OBI/ABI Image Log SummaryHole MW-14

Malcolm Pirnie

Phoenix, Maricopa County, Az

Image Features Rotated 11.5 deg E for Magnetic Declination to True North

Feature Dip is from 0 to 90 deg (0 = Horizontal, 90 = Vertical) Logged: June 10, 2008

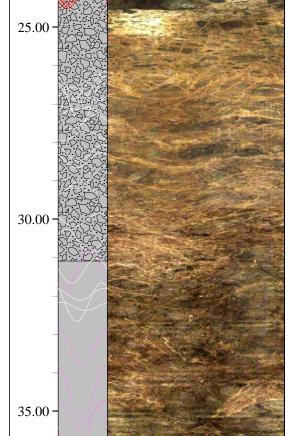


Southwest Exploration Services, LLC borehole geophysics & video services

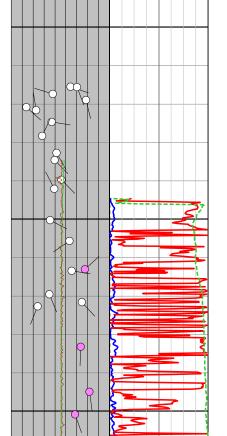


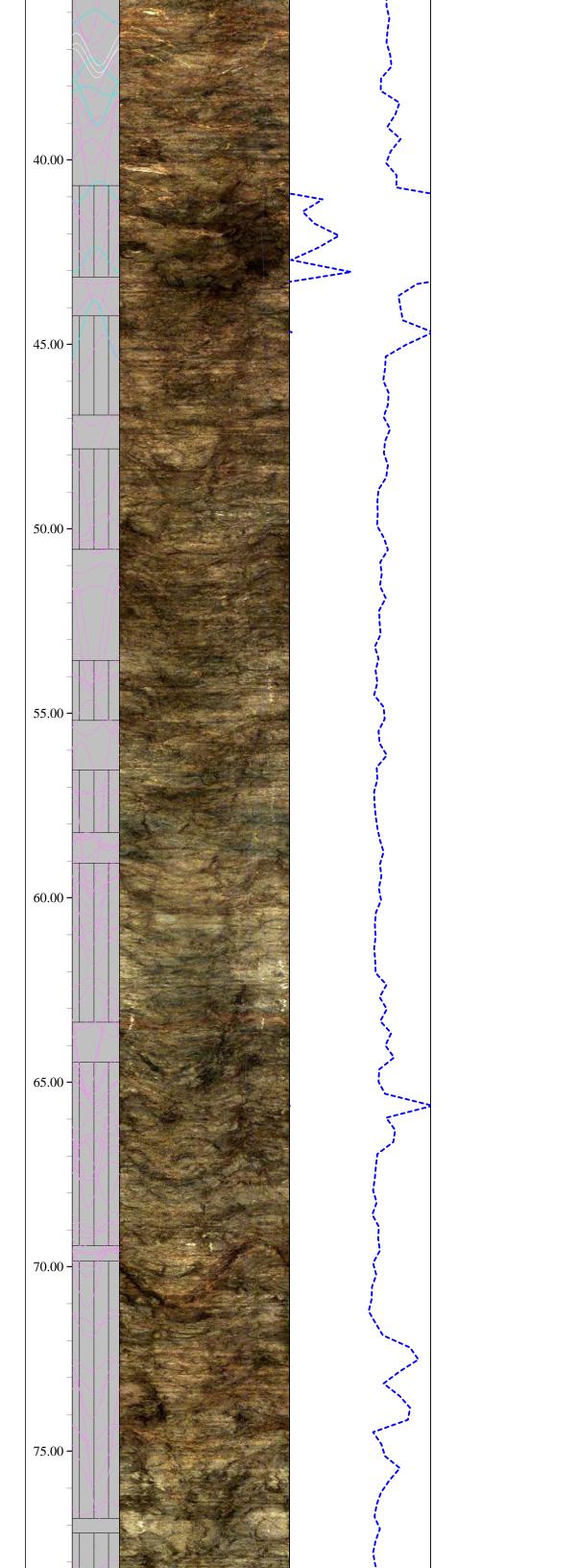
Optical and Acoustic Image Features Legend
O In-filled Fracture/joint or vein
Major fracture - distinct wide fracture/joint continuous around circumference of hole
Bedding - apparent bedding; rock boundary; banding or foliation feature
Fluid level in boreohle
• Unclassified - planar feature continuous around circumference - type of feature not determined: may be a: 1) fracture; 2) bedding feature; etc.
• Distinct probable fracture/joint continuous over a portion of the circumference of hole - usually terminated at another fracture interesection
Minor fracture - thin or discontinuous fracture/joint around circumference of hole
Bottom of Casing
VFx Lithology Legend
Breccia or Conglomerate 2 Near Vertical Fxs
Q ₀ Q ₀ Q Large Vugs/Vesicles (> 6") 2 Wide Near Vertical Fxs
Medium Vugs/Vesicles (2-6") Drilling Induced Fxs
Small Vugs/Vesicles (< 2")
>2 Near Vertical Fxs

Depth	Picks		Iı	mage-N	М		Centralized TT	Amplitude	3D-OBI	3D-ABI	F	eatur	es		Tilt	
1ft:30ft	DIPA		Orient	ted Mag	North		Oriented Mag North	Oriented Mag North	0°	0°		DIPT		Merg	ged OB	sI-ABI
		0°	90°	180°	270°	0°	0° 90° 180° 270° 0	0° 90° 180° 270° 0°			0		90	0	deg	8
	VFx						Caliper					ag.Fie			Azimut	
		-					4 inches	5			Merg	jed OE	BI-ABI	Mer	ged OB	I-ABI
	ARI					F	Min Acoustic Caliper	-			0	uΤ	90	0	deg	360
]					4 in	5				Gravit	-		CA	
							Max Acoustic Caliper				Merg	jed OE	BI-ABI	0	dog	260
							4 in	5			0.8	G	1.2	0	-	360
							Ave Acoustic Caliper								CD	
							4 in	5						0	[ft]	20
							Breakouts							0		
							MM	/-14 ABI-O	BI							
								Bottom of Steel Cond ~	.22'							
_		1.16			100	din .			100							
			To ye			10										
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	2.213.2				45.4	No.		Washout or Fx?	I DOWNER							
_	0.200			New York	-			-								

