WELL SUMMARY

A/S NORSKE SHELL EXPLORATION
& PRODUCTION

Nr.:

WELL 31/2-2

ANCHOR DRILLING FLUIDS AS

ANCHOR DRILLING FLUIDS AS

WELL SUMMARY

GENERAL SUMMARY

OPERATOR	A/S NORSKE SHELL EXPLORATION & PRODUCTION
WELL NO.	31/2-2
OPERATOR'S REPRESENTATIVES	MR. P. HOLAN MR. J. CARLISLE
CONTRACTOR	SMEDVIG DRILLING CO.
RIG	WEST VENTURE
CONTRACTOR'S REPRESENTATIVES	MR. B. MOHLMAN MR. H. BROCKMAN
ANCHOR ENGINEERS	MR. M. HOLGATE MR. C. BLANCHARD
WATER DEPTH	323 M
SEABED to RKB	355 M
36" HOLE DRILLED TO	432 M
30" CASING SET AT	430 M
26" HOLE DRILLED TO	812 M
20" CASING SET AT	800 M
17½" HOLE DRILLED TO	1480 M
13⅜" CASING SET AT	1470 M
12¼" HOLE DRILLED TO	1858 M
9⅝" CASING SET AT	1849 M
8½" HOLE DRILLED TO	2600 M
7" LINER SET AT	
6" HOLE DRILLED TO	

ANCHOR DRILLING FLUIDS AS
OSLO – STAVANGER

DAILY SUMMARY REPORT

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OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD

DATE 24.02.80

Mixed 1150 bbls. of spud mud with 100+ sec/qt viscosity.

Materials used: 12 m/t Wyoming Bentonite in bulk
8 sxs Caustic Soda

DATE 25.02.80

Prepare rig for spud-in.

DATE 26.02.80

Prepare rig for spud-in.

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OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD

DATE 27.02.80

Spudded in. Drilling 36" hole, pumping 25-30 bbls. pills of spud mud at each connection.

DATE 28.02.80

Completed 36" section - filled hole with 400 bbls. spud mud. W.O.W. for casing.

Preparing spud mud for future use.

Problems with guide base.

DATE 29.02.80

Made up 430 bbls. new spud mud.

Moved rig 25 off location. Reposition guide base. Spud in new hole.

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WELL NAME 31/2-2

OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD

DATE 01.03.80

Drilled new 36" hole. POOH after filling hole with 300 bbls. spud mud, plus 120 bbls. spud mud containing 5 sxs Mica and 5 sxs Nutplug.

(Spud mud, prehydrated Wyoming Bentonite).

DATE 02.03.80

R.I.H. and continue drilling. Drill with seawater and viscous slugs. Made up 150 bbls spud mud with 8 sxs Mica and 8 sxs Nutplug.

(Spud mud same as earlier).

DATE 03.03.80

POOH due to mechanical problem and weather. Filled hole with viscous mud. Made up new B.H.A., R.I.H. and drill ahead.

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WELL NAME 31/2-2

OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD

DATE 04.03.80

Drill ahead. Filled hole with 400 bbls. of spud mud plus 150 bbls. spud mud with L.C.M. POOH. Run casing. Cement casing.

DATE 05.03.80

Repairing. Prepare to R.I.H. to clean out casing. Mixed 400 bbls. of weighted mud to 1.2 SG. Also mixed 400 bbls. of spud mud.

DATE 06.03.80

Run riser. Made up B.H.A. Mixed 400 bbls. of spud mud. Prepare to R.I.H.

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WELL NAME 31/2-2

OPERATOR A/S NORSKE SHELL

ENGINEERS M. HOLGATE

DATE 07.03.80

Lowered 30". Tensioned and connected diverter. Drilled 17 1/2" pilot hole - 625 m using high visc. pills - 40 bbl/30 m.

DATE 08.03.80

Drilled 625 - 634 m. Power fail. P.O.O.H. to shoe. R.I.H. drilled to 671 m. Power fail. P.O.O.H. to shoe. R.I.H. Held up at 615 m. Wash and ream to 671 m - probably all fill. Drilled 671 - 775 m.

DATE 09.03.80

Drilled to 810 m. Dumped 100 bbls. spud mud and circ. bottoms up. Wiper trip, (max. 50,000 o/p - drag). Otherwise good. Ran Schlumberger Sonic, Gamma, FDC, CNL, LSS. Caliper showed severe wash out to 650 m (> 22"). Sand section. Below this clay 18 - 14". Logs held up 780 m.

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DAILY SUMMARY REPORT

WELL NAME 31/2-2

OPERATOR A/S NORSKE SHELL

ENGINEERS M. HOLGATE

DATE 10.03.80

Ctd. pulling riser, made up hole opener B.H.A. R.I.H. Opened hole to 26" 433-456. Held up. Torque no penetration. P.O.O.H. to check 26" stab o.k., R.I.H.

DATE 11.03.80

Stab into 30" W/H and R.I.H. to 445 m. Held up. Reamed to 456 m. Opened to 26" 456-812 m. Circ. bottoms up. Spotted 100 bbls on bottom - P.O.O.H. - tight at 707 m (200K O/P) - P.O.O.H.
Circulating with mud (1 pump) and S/W (2 pumps) to 648 m.

Probably something coming from earlier tight spot or from around the shoe.

Just about out of gel and drill water.

DATE 12.03.80

Pumped out 648-629 m. P.O.O.H. to 430 m.
W.O.W.

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WELL NAME 31/2-2

OPERATOR A/S NORSKE SHELL

ENGINEERS M. HOLGATE

DATE 13.03.80

Ream 444-456 m, 500-520 m, 706-812 m. Lots of trouble with bottom 3 connections. Circ. while mixing heavy pill- found baryte contained 50% gel. Circ. pill and displaced hole with 1200 bbls mud at 1.10 S.G. P.O.O.H. 744-735 and 475 tight. Pipe twisted off (on the way down through tight spot). Ctd. P.O.O.H.

DATE 14.03.80

R.I.H. with overshot and retrieved fish. Made up B.H.A. with 26" bit. R.I.H. but unable to stab into wellhead. P.O.O.H. and R.I.H. with utility guide frame. R.I.H. held up at 438 m, heavy reaming 438-454 m. Mud on conn.

Fluid loss reduced below 10 cc.

DATE 15.03.80

Ream 454-463 Spotting mud on conn. R.I.H. and ream 543-568, 705-740, 769-810 m. Displace OH with 1200 bbls at 1.30 S.G. P.O.O.H. 120-125 K O/P (drag) 746-740, 535-529, 494-488 m. Ream 438-463 m, 504-520 m. Spot 400 bbls 1.30 S.G. on bottom. P.O.O.H. Program called for wt 1.50 and displace hole. P.O.O.H. clean. Spot 200 bbls 1.50 S.G. in 30". R.I.H. clean, 2 m fill. Rig up and run 20".

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OPERATOR A/S NORSKE SHELL

ENGINEERS M. HOLGATE

DATE 16.03.80

Ran 20" casing. Slightly tight at 440 m but otherwise clean to bottom. Displaced mud in hole with s/w and cemented. No sign of cement at w/h. Backed off running string and P.O.O.H. Rig up to run riser.

Mixing up gyp mud.

DATE 17.03.80

Ran B.O.P.

Mixing up new mud.

DATE 18.03.80

Ran B.O.P Tested same. Repaired leaks on choke manifold.

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WELL NAME 31/2-2

OPERATOR A/S NORSKE SHELL

ENGINEERS M. HOLGATE

DATE 19.03.80

Made up 17 1/2" B.H.A. Tagged cement at 761 m. Drilled cement with s/w. Displaced hole with mud. Drilled ahead to 817M Leak off 1.72 S.G. Drill ahead to 836M

Lost 400 bbls during displacement - leaking slip joint and dump valve left open on shakers.

DATE 20.03.80

P.O.O.H. Light ream to 836 m. Drill ahead 836-930 m. Survey. Drill ahead 930-965 m - flowline blocked. Drill ahead 965-1025 m. Survey, flowline blocked.

Watch for mud losses when flowline blocked

DATE 21.03.80

Clean hole for survey - flowline plugged by clayball - drill 1066-1098 - circulate hole clean and survey. Wiper trip to shoe, R.I.H., no fill, drill to 1206 m.

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WELL NAME 31/2-2

OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD

DATE 22.03.80

Drill to 1254 m - survey at 1248 m (1/2°). Continue drilling 1254-1349, survey. Continue drilling to 1426 m. Survey and P.O.O.H. Tight hole from 1096-1077 m. Make up new bit and R.I.H.

DATE 23.03.80

R.I.H., drag at 1040-1250-1270. Drill to 1480 for 13 3/8" csg. Wiper trip. Hole swabbing - R.I.H. No fill, P.O.O.H. for logs.

DATE 24.03.80

Unable to run logs past shoe. R.I.H. to clean out. Drag at 820-905 (25,000 lbs). No fill. Log. Unable to pass bridge. R.I.H. with open ended drillpipe.

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DAILY SUMMARY REPORT

WELL NAME 31/2-2

OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD

DATE 25.03.80

Clean out hole with visc. pill. P.O.O.H. Run logs, hole tight at 1040 m and 1310 m. Logging depth 1479,5 m. Unable to run CNL. R.I.H. with bit and clean hole with 100 bbl hi vis pill. Increased mud weight to 1.35. Lost circulation - mix LCM pill containing 20 sxs Mica and 16 sxs Nutplug and 20 sxs Cellophane and spot on bottom.

DATE 26.03.80

Pull to 900 m and reduce mud weight to 1.30 S.G. Run in hole to reduce all mud in hole to 1.30 S.G. P.O.O.H. and log (FDG, GR, CNL). Log stopped at 1343 m. Run in hole and ream 1342-1351 m. Continue R.I.H. and tag 3 m fill, clean out.

Telex from Norske Shell, Stavanger, requiring certain mud properties and treatment to stabilize hole. After mud properties had been changed the mud and the hole looked very much better.

DATE 27.03.80

P.O.O.H. No drag. Run logs, no problem. R.I.H. to clean out for casing.

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OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD

DATE 28.03.80

Clean hole - run 13 3/8" casing. Cement + casing.
Lost 50 bbls of mud during displacement.

DATE 29.03.80

Prepare BOPs - run seal assembly - unable to go through hydril.
Displace riser with H_2O. Run seal assembly. Test BOPs.

