2/5-9
FINAL WELL REPORT
MARCH, 1992

VOLUME 1 OF 2

Amoco Norway Oil Company

FINAL WELL REPORT 2/5-9

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FINAL WELL REPORT

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Distribution

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FINAL WELL REPORT 2/5-9

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WELLSITE GEOLOGY AND PETROPHYSICS	Quad Consulting Ltd

FINAL WELL REPORT, WELL 2/5-9

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SECTION 1

SECTION 1: SUMMARY

1.1 Introduction

Block 2/5 was awarded to the Amoco Noco Group in 1965, as part of licence 006, with Amoco Norway Oil Company as operator.

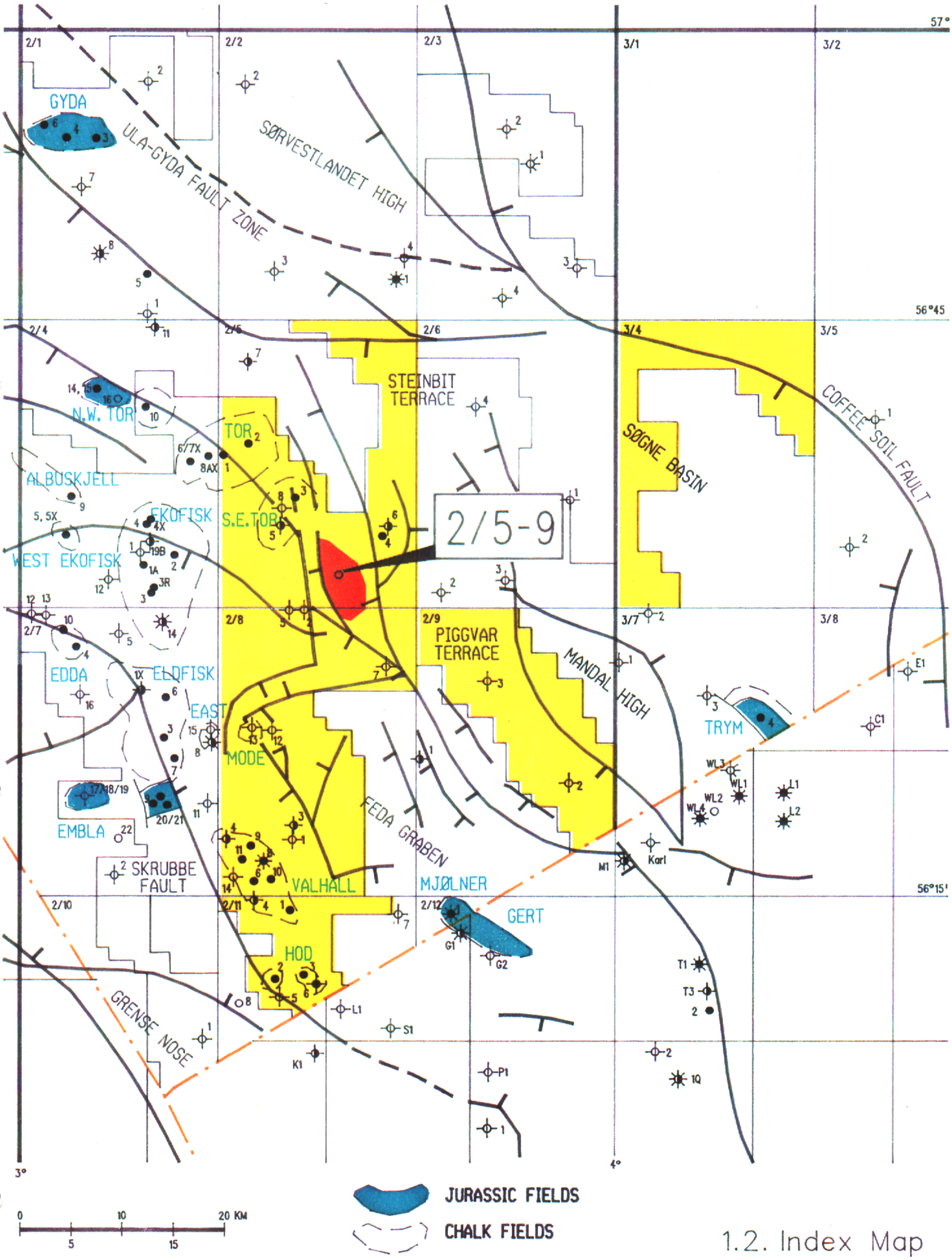
Well 2/5-9 was drilled to test the hydrocarbon potential of Upper Jurassic sands in a rotated fault block, designated as the Magne structure, on the east flank of the Cental Trough.

The well was spudded on 10th September 1991, and TD was reached on 10th January 1992, 122 days after spudding the well.

A total of 1323 m of Jurassic section were penetrated, without encountering any sandstones and the well was ended at 5460 m MDBRT, in Upper Jurassic claystones.

The well was plugged and abandoned as a dry hole with oil shows.

2/5-9 INDEX MAP



1.2. Index Map

1.3 Pertinent Data Sheet

LICENSE	006
BLOCK	2/5
WELL NUMBER	9
AREA	Magne Structure
CLASSIFICATION	Exploration
PRIMARY OBJECTIVE	Upper Jurassic submarine fans
SECONDARY OBJECTIVE	Upper Jurassic shelf sands and turbidites
PARTNERS	Amoco 28.33% (Operator)
	Amerada Hess 28.33%
	Enterprise 28.33%
	Elf 15.00%
SURFACE LOCATION	
Geographic	Latitude 56 32′ 7.17" N
	Longtitude 03 33′ 13.43" E
UTM	Northings 534,057.5 E
	Eastings 6,265,939.2 N
SEISMIC LINE	SGT8606-2203, SP 4203
RIG	West Vanguard
RT ELEVATION	22 m
WATER DEPTH	68.5
TOTAL DEPTH	5460 m MDBRT (5421 m TVDSS)
SPUD DATE	10 September 1991
DATE TD REACHED	10 January 1992
DATE OFF LOCATION	19 January 1992
WELL STATUS	Dry hole with oil shows
CORES	None taken
TESTS	No testing
FORMATION AT TD	Upper Jurassic

HOLE AND CASING RECORD

36" OH to 190 m MDBRT
30" casing to 187 m MDBRT

12 1/4" pilot hole to 960 m MDBRT
26" hole opened to 960 m MDBRT
20" casing to 950 m MDBRT

17 1/2" OH to 2880 m MDBRT
13 3/8 casing to 2872 m MDBRT

12 1/4" OH to 4525 m MDBRT
9 5/8" casing to 4515 m MDBRT

8 1/2" OH to 5460 m

1.4 Purpose of Well 2/5-9

The purpose of well 2/5-9 was to test the hydrocarbon potential of the Upper Jurassic section contained in a rotated fault block on the east flank of the Central Trough.

A Late Jurassic depocentre was predicted from paleogeographic reconstructions of the Magne area. It was forecast that Late Jurassic arenaceous deposits, eroded from fault scarps to the northeast, had accumulated in the depocentre.

The primary targets for well 2/5-9 were Upper Jurassic submarine fans/turbidites.

The secondary target were thin shelf sandstones and turbidities within the Upper Jurassic Mandal wedge.

The objectives of the test were to:

1. Discover any possible hydrocarbon accumulations contained within the predicted Upper Jurassic sandstone interval of the structure.

2. Determine the reservoir quality of any sand prone intervals penetrated in the well.

3. Determine the Jurassic stratigraphy in this portion of the Central Graben, and establish seismic well ties into prospective acreage surrounding the Magne prospect.

1.5 Results of Exploration Well 2/5-9

1. No shallow gas zones were penetrated in the well.

2. The top Rogaland 3126 m MDBRT (3104 m TVDSS) and top Shetland Group 3259 m MDBRT (3237 m TVDSS) came in 10 m and 17 m shallow to prognosis.

3. The top Lower Cretaceous 4083 m MDBRT (4061 m TVDSS) came in 64 m shallow to prognosis and was 54 m thick, 31 m thicker than prognosed.

4. Anticipated pore pressures in the order of 17 ppg were not encountered in the Lower Cretaceous although estimated pressures of maximum 14.3 ppg were found.

5. A tight oil bearing section of 33.5 m was encountered, 4074-4107.5 m MDBRT, in the lowermost Shetland Group and uppermost Cromer Knoll Group, with a net pay of 8.6 m.

6. The Upper Jurassic Tyne Group, 4137 m MDBRT (4115 m TVDSS) came in 33 m shallow than prognosed.

7. The entire Mandal Formation and uppermost section of the Farsund Formation were absent, represented by the Base Cretaceous unconformity.

8. Some 1323 metres of Upper Jurassic claystones were penetrated before TD was reached at 5460 m MDBRT. Pore pressure reached a maximum estimated value of 15.9 ppg at TD.

9. Neither the primary nor secondary Upper Jurassic sands which were forecast, were encountered in the well.

10. The well was plugged and abandoned as a dry hole with oil shows.

WELL: 2/5-9 STRATIGRAPHIC SECTION

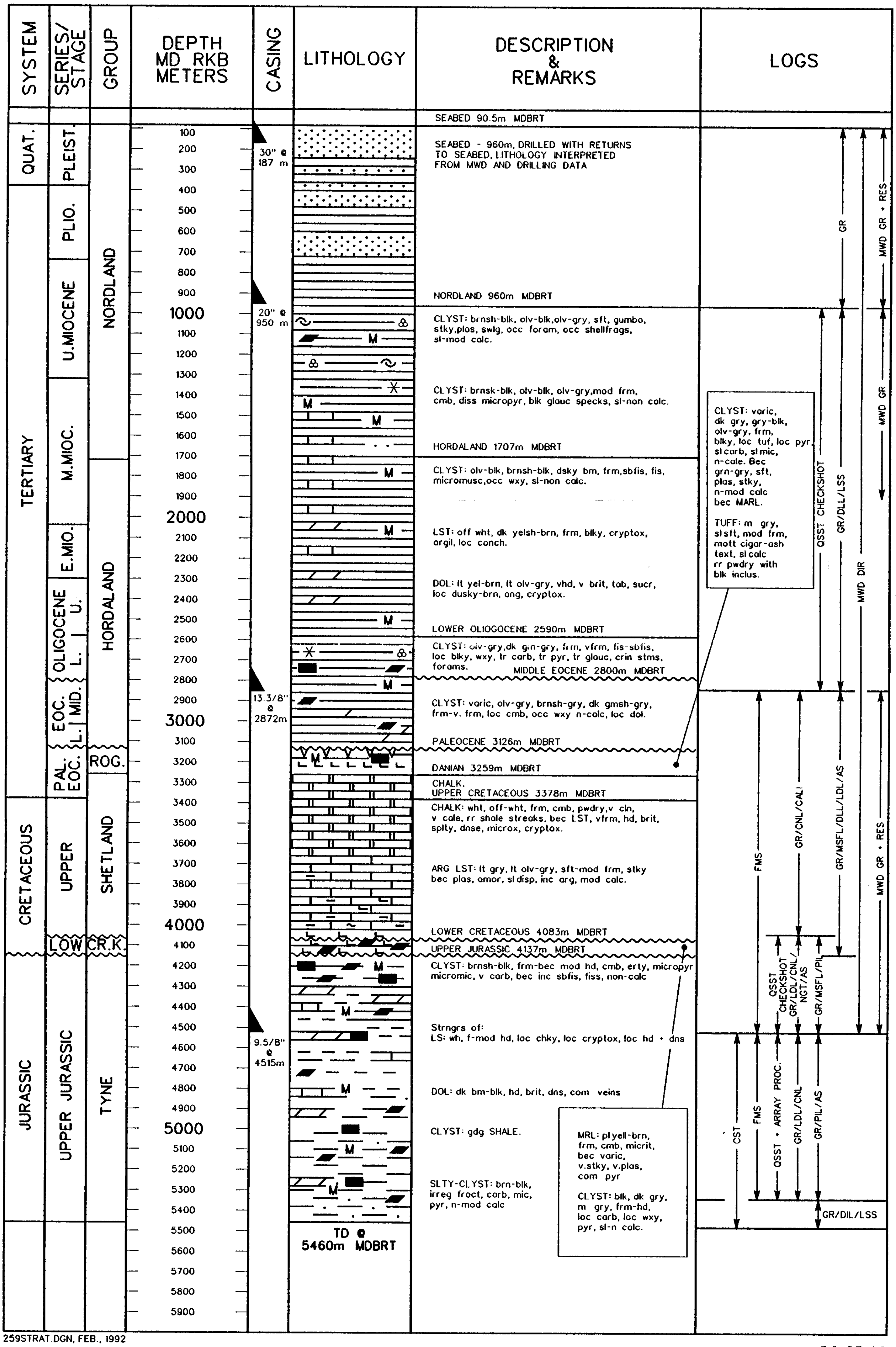


FIGURE 1.6

W28 W38 W48

1.7 Prognosed and Actual Formation Tops

FORMATION/ MARKER	PROGNOSED TVDSS	PROGNOSED TWT (sec)	ACTUAL TVDSS (m)	ACTUAL TWT (sec)	DIFFERENCE TVDSS m	DIFFERENCE TWT (sec)
RT	+22		+22		0	
Mean Sea Level	0		0		0	
Seabed	69		68.5		-0.5	
Pliocene	380		368	0.393	-12	
Miocene	750		711	0.760	-39	
Oligocene	1835		2288	2.358	+453	
Eocene	2572		2778	2.804	-206	
Paleocene Ash (Yellow Reflector)	3114	3.077	3104	3.082	-10	+.005
Top Chalk (Orange Reflector)	3254	3.181	3237	3.178	-17	-.003
Base Chalk (Pink Reflector)	4125	3.540	4061	3.537	-64	-.003
Base Cret. Unc./ Top Jurassic (Blue Reflector)	4148	3.555	4115	3.570	-33	+.015
Main Upp.Jurassic SS Unit (Yellow Reflector)	4292	3.660	4218	3.660	-74	0
Red Reflector	4464	3.785	4330	3.740	-134	-.045
Light Green Reflector	4741	3.986	4562	3.964	-179	-.022
Violet Reflector	5064	4.221	4860	4.208	-204	-.013
TD	5300	4.378	5421	4.609	+121	+.231

SECTION 2

SECTION 2: STRATIGRAPHY

2.1 Lithostratigraphic Summary

Group/Formation	Depth MDBRT (m)	Thickness (m)
Nordland Group	90.5	1616.5
Pleistocene	90.5	299.5
Pliocene	390	343
Upper Miocene	733	577
Middle Miocene	1310	397
Hordaland Group	1707	1419
Middle Miocene (continued)	1707	323
Lower Miocene	2030	280
Upper Oligocene	2310	280
Lower Oligocene	2590	210
Middle Eocene	2800	190
Lower Eocene	2990	136
Rogaland Group	3126	133
Balder Fm	3126	22
Sele Fm	3148	47
Lista Fm	3195	48
Våle Fm	3243	16
Shetland Group	3259	824
Ekofisk Fm	3259	119
Tor Fm	3378	325
Hod Fm	3703	375.5
Blodøks Fm	4078.5	2
Hidra Fm	4080.5	2.5
Cromer Knoll Group	4083	54
Tuxen Fm	4083	24.5
Åsgard Fm	4107.5	29.5
Tyne Group	4137	1323+
Farsund Fm	4137	176
Upper Haugesund	4313	65.5
Lower Haugesund	4378.5	122.5
Pre-Haugesund	4501	959+
Total Depth	5460	-

(Depths referenced to wireline logs)

2.2 Lithostratigraphic Description

Note: All depths are refer to meters MD BRT

Note: All depths refer to wireline log depths. Log depth is 3m deeper than sample depth at 3100 m, 7m at 4500 m and 8m at TD 5460 m.

Note: Lithology colours are in accordance with the colour chart of the Geological Society of America.

2.2.1. The Nordland Group

Depth: 90.5 - 1707 m
Thickness: 1616.5 m
Age: Recent - Middle Miocene

The interval 90.5 - 960 m was drilled without a marine riser, with all returns to seabed. From the 30 inch shoe at 187 m, Teleco's MWD GR and Resistivity tool was used exclusively to evaluate the formation and the seabed was monitored for gas with the ROV camera.

Shallow gas, anticipated at 447, 502 and 572 m, was not encountered. The MWD revealed clays with interbedded sands without any indication of gas. Prior to entering each potential shallow gas zone, the well was displaced from seawater to seawater mud of 10.0 ppg. Very minor gas bubbles were observed with the ROV at approximately 506 m.

A pilot hole of 12.25 inches was drilled 187-960 m, as a precaution in the event of shallow gas. This was later opened to 26 inches prior to running 20 inch casing.

Initially the MWD resistivity failed to function downhole but gave good readings once replaced at 268 m. The MWD functioned well but for sporadic losses of real-time data due to insufficient flowrate and occasional surface decoder problems. A full gamma-ray and resistivity log was later retrieved from downhole memory.

There were no drilling problems whilst drilling the Nordland Group.

Pleistocene and Pliocene

Depth: 90.5 - 733 m
Thickness: 642.5 m
Age: Pleistocene - Pliocene

MWD gamma-ray and resistivity indicated interbedded sands and clays in the Pleistocene which become increasingly thick from the top of the Pliocene at 390 m.

Upper and Middle Miocene

Depth: 733 - 1707 m
Thickness: 974 m
Age: Late - Middle Miocene

The top of the Miocene is marked on the MWD log by the onset of continuous clays. Returns to surface from 960 m, (following the running of 20 inch casing) confirmed the lithology, as did the GR/DLL/LSS wireline log run in the 17 1/2 inch hole.

Lithologically the interval is represented by a massive sequence of CLAYS and CLAYSTONES with minor interbedded LIMESTONE stringers.

The CLAYS and CLAYSTONES are brownish-black, olive-black, olive-grey and occasionally light and dark greenish-grey, soft, gumbo-like, sticky, plastic and swelling becoming moderately firm and crumbly with depth, variably micro-muscovitic with microfine black glauconite specks, with disseminated micropyrite and aggregates, slight to moderate, becoming slight to none calcareous with depth. At the top of the interval there are common pyritised worm tubes together with local forams and shell fragments.

The LIMESTONE stringers are buff-brown and pale grey-brown, firm, argillaceous and micritic, becoming increasingly dolomitic, orange-brown, dark yellowish-brown and light olive-grey.

There are very rare SAND stringers at the base, light green-grey, very fine to silty.

2.2.2. The Hordaland Group

Depth: 1707 - 3126 m
Thickness: 1419 m
Age: Middle Miocene - Early Eocene

The top of the Hordaland Group is marked by a distinct fall in gamma-ray with a notable gamma-ray signature at the base of the Nordland Group. There is little change of lithology to mark the top of the Hordaland Group other than a slight increase in firmness of the CLAYSTONES.

The group is represented by a sequence of grey CLAYSTONES with numerous LIMESTONE and DOLOMITE stringers, particularly at the top of the group. The lithology is very similar throughout the Hordaland Group until the Middle Eocene where there is a change in the CLAYSTONES which is also marked by a fall in gamma-ray.

The section was drilled with an MWD gamma-ray until 1903 m, when it was removed from the string until the 12 1/4 inch hole commenced at 2880 m.

The drilling of the 17 1/2 inch hole in the Hordland Group was marked by repeated balling-up of the bit combined with declining ROP which decreased to almost zero by the end of the 17 1/2 inch hole section at 2880 m. The slow drilling is attributed to the difficulty of cleaning the hole. High and low viscosity sweeps were used to assist in hole cleaning. Following the setting of the 13 3/8 inch casing, the claystones drilled much better with a 12 1/4 inch hole combined with a change in mud type from Cationic Brine KCl Polymer to PHPA/KCl Polymer.

Other than the Middle Eocene, the Hordaland Group varies little in lithology and the group is subdivided on the basis of biostratigraphy into six units as follows:

<u>Middle Miocene (continued)</u>

Depth: 1707 - 2030 m
Thickness: 323 m
Age: Middle Miocene

The CLAYSTONES are olive-black, brownish-black, dusky-brown and dark greenish-grey, firm to moderately hard, blocky, occasionally tabular, occasionally splintery, locally crumbly, locally waxy, rarely subfissile, slightly micromuscovitic, with rare forams and pyrite nodules, moderately calcareous.

From 1910 m, the CLAYSTONES become increasingly fissile and grade to SHALE, becoming dusky yellow-brown, firm, micromicaceous and none calcareous.

LIMESTONE stringers are off-white and dark yellowish-brown, firm, blocky, cryptocrystalline, argillaceous. DOLOMITE stringers are light yellow-brown, light brown and light olive-grey, very hard, very brittle, locally angular, locally sucrosic, slightly argillaceous, locally brittle, tabular and platy.

Lower Miocene

Depth:	2030 - 2310 m
Thickness:	280 m
Age:	Early Miocene

The CLAYSTONE/SHALE is dusky yellow-brown, locally dark greenish-grey, firm, friable, micromuscovitic and none calcareous.

From 2210 m, the CLAYSTONE/SHALE becomes olive-grey to olive-black, locally dark greenish-grey, locally medium dark-grey, medium grey, and very ocassionally greenish-grey, firm, subfissile to fissile, micromicaceous, locally waxy, none calcareous.

Frequent DOLOMITE stringers are light olive-grey, firm, locally hard, argillaceous, cryptocrystalline, locally microcrystalline. Occasional LIMESTONE stringers are white, firm, blocky, argillaceous and cryptocrystalline.

Upper Oligocene

Depth:	2310 - 2590 m
Thickness:	280 m
Age:	Late Oligocene

The CLAYSTONES/SHALES are medium grey, olive-grey, olive-black, locally greenish-grey, occasionally dusky yellow-brown, dominantely firm, locally soft, subfissile to fissile, micromicaceous, none to slightly calcareous.

Frequent DOLOMITE stringers are dark yellowish-brown, dusky brown, pale yellowish-brown, firm to hard, cryptocrystalline, microcrystalline, locally argillaceous, locally with a conchoidal fracture.

Occasional LIMESTONE stringers are off-white, firm, chalky, locally hard, angular to conchoidal fracture, locally cryptocrystalline with a trace of disseminated pyrite.

Lower Oligocene

Depth: 2590 - 2800 m
Thickness: 210 m
Age: Early Oligocene

The CLAYSTONES are olive-grey, occasionaly dark green-grey, with olive-black SHALE interbeds, firm to very firm, fissile to subfissile, locally blocky, locally slightly waxy, trace disseminated carbonaceous and micropyrite, withy trace forams, glauconite and crinoid stems in the upper section, none calcareous throughout.

Very poor oil shows were encountered in the CLAYSTONES and SHALES at the base of the Lower Oligocene, 2740-2800 m.

LIMESTONE stringers become infrequent and decline with depth. These are light brownish-grey, light brown and transparent yellow-brown, firm to moderately hard, blocky, brittle, argillaceous and moderately calcareous.

Middle Eocene

Depth: 2800 - 2990 m
Thickness: 190 m
Age: Middle Eocene

The Middle Eocene is marked on the wireline logs by a fall in gamma ray. This corresponds to a change in lithology to greenish-grey CLAYSTONES with olive-black SHALE interbeds and minor LIMESTONE and DOLOMITE stringers.

The CLAYSTONES are greenish-grey, occasionally dark greenish-grey, firm, crumbly, slightly waxy, occasionally blocky, locally subfissile, locally sticky and plastic, rarely with white, light brown, micritic, LIMESTONE pseudo-pellet inclusions, locally medium bluish-grey, medium grey, locally micromuscovitic, slight to very micropyritic, none calcareous.

From 2910 m the CLAYSTONES become dark grey, olive-grey, olive-black, firm to locally moderately hard, crumbly, with common disseminated micropyrite, very finely micromuscovitic, rarely microcarbonaceous, none calcareous.

SHALE interbeds are olive-grey, olive-black, brownish-black and locally black, very firm, slightly hard, subfissile, blocky, occasionally splintery, slightly waxy, very micropyritic, moderately micromuscovitic, none calcareous.

LIMESTONE stringers occur at the top of the Middle Eocene and are white, greyish-orange-pink, cream, light greenish-grey, firm, crumbly, argillaceous, occasionally brittle, locally slightly microcrystalline, occasionally satin spar crystalline, hard and brittle.

DOLOMITE stringers are brownish-grey, firm, brittle, microcrystalline, locally hard to very hard.

Lower Eocene

Depth: 2990 - 3126 m
Thickness: 136 m
Age: Early Eocene

The CLAYSTONES are olive grey, occasionally dark greenish-grey, firm, locally crumbly, locally blocky, with common disseminated micropyrite, none calcareous, locally becoming brownish-grey DOLOMITIC CLAYSTONE, firm, crumbly.

Thin DOLOMITE stringers occur in the uppermost section and are brownish-grey, hard to moderately hard, brittle, microcrystalline, locally micritic, crumbly slightly calcareous. From 3030 m DOLOMITE stringers are not encountered.

The very base of the Lower Eocene, 3116-3126 m, is marked by a distinct RED CLAYSTONE MARKER HORIZON, occurring immediately prior to the Rogaland Group and correlating well with nearby wells.

This marker coincides with chaotic dips on the dipmeter log, representing a hiatus, immediately above the Paleocene unconformity.

These CLAYSTONES are varicoloured, medium dark-grey, olive-grey, brownish-black, dark greenish-grey, medium bluish-grey, firm, crumbly, micropyritic, locally waxy, none calcareous and locally brownish-grey, greyish-red, blackish-red and bluish-red, firm to very firm, slightly hygrofissile, slightly dispersive, none calcareous.

2.2.3 The Rogaland Group

Depth:	3126-3259 m
Thickness:	133 m
Age:	Early Eocene - Early Paleocene

The Rogaland Group comprises a sequence of varicoloured CLAYSTONES with volcanic TUFFACEOUS CLAYSTONES at the top and MARLS towards the base.

There were no drilling problems whilst drilling the Rogaland Group.

The MWD gamma-ray and resistivity tool continued to function well in the 12 1/4 inch hole and proved very useful in lithostratigraphic correlation due to the distinct curve signatures and lithologies of four formations.

The top of the Rogaland Group is marked by an unconformity on the dipmeter logs.

At the top of the Rogaland Group, the Balder Formation is marked by TUFFACEOUS CLAYSTONES followed by dark grey CLAYSTONES with low gamma-ray readings. The top of the Balder Formation is also marked by a decrease in sonic travel time that persists throughout the Rogaland Group.

The Sele Formation is marked by a second gamma-ray peak corresponding to more TUFFACEOUS CLAYSTONES followed by dark and olive-grey CLAYSTONES with micromuscovite and microcarbonaceous material.

The Lista Formation shows a marked fall in gamma-ray combined with the occurrence of greenish-grey CLAYSTONES that become distinctly brown with depth.

The Våle Formation is marked by low gamma-ray readings corresponding to olive and green-grey MARLY-CLAYSTONES and MARLS.

Balder Formation

Depth: 3126 - 3148 m
Thickness: 22 m
Age: Early Eocene - Late Paleocene

The top of the Balder Formation is marked by a distinct gamma-ray peak which corresponds to a regional TUFFACEOUS CLAYSTONE MARKER HORIZON. The remainder of the formation consists of CLAYSTONES with minor DOLOMITE stringers.

The TUFFACEOUS CLAYSTONE MARKER is medium grey, medium dark-grey, crumbly, slightly soft to moderately firm, mottled with a cigarette-ash texture, slightly calcareous. Rarely it occurs light olive-grey, light grey, firm, crumbly, powdery, with abundant black microfine inclusions.

The CLAYSTONES are medium dark-grey, dark grey, firm, blocky, locally tuffaceous, locally with pyritic laminations and aggregates, none calcareous with rare, clear, very brittle, vitreous veins.

The DOLOMITE stringers are medium dark-grey, hard, very hard, very brittle, very angular, as very splintery shards.

Sele Formation

Depth: 3148 - 3195 m
Thickness: 47 m
Age: Late Paleocene

The top of the Sele formation is marked by a gamma-ray peak corresponding to more TUFFACEOUS CLAYSTONES. High gamma-ray readings persist throughout the CLAYSTONES of the remainder of the formation.

The CLAYSTONES, grading to SHALE at the top of the formation are dark grey, occasionally greyish-black and medium dark-grey, becoming increasingly olive-grey and olive-black, firm, occasionally blocky, occasionally fissile, locally hydrofissile, locally micromuscovitic and slightly microcarbonaceous, none calcareous.

Lista Formation

Depth: 3195 - 3243 m
Thickness: 48 m
Age: Late Paleocene

The top of the Lista Formation is marked by low gamma-ray readings corresponding to a change of formation to greenish-grey CLAYSTONES.

The CLAYSTONES are greenish-grey, light greenish-grey, locally olive-black, soft to firm, plastic, sticky, amorphous, locally dispersive, slight to moderately calcareous.

The lower part of the Lista Formation, 3218-3243 m, is marked by a BROWN CLAYSTONE MARKER HORIZON that corresponds to red-brown claystones that frequently occurs in the lower Lista Formation.

These CLAYSTONES are moderately brown and light brown-grey, locally varicoloured olive-grey, greenish grey and medium light-grey, soft to moderately firm, plastic, slightly sticky, amorphous, none to moderately calcareous.

Within the lower part of the Lista Formation a three metre MARL horizon occurs, 3235-3238 m, with a marked fall in gamma-ray and high resistivities corresponding to dense sonic values. The MARL is light olive-grey, light greenish-grey, soft, powdery, dispersive, locally moderately firm, blocky and moderately calcareous.

Våle Formation

Depth: 3243 - 3259 m
Thickness: 16 m
Age: Early Paleocene

The Våle Formation consists predominantely of MARLY CLAYSTONES that grade to MARL with depth.

The MARLY CLAYSTONES are varicoloured, olive-grey, greenish-grey, locally dark grey and greyish-black, moderately firm, slightly sticky, locally waxy, slight to dominantely moderate calcareous.

The MARLS are light olive-grey, light greenish-grey, soft to firm, sticky, amorphous, moderately calcareous.

Thin LIMESTONE stringers occur, off-white, light greenish-grey, powdery, chalky, crumbly, very calcareous.

2.2.3. The Shetland Group

Depth: 3259 - 4083 m
Thickness: 824 m
Age: Danian - Cenomanian

The Shetland Group is dominated by a massive sequence of clean CHALK and LIMESTONES that become increasingly ARGILLACEOUS and MARLY with depth. Because of the very similar lithology throughout the Shetland Group, the identification and confirmation of tops was based largely on micropaleontology.

Analysis of the dipmeter log proved particularly useful in distinguishing reworked Allochthonous CHALKS from Autochthonous LIMESTONES. Reworked units are widespread in the Ekofisk and Tor Formations and invariably have higher porosities.

There were no drilling problems experienced in the Shetland Group until a short trip at 3700 m, with stuck pipe at 3651 m and again at 3563 m as backreaming. Pipe was freed after jarring and spotting of acid and pipefree pills. There were no further drilling problems in the Shetland Group and the stuck pipe may have been due to a form of stress release expansion of the Tor Formation.

The MWD resistivity and gamma-ray tool failed at 3324 m, very shortly after entering the Ekofisk Formation. It continued to work well after replacement following a trip at 3730 m.

The action of pdc bits was typically to produce ribbed "pdc platelet cuttings" throughout the Shetland Group.

<u>Ekofisk Formation</u>

Depth: 3259 - 3378 m
Thickness: 119 m
Age: Danian

The top of the Ekofisk Formation is marked by a change of lithology to a clean and massive CHALK sequence with very minor SHALE partings. With the lithology change there is a marked fall in gamma-ray and decrease in sonic travel time.

Analysis of dipmeter logs suggests an unconformity at the top of the Ekofisk Formation. The dipmeter also indicates the formation is almost entirely of reworked allochthonous origen.

The CHALK is white, off-white, locally very light grey and rarely pale pinkish-grey, firm, crumbly, powdery, dominantely very clean, locally slightly argillaceous, locally brittle and amorphous, very calcareous.

The SHALE partings are olive-black, dark greenish-grey, moderate brown, medium bluish-grey, firm to moderately hard, brittle, platey, tabular, splintery, none calcareous.

Tor Formation

Depth:	3378 - 3703 m
Thickness:	325 m
Age:	Maastrichtian

The top of the Tor Formation is marked by the occurrence of Maastrichtian microfauna and there is no lithological change to distinguish the CHALK and LIMESTONES of the Tor Formation from the Ekofisk Formation above. Regionally the top of the Tor Formation is represented by an unconformity, which in the well is marked on the sonic and resistivity logs by a tight hardground LIMESTONE 3378-3382 m.

The CHALK is dominately white, occasionally off-white, firm, locally brittle, crumbly, powdery, micritic, amorphous, very clean, very calcareous. There were very rare stylolites. Rarely, clear, rounded, quartz grain inclusions were seen in a floating grain texture.

There occurred rare SHALE streaks, black, dark grey, red-brown, locally micropyritic. These locally develop into rare shale bands and discrete laminations.

There is a very rare occurrence of CHERT, white, medium brown-grey, very hard, very angular, very splintery.

In the lower part of the Tor Formation, particularly from 3570 m, the CHALK becomes increasingly dense, microcrystalline and cryptocrystalline, grading to LIMESTONE, dominantely off-white, locally white, very firm to hard, brittle, locally splintery, common amorphous, homogeneous, massive, very clean, very calcareous, with common pale grey-orange mineral fluorescence throughout. There are rare black and dark grey CLAY streaks and bands, often micropyritic.

Analysis of dipmeter logs indcates very widespread reworked allochthonous CHALKS to 3570 m, alternating with autochthonous CHALKS and LIMESTONES until the top of the Hod Formation, at 3703 m.

Hod Formation

Depth: 3703 - 4078.5 m
Thickness: 375.5 m
Age: Maastrichtian - Turonian

The top of the Hod Formation is marked on the wireline logs as consistentely high resistivity, reflecting the tight and dense nature of the LIMESTONES that become increasingly ARGILLACEOUS and MARLY with depth, particularly from 3850 m, with CHALK and LIMESTONE interbeds.

Analysis of dipmeter logs indicates almost entirely autochthonous LIMESTONES from 3703 m.

The LIMESTONES are white, off-white, becoming light grey, buff and light brownish-grey, firm, microcrystalline, cryptocrystalline, homogeneous, dense, brittle, irregular fracture, locally CHALKY, powdery and micritic. A pale grey and pale grey-pink mineral fluorescence persists only rarely.

Near the top of the Hod Formation there occurs a distinct PINK LIMESTONE MARKER HORIZON, 3765-3776 m. The limestone is pale red, pale pink-red, greyish-pink, light brownish-grey, light greenish-grey, firm, micritic, slightly to moderately argillaceous, very calcareous. The marker corresponds to the top of the Campanian, identified from microfauna at 3765 m.

The ARGILLACEOUS LIMESTONE and MARLS are light grey, olive-grey, light olive-grey, pale pinkish-grey, soft to moderately firm, sticky, becoming plastic, amorphous, slightly dispersive, locally subfissile, increasingly argillaceous, moderately calcareous.

From 4000 m the Hod Formation becomes particularly interbedded with LIMESTONES, MARLS and ARGILLACEOUS LIMESTONES and increasingly mottled with a dark grey argillaceous matrix, within which lithic grains can be identified and which develop into packestone and wackestone LIMESTONE textures.

At the very base of the Hod Formation thin 1-2 mm SILTSTONE ans SANDSTONE laminations occur within the LIMESTONE, locally clear, translucent, very fine to fine, grain supported with argillaceous calcareous matrix.

Oil shows begin at 4074 m at the very base of the Hod Formation.

The Blodøks Formation

Depth: 4078.5 - 4080.5 m
Thickness: 2 m
Age: Early Turonian - Late Cenomanian

The Blodøks Formation exists as a thin regional MARKER HORIZON and is identified from wireline logs by a high gamma-ray peak combined with low resistivity and sonic curves.

A faulted contact between the Blodøks and Hod Formations is indicated by FMS images at 4078.5 m.

Lithologically the formation consists of CLAYSTONE, dark green-grey, locally green (possiby due to glauconite), firm, blocky, irregular fracture, subfissile, silty, slightly calcareous. Good oil shows were observed.

Hidra Formation

Depth: 4080.5 - 4083 m
Thickness: 2.5 m
Age: Cenomanian

The Hidra Formation is represented by a mere two metre thickness of LIMESTONE.

The LIMESTONE is light grey-brown, buff, firm, crumbly, blocky, argillaceous in places, with a trace of light greenish-grey (possibly glauconitic) claystone, with oil shows.

Dipmeter logs and FMS images confirm a unconformable contact between the Shetland and Cromer Knoll Groups. The bulk of the Cenomanian, together with the entire Aptian and Albian, as well as the Late Barremian are absent.

2.2.5 Cromer Knoll Group

Depth: 4083 - 4137 m
Thickness: 54 m
Age: Middle Barremian - Valanginian (and possibly Late Ryazanian)

The top of the Cromer Knoll Group is marked by the occurrence of distinct Early Cretaceous microfauna combined with a change of formation to a dominant MARL lithology with interbedded CLAYSTONES with a slight increase in gamma-ray and sonic travel time.

The MWD gamma-ray and resistivity tool continued to function well in the Cromer Knoll Group. There were no drilling problems.

The Cromer Knoll Group is divided into Tuxen and Åsgard Formations at 4107.5 m by a marked increase in gamma-ray and sonic travel time and decrease in resistivity. Oil shows continue from the Shetland Group into the Cromer Knoll Group, to 4118 m. They range in quality from good to fair in the Tuxen Formation but decline rapidly to poor to very poor in the Åsgard Formation.

Tuxen Formation

Depth: 4083 - 4107.5 m
Thickness: 24.5
Age: Early Barremian - Middle Barremian

The MARLS of the Tuxen Formation, are dominantely pale yellow-brown and yellowish-grey, firm, crumbly, micritic, moderately argillaceous, moderate to very calcareous, with rare nodular pyrite becoming very light grey, off-white, soft, very sticky, very plastic, moderately calcareous with common euhedral pyrite inclusions.

The interbedded CLAYSTONES are black, dark grey, and dark green-grey, firm to hard, blocky, locally carbonaceous, locally dense and splintery, with common disseminated pyrite, moderately to dominantely none calcareous.

Within the Tuxen Formation the MONK MARL MARKER HORIZON occurs, 4091-4093 m, with high gamma-ray, low resistivity and high sonic travel time, corresponding to a black and greyish-black CLAYSTONE, firm, crumbly, brittle, waxy, earthy, very micropyritic and moderately calcareous.

Åsgard Formation

Depth: 29.5 m
Thickness: 4107.5 - 4137 m
Age: Late Hauterivian - Valanginian (and possibly Late Ryazanian)

The MARLS of the Åsgard Formation are very varicoloured, medium grey, medium light grey, off-white, light grey, light greenish-grey, light brownish-grey, dark yellow-brown, white, buff, cream, soft to firm, sticky, amorphous, locally crumbly, moderately argillaceous, moderately calcareous, locally with common disseminated and nodular pyrite and at the base becoming with abundant sand and silt inclusions.

CLAYSTONE interbeds are dark-grey, medium grey, light grey, firm to hard, locally waxy, splintery and brittle, slight to none calcareous. At the base they become bluish-grey, light greenish-grey, firm, waxy, subconchoidal to subfissile, with common disseminated and nodular pyrite.

2.2.6. Tyne Group

Depth:	4137-5460 m
Thickness:	1323+ m
Age:	Early Portlandian - Mid Oxfordian (J4-J11)

The Tyne Group consists of a very thick sequence of brownish-black CLAYSTONES with minor LIMESTONE and DOLOMITE stringers. The base of the group was not seen in the well.

At the top of the Tyne Group there is a dramatic increase in gamma-ray values, together with an equally dramatic fall in sonic travel time. The gamma-ray remains high throughout the organic rich CLAYSTONES, and the LIMESTONE and DOLOMITE stringers stand-out as clean gamma-ray peaks and tight carbonates on the sonic and resistivity curves.

There is very little lithological change throughout the Tyne Group. Stratigraphic subdivision is dependant on palynology. Correlation with other wells by wireline signature alone is difficult.

Throughout the drilling of the Tyne Group high barite concentration due to high mud weights, combined with slow drilling caused constant barite contamination of up to 90% of the sample and up to 10% quartz sand contamination. The barite was clear, loose, very fine to fine, very brittle and easily crushed when dry. Quartz from the barite was loose, clear, locally orange-red, common lithic, very fine to fine, moderately sorted, subangular to subrounded. Mica and nutplug contamination was common, particularly in the 12 1/4 inch hole.

In the Tyne Group, from 4400 m, the 12 1/4 inch hole was drilled with losses of 3-10 barrels per hour from 4400 m. The losses were probably caused by fracturing during flushing of kill and choke lines. Losses increased to 26 barrels per hour at 4485 m. Attempts to reduce losses by a reduction of mud weight from 15.2 to 14.5 ppg resulted in tight hole in the claystones and mud weight was raised to 14.8 ppg. Losses of 3-6 barrels per hole continued until the end of the 12 1/4 inch hole at 4525 m and the setting of the 9 5/8 inch casing.

Connection gases continued to be observed in the 8 1/2 inch hole section associated with increasing pore pressures, reaching a maximum estimated pore pressure of 15.9 ppg at TD. Tight hole occurred throughout the 8 1/2 inch hole associated with overpressured shales.

After a BOP test at 5147 m, there was junk in the hole. This was attempted to be fished with an Apple Core-catcher and was then milled 5147-5151 m.

In the 12 1/4 inch hole section of the Tyne Group, the MWD gamma-ray worked very well and was useful to identify carbonate stringers and for broad correlation. However, from the top of the Tyne Group, 4137 m, the MWD resistivity gave high readings with a marked seperation between Corrected and Apparent curves. Initially to 4363 m, although high, the MWD resistivity curves mirrored those of the wireline log, but from 4363 m little character was seen at all and are not valid readings. The problem with the resistivity tool was temperature related and because of this the MWD was not run in the 8 1/2 inch hole section.

There are very poor quality oil shows throughout the Tyne Group. Although of no reservoir potential, the CLAYSTONES are of good source rock quality and actively generating petroleum.

Farsund Formation

Depth:	4137 - 4313 m
Thickness:	176 m
Age:	Early Portlandian to Late Kimmeridgian (J4-J6)

The CLAYSTONES of the Farsund Formation are dominantely brownish-black, firm, very crumbly, very earthy, very micropyritic, micromicaceous, very carbonaceous, rarely silty, none calcareous, locally dolomitic, olive-grey, dark grey, medium dark-grey, dark greenish-grey, hard, brittle, waxy, elongate, splintery, very micropyritic, slightly calcareous.

LIMESTONE stringers occur towards the base of the formation, and are white, pale yellow-brown, firm to moderately hard, cryptocrystalline to microcrystalline, tight.

Haugesund Formation

Depth: 4313 - 5460 m
Thickness: 1147 m
Age: Early Kimmeridgian to Mid Oxfordian (J6.2?-J11)

The Haugesund Formation is subdivided by palynological zones into the following subdivisions:

Upper Haugesund

Depth: 4313 - 4378.5 m
Thickness: 65.5 m
Age: Early Kimmeridgian (J6.2?-J7)

The top of the Haugesund Formation in the well is marked by a distinct DOLOMITIC LIMESTONE stringer on the wireline logs.

The DOLOMITE is transparent brownish-black, dark brown-black, very hard to hard, dense, brittle, locally blocky, cryptocrystalline to microcrystalline, with a common dull gold mineral fluorescence and common dark brown crystalline dolomite veins, locally with a very poor oil show.

The CLAYSTONES are dominantely brownish-black, olive-grey, greyish-black, brownish-grey, rarely medium grey, firm to very firm, subfissile to locally fissile and tabular, occasionally blocky, locally very carbonaceous and earthy, slightly to abundantly micropyritic, occasionally slightly micromicaceous, locally silty, rare very fine quartz inclusions, none to slightly calcareous.

Lower Haugesund

Depth: 4378.5 - 4501 m
Thickness: 122.5 m
Age: Early Kimmeridgian (J7-J8)

The CLAYSTONES are brownish-black, olive-black, rarely brownish-grey, green-grey and medium grey, firm to moderately hard, subfissile to fissile, occasionally grading to SHALE, locally crumbly, locally blocky, locally very waxy, in parts carbonaceous and earthy, very micropyritic, locally with plant remains, slightly to moderately calcareous.

Common LIMESTONE stringers are white, off-white, yellow-grey, chalky, cryptocrystalline and frequent DOLOMITE stringers are brownish-black, dark smokey-brown, hard, anguyellow-gold mineral fluorescence, occasionally with sucrosic veins.

Pre-Haugesund

Depth: 4501 - 5460 m
Thickness: 959+
Age: Early Kimmeridgian - Mid Oxfordian (J9-J11)

The lithology consists of CLAYSTONES with common DOLOMITE and LIMESTONE stringers to 4970 m MDBRT, from which depth the stringers decline markedly.

The CLAYSTONES are brownish-black, olive black, greyish-black, subfissile, locally fissile grading to SHALE, blocky, common carbonaceous, micromicaceous, irregular fracture, rare black plant remains, very common to locally abundant micropyrite as bands, nodules and framboidal aggregates, none to moderately calcareous. Becomes silty with depth, grading to SILTSTONE, olive-black, dark-grey, brownish-grey, firm, friable, crumbly, locally very micropyritic, locally grading to very fine SANDSTONE.

The DOLOMITE stringers are transparent brownish-black, hard to very hard, brittle, dense, locally cryptocrystalline, locally blocky, tight, locally with cream-brown, dark brown, sucrosic and sparry crystalline veins, locally with a gold mineral fluorescence.

LIMESTONE stringers occur at the top of the Pre-Haugesund and are white, hard, angular, crystalline, brittle, dense, locally chalky and micritic, occasionally argillaceous, dominantely clean.

2.3 Biostratigraphic Summary

The biostratigraphic analysis was performed by Stratlab, Norway. Their findings, summarised below, are based upon a study of ditch cuttings samples over the interval 960 - 5460 m MDBRT. Discrepencies are observed between biostratigraphic and wireline log depth (log depth deeper than sample depth by 3 m at 3100 m, 9m at 4128 and 8m at 5460 m) due to stretch effects. In addition, within the Jurassic section, discrepencies occur where tops have been rounded up to picks on wireline logs.

Depths given in the biostratigraphic summary below are sample depths. Major differences from the wireline logs are shown in brackets. The tops given in section 2.1 are relative to wireline and are the finalized tops to be used for the well. Details of Stratlab's findings and analysis are to be found in their report.

AGE		DEPTH (m MDBRT)	
Early Pliocene - Late Miocene		970 - 1310	
Middle Miocene		1310 - 2030	
Early Miocene		2030 - 2310	
Late Oligocene		2310 - 2590	
Early Oligocene		2590 - 2800	
-------Unconformity------			
Eocene		2800 - 2990	
Early Eocene		2990 - 3129	
Late Paleocene		3126 - 3264	(3126-3259)
Early Paleocene		3261 - 3378	(3259-3378)
Maastrichtian		3381 - 3768	(3378-3765)
Campanian		3768 - 3843	
Late Santonian		3843 - 3861	
Middle and/or Early Santonian		3861 - 3951	
Coniacian to Late Turonian		3951 - 4023	
Middle to Early Turonian		4023 - 4074	
Late Cenomanian		4074 - 4077	(4080-4083)
-------Unconformity------			
Early to Middle Barremian		4077 - 4101	(4083-4107.5)
Late Hauterivian		4101 - 4107	(4107.5-4113)
Early Hauterivian to Valanginian		4107 - 4118	(4113-4123.5)
Early Valanginian to ?Ryazanian		4118.5 - 4128	(4123.5-4137)
-------Unconformity------			
Early Portlandian	Zone J4	4128 - 4161	(4137 - 4170)
Early Portlandian to Late Kimmeridgian	Zone J5	4161 - 4203	(4170 - 4212)
Late Kimmeridgian	Zone J6	4203 - 4323	(4212 - 4313)
Early Kimmeridgian	Zone J6.2?-J7	4323 - 4392	(4313 - 4379)
	Zone J7-J8	4392 - 4452	(4379 - 4443)
	Zone J8?-J9?	4452 - 4512	(4443 - 4501)
Early Kimmeridgian	Zone J9	4512 - 4671	(4501 - 4680)
Late-Mid Oxfordian	Zone J9.2-J11	4671 - 5147	(4680 - 5155)
Oxfordian ?	Zone J9.2-J11	5147 - 5460	(5155 - 5460)

SECTION 3

SECTION 3: HYDROCARBON SHOWS

3.1 Gas Record

Gas data was obtained using Exlog's flame ionisation gas detector and gas chromatograph. A full tabulated record of gas in well 2/5-9 is contained in Appendix III.