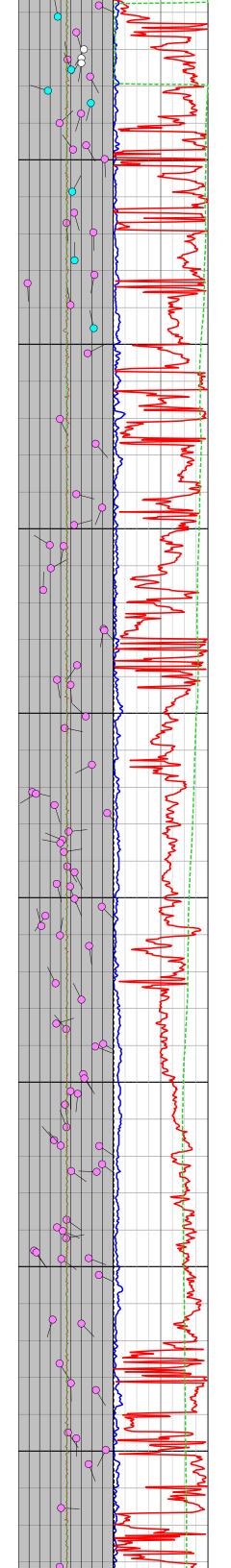


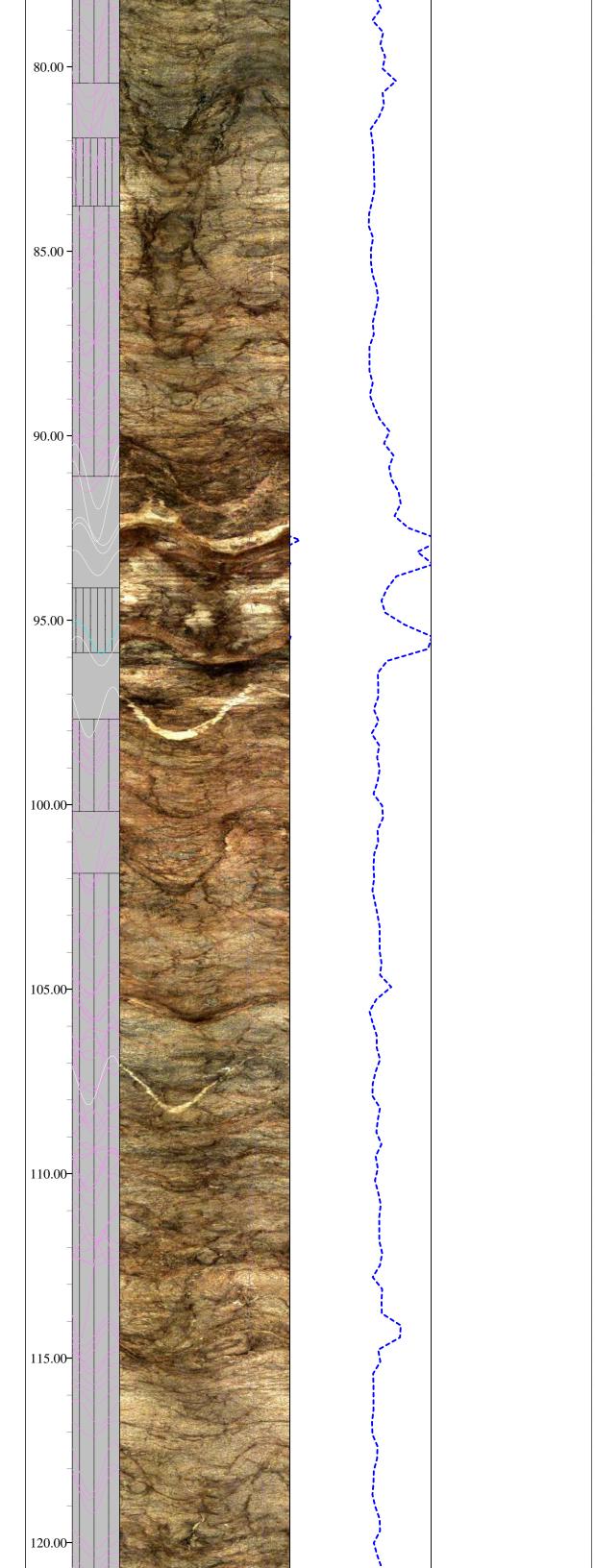




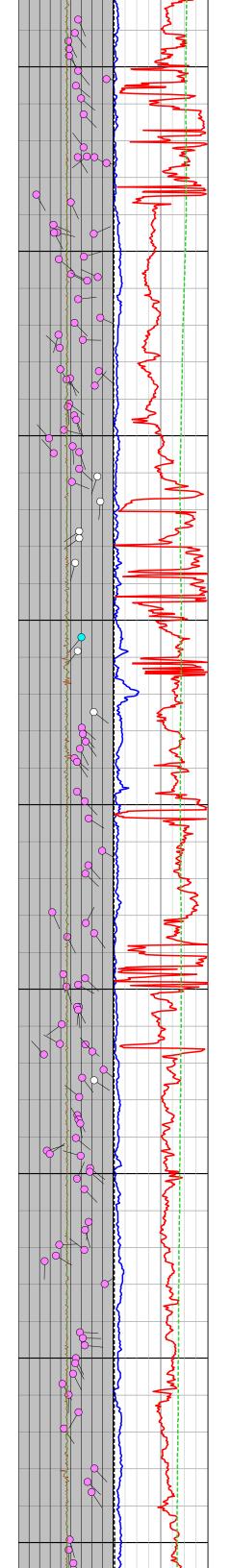


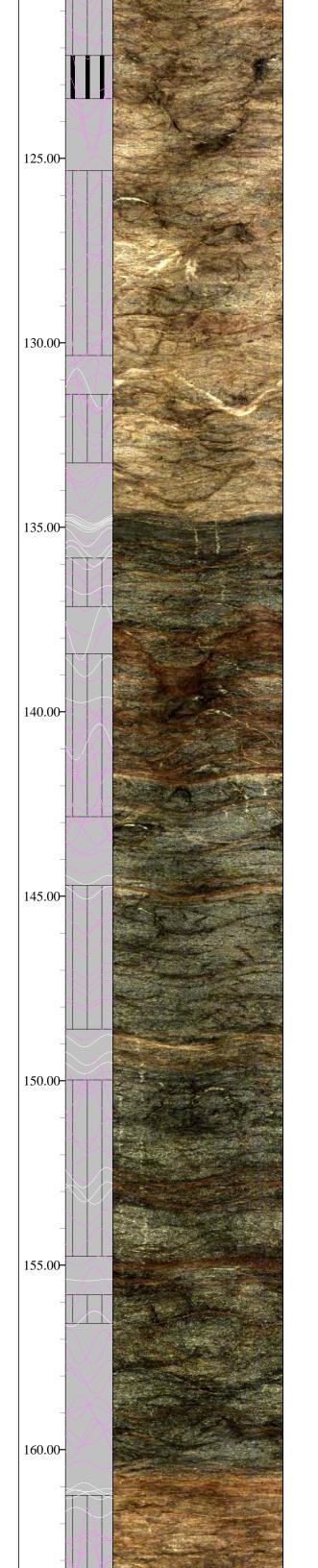


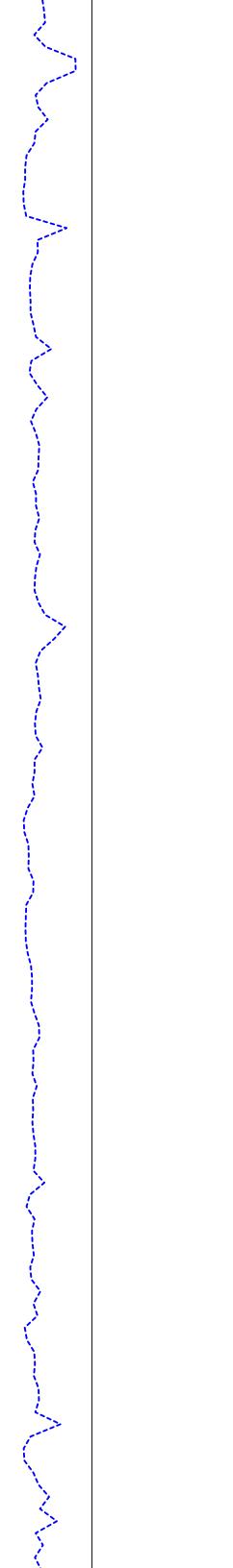




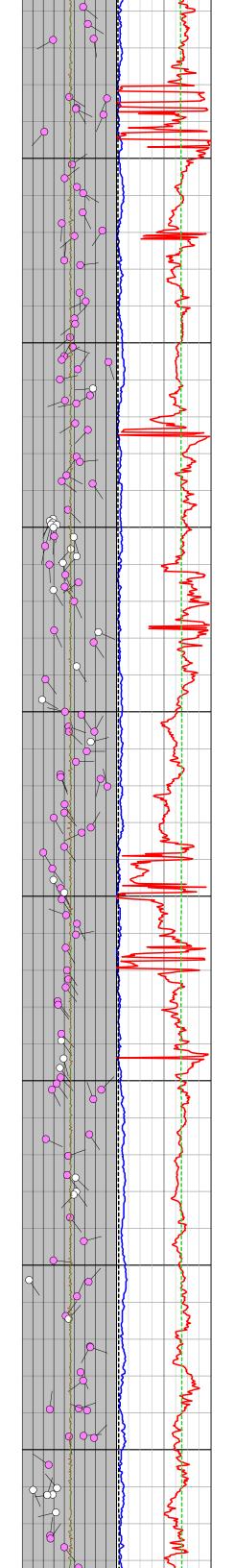


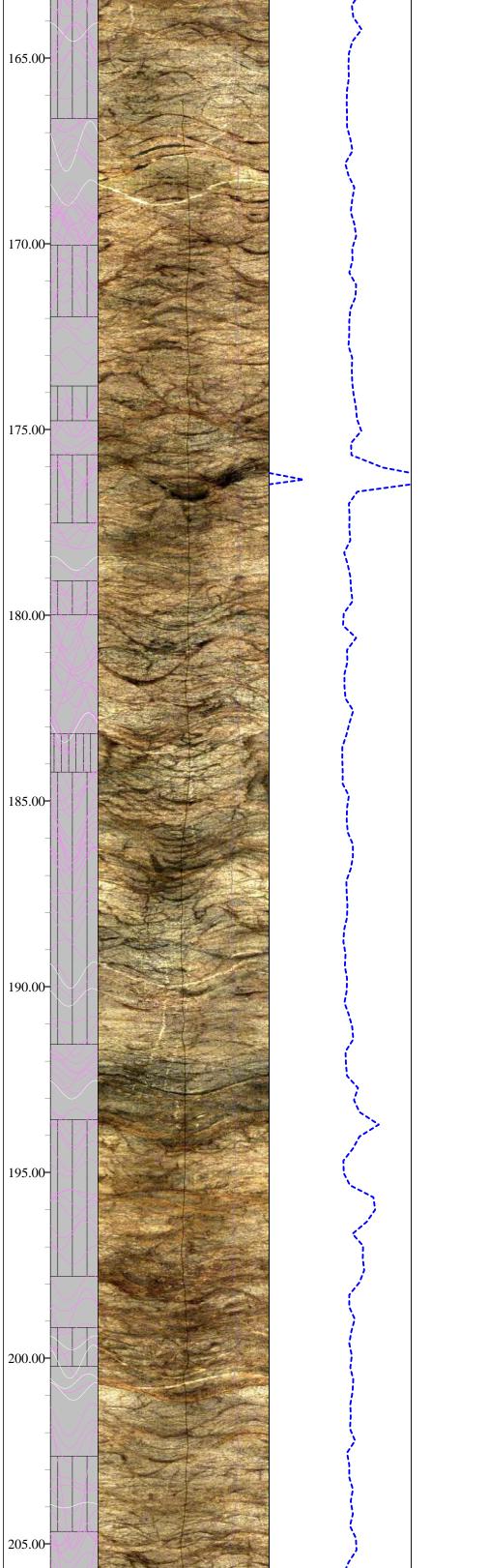




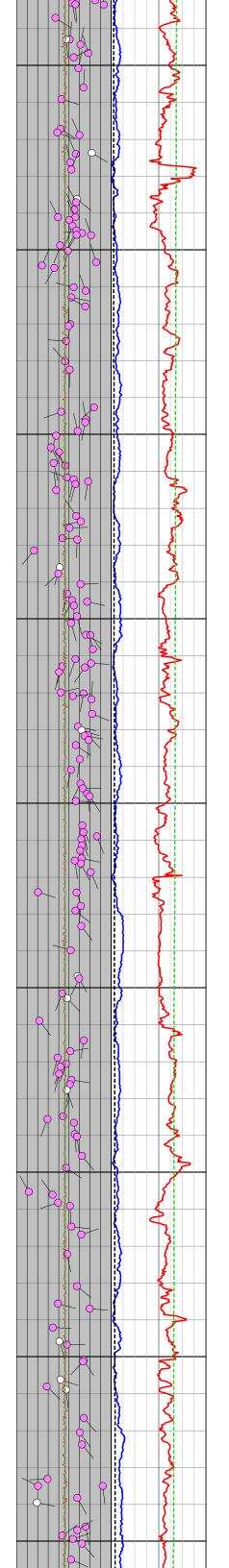


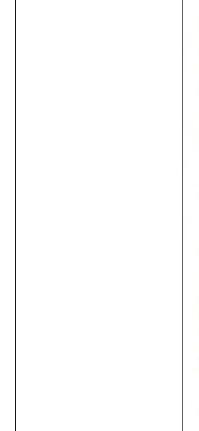


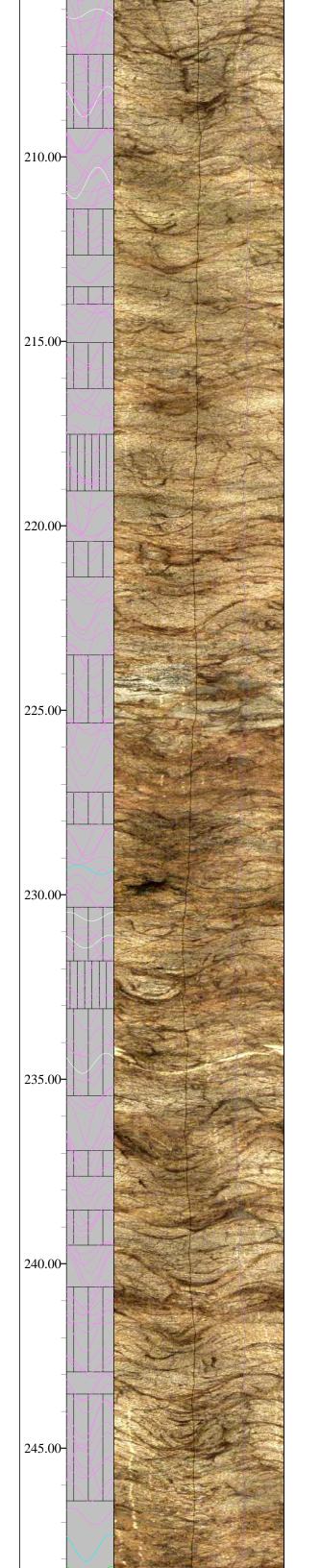




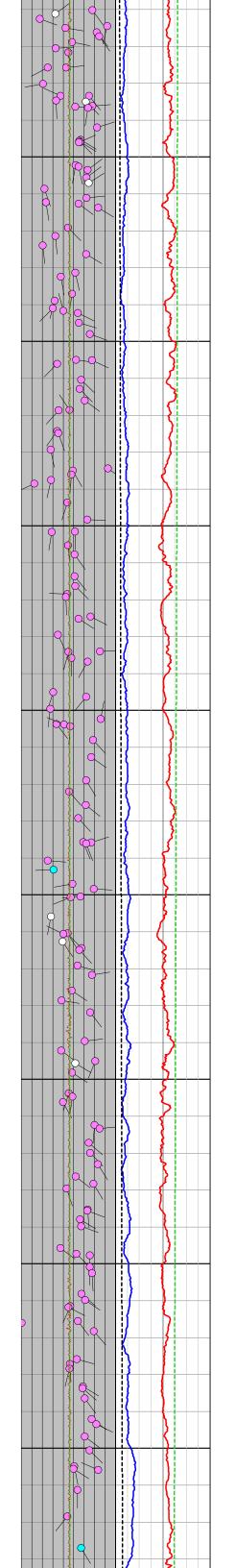




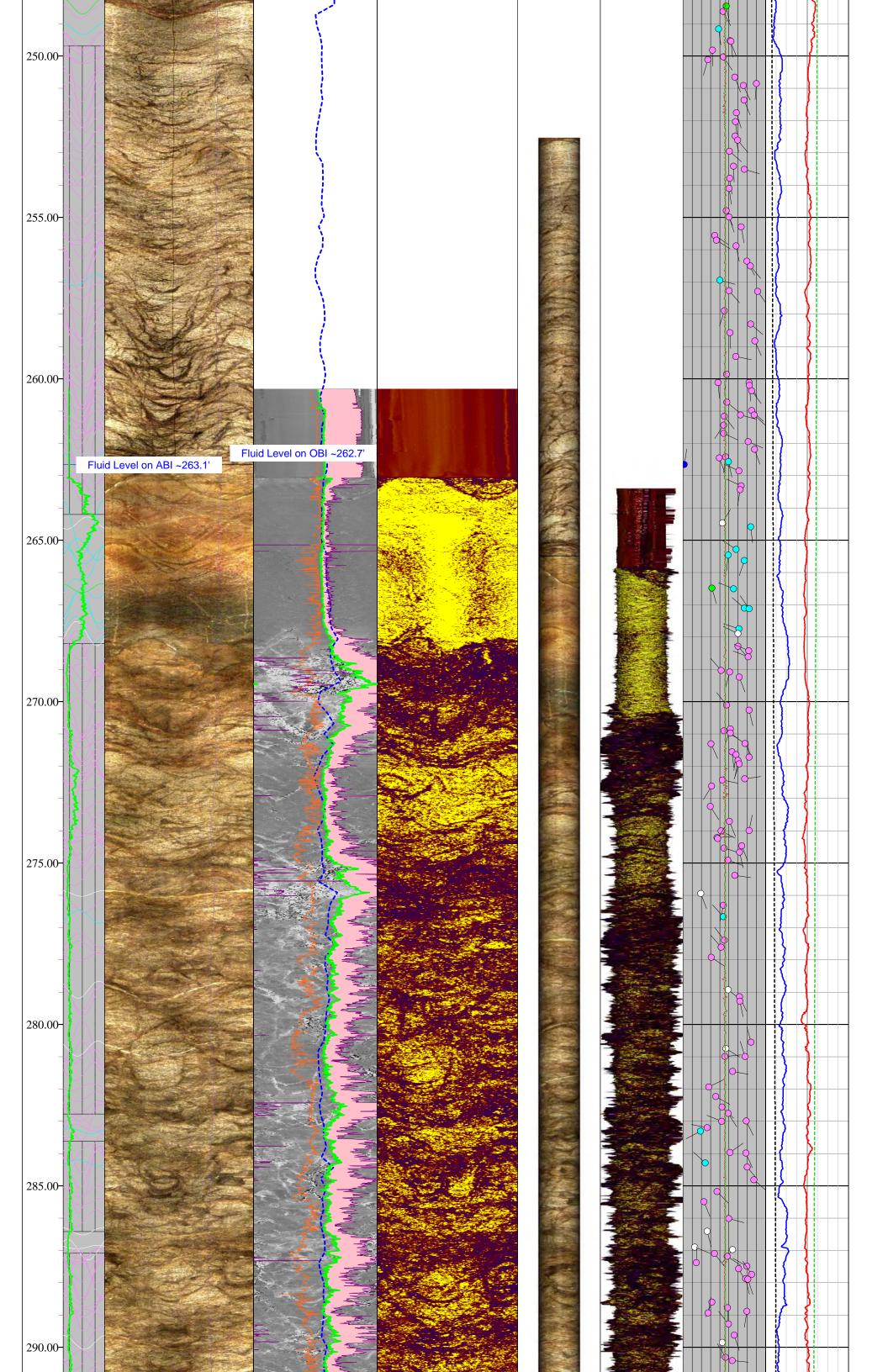


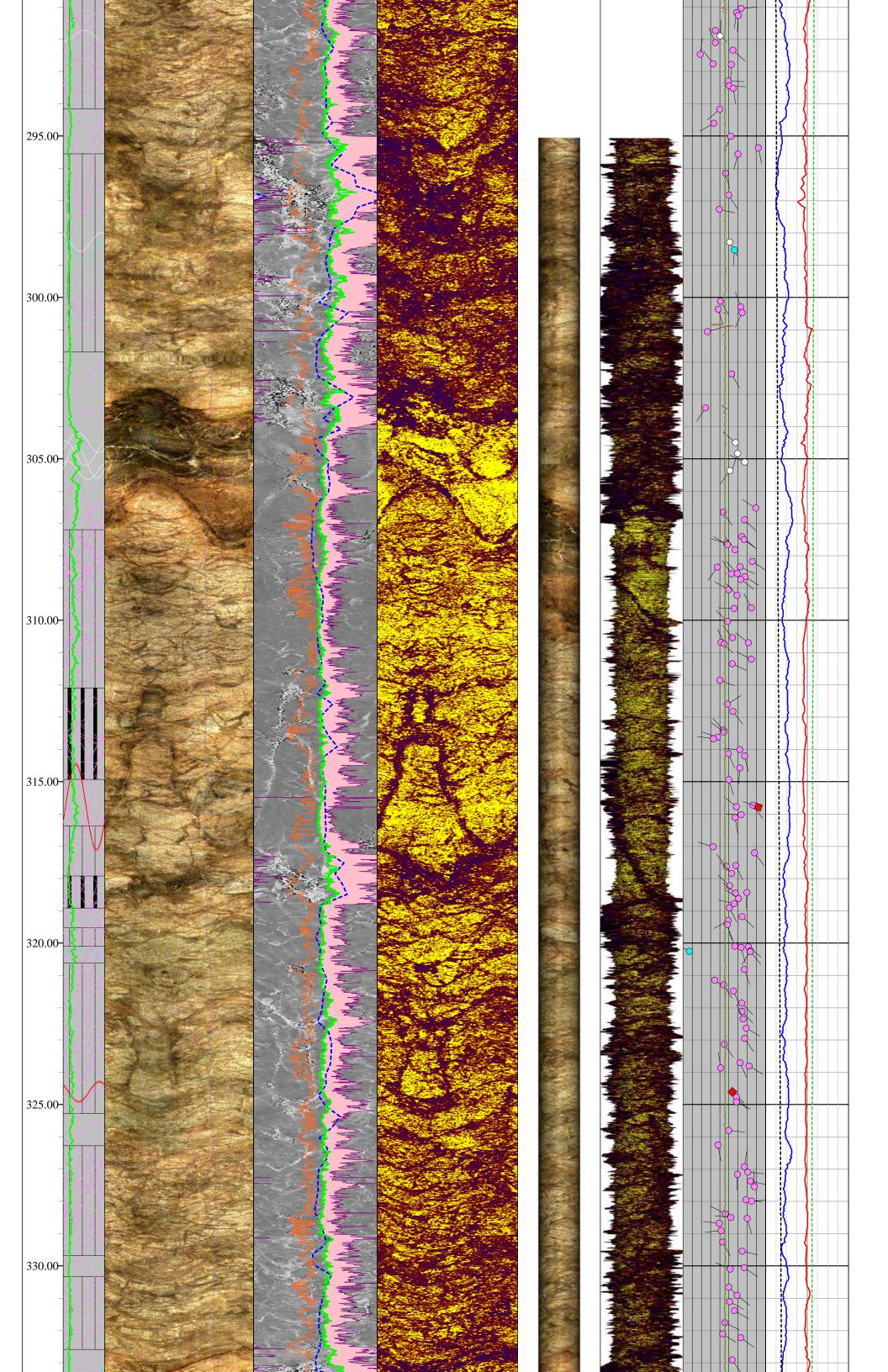


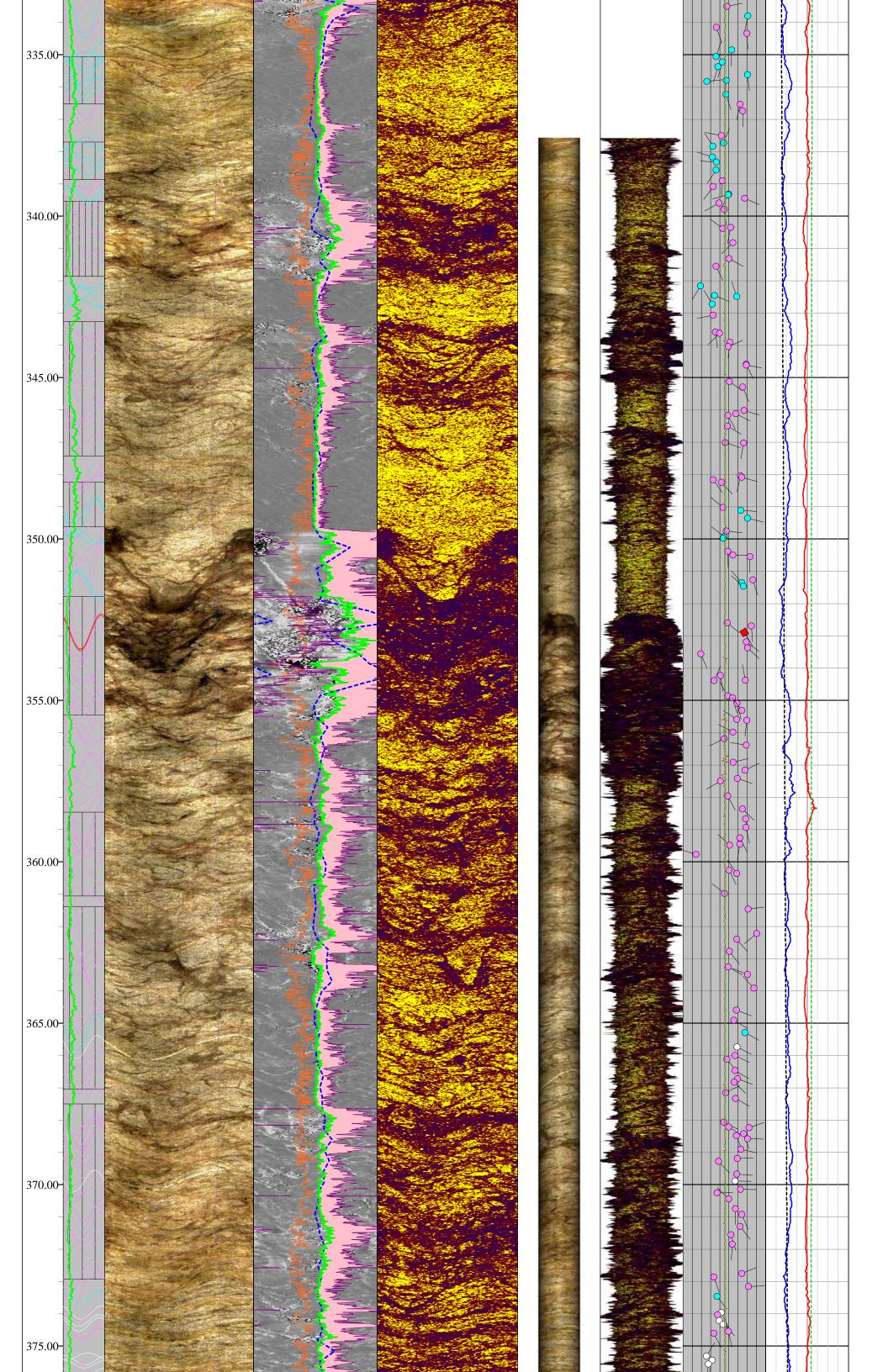


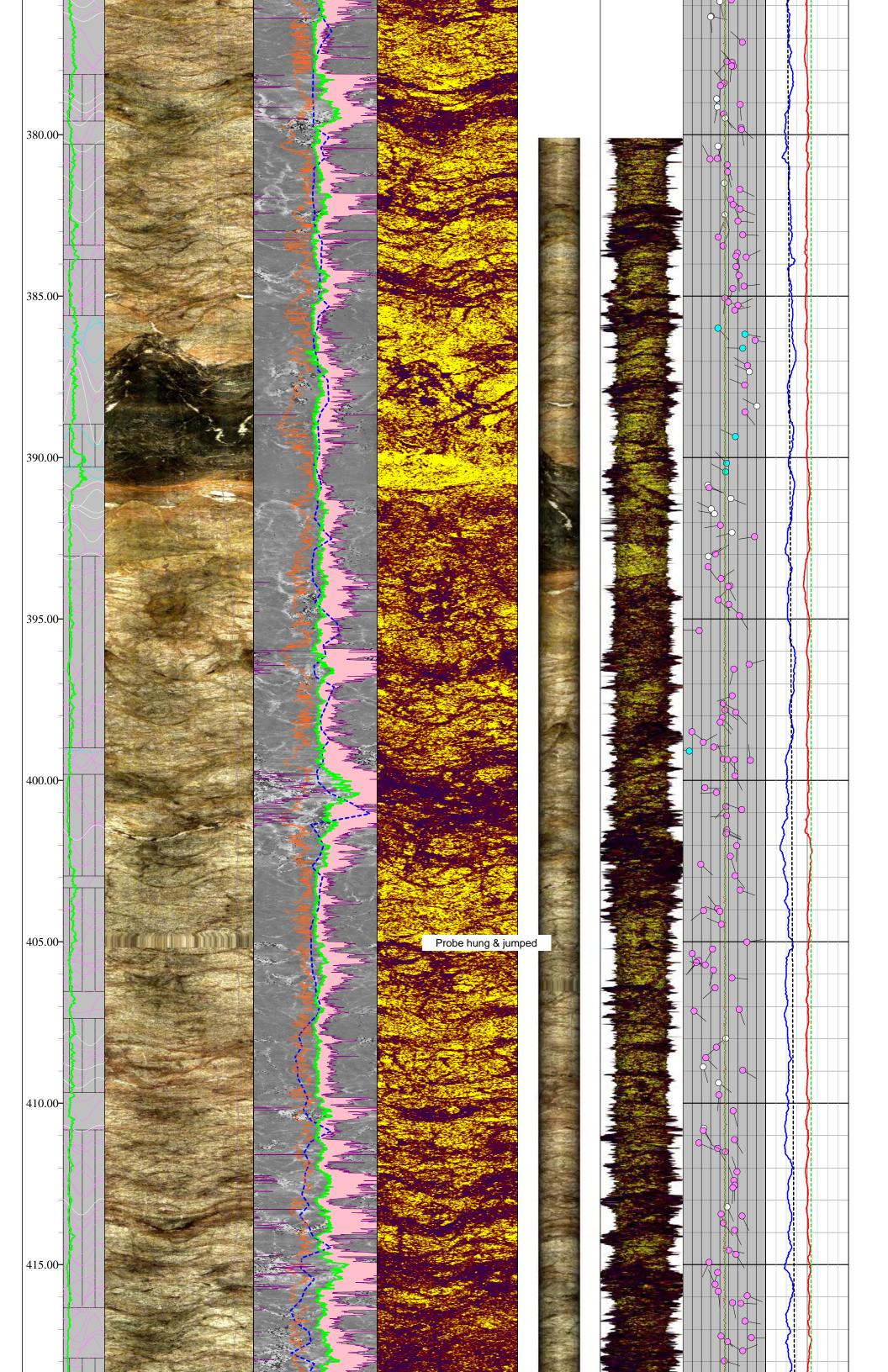


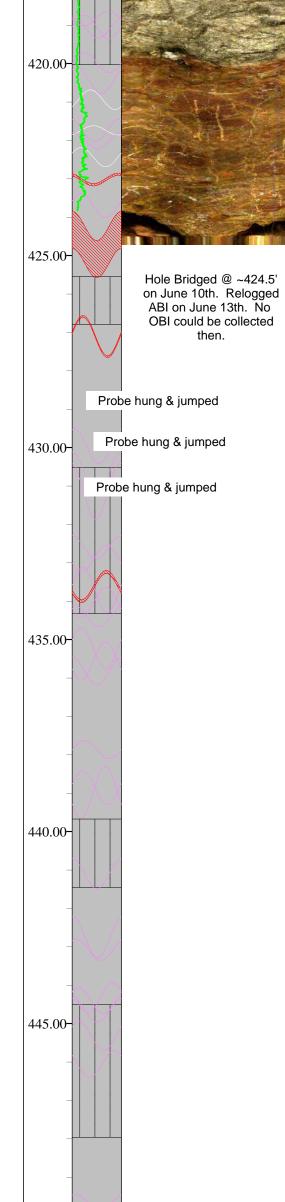


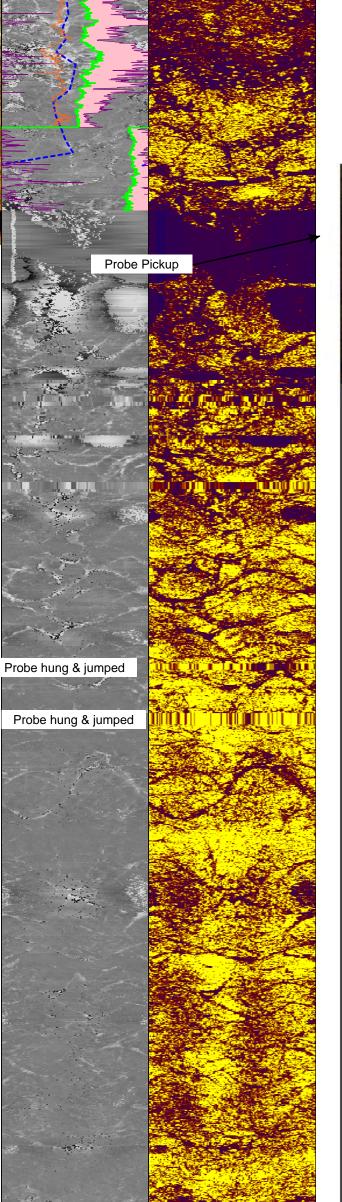


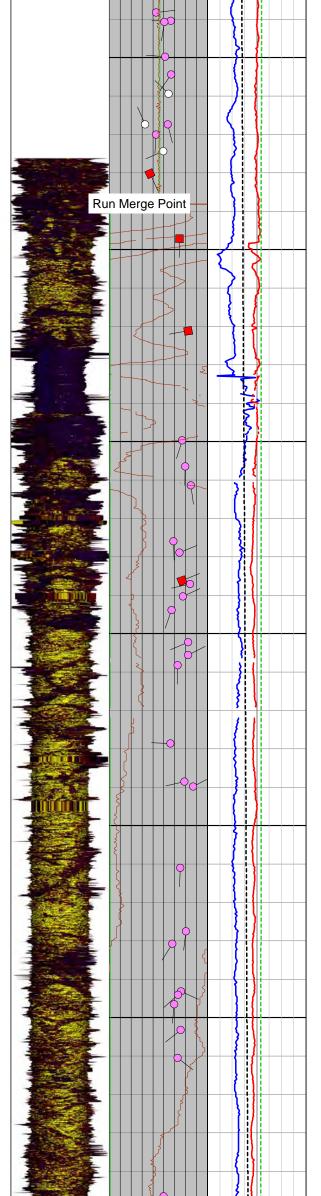


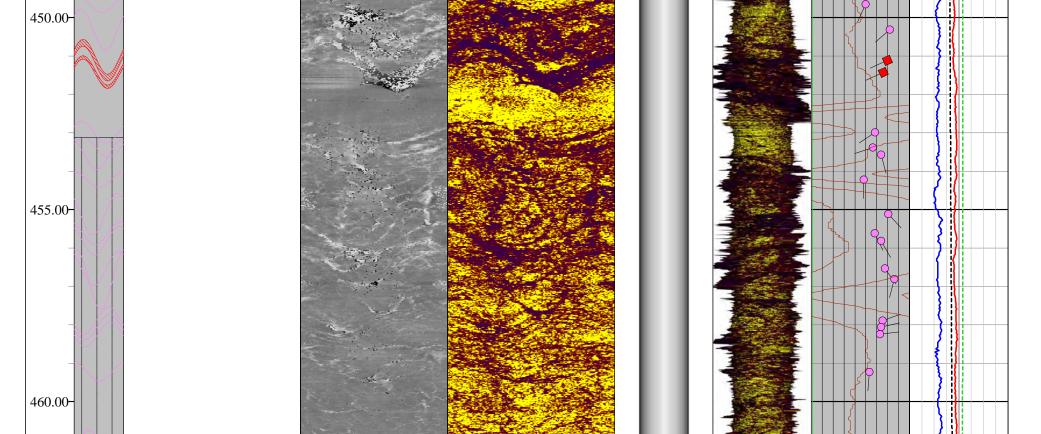


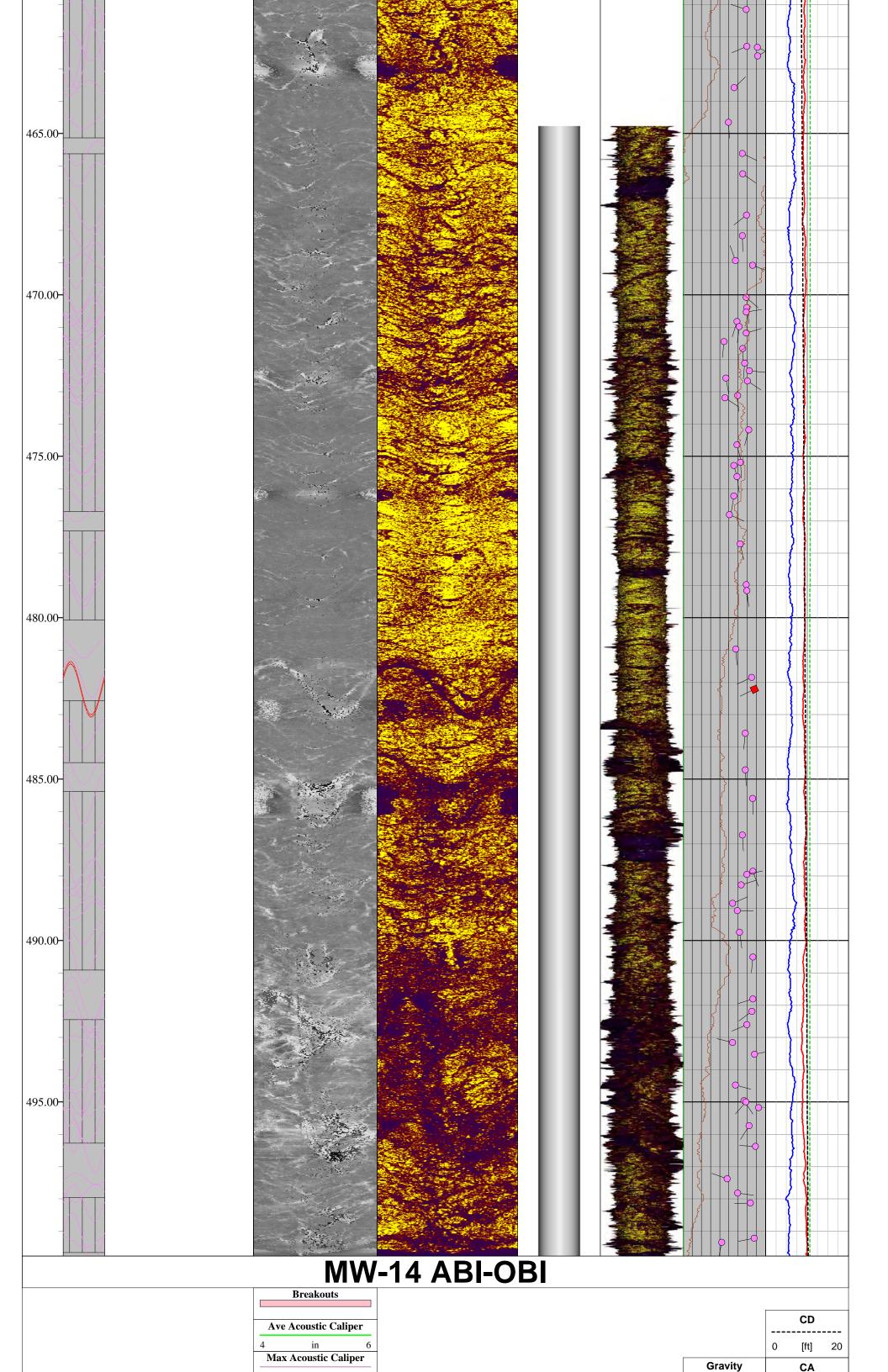




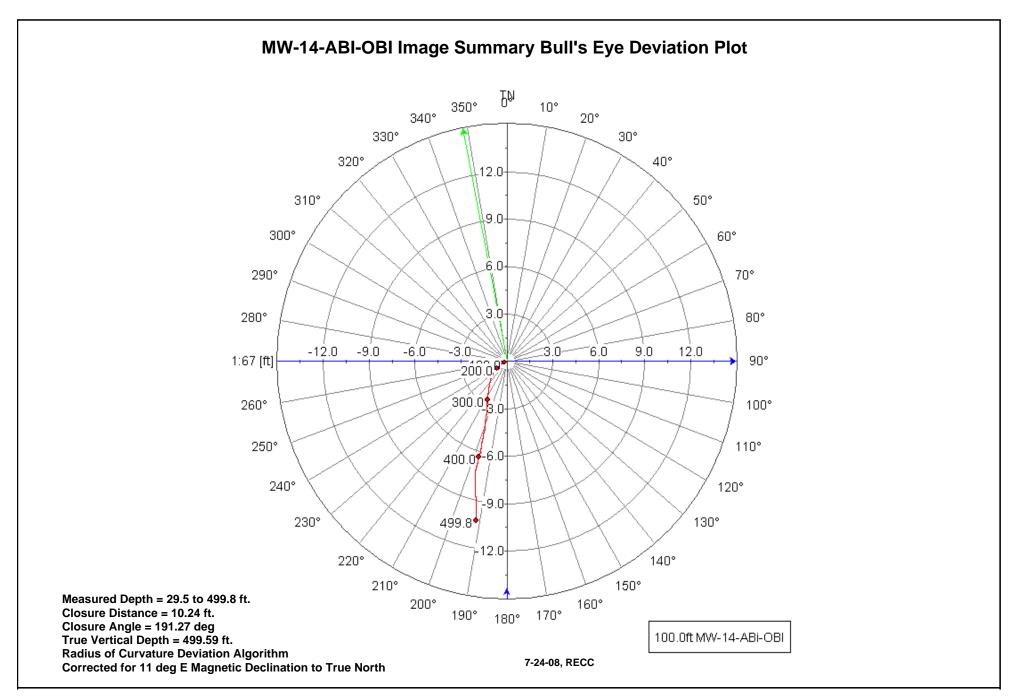


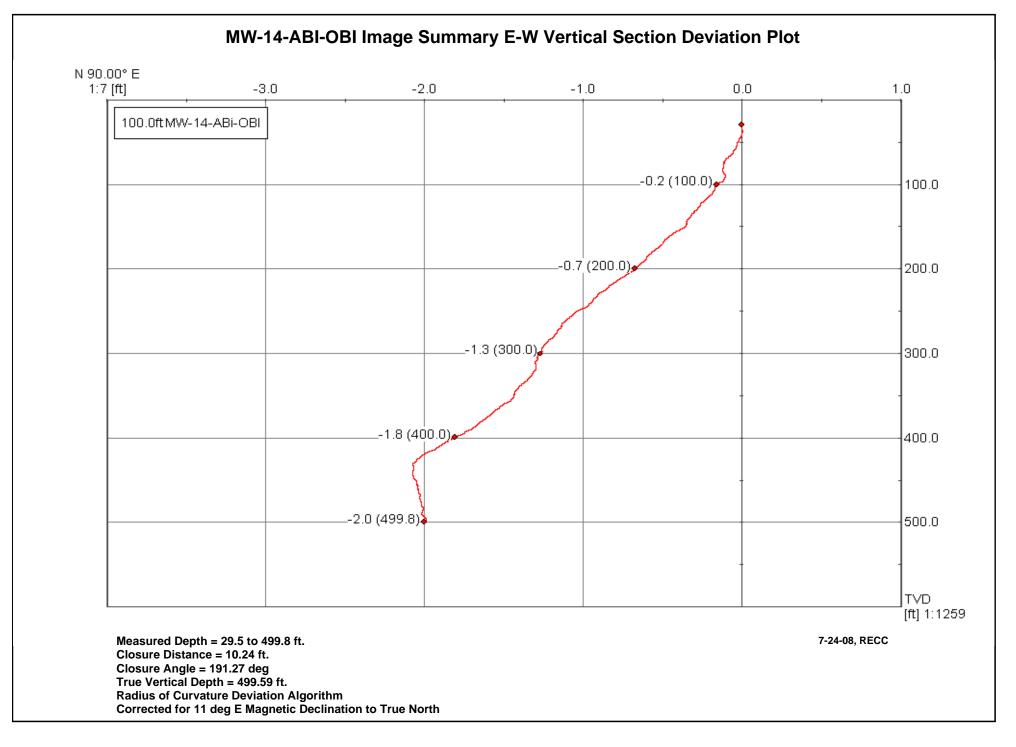






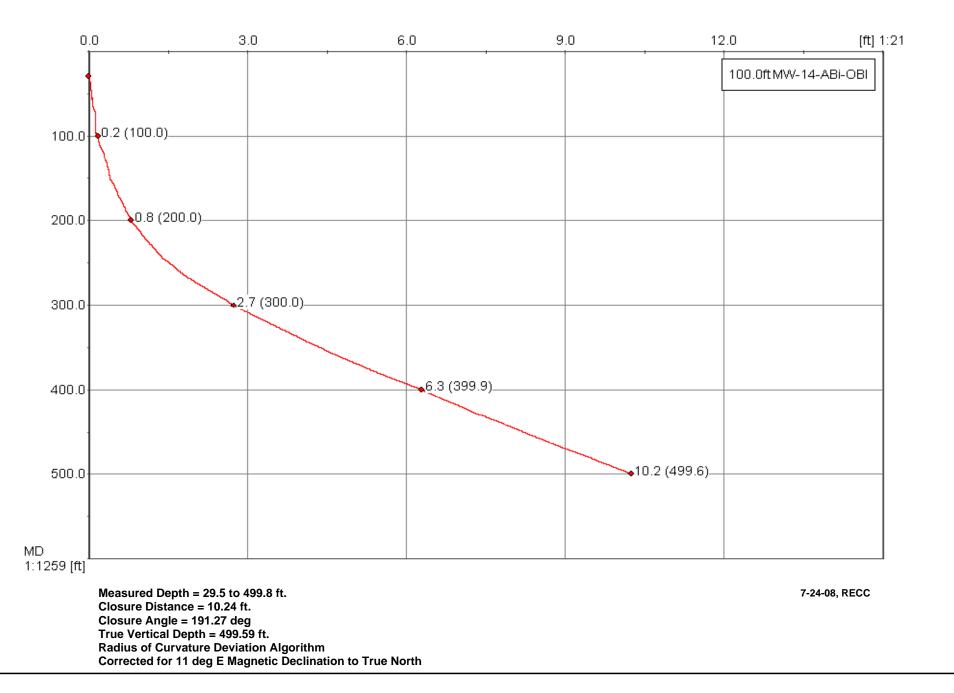
			4 in 6 Min Acoustic Caliper				Merged OBI-ABI		
	ARI						0.8 G 1.2	0 deg 360	
			4 in 6				Mag.Field	Azimuth	
	N/D		Caliper				Merged OBI-ABI	Merged OBI-ABI	
	VFx		4 inches 6				0 uT 90	0 deg 360	
	Picks	Image-NM	Centralized TT	Amplitude			Features	Tilt	
Depth	DIPA	Oriented Mag North	Oriented Mag North	Oriented Mag North	3D-OBI	3D-ABI	DIPT	Merged OBI-ABI	
1ft:30ft		0° 90° 180° 270° 0°	0° 90° 180° 270° 0°	0° 90° 180° 270° 0°	0°	0°	0 90	0 deg 8	





MW-14-ABLOBI Image Summary Closure Section Deviation Plot





Optical and Acoustic Image Summary Legend

Mnemonics and Comments

Picks	= planar featues picked on optical or acoustic borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip apparent hole axis
VFxs	= Near Vertical Fractures, highly fractured zones and Fanglomerate or Breccia zones
ARI	= Acoustic Reflectance Index or relative rock hardness from ABI Amplitude log. Plotted 0 (soft) to 1500 (harder) as green line.
OBI Image	= 2D plot of optical image oriented to magnetic north. Plotted from left to Right N-E-S-W-N
Centralize	d TT = 2D plot of acoustic image travel time with probe position centralized. Plotted from left to Right N-E-S-W-N
3-Arm	= 3-arm mechanical caliper of hole diameter plotted from 4-6 inches (blue line)
Min-Acous	stic Caliper = minimum acoustic caliper of hole diameter calculated from Travel Time data and plotted as orange line from 4 to 6 inches.
Max-Acou	stic Caliper = maximum acoustic caliper of hole diameter calculated from Travel Time data and plotted as purple line from 4 to 6 inches.
Avg-Acou	stic Caliper = average acoustic caliper of hole diameter calculated from Travel Time data and plotted as bright green line from 4 to 6 inches.
Breakouts	= pink shaded zone between Avg-Acoustic Caliper and Max-Acoustic Caliper calculated from Travel Time data showing borehole enlargment.
Amplitude	= 2D plot of unfiltered acoustic image amplitude oriented to magnetic north. Plotted from left to Right N-E-S-W-N
Amp-High	Pass = 2D plot of acoustic image amplitude with High Pass Normalization Filtering (can be toggled on/off) Plotted from left to Right N-E-S-W-N
3D-OBI	= 3D cylindrical projection of OBI image looking from the North.
3D-ABI	= 3D cylindrical projection of OBI image looking from the North.

Tadpole = tadpole plot of the image feature picks (fractures and bedding planes); plotted from 0 to 90 dip - see legend above. DIPT = True orientation; features corrected for hole deviation

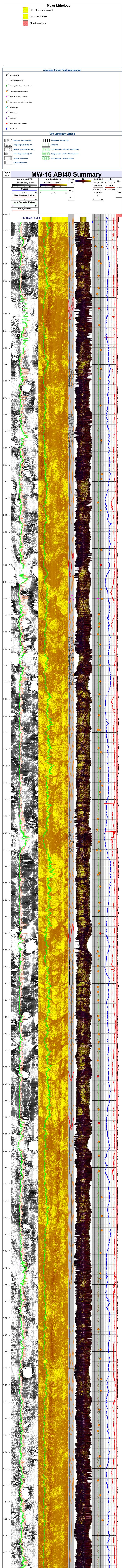
Magn. Field = Total magnetic field strength as measured by fluxgate magnetometer in OBI or ABI deviation sensor - plotted 0-90 uT. (green line)

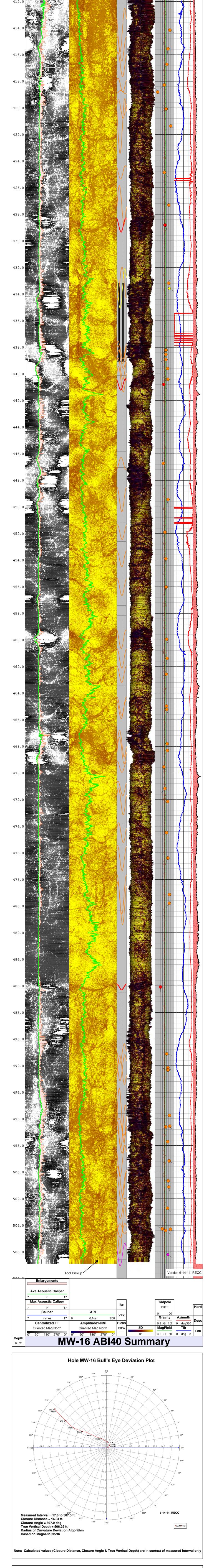
- **Gravity** = Total gravity (probe acceleration) as measured by 3-axis accelerometers in ABI deviation sensor plotted 0.8-1.2 g. (brown line)
- **Azimuth** = direction of tool tilt plotted 0 to 360 deg; represents borehole deviation direction (red line)
- **Tilt** = tool tilt (vertical = 0 and horizontal = 90) plotted 0 to 8 deg; represents borehole deviation tilt from vertical. (blue line)
- **CA** = Closure angle.= horizontal angle from hole to vertical projected collar location; plotted from 0 to 360 deg (dashed green line)
- **CD** = Closure Distance.= distance in feet in a horizontal plane from the borehole to vertical projected collar location; plotted from 0 to 20 ft. (dotted black line)

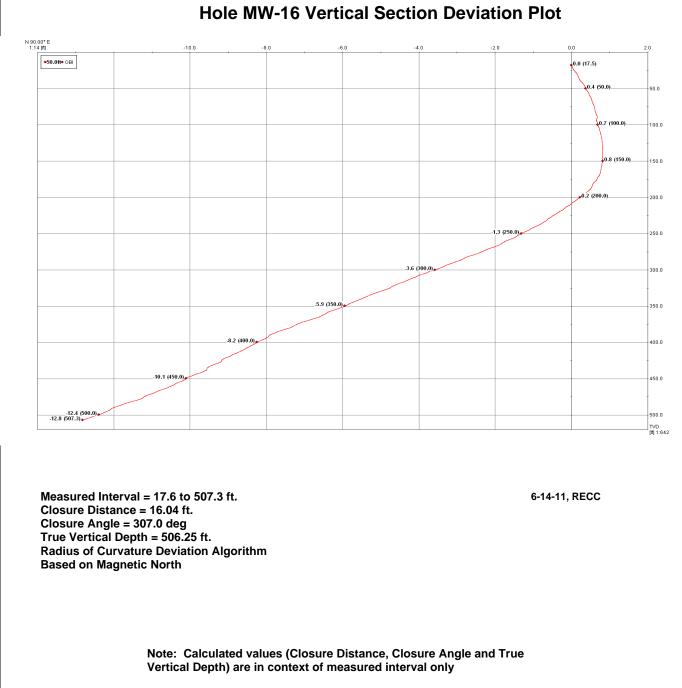
Prepared by Robert E. Crowder

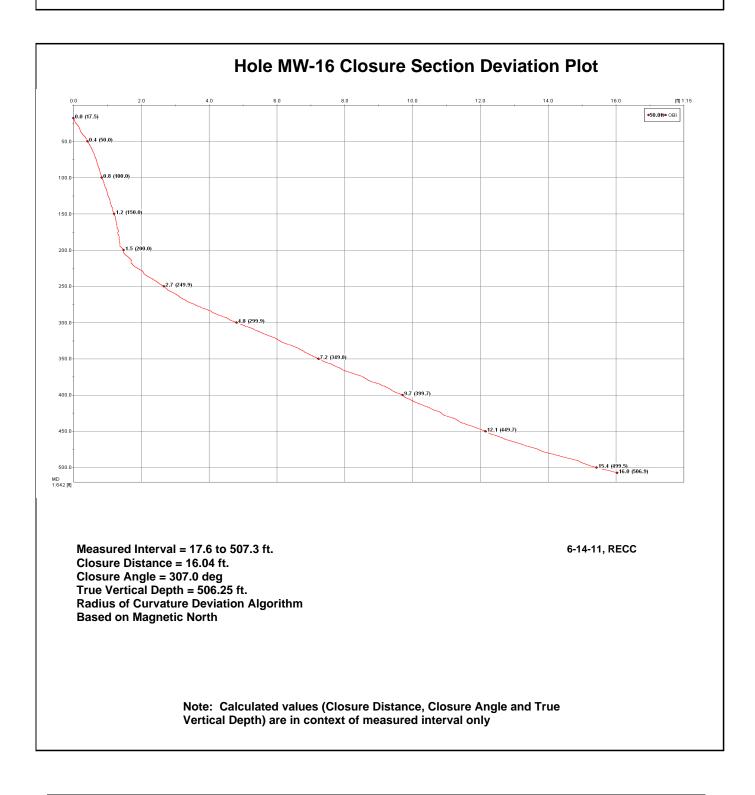
Rev 8-1-2008

								NID.	CONTATE
		ŀ	ł	ľ				VTS:	COMMENTS
					TOTAL DEPTH		20 FT	10" HAM	3 2
20.5 FT	SURFACE	SUR	STEEL	10"	20 FT	ICE	SURFACE	15"	1
TO	MC	FROM	WGT.	SIZE	TO		FROM	BIT	NO.
			ECORD	CASING RECORD			RECORI	BOREHOLE RECORD	RUN
	E 08:30 AM	F SITE	LOG TIME:ON SITE/OFF SITE	LOG TIME	PERNIE	MALCOLM PERNIE		SED BY	WITNESSED BY
10 SN 917	ALT-ABI-40 SN 917		ING/SN	TOOL STRING/SN	K. MITCHELL/ED TURNER	K. MITCHEI	ng Eng.	RECORDED BY / Logging Eng.	RECORD
689	TRUCK # 689		TRUCK	LOGGING TRUCK	ACKET	YELLOW JACKET		/ RIG#	DRILLER / RIG#
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TH	MAG NORTH		IMAGE ORIENTED TO:	IMAGE OR		507.5 FT	AL	BTM LOGGED INTERVAL	BTM LOO
	N/A		. TEMP.	MAX. REC. TEMP.		507.5 FT		OGGER	DEPTH-LOGGER
	250 FT			LEVEL		510 FT		ORILLER	DEPTH-DRILLER
	N/A		ΓY	DENSITY		ABI		G	TYPE LOG
	N/A		TY	SALINITY		1			RUN No
FORMATION WATER	FORMATIC		TYPE FLUID IN HOLE	TYPE FLU		03-30-11			DATE
	G.L.						Z	DRILLING MEAS. FROM	DRILLIN
	D.F.		UM	ABOVE PERM. DATUM	ABOVE]	GROUND LEVEL	GRO	LOG MEAS. FROM	LOG ME/
	K.B.		Z	ELEVATION				PERMANENT DATUM	PERMAN
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IC	DUAL INDUCTION 3 RX SONIC					LOCATION	LOC		
IMA	OBI NAT. GAMMA		PER	ABI TELEVIEW	JUGB: ADI J	MORE:	M		
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ſA	ARIZONA	STATE	ST		MARICOPA	COUNTY	CO		
					UPCO		FIELD		
					MW-16	WELL ID	WE		
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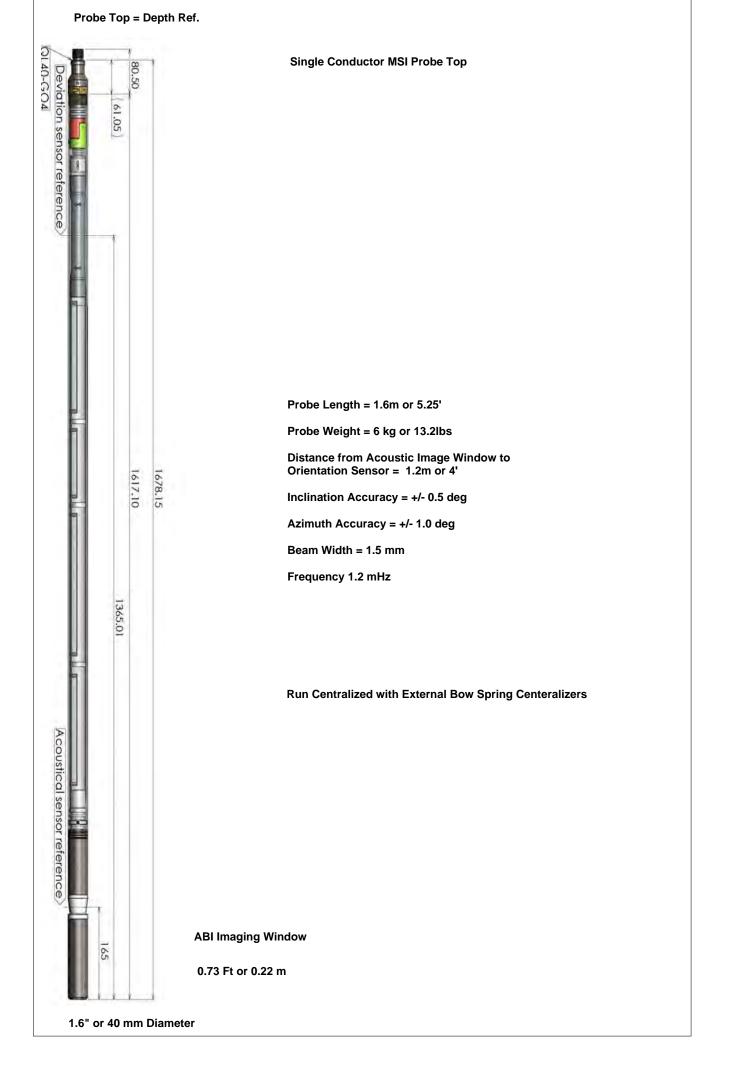








ABI-40 Acoustic Borehole Imager



ABI Image Summary Legend Mnemonics and Comments

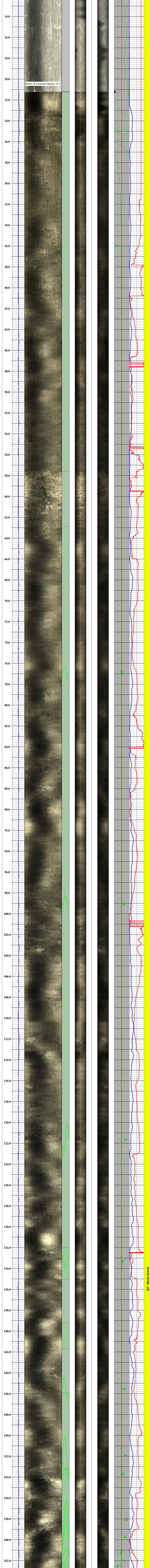
Centralized 1		plot of acoustic image travel time with probe position centralized. Oriented to gnetic north and plotted from left to right N-E-S-W-N
Caliper	= 3-arm med	chanical caliper of hole diameter plotted from 7 to 17 inches (blue line)
Max-Acoust	ic Caliper	= maximum acoustic caliper of hole diameter calculated from Travel Time data and plotted as orange line from 7 to 17 inches.
Ave-Acoust	ic Caliper	= average acoustic caliper of hole diameter calculated from Travel Time data and plotted as bright green line from 7 to 17 inches.
Enlargemen		k shaded zone between Avg-Acoustic Caliper and Max-Acoustic Caliper calculated Travel Time data showing borehole enlargment
Amplitude1-		plot of unfiltered acoustic image amplitude oriented to magnetic north. Plotted left to Right N-E-S-W-N. Image toggled off.
		Reflectance Index or relative rock hardness from ABI Amplitude log. Plotted 0 (soft) der) as green line.
		ucutral features picked on acoustic borehole image shown as colored sinusoid (color shown on header) DIPA = dip apparent hole axis
		cal Fractures, Vugs/Vessicles and other non-sinusoidal features. Breccia or Congomerate zones and Vugs/Vesicles/Cavities
	-	projection of ABI image using Centralized TT log for hole shape looking from North. ot of the ABI feature picks (fractures and bedding planes); plotted from 0 to 100 dip -
	see legen	d above. DIPT = True orientation; features corrected for hole deviation
		netic field strength as measured by fluxgate magnetometer in ABI deviation tted 40-60 uT. (green line)
		ity (probe acceleration) as measured by 3-axis accelerometers in ABI deviation tted 0.8-1.2 g. (brown line)
Azi-Edited		on of tool tilt plotted 0 to 360 deg; edited for anomalous magnetic influence - ts borehole deviation direction (red line)
	= tool tilt (ve from vertical	rtical = 0 and horizontal = 90) plotted 0 to 8 deg; represents borehole deviation tilt l. (blue line)
RBR	= Relative b (thin purple	earing - azimuth of the probe marker position to High Side measured clockwise. e line)
Lith	= major/prin	cipal lithology description based on geologic descriptions provided by Pirnie staff. cipal lithology symbol based on geologic descriptions provided by Pirnie staff. rock harness from ARI used to silhouette lithology.
Bulls Eye Pl		an view of drill hole path determined from magnetic sensor package in OBI an ABI referenced to Magnetic North
Vertical Pro		ew of drill hole path projected on E-W plane from magnetic sensor package in OBI probess reference to Magnetic North Radius of Curvature desurveying algorithm
Closure Pro	f ile = 2D pr	ojection of drill hole path of depth versus closure distance referenced to magnetic north
Prepared by R	obert E. Cro	wder

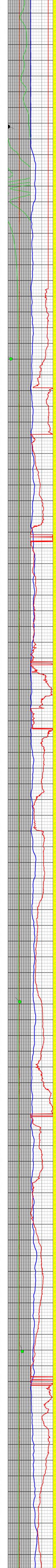
Prepared by Robert E. Crowder Rev 6/14/11

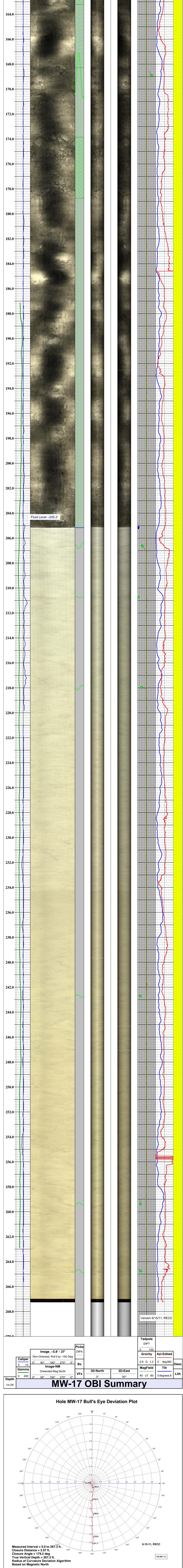
								NTS:	COMMENTS:
									3
					TOTAL DEPTH	FT	25 FT	9 7/8"	2
25 FT	SURFACE	SUF		10 3/4" I.D.	25 FT	NCE	SURFACE	12"	1
ТО	MC	FROM	WGT.	SIZE	то		FROM	BIT	NO.
			CORD	CASING RECORD			RECORI	BOREHOLE RECORD	RUN
	E 11:30 AM	FF SITI	ON SITE/O	LOG TIME: ON SITE/OFF SITE		ARCADIS		SED BY	WITNESSED BY
40-MK4	ALT OBI-40-MK4		NG/SN	TOOL STRING/SN	E. TURNER/ K. MITCHELL	E. TURNER	ing Eng.	RECORDED BY / Logging Eng.	RECORD
300	TRUCK # 300		TRUCK	LOGGING TRUCK	ACKET	YELLOW JACKET		/ RIG#	DRILLER / RIG#
	0.0096 FT		TERVAL	SAMPLE INTERVAL		SURFACE	AL	TOP LOGGED INTERVAL	FOP LOG
RTH	MAG NORTH		IENTED TC	IMAGE ORIENTED TO:		267 FT	/AL	BTM LOGGED INTERVAL	BTM LOO
	27.6 Deg C		TEMP.	MAX. REC. TEMP.		267 FT		,OGGER	DEPTH-LOGGER
	204 FT			LEVEL		270 FT		DRILLER	DEPTH-DRILLER
	N/A		Y	DENSITY		OBI-CAL		G	TYPE LOG
	N/A		ſY	SALINITY		1			RUN No
ATER	FRESH WATER		D IN HOLE	TYPE FLUID IN HOLE		04-04-11			DATE
	G.L.						M	DRILLING MEAS. FROM	DRILLIN
	D.F.		M	ABOVE PERM. DATUM		GROUND LEVEL	GRO	LOG MEAS. FROM	LOG ME.
	K.B.			ELEVATION	_			PERMANENT DATUM	PERMAN
				RGE	TWP		SEC		
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5i-43	ABI-40, abi-43 GAMMA			I ELEVII IPER	MORE: CALIPER	MORE:	M		
ERVICES	OTHER SERVICES		WED	TEI EVII	DES. DRIT	TEOEI			
VA	ARIZONA	STATE	ST		MARICOPA	COUNTY	CO		
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	rvices) se	videc	ysics &	borehole geophysics & video services	boreho			
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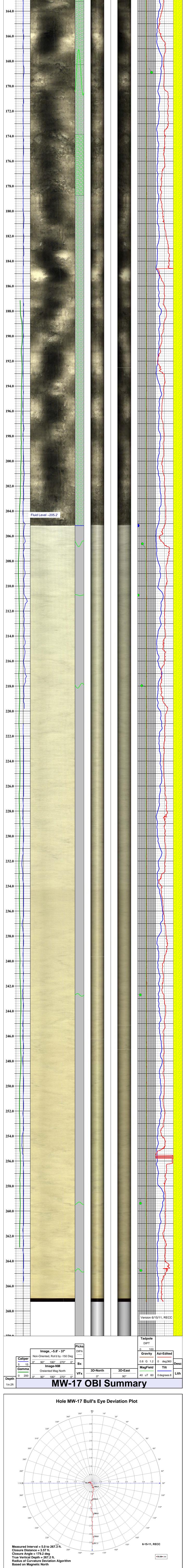
			Major I	Lithology				
		GM - Silty gra						
		GP - Sandy G	ravel					
		BT - Granodi	orite					
			Optical I	mage Features	Legend			
é e	8tm of Casing							
б ғ	filled Fracture /	loint						
é e	Bedding / Bandir	g / Foliation / Veins						
🥑 P	Partially Open Jo	int / Fracture						
• N	linor Open Join	/ Fracture						
o o)J/Fx terminates	at Fx intersection						
σ ι	Inclassified							
∢ s	Sulfide Vein							
e e	Breakouts							
· ·	lajor Open Joint	/ Fracture						
_	luid Level							
• .			VFx Li	thology Legen	d			
	ন্যন				-			
		r Conglomerate		Near Vertical Fxs				
0°0°0		ys/Vesicles (> 6") ugs/Vesicles (2-6")		ear Vert Fxs nerate - sand matrix sup	ported			
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000000	Small Vug	s/Vesicles (< 2")	Conglon	nerate - mud matrix sup	ported			
		ıs/Vesicles (< 2") ertical Fxs		nerate - mud matrix sup nerate - clast supported				
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Depth	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	ertical Fxs Ttical Fxs Image-NM Oreiented Mag Nor	Conglor N-17 rth 70° 0° Bx	nerate - clast supported	UMM 3D-East	MagField		Lith Desc
Depth	Sear V 2 Near V 2 Near Ve Gamma 0 200	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	40 uT 60	0 degrees 8	
Depth	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs Tical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth 70° 0° Bx	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2	0 degrees 8 Azi-Edited	
Depth	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft 2.0 4.0 6.0 	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft 2.0 4.0 	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft 2.0 4.0 	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft 2.0 4.0 	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	
Depth 1in:2ft 2.0 4.0 8.0 	Sear V 2 Near V 2 Near Ve Gamma 0 200 Caliper	rtical Fxs rtical Fxs Image-NM Oreiented Mag Noi 0° 90° 180° 27 Image_~5.8' - 3 Non-Oriented, Rot'd by -	Conglor N-17 rth <u>r0° 0°</u> Bx 150 Deg Picks Dist	nerate - clast supported	UMM 3D-East	MagField 40 uT 60 Gravity 0.8 G 1.2 Tadpole DIPT	0 degrees 8 Azi-Edited	

12.0

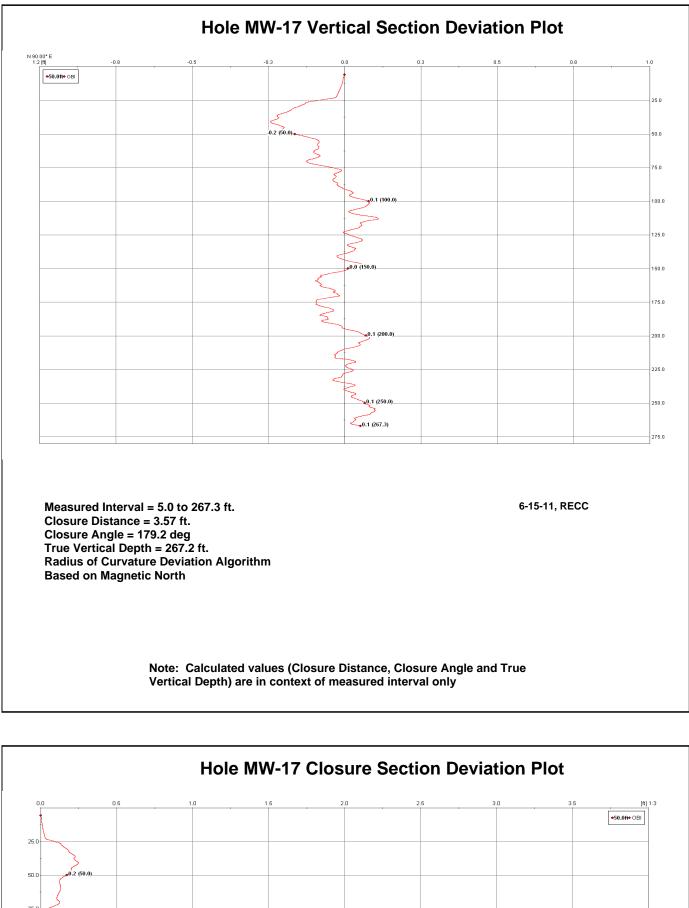








Note: Calculated values (Closure Distance, Closure Angle & True Vertical Depth) are in context of measured interval only





- -							•3.2 (249.9)	3.6 (267.2)
Closu Closu True \ Radiu	re Distar re Angle /ertical E s of Curv	netic North Note:	ft. eg 7.2 ft. iation Algorithn	ues (Closure I			6-15-11, R	ECC
	(DBI-4	10 Opti	cal Bo	orehole	e Imag	er	
Prot	oe Top =	Depth Ref.						
	50.90	[2,770]	Single C	Conductor MSI	Probe Top			
۵	<u>+</u>	*						
	Ť							
			Probe Len	gth = 1.6m or	5.25'			
н.				ght = g or 13.2 rom Acoustic	2lbs Image Window 2m or 4'	/ to		
l	[50.551] 1284		Inclination	Accuracy = +/-	/- 0.5 deg			
		[62.087] 1577	Asimuti A					
		77						
			External B	ow Spring Ce	nteralizers			
		- 1						
•								

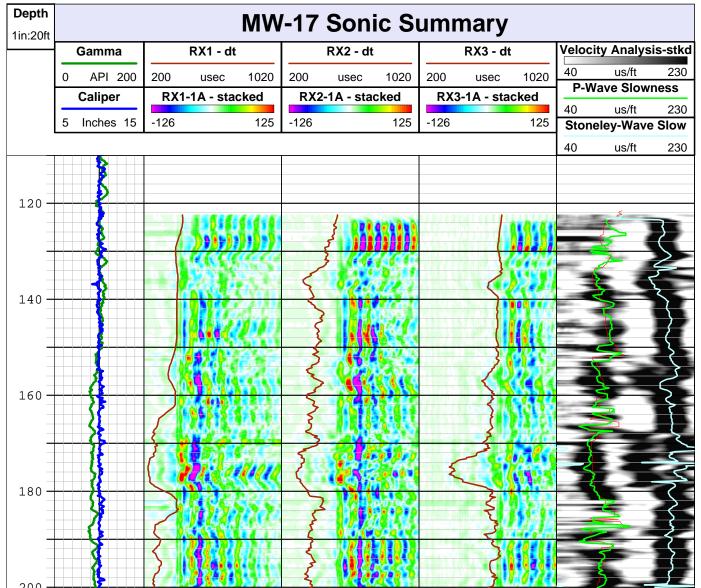
Optical Image Summary Legend

Mnemonics and Comments

Caliper Gamma	 = 3-arm mechanical caliper of hole diameter plotted from 5 - 15 inches (blue line) = natural gamma ray log plotted from 0 to 200 API units (green line)
Image-NM Image	 = 2D plot of optical image oriented to magnetic north. Plotted from left to Right N-E-S-W-N = Non-oriented 2D plot of optical image from 5.8 to 37' rotated by -150 deg. Plotted from left to Right N-E-S-W-N
Picks	= planar features picked on optical borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip apparent hole axis
VFxs Bx	 Near Vertical Fractures, Vugs/Vessicles and other non-sinusoidal features. Apparent Breccia or Congomerate zones and Vugs/Vesicles/Cavities
3D-N 3D-E	= 3D cylindrical projection of OBI image.viewed from north.= 3D cylindrical projection of OBI image viewed from east.
Tadpole	= tadpole plot of the image feature picks (fractures and bedding planes); plotted from 0 to 100 dip - see legend above. DIPT = True orientation; features corrected for hole deviation
Magn. Field	d = Total magnetic field strength as measured by fluxgate magnetometer in OBI deviation sensor - plotted 40-60 uT. (green line)
Gravity	= Total gravity (probe acceleration) as measured by 3-axis accelerometers in ABI deviation sensor - plotted 0.8-1.2 g. (brown line)
Azimuth-ec	dit = direction of tool tilt plotted 0 to 360 deg; edited for magnetic influence - represents borehole deviation direction (red line)
Tilt	= tool tilt (vertical = 0 and horizontal = 90) plotted 0 to 8 deg ; represents borehole deviation tilt from vertical. (blue line)
RBR	= Rotational Bearing Reference - difference between high side and marker position on probe; plotted as purple line from 0 to 360 deg.
Desc Lith	 major/principal lithology description based on geologic descriptions provided by Pirnie staff. major/principal lithology symbol based on geologic descriptions provided by Pirnie staff.
Bulls Eye F	Plot = 2D plan view of drill hole path determined from magnetic sensor package in OBI an ABI probes referenced to Magnetic North
Vertical Pro	ofile = 2D view of drill hole path projected on E-W plane from magnetic sensor package in OBI an ABI probes reference to Magnetic North Radius of Curvature desurveying algorithm
Closure Pr	ofile = 2D projection of drill hole path of depth versus closure distance referenced to magnetic north

Rev 6-15-11

							NTS:	COMMENTS:
				TOTAL DEPTH		20 FT	10"	2
	SURFACE	STEEL	12"	20 FT	ACE	SURFACE	15"	1
TO	FROM	WGT.	SIZE	TO		FROM	BIT	NO.
		RECORD	CASING RECORD		D	RECOR	BOREHOLE RECORD	RUN
7:00 AM	_	LOG TIME: ON SITE/OFF SITE	LOG TIM	MALCOLM PIRNIE: C. LEGG	MALCOLM		SED BY	WITNESSED BY
ALT 50 MM SONIC - 3RX	+	RING/SN	TOOL STRING/SN	ILL	K. MITCHELL	ng Eng.	RECORDED BY / Logging Eng.	RECORD
TRUCK # 400		TRUCK	LOGGING TRUCK	ACKET	YELLOW JACKET		₹/RIG#	DRILLER / RIG#
0.25	0	SAMPLE INTERVAL	SAMPLE		150 FT	AL	TOP LOGGED INTERVAL	TOP LOC
N/A	7	IMAGE ORIENTED TO:	IMAGE O		220 FT	'AL	BTM LOGGED INTERVAL	BTM LO
Deg C		C. TEMP.	MAX. REC. TEMP.		223 FT		,OGGER	DEPTH-LOGGER
150 FT			LEVEL		228 FT		ORILLER	DEPTH-DRILLER
N.A	1	TY	DENSITY	VIC	50 MM SONIC		Ğ	TYPE LOG
N/A	7	ITY	SALINITY		1			RUN No
FRESH WATER	H	TYPE FLUID IN HOLE	TYPE FLU		04-02-11			DATE
G.L.						Μ	DRILLING MEAS. FROM	DRILLIN
D.F.		IUM	ABOVE PERM. DATUM		GROUND LEVEL	GRO	LOG MEAS. FROM	LOG ME.
K.B.	H	Z	ELEVATION	_			PERMANENT DATUM	PERMAN
		Ē	RGE	TWP		SEC		
GUARD RESISTIVITY OBI-40 NEUTRON	700				LOCATION	LOC		
3-ARM CALIPER E-LOGS-GAMMA-TEMP			PER	CALIPER	MORE:	Μ		
OTHER SERVICES		[C-3 RX	M SONI	TYPE OF LOGS: 50 MM SONIC-3 RX	(PE OF I	T		
ARIZONA	STATE A	ST/		MARICOPA	COUNTY	СО		
				PHOENIX	FIELD	FIE		
				MW-17	WELL ID	WE		
			RNIE	MALCOLM PIRNIE	COMPANY	СО		
							6	
ices	serv	& video	/sics {	borehole geophysics & video services	boreho			
tion	ora	Exploration LC		Southwest Ex Services, LLC	Sou	J	TTT	
				•)			



