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FINAL GEOLOGICAL REPORT
APPRAISAL WELL 33/9-9

MOBIL EXPLORATION NORWAY INC.

MARCH 1978

MOBIL EXPLORATION NORWAY INC.
FINAL GEOLOGICAL REPORT
APPRAISAL WELL 33/9-9

FILE NO: 7.70

DEVELOPMENT GEOLOGY
ENGINEERING DEPARTMENT

MARCH, 1978

CONTENTS

NORWAY OFFSHORE
LICENSE 037
WELL 33/9-9

WELL DATA

Well Name:	33/9-9
Location:	61°17'10.1928"N Latitude
	01°54'26.0466"E Longitude
Classification:	Appraisal
Drilling Period:	
Spud Date:	27 July 1977
Drilling Complete:	29 September 1977
Rig Release:	19 November 1977
DF Elevation:	25.0 m
Water Depth:	145.0 m
Rig:	Borgny Dolphin
Status:	Successful Appraisal
Total Depth:	
Planned:	3000 m
Actual:	3100 m
Cost (US $ - MM):	
Planned:	9.0
Actual:	7.3*

* As of February 28, 1978

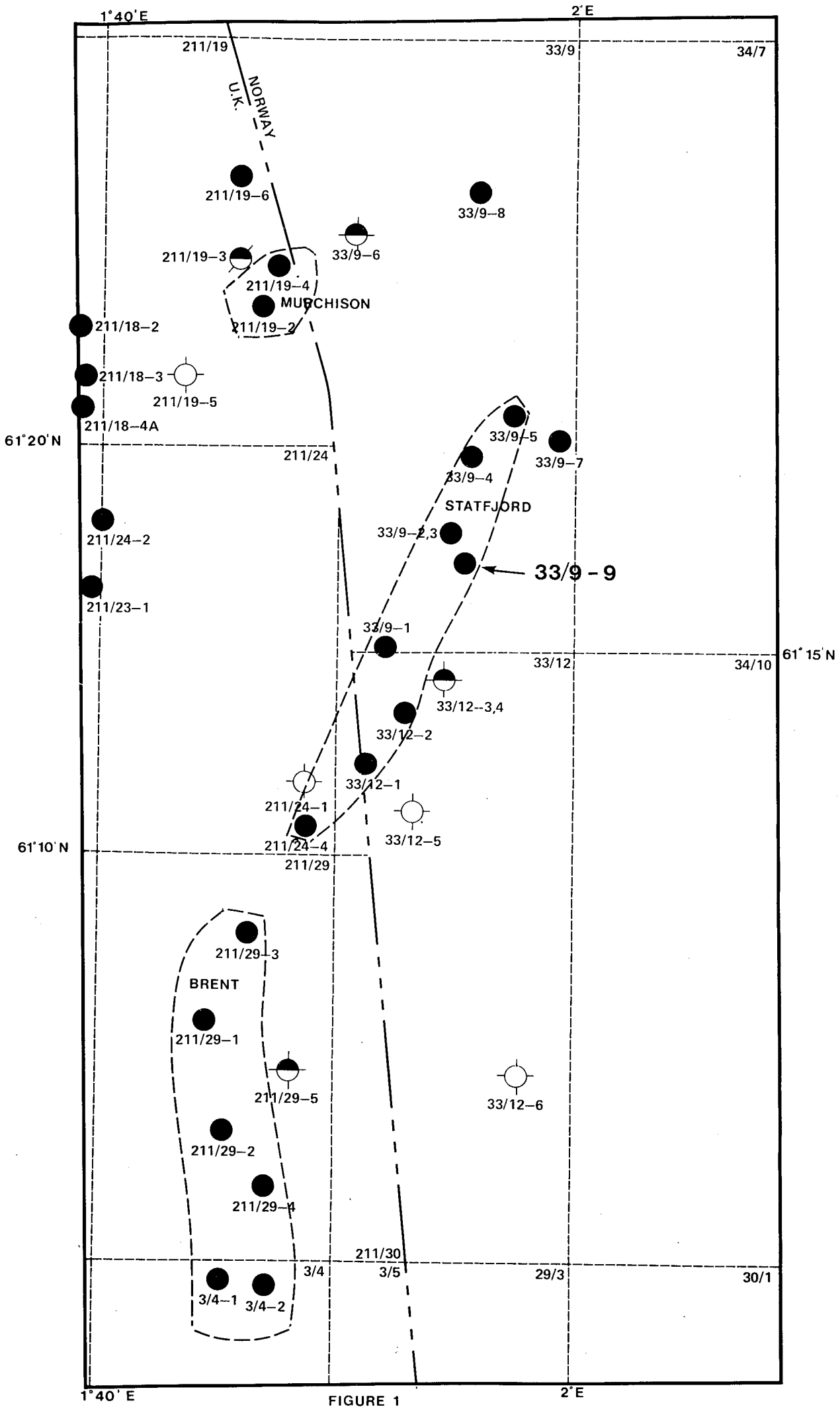
1°40'E
2°E
211/19
33/9
34/7
U.K.
NORWAY
211/19-6
33/9-8
211/19-3
33/9-6
211/19-4
MURCHISON
211/19-2
211/18-2
211/18-3
211/19-5
211/18-4A
61°20'N
211/24
33/9-5
33/9-7
33/9-4
STATFJORD
211/24-2
33/9-2,3
33/9-9
211/23-1
33/9-1
61°15'N
33/12
34/10
33/12-3,4
33/12-2
33/12-1
211/24-1
33/12-5
61°10'N
211/24-4
211/29
211/29-3
BRENT
211/29-1
211/29-5
33/12-6
211/29-2
211/29-4
211/30
3/4
3/5
29/3
30/1
3/4-1
3/4-2
1°40'E
2°E