The Nordland Group 90.5 - 1707 m

Prior to 960 m, the hole was logged without marine riser and gas and cuttings were released at seabed. During the drilling of the 12 1/4 inch pilot hole, 190-960 m, the seabed was monitored with the ROV cameras and no gas was observed.

Total gas readings ranged between 0.03 to 0.15 % and averaged 0.10 %. The gas was composed of C1 only for the bulk of the section, with only rare occurrences of C2 in very small amounts (C1:550-1200, C2:0-17 PPM).

An increase of total gas readings, towards the base of the Nordland Group, 1670-1710 m, to 0.20-0.50 %, is related to a reduction in overbalance with a rise in pore pressure, (C1:2300-4697, C2:0-15 PPM).

Hordaland Group 1707 - 3126 m

Total gas ranged from 0.02 - 0.29 %, and averaged 0.15 %. Gas composition was dominantely all C1, with only rare occurrences of C2 in very small amounts (Max C1:3570 PPM at 1810 m, Max C2:27 PPM at 2820 m).

Rogaland Group 3126 - 3259 m

Very little gas was observed with total gas readings of 0.01 - 0.02 % and was composed entirely of C1:10-130 PPM.

Shetland Group 3259 - 4083 m

Prior to the top of the oil bearing zone at 4074 m, very little gas was observed in the Shetland Group. From 3259 to 3729 m total gas readings were 0.01 to 0.02 % and as C1 only 35 - 100 PPM. From 3729-4074 m, total gas rose to 0.06-0.39%, as C1:60-250 PPM and as minor occurrences of C2:6-30 PPM.

At the very base of the Hod Group, from 4074 m, with the top of the oil bearing zone, total gas readings rose markedly to 1.5 % and began to include C3 and C4 for the first time. Ranges of gases in the oil bearing section at the base of the Shetland Group are C1:3980-6625, C2:363-546, C3:266-487, iC4:19-30, nC4:85-125 PPM.

Cromer Knoll Group 4083 - 4137 m

Gas readings remained relatively high throughout the oil bearing section 4074 - 4107.5 m, but varied with the quality of the oil shows.

In the Tuxen Formation, 4083 - 4107.5 m, gas values ranged 0.56-1.31 %, C1:761-5071, C2:96-523, C3:133-444, iC4:18-37, nC4:74-155 PPM

In the Åsgard Formation, 4107.5 - 4137 m, readings declined rapidly along with the oilshows, to values of 0.4 - 0.28 %, C1:83-328, C2:6-28, C3:0-22, iC4:0-3, nC4:0-11 PPM.

Tyne Group 4137 - 5460 m

Gas readings in the CLAYSTONES ranged from 0.06 to 0.68 %, and continued to occur as C1-C4 to TD. The maximum gas from CLAYSTONE of 0.68% yielded C1:3220, C2:510, C3:280,iC4:1346, nC4:4666 PPM. Gas peaks tended to correspond to DOLOMITE and LIMESTONE stringers of which a peak of 19.2% at 4882 m was the largest, yielding C1:64000, C2:15600, C3:9655, iC4:1350, nC4:4600 PPM.

Connection gases were recorded from 4377 m and consistently from 4563 m.

Variations of levels of drilled gases, as well as the occurrence of connection gases were related to changes in the degree of overbalance in the well with rises of pore pressure and changes of mud weight.

3.2 Oil Stain and Fluorescence in Ditch Cuttings

Oil shows were evaluated using a standard ultra-violet light fluoroscope and simple solvent tests. A record of oil shows in the well is contained in Appendix II.

Nordland Group 90.5 - 1707 m

The interval 90.5 - 960 m was drilled without marine riser with all returns to seabed. Samples of ditch cuttings were taken from 960 m, with the drilling of the 17 1/2 inch hole.

Other than a minor interval of very poor oil shows in the Upper Miocene, there were no shows encountered in the Nordland Group.

In the Upper Miocene very poor oil shows were observed 1215-1250 m, in pale grey-brown, crumbly, SILTY-CLAY stringers, with yellow-white fluorescence and streaming fluorescent cut and residual.

Hordaland Group 1707 - 3126 m

Other than a minor interval of very poor oil shows in the Lower Oligocene, there were no shows encountered in the Hordaland Group.

In the Lower Oligocene, very poor oil shows were observed in CLAYSTONES/SHALES, 2740-2800 m. The shows are seen in 100% of the sample, with a faint lemon yellow-white diffusive fluorescent cut and residual fluorescence.

Rogaland Group 3126 - 3259 m

There were no shows encountered in the Rogaland Group.

Shetland Group 3259 - 4083 m

There were no shows whatsoever in the Shetland Group until the section 4074-4083 m, at the very base of the Hod Formation and including the Blodøks and Hidra Formations. The shows are very poor to good, 20-80%, yellow to bright yellow fluorescence, very slow to instant and steady streaming and crush fluorescent cuts, with trace visible and fluorescent residual. The shows correspond to high resistivity readings in the oil bearing section 4074 - 4107.5 m, of interbedded MARLY LIMESTONES, CLAYSTONES and thin SANDSTONE stringers of the base Shetland and Cromer Knoll Groups.

Cromer Knoll Group 4083 - 4137 m

Oil shows continue from the Shetland Group into the Cromer Knoll Group, to 4118 m. They range in quality from good to fair in the Tuxen Formation but decline rapidly to poor to very poor in the Åsgard Formation.

In the Tuxen Formation, 4083-4107.5 m, oil shows range in quality from good to fair, 50-100% bright yellow-white, green-white and golden-yellow fluorescence, bright yellow and gold-yellow streaming and diffusive fluorescent cuts, locally straw to amber visible cuts, bright to weak golden yellow and yellow residual fluorescence.

Shows occur at the top of the Åsgard Formation, from 4107.5 m, but decline rapidly in quality to poor and very poor, 80-5% bright yellow-white, yellow-cream, becoming dull grey-gold fluorescence, cream-yellow blooming and crush fluorescent cut, locally very pale straw visible cut, yellow and yellow-white residual fluorescence. Shows were not observed in the Åsgard Formation below 4118 m.

Tyne Group 4137 - 5460 m

There are very poor quality oil shows throughout the Tyne Group. They are typical of the Upper Jurassic CLAYSTONES, being of good source rock quality. The CLAYSTONES exhibit no flourescence but yellow-white and white, slow streaming fluorescent cuts, that become weaker white and blue-white diffusion cuts with depth as the CLAYSTONES become increasingly mature and gas-prone. Similarly, fluorescent residues decline from strong lemon-yellow to pale yellow and faint blue-white residual rings.

To 4410 m, the LIMESTONE stringers exhibit a bright yellow-gold oil fluorescence and weak white-yellow blooming and streaming fluorescent cuts with pale yellow fluorescent residues. However, the DOLOMITE stringers tend to contain no oil shows except for slow yellow fluorescent cuts from crystalline veins within them and leaving pale yellow fluorescent residuals. From 4410 m, shows are not seen in the carbonate stringers.

3.3 Oil Stain and Fluorescence in Cores

No conventional nor sleeved cores were cut on well 2/5-9.

Although a CST run was attempted, the tool was lost downhole.

SECTION 4

SECTION 4: LOGGING

4.1 Geological Well Logging/Sampling

Quad Consulting Limited were contracted to provide the wellsite geological services on the 2/5-9 well.

Exploration Logging provided the mud logging and data acquisition services. Continuos monitoring and recording of all relevant drilling and geological operations was performed. Data logs were continually updated and field prints were available to partners and the NPD as required. A final well report was prepared at the wellsite and compiled at Exlog's office in Bergen. The report entitled End of Well Report, Well 2/5-9, summarises the significant engineering and geological aspects experienced during the drilling of the well.

Drilled cuttings were collected and prepared as follows:

Interval	Frequency	Remarks
Sea bed - 960 m	-	Returns to sea bed
960 - 3000 m	10 m	6 wet / 2 washed & dried
3000 - T.D.	3 m	6 wet / 2 washed & dried

Wet samples were distributed as follows:

Set A : Amoco Norway
Set B : Amoco Norway (trade set)
Set C : NPD
Set D : Geolab Nor (Geochemical analysis)
Set E : Stratlab (Biostratigraphical analysis)
Set F : Geco, where washed and dried and forwarded to Geoservices on behalf of Elf

Washed and dried samples were distributed as follows:

Set A : Amoco Norway
Set B : Amoco Norway

Additionally, hot shot samples for geochemical and biostratigraphical analysis were taken at approximately 150 m intervals from 4100 m MD to TD during the course of drilling.

4.2 MWD LOGGING

Teleco Sonat provided the MWD Service (directional data, gamma-ray, resistivity) on well 2/5-9 from 187 m MDBRT to the end of the 12 1/4 inch hole section.

The MWD data was used for correlation, directional control, lithology determination and pore pressure evaluation.

There were three instances of tool failure during the course of the well, two of which were tool failures and the third due to high bottom hole temperatures.

In the 12 1/4 inch pilot hole section 187 - 960 m, the tool was run throughout but failed for the first 81 m before replacement at a trip.

In the 17 1/2 inch hole section 960 - 2880 m, only the gamma-ray was run and although successful it was only run to 1903 m.

In the 12 1/4 inch hole section, 2880 - 4525 m, both gamma-ray and resistivity were run. Both failed at 3324 m until replaced at a trip at 3730 m. The gamma-ray continued to function well but the resistivity overheated from 4131 m and only gave sporadic valid data 4295-4364 m.

In the 8 1/2 inch hole MWD gamma-ray nor resistivity was run due to the high bottom hole temperatures.

Of the 5369.5 m of lithology drilled from seabed to TD, the gamma ray was run in 3361 m (62.5%) and the resistivity tool in 2418 m (45%). The gamma-ray worked successfully for a total of 2874 m (85.6%) and failed for 487 m (14.4%). The resistivity worked successfully for 1605 m (66.3%) and not for 813 m (33.6%). However 326 m of the resistivity failure can be attributed to overheating due to high downhole temperatures and if that is not included, the the lost data interval is 487 m (20.1%).

A detailed account and evaluation of the MWD service can be found in Teleco's End of Well report for Well 2/5-9.

4.3 Wireline Logging

Wireline logging services on well 2/5-9 were provided by Schlumberger. The following logs were run:

WIRELINE LOGGING SUMMARY

RUN No.	Log Type	Depth Interval (m MDBRT)
1a	GR/DLL/LSS	2880 - 950
	GR	950 - 90.5
1b	QSST	2875.2 - 1022
2a	GR/MSFL/DLL/LDL/AS	4150 - 2872.5
3a	GR/MSFL/PIL	4532.5 - 4000
3b	GR/LDL/CNL/NGT/AS	4532.5 - 3950
	GR/CNL/CALI	3950 - 2872
	QSST	4500 - 3978
3c	FMS/GR	4532.5 - 2872
3d	RFT	4314.5 - 3342.5
4a	GR/PIL/AS	5342 - 4518.5
4b	GR/CNL/LDL	5342 - 4518.5
	QSST	5320 - 4500
4c	FMS	5342 - 4518.5
5a	GR/PIL/AS	5468 - 5275
5b	CST	Tool lost in hole

Quality control of logging was conducted by Quad Consulting Limited. Logging details including a full logging time breakdown, logging time analysis, log quality, together with petrophysical analysis and summations are to be found in Logging Reports 1 to 5 of Well 2/5-9 by Quad Consulting Limited.

FMS was run over the interval 2872-5342 m in SHDT mode throughout, except for the repeat section 4125-4000 m, where it was run in FMS mode to include the oil bearing and Lower Cretaceous section.

Copies of density, neutron and sonic curves, together with QSST checkshot data, were included in seismic processing by READ well services.

Full waveforms were acquired with Array Sonic tool 5342 - 2855 m. Slowness Time Coherence (STC) processing was done over selected intervals 5300-5000 m and 4200-3250 m at AMOCO's request to derive compressional and shear slowness. Details of processing are to be found in Schlumberger's STC Report 5303-3250 m.

4.3.1 RFT Results

Test No	Depth MDBRT (m)	Depth TVDSS (m)	Hydro-static (psig)	Form-ation (psig)	Remarks
1	3342.5	3320.5	8360.0		Software problem
2	3342.5	3320.5	8360.0		Software problem
3	3342.5	3320.5	8360.0	7516.0	Poor K
4	3438.0	3416.0	8603.8	7269.0	Fair K
5	3656.0	3634.0	9168.0		Software aborted (system disk full)
6	3656.0	3634.0	9168.0	7835.0	0.02 md/cps
7	3688.0	3666.0	9245.0	tight	
8	3690.0	3668.0	9247.7	tight	
9	3675.0	3653.0	9212.0	tight	
10	3700.0	3678.0	9278.7	tight	
11	3895.0	3873.0	9758.9	9518.0	0.13 md/cps
12	3880.0	3858.0	9721.0	tight	
13	3885.0	3863.0	9729.0	tight	
14	3887.0	3865.0	9738.8	tight	
15	4075.5	4053.5	10202.0	tight	
16	4077.0	4055.0	10206.0	tight	
17	4082.0	4060.0	10216.0		Seal failure
18	4082.0	4060.0	10216.0		Seal failure
19	4089.5	4067.5	10236.0		Seal failure
20	4075.5	4053.5	10202.0	tight	
21	4096.0	4074.0	10254.7	tight	87 psi after 6 mins
22	4098.0	4076.0	10256.4	tight	
23	4314.5	4292.5		tight	442 psi after 7 mins

4.4 Formation Evaluation

4.4.1 Summary

Formation evaluation was performed by Quad Consulting Ltd, by quick-look and by computer analysis with AMOCO's Petcom software.

Details of logging, including log quality and petrophysical analysis are to be found in Logging Reports 1 to 5, well 2/5-9 by Quad Consulting Limited.

Tertiary 90.5 - 3378 m

Clean water-wet sands were observed in the Pleistocene and Pliocene from 187-733 m from MWD log curves.

Other than these shallow sands, no other reservoir lithology was encountered throughout the Tertiary section, until the Danian Ekofisk Formation of the Shetland Group at 3259 m.

Shetland and Cromer Knoll Groups 3259 - 4107.5 m

The porosity of the Shetland Group, was poorer than that encountered in nearby fractured oilfields, although very clean. Average porosity in the Ekofisk, Tor and Hod formations was 18.7, 14.5 and 11.3 percent respectively and average clay volume of 4.0, 1.7 and 4.6 percent. Applying cut-offs of minimum porosity 10%, maximum porosity 50% and maximum VClay 10%, the net to gross ratio of reservoir rock to gross interval for the Ekofisk, Tor and Hod formations is 0.98, 0.61 and 0.186.

An oil bearing section was identified 4074-4107.5 m consisting of interbedded MARLS, LIMESTONES and CLAYSTONES and comprising the lowermost Hod and the Blodøks and Hidra formations of the Shetland Group, and the Tuxen Formation of the Cromer Knoll Group. Although a gross oil bearing interval of 33.5 m is identified, there is only 11.4 m of reservoir rock, giving a net to gross ratio of 34.0 percent and an average porosity of 13.1 percent. Of this only a total of 8.6 m of net pay was determined in intervals of up to one meter thickness, with an average 13.4 percent porosity. Attempts to take RFT pressures within the oil bearing section proved unsuccessful and confirm the poor quality and tight nature of the reservoir.

Jurassic 4137 - 5460 m

There were no reservoir formations encountered in the Jurassic.

4.4.2 FORMATION EVALUATION SUMMATION

FORMATION	EKOFISK	TOR	HOD	OIL BEARING ZONE	LOWER CRETACEOUS Åsgard FM
DEPTH (MDBRT)	3259	3378	3703	4074	4107.5
GROSS INTERVAL	119	325	371	33.5	29.5
RESERVOIR ROCK					
(CUT OFFS: POR: Min 0.10, Max 0.5, VCl: Max 0.10)					
NET	116.4	198.8	69.1	11.4	0.0
AVGE POROSITY	0.187	0.145	0.113	0.131	0.0
AVGE VCLAY	0.40	0.017	0.046	0.048	0.0
NET TO GROSS	0.978	0.61	0.186	0.34	0.0
PAY					
(CUT OFF: SW: Min 0.5)					
NET	0.0	0.0	0.0	8.6	0.0
AVGE POROSITY				0.134	
AVGE VCLAY				0.04	
AVGE SW				0.366	
WATER SATURATION					
RW OHMM	.035	.034	.032	.030	
AT TEMP DEG F	212	225	243	260	262
m	2.0	1.7	2.0	2.0	
n	2.0	2.0	2.0	2.0	
a	1.0	1.0	1.0	1.0	
RW PPM	70k	70k	70k	70k	

4.5 Analysis of Dipmeter/FMS Images

4 4.5.1 Summary

Two dipmeter runs were made on 2/5-9, with an FMS tool. At 4525 m MDBRT, on 8 Dec/91, upon reaching the 9 5/8 inch casing point, the 12 1/4 inch hole was logged 4532.5-2872 m MDBRT. At 5337 m, upon reaching the prognosed TD, the 8 1/2 inch hole was logged 5332-4518.5 m MDBRT on 7 Jan/92. Thus the interval 5332-2872 m, MDBRT from the Middle Eocene to 1200 m into the Upper Jurassic was logged with dipmeter. The FMS tool was run in SHDT mode throughout, except for the interval 4125-4000 m MDBRT, where it was run in FMS mode to include the oil bearing and Lower Cretaceous section. T The data was processed entirely at Schlumberger's computing centre for dipmeter and FMS images. Details of processing are to be found in two Schlumberger reports MSD/LOC FMIE/FMP 4530-2875 m and MSD/LOC 5332-4518 m. D Details of MSD (Mean Square Dip) processing include pad to pad correlation interval of 1 meter, with an overlap of 50% and a fixed seach angle of 2x35 degrees. MSD computed results were the input to perform LOC (Local Dip) processing using a derivative length of 41 meters and a threshold value of 0.20. D Data quality varied with borehole quality. Comparison of the MSD log with the LOC log, with its more stringent constraints, enables the identification of reliable dips. R Rose diagrams of dips were made for each formation interval from the Middle Eocene to the Lower Cretaceous. Below the Base Cretaceous unconformity, rose diagrams are 50 meter summations. These rose diagrams are shown on the Composite Well Log.

FMS was run 4125-4000 m MDBRT and is of moderately good quality, except for 4102-4125 m MDBRT where data is bad due to washout. Any intention to run the FMS over the Base Cretaceous unconformity and uppermost Jurassic was abandoned due to severe washout.

The dipmeter is particularly useful in the Chalk to identify reworking. Higher porosities are encountered in the reworked allochthonous Chalk sections than the autochthonous sections.

4.6 VSP and Checkshot Surveys

VSP and Checkshot Surveys were run as follows:

Run No.	Survey Type	Depth Interval (m MDBRT)	Contractor	Date Run
1	QSST Checkshot	2873-1022	Schlumberger	13 Oct/91
2	Zero Offset VSP	4140-2592	READ	18 Nov/91
	Walkaway VSP	2650-2422	READ	18 Nov/91
3	QSST Checkshot	4500-3978	Schlumberger	7 Dec/91
4	QSST Checkshot (with VSP processing)	5320-4500	Schlumberger	7 Jan/91

Run 1: QSST Checkshot Survey: 13 Oct/91

A QSST Checkshot Survey was run, in 17 1/2 inch hole, upon reaching the 13 3/8 inch casing point at 2880 m MDBRT.

The seismic source employed was a Bolt Model 1900B, 200 cu inch airgun fired at 1900 psi, without waveshaping kit, five meters below Sea level, 51 m from the wellhead, azimuth zero degrees. A near field monitor hydrophone was set 2 meters below the airgun. The geophone employed was a QSST, one axis type, held onto the side of the wellbore by an LDL caliper arm.

Nine levels were shot, from 2873-1022 m MDBRT, at specific depths, plus one unsuccesfull shot in the 20 inch casing.

No processing was made at the wellsite other than wavetrain stacking and to produce a field Drift Curve. The survey was processed at Schlumberger's computing centre to generate a Calibrated Sonic Log.

The checkshot survey was later combined with the VSP survey data for inclusion in seismic processing by Read Well Services.

Run 2: Zero Offset and Walkaway VSP Surveys: 17 Nov/91

Following the penetration of the Base Cretaceous unconformity at 4137 m MDBRT, the 12 1/4 inch hole was logged, at 4150 m MDBRT. Logging included a VSP Zero Offset and Walkaway survey conducted by Read Well Services.

The Zero Offset VSP was shot with a one 550 cubic inch airgun source, with waveshaping kit, fired at 2000 psi, 60.8 meters from the wellbore, at 43 degrees azimuth and in 3.5 meters of water. The source monitoring hydrophone was set one meter above the airgun. The receiver array consisted of a main tool and three satellites, each containing a three component geophone cartridge, thus four levels were acquired simultaneously.

The Walkaway VSP survey was shot with two 550 cubic inch airguns, with waveshaping kits, fired at 2000 psi, at 3.5 meters of water, with hydrophone in 2.5 m of water, towed by the supply vessel Far Tarbut.

Six Walkaway lines were made parallel to the seismic line SGT8606-2230, on which the wellbore was located.

A total of 137 levels were recorded, including six checkshots going into the hole. Spacing for the Zero offset was at 10 meter intervals 3500-4140 m and 20 meter intervals 3480-2660 m MDBRT. For the Walkaway survey a 10 meter spacing was used 2650-2422 m MDBRT. Data from the Walkaway survey was also included in the Zero Offset processing.

Quicklook processing of the data at the wellsite produced a Corridor Stack and Final Deconvolved Upwave, from which two reflectors were identified ahead of the bit, as possible lithology or pressure changes, at 4162-4178 and 4197-4222 m MDBRT.

After ten days further processing at Read's Oslo offices, the predicted tops for the yellow, red and green reflectors were redefined at 4320, 4480 and 4820 m MDBRT. Inversion processing produced a Psuedo Sonic Log, 2600-4700 m MDBRT, including a look-ahead section from 4150 m MDBRT, which was used to identify potential pore pressure changes. Attempts were made, whilst drilling, to correlate the drilling parameters with the curve.

<u>Log Run 3: QSST Checkshot: 7 Dec/91</u>

A checkshot survey was run at 4525 m MDBRT, in 12 1/4 inch hole, upon reaching the 9 5/8 inch casing point.

The seismic source applied was from three Bolt airguns, of 200 cubic inches each and fired at 1900 psi, in 4 meters of water, offset 46 meters from the wellbore at azimuth 44 degrees, with a hydrophone at 9 meters water depth. Waveshaping was used on the gun by cluster and there was markedly less bubble effect than with first checkshot survey. The geophone was the QSST.

A spacing of 20 meters was used, 4500-3978 m MDBRT, giving a total of 28 levels.

No processing was done at the wellsite other than the stacking of wavetrains.

Processing of the survey was made by Read Well Services in Oslo, to produce a Calibrated Sonic Log and Synthetic Seismograms using both Ricker and Butterworth wavelets. Initial processing enabled the confirmation of having drilled the yellow and red reflectors and a revised look-ahead prediction was made for the green reflector.

Run 4: QSST Checkshot with VSP Processing: 7 Jan/92

A further QSST Checkshot was run upon logging at the prognosed TD of the well, 5337 m MDBRT.

The seismic source employed was three Bolt airguns, each of 200 cubic inches and fired at 1900 psi in four meters of water, offset 50 meters at azimuth 50 degrees, with a hydrophone depth of 8.5 meters. Waveshaping was applied by cluster with very little bubble effect.

Forty-two levels were shot, at 20 meter intervals, 5320-4500 m MDBRT. The data was processed by Schlumberger at the wellsite with an Array Processor, to produce an Upgoing Wave Display and a Corridor Stack, which were produced with half an hour of the last shotpoint. From these a reflector was identified at 5390 m MDBRT (+/-5m), some 58 meters ahead of the bit and an extension of 150 m was given to the well to enable the investigation of the reflector.

The data was further processed at Schlumberger's computing centre to produce Sonic and Synthetic in time, together with a Drift Curve. The data was also forwarded to Read Well Services where it was included in seismic processing.

Upon reaching TD of the well, 5460 m MDBRT, there was no further seismic surveys.

Post-well analysis of VSP and Checkshot data was carried out in liaison with the drilling department for pore pressure prediction techniques. Differences in prognosed and actual tops of reflectors in the Jurassic was due, in part, to the actual velocity of the claystone being far lower than anticipated. Moreover, major Jurassic reflectors proved not to be major breaks of lithology but the summation of changes of velocity and density within the claystone together with the effect of closely spaced carbonate stringers.

Details of processing and acquisition of VSP and Checkshot data are to be found in Read Well Services report "Zero Offset VSP 2/5-9".

4.7 Pore Pressure Prediction

Prior to drilling of 2/5-9

Prior to drilling of the well, pore pressures were predicted using the Scott-Thomsen P PRED Algorithm, PRESGRAPH and GPES determinations and by a study of nearby wells. Pore pressure prediction was of particular concern because of the high pore pressures encountered by other operators in the Upper Jurassic and Saga's 2/4-14 blowout a few days prior to the spudding of 2/5-9.

Estimated velocity and density from surface seismic were input to the PPRED Algorithm which was used to predict pore pressure for various velocity scenarios. Wide-ranging minimum and maximum pore pressure predictions were provided, together with a most likely pore pressure trend for each scenario.

Pore pressure predictions were used in the design of the drilling program , including the option of a 11 3/4 inch liner. Three pressure compartments were identified with a maximum anticipated pore pressure of 13.0 ppg in the Tertiary, rising to 14.0 ppg by the Lower Cretaceous unconformity and then rising dramatically over an estimated 23 m of Lower Cretaceous sediments to 17.1 ppg by the Base Cretaceous unconformity.

During drilling of 2/5-9

During drilling, quantitative estimates of pore pressure were from the monitoring of drilling parameters and real-time indicators (ROP, DcEXP, Gas, Shale Density, Temperature, Cuttings, MWD Resistivity). Estimates were periodically revised using GPES as the hole was logged with wireline tools. The well was drilled in accordance with these indications and predictions, with mud weights and drilling procedures changed accordingly.

An estimated maximum pore pressure of 12.7 ppg was observed in the Tertiary section, which rose to 14.3 ppg in the Chalk by the Lower Cretaceous unconformity. The Base Cretaceous unconformity was reached with an estimated pore pressure of 14.5 ppg, that is without experiencing the rapid rise of pore pressure as anticipated.

At 4150 m MDBRT, having penetrated the Upper Jurassic at 4137 m MDBRT, a Walkaway and Zero-Offset VSP survey was run to tie seismic to well data and also to look-ahead for potential reservoir sands and to revise pore pressure predictions for the Upper Jurassic section. Inverse processing provided a Pseudo-Sonic Log to 4700 m MDBRT which was used to attempt to identify potential pore pressure changes and prognosed reflectors during drilling.

During drilling of the Upper Jurassic section, pore pressure prediction ahead of the bit, from seismic, proved impossible because of poor velocity control.
Estimated pore pressures in the Upper Jurassic remained constant at 14.5 ppg to 4500 m MDBRT, rising to 15.9 ppg by the end of the well. Wireline logs were run at 4525, 5337 and 5460 m MDBRT, within the Upper Jurassic and used to revise estimated pore pressures with GPES.

After drilling 2/5-9

Following the drilling of the well, estimated pore pressures were compared with predictions, in an attempt to identify reasons for differences and to optimise PPRED for future application. A major reason for the difference between original predicted and actual estimated pore pressure in the Upper Jurassic section was that the actual velocity was much lower than anticipated.

SECTION 5

SECTION 5: CORING

5.1 Core Summary

No conventional or sleeved cores were cut in well 2/5-9

SECTION 6

SECTION 6: SIDEWALL CORING

6.1 Sidewall Summary

A CST was run at TD, to include 60 shots over the entire 8 1/2 inch open-hole section below the 9 5/8 inch shoe, 5460 - 4515 m, but it was lost downhole after breaking the weakpoint after 24 shots.

A total of 30 points were requested and these were doubled up, seperated by 0.5 m, to increase the likelehood of recovery and by varying the charge size 10 and 12 grams at each point. All wires were 13 cm and all bullets hardrock type.

It is believed that the weakpoint broke at 75% of its lower limit due to fatigue caused by the sudden shocks as each of the 24 tightly embedded cores were pulled out. An overpull of 2000 to 2500 lbs was recorded on each shot.

It is suspected that charges of 6 to 8 gram would have been more appropriate or possibly to abandon the percussion tool in favour of a rotary method with a Mechanical Sidewall Coring Tool (MSCT). However, this tool is scarce and in great demand and was unavailable at the time of drilling the well. The MSCT is also is limited to 300 degrees Fahrenheit.

SECTION 7

SECTION 7: GEOCHEMISTRY

Geolab Nor conducted a Geochemical Analysis on the 177 samples supplied to them between 2890m to 5460m. Details of the analytical program are tabulated below. Full details of the findings and methodology can be found in the Geolab Nor Report.

CONCLUSIONS:

Evaluation of the samples spanned five groups, The Hordaland, Rogaland, Shetland, Cromer Knoll and Tyne.

Source Rocks.

The potential in the Hordaland is poor to fair and the maturity is too low for any significant generation to have occurred. The Rogaland Group potential is at best fair to good. The Tyne Group is thought to have originally had a good to rich potential for oil and gas generation, containing kerogen type II/III with a mixed oil and gas potential. The final state of these hydrocarbons is assessed to be oil and gas.

Maturity.

The top of the oil window (0.6 % Ro) is situated in the Cromer Knoll Group at about 4000m. Peak oil generation (0.8 % Ro) should be around 4200m, i.e. in the upper part of the Tyne Group. The base of the oil window (1.0 % Ro) is around 4500 m. The oil floor (or base condensate window, 1.3% Ro) is estimated to be between 5200 m and 5500 m. The vitrinite data is considered to be too low due to oil film on the vitrinite particles, (which reduces measured reflectance), and the maturity estimates above are based on Tmax and SCI.

Generation

The Tyne Group is within the oil window and is a good source rock and is currently generating oil and gas. The maturity towards the base of the group is sufficiently high for cracking of the oil generated into gas to have started.

Oil generation in the Hordaland and Rogaland Groups is minor in comparison to the Tyne Group. The maturity of these two groups is insufficient for significant hydrocarbon generation to have occurred.

Migration.

Migrated hydrocarbons can be seen predominantly in the Cromer Knoll group and are probably a residue of oil migrated upwards from the underlying Tyne Group.The Hordaland Group also contains traces of oil. These hydrocarbons are different from those generated in the Tyne Group and are thought to be migrated in-situ. They are most likely generated fairly locally from the low mature source rocks of the Hordaland and Rogaland Groups.

DEPHTS	LITHOLOGY DESCRIPTION	TOC	ROCK-EVAL PYROLYSIS	THERMAL EXTRACTION GC(GHM.S1)	PYROLYSIS GC(GHM.S2)	EXTRACTION-MPLC SEPARATION	SATURATED HYDROCARBON GC	AROMATIC HYDROCARBON GG	VITRINITE REFLECTANCE	VISUAL KEROGEN MICROSCOPY
2890	x	x	x	x	x	x	x	x	x	x
2990	x									
3090	x	x	x						x	
3192	x	x	x	x	x				x	x
3288	x	x	x							
3318	x	x	x							
3348	x									
3378	x	x	x							
3408	x									
3438	x	x	x							
3468	x									
3498	x	x	x							
3531	x									
3561	x	x	x							
3600	x	x	x							
3621	x									
3651	x	x	x							
3681	x									
3702	x	x	x							
3732	x									
3759	x	x	x							
3789	x									
3819	x	x	x							
3849	x	x	x							
3879	x									
3909	x									
3939	x	x	x							
3989	x	x	x							
3999	x									
4002	x									
4011	x	x	x							
4020	x									
4032	x									
4041	x									
4050	x	x	x							
4059	x									
4071	x									
4080	x									
4089	x	x	x	x	x	x	x	x		x

DEPHTS	LITHOLOGY DESCRIPTION	TOC	ROCK-EVAL PYROLYSIS	THERMAL EXTRACTION GC(GHM.S1)	PYROLYSIS GC(GHM.S2)	EXTRACTION-MPLC SEPARATION	SATURATED HYDROCARBON GC	AROMATIC HYDROCARBON GG	VITRINITE REFLECTANCE	VISUAL KEROGEN MICROSCOPY
4101	x									
4110	x									
4119	x									
4131	x	x	x							
4140	x	x	x	x	x	x	x	x		x
4143	x	x x	x x	x	x					
4149	x	x	x							
4161	x	x	x	x	x					
4170	x	x	x							
4179	x	x	x							
4191	x	x	x	x	x	x	x	x		x
4200	x	x	x						x	
4209	x	x	x							
4221	x	x	x	x	x					x
4230	x	x	x							
4239	x	x	x							
4242	x									
4251	x	x	x	x	x					
4260	x	x	x							
4263	x	x	x							
4281	x	x	x							
4293	x	x	x	x	x	x	x	x		x
4300	x	x	x							
4302	x	x	x							
4311	x	x	x							
4323	x	x	x	x	x					
4332	x	x	x							
4362	x	x	x	x	x					x
4368	x	x	x						x	
4380	x	x	x	x	x					
4389	x	x	x							
4401	x	x	x							
4410	x	x	x							
4419	x	x	x	x	x	x	x	x		x
4431	x	x	x							
4440	x	x	x							
4449	x	x	x						x	

DEPHTS	LITHOLOGY DESCRIPTION	TOC	ROCK-EVAL PYROLYSIS	THERMAL EXTRACTION GC(GHM.S1)	PYROLYSIS GC(GHM.S2)	EXTRACTION-MPLC SEPARATION	SATURATED HYDROCARBON GC	AROMATIC HYDROCARBON GG	VITRINITE REFLECTANCE	VISUAL KEROGEN MICROSCOPY
4461	x	x	x							
4470	x	x	x							
4479	x									
4491	x	x	x							
4500	x									
4509	x	x	x	x	x				x	
4521	x	x	x							
4530	x	x	x							
4539	x	x	x	x	x	x	x	x		
4548	x	x	x							
4560	x	x	x						x	
4569	x	x	x							
4578	x	x	x	x	x					
4590	x									
4599	x									
4600	x	x	x							x
4611	x	x	x							
4620	x	x	x	x	x					
4629	x	x	x							
4638	x	x	x							
4641	x	x	x							x
4650	x	x	x	x	x				x	
4659	x									
4671	x	x	x							
4686	x	x	x							
4689	x	x	x							
4701	x	x	x	x	x	x	x	x	x	
4710	x	x	x							
4719	x	x	x							
4731	x	x	x							
4740	x	x	x							
4749	x	x	x	x	x					
4761	x	x	x							
4770	x	x	x						x	
4779	x	x	x							
4800	x	x	x	x	x					
4809	x	x	x							

DEPHTS	LITHOLOGY DESCRIPTION	TOC	ROCK-EVAL PYROLYSIS	THERMAL EXTRACTION GC(GHM,S1)	PYROLYSIS GC(GHM,S2)	EXTRACTION-MPLC SEPARATION	SATURATED HYDROCARBON GC	AROMATIC HYDROCARBON GG	VITRINITE REFLECTANCE	VISUAL KEROGEN MICROSCOPY
4821	x									
4830	x									
4851	x	x	x						x	
4860	x	x	x	x	x					
4869	x	x	x							
4878	x	x	x							
4890	x	x	x	x	x					
4899	x									
4911	x									
4920	x									
4929	x									
4941	x									
4950	x									
4959	x									
4968	x	x	x	x	x	x	x	x	x	
4977	x									
4986	x									
4998	x									
5007	x									
5025	x									
5034	x									
5043	x									
5052	x									
5061	x									
5070	x									
5079	x									
5088	x									
5097	x									
5106	x									
5115	x									
5130	x									
5139	x									
5145	x	x	x							x
5147	x	x	x							x
5148	x									
5157	x	x	x						x	
5166	x									

DEPHTS	LITHOLOGY DESCRIPTION	TOC	ROCK-EVAL PYROLYSIS	THERMAL EXTRACTION GC(GHM.S1)	PYROLYSIS GC(GHM.S2)	EXTRACTION-MPLC SEPARATION	SATURATED HYDROCARBON GC	AROMATIC HYDROCARBON GG	VITRINITE REFLECTANCE	VISUAL KEROGEN MICROSCOPY
5175	x	x	x							
5184	x									
5193	x									
5202	x	x	x	x	x					
5211	x									
5220	x									
5229	x									
5238	x									
5247	x									
5256	x	x	x							
5265	x									
5274	x	x	x						x	
5283	x									
5292	x	x	x	x	x					
5301	x									
5310	x									
5319	x									
5328	x									
5337	x									
5346	x	x	x							
5355	x									
5358	x									
5364	x									
5373	x									
5382	x									
5391	x									
5397	x	x	x							x
5400	x	x	x							
5407	x	x	x	x	x	x	x	x	x	
5418	x									
5427	x									
5436	x									
5445	x									
5454	x									
5460	x									
TOTAL	177	104	104	28	28	10	10	10	16	14

SECTION 8 - DRILLING REVIEW

8.1 Introduction

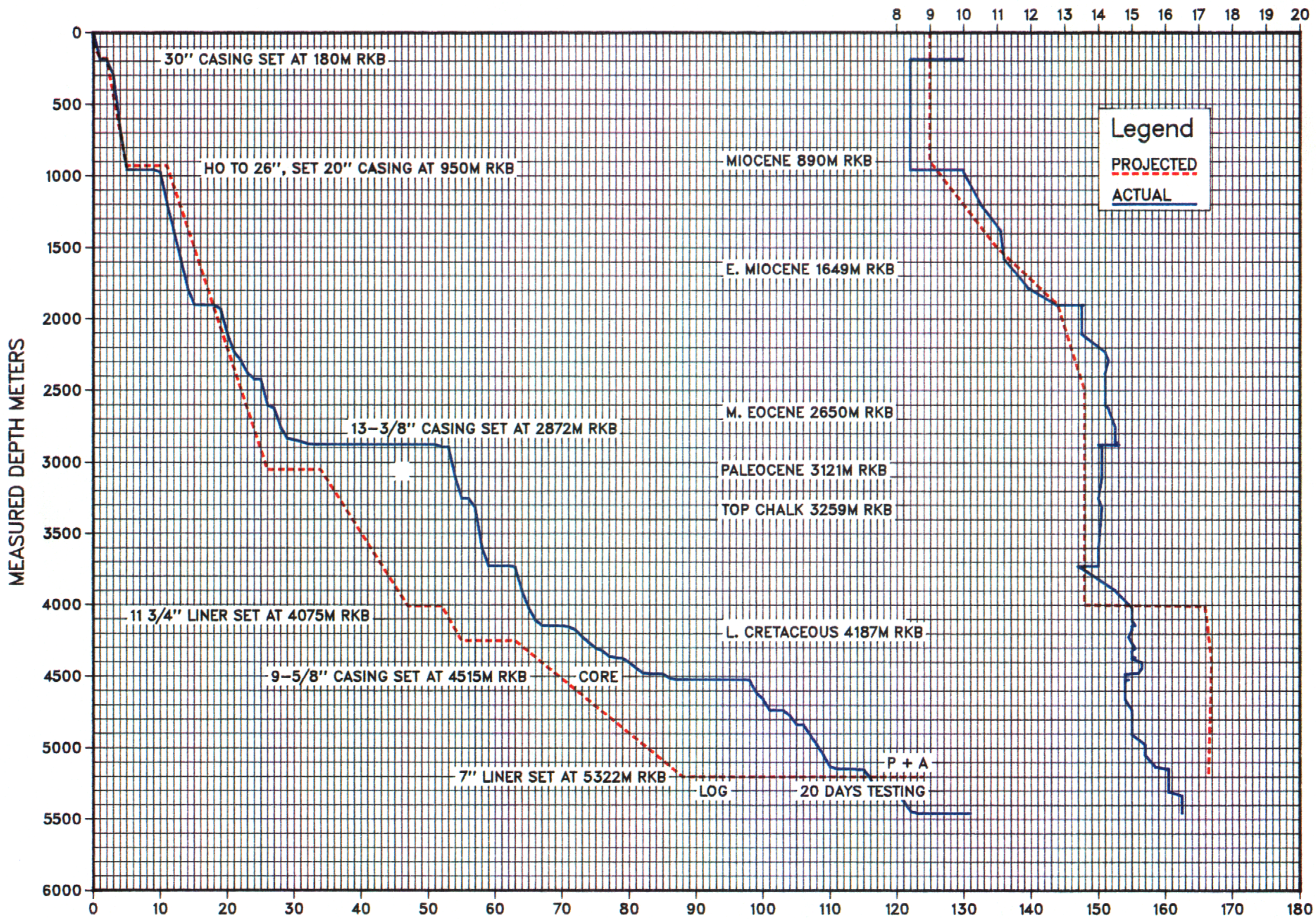
The Magne 2/5-9 well was spudded at 18:00 hrs on 10 September 1991 with the Smedvig semi-submersible drilling unit, West Vanguard. A total depth of 5337 m MD RT (original authorized TD) was reached on 5 January 1992, 117 days from spud. The well was logged and wireline seismic data indicated a reflector +/-60 meters below TD. An additional 123 meters were drilled for a final TD of 5460 m and the section logged. The well was found to be non-productive and was permanently plugged and abandoned as a dry hole and the rig released on 19 January 1992, 131 days from spud.

8.2 Drilling Time Curve

8.3 Actual Pressure Profile

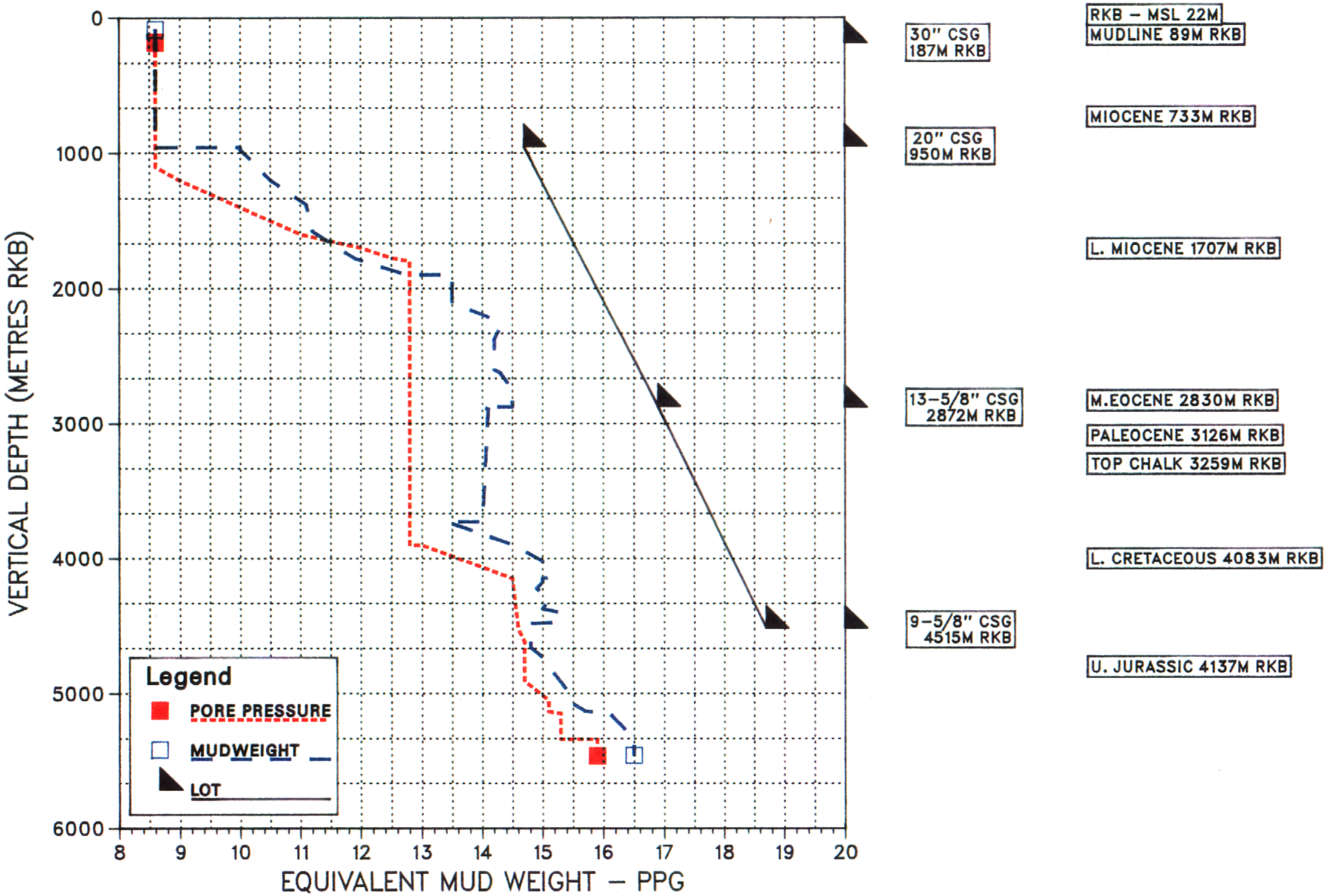
8.4 Temperature Data

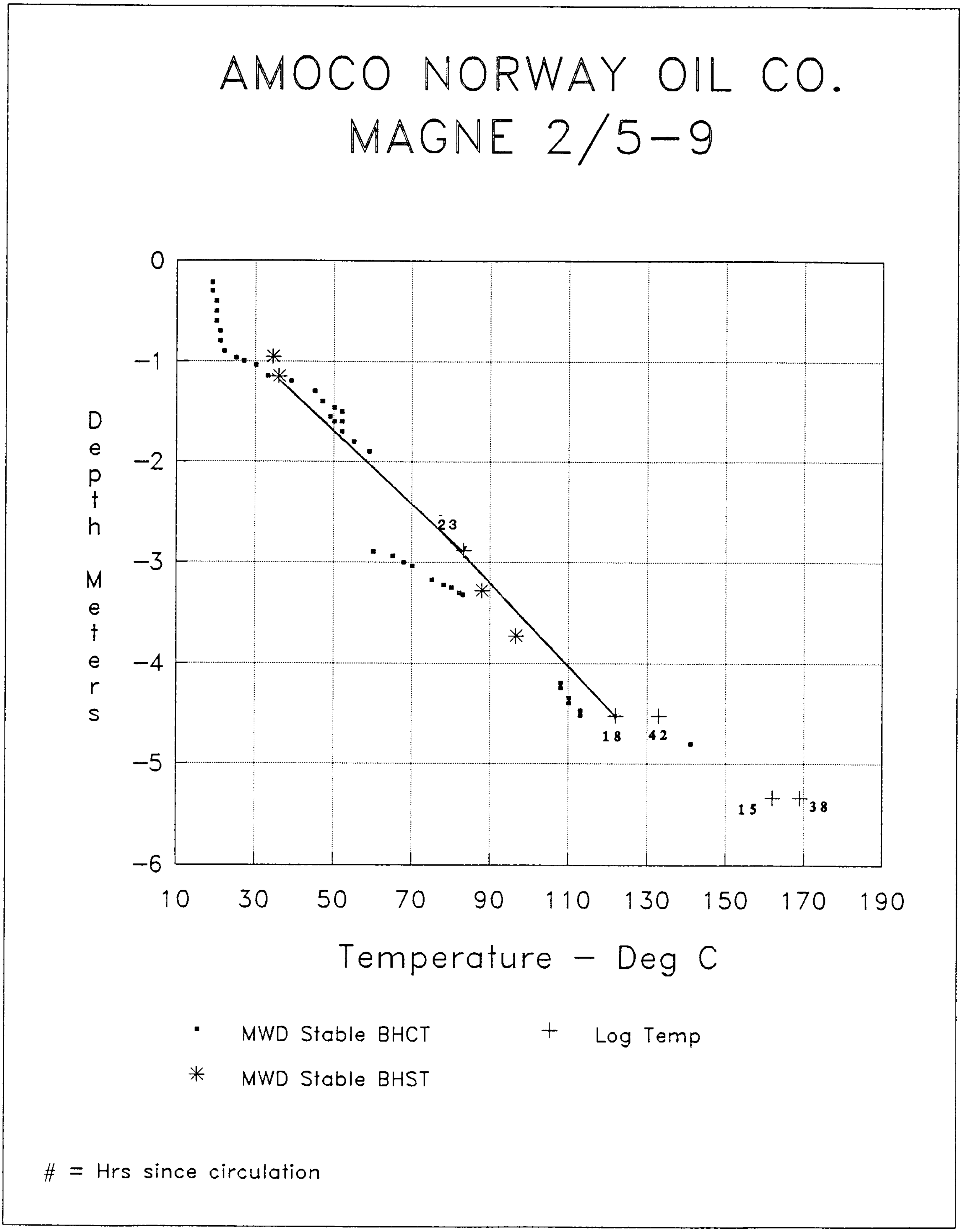
DRILLING TIME CURVE – ANOC WELL 2/5-9



259DAY DATA – 09 JAN 1992 – SAG

ACTUAL PRESSURE PROFILE
MAGNE WELL 2/5-9




AMOCO NORWAY OIL CO.
MAGNE 2/5-9
0
-1
-2
-3
-4
-5
-6
Depth Meters
23
18
42
15
38
10
30
50
70
90
110
130
150
170
190
Temperature - Deg C
MWD Stable BHCT
Log Temp
MWD Stable BHST
= Hrs since circulation

8.5 Pore Pressure Discussion

The predicted pore pressure profile for Magne 2/5-9 can be divided into two parts: 1) Pre Chalk Depositional Environment and 2) Jurassic Depositional Environment. The pressure environment of the Teritary, or pre chalk section is fairly consistent across this section of the central graben. The notable exceptions are in areas such as Valhall where the chalk has been uplifted and breached, resulting in gas cloud formation in the Tertiary and increased pore pressures. The "normal" Tertiary section is a thick, continuous depositional environment with the primary component being claystone / shale. An excellent normal compaction trend within the claystone / shale (as evidenced by the sonic travel time) is present in the Tertiary section. This type of environment lends itself to accurate pore pressure post analyses using classic, sonic travel time techniques (i.e. Hottman and Johnson, Eaton, etc.).

