Mud properties

The following mud properties, from both the drilling and testing phase have been taken from the DIMS report. Included, also, is the drilling fluid cost and product usage.

NORSK AGIP

Mud Summary Report

Legal Well Name: 2/5-11
Common Well Name: 2/5-11
Event Name: ORIG DRILLING
Contractor Name: TRANSOCEAN
Rig Name: TRANSOCEAN NORDIC

Start: 8/30/97
Rig Release: 11/23/97
Rig Number: 09

Spud Date: 9/6/97
End: 11/23/97

Day	Depth (m)	Hole Sz. (in.)	Mud Type	MW (g/cm³)	Visc. (s/L)	PV (mPa*s)	YP (Pa)	Gels 10s/10m/30m (Pa)	API WL (mL)	HTHP WL (mL)	HTHP T (°C)	pH	Cl- (mg/L)	Sand (%)	TS (%)	LGS (kg/m³)	MBT (kg/m³)	Oil (%)	Tot. Hard. (mg/L)	Tot. Vol. (m³)
5			GEL/DW	1.04	97	12	12	17 / 19 / 0				8.80								219.0
6			GEL/DW	1.04	130	14	13	21 / 23 / 0				8.80								231.0
7			GEL/DW	1.04	130	14	13	21 / 23 / 0				8.80								231.0
8	198.00	36.000	GEL/DW	1.04	130	14	13	21 / 23 / 0				8.80								408.0
9	220.00	36.000	GEL/DW	1.20	140	14	14	25 / 28 / 0				9.10								809.0
10	230.00	12.250	SW/GEL	1.03	44	8	4	7 / 7 / 0				8.60								328.0
11	254.00	26.000	SW/GEL	1.03	53	6	9	11 / 13 / 0				8.70								553.0
12	283.00	26.000	DW/GEL	1.03	120	10	15	25 / 28 / 0				9.10								500.0
13	650.00	12.250	DW PHB	1.19	50	6	10	10 / 12 / 0				10.90								436.0
14	775.00	26.000	SW-GEL	1.19	38	5	8	8 / 8 / 0				9.60								755.0
15	775.00	26.000	SW-GEL	1.14	35	6	5	10 / 11 / 0				9.10								879.0
16	775.00	26.000	SW-GEL	1.14	33	5	5	7 / 8 / 0				9.00								122.7
17	775.00	26.000	SW-GEL	1.14	30	5	4	1 / 2 / 0				9.20								671.0
18	775.00	26.000	SW-GEL	1.14	65	9	15	15 / 16 / 0				9.10								1,117.0
19	775.00	26.000	SW-GEL	1.14	50	7	9	7 / 7 / 0				9.00								583.0
20	775.00	26.000	SW-GEL	1.14	50	7	9	7 / 7 / 0				9.00								675.0
21	780.00	17.500	KCL/Polymer	1.28	64	21	9	1 / 2 / 0	3.8			9.80	43,500		11.0	21			600	604.0
22	1,244.00	17.500	KCL/Polymer	1.40	56	22	7	1 / 1 / 0	4.0			8.10	50,000	0.75	16.0	60	64.0		1,440	385.0
24	2,020.00	17.500	KCL/Polymer	1.50	70	33	12	7 / 20 / 0	4.4			7.50	64,000	0.85	21.5	176	80.0		1,600	656.0
25	2,020.00	17.500	KCL/Polymer	1.55	105	32	13	9 / 22 / 0	4.6			7.70	63,000	0.75	22.0	124	80.0		1,600	629.0
26	2,020.00	17.500	KCL/Polymer	1.55	95	32	13	9 / 22 / 0	4.6			7.80	63,000	0.75	22.0	124	80.0		1,600	644.0
27	2,020.00	17.500	KCL/SW	1.59	51	35	9	2 / 2 / 0	2.4			7.90	75,000			5			1,260	354.0
28	2,020.00	17.500	KCL/SW	1.55	95	32	13	9 / 22 / 0	4.6			7.80	63,000	0.75		124	80.0		1,600	374.0
29	2,168.00	12.250	KCl/PAC/Glycol	1.65	62	38	13	2 / 5 / 0	3.4	16.6	220	9.20	66,000	0.75	24.5	88	70.0		1,660	432.0
30	2,550.00	12.250	KCl/PAC/Glycol	1.69	69	49	11	3 / 11 / 0	3.2	14.2		8.20	68,000	1.00	26.0	99	85.0		1,420	489.0
31	2,791.00	12.250	KCl/PAC/Glycol	1.70	71	50	12	3 / 12 / 0	3.4	14.0	110	8.00	73,000	0.75	26.0	107	80.0		1,520	564.0
32	2,998.00	12.250	KCl/PAC/Glycol	1.69	66	49	10	2 / 9 / 0	3.4	12.6	110	7.80	74,000	0.50	26.5	113	72.0		1,520	698.0
33	3,120.00	12.250	KCl/PAC/Glycol	1.70	63	48	9	2 / 8 / 0	2.8	9.8	110	7.90	73,000	0.75	27.0	126	72.0		1,500	545.0
34	3,225.00	12.250	KCl/PAC/Glycol	1.69	62	46	9	2 / 10 / 0	2.6	9.8	110	7.60	1,260	0.75	27.0	142	75.0		1,420	534.0
35	3,225.00	12.250	KCl/PAC/Glycol	1.70	68	49	9	2 / 9 / 0	2.6	9.6	110	7.80	74,000	0.75	27.0	123	70.0		1,420	605.0
36	3,225.00	12.250	KCl/PAC/Glycol	1.70	60	43	9	2 / 9 / 0	2.8	9.6	110	7.70	73,500	0.75	27.0	124	70.0		1,460	475.0

