elf aquitaine norge a/s

Geological Completion Report
Well 15/3-5

June 1985

ELF AQUITAINE NORGE A/S
Exploration Division
311D 85/239-R
JER/bs

GEOLOGICAL COMPLETION REPORT 15/3-5

June 1985

Author:
J.E. Ringås

DISPATCHING LIST

Norwegian Petroleum Directorate		2
Norsk Hydro A/S, Sandvika		1
Total Marine Norsk A/S, Bergen		1
Total Marine, Paris		1
Lasmo, London		1
Statoil		1

EAN

General Manager		1
Exploration Manager		1
Chief Geologist		1
Chief Geophysicist		1
District 2		1
Drilling Department		1
Reservoir Department		1
File Exploration		1

SNEA(P)

DIG EUROPE	A.Duchemin	2
DEX DEFP	P.Mazelet	1
Laboratoire de Geologie		1
Direction Production		1
SID, Paris		1
SID, Pau		1

LIST OF CONTENTS

CHAPTER 1 : General data and hole record

CHAPTER 2 : Objectives and main results

CHAPTER 3 : Lithology and stratigraphy

CHAPTER 4 : Structural data, geophysical results

CHAPTER 5 : Organic geochemistry

CHAPTER 6 : Hydrocarbon shows

CHAPTER 7 : Reservoirs, formation pressure

CHAPTER 8 : Formation temperature

CHAPTER 9 : Correlations

CHAPTER 10: Conclusion

LIST OF ANNEXES

ANNEX 1 : CORING

ANNEX 2 : LOGGING

LIST OF APPENDICES

APPENDIX 1: Core descriptions

APPENDIX 2: Sidewall core descriptions

LIST OF FIGURES

Fig.1 : Position map
Fig.2 : Well summary chart, 15/3-5
Fig.3a : Bore card, Well 15/3-5
Fig.3b : " "
Fig.3c : " "
Fig.4 : Biostratigraphy, Jurassic Section
Fig.5 : Prognosed and actual time-depth curve for well 15/3-5
Fig.6 : Calibration of well 15/3-5 on seismic line EL 8206-418
Fig.7 : Hydrocarbon shows in the Middle Jurassic Sleipner Fm.
Fig.8 : Comparison of pressure measurements between 15/3-4 and 15/3-5
Fig.9 : Formation temperature
Fig.10 : Geological cross-section along Seismic line EL 8206-418

LIST OF PLATES

Pl.1 : Composite log, well 15/3-5
Pl.2 : Log correlation, Jurassic Section
wells 15/3-1,3,4 and 5.

POSITION MAP

BLOCK : 15/3

WELL : 15/3-5

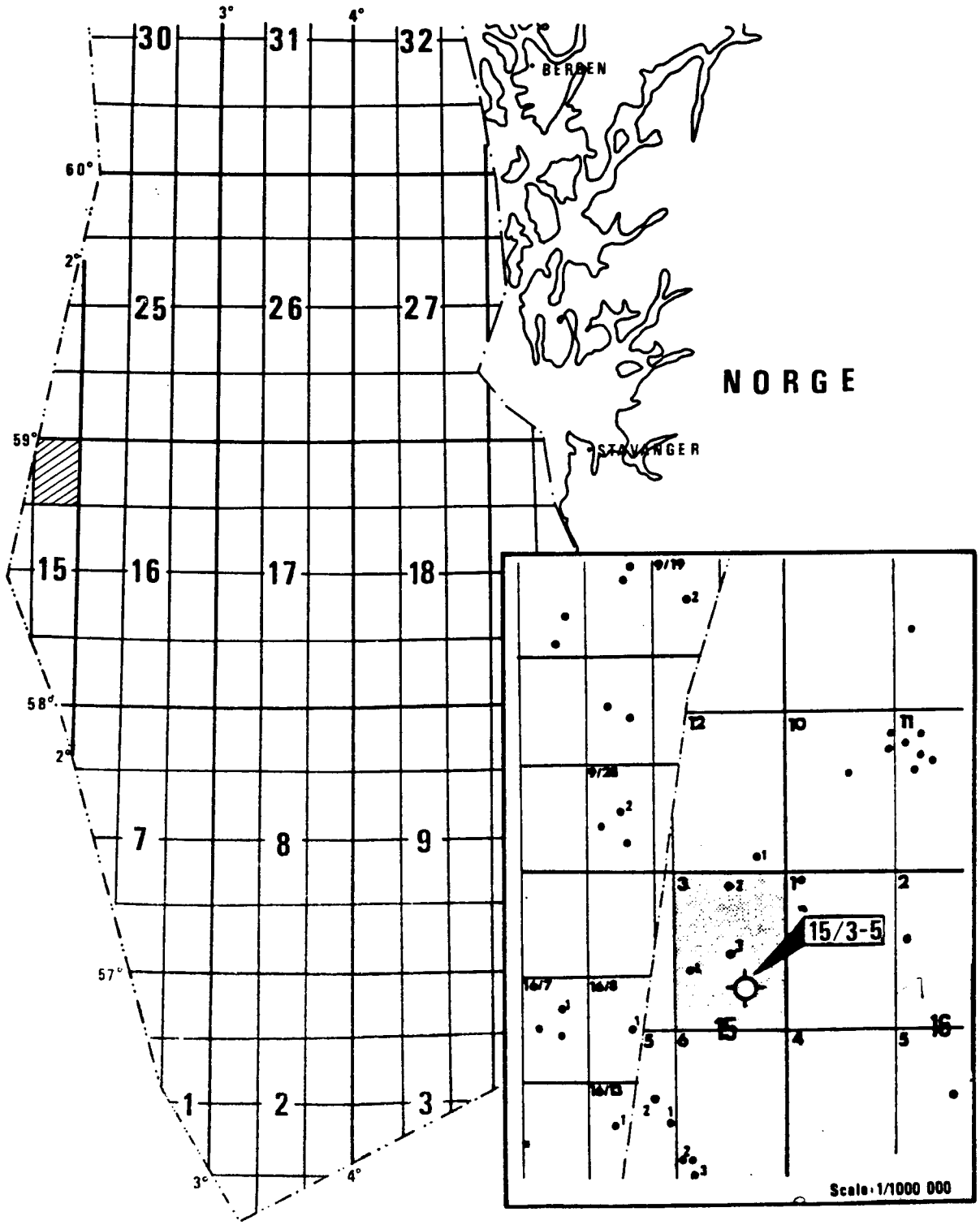
OWNER : PETRONORD GROUP

COORDINATES: X:01° 50'36"E
Y:58° 47'12,5"N

INTERSECTION OF SEISMIC LINES: 580-322 and EL 8206-418 A

Scale: 1/2500 000

Date:



EXPLORATION DIVISION

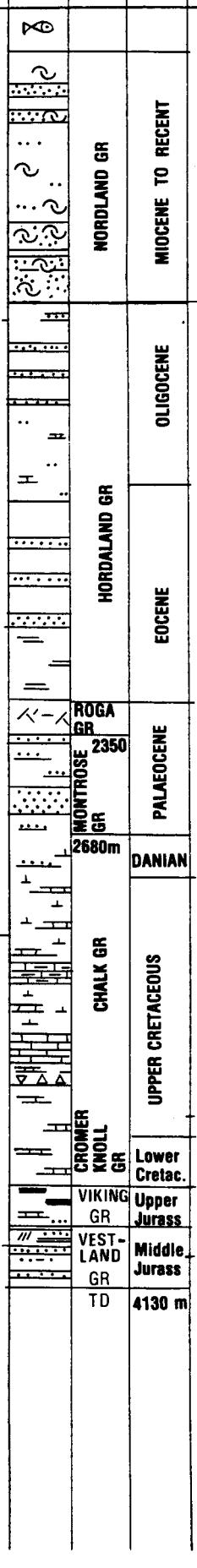
Fig.1

HOLE RECORDS

Drilling 26" hole with hole opener 36" to 195m
moved rig 25 m west direction.
Drilling 26" hole with hole opener 36" to 196m
set 30" casing at 196m
Drilling 17" 1/2 pilot hole to 997m
underreaming 26" to 977m
set 20" casing at 962m
Drilling 17" 1/2 hole to 2813m
set 13" 3/8 casing at 2798m
Drilling 12" 1/4 hole to 3832m
set 9" 5/8 casing at 3816m
Drilling 8" 1/2 hole to 4130m (T.D.)

NB! three cores have been cut during the 8" 1/2 phase.

BOX 121 NO 1460



DESCRIPTIONS	OBS.
Water depth. 110m Seabed 135 m Alternance CLAY clear grey and Sd . to M – Numerous shells fragments calcareous.	
Alternance CLAY/CLAYSTONE, grey to brownish grey, silty and SAND f. to Med.	
CLAYSTONE grey-brown, silty	
CLAYSTONE grey to grey-green w/ Levels of SAND F. to medium	
SHALE grey. dk grey. micromicaceous.	
SHALE A/A, OCC brownish. Presence of TUFF light grey and of LMST whitish	
Alternative of SH A/A and levels of SANDSTONE, fine to coarse	
MARL whitish to grey and LMST white argilleaceous.	
Whitish and grey LMST, chalk, MARL stringers of black SHALE	
SH dK crey calcareous and verved SM and CHERTS	
SH, light grey, occ. brownish with finer intercalatious of LMST beige	
SH brown to dk brown, silty SH dk grey silty – stringers of LMST SH A/A w/levels of COAL and of SDST Fine to medium Presence of SLST micromicaceous. At 4075 m SHALE, reddish Presence of beige Dolomite.	

WELL: 15/3-5

COUNTRY: NORWAY

LIC: 025

COORD:

X: 58°47'13,04"N

Y: 01°50'34,11"E

DEPTH REF: RKB

OPERATOR ELF AQUITAINE NORGE A/S

Close to intersection of seismic lines EL 8206.418A and 580.322

CASINGS

30" at 196m
20" at 962m
13"⅜ at 2798m
9"⅝ at 3816m

core 1 – 3971–3989m 98%
core 2 – 3989–4003m 84%
core 3 – 4020–4029m 94%

TARGETS:

Jurassic sandstones

RESULTS:

Oil bearing Middle Jurassic sandstone layers.

OBSERVATIONS:

ISF Sonic GR 973–135m	1		requested 30 18 full bullets	
LDT. GR Cal 967–194m	1		ISF-LSS. GR. SP 4005–3816m	4
			LDL. CNL. GR. 4005–3816m	4
ISF-Sonic GR. PS 2808–962m	2		ISF. LSS. GR. SP 4133–3816m	5
LDL-CAL 2808–962m	2		LDL-CNL. NGL 4135–3815m	1
BGT GR CAL 2800–962m	1		DLL. MSFL. GR 4133–3816m	1
ISF LSS. GR SP 3832,5–2797m	3		SHDT 4135–3815m	2
SHDT 3830–2797m	1		RFT 4135–3960m 18 pressure tests 1 sample 3970m	1
LDT. NGT. CAL 3817–2797m	3		RFT 4048–3984m 2 pressure tests 1 sample 3984m	2
CST 3828,5–3910m requested 51 in full bullets	1		RFT 4028,6–4022,2m 3 pressure tests	3
CST 3829–2817m	2			
2 samples at 4022,2m and 4028,6m			4,2 CUFT☼ + mud Filtrate (▲) PF 9139 psi – 3970m	
CST 4130–3938m requested 30 Full bullets: 15	3		2,5 CUFT☼ + mud Filtrate (▲) P.F. 9149 psi 3984m	
CST 3905–3830m requested: 30 Full bullets: 17	4		0,15 CUFT☼ + mud Filtrate (▲) P.F. 7873 psi 4022m	
			Traces☼ + mud Filtrate (▲) P.F. 8163 psi 4026,6m	
SSL 4125 – 1000 m 46 shot points	1			

Fig.2

CHAPTER 1

GENERAL DATA AND HOLE RECORD

GENERAL DATA (figs.1 and 2)

Country:	NORWAY	
Area:	Block 15/3 (Licence 025)	
Well identification:	15/3-5	
Owner:	PETRONORD	
Partners:	Elf Aquitaine Norge A/S	43.6%
	Total Marine Norsk A/S	21.8%
	Norsk Hydro Prod. A/S	19.6%
	LASMO	15.0%
Operator:	Elf Aquitaine Norge A/S	
Well classification:	Exploration well	
Geographical coordinates	X: 58° 47' 13,04"N	
	Y: 01° 50' 34,11"E	
Seismic location:	Around intersection of seismic lines EL 8206-418A (shot point 726) and 580.322 (shot point 1934)	
Drilling rig:	Byford Dolphin	
Water depth:	110 m	
RKB:	25 m	
TD:	4130 m (driller) 4135 m (logs)	
On location:	20/12/84	
First spudding: 28/12/84	Second spudding: 06/01/84	
At TD:	02/05/84	
Off location:	13/05/84	
Contractors:	Drilling	: Dolphin A/S
	Electrical logging	: Schlumberger
	Mud logging	: Geoservices
	MWD	: Teleco

CHAPTER 2

OBJECTIVES AND MAIN RESULTS

OBJECTIVES

The well 15/3-5 was drilled in a down-dip position of a structure explored by the well 15/3-4 where oil-bearing reservoirs of Middle Jurassic age (Sleipner Fm) were tested.
The main objective of well 15/3-5 was then to look for the extension of these hydrocarbon-bearing reservoirs, and to define a hydrocarbon-water contact. It was expected to find a thicker sand-development in 15/3-5.

MAIN RESULTS

Five thinner reservoir zones were encountered in the Sleipner Fm, in which three were hydrocarbon-bearing (see fig.7). Only one of these seems to be in pressure contact with a level in well 15/3-4, and WOC is estimated at 4022.6 m RKB.

No production test was performed.

CHAPTER 3

LITHOLOGY AND STRATIGRAPHY

See Composite log and figs.3b and 3c.
The chronostratigraphy is for the Cretaceous and Tertiary sequence based upon correlation with well 15/3-4. A micropaleontological study for these series is expected to be finished in October -85.

LITHOLOGY (all depths in m RKB)

PLEISTOCENE TO MIOCENE Sea bed - 928m
NORDLAND GROUP

135 - 196 m : Drilling without return

196 - 339 m : Interbedded SAND, fine to medium, clear to brown, occasionally coarse, and CLAY, silty, grey, soft and plastic.
Shell fragments present (bi-valves, mainly oysters).

and

339 - 702 m : CLAY, grey, soft, plastic, sticky and washable, occasionally slightly calcareous.
Laminations of SAND, fine to very fine, clear.
Presence of glauconite, pyrite, shell fragments and lignite.

702 - 928 m : UTSIRA FM
SAND, fine to medium, occasionally coarse, clear, sub-angular to subrounded, with abundant SHELL FRAGMENTS, white to beige (bi-valves, bryozoae, gastropods, etc.).

Interbeds of CLAY, silty, grey, soft and plastic.
Traces of SILTSTONE, dark brown, very micaceous, and SANDSTONE, fine to medium, grey, calcareous.
Glauconite and pyrite present.

OLIGOCENE TO EOCENE	928 - 2236 m HORDALAND GROUP
928 - 1129 m	: CLAY, silty to very silty, grey to brown-grey, slightly calcareous. Laminations of SAND, fine to very fine, translucent, colourless. Traces of mica, glauconite and shell fragments.
1129 - 1228 m	: Interbedded SAND, fine to medium, translucent, colourless, subrounded, and CLAYSTONE, silty, grey to brown, glauconitic, soft to mod. indurated, plastic.
1228 - 1596 m	: CLAYSTONE, silty, grey to brown, soft to mod. indurated, micromicaceous, with stringers of LIMESTONE, beige to white, medium hard, argillaceous. Interbeds of SILTSTONE, grey-green in the lower part of this sequence. Traces of glauconite and pyrite.
1596 - 2047 m	: FRIGG FM EQV. SAND, fine to medium, translucent, subrounded to subangular, becoming fine to very fine downwards. Interbeds of CLAYSTONE, silty, grey to green, occasionally brown, soft and micromicaceous. Stringers of SANDSTONE, fine, colourless, calcareous, and LIMESTONE, white, chalky and soft. Traces of glauconite and pyrite.
2047 - 2236 m	: SHALE, grey to green, occasionally brown, soft to fissile, micromicaceous, silty in the lower part. Stringers of DOLOMITE, beige to clear brown and microcrystalline are frequent at the top. Thinner beds of LIMESTONE, white, soft,are found at the base of the sequence.

