Culverin 1

FINAL WELL REPORT

Prepared by

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CONTENTS

1.0 WELL DATA SUMMARY

(All depths are measured depths from rotary table (MDRT) unless otherwise specified.)

Well Name	: Culverin 1
Basin	: Gippsland
Permit	: VIC/P-56
Operator	: Nexus Energy
Drilling Rig	: Ocean Patriot
Well Classification	: Exploration
Surface Location	
Latitude	: 38°24'08.14"
Longitude	: 148°39'14.92"
Easting	: 644437.3mE
Northing	: 5748256.4mN
Depth Reference	: L.A.T. (Lowest Astronomical Tide)
Water Depth	: 585 m
Rotary Table	: 21.5 m
Rotary Table to Seabed	: 606.5 m
Casing Data	: (1) 762/508 mm (30"/20") casing shoe at 650 m : (2) 340 mm (13.375") casing shoe at 1511 m
Hole Size	: (1) 445 mm (17.5") + 914 mm (36") hole opener from 606.5 m to 650 m : (2) 445 mm (17.5") hole from 650 m to 1525 m : (3) 311 mm (12.25") hole from 1525m to 3758m
Mud Type	: (1) Seawater / Pre-Hydrated Gel Sweeps : (2) Seawater / Pre-Hydrated Gel Sweeps : (3) KCl / NaCl / PHPA / Glycol
Offset Wells	: Volador 1, Bignose 1
Proposed Total Depth	: 3612 mRT MD (3590 m TVD RT)
Actual Total Depth	: 3758mRT MD (3753.9m TVD RT)
Subsea Vertical Depth	: 3732.4m TVDSS
Date Rig on Contract	: 17:00 hours, 06th November 2005
Date Spudded	: 13:30 hours, 16th December 2005
Date TD Reached	: 24:00 hours, 06th January 2006
Date Rig Released	: 15:00 hours, 15th January 2006
Well Status	: Plugged & Abandoned

2.0 GENERAL INFORMATION

2.1 Executive Summary

The Culverin 1 well was located in Permit VIC/P56 in the offshore Gippsland Basin in the eastern part of the Central Deep. The well was located approximately 80km from land in south-eastern Victoria, and was drilled by the semi-submersible rig "Ocean Patriot". This permit is flanked by oil and gas fields: Basker/Manta/Gummy to the northeast, Flounder to the northwest, Cobia/Halibut/Fortescue to the west and Blackback to the south. The water depth in this location was 585 m.

The rig initially arrived on location on the 6th of November 2005 and started deploying anchors, however due to an anchor winch failure it was decided to take the rig to Eden for repairs and a hull survey.

After the rig returned to the Culverin 1 location for a second time on 13th December 2005, the anchors were run and the initial 914 mm (36") surface hole was spudded at 13:30 hours on the 16th of December 2005. Culverin 1 was drilled in 3 sections, with the first section being drilled from the sea floor at 606.5 m to 650 m. The 762/508 mm (30"/20") surface conductor was then run and set at 650 m.

Following this the 445 mm (17.5") hole was drilled riserless from 650 m to 1525 m using one bit, with returns to the sea floor. The 340 mm (13.375") casing was then run with the shoe set at 1511 m. The BOP stack was run on the marine riser and landed out on the wellhead and pressure tested.

The 311 mm (12.25") hole section was drilled from 1525 m to 3402 m with a downhole motor and PDC bit before the drilling rate deteriorated and the bit was pulled to surface. Another 311 mm (12.25") PDC bit was run in hole and drilling proceeded, once more with downhole motor, from 3402 m to 3571 m before a slow pump pressure loss was observed, suggesting a washout in the drillstring. The bit was pulled to surface once more, however, no washout in the pipe or bottom hole assembly was found. A new tricone bit and BHA, without motor but including an extra stabilizer, was run in hole. However, testing of the MWD tools at 2500 m depth showed no communication, so this string was also pulled to surface. The stabilizer was then removed from the BHA and the same bit run back to bottom. Drilling of the 311 mm (12.25") hole section then continued from 3571 m to a final depth of 3578 mTD. A communication failure occurred with the MWD tools while drilling at 3721 m. However this did not terminate the drilling.. TD was reached at 24:00 hours on 06th January 2006. This drilling string was pulled out of hole without problem.

Schlumberger Wireline were then rigged up and the following logs were then run at TD in 2 runs:

Run 1: PEX-HALS-DSI-GR
Run 2: VSI(4)-GR (ZVSP)

Cement plugs were then run and set to abandon the well and the riser was pulled with BOPs. The rig was released at 15:00 hours on 15th January 2006. Geoservices provided a full mudlogging service from spud to TD during this well. This service included 'Reserval' gas monitoring.

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

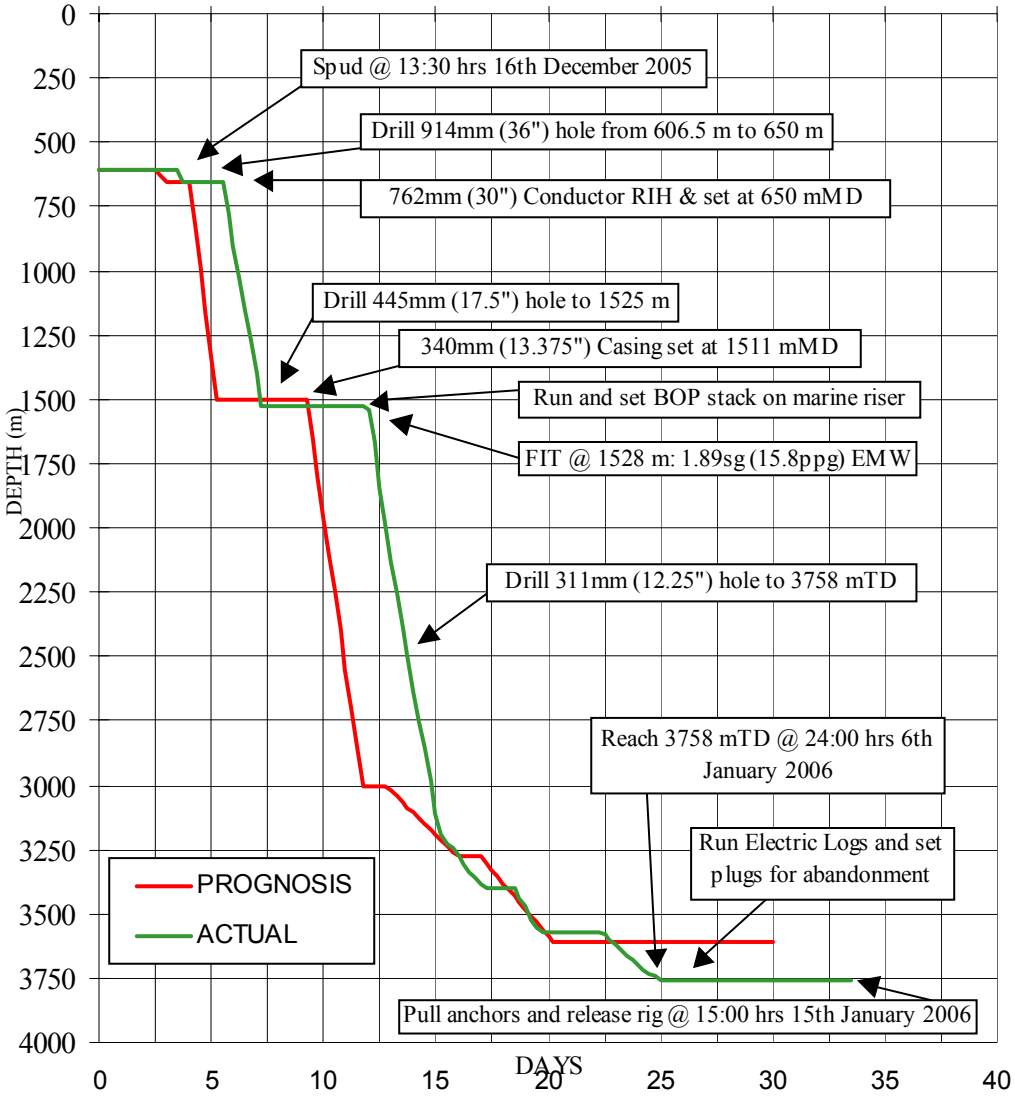
2.2 Geoservices Personnel

ALS Engineers	: Adderley, David
	: Dunn, Alan
	: Platt, Tom
	: Prosser, Scott
Mudloggers	: Elliott, Noel
	: Makhad, Farhad
	: Baretto, Melric
Sample Catchers	: Deeprose, Rebecca
	: Djukanovic, Alex
	: Munro, Gareth
	: Lowndes, Andrew

2.3 Contractor Information

Drilling	: Diamond Offshore General Company (DOGC)
Rig name	: Ocean Patriot
Rig type	: Semi-Submersible
Mudlogging	: Overseas Oilfield Services S.A.
Mud engineering	: M.I. Swaco
MWD	: Halliburton, Sperry Sun
Wireline logging	: Schlumberger
Cementing	: Dowell Schlumberger
Well head completion	: Cameron
ROV	: Fugro
Casing	: Weatherford
Work boats	: “Far Grip”, “Pacific Wrangler”
Helicopters	: Bristows
Catering	: E.S.S.

2.4 Days versus Depth Progress Chart



2.5 Sample Collection Summary

Five sets of washed and dried samples and one set of samplex trays were collected during Culverin 1, from 1525 m to TD at 3578 m.

Sample intervals: 1525 m to 2820 m, 30 m
2820 m to 3150 m, 10 m
3150 m to 3578 m, 5 m.

Sample distribution was as follows:

Recipient	Washed and Dried 200 g	Samplex Trays (box)
Nexus Energy	1	1
Geoscience Australia	1	
Victorian DPI	1	
KNOC	1	
Seoul City Gas	1	

Mud samples: 1528m, 2845m, 3758m.

3.0 GEOLOGICAL INFORMATION

3.1 Lithology and Show Summary

From spud to 1525 m returns were to the sea floor.

Interval (m)	ROP (Avg)	Lithology Description ARGILLACEOUS CALCILUTITE with trace DOLOMITE stringers					
1525 – 1530	19.0	ARGILLACEOUS CALCILUTITE (100%): light to medium grey, occasionally olive grey, soft to rarely firm, amorphous to very rarely sub-blocky, trace arenaceous grains, common forams, common fossil fragments, strongly calcareous, trace pyrite, trace black carbonaceous specks. DOLOMITE (Nil-Trace): light brown to yellowish-brown, hard to very hard, conchoidal fracture, trace forams visible within matrix, reacts weakly to acid when crushed.					
Gas averages	**T Gas : (units)**	18.0	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			3600	3590	10	0	0	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	12.6	150	5.01	771	1686

Interval (m)	ROP (Avg)	Lithology Description **Massive Argillaceous Calcilutite**						
1530-1620	24.0	ARGILLACEOUS CALCILUTITE (100%): light olive grey, light grey, rare medium light grey, very soft to soft, trace calcareous sand grains, sub-blocky to amorphous, trace carbonaceous specks, trace very fine pyrite patches, trace micro fossils (forams, echinoids), gradational to very fine to fine Calcarenite.						
Gas averages	**T Gas : (units)**	18.0	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			3600	3590	10	0	0	0
Show Details	No Hydrocarbon Shows.							
Drilling Parameters (Avg)	**WOB (Klbs)**	**RPM**	**TRQ**	**FLOW (gpm)**	**SPP (psi)**			
	13.1	200	6.52	782	1845			