Several offset wells to the Magne 2/5-9 were evaluated to define the pore pressure profile in the Tertiary section, namely 2/5-4, 2/5-6, 2/8-2, 2/6-2, and 2/9-3. During the actual drilling, the initial pressure transition within the Tertiary section occurred slightly shallower than predicted and, for a short time, an underbalanced condition existed in the wellbore. No permeable zones were present to cause any flow, but excessive cavings and tight hole problems were experienced. These problems were solved by increasing the mud weight from 12.75 ppg to 13.5 ppg. The sonic derived, pressure profile interpretation constructed after logging the interval confirmed this estimation and the results can be seen in the attached Actual Pressure Profile for the well. Further confirmation was obtained when the caliper log over the section indicated a severely washed out hole over the interval in question.

The pressures within the Cretaceous (chalk) section were as expected and the mud weights used varied between 13.5 ppg and 14.0 ppg. No pore pressure surprises occurred and drilling progressed as planned.

The second part of pore pressure evaluation for these types of wells has to do with the Lower Cretaceous and Jurassic depositional environment. The basic depositional history for the Magne 2/5-9 within the Lower Cretaceous / Jurassic was deepwater, marine claystone / shale deposition, with turbodite related sands deposited within the down faulted blocks and terraces of the central graben.

The inherent pressure evaluation problems for the described Tertiary through Jurassic depositional model have to do with the interruption of the continuous deposition of claystone / shale (by the major chalk deposition) which occurred during Upper Cretaceous. Another major contributing factor is the fact that a significant "time" gap exits across the Lower Cretaceous Unconformity which makes extrapolation of normal compaction trends established in the Tertiary inaccurate for predicting pressures below the unconformity. Evaluating the pressure profile within the shale section of the Jurassic using logging techniques such as the sonic travel time suffer from the lack of an established, normally compacted trend within the Jurassic section. In most instances the pressure at the top of the Jurassic is somewhat overpressured and therefore, no "normally" pressured Jurassic shale is present which could be used as the pressure evaluation baseline (i.e. normally compacted trend line). In the absence of a normally compacted shale section, a reliable, direct pressure measurement (such as an RFT) is required to "calibrate" the relationship between the observed shale sonic travel times and pore pressure. This evaluation entails using the RFT data to properly position a normally compacted sonic trend line and therefore define the relationship of sonic values to pressure within the shale (i.e. Eaton, Hottman and Johnson, etc.).

During the exploration planning of the Magne prospect, a geologic and geophysical analogy was developed between the Saga 2/4-14 discovery and the proposed Magne location. The geophysical and geological similarities between the two prospects of a rotated fault block / fault configuration and the geologic turbodite sand depositional model were the basis for the well recommendation. The experience of the Saga 2/4-14 confirmed the presence of sands, hydrocarbons and a seal existed within the G & G models.

The Saga 2/4-14 experienced severe well control problems, i.e. losses, underground transfer/blowout, and afterwards, Saga presented the data from the well to the industry (including a detailed pore pressure evaluation). A pressure model for the Lower Cretaceous / Jurassic section of the Magne 2/5-9 was then constructed. This pressure model was based on the actual pressures encountered in Saga's 2/4-14 and supported by the G and G model developed by Amoco Norway's Exploration department for Magne. The major feature of this pressure model is a +-3.1 ppg pressure transition from 14.5 ppg to 17.1 ppg occurring within the Lower Cretaceous section of the proposed well. The Predicted Pressure Profile for the Magne 2/5-9 has been included at the end of this section as reference. It should be noted that the Magne 2/5-9 pore pressure profile was developed based on the best available information, i.e. Saga 2/4-14, being fully aware that this model may be conservative. There was no effort made to either prove or deny the possibility of such a rapid pressure increase from a rock mechanics point of view.

The actual pressures encountered within the Jurassic section to TD never reached the projected 17.1 ppg. The 3.1 ppg pressure transition was not encountered and the actual pressure at the top of the Jurassic was approximately 14.5 ppg. A gradual increase in pore pressure was experienced within the Jurassic and the maximum encountered was +-15.9 ppg at the eventual TD of 5460 m. Real time monitoring of the pressure indicators was successfully accomplished with the aid of Exlog's Drilbyte work station system for mud logging and Amoco's SAM drilling data monitoring system. The results of these systems were good, as no pore pressure related surprises and/or kicks were taken while drilling the well. The Actual Pressure Profile for Magne 2/5-9 has been included at the end of this section for reference.

FRACTURE AND OVERBURDEN PRESSURES

The AGIP method was used to estimate zero tensile strength fracture pressures based on actual density log data from offset wells. The predictions based on this technique were generally very good as the fracture gradients obtained at the 20" and 13 5/8" casing points were in good agreement with the predictions. The fracture gradient obtained at the 9 5/8" casing point deep within the Jurassic section at 4515 m was equivalent to 18.7 ppg. This value was in excess of the predicted fracture pressure by 0.5 ppg. Similar, higher than expected fracture pressures have been recorded within the Jurassic interval in the vast majority of Central Graben Jurassic wells. This phenomena can be explained in the context of complex, rock mechanic properties such as tensile strength and accounting for these effects has not been attempted for the Magne well. In summary, the observed fracture pressures agreed very well with the AGIP method of estimating these values. The actual fracture pressures observed are included in the attached Actual Pressure Profile for Magne 2/5-9.

8.6 Drilling Time Analysis

The planned drilling time and costs for Magne 2/5-9 was based on ANOC's previous Jurassic drilling experiences, i.e. 2/8-12, 2/9-3 and 2/8-14 and adjusted for differnces in rig rates and the particular 2/5-9 well plan. The time and cost estimates were for a "trouble free" well and, as such no contingencies were added either in days or costs. This was fully understood and agreed upon at the onset of the operation.

The original authorized TD of 5337 m was reached 118 days from spud while the trouble free time curve allowed for 88 days. The well was subsequently deepened to a final TD of 5460 m 123 days from spud. The following unscheduled events account for the majority of the trouble time experienced.

13.3 days	Rig repair (primarily slip joint repair)
6.6 days	Hole problems (17-1/2" hole problems and LC problems in 12 1/4" hole)
5.8 days	Drilling equipment failures (lost storm packer slip element)
3.9 days	Weather

29.6 days	

The remaining unscheduled events in the Time Distribution totalled 7.1 days or 5.4% of the total well time. The complete graphical results of the time distribution for Magne 2/5-9 is included in Section 11 of this report.

8.7 CONCLUSIONS AND RECOMMENDATIONS

36" and 26" Hole Sections

1. Continue to use weighted mud for hole displacements on possible shallow gas zones and before casing jobs. This practice has ensured hole stability and trouble-free running of casing.

2. For 30" cementing jobs, investigate the use of alternative cements to the 14.0 ppg LITEFIL blend. The high cost, handling difficulties and long waiting on cement times could make other cement types attractive. In fact, the LITEFIL blend was an improvement over conventional slurries and, as such much better than previous results. This recommendation has been included to focus attention on the continuous improvement requried in the area of light weight, low temperature cementing techniques. This could be handled as a inquiry to the cementing companies and/or be pursued as a tech service request to the Cementing group in Amoco Tulsa Research.

3. Investigate the use of lower flow rate MWD tools. The MWD tool used for the 12-1/4" pilot hole section required 500 gpm flowrate through the tool to get acceptable readings. A substantial amount of mud (and rig time to keep up with mixing mud) could be saved when drilling the pilot hole, riserless if the MWD would function at lower rates. We should "encourage" the MWD companies to further develop this feature for the riserless pilot hole drilling application. In fact, this low flow rate requirement was specified for the Magne well, however a discrepancy between the "published" low flow rates, i.e. 350 gpm and the actual required, i.e. +-500 gpm, existed and should be addressed.

17-1/2" Hole section

1. A Cationic Brine Fluid (CBF) mud system was used in the 17-1/2" hole section of this well (Amoco's Cationic Polymer Brine Drilling Fluid). The fluid had been successfully used on a previous well on the Valhall platform. The CBF fluid proved to be a solids tolerant and easily maintained mud system but some serious concerns/problems were identified, specifically bit balling and subsequent low ROP tendencies. The particular problem of bit balling requires reconciliation before this fluid should be used again in this application. Tom Biehoffer from Amoco Tulsa Research mud group designed the mud program and supervised the running of the mud in the field. He has published a report on the subject of the CBF mud for Magne (which includes conclusions and recommendations) and is included as an attachment to this summary. Anchor Drilling Fluids has issued a Drilling Fluid Well Summary for 2/5-9 but due to its length, has not been included in this report, but is available on file. A few general comments are listed below.

a. Bit balling tendencies were observed to be greater with the CBF mud than with other systems (PHPA, etc) used in previous ANOC exploratory drilling. Drilling operations had to be halted in the 17-1/2" section before programmed casing point mainly due to severe bit balling problems. The use of various types of sweeps as well as drilling parameter manipulation, i.e. WOB and RPM, etc., did not completely cure the problem. Following drillout of the 13-3/8" - 13 5/8" casing and change over to a PHPA/KCL type system, the bit ROP increased tremendously (from 5.7 to 20 m/hr) and bit balling was not a further problem.

b. The test required to determine the concentration of active cationic polymer in the system, the Amoco bead test, is very "operator" sensitive. This sensitivity requires proper training of the mud company personnel so that the tests are consistently applied. Although sensitive, it was a very useful means to quantify polymer concentration.

c. Problems were experienced with the concentration of the calibration solution for the selective ion probe which is used to measure potassium ion concentration. In the beginning of the section, this problem caused under treatment which resulted in hole instability problems. In the future, special emphasis should be placed on confirming the accuracy of this critical test.

2. In order to successfully drill the 17 1/2" hole below 2500 m, special attention is required with regard to hydraulics/hole cleaning. Specific hydraulics/hole cleaning related recommendations for the 17 1/2" hole are listed below:

a. Recommended minimum flow rate of 1000 - 1200 gpm (Annular Velocities must be greater than 100 fpm!) and preferably higher.

b. Three, full sized mud pumps are a necessity to achieve the required flow rates and should be a key factor in the rig selection process.

c. The use of a full string of 6 5/8" drill pipe is also required and a rig's ability to handle this pipe should also be a key factor in the rig selection process.

d. Insure that the surface mud system, especially with respect to solids control and mud degassing equipment, can process these higher flow rates.

e. The use of combination Lo-vis/Hi-vis sweeps (+-70 bbls each) removed more solids from the wellbore than either a Lo-vis or Hi-vis sweep alone and is recommended for future wells. The Lo-vis portion was unweighted and the Hi-vis portion was weighted to an amount that would account for the reduction in hydrostatic due to the unweighted sweep.

f. Critically assess the need for MWD tools (including directional) in this section as the tools can have a negative impact on hydraulics and hole cleaning (due to their relatively large pressure losses). The key is to balance the negative impact the tool has on hydraulics with the benefits of the tool. The major considerations have to do with obtaining single shot surveys, and using wireline logs to obtain the formation evaluation data. The impact of taking single shot surveys can be reduced by dropping the survey on planned wiper trips. The need for "real time" formation evaluation information should also be scrutinized as the conventional GR-Resistivity data can be obtained after drilling. The need should be evaluated on a case by case basis but, typically the GR-Resistivity data is not critical during the drilling of this hole section.

3. Evaluate the use of mill tooth bits as an alternative to PDC bits. Numerous wiper trips are required while drilling these soft formations and the use of inexpensive mill tooth bits can be competitive with PDC bits on a cost per meter basis. It may be cheaper to trip to surface and change bits on wiper trips than to use the more expensive PDC bits (Reference 5. below).

4. An Eastman Christensen R523EG (eccentric) PDC bit drilled the upper hole interval at an acceptable rate but the harder limestone and dolomite stringers in the upper Oligocene damaged the PDC bit and it had to be pulled. Alternative bit types and designs should be investigated to drill the claystone/limestone interbedded formations.

12-1/4" HOLE SECTION

1. The mud system for the 12-1/4" hole section was a KCL/PHPA system. This mud system was successful in stabilizing the hole interval and providing exceptional borehole stability while drilling. During this time, no appreciable hole problems were encountered (aside from partial losses).

2. The partial losses experienced were brought under control with a combination of LCM materials. The most dramatic decrease in losses occurred when a pill containing 20 ppb Liquid Casing alone in active mud was used to sweep the hole. (For a detailed review of the mud system for all hole sections, reference is made to the Anchor Drilling Fluid Well Summary for 2/5-9 which is in the well file.)

3. The DBS TD290Q Quattro Cut PDC bit performed exceptionally well in drilling the Chalk section. The average penetration rate obtained with the TD290Q was nearly twice the best previous bit performance in deep chalk drilling. The continued use of this type bit is encouraged for drilling future Chalk sections with water based mud.

4. A serious stuck pipe incident occurred during a wiper trip within the chalk section at 3651 m. This incident resulted in approximately 3 days of lost time. Although the cause of the stuck pipe was never fully confirmed, it was freed using an oil based spotting fluid. Therefore, differential sticking cannot be ruled out and, in fact, similar stuck pipe instances have occurred in several wells (including Hod and Valhall). It is therefore recommended that the rig be able to rotate the drill string simultaneous to making a connection without an extended period of time with the pipe stationary. This pipe handling option should be evaluated during the rig selection process.

5. A second recommendation from this stuck pipe experience is that a sufficient amount of oil based, spotting fluid such as Pipe Free, be available on the rig prior to drilling into the chalk. In this way, the fluid can be spotted quickly and thereby reduce rig time and enhance its chances of success.

6. Drilling with 12 1/4" bits in the medium hard, Jurassic shales was somewhat slow, i.e. 2.6 - 3.3 m/hr, on average. Both an insert bit (Reed HP51J) and a TSD (Christensen S225) were used with comparable results. Based on recent bit research and design (Amoco Tulsa Research) and some field tests, it is recommended that an anti-whirl, PDC bit be evaluated for use in this section on the next well.

7. Casing point selection for the 11 3/4" - 9 5/8" casing was the critical factor for the 12 1/4" hole section. The use of the HPHT Drilling Alertness Levels was successful in maintaining a high level of crew alertness and safety during this critical section of the well. The specified criteria, i.e. crew drills, pit discipline, kick detection, drilling parameter monitoring, ROP limitations, dummy connections and communication provided an effective and focused atmosphere for safe and efficient drilling in situations with decreasing kick tolerance.

8. The standard Weatherford float equipment used in the 9-5/8" casing string failed while the casing was being floated in the hole. The maximum differential pressure at the time the floats failed was estimated to be approximately 2700 psi. (The floats were rated for 4500 psi differential pressure.) A final report on this failure has not been received from Weatherford as of this writing, but this failure should be reviewed carefully and appropriate actions taken if floating a deep, heavy string is required in the future.

8-1/2" HOLE SECTION

1. The Eastman Christensen S225 TSD bit (thermally stable ballaset cutters) on rotary was successful in drilling the Jurassic section. Based on previous experiences within ANOC

and other operators, this bit type has provided the best performance for drilling the Jurassic section. Future decisions with regard to bit selection for this interval should reference this type of performance as a baseline for improvement.

2. The temperature limitations of the 6 3/4" MWD tools was exceeded in the 8 1/2" section of the 2/5-9 well. The maximum recorded static temperature at TD was 336 deg F while the published operating temperature limit for these tools is 257 Deg F with the survival temperature being 320 Deg F. Two successive MWD failures occurred immediately after entering the open hole below the 9 5/8" casing shoe. Only one of three MWD's funcitoned properly, and only for a short while in the 8 1/2" hole section. Obviously, the operating conditions exceeded the tool limitations with respect to temperature. In the future, emphasis should be placed on extending the temperature limitations of these tools and the importance of this feature communicated to the MWD service companies.

3. Wellbore deviation of up to 12 degrees was experienced in the 8 1/2" hole section. This tendency was controlled and stopped through the use of a relatively stiff BHA, i.e. one consisting of tandem near bit stabilizers as part of a short, packed BHA. This BHA did generate higher torque than previous BHA's, but the observed torque was not excessive or limiting.

4. The chrome free, high temperature mud system used in the 8 1/2" hole section was successful and no major, mud related problems were experienced. Increases in viscosity were experienced and successfully treated as the BHT increased. Mud related activities that affect surface volume (and therefore impair the ability to accurately detect influxes) were discontinued during Level 3 drilling periods. Level 3 drilling periods were instituted as required when the predicted depths of upcoming seismic reflectors were approached. The particular mud related activities suspended were premix additions and use of the centrifuge. Obviously, these restrictions can have a negative impact on the rheology of the mud, but this impact was minimized by proper planning and pre treating of the system prior to Level 3 drilling.

5. Sidewall cores were unsuccessfully attempted at TD in the interval from 4515 m to 5460 m. The sidewall core gun and GR tool were lost in the hole after the wireline parted at the rope socket. Each shot of the core gun required near maximum allowable line pull to break the core bullet loose from the formation face. In most cases, the line pull was more than the breaking strength of the core attachment cable (i.e., the core was left in the wall of the hole and did not stay attached to the core gun). The frequent up and down movement of the wireline and core gun probably contributed to the weakening of the rope socket connection. Attempts to take conventional sidewall cores in the deeper hole sections

in future wells is not recommended due to the hardness of the formation and the expected poor recovery rate. The use of other sidewall coring equipment should be investigated such as the hard formation sidewall core drill available from companies such as Halliburton and Schlumberger.

Miscellaneous

1. All conclusions and recommendations with regard to casing and cementing operations are included in the individual hole section summaries.

2. The Dowell cementing unit was equipped with the VIP (computer controlled) mixing system. This equipment proved to be very reliable and aided in maintaining consistent cement slurry weights during jobs. This automatic slurry mixer or equivalent type equipment is recommended for use in future exploratory drilling.

3. Two specific instances of Dowell equipment failures were experienced, namely, a hurricane packer and a cement retainer failure. The hurricane packer was run in the hole as a precaution and was never set. However, when it was recovered at surface, one of the slip segments was missing and had to be fished/milled. During the plug and abandonment operations, a Dowell supplied, cement retainer failed to set in the 9 5/8" casing (run on drill pipe) and was left in the hole. Both incidents are currently under evaluation by Dowell and the recommendation here is to follow up and take the appropriate actions once the Dowell reports are issued.

4. The TAM packer was used on several of the casing jobs for this well. The purpose of this packer is to provide for efficient casing fill up and a means to quickly circulate the casing (in place of a circulating swedge) if required while running in the hole. In most cases, the use of the packer was unsatisfactory. The primary cause seemed to be poor maintenance from the service company. The product has many advantages and alternative vendors or products should be researched prior to drilling further wells.

5. The major unscheduled event experienced during the 2/5-9 was the result of the marine riser slip joint failure. This event alone accounted for approximately 14 days of downtime and the associated costs. While clauses in the contract provided for the stepped down reduction to an eventual 0 dayrate, ongoing spread costs were incurred during the downtime period. The recommendation is to require that in the future, contractors provide spares for the critical components of the marine riser, such as the slip joint.

6. The Amoco SAM computer system and the Exlog DRILBYTE system were both operational during the drilling of this well. Both systems record and graphically present drilling data (e.g. depth, MW, WOB, RPM, torque, gas units, etc) in the industry standard WITS format. The SAM and DRILBYTE data screens were both monitored in the Exlog and Amoco rig office and the Amoco SAM was monitored in the Amoco Stavanger office. Both systems are acceptable for monitoring real-time drilling data.

The DRILBYTE system utilizes computer workstation technology while the SAMS system works within the IBM compatible PC based format. The advanced capabilities of DRILBYTE were recognized as having significant advantages over SAM. Some of these capabilities have to do with the manipulation of the raw data and the capability for advanced, real time evaluation of drilling data. The actual field use of the two systems was such that the drilling foreman and engineer used DRILBYTE as the primary monitoring device and SAM as a backup. The Exlog system does require some training and in the future, this requirement should be addressed in advance of the actual drilling operation if possible. Training aside, the system was such that after a period of "hands on" experience, the Amoco personnel were able to utilize the system to the benefit of the operation. Feedback from the rig personnel was generally favorable and supportive of continued use of DRILBYTE in the future.

Another advantage of DRILBYTE is the ongoing development and support that the system receives from Exlog as compared to the end product nature of SAM. It does not appear that further development of SAM is planned, and as such, it is quickly becoming obsolete. Contractually, Exlog was required to provide service in support of SAM which was carried out on an as needed basis. The end result was a continuously operational SAM system that functioned adequately and in accordance with the design of the sytem. It is recommended, however, that on future applications where Exlog is utilized as the mud logging company, DRILBYTE be used in place of SAM both on the rig and in the Amoco office in Stavanger.

9.1 Mobilization

The semi-submersible West Vanguard departed Stavnger at 1500 hours on 7 September 1991 following ANOC's acceptance testing of the rig and service contractor's equipment. Assisted by ANOC's Far Trout on the tow bridal, the rig travelled at 8 knots and dropped the first anchor (No. 5) on the Magne 2/5-9 well location at 1630 hours on 9 September, 1991.

Anchors were run by the Far Trout and Maersk Shipper. The rig was ballasted down to drilling draft and the anchors pretensioned. The well was spud at 1800 hours on 10 September 1991.

9.2 Positioning

Positioning was done by Pulse/8 and differential GPS. The final position by differential GPS with the rig heading at 315.0 azimuth was:

Latitude: 56 deg 32 min 07.17 sec N

Longitude: 003 deg 33 min 13.43 sec E

In UTM (zone 31, central meridian 3 deg East, European Datum 1950) coordinates this corresponds to:

Northing: 6 265 939.2 m

Easting: 534 057.5 m

This was 6.8 m on a bearing of 124.4 deg (true) from the intended location. For more details, see Racal Survey Norge A/S report 3110, revision 0, 22,10,1991.

Subject: 36" Hole Section Summary

10.1 Operational Summary

A 26" x 36" hole was drilled from the seabed at 90.5 m RT to 190 m RT. The hole was drilled riserless with a 26" bit and 36" hole opener strap welded together. A marker buoy was placed 5 m from the BHA with the ROV prior to spud. Distance and bearing were recorded. The ROV remained on bottom to observe returns for the possibility of shallow gas but no gas was observed.

Initial drilling operations were performed with a rotary speed of 60 rpm and 8-10 Klbs weight on the bit. Some bouncing of the drill string was observed in the first 20 meters, but subsided shortly thereafter.

The hole section was drilled to a TD of 190 m RT in 9 hours at an average ROP of 11.06 m/hr without incident. Upon reaching TD, a single shot survey was taken on slick line and showed zero degrees of inclination.

10.2 Mud Summary

Prior to spud, 1512 bbls of high viscosity spud mud and 885 bbls of 11.0 ppg kill mud were prepared. The spud mud had a funnel viscosity of 100+ cp, a PV of 10 cp and a YP of 35 lb/100 sqft. This mud was used as sweeps in 50-100 bbl batches to clean the hole at 145, 160, and 175 m.

Seawater was used as the drilling fluid to TD. After sweeping the hole at TD with 200 bbls high viscosity mud, a wiper trip to within 10 m of the sea bed was performed. No fill was encountered on the trip. The hole was then displaced with 700 bbls of 10 ppg high viscosity mud prior to pulling the bit and running the 30" casing. Most of 11.0 ppg kill mud was diluted back and used for this purpose.

10.3 Bottom Hole Assemblies

BHA No. 1 drilled the 36" hole from spud to a TD of 190 m RT. The slick assembly successfully controlled deviation as was evident by the zero degree survey at TD.

ITEM	OD	ID	LENGTH	CUML
BIT NO. 1	26.0	--	0.54	0.54
HOLE OPENER	36.0	2.785	1.74	2.28
BIT SUB	9.5	3.125	1.78	4.06
3 DC	9.5	3.000	28.30	32.36
XO	9.5	3.062	1.79	34.15

3 DC	8.0	2.812	28.88	63.03
JARS	7.75	2.750	9.65	72.68
2 DC	8.0	2.812	18.81	91.49
XO	8.0	2.187	1.82	93.31

10.4 Bits and Hydraulics

The 26" bit was run using three 20/32" jet nozzles and was strap welded to the 36" hole opener which had four 18/32" nozzles. Flowrates of 1200 gpm with seawater were achieved with 800 psi standpipe pressure. This high flow rate produced annular velocities of 25 fpm around the 9.5" drill collars, 24 fpm around the 8" drill collars, and 23 fpm around the 5" drill pipe. The average rate of penetration was 11.06 m/hr. With the viscous spud mud sweeps, hole cleaning was achieved as noted by no fill on the wiper trip.

10.5 Casing and Cementing Summary

See attached Well 2/5-9 30" Casing and Cementing Summary

Amoco Norway Oil Company

MEMORANDUM

To: E. Hansen **Date:** 12 September 1991
From: Drilling Foreman W. Vanguard **Ref:** NO M 400(2/5-9)10
Subj: Well 2/5-9 30" Casing and Cementing Summary

The following details summarize the 30" casing and cementing program.

RT - Sea Level	22.0	m
RT - Mud Line	90.5	m
Water Depth	68.5	m
30" Casing Setting Depth	187.15	m
36" Hole TD	190.0	m

CASING SUMMARY

A string of 8 joints of 30" conductor was run as follows:

- Float shoe welded to a 30" 1" WT X-52 Vetco ST-2RB pin up shoe joint
- 6 joints 30" 1" WT X-52 Vetco ST-2RB conductor
- Dril-Quip 30" wellhead housing with a 30" 1" WT X-52 Vetco ST-2RB box down extension joint and Dril-Quip Retrievable Guide Base (RGB)

The casing was run to 184.65 m RT, where fill was tagged. The casing was washed down with seawater to 187.5 m and the final setting depth was 187.15 m. The top of the wellhead housing was observed to be 2.5 m above the sea floor by the ROV. The casing running was completed in nine hours in adverse weather conditions of 4-5 m seas and 30-40 knot winds.

A 5" drill pipe cementing stinger was run to 22 m above the shoe before making up the running tool and 5" heviwate drill pipe running string. Hole re-entry was trouble free. Prior to the cementing job, the well was circulated with 500 bbls of seawater with the rig pumps at 11.4 bpm. Returns were monitored with the ROV.

CEMENTING SUMMARY

Cement lines were tested to 2000 psi for 10 minutes and the over-pressure shut down switch set at 1500 psi. The following cement slurry was mixed and pumped:

1600 sacks Norcem Class "G" +

10.6% bwoc D-124 (Litefil ceramic bubbles)
0.02 gps D47 (defoamer)
0.50 gps D77 (accelerator)

Weight --- 14.0 ppg
Yield ---- 1.49 ft3/sx
Mixwater -5.42 gps seawater

In past experiences with the West Vanguard bulk system, there have been problems keeping up with the demand of the cementing unit. On this job, an effort was made to keep the mix rate and delivery rate of the bulk system at an equilibrium. As a result, no shut downs were necessary, although one period of reduced mix/pump rate (from 6 bpm to 3.5 bpm) was needed to allow the bulk system to catch up. The reduction in cement delivery was caused when the second air compressor failed to start, due to a blockage in the non-return valve between the tank and compressor. The blockage prevented the decrease in pressure to be transmitted to the pressure switch, which is designed to automatically start the compressor. The compressor was put online manually and the remainder of the cement job continued without problems. As the job started, a tub of slurry was mixed in the DS VIP mixer and weighed with the pressurized mud balance to check the densimeter of the VIP mixer. This densimeter had been programmed from the control panel to read "light" cement. The results of the mud balance confirmed the reading of the densimeter of 14.2 ppg.

During the job, however, periodic checks with the pressurized balance indicated that the slurry density was falling and the spread between pressurized mud balance weights and densimeter readings increased. The program for the densimeter was changed from the control panel and slurry density was read correctly from the panel and matched the pressurized balance. Thus, slurry densities of 13.6 - 13.8 ppg were mixed on a portion of the job.

A break down, in order of the slurry pumped is as follows:

125 bbls	13.8 ppg
210 bbls	13.6 ppg
145 bbls	14.0 ppg
--------	
480 bbls	Total slurry

Returns of cement were observed by the ROV. They were observed just after the first half of the slurry was pumped, or about 260 bbls of slurry pumped. This equates to an average open hole diameter of 39", assuming no channelling.

RECOMMENDATIONS

Examine an alternate slurry recipe for this section of hole.

Many precautions have been stated to warn that fluffing the LITEFIL blend can cause segregation of the low specific gravity ceramic bubbles and the higher specific gravity Class G. Even though the tanks on the West Vanguard were not fluffed, it is possible that some segregation may have taken place. This could account for why the initial verification of the densimeter on the VIP mixer was correct, and later on became "uncalibrated".

In view of these handling difficulties, the fact that the densimeters have difficulties correctly calculating slurry density, the high cost of the LITEFIL additive and the excessive "Waiting on Cement" time due to the long thickening times, it is recommended that a different slurry recipe for this hole section be examined to both reduce cost and provide adequate compressive strength.

Subject: 26" Hole Section Summary

11.1 Operational Summary

A 12-1/4" bit and BHA No. 3 were run in the hole to drill a pilot hole with returns taken to the seabed after the 30" conductor had been drilled out. The ROV remained on bottom while drilling to observe returns for the possibility of shallow gas. Prior to drilling ahead, an operational briefing was held to review Amoco's procedures for drilling possible shallow gas zones. Specific shallow gas drilling procedures had been developed as part of the drilling program and were included in Section 12.D.6 "Shallow Gas Procedures". This procedure was implemented as three potential gas zones were identified from the shallow seismic data that had been acquired for the Magne location.

The interval from 193 m to 268 m was drilled before pulling out of the hole to replace the MWD tool (failed resistivity sensor) and repair the blower motor on the top drive hydraulic pump. The drillstring stuck at 228 m and 233 m but was pulled free with 280 Klbs overpull each time.

Three potential shallow gas zones were identified based on shallow seismic before drilling operations began (447 m, 502 m and 572 m). The hole was displaced from 8.6 ppg seawater to 10.0 ppg drilling mud 10 m before drilling each of the suspected zones. The zones were then drilled with 10.0 ppg mud as a precaution to avoid a shallow gas kick. After drilling through the zone, a flow check was taken, the mud displaced back to seawater and another flow check taken with the ROV. Flow checks, MWD log evaluation and ROV monitoring did not show any signs of shallow gas in any of the penetrated zones. The 12-1/4" pilot hole interval was drilled to 960 m with no other indications of shallow gas or hole problems.

A 15-1/2"/26" combination hole opener was picked up and opened the hole to 270 m. Drilling operations were stopped at this point in order to recover a broken guideline. The softline used to center the 26" hole opener had wrapped around the drillpipe and pulled the guideline into the rotating drillstring. The lead bullet seal had been stripped from the guide post. The guide post was not damaged. Hole opening operations continued with no further problems to 960 m (interval TD).

11.2 Mud Summary

As in the 36" hole section, a prehydrated bentonite/seawater fluid was used for sweeps and hole displacements. Prior to drillout of the 30" conductor, the following mud volumes were prepared: 906 bbls 8.8 ppg, 195 bbls 10.0 ppg, 415 bbls 11.0 ppg and 534 bbls 15.0 ppg mud.

Seawater was used as the drilling fluid for this hole section and 10.0 ppg mud used for hole sweeps and displacements.

11.3 Bottom Hole Assemblies

BHA No. 2 was used to drill out the 30" shoe and 3 meters of new formation.

ITEM	OD	ID	LENGTH	CUML
BIT NO. 2	26.0	--	0.56	0.56
BIT SUB	9.5	3.12	1.78	2.34
3 DC	9.5	3.00	28.30	30.64
XO	9.5	3.06	1.79	32.43
3 DC	8.0	2.81	28.88	61.31
JARS	7.75	2.75	9.65	70.96
DC	8.0	2.81	9.36	80.32
XO	8.0	2.81	1.82	82.14

BHA Nos. 3 and 4 were the same and used to drill the 12-1/4" pilot hole section. BHA No. 4 was run after the MWD began malfunctioning and was changed out.

ITEM	OD	ID	LENGTH	CUML
BIT NO. 3, 4RR3	12.25	--	0.30	0.30
MWD	8.25	--	12.26	12.56
XO	8.37	2.87	1.13	13.69
XO	8.00	2.87	1.78	15.47
12-1/4" STAB	8.00	2.81	2.36	17.83
5 EA DC	8.00	2.81	47.68	65.51
JARS	7.75	2.75	9.65	75.16
2 EA DC	8.00	2.81	18.81	93.97
XO	8.00	3.50	1.10	95.07

BHA No 5 was used to open the 12-1/4" pilot hole to 26". The hole opener was a 15-1/2"/26" combination hole opener.

ITEM	OD	ID	LENGTH	CUML
BIT NO. 5	12.25	--	0.30	0.30
HO	26.00	2.75	2.72	3.02
BIT SUB	9.50	3.12	1.78	4.80
DC	9.50	3.00	9.41	14.21
26" STAB	9.50	3.00	2.65	16.86
2 EA DC	9.50	3.00	18.89	35.75
XO	9.50	3.06	1.79	37.54
3 EA DC	8.00	2.81	28.88	66.42
JARS	7.75	2.75	9.65	76.07
2 EA DC	8.00	2.81	18.81	94.88
XO	8.00	3.50	1.10	95.98

11.4 Bits and Hydraulics

The IADC code 1-1-4 bit (Hughes X3A) used for the 12-1/4" pilot hole drilled with ROP's controlled around 30 m/hr. Flowrates with seawater were approximately 850 gpm.

The 26" hole opener assembly was run with a maximum flowrate of 1340 gpm and the flow balanced between the bit and the two cutter sets in the tandem hole opener. Hole cleaning with the hole opener assembly was sufficient with hi-viscosity sweeps pumped on connections. With the viscous spud mud sweeps, hole cleaning was achieved as noted by no fill on the wiper trip. Seven inch pump liners were used in this section.

Total mud usage for the section was approximately 10,800 bbls and a total section mud cost of approximately 42,000 USD. These costs could be reduced in future wells if a lower flow rate MWD tool could be utilized. In order for signals to be received while drilling the 12-1/4" pilot hole with mud (riserless) through the potential shallow gas zones a minimum flow rate of 500 gpm was required. If the flow rate could be reduced then less mud would be consumed and therefore a lower mud cost. This area had been identified as a problem and a low flow rate tool was used. However, the "published" rate of 350 gpm was not enough to generate a strong enough signal that could be decoded at the surface.

11.5 Casing and Cementing Summary

See attached Magne 2/5-9 20" Casing and Cementing Summary

Amoco Norway Oil Company

MEMORANDUM

To: E. Hansen | **Date:** 20 September 1991

From: Drilling Foreman W. Vanguard | **Ref:** NO M 400(2/5-9)10

Subj: Magne 2/5-9 20" Casing and Cementing Summary

The following memorandum details the 20" casing and cementing job on the Magne 2/5-9 well.

CASING SUMMARY

The 12-1/4" pilot hole to 960 m RT was opened to 26" and the hole displaced with 10.0 ppg mud. A wiper trip was made from interval TD at 960 m RT back to the 30" casing shoe at 187 m RT. Maximum overpull on the wiper trip was 35M lbs at 805 m RT. The well was again displaced after the wiper trip with 10.0 ppg mud and the drillstring pulled out of the hole. Weatherford casing tools were rigged up to run the following casing string:

a. one joint of 20" 133 ppf X56 D-Q E60 casing with the float shoe prewelded to the pin end

b. one joint of 20" 133 ppf X56 D-Q E60 casing with a prewelded float collar

c. sixty-eight joints of 20" 133 ppf X56 D-Q E60 casing

d. one crossover joint of 20" 133 ppf X56 casing, E60 pin x HD90 pin

e. one wellhead hanger joint consisting of a Dril-Quip 18-3/4" SS15 wellhead with D-Q HD90 box

Weatherford bow spring centralizers were installed on the casing string as follows: two each on the float shoe and float collar joints and one each on the next three joints. Individual centralizers were also installed on the first two joints of 20" casing (one per joint) inside the 30" casing shoe. The first two casing connections were Baker-locked during makeup.

The E60 and HD90 connectors were cleaned and lightly oiled before running. Makeup torque averaged 15,000 ft-lbs. Softline guide ropes were attached to the shoe joint and guidelines while running in the hole. The ROV was used to monitor casing entry into the wellhead housing. The casing was washed down from 940 m to casing setting depth after the string took 50 Klbs weight at this point. The wellhead was successfully latched into the 30" housing and confirmed with 25 Klbs overpull. The final depth of the 20" wellhead housing was 86.57 m RT and the final casing setting depth was 950.06 m RT. The casing was run in 12 hours.

CEMENTING SUMMARY

Prior to the cementing job, the well was circulated with 1200 bbls of seawater with the rig pumps at 12 bpm. Continuous returns at the seabed were monitored using the ROV.

Cement lines (Dowell and rig) were tested to 3000 psi for 10 minutes before pumping operations began. The following cement slurries were pumped:

Lead Cement: 3354 sacks of Norcem Class G cement +

0.01 gps D47
0.42 gps D75
0.18 gps D81

Weight---12.5 ppg
Yield---2.18 ft3/sx
Mixwater---12.13 gps seawater

Dowell densimeter readings were within 0.1-0.2 ppg of the pressurized mud balance and did not vary during this stage. Cement mixing rates averaged 7-8 bpm and no equipment shut downs or problems were noted. Smedvig was able to provide bulk cement delivery at a constant rate of 0.88 metric tons/minute.

Tail Cement: 926 sacks of Norcem Class G cement +

0.01 gps D47
0.15 gps D604
0.04 gps D81

Weight---15.8 ppg
Yield---1.15 ft3/sx
Mixwater---4.83 gps freshwater

Dowell densimeter readings for the tail slurry were also within 0.1-0.2 ppg of the pressurized mud balance. Cement mixing rates averaged 4 bpm for this slurry with no equipment problems. Bulk cement delivery rate was 0.83 metric tons/minute. Rig bulk tank measurements indicated that 165 metric tons of cement were used for the 20" cement job. The theoretical usage was calculated to be 182 metric tons. The amount of mixwater used and the slurry density were as per the casing and cementing program.

The cementing dart was dropped after the cement had been pumped and was displaced with the rig pumps at 12 bpm (pump efficiency-97%) with 942 bbls of 10.0 ppg mud. The first ten barrels of displacement were pumped by Dowell in order to watch the dart shear in the sub sea plug launcher. Shearing pressure for the dart was 2000 psi. The cementing plug was bumped with 1950 psi (500 psi over final displacement pressure). The pressure was released and the floats held successfully. No equipment shut-downs or problems were noted.

The running tool was released and the cementing string retrieved from the well.

SERVICE COMPANY EVALUATIONS

Dowell-Schlumberger ---	No problems were encountered and all work was performed in a timely manner.
Weatherford -----------	The personnel did an excellent job considering the adverse weather conditions.
Dril-Quip -------------	The onsite technician was very helpful. Utilizing the same brand connectors and wellhead ensures that a service man is onboard and available to assist in connector makeup and verification.

CONCLUSIONS

The objective of this casing and cementing job was to provide a competent casing shoe, isolate the 30" x 20" annulus and provide structural support to the wellhead. These objectives were achieved after successful cementing, drillout and testing of the casing.

RECOMMENDATIONS

1. Add items a & b to future 20" cementing programs.

a) Circulate a minimum of one casing volume with mud or water prior to cementing. This will ensure that the casing has been adequately circulated before pumping cement.

b) Leave five barrels of tail cement in the mixing tank and spot this volume on top of the cementing plug. The cement on top of the drillable plug should aid in drillout operations.

2. The use of the Dowell VIP mixer should be continued on future cement jobs due to the excellent density control after calibration with the pressurized mud balance.

3. The Dowell cement unit is capable of mixing cement at higher rates than the Smedvig bulk system can deliver. Dowell and Smedvig should perform a joint study to identify possible modifications to the existing bulk system that will allow for faster delivery of bulk cement to the surge hopper.

A.E. Frazelle/ W. Henderson

Attachments: Amoco Forms 19 & 20

92016STA0090

Subject: 17-1/2" Hole Section Summary

12.1 Operational Summary

The 20" casing, set at 950 m, was drilled out with a 17-1/2" rock bit (Hughes S11J) and slick BHA assembly (Bit and BHA No. 6). After drilling out the float equipment and 3 m of new hole, a leak-off test was performed. The interpretation was 14.0 ppg EMW (which was less than the expected 14.6 ppge). After tripping for the drilling BHA, the leak-off test was repeated and found to be 14.7 ppg EMW. After comparing the two curves, it was concluded that the first test had been stopped prior to the actual formation leak-off and 14.7 ppg EMW was the accepted value.

The hole was then displaced to a cationic polymer brine fluid (CBF) which had been previously used at Valhall, instead of the PHPA system originally planned for the well. The reason for this change was to build upon the success achieved on Valhall's A-27 with CBF and ANOC's ongoing efforts to find a replacement for oil based mud for the drilling of the reactive clay section in this region of the North Sea. A modified mud program specific to the use of cationic brine fluids was developed by Tulsa research scientist, Tom Biehoffer. A special procedure for sampling, testing and mud detoxification was also developed based on the SFT Discharge Permit and internal Amoco requirements.

An Eastman Christensen 17-1/2" R523EG eccentric bit was used to drill from 963 to 1903 m. The bit drilled at ROP's ranging from 5-40 meters per hour but slowed to less than 10 meters per hour near 1900 m. Offset well logs indicated that thin, hard limestone or dolomite stringers could be expected (with slower ROP's) at this depth. The formation became firmer at 1707 m (top of Miocene) and the drill cuttings changed from primarily soft, "mushy" cuttings to individual, harder cuttings (with no change in mud properties). Wiper trips were performed at 1150 m, 1381 m and 1617 m. Some tight spots (45-70 Klbs drag) were encountered on each wiper trip but were negligible after the drillstring had passed through them on the trip. Trip gas from the 20" casing shoe to 1625 m RT was 0.05 % and increased to 0.16 % from 1625 to 1850 m.

A wiper trip was made at 1903 m with considerable drag and hole cleaning difficulties. The string was pulled to 1388 m and the hole appeared to pack off. Reaming was required to go up or down but the hole would circulate freely. Large amounts of soft cuttings and some hole cavings were seen at the shale shaker. The drill string was run back to bottom, mud weight raised to 13.5 ppg and the KCL concentration increased from 30 ppb to a new value of 40 ppb. (A post-appraisal pore pressure analysis carried out using wireline logging data (sonic) from this section indicated that the pore pressure was +/- 12.8-13.0 ppge by 1700 m. The section had therefore been drilled slightly underbalanced. The caliper log indicated that the section was severely washed out from 1600-1800 m which supported the sonic evaluation of underbalanced drilling.) An attempt was then made to pull out of the hole and the drillstring became stuck at 1385 m (no rotation or circulation). The jars were fired both up and down for 5 hours with no success. The pipe started to move upwards when an additional 250 Klbs pull over string weight was applied. Circulation and rotation were regained and the pipe backreamed out of the hole.

Twenty-six hours were required to backream and pull out of the hole with the drillstring. Large amounts of shale cuttings were circulated out of the hole while the string was backreamed. The pulled stabilizers were measured to be 0.5 to 1.5 inches undergauge and the PDC bit had only 7 of the original 70 cutters remaining.

A 15 meter pendulum BHA (without the MWD tool) and insert bit were run to replace the previous 10 meter pendulum BHA. Sixteen hours were required to ream back to bottom at 1903 m. Drilling resumed after the hole had been thoroughly circulated and cleaned. Hard, firm cuttings were removed at the shale shaker during reaming and circulation operations. The insert bit drilled 6 meters in 5 hours after numerous attempts to increase penetration rate by altering the drilling parameters. The bit was pulled and found to be undamaged and in gauge but balled up with shale and dolomite cuttings.

An Eastman Christensen R426GN PDC bit (fishtail type) was run and drilled from 1909 m to 2423 m. This particular bit had previously been run on Valhall's A-27 with CBF as the drilling fluid. Some tight hole was encountered (40 Klbs drag) on the trip in the hole and reaming was required. Six meters of hard fill was found on bottom. A short trip to the 20" shoe was made after drilling to 2109 m. Overpull of up to 60 Klbs and some swabbing was seen during this trip. The Dowell pump was used to boost the riser while circulating to aid in hole cleaning. Seven meters of fill was found on bottom. The mud weight was increased to 13.8 ppg in an attempt to lower the amount of wall cavings seen over the shale shakers.

Drilling continued from 2109 m to 2233 m at 10-15 meters per hour. The mud weight was increased from 13.8 ppg to 14.2 ppg in an attempt to improve hole conditions. Combination Lo-vis/Hi-vis sweeps were pumped to insure that the hole was being cleaned adequately. The sweeps consisted of 75 bbls of unweighted Lo-vis brine and 75 bbls of 18.0 ppg Hi-vis mud. The sweeps removed an amount over and above that of ordinary cuttings and wall cavings from the well. The Lo-vis\Hi-vis sweep combinations appeared to remove more cuttings from the hole than Hi-vis sweeps alone. A short trip from 2233 m to the 20" casing shoe was made with very little drag (up to 60 Klbs at one spot). The amount of wall cavings was reduced considerably and it appeared that the increase in mud weight to 14.2 ppg greatly improved the overall hole condition. No fill was found on bottom and drilling resumed from 2233 to 2380 m.

Rig mud pump repairs required 11 hours while drilling from 2233 to 2380 m. The pulsation dampener and pump fluid end had to be repaired before drilling operations could be resumed.

Drilling resumed at 2380 m with ROP's ranging between 3 and 5 m/hr. The PDC bit was pulled at 2423 m because of the low ROP and a BOP test performed. Bit No. 10 was a Smith MSDGHC mill tooth bit and was run on the same BHA as Bit No. 9. ROP values for the new bit were 5-10 m/hr. The bit was pulled at 2627 m after the rate of penetration suddenly dropped to zero. Examination of the bit on surface indicated that 12 of the teeth were badly damaged and one jet plugged. No apparent reason was seen for the drastic drop in ROP, however, bit balling was suspected. The trip out of the hole required 11.5 hours due to substantial amounts of backreaming. Large amounts of blocky, rectangular wall cavings were seen at the shale shaker while circulating out the Lo-vis\Hi-vis sweeps.