UPPER PALEOCENE 2236 - 2680 m

ROGALAND GROUP 2236 - 2350 m

2236 - 2294 m : BALDER FM

SHALE, silty, grey to brown, occasionally blue and green, medium indurated, pigmented with TUFF, light grey, soft.

Stringer of LIMESTONE, grey to beige, soft.

2294 - 2350 m : SELE FM

SHALE, silty, grey to green, occasionally brown, soft to medium hard, indurated, micro-micaceous, blocky.

MONTROSE GROUP 2350 - 2680 m

2350 - 2680 m : INTERFINGERING MAUREEN FM AND HEIMDAL FM EQV.

SAND, fine to coarse, subrounded to subangular, translucent, interbedded with SHALE, silty, grey to brown, occasionally green, soft to medium hard, micro-micaceous. Stringers of DOLOMITE are frequent. They are beige, hard and micro-crystalline.

Lamination of SANDSTONE, fine, grey to white, calcite-cemented, friable. The sediments are glauconitic and locally pyritic.

CHALK GROUP 2680 - 3623 m

LOWER PALEOCENE 2680 - 2803 m

2680 - 2803 m : EKOFISK FM.

MARL, white to grey, pink at the base, soft, with stringers of LIMESTONE, white, hard. Interbeds of SAND, medium to coarse, subrounded to subangular, translucent, and SHALE, silty, grey to brown.

Stringers of SANDSTONE, fine, white, calcite-cemented.

Traces of pyrite and glauconite.

UPPER CRETACEOUS 2803 - 3623 m

2803 - 3063 m : TOR FM

MARL, grey to dark grey, medium hard, locally soft. Interbeds of LIMESTONE, white to light grey, soft to medium hard, chalky.

3063 - 3401 m : HOD FM

LIMESTONE, pink to red-brown, medium hard, argillaceous, occasionally white to beige, soft to medium hard, amorphous, interbedded with MARL, grey to red-brown, soft to medium hard. Stringers of SHALE, dark grey, hard.

Traces of glauconite.

3401 - 3486 m : PLENUS MARL FM

SHALE, dark grey, indurated, calcareous, occ. silty. Interbeds of MARL, light grey to beige, soft to firm, and stringers of LIMESTONE, white, medium hard, microcrystalline.

The lowermost part of the formation consists of SHALE, black, very hard and silicified, with CHERTS, white, very hard, with flinty fracture.

3486 - 3623 m : HIDRA FM

SHALE, light grey to grey, medium hard, calcareous, occasionally silty. Grading to MARL, light grey to beige, soft to firm.
The calcareous content in this formation decreases downwards.

LOWER CRETACEOUS 3623 - 3808 m

CROMER KNOLL GROUP

3623 - 3674 m : RØDBY FM

SHALE, light grey to brown and red, soft, with stringers of LIMESTONE, white, soft to firm.

3674 - 3808 m : VALHALL FM

SHALE, dark grey, fissile, indurated, medium hard, occasionally brown to red, soft and calcareous. Stringers of LIMESTONE, white, hard and argilla- ceous, and traces of SAND, medium to coarse, subangular, translucent.

JURASSIC 3808 - 4135 m (TD)

UPPER JURASSIC 3808 - 3935 m

VIKING GROUP

3808 - 3881 m : DRAUPNE FM

SHALE, silty, dull dark, brown to dark grey and black, soft, becoming more indurated downwards. Stringers of SANDSTONE, fine, white to translucent, calcareous.
This interval is the classical organic rich Draupne Fm deposited in a marine environment with restricted bottom conditions.

Age: Lower Kimmeridgian to Ryazanian.

3881 - 3935 m : HEATHER FM

SHALE, silty, grey to dark grey, soft, micromicaceous occasionally dolomitic, with stringers of SILTSTONE, clear grey, soft, and LIMESTONE, white, soft, chalky, occasionally sandy.
This sequence is characterized by lower GR-values and a higher interval-velocity than the sequence above. This indicates a lower organic carbon content.
The Heather Fm is deposited in an open marine environment.

Age: Lower Oxfordian to Lower Kimmeridgian.

MIDDLE JURASSIC: 3935 - 4135 m

VESTLAND GROUP

3935 - 4135 m (TD) SLEIPNER FM

3935 - 4082 m : Alternating SANDSTONES, SILTSTONES, SHALES and COAL HORIZONS.

The sandstones are very fine to coarse grained, white to grey and clear brown, micromicaceous, subangular, occasionally cemented by calcite and silica. The siltstones are grey, hard, micromicaceous, occasionally calcareous.

The shales are silty, dark grey, micromicaceous, hard and calcareous in parts. The coal levels are brittle, massive, with presence of pyrites. In addition, coal fragments are frequent throughout this interval.

Shell-layers (bi-valves) were observed in core No.2 (3989 - 4003m).

From a sedimentological point of view, the sequence can be devided in three different intervals:

Interval 1, from 3935 to 3985m:

Interbedding coal horizons, shales, siltstones and sandstones. The interval is interpreted as lower delta plain deposits, where the sandstones represent fluvial channels (see Core No.1, Appendix 1), and the shales, coals and silts are interpreted as interdistributary marsh deposits.

Interval 2, from 3985 to 4022m:

Interbedded shales, siltstones and layers of limestone. These deposits are strongly influenced by marine to brackish water. Shell-layers can be observed in Core No.2 (Appendix 2).
The depositional environment is probably lagoonal, or a bay open to sea. The interval is still connected to the same lower delta plain system, but more seawards.

Interval 3, from 4022 - 4082m

This interval is similar to Interval 1, fluvial channels and coal horizons are again present. The depositional environment is a lower delta plain with less marine influence than in Interval 2.

The whole delta system (3935-4082m) is characterized by a very low net/gross ratio (0.2). No main distributary channel has been developed in this area.

Age: Bajocian to Bathonian

4082 - 4135 m : SHALE, silty, grey to brown and red, medium hard, calcareous, grading to MARL. Interbeds of SANDSTONE, fine to medium, white to translucent, subangular, calcite-cemented.
Stringers of LIMESTONE and DOLOMITE, beige to white, soft to medium hard.

The red colour of the shales, and the lack of organic matter (from palynology), indicate a continental environment. The sandstones can be interpreted as fluviatile channels.

Age: Presumed Bajocian

X: 58°47'13.04"N Y: 01°50'34,11"E	Z ground: − 110m Z RKB: + 25 m	Spudded: 20-12-83 Started drilling: 28-12-83 At T.D: 2-05-84 Completed: 13-05-84 T.D Driller: 4130m T.D. Logger: 4135m	Well 15/3-5 Country NORWAY offshore
Line: EL 8206-418A-580-322 Depths datum: RKB Rig: BYFORD DOLPHIN Stopped in: JURASSIC	SP:		

OPERATOR E.A.N.

LICENCE BLOCK 15-3-5 Licence 025 OWNED BY TOTAL-NH Prd. EAN LASMO

TARGETS

Appreciation of extension of sandstones encountered by 15/3-4 in Sleipner Formation.

RESULTS

Oil bearing Middle Jurassic sandstone layers.

CASINGS

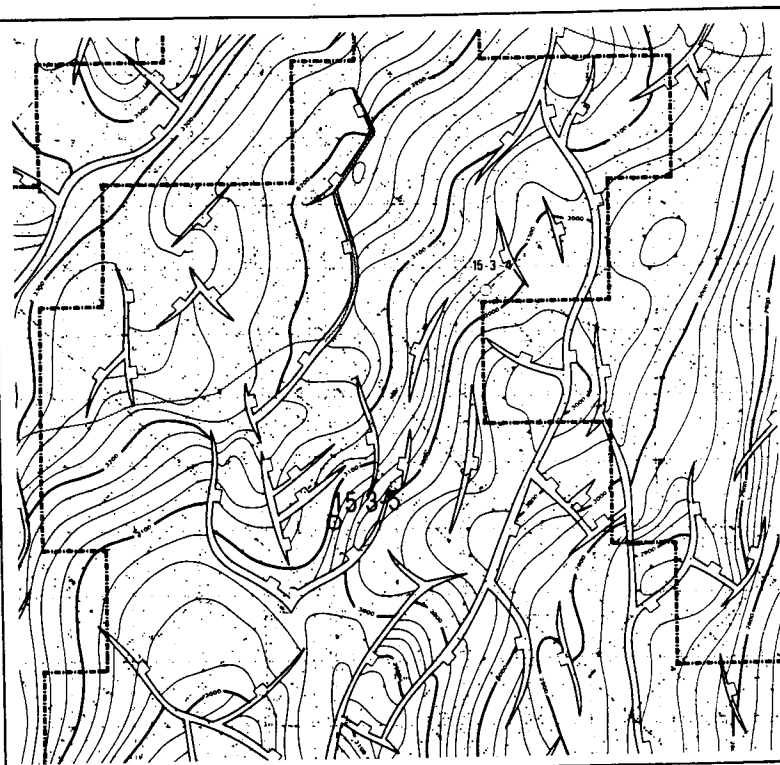
30" at 196m
20" at 962m
13⅜" at 2798m
9⅝ at 3816m

CORES

1	3971–3989	98%
2	3989–4003	84%
3	4020–4029	94%

SHOWS

3940–4032m:
SDST levels: 8–28% T G
(c.to nc4)
▲Pale to bright yellow
△whitish
+clear yellow



LOGS

16/01/84	ISF-Sonic GR. 973–135 m	1		requested 30. 18 full bullets	
16/01/84	LDT. GR Cal 967–194 m	1	26/4/84	ISF. LSS. GR. SP 4005–3816 m	4
				LDL. CNL. GR. CAL 4005 – 3816 m	4
3/03/84	ISF-Sonic GR SP 2808–962 m	2	3/5/84	ISF. LSS. GR. SP 4133 – 3816 m	5
3/03/84	LDL – CAL 2808–962 m	2		LDL – CNL. NGL 4135 – 3815 m	1
3/03/84	BGT. GR. CAL 2800 – 962 m	1		DLL. MSFL. GR 4133 – 3816 m	1
4/04/84	ISF.LSS. GR. SP 3832,5 – 2797m	3	4/5/84	SHDT 4135 – 3815 m	2
5/04/84	SHDT. 3830–2797m	1		RFT 4135 – 3960 m 18 pressure tests	1
3/04/84	LDT. NGT. CAL 3817 – 2797 m	3		1 sample 3970m	
6/04/84	CST 3828.5 – 3210 m requested 51 14 Full bullets	1		RFT 4048 – 3984 m 2 pressure tests	2
	CST 3829 – 2817 m	2		1 sample 3984 m RFT 4028,6 – 4022.2 m 3 pressure tests	3

5/5/84	2 samples at 4022,2 m and 4028,6 m.			
	CST 4130 – 3938 m requested 30 – Full bullets: 15	3		
	CST 3905–3830 m requested: 30 Full bullets. 17	4		
	SSL 4125–1000 m 46 shot points	1		

RFT

3969,9	4,2 CUFT ☼ + mud Filtrate (▲) F.P. 9139 psi
3984	2,5 CUFT ☼ + mud Filtrate (▲) F.P. 9149 psi
4022,2	0,15 CUFT ☼ + mud Filtrate (▲) F.P. 7873 psi
4028,6	Traces ☼ + mud Filtrate (▲) F.P. 8163 psi

Checked TISSERANT M
Date 10-05-84

34 Randaberg Trykk A.S

Fig.3a

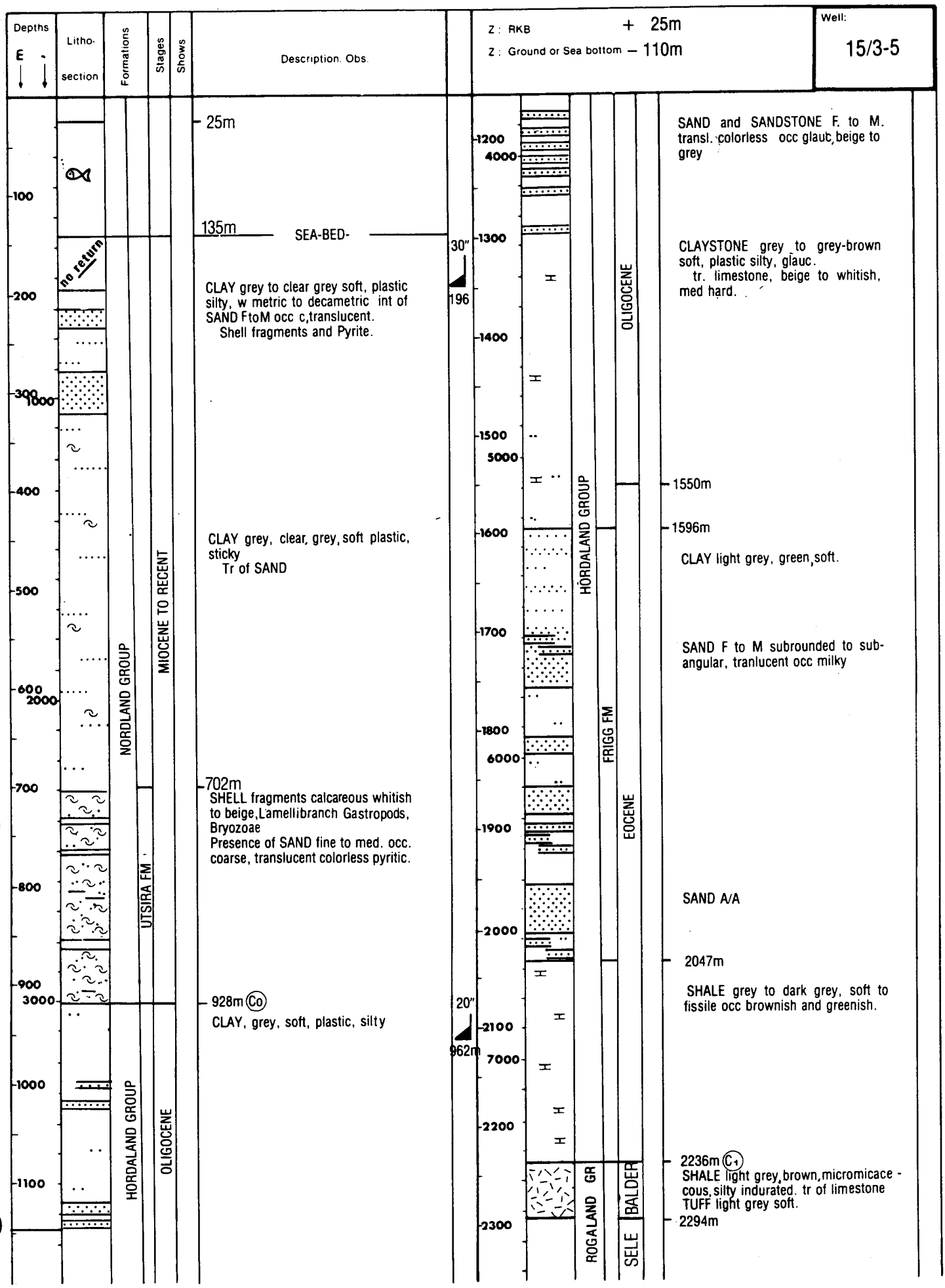

Depths
E
Litho-
section
Formations
Stages
Shows
Description. Obs.
Z : RKB + 25m
Z : Ground or Sea bottom – 110m
Well:
15/3-5
25m
135m
SEA-BED-
no return
CLAY grey to clear grey soft, plastic silty, w metric to decametric int of SAND FtoM occ c,translucent.
Shell fragments and Pyrite.
CLAY grey, clear, grey, soft plastic, sticky
Tr of SAND
702m
SHELL fragments calcareous whitish to beige,Lamellibranch Gastropods, Bryozoae
Presence of SAND fine to med. occ. coarse, translucent colorless pyritic.
928m Co
CLAY, grey, soft, plastic, silty
NORDLAND GROUP
HORDALAND GROUP
UTSIRA FM
MIOCENE TO RECENT
OLIGOCENE
30"
196
20"
962m
SAND and SANDSTONE F. to M. transl. colorless occ glauc, beige to grey
CLAYSTONE grey to grey-brown soft, plastic silty, glauc.
tr. limestone, beige to whitish, med hard.
1550m
1596m
CLAY light grey, green, soft.
SAND F to M subrounded to sub-angular, tranlucent occ milky
SAND A/A
2047m
SHALE grey to dark grey, soft to fissile occ brownish and greenish.
2236m C1
SHALE light grey, brown, micromicace - cous, silty indurated. tr of limestone
TUFF light grey soft.
2294m
HORDALAND GROUP
FRIGG FM
ROGALAND GR
OLIGOCENE
EOCENE
BALDER
SELE