Interval (m)	ROP (Avg)	Lithology Description **Dominantly Argillaceous Calcilutite with minor Calcarenite**						
1620-1770	44.0	ARGILLACEOUS CALCILUTITE (60-100%): light olive grey to light grey, rare medium light grey, very soft to soft, trace calcareous sand grains, sub-blocky to amorphous, trace carbonaceous specks, trace very fine pyrite patches, trace micro-fossils (forams, echinoids). CALCARENITE (nil-40%): light olive grey, soft to firm, sub-blocky, very fine to fine grained, moderately well sorted, rounded, common to abundant calcareous argillaceous matrix, poor visual porosity.						
Gas averages	**T Gas : (units)**	17.0	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			3400	3360	10	0	0	0
Show Details	No Hydrocarbon Shows.							
Drilling Parameters (Avg)	**WOB (Klbs)**	**RPM**	**TRQ**	**FLOW (gpm)**	**SPP (psi)**			
	14.8	224	8.05	885	2427			

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Massive Calcilutite with trace Dolomite**					
1770-1980	30.0	CALCILUTITE (100%): light olive-grey to light grey, occasionally pale yellowish-grey, soft to very soft, rarely firm, amorphous to sub-blocky, common very fine to fine calcareous silt and sand grains, trace carbonaceous specks, trace very fine pyrite, trace microfossils, gradational in part to very fine-grained Calcarenite and Calcisiltite. DOLOMITE (Nil-Trace): light brown to yellowish-brown, hard to very hard, conchoidal fracture, reacts weakly to acid when crushed.					
Gas averages	**T Gas : (units)**	18.2	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			3640	3560	20	10	0	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	12.6	240	7.95	893	2546

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Massive Calcilutite with trace Dolomite**						
1980-2010	27.0	CALCILUTITE (100%): light olive-grey to light grey, occasionally pale yellowish-grey, soft to very soft, rarely firm, amorphous to sub-blocky, common very fine to fine calcareous silt and sand grains, trace carbonaceous specks, trace very fine pyrite, trace microfossils, gradational in part to very fine-grained Calcarenite and Calcisiltite. DOLOMITE (Nil-Trace): light brown to yellowish-brown, hard to very hard, conchoidal fracture, reacts weakly to acid when crushed.						
Gas averages	**T Gas : (units)**	16.0	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			3200	3100	30	10	0	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	10.1	256	7.81	894	2641

Interval (m)	ROP (Avg)	Lithology Description **Massive Calcilutite**						
2010-2130	31.0	CALCILUTITE (100%): light to medium greenish-grey, commonly olive grey, occasionally pale yellowish-grey, soft to very soft, rarely firm, amorphous to sub-blocky, common very fine to fine calcareous silt grains, trace carbonaceous specks, trace very fine pyrite, trace microfossils, gradational in part to very fine Calcisiltite, trace splintery light brown dolomite (?) fragments.						
Gas averages	**T Gas : (units)**	29.3	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			5860	5790	20	10	0	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	8.8	257	7.47	893	2586

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Massive Calcilutite becoming more silty with depth**						
2130 – 2190	26.0	CALCLUTITE (100%): light olive grey, occasionally light brownish grey, rare medium grey patches, very soft to rarely firm, sub-blocky to amorphous, common calcareous silt and very fine calcareous sand, trace carbonaceous specks, trace microfossils, trace very fine pyrite associated with organic matter. Gradational in part to CALCISILTITE.						
Gas averages	**T Gas : (units)**	23.0	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			4600	4350	23	18	30	0
Show Details	No Hydrocarbon Shows.							
Drilling Parameters (Avg)	**WOB (Klbs)**	**RPM**	**TRQ**	**FLOW (gpm)**	**SPP (psi)**			
	12.2	260	7.78	896	2761			

Interval (m)	ROP (Avg)	Lithology Description **Dominantly Calcilutite with minor Calcisiltite**						
2190 – 2340	24.0	CALCLUTITE (80-100%): light olive grey, occasionally light brownish grey, rare medium grey patches, very soft to rarely firm, sub-blocky to amorphous, common calcareous silt and very fine calcareous sand, trace carbonaceous specks, trace microfossils, trace very fine pyrite. CALCISILTITE (Nil-20%): olive grey, brownish grey, soft to firm, friable in part, sub-blocky, trace calcareous sand, trace carbonaceous specks.						
Gas averages	**T Gas : (units)**	18.0	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			3600	3500	13	10	8	0
Show Details	No Hydrocarbon Shows.							
Drilling Parameters (Avg)	**WOB (Klbs)**	**RPM**	**TRQ**	**FLOW (gpm)**	**SPP (psi)**			
	13.5	258	8.37	872	2772			

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Dominantly Argillaceous Calcilutite with minor Calcisiltite and Calcarenite with rare fine glauconite grains**
2340 - 2508	29.0	ARGILLACEOUS CALCLUTITE (70-100%): light brownish grey, occasionally light grey, rare medium grey patches, very soft to rarely firm, sub-blocky to amorphous, common calcareous silt and very fine calcareous sand, trace carbonaceous specks, trace microfossils, trace very fine glauconite grains, trace very fine pyrite, 15% clay content. CALCISILTITE (Nil-20%): olive grey, brownish grey, soft to firm, friable in part, sub-blocky, trace calcareous sand, trace carbonaceous specks. CALCARENITE (Nil-30%): light brownish-grey, firm to moderately hard, sub-blocky, very fine to fine grained, moderately well sorted, angular grains, common to abundant calcareous argillaceous matrix, common fine glauconite grains, poor visual porosity.

Gas averages	T Gas : (units)	15.0	Composition (ppm)	C1	C2	C3	C4	C5
			3000	2905	10	9	10	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	16.0	259	8.04	889	2975

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Massive Calcareous Claystone**					
2508 - 2640	50.0	CALCAREOUS CLAYSTONE (100%): light to medium grey, soft, sub-blocky to blocky, trace very fine pyritic patches, occasional medium grey silty patches, rare carbonaceous specks.					
Gas averages	**T Gas : (units)**	6.0	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			1200	950	12	10	43	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	14.0	258	7.81	894	3236

Interval (m)	ROP (Avg)	Lithology Description **Calcareous Claystone with minor thin Calcilutite beds trace Dolomite and Sandstone at the base of the section**					
2640 – 2730	51.0	CALCAREOUS CLAYSTONE (50-90%): light grey, soft, sub-blocky to blocky, trace very fine pyritic patches, rare carbonaceous specks, trace very fine glauconite, homogenous. CALCILUTITE (10-50%): olive grey, firm, brittle in part, blocky, cryptocrystalline, trace calcareous silt and rare to common very fine calcareous sand grains, rare dark lithic grains, trace disseminated glauconite, trace very fine pyrite, gradational to CALCARENITE. DOLOMITE (Trace): orange brown, firm, brittle, blocky, common angular & splintery, cryptocrystalline, slightly argillaceous in part. SANDSTONE (Trace): clear to white, loose to soft aggregates, medium to rarely coarse, well sorted, sub-angular, high sphericity, minor white argillaceous matrix, trace glauconite, fair inferred porosity, no hydrocarbon shows.					
Gas averages	**T Gas : (units)**	7.0	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			1400	1234	15	20	53	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	15.0	265	6.86	897	3342

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1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Massive Argillaceous Calcilutite grading into Claystone**						
2730-2824	17.4	ARGILLACEOUS CALCILUTITE (Trace-100%): light olive grey, occasionally medium light grey, very soft – soft, sub-blocky, homogenous, trace glauconite, trace very fine disseminated pyrite. CLAYSTONE (Trace-100%): light olive grey, occasionally medium light grey, very soft – soft, sub-blocky, homogenous, trace calcareous silt and very fine sand in part, trace glauconite, trace very fine disseminated pyrite.						
Gas averages	**T Gas : (units)**	8.5	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			1700	1358	19	21	61	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	16.5	255	5.93	894	3387

Interval (m)	ROP (Avg)	Lithology Description **Massive Siltstone**						
2824-2836	46.4	SILTSTONE (100%): light brown to brownish-grey, soft to firm, occasionally very amorphous and reddish brown, generally massive to sub-blocky, common, glauconite grains, trace mica and black carbonaceous specks, trace pyrite, grading into fine sandstone.						
Gas averages	**T Gas : (units)**	6.4	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			1280	1013	45	27	17	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	9.8	265	8.37	895	3543

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description
		Massive Sandstone
2836-2844	50.0	SANDSTONE (100%): clear to translucent, loose, very fine to very coarse, very poorly sorted, sub-angular to sub-rounded grains, trace glauconite, trace pyrite, trace argillaceous matrix, very good inferred porosity, no fluorescence.

Gas averages	T Gas : (units)		Composition (ppm)	C1	C2	C3	C4	C5
		8.5						
			1700	1297	55	30	55	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	10.8	263	8.82	889	3516

Interval (m)	ROP (Avg)	Lithology Description
		Interbedded Sandstone and Argillaceous Siltstone and Siltstone with trace Claystone
2844-2930	33.0	SANDSTONE (10-90%): clear to translucent, loose, very fine to medium, mainly fine, very poorly sorted, sub-angular to rounded grains, very rare glauconite, common pyrite, common white amorphous argillaceous matrix inferred, poor to moderate inferred visual porosity, no fluorescence. ARGILLACEOUS SILTSTONE (0-80%): light grey to white, very soft to friable, occasionally firm, common loose grains of quartz, trace mica and black carbonaceous specks, common pyrite, grading into fine sandstone. SILTSTONE (10-40%): light grey to white, soft to friable, occasionally firm, common loose grains, trace mica and black carbonaceous specks, common argillaceous matrix, common pyrite, grading into fine sandstone. CLAYSTONE (trace): light grey, very soft to soft, trace mica & carbonaceous specks, common pyrite, grading into fine siltstone.

Gas averages	T Gas : (units)		Composition (ppm)	C1	C2	C3	C4	C5
		8.5						
			1700	882	64	76	111	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	10.1	260	8.06	901	3474

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Massive Claystone grading into Silty Claystone with depth**					
2930-2960	29.1	CLAYSTONE (0-100%): light grey, very soft to soft, amorphous to sub-blocky, trace mica and common black carbonaceous specks, non-calcareous, trace fine rounded-angular quartz silt, common pyrite, grading into silty claystone in part. SILTY CLAYSTONE (0-100%): light to medium grey, occasionally brown and firmer, very soft to firm in part, amorphous to dispersive, trace mica and common black carbonaceous specks, weakly calcareous in parts (may be cavings?), common pyrite, trace green glauconite grains and greenish stain on some fragments.					
Gas averages	**T Gas : (units)**	5.5	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			1100	672	60	42	53	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	12.9	256	8.08	873	3452

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description Silty Claystone with trace Sandstone and very rare Carbonaceous Claystone
2960-2975	37.5	SILTY CLAYSTONE (90-100%): light to medium grey, very soft, amorphous to dispersive, trace mica and common black carbonaceous specks, common pyrite, calcareous in part, trace light brown calcite/dolomite-cemented fragments, trace pyrite, trace glauconite. SANDSTONE (0-10%): clear to translucent, occasionally yellow, loose, very fine to medium grained, mainly fine grained, poorly sorted, sub-angular to rounded grains, common pyrite, moderate inferred porosity, common argillaceous matrix no fluorescence. CARBONACEOUS CLAYSTONE (Trace): black to medium grey, firm to moderately hard, sub-blocky to blocky, laminated into dark and light coloured layers in part, grading into silty claystone. (Thin 0.5m thick layer noted on LWD logs at 2972.5 mMDRT associated with elevated torque during drilling).

Gas averages	T Gas : (units)	5.3	Composition (ppm)	C1	C2	C3	C4	C5
			1060	543	47	32	83	0

Show Details	No Hydrocarbon Shows.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	11.3	255	8.59	864	3415

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description
		Massive Sandstone with very minor Claystone interbeds
2975-3078	56.0	SANDSTONE (100%): clear to translucent, occasionally yellow and white, loose, very fine to very coarse grained, mainly medium grained, very poorly sorted, sub-angular to rounded grains, common pyrite, very good inferred porosity, trace argillaceous matrix inferred, no fluorescence. CLAYSTONE (Trace): light to medium grey, very soft to soft, amorphous to dispersive, trace mica and black carbonaceous specks.