Bit No. 11 was a 17-1/2" Hughes MAX-11H (IADC-445M) and drilled from 2627 to 2849 m at an average ROP of 8.7 meters/hr. Normal drag was seen while tripping in and no fill seen on bottom, however the mud weight was increased from 14.2 ppg to 14.5 ppg in an attempt to stabilize the hole and minimize the amount of "golf-ball" sized shale chunks seen on the shale shakers. The rig shear pump was used to boost the riser while circulating. Lo-vis/Hi-vis sweeps of 70/75 bbls each were used to aid in hole cleaning while drilling ahead at 2627 m (BU), 2636 m, 2673 m (only Lo-vis pumped), 2710 m and 2733 m. Sweeps resulted in 3 to 6 times normal cuttings amount seen at the shale shaker. A carbide pill was pumped and indicated an average hole diameter of 18.25" in the open hole interval from 2750 m to the 20" shoe.

Drilling continued to 2779 m at which point a wiper trip was made to 1700 m. The viscous sweep from bottoms-up before the trip showed no appreciable increase in cuttings concentration. Some washing and reaming was required on both the trip out and in. Drilling continued to 2849 m with no significant increase in cuttings concentration on bottoms-up from the trip or on Lo-vis/Hi-vis sweeps. At 2849 m the bit stopped drilling. Attempts were made to clean the bit (suspected bit balling) without success. The trip out required less washing and reaming to POOH than previous trips. The bit and stabilizers were found balled up with a very sticky, greenish claystone.

Because the bit condition was excellent, Bit No. 12 was a rerun of No. 11. The bit was RIH to 2849 m with the last 4 stands washed and reamed (precautionary) to bottom. A Lo-vis (with nut plug) /Hi-vis sweep was pumped and drilling continued to 2852 m at which point the shakers were blinded by cuttings. This corresponded to returns from the mid-point of the annulus after the bit trip. Drilling again continued to 2856 m at which point the diverter and flow line were plugged with gumbo. Once circulation was again established, the bit drilled to 2859 m before suddenly stopping. Bit ROP had averaged 6.7 m/hr. Various attempts were made, including a caustic/nut plug pill, to get the bit to drill. Finally, the bit was pulled with no significant drag or washing/reaming required on the trip out. Again, the bit and stabilizers were found to be badly balled with a green/grey claystone.

Bit No. 13, a DBS GX2-TD2060 (IADC 0615), PDC bit, was RIH in an attempt to drill the soft formation at TD. Bottoms-up samples had shown a possible formation transition to a less sticky shale. A caustic/nut plug pill was pumped on bottom, pumps slowed while the pipe was rotated and the pill pumped at maximum rate out of the hole. Returns were 2 to 3 times normal circulating cuttings volume. The bit drilled from 2859 to 2880 m at an average of 1 m/hr due to severe bit balling. Pills consisting of 7% drilling detergent/nut plug, soap pill/nut plug and seawater/PHPA were pumped in an unsuccessful attempt to clean the bit. Cuttings concentration continued to increase 2 to 3 times normal amounts when the pills reached surface. The bit was pulled and found to have 3 plugged nozzles (out of 8) and 4 of the fluid courses packed with gray-black claystone/shale.

Based on this extremely poor drilling performance and the anticipated 16.5 ppg leakoff test at this depth, the decision was taken to stop drilling and set 13-5/8" casing. The planned casing setting depth was 3265 m for the 13-5/8" casing. The objectives of the casing point were:

1. Attain the necessary fracture gradient required to drill into the anticipated pressure transition zone in the Lower Cretaceous.

2. Cover the active Tertiary shale section.

3. Minimize the section to be underreamed in order to run an 11-3/4" liner.

The severe bit balling problems encountered resulted in the decision to set casing at the current depth of 2880 m. As part of this decision, an evaluation of the consequences of setting casing early was undertaken. While objectives 2 and 3 would be compromised to a certain extent, the analysis indicated that the primary objective of the original plan for the casing point, i.e., to provide a sufficient fracture gradient for drilling to the 11-3/4" casing point in the Lower Cretaceous formation, could still be accomplished. The compromise was in the length of section to be underreamed for the 11-3/4" casing and the amount of Tertiary shale exposed in the 12-1/4" hole section.

After the successful casing/cementing job, the weather worsened and the seal assembly could not be set despite the landing string/running tool being pulled. While WOW, it was noticed that the slip joint was damaged (crack had developed). The slip joint and riser were retrieved but no spare slip joint was available. The slip joint was then transported to Vetco's shop in Great Yarmouth for repair and then returned to the rig. The total lost time for the incident was 14 days.

12.2 Mud Summary

Also, see attached Memo - NO M 5858 400 (2/5-9) 1 TWB/HHP detailing the observed problems and action plan for CBF mud usage in future wells.

The prehydrated bentonite/seawater fluid used in the 26" hole section was used to perform the 20" casing shoe leak-off tests. The hole was then displaced to a 10.0 ppg Cationic Polymer Brine Fluid (CBF).

The CBF system is chemically different from conventional waterbased drilling fluids and was designed to provide more effective wellbore inhibition and added control over the fluid system.

The initial mud formulation was as follows:

Seawater		
Biocide	0.05 lb/bbl	(Glutaraldehyde)
KCL	38.0 lb/bbl	(57,000 mg/L K+)
Starch	3.0 lb/bbl	
XCD	1.0 lb/bbl	
Ancoquat I	7.0 lb/bbl	Amerfloc 425 EP
NaOH	0.50	pH > 8.3

Mud properties were adjusted while drilling the upper section of the 17-1/2" hole to achieve maximum performance from the bit and mud system. The excess cationic polymer in the mud and KCL concentrations were monitored closely to ensure maximum shale inhibition while drilling the dark grey, sticky shale sections. Examination of drill cuttings and observation of hole condition on wiper trips indicated that the CBF mud was sensitive to KCl and excess polymer values. Mud properties remained fairly constant from 1200 to 1903 m after the initial mud property fluctuations were stabilized. Three problem areas are discussed below.

While reaming out of the hole at 1300 m, the mud properties began to rapidly deteriorate (API filtrate increased to 14 ml/30, PV and YP increased from early values of 34 and 24 to new values of 57 cp and 37 lb/100 ft2 and the funnel viscosity increased from 85 to a new value of 142 sec/qt). It was determined that the excess polymer concentration had fallen from an original level of 10 lb/bbl to 1 lb/bbl. Five lbs/bbl Ancoquat I was added to the system and the excessively high rheology and fluid loss numbers were lowered significantly after several circulations.

It was discovered that the ion selective electrode meter was not properly calibrated in the upper section of the 17-1/2" hole down to 1397 m and was reading a KCL value higher than actual. Mud specifications called for a 10% K+ concentration but the actual concentration was between 6% and 7%. Also, the correct method of running the bead test for excess cationic polymer concentration was demonstrated and re-emphasized to the mud company. Consistent excess polymer values were obtained after this demonstration.

The mud properties were altered after tight hole was encountered at 1385 m. The KCL concentration was increased by 10 ppb to 40 ppb. Mud weight was increased to 13.5 ppg by 1903 m and the API filtrate decreased to 5 ml/30 min. These changes were made after further review of offset wells and discussions with other operators in the area.

The mud was conditioned and the following mud concentrations measured before drilling operations continued at 1903 m.

Seawater		
Biocide	0.05	lb/bbl
KCL	38.0	lb/bbl
Starch	6.0	lb/bbl
XCD	1.5	lb/bbl
Ancoquat I	9.0	lb/bbl
NaOH	0.50	lb/bbl

Mud concentrations remained constant at the above levels while drilling the interval from 1903 to 2233 m. The wiper trips had considerable amounts of drag and backreaming was required to pull out of the hole.

At 2233 m the mud weight was increased to 14.2 ppg (no appreciable change in other mud properties). The hole conditions improved after the mud weight change and drilling continued. The mud weight was raised again to 14.5 ppg at 2750 m in an attempt to continually stabilize the hole from "wall cavings".

Different types of sweeps were tried while drilling ahead to clean the hole of drilled cuttings. The three types were Lo-vis only, Hi-vis only and a Lo-vis/Hi-vis combination. The most effective type was the Lo-vis/Hi-vis utilizing 70 bbls of 9.5 ppg premix mud and 70 bbls of 18.0 ppg active mud that had been weighted up and thickened with XCD polymer. The inclusion of Nut-Plug did not seem to increase the effectiveness of the sweeps. The sweeps resulted in 3 to 6 times the normal cuttings load and primarily consisted of cuttings. A carbide lag pill showed an 18.25" equivalent hole diameter.

No changes were made to the CBF mud system while drilling to 2849 m. A wiper trip at 2779 m required less washing and reaming than previous trips. At 2849 m the bit suddenly stopped drilling. Lo-vis/Hi-vis sweeps with nut plug were again pumped but with no apparent effect on drilling conditions at the bit. When the bit was pulled a very sticky, greenish claystone was found balling the bit and caked on the stabilizers. The bit was rerun and while drilling ahead, the shakers were blinded by cuttings from the trip in the hole. Drilling continued to 2856 m at which point a severe gumbo attack plugged the flowline. Mud properties remained consistent and the problems appeared associated with a formation change. At 2859 m the bit again suddenly stopped and various sweeps were attempted using caustic and nut plug without success. No significant drag was seen when the bit was pulled. Again, the bit and stabilizers were balled up but with a green/grey claystone. A PDC bit was run but immediately balled up. Caustic/nut plug and seawater/PHPA pills were pumped without any positive effect on balling. Sweeps did start to show some increase in cutting amounts. Mud properties were still within acceptable ranges when the decision was made to set casing. A single arm caliper run while logging showed an equivalent hole diameter of 18.46". A 5% dilution brought the rheology down to acceptable levels and provided excellent mud for the casing job.

12.3 Bottom Hole Assembly

BHA No. 6 was used to drill out the 20" shoe and 3 meters of new formation.

ITEM	OD	ID	LENGTH	CUML
BIT NO. 6	17.5	--	0.45	0.45
BIT SUB	9.4	3.00	1.77	2.22
2 EA PONY DC	9.4	3.00	6.26	8.48
4 EA DC	9.5	3.00	37.62	46.10
XO	9.5	3.06	1.79	47.89
2 EA DC	8.0	2.81	19.23	67.12
JARS	7.7	2.75	9.65	76.77
2 EA DC	8.0	2.81	18.81	95.58
XO	8.0	3.50	1.10	96.68

BHA No. 7 was used to drill from 963 m to 1903 m. Directional surveys indicated angles of less than 1/2 degree from 960 m to 1738 m.

ITEM	OD	ID	LENGTH	CUML
BIT NO. 7	17.50	--	0.65	0.65
BIT SUB	9.43	3.00	1.77	2.42
2 EA PONY DC	9.43	3.00	6.26	8.68
17-1/2" STAB	9.38	3.00	1.90	10.58
XO	9.43	3.00	1.86	12.44
MWD	9.43	--	11.88	24.32
SAVER SUB	9.43	3.00	0.73	25.05
17-1/2" STAB	9.43	3.13	1.70	26.75
4 EA DC	9.50	3.00	37.62	64.37
XO	9.50	3.13	1.79	66.16
2 EA DC	8.00	2.81	19.23	85.39
JARS	7.75	2.75	9.65	95.04
2 EA DC	8.00	2.81	18.81	113.85
XO	7.87	3.00	0.95	114.80

BHA No. 8 was used to ream the interval from 950 to 1903 m and drill from 1903 to 1909 m RT.

ITEM	OD	ID	LENGTH	CUML
BIT NO. 8	17.50	--	0.46	0.46
BIT SUB	9.43	3.00	1.77	2.23
PONY DC	9.43	3.00	2.96	5.19
DC	9.50	3.00	9.32	14.51
17-1/2" STAB	9.38	3.12	1.70	16.21
DC	9.43	3.12	9.41	25.62
PONY DC	9.43	3.12	3.30	28.92
17-1/2" STAB	9.50	3.00	2.16	31.08
2 EA DC	9.50	3.00	18.89	49.97

XO	9.50	3.13	1.79	51.76
2 EA DC	8.00	2.81	19.23	70.99
JARS	7.75	2.75	10.62	81.61
2 EA DC	8.00	2.81	18.81	100.42
XO	7.87	3.00	0.95	101.37

BHA No. 9 was the same as BHA No. 8. The insert bit was changed and replaced with an Eastman Christensen R426GN PDC bit (used previously on Valhall) and drilled to 2434 m RT. Hole angle had increased to 2.0 degrees at 2108 m.

ITEM	OD	ID	LENGTH	CUML
BIT NO. 9	17.50	--	0.65	0.65
BIT SUB	9.43	3.00	1.77	2.42
PONY DC	9.43	3.00	2.96	5.38
DC	9.50	3.00	9.32	14.70
17-1/2" STAB	9.38	3.12	1.70	16.40
DC	9.43	3.12	9.41	25.81
PONY DC	9.43	3.12	3.30	29.11
17-1/2" STAB	9.50	3.00	2.16	31.27
2 EA DC	9.50	3.00	18.89	50.16
XO	9.50	3.13	1.79	51.95
2 EA DC	8.00	2.81	19.23	71.18
JARS	7.75	2.75	10.62	81.80
2 EA DC	8.00	2.81	18.81	100.61
XO	7.87	3.00	0.95	101.56

BHA No. 10 was the same as BHA No. 9. The PDC bit was changed and replaced with a Smith MSDGHC (mill tooth bit with center jet) and drilled to 2627 m RT.

ITEM	OD	ID	LENGTH	CUML
BIT NO. 10	17.50	--	0.44	0.44
BIT SUB	9.43	3.00	1.77	2.21
PONY DC	9.43	3.00	2.96	5.17
DC	9.50	3.00	9.32	14.49
17-1/2" STAB	9.38	3.12	1.70	16.19
DC	9.43	3.12	9.41	25.60
PONY DC	9.43	3.12	3.30	28.90
17-1/2" STAB	9.43	3.00	2.45	31.35
2 EA DC	9.50	3.00	18.89	50.24
XO	9.50	3.13	1.79	52.03
2 EA DC	8.00	2.81	19.23	71.26
JARS	7.68	2.75	10.62	81.88
2 EA DC	8.00	2.81	18.81	100.69
XO	7.87	3.00	0.95	101.64

BHA's No. 11 - 14 were similar to BHA No. 10 but an extra stand of 8" drill collars were put in below the jars to increase the available WOB. The bits used were Hughes MAX-11H insert (3 times) and a DBS GX-TD2060, PDC bit. The majority of the section was drilled with the first MAX-11H run (2849 m) before bit balling problems caused the section to be prematurely halted by 2880 m RT. No unusual torque or drag problems were experienced in this section.

ITEM	OD	ID	LENGTH	CUML
BIT NO. 11-14	17.50	--	0.42	0.42
BIT SUB	9.43	3.00	1.77	2.19
PONY DC	9.43	3.00	2.96	5.15
DC	9.50	3.00	9.32	14.47
17-1/2" STAB	9.38	3.12	1.70	16.17
DC	9.43	3.12	9.41	25.58
PONY DC	9.43	3.12	3.30	28.88
17-1/2" STAB	9.43	3.00	2.45	31.33
2 EA DC	9.50	3.00	18.89	50.22
XO	9.50	3.13	1.79	52.01
5 EA DC	8.00	2.81	47.37	99.38
JARS	7.68	2.75	10.62	110.00
2 EA DC	8.00	2.81	18.81	128.81
XO	7.87	3.00	0.89	129.70

12.4 Bits and Hydraulics

Bit No. 6 (Reed S11J) was used to drill the cement and float equipment in preparation for running a PDC bit in the upper 17-1/2" hole.

Bit No. 7 was an Eastman Christensen R523EG Eccentric PDC bit, designed to drill an 18" diameter hole. The bit was run at +/- 1100 gpm to provide maximum hole cleaning and still allow the Teleco MWD tool to function properly (max gpm for tool was 1150 gpm). The drillpipe pressures increased steadily from 1600 psi to 3000 psi while drilling the interval from 950 to 1903 m. The drillstring was pulled out of the hole at this depth and the Teleco MWD tool removed from the string to allow more circulation rate. Estimated Teleco pressure loss at 1050 gpm was 750 psi.

Bit No. 8 was a Smith 15LSCE (4-4-5 bit with two extended nozzles, one regular nozzle and a center jet). The bit drilled six meters in five hours and was pulled due to bit balling.

Bit No. 9 (Eastman Christensen, R426GN PDC bit with 3/4" cutters and 10 each 18/32 nozzles) was run in to 1909 m and drilled to 2423 m. Flowrate was 1050 gpm at 3400 psi. The mud pump liners were changed from 6-1/2" to 6" in order to pump at a higher pressure while drilling the deeper section of the 17-1/2" hole section. The bit drilled for 62.5 hrs and was pulled due to slow ROP. Examination of the bit on surface indicated that some bit balling had been occurring along with significant wear on the outer shoulder area.

Bit No. 10 was a Smith MSDGHC (IADC 1-3-9) with 3-22's and a 16 center jet nozzle. The nozzle area was decreased on this bit in an effort to improve bit cleaning and ROP. Instances of bit balling were minimal during this bit run. The bit was pulled after drilling for 25.5 hours and then experiencing a sudden drop in ROP apparently caused when the bit drilled into a hard limestone stringer.

Bit No. 11 was a Hughes MAX-11H (IADC 4-4-5M) with 3-18/32 nozzles and a 28/32 center jet. The bit drilled from 2627 to 2849 m. The bit proved well suited for the claystone/ shale formations being drilled. Hole cleaning and HSI (<0.8) became a significant problem by 2849 m when the bit suddenly stopped drilling. Bit condition was excellent and after cleaning the bit face and stabilizers, the bit was rerun as No. 12RR11. The bit continued drilling at the previous ROP before balling again by 2859 m RT. All attempts at unballing the bit, including water/caustic/nutplug viscous pills and variations in WOB/RPM, were unsuccessful.

Bit No. 13 was a DBS GX2-TD2060 (IADC 0615) PDC bit. The bit HSI could not be improved above 0.8 (pump limited). The shearing cutter action of the PDC bit was considered a solution to the soft sticky formation being drilled. The bit was started slowly with light WOB (10-15 klbs) in order to establish a pattern for the cutters. After attempting to drill with a light WOB and high RPM, a drill-off test was performed with no success in making the bit drill. The bit was pulled and found to have 3 plugged nozzles and 4 water courses packed with a gray-black shale/claystone.

Bit No. 14 was a rerun of the MAX-11H bit as a wiper trip before running casing.

12.5 Casing and Cementing Summary

See attached Well 2/5-9 - 13-3/8" x 13-5/8" Casing and Cementing Summary

Amoco Norway Oil Company

MEMORANDUM

To: E. Hansen
From: R. Munger
Subj: Well 2/5-9 - 13 5/8" X 13 3/8" Casing and Cementing Summary

Date: 17 October 1991
Ref: NO M 6017 (2/5-9)12 RM

HOLE SUMMARY

The 17-1/2" hole section was spud after drilling out the 20" casing shoe at 950 m. Drilling continued using a cationic polymer mud system until severe bit balling problems below 2840 m decreased ROP's significantly for both insert and PDC bits. The decision was made to set 13-3/8" casing after drilling to 2880 m. Logs were run and a wiper trip made to TD with no drag or hole problems seen.

CASING SUMMARY

Prior to and during the wiper trip the seal assembly running/BOP testing string was made up, the Multi-Purpose Running Tool (w/Jet-Sub) and Mill & Flush Adapter prepared, 4 Mid-Omega couplings removed for spares, the 13-3/8" Full Bore Casing Hanger Running Tool made up to the 13-3/8" hanger and the circulating swedge made up to its crossover. A pump test was performed from the mud pits to a stand-by boat to ensure the ability of the rig to transfer part of the +/- 1300 bbls mud returns during the cement job. Also, in the event of rough weather or transfer failure, a plan was devised to handle all anticipated volume increase with available pit space. The lead mixwater (chlorides checked - 400 ppm) and cement spacer were mixed in the pits.

The bore protector was pulled and hang-off point within 18-3/4" wellhead established at 87.87 m RT. Casing running equipment was rigged up and the DDM short bails changed out for the 500 ton long bails in order to facilitate the 3 plug loading procedure. The Tam packer fill-up tool was installed on the DDM. The Acme cement head crossover was then made up to the landing crossover (Mid-Omega pin x Buttress box) and the joint laid out. A pre-job safety meeting was held before casing running operations began. The 13-3/8" x 13-5/8" casing string running operations are outlined below.

The casing string to the Acme crossover consisted of:

1	-	13-3/8", SS-742 Plastic Float Shoe (W/ford)
1	jt	13-3/8", LS-125, 72 ppf, Butt.
1	jt	13-3/8", Q-125, 72 ppf, Butt.
1	-	13-3/8", SS-742 Plastic Float Collar (W/ford)
1	jt	13-3/8", LS-125, 72 ppf, Butt.
24	jts	13-3/8", Q-125, 72 ppf, Butt.
1	jt	13-5/8", Q-125, 88.2 ppf,Butt. pin x Mid-Om. box
203	jts	13-5/8", Q-125, 88.2 ppf, Mid-Omega
1	jt	13-5/8", Q-125, 88.2 ppf,Mid-Om. pin x New-Vam pin
1	-	Drilquip SS-15, 13-5/8" x 18-3/4" Casing Hanger
1	-	Drilquip SS-15, Full Bore Running Tool
1	jt	13-5/8", Q-125, 88.2 ppf,New-Vam pin x New-Vam box
1	jt	13-5/8", Q-125, 88.2 ppf,New-Vam pin x Mid-Om. box
6	jts	13-5/8", Q-125, 88.2 ppf, Mid-Omega
1	jt	13-5/8", Q-125, 88.2 ppf,Mid-Omega pin x Butt. box + Dowell Butt. x Acme crossover

The shoe joint was picked up at 03:00 hrs on Oct. 14th. Circulation was established through the float shoe joint (13-3/8", LS-125, 72 ppf, Butt.), a second joint (13-3/8", Q-125, 72 ppf, Butt.) run, and the float collar joint (13-3/8", LS-125, 72 ppf, Butt.) run next. All connections between the bottom 3 joints, float shoe and collar were Baker-locked. Fluid flow was confirmed through the float collar. The float collar joint was followed by 24 joints of 13-3/8", Q-125, 72 ppf, Butt. casing, filling every joint through the Tam packer. Side door elevators were used to handle and stab the casing. A safety clamp and single joint pick-up elevators were used to hold all of the above casing in the slips at the rotary table. Buttress connection torque averaged 9000 ft-lbs using API modified dope.

The 500 ton spider and elevators were rigged up and the 13-5/8", Q-125, 88.2 ppf, Butt. x Mid-Omega crossover run in the hole (final landed depth at 2525.43 m). The crossover was followed with 13-5/8", Q-125, 88.2 ppf, Mid-Omega casing until the casing shoe was at 2348 m. The Tam packer was used to fill each joint run. No significant drag was seen while running to this depth. Circulation was established and brought up to 140 spm (14.27 bpm) with no losses and a pump pressure of +/-375 psi. A maximum increase of 2 to 3 times normal cuttings load was seen at the shakers with returns cleaning up immediately after bottoms up. PU and SO weight both increased 20 Klbs between reaching circulation point and after bottoms up. Bottoms up gas peaked at 0.12%.

After circulating the hole clean the casing was then floated to bottom. 13-3/8", Q-125, 88.2 ppf, Mid-Omega casing was again RIH. With the string +/- 100 m off bottom, the Drilquip SS-15, 18-3/4" hanger/RT assembly (with pup jt. on either end) was picked up. The assembly was followed with a pup crossover (New-Vam pin x Mid-Omega box) and run to just above the BOP with 6 jts of 13-5/8", 88.2 ppf, Mid-Omega casing, plus the cement crossover joint. MU torque on the Mid-Omega connection averaged 20K ft-lbs to the triangle. Again, no excess drag was seen. One joint was rejected with a bad pin.

The string weight showed a PU of 297 MT and a SO of 231 MT (compensator maximum is 230 MT) which required the string to be set with the compensator on the beams. The 500 ton spider and slips were removed and the string was set 2 m above the calculated landing point. The string was compensated to the maximum of 230 MT and the bleed down valve left open on the compensator. Rig heave of +/-1 m with minimal roll was recorded. The casing string was lowered slowly to the hang-off point and landed on an up heave with the load ring shearing at 35 MT (set for 36.3 MT) at 87.87 m RT. A casing drop of +/- 1" was recorded. After removing the 500 ton elevators the cement head was made up to the Acme crossover and tied into the rig pump manifold.

The pumps were slowly brought up to 100 spm (10.2 bpm) with a standpipe pressure of 1500 psi until circulation was established after pumping 260 bbls of 14.5 ppg mud. Pumps were then increased to 140 spm (14.27 bpm) with no losses. The pump was shut down and a carbide pill inserted in the chicksan line. Circulation was again brought up to 140 spm and +/- 33% hole volume pumped. A second carbide pill was pumped and both pills circulated around. First indications of gas were seen after pumping 101% of calculated hole volume based on 18.46" equivalent hole diameter seen on the caliper log. C1 and C2 readings did not become indicative of the carbide pill until 111% of calculated hole volume had been pumped. Gas readings dropped after continued circulation and the second pill was never seen. After landing casing, a total of 4590 bbls (155% of circulatable volume based on caliper log) of 14.5 ppg mud was pumped (majority at 14.27 bpm) with no losses.

CEMENTING SUMMARY

The Dowell double plug cementing head had been loaded with a single bottom plug to pump in front of the spacer. Rig pumps were used to pump 5 bbls of 15.0 ppg Mudpush spacer. The bottom plug was released followed by another 5 bbls of spacer. Bottom and top cementing plugs were loaded into the cementing head. The rig pumped the remaining 140 bbls 15.0 ppg lead spacer after which the rig pump lines were pressure tested to 3500 psi. The rig pump manifold was isolated from the Dowell line and 800 psi backpressure applied. A 5 liter mixwater sample was taken from the pits. Mixwater samples were also taken at the Dowell mixwater tanks after liquid additives were mixed in.

The Dowell unit was used to pump 5 bbls mixwater to clear the lines to the rig floor. The line to the rig floor was then tested to 5000 psi. The bottom plug was released and mixing begun on the lead slurry at 17:25 hrs. Chloride level in the lead mixwater was tested at the Dowell mixwater tanks and found to be 400 ppm. Lead mixwater liquid additives were added using the Dowell L.A.S.system.

The lead Slurry consisted of the following:

Class G cement
+ 0.50% (BWOC) prehydrated D20 (bentonite)
+ 0.01 gps D47 (de-foamer)
+ 0.10 gps D81 (retarder)
+ 5.28 gps fresh water

Weight : 15.5 ppg
Yield 1.2 cuft/sx

The total volume of mixing water (including liquid additives) was 581 bbl, resulting in a calculated 4510 sxs of cement. The total slurry volume pumped was 967 bbls. The average pump rate over the entire lead job was 5.2 bpm, however sustained pump rates were achieved at 6.5+ bpm. After initial calibration, the Dowell PACR densimeter, VIP automatic slurry mixer densimeter and the pressurized mud balance reading agreed within 0.1 ppg throughout the job. Slurry density pumped downhole was strictly maintained between 15.4+ and 15.6 ppg. One slowdown and 4 shutdowns were experienced during the job directly attributable to rig cement deliverability. All shutdowns lasted less than 2 minutes with no appreciable lowering in density of cement pumped downhole. Feed rate was quickly re-established. Cement deliverability was significantly improved compared to the 2/8-14 well.

Immediately prior to pumping the tail, the mixwater was checked for chlorides content (1000 ppm). Chlorides were checked again with the same reading. This level was considered within the acceptable range of drillwater. The chemical additives were added entirely at the Dowell mixwater tanks using the L.A.S. system. Samples were taken of tail mixwater at the Dowell mixwater tanks. The tail slurry was pumped and consisted of the following:

Class G cement
+ 0.01 gps D47 (defoamer)
+ 0.15 gps D604
+ 0.05 gps D81
+ 4.82 gps fresh water

Weight : 15.8 ppg
Yield 1.15 cuft/sx

The total volume of mixing water (including liquid additives) was 70.2 bbls, resulting in a calculated 586 sxs of cement. The total slurry volume pumped was 117 bbls. The average pump rate over the entire tail job was 4.5 bpm. Slurry density pumped downhole was strictly maintained at +/-15.8 ppg. Again, all three density measuring devices were within 0.1 ppg.

The VIP automatic slurry mixer was recently installed on the West Vanguard. The unit provides an automatic density control which allows a faster bulk tank gate valve response to fluctuations in cement hopper density outside of the desired weight. This is extremely helpful in maintaining a desired density during fluctuations common in the cement delivering system on the West Vanguard. Cementing operations were significantly improved in both execution and average density control over similar jobs on the 2/8-14 well.

The top plug was released "on the fly" with 3 bbls tail slurry left in the Dowell tub mixer. The Dowell pump was switched directly to the mixwater tanks and 15 bbls lead mixwater (gel + DW) pumped behind the top plug to flush the lines. The rig pumps were brought on line and used for the remainder of displacement. Pumps were slowly brought up to 10.2 bpm (100 spm - 1500 psi) until the tail slurry was caught at +/- 51 bbls (500 strokes) pumped on the rig pumps. Pump rate was increased to 14.27 bpm (140 spm - 2600 psi) until a total of 1300 bbls (12757 strokes - 3200 psi) had been pumped. The pump rate was then reduced to 8 bpm (79 spm - 1650 psi) until a total of 1350 bbls (13247 strokes) had been pumped. The pump rate was reduced to 2 bpm (20 spm - 630 psi) for the remainder of calculated displacement to 1376 bbls (13502 strokes). No plug bump was seen so another 6 bbls (1/2 shoe track) was pumped, again with no plug bump seen. Total displacement behind the top plug was 1397 bbls using an efficiency of 97.2% for the rig pumps. Returns were full throughout the job, however PVT readings indicate a possible slow mud loss near the end of the 14.27 bpm displacing phase. A 25 bbl loss was recorded for the entire cement job. Final displacement pressure at 2 bpm was 750 psi. Final static pressure was 626 psi and was held for 5 minutes before being bled off. Floats held and the cementing equipment was rigged down while flushing the choke/kill lines and riser. No cement or spacer was seen in the returns. The hanger was released with 11 right hand turns and the running string POOH with no significant overpull. A mill and flush run was made to the hanger, however worsening weather required the assembly to be pulled and operations suspended. Tail cement samples in the Exlog oven at 180 deg. F were hard after 7-1/2 hours.

CONCLUSIONS

1. Cement deliverability continues to fluctuate unevenly.

2. VIP unit performed extremely well in constantly adjusting bulk tank gate aperture to provide designed cement density.

3. A rig pump efficiency of 97.2% was used in displacing the cement top plug without the plug bumping. Some intermittent loss of prime (pressure fluctuation) was experienced during the final 40 bbls of displacement which would have negatively affected the stroke/volume relationship. The rig toolpusher has stated that his experience has shown that a pump efficiency of of 96.7% is more accurate. On this job a pump efficiency of 96.7% would have been equal to the final total displacement including the 1/2 shoe volume pumped. Drill out will determine how close the plug was to bumping.

4. Final string weight exceeded the motion compensator rating which prevented a compensated landing.

5. When tested on a sampling of 13-5/8" casing, the sidedoor elevators would not latch on all joints and had to left out of casing running operations (500 ton elevators used instead).

RECOMMENDATIONS

1. Continue using the Dowell VIP automatic slurry mixer to optimize slurry density control and handle cement deliverability fluctuations.

2. Use a 96.7% pump efficiency for future cement displacement operations. This would more closely match rig experience and with the 1/2 shoe volume excess, increase the chance of plug bump

even with the intermittent loss of prime.

3. Float casing in when indicator string weight reaches 230 MT (rig compensator rating).

4. Use long bails (15 ft.) to run casing. This will allow a more efficient running operation.

R. T. Munger

RTM: rtm

cc: H. H. Prewett
M. D. Broussard
E. Hansen
Drilling Team, West Vanguard

92020STA0132

Amoco Norway Oil Company

MEMORANDUM

To: Final Well Report **Date:** 22 October 1991

From: T.W. Beihoffer **Ref:** NO M 5858 400 (2/5-9)1 TWB/HHP

Subj: Observed problems and action plan for well 2/5-9, 17.5" hole section.

Hole Instability

Wellbore instability was observed in the upper portion of the hole section. The hole began to cave in resulting in a temporary stuck pipe situation at a depth of 1380 Meters (TD at that time was 1903 M). Caving continued for most of the section and decreased as mud weight was increased. The cavings consisted initially of thin, concave shale pieces indicative of insufficient mud weight. Later in the section, the cavings became larger and more square with some large "fist" sized pieces.

INSUFFICIENT MUD WEIGHT?

The cavings observed while drilling to 1900 meters were thin concave splinters characteristic of insufficient mud weight. At approximately 1900 meters, the mud weight was raised from 12.5 to 13.5 and then to 14.2 in an attempt to reduce the cavings. The increase in mud weight significantly reduced the cavings and reduced drilling problems. Cavings were observed again several days later and a further increase in mud weight (to 14.5) again reduced cavings and improved drilling conditions. At TD the hole condition was excellent as determined by low drag wiper trips and lack of hole fill.

The caliper log from the section found that the hole enlargement below 1900 M is significantly less than above. This also suggests that the hole section above 1900 M was drilled with insufficient mud weight.

ACTION PLAN

Pore pressure evaluation using log data from the well is in progress. Initial results suggest that the interval, from 1600 - 1800 meters was drilled underbalanced. This correlates with the worst washout in the caliper log. Consideration should be given on future wells to provide faster response times to allow mud weights to be increased when hole instability is observed.

BELOW SPECIFICATION DRILLING FLUIDS?

The potassium chloride concentration specified for the 2/5-9 well is 10%. It was discovered that a calibration error on the Anchor Drilling Fluids potassium ion probe resulted in an actual potassium concentration of 6 to 7%. The potassium concentration was below specification from drillout of 20" casing to a depth of approximately 1397 M.

The error resulted from the use of improperly formulated electrode calibration standards supplied by anchor's laboratory. Attempts to increase the potassium concentration to 10% was hindered by the inability to add solid KCI directly to the active system. The KCI on the rig was supplied as brine and in "big bags". The use of brine to increase the potassium concentration resulted in unwanted dilution. The big bags were too large to be maneuvered into position to allow addition into the hoppers.

During the confusion generated by the below specification KCI, the cationic polymer concentration also fell below specification (5 lb/bbl) to 1 lb/bbl in the fluid.

The attached chart diagrams the concentrations of the KCI and cationic polymer for the hole section. The chart indicates that control of the KCI and cationic polymer concentrations was regained by 1400 Meters (some of the variation in concentration was caused by the use of firehoses on the shale shakers causing "thin spots" in the system). The continued hole enlargement encountered after 1400 M suggests that the hole problems were not caused by below-specification fluid.

RECOMMENDATION

It is recommended that on future wells that the mud company be required to maintain an extra set of standard solutions for calibrating the ion probe. In addition, materials to allow the formulation of calibration standards should also be maintained on the rig. The use of the ion probe to measure potassium concentration in the filtrate is an accepted mud maintenance procedure (API approved; API RP-13B) and it is reasonable to expect a mud company to perform the analysis without problems.

EXCESSIVE KCI CONCENTRATION?

There has been some discussion on the possibility that the hole instability is a result of some shales being destabilized by a KCI concentration that is too high.

A saturated solution of KCI (approximately 24%) in water lowers the activity of water from 1.0 to 0.85. This water activity is not low enough to dehydrate shale and cause caving. An oil mud with a calcium chloride concentration (in the water phase) of 30% lowers the activity of water from 1.0 to 0.55. Such oil muds are routinely used in this area and problems with shale instability caused by dehydration are not observed.

There is a possibility that KCI could destabilize shales by some other unknown mechanism but it is more likely that the hole problems on the 2/5-9 well were caused by conventional mechanisms (i.e, shale hydration, insufficient mud weight etc.).

Hole cleaning

Observations on the rig indicated that hole cleaning was insufficient. Evidence for this was: gumbo and cuttings "attacks", sticky cuttings, insufficient amounts of cuttings on shakers vs hole drilled and drag on wiper trips. The sticky cuttings and gumbo attacks appeared to result from the cuttings spending too much time in the hole, i.e., the more time spent in the hole, the softer and smaller they become. Gumbo attacks appeared to result from the agglomeration of soft cuttings into a large mass that is extruded from the hole when it becomes large enough to restrict fluid flow in the annulus.

The hole cleaning was improved by boosting the riser and by running sweeps. The incidence of gumbo attacks decreased as hole cleaning was improved.

INSUFFICIENT PUMP CAPACITY?

Throughout the hole section, the mud flow rates were limited by pump capacity. In the upper hole section, flow rate was further limited by the use of a MWD tool that increased pressure drop and reduced flow rate. The tool was removed after the stuck pipe incident to improve flowrate. Maximum flow rate for the section was 1120 gpm. Minimum flow rate was 880 gpm at TD of the section. The flowrate was lower at all times than in the 17.5 inch section on the Valhall well.

Cuttings removal from the riser was enhanced by boosting with the Dowell cement pump and the mud shear pump. The incidence of gumbo attacks decreased when the riser was boosted regularly.

RECOMMENDATIONS

If possible, rigs with 3 mud pumps should be used to drill wells with deep 17.5 inch hole section.

The riser should be boosted continuously during the hole section to improve cuttings removal and reduce gumbo attacks.

Flow rates should be optimized for the 17.5 inch section by careful consideration of the pressure drops associated with MWD tools, bit jetting etc.

LESS THAN OPTIMUM HOLE GEOMETRY?

The surface casing on the 2/5-9 well was 20" rather than the 18 5/8" used on the Valhall well. The larger diameter casing plus the use of smaller drillpipe (5" vs 6 5/8") resulted in annular velocities in the casing that were significantly less than those attained on the Valhall well (75 ft/min vs 90 ft/min at 1000 gpm). The longer riser (20" ID) used on the 2/5-9 well (90 M vs 10 M at Valhall) also hindered the ability to clean the hole.

RECOMMENDATIONS

On future wells use 6 5/8" drillpipe to improve annular velocities in the casing and riser.

Consider the use of 18 5/8" surface casing to improve annular velocity.

Consider the use of 16" bits to improve annular velocities in the open hole.

LESS THAN OPTIMUM FLUID RHEOLOGY

There was considerable discussion on the correct fluid rheology to optimize hole cleaning. A high yield point was desired to help transport cuttings but may also reduce circulatable hole volume. The effect of bottom hole temperature on fluid rheology was also a concern.

ACTION PLAN

Tulsa Research is currently evaluating the high temperature rheology (Fann 50) of CBF and comparing it with other waterbased drilling fluids. When this work is completed, a recommendation will be made on the optimum rheology for the CBF system in a 17.5 inch hole section.

SWEEP PROGRAM

A variety of sweeps were run to improve hole cleaning. The most effective sweep (as evidenced by a visual determination of cuttings volume) was a combination fo a 75 bbl low viscosity sweep (9.0 lb/gal; 35 lb/bbl KCL + ancoquat I) followed by a 75 bbl high viscosity sweep (18 lb/gal; active mud + XCD + Barite). The barite added to the high viscosity sweep offset the unweighted low viscosity sweep. The combination sweep was more effective than either sweep alone.

RECOMMENDATION

Sweeps should be pumped at 75 to 125 meter intervals throughout the 17.5 inch hole section to assist in hole cleaning. The sweep interval should be adjusted to suit drilling/hole conditions. Walnut shells can be added to the low viscosity sweep to help detect when the sweep has reached the shale shakers.

Bit Balling

Bit balling was observed in the lower half of the hole section. Balling was observed on both PDC and tricone bits. The bit balling caused very low penetration rates (less than 2 meters/hour) during the last several days of drilling. A variety of pills were pumped in attempts to clean and or lubricate the bit to speed up drilling. Pills included Nutplug (walnut shells, abrasive cleaning action), Drilling Mud Detergent, PHPA and caustic. None of the pills cured the bit balling.

INSUFFICIENT HYDRAULICS?

The flow rates in the lower half of the hole section were lower than desired (800 - 1000) due to the lack of pump capacity. It is well known that insufficient hydraulics at the bit can cause bit balling problems.

ACTION PLAN

The first 25 meters of the 12.25 inch hole section will be drilled with CBF to determine if insufficient hydraulics is responsible for the bit balling and low penetration rates.

Determine which aspect of the hydraulics influences bit balling the mos, i.e., flow rate or hydraulic horsepower at the bit. Determine what is known about the effect of bit type (PDC or Tricone), bit design (profile, number of blades, etc.) and jetting on bit balling. Develop guidelines to select the optimum bit for use when flowrate is limited.

IS CBF CHEMICALLY PROMOTING BIT BALLING?

If the above experiment indicates that low hydraulics is not responsible for the bit balling, it is possible that CBF may be chemically promoting bit balling.

ACTION PLAN

Samples of shale cuttings and balled clay from the bits have been taken and sent to Tulsa Research for analysis. This may provide information as to the chemical mechanism caused the bit balling. Studies can then be initiated to duplicate the balling phenomenon at the Catoosa, OK Field Testing Facility. Drilling fluid additives (i.e., detergents, lubricants, etc.,) can then be evaluated under actual drilling conditions for their ability to reduce bit balling.

IS THE OVERBALANCE IN MUD WEIGHT CONTRIBUTING TO BIT BALLING?

Pore pressure evaluation using log data from the well indicates that the lower part of the section is overbalanced by approximately 1.5 lb/gal. This also may have caused the reduced penetration rates and bit balling.

ACTION PLAN

The density of CBF will be reduced from 14.5 to 14.0 lb/gal prior to drilling 25 meters of the 12.5 inch section.

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TWB/HHP: bi

92066STA0016

Subject: 12-1/4" Hole Section Summary

13.1 Operational Summary

A 12-1/4" bit and BHA No. 15 was run in the hole to drill out cement and perform a LOT on the 13-5/8"/13-3/8" casing shoe. Soft, contaminated cement was tagged at 2732 m and washed down to 2760 m where hard cement was confirmed. The small clearance around the casing scraper in the BHA caused a limitation to circulation rates. High rates caused the bit to be "pumped" off bottom as was indicated by the decrease in string weight and the increase in pump pressure.

The casing was successfully tested to 5800 psi after drilling out cement to the float collar at 2846 m. Drilling of the cement, cement plugs and float collars took 7.5 hours and drilling the plugs alone took 1.5 hours.

The shoe was then penetrated and 3 m of new hole drilled to a TD of 2883 m. A LOT test was performed after circulating and conditioning the mud for a consistent mud weight of 14.0 ppg. Pressure testing of the shoe yielded a 16.9 ppg EMW integrity. This value was higher than the minimum acceptable value of 16.5 ppg EMW as set out in the original drilling program. The shallower than planned casing point would not have a significant impact on the subsequent 11-3/4" or 9-5/8" casing points.

Drilling continued for a planned 25 m to test the CBF mud's performance in a smaller hole with more optimum circulation rates versus the poor hole cleaning flow rates in the larger 17-1/2" hole section. Initially, the Hycalog DS47H bit appeared to ball up, so care was taken to prevent further balling. This was accomplished and 17 m of hole was drilled in 2.5 hours at an average penetration rate of 6.9 m/hr. The penetration rate dropped to 5.7 m/hr after 17 m and the bit was pulled to perform cased hole logging. The CBF mud in the hole was displaced with a PHPA/KCL mud after logging operations were completed (CBL and casing caliper). The same 12-1/4" bit was re-run on BHA No. 16. The bit ROP increased from 5.7 m/hr with the CBF mud to 9-10 m/hr after the new mud had been placed in the hole. Based on this experience it appears that a conventional PHPA mud has less of a tendency for bit balling than the CBF style mud system.

Drilling began at 2897 m and continued to 3277 m, 20 m into the Chalk, where the bit started to torque badly. The drillstring was pulled and the bit was replaced with a Diamond Boart TD290Q "Quattro Cut" PDC.

Drilling continued with the Quattro Cut bit to 3730 m where a wiper trip was started. Backreaming was necessary on the first three stands which experienced 70 Klbs overpull. On the fourth stand, the drillstring became stuck at 3651 m. Full circulation was maintained and jarring on the pipe initiated. The mud weight was dropped from 14.0 to 13.4 ppg in attempt to free the pipe if differentially stuck. This did not work and an unweighted 45 bbl "Free Pipe" pill was spotted around the BHA. The pipe came free after only 25 minutes of soak time. The pill was circulated out and stored in the reserve pit.

Backreaming out of the hole continued. The hole showed no torque or drag below where it had been backreamed, but stalled the rotary when being pulled up into "old" hole which had not been backreamed. At 3563 m, the drillstring became stuck again but full circulation was still maintained. Jarring was started immediately, concentrating on jarring down. After jarring 5.5 hours, a 65 bbl pill of 15% HCl acid was spotted around the BHA, with 20 bbls left inside the pipe. The acid pill was moved 10 bbls every hour. This did not free the drillstring and the acid was circulated out of the hole through the choke manifold as a precautionary method.

By this time, more Pipe Free had arrived on location and a 75 bbl pill was mixed and spotted around the BHA, with 25 bbls left inside to be moved at a rate of 1 bbl every hour. After 12 hours of jarring, the drillstring became free and the pill circulated out of the hole.

The well still showed no torque or drag below where backreaming had taken place, but stalled the rotary on the way out. Backreaming continued from 3563 to 3271 m taking 26.5 hours, for an average of 11 m/hr. At 3271 m, the pipe was free to pull out of the hole without backreaming and was pulled inside the 13-5/8" shoe where the drill line was slipped and cut.

After pulling the bit out of the hole, most of the drill collars, stabilizers, Teleco tool and the jars were changed out as a precautionary measure.

A new TD290Q bit was made up and BHA No. 18 tripped in the hole after testing the BOP's. Precautionary wash and ream was exercised from 3649 to 3730 m (TD). The rotary stalled at 3670 m with 35 Klbs drag on pick up. Drilling continued to 3845 m. At this point, high rotary torque was experienced on and off bottom, so the mud weight was increased from 13.4 to 13.9 ppg.

A wiper trip was then performed from TD to 3650 m, with the trip back to bottom showing no drag. Drilling continued to 3860 m while increasing the mud weight to 14.5 ppg as a precautionary step in anticipation of the transition zone in the Lower Cretaceous.

Drill rate averaged 7 m/hr to 3951 m where a wiper trip was performed to 3770 m while replacing a fluid end on mud pump #1. Eighteen joints were also laid down to facilitate drilling with singles instead of stands as "High Pressure - High Temperature Alertness Level 2 was enacted.

Drilling continued from 3978 to 4022 m while increasing the mud weight from 14.5 to 15.0 ppg in anticipation of the transition zone. When the depth reached 4070 m, control drilling on HPHT

Alertness Level 3 started. This, among other things, called for limiting the amount of cuttings in the hole to only 8 m at any one time. This slowed the overall average footage per day due to circulating lagged cuttings out of the hole to abide by these parameters.

Level 3 drilling continued to 4099 m, where the decision was made to limit the cuttings in the hole to only 5 m at any one time. The Lower Cretaceous had been penetrated and the upper half was missing. Thus, the Jurassic was expected to come in higher than expected. Dummy connections were made every half joint to check for connection gas increases. Background gas was 0.3% to 0.5%. Flow checks were made for ROP increases or variances in mud volumes of greater than 1/2 barrel.

The Jurassic was confirmed at 4131 m by samples and the MWD gamma ray readings, which identified the Kimmeridge Clay. Drilling was stopped at 4150 m to run a VSP "look ahead" log to determine the correlation to the seismic section and the location of future reflectors. This evaluation could also indicate the proximity to the anticipated pressure transition. A wiper trip to the shoe at normal speed showed no drag and a precautionary wash and ream from 4122 to 4150 m found only a minor tight spot 4 m off bottom. Short trip gas was 0.31% and dropped to 0.14%. On the trip out to log, the well was checked for flow at the 13-5/8" shoe prior to resuming the trip per HPHT awareness guidelines.

A Read VSP was rigged up on Schlumberger wireline and run in the hole with no difficulties. Zero offset and walk away logging was completed in 25 hours from rig up to rig down. Schlumberger GR\MSFL\SONIC\LDL\DLL\CAL log was run next and experienced no hole problems, but some tool problems. The Schlumberger logging time required 13.5 hours from rig up to rig down.