DATE 30.03.80

Test BOPs. R.I.H. to 1442 m. Drill float, cement, shoe.
Drill to 1485 m, run leak off test. Drill ahead.

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OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD

DATE 31.03.80

Drill to 1515, bit balling. Circulate bottoms up. Make up core barrel. Core no. 1 from 1515-1522 m.

DATE 01.04.80

Finish core no. 1 at 1525 m. P.O.O.H. Check hang off tool. R.I.H. to cut core no. 2.

DATE 02.04.80

Cut core to 1535 m, barrel jammed, 20% recovery on core no. 2. R.I.H. with bit to clean out hole. P.O.O.H. for core no. 3.

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OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD

DATE 03.04.80

Cut core no. 3 to 1553 m. 70% recovery. Cut core no. 4 to 1560 m.

DATE 04.04.80

P.O.O.H. for core no. 4, 100% recovery. Cut core no. 5 to 1569 m. Barrel jammed P.O.O.H., 100% recovery for core no. 5. R.I.H. to cut core no. 6.

DATE 05.04.80

Cut core no. 6 to 1578 m. P.O.O.H., 100% recovery. R.I.H. for core no. 7. Cut core to 1585 m, barrel jammed, 36% recovery for core no. 7. R.I.H. to cut core no. 8.

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OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD

DATE 06.04.80

Cut core no. 8 at 1598 - barrel jammed - 100% recovery. R.I.H. and cut core no. 9 to 1604 - P.O.O.H. with 100% recovery - cut core no. 10 to 1608 m.

DATE 07.04.80

P.O.O.H. core no. 10 - 60% recovery on core no. 10 - R.I.H. - held up at 1592. Ream. Cut core no. 11 to 1617 - barrel jammed - 40% recovery - R.I.H. and cut core no. 12 to 1626 - 78% recovery.

DATE 08.04.80

Make up new core assembly - 8 15/32" core bit - cut core no. 13 to 1635 m - P.O.O.H. with 72% recovery. Rig down core barrel - test B.O.P.s.

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OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD, M. HOLGATE

DATE 09.04.80

Test B.O.P.s. Make up drilling assembly. Run in hole to drill. Ream 1617-1635. Screens blocked with sand. Lost 130 bbls mud. Drill to 1655 m. Change screens on Brandt shaker, 60B x 80B.

DATE 10.04.80

Drill ahead. 1655-1858 with surveys. Circ. bottoms up. P.O.O.H. for wiper trip. Clean.

DATE 11.04.80

R.I.H. Clean. No fill. Ran logs.

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OPERATOR A/S NORSKE SHELL

ENGINEERS M. HOLGATE

DATE 12.04.80

Logging.
3 x RFT.

DATE 13.04.80

Logging. 2 x RFT. R.I.H. Wash 1844-1858 m. Circulate.

DATE 14.04.80

P.O.O.H. Clean. Completed RFT'S.
CST no 1 and 2.

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OPERATOR A/S NORSKE SHELL

ENGINEERS M. HOLGATE

DATE 15.04.80

R.I.H. Clean no drag - no fill. Circ. hole. P.O.O.H. clean.
Rig up and run 9 5/8" casing + cement with

200 sxs 'G' 1.62 + additives
650 sxs G 1.84 + additives

Displaced cement with 376 bbls 1.26 S.G. Bumped plug with 1600 psi.

DATE 16.04.80

Pressure test csg. to 4000 psi. Release running tool circ. bottoms up - no cement. Lay down dp. W.O.C.
Run temp survey and cbl.

DATE 17.05.80

Mix 1200 bbls of mud for start of 8 ½" section (1.20 S.G.).
Position rig and set anchors.
Materials mixed

9 sxs Wyoming Bentonite
3 sxs Caustic Soda
90 sxs CMS Low Vis
150 sxs Lignosulfonate

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OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD, M. HOLGATE

DATE 18.05.80

Mix mud for 8½" section. Continue to set anchors.

DATE 19.05.80

Set anchors. Total of 1300 bbls 1,20 S.G. gel/lignosulfonate mud mixed.

DATE 20.05.80

Set anchors.

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WELL NAME 31/2-2

OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD, M. HOLGATE

DATE 21.05.80

Repair retort thermostat - proper solids content 6 % by volume.
Rig setting anchors.

DATE 22.05.80

Mud enineer put on stand-by. Problems with valves on B.O.P. stack. Mud in tanks to be kept agitated at all times to keep barite suspended.

23 - 24 - 25 - 26 Engineers on SB.

DATE 27.05.80

Rig up guidelines. Condition mud in pits. Check solids control equipment.

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WELL NAME 31/2-2

OPERATOR A/S NORSKE SHELL

ENGINEERS M. HOLGATE

DATE 28.05.80

Wait on guidelines.
Check chemical inventory.

DATE 29.05.80

Stab last guideline. R.I.H. to retrieve corrosion cap.

DATE 30.05.80

Attempt to retrieve corrosion cap.

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WELL NAME 31/2-2

OPERATOR NORSKE SHELL

ENGINEERS Michael Holgate.

DATE 31.5.80

Retrieve corrosion cap. run riser.

DATE 1.6.80

Pressure test bop. Displace riser with mud. Lost 60BBLS through slip jo t.

DATE 2.6.80

Retrieve csg. Plug on IND. attemt.
R.I.H. Drill cement to 1863M. Water back to 1.15 s.g. (Shell orders). Balanue & stabilise column at 1.16 s.g. P.O.O.H. fok packer to run leak off.

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OPERATOR A/S NORSKE SHELL

ENGINEERS M. HOLGATE

DATE 03.06.80

R.I.H. with packer. Pressure up to 1.65 S.G. Equiv. W/O leaking off. P.O.O.H. R.I.H. with bit. Drill ahead 1863-1942. Treat with prehydrated gel at 40 ppb + 6 ppb Lignosulfonate for rheology. Worked well.

DATE 04.06.80

Drill ahead 1951-1961 m. P.O.O.H. Bit change, hole clean.
R.I.H. Ream 1951-1961 (bit was underguage).
Drill ahead 1961-2073 m.
Som mud losses over screens due to blinding of sand.

DATE 05.06.80

P.O.O.H. tight 2070-1875. R.I.H. clean wash 2059-2073 m.
Drill ahead 2073-2170 m. P.O.O.H. wiper trip. 2061-1948 80-100 K overpull, remainder (30-50 K). R.I.H. clean.
Drill ahead 2170-2208. 4 % gas on bottoms up - swabbing.
Mud weight to 1.18 S.G.

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OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD, M. HOLGATE

DATE 06.06.80

Drill from 2208-2380 m. Tight hole on wiper trips.

DATE 07.06.80

Make up new bit - drill to 2457. Tight hole on wiper trips.

DATE 08.06.80

Drill from 2457-2504 m - wiper trip - drill ahead to 2570 m.
Tight hole on wiper trips.

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WELL NAME 31/2-2

OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD, M. HOLGATE

DATE 09.06.80

Drill to T.D. 2600. Circulate hole clean. Run wiper trip and circulate hole with viscous pill. Rig up for logging.

DATE 10.06.80

Run logs.

DATE 11.06.80

Run logs.

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WELL NAME 31/2-2

OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD, M. HOLGATE

DATE 12.06.80

Plug hole with 5 cement plugs to 1600 m

No.	1	2595-2395
	2	2165-2139
	3	2135-1935
	4	1905-1705
	5	1675-1600

DATE 13.06.80

Test B.O.P.s. Run in hole with scraper - tag cement. Dress top of plug.

DATE 14.06.80

Displace mud system with seawater. Fill pits with 1.18 S.G. 1100 bbls of mud. Schlumberger ran bridge plug at 1595 prior to displacement.

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OPERATOR A/S NORSKE SHELL

ENGINEERS C. BLANCHARD, M. HOLGATE

DATE 15.06.80

Circulate hole clean with seawater. Displace hole with $CaCl_2$ water. Begin test program. Mud engineer on stand by.

DATE

DATE

SUMMARY OF EVENTS

OPERATOR: A/S NORSKE SHELL EXPLORATION & PRODUCTION

WELL NO. 31/2-2

~~36"~~ **HOLE/** 30" **CASING INTERVAL** (30" CONDUCTOR SET AT 430 m)

Prior to spudding of the well, 1150 BBLS high- viscosity (100+ secs./qt.) were mixed in the mud pits using approx. 35 p.p.b. prehydrated Bentonite.

The well was spudded in February 27th, 1980 and drilling commenced with 26" bit and 36" hole opener using seawater and 30-40 BBLS hi-vis. pills to assist hole cleaning as required.

The hole was drilled to 433 m and displaced with 400 BBLS of prehydrated Bentonite prior to running conductor.

Due to problems with Guide base, the rig was moved 25 m and a new 36" hole was drilled as above.

Prior to running 30" conductor the hole was displaced with 300 BBLS prehydrated Bentonite and 120 BBLS mud containing 5 sxs Mica and 5 sxs Nutplug.

The 30" conductor was run and cemented with shoe at 430 m.

SUMMARY OF EVENTS

OPERATOR: A/S NORSKE SHELL EXPLORATION & PRODUCTION

WELL NO. 31/2-2

26" HOLE/ 20" CASING INTERVAL (20" CASING SET AT 800 m)

The 17½" pilot hole was drilled with seawater using 25-30 BBLS hi-vis pills on connections.

T.D. (810 m) for the pilot hole was reached with few problems, and the hole was displaced with non flocculated prehydrated Bentonite with a fluid loss less than 15 cc API. However, Schlumberger logs were held up at 780 m.

Ran in the hole with 26" hole opener and encountered high torque problems below shoe. The bit was pulled to check and change stabelizers, but torque problems prevailed to 455 m. Sands and clays were drilled to 812 m.

The hole was very tight on subsequent wiper trips (see chart.1) with three troublesome sections at:

438 m - 450 m
500 m - 550 m
710 m - 812 m

all of which required reaming before connections could be made.

In order to keep the hole open, 1200 BBLS 1.3 S.G. mud was spotted at bottom, but hole was still tight.

After discussions with Shell Representative, it was decided to spot another 400 BBLS of 1.3 S.G. mud at bottom and also 200 BBLS of 1.5 S.G. mud inside 30" conductor.

Ran 20" casing to 800 m and cemented same.

All pits were cleaned out and work started on the Gyp./Lignosulfonate system to be utilized in the 17½" section.

