Sent:
Subject: FW: Documents
Importance: Normal
Attachments: Macondo Lessons Learned for Relief Wells.ZIP; Macondo_MC 252_1 _Schematic_Rev15.2_04222010_withBOP.ZIP; Macondo_MC 252_1 _Schematic_Rev15.2_04222010.ZIP; 2010-04-25_Macondo_Lithostrat.ZIP

1. Summary LL by hole section on Macondo.
<<...>>
2. As-drilled schematic for original well
<<...>> <<...>>
3. As-drilled lithologic column.
<<...>>

Thanks,
Tim

Lessons:

36" Jetting

- Modified Jetcap on location to account for actual weights and deviations in weight indicator.
- Jetting speeds are faster if you reduce skin friction at the on set of reciprocation to the minimum line and build up into the desired range while getting closer to the final depth
- Soak time of 2.5 hours was adequate to drill ahead with CADA tool.

28" Casing Interval

- Directional driller did not push WOB to reduce likelihood of building angle w/out directional control tools in the hole and the Smith DTU.
- Casing running went smooth, no gumbo or flow noted when spotting pad mud.
- Returns were seen during cement job from black dye and pH meter on the ROV.
- Issues releasing from the 28" running tool. It appeared that making it up with the top drive instead of by hand caused extra torque to be locked into the tool. It was made up by hand on the 22" (bumped with rig tongs, then slightly back off) and no issues were seen when breaking it out).

22" Casing Interval

- Fast drill worked well – required up to 100k WOB to maintain ROP between 300-400 fph (190 fph avg w/ connections). Able to achieve 9 6 ppg ECD No flow seen while drilling – quick connections and WOB are keys to Fast drill success
- Large amounts of gumbo were seen when pad mud was circulated to the wellhead. WSL opted to make a clean-out run, which did not show any tight spots, but gumbo continued during the entire run.
- ROV had to jet around the wellhead valves to gain access prior to the cement job because of the gumbo pile (be prepared to do the same or use BHA to do this without rotation).
- Well slightly flowed with 12.0 ppg pad mud while casing was being run, a tight spot was encountered at 6730'. Easily washed through without issue. Sands in the next interval at 8900'-9000' were drilled with 10.1-10.2 ppg ESD (deepest flowed at 10.11 ppg ESD /'didn't flow with 10.13 ppg ECD) Therefore if 22" is pushed deeper, 12.0+-12.5 ppg pad mud might be required.
- Casing took weight again at 7590' and had to be washed to TD.
- Black dye and pH were observed again on cement job.

18" Casing Interval

- Low LOT at the 22" shoe. The subsurface team says a sand may have been present at the shoe, but no conclusive evidence was found Some evidence indicates it could have been a weaker shales.
- Limit drill-out mud weight so there is pressure to build up during LOT. Margin between hydrostatic and LOT was too small at this shoe causing a lack in data and therefore difficulty understanding what issue was being faced (equipment, bad shoe or formation).
- Sands at ~8900-9000' were connected to Rigel and pressures were similar, causing a small influx. Difficult to kill without losses because of the small margin between the 18" LOT and kick (10 34 vs 10 12 ppg DH-MW). The 22" should be pushed at least 500' to increase fracture gradient
- A salt exit type strategy was deployed while drilling the sands from ~8900-9000' so a kick could be quickly caught (drill into sand pick up and flow check) This worked effectively for tight margins The new casing design increases these margins so using this strategy shouldn't be required If concerns exist about the depleted Rigel sands this technique could be used to reduce chances of getting stuck during a major loss event.
- 22" sheath reamer was run and no issues were encountered with the BHA or getting 18" to bottom.
- Ballooning was encountered while drilling ahead after the kick was killed.
- Losses were encountered while running the 18" liner in riser. Losses stopped once casing was past the wellhead. Losses we the same when running at 3-5 min/stand. Running speed of 3 min/stand was used to reduce losses by getting casing to bottom faster

16" Casing Interval

- Multiple LOT required again due to two leaky valves in the system (18" shoe) Pack-off occurred during LOT and broke formation down, shoe was eventually squeezed (cause of remediation not clear: bad primary cement job or issues caused during pack-off)
- Tried to push casing point and encountered high gas (3000 units) and required 0.4 ppg mud weight increase from 12.100-12250'.
- Weak marls at 9050-9250' broke down while circulating at the 16" TD. Marls also appear to be very brittle and once they are broken become difficult to fix (true for the 18" down). ECD's in this interval had been at 11.73 ppg and when the losses

occurred were dropping as the cuttings load was being removed (11.71 ppg). Formations appeared to be time sensitive and only slightly stronger than sand fracture gradient. Stresscage does not appear to help. Emergency LCM pill did work the first time, but did not hold up very long and after breaking down again, did future pills added no benefit. Mud weight was cut to 11.2 ppg surface and both EZ-Squeeze and Forma-set tandem pills were bullheaded away when the well was stable in order to regain circulation. Spotting pills in Marls was ineffective when well was unstable / taking fluid Forma-squeeze and Forma-set tandem pill was most effective (ez-squeeze added some benefit too), but both are needed in large volume 300+ bbls...

- Honoring initiation pressure/closure pressure on LOT might have prevented weak Marls from being broken down. New casing design margins should give room to stay below these pressures using the 0.5 ppg margin on shale fracture gradient.
- Casing went to desired depth smoothly, did encounter losses the entire trip, and shoe had to be squeezed (fluid swap because of 765' rathole). Did not make it back to bottom, due to high gas and a bridge being in the hole at ~11,638'. Team was concerned about what was below the bridge due mud weight cut.
- Dual Weatherford plugs – did not see bottom plug leave or land (no indication of why, saw both darts go through diverter)
- Depleted gas sands from the Rigel field were presented in the pre-drill risks (Rigel gas sands ~10,700' TVD). Stresscage could not manage this depletion if it was at or below 7.9 ppg. These sands were not present, but they are channel sands and could be present in another wellbore. Need contingency plans in place if encountered to reduce losses. There is also a water sand above these produced sands which was anticipated to be virgin pressure (~10,200' tvd)
- Don't raise mud weight until LOT is performed Reduces issues encountered when fixing a bad shoe.