200		See .	Z											
220		<u>}</u>				~	.0.2)			2				Ę
240													n 6-15-11,	
Г		Caliper	RX	1-1A - sta	cked	RX2	-1A - sta	cked	RX3	-1A - sta	cked	40	eley-Wave	230
	5	Inches 15	-126		125	-126		125	-126		125	P-W	ave Slow	230 ness
	_	Gamma		RX1 - dt	1		RX2 - dt			RX3 - dt	t		ty Analys	
	0	API 200	200	usec	1020	200	usec	1020	200	usec	1020	40	us/ft	230
Depth 1in:20ft					MW	-17	Son	ic S	umr	nary				

Full Waveform Sonic Summary Legend Mnemonics and Comments

Gamma	= natural gamma ray log plotted from 0 to 200 API units (green line)
Caliper	= 3-arm mechanical caliper of hole diameter plotted from 5-15 inches (blue line)
Camper	
RX1-1A-sta	
KAI-IA-Sta	acked = color variable density display of 0.6m Rx waveform; stacked over 5 waveforms and plotted from 100 to 1020 uSec.
RX1 - dt	= Manual P-wave travel time pick. Plotted 100 to 1020 uSec (brown line).
RX2-1A-sta	acked = color variable density display of 0.8m Rx waveform; stacked over 5 waveforms and
	plotted from 100 to 1020 uSec.
RX2 - dt	= Manual P-wave travel time pick. Plotted 100 to 1020 uSec (brown line).
RX3-1A-sta	
	plotted from 100 to 1020 uSec.
RX3 - dt	= Manual P-wave travel time pick. Plotted 100 to 1020 uSec (brown line).
Velocity A	nalysis stkd = gray scale variable density display of velocity semblence waveform of the
	stacked waveforms; plotted from 40 to 230 uSec/ft.
P-Wave Slo	
	semblence velocity waveform in uSec/ft (green line).
Stopolov M	Novo Slow
Stoneley-V	Vave Slow = apparent Stoneley-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft. (light blue line).
	semblence velocity waveform in usec/n. (light blue line).
Prepared by	v Robert E. Crowder
Ver 6-15-11	
V G I U - I U - I I	

OBI Image Log Summary

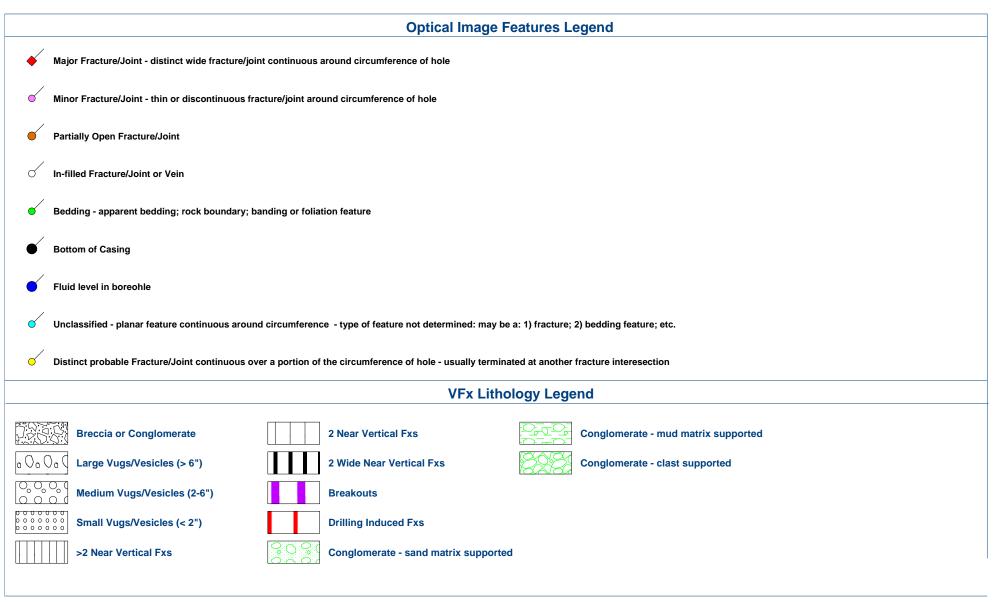
Malcolm Pirnie

Hole MW-18

Phoenix, Maricopa County, Az

Image Features Oriented to Magnetic North and not Corrected for Magnetic Declination

Feature Dip is from 0 to 90 deg (0 = Horizontal, 90 = Vertical) Logged: Sept. 17, 2009



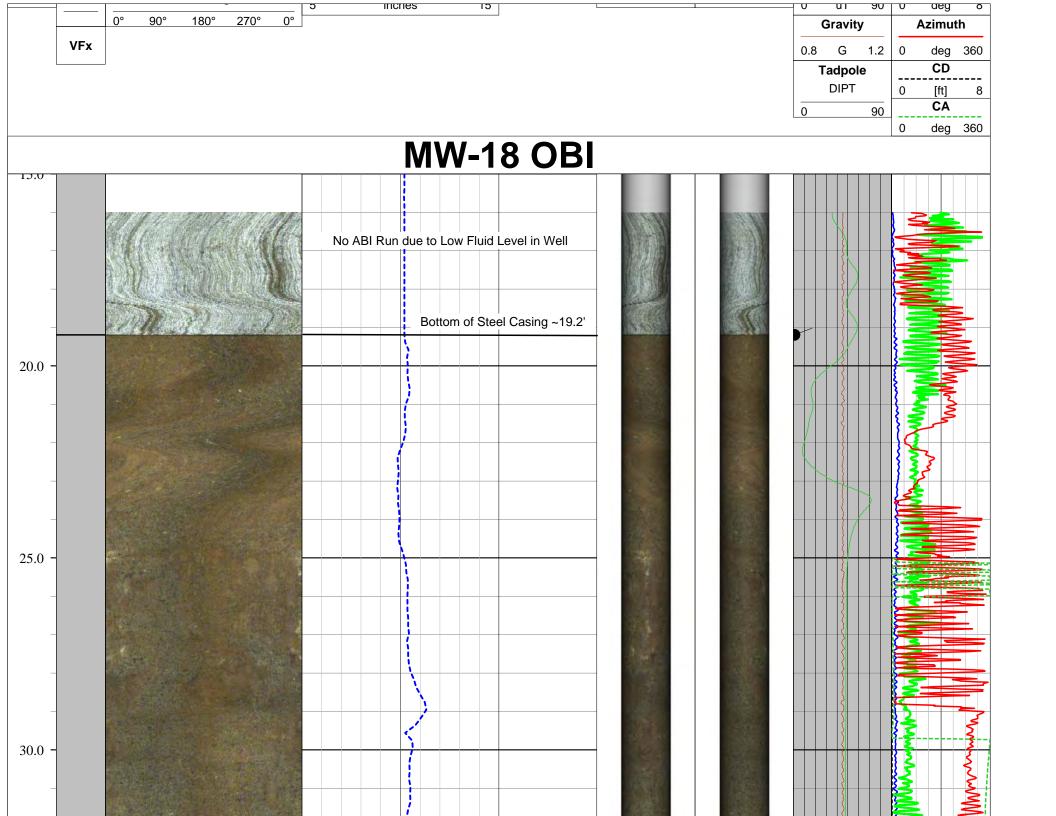
Depth	Picks	OBI Image	3-Arm Caliper	3D-North	3D-East	MagField	Tilt	
1 in:2.5ft	DIPA	Oriented to Mag North	E inchas 45	0°	90°		0 1 0	