SUMMARY OF EVENTS

OPERATOR: A/S NORSKE SHELL EXPLORATION & PRODUCTION

WELL NO. 31/2-3

26" HOLE/ 20" CASING INTERVAL

CHART 1.

BIT SIZ	BIT NO	TRIP NO	REMARKS
17 ½"	3	1	Drilled from 433M - 634M Power failure - Pulled to shoe.
		2	R.I.H. tight at 615M wash and to 671 M Drill ahead to 810M Circulated bottoms up Logging.
26"	H/O	1	R.I.H. 433M - 456M high torque No Progress P.O.H.
26"	H/O	2	R.I.H. to 445M, Held up. ream to 456M. Open up to 812M. Circulated bottoms up and spotted 100 bbls mud P.O.O.H. tight off bottom 200,000 O/P pumped 400 bbls mud. Circulated out from 707M to 648M - 629M. P.O.O.H. to 430 M.
26"	H/O	3	R.I.H. ream 444M - 456M 500M - 520M 706M - 812M Increase mud weight to 1.10 s.g. P.O.O.H. tight at 744M - 735M 475M - 455M
26"		5	R.I.H. Held up 438M Ream. 438M - 463M 543M - 568M 705M - 740M 769M - 810M Displace mud with 1.30 s.g. P.O.O.H.Tighe at:- 746M -740M 535M -529M 492M -488M

SUMMARY OF EVENTS

OPERATOR: A/S NORSKE SHELL EXPLORATION & PRODUCTON

WELL NO. 31/2-2

17½" **HOLE/** 13 3/8" **CASING INTERVAL** (17 3/8" CASING SET AT 1470 m)

The cement and shoe were drilled with seawater and displaced with a Gyp./Lignosulfonate system S.G. 1.20, at 798 m.

Due to a leaking slip joint and dump valve left open when displacing, 400 BBLS. was lost.

The Gyp./Lignosulfonate mud was prepared following the mud program with 9 p.p.b. Gyp. The soluble Ca++ levels were higher than expected. This was due to lack of pretreatment of the saltwater used. This will be corrected in future operations. The excessive calcium levels in combination with high MBT resulted in high gel strengths which in turn adversly effected flow properties.

Soluble Ca++ level was reduced with Soda Ash to 1600 p.p.m. and excess gyp. increased to 6 p.p.b. on Shell's instructions. This gradually improved hole conditions.

Before logging mud weight was raised to 1.3 S.G. logs were unable to get past shoe on first attempt, and hole had to be cleaned out. On second attempt the mud weight was increased to 1.35 S.G. and viscous pills of 150 BBLS. circulated around. Circulated with partial returns, lost returns. A L.C.M. pill was mixed and mud weight reduced to 1.30 S.G. which enabled logs to be run. Made another wiper trip and finished logging.

Ran 13 3/8" casing and cemented same. Lost approx. 50 BBLS. of mud to the formations during displacement.

SUMMARY OF EVENTS

OPERATOR: A/S NORSKE SHELL EXPLORATION & PRODUCTION

WELL NO. 31/2-2

12 1/4" HOLE/ 9 5/8" CASING INTERVAL (9 5/8" CASING SET AT 1849 m)

The 13 3/8" shoe was drilled out with 1.26 S.G. mud. 13 cores were cut from 1515 m to 1635 m. This section reached T.D. at 1858 m and logged.

9 5/8" Casing was run and cemented with shoe at 1849 m.

The hole was then secured; mud dumped and the rig taken into yard for repairs.

The mud properties were stable in this section of the hole and the mud required minimum chemical treatment.

SUMMARY OF EVENTS

OPERATOR: A/S NORSKE SHELL EXPLORATION & PRODUCTION

WELL NO. 31/2-2

8½" **HOLE/** _____ **CASING INTERVAL**

On arrival back on location, 1300 BBLS. of aGel/Lignosulfonate mud at 1.20 S.G. was mixed for the 8½" section. Drilling was delayed by problems retrieving the corrosion cap. This time was spent on stripping down and checking all Solids removel equipment.

Nippled up and ran in the hole. Old mud in the hole was watered back and Bentonite was added to the system to maintain a Bentonite content of 17.5 p.p.b. mud balanced out at 1.16 S.G.

A packer was set in the 9 5/8" Casing and P.I.T. test performed equivalent to 1.65 S.G.

Drilling proceeded without problems although tight hole was experienced on trips. No satisfactory explanation was given for this as there was little evidence of swelling clays. Breaking over to a Gyp. system was discussed but hole conditions improved after a few trips.

Mud losses over the shaker screens (60 x 40) were controlled by changing to a finer mesh screen (80 x 80), thus preventing screens to be plugged by sand.

The 8½" section was drilled to 2600 m, Schlumberger logs were run, and the hole was plugged back to 1600 m. Bridge plug was set at 1595 m and the hole circulated clean with seawater before displaceing with $CaCl_2$ fluid.

Test program started.

Achor engineer released.

OPERATOR A/S NORSKE SHELL EXPLORATION & PRODUCTION

WELL NO. 31/2-2

MATERIAL CONSUMPTION & COST ANALYSIS

36" HOLE DRILLED TO 432 Meters ~~Feet~~ 30" CASING SET AT 430 Meters ~~Feet~~

ACTUAL AMOUNT OF HOLE DRILLED 77 Meters / Feet DAYS ON INTERVAL 11

DRILLING FLUID SYSTEM SPUD MUD - GEL

MATERIAL	UNIT SIZE	PROG.	USED	VARIANCE ±	COST
WYOMING BENTONITE	M/T	21	35	+14	$ 9.450.00
CAUSTIC SODA	25 KG	26	18	- 8	189.00
MICA	25 KG	0	18	+18	238.50
WALNUT	25 KG	0	18	+18	238.50
LIME	25 KG	0	7	+ 7	29.75
CHROME LIGNOSULF.	25 KG	0	1	+ 1	15.00

COST/DAY $ 923.70 TOTAL COST FOR INTERVAL $ 10.160.75

COST/Mt. or Ft. $ 131.95 PROG. COST FOR INTERVAL $ 5.398.00

ENGR. COST $ 3.850.00 COST VARIANCE FOR INTERVAL $ 4.762.75

OPERATOR A/S NORSKE SHELL EXPLORATION & PRODUCTION

WELL NO. 31/2-2

MATERIAL CONSUMPTION & COST ANALYSIS

26" HOLE DRILLED TO 812 Meters ~~Feet~~ 20" CASING SET AT 800 Meters ~~Feet~~

ACTUAL AMOUNT OF HOLE DRILLED 380 Meters ~~Feet~~ DAYS ON INTERVAL 10

DRILLING FLUID SYSTEM SPUD - MUD - GEL - WEIGHTED

MATERIAL	UNIT SIZE	PROG.	USED	VARIANCE ±	COST
BARYTE	M/T	20	273	+253	$ 30.576.00
WYOMING BENTONITE	M/T	16	99	+ 83	24.730.00
CHROME LIGNOSULF.	25 KG		29		435.00
CMC HI VIS	25 KG		40		2.120.00
CMC LO VIS	25 KG		10		500.00
CAUSTIC SODA	25 KG	38	24	- 16	252.00
SODA ASH	50 KG		19		313.50
LIME	25 KG		14		59.50

COST/DAY $ 6.098.60 TOTAL COST FOR INTERVAL $ 60.986.00

COST/Mt. or Ft. $ 160.49 PROG. COST FOR INTERVAL $ 12.622.00

ENGR. COST $ 3.500.00 COST VARIANCE FOR INTERVAL $ 48.364.00

OPERATOR A/S NORSKE SHELL EXPLORATION & PRODUCTION

WELL NO. 31/2-2

MATERIAL CONSUMPTION & COST ANALYSIS

17 ½" HOLE DRILLED TO 1480 Meters ~~Feet~~ 13 3/8" CASING SET AT 1476 Meters ~~Feet~~

ACTUAL AMOUNT OF HOLE DRILLED 668 Meters ~~Feet~~ DAYS ON INTERVAL 13

DRILLING FLUID SYSTEM GYP-LIGNOSULFONATE

MATERIAL	UNIT SIZE	PROG.	USED	VARIANCE ±	COST
WYOMING BENTONITE	M/T	23	7	- 16	$ 1.890.00
BARITE	M/T	242	210	- 32	23.520.00
CMC HI VIS	25 KG		15		795.00
CMC LO VIS	25 KG	42	125	+ 83	6.250.00
MICA	25 KG		20		265.00
WALNUT FINE	25 KG		23		304.75
CAUSTIC SODA	25 KG	32	265	+233	2.782.50
GYP	50 KG	145	520	+375	4.420.00
CHROME LIGNOSULF.	25 KG	288	520		7.800.00
XC-POLYMER	50 LB		33		9.236.70
SODA ASH	50 KG		51		841.50
DRILLING DETERGENT	200 L	10	9	- 1	1.575.00
IDFLO	25 KG	85	30	- 55	945.00
AL. STEARATE	25 KG		2		100.00
CELLOPHANE	25 KG		25		442.50

COST/DAY $ 4.705.23 TOTAL COST FOR INTERVAL $ 61.167.95

COST/Mt. or Ft. $ 91.57 PROG. COST FOR INTERVAL $ 46.120.00

ENGR. COST $ 4.550.00 COST VARIANCE FOR INTERVAL $ 15.047.95

OPERATOR A/S NORSKE SHELL EXPLORATION & PRODUCTION

WELL NO. 31/2-2

MATERIAL CONSUMPTION & COST ANALYSIS

12 1/4" HOLE DRILLED TO 1858 Meters ~~Feet~~ 9 5/8" CASING SET AT 1849 Meters ~~Feet~~

ACTUAL AMOUNT OF HOLE DRILLED 378 Meters ~~Feet~~ DAYS ON INTERVAL 19

DRILLING FLUID SYSTEM GYPSUM - LIGNOSULFONATE

MATERIAL	UNIT SIZE	PROG.	USED	VARIANCE ±	COST
BARYTE	M/T	184	48	- 136	$ 5.376.00
CAUSTIC SODA	25 KG	24	97	+ 73	1.018.50
CHROME LIGNOSULF.	25 KG	218	67	- 191	1.005.00
GYPSUM	50 KG	110	100	- 10	850.00
CMC LO VIS	25 KG	66	133	+ 67	6.650.00
CMC HI VIS	25 KG	0	16	+ 16	848.00
DRILLING DETERGENT	DRM	11	0	- 16	0.00
STARCH	25 KG	66	120	+ 54	3.780.00
XC-POLYMER	25 KG	0	13	+ 13	3.638.70
SODA ASH	50 KG	0	52	+ 52	858.00
WALNUT	25 KG	0	32	+ 32	424.00
MICA	25 KG	0	52	+ 52	689.00