FIGURE 1

SUMMARY

The 33/9-9 appraisal well is located in the northern portion of the Statfjord field, about 1.6 kilometers southeast of 33/9-3 well on seismic line MNG-22.5 (Figure 1). The objectives of the well were;

A. To provide structural and stratigraphic control on the Brent reservoirs in the northern, crestal portion of the field.

B. To provide stratigraphic control and to establish an oil/water contact for the Statfjord reservoir.

The well was spudded on 27 July 1977 and plugged and abandoned as a successful test on 19 November 1977 at the depth 3100 meters DF, probably in Triassic sediments.

The top of Brent was 77.5 meters lower than prognosed and the Brent reservoir was 44.0 meters thinner than anticipated in comparison to 33/9-3 (Figures 2 & 3). Thinning in the Brent reservoir could be due to normal faulting, stratigraphic thinning, or erosion. Analysis of the dip meter and the conventional core is in progress to try to answer this question.

Eight cores were taken through Brent reservoir and shipped to Mobil's Field Research Laboratory for special core analyses (Enclosure 4).

The Lower Jurassic Dunlin Formation had 23.2 meters (gross) of oil saturated sands between 2528.4-2551.6 meters DF. Fourteen sidewall samples were taken from Dunlin sand interval for porosity, permeability and saturation measurements (See Enclosure 5 and 6). One drillstem test in the upper part of Dunlin sand produced 8314 BOPD, 24.4^{o} API oil on a 1 1/4" choke (Attachment 3). Preliminary stock-tank-oil-in-place calculations based on the assumption that the oil/water contact is at -2584.1 meters subsea, i.e. same as Brent Formation, indicate 28.3 MMB for Dunlin sand.

The Lower Jurassic Statfjord Formation was only 5.0 meters low to prognosis confirming that the Statfjord seismic reflector is a reliable mapping horizon. The anticipated oil/water contact was not found. The oil/shale contact at -2802.7 meters subsea (2827.7 m KB) found in 33/12-2 falls in a zone of interbedded shales and tight sands in the 33/9-9 well. Fifteen cores were taken in the prospective section for special core analysis (Enclosure 4). A depth error of +11.3 meters was found at 2781.7 meters DF and was subsequently corrected (Attachment 4).

The well was plugged and abandoned at 3100.0 m DF in Triassic (?) red beds.

HYDROCARBON SHOWS AND EVALUATION

Middle Jurassic - Brent Formation

Good oil shows were encountered at the top of the Brent Formation and continued throughout the reservoir. The entire Brent Formation section between 2413.0 and 2504.5 meters DF (log) was above the field oil/water contact of -2584.1 meters subsea (2609.1 meters DF). Log calculations show that of the 87.0 meters of gross oil section 84.6 meters is net sand with 27.5% average porosity and 13.1% average water saturation. Two DST's were run, one immediately above middle shaly zone (No. 9) and one immediately below the middle shaly zone (No. 8). DST No. 9, from 2426.0 to 2432.8 meters DF flowed at the rate of 10,500 BOPD through 50/60" choke. DST No. 8, 2458.0 - 2460.7 meters DF, flowed at a rate of 9224 BOPD on a 48/64" choke (Attachment 3).