13-5/8" Casing Interval

- Previously drilled hole was washed out, unstable, and caused numerous sticking/pack-off events while getting back to 12,350'. It did no react this way when originally drilled, but the losses and mud weight change appeared to destabilize.
- Channel sand kicked at 13,250'-13,305' (slow influx over 30 minutes). Sand estimated to be pressured between 12.55 and 12 8 ppg (drilling w/ 12 42 ppg ECD) No clear indication of the actual sand pressure as the hole packed off around the BHA and the sand was not present on the sidetrack 60' away. BHA was left in the hole and wellbore sidetracked.
- No issues running liner or cementing

11-7/8" Liner Interval

- High LOT over overburden experienced. Did not do an open hole LOT to confirm as the plan was to not push this casing point based on previous experience with weak formations. Again no clear explanation of this phenomena, but both leading explanations so far point to having a short open hole section open below the casing shoe. This higher LOT was also seen on the Yumuri offset well. Not setting casing on bottom or drilling more formation (~50) prior to doing the LOT is expected to alleviate the issue.

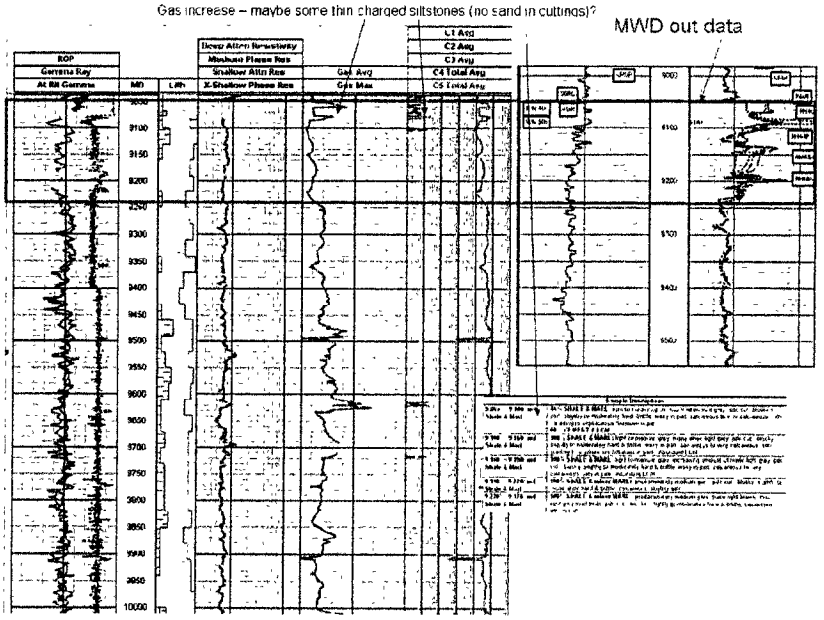
9-7/8" Liner Interval

- Normal LOT – Liner was set on bottom and only 10' of new formation drilled for this section (same conditions as 11-7/8")
- Resistivity trends showed increasing pore pressure throughout the interval, mud weight was raised based on this phenomenon. Near end of interval drilling team pushed ahead without raising mud again based on only having one indicator of pore pressure increase. A second indicator was never seen and there wasn't any issues during the liner job.