BHA No. 19 was run in the hole with a Reed HP51C tungsten carbide insert bit to resume drilling. The hole was washed and reamed as a precautionary measure from 4087 to 4150 m and relogged with the MWD from 4115 to 4150 m. One meter of fill was seen on bottom.

A Level 3 kick alertness action plan was in effect while drilling the interval from 4150 to 4173 m. Three meters of new hole was drilled and then circulated out as a precautionary measure before drilling the next three meters. A three barrel pit gain was recorded at 4173 m and this gain was circulated out with no indications of fluid/gas inflow. Drilling ROP during this interval was +\- 3 m\hr. The interval from 4173 to 4271 m was drilled at an average ROP of 4.5 m/hr. A drilling break at 4271 m was closed in at the BOP's and +\- 25 psi read on the choke gauge. The well was circulated out and the total gas reading was 0.7%. Drilling continued to 4324 m with intermittent drilling breaks of 7-9 m/hr. The drilling breaks were usually 1-3 m in length. The drilling plan was modified to allow +/- 5 m of formation in the annulus and only one dummy or actual connection in the hole at any time.

A wiper trip to the 13-3/8" shoe was made after drilling to 4324 m. The bit and drillstring had been drilling for five days without a trip. The hole conditions during the trip were good and the maximum overpull seen was at bottom and was 50 Klbs. After returning to bottom, the well was circulated and the maximum gas reading was 2.8% (compared to +/- 0.3% BGG). At this time, a substantial amount of slivered shale was seen coming over the shale shakers. This was the first instance that this type shale cutting had been seen in the 12-1/4" hole interval.

Limestone stringers (+/- 3 meters thick) at 4250 m and hard dolomite stringers (3-10 meters thick) at 4300 m drilled at very low ROP's. The drilling rate would drop to less than 1 meter per hour while drilling these stringers and then increase to 3-4 meters per hour while drilling the claystone sections between the stringers.

Drilling continued to 4372 m and the bit was pulled due to low ROP. BOP's were tested, drill line slipped and BHA items replaced during this bit trip. Upon returning to bottom, nine meters of fill was found. The hole was washed to 4372 m. Cuttings analysis of the bottoms-up samples revealed +/- 25% splintery cavings (no appreciable gas was seen at this time). While circulating the bottoms-up mud sample through the choke, a 15-barrel mud loss was measured. An open hole leak off test was performed and a 16.3 ppge leak off measured (assuming 4100 m depth). The original leak off was 16.9 ppge at the 13-3/8" shoe (2872 m). The depth of the "weak zone" was not known but a dolomitic limestone stringer at 4100 m was assumed as a worst case scenario and was used for calculating MAASP and kick tolerances.

Drilling operations from 4372 to 4407 m were with an Eastman Christensen S225 TSD bit at ROP's ranging from 2 m/hr to 6 m/hr. A Level 3 drilling plan (maximum alertness) was in effect which called for tightened drilling and trip monitoring operations.

Mud losses of +\- 4 BPH were observed while drilling from 4407 to 4444 m. A small increase in background and connection gases was also seen at this time. A swab test was made at 4444 m with minimal bottoms up gas reported.

The 12-1/4" hole continued to 4478 m (+/- 5 meters above the seismic red reflector at 4480 m). A wiper trip was made to the base of the Chalk and a complete bottoms up circulation made after returning to bottom. Gas readings from 4478 m were less than 1%.

Seven meters of hole were drilled to 4485 m and mud losses increased to +/- 15 bbl/hr. A 100 bbl LCM pill containing 25 ppb Fine Mica, 25 ppb Fine Nut Plug and an additional 3 ppb bentonite was spotted at TD and the drillstring pulled to 4200 m. The mud weight was cut to 14.5 ppg in an effort to minimize the downhole losses. Hole conditions deteriorated after the mud weight was cut to 14.5 ppg and the drillstring had to be backreamed to 3950 m. The mud weight was increased to 14.8 ppg while circulating to try and re-stabilize the hole. The drillstring was washed and reamed back to bottom using the 14.8 ppg mud. Mud losses continued at 2-6 bph. The ROV was used to inspect the riser and BOP for leaks, none were found.

A 100 bbl LCM pill consisting of 10 ppb Liquid Casing + 3.5 ppb Kwik-seal medium + 11 ppb Kwik-seal fine + 20 ppb Mica + 2.5 ppb Nutplug coarse + 10 ppb Nutplug fine was spotted in the annulus from 4485 to 4165 m. The LCM pill was pumped up the annulus in 100 bbl increments with 30 minute stopping intervals between stages. After passing the open hole section, the pill was circulated to surface and incorporated in the mud system. No appreciable change in the mud losses was seen after pumping this pill.

The 12-1/4" hole was continued to 4525 m under Level 3 drilling conditions. Mud losses remained in the 5-10 bph range and LCM material (Liquid casing, Nut plug and Mica) was maintained in the mud system. The VSP data had been processed in a "look ahead" format in an attempt to estimate the depths of the upcoming major reflectors. The actual format of the look ahead log was delta T in microseconds per foot versus depth. These reflectors had been identified as the Yellow (anticipated primary reservoir) and the Red (secondary reservoir) reflectors. The projected depths, based on the VSP log were 4320 m and 4480 m, respectively. The objective of the 12-1/4" section then became the evaluation of these two primary reflectors. The overall character of the look ahead data did not suggest an imminent and severe pressure transition, therefore drilling continued to 4525 m. Drilling ahead was considered safe because the velocities were thought to be slower than even gas filled sandstone. Based on this, and the fact there was good reason to suspect that the reflectors may be associated with lithology changes, drilling continued. It was felt that both reflectors were exposed and due to the persistent partial losses, it was decided to stop drilling, log and set 9-5/8" casing.

After drilling to interval TD of 4525 m, the hole was circulated, a wiper trip made to the 13-3/8" shoe and the drillstring pulled out of the hole to log. A carbide pill was pumped while on bottom and indicated an average hole size of 13" for the open hole interval.

Schlumberger wireline equipment was rigged up and log run #1 (PIL/MSFL/GR) was run from interval TD to 4000 m. Log run #2 (QSST/NGT/CNL/LDL/ARRAY SONIC) was run from TD to 3950 m. Log run #3 consisted of the FMS/GR and was run from TD to 2872 m. The final wireline run was the RFT tool. Twenty four RFT pressures were attempted from 3342 to 4315 m (4-good, 13-tight, 4-seal failures and 3-aborted). Recorded pressures were 13.2 ppge at 3342 m, 12.4 ppge at 3438 m, 12.6 ppge at 3656 m and 14.3 ppge at 3895 m (No RFT's were possible in the Jurassic section). Mud losses continued at +/- 8 bbl/day while logging. No indications of wellbore problems were seen while running any of the logging tools.

The QSST (Quick Shot Seismic Tool) confirmed that the actual depth of the Yellow reflector was 4257 m and the Red reflector was at 4382 m. The predictions for these reflectors based on the VSP were quite different. A comparison of the predicted sonic travel time versus the actual sonic log also showed substantial quantitative differences. However, the two curves showed some qualitative similarities and were correlatable to a certain extent.

After logging, a conditioning trip was made to TD. A maximum gas reading of 4.05% was measured while circulating bottoms up mud. No drag was recorded but 3 meters of fill was recorded on bottom. The drillstring was pulled out of the hole to run 9-5/8" casing and total mud losses during the trip were 8 bbls. The wear bushing was pulled prior to running the 9-5/8" casing and no appreciable wear was seen upon examination.

13.2 Mud Summary

The 14.1 ppg Cationic Brine Fluid mud from the previous hole section was used to drill out the 13-5/8" casing and a scheduled 25 m of new hole to test its effectiveness on drilling with more optimum hydraulics and hole cleaning. After initial balling of the bit was remedied, the mud worked reasonably well until the ROP dropped at 2897 m.

The CBF mud was displaced with a 14.0 ppg KCl/PHPA mud after a trip out to log and change the BHA. An 83 bbl weighted (14.0 ppg) spacer of salt water, KCl and XCD polymer was pumped ahead of the new mud.

The system was maintained from initial displacement at 2897 to 3729 m by adding 20-30 bbl/hour of premix to control rheology and MBT. The PAC SL concentration was increased to 1.4 ppb in the active system to decrease API Filtrate and a 1.5 ppb concentration of Anco Resin to decrease HTHP fluid loss. Also added was 0.25 ppb Ancotemp directly to the active system and 0.7 ppb to the premix to control YP. The centrifuge was started in the barite recovery mode. Both Thule shakers were used with 10/100 mesh screens.

At 3729 m a wiper trip was initiated. The pipe became stuck with the bit at 3652 m. The mud weight was reduced from 14.1 ppg to 13.4 ppg as differential sticking was thought to be the cause. When drilling resumed after the pipe was freed, the same mud properties for 14.1 ppg mud were adhered to for the 13.4 ppg mud. The mud weight was increased to 13.9 ppg at 3845 m due to high torque on and off bottom. The mud weight was further increased to 14.5 ppg at 3860 m in anticipation of the transition zone.

Drilling continued with additions of premix to maintain flow properties and fluid loss control. This was done only while circulating samples out of the hole and not during drilling to help in monitoring total mud volume for possible pit gains. The active system volume on the surface was reduced to 150-200 bbls (maximum) also to help in monitoring possible gains in the system.

At 4150 m, the well was circulated prior to pulling out of the hole for logging. The mud was treated with premix additions (5%

dilution) and the centrifuge run with 50 bbls of 11.5 ppg effluent dumped. A sample of the conditioned mud was taken from the flow line before circulation stopped and a 20 hour static aging test started. Temperature used for the test was 300 deg F.

Mud properties and static aging tests continued to remain constant while drilling the interval from 4150 to 4485 m. Static aging tests of 20 to 48 hrs at 300 degrees F were performed daily. Ligthin was added to the mud system at 2 ppb after running pilot and static aging tests. The Ligthin was added to the new HTHP premix and bled into the system while drilling. The addition of this chemical reduced the 10 minute gel strengths by +\- 5 lb/100sqft.

At 4296 m, the static aging test temperature was increased to 310 degrees F, based on temperature gradients. The temperature was increased to 315 degrees F for the sample taken at 4462 m and this temperature remained constant for the remainder of the static aging tests through 4525 m.

A premix tank was blended with 14.8 ppg mud and 5 ppb Mica, 5 ppb Nutplug fine and 8 ppb Liquid casing. This mixture was gradually added to the system while drilling.

The mud system stayed in good condition during the entire 12-1/4" interval. Bottoms up mud after logging (79 total hrs without circulating at TD) tested favorably and the rheological properties remained level.

13.3 Bottom Hole Assemblies

BHA No. 15 was used to drill out the 13-5/8" x 13-3/8" casing cement, shoe, 3 m of new hole and 17 m of new hole with the CBF mud prior to displacement with the KCl/PHPA mud.

ITEM	OD	ID	LENGTH	CUML
Bit No. 15	12.25	----	0.45	0.45
Bit Sub	8.00	2.87	1.77	2.07
4-8" DC	8.00	2.81	36.38	38.45
Csg Scraper	7.68	3.50	1.50	39.95
9-8" DC	8.00	2.81	83.44	123.39
Jars	7.87	3.00	9.62	133.01
2-8" DC	8.00	2.81	18.81	151.82
X/O	8.00	2.75	1.60	153.43
1-HWDP	5.00	3.00	9.17	162.59
Dart Sub	6.37	2.81	0.69	163.28
14-HWDP	6.37	3.00	125.62	288.90

BHA No. 16 was used to drill the remaining Eocene section from 2987 m to the top of the Chalk at 3258 m before being pulled for a worn bit at 3277 m. Directional surveys were taken using the Teleco MWD with angle increasing from 0.73 degrees below the casing to 1.46 degrees in the Eocene\Paleocene, then decreasing to 0.95 just before the Chalk was penetrated.

ITEM	OD	ID	LENGTH	CUML
Bit No.16(15R)	12.25	----	0.30	0.30
NB Stab(Float)	12.25	2.87	1.72	2.02
Short DC	8.00	2.25	3.55	5.57
Stab	12.25	2.87	1.87	7.44
PxP Sub	8.25	2.81	1.26	8.70
MWD (GRD-Raw)	8.25	----	11.84	20.54
Saver Sub	8.25	2.81	0.70	21.24
Stab	12.25	2.87	1.48	22.72
12-8" DC	8.00	2.81	110.71	133.43
Jar	7.87	3.00	9.62	143.05
2-8" DC	8.00	2.87	18.81	161.86
X/O	6.50	2.75	1.60	163.46
1-HWDP	5.00	3.00	9.17	172.63
Dart Sub	6.37	2.81	0.69	173.32
14-HWDP	5.00	3.00	125.62	298.94

BHA No. 17 was the same as No. 16. The mill tooth bit was replaced with a Diamond Boart TD290Q "Quattro Cut" PDC bit. This assembly was used to drill from 3277 to 3730 m where a wiper trip was started. The drill string became stuck twice trying to pull out of the hole in the Chalk, a process which required the entire Chalk section to be backreamed.

ITEM	OD	ID	LENGTH	CUML
Bit No.17	12.25	----	0.45	0.45
NB Stab(Float)	12.25	2.87	1.72	2.17
Short DC	8.00	2.25	3.55	5.72
Stab	12.25	2.87	1.87	7.59
PxP Sub	8.25	2.81	1.26	8.85
MWD (GRD-Raw)	8.25	----	11.84	20.69
Saver Sub	8.25	2.81	0.70	21.39
Stab	12.25	2.87	1.48	22.87
12-8" DC	8.00	2.81	110.71	133.58
Jars	7.87	3.00	9.62	143.20
2-8" DC	8.00	2.87	18.81	162.01
X/O	6.50	2.75	1.60	163.61
1-HWDP	5.00	3.00	9.17	172.78
Dart Sub	6.37	2.81	0.69	173.47
14-HWDP	5.00	3.00	125.62	299.09

BHA No. 18 was picked up after the hole problems experienced with BHA No. 17 and drilled the remaining Chalk section from 3730 to 4078 m, the Lower Cretaceous from 4078 to 4135 m and into the Jurassic at 4150 m. The BHA was pulled in order to run wireline logs.

To ensure that possibly fatigued components were not rerun, most of BHA No. 18 was comprised of new equipment. Since differential sticking was thought to be part of the hole problem, 6-5/8" Heavy weight drill pipe was substituted for as many drill collars as possible to provide adequate weight available to the bit. In addition, a 3-point roller reamer was run in case back reaming out of the hole would again be necessary. A shock sub was picked up due to the bit coming out with many lost teeth and a MWD failure soon after BHA No. 17 started drilling.

ITEM	OD	ID	LENGTH	CUML
Bit No. 18	12.25	----	0.45	0.45
NB Stab (Float)	12.25	2.87	1.72	2.17
Shock Sub	7.87	2.25	4.16	6.27
Stab	12.25	2.87	1.87	8.16
PxP Sub	8.37	2.81	1.12	9.28
MWD (GRD-Raw)	8.37	----	11.90	21.18
Saver Sub	8.37	2.81	0.76	21.94
Stab	12.25	2.87	1.78	23.72
1-8" DC	7.87	2.87	8.84	32.56
Roller Reamer	8.00	2.87	2.36	34.92
5-8" DC	8.00	2.87	46.18	81.10
Jars	7.75	3.00	9.79	90.89
2-8" DC	8.00	2.87	18.26	109.15
X/O	7.81	3.00	0.53	109.68
9-HWDP	7.56	5.00	81.77	191.45
X/O	6.50	3.50	1.10	192.55
Dart Sub	6.37	2.81	0.69	193.24

BHA No. 19 was run after wireline logging was completed and drilling was to continue to find a suitable casing seat. A tricone insert bit was chosen due to the fact that a limited amount of hole to drill was anticipated. Additional drill collars were picked up to add available weight on bit.

ITEM	OD	ID	LENGTH	CUML
Bit No. 19	12.25	----	0.34	0.34
NB Stab (Float)	12.25	2.87	1.72	2.06
Shock Sub	7.87	2.25	4.12	6.28
Stab	12.25	2.87	1.87	8.05
PxP Sub	8.37	2.81	1.12	9.17
MWD (GRD-Raw)	8.37	----	12.01	21.18
Saver Sub	8.37	2.81	0.76	21.94
Stab	12.25	2.87	1.78	23.72
9-8" DC	7.87	2.87	83.51	107.23
Jars	7.75	3.00	9.79	117.02
2-8" DC	8.00	2.87	18.26	135.28
X/O	7.81	3.00	0.53	135.81
9-HWDP	7.56	5.00	81.77	217.58
X/O	6.50	3.50	1.10	218.68
Dart Sub	6.37	2.81	0.69	219.37

BHA No. 20 was run after Bit No. 19 was pulled due to low ROP's. An Eastman Christiansen S225 TSD bit was run in an effort to increase ROP. The average penetration rate for this bit was 2.6 m/hr.

ITEM	OD	ID	LENGTH	CUML
Bit No. 20	12.25	----	0.52	0.52
NB Stab (Float)	12.25	2.87	1.68	2.20
Shock Sub	7.87	2.25	4.10	6.30
Stab	12.25	2.87	1.87	8.17
PxP Sub	8.37	2.81	1.12	9.29
MWD (GRD-Raw)	8.37	----	12.01	21.30
Saver Sub	8.37	2.81	0.76	22.06
Stab	12.25	2.87	1.78	23.84
9-8" DC	7.87	2.87	83.51	107.35
Jars	7.75	3.00	9.79	117.14
2-8" DC	8.00	2.87	18.26	135.40
X/O	7.81	3.00	0.53	135.93
9-HWDP	6.62	5.00	81.77	217.70
X/O	6.50	3.50	1.10	218.80
Dart Sub	6.37	2.81	0.69	219.49

BHA No. 21 was run as a clean out/conditioning assembly after logging and before the 9-5/8" casing/cementing job.

ITEM	OD	ID	LENGTH	CUML
Bit No. 21(20RR)	12.25	----	0.52	0.52
NB Stab (Float)	12.25	2.87	1.68	2.20
1-8" DC	8.00	2.87	8.84	11.04
Stab	12.25	2.87	1.87	12.91
2-8" DC	8.37	2.81	19.22	32.13
Stab	12.25	2.87	1.78	33.91
6-8" DC	8.00	2.81	55.45	89.36
Jars	7.75	3.00	9.78	99.14
2-8" DC	8.00	2.87	18.26	112.42
X/O	7.81	3.00	0.53	112.93
9-HWDP	6.62	5.00	81.77	199.70
X/O	7.94	3.50	1.10	200.80
Dart Sub	6.37	2.81	0.69	201.49

13.4 Bits and Hydraulics

Bit No. 15, a 12-1/4" Smith MSDGHC (IADC code 1-3-5; "M" for mud motor, "C" for center jet) successfully drilled 112 m of cement and 17 m of new hole using the CBF mud from the 17-1/2" hole section prior to being pulled. The average ROP was 5.7 m/hr in open hole and the bit was pulled for cased hole logging and a BHA change. The pump rate used was 738 gpm at 3950 psi yielding 342 HHP at the bit with 3 x 18/32 jets plus 1 x 16/32 center jet. Average WOB was 35 Klbs and rotary speed 80 rpm.

Bit No. 16 was Bit No. 15 RR. It drilled from 2897 to 3277 m (20 m into the Chalk) in 45.5 hours for an average ROP of 8.35 m/hr. WOB was 35 Klbs and rotary speed 150 rpm. The primary reason the bit was pulled was penetration rate, as the last 22 m took 7 hours to drill (3.1 m/hr). Hydraulic parameters were 678 gpm and 4000 psi using 3 x 18/32 jets and a 1 x 20/32 center jet.

Bit No. 17 was a DBS TD290Q "Quattro Cut" PDC type (IADC 0646) with 6 x 16/32 jets. This bit was chosen for its excellent performance in drilling offset well Chalk sections. The bit drilled 453 m in 35.5 hours for an average ROP of 11.76 m/hr. This drilling rate was 150% better than the best offset record. The bit was pulled after drilling from 3277 to 3726 m when the drillstring became stuck while backreaming at 3651 m during a short trip. Numerous cutters on the shank and nose were broken or missing.

Another DBS TD290Q was run in the hole as Bit No. 18. Its performance was similar in the Chalk section but slowed in the Lower Cretaceous and Jurassic. Overall, it drilled 420 m in 68 hours for an average ROP of 6.2 m/hr. The same jet nozzle configuration was used as on Bit No. 17 (6 x 16/32) and the same weight (15 Klbs) and rotary speed (150 rpm). The bit looked very good after being pulled for logging but on further inspection a microfracture on the matrix near the nozzles was found. The decision to re-run the bit was changed after this inspection.

Bit No. 19 was a 12-1/4" Reed HP51-J (IADC code 517). This bit was used to drill the upper Jurassic interval from 4150 to 4372 m. The bit drilled for 83.0 hours at an average ROP of 2.67 m/hr. Bit inspection revealed that the cones were very "wobbly" and a total of 12 teeth were missing.

Bit No. 20 was an Eastman Christiansen S225 ballaset bit and was run from 4272 to 4525 m. The bit was designed to drill soft-medium formations including limestone, dolomite and sandstone as well as shale. The bit was built with a TFA of 2.0 sq inches. A flow rate of 625-650 gpm and 150 RPM was used to obtain an average ROP of 2-6 m/hr.

Bit No. 21 was Bit No. 20RR and was used on the conditioning trip after logging and before running 9-5/8"casing. No reaming was required and no fill was found on bottom.

13.5 Casing and Cementing

See attached Magne 2/5-9 9-5/8" Casing and Cementing Summary

Amoco Norway Oil Company

MEMORANDUM

To:	E. Hansen	**Date:**	14 December 1991
From:	Drilling Foreman W. Vanguard	**Ref:**	NO M 400(2/5-9)PGH
Subj:	Magne 2/5-9 9-5/8" Casing and Cementing Summary		

The following memorandum details the 9-5/8" casing and cementing job on the Magne 2/5-9 well.

CASING SUMMARY

Casing tools (350 ton) were rigged up for the 9-5/8" casing job. The DDM short bails were replaced by 500 Ton long bails. The full bore running tool was made up to the casing hanger (with pup joint already installed). The two plug cement head was loaded and the quick coupling made up to the last joint in the landing string.

At 1300 hrs on 10 December, 1991, the 9-5/8" Weatherford SS 742 PDC drillable float shoe joint was picked up and filled with mud. Three joints were added to the shoe joint, then a fifth joint was added which had a Weatherford SS 742 PDC drillable float collar made up to the pin end. All of these joints were Baker locked. Circulation was established through the shoe track. The total shoe track length between the shoe and collar totaled 50.62 m.

Ray Oil Tool rigid centralizers (12") were installed on the casing string on the following joints: 2, 3, 4, 6, 7, 9, 11, 13, and 15.

The Hydril MAC and NEW VAM connections were cleaned on the pipe rack so that they could be visually inspected. API Modified dope with a friction factor of 1 was applied prior to make up. Make up torque averaged 30,000 ft-lbs for the MAC and 15,900 ft-lbs for the NEW VAM as monitored by Weatherford's JAM process.

When the casing string reached 1513.5 m, all the Hydril MAC casing had been run and a total of 11 joints rejected due to non drift. At this point, the 350 MT elevators and slips were replaced with 500 MT equipment and the cross-over from Hydril MAC to NEW VAM made up.

The casing string was filled each joint with mud until a total depth of 2998 m, or 220 MT was reached. From this point on, the casing was not filled with mud but floated in the hole.

However, upon reaching 4064 m, both the float shoe and float collar appeared to fail, one after another, as evident from the rapid venting of air from the casing string. The hook load also increased from 215 MT to 305 MT. The annulus was quickly filled with mud and required 223 bbls to fill. The floats failed under a calculated differential pressure of 2691 psi and were rated for 4500 psi.

The circulating swedge and safety valve were installed and circulation down the casing commenced after a static flow check was verified. The pumps were staged up to a maximum of 115 spm (415 gpm) with 1800 psi initial circulating pressure. A total of 1-3/4 annular volumes was circulated and bottoms up gas was 0.4% max, dropping to a background of 0.24%. No evidence of float shoe or float collar equipment was observed in the returns. Final circulating pressures had dropped to 1350 psi.

Running the casing resumed with precautionary washing of each joint. At 4311 m, the mud column became unbalanced and mud U-tubed out of the 9-5/8" casing. Bottoms up was circulated and a maximum of 1.82% gas was observed. Upon stopping the pumps, 100 psi back pressure was observed on the casing and attempts to balance the mud by pumping slugs of 18 ppg mud were not successful. The decision was made to circulate and raise the mud weight to 14.9 ppg due to the gas observed from bottoms up. The well was checked for stability when the new mud weight reached the casing shoe and was static. Running and washing of casing was resumed and the setting depth of 4515 m reached without incident.

Before landing the casing, the pickup weight was recorded as 325 MT and slack off weight was 315 MT. The hanger was landed at 87.57 m RT as confirmed with a reference line tied to the slip joint outer barrel. Some bobble of the weight indicator was noted as the hanger assembly was passing through the BOPs. This turned out to be significant as noted below in the Wellhead Summary of this memo.

Total mud losses during the casing running was 59 bbls.

The total casing string configuration was as follows:

a. One joint of 9-5/8" 53.5 ppf Q125 Hydril MAC casing with the float shoe pre-installed to the pin end

b. Three joints of 9-5/8" 53.5 ppf Q125 Hydril MAC casing with a pre-installed float collar on the top joint

c. 120 joints of 9-5/8" 53.5 ppf Q125 Hydril MAC casing

d. One crossover joint of 9-5/8" 53.5 ppf Hydril MAC pin by NEW VAM box

e. 226 joints of 53.5 ppf Q125 NEW VAM casing

f. One Dril-Quip 9-5/8" hanger with NEW VAM pin x pin sub on bottom and the full bore running tool with NEW VAM pin x box pup on top.

CEMENTING SUMMARY

The casing was topped off with mud and a carbide pill placed inside prior to attaching the cement head. Surface lines were tested to 5000 psi and circulation staged up to a maximum rate of 100 spm (360 gpm). Final circulating pressure was 1250 psi and maximum gas observed from bottoms up was 3.88%, dropping to a background of 0.27%. No trace of the carbide pill was observed. This was attributed to the fact that it took almost 1/2 hour to make up the cement head and the gas was probably lost during this time.

Prior to mixing and pumping the cement slurry, 70 bbls of "MUDPUSH XL" spacer weighted to 15.5 ppg were pumped with the rig pumps from the slug pit. The bottom wiper plug was then released and the cement job turned over to Dowell.

The following cement slurry was pumped:

<u>Tail Cement:</u> 1500 sacks of Norcem Class G cement + 35% BWOC Silica Flour +

0.05 gps D144
2.84 gps D600
0.17 gps D135
0.10 gps D150
0.45% BWOC D121
2.16 gps Fresh Water

Weight---16.5 ppg
Yield---1.40 ft3/sx
Mixwater---5.65 gps (as above)

A total of 210 bbls of the mix water was prepared prior to the cement job using both of the tanks on the Dowell unit (10 bbls each), both permanent batch mixing tanks on the rig (45 bbls each) and 2 ea 50 bbl portable batch mixing tanks brought out especially for this job.

Total mix water used during the job was 196 bbls. Total slurry volume pumped as recorded by the VIP mixer and PACR computer was 384 bbls, most of which weighed 16.6 ppg on the average. Total bulk cement used as recorded by the VIP mixer was 86 MT or approximately 1500 sxs.

Dowell densimeter readings were within 0.1 ppg of the pressurized mud balance and did not vary during this stage. Cement mixing rates averaged 3-4 bpm and no equipment shut downs or problems were noted. Smedvig was able to provide bulk cement delivery at a fairly constant rate with only one small period of low deliverability which resulted in Dowell having to slow the mix/pump rate.

The top plug was dropped after the cement had been pumped and was followed by the cement remaining in the lines plus 10 bbls of the 15.5 ppg spacer. The slurry was then displaced with the rig pumps at 8 bpm (pump efficiency-96%) with 1031 bbls of 14.9 ppg mud. Theoretical volume was 1026 bbls, but when the plug did not bump, an additional 5 bbls was pumped (approximately half of the shoe track volume) for a total of 1031 bbls. Since the floats were known to be ineffective, the final shut down pressure of 270 psi was held on the casing. A total of 17 bbls of mud was lost to the hole during the cementing and 4 bbls while displacing.

Back pressure was held on the casing for an initial time of 6 hours. After this time, the pressure was bled off from 270 to 20 psi and 1.9 bbls of mud recovered. The casing was shut in and pressure increased to 100 psi. The 1.9 bbls of mud was pumped back down the casing and pressure increased to 450 psi, then stabilized at 270 psi.

After 2 more hours, the above process was tried again, with only 1 bbl bled back. Pressure dropped from 260 to 40 psi, and upon shutting in, increased to 130 psi. The 1 bbl was pumped back with an initial pressure of 430 psi, stabilizing to 260 psi.

After 2 more hours, for a total of 10 hours since displacement stopped, the pressure was again bled off with 1 bbl mud returning, but this time the shut in pressure was 0 psi. No build up in pressure was observed and the casing was opened and an additional 0.25 bbls of mud bled back before becoming static. Total WOC time from the beginning of mixing cement was 14 hours.

The full bore running tool was released with 5 RH turns and the 9-5/8" landing string retrieved from the well.

WELLHEAD SUMMARY

After the 9-5/8" landing string and full bore running tool were laid down, the mill and flush tool was picked up and run in the hole on Hevi-Wate drillpipe. Circulation was established and the tool rotated to polish the hanger and seal assembly seat. Upon pulling the mill and flush tool, it was noted that the nylon indicators had not been worn, indicating that the tool had not been worked down far enough. Six 6-1/2" drill collars were picked up and run below the mill and flush tool which was again run to prepare the hanger. This time the drill collars could not be worked below the hanger. Many attempts were made, including rotating very slowly, but none were successful.

The tool was pulled, and the drill collars placed on top of the mill and flush tool. This configuration was successfully run in the hole and rotation and circulation was performed on the hanger.

Upon pulling the assembly, no wear was seen on the nylon pads. The assembly was changed to 2 stands of HWDP and 2 stands of 6-1/2" drill collars below the tool and 2 stands of 6-1/2" drill collars on top of the tool. The tool was rotated and worked over the hanger with 20 Klbs of rotating weight. The string suddenly jumped and the torque increased from 1500 to 6000 ft-lbs, dropping off to a steady 3000 ft-lbs.

The assembly was pulled out of the hole and the metal protector sleeve from the circulation bypass area of the hanger was recovered inside the mill and flush tool, minus a small rectangular piece of size 2" x 4" x 1/2". The same mill and flush assembly was re-run to make sure the missing piece from the protective sleeve was not in the seal assembly seating area. Upon pulling the mill and flush tool, the nylon indicators showed definite contact with the hanger indicating no obstructions around the hanger. The missing piece was not recovered.

The 18-3/4" x 9-5/8" SS15 seal assembly was picked up and run in the hole with 2 stands of HWDP and 2 stands of 6-1/2 drill collars below and one joint of drillpipe plus 2 stands of collars and HWDP to surface. The seal assembly was set and pressure applied with the cement unit to 3500 psi to energize the seals. The test did not hold and the nature of the leak could not be determined. The pressure was increased to 7000 psi and held. Upon increasing to 9900 psi, the seals on the running tool started to leak as was noted by water returning out of the top of the drill string. The running tool was pulled, and the two poly-pack seals amd the one o-ring were missing. The tool was redressed and re-run and a successful test to 9900 psi achieved.

The protective sleeve which was torn from the hanger and retrieved with the mill and flush tool was sent in on the helicopter to Dril-Quip for inspection. It was noted in the rig files from the 2/8-14 well that a same protective sleeve was torn from the 9-5/8" hanger during the PxA process when trying to pull the hanger after casing was cut.

CONCLUSIONS

The two incidents which occurred during running of the casing were 1) the floats failing, which added numerous complications and hours to the job due to having to wash down the casing and holding pressure on the casing while WOC and 2) the protective sleeve being torn off the hanger when the casing was being landed, which added numerous hours and possibly serious downtime, prior to setting the seal assembly.

The objective of isolating the chalk and the weak zone (which was taking mud) were accomplished.

RECOMMENDATIONS

1. Continue to use a single slurry on this type of job for simplicity and compressive strength.

2. The use of the Dowell VIP mixer should be continued on future cement jobs due to the excellent density control and consistency. Data recorded by VIP and PACR were very helpful in post job analysis.

3. Review use of plastic float equipment for floating in deep casing strings and/or verify design limits vs. temperature.

4. Confirm by post inspection of protective sleeve with Dril-Quip that it is not a design flaw, and insure that this problem will be addressed before the next well. Take extra care and precautions when landing heavy casing strings, as most heave compensators cannot handle these types of weight and thus complicate the hangoff process.

Subject: 8-1/2" Hole Section Summary

14.1 Operational Summary

The 9-5/8" casing set at 4515 m, was drilled out with BHA No. 22 and tagged top of cement at 4422 m. The cement was very hard and required 22 hours to drill out. The casing was retested at 4450 m to 10,600 psi (based on an anticipated 18.5 ppg LOT). Drilling of cement continued through the float collar and float shoe and the rat hole was cleaned out below the shoe from 4515 to 4525 m. Three meters of new hole was drilled to 4528 m prior to performing a leak off test.

The mud was circulated and the density confirmed to be 14.8 ppg. The leak off test was performed with 3040 psi surface pressure, or an 18.7 ppg equivalent mud weight. Twelve bbls of mud were used to pressure up and eleven bbls bled back for a total of 1 bbl lost to the formation during the test.

The QSST, which was run at 4525 m was processed in a "look ahead" mode in order to predict the depths of the upcoming Green and Purple reflectors. Since the previous VSP look ahead reflector depths were somewhat inaccurate, a modified technique was used to project the QSST results. Two look ahead projections were generated, one assuming that the formations to drill would be slow (shale prone) and the other assuming that the formations to drill would be fast (sand prone). In this way, the projected depths of the upcoming reflectors were "bracketed" and given as a minimum and maximum depth. The "window" for the Green reflector was 4630-4690 m and the Purple reflector was 4930-5040 m.

Drilling of the 8-1/2" hole continued under Level 3 of the HPHT Awareness Levels from 4528 m towards the expected Green reflector at 4630-4690 m. No change in formation was found and at 4700 m, the drilling awareness state was dropped to Level 1.

At 4736 m, drilling stopped and the drillstring was pulled into the casing and hung off in the BOP's for bad weather. A total of 28 hours were charged to waiting on weather time.

The bit was run back to bottom at 4736 m and bottoms up circulated prior to dropping a single shot survey (Teleco tool failed immediately after drilling out of casing). With bottoms up 1000 m from the BOPs, the well was closed in and circulation was taken through the choke and poor boy degasser as a safety precaution. Maximum gas seen was 4.6% with background levels returning to 0.3%.

The drillstring was circulated out of the hole to the casing shoe and the survey retrieved by 0.092" wireline. The survey read 10+ degrees (off scale on a 10 degree angle unit) so the drillstring was pulled for a BHA change.

BHA No. 23 was picked up (new MWD) with a new Eastman Christensen S225 bit. While circulating and washing down (to keep MWD cool), the stem on the automatic kelly valve on the top drive started leaking. The pipe was pulled into the casing and repairs to the valve initiated. These repairs took 11.5 hours. The hole was washed and reamed (precautionary) to bottom at 4736 m with one meter of fill on bottom and one tight spot at 4732 m.

Drilling continued from 4736 to 4838 m with steady background gas of 0.3-0.6% and a maximum connection gas of 1.55% from a dolomite stringer at 4799 m. The hole was circulated at 4838 m prior to dropping a single shot survey (MWD failed once again as soon as drilling started at 4736 m). The survey was dropped and the drillstring pulled into the casing to retrieve the survey. The survey tool was latched, but upon pulling out of the hole with the survey, the 0.092" wireline parted just downstream from the winch.

The wire was spliced together and the blocks used to pull on the tool. The wire parted again and fell down the pipe. Three stands were pulled to find the top of the wire and once again the wire was spliced and the tool attempted to be pulled. This attempt was unsuccessful and the decision was made to trip out of the hole to retrieve the survey. The 0.092" wireline was cut after breaking out each stand and deposited down the Vee-door.

Once out of the hole, the survey instrument was retrieved from on top of the MWD tool and the survey revealed a missrun. A new MWD and Bit No. 23 were rerun back in the hole.

The pipe was washed down to TD to keep the MWD tool cool and one meter of fill was found on bottom. Surveys were taken with the MWD and the survey on bottom showed hole angle had dropped to 11.2 degrees at 4823 m from 12.2 degrees at 4715 m. Bottoms up gas yielded a maximum 6.6% with background levels returning to 0.4%.

Drilling continued under Level 1 awareness from 4838 to 4886 m where formation samples from 4880 m reached the surface and brought a maximum of 19.9% gas. Drilling parameters while drilling this interval showed no signs of a drilling break or an increase in torque. The well was checked for flow and was negative. Bottoms up was circulated through the choke and poorboy degasser with an average of 3-4% gas with a maximum of 5.7% from the flow check. The riser was boosted with new mud and the well opened up to normal circulation. Background gas dropped back to normal levels of 0.4-0.5% and drilling continued on Level 1 awareness to 4930 m.

At 4930 m, Level 3 awareness was started from the prognosis of the Purple Reflector being within the range of 4930 to 5040 m. Drilling was stopped at 4933 m to bring the mud weight up to 15.4 ppg from 15.0 ppg due to steady connection gas increases of two to three times normal background gas levels. When drilling resumed, torque values were less and ROP remained at or above previous mud weight rates.

While drilling the Level 3 interval, numerous dolomite stringers were penetrated which brought formation gas levels to the surface of 0.5 to 9.7%. No sand sequences were encountered.

The MWD stopped sending pulses at 4950 m after a total of 34 hours rotating time. Surveys with the MWD had been steady at 11.0 - 11.2 degrees and it was felt that the BHA had stopped the angle building tendency and was holding angle. The decision was made to drop a single shot survey on bit trips and retrieve it when the BHA was at the rotary. Conversations with Teleco (MWD) management discussed the problems of the MWD failures and it was concluded that the temperature of the well (288 degree F circulating) had exceeded the operating limits of the MWD and no more MWD's would be run in this hole section.

The bottom range of the Purple reflector was reached at 5040 m and alertness levels reduced from Level 3 to Level 1. Connection gases were again increasing to two to three times over background and the mud weight was increased from 15.4 to 15.7 ppg. The 0.3 ppg increase was equivalent to the amount of ECD at normal drilling circulating rates (350 gpm). After the heavier mud reached a full circulation, torque decreases were noticed.

Drilling continued under Level 1 alertness levels from 5040 to 5147 m. Connection gas was still observed with 15.7 ppg mud in varying amounts from 0.6 to 1.4% with background gas ranging from 0.35 to 0.5% .

At 5147 m, an electrical problem was noted on the BOP panel on the rig floor. This problem was discovered when opening the choke and kill line fail safe valves to flush these lines. The indicator lights stayed in the on position even after the valves were closed (as verified by the flow meter). It was diagnosed as a ground fault and the decision was made to pull into the casing and hang off the drill string while troubleshooting this problem.

Bottoms up was circulated and the mud weight increased to 16.0 ppg for riser margin. It was decided to pick up the Dowell hurricane packer to have in the hole in case the problem took longer to fix than expected.

The packer and hang off tool were picked up and the drillstring hung off in the wellhead. The ground fault was found in the junction box near the shale shakers which had water inside. This caused an earth fault in the micro switches for the lamp indicators for the trip tank valve and shale shaker by-pass valves. The BOP's function tested on both the blue and yellow pods after the junction box was isolated.

The drill string was pulled to lay down the hang off tool and hurricane packer and it was discovered that one of the bottom slip segments on the Dowell packer was missing. It was determined that this slip segment had to have been broken in order to come off the tool. The larger piece measured 2" x 2" x 3" and could not fall down past the bit inside the casing.

The BOP test tool was picked up and run in the hole and the BOP's successfully pressure tested.

The drill string was pulled out of the hole with frequent sticking from the junk being lodged between drill collars, stabilizers and/or the bit. Some jarring down was necessary to free the string when the junk got wedged between the casing and drillstring at 2370, 1970, 1200 and 500 m. Circulation was required to work the BHA out at 96 m and through the wellhead after the jars were removed. The stabilizers, MWD, Monel collars and the bit all showed marks of being scared by the junk.

A hydraulic apple basket junk retriever was made up on slick drill collars (BHA No. 24) and run in the hole. The drill string was washed, rotated and reciprocated three times per stand below the casing shoe from 4510 to 4570 m and the last stand washed to bottom. Five meters of fill was observed on bottom and the string rotated and washed with 40 rpm and 300 gpm to clean out same. Bottoms up was circulated with maximum gas of 5.15% from 5147 m.

The setting ball was dropped and circulated to the tool with 40 spm. The junk retriever was placed on bottom while pumping the ball and rotation stopped. The ball seated after 40 minutes and the hydraulic sleeve activated with 2500 psi. Pressure was increased after 2 minutes to 3300 psi where the rupture disk broke and allowed circulation above the tool. Overpull of 15 Klbs was observed off bottom and the drillstring was pulled wet to 4600 m before pumping a slug.

When the tool reached surface, only large fist sized pieces of shale were recovered. All functions of the tool had worked correctly. The tool was laid down and a junk mill (Bit No. 25) was made up on BHA No. 26. One and one half meters of fill was observed on bottom with the mill. A slow rotary speed of 40-50 rpm and light weight of 10-15 Klbs was used to mill on the junk. Rotary torque oscillated between 2500-4500 ft-lbs, with occasional increases to 6000 ft-lbs. A total of 4 m of new hole was cut from 5147-5151 m with the junk mill. Tandem single shot survey tools were dropped prior to pulling the BHA.

Upon cleaning the boot basket, several large pieces of the slip segment were retrieved plus numerous smaller pieces of black metal of unknown origin. The mill was scarred mostly on the side and very little on the bottom. Bit No. 26, another Eastman Christensen S225 Ballaset, was picked up and run in the hole on BHA No. 27.

Bit No. 26 was run in to 5100 m and the drillstring was reamed (precautionary) to bottom at 5151 m. No indications of additional torque due to junk in the hole was seen. The hole was circulated prior to resuming drilling and the maximum gas seen was 7.4%. A 38 bbl weighted hi-vis sweep was pumped during the connection at 5185 m in an attempt to remove any remaining junk in the hole. Examination of the returns at surface indicated no additional metal in the mud returns.

The 8-1/2" hole section was drilled to the original authorized TD of 5337 m MD (5322 m TVD RT). A wiper trip to the 9-5/8" shoe was made and the mud weight raised to 16.5 ppg before logging due to increased gas readings. Upon returning to bottom after the wiper trip, a 17.3 ppg hi-viscosity sweep was pumped around and a tandem survey tool dropped. The drillstring was momentarily stuck at 5333 m and 5312 m while taking the survey but pulled free with 110 Klbs overpull and the string was pulled out of the hole to begin logging operations. Retrieval of the surveys revealed that both of the cameras recorded mis-runs.

Log run #1 consisted of PIL/AS/GR/AMS tools. Loggers TD was 5342 m and the logs were run from TD to 4518 m. Maximum recorded temperature was 323 degrees F after 15 hours.

Log run #2 was the LDL/CNL/GR/QSST/AMS tool string. Maximum recorded temperature was 331 degrees F after 28.5 hours. The caliper log indicated an average hole size of 11 inches with scattered areas of up to 15 inches in diameter.

Log run #3 consisted of the FMS/GR/AMS tools. Logging depth was TD to 4518 m. Maximum recorded temperature was 336 degrees F after 38.5 hours.

Interpretation of the QSST data confirmed the depth of the Green reflector to be 4630 m (exact depth prediction from the slow, shale prone projection) and the Purple reflector to be 4950 m (20 m deeper than the slow, shale prone projection). The conclusion drawn was that the depth projections for the reflectors based on the slow, shale prone evaluation were excellent. A comparison of the slow formation projection (sonic travel time) with the actual sonic log was very good, both qualitatively and quantitatively. Therefore, a good match can be obtained for pore pressure prediction using the projected sonic travel time from the QSST versus the actual sonic travel time as measured by the wireline sonic tool.

The ability to reliably predict the pore pressure ahead of the bit using seismic "look ahead" techniques would be extremely valuable in future exploratory drilling and this subject should be pursued further.

Review of the QSST data also indicated a reflector at +/- 60 meters below TD. The decision was made to drill an additional 150 meters to investigate the reflector. Sidewall cores were then deferred due to the drill ahead plans.

After testing BOP's and slipping drill line, drilling resumed and 8-1/2" hole was drilled from 5337 to 5460 m. The new authorized TD was 5472 m TVD. The well was stopped early due to 1) the desired reflector at 5390 m had been drilled and 2) deteriorating hole conditions made further drilling operations risky. Maximum gas seen while drilling was 0.62 %. While drilling from 5430-5460 m, the hole became "sticky" when the pumps were off. The decision was made to weight up the mud system to 16.9 ppg to try and regain acceptable hole conditions. After weighting up, a wiper trip was made to the 9-5/8" casing shoe. Numerous tight spots were reamed while making the wiper trip. A large amount of cuttings and wall cavings were seen at the shaker after reaming. The return trip to TD indicated that the hole conditions had improved and the string was pulled to begin logging operations.

Log run #1 was a DIL/LSS/GR/AMS string and was run from a loggers TD of 5467 m to 5275 m (overlap into previously logged section). Maximum recorded temperature was 330 degrees F after 12 hours. No tight spots were encountered while logging.

Log run #2 was the CST/GR/AMS combination tool. The tandem sidewall core gun was built to shoot 60 cores. After shooting 24 times, all communication with the GR and AMS tools was lost. The wireline was pulled out of the hole and it was found that the tool had pulled out of the wireline rope socket. In each of the 24 core attempts, it had been necessary to "rock" the downhole tool in order to pull free from the formation. The sidewall cores were firing into the formation but maximum allowable line pull was required to pull the core gun free of the formation face. This frequent up and down motion to free the core gun apparently weakened the "weak point" at the wireline rope socket. It also appeared that very few sidewall cores had been saved with the tool because the line pull required to get the core gun free was more than the rated strength of the core bullet attachment wire. The core guns were left in the hole and the decision was made to forego any further sidewall coring attempts and begin PxA operations.

14.2 Mud Summary

Mud used on the previous hole section was used to start the 8-1/2" hole section. Contaminated mud was observed when circulating bottoms up from 4422 m where the cement was tagged. Approximately 250 bbls of mud was lost over the shakers or dumped. The mud weight was reduced from 14.9 to 14.8 ppg with premix and drill water. The active system was treated with citric acid and sodium bicarbonate to control pH and hardness while drilling cement. Ligthin was added to control rheology and gels.

Drilling hard cement took 22 hours and approximately 40% of the active system was replaced by old reserve mud and weighted premix. Upon drilling new formation, the mud was treated with premix at 15 bbl/hr. Premix contained 3.3 ppb Miltemp, 6.4 ppb Anco Resin, 5.2 ppb Bentonite, 2.7 ppb Ligthin and 1.9 ppb Hostadrill.

Static aging tests were continued daily as was the practice on the previous hole section. The test temperature, however, was reduced to 295 degrees F (BHT + 15 degrees F) due to revised BHT recorded during logging of the 12-1/4" hole.

The dilution rate was increased to 18 bbl/hr of premix by 4641 m to try and lower the gels and control mud weight. Ligthin was added directly to the active system for gels. The low gravity solids were the primary source of the rheology problems as the S225 synthetic diamond bit generated very small cuttings.

The mud weight was increased from 14.8 ppg to 15.0 ppg from 4641 to 4700 m for riser margin in preparation of possibly having to hang off due to approaching bad weather. Also during this interval, no premix was allowed to be added to the active system as per the Level 3 Awareness guidelines while drilling towards the "Green" Reflector. Gels and rheology increased accordingly until the 4700 m barrier was past, then Level 1 Awareness was observed and premix additions resumed.

At 4736 m, the drillstring was pulled into the casing and hung off in the BOP's while waiting on weather. The active suction pits, shaker box and shaker pits were dumped and cleaned.

Upon returning to drilling, the centrifuge was run in the barite recovery mode and approximately 17 bbl/hr of 11.0 ppg premix was added to the active system while centrifuging. The Anco Resin concentration was increased to 4.8 ppb and the Thermopol increased to 2.2 ppb in the premix to improve HTHP fluid loss. Approximately 15 bbls/hr of 14.8 ppg premix was added to the system when the centrifuge was not being run.