Lower Jurassic - Dunlin Formation

Oil shows were reported from ditch samples in the Dunlin sand between 2535 and 2575 meters (sample depth). The log interpretation indicated 23.2 meters gross oil column between 2528.4 and 2551.6 meters DF (log) with 17.9 meters net oil sand. The interval has a 20.2% average porosity and 34.6% water saturation.

DST No. 7 (2531.0 - 2537.5 meters DF) flowed 8314 BOPD, 34.4° API oil on a 1 1/4" choke, from the upper part of this interval (Attachment 3). This is the first well to find this unit productive in the field.

Lower Jurassic - Statfjord Formation

Good oil shows were reported from the top at 2715.0 meters down to about 2850.0 meters DF (sample). The lowest potential pay sand indicated on the CPI log occurs between 2847.5 and 2852.5 meters DF. A test in this interval, DST No. 2, produced 1350 BWPD on a 3/4" choke (Attachment 3). The next interval above this (2715.0 meters - 2815.0 meters DF) was sucessfully tested by DST No. 6 which flowed at a rate of 5420 BOPD on a 7/16" choke. DST No. 5 over the same interval was a sand production test flowing at rates of up to 7577 BOPD on a 5/8" choke, with moderate amounts (20 - 40 ptb) sand production. DST No. 3, at 2800.0 - 2803.5 meters DF, flowed at a rate of 9034 BOPD on a 3/4" choke with 90 ptb sand production (Attachment 3). The CPI evaluation for the 100 meter interval from 2715.0 to 2815.0 meters DF (log) showed 78.8 meters net sand with 24.0% average porosity and 27.1% average water saturation (Attachment 1). The lowest-known-oil in the well at 2815.0 meters DF (-2790.0 meters subsea) is 13.1 meters above the lowest-known-oil previously established in the 33/12-2 well and falls within a section of tight sands and shales.

STRATIGRAPHY/STRUCTURE

Tertiary

The Mio-Pliocene section consists of gray colored, soft, sandy, fossiliferous claystones. The underlying Oligocene is mostly gray-brown siltstones with occasional glauconitic sands. These sands become predominant lithology in the basal 50 meters of the section. The upper part of the Eocene is gray-brown firm claystones which become increasingly calcareous, with frequent calcilutite stringers, towards the base. Light colored, tuffaceous claystones and mudstones mark the top of the Paleocene section. Near the base, the Paleocene section contains generally coarse grained sands. An unconformity, based on paleo data, marks the base of Tertiary section in the well.

