choke.
10:11 Decreased to 25.400 mm adj. choke.
10:13 Decreased to 23.813 mm adj. choke.
10:24 Decreased to 22.225 mm fixed choke.
10:45 Directed flow through separator.
SECOND BUILDUP
20:00 Well shut in at LPR-N valve.
20:02 Closed choke manifold.
20:25 Started rigging up MUST tool-string.
22:22 Dropped tool-string onto lubricator valve.
23:55 Commenced fishing for tool-string.

09.November 1986

19:15 Fishing completed successfully.

10.November 1986

02:08 Started running in hole with MUST tool-string.
04:42 Latched into MUST valve and closed valve.

LOW RATE FLOW

06:30 Opened LPR-N valve.
06:40 Opened choke manifold on 12.700 mm fixed choke.
06:50 Fixed choke plugging, changed to 12.700 mm adj. choke.
07:12 Decreased to 11.113 mm fixed choke.
09:32 Directed flow through separator.

THIRD BUILDUP

18:15 Well shut in at MUST valve.
18:16 Closed choke manifold.

11.November 1986

11:59 Closed LPR-N valve.
12:01 Opened MUST valve.
12:11 Opened kill valve.
12:14 Pressured up string to 11000 Kpa.
12:30 Closed kill valve.

HIGH RATE FLOW

12:32 Opened LPR-N valve.
12:33 Opened choke manifold on 50.800 mm fixed choke.
Adjusting chokes according to downstream pressure.
12:36 Both chokes fully opened.
14:12 Directed flow through separator.

FOURTH BUILDUP

23:00 Well shut in at MUST valve.
23:02 Closed choke manifold.

BOTTOM HOLE SAMPLING

12.November 1986

09:18 Started to equalize across MUST valve.
10:01 Closed LPR-N valve, lost signal from MUST gauge.
10:03 Opened MUST valve.
10:13 Opened LPR-N valve.
10:15 Opened choke manifold on 9.525 mm adj. choke.
10:21 Increased to 12.700 mm adj. choke.
10:32 Increased to 15.875 mm adj. choke.
10:56 Increased to 17.463 mm adj. choke.
10:58 Increased to 19.050 mm adj. choke.
10:59 Increased to 22.225 mm adj. choke.
11:15 Decreased to 12.700 mm adj. choke.
11:20 Decreased to 4.762. mm adj. choke.
11:30 Closed choke manifold.
11:32 Started cycling MUST tool.
11:54 Released MUST tool.
12:07 Closed LPR-N valve.
14:19 Pull out of hole with MUST tool.
19:15 Opened LPR-N valve.
19:23 Opened choke manifold on 11.113 mm adj. choke.
19:28 Increased to 12.700 mm adj. choke.
21:00 Decreased to 7.937 mm adj. choke.
21:10 Decreased to 4.762 mm adj. choke.
21:20 Decreased to 3.175 mm adj. choke.
21:30 Closed choke manifold.
23:06 Ran in hole with samplers and Sperry Sun gauge.

23:52 Opened choke manifold slowly.
23:54 Choke on 9.525 mm adj.

13. November 1986

00:30 Increased to 12.700 mm adj. choke.
00:33 Decreased to 9.525 mm adj. choke.
01:05 Decreased to 3.175 mm fixed choke.
01:15 Directed flow through separator.
03:15 Started pulling out of hole with samplers.
03:30 Closed choke manifold.
04:40 Samplers out of hole.
05:35 Opened choke manifold on 6.350 mm adj. choke.
05:56 Closed master valve.
08:39 Opened master valve.
08:40 Started bullheading.

14. November 1986

05:25 Gauge carrier with GRC gauges out of hole.
06:20 SWC Gauges out of hole.

End of DST no. 2.

Flow Data Summary, 6406/3-2, DST No. 1

Perforated interval: 4302 - 4336 m RKB, Aldra Formation

Description		First Flow
Production time		438 min
Total influx		4.5 sm^3
Fluid		water
Well head pressure		177 kpa
B.H. flowing pressure	1)	38100 kpa
Bottom hole temperature	2)	145.8 deg C
Build-up time		751 min
B.H. build-up pressure	1)	50100 kpa

1) Last recorded flowing/buildup pressure at 4192 m RKB

2) Last recorded temperature reading at 4192 m RKB

NB! Water produced into string was reversed circulated out.

DST No. 1, Formation Water Properties:

Density : 1.060 g/cc
Chloride, Cl- : 51000 mg/l
PH at 20 deg C : 6.0

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Flow Data Summary, 6406/3-2, DST No. 2

Perforated interval: 3937 - 3995 m RKB, Tomma I Formation

Description	Clean-up Flow	Main Flow	High Rate Flow
Production time	1288 min	695 min	627 min
Flow rate	550 sm^3/D	327 sm^3/D	645 sm^3/D
Fluid	oil	oil	oil
Well head pressure	4130 kpa	8550 kpa	2130 kpa
B.H.flowing pressure 1)	24100 kpa	30200 kpa	24600 kpa
Bottom hole temp. 2)	145 deg C	144 deg C	145 deg C
Build-up time	1455 min	1100 min	673 min
B.H.build-up pressure 1)	40000 kpa	40000 kpa	39600 kpa

1) Last recorded flowing/build-up pressure at 3785.4 m RKB

2) Last recorded temperature reading at 3785.4 m RKB

DST No. 2, Formation Oil/Gas Properties:

Density Oil : 825 - 830 kg/m^3
GOR : 166 - 202 sm^3/sm^3 (increased during the test)
Spes.Density Gas: 0.79-0.85 (increased during the test)

LETK87202135R