COST/DAY	$ 1.323.01	TOTAL COST FOR INTERVAL	$ 25.137.20
COST/Mt. or Ft.	$ 66.50	PROG. COST FOR INTERVAL	$ 36.279.00
ENGR. COST	$ 6.650.00	COST VARIANCE FOR INTERVAL	$ 11.141.80

OPERATOR A/S NORSKE SHELL EXPLORATION & PRODUCTION

WELL NO. 31/2-2

MATERIAL CONSUMPTION & COST ANALYSIS

8 ½" HOLE DRILLED TO 2600 Meters ~~Feet~~ OPEN HOLE CASING SET AT / Meters Feet

ACTUAL AMOUNT OF HOLE DRILLED 742 Meters ~~Feet~~ DAYS ON INTERVAL 26

DRILLING FLUID SYSTEM GEL-LIGNOSULFONATE

MATERIAL	UNIT SIZE	PROG.	USED	VARIANCE ±	COST
WYOMING BENTONITE	M/T		18.5		$ 4.995.00
BARYTE	M/T		73		8.176.00
CMC HI VIS	25 KG		90		4.770.00
CMC LO VIS	25 KG		105		5.250.00
CAUSTIC SODA	25 KG		102		1.071.00
CHROME LIGNOSULF.	25 KG		250		3.705.00
XC-POLYMER	50 LB		28		7.837.20
SODA ASH	50 KG		9		148.50
AL. STEARATE	25 KG		2		100.00
IDLO	25 KG		31		976.50

COST/DAY $ 1.425.93 TOTAL COST FOR INTERVAL $ 37.074.20

COST/Mt. or Ft. $ 49.96 PROG. COST FOR INTERVAL -

ENGR. COST $ 9.100.00 COST VARIANCE FOR INTERVAL -

OPERATOR A/S NORSKE SHELL EXPLORATION & PRODUCTION

WELL NO. 31/2-2

TOTAL CONSUMPTION & COST ANALYSIS

TOTAL DEPTH 2600 Meters

TOTAL HOLE DRILLED 2245 Meters

TOTAL DAYS 79

MATERIAL	UNIT SIZE	PROG.	USED	VARIANCE ±	COST
BARYTE	M/T	455	604	+ 149	$ 67.648.00
WYOMING BENTONITE	M/T	96	159.5	+ 48.5	43.065.00
CAUSTIC SODA	25 KG	120	506	+ 386	5.313.00
CHROME LIGNOSULF.	25 KG	506	867	+ 360	13.005.00
GYPSUM	25/50 KG	255	620	+ 365	5.270.00
CMC LO VIS	25 KG	108	373	+ 265	18.650.00
CMC HI VIS	25 KG		161		8.533.00
LF-5	25 KG	151	181	+ 30	5.701.50
DRILLING DETERGENT	DRUM	16	9	- 7	1.575.00
XC-POLYMER	25 KG		74		20.712.60
SODA ASH	50 KG		131		2.161.50
LIME	25 KG		21		89.25
MICA	25 KG		90		1.192.50
WALNUT	25 KG		73		967.25
AL. STEARATE	25 KG		4		200.00
CELLOPHANE	25 KG		25		442.50

COST/DAY $ 2.462.35

TOTAL COST FOR INTERVAL $ 194.526.10

COST/Mt. or Ft. $ 86.64

PROG. COST FOR INTERVAL $ 100.419.00

ENGR. COST $ 27.650.00

COST VARIANCE FOR INTERVAL $ 94.107.10

ANCHOR DRILLING FLUIDS AS

OSLO — STAVANGER

rilling Fluid & Material Consumption Report

UD SYSTEM SPUD MUD, GYP LIGNOFULFONATE

WELL NAME 31/2-2 AREA NORTH SEA

OPERATOR A/S NORSKE SHELL RIG. WEST VENTURE

ENGINEERS C. BLANCHARD, M. HOLGATE

ay	DATE	ESTIMATED DAILY MUD VOLUMES			BULK MATERIALS		SACK MATERIALS		MATERIALS ADDED TO CONTROL PRORERTIES																		
									THINNERS				POLYMERS						OTHERS								
		LOSSES SUB SURFACE	LOSSES SURFACE	VOLUME MUD BUILT	BARITE	BENTONITE			LIGNO								CAUSTIC SODA		LIME			MICA	WALNUT				
1	24.2			1150		12											8										
2	25.2																										
3	26.2																										
4	27.2	150																									
5	28.2	570		300		3½											2										
6	29.2	30		460		4½											2										
7	1.3	670		700		6											4					5	5				
8	2.3	20																				8	8				
9	3.3	570		600		6			1								1		7								
10	4.3	800															1					5	5				
11	5.3			400		3				36" HOLE																	
12	6.3			400	15	5/12x											2		3								
13	7.3			300		5											2		2								
14	8.2			300	27	4											1										
FORWARD																											
ESTIMATED TOTALS		2810		4710	42	61			1								23		12			18	18				

REMARKS:

XCOST CORRECTION

ANCHOR DRILLING FLUIDS AS

OSLO — STAVANGER

Drilling Fluid & Material Consumption Report

MUD SYSTEM SPUD MUD

WELL NAME 31/2-2 AREA NORTH SEA

OPERATOR A/S NORSKE SHELL RIG. WEST VENTURE

ENGINEERS C. BLANCHARD, M. HOLGATE

Day No	DATE	ESTIMATED DAILY MUD VOLUMES: LOSSES SUB SURFACE	LOSSES SURFACE	VOLUME MUD BUILT	BULK MATERIALS: BARITE	BENTONITE	SACK MATERIALS	MATERIALS ADDED TO CONTROL PROPERTIES: THINNERS: LIGNO				POLYMERS: CMC HI VIS	CMC LO VIS	XC			OTHERS: CAUSTIC SODA	SODA ASH	LIME	GYP	WALNUT	AL. STEARATE	D.D.	IDFLO	MICA
15	9.3	897		800		13											3	2							
16	10.3	80		350		4											1	2	4						
17	11.3	1130		600		13[X]											1	4							
18	12.3			620		13[X]						15					5	11	5						
19	13.3	1430		1000				29				25	10				1								
20	14.3	1600		1200	97	15																			
21	15.3	1900		2160	134	15			26"	HOLE							8								
22	16.3	260				4		75				8					14			[illegible]					
23	17.3			375				167					5				29	15[X]		113	7[X]	1			
24	18.3																5			17					
25	19.3	50	400	659	25	3		51						4			11	1		25		1			
26	20.3	110	100	559	47[X]			45					10	13			30			20			2		
27	21.3		85	400	13			65					20	9			38	2		70					
28	22.3			792	12			70					26				61			30				30	
FORWARD		2810		4710	42	61		1									23		12	325	18				18
ESTIMATED TOTALS		[illegible]26	[illegible]85	[illegible]525	[illegible]0	[illegible]	[illegible]	[illegible]503	[illegible]	[illegible]	[illegible]	48	71	26	[illegible]	[illegible]	230	37	21	325	25	2	2	30	18	[illegible]

REMARKS:

ANCHOR DRILLING FLUIDS AS

OSLO — STAVANGER

Drilling Fluid & Material Consumption Report

MUD SYSTEM GYP - LIGNOSULFONATE

WELL NAME 31/2-2 AREA NORTH SEA

OPERATOR A/S NORSKE SHELL RIG. WEST VENTURE

ENGINEERS C. BLANCHARD, M. HOLGATE

DAY	DATE	ESTIMATED DAILY MUD VOLUMES: LOSSES SUB SURFACE	LOSSES SURFACE	VOLUME MUD BUILT	BULK MATERIALS: BARITE	BENTONITE	SACK MATERIALS	MATERIALS ADDED TO CONTROL PROPERTIES: THINNERS: LIGNO				POLYMERS: CMC HI VIS	CMC LO VIS	XC			OTHERS: CAUSTIC SODA	SODA ASH	LIME	GYP	WALNUT	AL. STEARATE	D.D.	IDFLO	MICA	CELL
29	23.3		200	450	60			21					21				29			40			3			
30	24.3		125		12			12				5	10				16						2			
31	25.3				31			4				2	.6	3			5			30	16		1		20	25
32	26.3	375		400	4			10					24				22	33		125			1			
33	27.3		55		4								1	2			4									
34	28.3	50	638		2			17½ " HOLE					2	2			1									
35	29.3		121																							
36	30.3		278		2			2										24						25		
37	31.3		135		12[X]			21					18				19			30				80		
38	1.4			155	9			17					15	1			1							5		
39	2.4		60		2							5		2			10									
40	3.4		5		2									2												
41	4.4		43		4			10					6				13	20		30						
42	5.4			6	4								9	2			5									
FORWARD		10267	585	14625	370	141		503				48	71	26			230	37	21	325	25	2	2	30	18	
ESTIMATED TOTALS		10692	2245	15636	518	141		600				60	183	40			355	114	21	580	41	2	9	140	38	25

REMARKS

[X] INVENTORY ADJUSTMENT

ANCHOR DRILLING FLUIDS AS

OSLO — STAVANGER

Drilling Fluid & Material Consumption Report

WELL NAME 31/2-2 AREA NORTH SEA

OPERATOR A/S NORSKE SHELL RIG. WEST VENTURE

MUD SYSTEM GYP - LIGNOSULFONATE ENGINEERS C. BLANCHARD, M. HOLGATE

DATE	ESTIMATED DAILY MUD VOLUMES			BULK MATERIALS		SACK MATERIALS	MATERIALS ADDED TO CONTROL PROPERTIES																				
							THINNERS				POLYMERS					OTHERS											
	LOSSES SUB SURFACE	LOSSES SURFACE	VOLUME MUD BUILT	BARITE	BENTONITE		LIGNO				CMC HI VIS	CMC LO VIS	XC			CAUSTIC SODA	SODA ASH	LIME	GYP	CELLOPHANE	AL. STEARATE	D.D.	IDFLO	MICA	WALNUT	
3 6.4			7	4								10				7							10			
4 7.4			7	6							2	6	2			9										
5 8.4			45	1							9[X]	3				5										
6 9.4		133										8				5			40							
7 10.4			171	2			6					48				14	8									
8 11.4		140																								
9 12.4													3			1										
50 13.4																										
51 14.4							15						1			6										
52 15.4																										
53 16.4							4		12	1/4"	HOLE					2[X]								52[X]	32	
54 17.4	(451)	(1480)	1200		9		150				90					3										
55 18.5			100	42									1			27	3									
56 19.5							NO MATERIALS USED																			
FORWARD	10692	2245	15136	518	141		600				60	183	40			355	114	21	580	25	2	9	140	38	41	
DETAILED TOTALS	11143	3998	16666	573	150		767				161	268	47			434	125	21	620	25	2	9	150	90	73	

REMARKS [redacted] INVE[redacted]RY [redacted]JUS[redacted]NT [redacted]) A[redacted] MUD [redacted] DUMPED DUE TO REPAIR OF RIG IN BERGEN.