Fig.3b

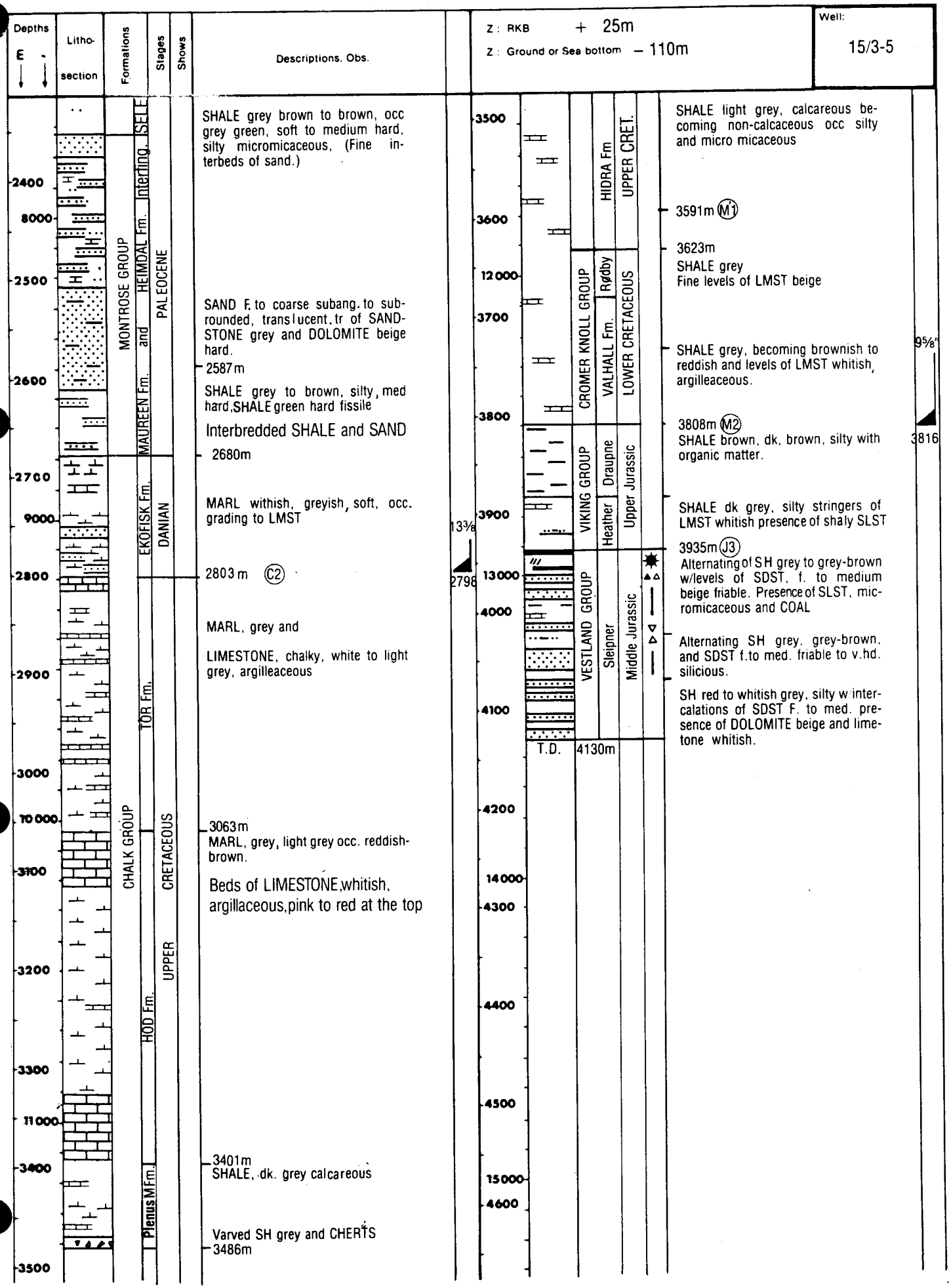

Depths
E
Litho-section
Formations
Stages
Shows
Descriptions. Obs.
Z: RKB + 25m
Z: Ground or Sea bottom – 110m
Well:
15/3-5
SHALE grey brown to brown, occ grey green, soft to medium hard, silty micromicaceous, (Fine interbeds of sand.)
SAND F. to coarse subang. to subrounded, translucent. tr of SANDSTONE grey and DOLOMITE beige hard.
2587m
SHALE grey to brown, silty, med hard, SHALE green hard fissile
Interbredded SHALE and SAND
2680m
MARL withish, greyish, soft, occ. grading to LMST
2803m C2
MARL, grey and
LIMESTONE, chalky, white to light grey, argilleaceous
3063m
MARL, grey, light grey occ. reddish-brown.
Beds of LIMESTONE, whitish, argillaceous, pink to red at the top
3401m
SHALE, dk. grey calcareous
Varved SH grey and CHERTS
3486m
MONTROSE GROUP
CHALK GROUP
SELE
Interfing.
HEIMDAL Fm.
and
MAUREEN Fm.
EKOFISK Fm.
TOR Fm.
HOD Fm.
Plenus M Fm.
PALEOCENE
DANIAN
CRETACEOUS
UPPER
13⅜
2798
SHALE light grey, calcareous becoming non-calcaceous occ silty and micro micaceous
3591m M1
3623m
SHALE grey
Fine levels of LMST beige
SHALE grey, becoming brownish to reddish and levels of LMST whitish, argilleaceous.
3808m M2
SHALE brown, dk. brown, silty with organic matter.
SHALE dk grey, silty stringers of LMST whitish presence of shaly SLST
3935m J3
Alternating of SH grey to grey-brown w/levels of SDST, f. to medium beige friable. Presence of SLST, micromicaceous and COAL
Alternating SH grey, grey-brown, and SDST f. to med. friable to v.hd. silicious.
SH red to whitish grey, silty w/intercalations of SDST F. to med. presence of DOLOMITE beige and limetone whitish.
T.D. 4130m
HIDRA Fm
UPPER CRET.
CROMER KNOLL GROUP
Rødby
VALHALL Fm.
LOWER CRETACEOUS
VIKING GROUP
Draupne
Heather
Upper Jurassic
VESTLAND GROUP
Sleipner
Middle Jurassic
9⅝"
3816

Fig.3c

STRATIGRAPHY

A biostratigraphical study has so far been performed in the Jurassic and Lower Cretaceous section. The results can be seen in fig. 4.

The well was sampled for micropaleontology from 3795m to 4130m. The interval ranges from Albian-Aptian to Bathonian.
A palynological study was performed between 3809 and 4124m, ranging from Ryazanian to Bajocian.
The results of the dating of well 15/3-5 are in accordance with well 15/3-4.

Note that the unconformity on top of the Middle Jurassic deposits can be clearly defined, with the lacking of Callovian sediments.

The lowermost purely continental sequence, which was drilled from 4082m to TD in well 15/3-5, is probably of Bajocian age, and the Triassic series were not reached.
For further details, see Biostratigraphical Report, Well 15/3-5.

WELL 15/3-5

STRATIGRAPHY JURASSIC SECTION

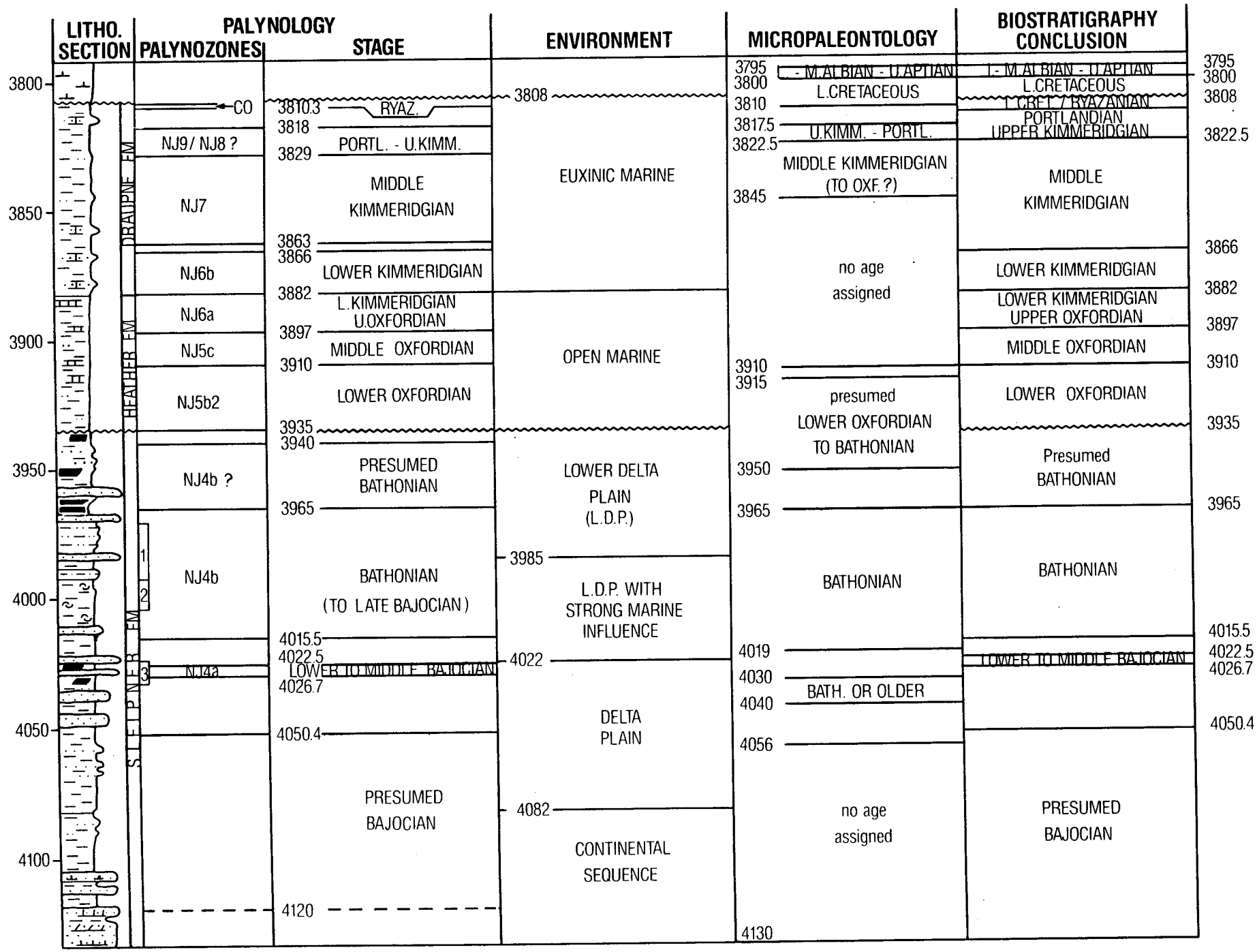


Fig.4

CHAPTER 4 STRUCTURAL DATA

Geophysical Results

The prognosed and actual depths with the corresponding two-way travel times to the different markers picked are as follows :

Table 1

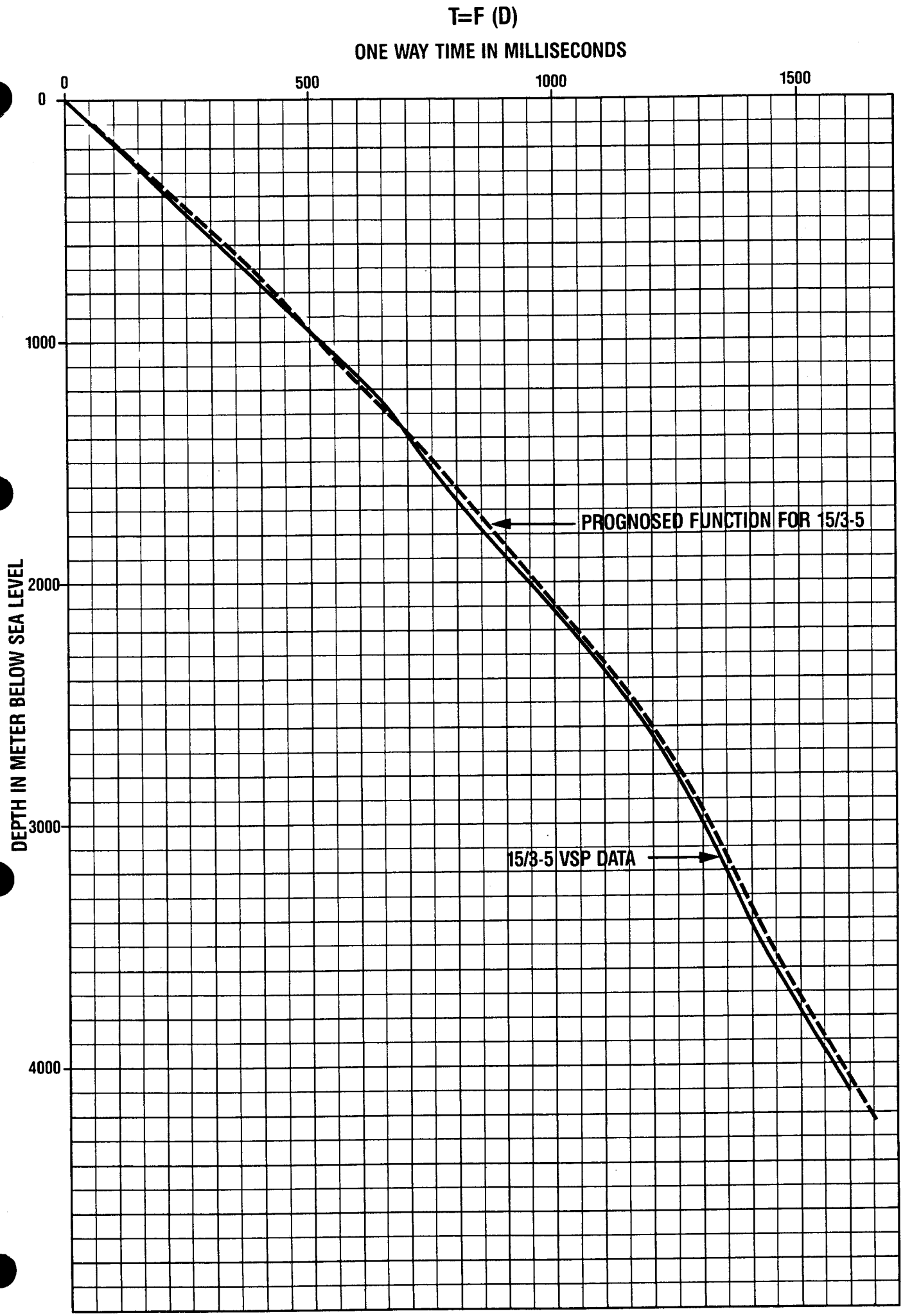
Marker picked	Depth (m RKB)		TWT
	Prognosed	Actual	ms below MSL
C1 Top Balder Fm	2210	2236	2098
C2 Top Cretaceous (Top Tor Fm)	2820	2803	2486
M2 Base Cret.Unc.	3790	3808	3007
J2 Top Sleipner Fm	3900	3935	3088
J4 First positive contrast after coal sequence.	4010	4038	3145

Vertical Seismic Profile and Calibrated Sonic

The VSP was recorded and processed by SSL (England). The survey was carried out the 5th of May 1984, between depths of 4125 and 1000m with shots taken at 25m intervals below 3300m and then processed.