CROSS–SECTION SHOWING FAULT INTERPRETATION IN 33/9-9 WELL

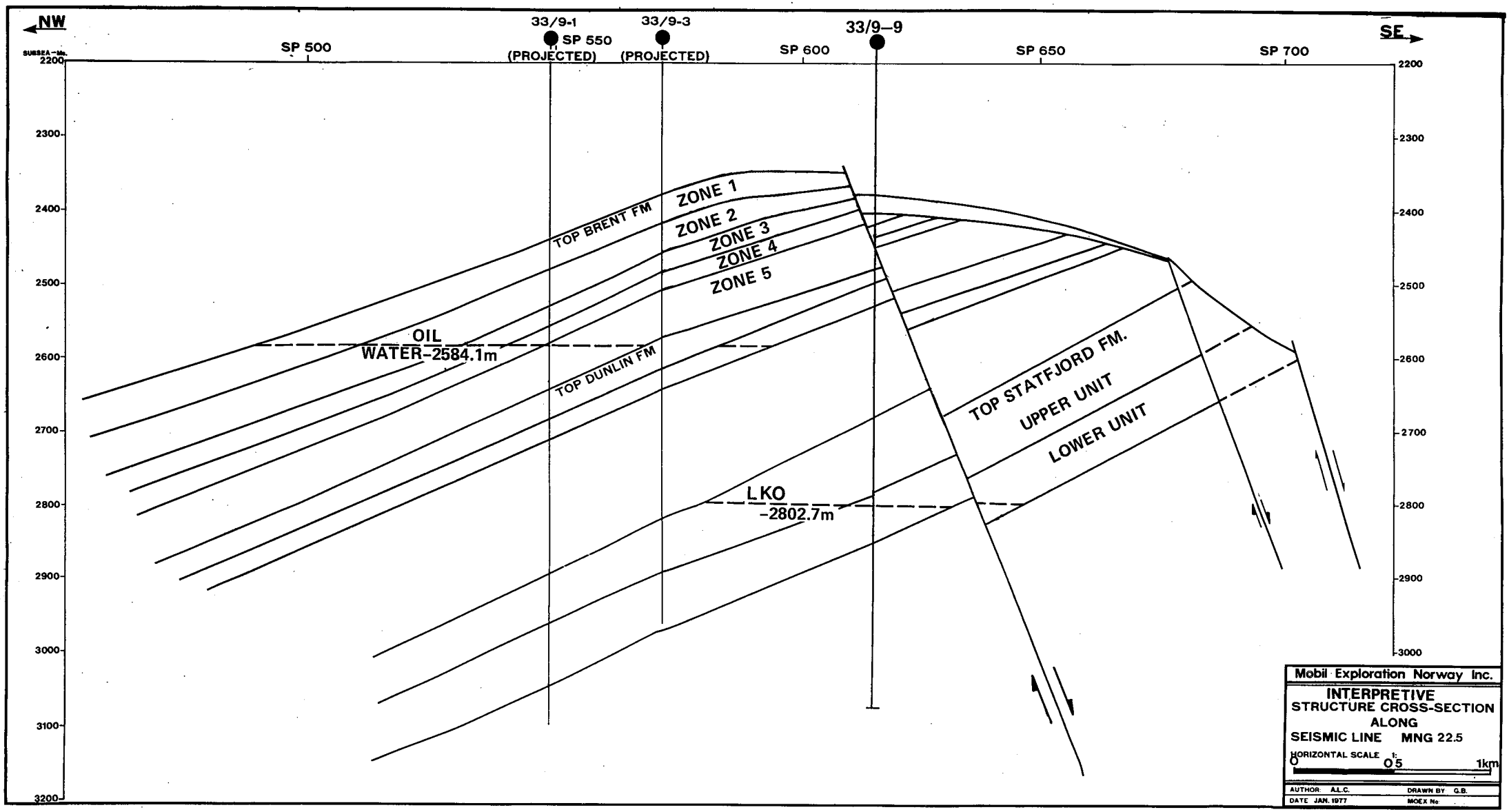

FIGURE 2.

78/176–1805

Cretaceous

The Upper Cretaceous sediments, ranging in age from Late Maastrichtian to Early Campanian, consist of gray claystones with increasing interbeds of fine grained calcareous sandstones, calcilutities and dololutites. Interpretation of dipmeter data indicates a low energy environment of deposition for the Upper Cretaceous section down to 2350 meters DF (log). The dipmeter structural dips for this interval are 2-3^{o} at 94^{o} azimuth. From 2350.0 meters to 2396.3 meters DF (log), the section consists mainly of claystones, and from the dipmeter log, although the dip vectors are scarce and poor in quality, the section appears to be concordant with the section above.

The Lower Cretaceous section consists of gray carbonaceous, glauconitic claystones overlying the white calcilutes of Barremian age. The upper boundary of the Lower Cretaceous section which corresponds to a time gap from top Santonian to probably base Cenomanian, (assuming that the clayey section above Barremian is of Aptian-Albian in age as in wells 33/9-4 and 12-4) is not clearly marked on the dipmeter logs. Dip orientation show concordance with the overlying Upper Cretaceous section. There are however, well developed dip vectors showing gradual decrease in the amount of dip near the top of Barremian Limestone section. A distinct change in the dip vectors from 5^{o} to about 16^{o} at 110^{o} azimuth to 4^{o} at 65^{o} azimuth, occurs around 2400.7 meters DF indicating an unconformity at the top of Barremian Limestone. The paleo evidence (corrected for drilling depth error of +11.3 meters*) also indicates an unconformity at this level, confirming the dipmeter data. Within the Barremian section the amount of dip increases from 4^{o} to 6^{o} near the base, giving a slight indication of the regional Kimmerian Unconformity at the base.

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* Drilling depths were recorded 11.3 m too high starting at about 2200 meters DF. The error was corrected after 2781.7 meters DF. The paleo sample depths are in error in the above interval.

Jurassic

A thin veneer (0.6 meters) of Upper Jurassic Hot Shale Formation is preserved between 2412.5 and 2413.6 meters DF (log) in the 33/9-9 well.

Below this the Brent Formation was encountered at 2413.0 meters DF (log), 77.5 meters low to prognosis. This is due to significantly higher actual seismic velocities than those used for prognosis.