Gas averages	T Gas : (units)	3.7	Composition (ppm)	C1	C2	C3	C4	C5
			740	483	38	26	29	22

Show Details	No Hydrocarbon Shows.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	6.8	250	9.11	851	3389

Interval (m)	ROP (Avg)	Lithology Description
		Sandstone and Claystone
3078 – 3103	37.0	SANDSTONE (80%): clear to translucent, medium to very coarse, sub angular to well rounded, hi-sphericity, moderately sorted, trace pyrite cement and nodules, very good porosity, no fluorescence. CLAYSTONE (20%): light grey, brownish grey, very soft, sub-blocky to dominantly amorphous, carbonaceous specks, very silty in part, pyritic in part, gradational to Argillaceous Siltstone.

Gas averages	T Gas : (units)	4.2	Composition (ppm)	C1	C2	C3	C4	C5
			840	465	49	28	28	21

Show Details	No Hydrocarbon Shows.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	10.1	255	8.90	888	3643

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1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description
		Massive Sandstone with minor Claystone (probably cavings) at the top of the section.
3103 – 3115	34.0	SANDSTONE (90-100%): clear, rare yellow / brown grains, medium to very coarse, dominantly coarse, sub-angular to well rounded, hi-sphericity, well sorted, trace pyrite cement, trace strong siliceous cement, very good inferred porosity, no fluorescence. CLAYSTONE (0-10%): light grey, brownish grey, very soft, sub-blocky to dominantly amorphous, arenaceous in part, carbonaceous specks, very silty in part, pyritic in part, gradational to Argillaceous Siltstone.

Gas averages	T Gas : (units)		Composition (ppm)	C1	C2	C3	C4	C5
		4.4						
			880	451	40	28	43	21
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	5.8	262	8.32	893	3668

Interval (m)	ROP (Avg)	Lithology Description
		Massive Sandstone with minor Argillaceous Siltstone (Sandstone had strong pyritic cement from 3146 – 3149 mMDRT)
3115 – 3158	36.0	SANDSTONE (95-100%): clear to light grey, loose to very hard aggregates, medium to very coarse, poorly sorted, occasional very hard pyrite cement, good inferred porosity in loose component, poor visual porosity in aggregates, no fluorescence. ARGILLACEOUS SILTSTONE (0-5%): brownish grey, very soft, amorphous, trace carbonaceous specks, micro mica.

Gas averages	T Gas : (units)		Composition (ppm)	C1	C2	C3	C4	C5
		3.7						
			740	440	41	27	33	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	8.5	258	9.16	860	3542

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1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Dominantly Siltstone with Sandstone**					
3158-3185	31.0	ARGILLACEOUS SILTSTONE (30-70%): brownish grey to light brownish grey, occasionally light grey, very soft to soft, rarely friable, sub-blocky to amorphous, occasionally sub-fissile, very carbonaceous in part, carbonaceous laminae, micro-mica, trace fine pyrite. SANDSTONE (30-70%): clear to translucent, loose, fine to very coarse, poorly sorted, sub-angular to rounded, common fractured grains, trace pyrite cement, very good inferred porosity.					
Gas averages	**T Gas : (units)**	6.0	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			1200	647	108	50	46	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	16.4	256	9.92	851	3654

Interval (m)	ROP (Avg)	Lithology Description **Dominantly massive Sandstone with minor Argillaceous Siltstone**					
3185 – 3210	14.0	SANDSTONE (40-80%): clear to translucent, medium to granular grained, poorly sorted, sub-angular to sub-rounded, moderate sphericity, occasional fractured grains, commonly pyrite cemented, possible traces of weak carbonate cement (calcite/dolomite?), very good inferred porosity, no fluorescence. ARGILLACEOUS SILTSTONE (20-60%): brownish grey to light brownish grey, rarely light grey, very soft to rarely firm, sub-blocky to amorphous, common carbonaceous specks and laminae, very argillaceous, trace pyrite, gradational to Argillaceous Siltstone.					
Gas averages	**T Gas : (units)**	5.1	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			1020	511	69	42	55	0
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	8.6	248	10.32	858	3602

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description Dominantly Argillaceous Siltstone, Siltstone with Interbedded Silty Claystone and Claystone and minor Sandstone
3210- 3275	7.8	ARGILLACEOUS SILTSTONE (55-95%): brownish grey to light brownish grey, light grey, very soft to rarely firm, sub-blocky to amorphous, common carbonaceous specks and laminae, very argillaceous, trace pyrite, gradational to Siltstone. SILTSTONE (0-30%): brownish grey to light brownish grey, argillaceous to arenaceous, very soft to friable, sub-fissile in part, common carbonaceous specks and laminations, occasional very fine pyrite. SILTY CLAYSTONE (5-15%): brownish grey to light brownish grey, occasionally light grey, very soft to rarely firm, sub-blocky to amorphous, common carbonaceous specks and laminae, hard dolomite/calcite fragments, trace pyrite, gradational to Argillaceous Siltstone. CLAYSTONE (0-90%): olive grey, light brownish grey, very soft, amorphous, slightly calcareous, trace carbonaceous grains, rare very fine disseminated pyrite. SANDSTONE (Trace-40%): clear to translucent, very fine grained, poorly sorted, sub-angular to sub-rounded, moderate sphericity, occasional fractured grains, trace pyrite cement, moderate inferred porosity, no fluorescence.

Gas averages	T Gas : (units)	4.7	Composition (ppm)	C1	C2	C3	C4	C5
			940	426	47	33	49	20

Show Details	No Hydrocarbon Shows.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	17.1	244	8.39	869	3588

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Sandstone with minor Siltstone and Claystone**
3275 - 3296	8.2	SANDSTONE (60-80%): clear to translucent, off white, loose to friable aggregates, fine to very coarse, dominantly medium to coarse, poorly sorted, sub-rounded to angular, trace to 50% white argillaceous matrix, trace chlorite, trace lithic grains, fair to good inferred porosity, no fluorescence. SILTSTONE (10-20%): light brownish grey, brownish grey, very soft to friable, sub-fissile in part, very argillaceous to arenaceous, common carbonaceous specks and flakes, gradational to Argillaceous Siltstone. CLAYSTONE (10-20%): light olive grey, light brownish grey, trace yellowish brown, very soft, amorphous, slightly calcareous, rare very fine disseminated pyrite.

Gas averages	T Gas : (units)	4.7	Composition (ppm)	C1	C2	C3	C4	C5
			940	508	72	45	53	31

Show Details	No Hydrocarbon Shows.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	18.8	229	9.23	844	3533

Interval (m)	ROP (Avg)	Lithology Description **Claystone with interbedded Siltstone and very minor Sandstone with trace Coal/Carbonaceous Claystone**
3296 – 3335	7.85	SANDSTONE (5-20%): off white, soft aggregates, occasional loose grains, very fine, moderately well sorted, sub-angular to rounded, 80% white argillaceous matrix, poor inferred porosity, no fluorescence. SILTSTONE (10-60%): light brownish grey to brownish grey, very soft to soft, sub-blocky to amorphous, abundant carbonaceous specks and laminae, very argillaceous, disseminated pyrite in part. CLAYSTONE (35-85%): light brown to very light greyish brown, pale grey, very soft, amorphous, carbonaceous specks in part, silty in part, trace very fine disseminated pyrite. COAL (Trace-5%): black to dark brown, soft to very hard and splintery, grading into carbonaceous claystone, pyrite cemented in part (3m thick coal/carbonaceous claystone at 3324.0 mMDRT based on LWD logs).

Gas averages	T Gas : (units)	5.1	Composition (ppm)	C1	C2	C3	C4	C5
			1020	409	72	49	67	12

Show Details	No Hydrocarbon Shows.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	15.7	217	7.70	848	3514

Interval (m)	ROP (Avg)	Lithology Description **Massive Sandstone**					
3335 – 3343	9.39	SANDSTONE (100%): clear to translucent, occasionally off white and pink, loose, occasionally cemented into small aggregates with silica cement (quartz overgrowths?), fine to very coarse, occasionally granular, mainly medium grained, very poorly sorted, sub-angular to angular, very good inferred porosity, trace pyrite, trace carbonaceous fragments (possibly cavings?), no fluorescence, thin (1.0 m thick) very hard/brittle cemented cap at the top of the massive sandstone at 3335.0 mMDRT identified from LWD logs.					
Gas averages	**T Gas : (units)**	6.0	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
			1200	438	100	61	62	19
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	10.0	220	8.30	841	3486

Interval (m)	ROP (Avg)	Lithology Description **Claystone and Siltstone with minor Sandstone and trace Coal/Carbonaceous Claystone**
3343 – 3385	6.4	SANDSTONE (5-30%): clear to translucent, loose, very fine to fine, mainly fine grained, well sorted, sub-angular to angular, white argillaceous matrix washing out in part, fair - good inferred porosity, trace pyrite, trace carbonaceous fragments (possibly cavings?), no fluorescence. SILTSTONE (0-70%): light brownish grey to brownish grey, very soft to soft, sub-blocky to amorphous, abundant carbonaceous specks and laminae, very argillaceous, disseminated pyrite in part. Also in 3385m sample, trace SILTSTONE dark grey, brownish black, silicified, very hard, sub blocky, occasionally completely replaced with silica, banded in part. CLAYSTONE (Trace-90%): light brown to very light greyish brown, pale grey, very soft, amorphous, carbonaceous specks in part, silty in part, trace very fine disseminated pyrite. COAL (Trace-5%): black to dark brown, soft to very hard and splintery, sub-vitreous to vitreous, grading into Carbonaceous Claystone, pyrite cemented in part (thin coals/carbonaceous claystones identified at 3344.0 and 3352.0 mMDRT from LWD logs), traces of very hard pyritised fragments in part at 3380.0 mMDRT.

Gas averages	T Gas : (units)	9.0	Composition (ppm)	C1	C2	C3	C4	C5
			1800	687	143	77	78	50

Show Details	No Hydrocarbon Shows.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	22.6	241	7.17	879	3803

Interval (m)	ROP (Avg)	Lithology Description **Argillaceous Sandstone with interbedded Sandy Claystone, Claystone and minor Siltstone**
3385 - 3400	3.9	ARGILLACEOUS SANDSTONE (0-80%): dominantly white to very light grey, minor clear to translucent, dominantly very soft aggregates, minor loose grains, very fine to medium, poorly sorted, sub-angular to sub-rounded, moderate to high sphericity, trace carbonaceous material, abundant white argillaceous matrix, commonly matrix supported, gradational to Sandy Claystone, poor to fair inferred porosity, no fluorescence. CLAYSTONE (0-50%): brownish grey, light brownish grey, light grey, very soft, amorphous, silty in part, trace carbonaceous specks, rare pyrite, gradational to Argillaceous Siltstone. SILTSTONE (10%): light brownish grey to brownish grey, very soft to soft, sub-blocky to amorphous, abundant carbonaceous specks, very argillaceous, disseminated pyrite in part. SANDY CLAYSTONE (0-60%): very light grey to white, very soft, amorphous, trace lithic fragments, 5-30% very fine well rounded quartz sand grains, grading to Argillaceous Sandstone.

Gas averages	T Gas : (units)	5.8	Composition (ppm)	C1	C2	C3	C4	C5
			1160	456	73	52	83	16

Show Details	No Hydrocarbon Shows.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	19.8	212	6.27	869	3654

Interval (m)	ROP (Avg)	Lithology Description **Siltstone with interbedded Sandy Claystone and minor Coal**					
3400 - 3410	19.9	SILTSTONE (70-90%): light brownish grey to brownish grey, soft to firm, sub-blocky to amorphous, abundant carbonaceous specks, very argillaceous, disseminated pyrite in part, no fluorescence. SANDY CLAYSTONE (10-30%): very light grey to white, occasionally greenish-white, soft to firm, amorphous to sub-blocky, trace lithics, 5-20% fine, well rounded quartz sand, grading into Argillaceous Sandstone, quite calcareous in part, no fluorescence. COAL (Trace): black to dark brown, soft to firm, dull to bright, rare conchoidal fracture, commonly laminated, grading into carbonaceous siltstone, firmly pyrite cemented in part.					