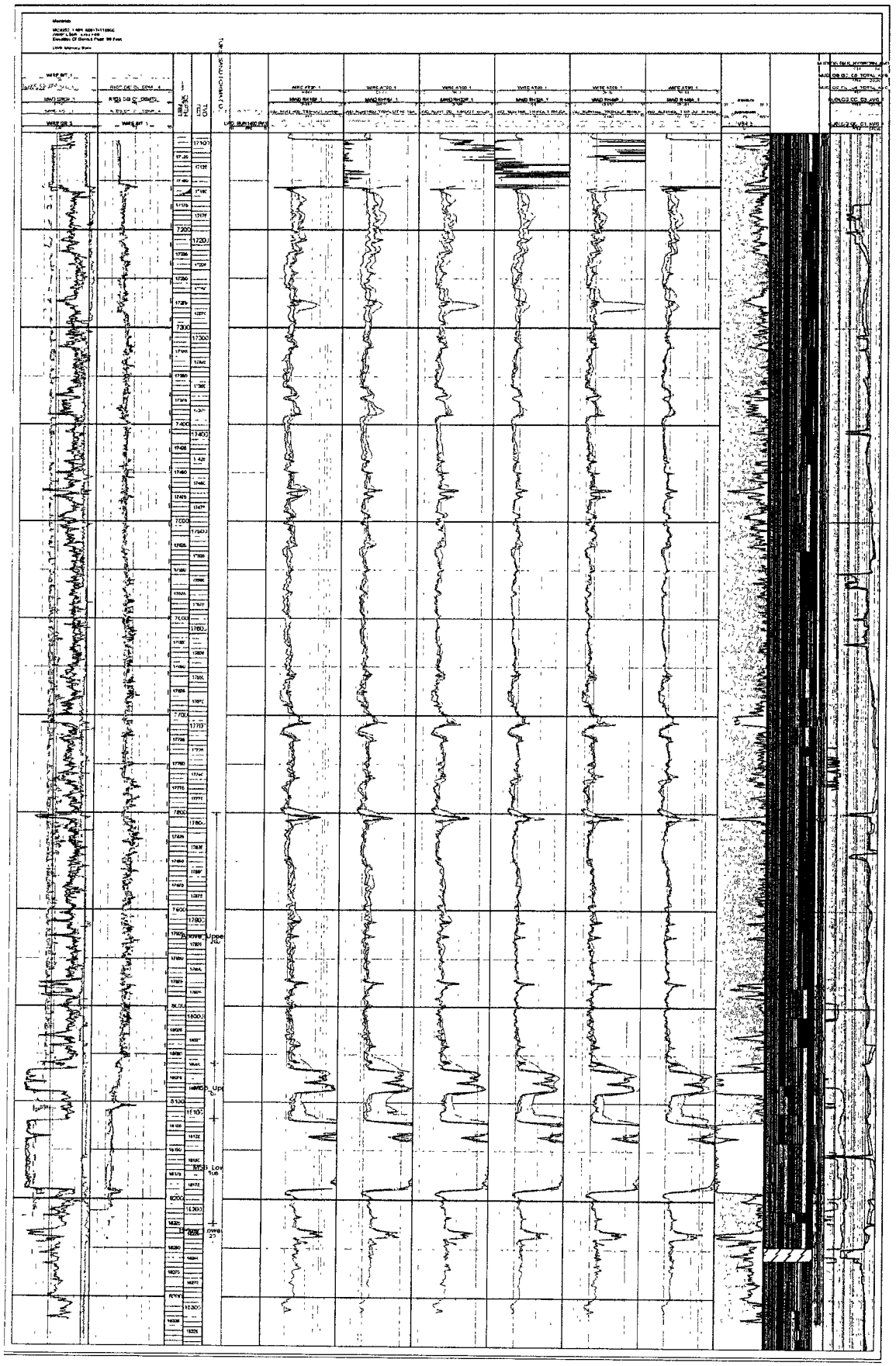
Production Interval

- Elevated LOT similar to 11-7/8" hole section – liner was set on bottom again.
- Losses incurred while drilling hole section due to raising mud weight to 14 5 ppg surface. Emergency did pill some good, but decreasing mud weight allowed for drilling ahead. After the losses ballooning was also experienced.
- Upper sand pressures seen from 14 15 ppg to 12.5 ppg
- Losses occurred for a second time with the bit at 18,260' MD, while circulating to POOH for a new BHA (ECD 14.5 ppg / drilling ECD at max in interval was 14.9 ppg). No clear indication of loss zone from memory data, but expected by subsurface team to be at the bottom of the large sand lobe (brittle sand is present) Cut mud weight in the riser to reduce losses and spotted a tandem forma-squeeze and forma-set pill (300 bbls). After the Forma-set cured, losses continued until the pumps were turned on, at which time the LCM pill appeared to be squeezed into the loss zone. At this point we were able to circulate up to 14.5 ppg without issue.

Losses at 9050-9250' TVD



Losses below 9-7/8" Shoe



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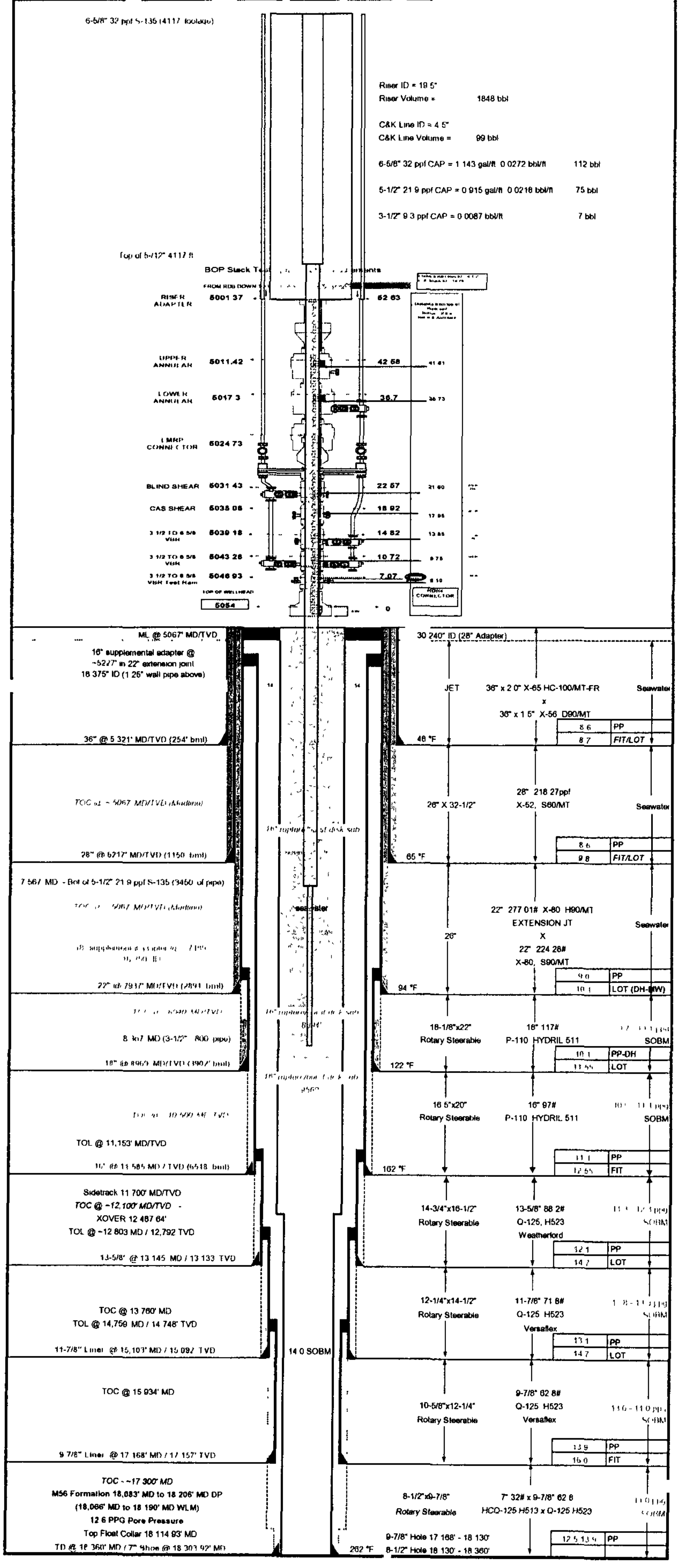
BP GoM Deepwater Exploration