NORSK AGIP

Mud Summary Report

Legal Well Name: 2/5-11
Common Well Name: 2/5-11
Event Name: ORIG DRILLING
Contractor Name: TRANSOCEAN
Rig Name: TRANSOCEAN NORDIC

Start: 8/30/97
Rig Release: 11/23/97
Rig Number: 09

Spud Date: 9/6/97
End: 11/23/97

Day	Depth (m)	Hole Sz. (in.)	Mud Type	MW (g/cm³)	Visc. (s/L)	PV (mPa*s)	YP (Pa)	Gels 10s/10m/30m (Pa)	API WL (mL)	HTHP WL (mL)	HTHP T (°C)	pH	Cl- (mg/L)	Sand (%)	TS (%)	LGS (kg/m³)	MBT (kg/m³)	Oil (%)	Tot. Hard. (mg/L)	Tot. Vol. (m³)
37	3,225.00	12.250	KCl/PAC/Glycol	1.70	60	43	9	2 / 9 / 0	2.8	9.6	110	7.70	73,500	0.75	27.0	123	70.0		1,460	893.0
38	3,225.00	12.250	KCl/PAC/Glycol	1.70	60	43	9	2 / 9 / 0	2.8	9.6	110	7.70	73,500	0.75	27.0	123	70.0		1,460	414.0
39	3,229.00	8.500	FW/PAC/GLYCOL	1.60	67	56	10	3 / 4 / 0	2.6	70.4	120	8.50	5,500	0.25	19.5	16			600	561.0
40	3,256.00	8.500	FW/PAC/GLYCOL	1.57	61	48	11	2 / 3 / 0	2.2	7.0	120	8.30	5,000	0.50	18.5	13	5.0		480	303.0
41	3,312.00	8.500	FW/PAC/GLYCOL	1.55	52	30	12	2 / 3 / 0	2.6	7.6	120	8.30	5,000	0.75	18.0	20	5.0		480	308.0
42	3,330.00	8.500	PAC	1.55	57	30	11	1 / 3 / 0	2.3	7.6			4,500	0.70	18.5	47	3.0			306.0
43	3,393.00	8.500	PAC	1.55	49	29	11	1 / 2 / 0	2.2	7.4			4,800	0.50	18.0	21	3.0			319.0
44	3,419.00	8.500	PAC	1.55	51	30	11	1 / 2 / 0	2.4	6.4			4,700	0.50	18.0	21	3.0			324.0
45	3,464.00	8.500	PAC	1.54	56	32	11	1 / 2 / 0	2.3	6.6	75	9.30	4,600	0.50	17.5	11	3.0		280	335.0
46	3,550.00	8.500	PAC-GLYCOL	1.54	52	29	17	2 / 3 / 0	2.3	9.0	121	9.00	4,300	0.50	18.0	38	3.0			336.0
47	3,550.00	8.500	PAC-GLYCOL	1.54	63	31	17	2 / 3 / 0	2.4	8.8	121	9.20	4,200	0.50	18.0	38	3.0			327.0
48	3,550.00	8.500	PAC-GLYCOL	1.54	66	32	16	4 / 5 / 0	2.0	8.8	121	9.00	4,400	0.30	18.5	64	2.0		160	325.0
49	3,550.00	8.500	PAC-GLYCOL	1.52	57	34	14	4 / 5 / 0	2.0	9.0	121	9.00	4,500	0.30	17.6	44	2.0		160	327.0
50	3,550.00	8.500	PAC-GLYCOL	1.52	60	35	13	5 / 6 / 0	2.0	9.2	121	8.90	4,500	0.30	18.5	96	2.0		200	326.0
51	3,550.00	8.500	PAC-GLYCOL	1.52	63	34	14	5 / 6 / 0	2.1	9.2	121	8.90	4,500	0.30	18.5	96	2.0		280	318.0
52	3,550.00	12.250	PAC-GLYCOL	1.51	62	29	10	3 / 3 / 0	2.8		121	8.60	5,400	0.25	18.0	85	2.0		420	452.0
23	1,591.00	17.500	KCL/Polymer	1.45	72	27	12	7 / 17 / 0	5.5			7.70	54,000	0.75	20.0	199	92.0		1,760	616.0