ANCHOR DRILLING FLUIDS AS

OSLO — STAVANGER

Drilling Fluid & Material Consumption Report

MUD SYSTEM GYP - LIGNOSULFONATE

WELL NAME 31/2-2 AREA NORTH SEA

OPERATOR A/S NORSKE SHELL RIG. WEST VENTURE

ENGINEERS C. BLANCHARD, M. HOLGATE

Day	DATE	ESTIMATED DAILY MUD VOLUMES: LOSSES SUB SURFACE	LOSSES SURFACE	VOLUME MUD BUILT	BULK MATERIALS: BARITE	BENTONITE	SACK MATERIALS		MATERIALS ADDED TO CONTROL PROPERTIES: THINNERS: LIGNO				POLYMERS: CMC HI VIS	CMC LO VIS	XC			OTHERS: CAUSTIC SODA	SODA ASH	LIME	GYP	CELLOPHANE	AL. STEARATE	D.D.	LF-5	MICA	WALNUT
17	20.5																										
18	21.5																										
19	22.5																										
20	27.5														1												
21	28.5														3			4									
22	29.5																										
23	30.5																	2									
25	31.5		160	400		6			40									11	1								
26	2.6		20	61											7												
27	3.6			4	10	2								30													
28	4.6	21	20		4				15									10									
29	5.6	25	53						15					15	9			5	5				1				
30	6.6		30	45	4½									45				10					1				
31	7.6		64		3½										3			9									
FORWARD		11143	3998	16666	573	150			767				161	268	47			434	125	21	620	25	2	9	150	90	73
ESTIMATED TOTALS		11189	4345	17176	595	158			837				161	358	70			485	131	21	620	25	4	9	151	90	73

REMARKS:

ANCHOR DRILLING FLUIDS AS

OSLO — STAVANGER

Drilling Fluid & Material Consumption Report

MUD SYSTEM GEL - LIGNOSULFONATE

WELL NAME 31/2-2 AREA NORTH SEA

OPERATOR A/S NORSKE SHELL RIG. WEST VENTURE

ENGINEERS C. BLANCHARD, M. HOLGATE

DAY	DATE	ESTIMATED DAILY MUD VOLUMES: LOSSES SUB SURFACE	LOSSES SURFACE	VOLUME MUD BUILT	BULK MATERIALS: BARITE	BENTONITE	SACK MATERIALS	MATERIALS ADDED TO CONTROL PROPERTIES — THINNERS: LIGNO			POLYMERS: CMC HI VIS	CMC LO VIS	XC	(DIASEAL)	CAUSTIC SODA	SODA ASH	LIME	OTHERS: GYP	CELLOPHANE	AL. STEARATE	D.D.	LF-5	MICA	WALNUT
2	8.6			70	5	1½		30				15	3			15							30		
3	9.6			50	2								1		100X	6				80X					107X
4	10.6																								
5	11.6																								
6	12.6		17		2																				
7	13.6		119		35X													120X				29X			
8	14.6		762																						
9	15.6																								
10	16.6																								
11	17.6																								
12	18.6																								
13	19.6																								
14	20.6																								
15	21.6																								
FORWARD		11189	4345	17176	595	158	837					161	358	70			485	131	21	620	25	4	9	151	90	73
ESTIMATED TOTALS		11189	4345	17296	604	159,5	837					161	373	74			506	131	21	620	25	4	9	181	90	73

REMARKS:

MATERIALS BACK LOADED TO TOWN.

ANCHOR DRILLING FLUIDS AS
OSLO — STAVANGER

rilling Mud Properties Record

WELL NAME 31/2-2 AREA NORTH SEA

OPERATOR A/S NORSKE SHELL RIG. WEST VENTURE

JD SYSTEM SPUD MUD - GYP LIGNOSULFONATE

ENGINEERS C. BLANCHARD, M. HOLGATE

DATE	DEPTH FEET □ METERS ☒	MUD PROPERTIES: DENSITY PPG □ SG ☒	VISCOSITY: sec/qt	A.V. cps	P.V. cps	Y.P. #/100 sq.ft.	GELS 0/10	FLUID LOSS 30 Min cc's	CAKE 32 nds	H.T.H.P. cc's	pH	Filtrate Analysis: Cl⁻ ppm	Ca ++ ppm	Pf	RETORT: % OIL	% SOLIDS	% SAND	BENTONITE #/BBL	POTASH #/BBL	POLYMER #/BBL	"N"	"K"	OPERATION REMARKS
24.2		1.05	80					N/C										25					Spud mud. Prepare to spud well.
25.2		1.05	90					N/C										25					Prepare rig for spud in.
26.2		1.05	100					N/C										25					Prepare to spud well
27.2	406	1.05	100±					N/C										25					Drill 36" hole + visc. pills.
28.2	433	1.05	100±					N/C										25					Finish 36" section
29.2	381	1.05	100±					N/C			SPUD NEW HOLE							25					Move rig and spud new hole due to guid base.
1.3	424	1.05	100±					N/C										25					Drill ahead.
2.3	426	1.05	100±					N/C										25					Make 150 bbl LCM pi Drill with seawate
3.3	430	1.05	100±					N/C										25					Mechanical problem Fill hole 400 bbls
4.3	432	1.05	100±					N/C										25					spud mud. Run csg - cement.
5.3	432	1.05	100±					N/C										25					Clean out casing.
6.3	429	1.05	100±					N/C										25					Drill 17½" pilot hole.
7.3	725	1.05	100±					N/C										25					-"-
8.3	775	1.05	100±					N/C										22.5±					-"-

MARKS

ANCHOR DRILLING FLUIDS A·S
OSLO — STAVANGER

Drilling Mud Properties Record

MUD SYSTEM: SPUD MUD, GYP LIGNOSULFONATE

WELL NAME: 31/2-2 AREA: NORTH SEA

OPERATOR: A/S NORSKE SHELL RIG: WEST VENTURE

ENGINEERS: C. BLANCHARD, M. HOLGATE

Day No	DATE	DEPTH (FEET ○ METERS ✕)	MUD PROPERTIES																							OPERATION REMARKS
			DENSITY PPG □ SG ✕	VISCOSITY sec/qt	A.V. cps	P.V. cps	Y.P. #/100 sq.ft.	GELS 0/10	FLUID LOSS 30 Min cc's	CAKE 32 nds	H.T.H.P. cc's	pH	Filtrate Analysis Cl ppm ÷ 1000	Filtrate Analysis TH/Ca. ++ ppm	Filtrate Analysis Pf/Mf	RETORT % OIL	RETORT % SOLIDS	% SAND	BENTONITE #/BBL	POTASH #/BBL	XC GYP	"N"	"K"	
15	9.3	810	1.06	95	30	10	40	30/31	N/C	3		11.2	5	60	0.2 0.3		2		20						Logging
16	10.3	445	1.06	100±					N/C										20±						Opening hole 26"
17	11.3	812	1.06	100±					N/C			11.8							22.5						-"-
18	12.3	812	1.06	100+															22.5						W.O.W.
19	13.3	812	1.10						16.5	2									22.5						Cleaning up hole.
20	14.3	812	1.30	75	33.5	25	27	22/58	6.0	1		11.6	2.5	TR	0.2 0.5				20						-"-
21	15.3	812	1.50	60	39.5	29	21	27/85	8.9	1		11.9							17.5						-"-
	16.3	800			MIXING																				Ran 20".
	17.3	800			MIXING																				Ran BOP.
	18.3	800	1.22	41	16.5	17	3	1/2	5.8	1		9.8	9.0	2.6 2.0	0.2 0.8		8		15		3.3				Tested BOP.
25	19.3	823	1.20	44	18.5	14	9	2/18	5.8	2		9.9	9.0	2.1	0.2 0.7		9		15		3.1				Drilling 17½" hol
26	20.3	1025	1.22	49	23	17	12	5/42	8.9	2		10	12	2.24 2.0	0.2 0.7		10		20		3.3				-"-
27	21.3	1176	1.21	55	29	20	17	10/40	9.5	1		10	14	24	.15 .7		10	1/4	24		3.0				Wiper trip. Drill ahead.
28	22.3	1425	1.22	+50	22	16	12	5/38	9.0	1		10.8	14	18	.3 .8		12	1/4	29		3.25				Drill ahead 17½".