Macondo

OPERATOR	BP PARTNER Anadarko MOEX	DATE	4/22/2010 Rev 15
WELL NAME	MC 252 #1 MACONDO PROSPECT OCS-G 32306	PTD	19 650' MD/TVD
FIELD / PROSPECT	WILDCAT AREA OFFSHORE STATE LA	RF ELEV	75 (Horizon) WD 4992
SURFACE LOCATION	X=1 202 798 33 Y=10 431 619 79	BHL	X=1 202 638 20 Y=10 431 565 74
OBJECTIVE ZONE(S)	M56	RIG	Transocean Deepwater Horizon

DRIL-QUIP SS-15 BIGBORE II - 27" O D HD-H4 Conn

LPWH Stickup - 10 DEPTH (RKB) WELLHEAD SYSTEM WITH 18 500" ID HOLE SIZE CASING MUD



6-5/8" 32 ppf S-135 (4117 footage)
Riser ID = 19 5"
Riser Volume = 1848 bbl
C&K Line ID = 4 5"
C&K Line Volume = 99 bbl
6-5/8" 32 ppf CAP = 1 143 gal/ft 0 0272 bbl/ft 112 bbl
5-1/2" 21 9 ppf CAP = 0 915 gal/ft 0 0218 bbl/ft 75 bbl
3-1/2" 9 3 ppf CAP = 0 0087 bbl/ft 7 bbl
Top of 5-1/2" 4117 ft
BOP Stack
RISER ADAPTER 5001 37 62 63
UPPER ANNULAR 5011.42 42 58
LOWER ANNULAR 5017 3 36.7
LMRP CONNECTOR 5024 73
BLIND SHEAR 5031 43 22 57
CAS SHEAR 5035 08 18 92
3 1/2 TO 6 5/8 VBR 5039 18 14 82
3 1/2 TO 6 5/8 VBR 5043 28 10 72
3 1/2 TO 6 5/8 VBR Test Ram 5046 93 7 07
TOP OF WELLHEAD
5054
0
H4 CONNECTOR
ML @ 5067' MD/TVD
30 240" ID (28" Adapter)
16" supplemental adapter @ ~5227' in 22" extension joint 18 375" ID (1 25" wall pipe above)
JET
36" x 2 0" X-65 HC-100/MT-FR x 36" x 1 5" X-56 D90/MT
Seawater
8 6 PP
8 7 FIT/LOT
36" @ 5 321' MD/TVD (254' bml)
48 °F
26" X 32-1/2"
28" 218 27ppf X-52, S60/MT
Seawater
8 6 PP
9 8 FIT/LOT
28" @ 6217' MD/TVD (1150 bml)
65 °F
7 567 MD - Bot of 5-1/2" 21 9 ppf S-135 (3450 of pipe)
seawater
26"
22" 277 01# X-80 H90/MT EXTENSION JT x 22" 224 28# X-80, S90/MT
Seawater
9 0 PP
10 1 LOT (DH-MW)
22" @ 7937' MD/TVD (2891 bml)
94 °F
8 367 MD (3-1/2" 800 pipe)
18-1/8"x22" Rotary Steerable
18" 117# P-110 HYDRIL 511
SOBM
10 1 PP-DH
11 55 LOT
18" @ 8969 MD/TVD (3902' bml)
122 °F
16 5"x20" Rotary Steerable
16" 97# P-110 HYDRIL 511
SOBM
TOL @ 11,153' MD/TVD
11 1 PP
12 55 FIT
16" @ 11 585 MD / TVD (6518 bml)
162 °F
Sidetrack 11 700' MD/TVD
TOC @ ~12,100' MD/TVD
XOVER 12 487 64'
TOL @ ~12 803 MD / 12,792 TVD
14-3/4"x16-1/2" Rotary Steerable
13-5/8" 88 2# Q-125, H523 Weatherford
SOBM
12 1 PP
14 7 LOT
13-5/8" @ 13 145 MD / 13 133 TVD
TOC @ 13 760' MD
TOL @ 14,759 MD / 14 748' TVD
12-1/4"x14-1/2" Rotary Steerable
11-7/8" 71 8# Q-125 H523 Versaflex
SOBM
13 1 PP
14 7 LOT
11-7/8" Liner @ 15,103' MD / 15 092 TVD
14 0 SOBM
TOC @ 15 934' MD
10-5/8"x12-1/4" Rotary Steerable
9-7/8" 62 8# Q-125 H523 Versaflex
SOBM
13 9 PP
16 0 FIT
9 7/8" Liner @ 17 168' MD / 17 157' TVD
TOC - ~17 300' MD
M56 Formation 18,083' MD to 18 206' MD DP
(18,066' MD to 18 190' MD WLM)
12 6 PPG Pore Pressure
Top Float Collar 18 114 93' MD
TD @ 18 360' MD / 7" Shoe @ 18 303 92' MD
8-1/2"x9-7/8" Rotary Steerable
7" 32# x 9-7/8" 62 8 HCQ-125 H513 x Q-125 H523
SOBM
9-7/8" Hole 17 168' - 18 130'
8-1/2" Hole 18 130' - 18 360'
262 °F
12 5 13 9 PP

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Schematic_AS DRILLED, 7/21/2011

Document Produced Natively

BP GoM Deepwater Exploration

Macondo

OPERATOR:	BP PARTNER: Anadarko, MOEX	**DATE:**	4/22/2010_Rev 15
WELL NAME:	MC 252 #1, MACONDO PROSPECT, OCS-G-32306	**PTD:**	19,650' MD/TVD
FIELD / PROSPECT:	WILDCAT AREA: OFFSHORE STATE LA	**RF ELEV:**	75' (Horizon) WD: 4992'
SURFACE LOCATION:	X=1,202,798.33 Y=10,431,619.79	**BHL:**	X=1,202,638.20 Y=10,431,565.74
OBJECTIVE ZONE(S):	M56	**RIG:**	Transocean Deepwater Horizon

DRIL-QUIP, SS-15 BIGBORE II - 27" O.D. HD-H4 Conn.