Fig.5 shows the time-depth curves from the two wells 15/3-5 and 15/3-4. There is a difference in velocities of up to 40 m/s between the two wells.
The time-depth curve was calculated from the nearby wells, and this velocity-changes can explain the difference in prognosed and actual depth to the different seismic markers (see Table 1).

The two-way travel time log is calibrated against the seismic section EL 8206-418 in fig.6. The calibration confirms that on the seismic survey EL 8206 a static correction of 50ms must be added to fit the calibrated sonic log from the different wells.



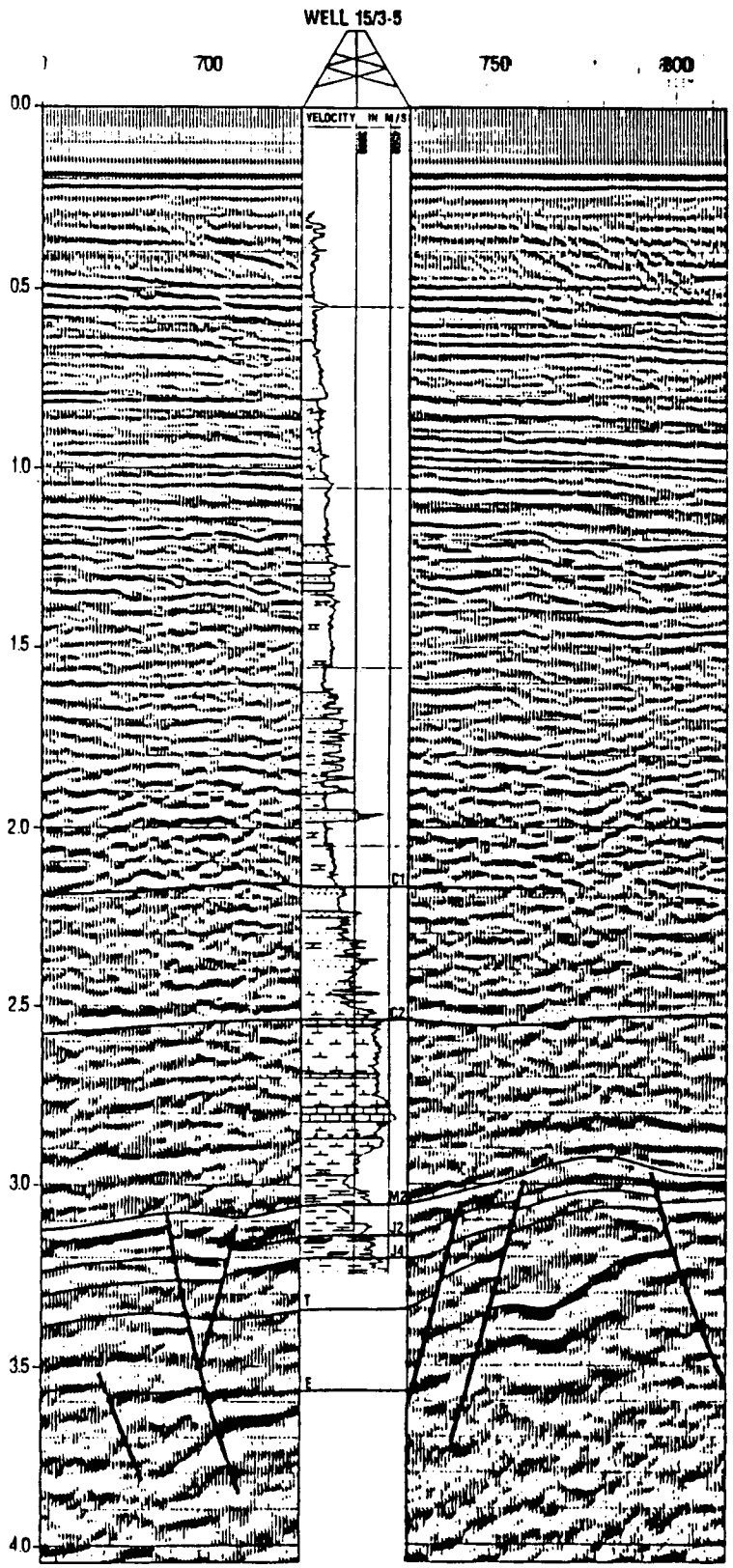
Prognosed and actual time-depth curve for well 15/3-5

Fig 5

LINE : EL 8206 - 418

6000% DIP FILTER, DBS, DAS, MIG, TVF.

SOUTHEAST



— COMPRESSION PULSES RECORD AS NEGATIVE NUMBERS ON TAPE AND PLOT AS PEAKS (BLACK) ON PLAYBACK.

— THE SEISMIC SECTION IS SHIFTED 50 ms UPWARDS TO FIT THE CALIBRATED LOG.

Fig.6

J.E.R. Nov.1984

CHAPTER 5 : ORGANIC GEOCHEMISTRY

An optical and geochemical study of the organic matter has been performed in the Jurassic sequence.

The main findings are:

1. Organic facies and HC potential

- In the Draupne Fm: organic matter is abundant, mainly marine sapropelic with some terrestrial input downwards ; very high oil genetic potential.
- In the Heather Fm: marine and continental organic matter; low to very low potential.
- In the Sleipner Fm: kerogen of marine origin associated with land derivatives for the upper sequence; the lower sequence includes continental organic matter; low to medium potential.

2. Maturation stage

- Diagenesis increases slightly more than in normal rank evolution, between 0.60% VR. (3808.30m) and 0.8 VR. at TD = 4130m, and sites the Jurassic in the oil generation zone.

3. Migration evidence

- The migrated hydrocarbons in the 3980.75m sandy level of the Sleipner Fm have characteristics which were previously found in syngenetical extracts from Portlandian -Kimmeridgian rocks in wells 15/3-1,3 and 4.

For further details, see "15/3-5 Well, Optical and Geochemical Study of Organic Matter in the Jurassic Section".

CHAPTER 6

HYDROCARBON SHOWS

The evaluation of hydrocarbon shows was carried out using a gas-chromatograph and fluorescence observation on cutting and core samples.

Gas shows

Quaternary to Tertiary

In these series the background gas varied from traces to 9%, mainly C1, but traces of C2 and C3 were found in the Paleocene sequence. The highest gas readings correspond to sandy or lignitic intervals.

Cretaceous

In the upper part of the section only traces of gas were recorded (mainly C1). Below 3470m (mainly Lower Cretaceous) the background gas varied from traces to 4%. Up to 1% C1 was recorded, with traces of C2 (max 0.02%) and C3 (max 0.01%).

Jurassic

The Jurassic "hot shales" (Draupne Fm) is marked by an increase in the gas reading from 0.2 to 3% BG, consisting of C1, C2 and C3, and the first appearance of iC4 and nC4.

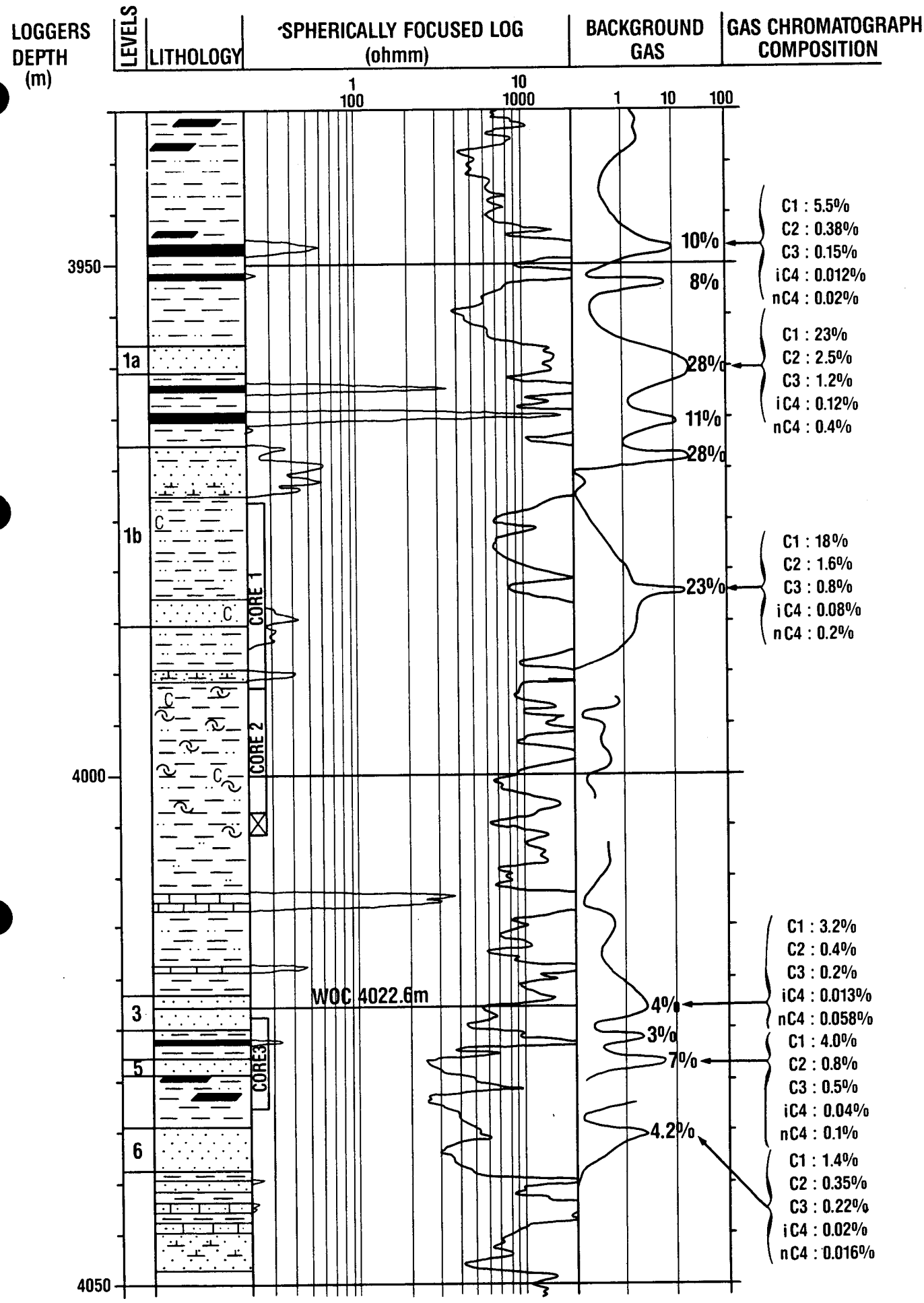
In the interval 3805 - 3935m the background gas was between 0.4 and 5.5% (C1 - nC4).

The hydrocarbon-bearing zone is illustrated in fig.7. The background gas-curve (taken from mud-log) had to be shifted 3.5m down-wards to fit with the resistivity log. In the interval 3935 - 4038m several gas-peaks were observed, max 28%. These peaks correspond either to sand- or coal-layers. The composition of the Background gas indicates oil-bearing sandstones.

Below 4038m to TD only traces of background gas were observed, except one single sandstone layer at 4062m (B.G = 1.0%).

The OWC has been calculated from logs to be at 4022.6m.

For further details : See Reservoir Evaluation Report.



Hydrocarbon shows in the Middle Jurassic Sleipner Fm.

Fig.7

Fluorescence and Oil shows

In the Quaternary, Tertiary and Cretaceous series no fluorescence due to hydrocarbons were observed.

In the Upper Jurassic sequence, a weak yellow colour in direct fluorescence light was observed on sandstone pieces.

A pale to clear yellow and orange colour in direct fluorescence light was reported from the Middle Jurassic sequence down to about 4060m.

The colour of the fluid extraction ($CHCl_3$) was clear yellow becoming milky white and dull white in fluorescence light.

Gas bubbles were observed on the cores taken, numerous in the sandstone and siltstone intervals.

Below 4060m to TD nil to very weak direct fluorescence was observed.

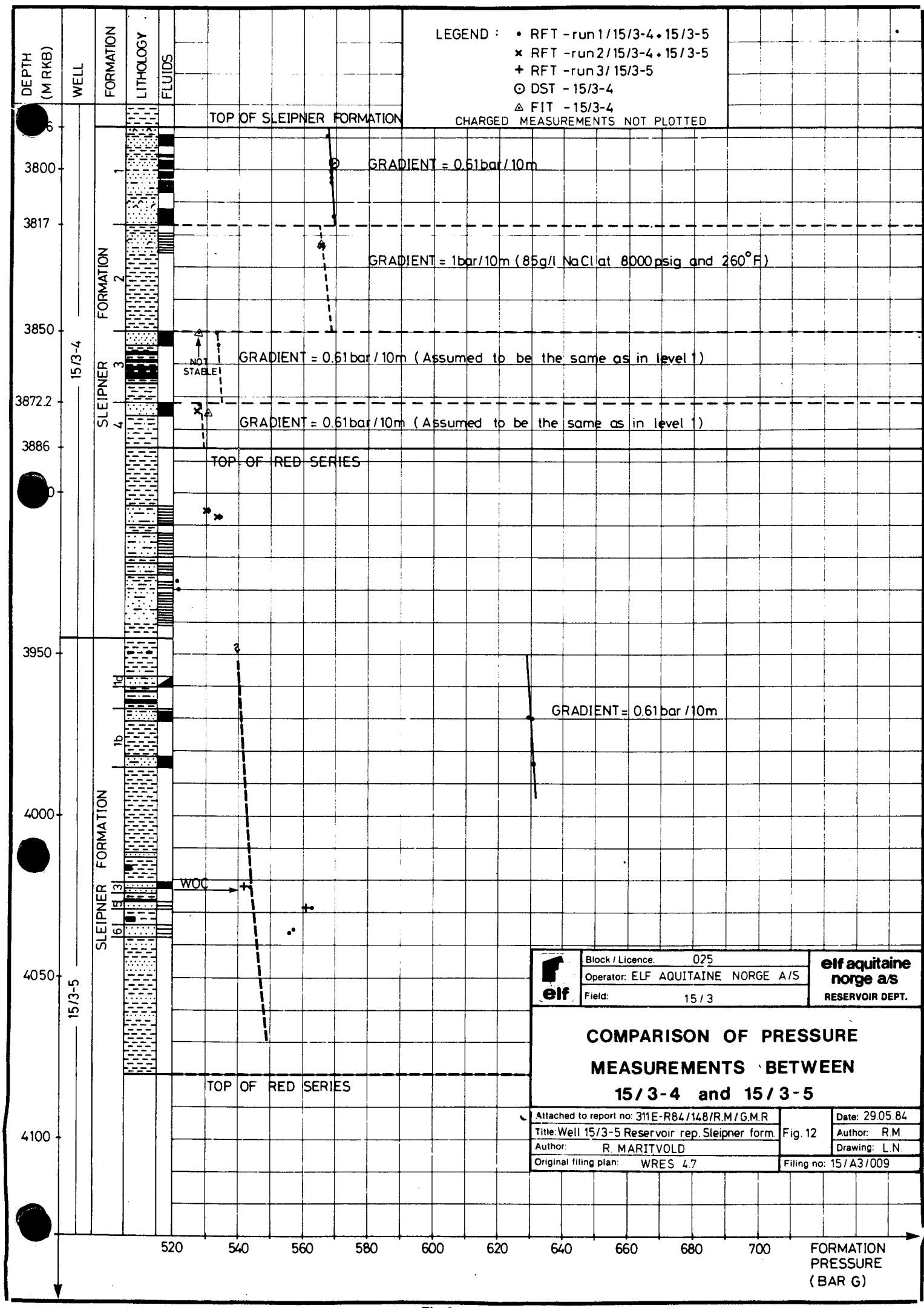

DEPTH (M RKB)
WELL
FORMATION
LITHOLOGY
FLUIDS
LEGEND :
• RFT - run 1 / 15/3-4 + 15/3-5
× RFT - run 2 / 15/3-4 + 15/3-5
+ RFT - run 3 / 15/3-5
⊙ DST - 15/3-4
△ FIT - 15/3-4
CHARGED MEASUREMENTS NOT PLOTTED
TOP OF SLEIPNER FORMATION
GRADIENT = 0.61 bar / 10m
GRADIENT = 1 bar / 10m (85 g/l NaCl at 8000 psig and 260°F)
GRADIENT = 0.61 bar / 10m (Assumed to be the same as in level 1)
NOT STABLE
GRADIENT = 0.61 bar / 10m (Assumed to be the same as in level 1)
TOP OF RED SERIES
GRADIENT = 0.61 bar / 10m
WOC
TOP OF RED SERIES
SLEIPNER FORMATION
15/3-4
15/3-5
3800
3817
3850
3872.2
3886
3950
4000
4050
4100
520
540
560
580
600
620
640
660
680
700
FORMATION PRESSURE (BAR G)
Block / Licence. 025
Operator: ELF AQUITAINE NORGE A/S
Field: 15 / 3
elf aquitaine norge a/s
RESERVOIR DEPT.
COMPARISON OF PRESSURE MEASUREMENTS BETWEEN 15/3-4 and 15/3-5
Attached to report no: 311E-R84/148/R.M/G.M.R
Title: Well 15/3-5 Reservoir rep. Sleipner form.
Author: R. MARITVOLD
Original filing plan: WRES 4.7
Fig. 12
Date: 29.05.84
Author: R.M
Drawing: L.N
Filing no: 15/A3/009

Fig.8

CHAPTER 7

Reservoirs, formation pressure

Four thinner sandstone layers belonging to the Middle Jurassic Sleipner formation were found oil-bearing (fig.7). The average water saturation in the oil-bearing zone is 30%.