While drilling from 4838 m towards 4930 m (where Level 3 would start), dilution rates increased to prepare the mud for Level 3 drilling which allowed mud additions only while circulating. While centrifuging, 20 bbls/hr of 11.0 ppg premix was added. When the centrifuge was not running, 22 bbl/hr of 14.8 ppg premix was added to the active system.

The active system was not treated for 8 hours during this stage of Level 3 alertness. Dilution started towards the end of the section when rheologies started to increase. Premix weighing 15.2 ppg was added at a rate of 18-22 bbls/hr. The concentration of Anco Resin in the premix was increased to 8.5 ppb to improve HTHP fluid loss. Static aging test temperature, as well as HTHP fluid loss test temperature was raised to 325 degree F.

Drilling stopped at 5147 m to pick up into the casing to repair the BOP panel on the rig floor. It was 28 hours before the mud on the bottom of the hole was circulated. Rheologies from bottoms up showed only minor increases in YP and 10 minute gels. Premix was added at the rate of 30 bbls/hour as the drill string was not staying in the hole but a few hours fishing for junk. The sand trap was dumped and an additional 189 bbls of old reserve mud was dumped while tripping out of the hole.

The junk was not retrieved and a junk mill was made up on the BHA and the drill string tripped in the hole. Upon reaching bottom, one and one half meters of fill was observed on bottom. Premix was added to the active system at a rate of 20 bbls/hour. Mud properties on bottoms up were still excellent for being static at bottom hole temperatures for 26 hours.

A solids analysis was performed on the 165 mesh bottom screens of the two Thule shale shakers with the following results: Weight-21 ppg, Solids-81%, HGS-21.7 ppb (19.2% by volume), LGS-560 ppb (61.7% by volume). The analysis was performed to confirm that the 165 mesh screens were discarding primarily drilled solids and not barite.

Premix was added to the system while drilling the interval from 5151 to 5337 m at a rate of 15-20 bph. The premix consisted of 5 ppb bentonite, 3.1 ppb each of Ancoresin, Ligthin and Miltemp and 1.4 ppb Kemseal (all mixed in drillwater). The premix was added to control rheology and maintain the HTHP fluid loss properties.

A thirty-eight barrel 17.3 ppg hi-vis sweep (195-funnel viscosity) was pumped while making the connection at 5185 m. The sweep was pumped to try and remove any remaining junk left in the hole from the hurricane packer slip. No additional metal was recovered while circulating the sweep to surface.

Drilling continued to 5337 m and the interval was logged. After logging, the decision was made to deepen the well to investigate a reflector seen from wireline seismic logs.

The drillstring was tripped to TD and the hole circulated before drilling. Bottoms up mud (after 62.5 hrs) had the following properties: PV-24, YP-11, Gels-3/13, Funnel viscosity-125, pH-9.1. All of these properties, except the funnel viscosity, were similar to the original drilling fluid properties.

Drilling continued to 5460 m. Premix consisting of drillwater + 3.0 ppb Ancotemp + 5.3 ppb Ancoresin + 410 ppb barite + 4.8 ppb bentonite + 3.3 ppb Ligthin + 2.1 ppb Kemseal was added at 20-30 bbls per hour. The chloride content of the mud increased from an original level of 3300 mg/l to a new level of 5000 mg/l while drilling from 5394 m to 5433 m. It was discovered that the premix tank had been contaminated with seawater and this was causing the chloride content to increase (not drilled formation). The hole became tight while drilling at 5459 m and the decision was made to weight up the mud to 16.9 ppg. The mud weight was increased and a wiper trip made before beginning logging operations.

Logging operations were completed without any hole problems and PxA operations begun.

14.3 Bottom Hole Assemblies

BHA No. 22 was used to drill out of the 9-5/8" casing and new hole from 4525 to 4736 m before being pulled for hole deviation reasons. Hole inclination increased from 5.6 to 10.0 degrees in 211 m equating to a rate of 0.625 degrees/30 m. This increase in deviation was not noticed earlier due to the fact that the MWD had stopped working just after drilling out of the casing and an earlier attempt to take a single shot survey using wireline at 4644 m ended in a missrun.

ITEM	OD	ID	LENGTH	CUML
Bit No. 22	8.50	--	0.35	0.35
Near Bit Stab	6.50	3.00	1.42	1.74
X/O	6.31	2.81	0.53	2.27
Shock Sub	6.37	2.75	3.80	6.07
X/O	6.50	2.87	0.33	6.40
Bit Sub w/Float	6.56	2.87	1.70	8.10
Stab	6.12	2.81	1.65	9.75
X/O	6.50	2.81	1.80	11.55
MWD (GR-RES-DRAW)	6.75	--	12.76	24.51
X/O	6.50	2.81	1.81	26.32
Stab	6.06	2.81	1.54	27.86
14 - Drill Collars	6.50	2.81	131.46	159.32
X/O	6.50	2.75	1.80	161.12
Jar	6.37	2.75	9.30	170.42
1 - HWDP	5.00	3.00	9.17	179.59
Dart Sub	6.25	2.81	0.37	179.96
14 - HWDP	5.00	3.00	125.62	305.58

BHA NO. 23 was used to drill from 4736 to 4838 m. This assembly was run to try and stop the increase in hole angle and hopefully reduce the 12+ degrees of angle recorded by the MWD at 4715 m. The two crossovers were used to simulate a short drill collar since one was not available on location. The two stabilizers below the "short drill collar" and the string stabilizer on top represented the stiffest assembly that could be made with equipment on the rig. Two monel drill collars were run on top of the MWD to facilitate running single shot surveys in case the MWD failed. This proved to be the case as the MWD tool failed shortly after drilling began at 4736 m.

ITEM	OD	ID	LENGTH	CUML
Bit No. 23	8.50	--	0.35	0.35
Near Bit Stab (Float)	6.50	2.87	1.88	2.23
Stab	6.50	2.87	1.50	3.73
X/O	6.50	2.81	1.80	5.53
X/O	6.50	2.81	1.80	7.33
Stab	6.50	2.87	1.31	8.64
X/O	6.75	2.81	0.68	9.32
MWD (GR-RES-DRAW)	6.75	--	12.25	21.57
2 - Monel DC's	6.50	2.87	18.57	40.14
X/O	6.50	2.81	1.81	41.95
Stab	6.50	2.81	1.54	43.49
12 - Drill Collars	6.50	2.81	112.70	156.19
X/O	6.50	2.75	1.80	157.99
Jar	6.37	2.75	9.30	167.29
1 - HWDP	5.00	3.00	9.17	176.46
Dart Sub	6.25	2.81	0.49	176.95
14 - HWDP	5.00	3.00	125.62	302.57

BHA No. 24 was the same as BHA No. 23 with a new MWD. Lengths of all components and the total length of the assembly were identical. This assembly drilled from 4838 to 5147 m and successfully stopped the hole angle from building and actually maintained 11.2 degrees throughout the run. A survey taken at 5140 m indicated an angle of 10.33 degrees. The MWD tool worked for 34 hours before experiencing total failure. This assembly was pulled due to BOP panel electrical problems, which caused further downtime due to a slip segment being lost off the hurricane packer. The assembly was pulled to run in the hole with a fishing assembly.

BHA No. 25 was picked up in an attempt to recover the missing slip segment dropped in the hole from the hurricane packer. The Hydraulic junk retrieving tool worked as designed, only it did not retrieve the junk but rather fist sized pieces of claystone.

ITEM	OD	ID	LENGTH	CUML
Hydraulic Junk Retr.	8.38	--	1.18	1.18
X/O	6.50	2.81	1.80	2.98
11 - Drill Collars	6.50	2.81	103.21	106.19
X/O	6.50	2.75	1.80	107.99
Jar	6.37	2.75	9.30	117.29
1 - HWDP	5.00	3.00	9.17	126.46
Dart Sub	6.25	2.81	0.49	126.95
14 - HWDP	5.00	3.00	125.62	252.57

BHA No. 26 was run in the hole to try and mill up the slip segment dropped off the hurricane packer. The junk mill was recorded as Bit No. 25 due to the fact that it made 4 m of new hole while milling on junk.

ITEM	OD	ID	LENGTH	CUML
Concave Junk Mill	8.25	--	0.25	0.25
Junk Basket	7.38	2.13	0.94	1.32
Near Bit Stab (Float)	6.50	2.87	1.88	3.20
Short Drill Collar	6.38	2.88	2.88	6.08 Stab
6.50 2.87 1.31	7.39			
2 - Monel DC's	6.50	2.87	18.57	25.96
X/O	6.50	2.81	1.81	27.77
Stab	6.50	2.81	1.54	29.31
12 - Drill Collars	6.50	2.81	112.70	142.01
X/O	6.50	2.75	1.80	143.81
Jar	6.37	2.75	9.45	153.26
1 - HWDP	5.00	3.00	9.17	162.43
Dart Sub	6.25	2.81	0.49	162.92
14 - HWDP	5.00	3.00	125.62	288.54

BHA NO. 27 was used to drill from 5151 to 5337 m (original TD). The same stiff assembly as was run previously was rerun in an attempt to minimize the total hole angle.

ITEM	OD	ID	LENGTH	CUML
Bit No. 26 (S225)	8.50	--	0.35	0.35
Near Bit Stab (Float)	8.50	2.87	1.88	2.23
Stab	8.50	2.87	1.50	3.73

Pony DC	6.50	2.81	2.88	6.61
Stab w/Totco	8.50	2.87	1.31	7.92
2 - Monel DC's	6.50	2.81	18.57	26.49
X/O	6.50	2.81	1.81	28.30
Stab	8.50	2.87	1.54	29.84
12 - Drill Collars	6.50	2.81	112.70	142.54
X/O	6.50	2.81	1.80	144.34
Jars	6.50	2.75	9.45	153.79
1 - HWDP	5.00	3.00	9.17	162.96
Dart Sub	6.50	2.50	0.49	163.45
14 - HWDP	5.00	3.00	125.62	289.07

BHA NO. 28 was used to drill from 5337 to 5460 m (new authorized TD after logging). The assembly was run because directional surveys indicated that the hole angle was holding steady or dropping slightly.

ITEM	OD	ID	LENGTH	CUML
Bit No. 27RR23 (S225)	8.50	--	0.35	0.35
Near Bit Stab (Float)	8.50	2.87	1.99	2.34
Stab	8.50	2.87	1.89	4.23
Pony DC	6.50	2.81	2.88	7.11
Stab w/Totco	8.50	2.81	1.50	8.61
2 - Monel DC's	6.50	2.87	18.57	27.18
X/O	6.50	2.81	1.81	28.99
Stab	8.50	2.81	1.54	30.53
12 - Drill Collars	6.50	2.81	112.70	143.23
X/O	6.50	2.75	1.80	145.03
Jars	6.50	2.75	9.45	154.48
1 - HWDP	5.00	3.00	9.17	163.65
Dart Sub	6.50	2.50	0.49	164.14
14 - HWDP	5.00	3.00	125.62	289.76

14.4 Bits and Hydraulics

Bit No. 22 was a Eastman Christensen S225 Ballaset (thermally stable, synthetic polycrystalline diamond cutters - IADC T5X8) with a 1.0 sq.in. flow area. This bit drilled 93 m of cement, 10 m of rat hole (cement) and 211 m of formation before being pulled for a BHA change (high hole angle). ROP while drilling cement and rat hole was 4.6 m/hr and formation was 4.0 m/hr. WOB varied from 20-25 Klbs and rotary speeds from 110-180 rpm. When pulled, it was discovered that most of the cutters were either very worn or broken. This was a surprise because the bit was still maintaining a good ROP when drilling stopped, plus a shock sub had been used.

Bit No. 23 was also an Eastman Christensen S225 Ballaset. It drilled from 4736 to 4838 m in 28.5 hours for an average penetration rate of 3.57 m/hr. WOB was 20 Klbs and rotary speed averaged 150 rpm. The bit was pulled when 0.092" wireline broke at the surface while retrieving a single shot survey. Hydraulic parameters for the bit run were 405 gpm at 2600 psi.

This bit was rerun in the hole as Bit No. 24R23. Penetration rates continued to be 4-5 m/hr from 4838 to 5147 m.

Bit No. 25 was a 8-1/4" Concave Junk Mill. While milling on junk, the mill made 4 m in 4 hours. Rotary speed was 40-60 rpm and WOB varied from 10-15 Klbs.

Bit No. 26 was another Eastman Christensen S225 (TFA-1.2). The bit was used to drill the interval from 5151 to 5337 m (interval TD). ROP's during this section ranged from 3 m/hr to 7 m/hr. The interval consisted of claystone with small amounts of silt.

Bit No. 27 was a previously run S225 (Bit #23). This bit drilled from 5337 to 5460 at an average ROP of 3.4 meters per hour in the silty claystone. The bit was in poor condition although it was still drilling with an ROP of 3-4 meters per hour.

14.5 Casing and Cementing

Casing not run in this interval.

Subject: FWR Plug and Abandonment

15.1 Operational Summary

Reference is made to the attached "Magne 2/5-9 Plug and Abandonment Summary".

The 20" and 30" casings were cut 5 meters below the mudline and the wellhead retrieved. Prior to moving off location, an ROV survey was completed of the drilling area. No debris was found and the location was confirmed to be clear of all debris and obstructions.

The anchors were pulled and the rig released for the tow to Dusavik at 0512 hrs on 19 January, 1992.

MEMORANDUM

To: E. Hansen | **Date:** January 21, 1992

From: West Vanguard | **Ref:** NO L 5870 400 (2/5-9) WDH

Subj: Magne 2/5-9 Plug and Abandonment Summary

Summary of Plugs and Procedure

The Magne 2/5-9 well was abandoned as follows: Refer to the permanent abandonment wellbore sketch for additional details.

Plug #1

A Dowell retainer was run in on 5" drillpipe to 4485 m. The retainer did not appear to set and the drillpipe was pulled out of the hole. After pulling out, the retainer was found to have been released from the drillpipe and was left in the wellbore. A Schlumberger wireline run was made to try and find the lost tool, but no sign of the tool was found in the casing. A combination pump-in/LOT to 18.4 ppge was performed and confirmed that the lost tool was not interfering with injection into the open hole. A Halliburton EZSV was then run on wire line and set at 4485 m (wireline measurements). The EZSV was pressure tested to 3150 psi prior to running in the hole with drillpipe. The stinger and drillpipe were run in the hole to 4450 m and the hole was circulated prior to cementing to insure that the top of the retainer and stinger were clear of any obstructions. The retainer was tagged at 4478 m (drillpipe measurements). Injection below the retainer was done with the rig pumps at 0.75 bpm-1100 psi and 2.5 bpm-1600 psi. Cement lines were tested to 4000 psi for five minutes before pumping operations began. The following spacer and cement slurry was pumped:

<u>Cement:</u> 193 sacks (50 bbls) of Norcem Class G cement +

35% bwoc D66 (silica flour)
20% bwoc D76 (Micromax)
0.01 gps D144
0.20 gps D604
0.20 gps D150

Weight---17.5 ppg
Yield----1.46 ft3/sx
Mixwater-4.93 gps freshwater

Spacer: 24 barrels of 17.0 ppg Mudpush XL consisting of:

0.676 bbl/bbl freshwater
0.20 gal/bbl D144
2.61 gal/bbl D149
473 lb/bbl barite

The cement and spacer were batch mixed prior to pumping. The Dowell unit required +/- 2 hrs to batch mix the cement due to problems with the recirculating mixer. A suction line in the recirculating tub was partially plugged with Micromax while mixing. Once the line was cleared, the job continued as planned.

Forty barrels (154 sx) of cement and ten barrels of spacer were squeezed below the retainer and the remainder was spotted on top of the cement retainer. The cement slurry was pumped below the retainer at 3 bpm/1730 psi. Three hundred psi was maintained on the drillpipe/9-5/8" annulus while squeezing.

After cementing, the drillpipe was pulled to 4285 m (+/- 150 m above estimated TOC). The well was reverse circulated for one complete hole volume to clean out any excess cement. After pumping, the retainer was tested once again to 3000 psi for 10 minutes.

Plug #1 depths after cementing:

Top of spacer above retainer------4398 m
Top of cement above retainer------4438 m
Retainer--------------------------4478 m
Bottom of cement (assumes 11" OH)-4565 m

Plug #2

Drillpipe was pulled to +/- 2800 m in preparation for cement plug #2. The 16.9 mud in the hole was stored and displaced with 14.5 ppg mud. The purpose of this reduction was to match the anticipated mud weight in the 9-5/8" x 13-3/8" annulus before perforating. Excess drillpipe was also laid down at this time.

The Schlumberger pressure equipment was rigged up and a perf gun loaded with 6 ea 1-11/16" shots was run in the well. The 9-5/8" casing was perforated from 2771.25-2772 m. The lubricator pressure tested to 2500 psi. Three hundred psi was left on the drillpipe while perforating for pressure monitoring purposes. After firing, the drillpipe pressure dropped to zero. An injection test was performed with pump-in rates/pressures of 1 bpm/1300 psi, 2 bpm/1650 psi and 2.5 bpm/1900 psi. After flow checking the well, the drillstring was pulled out of the hole.

A 9-5/8" EZSV was run and set on wireline at 2742 m. The retainer was pressure tested to 3000 psi for 15 minutes prior to running in the hole with the drillpipe and stinger.

The Halliburton EZSV stinger was run in on drillpipe and the hole circulated prior to stinging into the retainer. After stinging into the retainer, an injection test was performed to establish pump in rates and pressures. Cement lines were tested to 4000 psi. The following spacer and cement slurry were pumped:

Cement: 300 sacks (50 bbls) of Norcem Class G cement +

0.01 gps D47
0.20 gps D604
0.05 gps D81

Weight---17.5 ppg
Yield----0.94 ft3/sx
Mixwater-3.18 gps freshwater

Spacer: 24 barrels of 17.0 ppg Mudpush XL consisting of:

0.676 bbl/bbl freshwater
0.20 gal/bbl D144
2.61 gal/bbl D149
473 lb/bbl barite

Forty barrels (240 sx) of cement and ten barrels of spacer were squeezed below the retainer and the remainder was spotted on top of the cement retainer. The cement slurry was pumped below the retainer at 2.5 bpm/1500 psi. Three hundred psi was maintained on the drillpipe/9-5/8" annulus while squeezing.

After cementing, the drillpipe was pulled to 2600 m (+/- 100 m above estimated TOC). The well was reverse circulated for one complete hole volume to clean out any excess cement (no cement, small amount of contaminated mud seen). After pumping, the retainer was tested once again to 3000 psi for 10 minutes. The drillpipe was pulled and laid down to 350 m in preparation for the next cement plug.

Plug #2 depths after cementing:

Top of spacer above retainer------2662 m
Top of cement above retainer------2702 m
Retainer--------------------------2742 m
Bottom of cement------------------2872 m

The 9-5/8" wear bushing and seal assembly were retrieved. After pulling the seal assembly, the well was monitored for pressure and flow on the choke line. The well flowed 1.25 bbls and then was completely static. A casing cutter was run in to 346 m and the 9-5/8" casing cut at that point. A casing spear was then run and retrieved the cut 9-5/8" casing joints.

A 13-3/8" Halliburton EZSV was run on drillpipe and set at 336 m. The retainer was top tested to 2000 psi but a test below the retainer could not be obtained (the formation took fluid at 1 bpm at 1360 psi).

Dowell cement lines were rigged up and the following cement squeeze (Plug 2A) pumped. This cement volume was designed to be pumped below the 9-5/8" cement retainer and into the 9-5/8" x 13-5/8" annulus (previously cemented but would not hold pressure).

<u>Cement:</u> 510 sacks (100 bbls) of Norcem Class G neat cement

Weight---16.2 ppg
Yield----1.10 ft3/sx
Mixwater-4.67 gps seawater

The cement was displaced with 35 barrels of 14.5 ppg mud. Before unstinging from the retainer, the drillpipe pressure was steady at 900 psi. The cement was designed to cover 500 m in the 9-5/8" x 13-5/8" annulus and be 10 bbls below the 9-5/8" casing stub at 346 m. The annulus was later successfully tested to 2000 psi after the 13-5/8" casing had been cut.

Plug #3

The multi-purpose tool was run and used to retrieve the 13-3/8" seal assembly from the wellhead. An overpull of 30 Klbs was required to unseat the assembly. No pressure was seen after release and the trip tank showed a 2 bbl loss and then the well was static. The drillpipe was pressured up to 500 psi and held for 15 minutes to successfully test the integrity of the seal in the 13-5/8" x 20" casing annulus.

The 13-5/8" casing cutter was run and cut the casing at 176 m. A casing spear was run but the casing could not be freed after pulling with 180 Klbs overpull. The cutter was run again and cut the casing at 128 m. The casing came free but only after using 200 Klbs overpull to break it free. When the casing was pulled to surface, only the hanger and one joint were attached to the spear. Another spear run was needed to retrieve the remaining two joints of casing which had backed off at a connection.

The Halliburton EZSV stinger was run in on drillpipe and the hole circulated prior to stinging into the retainer. Cement lines were tested to 2500 psi prior to cementing. The following cement slurry was pumped and spotted on top of the retainer as a balanced plug.

<u>Cement:</u> 750 sacks (147 bbls) of Norcem Class G neat cement

Weight---16.2 ppg
Yield----1.10 ft3/sx
Mixwater-4.67 gps freshwater

After cementing, the drillstring was pulled to 110 m (18 m above 13-5/8" stub) and the well circulated free of cement. Twenty barrels of cement were reversed out of the drillstring.

The wellhead connector was unlatched and the wellhead inspected with the ROV (no indication of gas bubbles, etc). The riser and BOP's were pulled and the riser laid down.

A MOST tool (one run cutting and retrieving tool) was used to cut and retrieve the 20" and 30" casing at 96 m (5 m below the mudline). Ten Klbs overpull was required to pull the wellhead and casing stubs. No indication of gas bubbles or seafloor debris was seen by the ROV during its final seafloor inspection. A video record was made of this inspection. The rig was de-ballasted, anchors pulled and prepared for the tow to Dusavik, Norway. Final rig release date was 0512 hrs on 19 January 1992.

Plug #3 depths after cementing:

Top of cement above retainer------110 m (mudline at 91 m)
Retainer--------------------------336 m
Bottom of cement------------------336 m

SERVICE COMPANY EVALUATIONS

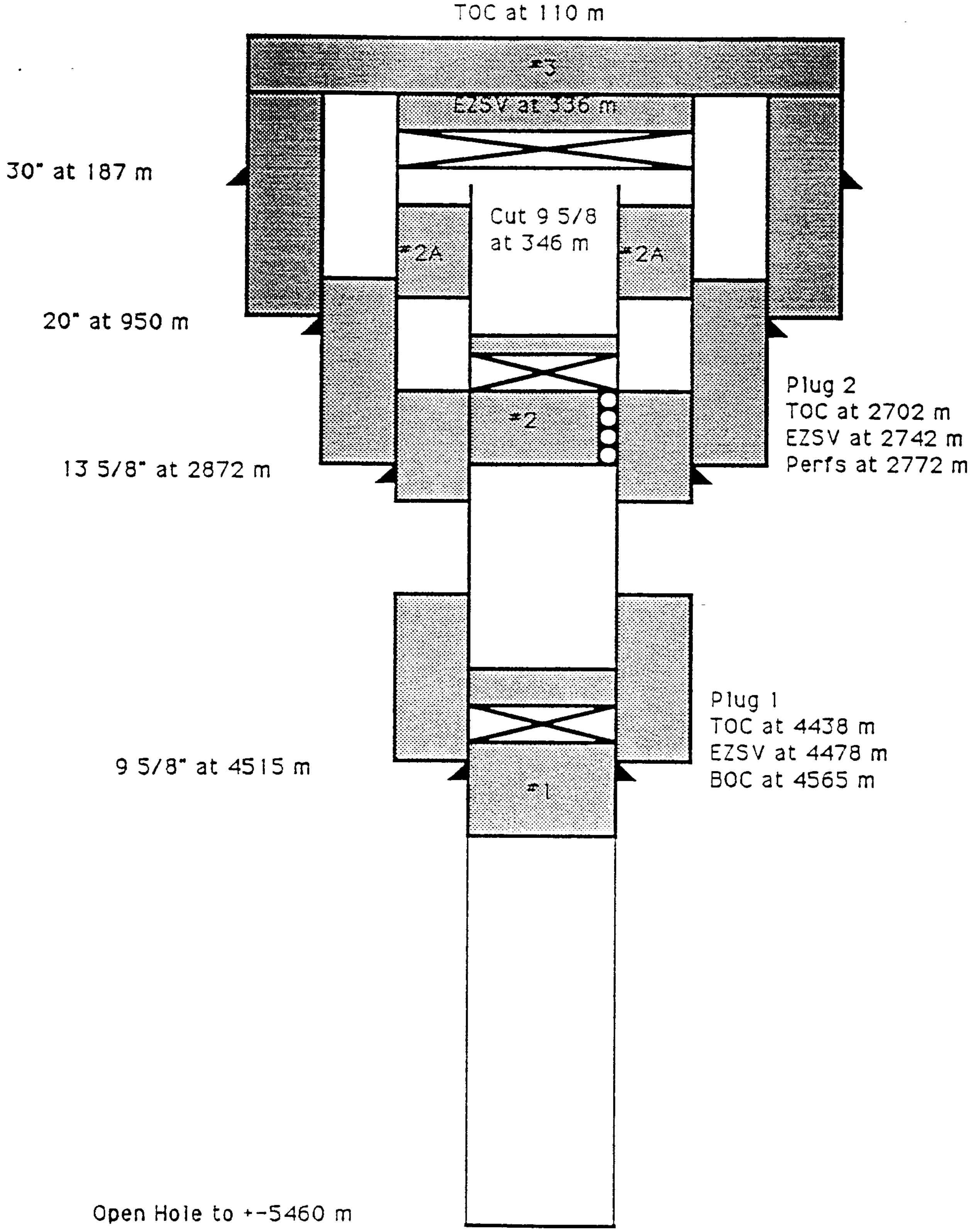
Dowell -----------------	No problems were encountered during all but one of their cement jobs. Plug #1 required +/- two hours to batch mix the cement due to plugging of the mixing lines. This job was also performed using the recirculating mixer and not the VIP mixer. A 9-5/8" Dowell cement retainer did not function properly during the PxA operations. Examination of the cement retainer setting tool indicated that the setting tool had worked properly. At this time, Dowell is checking with the manufacturer of the tool (Elder Oil Tools) for further information. One possible explanation is that the hardness of the casing (Q-125) would not allow the retainer slips to properly set in the casing wall. It may not be indicative of overall tool quality, but the use of Dowell downhole tools on future jobs should be evaluated carefully.
Halliburton ------------	Halliburton tools and personnel did an excellent job and should be considered for future operations.
Dril-Quip --------------	Onsite technician very knowledgeable and helpful.
KL Oil Tools -----------	Very professional and excellent quality work from tools and personnel.
Schlumberger -----------	Schlumberger personnel and equipment performed well even though there were minor difficulties with the electrical firing equipment when setting one of the retainers on wireline.

CONCLUSIONS

The objective of this PxA procedure was to obtain a securely abandoned wellbore in accordance with Amoco and NPD requirements. This objective was achieved in a timely manner and confirmed by successfully pressure testing each interval.

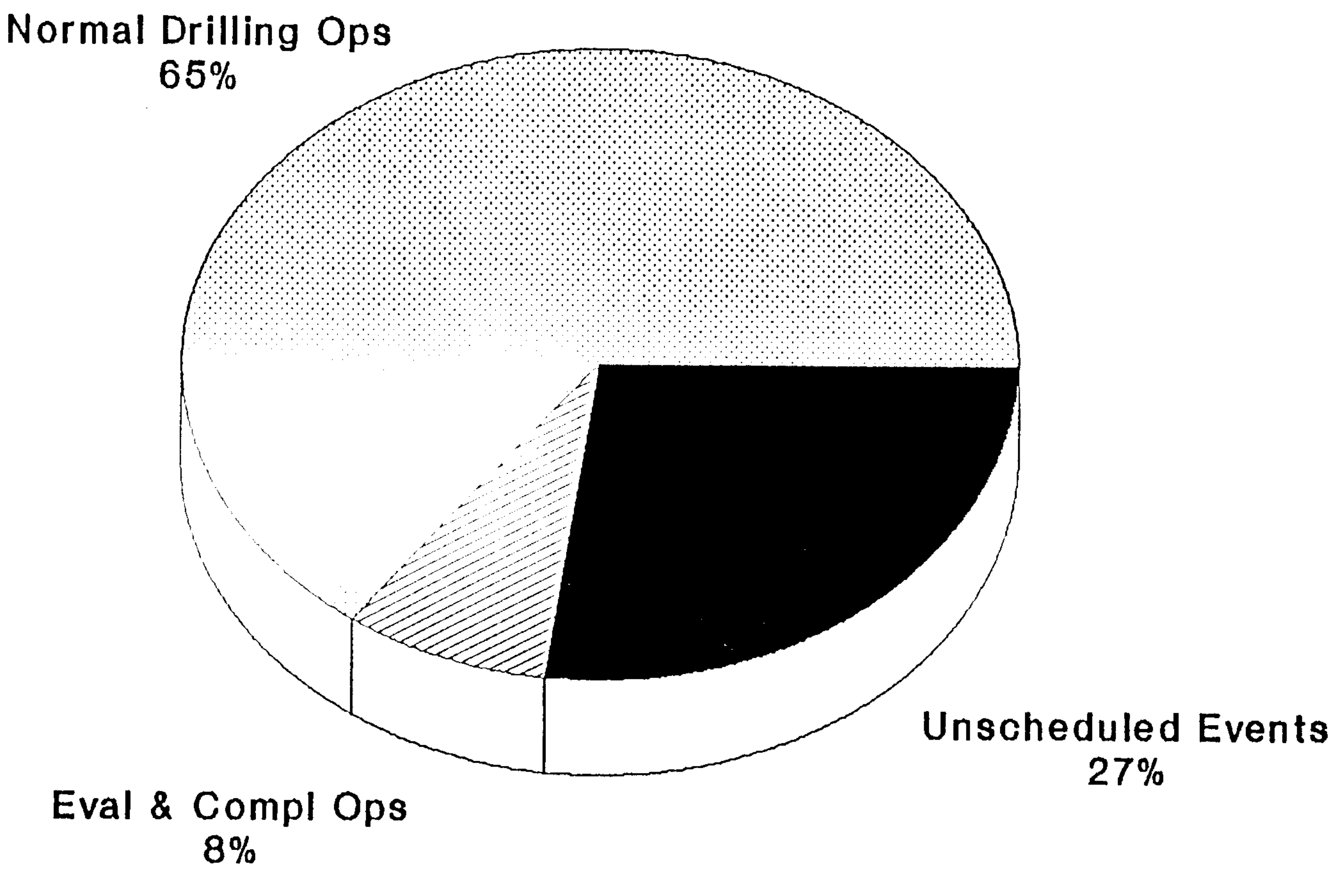
92016STA0093

Magne 2/5-9
Wellbore Sketch
Plug And Abandonment



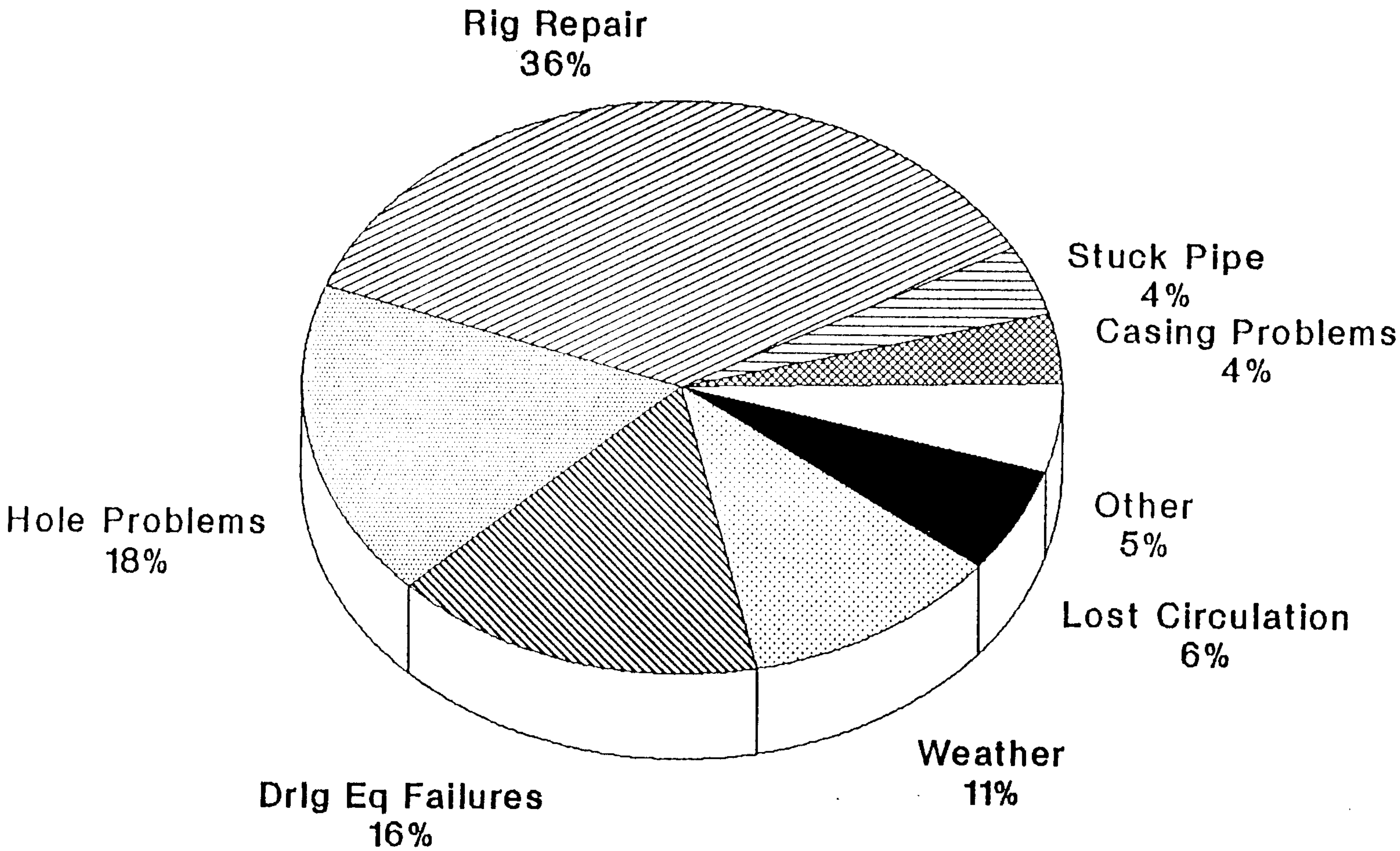
DRILLING TIME DISTRIBUTION

MAGNE 2/5-9



UNSCHEDULED EVENTS

MAGNE 2/5-9



AMOCO NORWAY OIL COMPANY
MAGNE 2/5-9
EXPLORATORY DRILLING

TIME DISTRIBUTION SUMMARY

Page 1
21/01/92
WELLTIME.WK1

GENERAL INFORMATION
(Input the following General Information)

OPERATOR..........:AMOCO NORWAY OIL COMPANY
WELL NAME..................:MAGNE 2/5-9
WELL TYPE..................:EXPLORATORY DRILLING
WELL LOCATION.............:OFFSHORE NORWAY

KICKOFF DEPTH.............: 0 Feet
0 Meters

ACTUAL TD.................:17,914 Feet
5,460 Meters

FOOTAGE DRILLED...........:17,914 Feet
5,460 Meters

COMPLETION STATUS.........:PLUGGED AND ABANDONED

RIG TYPE...................:SEMISUBMERSIBLE
RIG NAME...................:WEST VANGUARD
DRILLING CONTRATOR........:SMEDVIG

DATE & TIME INFORMATION
(Input the following dates & times)

	MONTH	DATE	YEAR	HOUR
1 Report Start Date.	9	9	91	16:30
2 Start Mob./Rig-Up.	9	9	91	16:30
3 Spud Date.........	9	10	91	18:00
4 TD Date & Time....	1	10	92	11:00
5 Rig Release Date..	1	19	92	05:12

MILESTONE DATES & TIMES SUMMARY

1	09/09/91 @ 16:30	Report Start Date
2	09/09/91 @ 16:30	Start Mob./Rig-Up
3	10/09/91 @ 18:00	Spud Date
4	10/01/92 @ 11:00	TD Date & Time
5	19/01/92 @ 05:12	Rig Release Date

TIME SUMMARY

TIME SUMMARY	DAYS	%
I. NORMAL DRILLING OPERATIONS	88.1	65.26%
II. EVAL. & COMPL. OPERATIONS	10.2	7.53%
III. UNSCHEDULED EVENTS	36.8	27.21%
TOTAL TIME	135.1	100.00%

COST INFORMATION

23538000.0 CUMULATIVE WELL COST
£174,275 /DAY (Operating Days)
£1,314 /FOOT
147.19 FOOTAGE/DRILLING DAY

TIME CATEGORIES

	TIME CATEGORIES	TIME DIST. (Hours)	% TIME OF CATEGORY	% TIME OF TOT WELL
I.	NORMAL DRILLING OPERATIONS			
1	MOB/DEMOB, ANCHORING	126.0	5.96%	3.8
2	RIG UP/RIG DOWN (Rig Only)	0.0	0.00%	0.0
3	DRILLING	879.0	41.55%	27.1
4	TRIPS (Incl PU/LD BHA & D.P.)	309.0	14.61%	9.5
5	CIRCULATE & CONDITION	251.5	11.89%	7.7
6	DIRECTIONAL WORK (EXCL. DRLG.)	19.5	0.92%	0.6
7	WASH & REAM (ROUTINE)	8.5	0.40%	0.2
8	DRILLING CEMENT / PLUGS	59.5	2.81%	1.8
9	RIG SERVICE	9.0	0.43%	0.2
10	RU & RUN CASING	126.5	5.98%	3.9
11	CEMENTING & WOC	48.0	2.27%	1.4
12	INSTALL WELLHEAD/PACKOFF	19.5	0.92%	0.6
13	NIPPLE-UP / NIPPLE-DOWN BOPE	12.5	0.59%	0.3
14	TEST BOPE/WELLHEAD/CSG./LOT	69.5	3.29%	2.1
15	DIVERS/ROV WORK/SUBSEA	4.5	0.21%	0.1
16	SET/PULL WEAR BUSHING/TEST PLUG	13.0	0.61%	0.4
17	P&A / TA - CMT. PLUGS/CUT CSG.	125.0	5.91%	3.8
18	WAIT ON ORDERS	8.5	0.40%	0.2
19	MISC. (CUT & SLIP DL., ETC.)	26.5	1.25%	0.8
	Subtotal	2115.5	100.00%	65.2
II.	EVAL. & COMPL. OPERATIONS			
1	TRIPS	78.0	31.97%	2.4
2	CIRC. / COND. / SAMPLES	14.5	5.94%	0.4
3	LOGGING / PERFORATING	151.5	62.09%	4.6
4	CORING OPERATION	0.0	0.00%	0.0
5	DST / PRODUCTION TEST	0.0	0.00%	0.0
6	RUNNING TUBING, ETC.	0.0	0.00%	0.0
7	CEMENTING / SETTING RETAINERS	0.0	0.00%	0.0
8	STIMULATION	0.0	0.00%	0.0
9	OPENING PILOT HOLE (LOG)	0.0	0.00%	0.0
10	MISC.	0.0	0.00%	0.0
	Subtotal	244.0	100.00%	7.5
III.	UNSCHEDULED EVENTS			
1	WEATHER	95.0	10.77%	2.9
2	CASING PROBLEMS	36.5	4.14%	1.1
3	CEMENT PROBLEMS	0.0	0.00%	0.0
4	WELLHEAD PROBLEMS	11.5	1.30%	0.3
5	BOP EQUIPMENT PROBLEMS	0.0	0.00%	0.0
6	WELL CONTROL PROBLEMS	0.0	0.00%	0.0
7	HOLE PROBLEMS / REAMING	158.5	17.97%	4.8
8	LOST CIRCULATION	52.0	5.90%	1.6
9	STUCK PIPE	32.0	3.63%	0.9
10	RIG REPAIR	319.0	36.17%	9.8
11	DIRECTIONAL RELATED PROBLEMS	0.0	0.00%	0.0
12	DRILLSTRING FAILURE	0.0	0.00%	0.0
13	EQUIPMENT FAILURE - DRILLING	139.5	15.82%	4.3
14	EQUIPMENT FAILURE - EVALUATION	19.0	2.15%	0.5
15	MISC.	19.0	2.15%	0.5
	Subtotal	882.0	100.00%	27.2
	Grand Total	3241.5	-	100.0

Do you wish to include time prior to Spud (i.e. Mob/Rig-Up time) in with the Time Distribution? Enter Yes or No... YES

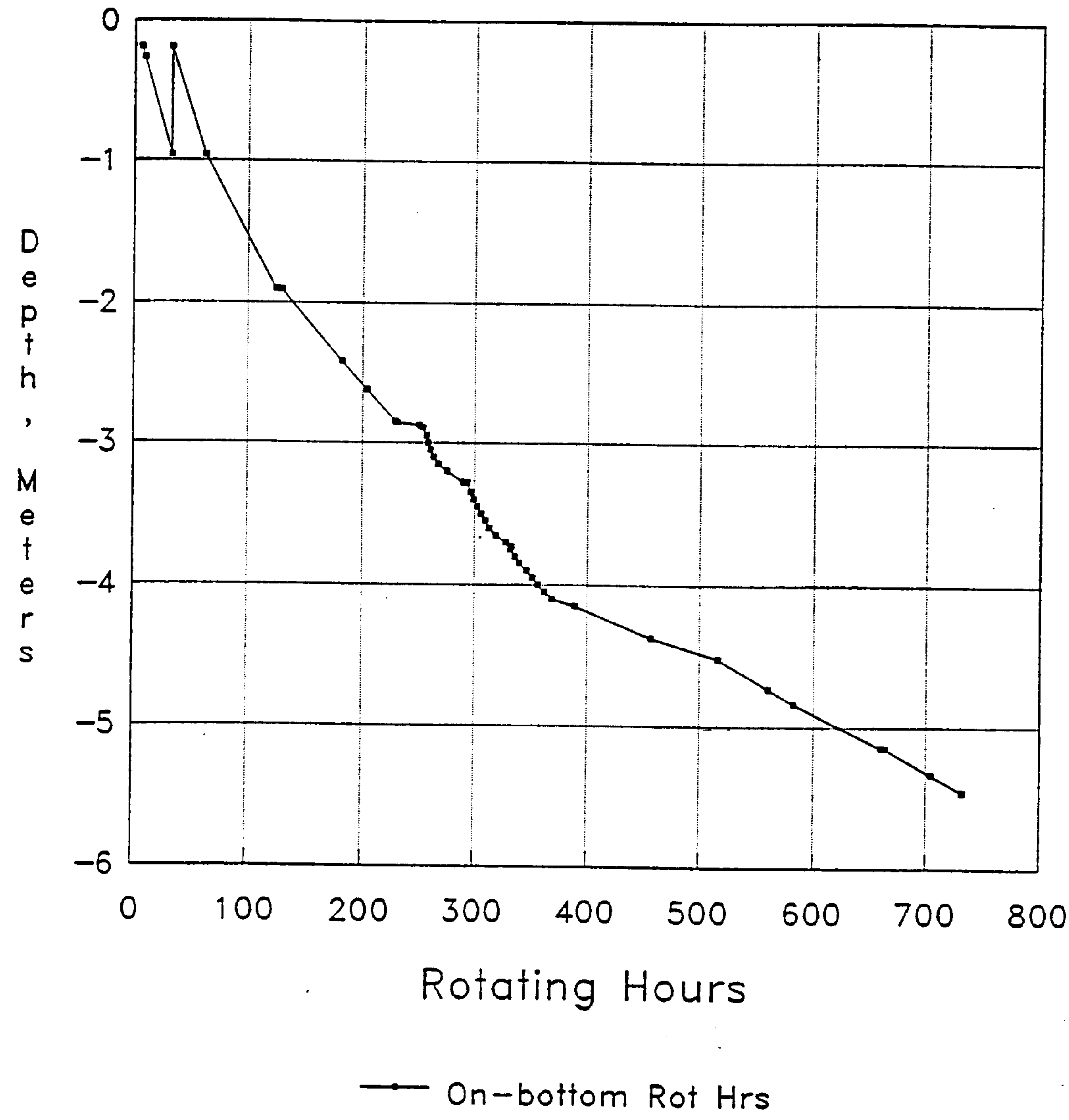
WELL 2/5-9 BIT RECORD

AMOCO NORWAY OIL COMPANY

BIT NO	SIZE	MAN	TYPE	SERIAL NO.	TFA/ JETS	OUT M MD	DIST	DRLG HRS	ROT HRS	CUM HRS	ROP M/HR	WOB KLBS	Wt * Rpm * Rot Hrs	RPM	GPM	PP	MW	GRADE	REMARKS
1-HO	36	GRANT	TANDEM HO	25971	4x18	190	99	9.0	6.5	9.0	15.2	10	5200	80	1170	1800	10.0		Hole Opener
1	26	HTC	R3	HA194	3x20	190	99	9.0	6.5	9.0	15.2	10	5200	80	1170	1800	10.0	1-1-NO-A-1-I-NO-TD	Pilot Hole
2	26	HTC	CR-1	H90BX	OPEN	193	3	0.2	0.1	9.2	30	25	150	60	883	1700	SW	1-1-NO-A-0-I-NO-TD	Clean out 30"
3	12.25	HTC	X3A	783XL	3x24,1x18	268	75	4.5	2.0	13.7	37.5	5	1000	100	883	1700	SW	1-1-NO-A-1-I-NO-DTF	Pulled to replace MWD
4RR3	12.25	HTC	X3A	783XL	3x24,1x18	960	692	37.0	24.0	50.7	28.8	5	12000	100	879	1820	SW	1-2-CT-H-E-I-SS-TD	Pilot hole
5RR3	12.25	HTC	X3A	783XL	3x24	960	767	35.0	29.5	85.7	21.9	14	41300	100	1340	1600	SW	2-2-CT-HH-E-I-SS-TD	Pilot bit
5RR3-HO	15.5X26	GRANT	TANDEM HO	31282	6x20,3x24	960	767	35.0	29.5	85.7	21.9	14	41300	100	1340	1600	SW	2-2-CD-A-7-I-BU-TD	Hole opener run
6	17.5	REED	S11J	HD3478	3x20	963	3	0.1	0.1	85.8	30.0	15	90	60	1100	1600	10.0	1-1-NO-A-F-I-NO-BHA	Clean out 20"
7	17.5	CHRIS	R523EG	1205034	7x20	1903	940	87.5	62.0	173.3	15.2	25	232000	150	1050	3000	12.0	8-8-BT-A-X-1/8-LT-PR	Eccentric bit
8	17.5	SMITH	15SLCE	NA1692	2x24,1x28 1x18	1909	6	5.0	5.0	178.3	1.2	30	15000	100	1050	3000	13.5	0-0-NO-NO-E-I-BU-PR	Ream from 950-1903 m
9	17.5	CHRIS	R428GN	1204211	10x18	2423	514	62.5	52.5	240.8	9.8	35	276000	150	1020	3500	14.2	4-5-WT-S-X-I-BT-PR	Previously used on Valhall
10	17.5	SMITH	MSDGHC	NB6030	3x22,1x18	2627	204	25.5	22.0	266.3	9.3	40	88000	100	920	3500	14.2	2-3-BT-M-E-I-PN-PR	
11	17.5	HUGHES	MAX-11H	J62B5	3x18,1x28	2849	222	38.0	25.5	304.3	8.7	40-50	191250	150	930	3700	14.5	1-1-BU-A-2E-I-NO-PR	Bit balling
12RR11	17.5	HUGHES	MAX-11H	J62B5	3x18,1x28	2859	10	1.5	1.5	314.3	6.7	40-60	13500	150	930	3750	14.5	1-1-BU-A-2E-I-NO-PR	Bit balling
13	17.5	DBS	GX2TD2060	7910568	2x20,6x18	2880	21	27.0	19.5	335.3	1.1	40-65	190125	150	910	3600	14.5	0-0-BU-N-0-I-PN-PR	Bit balling
14RR11	17.5	HUGHES	MAX-11H	J62B5	3x18,1x28	2880	0	0	0	335.3	0	0	0	0	930	3550	14.5	1-1-BU-A-2E-I-NO-PR	Wiper Trip
15	12.25	SMITH	MSDGHC	NB5871	3x18,1x18	2897	17	5.6	3.0	340.9	5.7	35	8400	80	718	3950	14.0	1-1-CD-MH123-E-I-PN	Drill cmt, LOT, POOH Log
16RR15	12.25	SMITH	MSDGHC	NB5871	3x18,1x20	3277	380	58.2	39.8	399.1	9.5	45	261900	100	678	4000	14.0	8-5-BT-CD-A-8-1/4-WT-PR	Bit Torqueing Badly
17	12.25	DBS	TD290Q	7911004	8x18	3730	453	44.4	39.8	443.5	11.4	20	179100	150	881	4100	13.4	1-2-BT-S,N-X-I-CT,1PN-HP	Hole Problems, Back Ream
18	12.25	DBS	TD290Q	7910715	8x18	4150	420	86.3	56.1	529.8	7.5	15	118800	150	702	4000	15.0	0-2-CT-S,G-X-I-WT42-LOG	Micro Crack-Matrix
19	12.25	REED	HP51-J	JY2090	3x14	4372	222	83.0	68.0	612.8	3.3	45	275400	90	540	4150	15.0	3-4-BT12-N-SF-X-NO-PR	All cones very loose
20	12.25	CHRIS	S225	1810258	TFA=2.0	4525	153	78.5	59.5	691.3	2.6	25	223125	150	540	3100	14.8	0-1-LT-T,G-X-I-NO-TD	
21	12.25	CHRIS	S225	1810258	TFA=2.0	4525	-	-	-	691.3	-	10	-	100	505	3100	14.8	0-1-LT-T,G-X-I-NO-TD	Conditioning trip after log
22	8.5	CHRIS	S225	1204499	TFA=1.0	4736	211	56.9	43.8	748.2	4.8	20	204840	180	355	2500	15.0	5-4-CT-A-X-I-ER-WT-BHA	Drl 93M Cmt/Float Equip
23	8.5	CHRIS	S225	1800651	TFA=1.0	4838	102	29.3	22.2	777.5	4.6	20	87900	150	405	2600	15.0	1-2-CT-S-X-I-NO-DTF	
24R23	8.5	CHRIS	S225	1800651	TFA=1.0	5147	309	90.3	77.5	867.8	4.0	25	319688	165	352	2200	15.7	2-3-CT-S-X-I-NO-RIG/DTF	BOP repair, Lost pkr slip
25	8.25	SMEDVIG	J/MILL	2WV.408	TFA=1.5	5151	4	6	4	873.8	1.0	15	5400	60	350	1160	16.1	1-8-NO-S/G-X-I-NO-BHA	Mill on pkr slip segment
26	8.5	CHRIS	S225	1204307	TFA=1.2	5337	186	47.5	40.7	921.3	4.6	25	152625	150	350	2300	16.5	2-4-CT-30T/15S-X-I-TD	
27R23	8.5	CHRIS	S225	1800651	TFA=1.0	5460	123	36.0	27.2	957.3	4.5	20	84320	155	355	2450	16.9	3-5-BT/CT-80T/20C-X-I-TD	TD