LPWH Stickup - **10'** DEPTH (RKB) WELLHEAD SYSTEM WITH 18.500" ID HOLE SIZE CASING MUD

ML @ 5067' MD/TVD

16" supplemental adapter @ **~5227'** in 22" extension joint
18.375" ID (1.25" wall pipe above)
Top 6-5/8" 32 ppf S-135 ~4916' (4117' footage)

36" @ 5,321' MD/TVD (254' bml)

TOC @ ~ 5067' MD/TVD (Mudline)

28" @ 6217' MD/TVD (1150' bml)

TOC @ ~ 5067' MD/TVD (Mudline)

18" supplemental adapter @ ~ 7489'
18.250" ID

22" @ 7937' MD/TVD (2891' bml)

TOC @ ~8040' MD/TVD

18" @ 8969' MD/TVD (3902' bml)

5-1/2" 21.9 ppf S-135 (Top 9033' - 3450' of pipe)

TOC @ ~10,500' MD/TVD

TOL @ 11,153' MD/TVD

16" @ 11,585 MD / TVD (6518' bml)

Sidetrack 11,700' MD/TVD
TOC @ ~12,100' MD/TVD -
XOVER 12,487.64' - 12,483.86' MD (Top of 3-1/2" - 800' pipe)
TOL @ ~12,803 MD / 12,792 TVD

13-5/8" @ 13,145' MD / 13,133' TVD

TOC @ 13,760' MD
TOL @ 14,759' MD / 14,748' TVD
Base 3-1/2" 13,283' MD

11-7/8" Liner @ 15,103' MD / 15,092' TVD

TOC @ 15,934' MD

9-7/8" Liner @ 17,168' MD / 17,157' TVD

TOC - ~17,300' MD

Top Float Collar 18,114.93' MD

TD @ 18,360' MD / 7" Shoe @ 18,303.92' MD

14 14

16" rupture burst disk sub 6947'

Seawater

16" rupture burst disk sub 8304'

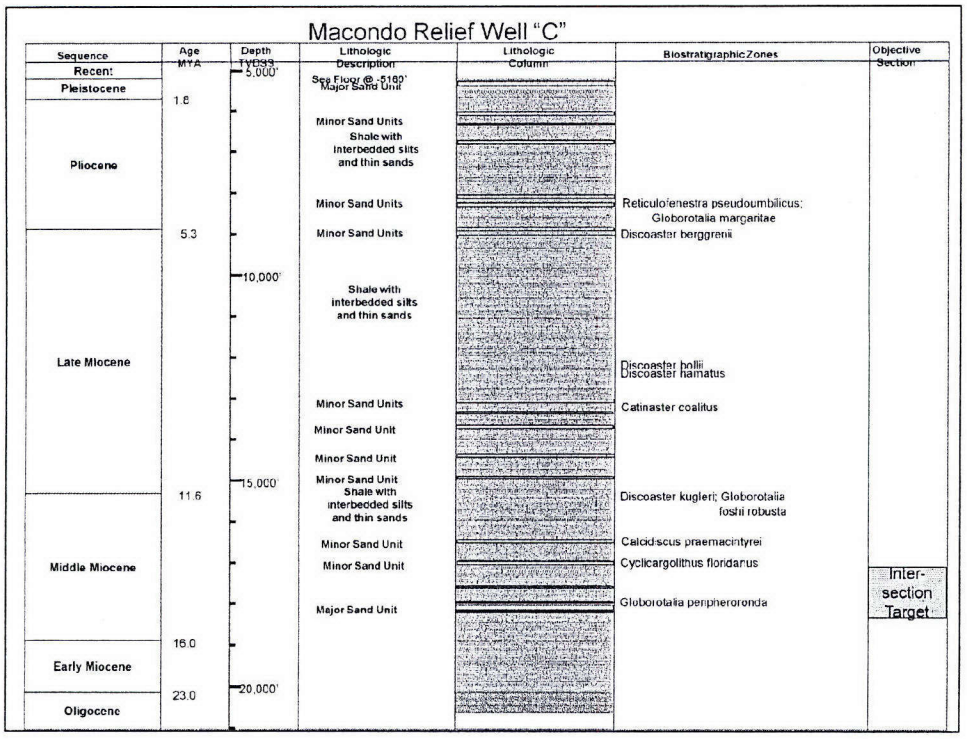
16" rupture burst disk sub 9590'