The RFT measurements showed that two of these layers were in pressure communication (level 1b, Table 2), the other sandstones had different pressure regimes.

Table 2

Level	1a	1b	3		5	6
Gross pay (H)	1.2m	17.0m	1.7m	1.7m	1.5m	3.2m
Net pay (h)	1.2m	3.8m	1.7m	0.6m	1.5m	2.8m
Porosity (Ø)	11%	13%	14%	9%	16%	11%
Water saturation (S_w)	28%	19%	39%	72%	83%	97%
Shale content in net pay(V_{sh})	25%	19%	8%	25%	18%	10%
Reference depth (m MSL)	-3935	-3945	-3097	-3098	-4003	-4010
Reservoir pressure (bar rel.)	?	629.8	543.7	543.8	562.7	556.5
Reservoir temperature	123°C	123°C	126°C	126°C	126°C	127°C
FLUID	OIL	OIL	OIL	WATER	WATER	WATER

Fig.8 shows the comparison of pressures measured in the two wells 15/3-4 and 15/3-5. The figure shows a possible pressure communication between level 3 in 15/3-4 and level 3 in 15/3-5. The layers can also be correlated on logs. A water-oil contact can in this level be established at 4022.6m RKB.

For further details: see Reservoir Evaluation Report, Well 15/3-5.

CHAPTER 8

FORMATION TEMPERATURE

In fig.9 the temperatures measured in the well are plotted against depth, and show an increase in formation temperature in the Jurassic series.
The corrected temperatures are calculated using the "Horner-plot" - method.

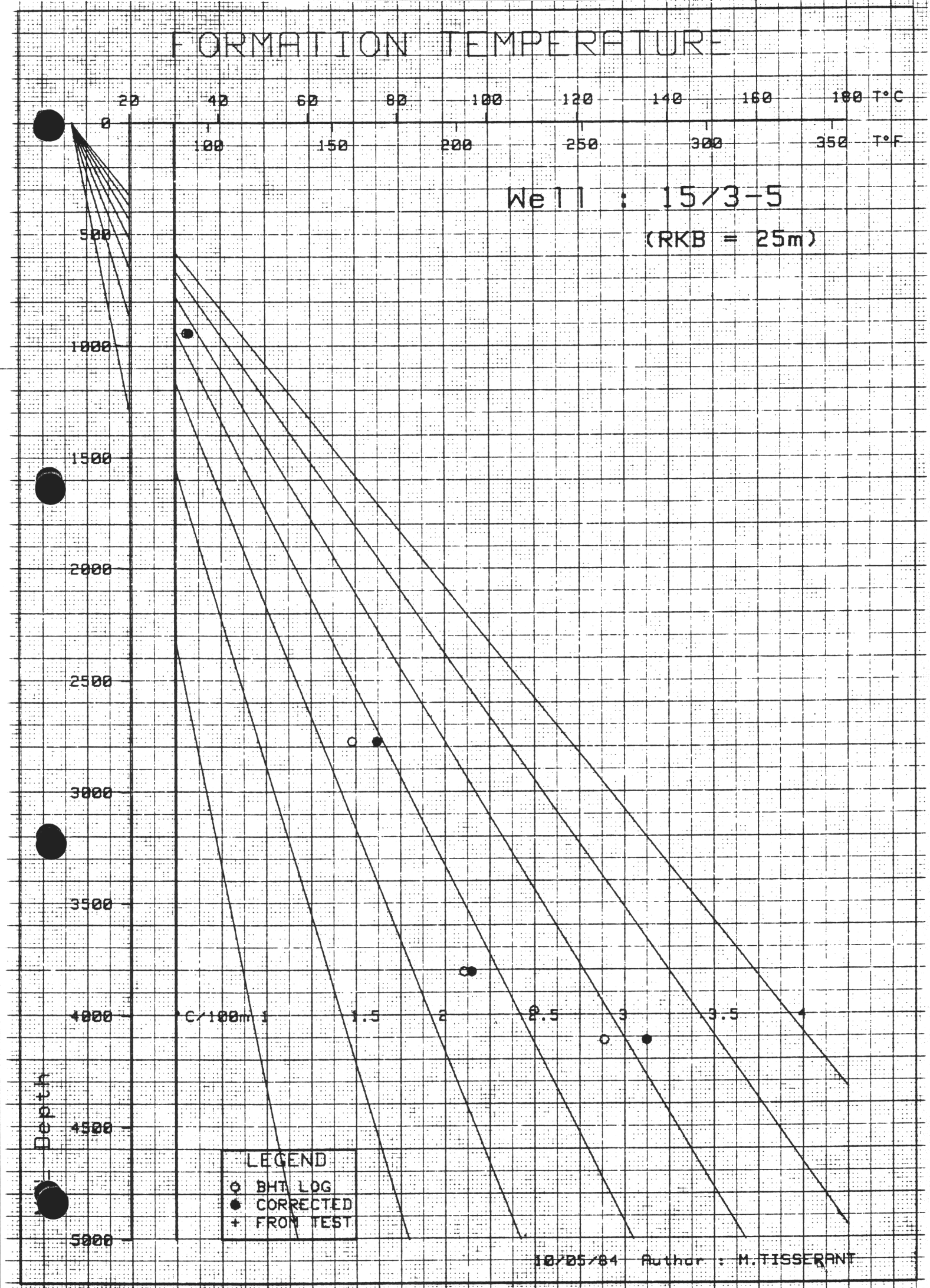

FORMATION TEMPERATURE
20
40
60
80
100
120
140
160
180 T°C
0
100
150
200
250
300
350 T°F
Well : 15/3-5
(RKB = 25m)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Depth
°C/100m 1
1.5
2
2.5
3
3.5
4
LEGEND
BHT LOG
CORRECTED
FROM TEST
10/05/84 Author : M.TISSERANT

Fig. 9

CHAPTER 9

CORRELATIONS

Plate 2 shows a correlation for the Jurassic section between the wells 15/3-1,3,4 and 5.
Well 15/3-5 can be correlated with well 15/3-4 without any problem; both wells being drilled on the Sleipner Terrace. We observe an abrupt change in sedimentary style when going westwards to the wells 15/3-1 and 3, especially in the Upper Jurassic series.

The whole Jurassic sequence will be described from base to top.
Only well 15/3-4 has been drilled into the Triassic series. The transition between the Triassic Skagerrak Fm and the Middle Jurassic Sleipner Fm is not obvious. It has been defined from the sonic log by a change downwards from erratic to smooth shape at 4044m, though palynological data indicate Triassic age from 4006m.

The lithology of the lower part of the Sleipner Fm is characterized by a calcareous cemented sandy sequence overlaid by a red to grey-green soft shale, quite similar to the underlaying Triassic series. This shale-horizon can easily be recognized both in cuttings and from logs (low velocity and resistivity). Due to very spare organic matter, the dating of this horizon has been performed with some uncertainties, but a Bajocian age is suggested.

The above-lying sand/shale/coal sequence has been drilled through in the three wells 15/3-3, 4 and 5. Intervals characterized by stronger marine influx can be recognized in the upper part of this sequence. We observe an increase in thickness westwards from 100m in 15/3-4 to 511m in 15/3-3. The sequence is well dated to Bajocian-Bathonian, and the Middle Jurassic tectonic phase forming the Viking Graben started probably during this time. This caused a differential subsidence, and combined with erosion on top of the Bathonian deposits on the Sleipner Terrace, it can explain the thickness variations.

We notice the rapid change of sandstone developments in the Bathonian sequence. A detailed paleogeographical map is therefore very difficult to outline, but is of great importance for further exploration. The 15/3-4 structure is certainly not only a structural trap, but also a stratigraphical one.

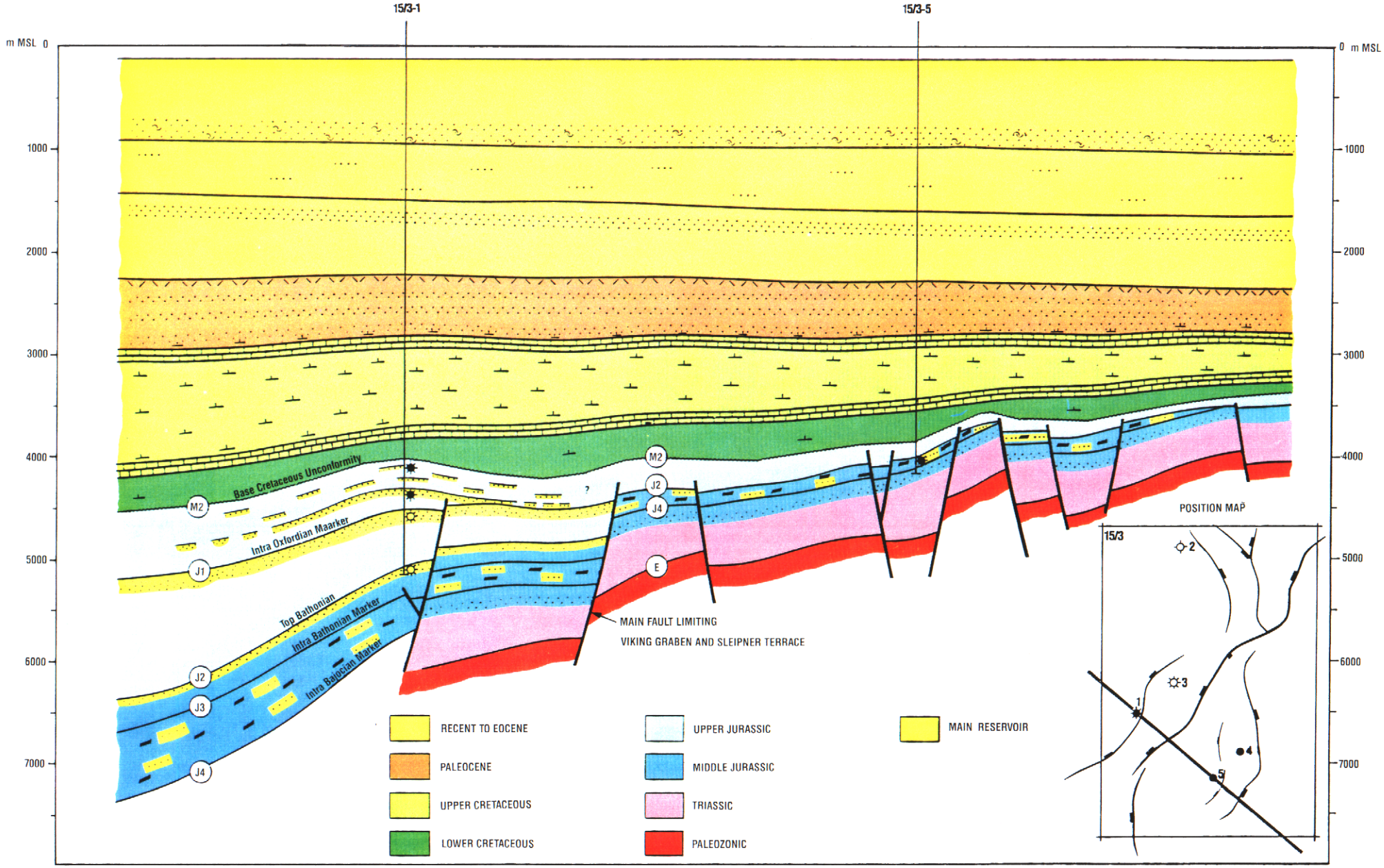
Concerning the over-laying Heather formation, the dating show clearly that this formation was deposited during Callovian time in the 15/3-1 and 3 area, while the Sleipner Terrace remained a high area, with no deposition or most probably erosion. The deposition of the Heather Fm started as late as Oxfordian time on the terrace. However, this erosion of the Middle Jurassic series on the terrace could open for development of Callovian material in lower situated areas further west. These sediments could have good reservoir characteristics.
The Heather Fm varies in thickness from 233m in well 15/3.1 (west) to only 44m in 15/3-4 (east).

The main fault limiting the Viking Graben and the Sleipner Terrace seems to play an important role during deposition of the Viking Group. This can also be observed on the geological cross-section in fig.10.

The deposition of the Draupne formation shows the same evolution as the Heather Fm. It seems that stagnant water conditions were established in Lower Oxfordian time in the 15/3-1 and 3 area, and not earlier than Upper Oxfordian/ Kimmeridgian time in the 15/3-4 and 5 area.

The Draupne Fm contains in this area beds of sandstone.
During Oxfordian time, large amounts of sand were "flushed" into the basin, limited to the east by the main fault mentioned above. In the wells 15/3-1 and 3 the sand is represented by two coarsening-upward cycles, the uppermost cycle found very reduced in well 15/3-3.
Oxfordian sandstones are also developed further north along the Utsira High (wells 15/3-2 and 24/12-1), but here inside the Heather Fm.

Upper Oxfordian, Kimmeridgian and Portlandian are represented by "hot shales" with layers of sand in the two wells 15/3-1 and 3. These sands are probably deposited as turbidites, and we observe a rapid dissappearance towards east, indicating a source area on the Shetland Platform.



GEOLOGICAL CROSS - SECTION BASED ON LINE EL 8206 - 418

Fig.10

CHAPTER 10

CONCLUSION

Well 15/3-5 was drilled in a down-dip position on the same structure as 15/3-4. The purpose of the well was to look for the extension of the oil-bearing sands in well 15/3-4, and to define a hydrocarbon/water-contact.

It was expected to find a thicker sand development in well 15/3-5, supposed to have been deposited as a distributary channel in a deltaic system in connection with the HC-bearing sands in 15/3-4. The depositional environment of the 15/3-4 sands are of storm-deposits in a lagoon in the upper part and of a deltaic sequence with fluvial channels below. But, instead of finding a single distributary channel acting during Bathonian time, we encountered minor fluvial channels (2 to 5m in thickness) deposited in two main sequences. Four of these channels were oil-bearing, and an OWC can be established at 4022,6m RKB. The upper fluvial channel sequence is over-pressured, and not in contact with the sands encountered in well 15/3-4. Pressure measurements showed that the lower fluvial sequence encountered in both wells could be connected.

ANNEX 1

CORING

1. Conventional coring (Appendix 1)

Three cores were cut in the Jurassic section.