NOTE: ROP calculated using rotating hours
Cumulative bit hours calculated using drilling hours

AMOCO NORWAY OIL CO.
MAGNE 2/5-9



92021STA0122

Subject: Directional Surveys

xx.x Directional Surveys

The final directional survey for Magne 2/5-9 is titled MARINDIR DATA and is stored on the SURVEYS userid on the STAVM system. The file is composed of the following surveys:

0 - 85 m	Distance between actual and proposed surface location.
90 - 2870 m	Sperry-Sun gyro survey, 2 November, 1991
2882 - 4509 m	Teleco MWD surveys while drilling
4530 - 5310 m	Schlumberger dipmeter, 7 January, 1992

```
APPLICATION NAME: WELLPATH

DESCRIPTION: Directional survey calculations using various methods

EFFECTIVE DATE: 85/01/03

WOULD YOU LIKE ANY ADDITIONAL INFORMATION:
  ( ) NO - CONTINUE
  (G) GENERAL INFO - ALL DRILLING PROGRAMS
  (A) ALL DETAIL - THIS PROGRAM
  (E) EXPANDED DESCRIPTION
  (T) APPLICATION DEVELOPMENT THEORY
  (I) INPUT DESCRIPTION
  (S) SAMPLE INPUT DATA
  (P) POSSIBLE PROBLEM AREAS
  (R) PROBLEM REPORTING SECTION........?

INPUT AND OUTPUT IN TRADITIONAL U.S. OIL FIELD UNITS(Y)*** OR (N)...?
n

INPUT UNITS-TRADITIONAL(T) OR METRIC(M)***....?
m

OUTPUT UNITS-TRADITIONAL(T) OR METRIC(M)***...?
m

ENTER FILE NAME  ...?
  marindir data

IS THIS INERTIAL DATA (N)***. . . . . . . . . . . . . . ?

BAD DATA - LINE IGNORED DEPTH BELOW 5310 - E


BAD DATA - LINE IGNORED MAGNE 2/5-9 WELL


BAD DATA - LINE IGNORED MSS AT 85 M IS DISTA

ENTER THE CALCULATION METHOD DESIRED
```

```
ENTER: 'A'  ,  E AVERAGE (DEFAULT)
       'B'  FOR BALANCED TANGENTIAL
       'T'  FOR TANGENTIAL
       'M'  FOR MINIMUM CURVATURE
       'R'  FOR RADIUS OF CURVATURE
       'ME' FOR MERCURY . . . . . . . . . . . . . . . . ?
m

AT WHAT DEPTH (M) DO YOU WANT TO START THE
PRINTOUT (NOTE: AN ENTRY OF '1' WILL GIVE
YOU THE TVD CALCULATIONS) (0)***. . . . . . . . . . . . ?
```

DEPTH 90 M TO 2870 M, SPERRY-SUN GYRO, NOV 2, 1992
DEPTH 2882 M TO 4509 M, TELECO MWD SURVEYS WHILE DRILLING
DEPTH 4530 M TO 5310 M, SCHLUMBERGER DIPMETER, JAN 7, 1992

FILENAME: MARINDIR   METRIC UNITS   1992-01-22   10:27

MINIMUM CURVATURE METHOD

VERTICAL SECTION OR CLOSURE DIRECTION IS 227.51 DEGREES

MEAS.	SURVEY		DEPTH	NORTH	EAST	VERT.	CLOSURE		DOG
DEPTH	INCL.	DIR.	(TVD)	-SOUTH	-WEST	SECTION	DIST.	DIR.	LEG
85.00	0.00	124.40	85.00	-3.84	5.61	-1.54	7	124	
... THE ABOVE LINE IS MULTISHOT INPUT DATA ...									
90.00	1.60	0.00	90.00	-3.77	5.61	-1.59	7	124	9.7
120.00	1.06	349.80	119.99	-3.08	5.56	-2.02	6	119	0.6
150.00	0.56	16.70	149.99	-2.66	5.55	-2.30	6	116	0.6
180.00	0.30	31.00	179.99	-2.46	5.64	-2.50	6	114	0.3
210.00	0.44	25.40	209.99	-2.29	5.73	-2.68	6	112	0.1
240.00	0.48	24.20	239.99	-2.07	5.83	-2.90	6	110	0.0
270.00	0.44	30.40	269.98	-1.85	5.94	-3.13	6	107	0.0
300.00	0.56	45.50	299.98	-1.65	6.10	-3.38	6	105	0.2
330.00	0.49	42.30	329.98	-1.45	6.29	-3.66	6	103	0.0
360.00	0.58	57.90	359.98	-1.28	6.51	-3.93	7	101	0.2
390.00	0.33	65.30	389.98	-1.16	6.71	-4.17	7	100	0.3

420.00	0[illegible]	58.20	419.98	-1.05	6.91	-4.39	7	[illegible]9	0.2
450.00	0.30	61.00	449.98	-0.93	7.10	-4.61	7	97	0.3
480.00	0.37	67.20	479.98	-0.86	7.26	-4.78	7	97	0.0
510.00	0.07	159.30	509.98	-0.84	7.36	-4.86	7	97	0.4
540.00	0.17	131.50	539.98	-0.89	7.40	-4.86	7	97	0.1
570.00	0.06	15.60	569.98	-0.90	7.44	-4.88	7	97	0.2
600.00	0.11	163.10	599.98	-0.91	7.45	-4.88	8	97	0.2
630.00	0.22	93.90	629.98	-0.94	7.51	-4.90	8	97	0.2
660.00	0.17	351.30	659.98	-0.90	7.57	-4.97	8	97	0.3
690.00	0.26	18.80	689.98	-0.80	7.58	-5.05	8	96	0.1
720.00	0.59	17.10	719.97	-0.58	7.65	-5.25	8	94	0.3
750.00	0.72	1.60	749.97	-0.25	7.70	-5.51	8	92	0.2
780.00	0.66	358.80	779.97	0.11	7.70	-5.75	8	89	0.0
810.00	0.10	309.20	809.97	0.30	7.68	-5.87	8	88	0.6
840.00	0.51	355.10	839.97	0.45	7.64	-5.94	8	87	0.4
870.00	0.65	339.70	869.97	0.75	7.57	-6.09	8	84	0.2
B									
900.00	0.40	328.30	899.97	0.99	7.46	-6.17	8	82	0.3
930.00	0.38	336.80	929.97	1.17	7.37	-6.22	7	81	0.0
960.00	0.37	82.90	959.96	1.28	7.42	-6.34	8	80	0.6
990.00	0.34	53.30	989.96	1.34	7.59	-6.50	8	80	0.2
1020.00	0.32	5.80	1019.96	1.48	7.67	-6.66	8	79	0.3
1050.00	0.10	343.70	1049.96	1.59	7.67	-6.73	8	78	0.2
1080.00	0.25	31.60	1079.96	1.67	7.70	-6.80	8	78	0.2
1110.00	0.23	35.00	1109.96	1.77	7.77	-6.93	8	77	0.0
1140.00	0.34	23.10	1139.96	1.91	7.84	-7.07	8	76	0.1
1170.00	0.37	16.00	1169.96	2.08	7.90	-7.23	8	75	0.0
1200.00	0.30	342.70	1199.96	2.25	7.90	-7.35	8	74	0.2
1230.00	0.23	345.30	1229.96	2.38	7.86	-7.41	8	73	0.0
1260.00	0.14	358.60	1259.96	2.48	7.85	-7.46	8	72	0.0
1290.00	0.11	42.10	1289.96	2.53	7.86	-7.51	8	72	0.0
1320.00	0.27	18.40	1319.96	2.62	7.91	-7.60	8	72	0.2
1350.00	0.21	13.10	1349.96	2.74	7.94	-7.71	8	71	0.0
1380.00	0.26	12.00	1379.96	2.86	7.97	-7.81	8	70	0.0
1410.00	0.08	334.60	1409.95	2.95	7.97	-7.87	9	70	0.2
1440.00	0.13	6.20	1439.95	3.00	7.97	-7.90	9	69	0.0
1470.00	0.14	117.20	1469.95	3.02	8.00	-7.94	9	69	0.2
1500.00	0.04	276.50	1499.95	3.00	8.03	-7.95	9	69	0.2
B									
1530.00	0.25	179.90	1529.95	2.94	8.02	-7.90	9	70	0.3
1560.00	0.13	165.20	1559.95	2.84	8.02	-7.84	9	71	0.1
1590.00	0.27	174.60	1589.95	2.74	8.04	-7.78	8	71	0.1
1620.00	0.39	162.50	1619.95	2.57	8.08	-7.69	8	72	0.1

1650.00	[illegible]	161.80	1649.95	2.38	8.14	-7.61	8	74	0.0
1680.00	0.40	150.90	1679.94	2.19	8.22	-7.54	9	75	0.0
1710.00	0.30	186.80	1709.94	2.02	8.26	-7.46	9	76	0.2
1740.00	0.78	242.70	1739.94	1.85	8.07	-7.20	8	77	0.7
1770.00	0.97	259.40	1769.94	1.71	7.64	-6.79	8	77	0.3
1800.00	1.07	264.10	1799.93	1.63	7.11	-6.35	7	77	0.1
1830.00	1.29	260.20	1829.92	1.54	6.50	-5.84	7	77	0.2
1860.00	1.18	239.90	1859.92	1.33	5.90	-5.25	6	77	0.5
1890.00	1.29	262.00	1889.91	1.13	5.30	-4.67	5	78	0.5
1920.00	1.42	260.10	1919.90	1.02	4.60	-4.08	5	78	0.1
1950.00	1.44	261.50	1949.89	0.90	3.86	-3.45	4	77	0.0
1980.00	1.32	250.00	1979.88	0.73	3.16	-2.82	3	77	0.3
2010.00	1.16	246.10	2009.87	0.48	2.56	-2.22	3	79	0.2
2040.00	1.22	251.30	2039.87	0.26	1.98	-1.64	2	83	0.1
2070.00	1.34	238.00	2069.86	-0.03	1.38	-1.00	1	91	0.3
2100.00	1.40	220.70	2099.85	-0.49	0.85	-0.29	1	120	0.4
2130.00	1.65	220.50	2129.84	-1.10	0.33	0.50	1	164	0.2
B									
2160.00	1.50	215.10	2159.83	-1.75	-0.18	1.31	2	186	0.2
2190.00	1.46	217.90	2189.82	-2.37	-0.64	2.08	2	195	0.0
2220.00	1.51	223.90	2219.80	-2.96	-1.15	2.85	3	201	0.2
2250.00	1.53	224.10	2249.79	-3.53	-1.70	3.64	4	206	0.0
2280.00	1.53	226.00	2279.78	-4.10	-2.27	4.44	5	209	0.0
2310.00	1.30	215.40	2309.77	-4.65	-2.75	5.17	5	211	0.3
2340.00	1.54	204.50	2339.76	-5.30	-3.12	5.88	6	210	0.4
2370.00	1.64	196.90	2369.75	-6.07	-3.41	6.62	7	209	0.2
2400.00	1.51	193.10	2399.74	-6.87	-3.63	7.31	8	208	0.2
2430.00	1.51	190.20	2429.73	-7.64	-3.79	7.95	9	206	0.0
2460.00	1.41	178.00	2459.72	-8.40	-3.84	8.51	9	205	0.3
2490.00	1.16	178.80	2489.71	-9.07	-3.82	8.95	10	203	0.3
2520.00	1.18	165.50	2519.70	-9.68	-3.74	9.29	10	201	0.3
2550.00	1.07	148.40	2549.70	-10.21	-3.52	9.49	11	199	0.3
2580.00	1.32	134.60	2579.69	-10.70	-3.12	9.53	11	196	0.4
2610.00	1.11	121.50	2609.68	-11.09	-2.63	9.43	11	193	0.3
2640.00	0.95	118.30	2639.68	-11.36	-2.16	9.27	12	191	0.2
2670.00	0.95	115.70	2669.67	-11.59	-1.72	9.09	12	188	0.0
2700.00	0.96	107.40	2699.67	-11.77	-1.25	8.87	12	186	0.1
2730.00	1.15	106.10	2729.66	-11.93	-0.73	8.59	12	183	0.2
2760.00	1.09	100.40	2759.66	-12.06	-0.16	8.26	12	181	0.1
B									
2790.00	0.96	101.40	2789.65	-12.16	0.37	7.94	12	178	0.1
2820.00	0.65	90.50	2819.65	-12.21	0.79	7.67	12	176	0.3
2850.00	0.51	73.00	2849.64	-12.18	1.09	7.42	12	175	0.2

2870.00	[illegible]	95.60	2869.64	-12.17	1.34	7.23	[illegible]	[illegible]	0.8
2882.00	0.73	230.44	2881.64	-12.23	1.38	7.24	12	174	4.0
2977.00	0.88	228.67	2976.63	-13.09	0.37	8.57	13	178	0.0
3059.00	1.25	236.13	3058.62	-14.01	-0.85	10.09	14	183	0.1
3144.00	1.46	231.09	3143.59	-15.21	-2.46	12.08	15	189	0.1
3229.00	0.95	245.61	3228.57	-16.18	-3.94	13.83	17	194	0.2
3313.00	0.83	212.06	3312.56	-16.98	-4.90	15.08	18	196	0.2
3400.00	0.99	218.69	3399.55	-18.10	-5.70	16.43	19	197	0.1
3485.00	0.73	225.44	3484.54	-19.05	-6.55	17.70	20	199	0.1
3573.00	0.79	239.14	3572.53	-19.76	-7.47	18.85	21	201	0.1
3658.00	0.68	240.28	3657.52	-20.31	-8.41	19.92	22	202	0.0
3749.00	0.64	255.03	3748.51	-20.71	-9.37	20.90	23	204	0.1
3836.00	0.63	263.58	3835.51	-20.89	-10.31	21.71	23	206	0.0
3921.00	0.83	249.71	3920.50	-21.15	-11.36	22.66	24	208	0.1
[illegible]	0.64	239.08	[illegible]	-21.61	-12.34	23.70	25	210	0.1
[illegible]	0.45	213.25	[illegible]	-22.16	-12.96	24.52	26	210	0.1
4135.00	0.49	210.06	4134.49	-22.44	-13.13	24.84	26	210	0.0
4168.00	0.19	201.40	4167.48	-22.61	-13.22	25.02	26	210	0.3
B									
4223.00	0.54	192.64	4222.48	-22.95	-13.31	25.32	27	210	0.2
4270.00	1.20	155.95	4269.48	-23.61	-13.16	25.65	27	209	0.5
4309.00	1.45	151.55	4308.47	-24.42	-12.76	25.90	28	208	0.2
4358.00	2.72	172.72	4357.43	-26.12	-12.32	26.72	29	205	0.9
4405.00	3.49	175.71	4404.36	-28.65	-12.07	28.25	31	203	0.5
4444.00	3.90	169.89	4443.28	-31.14	-11.75	29.70	33	201	0.4
4490.00	4.74	154.19	4489.15	-34.39	-10.64	31.08	36	197	1.0
4509.00	4.91	151.52	4508.08	-35.81	-9.91	31.50	37	195	0.4
4531.00	5.71	150.27	4529.99	-37.59	-8.92	31.97	39	193	1.1
4561.00	7.13	144.74	4559.80	-40.41	-7.11	32.53	41	190	1.6
4591.00	7.70	142.22	4589.55	-43.52	-4.80	32.93	44	186	0.7
4622.00	8.59	139.92	4620.23	-46.93	-2.04	33.20	47	182	0.9
4652.00	9.51	139.33	4649.86	-50.52	1.02	33.37	51	179	0.9
4683.00	10.61	138.11	4680.38	-54.59	4.59	33.49	55	175	1.1
4713.00	11.67	138.72	4709.82	-58.93	8.44	33.58	60	172	1.1
4744.00	12.51	140.30	4740.13	-63.87	12.65	33.81	65	169	0.9
4775.00	12.13	142.12	4770.41	-69.02	16.80	34.23	71	166	0.5
4805.00	11.94	142.28	4799.75	-73.96	20.63	34.75	77	164	0.2
4836.00	11.41	144.94	4830.11	-79.01	24.35	35.41	83	163	0.7
4866.00	11.45	144.58	4859.52	-83.86	27.79	36.16	88	162	0.0
4897.00	11.78	145.01	4889.88	-88.96	31.38	36.95	94	161	0.3
B									
4928.00	11.77	144.75	4920.23	-94.14	35.02	37.76	100	160	0.0
4958.00	11.52	145.26	4949.61	-99.10	38.50	38.55	106	159	0.3

4989.00	[illegible]	144.95	4979.99	-104.15	42.02	39.37	112	158	0.1
5020.00	11.62	143.74	5010.37	-109.17	45.62	40.10	118	157	0.3
5050.00	11.54	145.56	5039.76	-114.08	49.10	40.85	124	157	0.4
5081.00	11.46	145.82	5070.14	-119.18	52.59	41.73	130	156	0.0
5111.00	11.16	144.57	5099.55	-124.01	55.94	42.52	136	156	0.4
5142.00	10.92	143.33	5129.98	-128.81	59.44	43.18	142	155	0.3
5172.00	10.85	143.47	5159.44	-133.36	62.81	43.76	147	155	0.0
5203.00	10.84	143.47	5189.88	-138.05	66.29	44.37	153	154	0.0
5233.00	10.74	144.20	5219.36	-142.58	69.60	44.99	159	154	0.2
5264.00	10.85	144.61	5249.80	-147.30	72.98	45.68	164	154	0.1
5294.00	10.66	146.96	5279.28	-151.93	76.13	46.49	170	153	0.5
5325.00	10.43	148.86	5309.75	-156.74	79.14	47.51	176	153	0.4
5460.00	10.43	148.86	5442.52	-177.66	91.78	52.32	200	153	0.0

CHANGE: (W)ELL
(M)ETHOD
(V)ERTICAL SECTION
(C)REATE A FILE

B

(T)RUE VERTICAL DEPTH
(P)LOT
(A)LTERNATE FORMAT
(O)UTPUT UNITS
(E)XTRAPOLATE TO TARGET
(S)TOP (DEFAULT) . . . . ?

AMOCO NORWAY OIL COMPANY

DAILY DRILLING MUD PROPERTIES

Date	Section	Depth	FSR No	Mud Density	Funnel Viscosity	Plastic Viscosity	Yield Point	10 sec. gel	10 min. gel	API Filtr.	HTHP Filtr.	pH	Pf	Mf	Pm	Total hardn.	Ca++	Chlorides	KCL	Solids Content	Sand Content	MBT	Excess Ancoquat I	Sodium Sulphite
		meter		ppg	Sec/Qt	cP	lb/100ft^2	lb/100ft^2	lb/100ft^2	ml	ml		ml	ml	ml	mg/l	mg/l	mg/l	ppb	uncor.Vol%	%	ppb	ppb	mg/l
10-9-91	36"	190	1	8,5-10	100+	11	40	25	30	n/a	n/a	10,5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
11-9-91	36"	190	2	8,5-10	100+	11	40	25	30	n/a	n/a	10,0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
12-9-91	26"	268	3	8,5-10	100+	12	44	20	30	n/a	n/a	10,5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
13-9-91	26"	554	4	8,5-10	100+	18	123	45	45	n/a	n/a	11,0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
14-9-91	26"	960	5	8,5-10	100+	13	46	20	30	n/a	n/a	10,5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
15-9-91	26"	960	6	8,5-10	100+	21	63	17	38	n/a	n/a	10,5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
16-9-91	26"	960	7	10,0	100+	31	53	21	48	n/a	n/a	11,0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
17-9-91	26"	960	8	10,0	100+	18	49	19	48	n/a	n/a	10,5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
18-9-91	26"	960	9	10,0	100+	18	49	19	48	n/a	n/a	11,0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
19-9-91	17 1/2"	963	10	10,0	41	9	7	1	2	n/a	n/a	9,1	0,12	0,36	0,26	1880	560	54000	36	6	6	n/a	6	n/a
20-9-91	17 1/2"	1150	11	10,5	43	15	22	6	7	6,8	n/a	8,0	0,00	0,33	0,00	2000	640	52000	37	11	-	n/a	2	n/a
21-9-91	17 1/2"	1368	12	11,1	52	21	17	3	6	7,5	n/a	8,6	0,13	0,61	-	2120	650	76000	34	16,5	-	n/a	6	n/a
22-9-91	17 1/2"	1550	13	11,2	43	17	17	3	4	5,8	n/a	8,7	0,22	0,54	-	2060	620	64000	29	-	-	n/a	5	n/a
23-9-91	17 1/2"	1699	14	11,9	51	24	20	3	4	7,4	n/a	8,4	0,13	0,48	0,05	2080	630	70000	30	18,5	0,5	n/a	6	n/a
24-9-91	17 1/2"	1903	15	12,8	67	31	23	3	4	4,8	n/a	8,3	0,00	0,40	-	2120	640	67000	33	22	0,75	n/a	10	150
25-9-91	17 1/2"	1903	16	13,5	85	34	24	4	10	8,3	n/a	8,3	0,05	0,60	-	2200	800	75000	41	25	1	n/a	10	180
26-9-91	17 1/2"	1903	17	13,5	63	40	20	3	10	10,0	n/a	8,5	0,00	0,80	-	2400	1000	73000	39	24	0,75	n/a	9	180
27-9-91	17 1/2"	1903	18	13,5	79	25	29	5	19	13,0	n/a	7,6	0,00	0,50	-	2360	1200	74000	40	25	1	n/a	5,5	220
28-9-91	17 1/2"	1909	19	13,5	62	26	26	4	9	8,8	n/a	7,9	0,00	1,00	-	2000	700	73000	36	25	0,75	n/a	11	160
29-9-91	17 1/2"	2109	20	13,5	70	38	23	4	9	7,0	n/a	8,3	0,10	1,20	-	2160	820	69000	35	25	0,75	n/a	13	180
30-9-91	17 1/2"	2184	21	14,2	120	46	22	3	12	9,0	n/a	8,2	0,10	1,20	-	2080	860	77000	40	28	1	n/a	11	180
1-10-91	17 1/2"	2242	22	14,3	65	37	21	3	7	8,8	n/a	8,1	0,10	1,10	-	2260	960	75000	36	28	0,75	n/a	10,5	160
2-10-91	17 1/2"	2347	23	14,2	69	50	24	4	10	7,5	n/a	8,1	0,10	1,10	-	2320	1080	81000	41	27	0,75	n/a	11,5	200
3-10-91	17 1/2"	2415	24	14,2	67	46	20	4	10	7,0	n/a	7,9	0,00	1,40	-	2260	1560	81000	43	27	0,75	n/a	10,5	180
4-10-91	17 1/2"	2423	25	14,2	77	38	21	5	8	6,0	n/a	8,0	0,10	1,20	-	2260	1040	79000	39	27	0,75	n/a	10,5	220
5-10-91	17 1/2"	2560	26	14,2	80	55	31	7	15	7,0	n/a	8,0	0,00	1,70	-	2240	1040	80000	40	28	0,75	n/a	10,5	180
6-10-91	17 1/2"	2627	27	14,3	110	50	26	7	14	7,0	n/a	8,0	0,00	1,70	-	2440	880	82000	40	28	0,75	n/a	14	220
7-10-91	17 1/2"	2710	28	14,5	85	58	18	6	21	10,0	n/a	8,3	0,10	1,70	-	2560	1320	80000	36	29	0,75	n/a	12,5	180
8-10-91	17 1/2"	2795	29	14,6	141	64	24	7	38	11,0	n/a	8,1	0,10	2,00	-	2040	1040	80000	37	29	0,75	n/a	7,5	160
9-10-91	17 1/2"	2848	30	14,5	70	34	22	8	21	10,0	n/a	8,3	0,20	2,10	-	2160	1080	81000	38	29	0,75	n/a	7	180
10-10-91	17 1/2"	2859	31	14,5	57	34	16	4	10	7,0	n/a	8,2	0,10	2,20	-	1840	1120	80000	36	28	0,75	n/a	8,6	160
11-10-91	17 1/2"	2875	32	14,6	72	46	25	6	17	7,8	n/a	8,4	0,15	2,80	-	2000	1240	79000	36	28	0,75	n/a	11	160
12-10-91	17 1/2"	2880	33	14,5	78	38	19	6	18	10,3	n/a	8,7	0,30	2,70	-	2200	1200	78000	35	29	0,75	n/a	10,5	160
13-10-91	17 1/2"	2880	34	14,5	68	34	14	4	15	7,9	n/a	8,0	0,00	2,70	-	2400	960	83000	37	29	0,75	n/a	15,5	140
14-10-91	17 1/2"	2880	35	14,5	55	33	14	4	15	9,2	n/a	8,6	0,5	3,2	-	2440	1040	82000	34	29	0,75	n/a	15,5	140

AMOCO NORWAY OIL COMPANY

DAILY DRILLING MUD PROPERTIES

Date	Section	Depth	FSR No	Mud Density	Funnel Viscosity	Plastic Viscosity	Yield Point	10 sec. gel	10 min. gel	API Filtr.	HTHP Filtr.	pH	Pf	Mf	Pm	Total hardn.	Ca++	Chlorides	KCL	Solids Content	Sand Content	MBT	Excess Ancoquat I	Sodium Sulphite
		meter		ppg	Sec/Qt	cP	lb/100ft^2	lb/100ft^2	lb/100ft^2	ml	ml		ml	ml	ml	mg/l	mg/l	mg/l	ppb	uncor.Vol%	%	ppb	ppb	mg/l
15-10-91	17 1/2"	2880	36	14,5	65	30	17	4	12	9,2	n/a	8,2	0	3,2	-	2080	1040	83000	36	29	0,75	n/a	13	140
16-10-91	17 1/2"	2880	37	14,5	55	30	17	4	11	11,4	n/a	7,8	0	3	-	2200	1000	80000	33	29	0,75	n/a	11,7	140
17-10-91	17 1/2"	2880	38	14,6	51	24	11	4	12	12,2	n/a	10,9	4,6	7,3	-	3360	3280	60000	22	29	0,75	n/a	10	100
18-10-91	17 1/2"	2880	39	14,5	65	32	15	4	12	13	n/a	7,6	0	3,6	-	1800	1040	81000	30	28	0,75	n/a	12	100
19-10-91	17 1/2"	2880	40	14,5	65	31	14	4	11	10,8	n/a	7,6	0	2,8	-	2200	1040	81000	33	28	0,75	n/a	12	100
20-10-91	17 1/2"	2880	41	14,5	53	25	15	3	7	12,4	n/a	9,2	1,2	3,4	-	2080	1240	79000	36	28	0,75	n/a	12	100
21-10-91	17 1/2"	2880	42	14,5	53	25	10	3	6	12,4	n/a	9,2	1,2	3,2	-	1920	1160	78000	34	28	0,5	n/a	12	100
22-10-91	17 1/2"	2880	43	14,5	53	23	12	3	7	12,6	n/a	9,2	1,2	3,2	-	1960	1120	78000	34	28	0,5	n/a	11	100
23-10-91	12 1/4"	2880	44	14,5	52	23	11	3	6	12,4	n/a	9,2	1,1	3,1	-	2000	1160	78000	34	28	0,5	n/a	11	100
24-10-91	12 1/4"	2880	45	14,4	50	21	11	3	6	12,6	n/a	9,2	1	3,2	-	1960	1160	77000	33	28	0,5	n/a	11	100
25-10-91	12 1/4"	2880	46	14,4	50	21	10	3	6	12,5	n/a	9,2	1,2	3,2	-	1920	1080	76000	33	28	0,5	n/a	11	-
26-10-91	12 1/4"	2880	47	14,4	51	21	10	3	6	12,8	n/a	9,2	1,1	3,2	-	1960	1120	76000	33	28	0,5	n/a	11	-
27-10-91	12 1/4"	2880	48	14,1	48	17	10	3	6	13,4	n/a	9,2	1	3,2	-	1920	1040	72000	31	26,5	0,5	n/a	10,5	-
28-10-91	12 1/4"	2880	49	14,1	47	17	10	3	6	14	n/a	9,1	1	3,2	-	1960	960	71000	31	26,5	0,5	n/a	10,5	-
29-10-91	12 1/4"	2880	50	14,1	48	19	13	3	9	13,8	n/a	8,8	0,9	3	-	1960	1040	71000	32	26,5	0,5	n/a	10,5	-
30-10-91	12 1/4"	2880	51	14,1	46	18	14	3	12	14,6	n/a	8,6	0,6	3	-	2000	1080	70000	32	26,5	0,5	n/a	10,5	-
31-10-91	12 1/4"	2880	52	14	47	18	12	8	48	18	n/a	11	2,8	10	6	4000	4000	68000	26	27	0,5	n/a	9	-
1-11-91	12 1/4"	2897	53	14,1	59	30	16	4	24	14	n/a	10,5	3,2	8	8	3200	3200	68000	31	27	0,5	n/a	8,3	-
2-11-91	12 1/4"	2897	54	14	58	27	18	5	28	13	n/a	10,7	3,4	7,4	8	2800	2800	69000	31	27	0,5	n/a	8,3	-
3-11-91	12 1/4"	3069	55	14	46	28	23	2	7	6,4	47	8,6	0,1	0,8	0,2	1320	920	51000	21	24	0,75	6	PHPA-mud	-
4-11-91	12 1/4"	3226	56	14	50	36	21	3	5	3,6	19	8,5	0,05	0,8	0,6	680	620	48000	19	25	1	7,5	n/a	220
5-11-91	12 1/4"	3277	57	14,1	47	31	16	3	4	3,8	20	8,7	0,1	1	0,9	520	440	47000	19	25,5	0,75	7,5	n/a	180
6-11-91	12 1/4"	3524	58	14	44	26	13	2	5	4,5	20	9,2	0,2	1	1,5	300	160	48000	19	24,5	0,5	8,5	n/a	200
7-11-91	12 1/4"	3726	59	14	48	24	17	2	3	3,8	20	9,1	0,1	0,8	1,6	200	160	46000	19	24	0,25	7,5	n/a	240
8-11-91	12 1/4"	3729	60	13,4	48	24	18	2	3	3,4	18	8,8	0,1	0,7	1,6	240	200	44000	17	22	TR	7,5	n/a	240
9-11-91	12 1/4"	3729	61	13,4	55	19	15	1	2	5	21	7	0	0,8	0	960	920	45000	17	22	TR	5,5	n/a	160
10-11-91	12 1/4"	3279	62	13,4	52	26	18	2	3	2,4	16	9	0,1	0,8	1,4	420	400	43000	16	22	TR	5	n/a	140
11-11-91	12 1/4"	3729	63	13,4	61	30	16	2	4	2,4	16	8,8	0,1	0,8	1,4	360	320	43000	16	22	TR	5	n/a	140
12-11-91	12 1/4"	3860	64	14,5	51	31	17	2	4	3,2	14	9	0,1	0,7	1,6	320	240	43000	16	26	TR	5	n/a	140
13-11-91	12 1/4"	3978	65	15	51	33	17	3	8	3,4	15	9	0,1	0,8	1,7	180	160	40000	16	27,5	0,75	6	n/a	180
14-11-91	12 1/4"	4099	66	15	48	30	16	3	8	3,4	16	8,9	0,1	0,8	1,5	180	160	38000	16	27,5	0,5	6	n/a	180
15-11-91	12 1/4"	4140	67	15,1	51	34	18	3	13	3,6	16	8,9	0,1	0,9	1,6	120	100	37000	16	28	0,5	7	n/a	180
16-11-91	12 1/4"	4150	68	15	48	27	13	2	8	3,4	15	8,7	0,1	0,8	1,4	120	120	35000	15	27,5	0,5	7	n/a	160
17-11-91	12 1/4"	4150	69	15	55	28	13	2	9	3,4	15	8,6	0,1	0,8	1,4	160	140	36000	16	27,5	0,5	7	n/a	-
18-11-91	12 1/4"	4150	70	15	56	23	11	2	7	3,4	15	8,6	0,1	0,9	1,4	320	240	37000	16	27,5	0,5	6	n/a	-

AM[illegible] NORWAY OIL COMPANY

DAILY DRILLING MUD PROPERTIES

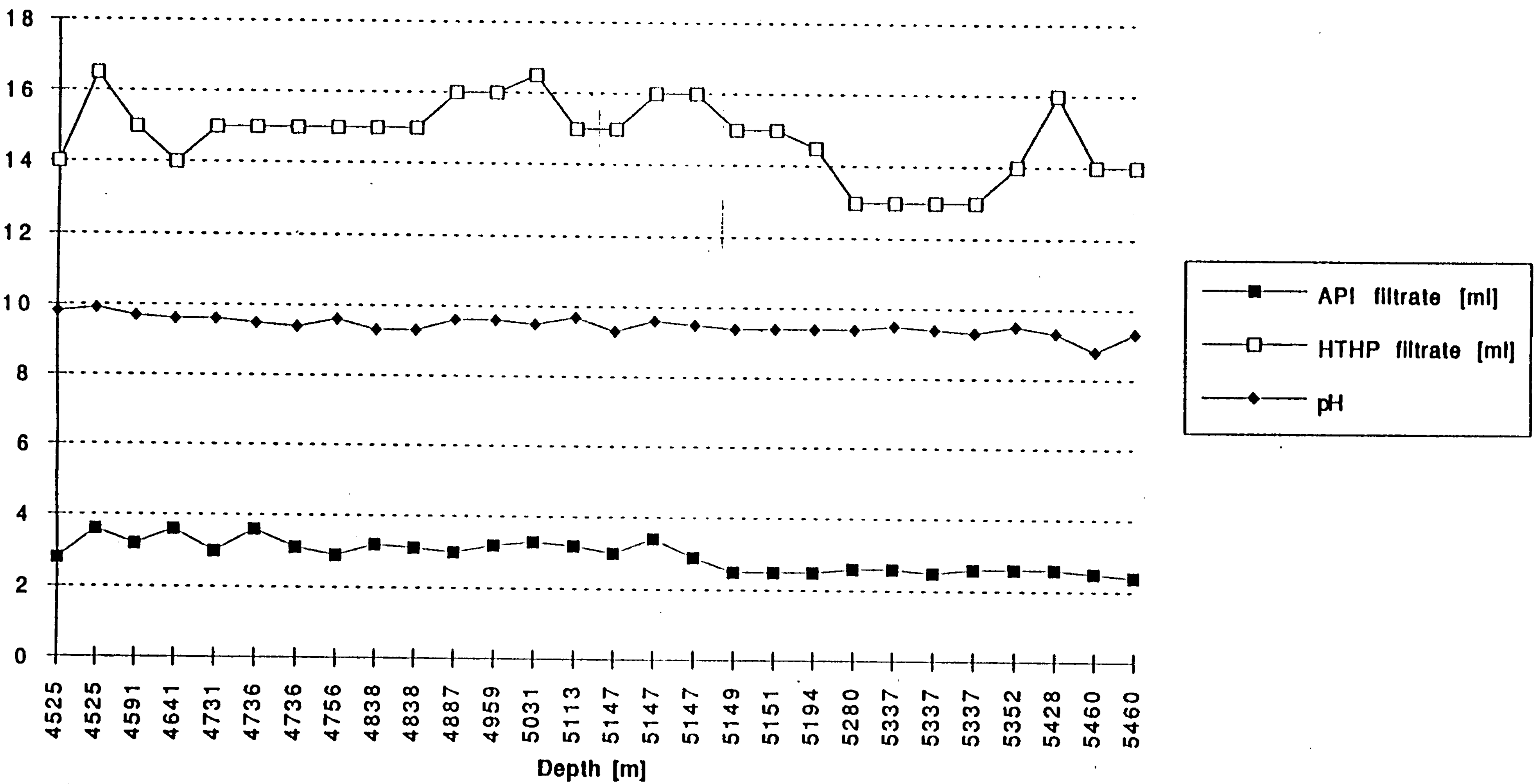
Date	Section	Depth	FSR No	Mud Density	Funnel Viscosity	Plastic Viscosity	Yield Point	10 sec. gel	10 min. gel	API Filtr.	HTHP Filtr.	pH	Pf	Mf	Pm	Total hardn.	Ca++	Chlorides	KCL	Solids Content	Sand Content	MBT	Excess Ancoquat I	Sodium Sulphite
		meter		ppg	Sec/Qt	cP	lb/100ft^2	lb/100ft^2	lb/100ft^2	ml	ml		ml	ml	ml	mg/l	mg/l	mg/l	ppb	uncor.Vol%	%	ppb	ppb	mg/l
19-11-91	12 1/4"	4154	71	15	51	32	16	3	13	3,4	15	8,5	0,05	0,8	1,4	200	160	34000	15	27,5	0,5	7	n/a	140
20-11-91	12 1/4"	4173	72	15	49	30	15	3	12	3,2	15	9,3	0,2	1,2	1,4	160	120	32000	14	27,5	0,5	7	n/a	160
21-11-91	12 1/4"	4213	73	14,9	53	31	18	4	18	3,6	16,5	9,2	0,45	1,45	1,4	140	100	32000	11	27	0,5	9	n/a	-
22-11-91	12 1/4"	4254	74	15	48	30	13	3	15	3,4	17	8,9	0,35	1,65	1,3	180	130	28000	9,1	27,5	0,25	8,5	n/a	140
23-11-91	12 1/4"	4304	75	15,1	47	27	14	3	17	3,3	16	9,3	0,9	2,2	1,5	160	120	26000	7,5	28	TR	10	HTHP-mud	200
24-11-91	12 1/4"	4324	76	15	47	28	13	3	15	3,3	16	9,2	0,8	2,1	1,5	200	140	24000	5,7	27,5	TR	10	n/a	220
25-11-91	12 1/4"	4354	77	15	48	26	13	3	17	3,4	16	9	0,7	1,9	1,4	200	140	18000	5,1	27,5	TR	11	n/a	220
26-11-91	12 1/4"	4372	78	15,1	45	24	11	3	14	3,1	16	9,1	0,65	1,9	1,4	200	150	18000	4,5	27,5	TR	11	n/a	200
27-11-91	12 1/4"	4373	79	15	43	25	12	3	13	3,2	16	9	0,7	1,9	1,4	240	160	18000	3,9	27,5	TR	9	n/a	160
28-11-91	12 1/4"	4400	80	15,3	45	25	11	3	12	2,9	15	9,3	1,1	2,2	1,4	250	180	14000	3,3	28,5	TR	10,5	n/a	180
29-11-91	12 1/4"	4441	81	15,3	47	28	11	3	16	3	14	9,4	1,1	2,2	1,5	250	180	13000	2,5	28,5	TR	11	n/a	220
30-11-91	12 1/4"	4473	82	15,2	45	26	12	3	16	3	16	9,4	1,15	2,8	1,4	180	110	12000	2,3	28	TR	12	n/a	210
1-12-91	12 1/4"	4485	83	15,2	45	25	10	2	13	2,9	16	9,5	1,1	2,9	1,3	180	120	10000	1,7	28	TR	10,5	n/a	210
2-12-91	12 1/4"	4485	84	14,5	42	22	9	2	10	2,9	14	9,5	1,1	2,8	1,1	170	110	8000	1,1	25,5	TR	10	n/a	220
3-12-91	12 1/4"	4485	85	14,8	40	19	10	2	9	2,8	13,5	9,5	1,1	3	1,2	190	120	8000	1	26,5	TR	10	n/a	220
4-12-91	12 1/4"	4505	86	14,8	44	24	10	3	10	2,8	13,5	9,2	1	3,2	1,2	180	110	8000	1	26,5	TR	10,5	n/a	210
5-12-91	12 1/4"	4525	87	14,8	48	24	9	3	10	2,8	14	9,5	0,8	3,4	1,5	160	100	7500	n/a	26,5	TR	10,5	n/a	240
6-12-91	12 1/4"	4525	88	14,8	52	23	10	3	10	2,8	14	9,5	0,8	3,5	1,6	160	100	7500	n/a	26,5	TR	10	n/a	200
7-12-91	12 1/4"	4525	89	14,8	47	22	9	2	10	2,6	14	9,5	0,7	3,5	1,5	160	100	7500	n/a	26,5	TR	10	n/a	-
8-12-91	12 1/4"	4525	90	14,8	52	21	10	3	11	2,6	14	9,5	0,8	3,5	1,5	140	100	7500	n/a	26,5	TR	10	n/a	-
9-12-91	12 1/4"	4525	91	14,8	50	23	9	3	11	2,6	13,5	9,5	1	3,8	1,7	120	40	7200	n/a	26,5	TR	11	n/a	240
10-12-91	12 1/4"	4525	92	14,8	82	22	9	2	11	2,6	14	9,5	1	3,7	1,7	120	60	7500	n/a	26,5	TR	11	n/a	200
11-12-91	12 1/4"	4525	93	14,8	55	20	9	2	10	2,4	13,5	9,6	1	3,6	1,6	120	60	7500	n/a	26,5	TR	11	n/a	-
12-12-91	12 1/4"	4525	94	14,9	45	23	11	3	12	2,8	14,5	9,5	0,8	3,6	1,5	120	60	7600	n/a	27	TR	11	n/a	-
13-12-91	12 1/4"	4525	95	14,9	46	22	11	3	14	2,6	14	9,5	0,8	3,6	1,6	120	60	7800	n/a	27	TR	11	n/a	-
14-12-91	12 1/4"	4525	96	14,9	48	22	12	3	17	2,6	14	9,2	0,7	3,6	1,5	120	60	7800	n/a	27	TR	11	n/a	-
15-12-91	8 1/2"	4525	97	14,9	58	23	12	3	16	2,8	14	9,8	0,8	3,8	1,7	100	60	7500	n/a	27	TR	11	n/a	-
16-12-91	8 1/2"	4525	98	14,8	46	21	12	6	29	3,6	16,5	9,9	1	3,8	2,3	240	220	7200	n/a	26,5	TR	11	n/a	220
17-12-91	8 1/2"	4591	99	14,8	47	20	10	5	21	3,2	15	9,7	0,9	4	1,9	220	200	6600	n/a	26,5	TR	10	n/a	190
18-12-91	8 1/2"	4641	100	14,8	55	20	15	6	25	3,6	14	9,6	0,8	3,9	1,8	300	160	6700	n/a	26,5	TR	10	n/a	240
19-12-91	8 1/2"	4731	101	15	50	13	18	11	25	3	15	9,6	0,9	3,1	1,8	280	220	6400	n/a	27,5	TR	11	n/a	210
20-12-91	8 1/2"	4736	102	15	42	17	10	3	14	3,6	15	9,5	0,9	3	1,6	280	220	6400	n/a	27,5	TR	10	n/a	180
21-12-91	8 1/2"	4736	103	15	42	16	11	3	15	3,1	15	9,4	0,8	2,9	1,4	280	220	6300	n/a	27,5	TR	11	n/a	180
22-12-91	8 1/2"	4756	104	15	42	16	7	2	11	2,9	15	9,6	0,9	3,4	1,5	280	200	6200	n/a	27,5	TR	11	n/a	190
23-12-91	8 1/2"	4838	105	15	41	16	8	3	12	3,2	15	9,3	1,1	3,8	1,5	260	180	6100	n/a	27,5	TR	10	n/a	190