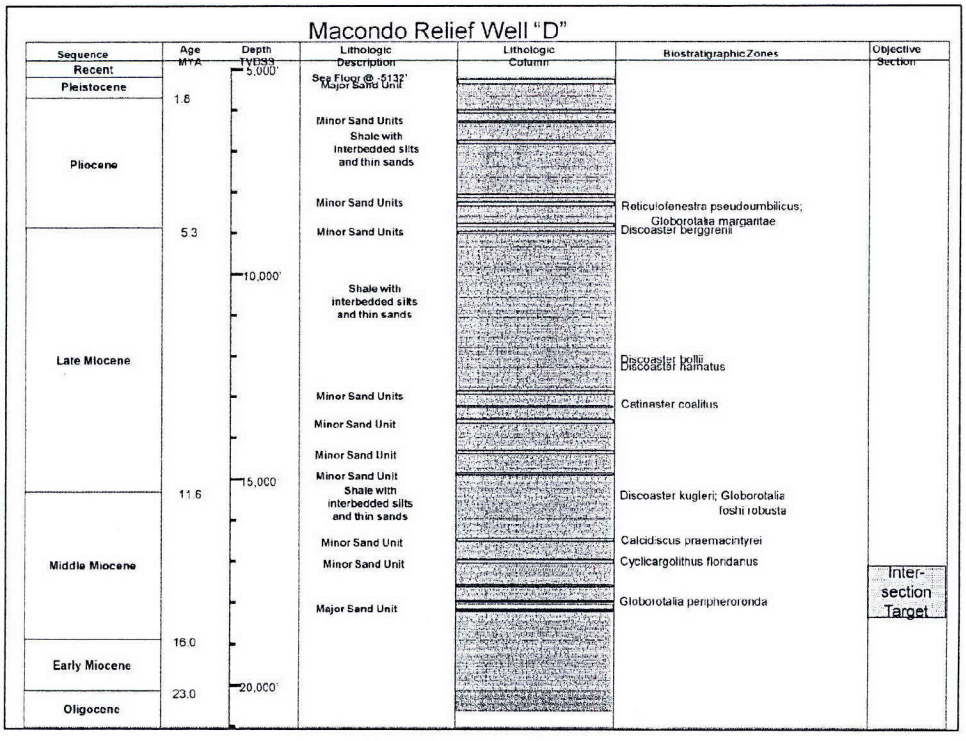
14.0 SOBM

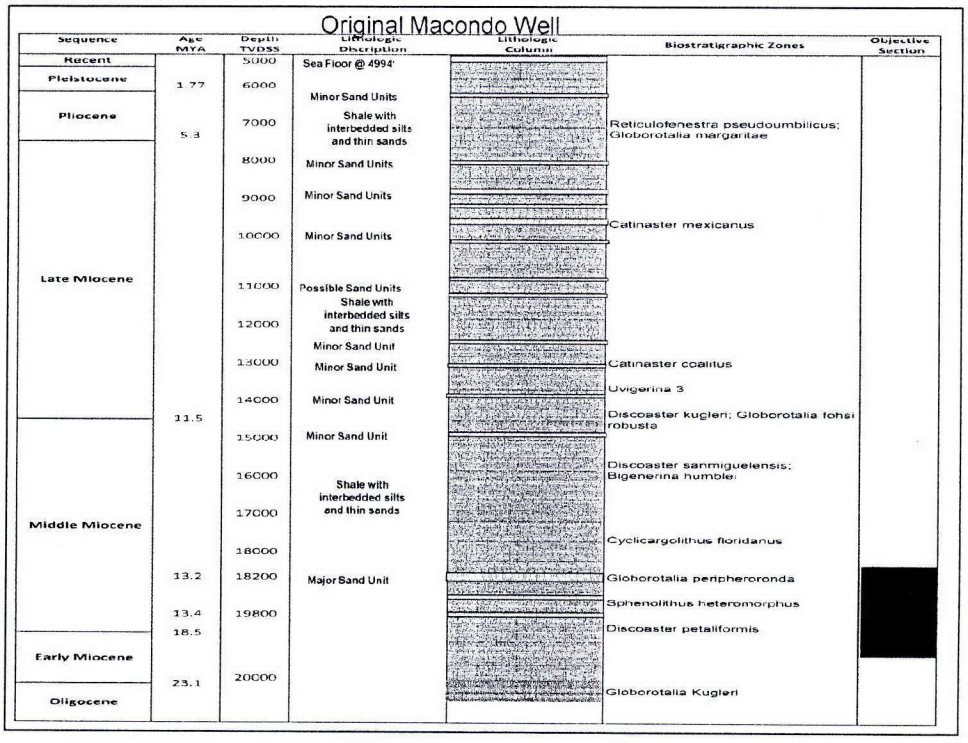
30.240" ID (28" Adapter)

JET	36" x 2.0",X-65 HC-100/MT-FR x 36" x 1.5", X-56, D90/MT	Seawater	8.6 PP	48 °F
			8.7 FIT/LOT	
26" X 32-1/2"	28", 218.27ppf X-52, S60/MT	Seawater	8.6 PP	65 °F
			9.8 FIT/LOT	
26"	22", 277.01#, X-80, H90/MT EXTENSION JT X 22", 224.28# X-80, S90/MT	Seawater	9.0 PP	94 °F
			10.1 LOT (DH-MW)	
18-1/8"x22" Rotary Steerable	18" 117# P-110, HYDRIL 511	9.7 - 10.1 ppg SOBM	10.1 PP-DH	122 °F
			11.55 LOT	
16.5"x20" Rotary Steerable	16" 97# P-110, HYDRIL 511	10.9 - 11.1 ppg SOBM	11.1 PP	162 °F
			12.55 FIT	
14-3/4"x16-1/2" Rotary Steerable	13-5/8" 88.2# Q-125, H523 Weatherford	11.8 - 12.3 ppg SOBM	12.1 PP	
			14.7 LOT	
12-1/4"x14-1/2" Rotary Steerable	11-7/8" 71.8# Q-125, H523 Versaflex	12.8 - 13.3 ppg SOBM	13.1 PP	
			14.7 LOT	
10-5/8"x12-1/4" Rotary Steerable	9-7/8" 62.8# Q-125, H523 Versaflex	13.6 - 14.0 ppg SOBM	13.9 PP	
			16.0 FIT	
8-1/2"x9-7/8" Rotary Steerable	7" 32# x 9-7/8" 62.8 HCQ-125 H513 x Q-125 H523	14.0 ppg SOBM	12.5-13.9 PP	262 °F