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OFFSHORE NORWAY

PL 067 - WELL 2/5-11

Report title:

Well 2/5-11 - Well Test Report

Abstract:

The report contains the interpretation of the 2 tests performed on well 2/5-11:

DST 1	3363 - 3381 m
DST 2	3289 - 3329 m (before/after acid)

Note:

Date: November 25, 1997	**Report no.:** 971101	
Prepared by:	**Verified by:**	**Approved by:**
E. Beretta (Agip S.p.A)	T. .Lorentzen-Styr	F. Genovesi
L. Andrian (Agip S.p.A)	E. Beretta (Agip S.p.A)	F. Conticini

The tests were performed inside a 7" liner by using a 3" 1/2 DST string.

During DST 2 an acid-job was also performed to improve the reservoir production.

Objectives of these tests are both to define the nature and amount of produced formation fluids and estimate the main reservoir properties such as reservoir pressure, permeability and formation damage and finally to verify the existence of potential boundaries (i.e. facies variations/faults) if any.

In particular the improvement due to acid - job was also quantified.

2) CONCLUSIONS

⇒ The main Dst 1 results are the following :

- **Reservoir model** : **Homogeneous - Infinite**
- **Formation pressure** : **P_{st} = 462.4 kg/cm^2 @ 3297 mssl**
- **Total transmissibility** : **$(kh/\mu)_t$ = 844 md m / cp**
- **Radial oil permeability** : **k_o = 6.6 md**
- **Well Skin factor** : **S_w = 10.7**

During the whole test a total of 3.8 m^3 of oil (38.7 ° API) were produced. The final BSW was close to 94 %. The formation deliverabilty was estimated through the total productivity index definition (in transient conditions) :

PI_{TOT} = 0.8 m^3/g / kg/cm^2 (Bottom Dp = 28 %)

⇒ The main Dst 2 results (**before Acid - Job**) are the following :

- **Reservoir model** : **Radial Composite - Infinite**
- **Formation pressure** : **P_{st} = 471.7 kg/cm^2 @ 3215 mssl**
- **Total transmissibility** : **$(kh/\mu)_t$ = 85 md m / cp (outer zone)**
- **Oil permeability** : **k_{OIL} = 1.6 md (outer zone)**
- **Well Skin** : **S_w = 3.2**

The total transmissibility in the outer zone was estimated 65% more with respect to the inner one and the interface radius was calculated 14 m far from wellbore.

During the whole test a total of 12.8 m^3 of oil (38.7 ° API) were produced. The final BSW was close to 45 %. The total productivity index definition (in transient conditions) was :

$$\mathbf{PI_{TOT} = 0.29\ m^3/g\ /\ kg/cm^2 \quad (Bottom\ Dp = 44\ \%)}$$

⇒ The main Dst 2 results (**After Acid - Job**) are the following :

- **Reservoir model** : **Infinite Conductivity Vertical Fracture**
- **Formation pressure** : P_{st} = **472.0 kg/cm² @ 3215 mssl**
- **Total transmissibility** : $(kh/\mu)_t$ = **115 md m / cp**
- **Oil permeability** : k_{OIL} = **0.9 md**
- **Well Skin** : S_w = **0**
- **Half - lenght fracture** : x_f = **17 m**

The generation of the vertical fracture is most likely due to the fact that during acid job injection in bullheading, the formation fracturation gradient was reached (0.2 kg/cm²/m).