AMOCO NORWAY OIL COMPANY

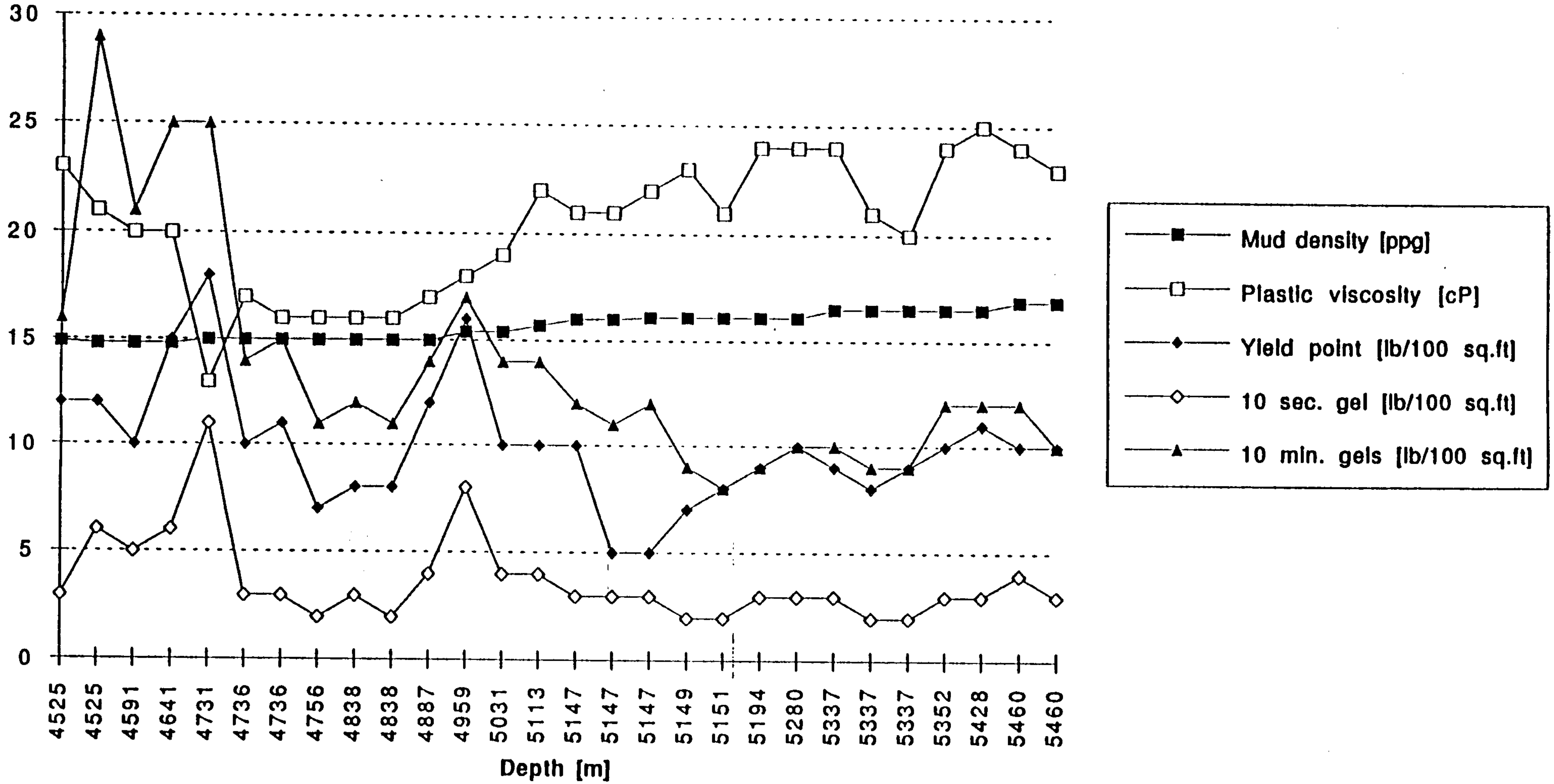
DAILY DRILLING MUD PROPERTIES

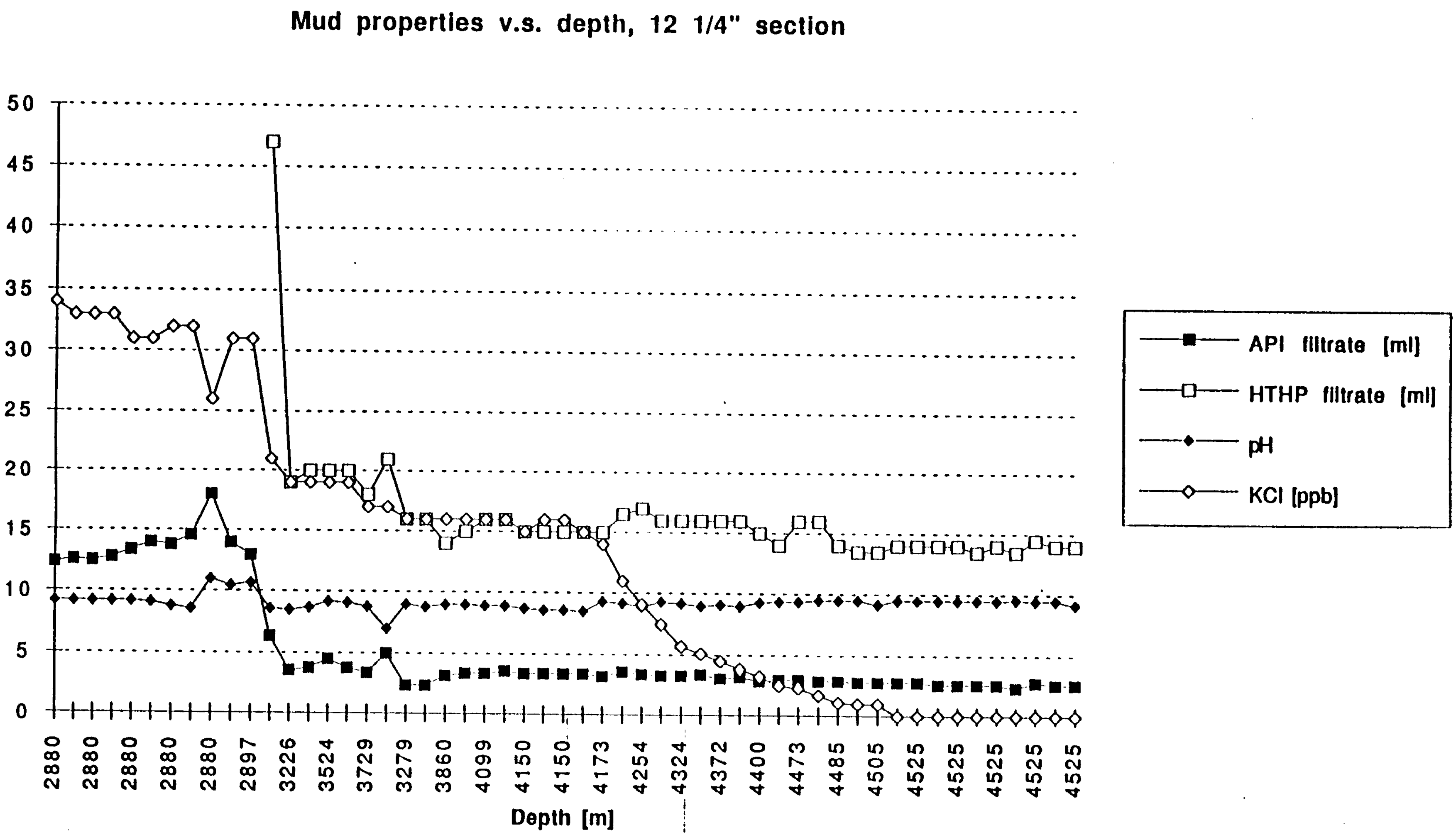
Date	Section	Depth	FSR No	Mud Density	Funnel Viscosity	Plastic Viscosity	Yield Point	10 sec. gel	10 min. gel	API Filtr.	HTHP Filtr.	pH	Pf	Mf	Pm	Total hardn.	Ca++	Chlorides	KCL	Solids Content	Sand Content	MBT	Excess Ancoquat I	Sodium Sulphite
		meter		ppg	Sec/Qt	cP	lb/100ft^2	lb/100ft^2	lb/100ft^2	ml	ml		ml	ml	ml	mg/l	mg/l	mg/l	ppb	uncor.Vol%	%	ppb	ppb	mg/l
24-12-91	8 1/2"	4838	106	15	39	16	8	2	11	3,1	15	9,3	1	3,8	1,5	280	200	6100	n/a	27,5	TR	10	n/a	190
25-12-91	8 1/2"	4887	107	15	46	17	12	4	14	3	16	9,6	1	3,9	1,4	260	200	5900	n/a	27,5	TR	10	n/a	164
26-12-91	8 1/2"	4959	108	15,4	51	18	16	8	17	3,2	16	9,6	1,2	3,8	1,3	260	180	5900	n/a	29	TR	11,5	n/a	250
27-12-91	8 1/2"	5031	109	15,4	46	19	10	4	14	3,3	16,5	9,5	0,8	3,6	1,2	240	200	5000	n/a	29	TR	10,5	n/a	200
28-12-91	8 1/2"	5113	110	15,7	49	22	10	4	14	3,2	15	9,7	0,8	3,7	1,3	240	180	4800	n/a	30	TR	11	n/a	150
29-12-91	8 1/2"	5147	111	16	42	21	10	3	12	3	15	9,3	0,8	3,8	1,3	240	160	4900	n/a	31	TR	10	n/a	250
30-12-91	8 1/2"	5147	112	16	44	21	5	3	11	3,4	16	9,6	0,7	3,8	1,3	220	160	4800	n/a	31	TR	10	n/a	235
31-12-91	8 1/2"	5147	113	16,1	48	22	5	3	12	2,9	16	9,5	0,7	3,5	1,2	240	160	4700	n/a	31,5	TR	10	n/a	220
1-1-92	8 1/2"	5149	114	16,1	53	23	7	2	9	2,5	15	9,4	0,7	3,1	1,1	260	200	4400	n/a	31,5	TR	10,5	n/a	200
2-1-92	8 1/2"	5151	115	16,1	48	21	8	2	8	2,5	15	9,4	0,7	3,2	1,1	240	180	4400	n/a	31,5	TR	10,5	n/a	-
3-1-92	8 1/2"	5194	116	16,1	51	24	9	3	9	2,5	14,5	9,4	0,6	3,5	1	180	120	3800	n/a	31,5	TR	10,5	n/a	180
4-1-92	8 1/2"	5280	117	16,1	51	24	10	3	10	2,6	13	9,4	0,4	3,4	1	200	140	3400	n/a	31,5	TR	10	n/a	220
5-1-92	8 1/2"	5337	118	16,5	47	24	9	3	10	2,6	13	9,5	0,4	3,4	1	180	140	3200	n/a	32,5	TR	10	n/a	200
6-1-92	8 1/2"	5337	119	16,5	44	21	8	2	9	2,5	13	9,4	0,3	3,2	0,9	180	140	3300	n/a	32,5	TR	10	n/a	-
7-1-92	8 1/2"	5337	120	16,5	45	20	9	2	9	2,6	13	9,3	0,3	3,2	0,9	180	160	3600	n/a	32,5	TR	10	n/a	-
8-1-92	8 1/2"	5352	121	16,5	51	24	10	3	12	2,6	14	9,5	0,3	3,6	1	180	100	3300	n/a	32,5	TR	10	n/a	240
9-1-92	8 1/2"	5428	122	16,5	60	25	11	3	12	2,6	16	9,3	0,4	3,6	1	200	80	5000	n/a	32,5	TR	9	n/a	220
10-1-92	8 1/2"	5460	123	16,9	60	24	10	4	12	2,5	14	8,8	0,3	2,8	0,8	140	80	4000	n/a	34	TR	8	n/a	240
11-1-92	8 1/2"	5460	124	16,9	52	23	10	3	10	2,4	14	9,3	0,4	2,9	0,7	140	100	4000	n/a	34	TR	8	n/a	-
12-1-92	P & A	5460	125	16,9	61	25	11	4	11	2,4	15	9,2	0,3	2,9	0,7	140	100	4000	n/a	34	TR	8	n/a	-
13-1-92	P & A	4478	126	16,9	84	56	30	3	11	2,4	-	9	0,3	2,9	0,6	140	100	4000	n/a	34	TR	8	n/a	-
14-1-92	P & A	4468	127	14,5	48	17	11	3	11	-	-	10	-	-	-	-	-	-	n/a	-	-	-	n/a	-
15-1-92	P & A	2880	128	16,9	63	28	15	8	20	-	-	10	-	-	-	-	-	-	n/a	-	-	-	n/a	-
16-1-92	P & A	2880	129	16,9	-	28	15	-	-	-	-	10	-	-	-	-	-	-	n/a	-	-	-	n/a	-

Mud properties v.s. depth, 8 1/2" section

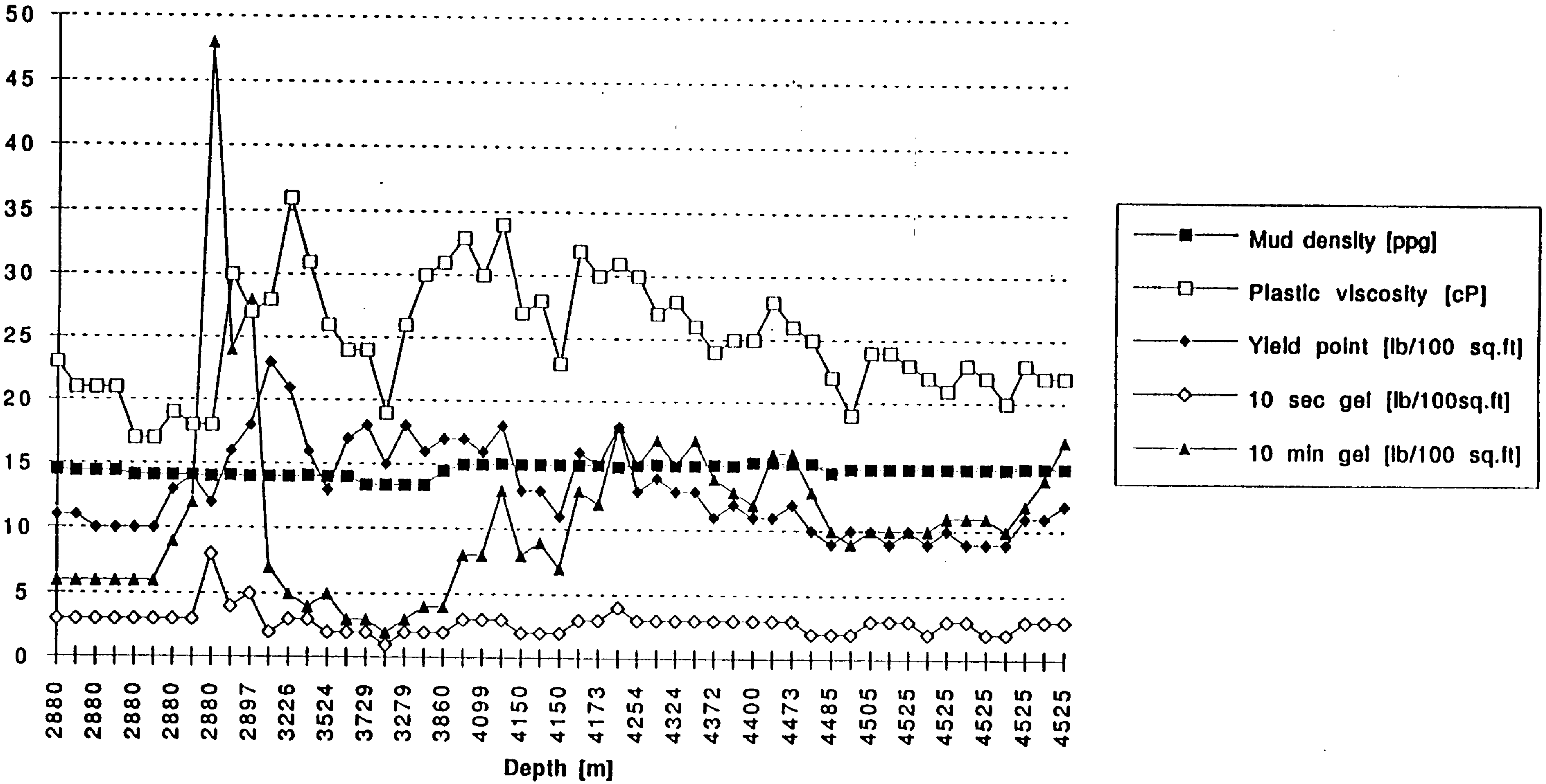


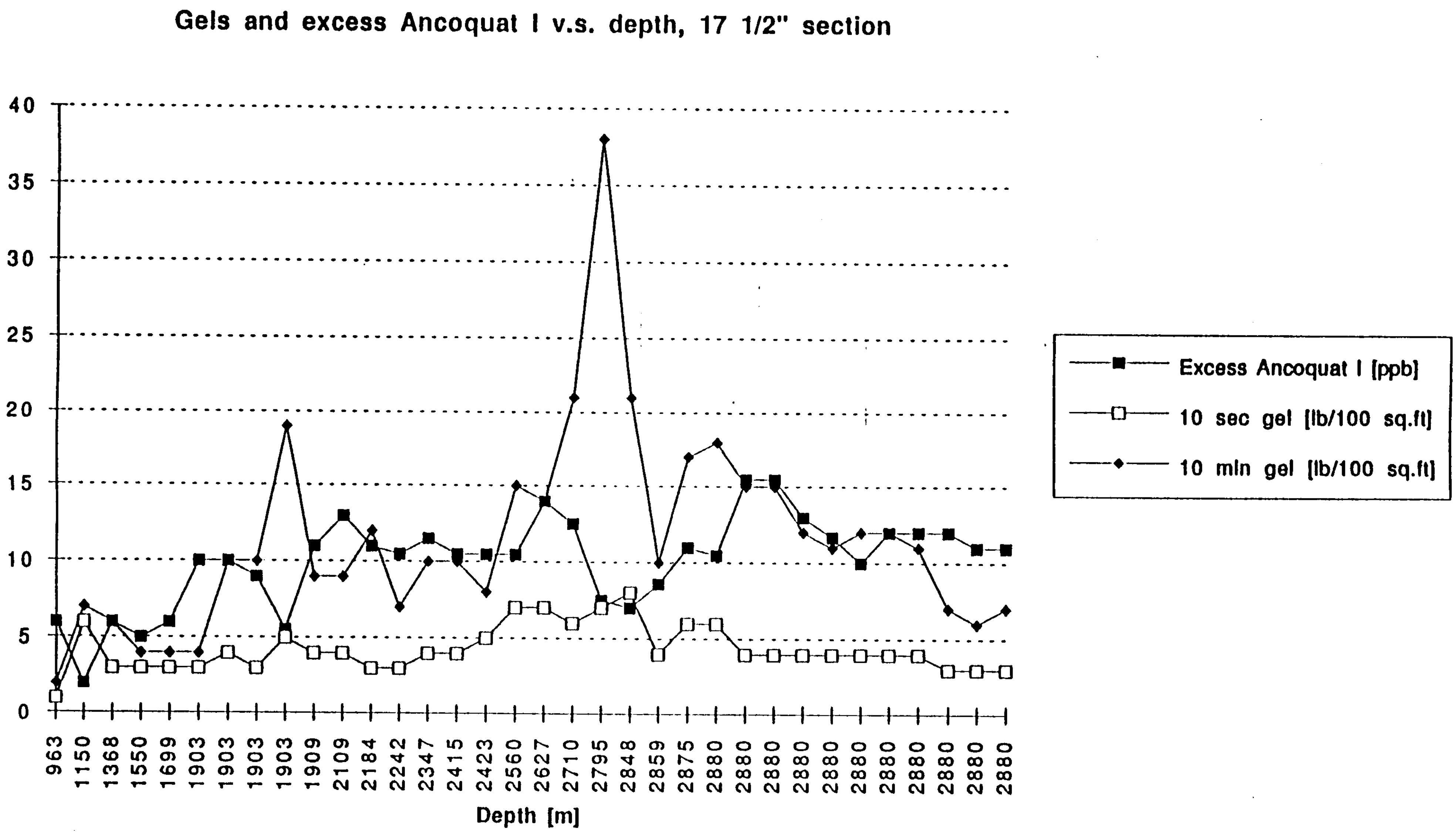
Rheology properties v.s. depth, 8 1/2" section



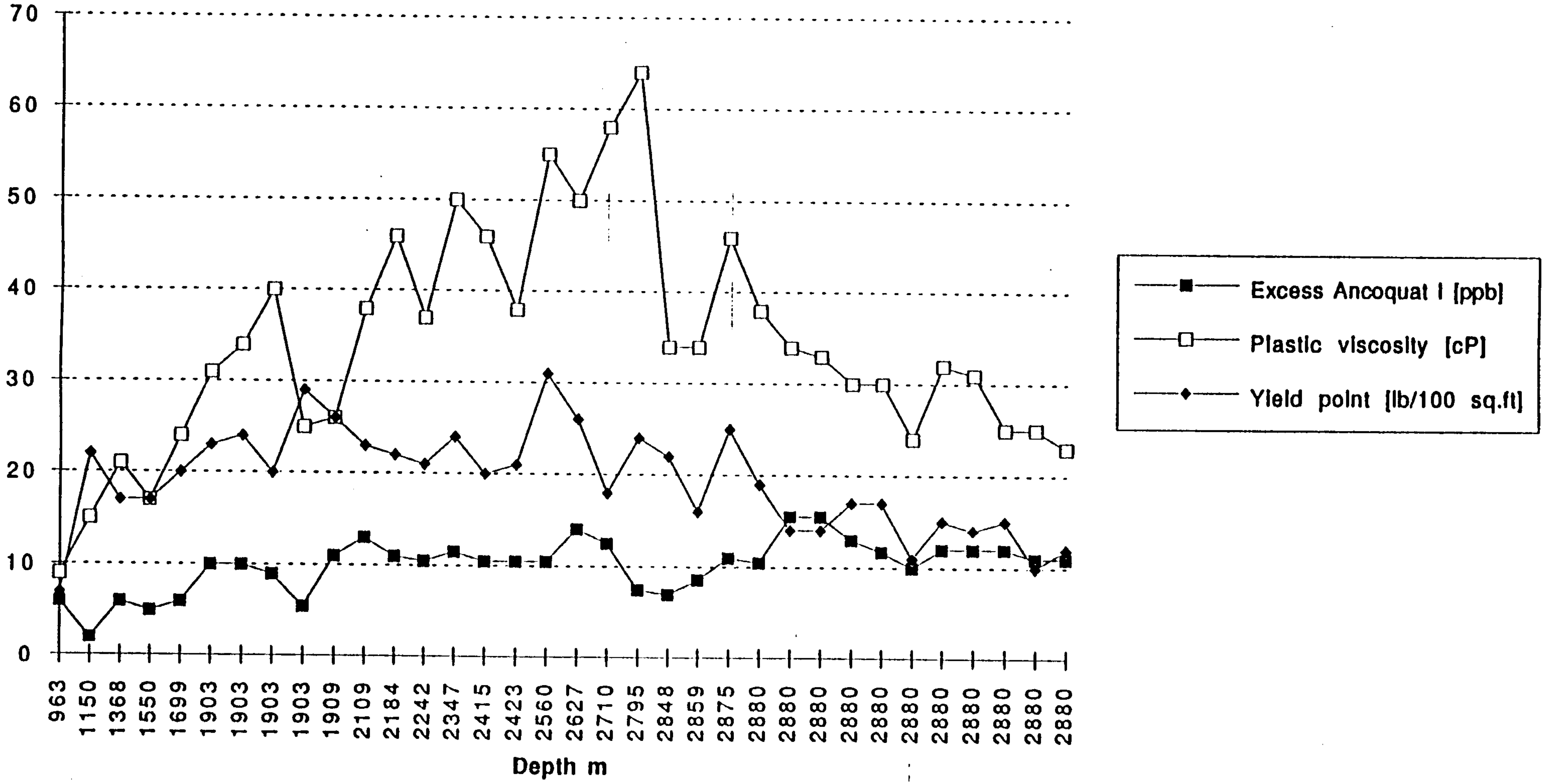

Mud properties v.s. depth, 12 1/4" section
50
45
40
35
30
25
20
15
10
5
0
2880
2880
2880
2880
2880
2880
2897
3226
3524
3729
3279
3860
4099
4150
4150
4173
4254
4324
4372
4400
4473
4485
4505
4525
4525
4525
4525
4525
Depth [m]
API filtrate [ml]
HTHP filtrate [ml]
pH
KCl [ppb]

Rheology properties v.s. depth, 12 1/4" section

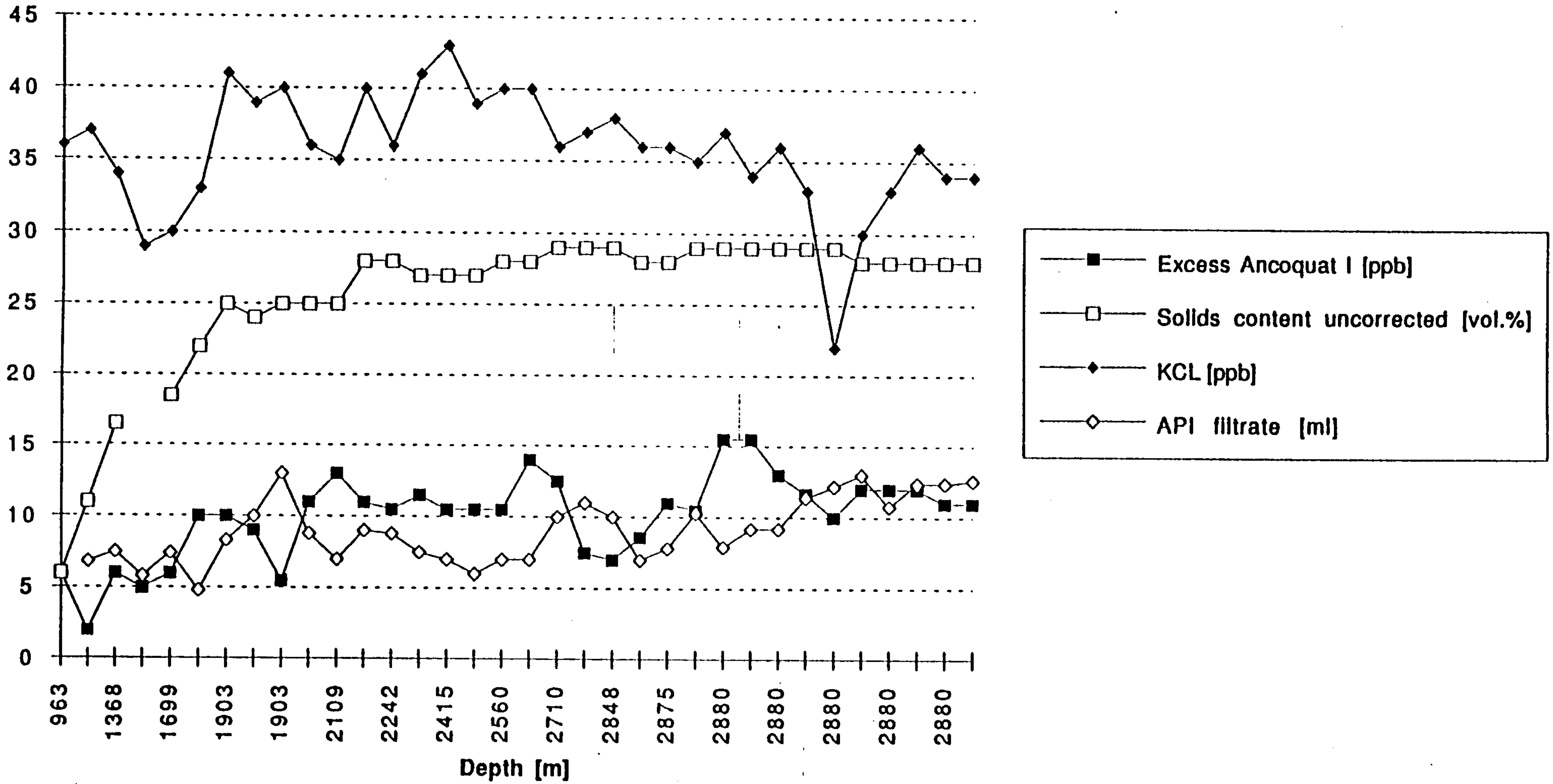



Gels and excess Ancoquat I v.s. depth, 17 1/2" section
40
35
30
25
20
15
10
5
0
963
1150
1368
1550
1699
1903
1903
1903
1903
1909
2109
2184
2242
2347
2415
2423
2560
2627
2710
2795
2848
2859
2875
2880
2880
2880
2880
2880
2880
2880
2880
2880
2880
Depth [m]
Excess Ancoquat I [ppb]
10 sec gel [lb/100 sq.ft]
10 min gel [lb/100 sq.ft]

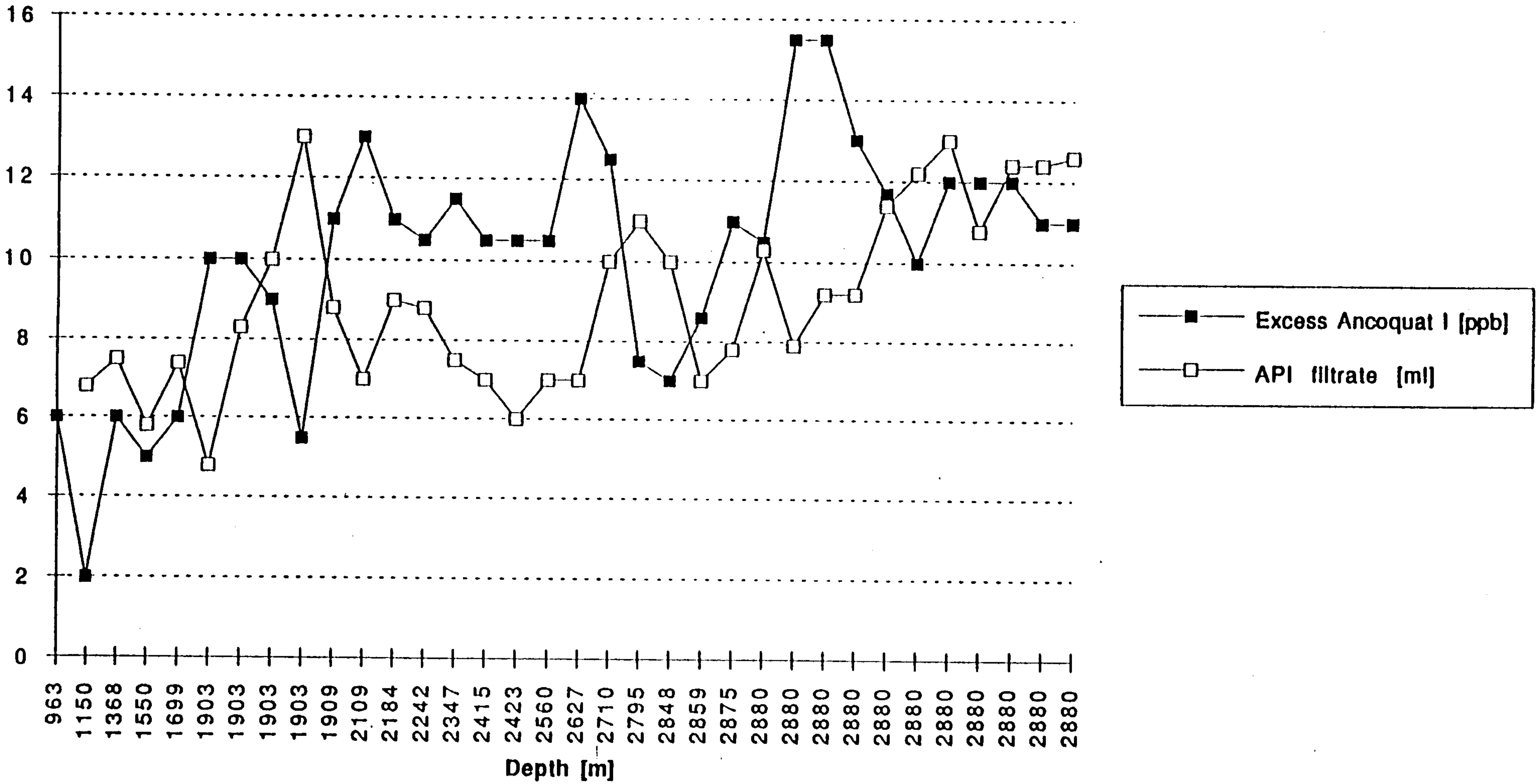
Yield point, plastic viscosity and excess Ancoquat I v.s. depth, 17 1/2" section



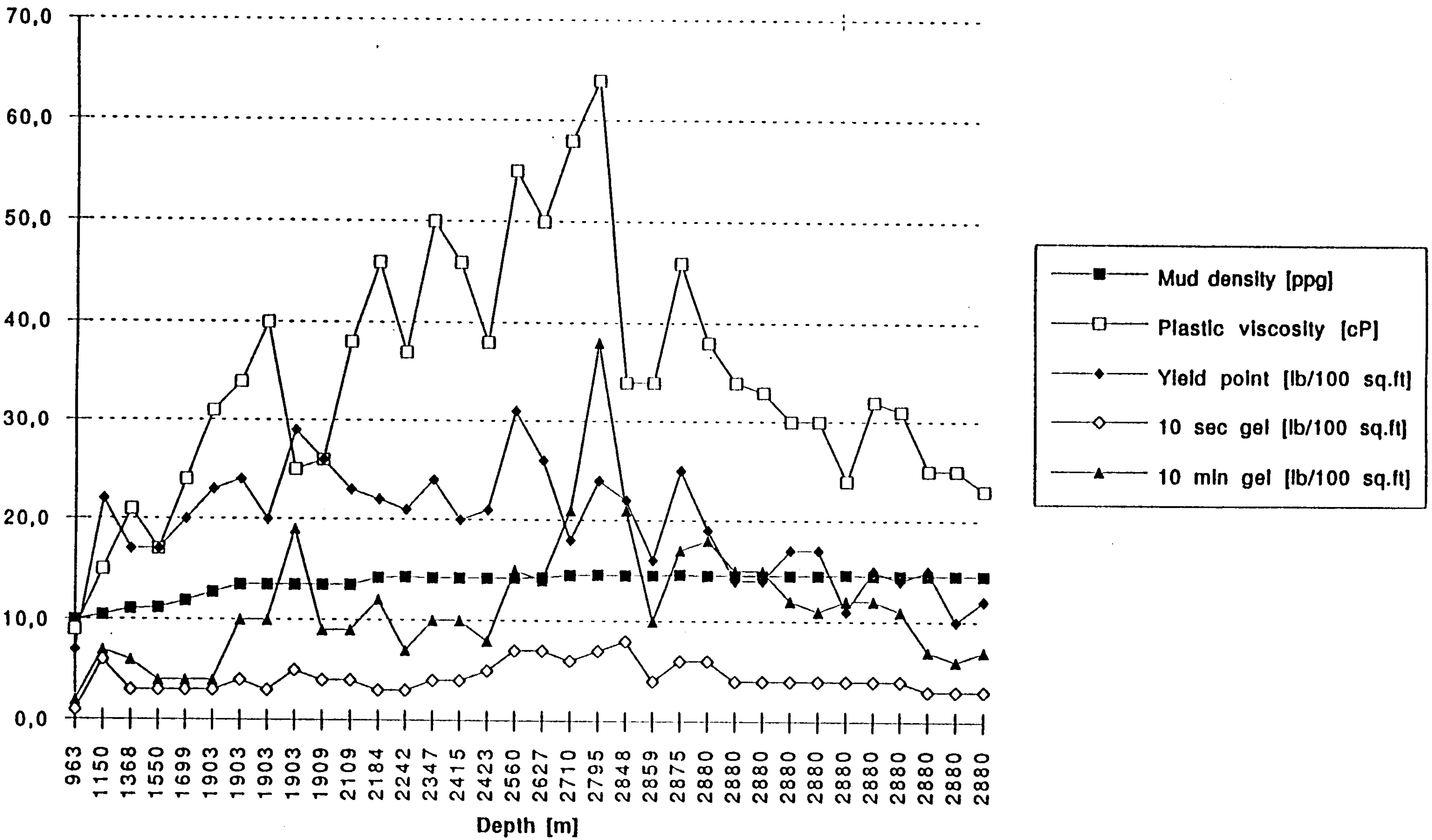
Mud properties v.s. depth, 17 1/2" section



Excess Ancoquat I and API filtrate v.s. depth, 17 1/2" section



Rheology properties v.s. depth, 17 1/2" section



CHEMICAL CONCENTRATIONS FOR 17 1/2" SECTION

REPORT No	DEPTH m	KCL ppb	XCD ppb	ACOQUAT FC ppb	ANCOQUAT I ppb	DRILLING DET. ppb	BARITE ppb	ANCOCIDE ppb	SULFIT ppb
10	963	72,00	1,53	3,94	16,37		141,00	0,16	0,00
11	1150	35,60	0,81	2,07	8,61		74,00	0,08	0,00
12	1368	44,70	1,51	3,02	25,27		62,00	0,06	0,05
13	1550	46,60	1,80	3,39	31,54		57,00	0,05	0,22
14	1699	55,04	1,67	4,10	32,39		64,00	0,16	0,24
15	1903	44,96	1,62	5,13	54,25		161,00	0,14	0,18
16	1903	45,37	1,58	5,79	49,19		213,00	0,27	0,21
17	1903	44,47	1,56	5,87	44,82		216,00	0,53	0,23
18	1903	47,35	1,66	6,42	44,68		207,00	0,80	0,26
19	1909	47,02	1,65	6,38	44,30		221,00	0,80	0,26
20	2109	39,90	1,49	9,87	64,78		201,00	0,52	0,30
21	2184	43,96	1,44	9,15	63,68		214,00	0,49	0,30
22	2242	42,28	1,32	9,56	60,02		227,00	0,55	0,29
23	2347								
24	2415	43,65	1,46	8,83	61,81		222,00	0,54	0,35
25	2423	41,44	1,32	9,24	67,59		231,00	0,48	0,34
26	2560	42,77	1,49	9,28	71,04		225,00	0,57	0,39
27	2627								
28	2710	41,72	1,42	9,51	68,64		240,00	0,63	0,45
29	2795	42,06	1,47	9,41	68,95		257,00	0,57	0,42
30	2848	40,45	1,40	9,29	76,19		247,00	0,58	0,40
31	2859	39,46	1,36	9,79	71,43		244,00	0,54	0,38
32	2859	39,46	1,36	9,78	71,43		244,00	0,54	0,38
33	2875	35,98	1,32	8,54	69,27	1,71	246,00	0,62	0,31
34	2880	35,62	1,34	8,63	69,84	1,66	269,00	0,68	0,37
35	2880	36,04	1,33	8,57	69,24	1,61	267,00	0,67	0,36
36	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
37	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
38	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
39	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
40	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
41	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
42	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
43	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
44	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55

CHEMICAL CONCENTRATIONS FOR 12 1/4" SECTION

REPORT No	DEPTH m	KCL ppb	XCD ppb	ANCOQUAT FC ppb	ANCOQUAT I ppb	DRILLING DET. ppb	BARITE ppb	ANCOCIDE ppb	SULFITE ppb
44	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
45	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
46	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
47	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
48	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
49	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
50	2880	35,13	1,31	8,24	69,70	1,92	279,00	0,85	0,55
51	2880	34,93	1,33	8,20	69,30	1,91	277,00	0,84	0,55
52	2880	34,71	1,32	8,15	68,87	1,90	276,00	0,84	0,54
53	2897	33,05	1,57	8,59	68,62	1,80	262,00	0,79	0,52
54	2897	32,35	1,53	8,40	67,13	1,77	258,00	0,78	0,50

REPORT No	DEPTH m	KCL ppb	XCD ppb	PAC ppb	MILTEMP ppb	PHPA ppb	RESIN ppb	BARITE ppb	BENTONITE ppb	LIGTHIN ppb	THERMOPOL ppb	POT. NITRATE ppb
55	3069	18,10	0,40	2,42	0,35	0,86	0,00	278,00	0,00	0,00	0,00	0,00
56	3226	19,46	0,35	3,75	0,54	0,82	0,54	256,00	0,00	0,00	0,00	0,00
57	3277	18,82	0,31	3,42	0,51	0,81	0,57	246,00	0,00	0,00	0,00	0,00
58	3524	17,46	0,31	3,02	0,49	0,64	0,71	224,00	0,00	0,00	0,00	0,00
59	3726	16,62	0,30	2,79	0,48	0,54	0,77	239,00	0,00	0,00	0,00	0,00
60	3726	16,24	0,31	2,64	0,48	0,47	0,85	225,00	0,00	0,00	0,00	0,00
61	3729	15,95	0,30	3,17	0,55	0,46	3,07	238,00	0,00	0,00	0,00	0,00
62	3729	15,67	0,45	3,37	0,54	0,43	5,16	241,00	0,00	0,00	0,00	0,00
63	3729	15,67	0,45	3,37	0,54	0,43	5,16	241,00	0,00	0,00	0,00	0,00
64	3860	16,10	0,43	3,17	0,50	0,39	4,87	225,00	0,00	0,00	0,00	0,00
65	3978	15,77	0,41	2,94	0,58	0,35	4,56	271,00	0,00	0,00	0,00	0,00
66	4099	14,99	0,46	2,82	0,76	0,33	4,39	278,00	0,00	0,00	0,00	0,00
67	4140	14,08	0,43	2,62	1,02	0,31	4,44	279,00	0,00	0,00	0,00	0,00
68	4150	13,22	0,40	2,75	1,17	0,29	4,43	274,00	0,00	0,00	0,00	0,00
69	4150	13,36	0,40	2,77	1,13	0,30	4,45	274,00	0,00	0,00	0,00	0,00
70	4150	13,36	0,40	2,77	1,13	0,30	4,45	274,00	0,00	0,00	0,00	0,00
71	4154	12,99	0,39	2,76	1,25	0,29	4,46	274,00	0,00	0,00	0,00	0,00
72	4173	12,01	0,36	2,80	1,65	0,27	4,63	253,00	0,00	0,00	0,00	0,00
73	4213											0,00
74	4254	9,94	0,30	2,76	2,16	0,22	4,78	219,00	0,21	0,39	0,09	0,00
75	4301	8,03	0,25	2,39	2,06	0,18	4,57	256,00	1,36	0,60	0,31	0,00
76	4224	6,15	0,19	1,83	2,27	0,14	4,92	275,00	2,32	1,65	0,61	0,00
77	4350	5,14	0,17	1,53	2,47	0,12	5,21	268,00	2,86	2,47	0,80	0,00
78	4372	4,38	0,17	1,30	2,58	0,10	5,32	280,00	3,18	2,84	0,91	0,00
79	4372	3,78	0,16	1,12	2,70	0,08	5,49	276,00	3,50	3,01	0,92	0,00
80	4396	3,26	0,15	0,97	2,71	0,07	5,45	283,00	3,62	2,89	0,98	0,00
81	4437	2,69	0,14	0,80	2,84	0,00	5,65	264,00	3,96	2,87	1,11	0,00
82	4470	2,33	0,00	0,69	3,14	0,00	6,19	258,00	4,52	3,03	1,30	0,00
83	4486	1,87	0,00	0,56	3,16	0,00	6,19	270,00	4,66	2,95	1,41	0,16
84	4486	1,62	0,00	0,48	3,12	0,00	6,09	246,00	4,77	2,86	1,46	0,14
85	4486	1,53	0,00	0,45	3,06	0,00	5,97	254,00	4,69	2,79	1,44	0,13
86	4505	1,41	0,00	0,42	3,09	0,00	6,00	251,00	4,75	2,78	1,48	0,12
87	4526	1,31	0,00	0,39	3,12	0,00	6,06	246,00	4,81	2,79	1,61	0,13
88	4525	0,00	0,00	0,39	3,12	0,00	6,05	247,00	4,81	2,78	1,51	0,13
89	4525	0,00	0,00	0,39	3,12	0,00	6,05	247,00	4,80	2,78	1,61	0,13
90	4525	0,00	0,00	0,39	3,12	0,00	6,05	247,00	4,80	2,78	1,61	0,13
91	4525	0,00	0,00	0,37	3,13	0,00	6,06	248,00	4,82	2,78	1,52	0,12
92	4525	0,00	0,00	0,37	3,13	0,00	6,06	248,00	4,82	2,78	1,52	0,12
93	4626	0,00	0,00	0,37	3,13	0,00	6,06	248,00	4,82	2,78	1,62	0,12
94	4626	0,00	0,00	0,36	3,13	0,00	6,03	251,00	4,77	2,76	1,63	0,12
95	4625	0,00	0,00	0,36	3,13	0,00	6,03	251,00	4,77	2,76	1,63	0,12
96	4626	0,00	0,00	0,36	3,13	0,00	6,03	251,00	4,77	2,76	1,63	0,12

CHEMICAL CONCENTRATIONS FOR 8 1/2" SECTION

REPORT No	DEPTH m	PAC SL ppb	ANCOTEMP ppb	ANCORESIN ppb	BARITE ppb	BENTONITE ppb	LIGTHIN ppb	THERMOPOL ppb	POT. NITRATE ppb
97	4525	0,36	3,13	6,03	251,00	4,77	2,76	1,53	0,12
98	4525	0,32	3,12	5,97	242,00	4,68	3,91	1,53	0,11
99	4591	0,28	3,16	6,05	271,00	4,81	4,55	1,61	0,17
100	4641	0,25	3,25	6,12	244,00	4,77	5,23	1,67	0,16
101	4731	0,21	3,33	6,15	273,00	4,60	4,67	1,72	0,13
102	4736	0,13	3,15	5,05	321,00	4,06	3,55	1,67	0,08
103	4736	0,13	3,15	5,05	321,00	4,06	3,55	1,67	0,08
104	4756	0,13	3,14	5,00	322,00	4,04	3,50	1,67	0,16
105	4838	0,09	3,22	4,76	278,00	3,96	3,06	1,77	0,11
106	4838	0,00	3,20	4,75	282,00	3,94	3,03	1,76	0,11
107	4887	0,00	3,11	4,69	310,00	3,77	2,77	1,91	0,09
108	4959	0,00	3,11	4,79	302,00	3,68	2,50	1,95	0,14
109	5031	0,00	3,04	5,49	318,00	3,56	2,48	2,00	0,11
110	5113	0,00	2,97	5,83	354,00	3,66	2,43	2,15	0,08
111	5147	0,00	2,93	5,77	376,00	3,75	2,47	2,23	0,14
112	5147	0,00	2,94	5,78	377,00	3,83	2,52	2,27	0,13
113	5147	0,00	2,95	5,80	380,00	3,92	2,56	2,33	0,12
114	5149	0,00	2,95	5,81	383,00	4,00	2,60	2,38	0,11
115	5151	0,00	2,96	5,83	383,00	4,05	2,63	2,40	0,10
116	5194	0,00	2,97	5,86	385,00	4,16	2,68	2,47	0,16
117	5280	0,00	3,00	5,37	386,00	4,36	2,79	2,30	0,11
118	5337	0,00	2,96	4,99	404,00	4,37	2,78	2,15	0,17
119	5337	0,00	2,97	4,88	416,00	4,40	2,80	2,10	0,16
120	5337	0,00	2,97	4,88	416,00	4,40	2,80	2,10	0,16
121	5352	0,00	2,97	4,90	416,00	4,42	2,81	2,11	0,15
122	5428	0,00	2,96	4,98	412,00	4,49	3,25	2,10	0,11
123	5460	0,00	2,89	4,53	438,00	4,34	4,11	2,02	0,12
124	5460	0,00	2,89	4,56	437,00	4,37	4,43	2,02	0,11
125	5460	0,00	2,89	4,56	437,00	4,37	4,43	2,02	0,11

SECTION XX – DRILLING DATA – XX.XX WELL COST DATA

Cost Categories	Cost Code	Well Tota USD
INTANGIBLES		
SALARIES	001	277735
AIR TRANSPORT	208	1212407
SEA TRANSPORT	209	1493702
ONSHORE TRANSPORT	210	242245
MUD MATERIALS	303	2311291
BITS	305	454719
CASING ACCESSORIES	306	18742
CEMENT MATERIALS	307	365221
RIG MATERIALS	402	607189
RIG DAYRATE	501	10469262
CATERING	503	129920
ROV/DIVING	504	242061
MUD ENGINEERS	505	185886
MUD LOGGING SERVICES	507	472603
MWD PERSONNEL	508	85625
SURVEYING SERVICES	510	24578
LOGGING	511	1397691
CASING SERVICES	512	54116
CEMENT SERVICES	513	302470
MWD TOOLS	702	460345
DRILLING TOOLS	703	279403
CASING RUNNING EQUIPMENT	705	84308
CORING TOOLS & SERVICES	713	36738
SITE SURVEY	805	150000
MISC MOB/DEMOB	806	94802
OTHER TANGIBLES	807	476452
TANGIBLE EQUIPMENT–ABANDONMENT	808	32670
ONSHORE SUPPORT	809	218785
TANGIBLES		
CASING	211	1131819
WELLHEAD EQUIPMENT	215	225395
		=======
TOTAL		23538180

SECTION 17

SECTION 17: ADDITIONAL REPORTS

17.1 List of Well Reports

1) Shallow Site Survey
2) 2/5-9 Drilling Program, Amoco Norway
3) 2/5-9 Wellsite Instructions, Amoco Norway
4) Biostratigraphy of the interval 960 - 5460 m / Stratlab
5) Geochemistry of the interval 960 - 5460 m / Geolab Nor
6) End of Well Report / Teleco
7) End of Well Report - Mud Logging and Data Engineering / Exlog
8) Dowell Schlumberger Cementing Services Post Well Report
9) Aker (Anchor Drilling Fluids) Final Well Report
10) Logging Reports Nos: 1,2,3,4,5 / Quad Consulting Ltd
11) STC Report 5303 - 3250 m / Schlumberger
12) Zero Offset VSP 2/5-9 / Read Well Services
13) MSD/LOC FMIE/FMP 4530 - 2875 m / Schlumberger
14) MSD/LOC 5332 - 4518 m / Schlumberger