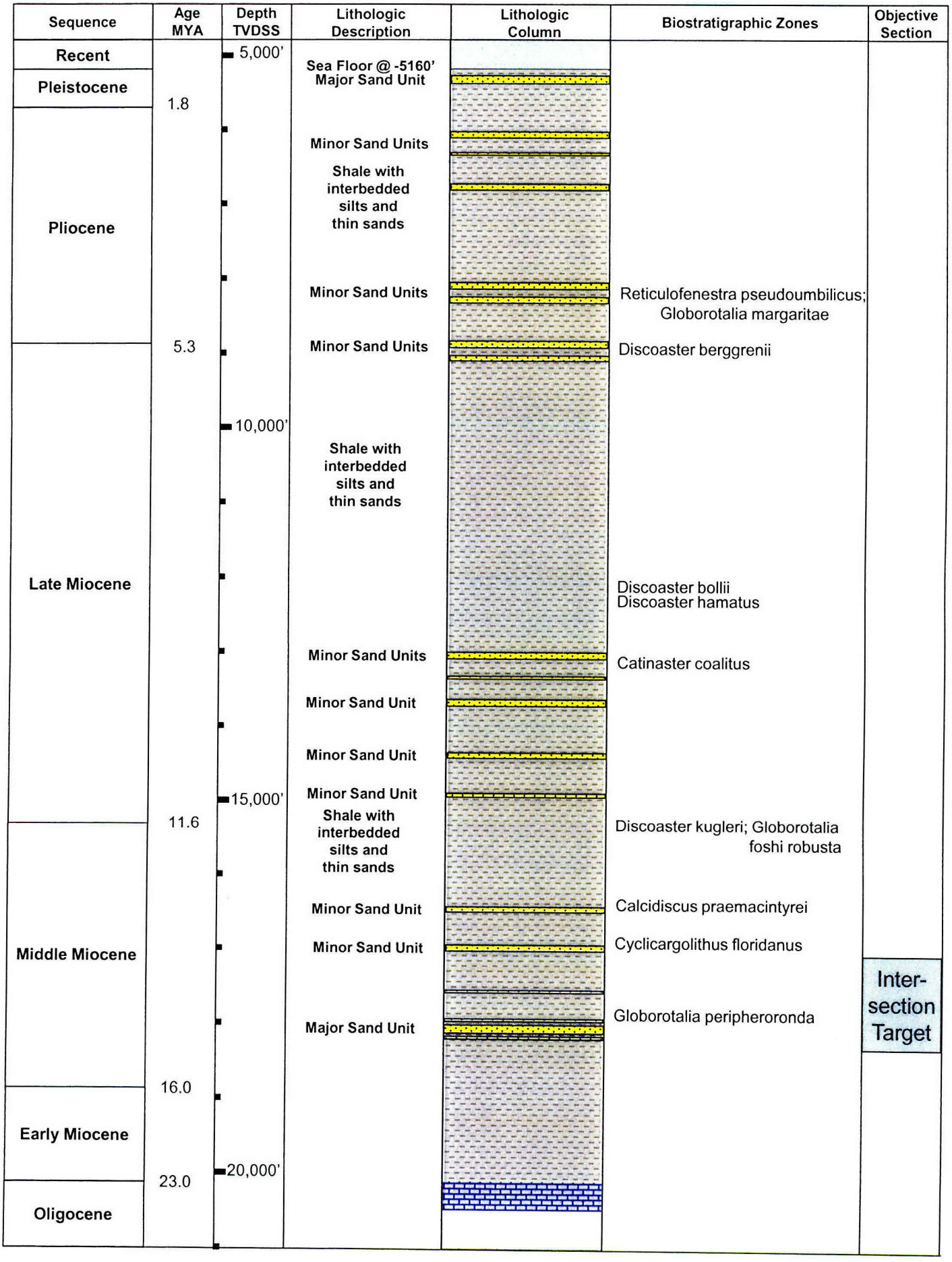
9-7/8" Hole 17,168' - 18,130'
8-1/2" Hole 18,130' - 18,360'


Macondo Relief Well "C"
Sequence
Age MYA
Depth TVDSS
Lithologic Description
Lithologic Column
Biostratigraphic Zones
Objective Section
Recent
Pleistocene
1.8
Pliocene
5.3
Late Miocene
11.6
Middle Miocene
16.0
Early Miocene
23.0
Oligocene
5,000'
10,000'
15,000'
20,000'
See Floor @ -5180'
Major Sand Unit
Minor Sand Units
Shale with interbedded silts and thin sands
Minor Sand Units
Minor Sand Units
Shale with interbedded silts and thin sands
Minor Sand Units
Minor Sand Unit
Minor Sand Unit
Minor Sand Unit
Shale with interbedded silts and thin sands
Minor Sand Unit
Minor Sand Unit
Major Sand Unit
Reticulofenestra pseudoumbilicus; Globorotalia margaritae
Discoaster berggrenii
Discoaster bollii
Discoaster hamatus
Catinaster coalitus
Discoaster kugleri; Globorotalia foshii robusta
Calcidiscus praemacintyrei
Cyclicargolithus floridanus
Globorotalia perpheroronda
Inter-section Target