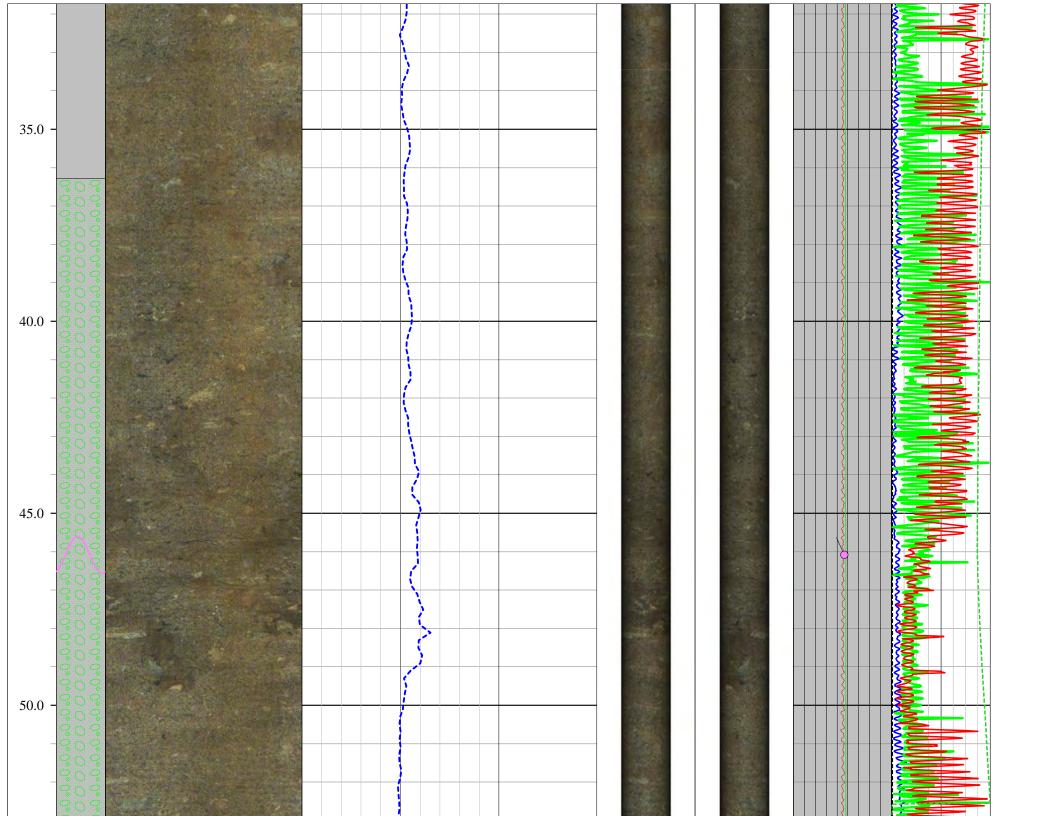


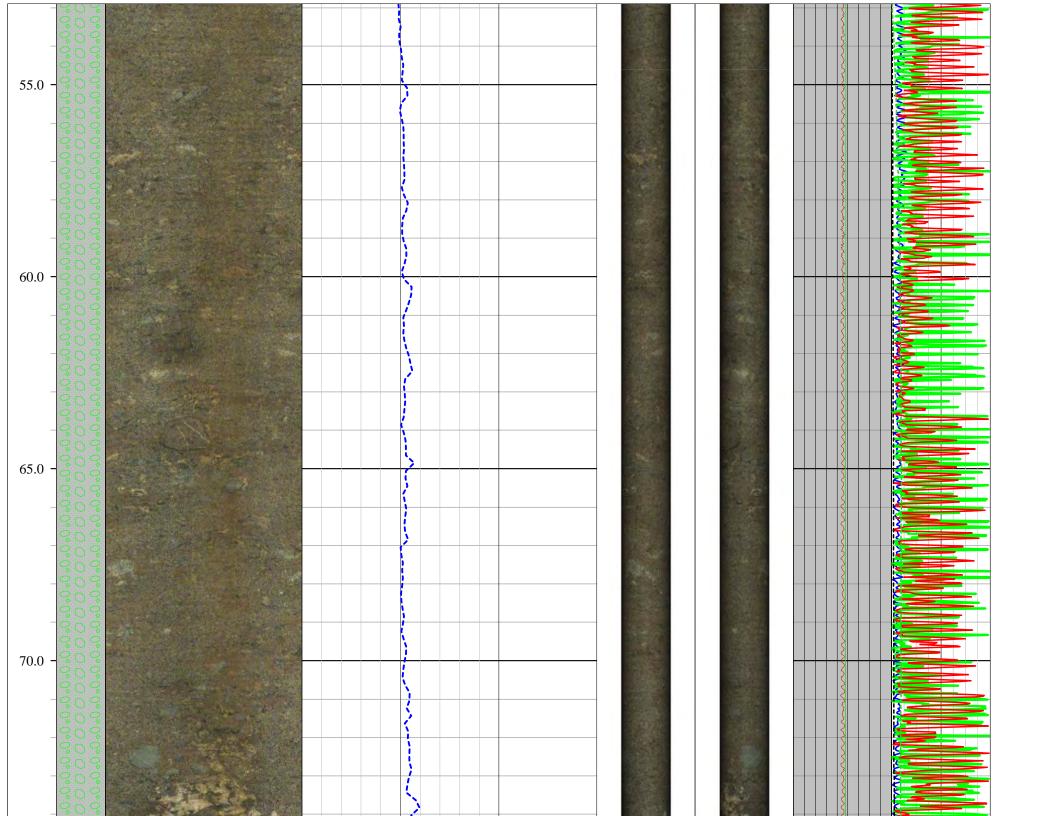
Southwest Exploration

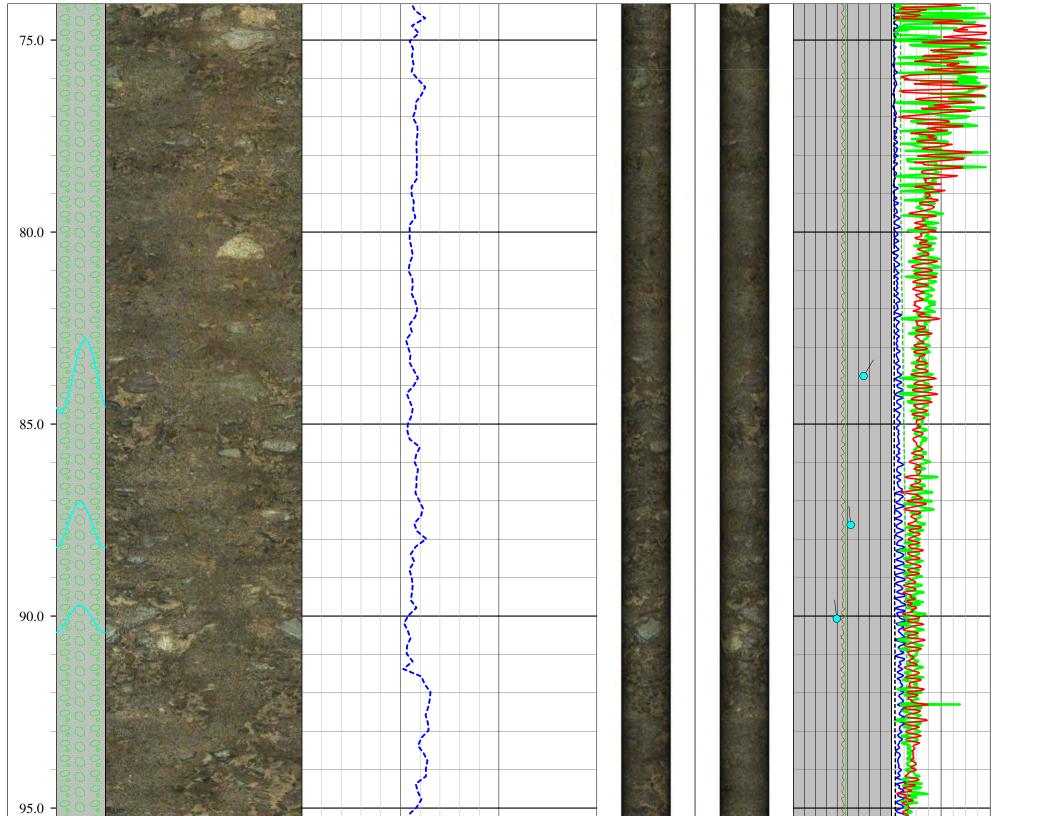
borehole geophysics & video services

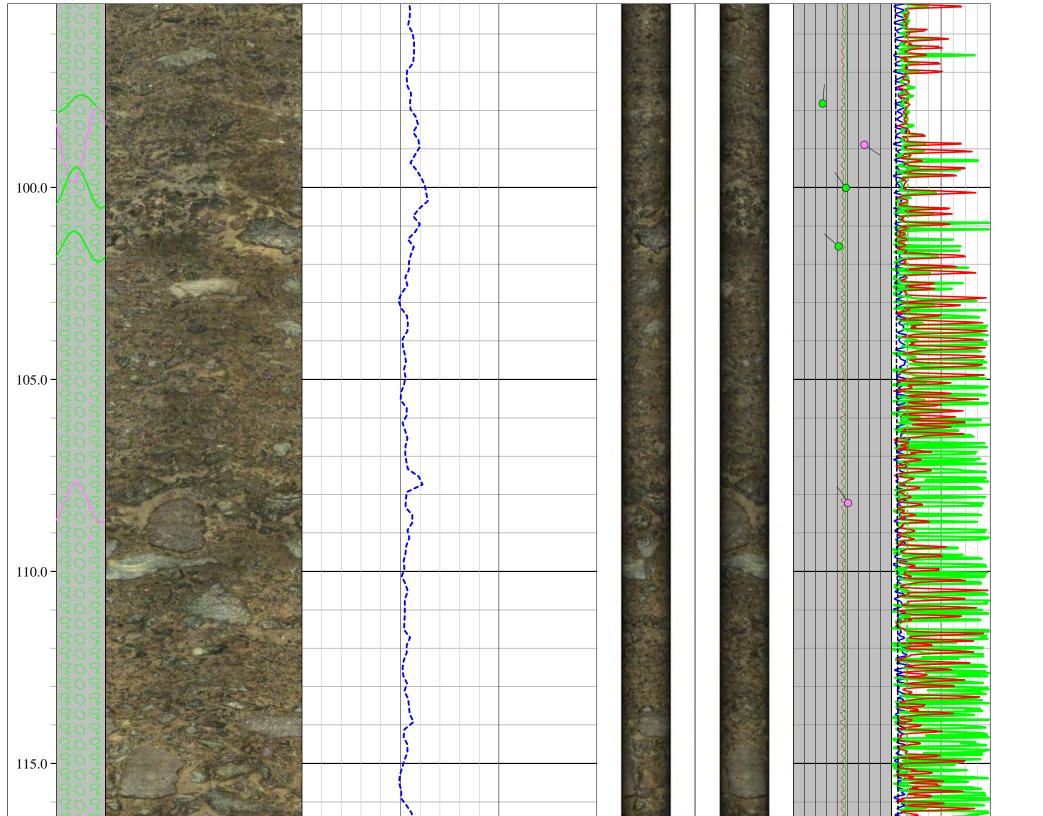
Services, LLC

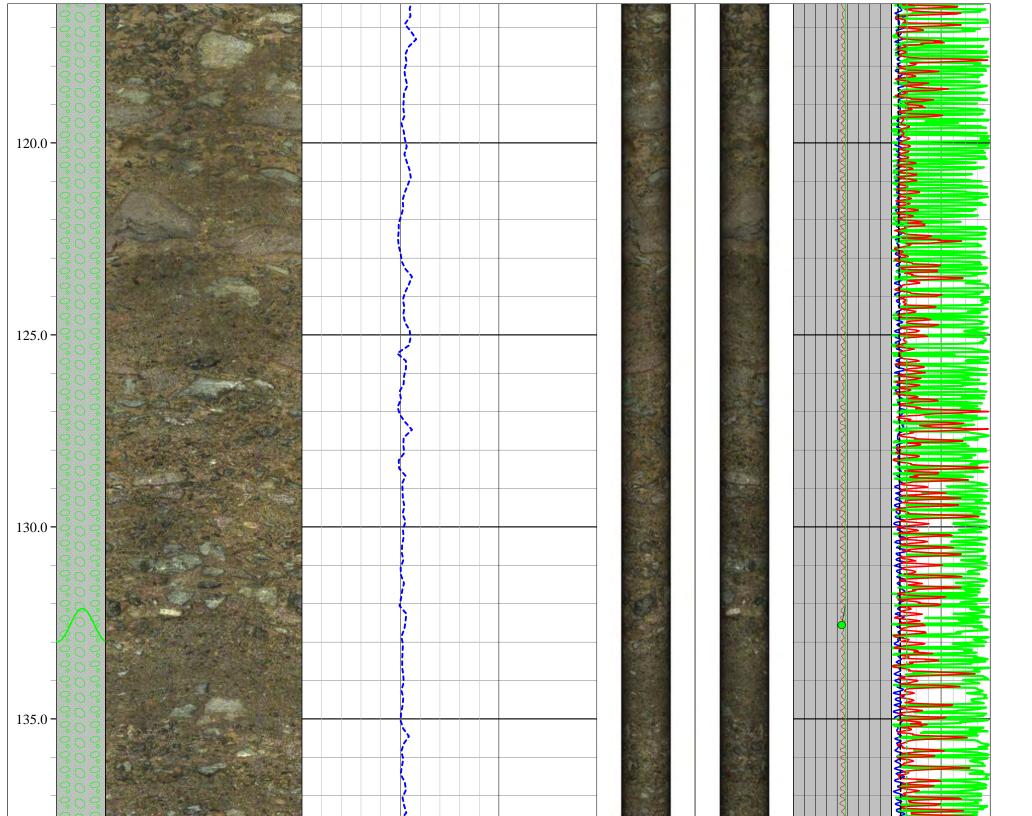


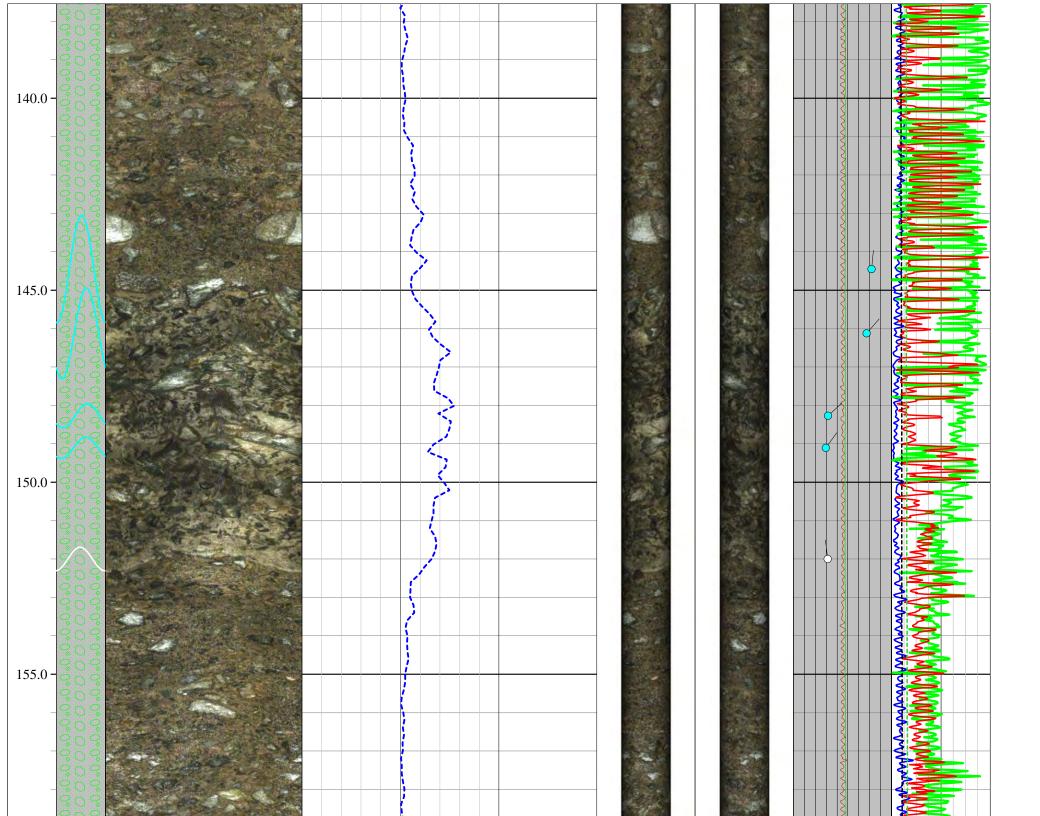


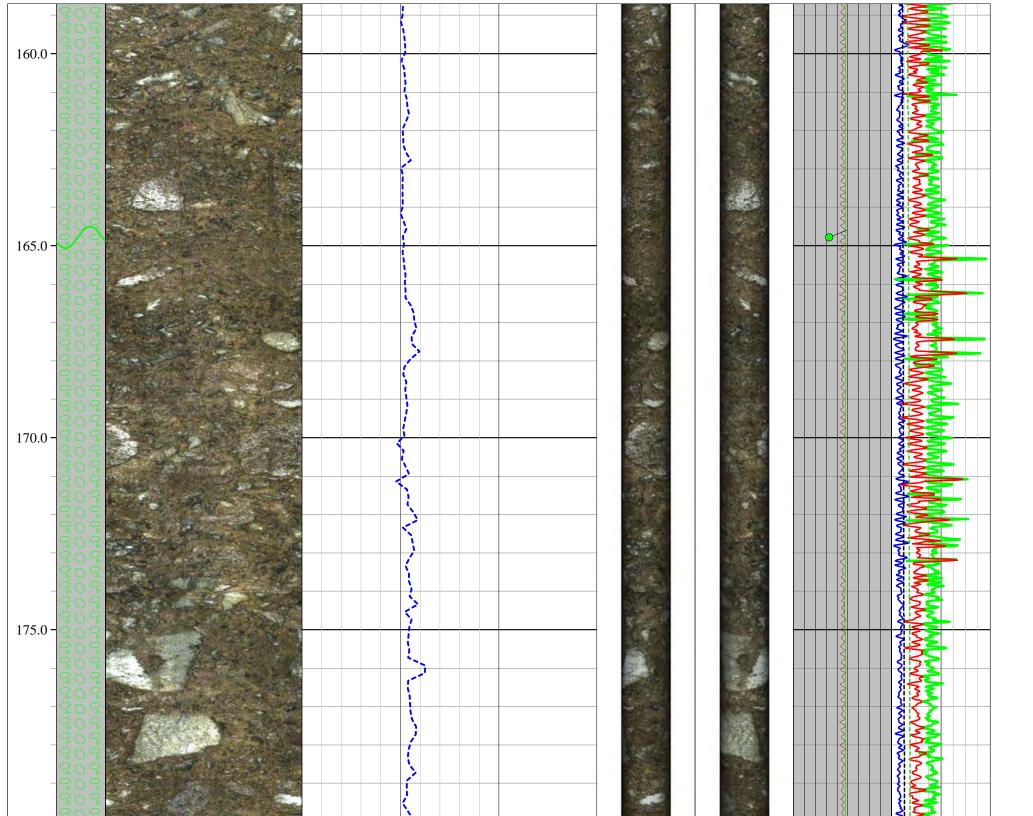


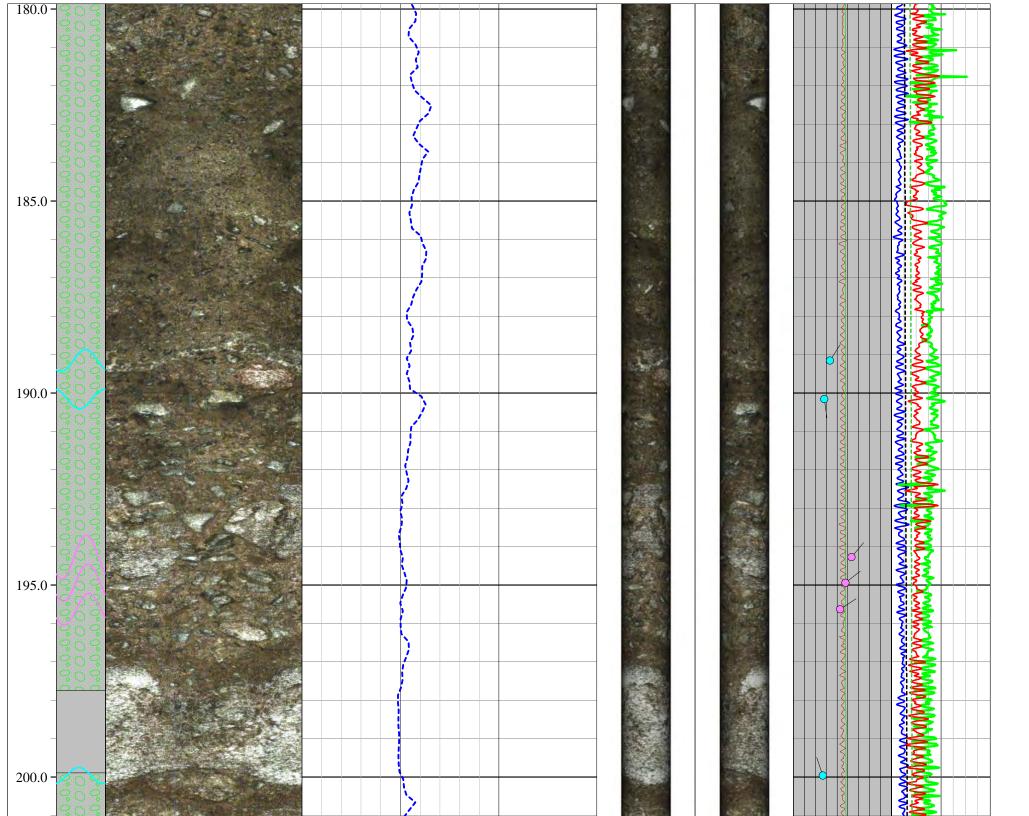


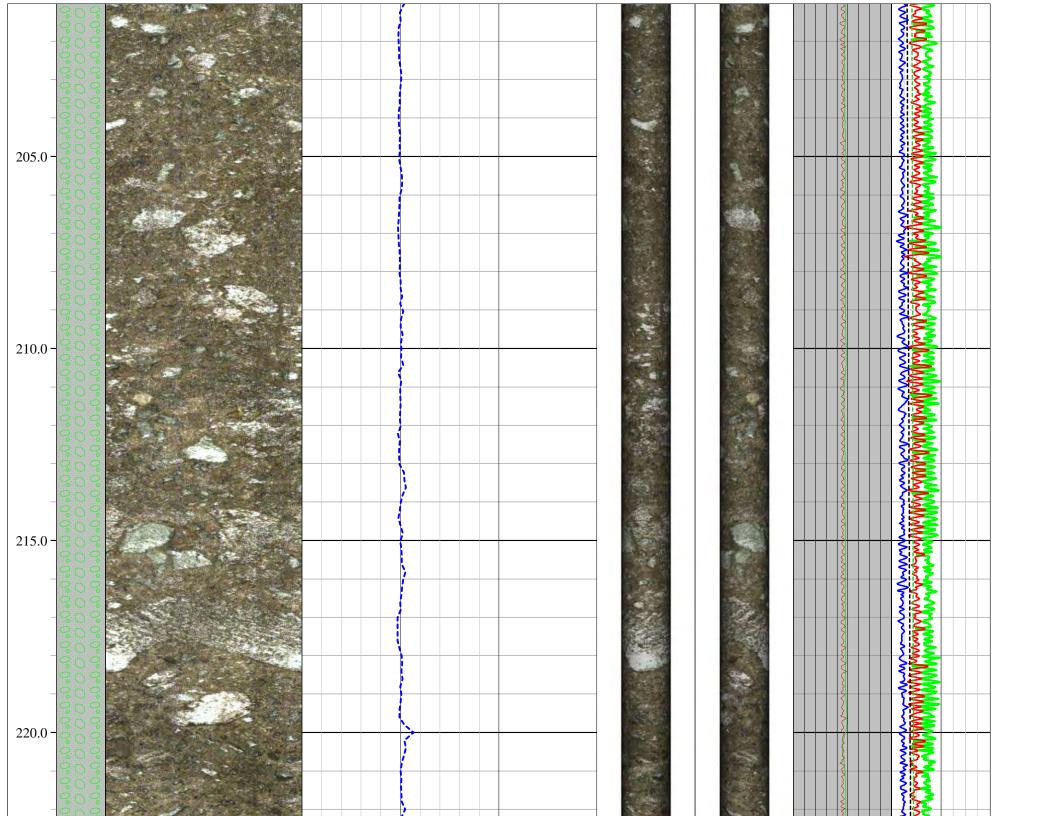


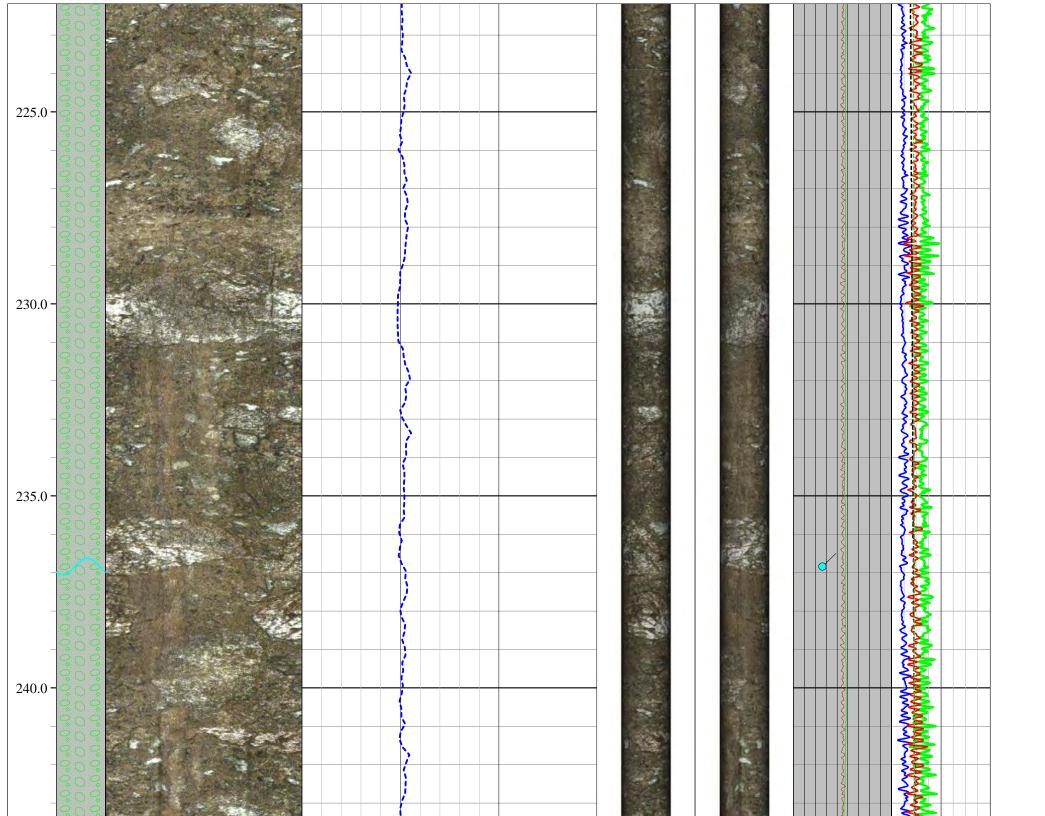


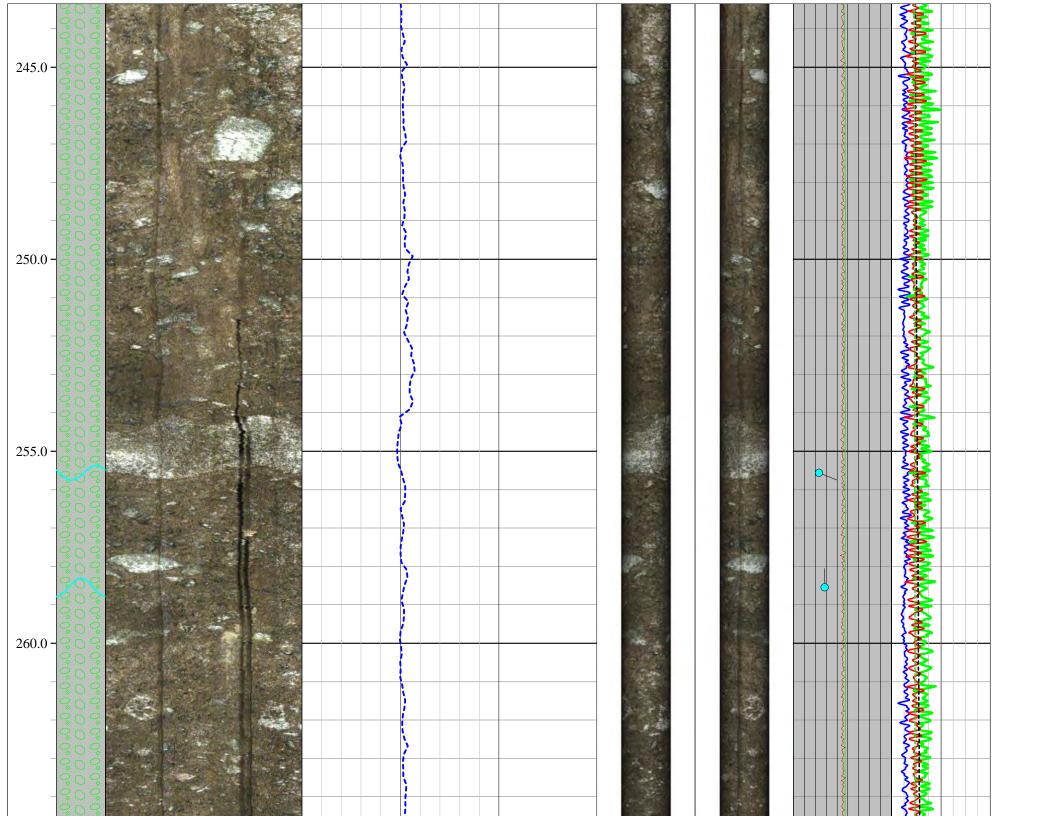


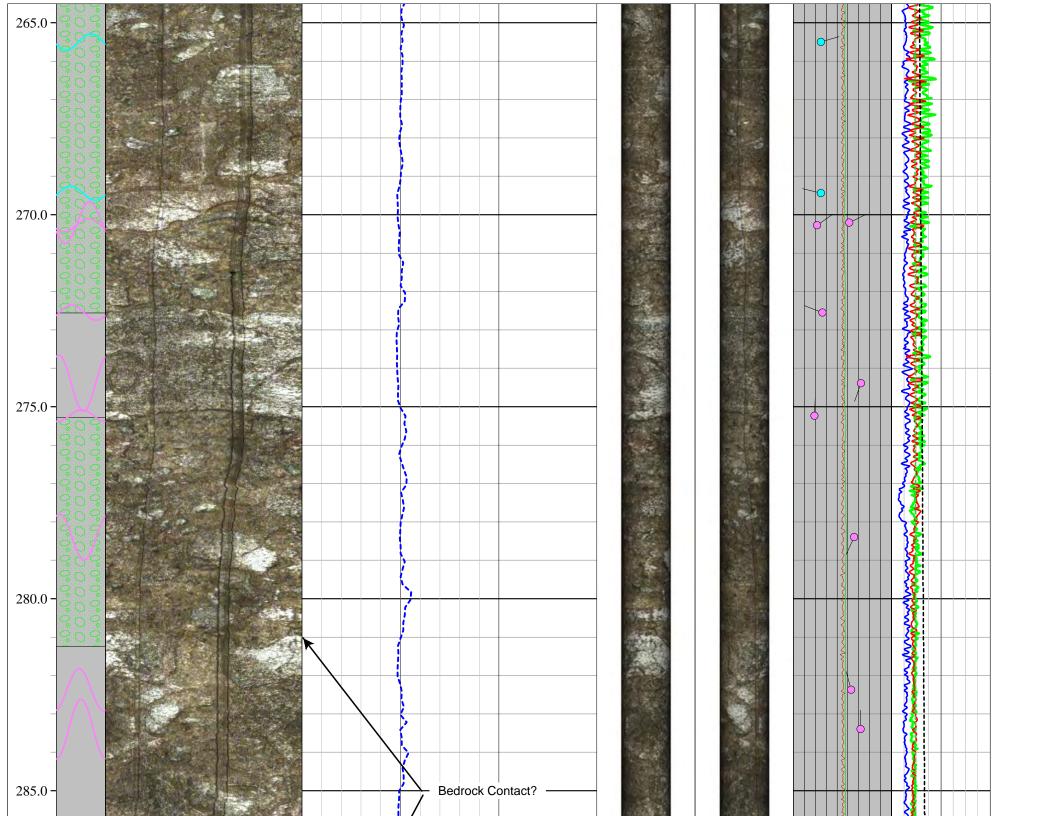


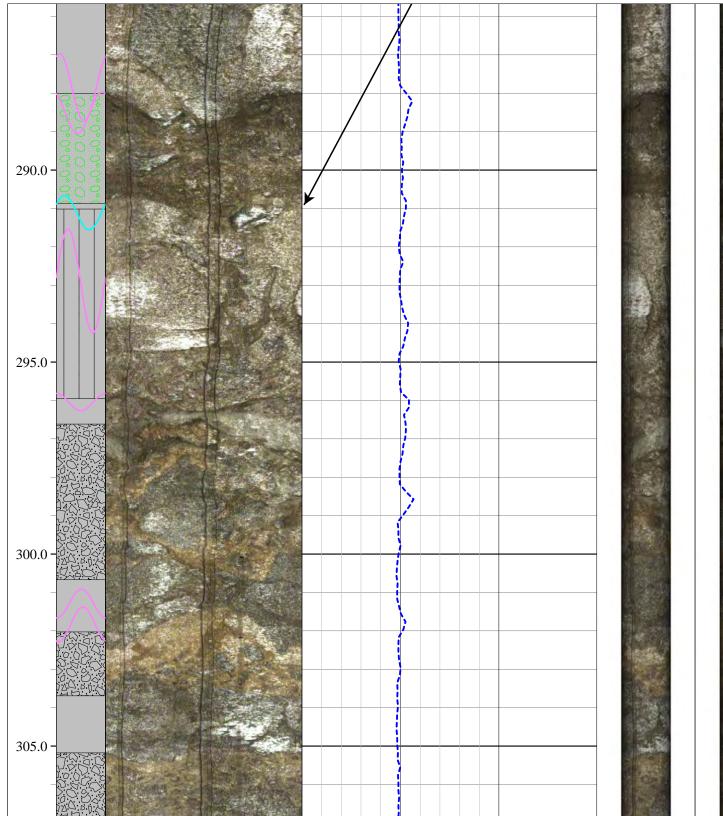


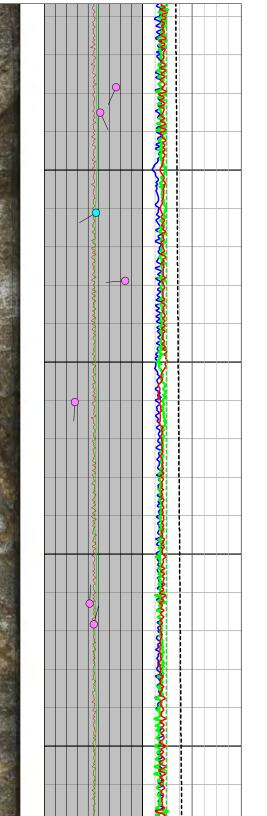


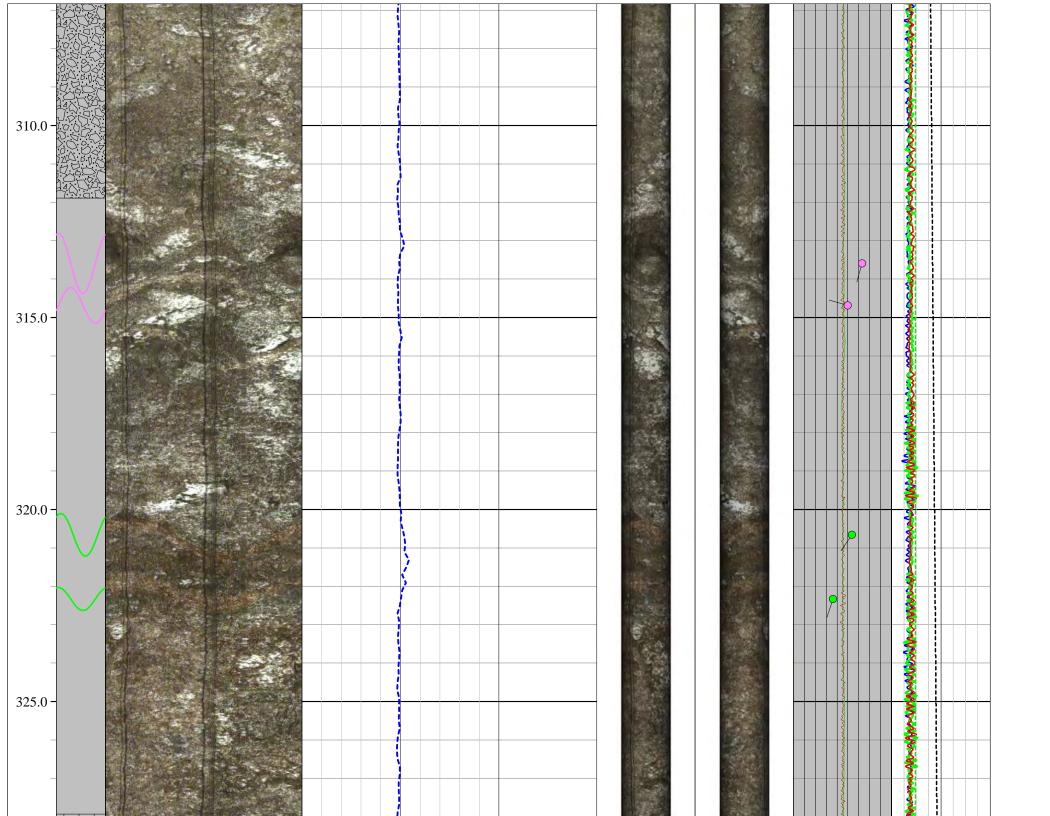


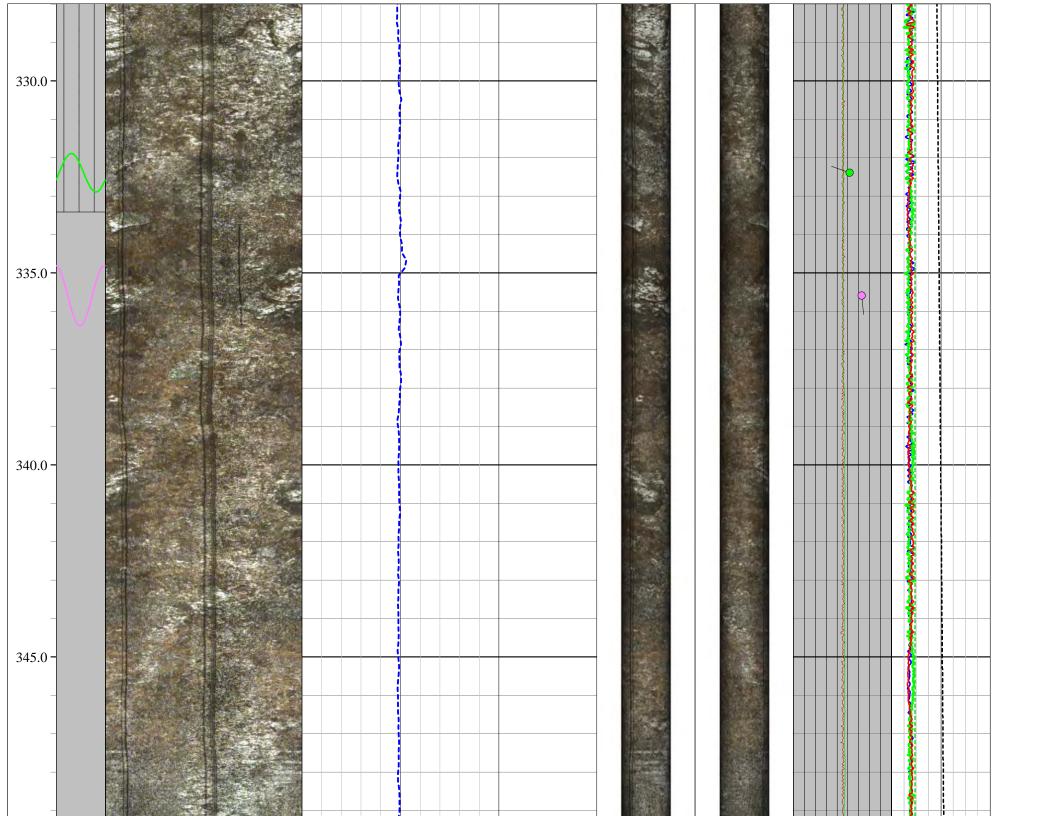


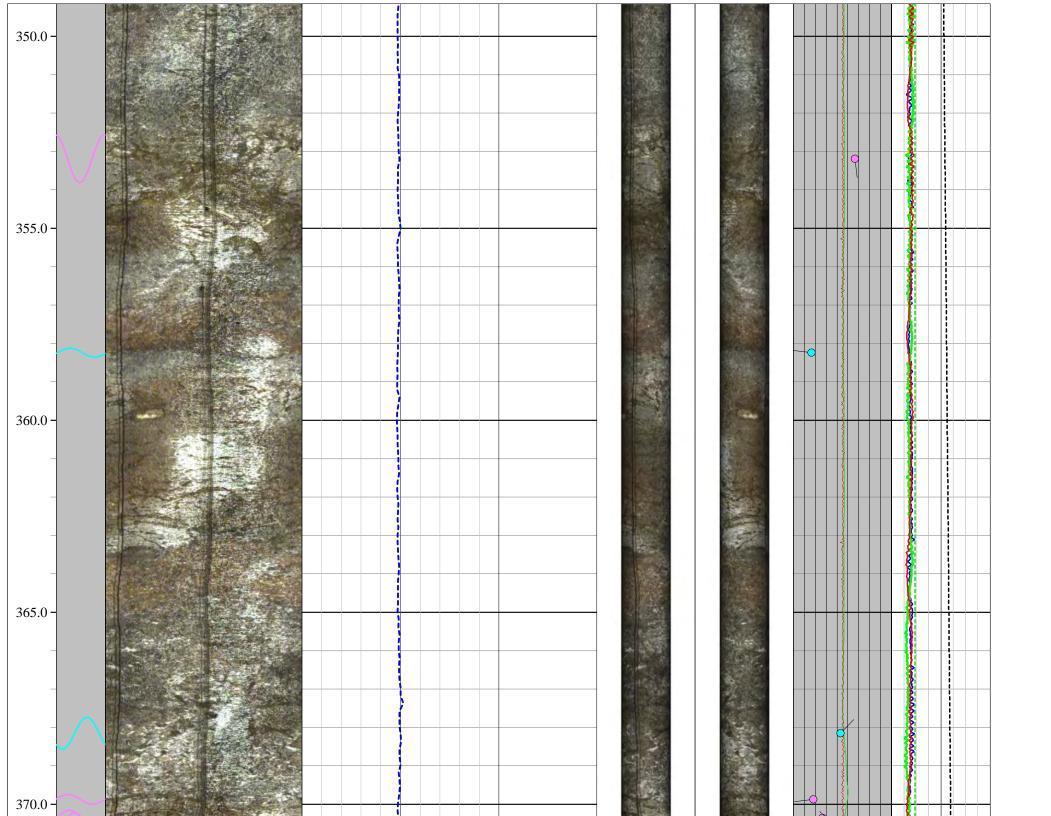


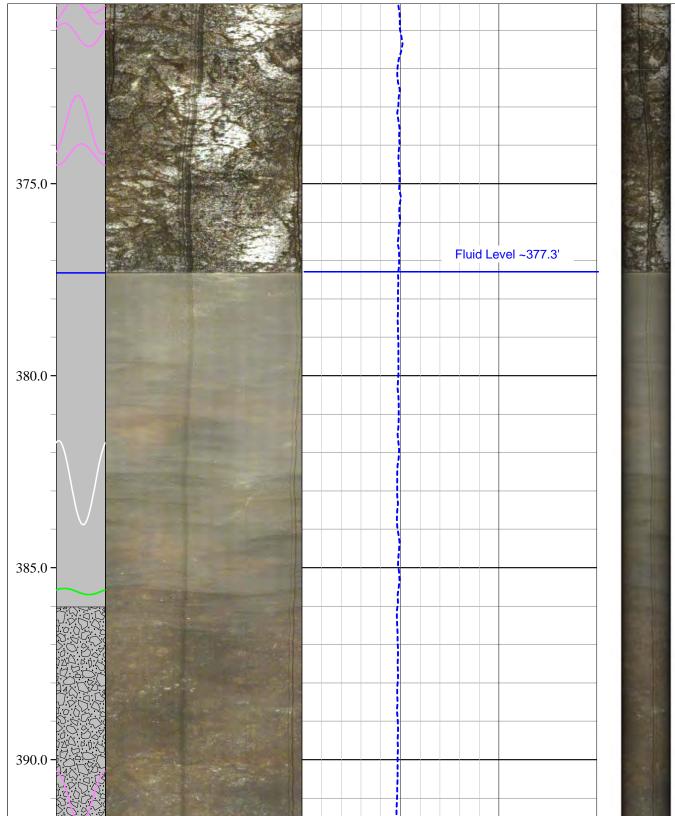


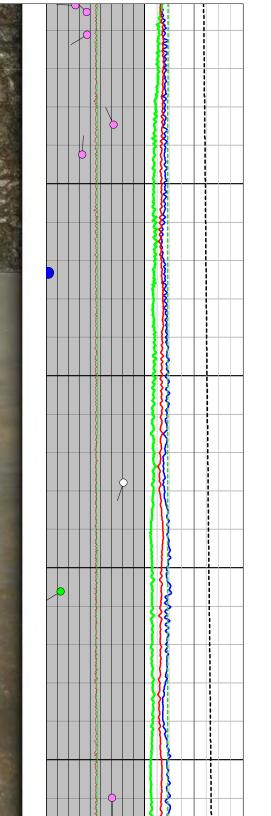


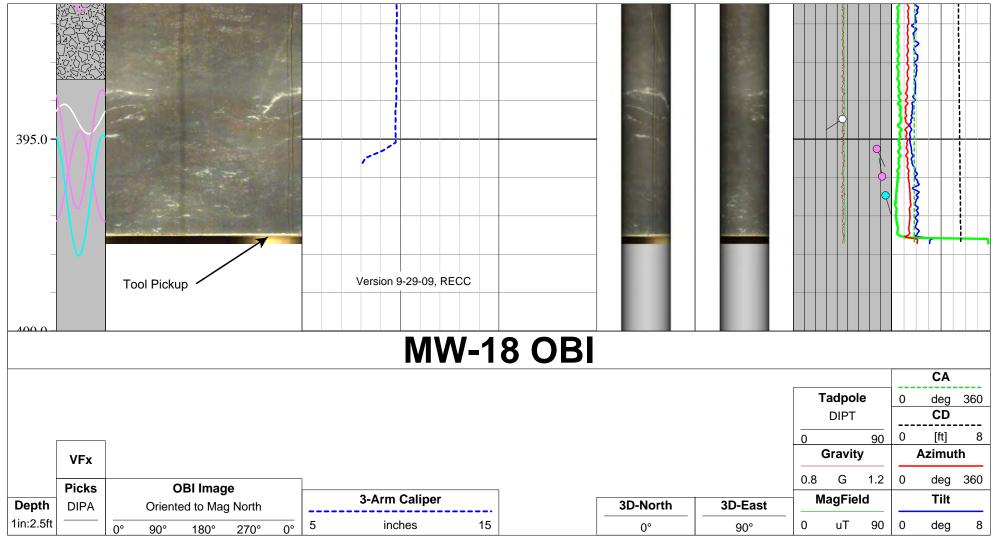


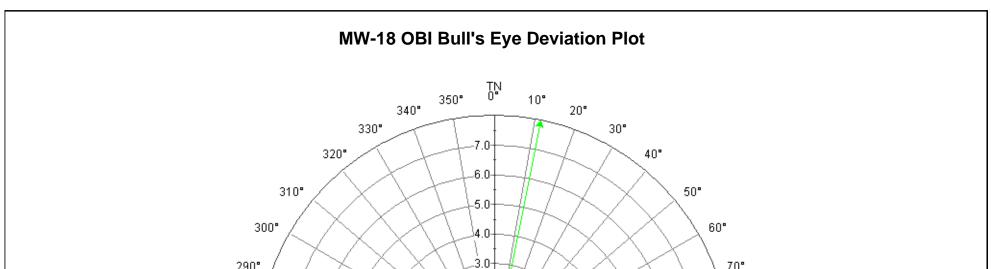


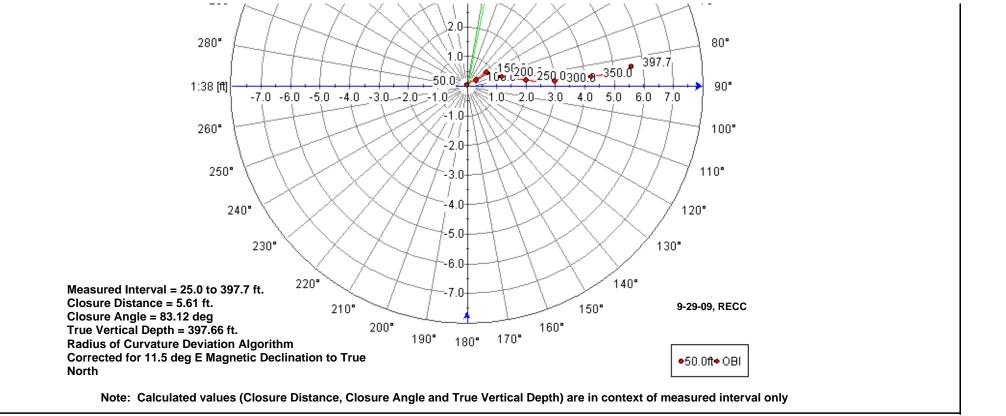


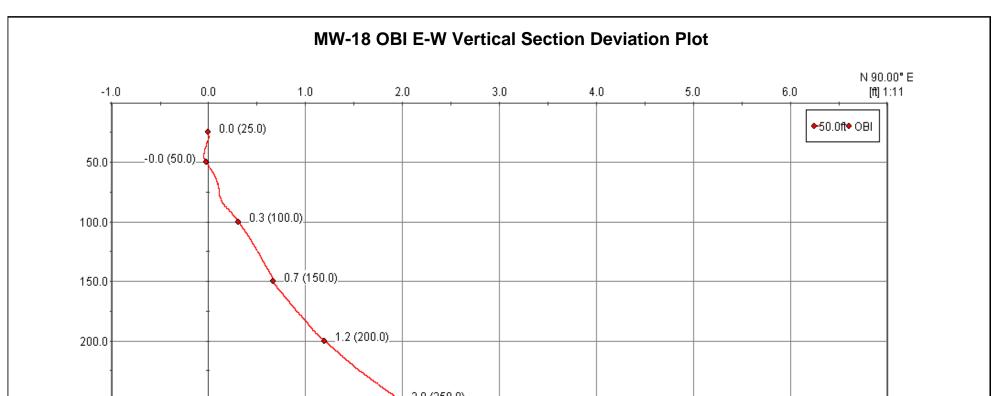


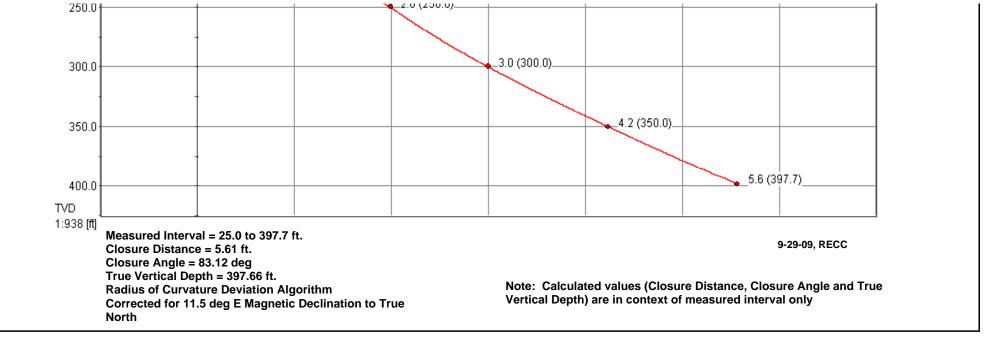


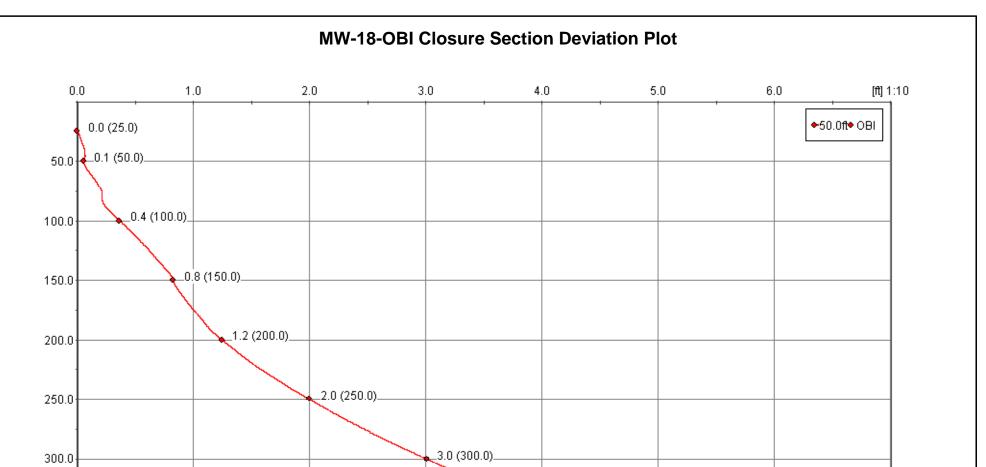


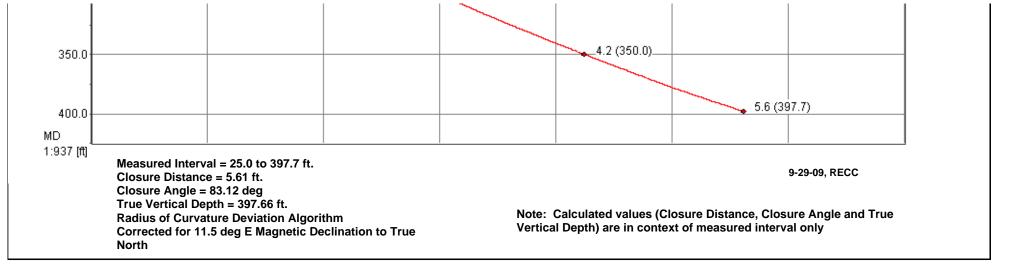










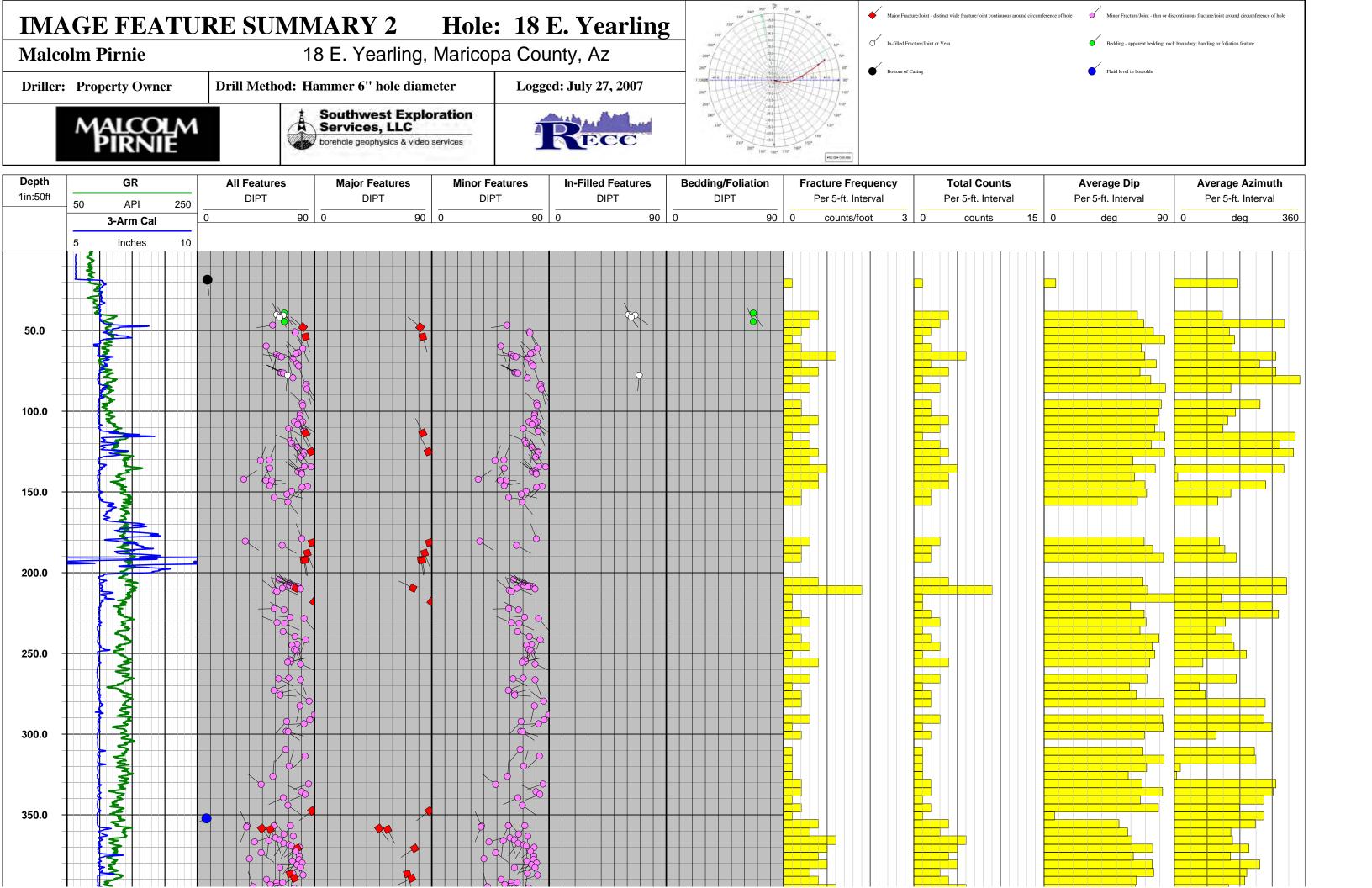


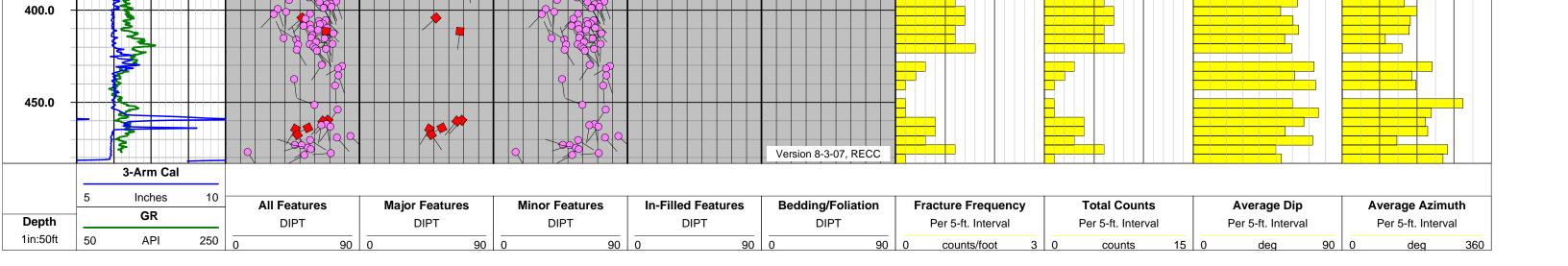
Optical Image Summary Legend

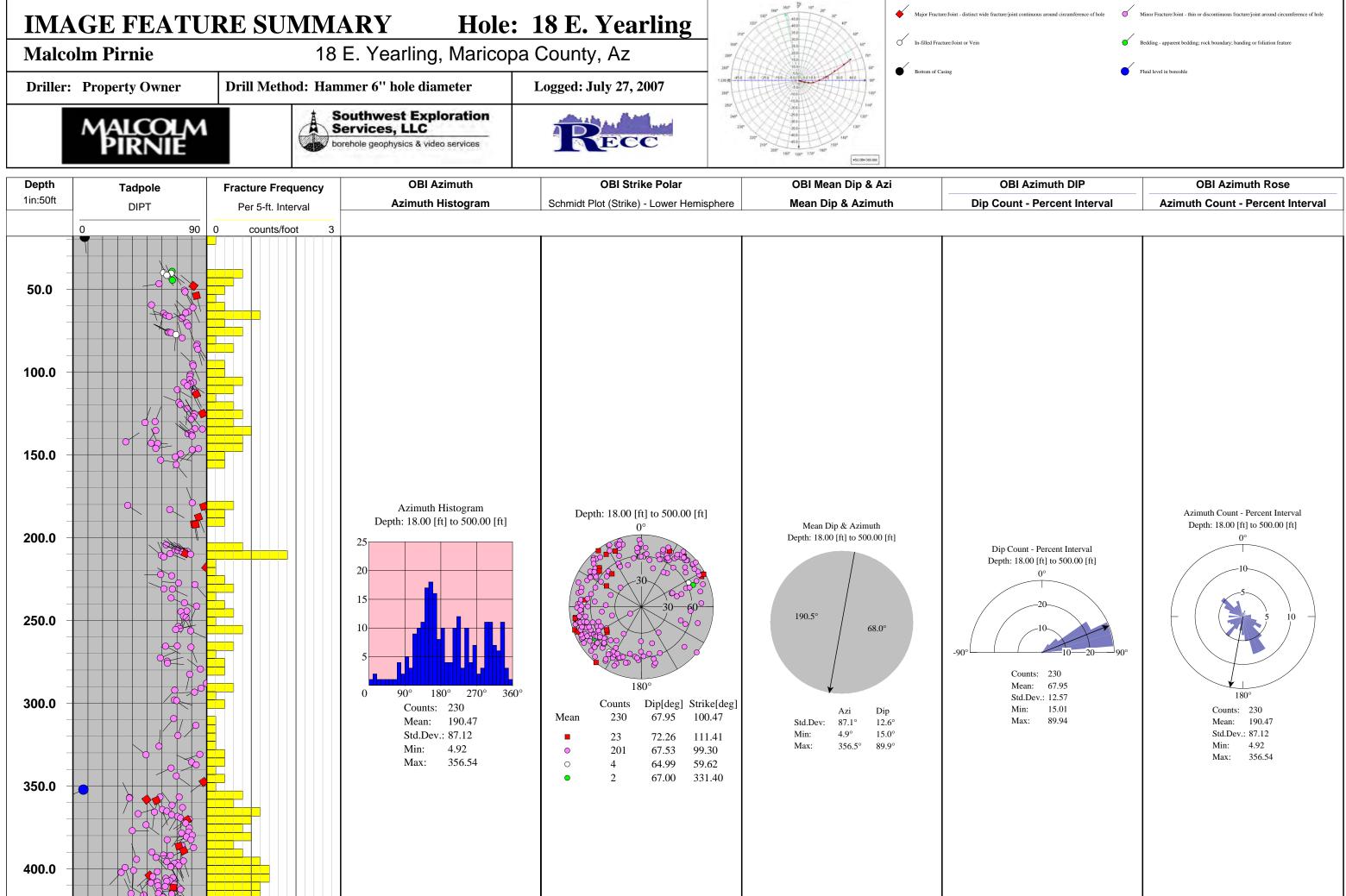
Mnemonics and Comments

- **ARI** = Acoustic Reflectance Index or relative rock hardness was not provided since ABI was not run due to low fluid level in well.
- VFxs = Near Vertical Fractures, highly fractured zones and Fanglomerate or Breccia zones
- **Picks** = planar featues picked on optical borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip apparent hole axis
- **OBI Image-NM** = 2D plot of optical image oriented to magnetic north. Plotted from left to Right N-E-S-W-N
- **3-Arm** = 3-arm mechanical caliper of hole diameter plotted from 5-15 inches (blue line)
- **Centralized TT** = 2D plot of acoustic image travel time was not provided since the ABI probe was not run due to low fluid level in well.
- **Amplitude** = 2D plot of unfiltered acoustic image amplitude was not provided since ABI was not run due to low fluid level in well.
- **3D-North** = 3D cylindrical projection of OBI image looking from the North.
- **3D-East** = 3D cylindrical projection of OBI image looking from the East.
- **Tadpole** = tadpole plot of the image feature picks (fractures and bedding planes); plotted from 0 to 90 dip see legend above. DIPT = True orientation; features corrected for hole deviation
- **Magn. Field** = Total magnetic field strength as measured by fluxgate magnetometer in OBI deviation sensor plotted 0-90 uT. (green line)

Azimuth	= direction of tool tilt plotted 0 to 360 deg; represents borehole deviation direction (red line)
Tilt	= tool tilt (vertical = 0 and horizontal = 90) plotted 0 to 8 deg; represents borehole deviation tilt from vertical. (blue line)
CA	= Closure angle.= horizontal angle from hole to vertical projected collar location; plotted from 0 to 360 deg (dashed green line)
CD	= Closure Distance.= distance in feet in a horizontal plane from the borehole to vertical projected collar location; plotted from 0 to 8 ft. (dotted black line)
Prepared b	by Robert E. Crowder
Rev 9-29-2	2009



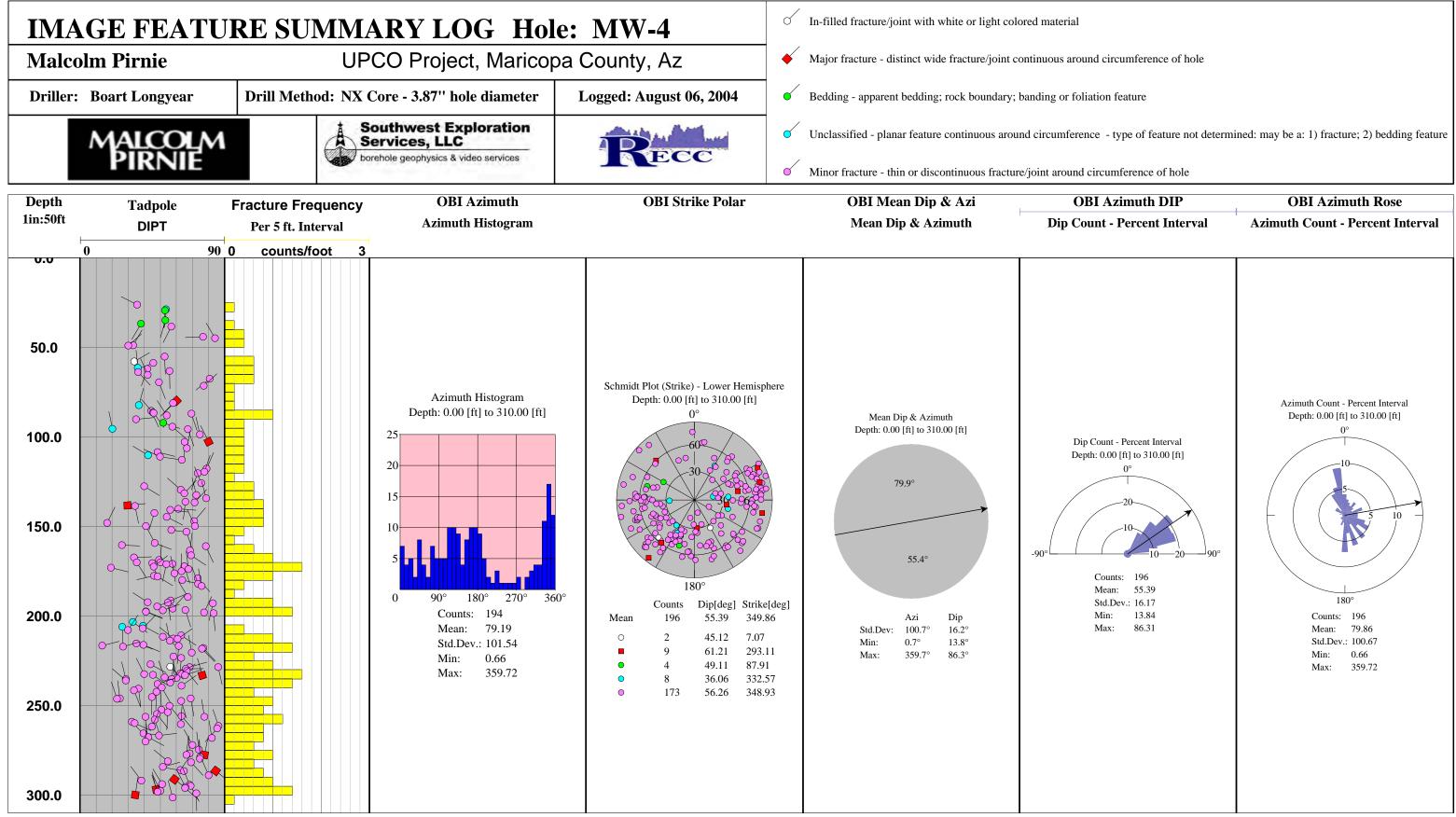


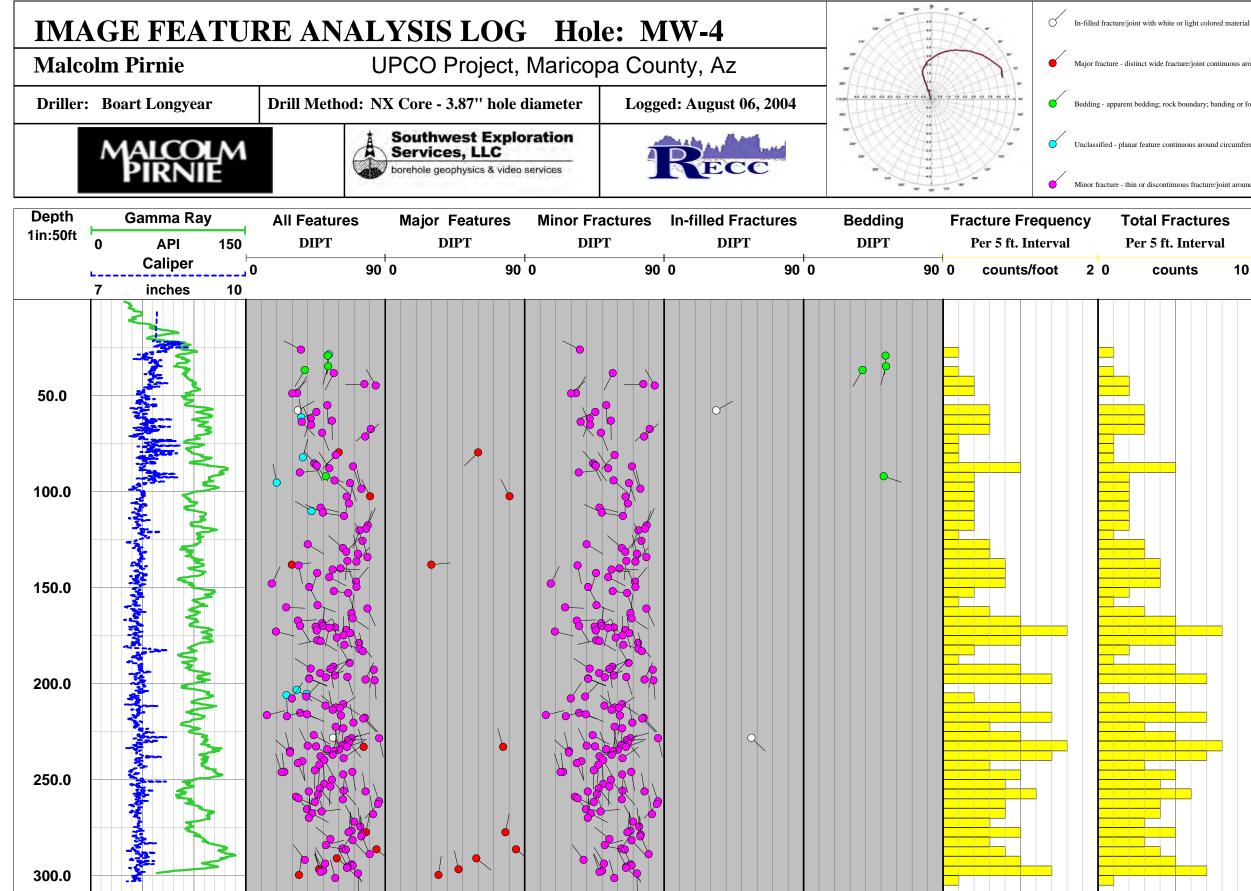




1in:50ft	0 90	0 counts/foot 3	Azimuth Histogram	Schmidt Plot (Strike) - Lower Hemisphere	Mean Dip & Azimuth	Dip Count -
Depth	DIPT	Per 5-ft. Interval	OBI Azimuth	OBI Strike Polar	OBI Mean Dip & Azi	OBI A
	Tadpole	Fracture Frequency				
500.0				Version 8-3-07, RECC		
450.0						

Azimuth DIP	OBI Azimuth Rose
- Percent Interval	Azimuth Count - Percent Interval





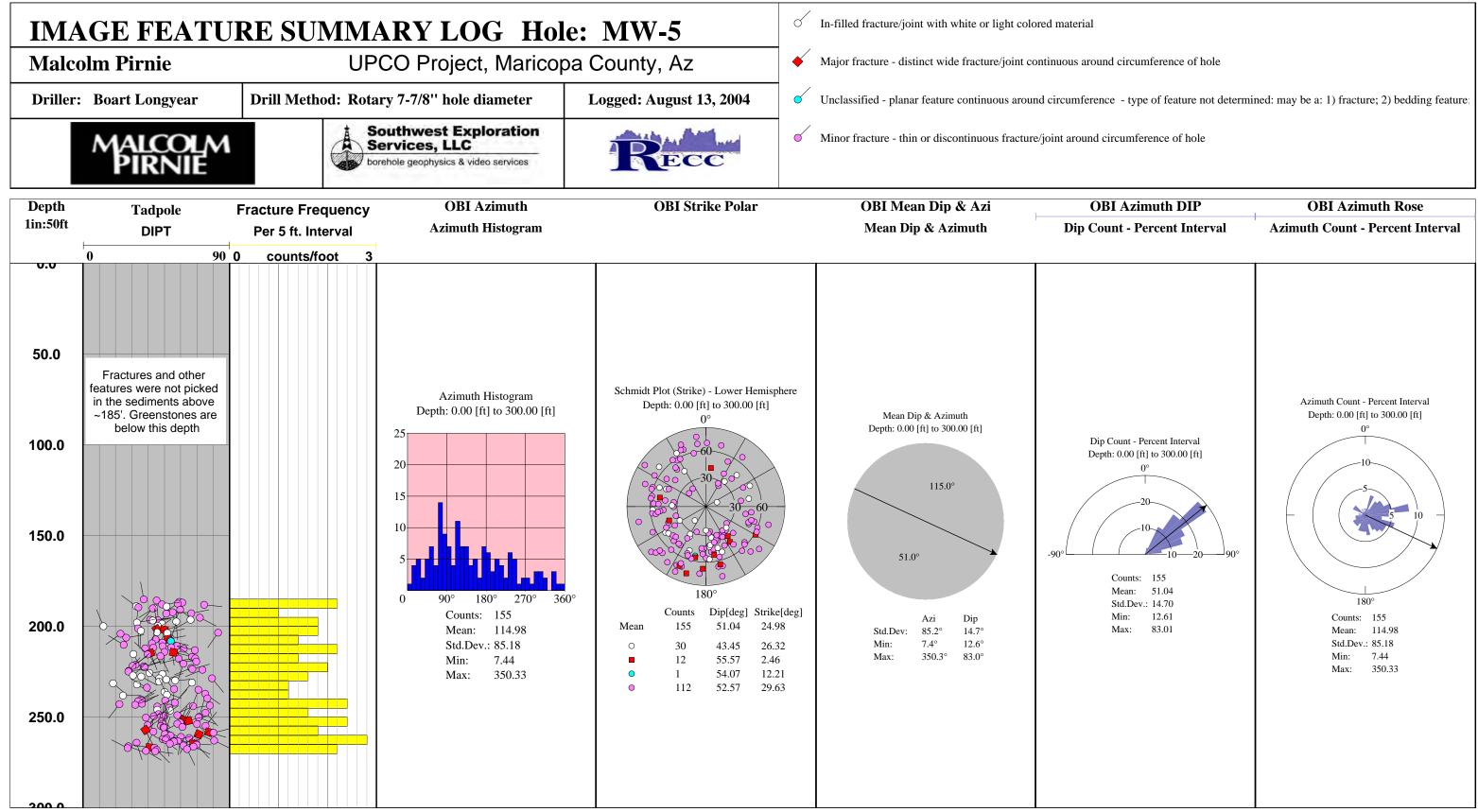
Major fracture - distinct wide fracture/joint continuous around circumference of hole

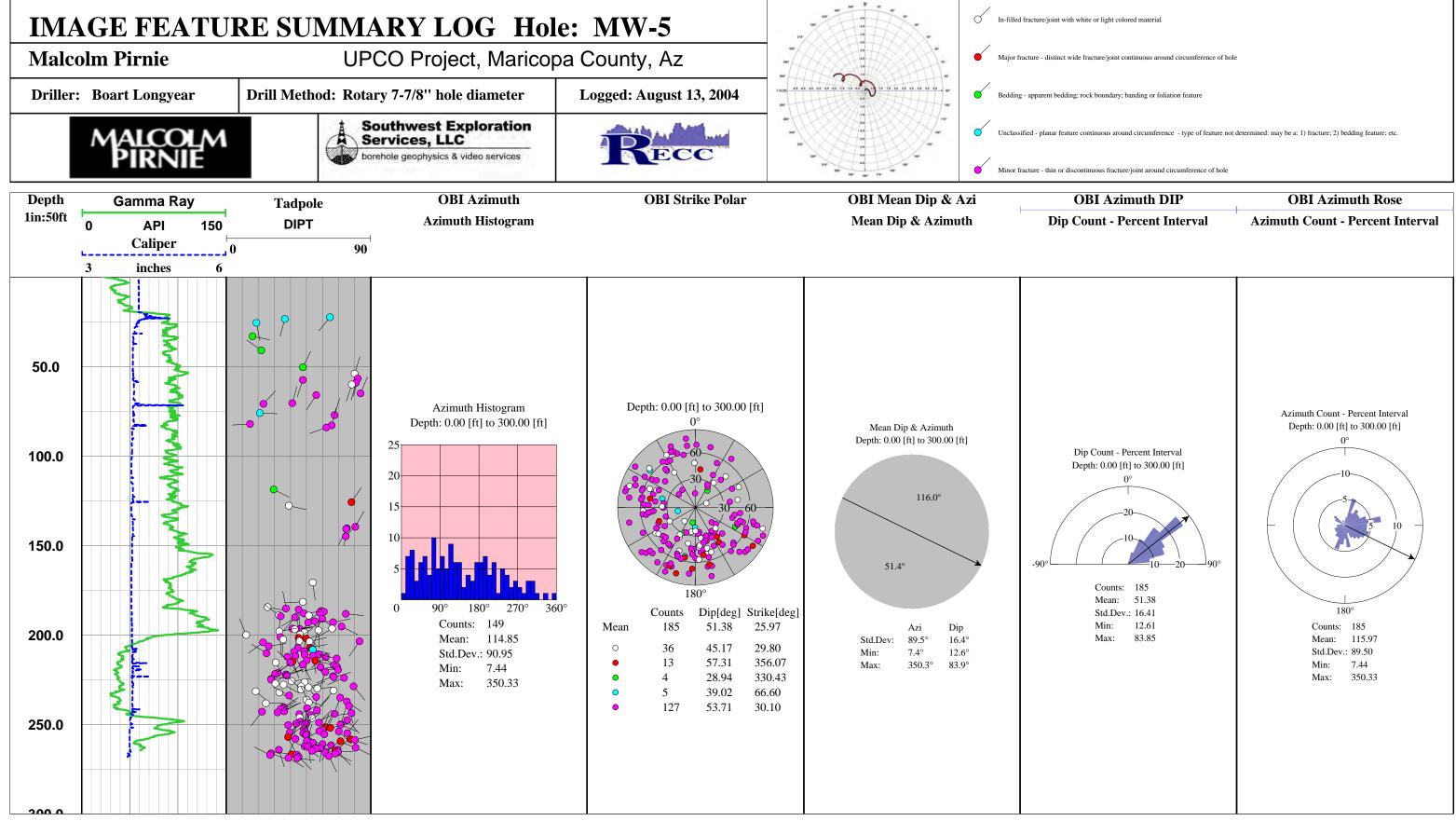
apparent bedding; rock boundary; banding or foliation feat

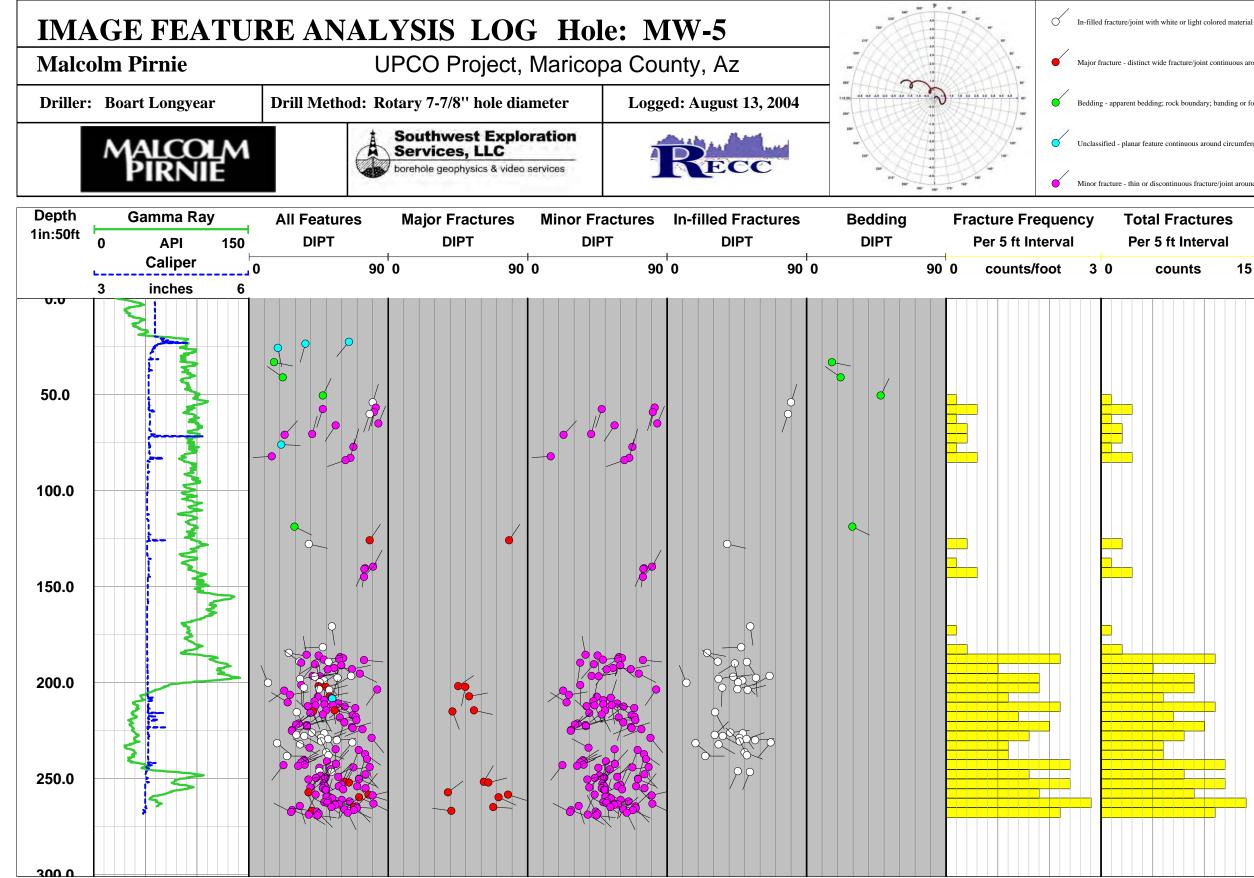
- type of feature not determined: may be a: 1) fracture; 2) bedding feature; etc.