The computer processed log interpretation (CPI) over the interval shows that the oil bearing sands of Brent Formation have an average net/gross ratio of 0.97 and an average porosity of 27.5%. (Attachment 1). Although the section is cored from 2415.0 to the base at 2504.5 meters DF (Cores 1 through 7), no core porosity data is available at the time of this report (Enclosures 1 and 4).

The structural dips on the dipmeter log across the Brent Formation interval between 2504.5 and 2425.0 meters DF (log) are about 2^{o}, with 295^{o} average azimuth. The overlying Upper Brent section between 2425.0 and 2413.0 meters DF (log) however, shows a gradual change from 6^{o} northwest dips at 2424.0 meters to 5^{o} southeast dips at 2414.0 meters DF (log). Such dip vector pattern can be interpreted as the differential compaction of the sediments (See "Fundamentals of Dipmeter Interpretation" 1972, page 100, Pattern Nos: 15 and 16, Schlumberger).

Log correlations and the dipmeter data lend to the interpretation of a possible normal fault at about 2471.0 meters DF, which cut out about 44.0 meters of section in comparison with 33/9-3 well (Figure 2).

The Lower Jurassic Dunlin Formation was topped at 2504.5 meters DF, 44.5 meters low to the prognosis. The section was typical of Dunlin with the exception of a better sand development that in any of the previous Statfjord Field wells, between 2528.4 and 2592.0 meters DF (log). The top 23.2 meters of this same interval had good oil shows. CPI calculations over the oil leg yield 17.9 meters net oil sand and a net-to-gross ratio of 0.77, and average porosity of 20.2% (Attachment 1).

Interpreted structural dips through the Dunlin are low, about 2 - 3° at 330° azimuth. Range of sedimentary dips (2° and 15°) indicate moderately high energy environment of deposition. Three, or possibly five, minor depositional breaks (diastems) can be interpreted within the Dunlin sand interval. Log correlation with 33/9-3 well indicate that the Dunlin Formation is approximately 30 meters thinner in 33/9-9.

Lower Jurassic Statfjord Formation was topped at 2715.0 meters DF (log), only 5.0 meters low to prognosis.

The Statfjord section consists of predominantly medium grained, kaolinitic sandstones interbedded with variegated claystones and mudstones. The frequency and thickness of the sandstone beds decrease sharply below 2815.0 meters DF (log), making this the base of Statfjord Formation, Upper Unit which has higher net-to-gross ratio than that of the Lower Unit. Log analysis over the interval from 2715.0 to 2815.0 meters DF (log) indicated a net-to-gross ratio of 0.75 and an average porosity of 24.0%. The Lower Unit of the Statfjord Formation is wet in this well. A sand count, using 40% clay volume as cut off value indicate 29.1 meters of clean sand, 29.7 meters shale and a sand-shale ratio of 0.98 for the interval from 2815.0 to 2873.8 meters DF (log). The dipmeter log indicates structural dips ranging between 2 - 7° at 295° azimuth (average), over the Statfjord Formation interval.

Triassic

Although the Robertson Research paleo summary shows the top of the Triassic at 2764.0 m DF (Attachment 5), this is based on appearance of red beds only, and not supported either by fossils or by log correlations.

CONCLUSIONS

In terms of stratigraphy, the results of 33/9-9 did not produce significant changes in the Statfjord Field stratigraphy. Structural dips obtained from the well has provided better control over structural configuration of the Brent Formation in the northern crestal area where seismic reflection data is highly questionable. However, the revision of the structure maps in the northern crestal area was not large enough to have signficant impact on the Development Plans of the Statfjord Field.

As for the Statfjord reservoir, results of log and core analyses will provide an additional control point for the reservoir in the northern part of the field.

In summary, well 33/9-9, provided additional structural control and reservoir data for Brent and Statfjord formations in the northern crestal portion of the field, and substantiated the oil potential of Dunlin Formation. It failed to establish an oil/water contact for the Statfjord reservoir.