Gas averages	T Gas : (units)	15.0	Composition (ppm)	C1	C2	C3	C4	C5
			3000	2028	228	53	66	24
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	14.7	213	7.80	858	3684

Interval (m)	ROP (Avg)	Lithology Description **Argillaceous Sandstone with interbedded Siltstone**
3410 – 3430	22.6	ARGILLACEOUS SANDSTONE (40-70%): white to pale grey in aggregates, mainly loose, clear to translucent when loose, friable when in rare aggregates, fine to coarse grained, mainly medium grained, poorly sorted, sub-angular to angular, abundant white argillaceous clay matrix, generally non-calcareous matrix, poor inferred visual porosity, trace pyrite, trace carbonaceous fragments and laminations, trace firm calcite cement fragments, no fluorescence. SILTSTONE (30-60%): light grey to light brownish grey, soft to firm, sub-blocky to amorphous, abundant carbonaceous specks, very argillaceous, disseminated pyrite in part, no fluorescence.

Gas averages	T Gas : (units)	5.9	Composition (ppm)	C1	C2	C3	C4	C5
			1180	630	77	43	56	9
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	16.1	220	8.52	811	3462

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1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Siltstone with minor Argillaceous Sandstone and trace Coal**
3430 – 3475	11.0	ARGILLACEOUS SANDSTONE (10-30%): clear to translucent, loose, very fine to coarse grained, mainly fine grained, very poorly sorted, sub-angular to angular, abundant white argillaceous matrix, trace pyrite, trace carbonaceous specks, poor to moderate visual inferred porosity, no hydrocarbon fluorescence. SILTSTONE (70-90%): light brownish grey to brownish grey, soft to firm, sub-blocky to amorphous, abundant carbonaceous specks, grading into carbonaceous siltstone, very argillaceous, disseminated pyrite in part, no fluorescence. COAL (Trace): black to dark brown, soft to firm, dull to bright lustre, rare conchoidal fracture, commonly laminated, grading into carbonaceous siltstone.

Gas averages	T Gas : (units)	9.9	Composition (ppm)	C1	C2	C3	C4	C5
			1980	876	150	82	76	47
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	18.6	229	7.55	865	3824

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1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Argillaceous Sandstone, Sandstone (only at 3530m sample), Siltstone and thin Coals in an interbedded sequence.**
3475 – 3510	20.0	ARGILLACEOUS SANDSTONE (40-80%): 60% white aggregates to 40% clear translucent loose grains, fine to coarse, dominantly fine to medium, moderately sorted, sub-angular to angular, moderate sphericity, 70% white argillaceous matrix in aggregates, fair to moderate inferred porosity, no fluorescence. (3505m) SANDSTONE (70%): 50% white aggregates 50% loose grains, dominantly fine to medium, occasionally coarse, moderately well sorted, sub-angular to rounded, high sphericity, common white argillaceous matrix, trace pyrite nodules and cement, good inferred porosity, no fluorescence. SILTSTONE (15-60): light brownish grey, brownish grey, off white / light brownish grey, very soft to rarely friable, very argillaceous, carbonaceous specks and carbonaceous laminae in part, slightly pyritic in part. Sample from 3490.0 mMDRT contained hard siliceous and pyritic Siltstone. COAL (Trace-5%): black, dull black, sub-vitreous, firm, blocky, silty in part.

Gas averages	T Gas : (units)	37.0	Composition (ppm)	C1	C2	C3	C4	C5
			7400	5572	483	153	82	12

Show Details	No Hydrocarbon Shows.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	22.5	225	8.85	872	3897

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Argillaceous Sandstone, Siltstone and common Coal in an interbedded sequence.** **Trace Fluorescence present at 3515.0 mMDRT (see fluorescence summary below).**
3510 – 3550	10.0	ARGILLACEOUS SANDSTONE (10-80%): white to very light grey, soft aggregates, trace loose grains, very fine to fine, occasional medium grains, moderately well sorted, sub-angular to angular, white argillaceous matrix to 80% (possibly weathered feldspars?), poor inferred porosity, no fluorescence (except trace at 3515.0 mMDRT see fluorescence summary below). SILTSTONE (20-90%): light brownish grey, brownish grey, light grey, very soft, rarely sub-firm, amorphous to sub-blocky, rarely sub-fissile, trace carbonaceous specks and carbonaceous laminae, occasionally pyritic, occasionally very pyritic, trace very hard black & white finely banded siliceous fragments. COAL (Trace-5%): dull black, sub-vitreous, firm, brittle in part, hackly fracture, very silty in part and gradational to carbonaceous siltstone. **(Based on the LWD logs the thin coals probably make up 20% of the entire section but are under-represented in the cuttings samples).**

Gas averages	T Gas : (units)	67.5	Composition (ppm)	C1	C2	C3	C4	C5
			13500	10210	904	279	132	26

Show Details 3510-3515	Trace dull yellow, trace very slow cut, trace dull cream incomplete residue ring. Fluorescence occurred in white Argillaceous Sandstone.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	25.7	227	8.34	855	3776

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1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Dominantly Siltstone with minor Argillaceous Sandstone and thin Coals.**
3550 – 3565	4.5	SILTSTONE (80-90%): light brownish grey, brownish grey, occasionally white, very soft, amorphous to dispersive, very argillaceous, common carbonaceous specks and carbonaceous laminae, occasionally pyritic, trace very hard black & white finely banded siliceous fragments. ARGILLACEOUS SANDSTONE (10-20%): white to very light grey, loose grains, very fine to fine, occasional medium grains, well sorted, sub angular to angular, white argillaceous matrix to 80% (weathered feldspars?), poor inferred porosity, no fluorescence. COAL (Trace): dull black, sub-vitreous, firm, brittle in part, hackly fracture, very silty in part and gradational to Carbonaceous Siltstone.

Gas averages	T Gas : (units)	67.5	Composition (ppm)	C1	C2	C3	C4	C5
			13500	10210	904	279	132	26
Show Details	No Hydrocarbon Shows.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	25.1	184	7.08	799	3322

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1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Interbedded Siltstone and Claystone with minor Argillaceous Sandstone and thin Coals**
3565 - 3590	5.6	ARGILLACEOUS SANDSTONE (5-20%): white to very light grey with carbonaceous laminations, firm to friable, very fine to fine, occasional medium grains, moderately well-sorted, sub-angular to rounded, white argillaceous matrix to 60% (weathered feldspars?), moderate inferred visual porosity, trace pyrite, abundant carbonaceous specks and laminae, glowing white residual crush cut fluorescence inferred to be from carbonaceous material, no hydrocarbon fluorescence noted from clean sand fragments. SILTSTONE (50-80%): light brownish grey to brownish grey, occasionally white, very soft to firm, amorphous to laminated, argillaceous, common carbonaceous specks and carbonaceous laminae, occasionally pyritic, trace very hard black & white finely banded siliceous fragments, grading occasionally into brown claystone. CLAYSTONE (0-40%): very light greenish-grey, firm to moderately hard, sub-blocky to fissile, occasionally splintery shaped fragments, trace glauconite?, trace silty quartz grains, calcareous in nature. COAL (Trace-5%): black, dull black, sub-vitreous, firm, blocky, silty in part.

Gas averages	T Gas : (units)	52.6	Composition (ppm)	C1	C2	C3	C4	C5
				8183	595	229	58	19

Show Details	
	3575 – 3580m: Moderately bright, very slow, diffuse, white, crush cut fluorescence (inferred to be from carbonaceous material associated with thin fine sand stringers), thin white residual ring. No direct UV or crush-cut UV hydrocarbon fluorescence noted from clean sand fragments. **3585 – 3590m**: Trace weak pale yellowish direct UV fluorescence from carbonaceous laminations.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	25.0	130	6.2	817	3852

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1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Interbedded Sandstone and Siltstone with thin Coals**
3590 - 3620	3.7	SANDSTONE (30-40%): white to very light grey in aggregate form, very firm to firm, occasionally very well cemented with quartz overgrowths, very fine to coarse white to yellowish grains when loose, occasional granular grains, mainly medium grained, poorly sorted, sub-angular to angular, abundant white argillaceous and calcareous matrix (weathered feldspars? and calcite cement), silica cemented with quartz overgrowths in part, poor inferred visual porosity, trace pyrite, trace fractured grains, common black and dark brown carbonaceous/woody specks, pale yellow mineral fluorescence from various cements, no hydrocarbon fluorescence. SILTSTONE (60-70%): light brownish grey to brownish grey, occasionally dark brown, soft to firm, amorphous to laminated, argillaceous, common black and dark brown carbonaceous/woody specks and carbonaceous laminae, occasionally pyritic. COAL (Trace): black to very dark brown, hard to very hard, sub-blocky to splintery, dull to bright with vitreous lustre and conchoidal fracture, commonly pyritised.

Gas averages	T Gas : (units)	100.2	Composition (ppm)	C1	C2	C3	C4	C5
				14483	1401	655	150	45

Show Details	
	3590 – 3595m: Pale yellow direct UV fluorescence from calcite-cemented sandstone fragments, no hydrocarbon fluorescence. **3605 – 3620m**: Pale yellow direct UV fluorescence from silica and calcareous cemented sandstone fragments, no hydrocarbon fluorescence.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	28.6	100	6.0	802	3964

Interval (m)	ROP (Avg)	Lithology Description **Interbedded Sandstone, Siltstone and Coal**
3620 - 3650	2.5	SANDSTONE (15-65%): white to very light grey in aggregate form, occasionally clear to white when in loose grains, firm to very well cemented in part, blocky to massive, very fine to medium grained, mainly fine grained, moderately sorted, sub-angular to angular, common white argillaceous matrix (weathered feldspars?), common quartz overgrowths cementing sandstone, common calcareous cement, poor inferred visual porosity, common pyrite both as cement and in nodular form, trace fractured grains, trace carbonaceous specks and laminations, common pale yellow-dull orange mineral fluorescence from calcite & silica(?) cement, no hydrocarbon fluorescence. SILTSTONE (30-80%): light brownish grey, very light brownish grey, soft to very firm, argillaceous, amorphous to laminated, common carbonaceous specks and laminae, occasional pyrite, gradational to Carbonaceous Siltstone. COAL (Trace-5%): dull black, firm, brittle in part, sub-vitreous to rarely vitreous in patches, occasionally pyritic.

Gas averages	T Gas : (units)	48.3	Composition (ppm)	C1	C2	C3	C4	C5
				6049	693	431	125	50

Show Details	
	3620 – 3625m: Trace – 5% dull yellow mineral fluorescence from the calcareous cement. **3625 – 3630m**: Trace – 10% dull yellow mineral fluorescence from the calcareous cement. **3645 – 3650m**: Common (5%) pale yellow-dull orange mineral fluorescence from calcite/silica cement, no hydrocarbon fluorescence.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	34.1	93	6.15	801	3977

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1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Dominantly Siltstone with minor Sandstone and thin Coal**
3650 – 3667	4.1	SANDSTONE (20-30%): white to very light grey in aggregate form, occasionally clear to white when in loose grains, firm to well-cemented in part, blocky to massive, very fine to medium grained, mainly fine grained, poorly to moderately sorted, sub-angular to angular, trace white argillaceous matrix (weathered feldspars?), trace quartz overgrowths, trace calcareous cement, poor inferred visual porosity, trace carbonaceous specks and laminations, trace pale yellow-dull orange mineral fluorescence from calcite(?) cemented fragments, no hydrocarbon fluorescence. SILTSTONE (70-80%): brownish grey to very light brownish grey, occasionally dark brown, soft to very firm, argillaceous, common fine quartz grains, amorphous to laminated, common carbonaceous specks and laminae, occasional pyrite, grading into Carbonaceous Siltstone. COAL (Trace): dull black, firm, brittle in part, sub-vitreous to rarely vitreous in patches, occasionally pyritic.