Minor fracture - thin or discontinuous fracture/joint around circumference of hole

l Fractures 5 ft. Interval	Averag Per 5 ft. 1		Average Per 5 ft.	Azimuth Interval
counts 10	0 de	g 90	0 de	eg 360





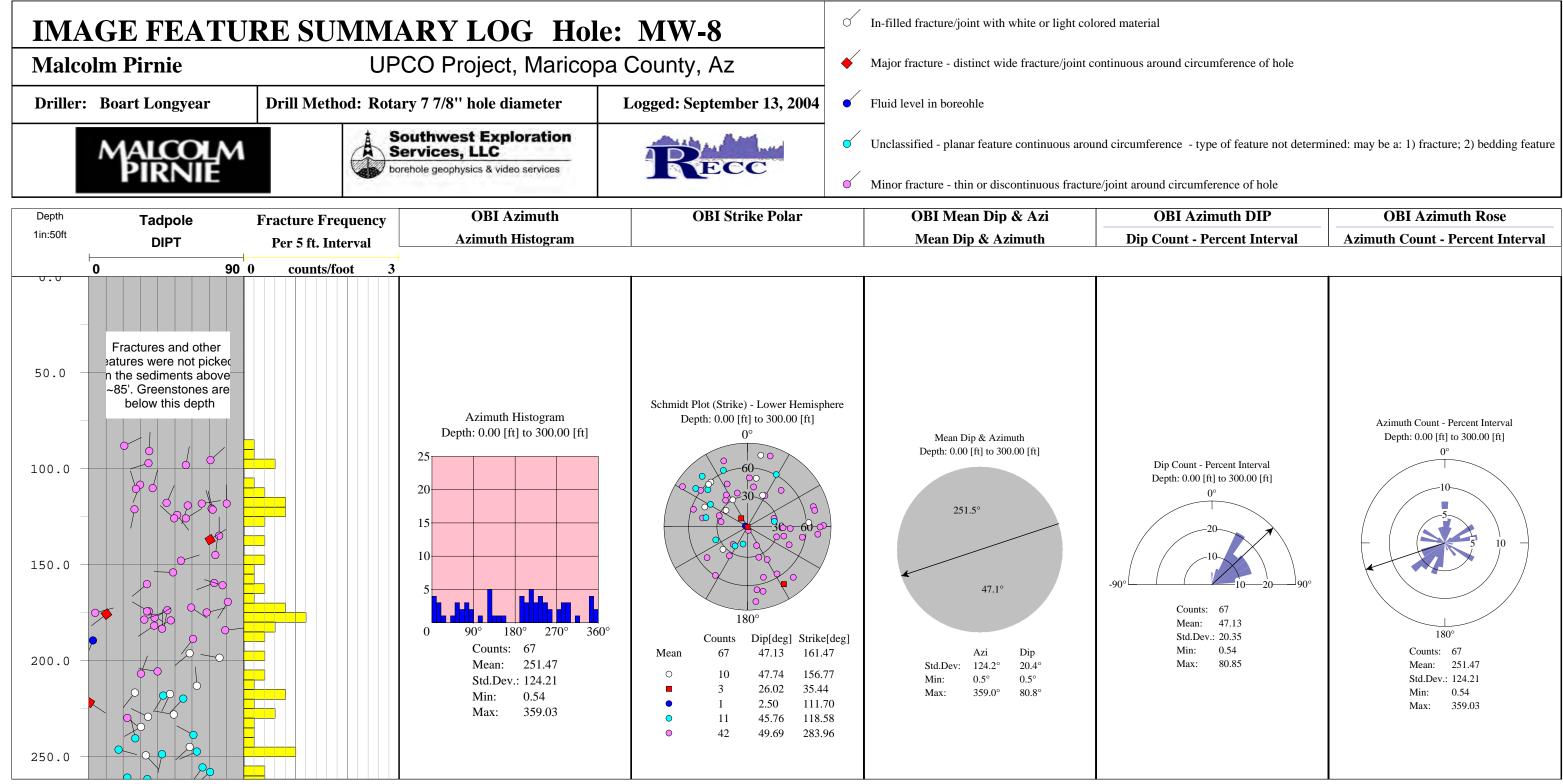


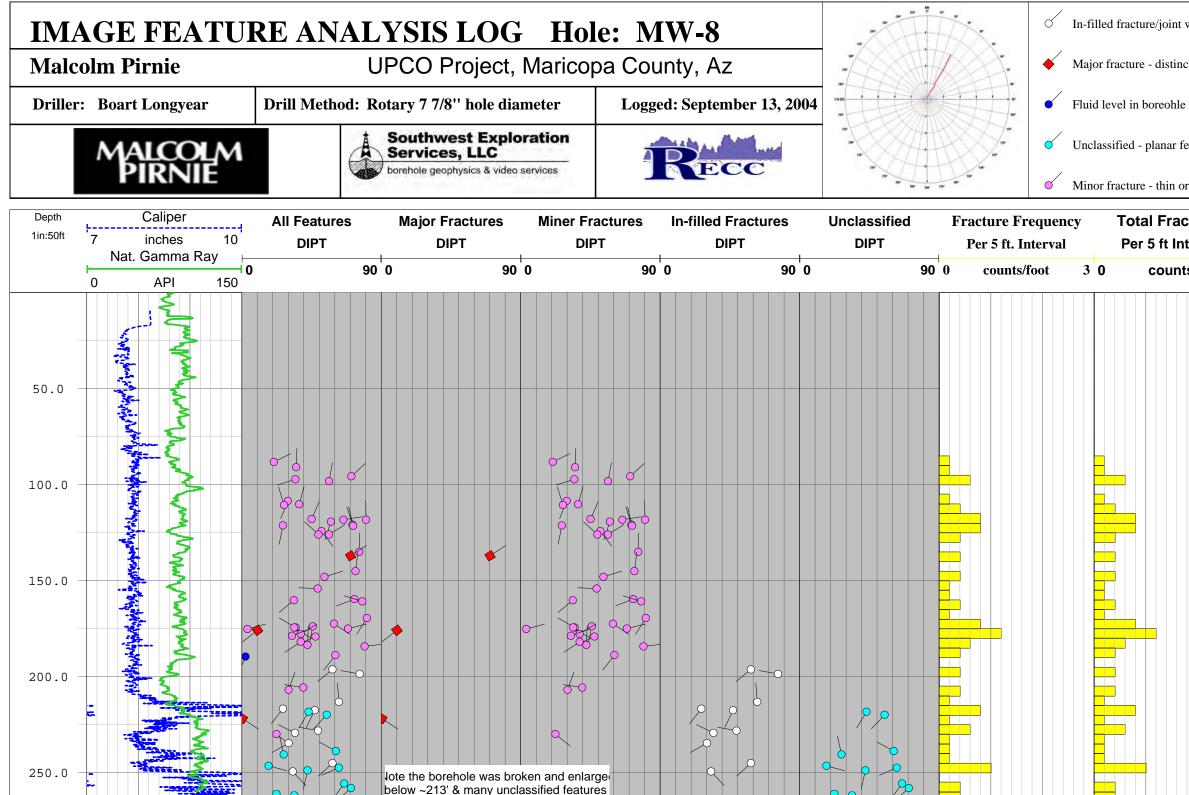
Major fracture - distinct wide fracture/ioint continuous around circumference of hole

type of feature not determined: may be a: 1) fracture; 2) bedding feature; etc.

Minor fracture - thin or discontinuous fracture/joint around circumference of hole

l Fractures 5 ft Interval		Average Per 5 ft In			ge Azim 5 ft Interv	
counts ²	15	0 deg	90	0	deg	360





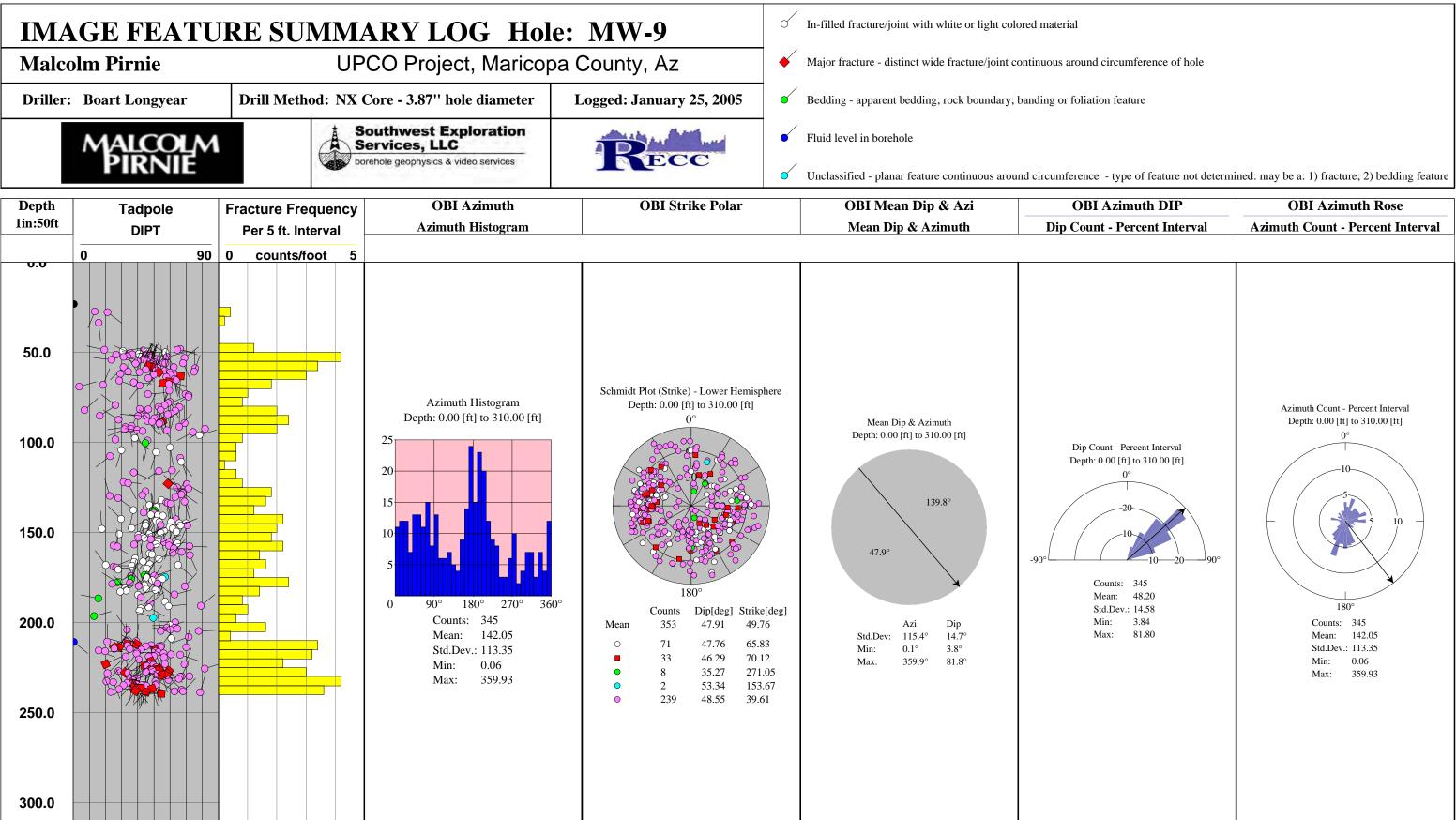
In-filled fracture/joint with white or light colored material

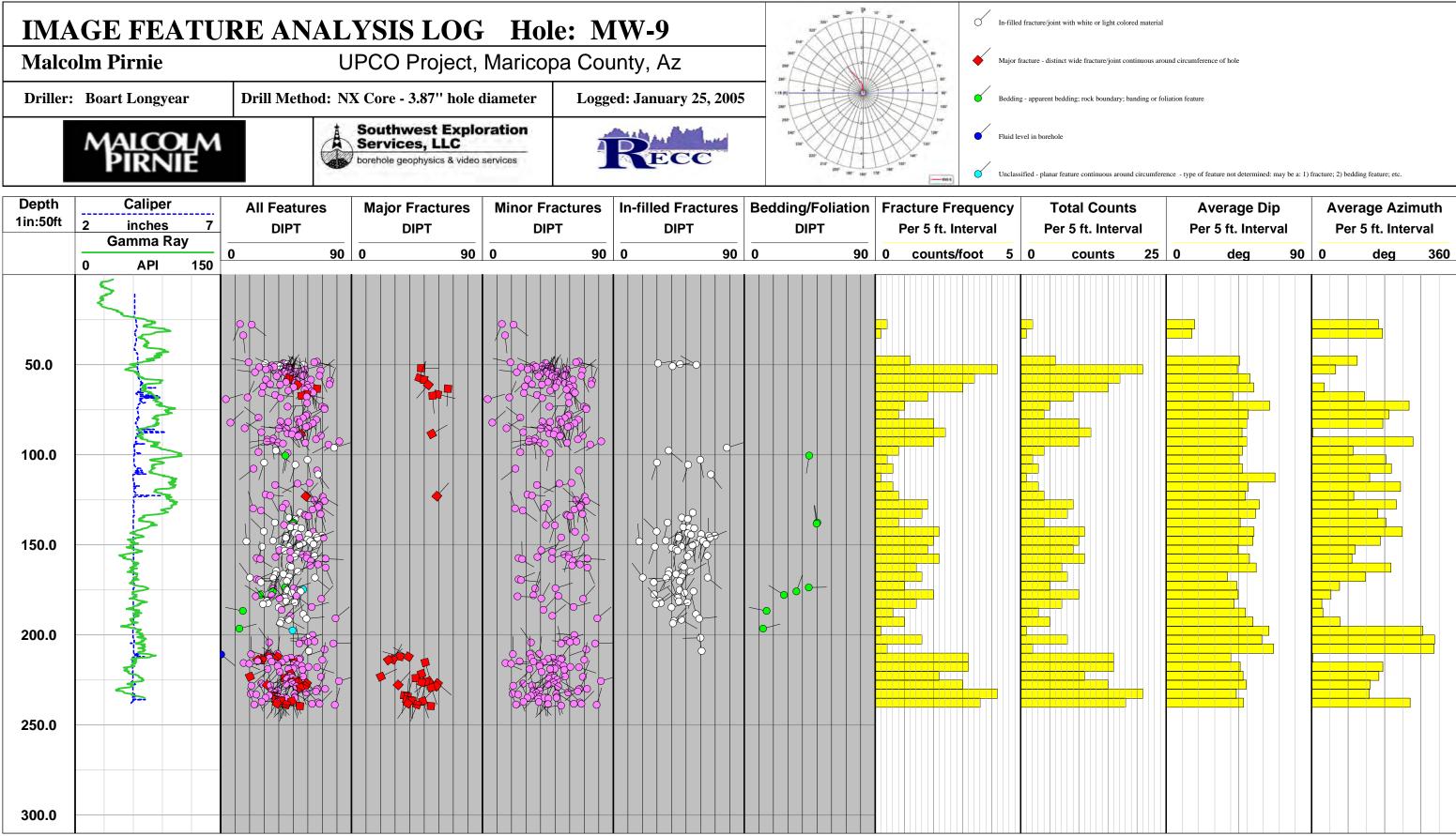
Major fracture - distinct wide fracture/joint continuous around circumference of hole

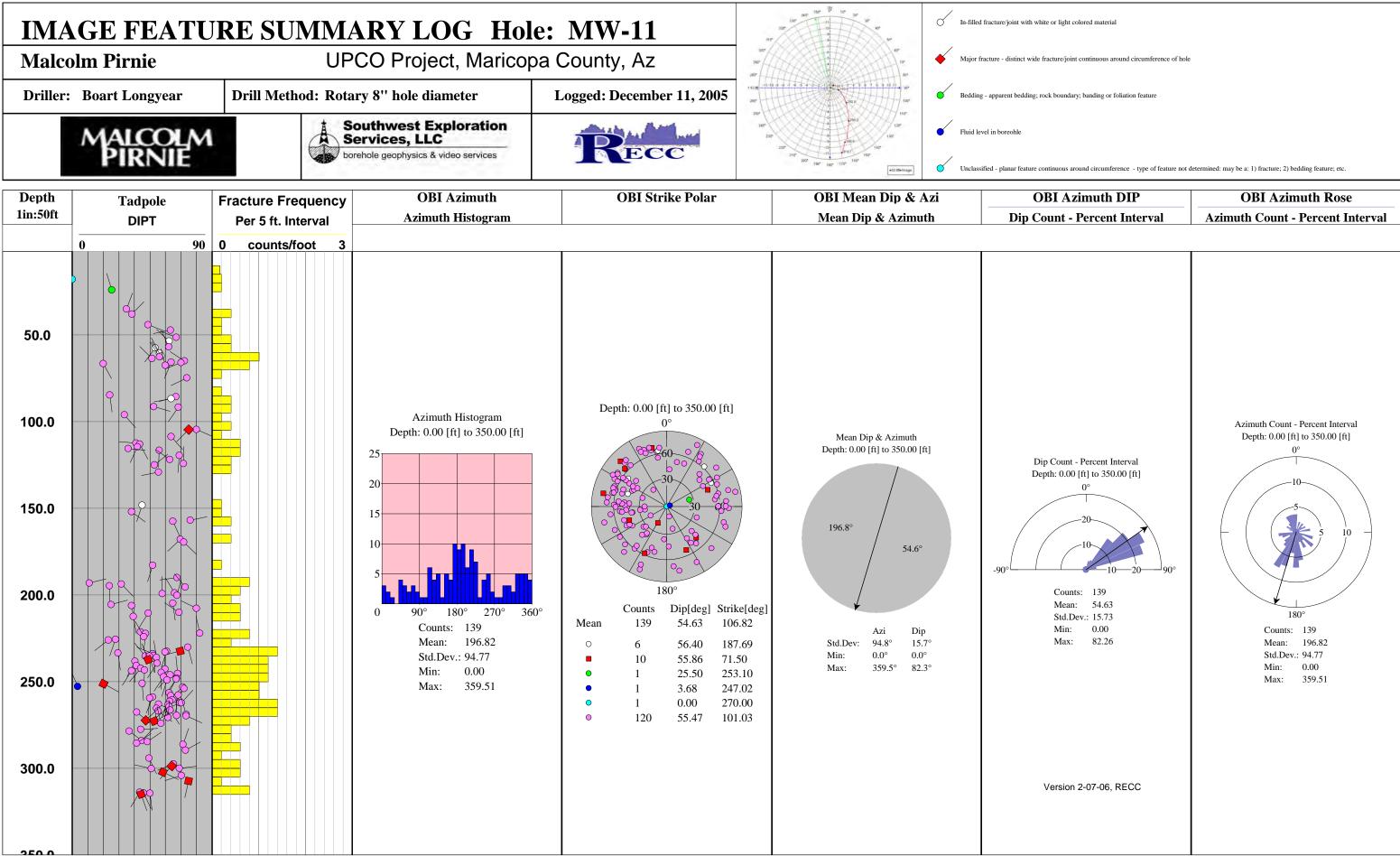
• Unclassified - planar feature continuous around circumference - type of feature not determined:

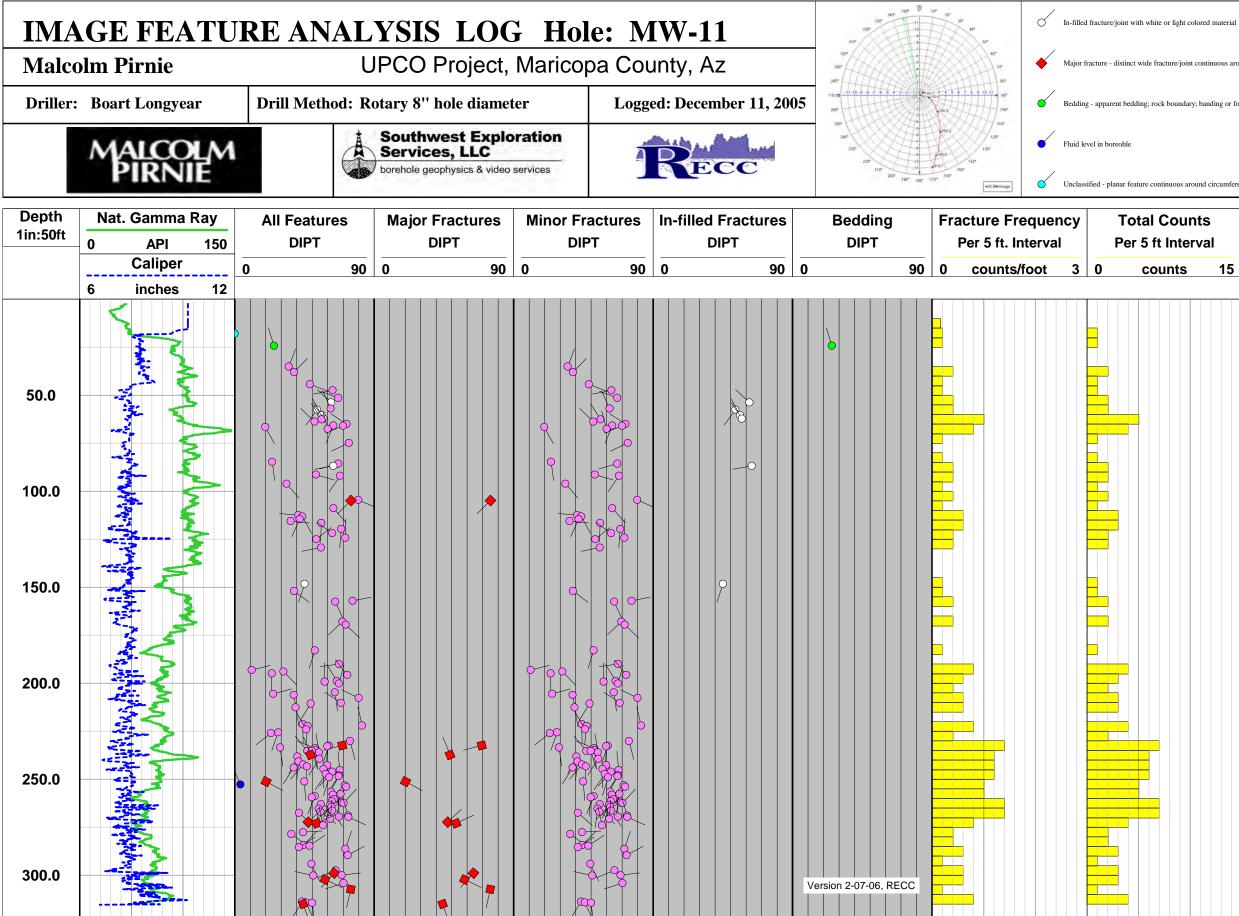
Minor fracture - thin or discontinuous fracture/joint around circumference of hole

I Fractures 5 ft Interval			Verage Dip er 5 ft Interva			erage Azin er 5 ft Inter	
counts	15	0	deg	90	0	deg	360







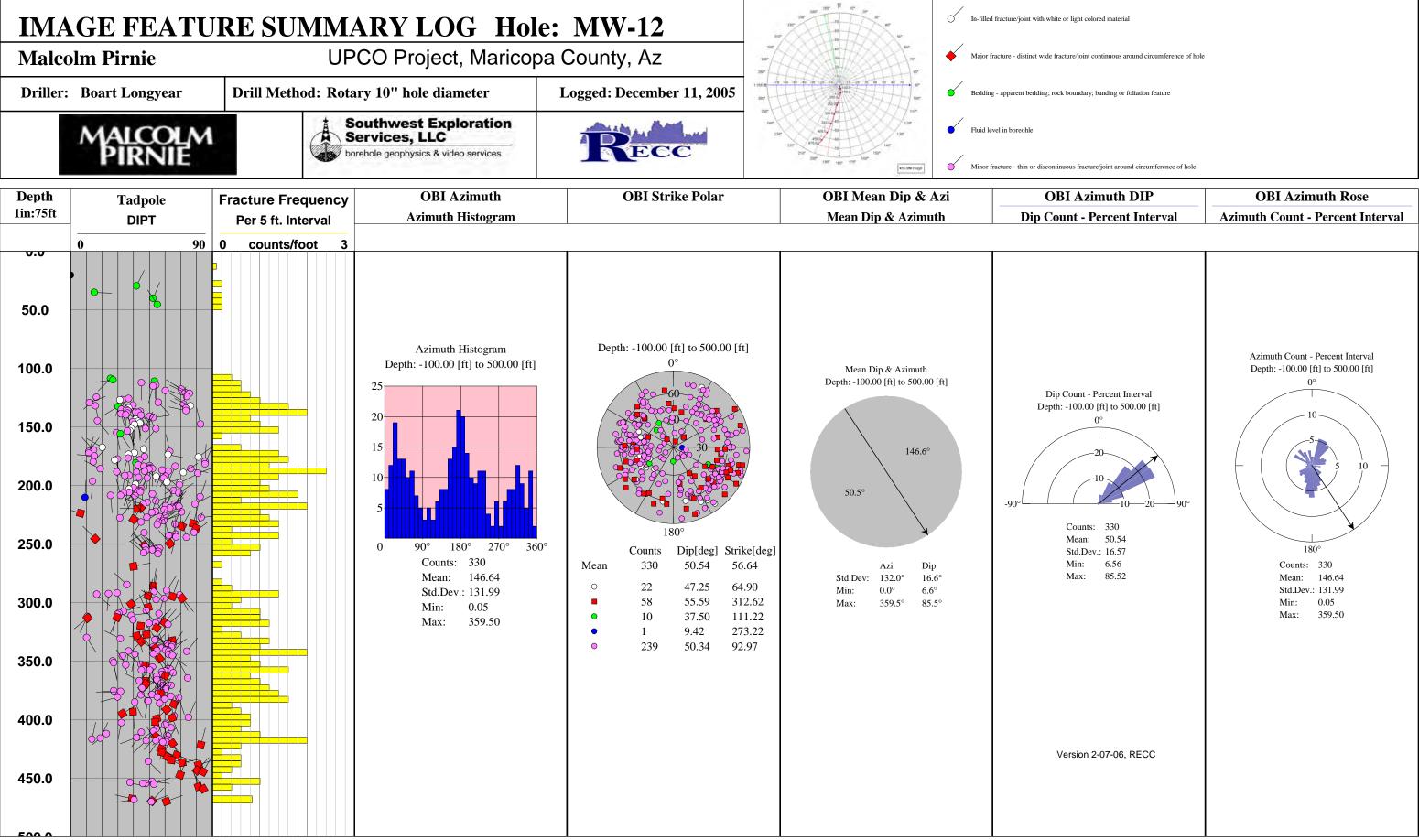


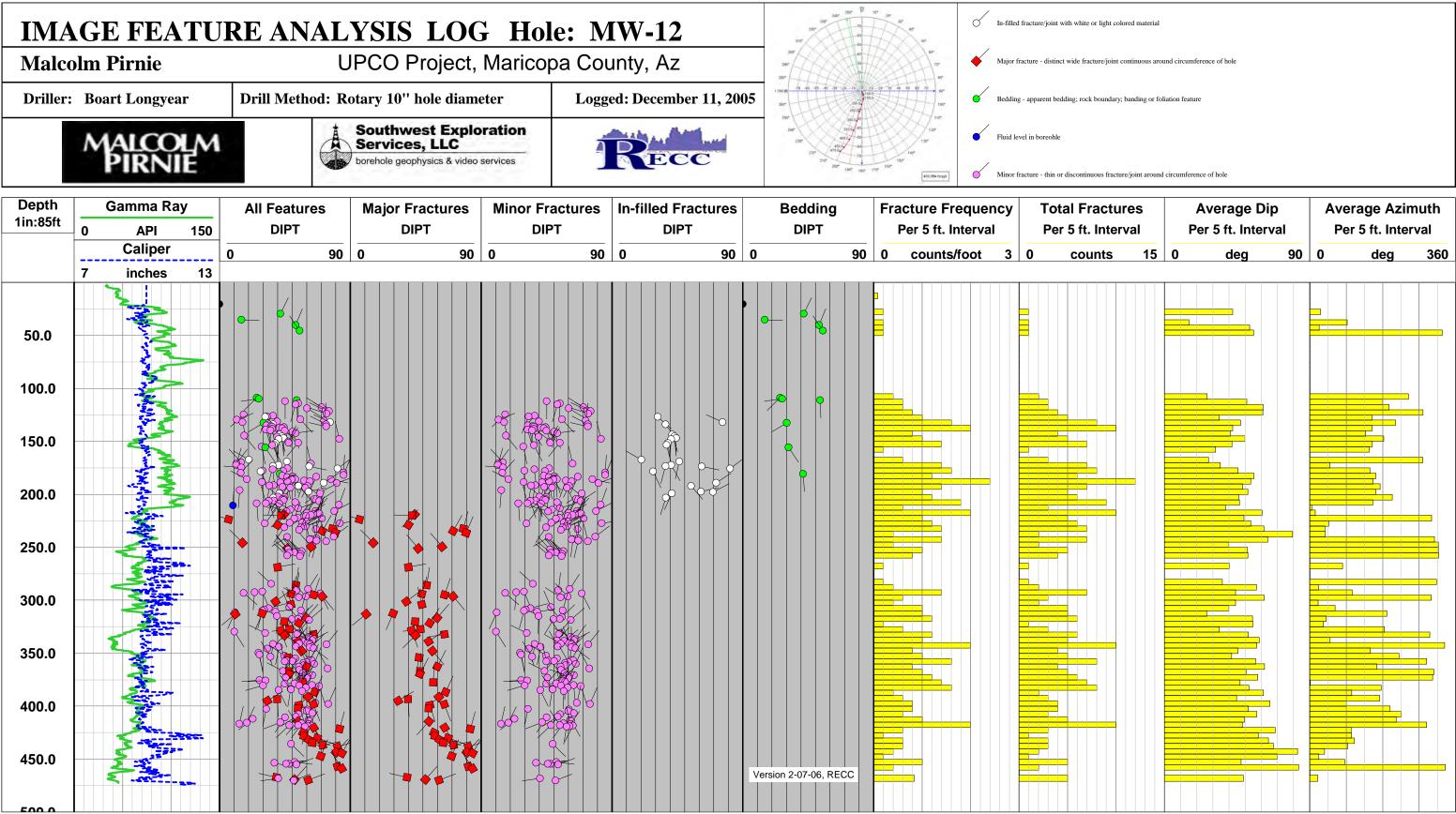
Major fracture - distinct wide fracture/joint continuous around circumference of hole

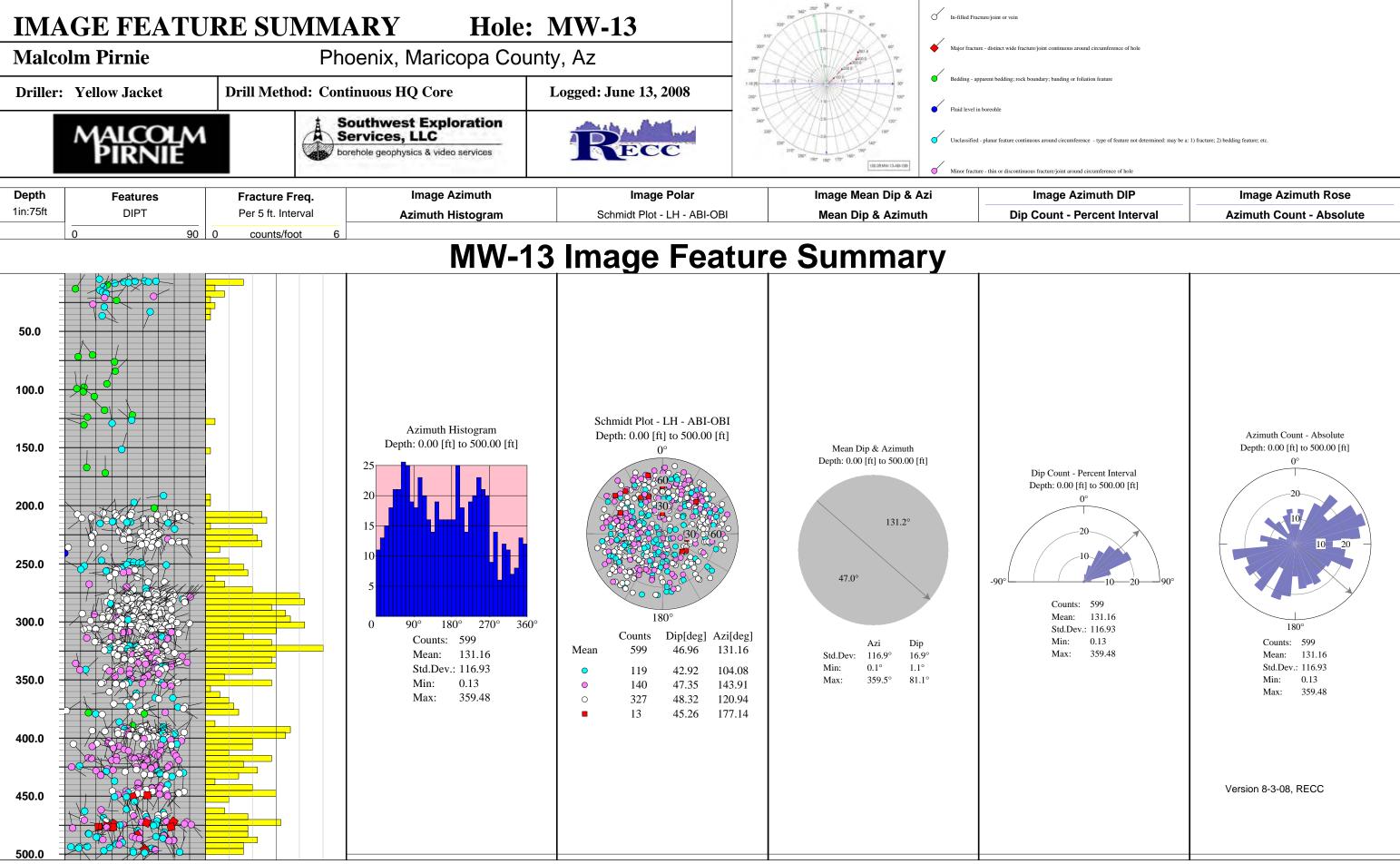
Bedding - apparent bedding; rock boundary; banding or foliation feature

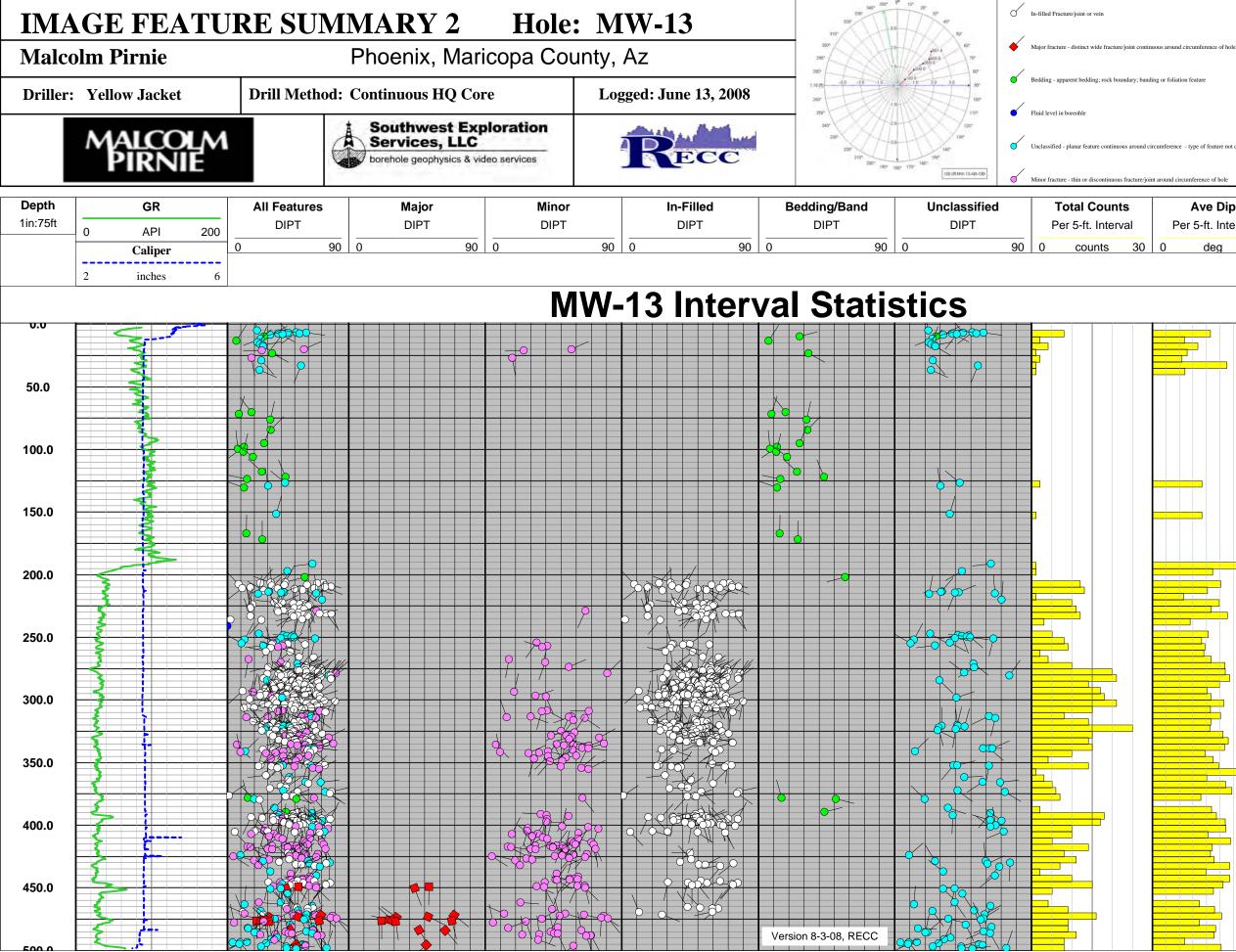
bus around circumference - type of feature not determined: may be a: 1) fracture; 2) bedding feature; etc.

al Counts 5 ft Interval		erage Dip 5 ft Interva	I		age Azim 5 ft Interv	
counts 15	0	deg	90	0	deg	360