NTank/ct
7 March 1978

WELL 33/9-9 PROGNOSIS VS ACTUAL DEPTHS

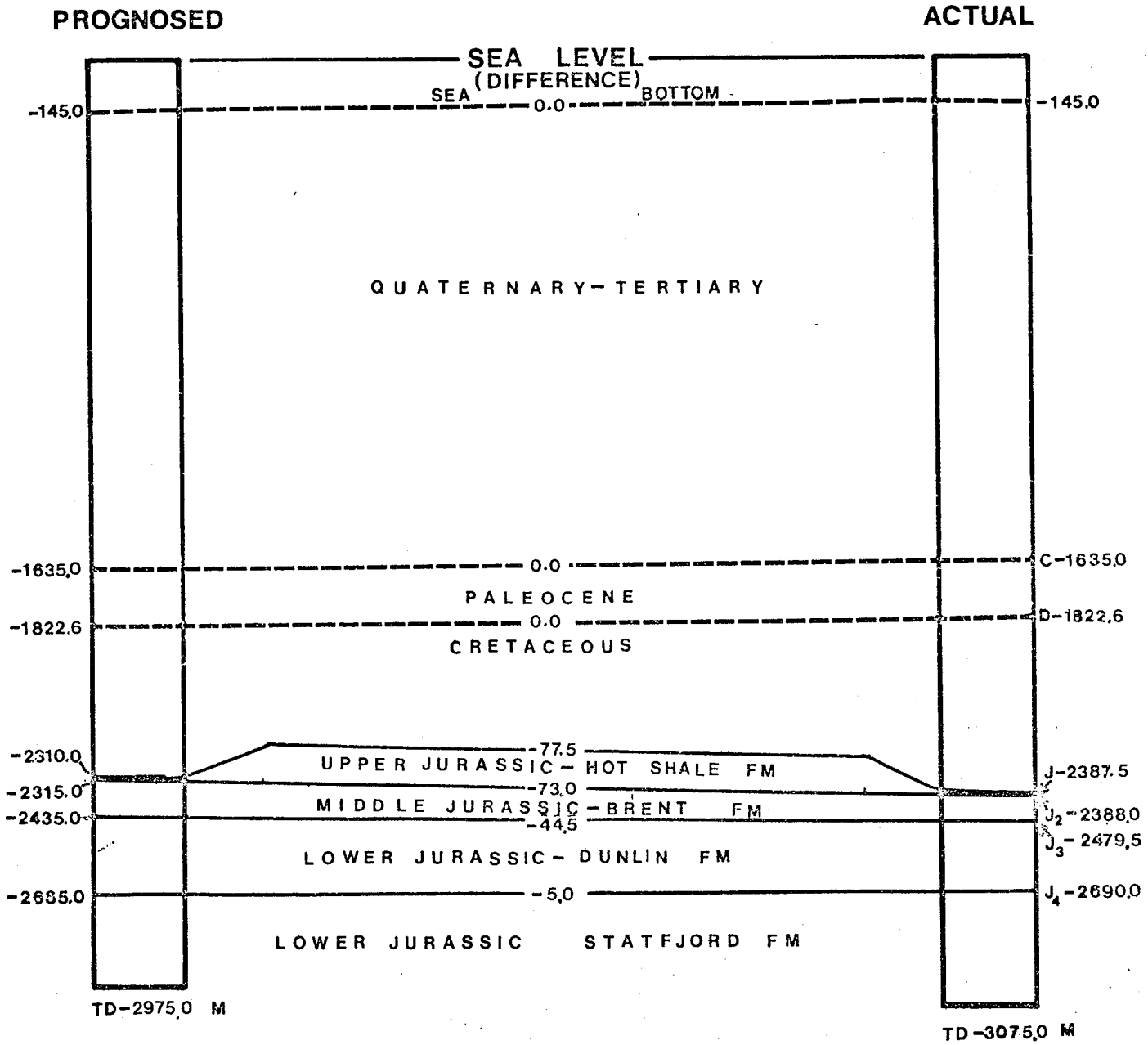

FIGURE 3

ALL DEPTHS ARE IN METERS
SUBSEA
VERTICAL SCALE 1:20,000

ATTACHMENT 1

WELL 33/9-9
LOG INTERPRETATION SUMMARY
(BASED ON CPI RESULTS)

	BRENT FORMATION	DUNLIN FORMATION (DUNLIN SAND)	STATFJORD FORMATION
Top	- 2388.7(SS)	-2503.4 m (SS)	- 2690.0m (SS)
Bottom	-2479.5 (SS)	-2567.0 m (SS)	- 2790.0m (SS)
KB	25.3 m	25.3 m	25.3 m
Ave Ø	27.5%	20.2%	24.0%
Ave Sw	13.1%	34.6%	27.1%
Net	84.6 m	17.9 m	74.8 m
Gross	87 m	23.2 m	100 m
N/G	.97	.77	.75
ALC/ct			

MOBIL

Attachment - 2
MOBIL EXPLORATION NORWAY INC.