Gas averages	T Gas : (units)	64.2	Composition (ppm)	C1	C2	C3	C4	C5
				8216	808	426	132	52

Show Details	No Hydrocarbon Shows.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	35.8	108	6.4	795	4036

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Interbedded Sandstone Siltstone and Coal**						
3667 – 3697	3.0	SANDSTONE: white to very light grey, dominantly soft to friable aggregates, also loose grains, very fine to fine, occasional medium grains, sub-angular to well rounded, moderately will sorted, 5 – 80% white argillaceous matrix, occasional carbonaceous grains and siltstone lithics, poor to fair porosity, no fluorescence. SILTSTONE: light brownish grey, very soft to sub firm, amorphous to sub-blocky, occasionally sub-fissile when carbonaceous, commonly carbonaceous grains and laminae, very argillaceous, trace pyrite, intercalated with very fine sandstone. COAL: dull black, sub-vitreous, firm, brittle in part, hackly fracture, silty.						
Gas averages	**T Gas : (units)**	41.6	**Composition (ppm)**	**C1**	**C2**	**C3**	**C4**	**C5**
				4956	499	291	101	50
Show Details	**3670 – 3690m**: Trace pale yellow-dull orange calcite/silica Mineral fluorescence.							

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	34.1	106	6.5	800	4043

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1	16-Jan-06	Geoservices Unit 170	Base Mudlogging Coordinator	

Interval (m)	ROP (Avg)	Lithology Description **Interbedded Sandstone, Siltstone, Coal and minor Dolomite**
3697 - 3725	4.1	SANDSTONE (5-70%): white to light brownish grey in fragments, occasionally speckled black and white (due to abundant carbonaceous specks), translucent to white as loose grains, dominantly very fine to fine, very occasionally medium to coarse grained, sub-angular to angular, moderately well-sorted, common white argillaceous matrix in part, trace pyrite, trace calcareous cement in part, trace to common carbonaceous specks, poor inferred visual porosity, trace dull yellow-orange calcite mineral fluorescence, trace mineral(?) fluorescence giving only dull yellow crush-cut residue ring under UV light, grading into coarse brown carbonaceous siltstone. SILTSTONE (30-95%): light to dark brownish-grey, soft to firm, amorphous to fissile in parts, very argillaceous, common carbonaceous grains and laminations, very fine sand grains in part, trace pyrite, grading to fine sandstone. COAL (Trace-5%): dull black, sub-vitreous, firm, brittle in part, hackly fracture, silty. DOLOMITE (Trace-5%): dark yellowish brown, hard, blocky, sub-conchoidal fracture in part, cryptocrystalline, trace pyrite, trace dull yellow mineral fluorescence.

Gas averages	T Gas : (units)	20.8	Composition (ppm)	C1	C2	C3	C4	C5
				2325	273	191	73	39

Show Details	**3720 - 3725m**: Very Poor Show in sample - Trace dull yellow, pinpoint, no direct cut, trace crush cut, trace light green / cream broken residue ring.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	38.9	108	6.9	785	4059

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Interval (m)	ROP (Avg)	Lithology Description **Dominantly Siltstone interbedded with Sandstone and Coal**
3725 – 3758	2.3	SILTSTONE (60-80%): light to dark brownish-grey, soft to firm, amorphous to rarely sub-blocky, very argillaceous, common carbonaceous grains and laminations, trace very fine sand grains in part, trace pyrite, grading to very fine silty sandstone. SANDSTONE (10-40%): white to light grey, occasionally speckled white / black when carbonaceous, soft to very soft aggregates, very fine to fine, rarely medium, sub-angular to rounded, high sphericity, common carbonaceous grains in part, 5 – 80% white argillaceous (weathered feldspar?) matrix, poor porosity, trace dull yellow mineral fluorescence. COAL (tr-5%): dull black, sub-vitreous, firm, brittle in part, hackly fracture, silty.

Gas averages	T Gas : (units)	34.7	Composition (ppm)	C1	C2	C3	C4	C5
				4598	376	217	71	36

Show Details	
	3725 – 3730m: Trace dull yellow mineral fluorescence. **3740 – 3745m**: Trace mineral fluorescence giving only dull yellow crush-cut residue ring under UV light. **3745 – 3758m**: Yellow-white and dull orange-yellow direct UV mineral fluorescence only.

Drilling Parameters (Avg)	WOB (Klbs)	RPM	TRQ	FLOW (gpm)	SPP (psi)
	35.9	121	7.6	795	4029

3.2 Gas Ratio Interpretation – Introduction

Gas composition and total gas in mud were principally measured using the Geoservices Reserval (a combined total gas detector and chromatograph coupled with a GZG degasser). As a backup gas detection system, a Geoservices FID Chromatograph Panel (FCP) and FID Gas Panel (FGP) were in operation, in tandem with a GZ1 degasser motor. Both gas systems use the FID technique of measuring ions released when hydrocarbons are burnt in a hydrogen flame.

The first advantage that the Reserval gas system has over the older style of auxiliary equipment being used is the type of degasser that provides the sample. In both cases gas is extracted from the mud prior to it reaching the shale shakers by the degassers, which are essentially an agitator inside a chamber through which the mud continually passes. However, the GZG degasser that the Reserval uses is specially designed to degas a constant volume of mud regardless of pump rates, so is not affected by mudflow variations unlike the older style GZ1 degasser. Also, it has the advantage of being placed within the flowline, limiting any early emissions of gas from the mud as it is circulated through the rig. The high energy to volume ratio of the GZG degasser also means that a much higher proportion of the gas is removed from the mud. These features mean that a very high quality sample is obtained for accurate analysis.

This high quality sample is then analysed by the high-speed chromatograph of the Reserval. The auxiliary gas chromatograph on the other hand, the FCP, has a typical analysis time of about four minutes compared with the Reserval, which has a fast cycle time of just 42 seconds. This short cycle time means that much better definition is possible while drilling. This combined with the much greater accuracy of the Reserval, combine to provide a much more accurate representation of the hydrocarbon gas contained within the formations of interest when compared with the older auxiliary gas detection equipment that we have in use.

The GZ1 degasser for the auxiliary equipment is located on the header box in the shaker room where it is reliant on stable mud circulation and shaker operation. The gas is then drawn back to the unit through tubing to the gas analysis equipment. Independent sensors in the unit also measure H2S and CO2.

The composition of the gas in mud from the formation is significant in determining the geochemical origin and value of a show. There are several methods that can be used to determine whether the hydrocarbon gas in mud comes from a potential gas or oil zone. Amongst these methods are the Triangle Diagram (also known as the gas composition diagram), Pixler Diagram (also known as the gas ratios method) and the gas Wetness/Balance/Character plots.

3.3 Explanation of Gas Composition Diagrams

The Triangle or Gas Composition Diagram is used to graphically represent the hydrocarbon distribution in the gas and to determine whether it corresponds to a gas or oil reservoir. The triangular diagram is obtained by tracing lines on three scales at 120° to each other, corresponding respectively to the ratios of ethane, propane and normal butane to the total gas.

The scales are arranged in such a way that if the apex of the triangle is upward, the diagram represents the analysis of gas from a gas zone, while if the apex points downwards, the diagram represents the analysis of gas from an oil zone. A large triangle diagram represents dry gas or low GOR oil, while small triangles represent wet gases or high GOR oils. The centre of the triangle should fall inside the area delineated by the dotted line, which encircles compositions that are regarded as 'normal'. If the triangle area is outside this area the gas indicates that the reservoir is not exploitable and that the heavier hydrocarbon composition is 'abnormal' i.e. hydrocarbons that are chemically altered or gases with special compositions which are not associated with oil.

The Gas Ratio Analysis Diagram is a plot of the ratio of C1 to the other gas elements. The magnitude of the methane to ethane ratio determines if the reservoir contains gas or oil or if it is non-productive. The following conclusions are possible:

Ratio C1/C2:	< 2	non-productive zone
	2 - 15	oil present
	15 - 65	gas present
	> 65	non-productive zone

The slope of the line of the ratio plot of C1/C2, C1/C3, C1/C4 and C1/C5 indicates whether the reservoir will produce hydrocarbons or hydrocarbons and water. Positive line slopes indicate production; negative line slopes indicate water-bearing formations. When using the Gas Ratio Diagram, the following points should be borne in mind:

1. Productive dry gas zones may show only C1, but abnormally high shows of C1 are usually indicative of saltwater zones.
2. If the ratio C1/C2 is low in the oil section and the ratio C1/C4 is high in the gas section, the zone is probably non-productive.
3. If any ratio (C1/C5 excepted in an oil based mud) is lower than the preceding ratio then the zone is probably non-productive.
4. The ratios may not be definitive for zones of low permeability.
5. Steep gas ratio plots may be indicative of tight zones.

3.4 Explanation of Wetness/Balance/Character Curves

Another method for evaluating gas zones plots against depth three ratios: hydrocarbon Wetness (W_h), hydrocarbon Balance (B_h) and hydrocarbon Character (C_h), where:

$$W_h = \frac{(C2 + C3 + C4 + C5)}{(C1+C2+C3+C4+C5)} \times 100\ (\%)$$

$$B_h = \frac{(C1 + C2)}{(C3 + C4 + C5)}$$

$$C_h = \frac{(C4 + C5)}{C3}$$

Wetness (W_h) is the primary zone indicator and provides a measure of the relative proportion of heavier gases in the overall gas show as follows:

$W_h < 0.5$	Light non-associated gas with low productivity potential or only geo-pressured methane.
$0.5 < W_h < 17.5$	Potentially productive gas with gas density increasing with W_h.
$17.5 < W_h < 40.0$	Potentially productive oil with gravity decreasing as W_h increases.
$W_h > 40.0$	Heavy or residual oil with low productivity potential.

As reservoir hydrocarbons become denser in the transition from gas to oil, Balance (B_h) and Wetness (W_h) values move closer together and eventually intersect. The zone guidelines for B_h combine with those for W_h to improve reliability of show evaluation as follows:

$W_h < 0.5$ and $B_h > 100$	Very light, dry gas that is almost certainly non-productive.
$0.5 < W_h < 17.5$ and $W_h < B_h < 100$	Productive gas with gas increasing in wetness and density as the two curves converge.
$0.5 < W_h < 17.5$ and $B_h < W_h$	Productive gas condensate or a high gravity gas/oil ratio.
$17.5 < W_h < 40$ and $B_h < W_h$	Productive oil with oil gravity decreasing - density increasing as the curves diverge.
$17.5 < W_h < 40$ and $B_h > W_h$	Non-productive residual oil.

Character (C_h) values serve to resolve ambiguities between oil or gas indications by defining the following:

$0.5 < W_h < 17.5$ and $B_h < W_h$ and $C_h < 0.5$	Productive wet gas or condensate.
$0.5 < W_h < 17.5$ and $B_h < W_h$ and $C_h > 0.5$	Productive high gravity and/or high GOR oil.

It is important to note that in the conclusion to each of the interpretive tools, the terms ‘productive’ and ‘non-productive’ are used in a geochemical sense. Ultimate production of a zone is dependent upon reservoir thickness and extent as well as other physical and economic factors that are not taken into account when analysing gas compositions. The methods discussed here are intended to assist the interpretive skills of the geologist or log analyst. Please refer to the Gas Ratio Log enclosure.

3.5 Gas Composition Discussion – Reserval

Gas monitoring commenced using the Geoservices Reserval from the beginning of the 311mm (12.25") phase at 1525 m through to the well's total depth of 3758 m. All of the gas equipment was calibrated prior to the commencement of drilling of the 12.25" phase and was re-checked at T.D. of the well.