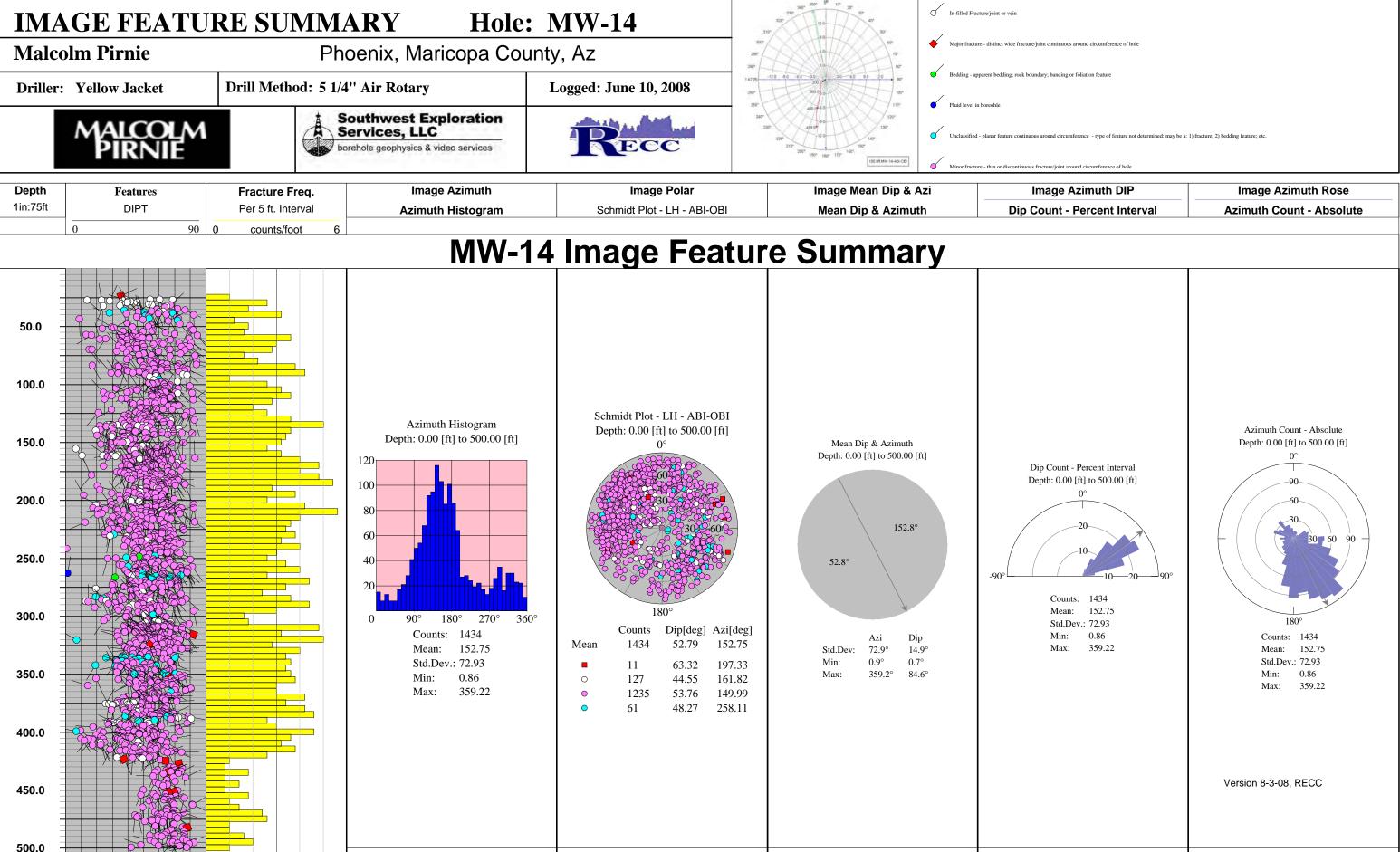


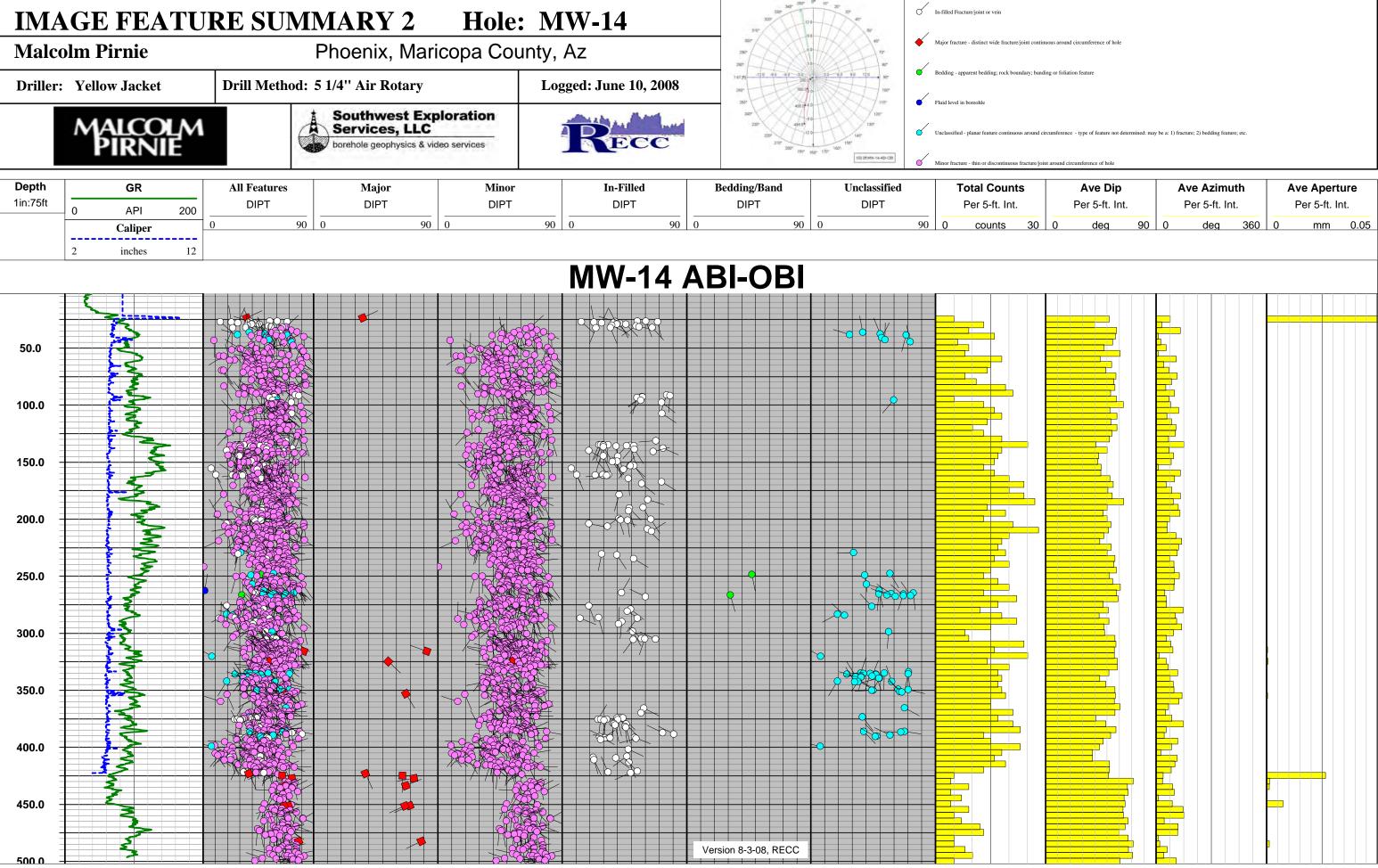






Unclassified - planar feature continuous around circumference - type of feature not determined: may be a: 1) fracture; 2) bedding feature; etc. Ave Dip Ave Azimuth Ave Aperture Per 5-ft. Interval Per 5-ft. Interval Per 5-ft. Interval 90 0 360 0 deg deg 0.1 ln 0.025





-)	•		•			
Kent	Sou	Southwest Ex Services, LLC		Exploration LC	2	tion	
	boreho	borehole geophysics & video services	/sics &	video s	iervi	ces	
	COMPANY	MALCOLM PERNIE	ERNIE				
_	WELL ID	MW-16					
Η	FIELD	UPCO					
	COUNTY	MARICOPA		STATE		ARIZONA	
	TYPE OF I	TYPE OF LOGS: ABI TELEVIEWER	TELEVII	EWER	0	OTHER SERVICES	7ICES
	MORE:	3-ARN	3-ARM CALIPER	'ER	zc	OBI NAT. GAMMA	A
1	LOCATION				<u>ں</u> در	DUAL INDUCTION 3 RX SONIC	CTION
S	SEC	TWP	RGE				
PERMANENT DATUM		_	ELEVATION		K	K.B.	
LOG MEAS. FROM	GROUND LEVEL		ABOVE PERM. DATUM	M		D.F.	
DRILLING MEAS. FROM						G.L.	
DATE	03-30-11		TYPE FLUID IN HOLE	D IN HOLE	F	FORMATION WATER	WATER
RUN No	1		SALINITY	ΓY	z	N/A	
TYPE LOG	ABI		DENSITY	Y	z	N/A	
DEPTH-DRILLER	510 FT		LEVEL		2 2	250 FT	
DEPTH-LOGGER	507 5 FT		MAX. REC. TEMP.	TEMP.	< 2	N/A	
TOP LOGGED INTERVAL	250 250		SAMPLE INTERVAL	SAMPLE INTERVAL	0. 19	0.0096 FT	
DRILLER / RIG#	YELLOW JACKET	ACKET	LOGGING TRUCK	FRUCK	T	TRUCK # 689	
RECORDED BY / Logging Eng.		K. MITCHELL/ED TURNER	TOOL STRING/SN	NG/SN	A	ALT-ABI-40 SN 917	SN 917
WITNESSED BY	MALCOLM PERNIE	I PERNIE	LOG TIME	LOG TIME: ON SITE/OFF SITE		08:30 AM	
RUN BOREHOLE RECORD	ORD		CASING RECORD	CORD			
NO. BIT FRO	FROM	TO	SIZE	WGT.	FROM		ТО
	SURFACE	20 FT	10"	STEEL	SURFACE	E	20.5 FT
2 10" HAM 20 FT 3 10" HAM 20 FT	FT	TOTAL DEPTH					
COMMENTS:							
•							

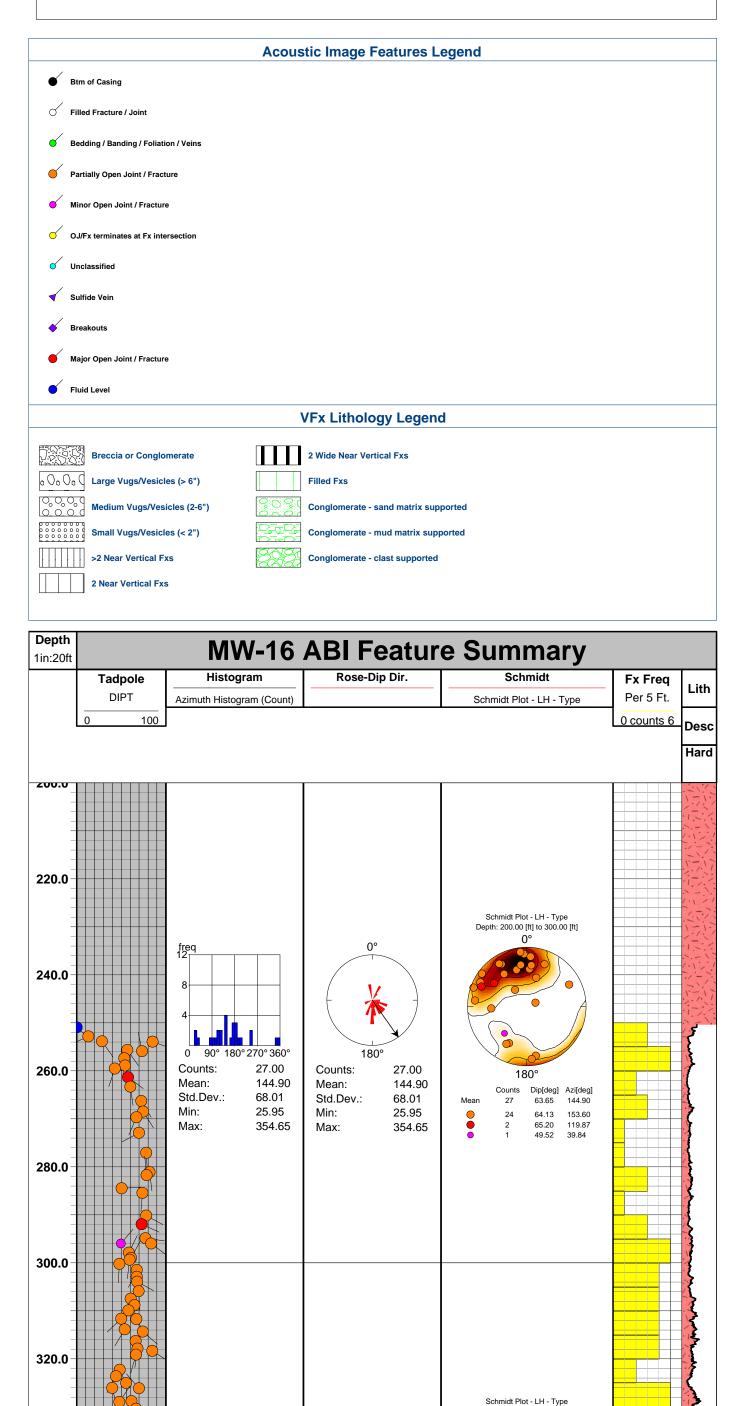
Major Lithology



GM - Silty gravel w/ sand

GP - Sandy Gravel

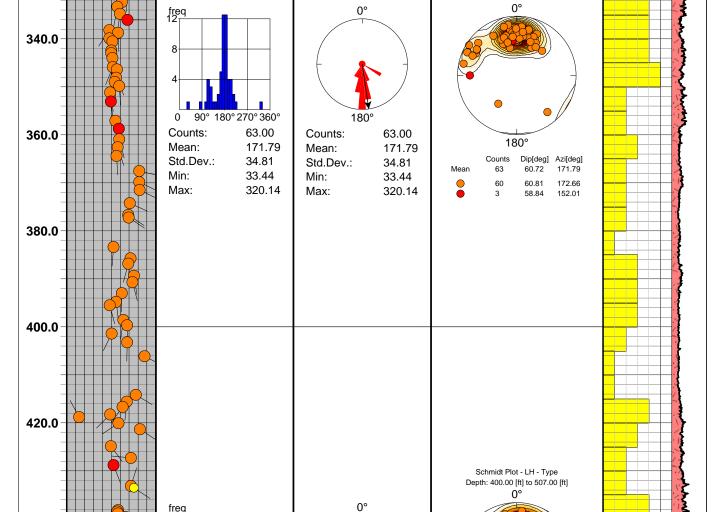
BR - Granodiorite

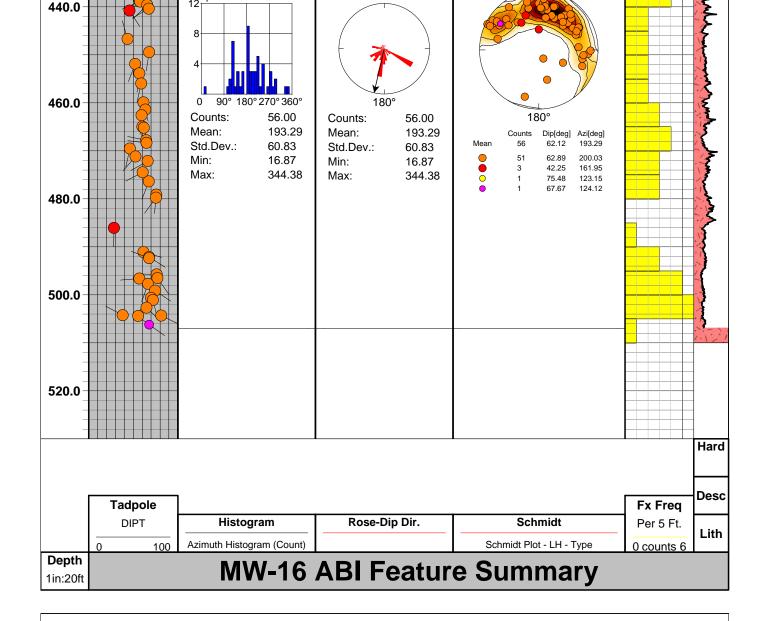


0°

freq 12⊢

Depth: 300.00 [ft] to 400.00 [ft] 0°





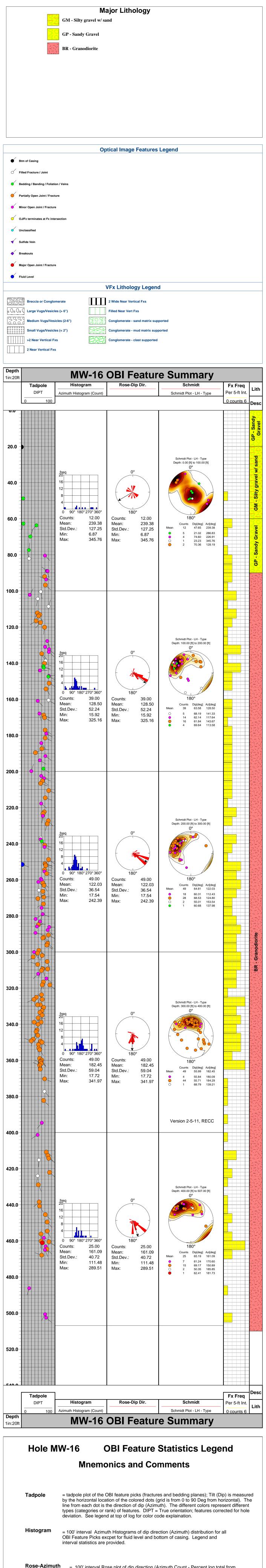
lole MW-	16 ABI Image Feature Statistics Legend
	Mnemonics and Comments
Tadpole	 = tadpole plot of the ABI feature picks (fractures and bedding planes); Tilt (Dip) is measured by the horizontal location of the colored dots (grid is from 0 to 90 deg from horizontal). The line from each dot is the direction of dip (Azimuth). The different colors represent different types (categories or rank) of features - see legend at top of log for color classification. DIPT = True orientation; features corrected for hole deviation
Histogram	= Azimuth Histograms of dip direction (Azimuth) distribution for all ABI Feature Picks excpet for fluid level and bottom of casing. Legend and interval statistics are provided.
Rose-Azimuth	 = 100' interval rose plot of dip direction (Azimuth Count - Percent log total from 0 to 5) for all ABI feature picks except fluid level and bottom of casing. Legend and interval statistics are provided.
Schmidt	= 100' interval Schmidt (area equal polar) Plot, lower hemisphere for all ABI feature picks except for fluid level and bottom of casing. The polar dip diagram displays the polar projection of a dipping plane and its normal vector into the horizontal plane of a reference sphere. Plot includes poles and shaded contours plus legend and statastics.
Fx Freq	= ABI feature frequency plotted from 0 to 6 features per 5-foot interval as a yellow bar graph
Desc =	major/principal lithology description based on geologic descriptions provided by Pirnie staff.

Lith = major/principal lithology symbol based on geologic descriptions provided by Pirnie staff.

Hard = apparent rock harness from ARI used to silhouette lithology.

Prepared by Robert E. Crowder Ver 6/14/2011

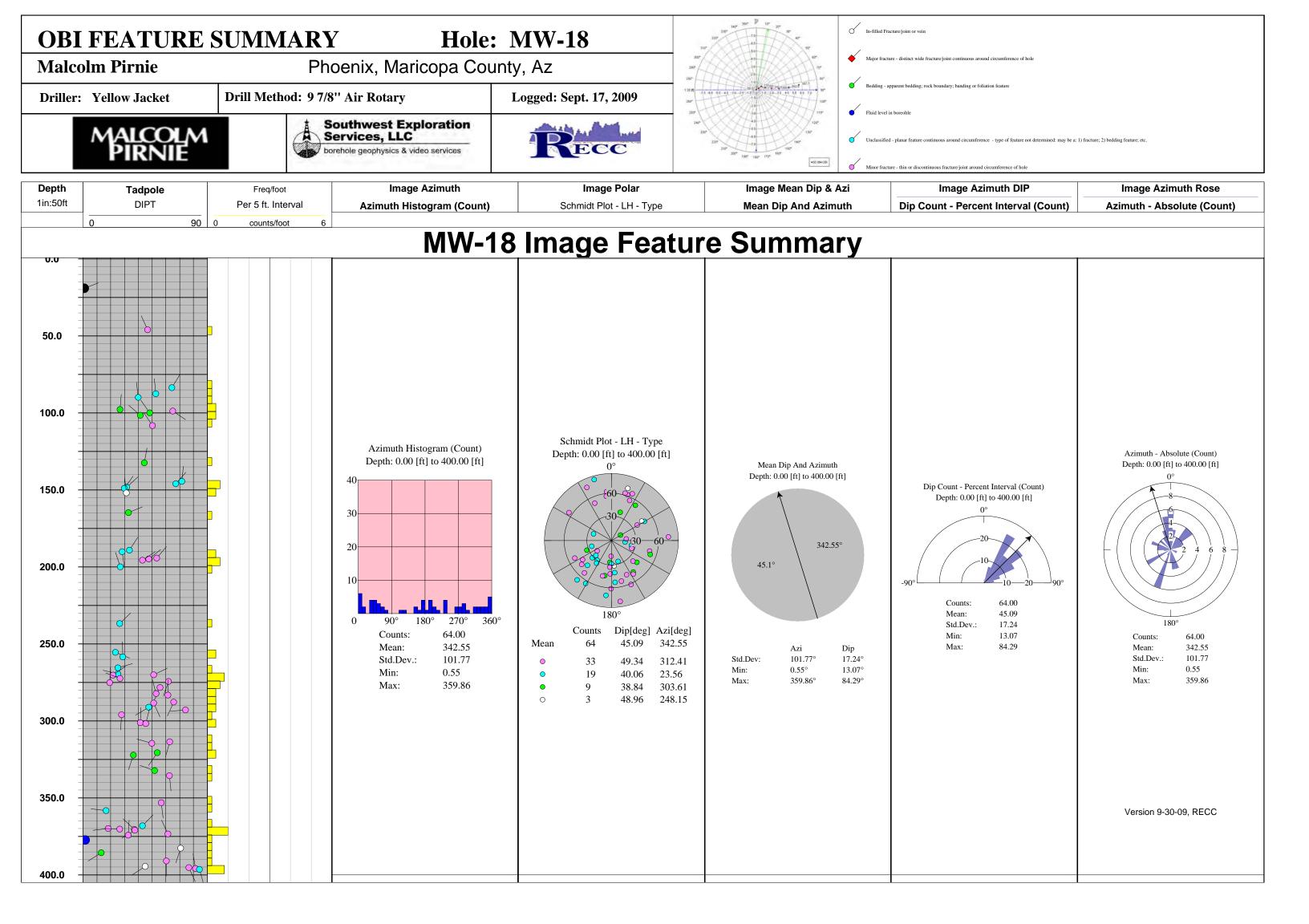
No No	Inwe		xpiq X	ra	tion	
boreho	ble geophy	vsics &	video	serv	ices	
OMPANY	MALCOLM PI	ERNIE				
VELL ID	MW-16					
IELD	UPCO					
OUNTY	MARICOPA		ST/		NRIZONA	•
TYPE OF I	LOGS: OBI]	TELEVIE	EWER		OTHER SERV	VICES
MORE:	3-ARI	M CALIP	ER		ABI VAT. GAMM	ίA
DCATION					3 RX SONIC FEMPERATU	JRE
Ĵ	TWP	RGE				
		ELEVATION			К.В.	
ROUND LEVEL		PERM. DATU	X		D.F.	
					3.L.	
03-30-11		TYPE FLUI	D IN HOLE		FORMATION	WATER
1		SALINI	Y		V/A	
OBI		DENSIT	Y		V/A	
510 FT		LEVEL			251.5 FT	
507.5 FT		MAX. REC.	TEMP.		N/A	
507.5 FT		IMAGE OR	ENTED TO:		MAG NORTH	Í
SURFACE	ACVET	SAMPLE IN	TERVAL).0096 FT	
	AUNEI AUNEI	TOOL STRI	NG/SN		ALT-ORI-401	MK-4 SN
_	I PERNIE	LOG TIME:	ON SITE/OF)8:30 AM	
)RD		CASING RE	CORD			
M	TO	SIZE	WGT.	FROM		ТО
FACE	20 FT	10"	STEEL	SURFA	CE	20.5 FT
Т	TOTAL DEPTH					
	COMPANY Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser				Services, LLC borehole geophysics & video serv MALCOLM PERNIE ELL ID MW-16 ELD UPCO DUNTY MARICOPA STATE ELL ID MW-16 ELD UPCO DUNTY MARICOPA STATE A TWP RE ELEVATION OUND LEVEL ABOVE PERM. DATUM 06-30-11 TYPE FLUID IN HOLE 1 07-30-11 TYPE FLUID IN HOLE 507.5 FT SID FT LEVEL SURFACE SAMPLE INTERVAL VELLOW JACKET LOGGING TRUCK K.MITCHELL/ED TURNER TOOL STRING'SN MALCOLM PERNIE LOG TIME:ON SITEOFF SITE 100 CASING RECORD MALCOLM PERNIE LOG TIME:ON SITEOFF SITE 100 TOTAL DEPTH 10° STEEL SURFACE	Services, LLC borehole geophysics & video : MPANY MALCOLM PERNIE ELL ID MW-16 ELD UPCO JUNTY MARICOPA STAY MARICOPA STAY MARICOPA STAY MARICOPA STAY ORE: 3-ARM CALIPER CATION OUND LEVEL ABOVE PERM. DATUM 03-30-11 TYPE FLUD IN HOLE 1 S07.5 FT ABOVE PERM. DATUM S10 FT SIURFACE SALINITY S10 FT LOW JACKET LOGGING TRUCK K.MITCHELLED TURNER TOOL STRING'SN MALCOLM PERNIE LOG TIME:ON SITEOFF TOTAL DEPTH 10" STEEL

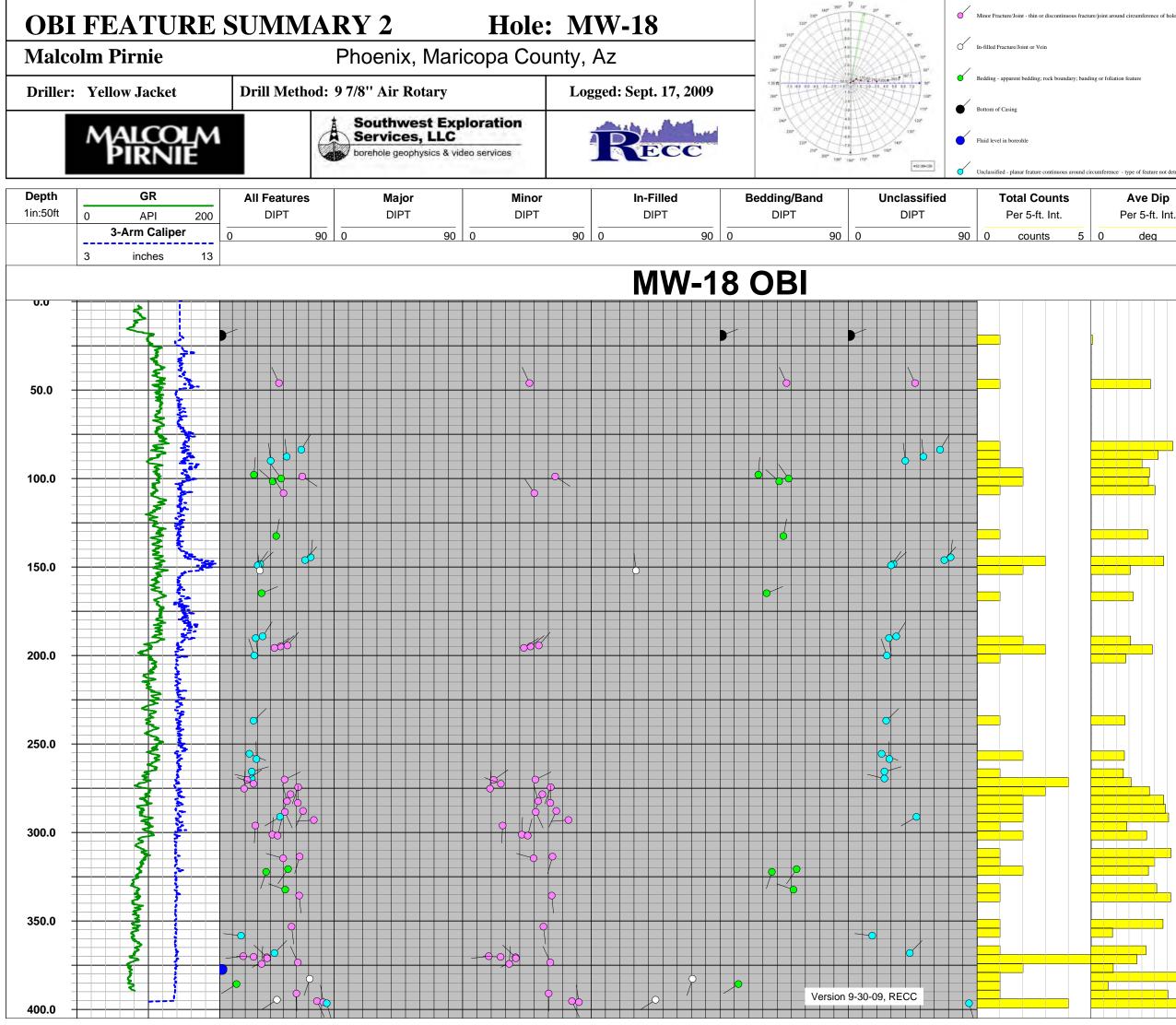


= 100' interval Rose plot of dip direction (Azimuth Count - Percent log total from 0 to 7) for all OBI feature picks except fluid level and bottom of casing. Legend

	and interval statistics are provided.
Schmidt	= 100' interval Schmidt (area equal polar) Plot, lower hemisphere for all OBI feature picks except for fluid level and bottom of casing. The polar dip diagram displays the polar projection of a dipping plane and its normal vector into the horizontal plane of a reference sphere. Plot includes poles and shaded contours plus legend and statastics.
Fx Freq	= OBI feature frequency plotted from 0 to 6 features per 5-foot interval as a yellow bar graph
Desc	= major/principal lithology description based on geologic descriptions provided by Pirnie staff.
Lith	= major/principal lithology symbol based on geologic descriptions provided by Pirnie staff.

Prepared by Robert E. Crowder Ver 6/14/2011





nce - type of feature not determined: may be a: 1) fracture; 2) bedding feat Ave Aperture Ave Dip Ave Azimuth Per 5-ft. Int. Per 5-ft. Int. Per 5-ft. Int. inch/10 0.05 deg 90 deg 360 0 0 0

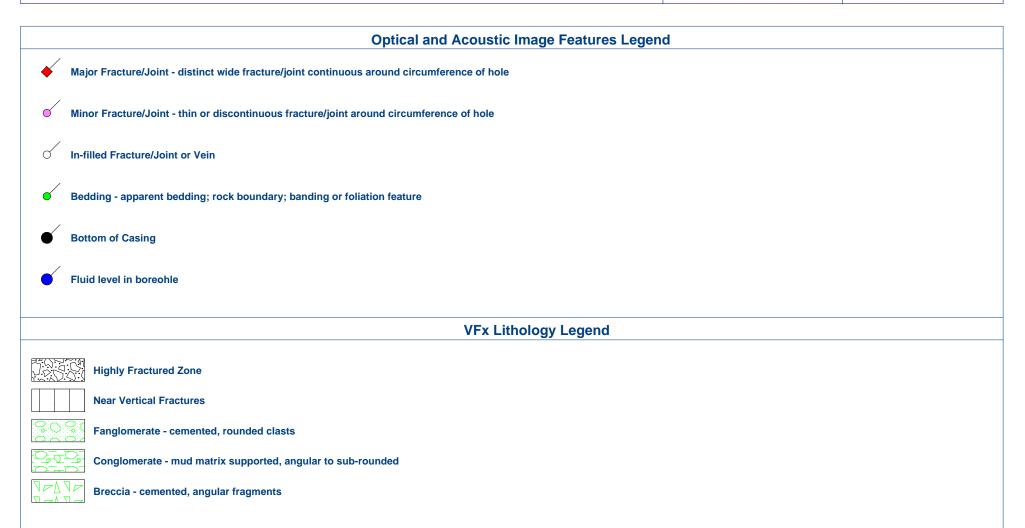
Geophysical Log Summary Hole 18 E. Yearling

Malcolm Pirnie

18 E. Yearling, Maricopa County, Az

Image Features Rotated 11.5 deg E for Magnetic Declination to True North

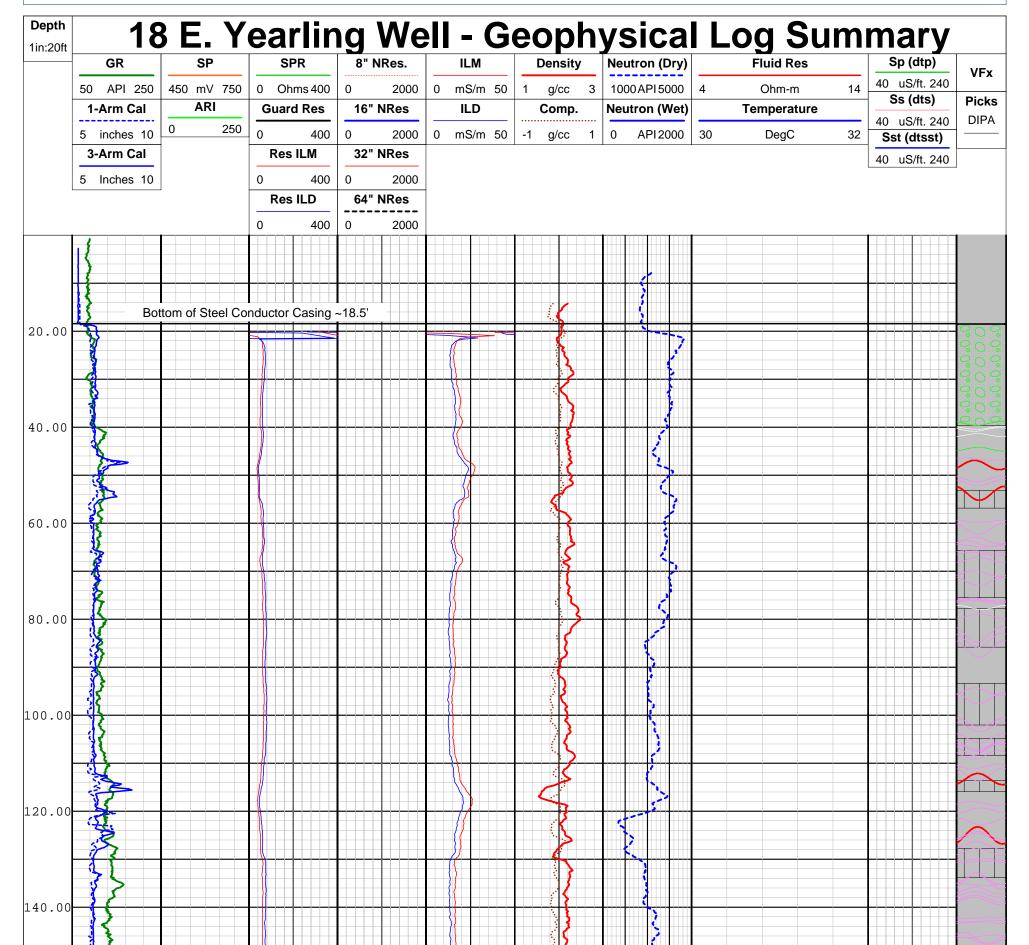
Feature Dip is from 0 to 90 deg (0 = Horizontal, 90 = Vertical) Logged: July 27, 2007

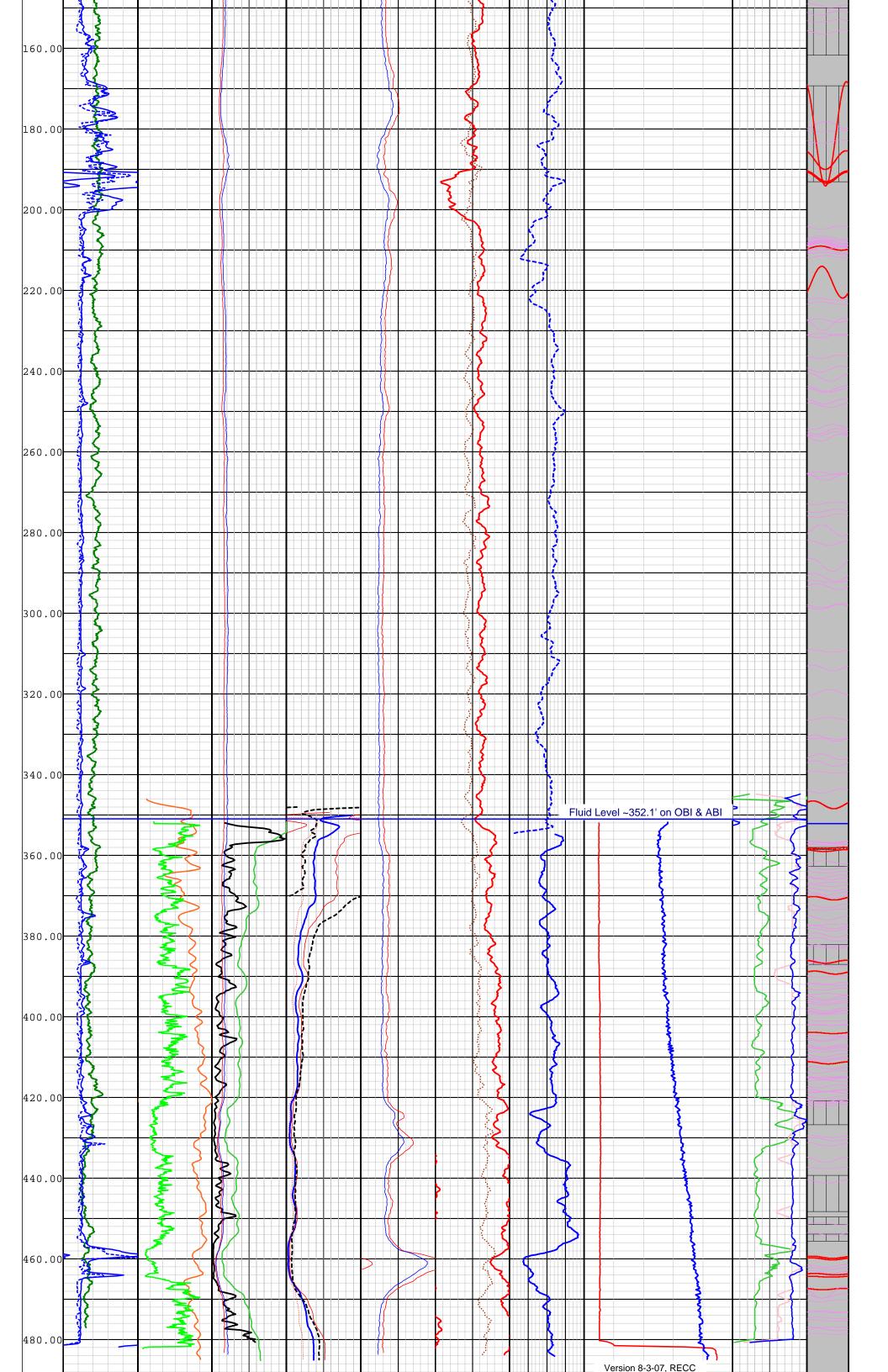


Southwest Exploration

borehole geophysics & video services

Services, LLC



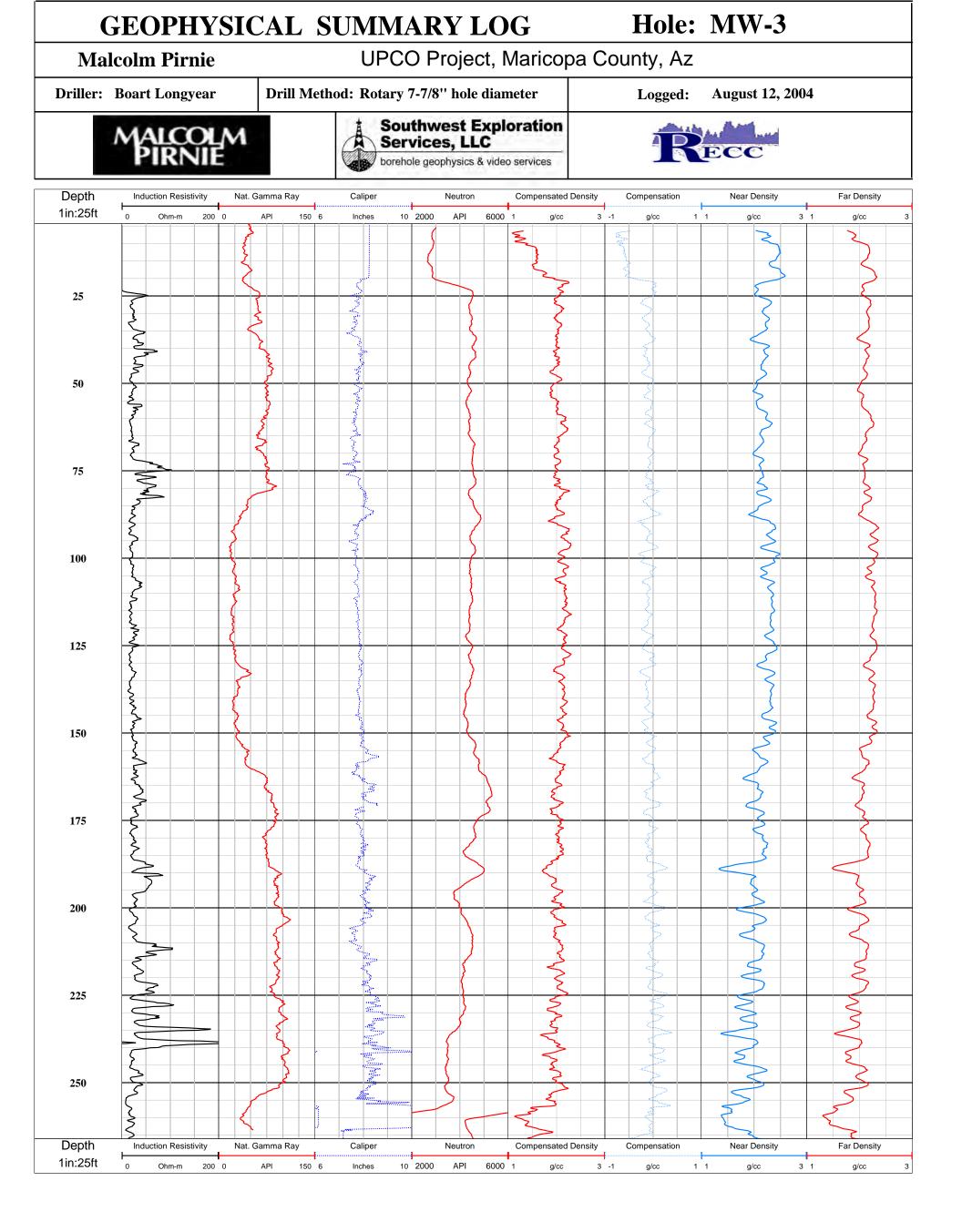


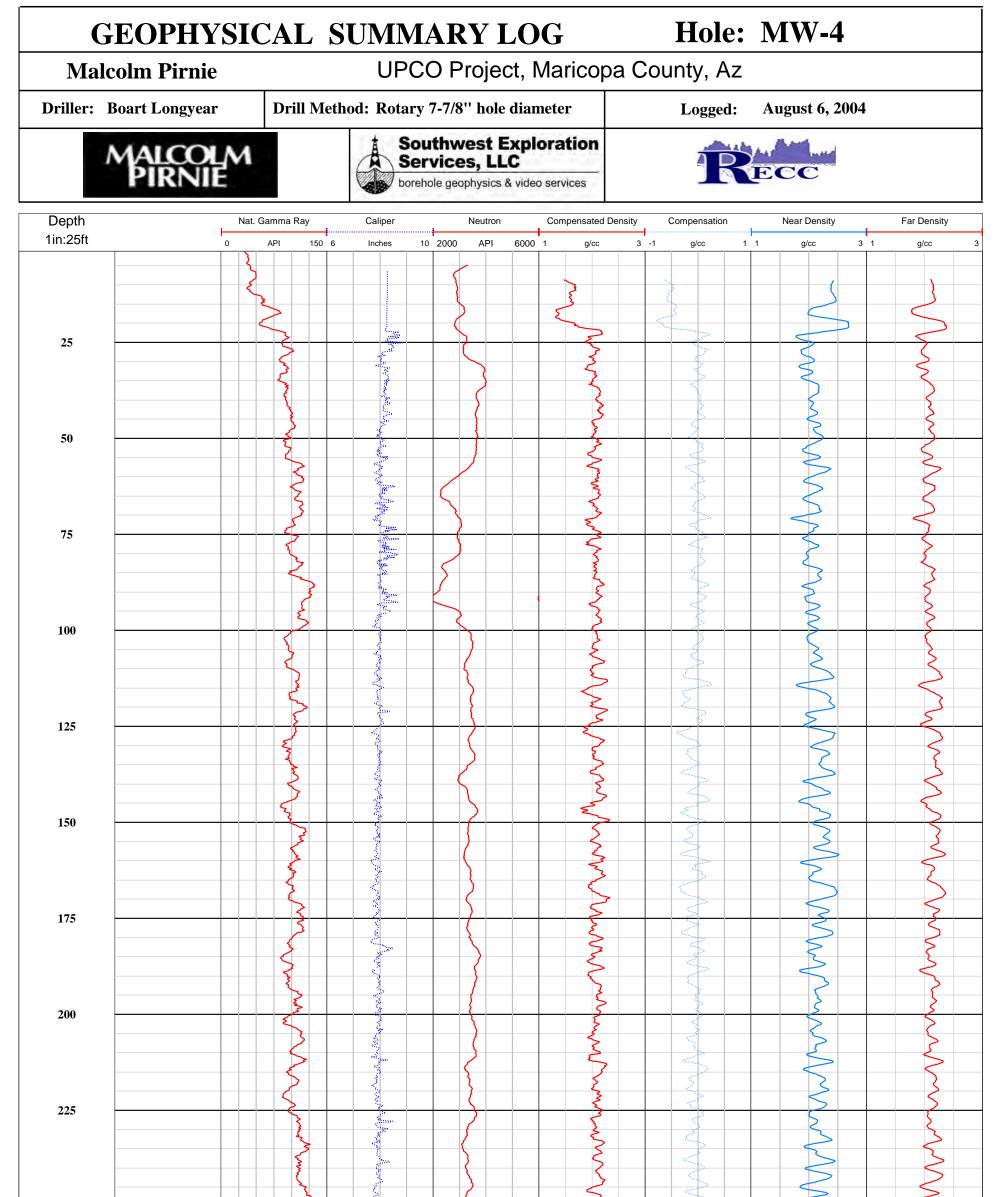
						Res ILD	64	4" NRes											
					0	400	0	2000											
		3	-Arm Cal			Res ILM	32	2" NRes											
		5	Inches 10		0	400	0	2000										Sst (dtsst)	
		1	-Arm Cal	ARI	G	uard Res	16	6" NRes		ILD		Comp		Neutron (Wet)		Temperature		40 uS/ft. 240	Picks
		5	inches 10	0 250	0	400	0	2000	0	mS/m 50	-1	1 g/cc	1	0 API 2000	30	DegC	32	Ss (dts)	DIPA
			GR	SP		SPR	8	" NRes.		ILM		Densit	у	Neutron (Dry)		Fluid Res		40 uS/ft. 240	
		50	API 250	450 mV 750	0	Ohms 400	0	2000	0	mS/m 50	1	g/cc	3	1000 API 5000	4	Ohm-m	14	40 uS/ft. 240	VFx
	Depth		10			orlin						0 0	h	Veioo				morv	
Ĺ	1in:20ft				e	aiiii	IY	vve		I - G		op		ysica		₋og S u		mary	