WELL NAME: 33/9-9 **well record sheet**

COMPANY: Mobil Exploration Norway Inc.	STATUS: Successful Appraisal
AREA/BLOCK Norway 33/9	RIG & PICK UP DATE: Borgny Dolphin 22 July 1977
LATITUDE: 61° 17' 10.1928" N	SPUDDED: 27 July 1977 / REACHED T.D.: 29 Sep.'77
LONGITUDE: 01° 54' 26.0466" E	RIG RELEASE DATE: 19 November 1977
CLASSIFICATION: Appraisal	RIG MONTHS: 3.7 / TRADE DATA:
K.B.: 25.3 m / FM. AT T.D.:	WATER DEPTH: 145 m
T.D.: 3100 m	CASING: 30" at 244m, 20" at 475m, 13 3/8" at 1984m, 9 5/8" at 3067.5m
LOGS: ISF/SONIC 245.5-3100m, FDC/CNL 475.5-3100m, DLL 2350-3100m, HDT 2300-3100m GR Spectroscopy 2350-3100 Long Space Sonic 1990-3098.5.12 Check Shots (355-2955m)	

STRATIGRAPHIC TOPS

UNIT	K.B. DEPTH		SUBSEA DEPTH		THICKNESS	
	METERS	FEET	METERS	FEET	METERS	FEET
TERTIARY						
ROGALAND GROUP (PALEOCENE)	1660.0	5446	-1634.7	5363	187.6	616
BALDER FORMATION						
LISTA FORMATION						
SHETLAND GROUP (U. CRETACEOUS)	1847.6	6062	-1822.3	5979	515.7	1800
CROMER KNOLL GROUP (L. CRETACEOUS)	2396.3	7862	-2371.0	7779	16.5	54
BARREMIAN LIMESTONE UNIT	2407.0	7897	-2381.7	7814	5.8	19
HUMBER GROUP (U./M. JURASSIC)	2413.2	7917	-2387.9	7834	0.1	
HOT SHALE FM (U. JURASSIC)	2413.2	7917	-2387.9	7834	0.1	
COLD SHALE FM (M./U. JURASSIC)	ABSENT	-	-	-	-	-
BRENT FM. (M. JURASSIC)	2413.3	7918	-2388.0	7835	91.5	300
ZONE – 1 (1R)	2413.3	7918	-2388.0	7835	19.6	64
ZONE – 2	2432.9	7982	-2407.6	7899	11.2	37
ZONE – 3	2444.1	8019	-2418.8	7936	13.2	43
ZONE – 4	2457.3	8062	-2432.0	7979	14.0	46
ZONE – 5	2471.3	8108	-2446.0	8025	29.0	95
ZONE – 6	2500.3	8203	-2475.0	8120	4.5	15
DUNLIN FM. (L. JURASSIC)	2504.8	8218	-2479.5	8135	210.5	690
TOP DUNLIN – 2 MBR	2529.8	8300	-2504.5	8217	62.5	205
BASE DUNLIN – 2 MBR	2592.3	8505	-2567.0	8422		
CALCAREOUS MEMBER	2685.8	8825	-2664.5	8742	25.5	83
STATFJORD FM. (L. JURASSIC/U. TRIASSIC)	2715.3	8908	-2690.0	8825	158.8	521
UNIT – 1	2715.3	8908	-2690.0	8825	100.0	329
UNIT – 2	2815.3	9237	-2790.0	9154	58.8	192
BASE UNIT – 2	2874.1	9429	-2848.8	9346		
BASE STATFJORD FORMATION	2874.1	9429	-2848.8	9346		
CORMORANT FORMATION (U. TRIASSIC)	2874.1	9429	-2848.8	9346	226.5+	742+
TOTAL DEPTH (FORMATION):	3100.0	10171	-3074.7	10088		

CORING: Depths for cores 1 through 16 are 11.3 m too high.

Core	1	2402.7-2421	m	100%	rec.	Core	9	2707 -2711	m	63%	rec.	DEPTH CORRECT:				
"	2	2421 -2433	m	97%	"	"	10	2711 -2721	m	80%	"	Core	17	2793 -2807.5	m	47%
"	3	2433 -2435	m	25%	"	"	11	2721 -2729	m	81%	"	"	18	2807.5-2818.4	m	80%
"	4	2435 -2444	m	100%	"	"	12	2729 -2743.5	m	90%	"	"	19	2814.4-2826.2	m	100%
"	5	2444 -2457	m	85%	"	"	13	2743.5-2757.3	m	90%	"	"	20	2826.2-2837.5	m	88%
"	6	2457 -2471	m	93%	"	"	14	2757.3-2763	m	9%	"	"	21	2837.5-2853.5	m	94%
"	7	2471 -2489.3	m	100%	"	"	15	2763 -2775.3	m	97%	"	"	22	2853.5-2866	m	96%
"	8	2489.3-2506.5	m	95%	"	"	16	2775.3-2781.7	m	100%	"	"	23	2866 -2876.5	m	100%

Two runs for sidewall cores resulted in 51 of 60 posssible SWC in the Jurassic.