REMARKS

ANCHOR DRILLING FLUIDS AS
OSLO — STAVANGER

rilling Mud Properties Record

JD SYSTEM SYP/LIGNOSULFONATE

WELL NAME 31/2-2 AREA NORTH SEA

OPERATOR A/S NORSKE SHELL RIG. WEST VENTURE

ENGINEERS C. BLANCHARD, M. HOLGATE

DATE	DEPTH FEET / METERS	MUD PROPERTIES: DENSITY PPG / SG	VISCOSITY: sec/qt	A.V. cps	P.V. cps	Y.P. #/100 sq.ft.	GELS 0 / 10	FLUID LOSS 30 Min cc's	CAKE 32 nds	H.T.H.P. cc's	pH	Filtrate Analysis: x 1000 ppm	Ca. ++ ppm	PI /MF	RETORT: % OIL	% SOLIDS	% SAND	BENTONITE #/BBL	XS GYP #/BBL	POLYMER #/BBL	"N"	"K"	OPERATION REMARKS
23.3	1481	1.30	52	25	18	14	9/40	9.6	1		11.0	17	2000	.25/.55		10	1/4	28	3.25				Raise pH-wiper tri for logs
24.3	1481	1.30	51	27	20	14	8/40	9.5	1		11.0	15	2000	.3/.6		10	1/4	30	3.0				Run logs, unable t pass shoe
25.3	1481	1.35	53	35	28	14	5/35	9.8	1		10.8	18	2000	.2/.6		11	1/4	29	2.5				Unable to run all logs Incr. mwl.35 S.G.
26.3	1481	1.30	+45	28	19	17	5/13	8.5	1		10.8	18	1600	.25/.6		11	TR	22	4.5				Loss circ. reduce mw 1.30, log
27.3	1481	1.31	45	27	19	15	4/14	9.5	1		11.0	18	1500	.25/.7		11	TR	25	6.0				Log clean out for casing
28.3	1481	1.31	45	23	16	14	5/14	9.5	1		10.8	17	1800	.2/.7		11	TR	25	6.0				Run+cement+ casing
29.3	1481	1.30	+45	24	17	13	4/14	9.5	1		10.6	18	1800	.2/.6		11	TR	25	5.0				Problems with seal ass. Displ. riser w/H_2O
30.3	1501	1.26	47	28	20	16	5/20	4.9	1		11.2	18	1200	.5/1.0		10	TR	25	4.0				Displ. riser w/mud
31.3	1523	1.25	+45	29	22	14	4/15	5.0	1		11.5	18	1600	.8/1.5		10	TR	23	5.0				Red. fluid loss to cc Core
1.4	1535	1.25	45	27	20	13	5/10	4.7	1		10.9	18	1600	.7/1.4		10	TR	25	5.0				POOH jammed barrel RIH, core
2.4	1536	1.26	50	31	23	15	3/10	4.8	1		11.0	17	1680	.55/1.2		10	TR	25	5.0				20 % recovery Core no. RIH with bit
3.4	1560	1.25	+50	33	26	14	4/12	4.9	1		11.0	17	1620	.5/1.0		10	-	25	5.0				70 % recovery core no. RIH continue core
4.4	1577	1.26	47	32	23	17	4/12	4.9	1		11.0	17	1000	.8/1.6		11	-	24	6.0				100 % recovery cor POOH for core no.
5.4	1591	1.26	45	29	21	15	5/12	4.7	1		10.9	15	1200	.45/1.0		11	-	23	5.3				Cut core no. 7 36 % recovery

EMARKS

ANCHOR DRILLING FLUIDS AS
OSLO — STAVANGER

rilling Mud Properties Record

JD SYSTEM GYP-LIGNOSULFONATE

WELL NAME 31/2-2 AREA NORTH SEA

OPERATOR A/S NORSKE SHELL RIG. WEST VENTURE

ENGINEERS C. BLANCHARD, M. HOLGATE

ay lo.	DATE	DEPTH FEET □ METERS □	MUD PROPERTIES: DENSITY PPG □ SG □	VISCOSITY: sec/qt	A.V. cps	P.V. cps	Y.P. #/100 sq.ft.	GELS 0/10	FLUID LOSS 30 Min cc's	CAKE 32 nds	H.T.H.P. cc's	pH	Filtrate Analysis: Cl ppm x 1000	Ca. ++ ppm	Pf	RETORT: % OIL	% SOLIDS	% SAND	BENTONITE #/BBL	XS GYP #/BBL	POLYMER #/BBL	"N"	"K"	OPERATION REMARKS
3	6.4.	1608	1.26	46	29	22	13	3/9	4.8	1		10.8	17	1000	.5 1.0	TR	11	TR	23	5.0				Core no. 8,9,10.
4	7.4.	1626	1.26	47	38	28	20	5/10	4.8	1		11.1	16	1200	.4 .9	-	11	-	20	5.0				Cut core no. 11,1
5	8.4.	1635	1.26	+44	22	15	14	3/9	4.8	1		10.8	17	1200	.4 .8	TR	11	-	20	5.0				Cut core no. 13 72 % recovery.
6	9.4.	1683	1.26	50	34	24	19	3/12	4.8	1		11.4	17	2000	.8 1.6	-	11	TR	20	5.0				Test BOPs. Drill ahead.
7	10.4.	1858	1.26	+50	38	27	21	4/10	4.9	1		11.0	17	1500	.35 0.7	TR	11	TR	20	5.2				Drill 12 1/4 to T.
8	11.4.	1858	1.26	+51	31.5	24	15	3/5	4.4	1		10.8	18	1520	0.2 0.9	TR	10	1/2	17.5	4.4				Logging.
9	12.4.	1858	1.26	48	31.5	21	13	3/4	4.6	1		10.9	18	1200	0.2 0.8	TR	10	1/2	17.5	4.2				"
0	13.4.	1858	1.26	54	39.5	30	19	3/5	4.0	1		10.8	19	1440	0.3 1.0	TR	12	1/2	17.5	4.5				"
1	14.4.	1858	1.26	47	28	22	12	3/4	4.3	1		10.9	18	1280	0.4 1.3	TR	12	1/2	17.5	4.3				"
2	15.4.	1858	1.26	53	32.5	26	15	3/4	4.2	1		10.7	19	1360	0.3 1.0	TR	11	1/4	17.5	4.3				Ran and cement 9 5/8" casing.
3	16.4.										MUD	DUMPED												WOC, run cbl.
4	17.5										MIX	NEW MUD												Mix new mud.
5	18.5.	1858	1.20	54	40	32	16	4/5	4.0	1		10.9	12	200	.6 1.4		9		13			.72	.53	Mix mud for 8 1/2" hole
6	19.5.	1858	1.21	+53	38	31	13	4/4	4.0	1		10.9	12	200	.6 1.4		9		13			.71	.52	Set anchors.

REMARKS

ANCHOR DRILLING FLUIDS AS
OSLO — STAVANGER

Drilling Mud Properties Record

MUD SYSTEM GYP-LIGNOSULFONATE

WELL NAME 31/2-2 AREA NORTH SEA

OPERATOR A/S NORSKE SHELL RIG. WEST VENTURE

ENGINEERS C. BLANCHARD, M. HOLGATE

Day No	DATE	DEPTH FEET ☐ METERS ☐	MUD PROPERTIES																						OPERATION REMARKS
			DENSITY PPG ☐ SG ☐	VISCOSITY sec/qt	A.V. cps	P.V. cps	Y.P. #/100 sq.ft.	GELS 0 / 10	FLUID LOSS 30 Min cc's	CAKE 32 nds	HT/HP 200°F 100 psi cc's	pH / MF	Filtrate Analysis Cl⁻ ppm	Ca ++ ppm	Pf	RETORT % OIL	% SOLIDS	% SAND	XS GYP #/BBL	POTASH #/BBL	POLYMER #/BBL	"N"	"K"	
57	20.5	1858	1.21	+ 53	38	31	13	4 / 4	4.0		8	10.8	10	300	.6 / 1.4		9		13			.71	.52	Set Anchors.
58	21.5	1858	1.21	+ 50	35	30	10	3 / 3	4.0		8	10.8	10	300	.6 / 1.4		6		13			.8	.29	Retort repaired. Set Anchors.
59	22.5	1858	1.24	51	35	30	10	3 / 3	4.0		8	10.7	10	300	.6 / 1.4		6		13			.8	.29	Mud engineer put stand-by
60	27.5	1858	1.21	53	32	26	12	3 / 3	3.4	2		10.6	10	240	.6 / 1.8		8		12.5					"
61	28.5	1858	1.21	51	34	28	12	2 / 3	3.6	2		10.2	10	280	.5 / 1.7		8		12.5					"
62	29.5	1858	1.21	52	34	28	12	2 / 3	3.5	1		10.1	10	300	.5 / 1.7		8		12.5					"
63	30.5	1858	1.21	51	34	29	11	2 / 3	3.4	1		10.6	10	240	.7 / 1.8		8		12.5					Retrieve corr. ca
64	31.5	1858	1.21	51	34	28	12	2 / 3	3.4	1		10.4	10	240	.7 / 1.8		8		12.5					Run riser.
65	1.6	1858	1.19	54	35.5	29	13	2 / 5	3.6	1		10.1	10.5	320	.6 / 1.7		7		12.5					Test BOP. Displace riser.
66	2.6	1858	1.16	48	21	17	8	2 / 3	5.2	1		10.6	13.5	400	.8 / 1.9		8		12.5					Drill cement leak off.
67	3.6	1935	1.15	54	27.5	20	15	3 / 10	4.0	1		10.5	13	400	.5 / 1.6		9		17.5					Drilling.
68	4.6	2073	1.14	+ 48	24	21	12	3 / 5	4.7	1		10.7	13	360	.5 / 1.5		8		17.5					"
69	5.6	2208	1.15	52	39.5	26	17	3 / 10	4.7	1		10.4	14	280	.7 / 1.8		8		15					Tight hole wt.
70	6.6	2380	1.18	48	33	25	15	3 / 10	5.0	1	9.0	10.0	15	320	.5 / 1.4		10		15					Wiper trip, tight hole incr. mud wt. 1.18 S.G.

REMARKS

ANCHOR DRILLING FLUIDS AS
OSLO — STAVANGER

Drilling Mud Properties Record

MUD SYSTEM GEL-LIGNOSULFONATE

WELL NAME 31/2-2 AREA NORTH SEA

OPERATOR A/S NORSKE SHELL RIG. WEST VENTURE

ENGINEERS C. BLANCHARD; M. HOLGATE

Day No.	DATE	DEPTH FEET □ METERS □	MUD PROPERTIES: DENSITY PPG □ SG □	VISCOSITY: sec/qt	A.V. cps	P.V. cps	Y.P. #/100 sq.ft.	GELS: 0 / 10	FLUID LOSS 30 Min cc's	CAKE 32 nds	H.T.H.P. cc's 200°C 400°F	pH	Filtrate Analysis: Cl ppm x 1000	Ca. ++ ppm	Pf/Mf	RETORT: % OIL	% SOLIDS	% SAND	BENTONITE #/BBL	POTASH #/BBL	POLYMER #/BBL	"N"	"K"	OPERATION REMARKS
71	7.6.	2460	1.18	44	27	20	13	3 / 7	4.8	1	8.5	10.7	15	360	.5 / 1.3		10	TR	13.5					Wiper trip, no problems. RIH new bit drl ahead.
72	8.6.	2570	1.18	47	35	26	17	3 / 8	4.5	1	9.5	10.4	15	320	.3 / .8		11	TR	17					Drl ahead, some ti hole on wiper tri
73	9.6.	2600	1.18	48	33	25	15	3 / 8	4.9	1	11	10.8	15	320	.5 / 1.2		11	TR	17					Logging.
74	10.6.	2600	1.18	44	25	20	10	3 / 5	4.9	1	11	10.5	15	320	.4 / 1.1		11	TR	17					"
75	11.6.	2600	1.18	43	25	20	10	3 / 4	4.9	1	11.5	10.5	15	320	.4 / 1.1		11	TR	17					"
76	12.6.	1600	1.18	45	36	27	18	3 / 6	4.9	1	11.5	10.4	15	320	.3 / .9		11	TR	17					Plug hole with cement to 1600 m.
77	13.6.	1600	1.18	45	36	27	18	3 / 8	5.0	1		10.8	15	400	.7 / 1.7		11	TR	17					Tag cement.
78	14.6.	1600	1.18	45	32	25	15	3 / 5	5.0	1		10.5	15	320	.3 / .9		11	TR	17					Displace hole with seawater.
79	15.6.								DISPLACE HOLE WITH $CACL_2$ FLUID															Testing.
80	16.6.																							
81	17.6.																							
82	18.6.																							
83	19.6.																							
84	20.6.																							