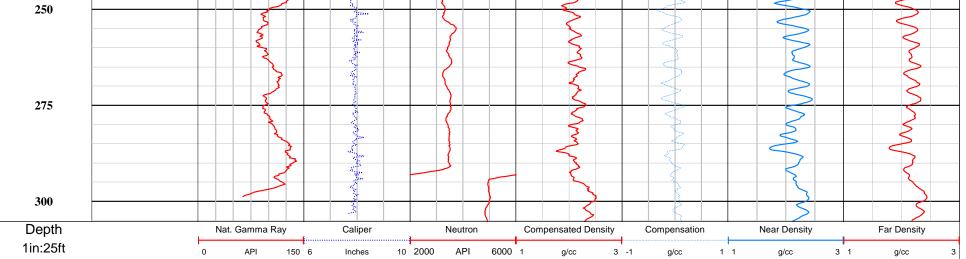
Geophysical Summary Legend

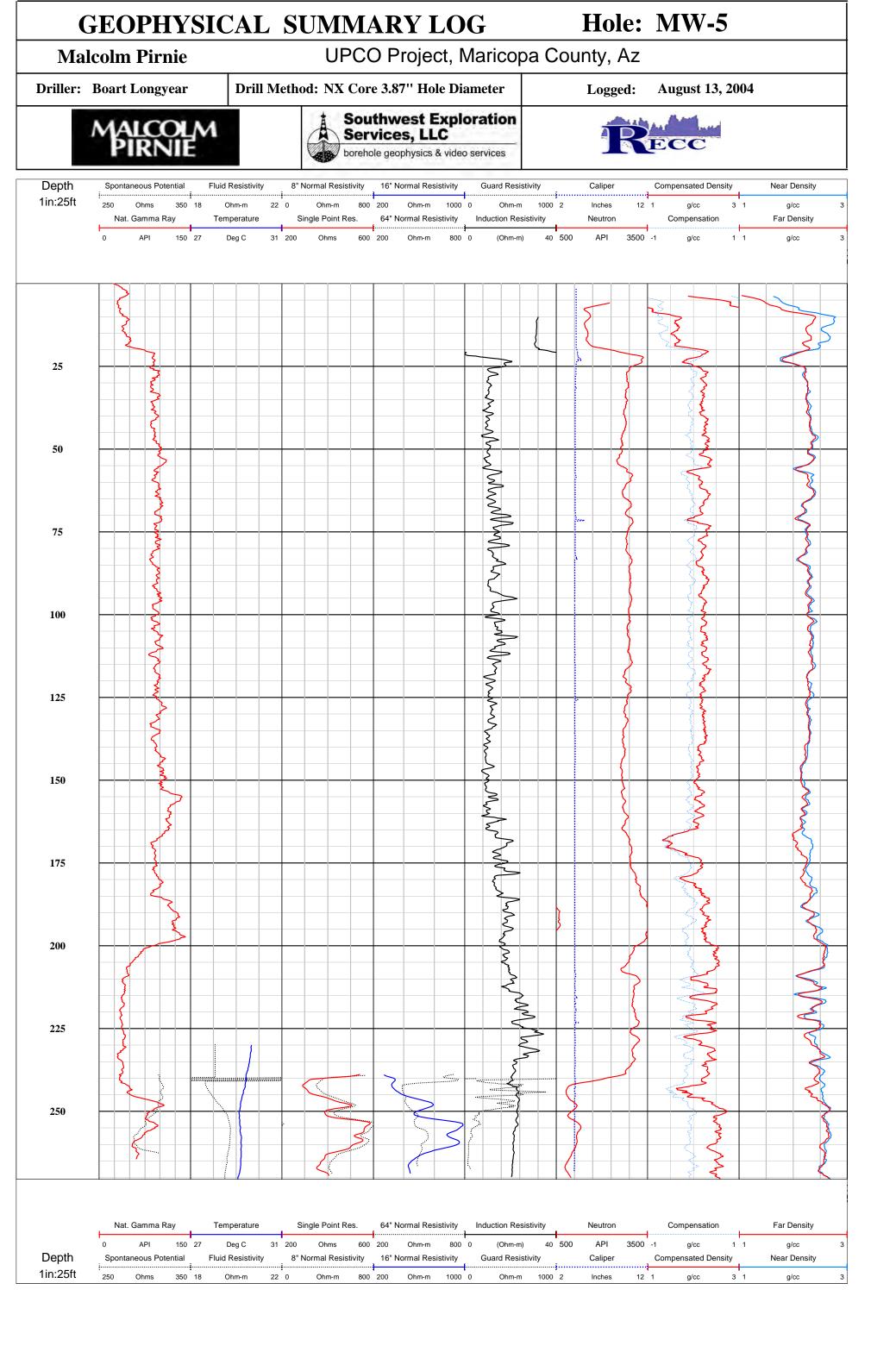
Mnemonics and Comments

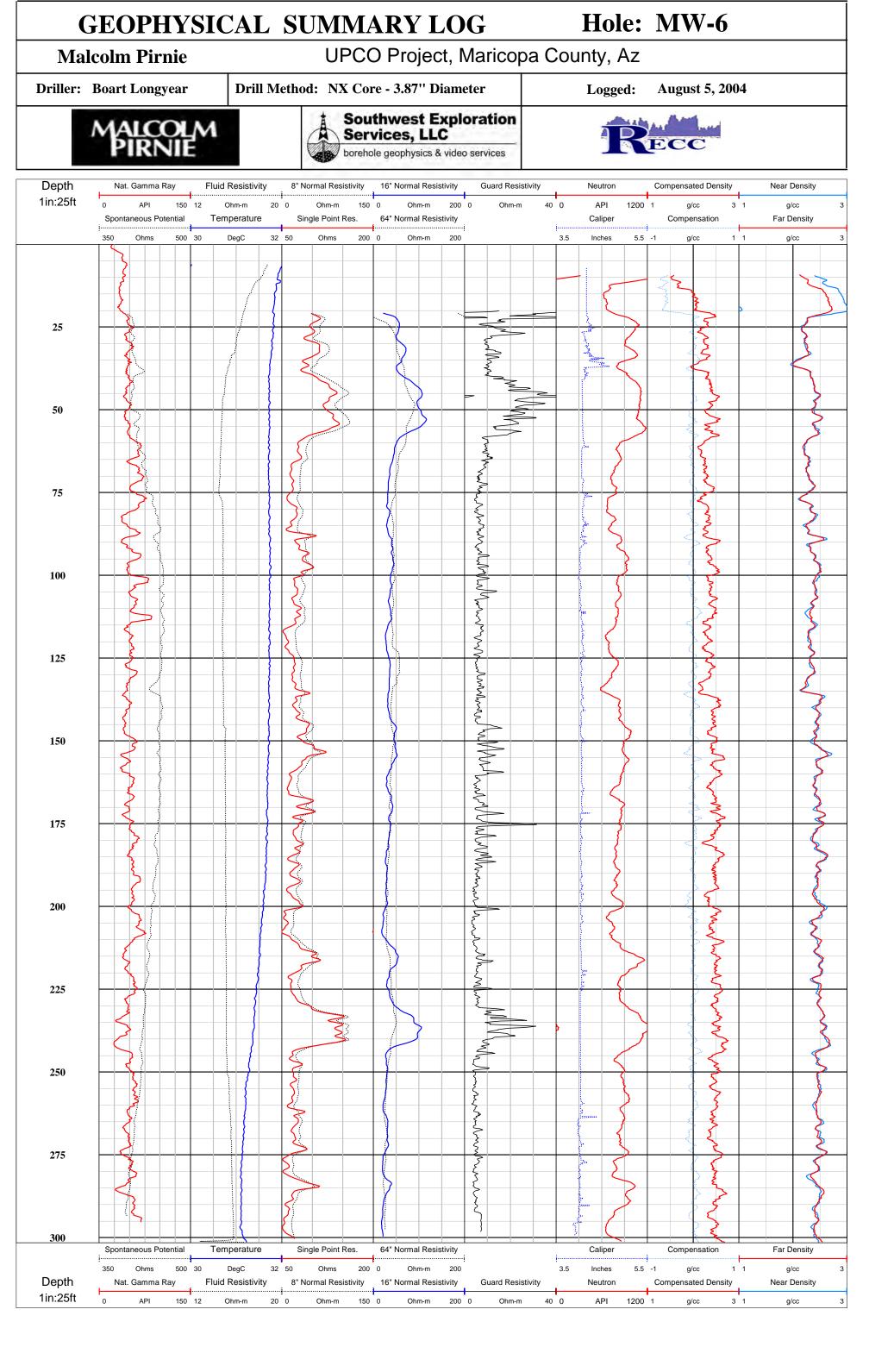
GR 3-Arm Cal 1-Arm Cal	 = natural gamma ray log plotted from 50 to 250 API uints (green line) = 3-arm mechanical caliper of hole diameter plotted from 5-10 inches (blue line) = 1-arm mechanical caliper of hole diameter plotted from 5-10 inches (dotted blue line)
SP ARI	 = spontaneous potential log plotted 450 to 750 mV (orange line) = Acoustic Reflectance Index or relative rock hardness from ABI Amplitude log. Plotted 0 (soft) to 250 (harder) as green line.
SPR Guard Res Res ILM Res ILD	 = single point resistance log plotted 0 to 400 ohms (green line) = micro-guard or LL3 resistivity log plotted 0 to 400 ohm-meters (black line) = medium induction resistivity log plotted 0 to 400 ohm-meters (red line) = deep induction resistivity log plotted 0 to 400 ohm-meters (blue line)
8" NRes 16" NRes 32" NRes 64" NRes	 = 8" normal resistivity log plotted 0 to 2000 ohm-meters (dotted red line) = 16" normal resistivity log plotted 0 to 2000 ohm-meters (blue line) = 32" normal resistivity log plotted 0 to 2000 ohm-meters (red line) = 64" normal resistivity log plotted 0 to 2000 ohm-meters (dotted black line)
ILM ILD	= medium induction log plotted 0 to 50 mS/m (red line) = deep induction log plotted 0 to 50 mS/m (blue line)
Density Comp.	 = gamma-gamma density log plotted 1 to 3 g/cc (red line) = density compensation log plotted -11 to 1 g/cc (dotted brown line)
Neutron (D Neutron (V	
Fluid Res Temperatu	 = fluid resistivity log plotted 4 to 14 ohm-meters (red line) = fluid temperature log plotted 30 to 32 deg Celcius (blue line)
Sp (dtp) Ss (dts) Sst (dtsst)	 = P-wave slowness or transit time log plotted 40 to 240 uSec/ft (green line) = S-wave slowness or transit time log plotted 40 to 240 uSec/ft (pink line). Values greater than ~200 uS/ft are invalid. = Stoneley-wave slowness or transit time log plotted 40 to 240 uSec/ft (blue line).
VFxs Picks	 Near Vertical Fractures, highly fractured zones and Fanglomerate or Breccia zones planar featues picked on optical or acoustic borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip apparent hole axis

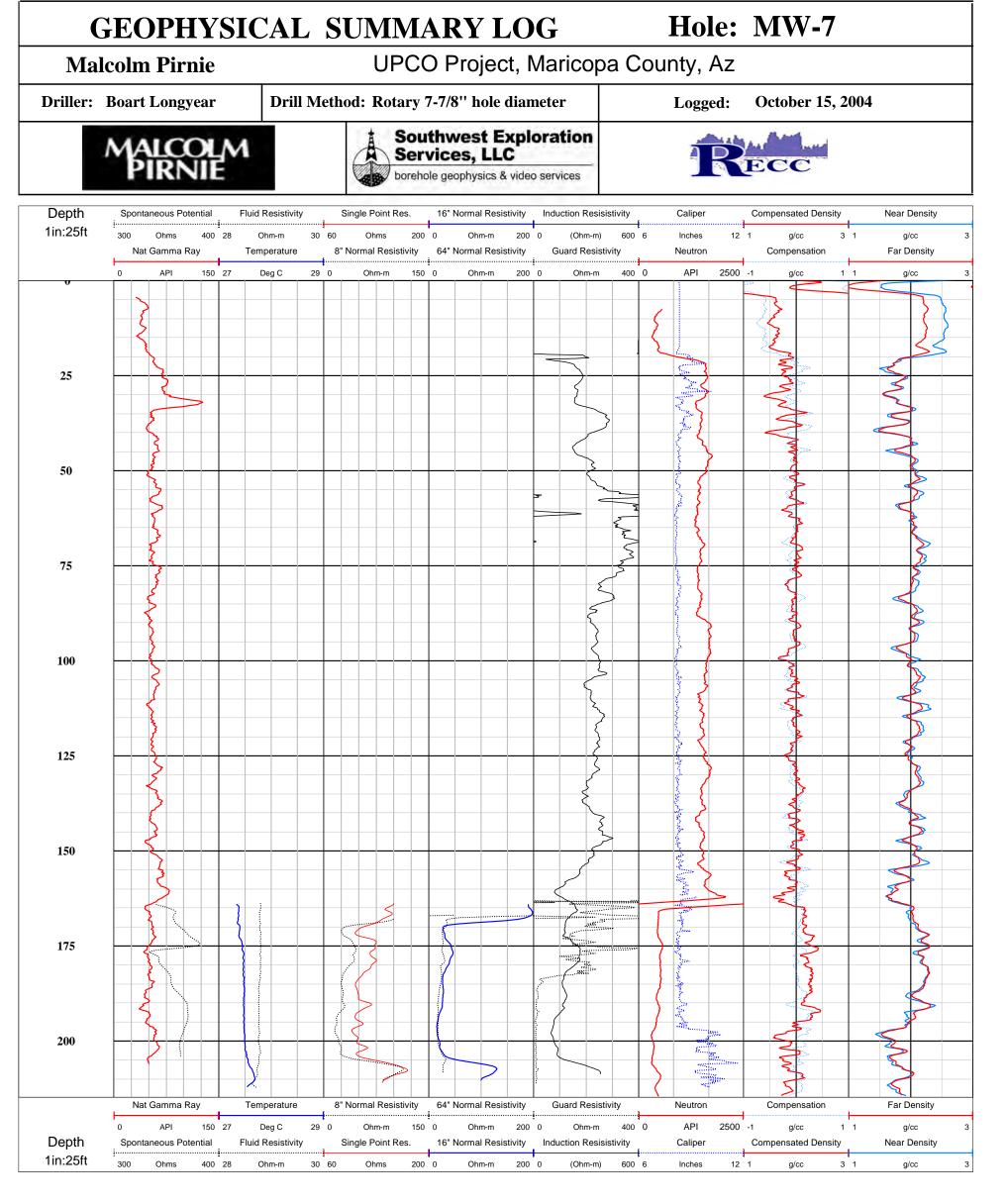


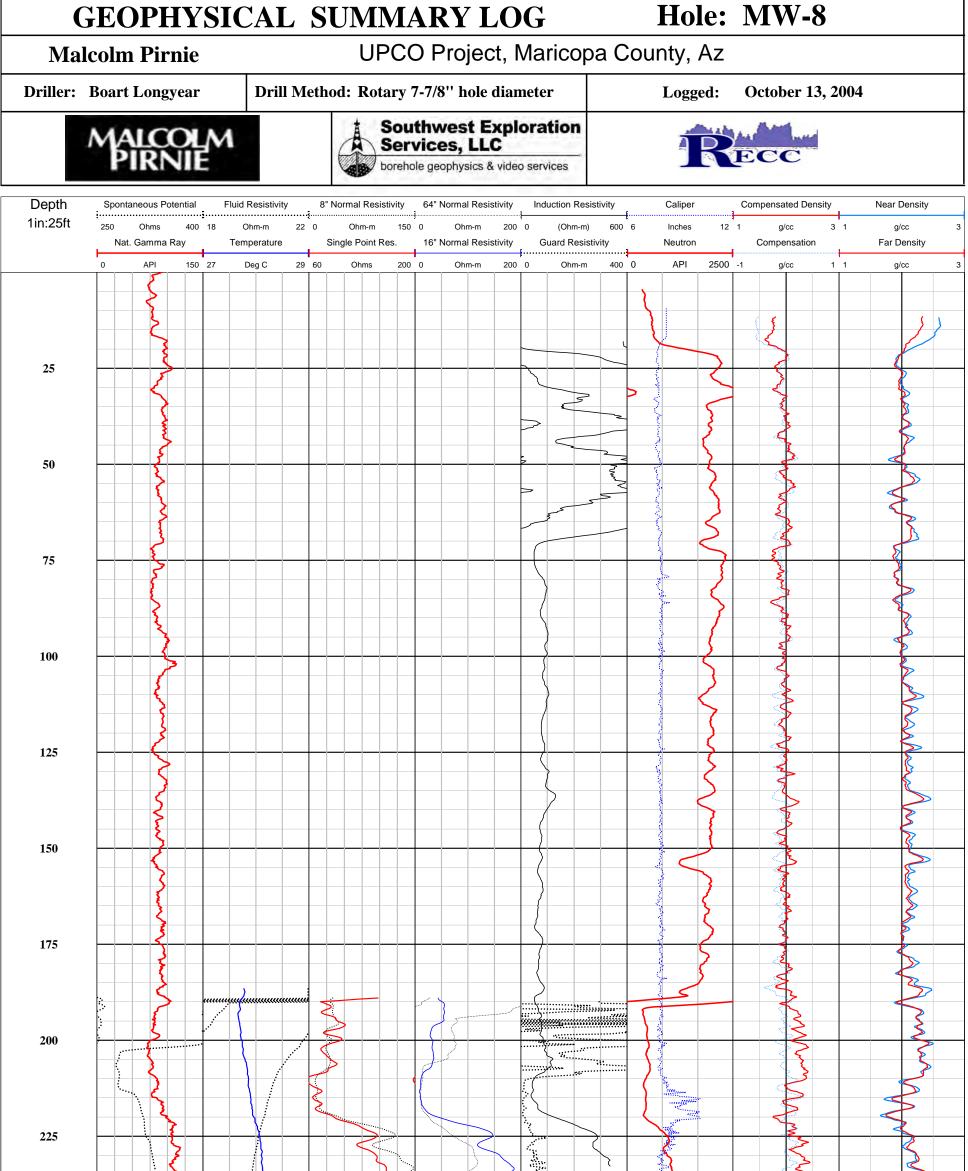




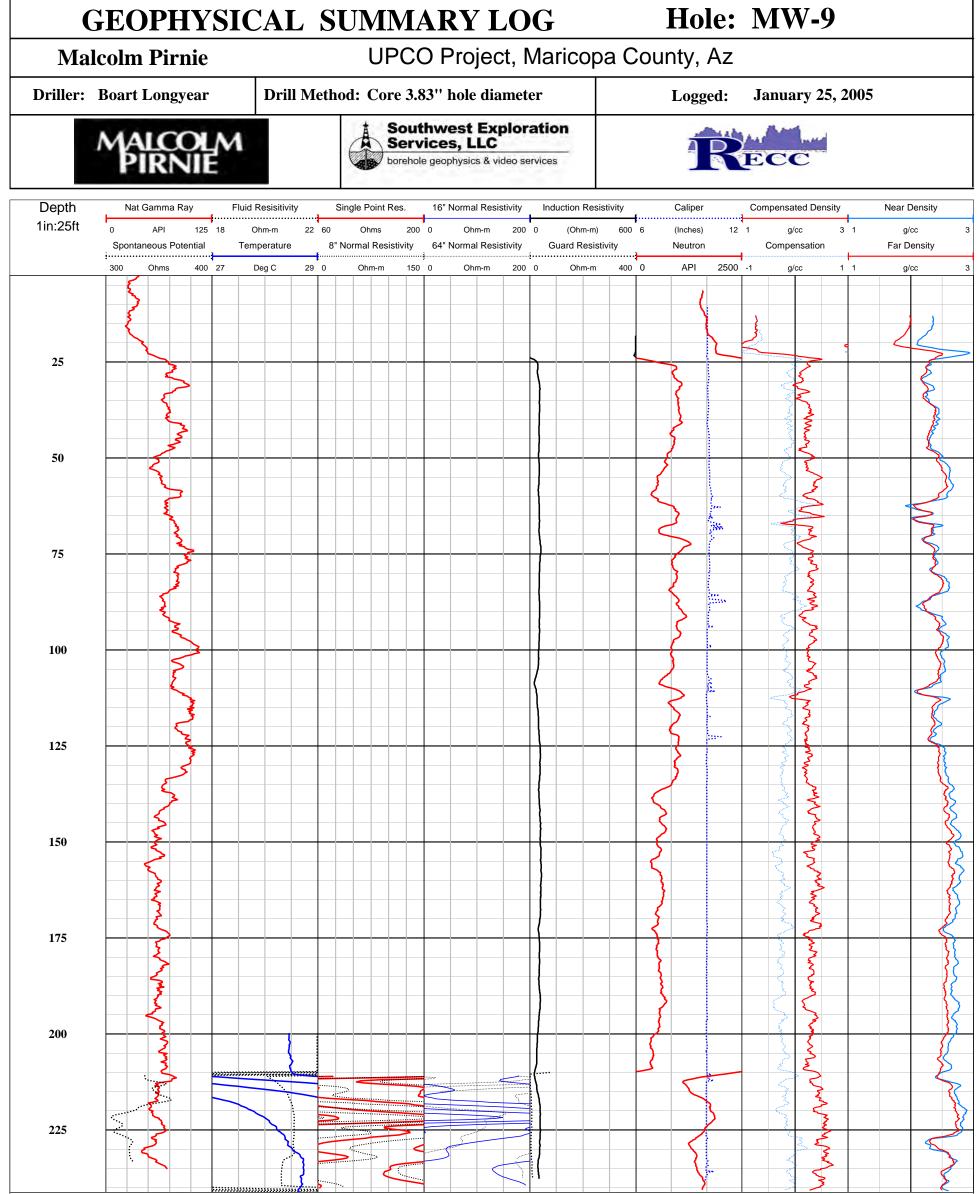




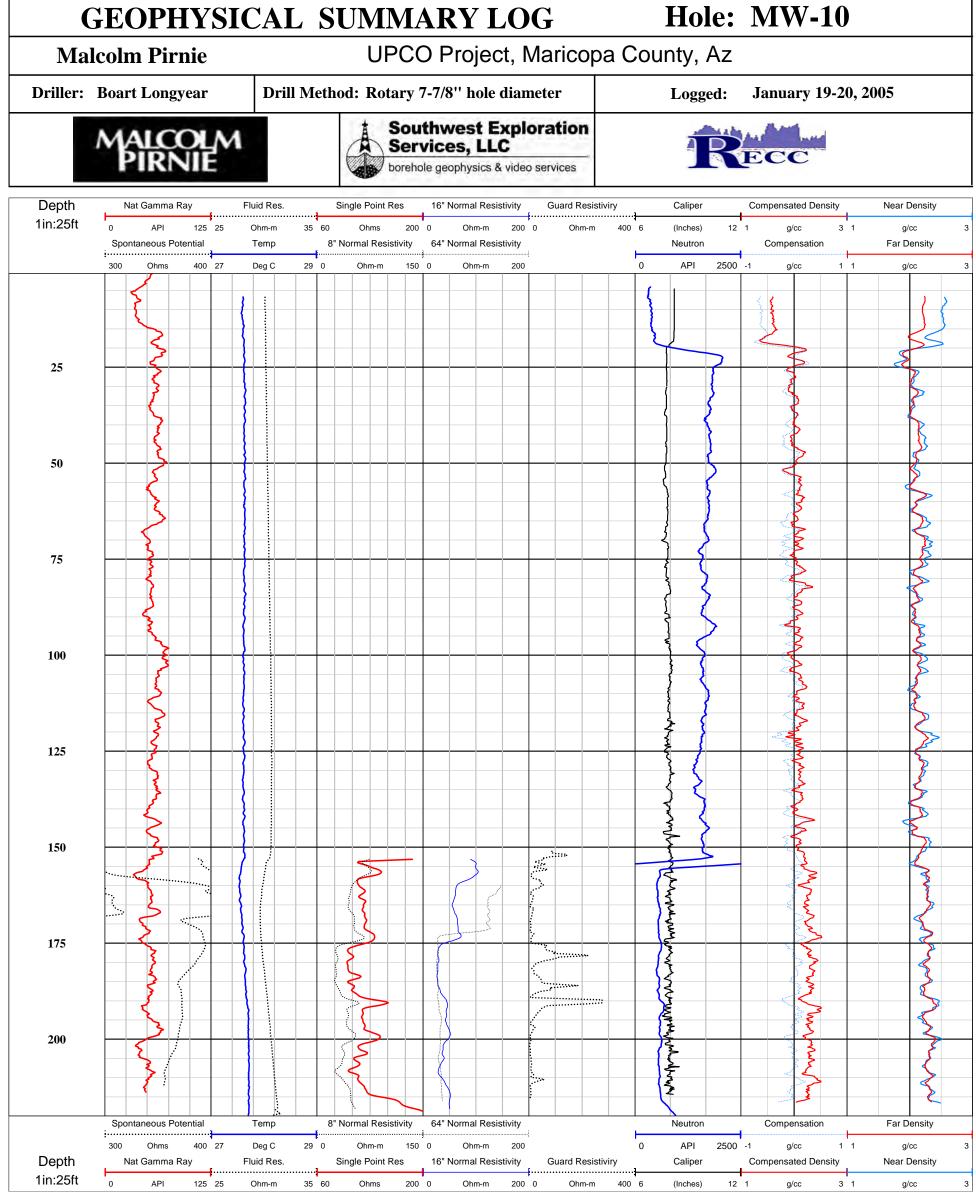


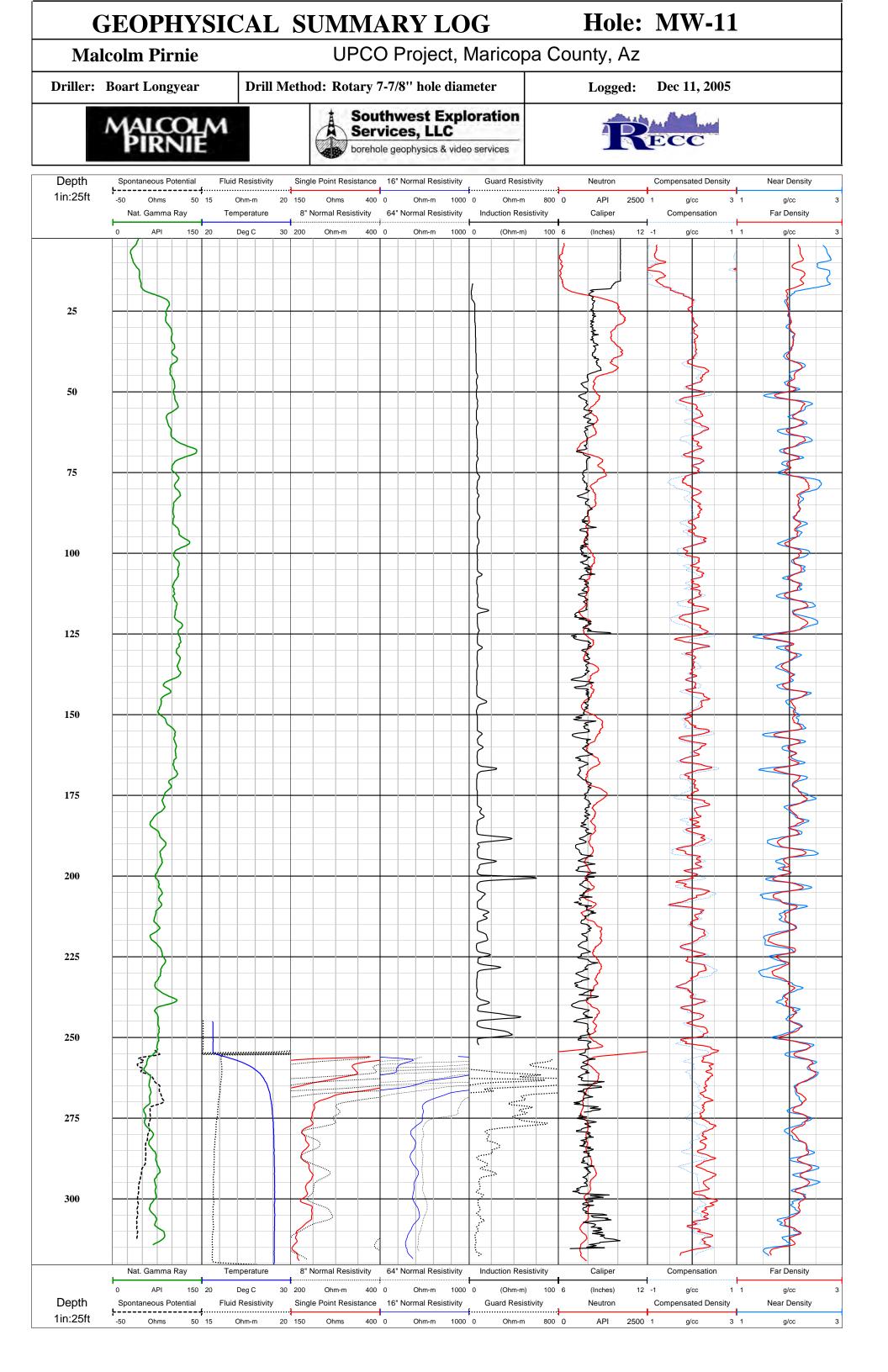


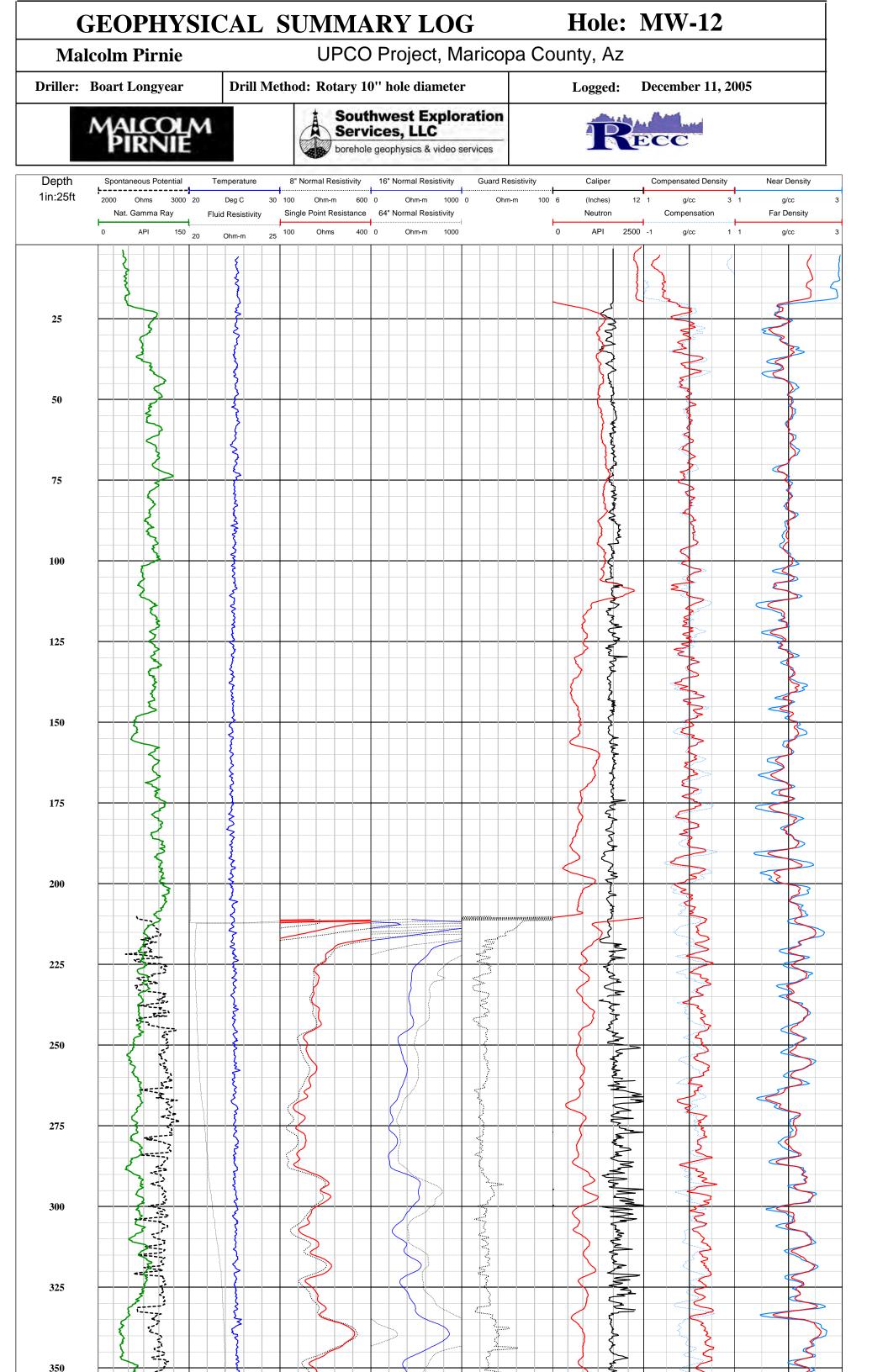
250					
Nat. Gamma Ray Temperature	Single Point Res. 10	16" Normal Resistivity Guard Resistivity	v Neutron	Compensation	Far Density
0 API 150 27 Deg C 29 60 Depth Spontaneous Potential Fluid Resistivity 8		Ohm-m 200 0 Ohm-m 64" Normal Resistivity Induction Resistivit	400 0 API 2500 -1 ty Caliper 0	I g/cc 1 1 Compensated Density	g/cc Near Density

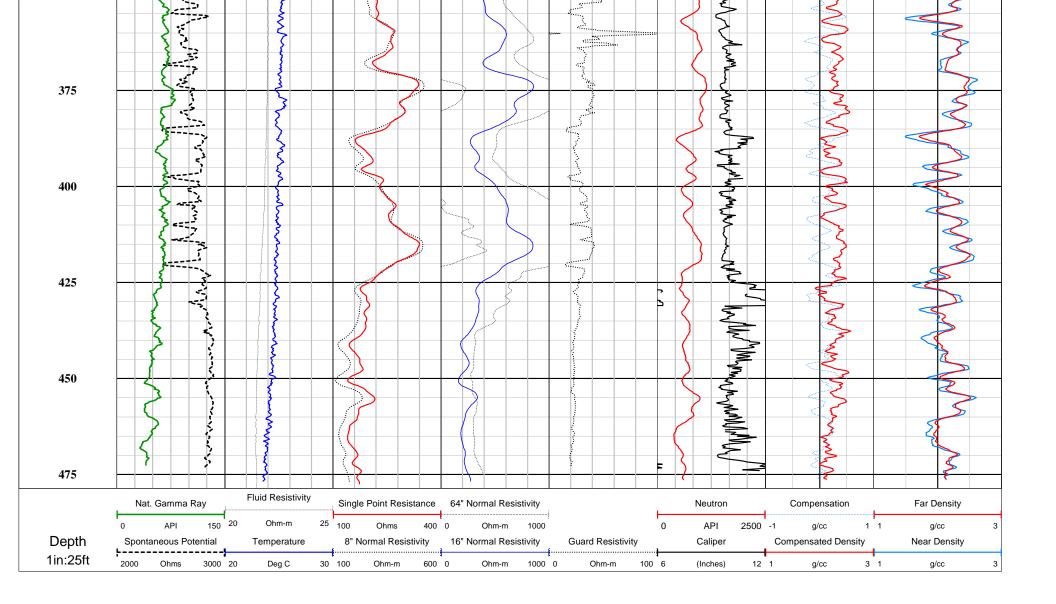


		taneous Po	otential	Temperature		8" Normal Resis	· · · ,	64" Normal Resi	· · · · ·	Guard Resisti	· .	Neutron		Compensa	tion	Far Density	
	300	Ohms	400 27	Deg C	29 0	Ohm-m	150	0 Ohm-m	200	0 Ohm-m	400 () API	2500	-1 g/cc	1 1	g/cc	3
Depth	Na	at Gamma I	· ·	Fluid Resisitivit	· .	Single Point R	es.	16" Normal Resi	istivity	Induction Resis	· · ·	Caliper	,	Compensated	Density	Near Density	
1in:25ft	0	API	125 18	Ohm-m	22 60	Ohms	200	0 Ohm-m	200	0 (Ohm-m)	600 6	6 (Inches)	12		3 1	g/cc	3









Geophysical Log Summary Hole MW-13

Malcolm Pirnie

Phoenix, Maricopa County, Az

Image Features Rotated 11.5 deg E for Magnetic Declination to True North

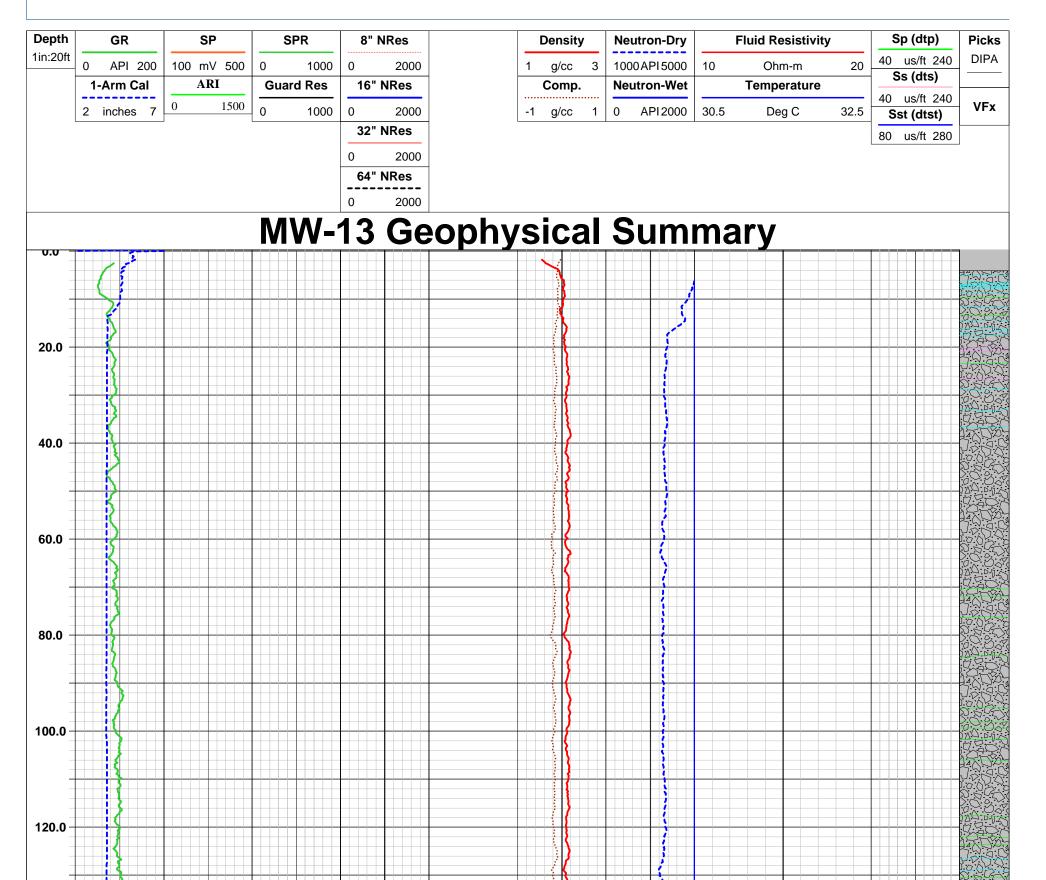
Feature Dip is from 0 to 90 deg (0 = Horizontal, 90 = Vertical) Logged: June 13, 2008