Paleontology / Palynology

Interval Meters-KB	Thickness-M	Stage/Substage	System/Subsystem
254-506	± 252		Tertiary-Pliocene
512-548	± 36		Tertiary-Upper Miocene
554-905	± 351		Tertiary-Middle Miocene
914-977	± 63		Tertiary-Lower Miocene
986-1352	± 366		Tertiary-Oligocene
1358-1388	± 30		Tertiary-Upper Eocene
1394-1406	± 12		Tertiary-Middle Eocene
1412-1628	± 216		Tertiary-Lower Eocene-Paleocene
1634-1844	± 210		Tertiary-Paleocene
Unconformity	-		
1850-1856	± 6	Late Maastrichtian	Upper Cretaceous
1862-1922	± 60	Maastrichtian	Upper Cretaceous
1928-2078	± 50	Early Maastricht Late Campanian	Upper Cretaceous
2081-2393	± 312	Early Campanian - ? Santonian	Upper Cretaceous
Unconformity			
2396	± 3	Barremian	Lower Cretaceous
Unconformity			
2399.0-2417.7	± 18.7	?Bathonian (? t/V1)	Middle Jurassic
2422.2-2431.0	± 8.8	Earliest Bathonian - Bajocian (V1)	Middle Jurassic
2435.5-2492.0	± 56.5	Early Bajocian (V2)	Middle Jurassic
2492.5-2519.0	± 26.5	Late Toarcian (W)	Lower Jurassic
2522.0-2555.0	± 33	Early Toarcian (X1)	Lower Jurassic
2558.0-2597.0	± 39	Domerian (X2)	Lower Jurassic
2600.0-2693.0	± 93	Carixian-Late Sinemurian (Y)	Lower Jurassic
2696.0-2762.0	± 66	?Early Sinemurian-Hettangian (Z)	Lower Jurassic
2764.0-3100.0	± 33	Indeterminate Red Beds	?Triassic

Note: The summary is based on telex report by Robertson Research, dated 18 January, 1978.

TEST DATA (INDICATE IF DST, PT, OR FIT) (TIMES IN MINUTES, PRESSURE IN P.S.I.)

NO	INTERVAL	TOTAL FLOW PERIOD	RECOVERY AND REMARKS	MAX. PRESSURE FFP	FSIP	HH
DST 2	2847.5-2852.5m Statfjord Fm	7:19	1350 BWPD on 3/4" choke 14200 ppm Chlorides 30 WHP	4057	5960	7027
DST 3	2800 - 2803.5m Statfjord Fm	14:40	9034 BOPD on 3/4" choke 1500 WHP GOR 412,37.8° API	4387	5912	6890
DST 5	2742 - 2745m Statfjord Fm	21:47	7577 BOPD on 5/8" choke 2153 WHP GOR 545, 38.0° API	4982	5852	6731
DST 7	2531 - 2537.5m Dunlin Sand	25:54	8314 BOPD on 1 1/4" choke 1130 WHP GOR 569,34.4° API	3538	5295	6240
DST 8	2458 - 2460.7m Brent Fm	35:15	9224 BOPD on 3/4" choke 2300 WHP GOR 1058,37.6° API	5041	5539	6014
DST 9	2426 - 2432.8m Brent Fm	24:28	10500 BOPD on 50/64" choke 2300 WHP GOR 1058,37.6° API	5249	5488	5974

ABBREVIATIONS:

NP	NOT PRESENT	ER	ERODED	SL	SONIC LOG
NL	NOT LOGGED	F	FAULTED	DL	DENSITY LOG
NR	NOT REACHED	GR	GAMMA RAY LOG	NL	NEUTRON LOG
		PT	PALEO TOP	ST	SAMPLE TOP
				SD	SCOUT DATA

BY: N. Tank

DATE: November 1979 REVISED T.A.W. 12/79 PAGE ..... OF .....