During the whole test a total of 92 m^3 of oil (37.1 ° API) were produced. The final BSW was close to 80 %. The total productivity index definition was :

$$\mathbf{PI_{TOT} = 3.4\ m^3/g\ /\ kg/cm^2 \quad (Bottom\ Dp = 29\ \%)}$$

The actual well deliverability had been quantified 10 times more with respect to the productivity before acid treatment.

⇒ In both the tests, during the observed time, no faults and/or facies variations were detected. The reservoirs act as an infinte system.

⇒ The physical water parameters monitored during both the tests were clearly representative of formation water.

ENI S.p.A.
Divisione Agip

Eni

GEOCHEMICAL STUDY IN BLOCK 2/5 AREA
WELL 2/5-11 OILS UPDATE
(PL 067 Area - Norway)

B198 · 2118 - 1

Edited by: R.Galimberti
With the contribution of: T.Ricchiuto and R.Dellea

S.Donato Milanese, OCTOBER 1998

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LETTER OF TRANSMITTAL

PL.067, WELL 2/5-11.

Please find enclosed 1 report:

- GEOCHEMICAL STUDY IN BLOCK 2/5 AREA: WELL 2/5-11 OILS UPDATE.
  By: ENI SpA, Divisione Agip.
  October 1998.

Date: 3/12-98

Date: November 25, 1998

Received by: Tone Tangen

Gro Dahle
Norsk Agip A/S

One copy to be signed and returned

Introduction

In order to update the previous study on the PL067 area (Geochemical Study in Block 2/5 Area; AGIP-GEOC; November 1995) new oil samples coming from well 2/5-11 have been analysed.
New data have been integrated in the previous database and reinterpreted focusing our attention to the reservoir continuity aspect.

Oil database:

Well	Depth (ft)	GEOC n°	Test	%S	°API
2/4-A14R dir		1246		0.55	37.1
2/4-B10 dir		1244		0.50	36.0
2/4-B23R dir		1245		0.51	37.1
2/4-B9		1243		0.50	35.7
2/5-1	9981 10175	1236			39.2
2/5-2	10385 10442	1239			36.2
2/5-2	10824 10874	1241			37.8
2/5-3	10016 10057	1238			30.6
2/5-3	10238 10470	1240			37.4
2/5-4	10292 10400	1237			34.2
2/5-7		1242		0.39	37.8
2/5-11		1535	Test n°1	0.09	37.9
2/5-11		1536	Test n°2	0.09	38.9

Block 2/5 Study: Stable Isotopes Data

Well	OIL n°	Sat	Aro	Res
2/5-11	1535	-28.87	-27.46	-27.15
2/5-11	1536	-28.49	-27.64	-27.57
2/5-7	1242	-28.17	-27.50	-27.55
2/5-1	1236	-28.44	-27.52	-27.36
2/5-2	1239	-28.50	-27.72	-27.41
2/5-2	1241	-28.50	-27.50	-27.35
2/5-3	1238	-30.00	-28.87	-28.17
2/5-3	1240	-29.82	-28.68	-28.66
2/5-4	1237	-28.01	-27.15	-27.09
2/4-B-9	1243	-28.06	-27.22	-27.03
2/4-B-10	1244	-28.14	-27.42	-26.90
2/4-B-23R	1245	-27.92	-27.67	-26.62
2/4-A-14R	1246	-27.92	-27.50	-26.84