REMARKS

TECHNICAL REPORT
FOR
SHELL EXPLORATION NORWAY
ON SHALE ANALYSIS
FROM WELL 31/2-2

MAY 1980

PREPARED BY:
RESEARCH AND DEVELOPMENT DEPT.
ANCHOR DRILLING FLUIDS A/S

RUNE LARSEN
TECH. SERVICE

C O N T E N T :

ANALYSIS OF SHALE SAMPLES

SHELL EXPLORATION WELL 31/2-2 750 m. - 1475 m.

TESTS PERFORMED :

1) MINERALOGICAL ANALYSIS OF BULK SAMPLES

2) MINERALOGICAL ANALYSIS OF SHALE FRACTIONS

3) DETERMINATION OF ION EXCHANGE CAPACITY. CEC.

4) SHALE HYDRATION TESTING

INTRODUCTION

Shale cutting samples have been collected from Shell Exploration Well 31/2 - 2'.
The samples have been taken by 25 m. and 50 m. intervals of depth between 750 m. and 1475 m.

The shale samples were subjected to both physical and chemical tests attempting to characterize the properties of the shales as fully as possible.

In the light of this analysis the problems of the tight hole at 880 m., will be examined and related to the mud system that would be recommended for this area. Ref. Appendix section.

MINERALOGICAL ANALYSIS

The mineralogical composition of the shale samples, was determined using the X-ray Powder Diffraction method.

The samples from Well 31/2-2 were washed, dried and milled to reduce the material to μ74.

The XRD-method gives a good qualitative determination for minerals that exists in concentrations more than 5%, but the quantitative determination is less accurate and must be looked upon as semi-quantitative.

By the XRD-method the minerals were identified as follows:

SMECTITE :	17 Å
ILLITE / MUSCOVIT :	10 Å
CHLORITE / KAOLINITE :	7 Å
BLANSKIKT : MIXED MINERALS	10-14 Å
QUARTZ :	4,26 Å
FELSPAR :	3,24 '
PLAGIOKLAS :	3,18 Å
CALCITE :	3,03 Å
PYRITE :	2,73 Å
HALITE :	2,82 Å
AMFIBOL :	8,5 Å

From 1000 m. of depth 9Å minerals were noted. These minerals were not anticipated, but were recognized as possible ceolite.

The amounts of Halite and Barite will be referred to as additives to the drilling fluid, not 100% wahsed out of the test sample.

CLAY FRACTION

SAMPLE DEPTH	SMECTITE	ILLITE MUSCOVIT	CHLORITE CAOLINITE	BLAN-SKIKT	9 Å CLAY MINERALS	QUARTZ	FELSPAR/ PLAGIO_KLAS	CALCITE
750 M	30	45	15	5-10	0	TR	TR	0-5
800 M	45-50	25-30	20	0	0	TR	TR	TR
850 M	55	25-30	10	5	0	TR	TR	0
900 M	85-90	10	5	0	0	TR	TR	0
950 M	90	5	5	0	0	TR	TR	0
975 M	80	10	5	0	0	TR	TR	0
1000 M	70	15	10	0	0	TR	TR	TR
1025 M	80	10	5-10	0	0	TR	TR	0
1050 M	85	5-10	5-10	0	TR	TR	TR	0
1075 M	80	10	10	0	TR	TR	TR	0
1100 M	80	10	10	0	TR	TR	TR	0
1125 M	80	10	10	0	TR	TR	TR	0
1150 M	90	5	5	0	TR	TR	TR	0
1175 M	90	5	5	0	TR	TR	TR	0
1200 M	90	5	5	0	TR	TR	TR	0
[illegible] M	85	5-10	5	0	TR	0-5	0-5	0
[illegible] M	85	5-10	5	0	TR	0-5	0-5	0
[illegible] M	75	10	5	0	0	5	5	0
[illegible] M	75	10	5	0	0	5	0-5	0-5
[illegible] M	75-80	15	5	0	0	0-5	0-5	0
[illegible] M	80	10	5	0	0	0-5	0-5	0
[illegible] M	80	10	5	0	0	0-5	0-5	0
[illegible] M	80	10	5	0	0	0-5	0-5	0-5
[illegible] M	80	10	0-5	0	0	0-5	0-5	5
[illegible] M	65	20	5	5	0	0-5	0-5	5
[illegible] M	65	15-20	5	5	0	0-5	0-5	5

DEPTH	SMECTITE	ILLITE MUSCOVIT	CHLORITE CAOLINITE	BLAN- SKIKT	QUARTZ	FELSPAR	PLAGIO KLAS	CALCITE	PYRITE	HALITE	AMFIBOL	BARITE	9 Å CLAY MINERA
[illegible] M	10	20	10	5-10	30-35	5-10	0-5	5	0-5	0	0	0	
[illegible] M	0-5	15	10-15	0-5	15	15	10	10-15	0	5	TR	TR	
[illegible] M	5	40	25	0-5	15	5	0-5	TR	0-5	5	0	0-5	
900 M	5	25	10-15	5	20-25	5	5	5	0-5	5	0	5	
950 M	0-5	50	5-10	5-10	10	0-5	0-5	5	0-5	0-5	5	TR	
975 M	0-5	35-40	10	5	25	5	5	5	TR	0-5	0	TR	
000 M	5	20	10-15	5-10	35-40	5	0-5	5	TR	TR	0	0	0-5
025 M	0-5	15-20	10	25	30	0-5	0-5	5	TR	0	0	0	TR
050 M	0-5	15-20	10-15	5-10	40	5	0-5	0	0	5	0	0	0-5
[illegible] M	5-10	25-30	10	10	30	0-5	0-5	0	TR	5	0	0	0-5
[illegible] M	5	30-35	15	5-10	20-25	5	0-5	TR	TR	5	0	0	0-5
[illegible] M	0-5	20-25	15	5	25	5	0-5	5	TR	5	0	0	0-5
[illegible] M	5	15	10	5-10	35	5	0-5	5	0-5	5	0	0	0-5
[illegible] M	0-5	5-10	5	10	35	5	5	20	TR	5	0	0	0-5
[illegible] M	0-5	10-15	5-10	10	25	10	5	10-15	0-5	0	0	0	5
[illegible] M	15	15	5	10-15	25	5	5	10	0-5	0	0	0	5
[illegible] M	TR	10	10	10	40	10	5	10	TR	0	0	0	0-5
[illegible] M	5	25	5-10	20	30-35	5	0-5	0	TR	0	0	0	0
[illegible] M	5	35	5-10	10-15	25-30	5	0-5	0	TR	0	0	0	TR
[illegible] M	5-10	40	10	10-15	25	0-5	0-5	TR	TR	0	0	0	0
[illegible] M	0-5	15	10	15	35-40	5-10	5-10	0-5	TR	0	0	0	0-5
[illegible] M	5	40	5-10	5-10	25	5	0-5	0-5	TR	0	0	0	0
[illegible] M	0-5	35	5-10	5	30-35	5	0-5	5	TR	0	0	0	TR
[illegible] M	10	30	5	0	25-30	5-10	5	15	TR	0	0	0	TR
150 M	10	50	5-10	10-15	5	0-5	0-5	5-10	TR	0	0	0	TR
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The significant feature throughout the section is a fairly low concentration of Smectite which contains the swelling clay Montmorillonite.

There is high concentration of Illite/Muscovite combined, with presence of Chlorite/Cholinite and 10 - 14 Å clay minerals, which can either be Illite/Chlorite or Illite/ Smectite.

In this case it is Illite/Smectite clays in combination with Smectite due to its swelling nature.

At 850 M - 900 M the Smectite concentration does not correlate to the problem of tight hole, experienced in 31/2-2 though the shale hydration test and cation exchange capacity gives a positive value for a swelling clay situation.
A further investigation to the clay fraction will assist to evaluate this situation.

Methylene Blue Index

This test on the shale is identical to the on performed on the drilling mud and is designed to measure the surface area and cation exchange of the sample.

Rigorous treatment of the results is difficult since the samples are a complex mixture of minerals of ill-defined particle size. However, a correlation can be established between the Methylene Blue Index (M.B.I.), clay contents, shale hydration and mineralogy.

The Methylene Blue Index determination is carried out on dried ground shale samples as follows:-

A sample of dried shale (1.0g) was titrated with 0.01N methylene blue solution after pre-treatment with 3% hydrogen peroxide (15 mls) and sulphuric acid (1 ml of 5N) for 10 minutes on a boiling water bath. The end point was determined when a drop of slurry on to a filter paper formed a light blue halo. The reaction should be reproduced after leaving the solution stirring for 1 minute. The Methylene Blue Index (M.B.I.) is the milli-equivalent of methylene blue absorbed per 100 grms of dry shale.

Generally, values of 0-5 indicate inactive shales, of 5-10 moderately active shales, possibly requiring inhibition, and of 10-15 highly active shales containing montmorillonite.

TABLE 3.