No significant gas was encountered while drilling through the sediments above 3470 m in the 311mm (12.25") hole section. Background total gas levels in this section ranged from 7 to 30 Units, with the maximum gas reading of 58 Units occurring at 2008 m. The gas throughout this section was extremely dry, consisting of 96-99 % C1 (methane), with traces of C2 (ethane), C3 (propane), C4 (butane), and C5 (pentane) gas. These low gas values were partly due to mud weight being gradually increased during this interval from 9.5 to 10.2 ppg.

One gas anomaly was observed in this upper part of the 311mm (12.25") section with the persistent and unexplained presence of minor iC4 traces, recording slightly larger than the C2 and C3 gas components. The proportion of C4 recorded was largely unchanged, never more than 1% of the total gas percentage, and varied only as the total gas recorded increased or decreased. It occurred between the top of this section at 1525 m until about 2820 m, and then dropped back to a more normal proportion of the total gas. This change coincided with an abrupt change in the drilled lithology becoming more sandy and a weighting up of the drilling fluid, so it is possible that this anomaly is either artificial and due to some agent in the mud which "masked" the presence of iC4 in the gas analysis system (such as MAGNAFLOC), or it could be genuinely derived from the silty or calcareous lithology.

Below 3470 m the background total gas levels began to steadily increase, primarily due to the increased incidence of thin gas bearing sandstone layers and intercalated coals in the drilled lithology. The mud weight was consistently held between 10.15 and 10.2 ppg for the interval from 3470 m to 3758 mTD, and the rare low levels of connection gas suggested that the hydrostatic pressure provided by this mud weight was generally sufficient to counter the formation pore pressures at this depth. The background gas levels between 3470 m and 3758 mTD ranged from 20 to 45 Units, and were not so dry with C1 to C5 proportions commonly between 74-88% C1, 8-12% C2, 3-8% C3, 1-5% C4 and Trace-3% C5. The maximum gas peak encountered in this well occurred at 3608 m with 272 Units of total gas recorded and a C1 to C5 breakdown of 82/10/5/2/1. However, several other notable gas peaks relating to coal and sandstone bodies were also recorded at:

- 3533m – 148 units – C1 to C5 breakdown of 92/6/1/1/Trace
- 3544m – 186 units – C1 to C5 breakdown of 88/7/3/2/Trace
- 3582m – 155 units – C1 to C5 breakdown of 92/5/2/1/Trace
- 3595m – 248 units – C1 to C5 breakdown of 92/5/2/1/Trace
- 3613m – 161 units – C1 to C5 breakdown of 88/8/3/1/Trace

It is interesting to note that according to the hydrocarbon Wetness, Balance and Character ratio indicators, each of these gas peaks in the reservoir zone corresponds to a potentially productive gas zone (i.e. where $0.5 < W_h < 17.5$, and $B_h < W_h < 100$), except for the gas peak at 3608 mMD which has gas ratios indicative of a potentially productive oil zone (i.e. where $17.5 < W_h < 40$, and $B_h < W_h$). The interpretations of these zones are listed below and gas ratio diagrams are shown on the page that follows.

3.6 Gas Composition Discussion – Auxiliary Gas Equipment

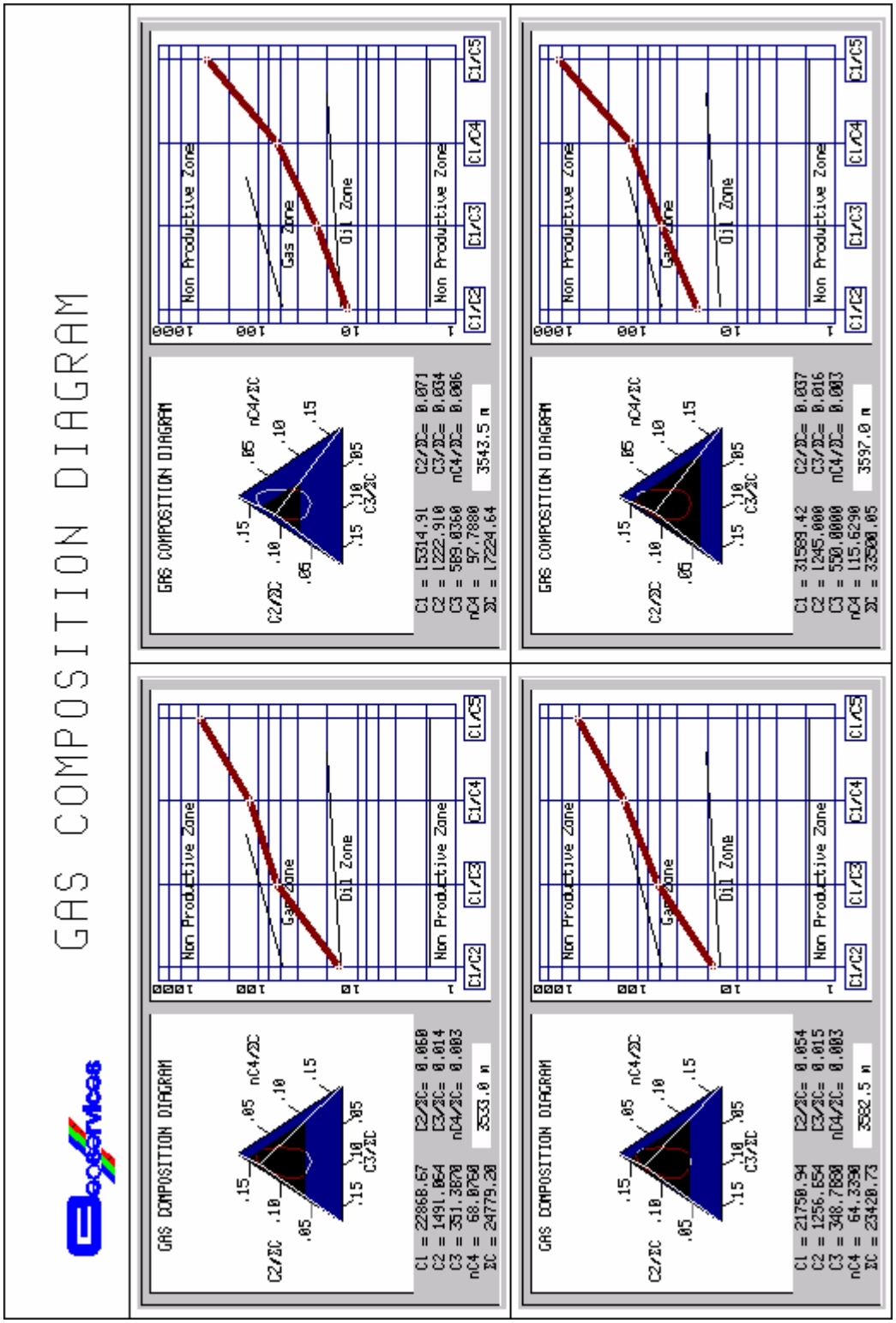
Throughout this well the gas readings recorded from the auxiliary gas equipment showed similar trends to that of the Reserval, as would be expected. The most obvious difference between the readings of the main gas equipment and the auxiliary gas equipment was the level of heavier gas components recorded, in particular C4 (butane) and C5 (pentane) levels. The Geoservices Reserval when used in combination with the GZG degasser is a much more precise instrument which, due to its advanced position in the flowline, and improved agitation of a constant volume of mud per unit time, can more accurately determine the level of these heavy hydrocarbon gas components carried in the mud before degassing occurs in the open possum belly.

Additionally, due to the fluctuating mud levels in the possum belly, particularly during connections or whenever the flow rate was changed, the auxiliary gas readings were occasionally affected, giving false increases and decreases in gas levels that were not related to the drilled lithology or ROP variation. Generally, however, the FCP / FGP system gave a reliable indication of the gas trends, and in most cases, the same conclusions can be drawn from the auxiliary equipment data as from the data provided by the Reserval.

No H2S or CO2 was recorded during the drilling of this well.

3.7 Gas Ratio Interpretation and Diagrams

Depth Interval (m)	Main / Auxiliary	Gas Peak (units)	Wetness	Balance	Character	Zone Interpretation
3531 – 3533	Main	148	8.4	40.9	0.70	Potentially productive low
	Auxiliary	187	6.9	91.1	0.18	density gas zone
3543 – 3544	Main	186	12.0	19.1	0.47	Potentially productive medium
	Auxiliary	130	9.6	43.5	0.40	density gas zone
3581 – 3583	Main	155	7.6	42.3	0.59	Potentially productive low
	Auxiliary	121	5.8	100.0	0.28	density gas zone
3594 – 3597	Main	248	8.1	38.4	0.55	Potentially productive low
	Auxiliary	129	6.2	82.0	0.31	density gas zone
3605 – 3610	Main	272	18.0	11.4	0.54	Potentially productive low gravity oil zone
	Auxiliary	169	14.0	22.4	0.27	Potentially productive high density gas zone
3611 – 3615	Main	161	12.9	20.1	0.52	Potentially productive high
	Auxiliary	100	9.9	39.1	0.24	density gas zone



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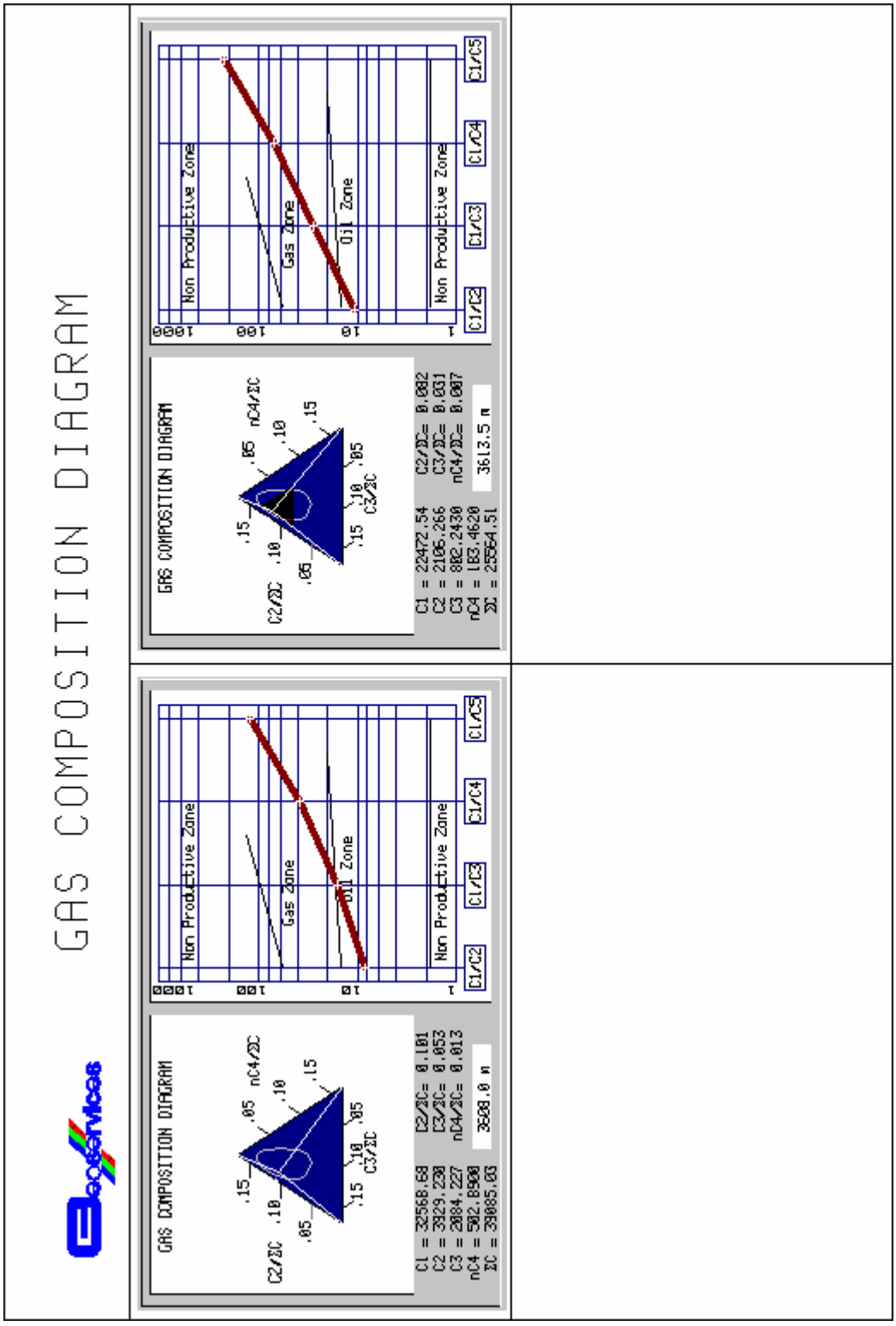