	Drillers depth	Length	Recov.	% Rec.	Loggers depth
1	3971 - 3989 m	18m	17.8m	98	3973.6-3991.6m
2	3989 - 4003 m	14m	11.7m	84	3991.6-4005.6m
3	4020 - 4029 m	9m	8.5m	94	4023.9-4032.9m

Lithology:

Core 1 : Grey, hard, micaceous SILTSTONE, non-calcareous to slightly calcareous and dolomitic. Grading to light grey and beige, argillaceous, very fine SANDSTONE between 3982.40-3985m (D.D).
Interbeds of dark grey to black, micaceous, hard and silty SHALE, occ. calcareous.
One bed of grey to brown-grey, hard, micaceous, fine to medium SANDSTONE at 3979.7 - 3982.3m (D.D).
Coal fragments abundant, shell-layers are found in the shales and siltstones.

Core 2 : Mainly dark grey to black, hard, micaceous SHALE, with stringers of grey to brown-grey, micaceous SILTSTONE. Abundant shell-layers and coal fragments.

Core 3 : Interbedded SANDSTONES, SILTSTONES, SHALES and COAL beds. The sandstones are very fine to medium, grey, micaceous, often argillaceous, in parts silica cemented. Frequent coal fragments.
The siltstones are light grey to beige, micaceous with coal pieces.
The shales are beige to grey, occ. silty. Black, carbonaceous shales are also present. The coal beds are brittle, massive, occasionally presence of pyrites.

2. Sidewall coring (Appendix 2)

Four runs of CST were made in the Cretaceous and Jurassic series. Out of 141 requested bullets only 64 were filled.

Run	Date	Request	Shot	Misfire	Lost	Recov.	Empty	Full
1	06.04.84	51	27	3	10	17	3	14
2	06.04.84	30	22	8	2	20	2	18
3	05.05.84	30	22	8	6	16	1	15
4	05.05.84	30	30	0	12	18	1	17

ANNEX 2

LOGGING

Following Electrical logs were run:

Resistivity and sonic logs:

Run 1:	ISF-LSS-GR-SP	135	-	973	m
" 2:	ISF-LSS-GR-SP	962	-	2808	m
" 3:	ISF-LSS-GR-SP	2797	-	3832.5	m
" 4:	ISF-LSS-GR-SP	3816	-	4005	m
" 5:	ISF-LSS-GR-SP	3816	-	4133	m
" 1:	DLL-MSFL-GR	3816	-	4133	m

Neutron and density logs:

Run 1:	LDL-GR-CAL	194	-	967	m
Run 2:	LDL-CAL	962	-	2808	m
Run 3:	LDL-NGL-CAL	2797	-	3817	m
Run 4:	LDL-CNL-GR-CAL	3816	-	4005	m
Run 1:	LDL-CNL-NGL	3815	-	4135	m

Dipmeter logs:

Run 1:	SHDT	2797	-	3830	m
Run 2:	SHDT	3815	-	4135	m

Cement logs:

Run 1:	BGT-GR-CAL	962	-	2800	m

Remark: There is a gap of 3m between the sonic runs 2 and 3 (2797 - 2800m).

Sidewall cores:

Run 1:	CST	3120	-	3828.5	m
Run 2:	CST	2817	-	3829	m
Run 3:	CST	3938	-	4130	m
Run 4:	CST	3830	-	3905	m

See Appendix 2.

Pressure tests, sampling:

Run 1: RFT 3960 - 4135 m

18 pressure tests

1 sample at 3969.9m

Run 2: RFT 3984 - 4048 m

2 pressure tests

1 sample at 3984m

Run 3: RFT 4022.2- 4028.6m

3 pressure tests

2 samples: 4022.2m and 4028.6m

See Ch. and Reservoir Evaluation Report

Vertical Seismic Profile:

VSP 1000 - 4125 m

46 shot points

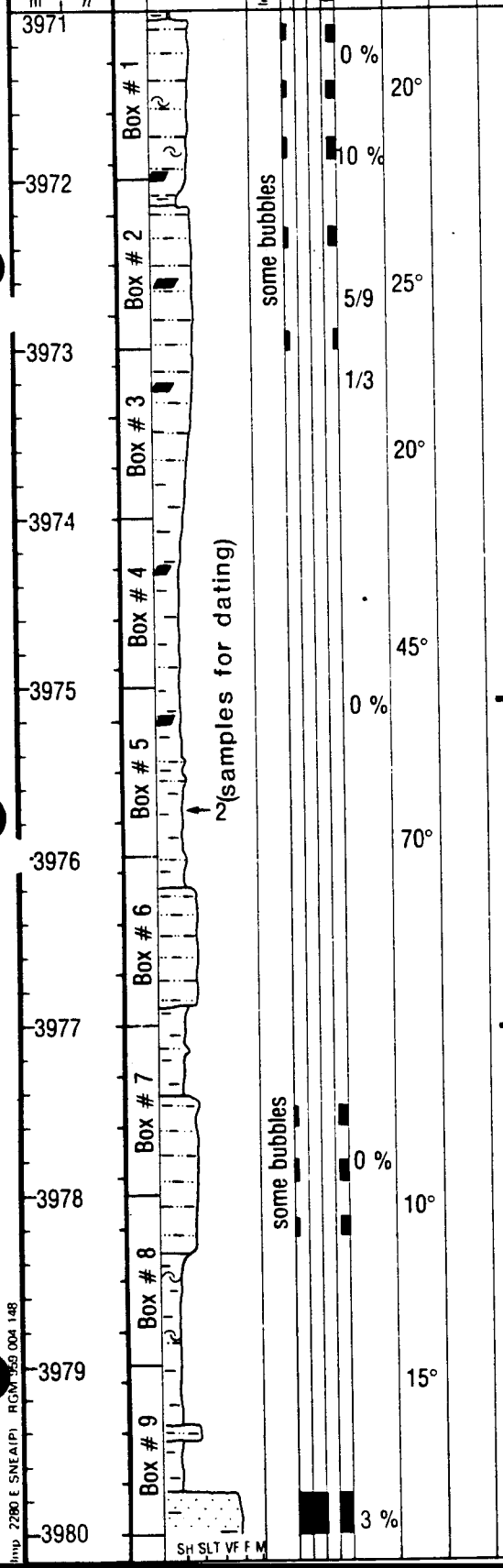
See Ch.4 Structural Data

APPENDIX 1

Core Descriptions

elf aquitaine

SOCIÉTÉ / *OPERATOR* **Elf Aquitaine Norge A/S**	CAROTTE : / *CORING LENGHT* : 18 m (m en / *ft in*) 15 h		SIGLE : / *ABB.TITLE* : 15/3-5
	RÉCUPÉRÉ : / *RECOVERY LENGHT* 17.80 m (m soit / *ft so*) 98 %		CAROTTE N : / *CORE N°* 1
SONDAGE : / *WELL* : 15/3-5	DATE EXTRACTION : / *OPERATION DATE* : 25/4-84		TÊTE / *TOP* 3971 m (m / *ft*)
			PIED / *BASE* 3989 m (m / *ft*)
PERMIS : / *AREA* : 15/3	CAROTTIER (Type, Ø) / *CORE BARREL* chr. C20 6 1/4" x 3"	BOUE : / *MUD* : FCL	Feuille n° : / *sheet n°* : 1 de / *from* 3971 à / *to* 3980



DESCRIPTION LITHOLOGIQUE / *LITHOLOGICAL DESCRIPTION*

SHALE, dark grey to black, hard, micromicaceous

SILTSTONE, grey, hard, micromicaceous, non calcareous, becoming slightly calcareous and dolomitic, occ. laminated. Woody fragments and shells (bi-valves) present

▲ Pale yellow, patches △ white, milky + clear yellow

SLST A/A, interlaminated with **SH**, silty, dark grey, laminated, locally cross-laminations
Coal fragments are common

Slickensides at 3971.50 m (dip 20°)

SH, dark grey, silty, micromicaceous, hard w/laminations of **SLST**, grey to light grey, hard, micromicaceous, slightly calcareous
Coal fragments present

Slickensides abundant between 3974.60 – 3978.40 m (dip between 5° and 75°)

← microfaults

disturbed zone

← **SLST** A/A
folded, synsedimentary deformation?

SH A/A

SLST, grey, hard, micromicaceous, non-calcareous

▲ Pale yellow △ white, milky + clear yellow

SH, grey to dark grey, silty, micromicaceous, hard presence of shells (bi-valves), occ. pyritized

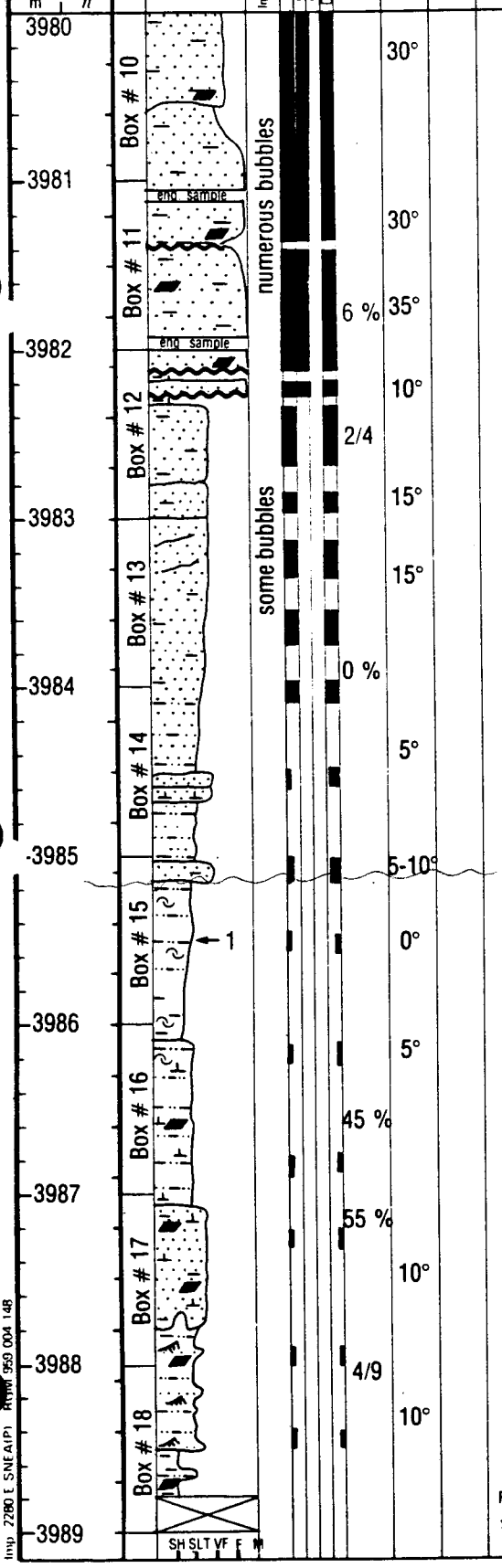
FLUO :
1 trace / *trace* 2 moyen / *fair* 3 forte / *good*

Fiche établie par : / *Established by* : TISSERANT MINSAAS RINGÅS

Imp 2280 E SNEA(P) RGM 159 004 148

elf aquitaine

SOCIÉTÉ / *OPERATOR* **Elf Aquitaine Norge A/S**	CAROTTE : *CORING LENGHT* : 18 m (m en / *ft in*) 15 h		SIGLE : *ABB.TITLE* : 15/3-5
SONDAGE : *WELL* : 15/3-5	RÉCUPÉRÉ : *RECOVERY LENGHT* 17.80 m (m soit / *ft so*) 98 %		CAROTTE N° : *CORE N°* : 1
PERMIS : *AREA* : 15/3	DATE EXTRACTION : *OPERATION DATE* : 25/4-84		TÊTE / *TOP* 3971 m / *ft*
	CAROTTIER (Type, Ø) *CORE BARREL* chr. C20 ø 1/4"x3"	BOUE : *MUD* : FCL	PIED / *BASE* 3989 m / *ft*
			Feuille n° : *sheet n°* : 2 de / *from* 3980 à / *to* 3989



DESCRIPTION LITHOLOGIQUE
LITHOLOGICAL DESCRIPTION

SANDSTONE, fine to medium, grey to brown-grey, argillaceous,hard, micaceous, poor calcite cemented.coal fragments

Smelling of HC. ▲ Pale yellow, △ white to yellow, milky + clear yellow

← erosive base interlaminated **SLST,** grey and **SH,** grey to brown
SST A/A w/coal fragments

interbedded SH, brown-grey and SST A/A w/erosional base

SST, very fine, grey to beige, very hard, laminated, very micaceous occ. argillaceous stringers
grading to **SLST** downwards

▲ Pale yellow, patches △ yellow, milky + clear brown

cross-laminated

layer of **SST,** very fine, light grey, calcite cemented

SST A/A, very argillaceous, laminated occ. cross laminated

▲ Pale orange △ dull white + clear yellow

SLST, grey to grey brown, hard, fossiliferous (bi-valves) becoming shaly

SLST, very hard, grey to brown, very calcareous w/coal fragments

SST, very fine, very argillaceous w/abundant rootlets
← microfaults (synsedimentary?)
current ripples and cross laminations
← slumping

SLST, grey to dark grey w/sandy ripples, light grey

SH, dark grey w/coal fragments, stringers of SLST A/A

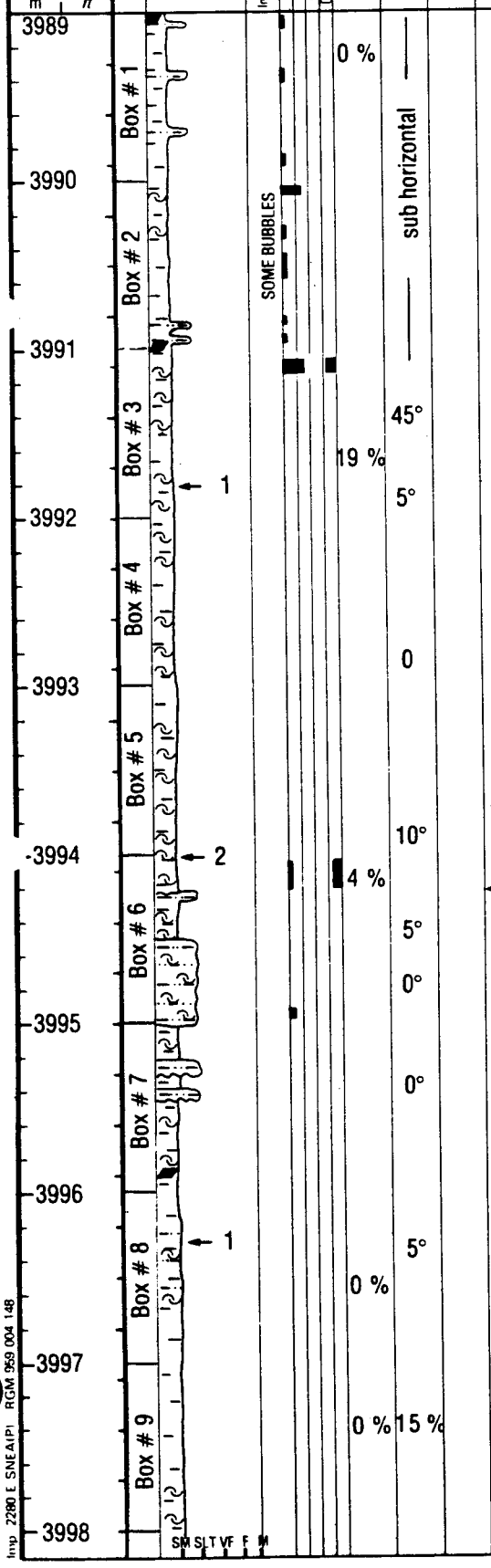
FLUO :
1 trace / *trace* 2 moyen / *fair* 3 forte / *good*