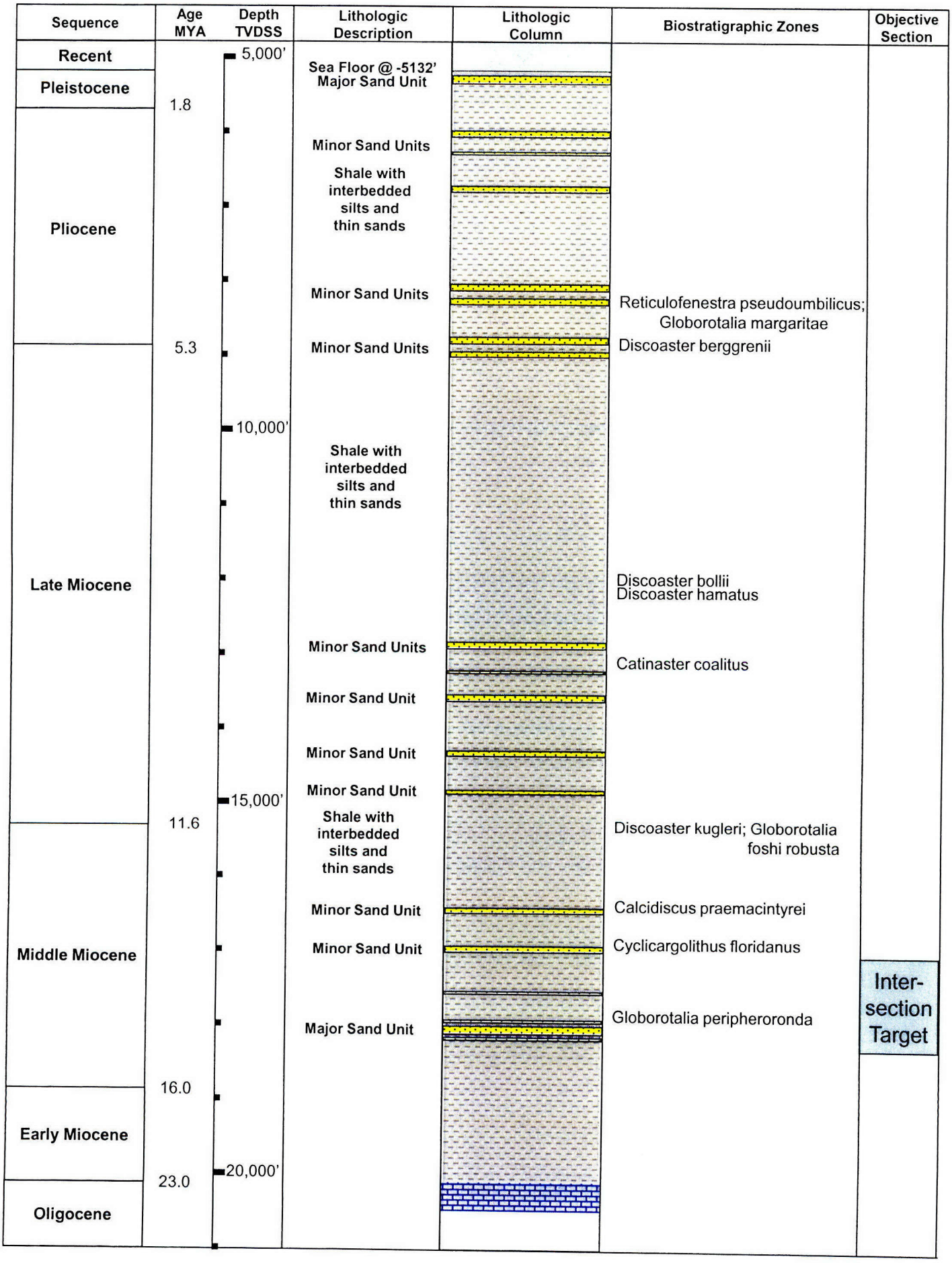

Macondo Relief Well "D"
Sequence
Age MYA
Depth TVDSS
Lithologic Description
Lithologic Column
Biostratigraphic Zones
Objective Section
Recent
Pleistocene
1.6
Pliocene
5.3
Late Miocene
11.6
Middle Miocene
16.0
Early Miocene
23.0
Oligocene
5,000'
10,000'
15,000'
20,000'
Sea Floor @ -5132'
Major Sand Unit
Minor Sand Units
Shale with interbedded silts and thin sands
Minor Sand Units
Minor Sand Units
Shale with interbedded silts and thin sands
Minor Sand Units
Minor Sand Unit
Minor Sand Unit
Minor Sand Unit
Shale with interbedded silts and thin sands
Minor Sand Unit
Minor Sand Unit
Major Sand Unit
Reticulofenestra pseudoumbilicus; Globorotalia margaritae
Discoaster berggrenii
Discoaster bollii
Discoaster hamatus
Catinaster coalitus
Discoaster kugleri; Globorotalia foshi robusta
Calcidiscus praemacintyrei
Cyclicargolithus floridanus
Globorotalia perpheroronda
Inter-section Target


Original Macondo Well
Sequence
Age MYA
Depth TVDSS
Lithologic Discription
Lithologic Column
Biostratigraphic Zones
Objective Section
Recent
Pleistocene
Pliocene
Late Miocene
Middle Miocene
Early Miocene
Oligocene
1.77
5.3
11.5
13.2
13.4
18.5
23.1
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
18200
19800
20000
Sea Floor @ 4994'
Minor Sand Units
Shale with interbedded silts and thin sands
Minor Sand Units
Minor Sand Units
Minor Sand Units
Possible Sand Units
Shale with interbedded silts and thin sands
Minor Sand Unit
Minor Sand Unit
Minor Sand Unit
Minor Sand Unit
Shale with interbedded silts and thin sands
Major Sand Unit
Reticulofenestra pseudoumbilicus; Globorotalia margaritae
Catinaster mexicanus
Catinaster coalitus
Uvigerina 3
Discoaster kugleri; Globorotalia fohsi robusta
Discoaster sanmiguelensis; Bigenerina humblei
Cyclicargolithus floridanus
Globorotalia peripheroronda
Sphenolithus heteromorphus
Discoaster petaliformis
Globorotalia Kugleri

Macondo Relief Well "C"



Macondo Relief Well "D"



Original Macondo Well