DEPTH M.	0-5 meq/100 g INACTIVE	5-10 meq/100 g ACTIVE	10-15 meq/100 g HIGHLY ACTIVE
750			
800			
850	2,5		
900			12,5
950		8,5	
975	4,5		
1000		8,0	
1025	4,0		
1050		9,0	
1075		6,5	
1100		8,5	
1125		6,0	
1150	,5		
1175		5,0	
1200	3,5		
1225	3,5		
1250	4,5		
1275		7,5	
1300		6,5	
1324	3,5		
1350	4,5		
1375	4,0		
1400	3,5		
1425		8,0	
1450	2,0		
1475	2,5		

The results given in Table 3 show a decrease in cation exchange capacity with depth. The CEC value from 850 - 950 M. can be directly related to the type and quantity of the clays provided in the X-ray Diffraction analysis of the shales. This shows the presence of a combination of highly active clay minerals.

SHALE HYDRATION TESTING

This test is designed to show the hydratability of the shale when it is put in water, and also the effect of a KCl combination in preventing and reducing the hydration.

The shale hydration test was carried out on a dried ground sample.

A sample of 10 ml. material was carefully put into a 50 ml. cylinder containing 45 ml. destilled water. The hydration is, that volume the material takes after swelling, expressed in per cent of the original volume of 10 ml. dried material.

To determine which effect the different cations have upon the hydration properties, the samples can be treated with the ion wanted, and thereafter make a hydration test to obtain a comparison to the different results.

The samples from Well 31/2-2 were dried out and milled. This material was shared into two equal parts, one of them was treated with KCl. Hydration test was executed on both samples.

The KCl solution was prepared with a concentration of 25 PPB KCl.
The test showed these values:

TABLE 4

SHALE HYDRATION CHART
% SWELLING

DEPTH M.	Non-treated sample	K^+-treated sample	% Reduction
750	-	-	-
800	-	-	-
850	125	90	35
900	170	115	55
950	155	109	46
975	140	90	50
1000	120	87	43
1025	105	90	15
1050	130	93	37
1075	140	105	35
1100	145	90	55
1125	130	100	30
1150	100	87	13
1175	120	90	30
1200	125	80	45
1225	115	92	22
1250	130	93	27
1275	150	90	60
1300	150	110	40
1325	110	85	25
1350	150	103	47
1375	145	103	42
1400	140	100	40
1425	140	105	35
1450	105	94	11
1475	115	95	20

The results in Table 4 shows the high levels of swelling in the 17½" hole. The swelling percentage at 900 M. must be related to the problem of tight hole.
The test solution containing 25 PPB KCl, will indicate that a large concentration of K+ environment assisted with an encapsulating polymer, will provide inhibition.
The inhibitor concentration levels will be dependant on the drilling rate and the nature of formation being drilled, due to the fact that this is a dynamic situation where newly drilled cuttings continously are being injected to the circulating drilling fluid. In the dynamic drilling situation levels of inhibitors should be maintained, to ensure that the inhibition proceeds at the desired rate.

DISCUSSION

The results from the bulk sample (74μ grind) show low levels of smectite averaging 5.2%. This fraction is mainly comprised of the swelling clay, montmorillonite. Some montmorillonite may also be present in the Blanskikt or mixed layer fractions; this averaged 8.7% of the bulk sample. However, about 45% of the bulk fraction is made up of non-clay minerals.

The 2μ grind is designed to exclude the non-clay minerals and thus give a more realistic figure of the clay constituents. Here we see that below 900m, smectite and mixed layer minerals make up 80% of the clay fraction. The Thite/muskovite fraction is greatly reduced, indicating that it is largely made up of muskovite (mica), which fits in well with the geological data.

The accompanying graph has been prepared to check the correlation between the XRD data and the methylene blue index or shale factor. The shale factors determined by the logging crews at the rigsite, are included together with the hole caliper and lithology.

No clear correlation can be made between the clay content, shale hydration and shale factors, although there is some evidence that the mixed layer clays below 1275m are more bentonitic. This is disappointing because the laboratory analysis were carried out on the same samples which were all prepared using identical techniques.

However, XRD is only a semi-quantitative method. With the 74μ grind the larger non-clay minerals tend to shadow the reflections of the smaller clay particles, while with the 2μ grind there is a possibility that they will be some enrichment of the smectite fraction as these are the smallest particles, though the 2μ grind is now generally accepted as being the clay fraction. In addition, there are errors in relating the size of the deflections to the amount present in the sample. This is true to a much lesser extent with the 2μ fraction, when the absence of other minerals make calibration much simpler.
The differences between the field and laboratory shale factor results are probably best explained by different washing procedures. If the sample is washed very virgorously, then the finer, fragile hydrateable montmorillonite clays tend to get washed away leaving the sample artificially enriched with less reactive clays.
Values from the rig tended to be 2-3 times greater than those from the laboratory for samples caught from the same depths.

Another reason why the [illegible] fraction in the bulk sample is so low, is that the cuttings with the highest smectite concentrations were dispersed into the mud before they reached the shakers.
The following calculations were made to see whether an estimate of this could be made from the cation exchange capacity measurements on the mud which rose dramatically in this section, despite a large amount of dilution.

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e.g. 20.3.80

Amount drilled 834 - 1025 m
Volume drilled at 0.1522 m^3/m = 29.6 m^3
Assume shale density of 2.2 S.G. = 63.9 m/t

Volumes :		
	Start (total):	1776 bbls.
	Mud in circulation :	1366 "
	Water added :	560 "
	Final volume :	2206 "
	Initial CEC :	15 ppb.
	Final CEC :	20 "

Thus the mud in circulation was increased by 5 ppb to 20 ppb.
Amount of bentonite required : 1366 x 5 lb
= 6830 lb
= 3.09 m/t

Amount of bentonite required to raise the concentration to 20 ppb in the water added is : 559 x 20 lb
= 11180 lb
= 5.07 m/t

Assume that $\frac{4}{5}$ of the increase in CEC readings is due to smectite

Total smectite in mud : $\frac{4(5.07 + 3.09)}{5}$

= 6.53 m/t

% of bulk sample containing smectite in mud = $\frac{6.53}{63.9}$

= 10%

Similar calculations carried out on intervals 1025 - 1176 m and 1176 - 1425 m showed that at least 11% of the total amount of rock drilled was smectite dispersed into the mud.

CONCLUSION

In view of the methodological problems discussed above, we feel that this approach lends itself to qualitative rather than quantitative analysis. Thus no attempt has been made to correlate these results directly with the more troublesome sections of the hole.

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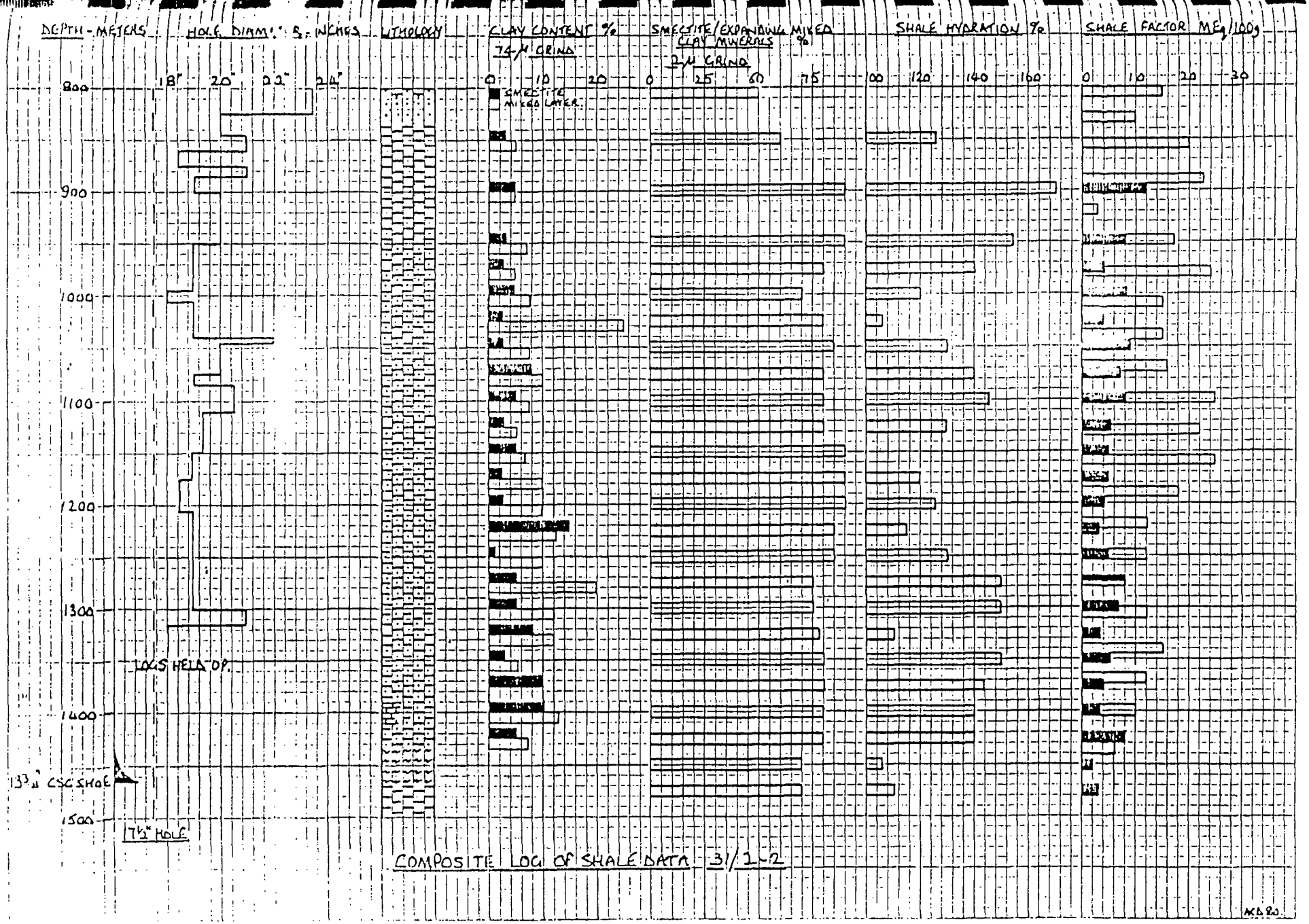
The results from the clay fraction (20μ) clearly show that smectite is the predominant clay mineral and this confirms the feeling on the rig, that the section was a typical gumbo shale. In view of this, the more inhibitive KCL-Polymer mud system should substantially improve hole conditions generally, but should not be relied upon to stop the trouble caused by mud rings.



COMPOSITE LOG OF SHALE DATA 31/2-2