Fiche établie par : / *Established by* : TISSERANT MINSAAS RINGÅS

Imp. 2280 E SNEAP Repro 959 004 148

elf aquitaine

SOCIÉTÉ / *OPERATOR* **Elf Aquitaine Norge A/S**	CAROTTE : / *CORING LENGHT* : 14 m (m en / *ft in*) 14h30' h		SIGLE : / *ABB. TITLE* : 15/3-5
SONDAGE : / *WELL* : 15/3-5	RÉCUPÉRÉ : / *RECOVERY LENGHT* : 11.70 m (m soit / *ft so*) 84 %		CAROTTE N : / *CORE N°* : 2
PERMIS : / *AREA* : 15/3	DATE EXTRACTION : / *OPERATION DATE* : 26/4-84		TÊTE / *TOP* 3989 m (m / *ft*)
	CAROTTIER (Type, Ø) / *CORE BARREL* : chr. C20.6 1/4"x3"	BOUE : / *MUD* : FCL	PIED / *BASE* 4003 m (m / *ft*)
			Feuille n° : / *sheet n°* : 1 de / *from* 3989 à / *to* 3998



DESCRIPTION LITHOLOGIQUE / *LITHOLOGICAL DESCRIPTION*

COAL seam

SH, dark grey, micromicaceous, non-calcareous, hard occ. stringers of **SLST**, grey, micromicaceous. Slickensides, dips from 30° to 75°

▲ orange to dull yellow

SH A/A

stringers of **SLST** A/A, and **COAL**

▲ clear yellow △ dull white, milky + clear yellow

very fossiliferous (bi-valves)

slump fold Part from Box # 3

SH A/A w/abundant shell-layers (Bi-valves)

▲ Pale yellow △ dull white + clear yellow

← erosional surface

SH A/A, with thin **SLST** laminations, slightly calcareous

SLST, shaly, grey to grey-brown, very shell-rich

SH A/A with laminations of SLST, very micaceous and erosional base

Slickensides

SH, dark grey to black, hard, locally tectonized occ. laminations of **SLST** A/A

SH A/A, very tectonized, w/slickensides (dip 15–20°)

occ development of cleavage

FLUO :
1 trace / *trace* 2 moyen / *fair* 3 forte / *good*

Fiche établie par : / *Established by* : M. TISSERANT, O. MINSAAS, J.E. RINGÅS

Imp. 2280 E SNEAIPI RGM 959 004 148

elf aquitaine

SOCIÉTÉ / *OPERATOR* **Elf Aquitaine Norge A/S**	CAROTTE : *CORING LENGHT* : 14 m (m en / *ft in*) h		SIGLE : *ABB. TITLE* : 15/3-5
SONDAGE : *WELL* : 15/3-5	RÉCUPÉRÉ : *RECOVERY LENGHT* 11.70 m (m soit / *ft so*) 84 %		CAROTTE N : *CORE N* : 2
	DATE EXTRACTION : *OPERATION DATE* : 26/4-84		TÊTE / *TOP* 3989 m (m / *ft*)
PERMIS : *AREA* : 15/3	CAROTTIER (Type, Ø) *CORE BARREL* chr. C20.6 1/4" x3"	BOUE : *MUD* : FCL d=1,70	PIED / *BASE* 4003 m (m / *ft*)
			Feuille n° : *sheet n°* : 2 de *from* 3998 à *to* 4003

Cotes echelle 1:40 *Depth scales 1:40* m ft	N	Figure *Section*	Ind *Shows*	FLUO *Direct* 1 2 3	CO_3 CA %	PEND *DIP*	FIS	DESCRIPTION LITHOLOGIQUE *LITHOLOGICAL DESCRIPTION*
3998	Box # 10					15°		← varved, ripply **CLST**, light brown, hard, erosive base
						30°		interbedded **SLST**, fining upward and erosive base
3999	Box # 11					15°		SH, dark grey, hard, occ tectonized (Slickenside) abundant bi-valves
						5°		
4000	Box # 12	← 1				5-10°		
4001	Box # 13							
4002	Box # 14							
4003								

SM SLT VF F M

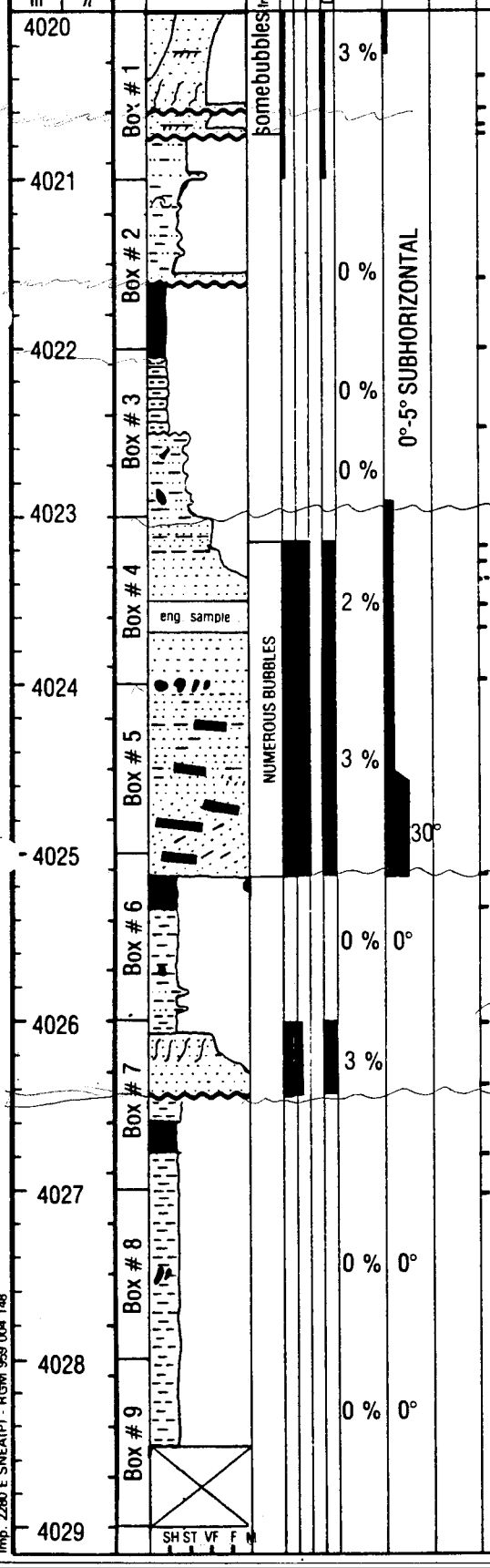
FLUO :
1 trace *trace* 2 moyen *fair* 3 forte *good*

Fiche établie par : *Established by* : M. TISSERANT, O. MINSAAS, J.E. RINGÅS

Imp. 2280 E SNEAP RGM 959 004 148

elf aquitaine

SOCIÉTÉ / *OPERATOR* **Elf Aquitaine Norge A/S**	CAROTTE : *CORING LENGHT* : 9 m (m en / *ft in* 6 h)		SIGLE : *ABB.TITLE* : 15/3-5
SONDAGE : *WELL* : 15/3-5	RÉCUPÉRÉ : *RECOVERY LENGHT* : 8,5 m (m soit / *ft so* 94 %)		CAROTTE N° : *CORE N°* 3
PERMIS : *AREA* : 15/3	DATE EXTRACTION : *OPERATION DATE* : 28/4-84		TÊTE / *TOP* 4020 m (m / *ft*)
	CAROTTIER (Type, Ø) *CORE BARREL* chr. C-20.8 7/16'	BOUE : *MUD* : FCL d: 1.70	PIED / *BASE* 4029 m (m / *ft*)
			Feuille n° : *sheet n°* : 1 de *from* 4020 à *to* 4029



DESCRIPTION LITHOLOGIQUE
LITHOLOGICAL DESCRIPTION

SANDSTONE very fine to fine, grey, siliceous cemented with freq. laminations o micas. ▲ Few pts. pale yellow △ Dull whitish, + nil to slightly colored

Numerous synsedimentary slumps, top part cut by subvertical fault LAYER OF FREE **QTZ:** subond, translucent, med.

FREE **QTZ** A/A

Varved laminations and thin layers of **SILTSTONE,** hard, siliceous, grey to grey brownish and **SHALE,** grey blackish, some **coal** laminations, Occ. bi-valves.

COAL, black, brittle, massive occ. precence of Pyrite

☼ 3 % T.G. $C_1 - nC_4$

SHALE. dk. grey to black, numerous layers of **COAL** (cm/cm scale)

SILTSTONE, beige to light grey, tectonized (SLICKENSIDES), pieces of **COAL**

SANDSTONE, very fine, sub.ang., mod. sorted, friable, terrigeneous material (leaves, wood). Thin laminations of **SHALE A/A**

TG. 7 %, C_1:4%, C_2:0.8 %, C_3:0.5 %, IC_4:0.04 %, nC_4:0.1 %

SANDSTONE A/A med, ess. qtz translusent, argilleaceous cam., bits of COAL no. structures.

Wellrounded pebbles of **DOLOMITE** Ø 3 cm, reddish brown.

OCC. Stringers of **COAL**

odour of HC

▲ bright yellow, △ white milky to dull whitish, + clear yellow

SANDSTONE A/A, fair app.por., some laminations of **SHALE** A/A

COAL A/A

SHALE, beige to lt. grey, hard, tectonized (SLICENSIDES). occ. pyrite, occ. silty laminations towards base

SANDSTONE, fine to medium, grey, med. sorted, subnd. siliceous cemented, slight odour of HC. ▲ yellow, △ dull whitish, + slightly colored

SHALE A/A

COAL A/A

SHALE, grey occ. beige, tectonized (SLICENSIDES)

SHALE, beige to clear grey

← 3–4 subr nd, pebbles of a hard, slaty, deepgreenish metamorphic (?) rock

SHALE, grey dk grey

FLUO :
1 : trace *trace* 2 : moyen *fair* 3 : forte *good*

Fiche établie par : *Established by* : M. TISSERANT O. MINSAAS

Imp. 2280 E SNEA(P) - RGW 959 004 148

APPENDIX 2

Sidewall Core Descriptions

elf aquitaine

DESCRIPTION DES CLABS
DESCRIPTION OF SIDE WALL SAMPLES

SONDAGE : *WELL* : 15/3-5	DESCENTE N° : *RUN N°* : 1
PERMIS : *PERMIT* :	PAGE N° : 1
PAYS : *COUNTRY* : NORWAY	DATE : 06.04.84

Cie opératrice/*Company* :	
Nbr clabs demandés/*requested* :	51
Nbr clabs récupérés/*recovered* :	17
Nbr balles tirées/*shot* :	27
Nbr balles perdues/*lost* :	10
Nbr balles pleines/*full* :	14
Récupération/*Recovery* :	33
Examinés par : *Examined by* :	D. Stensland

1 : Trace/*Trace* 2 : Faible/*Fair* 3 : Fort/*Strong*

N°	PROF. *DEPTH*	REC %	REC cm.	DESCRIPTION	FLUORESCENCE de l'échantillon : *of sample*				CCI 4		
						1	2	3	1	2	3
1	3828,5			LOST							
2	3826,4	30	1,5	SHALE, DARK GREY TO DARK BROWN, SOFT, SILTY MICACEOUS							
3	3823,5			LOST							
4	3820,5			LOST							
5	3815,5			LOST							
6	3812,1	40	2	SHALE, DARK GREY, TO DARK BROWN, SOFT, SILTY MICACEOUS							
7	3809,5			LOST							
8	3807,5			LOST							
9	3806,4	20	1	SHALE, LIGHT GREY, MOD. INDURATED, MICROMICACEOUS CALCAREOUS							
10	3805,8			LOST							
11	3805,8			LOST							
12	3804			EMPTY							
13	3802,5			LOST							
14	3796,9	20	1	SHALE, LIGHT GREY, MOD. INDURATED, MICROMICACEOUS, CALCAREOUS							
15	3790,4	20	1	SHALE A/A							
16	3775,4	60	3	SHALE, RED BROWN, SOFT, MICROMICACEOUS							
17	3761,4	50	2,5	SHALE, RED BROWN, IDURATED, SILTY, MICROMICACEOUS W/PYRITE							
18	3754,1	20	1	SHALE, RED BROWN, SOFT, MICROMICACEOUS							
19	3747,4	30	1,5	SHALE, DARK GREY, SOFT, MICROMICACEOUS CALCAREOUS							

Imp. 3044 S SNEA(P) - RGM 969 004 146

elf aquitaine

DESCRIPTION DES CLABS
DESCRIPTION OF SIDE WALL SAMPLES

SONDAGE : *WELL* : 15/3-5	DESCENTE N° : *RUN N°* : 1
PERMIS : *PERMIT* :	PAGE N° : 2
PAYS : *COUNTRY* : NORWAY	DATE : 06.04.84

Cie opératrice/*Company* :	EAN
Nbr clabs demandés/*requested*	51
Nbr clabs récupérés/*recovered*	17
Nbr balles tirées/*shot* :	27
Nbr balles perdues/*lost* :	10
Nbr balles pleines/*full* :	14
Récupération/*Recovery* :	33
Examinés par : *Examined by* :	D. STENSLAND

1 : Trace/*Trace* 2 : Faible/*Fair* 3 : Fort/*Strong*

N°	PROF. *DEPTH*	REC %		DESCRIPTION	FLUORESCENCE de l'échantillon : *of sample* 1	2	3	CO 4 1	2	3
20	3738,6	60	3	SHALE, LIGHT GREY, INDURATED, SUBFISSILE, MICROMICACEOUS WEAKLY CALCAREOUS						
21	3647,4	40	2	SHALE, GREY, INDURATED, MICACEOUS, CALCAREOUS						
22	3372,5			LOST						
23	3307,7			MISFIRE						
24	3247			EMPTY						
25	3232,5			EMPTY						
26	3197,5			MISFIRE						
27	3192,6	30	1,5	MARL, RED-BROWN, SOFT						
28	3160,6	40	2	MARL, LIGHT GREY, SOFT						
29	3127,6			MISFIRE						
30	3119,6	30	1,5	LIMESTONE, LIGHT GREY, MOD. HARD CRYPTOCRYSTALLIN						

Imp. 5644(P) - RGM 959 004 146

elf aquitaine

DESCRIPTION DES CLABS
DESCRIPTION OF SIDE WALL SAMPLES

SONDAGE : *WELL* : 15/3-5	DESCENTE N° : *RUN N°* : 2
PERMIS : *PERMIT* :	PAGE N° : 1
PAYS : *COUNTRY* : NORWAY	DATE : 06.04.84

Cie opératrice/*Company* :	FAN
Nbr clabs demandés/*requested* :	30
Nbr clabs récupérés/*recovered* :	20
Nbr balles tirées/*shot* :	22
Nbr balles perdues/*lost* :	2
Nbr balles pleines/*full* :	18
Récupération/*Recovery* :	66,6
Examinés par : *Examined by* :	D. STENSLAND

1 : Trace/*Trace* 2 : Faible/*Fair* 3 : Fort/*Strong*

N°	PROF. *DEPTH*	REC %	REC cm	DESCRIPTION	FLUORESCENCE de l'échantillon : *of sample* :				CO 4	
						1	2	3	1	2
1	3829	40	2	SHALE, DARK GREY TO BLACK, INDURATED, MICROMICACEOUS PYRITIC.						
2	3823	20	1	SHALE, DARK GREY, SOFT, SILTY, MICACEOUS						
3	3818	24	1,2	SHALE, DARK GREY TO BLACK, INDURATED, MICROMICACEOUS, PYRITIC						
4	3814,7			EMPTY						
5	3810,3	30	1,5	SHALE A/A						
6	3809	40	2	SHALE A/A						
7	3808,3	60	3	SHALE DARK GREY, INDURATED, SLIGHTLY SILTY WEAKLY CALCAREOUS						
8	3807,3			LOST						
9	3585	10	0,5	SHALE, DARK GREY, INDURATED, MICROMICACEOUS SILTY, CALCAREOUS						
10	3530	10	0,5	SHALE A/A						
11	3492			LOST						
12	3475			EMPTY						
13	3460	30	1,5	SHALE, DARK GREY, INDURATED, MICACEOUS CALCAREOUS, W/GLAUCONITE						
14	3411	30	1,6	SHALE A/A						
15	3370	10	0,5	LIMESTONE, HARD LIGHT BEIGE, MICROCRYSTALLIN W/LAMINA OF SHALE, DARK GREY						
16	3305,2	40	2	MARL, LIGHT GREY, FIRM, W/GLAUCONITE						
17	3244	10	0,5	MARL LIGHT GREY, SOFT						
18	3230	60	2,5	LIMESTONE, WHITE, FIRM, CRYPTOCRYSTALLIN						
19	3099	40	2	MARL, RED SOFT						