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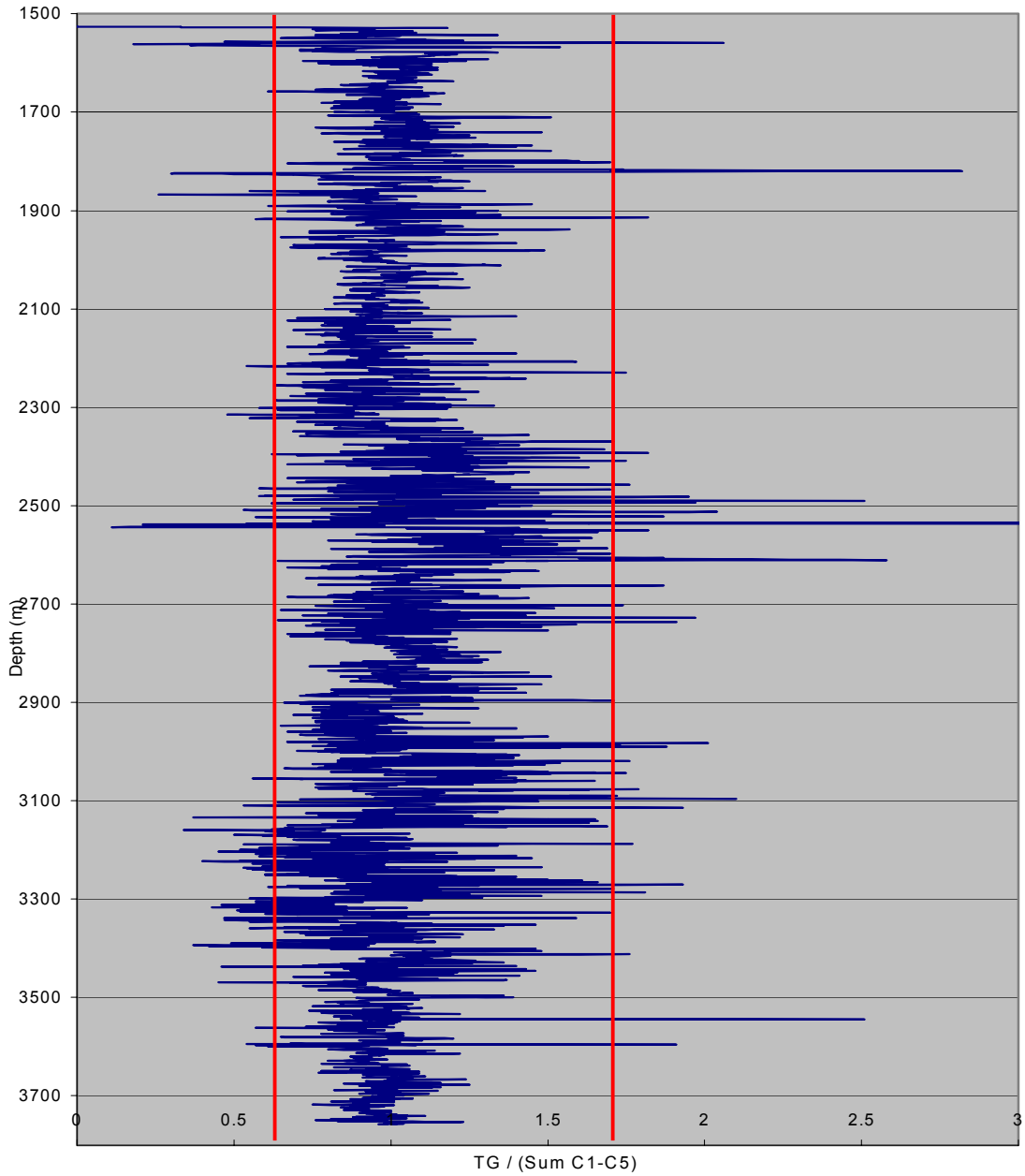
3.8 Gas Equipment Problems and Reserval Function Plot

Depth (m)	Problem Encountered	Main or Auxiliary Gas
1525	Degasser pump rubber check – Replaced rubber	Main
1525 – 1528	Insufficient mud flow while displacing	Main & Auxiliary
2533 – 2544	Poor suction of gas at gas trap – Reposition degasser head in flowline	Main

Reserval QC Plot – 311mm (12.25") Hole Section



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4.0 PRESSURE ANALYSIS

4.1 Introduction

There are several techniques available which when used in the appropriate overpressured environment, can often predict an approaching overpressured zone while drilling. Each technique may give slightly different results according to geological and drilling conditions. Geoservices currently uses the following parameters to indicate overpressured regions while drilling:

D Exponent: This is a normalized rate of penetration that takes into account mud weight, bit wear and hydraulics. It can be reliably used in shales and clean claystones; and as an indicator in siltstones, silty shales and calcareous claystones. A normal trend line is established through normally pressured shale points, representing a normal compaction trend, and any leftward deviation of subsequent shale points from this trend, representing relative undercompaction, indicates overpressure (plotted relative to depth) or increased porosity due to changes in the lithology.

Temperature: By plotting mud flowline temperature against depth a temperature gradient can be established. Theory states that a zone of low heat flow or "thermal shadow" occurs prior to the overpressured zone, which in turn is followed, by a complementary zone of abnormally high heat flow in the overpressured zone (due to its higher water content). However, the data has to be interpreted cautiously as additions of water to the active system/shakers can lower the mud temperature and mud chemicals added to the active system can cause exothermic/endothermic reactions. Bit and wiper trips cause decreases in temperature on surface.

Cuttings: Small, splintery cuttings can be used as an indicator of overpressured regions. Long propeller shaped cuttings may be an indicator of overpressure or may be the result of hydration of reactive or swelling clays.

Overpull/Torque/Fill: Overpull when making a connection or tripping can be an indicator that the hole is collapsing into the well bore, either due to clay hydration or a formation pressure that is greater than the mud weight. Similarly, excessive fill on a trip or after a connection can also indicate that the well bore is collapsing in. High torque can also be an indicator of well bore collapse, although it can also be due to formation type, bearing failure or simply the annulus becoming clogged up by cuttings due to insufficient hole cleaning in large diameter holes.

Gas *Connection gas*: During circulation the downhole pressure exerted by the mud, weight increases due to friction losses in the annulus. This is calculated as an ECD - or equivalent circulating density. Thus, when the pumps are stopped for a connection the downhole pressure exerted by the mud decreases by an amount equivalent to the difference between the ECD and mud weight. If the mud weight is close to or actually underbalanced, then gas may be fed-in to the well bore during the few minutes the pumps are turned off and register as a gas peak one lag time after the connection. The magnitude of this peak is determined by such factors as permeability, gas content of the formation, amount of swabbing as well as the relative pore pressure / mud weight.

Background gas: Background gas is not as good an indicator of formation pressure as connection gas since several factors can influence it unrelated to abnormal pressure. Increases in porosity and permeability, gas saturation, coal content of formation, etc., can cause the background to increase in addition to an underbalanced situation. Another point is that the formation pressure would have to exceed the ECD (not just the mud weight as in connection gas), in order for the formation gas to feed-in to the well bore.

Trip gas: Analogous in some ways to connection gas, trip gas is the gas registered at surface after circulating bottoms up after a round trip. However, trip gas magnitude is influenced by various other factors such as amount of swabbing and time since last circulation. The presence of trip gas is not necessarily indicative of an underbalanced situation, but the value above background can be used comparatively with other trip peaks.

4.2 Pressure Summary

Formation pressures were monitored throughout this well by recording a range of indicators, varying from direct observations of background gas and cuttings, to drilling characteristics such as torque and drag when pulling off bottom. Incorrect hole fill when tripping and mud properties such as flowline temperature are also taken into consideration. The Geoservices D'Exponent package is also used as a tool in the determination of abnormal formation pressures.

D'exponent:
Coefficients used for this well, with results plotted in Geoservices Pressure Log enclosed.

From 607 m to 3758 m

a coefficient	=	0.0000694
b coefficient	=	-0.1531207
b offset	=	-0.0320000

The D'exponent plot increased in a generally steady linear direction. The plot of the trend gave no indication at all of abnormally pressured zones. The first argillaceous section was from 1525 m down to 2836 m in which the trend was set; this consisted of argillaceous calcilutite and calcareous claystone. The sandstones that were encountered below 2836 m caused a shift to the left in the D'exponent curve as is expected; however other than this the curve followed the normal trend line quite closely.

Gas: This well was drilled with a 1.22 sg (10.2 ppg) over balanced mud system, and while there were several instances of suspected connection gas being observed, this on it's own did not indicate any abnormally pressured zones. There were several small gas peaks observed of levels up to 5% concentration and these were liberated mainly from coal seams. No trip gas of any significance was observed while drilling Culverin 1.

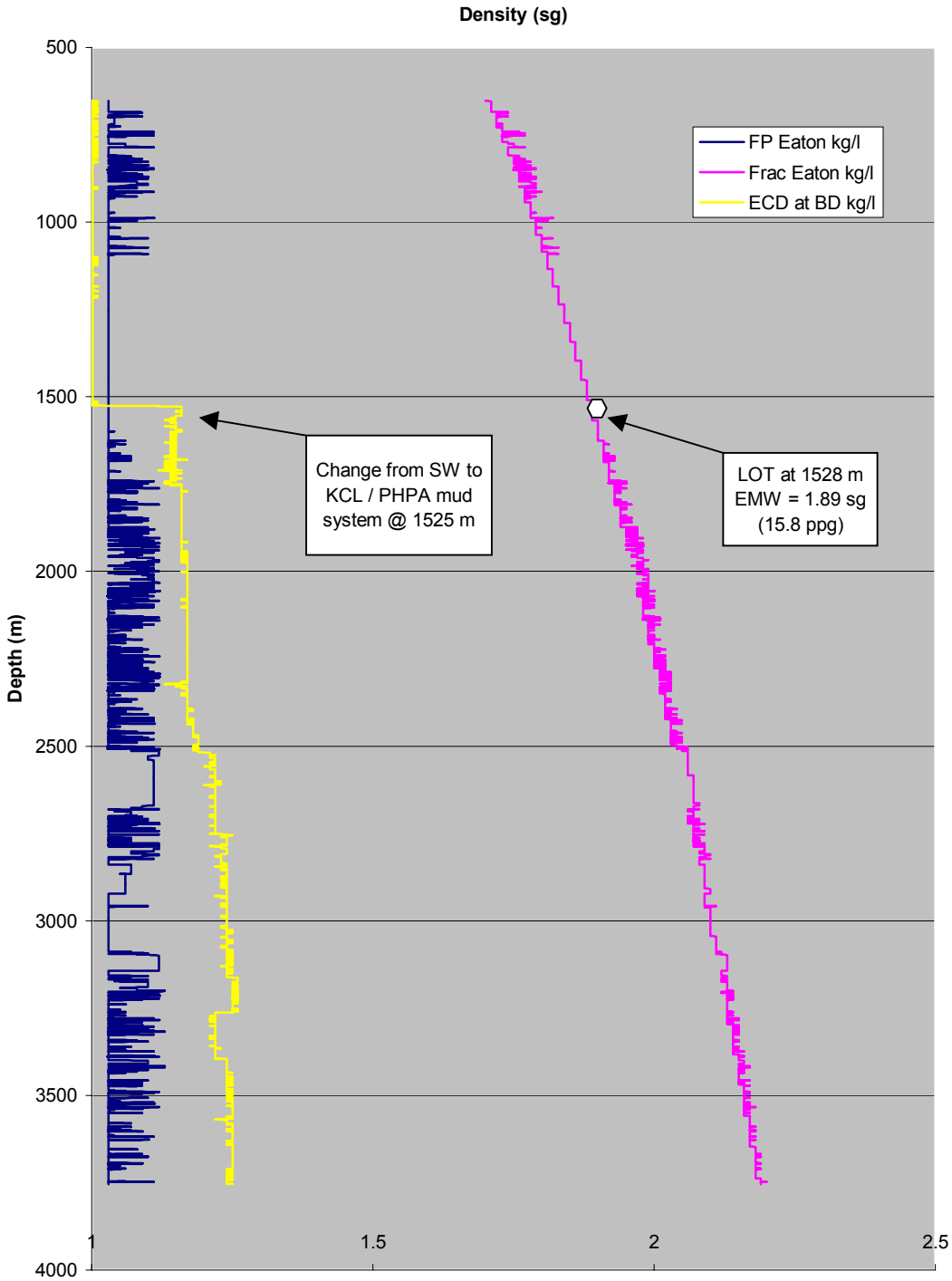
Torque & Drag: No abnormal torque or drag was observed during the drilling or tripping operations, which took place on the Culverin-1 well.