Block 2/5 Study:
GC and GC-MS Parameters

	Well	2/5-1	2/5-2	2/5-2	2/5-7	2/5-11	2/5-11
	OIL n°	1236	1239	1241	1242	1535	1536
GC	Pr/C17	0.64	0.63	0.57	0.55	0.65	0.62
parameters	Ph/C18	0.57	0.48	0.48	0.44	0.52	0.49
	PrPh	1.30	1.36	1.19	1.26	1.27	1.26
	Tri	0.31	0.24	0.16	0.13	0.12	0.13
	Tet	0.21	0.17	0.10	0.09	0.08	0.09
	Trit	1.50	1.44	1.60	1.50	1.59	1.52
	TsTm	2.03	1.89	1.62	1.79	1.68	1.67
	TNH	0.00	0.05	0.00	0.00	0.05	0.03
Terpanes	29/30	0.52	0.58	0.44	0.46	0.43	0.42
	29Ts	0.55	0.53	0.42	0.45	0.37	0.42
	C30*	0.35	0.34	0.36	0.30	0.26	0.30
	29Ts/ C30*	1.57	1.55	1.15	1.49	1.46	1.43
	Gam	0.00	0.00	0.00	0.00	0.00	0.00
	S/S+R	0.59	0.61	0.58	0.59	0.57	0.56
	31/30	0.75	0.83	0.89	0.91	0.92	0.94
	Steranes/Terpanes	0.62	0.90	1.71	1.25	1.40	1.36
Aromatics	MPI	0.74	0.70	0.71	0.75	0.63	0.71
	T/TM	1.00	1.00	1.00	1.00	0.68	0.58
	C29 S/S+R	0.51	0.52	0.52	0.54	0.52	0.53
	C29 abb/aaa+abb	0.66	0.68	0.63	0.62	0.61	0.61
	C29 Dia/ Reg+Dia	0.79	0.77	0.79	0.77	0.76	0.79
	C27%	26	25	25	27	27	29
Steranes	C28%	26	25	26	24	26	29
(MS-MS)	C29%	43	40	40	39	40	39
	C30%	5	10	10	9	7	3
	C27/ C29	0.74	0.70	0.63	0.71	0.77	0.76
	C30/ C29	0.23	0.25	0.25	0.26	0.20	0.07

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Block 2/5 Study:
GC and GC-MS Parameters

	Well	2/5-4	2/5-3	2/5-3	2/4-B-9	2/4-B-10	2/4-B23R	2/4-A-14R
	OIL NR	1237	1238	1240	1243	1244	1245	1246
GC	Pr/C17	0.63	0 48	0.41	0.47	0.44	0.49	0 43
parameters	Ph/C18	0.35	0.37	0.33	0.41	0.36	0.39	0.35
	PrPh	1.86	1.29	1.07	1.30	1.29	1.28	1.34
	Tri	0.05	0.22	0.28	0.05	0.05	0.05	0.05
	Tet	0.05	0.13	0.19	0.05	0.05	0.05	0.05
	Trit	1.04	1.65	1.49	1.17	1.00	1.15	1.00
	TsTm	0.92	1.77	1.67	1.50	1.68	1.37	1.48
	TNH	0.00	0.00	0.17	0.05	0.05	0.00	0.00
Terpanes	29/30	0.39	0.38	0.51	0.45	0.49	0.45	0 48
	29Ts	0.26	0.55	0.53	0.24	0.25	0.26	0.27
	C30*	0.15	0.50	0.49	0.09	0.10	0.10	0 12
	29Ts/ C30*	1.73	1.10	1.07	2.58	2.46	2.59	2.19
	Gam	0.00	0.00	0.00	0.05	0.05	0.00	0.05
	S/S+R	0.59	0.53	0.58	0.58	0.59	0.59	0.60
	31/30	0.92	0.97	1.04	0.73	0.75	0.83	0.78
	Steranes/Terpanes	2.89	1.00	0.63	3.83	3.20	5.28	3.80
Aromatics	MPI	0 52	0.72	0.56	0.66	0.68	0.69	0 68
	T/TM	0.55	1 10	1.10	0.66	0 68	0.63	0 65
	C29 S/S+R	0.54	0.56	0.53	0 48	0 44	0 43	0 47
	C29 abb/aaa+abb	0.54	0 62	0.65	0.52	0 48	0 47	0 48
	C29 Dia/ Reg+Dia	0.72	0.81	0.85	0.57	0 49	0 47	0 44
Steranes	C27%	24	21	23	29	26	23	21.37
(MS-MS)	C28%	27	27	29	25	26	26	22 01
	C29%	42	42	36	40	40	47	47.53
	C30%	6	10	12	6	8	5	9.09
	C27/ C29	0.66	0.57	0.73	0.81	0 67	0.55	0.51
	C30/ C29	0.18	0.24	0.31	0 19	0.27	0.21	0 26

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