Imp. EA(P) - RGM 959 004 146

elf aquitaine

DESCRIPTION DES CLABS
DESCRIPTION OF SIDE WALL SAMPLES

SONDAGE : *WELL* :	15/3-5
PERMIS : *PERMIT* :	
PAYS : *COUNTRY* :	NORWAY
DESCENTE N° : *RUN N°* :	2
PAGE N° :	2
DATE :	06.04.84

Cie opératrice/*Company* :	
Nbr clabs demandés/*requested* :	30
Nbr clabs récupérés/*recovered* :	20
Nbr balles tirées/*shot* :	22
Nbr balles perdues/*lost* :	2
Nbr balles pleines/*full* :	18
Récupération/*Recovery* :	666 %
Examinés par : *Examined by* :	D. STENSLAND

1 : Trace/*Trace* 2 : Faible/*Fair* 3 : Fort/*Strong*

N°	PROF. *DEPTH*	REC %	REC cm	DESCRIPTION	FLUORESCENCE de l'échantillon : *of sample* :				CO 4		
						1	2	3	1	2	3
20	3073			MISFIRE							
21	3060	70	3,5	MARL, GREY, FIRM							
22	3007	60	3	MARL, LIGHT GREY, FIRM							
23	2975			MISFIRE							
24	2950	40	2	LIMESTONE, WHITE, AMORPHOUS, FIRM							
25	2920			MISFIRE							
26	2888			"							
27	2850			"							
28	2830			"							
29	2820			"							
30	2817			"							

Imp. 5[illegible] A(P) - RGM 950 004 146

elf aquitaine

DESCRIPTION DES CLABS
DESCRIPTION OF SIDE WALL SAMPLES

SONDAGE : *WELL* :	15/3-5	DESCENTE N° : *RUN N°* :	3
PERMIS : *PERMIT* :		PAGE N° :	1
PAYS : *COUNTRY* :	NORWAY	DATE :	05.05.84

Cie opératrice/*Company* :	EAN
Nbr clabs demandés/*requested* :	30
Nbr clabs récupérés/*recovered* :	16
Nbr balles tirées/*shot* :	22
Nbr balles perdues/*lost* :	6
Nbr balles pleines/*full* :	15
Récupération/*Recovery* :	50%
Examinés par : *Examined by* :	D. STENSLAND

1 : Trace/*Trace* 2 : Faible/*Fair* 3 : Fort/*Strong*

N°	PROF. *DEPTH*	REC %		DESCRIPTION	FLUORESCENCE de l'échantillon : *of sample* : 1	2	3	CO2 : 1	2
1	4130		2cm	SANDSTONE, FINE-MED; SUBROUND. SUB ANG. CALC.CMT. 14% Ca CO_3					
2	4125		1"	SANDSTONE, WHITE, FINE-V.FINE, SUBROUND CALC.CMT. 3% $CaCO_3$					
3	4118,5		2,5	SANDSTONE; A/A LOC. GREENISH 18% $CaCO_3$					
4	4113		1,5	LIMESTONE, WHITE, CHALKY, SOFT, W/CALCITE 83% $CaCO_3$					
5	4107		1	SANDSTONE, WHITE, FINE-V.TINE, SUBROUND, CALC.CMT. 5% $CaCO_3$					
6	4104		4	SHALE, RED-DK.RED, SOFT, SILTY, CALCAREOUS.					
7	4095		3	SHALE, DK.RED-BROWN, SOFT, SILTY, CALCAREOUS.					
8	4083		3	SHALE, GREY, MOD. INDURATED, SILTY, MICOMICACEOUS, W/THIN LEVEL OF SHALE, RED A/A.					
9	4078			LOST					
10	4072			EMPTY					
11	4051		1cm	SANDSTONE, V.FINE-FINE, WHITE-LT. GREY, MOD. HD. ARGIL CMT.					
12	4046			LOST					
13	4037			SANDSTONE, V.FINE, WHITE-TRANSLUCENT, W/THIN LAMINA OF SHALE.					
14	4034			LOST					
15	4022			LOST					
16	4016		2	SHALE, DK.GREY, HD, SUBFISSILE, MICROMICACEOUS, WEAK CALCAREOUS.					
17	4008		1,6	SHALE A/A.					
18	3965		0,5	SILTSTONE, DK.GREY TO BROWNISH, ARGILACEOUS W/MICA					
19	3959		1	COAL, BLACK					

Imp. SNEA(P) - RGM 958 004 146

elf aquitaine

DESCRIPTION DES CLABS
DESCRIPTION OF SIDE WALL SAMPLES

SONDAGE : *WELL* :	15/3-5	DESCENTE N° : *RUN N°* :	3
PERMIS : *PERMIT* :		PAGE N° :	2
PAYS : *COUNTRY* :	NORWAY	DATE :	05.05.84

Cie opératrice/*Company* :	EAN
Nbr clabs demandés/*requested* :	30
Nbr clabs récupérés/*recovered* :	16
Nbr balles tirées/*shot* :	22
Nbr balles perdues/*lost* :	6
Nbr balles pleines/*full* :	15
Récupération/*Recovery* :	50%
Examinés par : *Examined by* :	D. STENSLAND

1 : Trace/*Trace* 2 : Faible/*Fair* 3 : Fort/*Strong*

N°	PROF. *DEPTH*	REC %		DESCRIPTION	FLUORESCENCE de l'échantillon : *of sample* 1	2	3	CO 4 1	2	3
20	3956			LOST						
21	3952			LOST						
22	3938		2cm	SHALE, DK.GREY, INDURATED, SUBFISSILE, MICROMICACEOUS						
				1 No. 23-30 MISFIRE						

Imp. SNEA(P) - RGM 959 (3/4 1 ro)

elf aquitaine

DESCRIPTION DES CLABS
DESCRIPTION OF SIDE WALL SAMPLES

SONDAGE : *WELL* :	15/3-5
PERMIS : *PERMIT* :	
PAYS : *COUNTRY* :	NORWAY
DESCENTE N° : *RUN N°* :	4
PAGE N° :	1
DATE :	05.05.84

Cie operatrice/*Company* :	EAN
Nbr clabs demandés/*requested* :	30
Nbr clabs récupérés/*recovered* :	18
Nbr balles tirées/*shot* :	30
Nbr balles perdues/*lost* :	12
Nbr balles pleines/*full* :	17
Récupération/*Recovery* :	56%
Examinés par : *Examined by* :	D. STENSLAND

1 : Trace/*Trace* 2 : Faible/*Fair* 3 : Fort/*Stro*

	N°	PROF. *DEPTH*	REC %		DESCRIPTION	FLUORESCENCE de l'échantillon : *of sample* 1	2	3	CCI 1	2
1	1	3905			LOST					
	16	"			LOST					
3	2	3900		0,5	SHALE, DK.GREY, INDURATED, SILTY, BLOCKY, WEAKCALC.					
4	2b	"			LOST					
5	3	3897		1cm	SHALE, DK.BROWN-BLACK, SOFT, SILTY, MICROMICACEOUS WEAK. CALCAREOUS					
6	3b	"		2cm	SHALE A/A					
7	4	3895		3	SHALE A/A					
8	4b	"			LOST					
9	5	3888			LOST					
	5b	"			LOST					
11	6	3886		0,5	SHALE, DK.GREY, INDURATED, SUBFISSILE, SILTY, MICROMIC. WEAK CALC.					
12	6b	"		2	SHALE A/A					
13	7	3882			LOST					
14	7b	"		2,5cm	SHALE, DK.GREY, MOD. HD. BLOCKY, CALCAREOUS					
15	8	3876		1,5	SHALE, DK.GREY-BLACK, MOD. INDURATED, SUBFISSILE MICACEOUS					
16	8b	3876		2	SHALE A/A					
17	9	3874		3	SHALE A/A					
18	9b	"		1,5	SHALE A/A					

Imp. 5644-5 SNEA(P) - RGM 959 004 146

elf aquitaine

DESCRIPTION DES CLABS
DESCRIPTION OF SIDE WALL SAMPLES

SONDAGE : *WELL* :	15/3-5	DESCENTE N° : *RUN N°* :	4
PERMIS : *PERMIT* :		PAGE N° :	2
PAYS : *COUNTRY* :	NORWAY	DATE :	05.05.84

Cie opératrice/*Company* :	EAN
Nbr clabs demandés/*requested* :	30
Nbr clabs récupérés/*recovered* :	18
Nbr balles tirées/*shot* :	30
Nbr balles perdues/*lost* :	12
Nbr balles pleines/*full* :	17
Récupération/*Recovery* :	56%
Examinés par : *Examined by* :	D. STENSLAND

1 : Trace/*Trace* 2 : Faible/*Fair* 3 : Fort/*St*

	N°	PROF. *DEPTH*	REC %		DESCRIPTION	FLUORESCENCE de l'échantillon : *of sample* : 1	2	3	CO 1
19	10	3870		2,5cm	SHALE, DK BROWN-BLACK, SOFT, WEAK.CALCAREOUS MICROMICACEOUS				
20	10b	"		2cm	SHALE A/A				
21	11	3866			EMPTY				
22	11b	"		1	SHALE A/A				
23	12	3863			LOST				
24	12b	"		1	SHALE, DK. GREY-BROWN, MOD. HD. SUBFISSILE, SILTY				
25	13	3856			LOST				
26	13b	"			LOST				
27	14	3840			LOST				
	14b	"		3cm	SHALE, DK.GREY. MOD. HD. MICROMICACEOUS, SILTY				
29	15	3835		3cm	SHALE A/A				
30	16	3830			LOST				

Imp. 5544 B SNEA(P) - RGM 959 004 146

COMPOSITE LOG

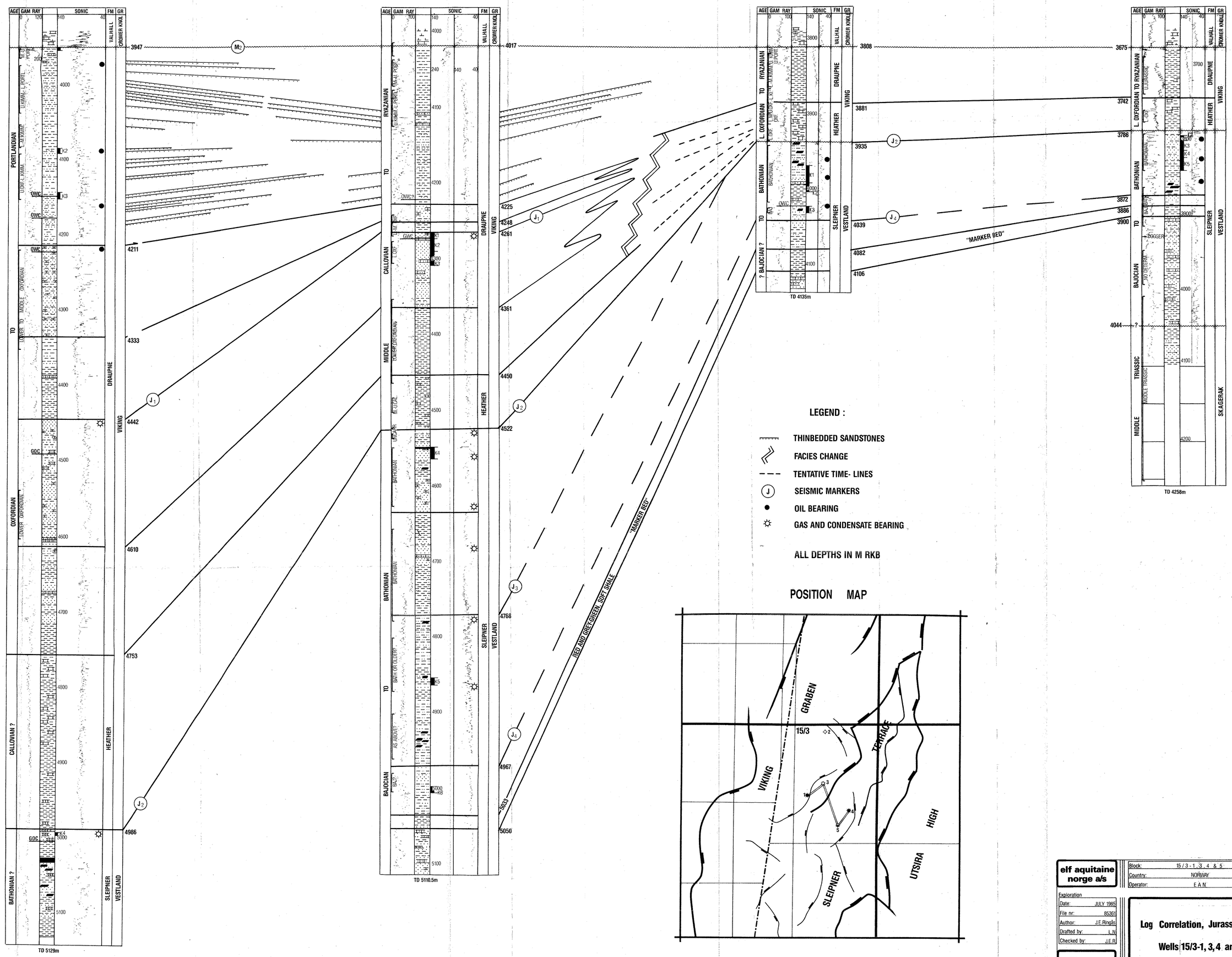
BP/MGS
Mukluk #1

SCALE: 1:500

Operator	BP Exploration (Alaska) Inc.
Contractor	Marathon Oil Company
Rig	Mobil Drilling Unit #1
Spud Date	12-Jan-1984
Completion Date	24-Mar-1984
Total Depth	12,000 ft
Elevation	0 ft
Water Depth	0 ft
Casing Program	30" @ 1,000 ft 20" @ 2,000 ft 13 3/8" @ 4,000 ft 9 5/8" @ 8,000 ft 7" @ 12,000 ft
Bit Program	17 1/2" to 4,000 ft 12 1/4" to 8,000 ft 8 1/2" to 12,000 ft
Mud Program	Spud Mud Lignosulfonate Polymer

LEGEND

Sandstone	
Shale	
Coal	
Limestone	
Dolomite	
Chert	
Tuff	
Volcanic Ash	
Bentonite	
Pyrite	
Glauconite	
Carbonaceous Material	
Fossiliferous	
Bioturbation	
Cross Bedding	
Parallel Lamination	
Ripple Lamination	
Soft Sediment Deformation	
Slickensides	
Fracture	
Fault	
Core Gap	
Core Recovery	
Sidewall Core	
Cuttings	
Gas Shows	
Oil Shows	
Water Shows	
Coal Shows	
Lithology	
Porosity	
Permeability	
Hydrocarbon Potential	
Reservoir Quality	
Source Rock	
Seal	
Trap	
Structural Dip	
Stratigraphic Dip	
Depositional Environment	
Biostratigraphy	
Chronostratigraphy	
Sequence Stratigraphy	
Diagenesis	
Tectonics	
Structure	
Stratigraphy	
Petrophysics	
Geochemistry	
Geophysics	
Geomechanics	
Geochronology	
Geochronology	
Geochronology



elf aquitaine norge a/s

Block:	15 / 3 - 1 , 3 , 4 & 5
Country:	NORWAY
Operator:	E A N

Exploration

Date:	JULY 1985
File nr:	85361
Author:	J.E.Ringås
Drafted by:	L.N
Checked by:	J.E.R

PL. 2

Log Correlation, Jurassic Section

Wells 15/3-1, 3, 4 and 5