Flowline Temperature: The flowline temperature increased generally in a linear trend over the length of the well. It went from a low of 20°C at the beginning of the 12.25" section to a maximum of 41°C by T.D. The only notable points where the temperature fluctuated was when it dropped after a bit trip, and this occurred only twice where it was expected. Mud temperatures in this well were relatively low due to the cooling effect of the riser in deep water (585 m water depth).

Cuttings: There were no unusually sharp splintery cavings or large cuttings with concave cross section observed at the shakers that may have indicated an abnormally pressured zone in this well.

The majority of indicators pointed to a normally pressured environment from surface to TD while drilling Culverin 1.

4.3 Formation Pressure Plot



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5.0 DRILLING INFORMATION

5.1 Mud Record

From spud at 606.5 m to 1525 m the hole was drilled riser less with returns to the sea floor. These sections were drilled with seawater and swept with hi-vis gel mid-stand and on connections.

From 1525 m to T.D. at 3758 m the hole was drilled with a KCl/NaCl/PHPA/Glycol mud system. The properties of this mud are also listed below.

Depth m	MW ppg	FV sec/qt	PV cps	YP lb/100'	Gels Lb/100'	WL cc/ 30"	Solids %	Sand %	Chlorides mg/L	Cake /32"
1527	9.5	48	10	13	4/6/12	6.6	5.35	NC	36000	1
2070	9.65	56	15	20	4/5/6	6	6	1	36500	1
2600	10.0	55	16	25	6/9/12	4	10	0.8	65000	1
3052	10.2	57	17	26	7/9/12	4	10	1.25	75000	1
3260	10.3	57	17	26	6/9/13	4	10.5	1.25	81500	1
3380	10.2	57	17	30	7/9/11	4	10.5	1.25	82000	1
3402	10.2	60	16	28	7/9/11	4	10.5	1	82500	1
3452	10.2	62	17	33	8/11/13	3.6	10.5	1.5	84000	1
3571	10.2	62	18	27	7/9/11	3.6	10.5	1.25	82000	1
3571	10.2	66	17	31	7/9/11	3.6	10.5	1	82000	1
3571	10.15	57	16	27	6/8/12	3.8	10.5	1	78000	1
3576	10.15	64	17	33	8/11/15	3.6	10.5	1	79000	1
3661	10.15	61	16	30	8/12/15	3.6	10.5	0.8	79000	1
3752	10.15	59	15	30	7/11/15	3.8	10.5	0.7	79000	1

5.2 Bit Record

Bit #	Size (in)	Make	Type	Jets	TFA In^2	In (m)	Out (m)	Run (m)	Hrs	WOB klbs	RPM	TORQ kft*lbs	SPP psi	Flow gpm	Grading
1	17.5" / 36" H.O	Reed	T11	3x22 1x16	1.310	Spud 606.5	650	43	1.5	2-6	-	3.3-4.7	1860-2090	432	0-0-NO-A-O-1-NO-TD
2RR	17.5"	Reed	T11	3x22 1x16	1.310	650	1525	875	31.6	2-36	85-165	3.0-7.0	830-3340	430-1120	1-2-ER-A-O-1-NO-TD
3	12.25"	Reed	RSX616M	4x18 2x28	2.197	1525	3402	1877	96.7	1-29	125-315	4.0-14.4	870-4010	320-1315	4-6-WT-S-X-1-RO-ROP
4	12.25"	Reed	RSX616M	4x18 2x28	2.197	3402	3571	169	27.0	6-30	165-260	4.5-13.8	2830-4060	450-905	3-5-WT-S-X-1-LT-PP
5RR	12.25"	Smith	GF30BOVCPS	3x20	0.920	3571	3758	187	56.4	10-43	70-120	4.5-9.0	3900-4100	790-810	3-3-WT-A-E-IN-CT-TD

5.3 Hydraulic Listing

Depth (m)	Mud Weight (ppg)	ECD (ppg.)	Flow Rate (gpm)	Total Pressure Loss (psi)	Pressure Loss Across Bit (psi)	Mud Velocity Through bit (m/sec)	Bit Hydraulic Power (hp)	Mud Impact at Bit (lbf)	Total Hydraulic Power (hp)	Ratio (Bit Pwr/Total Pwr) (%)
650	8.7	8.7	750	1288	263	56	116	616	570	20.4
900	8.7	8.7	1010	2579	476	75	284	1118	1538	18.5
1400	8.7	8.7	1115	3941	580	83	382	1362	2595	14.7
1525	8.7	8.7	1110	4121	575	83	377	1350	2701	14.0
1544	9.5	9.6	765	2602	108	34	49	425	1178	4.2
2131	9.65	9.75	895	2507	149	40	79	588	1323	6.0
2641	10.0	10.1	900	2815	156	40	83	614	1492	5.5
3115	10.2	10.3	890	3140	156	40	82	613	1649	5.0
3277	10.2	10.3	850	3059	143	38	72	561	1538	4.7
3385	10.2	10.3	890	3279	156	40	82	613	1722	4.7
3402	10.2	10.3	900	3326	159	40	84	624	1763	4.8
3473	10.2	10.3	875	3479	151	39	78	595	1801	4.3
3571	10.2	10.3	870	3277	148	39	76	584	1680	4.5
3571	10.2	10.3	850	3982	1238	112	622	1654	2002	31.1
3619	10.2	10.3	800	3931	1095	105	518	1462	1858	27.8
3697	10.2	10.3	800	3766	1095	105	518	1462	1780	29.1

Revision	Date	Issued by	Approved by	Remarks
1	16-Jan -06	Geoservices Unit 170	Base Mudlogging Coordinator	

5.4 Drilling Phase Summary

5.4.1 914mm (36") Hole Section

Date	: 16th December 2005
Measured depth	: 606.5 m – 650 m
TVDSS LAT	: 585 m – 628.5 m
Number of bits used	: 1
Mud type	: Seawater, with gel sweeps

The rig initially arrived on location on the 6th of November 2005 and started deploying anchors, however due to an anchor winch failure it was decided to take the rig to Eden for repairs and a hull survey.

After the rig arrived on location for a second time on 13th December 2005 the anchors were run and a 445 mm (17.5") Reed T11 bit, with 3x22, 1x16 jets and a 914 mm (36") hole opener and associated BHA were made up. This was run in and tagged the sea floor at 606.5 m. Culverin 1 was spudded at 13:30 hours on the 16th of December 2005. This section was drilled from the sea floor at 606.5 m to 650 m without incident, at this point the hole was displaced to gel mud prior to pulling out. This bit drilled a total of 43 m in 1.5 on bottom hours at an average ROP of 28.7 m/hr and was graded 0-0-NO-A-0-1-NO-TD. 762/508 mm (30"/20") surface conductor was then run and set on bottom at 650 m.

5.4.2 445mm (17.5") Hole Section

Dates	: 18th – 20th December 2005
Measured depth	: 650 m - 1525 m
TVDSS LAT	: 628.5 m – 1503.5 m
Number of bits used	: 1
Mud type	: Seawater with gel sweeps

The next section of hole was drilled with the same 445 mm (17.5") Reed T11 bit with the same 3x22, 1x16 jets. This bit and BHA was run in hole and drilled riser less from 650 m to 1525 m using one bit, with returns to the sea floor. No problems were encountered in this phase, and this bit drilled 875 m in 31.6 on bottom hours at an average ROP of 27.7 m/hr and was graded 1-2-ER-A-0-1-NO-TD. The 340 mm (13.375") casing was then run in hole on drill pipe and the casing shoe was set at 1511 m.

The BOP stack was then run on marine riser and landed out on the wellhead, following this it was pressure tested.

5.4.3 311mm (12.25") Hole Section

Dates	: 24th December 2005 to 6th January 2006
Measured depth	: 1525 m - 3758 mTD
TVDSS LAT	: 1503.5 m – 3753.9 m
Number of bits used	: 3
Mud type	: KCl / NaCl / PHPA / Glycol

A 311 mm (12.25") Hycalog RSX-616M PDC bit was made up with 4x18, 2x28 jets. This was combined with a down hole motor and associated BHA and run in hole down to the top of cement at 1478 m. The cement, float, shoe and shoe track were drilled out and the well displaced to KCl / NaCl / PHPA / Glycol mud. The new hole was then drilled ahead from 1525 m to 1528 m at which point a leak off test was performed, this resulted in an EMW of 1.89sg (15.8ppg). Drilling then resumed from 1528 m to 3402 m before the drilling rate deteriorated and the bit was pulled to surface without problems. This bit drilled 1877 m in 96.7 on bottom hours with an average ROP of 19.4 m/hr, and was graded 4-6-WT-S-X-1-RO-ROP.

Another 311 mm (12.25") Hycalog RSX-616M PDC bit was run in hole and drilling proceeded, once more with downhole motor, from 3402 m to 3571 m before a slow pump pressure loss was observed, suggesting a washout in the drillstring. This bit was then pulled to surface and replaced, however, no washout in the pipe or bottom hole assembly was found. This bit drilled 169 m in 27.0 on bottom hours with an average ROP of 6.3 m/hr, and was graded 3-5-WT-S-X-1-LT-PP.

A new 311 mm (12.25") Smith GF30BOVCPS tricone bit was made up with 3x18 jets and this was run in hole with a BHA without motor but including an extra stabilizer. However, testing of MWD tools at 2500 m depth showed no communication, so this string was also pulled to surface. The stabilizer was then removed from the BHA and this bit was run back to bottom with 3x20 jets. Drilling of the 311 mm (12.25") hole section then continued from 3571 m to a final depth of 3578 mTD. A communication failure occurred with the MWD tools while drilling at 3721 m, however, this did not terminate the drilling and some data below this depth was captured later when the tools were downloaded at surface. This bit drilled 187 m in 56.4 on bottom hours with an average ROP of 3.3 m/hr, and was graded 3-3-WT-A-E-IN-CT-TD. Mud weight ranged from 1.21 to 1.22 sg (10.15-10.2 ppg). The final survey was 2.98° bearing 50.16°. TD was reached at 24:00 hours on 06th January 2006.

Prior to pulling out of hole a section of the hole from 3630 m to 3575 m was re-logged by MWD/FEWD tools, then the drilling string was pulled out of hole without problem. Wireline logs were then run at TD in 2 suites:

Run 1: PEX-HALS-DSI-GR
Run 2: VSI(4)-GR (ZVSP)

Cement plugs were then run and set to abandon the well and the riser was pulled with BOPs. The rig was released at 15:00 hours on 15th January 2006.