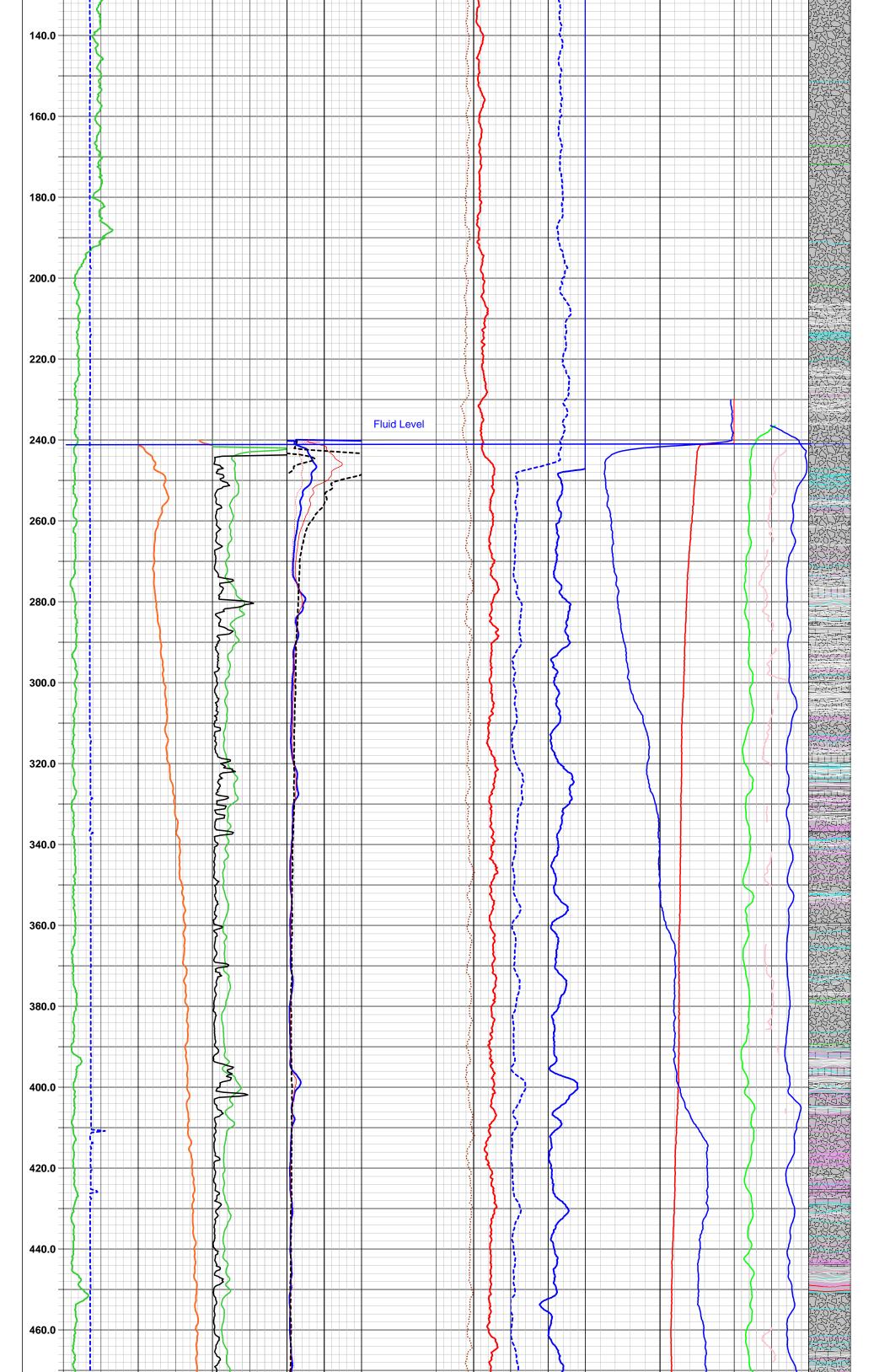


Southwest Exploration Services, LLC borehole geophysics & video services



Optical and Acoustic Image Features Legend
In-filled Fracture/joint or vein
Major fracture - distinct wide fracture/joint continuous around circumference of hole
Bedding - apparent bedding; rock boundary; banding or foliation feature
Fluid level in boreohle
• Unclassified - planar feature continuous around circumference - type of feature not determined: may be a: 1) fracture; 2) bedding feature; etc.
O Distinct probable fracture/joint continuous over a portion of the circumference of hole - usually terminated at another fracture interesection
Minor fracture - thin or discontinuous fracture/joint around circumference of hole
Bottom of Casing
VFx Lithology Legend
Breccia or Conglomerate 2 Near Vertical Fxs
□ ○ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □
Medium Vugs/Vesicles (2-6") Drilling Induced Fxs
Small Vugs/Vesicles (< 2")
>2 Near Vertical Fxs





480.0									
500.0	Ŋ.		$\left\{ \right\}$		ECC				
			MW-		ysical	Sum	mary		
				64" NRes 0 2000					
				32" NRes 0 2000				Sst (dtst)]
	1-Arm Cal	ARI	Guard Res	16" NRes	Comp.	Neutron-Wet	Temperature	80 us/ft 280	VFx
	2 inches 7	0 1500	0 1000	0 2000	-1 g/cc 1	0 API2000	30.5 Deg C 32.5	Ss (dts) 40 us/ft 240	Picks
Depth	GR	SP	SPR	8" NRes	Density	Neutron-Dry	Fluid Resistivity	Sp (dtp)	DIPA
1in:20ft	0 API 200	100 mV 500	0 1000	0 2000	1 g/cc 3	1000 API 5000	10 Ohm-m 20	40 us/ft 240	I

Geophysical Summary Legend

Mnemonics and Comments

GR	= natural gamma ray log plotted from 0 to 200 API uints (green line)
1-Arm Cal	= 1-arm mechanical caliper of hole diameter plotted from 2-7 inches (dotted blue line)
SP	= spontaneous potential log plotted 100 to 500 mV (orange line)
ARI	= Acoustic Reflectance Index or relative rock hardness from ABI Amplitude log. Plotted 0 (soft) to 1500 (harder) as green line.
SPR	= single point resistance log plotted 0 to 1000 ohms (green line)
Guard Res	= micro-guard or LL3 resistivity log plotted 0 to 1000 ohm-meters (black line)
8" NRes	= 8" normal resistivity log plotted 0 to 2000 ohm-meters (dotted red line)
16" NRes	= 16" normal resistivity log plotted 0 to 2000 ohm-meters (blue line)
32" NRes	= 32" normal resistivity log plotted 0 to 2000 ohm-meters (red line)
64" NRes	= 64" normal resistivity log plotted 0 to 2000 ohm-meters (dotted black line)
Density Comp.	 gamma-gamma density log plotted 1 to 3 g/cc (red line) density compensation log plotted -1 to 1 g/cc (dotted brown line)
Neutron (D	ry) = neutron log above fluid level plotted 1000 to 5000 API units (dotted blue line)
Neutron (V	
Fluid Res	= fluid resistivity log plotted 10 to 20 ohm-meters (red line)
Temperatu	e = fluid temperature log plotted 30.5 to 32.5 deg Celcius (blue line)
Sp (dtp)	= P-wave slowness or transit time log plotted 40 to 240 uSec/ft (green line)
Ss (dts)	= S-wave slowness or transit time log plotted 40 to 240 uSec/ft (pink line). Values greater than ~200 uS/ft are invalid.
Sst (dtst)	= Stoneley-wave slowness or transit time log plotted 80 to 280 uSec/ft (blue line).
VFxs	= Near Vertical Fractures, highly fractured zones and Fanglomerate or Breccia zones
Picks	= planar featues picked on optical or acoustic borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip apparent hole axis

Prepared by Robert E. Crowder Rev 8-1-2008

Geophysical Log Summary Hole MW-14

Malcolm Pirnie

Phoenix, Maricopa County, Az

Image Features Rotated 11.5 deg E for Magnetic Declination to True North

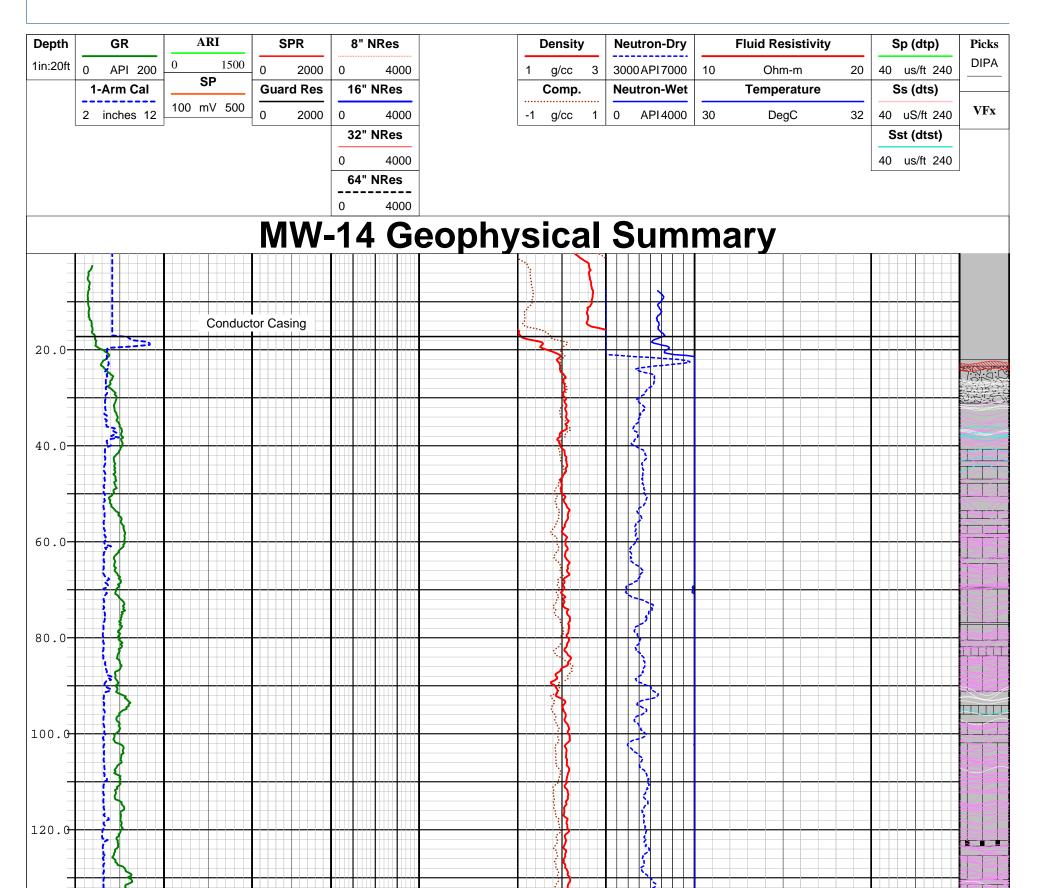
Feature Dip is from 0 to 90 deg (0 = Horizontal, 90 = Vertical) Logged: June 10, 2008

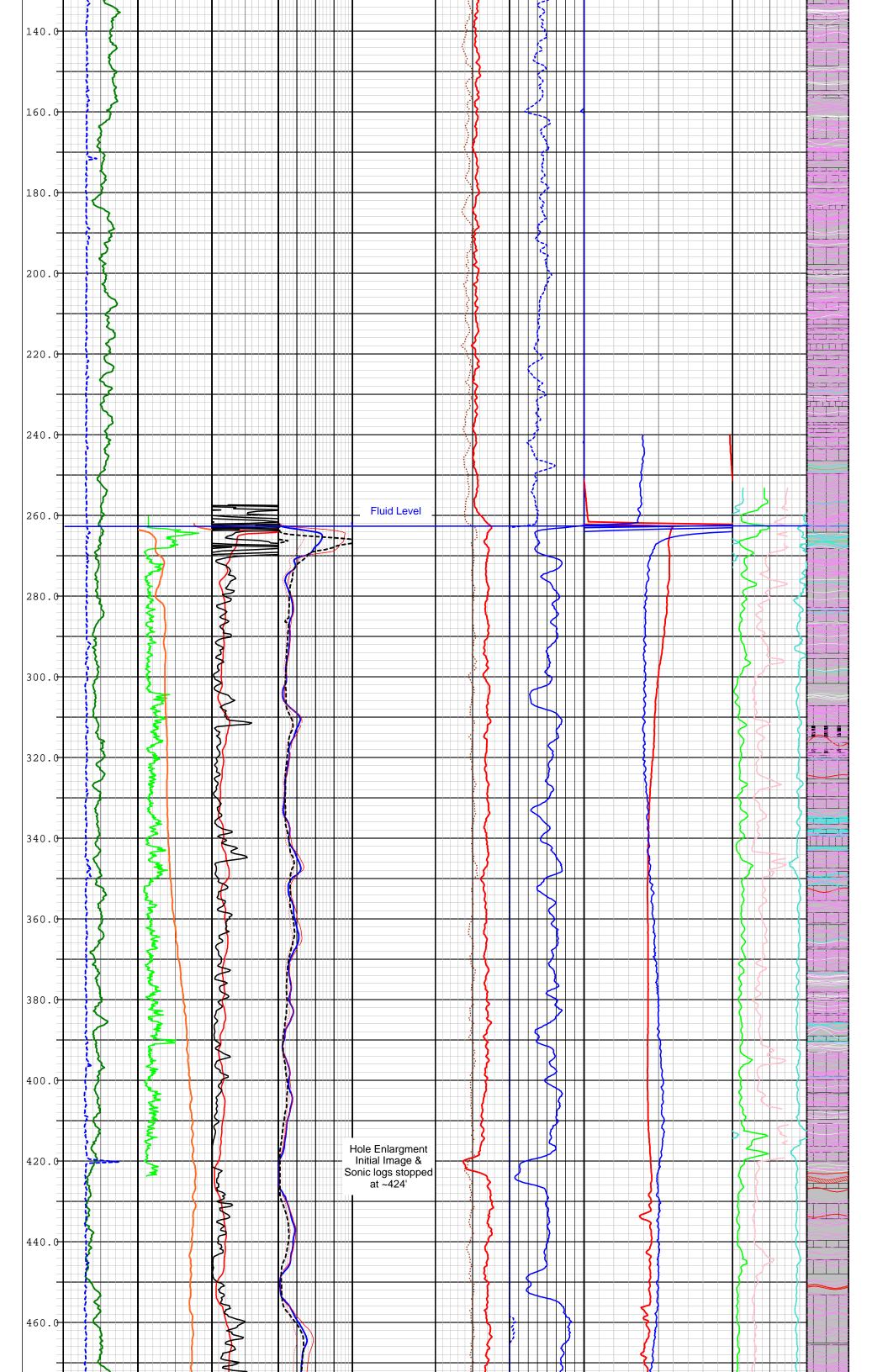


Southwest Exploration Services, LLC borehole geophysics & video services



Optical and Acoustic Image Features Legend
In-filled Fracture/joint or vein
Major fracture - distinct wide fracture/joint continuous around circumference of hole
Bedding - apparent bedding; rock boundary; banding or foliation feature
Fluid level in boreohle
• Unclassified - planar feature continuous around circumference - type of feature not determined: may be a: 1) fracture; 2) bedding feature; etc.
O Distinct probable fracture/joint continuous over a portion of the circumference of hole - usually terminated at another fracture interesection
Minor fracture - thin or discontinuous fracture/joint around circumference of hole
Bottom of Casing
VFx Lithology Legend
Breccia or Conglomerate 2 Near Vertical Fxs
Oo Oo Oo Large Vugs/Vesicles (> 6") 2 Wide Near Vertical Fxs
Medium Vugs/Vesicles (2-6") Drilling Induced Fxs
Small Vugs/Vesicles (< 2")
>2 Near Vertical Fxs





Depth	2 inches 12 GR	100 mV 500	0 2000 SPR	0 4000 8" NRes	-1 g/cc Density	1 0 API4000	30 DegC 32 Fluid Resistivity	40 uS/ft 240	Pic
	2 inches 12		0 2000	0 4000	-1 0/00	1 0 API4000	30 DeaC 32	40 uS/ft 240	
									I
	1-Arm Cal	SP	Guard Res	16" NRes	Comp.	Neutron-Wet	Temperature	Ss (dts)	l vi
				0 4000				40 us/ft 240	
				32" NRes				Sst (dtst)	
				0 4000					_
				64" NRes					
			MW-		ophysica	I Sum	mary		
_					ion 8-3-08, RECC				
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	'}		<i>{</i>						
			2)				2 [\$	
_			×						
80.0-				1 1 / / /					and the second se

Geophysical Summary Legend

Mnemonics and Comments

	 = natural gamma ray log plotted from 0 to 200 API uints (green line) = 1-arm mechanical caliper of hole diameter plotted from 2-12 inches (dotted blue line)
SP ARI	 = spontaneous potential log plotted 100 to 500 mV (orange line) = Acoustic Reflectance Index or relative rock hardness from ABI Amplitude log. Plotted 0 (soft) to 1500 (harder) as green line.
	 = single point resistance log plotted 0 to 2000 ohms (green line) = micro-guard or LL3 resistivity log plotted 0 to 2000 ohm-meters (black line)
16" NRes 32" NRes	 = 8" normal resistivity log plotted 0 to 4000 ohm-meters (dotted red line) = 16" normal resistivity log plotted 0 to 4000 ohm-meters (blue line) = 32" normal resistivity log plotted 0 to 4000 ohm-meters (red line) = 64" normal resistivity log plotted 0 to 4000 ohm-meters (dotted black line)
Density Comp.	 gamma-gamma density log plotted 1 to 3 g/cc (red line) density compensation log plotted -1 to 1 g/cc (dotted brown line)
Neutron (Dr Neutron (We	
Fluid Res Temperatue	 = fluid resistivity log plotted 10 to 20 ohm-meters (red line) = fluid temperature log plotted 30 to 32 deg Celcius (blue line)
Sp (dtp) Ss (dts) Sst (dtst)	 = P-wave slowness or transit time log plotted 40 to 240 uSec/ft (green line) = S-wave slowness or transit time log plotted 40 to 240 uSec/ft (pink line). Values greater than ~200 uS/ft are invalid. = Stoneley-wave slowness or transit time log plotted 40 to 240 uSec/ft (blue line).
	= Near Vertical Fractures, highly fractured zones and Fanglomerate or Breccia zones planar featues picked on optical or acoustic borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip

apparent hole axis

Prepared by Robert E. Crowder Rev 8-1-2008

	Sou	Southwest Services. L		Exploration	ra	tion
	boreh	borehole geophysics & video services	/sics &	, video	servi	ices
	COMPANY	MALCOLM PIRNIE	RNIE			
	WELL ID	MW-16				
	FIELD	PHOENIX				
	COUNTY	MARICOPA		STATE		ARIZONA
	TYPE OF I	TYPE OF LOGS: SUMMARY LOG	MARY L	,OG	2 0	OTHER SERVICES
	MORE:				πω	3-ARM CALIPER E-LOGS-GAMMA-TEMP
	LOCATION				700	GUARD RESISTIVITY OBI-40 NEUTRON
	SEC	TWP	RGE		ں ن	3 4A SUNIC
PERMANENT DATUM			ELEVATION		K	K.B.
LOG MEAS. FROM	GROUND LEVEL		ABOVE PERM. DATUM	M	п	D.F.
DRILLING MEAS. FROM						G.L.
DATE	04-02-11		TYPE FLUID IN HOLE	D IN HOLE	F	FRESH WATER
RUN No	1		SALINITY	ΓY	7	N/A
TYPE LOG	SUMMARY	Y	DENSITY	Y	7	N.A
DEPTH-DRILLER	510 FT		LEVEL		2	251 FT
DEPTH-LOGGER	508 FT		MAX. REC. TEMP.	. TEMP.	2	26.6 Deg C
BTM LOGGED INTERVAL	, 508 FT		IMAGE OR	IMAGE ORIENTED TO:	7	N/A
TOP LOGGED INTERVAL	SURFACE		SAMPLE INTERVAL	VTERVAL	0	0.25
DRILLER / RIG#	YELLOW JACKET	JACKET	LOGGING TRUCK	TRUCK	Г	TRUCK # 400
RECORDED BY / Logging Eng.	Eng. K. MITCHELL	ELL	TOOL STRING/SN	NG/SN	7	MULTIPLE
WITNESSED BY		MALCOLM PIRNIE: C. LEGG	LOG TIME	LOG TIME:ON SITE/OFF SITE	SITE	
RUN BOREHOLE RECORD	CORD		CASING RECORD	CORD		
NO. BIT F	FROM	ТО	SIZE	WGT.	FROM	ТО
1 15" S	SURFACE	20 FT	12"	STEEL	SURFACE	CE 21 FT
2 10" 20	20 FT	TOTAL DEPTH				
COMMENTS:						-

Major Lithology

GM - Silty gravel w/ sand

GP - Sandy Gravel

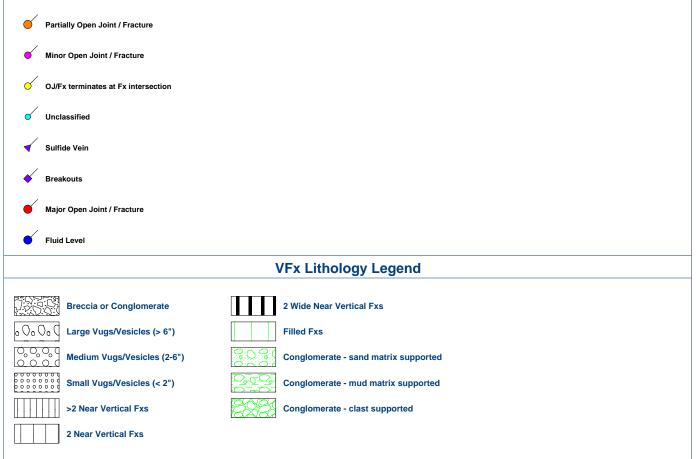


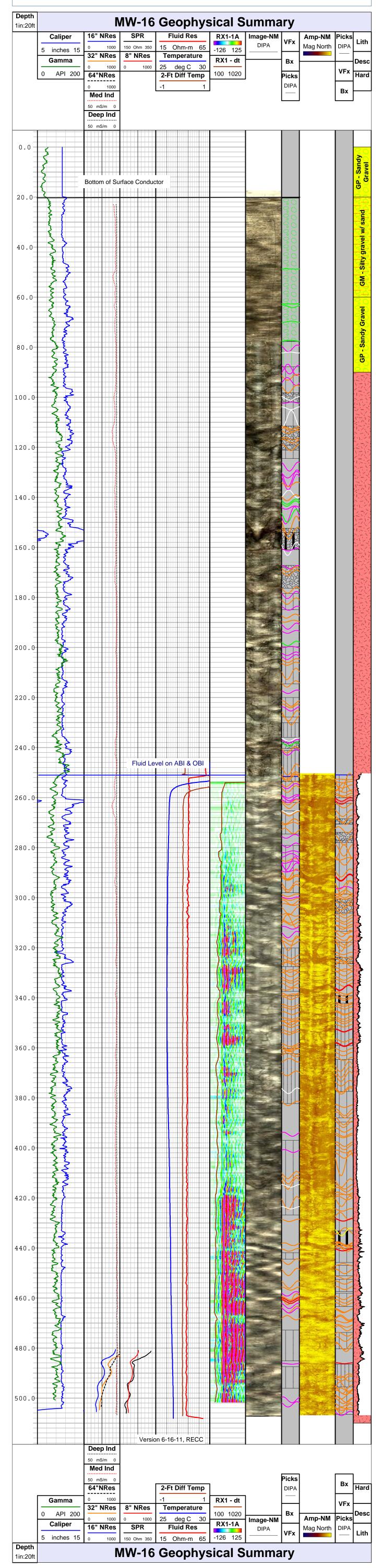
Optical Image Features Legend



6

Bedding / Banding / Foliation / Veins





]									
	XXXX+	ົ້	ên î	Southwest Ex Services, LLC		Exploration LC	Ĩa.	tion	
		bd	oreho	borehole geophysics & video services	sics &	t video s	serv	ices	
		COMPANY	۲	MALCOLM PIRNIE	RNIE				
		WELL ID	Đ	MW-17 PHOENIX					
		COUNTY	ΓY	MARICOPA		STATE		ARIZONA	
		TYPH	E OF L	TYPE OF LOGS: SUMMARY LOG	MARY L	,0G		OTHER SERVICES	ICES
		MORE:	E				H (1)	3-ARM CALIPER E-LOGS-GAMMA-TEMP	IMA-TEMP
		LOCATION	ON				700	GUARD RESISTIVITY OBI-40, ABI-40 NEUTRON	10 10
		SEC		TWP	RGE				
PERMANI	PERMANENT DATUM			н	ELEVATION			K.B.	
LOG MEAS. FROM	S. FROM	GROUN	GROUND LEVEL	ABOVE P	ABOVE PERM. DATUM	JM		D.F.	
DRILLING	DRILLING MEAS. FROM	1						G.L.	
DATE		04-	04-02-11		TYPE FLUID IN HOLE	D IN HOLE		FRESH WATER	R
RUN No		1			SALINITY	ГҮ		N/A	
TYPE LOG		SU	SUMMARY		DENSITY	Y	7	N.A	
DEPTH-DRILLER	RILLER	28	280 FT		LEVEL	TEMD		150 FT	
BTM LOGGED IN	BTM LOGGED INTERVAL		272 FT		IMAGE ORIENTEI	IMAGE ORIENTED TO:	7	N/A	
TOP LOG	TOP LOGGED INTERVAL		SURFACE		SAMPLE INTERVAL	VTERVAL	0	0.25	
DRILLER / RIG#	/ RIG#		YELLOW JACKET	CKET	LOGGING TRUCK	TRUCK		TRUCK # 400	
RECORDE	RECORDED BY / Logging Eng.	_	K. MITCHELL	Ľ	TOOL STRING/SN	ING/SN	1	MULTIPLE	
WITNESSED BY	ED BY	M	ALCOLM F	MALCOLM PIRNIE: C. LEGG	LOG TIME	LOG TIME: ON SITE/OFF SITE		7:00 AM	
RUN	BOREHOLE RECORD	ECORD			CASING RECORD	CORD			
NO.	BIT	FROM		ТО	SIZE	WGT.	FROM		ТО
1		SURFACE		20 FT	12"	STEEL	SURFACE	CE	21 FT
2	10"	20 FT		TOTAL DEPTH					
COMMENTS:	TS:								
·									

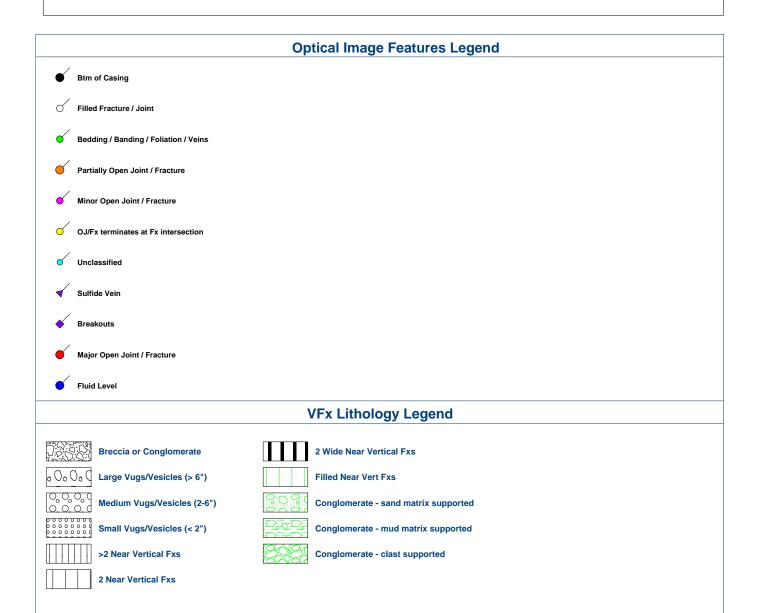
Major Lithology

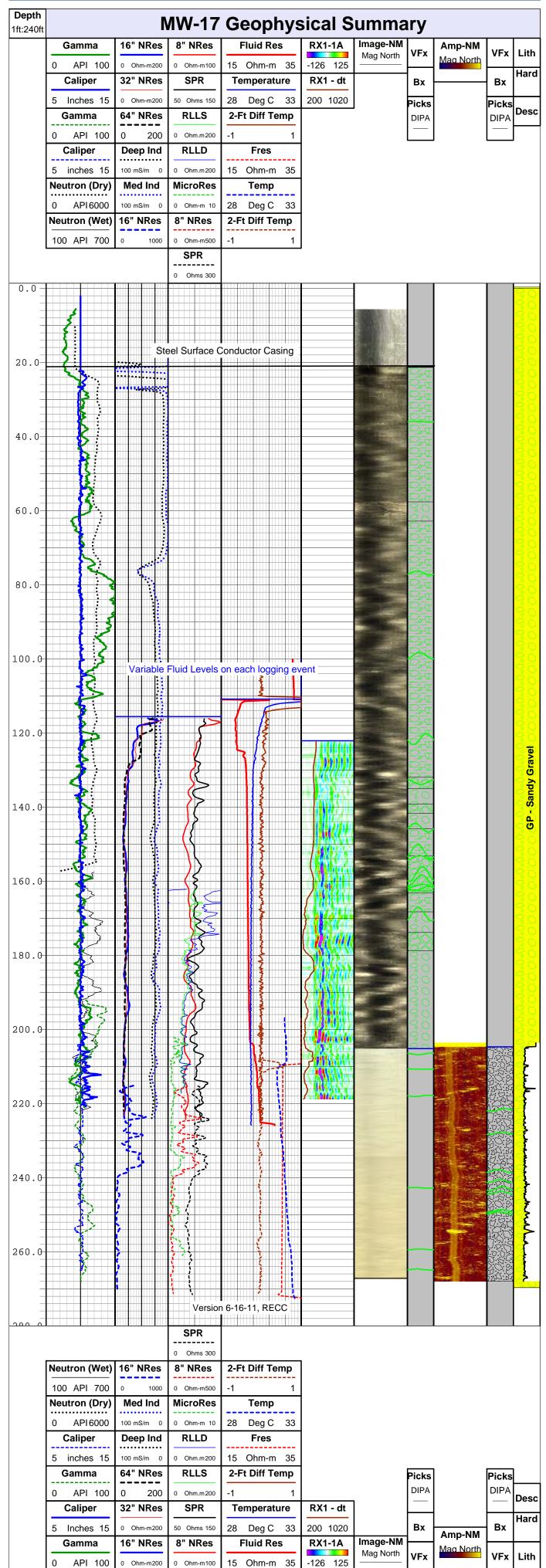


GM - Silty gravel w/ sand

GP - Sandy Gravel

BT - Granodiorite





Depth	n		Coophy					
1ft:240ft	N	/1	Geophys	Sical S	umma	ry		

Geophysical Log Summary Hole MW-18

Malcolm Pirnie

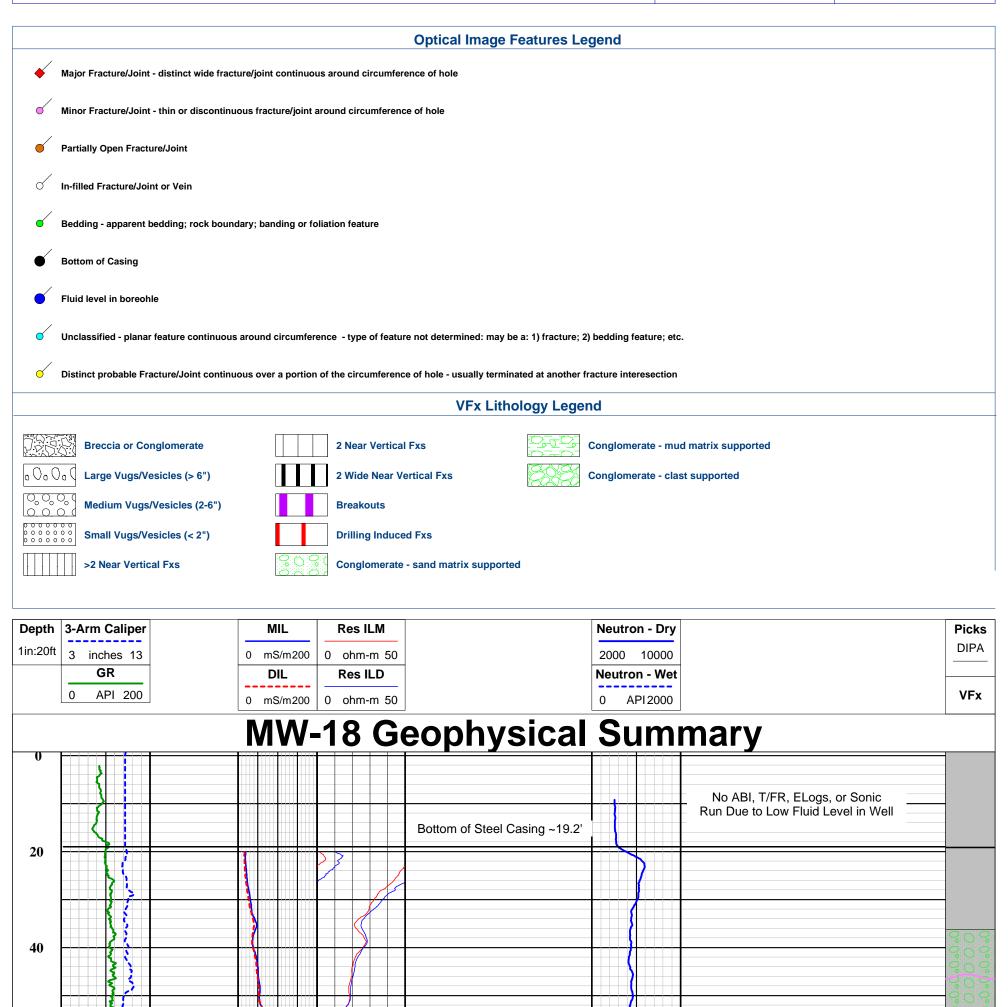
Phoenix, Maricopa County, Az

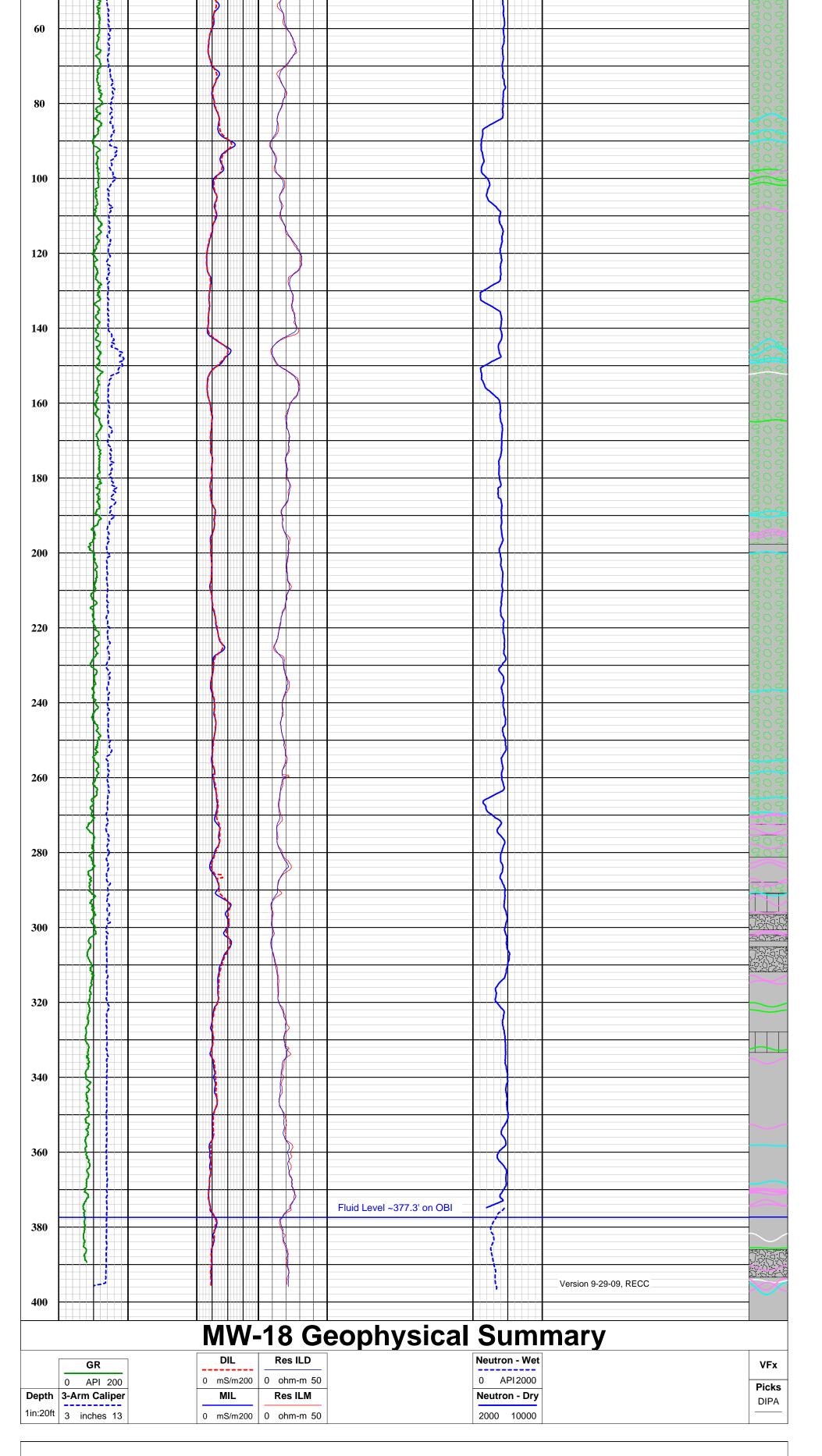
Southwest Exploration

Services, LLC borehole geophysics & video services

Image Features Oriented to Magnetic North and not Corrected for Magnetic Declination

Feature Dip is from 0 to 90 deg (0 = Horizontal, 90 = Vertical) Logged: Sept. 17, 2009





	Mnemonics and Comments							
GR	= natural gamma ray log plotted from 0 to 200 API uints (green line)							
3-Arm Cal	= 3-arm mechanical caliper of hole diameter plotted from 3-13 inches (dotted blue line)							
SP	= spontaneous potential log was not run due to low fluid level in well.							
ARI	= Acoustic Reflectance Index or relative rock hardness from ABI log ABI was not run due to low fluid level in well.							
SPR	= single point resistance log was not run due to low fluid level in well.							
Guard Res	= micro-guard or LL3 resistivity log was not run due to low fluid level in well.							
8" NRes	= 8" normal resistivity log was not run due to low fluid level in well.							
16" NRes	= 16" normal resistivity log was not run due to low fluid level in well.							
32" NRes	= 32" normal resistivity log was not run due to low fluid level in well.							
64" NRes	= 64" normal resistivity log was not run due to low fluid level in well.							
MIL	= medium depth induction log plotted 0 to 200 mS/meter (dotted blue line)							
DIL	= deep depth induction log plotted 0 to 200 mS/meter (dotted dashed red line)							
Res ILM	= medium depth induction resistivity log (recipocal of conductivity) plotted 0 to 50 ohm-meter (red line)							
Res ILD	= deep depth induction resistivity log (recipocal of conductivity) plotted 0 to 50 ohm-meter (blue line)							
Density	= gamma-gamma density log was not run.							
Comp.	= density compensation log was not run.							
Neutron (D	ry) = neutron log above fluid level plotted 2000 to 10000 API units (blue line)							
Neutron (W	et) = neutron log below fluid level plotted 0 to 2000 API units (dotted blue line)							
Fluid Res	= fluid resistivity log was not run due to low fluid level in well.							
Temperatu	e = fluid temperature log was not run due to low fluid level in well.							
Sp (dtp)	= P-wave slowness or transit time log sonic log not run due to low fluid level in well.							
Ss (dts)	= S-wave slowness or transit time log sonic log not run due to low fluid level in well.							
Sst (dtst)	= Stoneley-wave slowness or transit time log sonic log was not run due to low fluid level in well.							
VFxs	= Near Vertical Fractures, highly fractured zones and Fanglomerate or Breccia zones							
	= planar featues picked on optical or acoustic borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip apparent hole axis							

Sonic Log Analysis

Hole 18 E. Yearling



Southwest Exploration Services, LLC

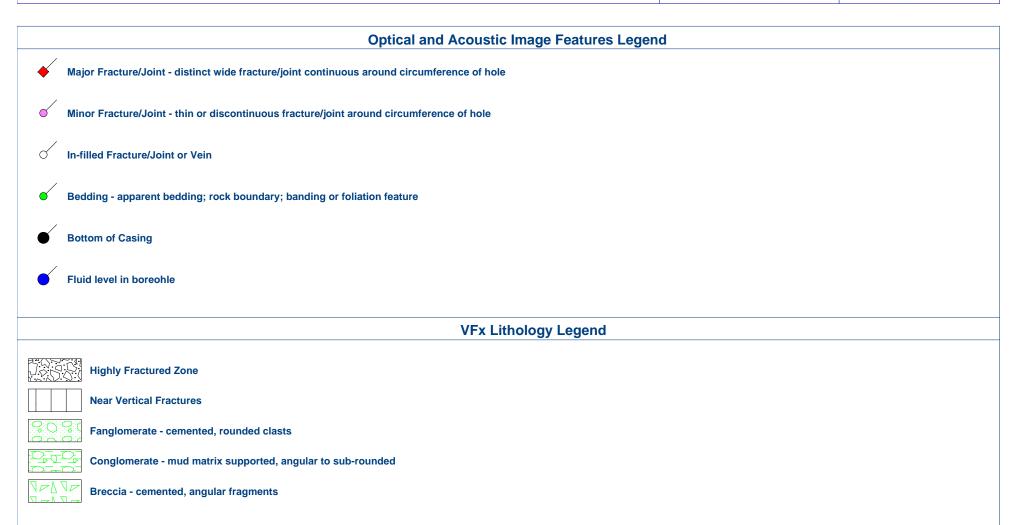
borehole geophysics & video services

Malcolm Pirnie

18 E. Yearling, Maricopa County, Az

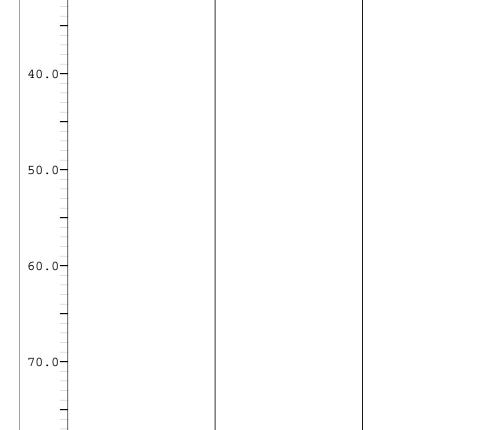
Image Features Rotated 11.5 deg E for Magnetic Declination to True North

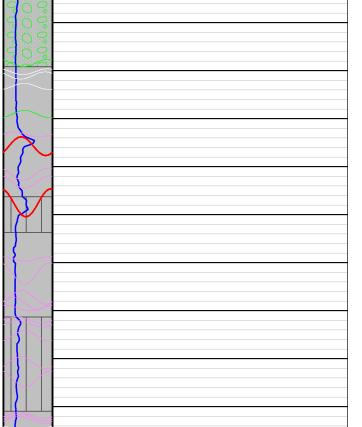
Feature Dip is from 0 to 90 deg (0 = Horizontal, 90 = Vertical) Logged: July 27, 2007

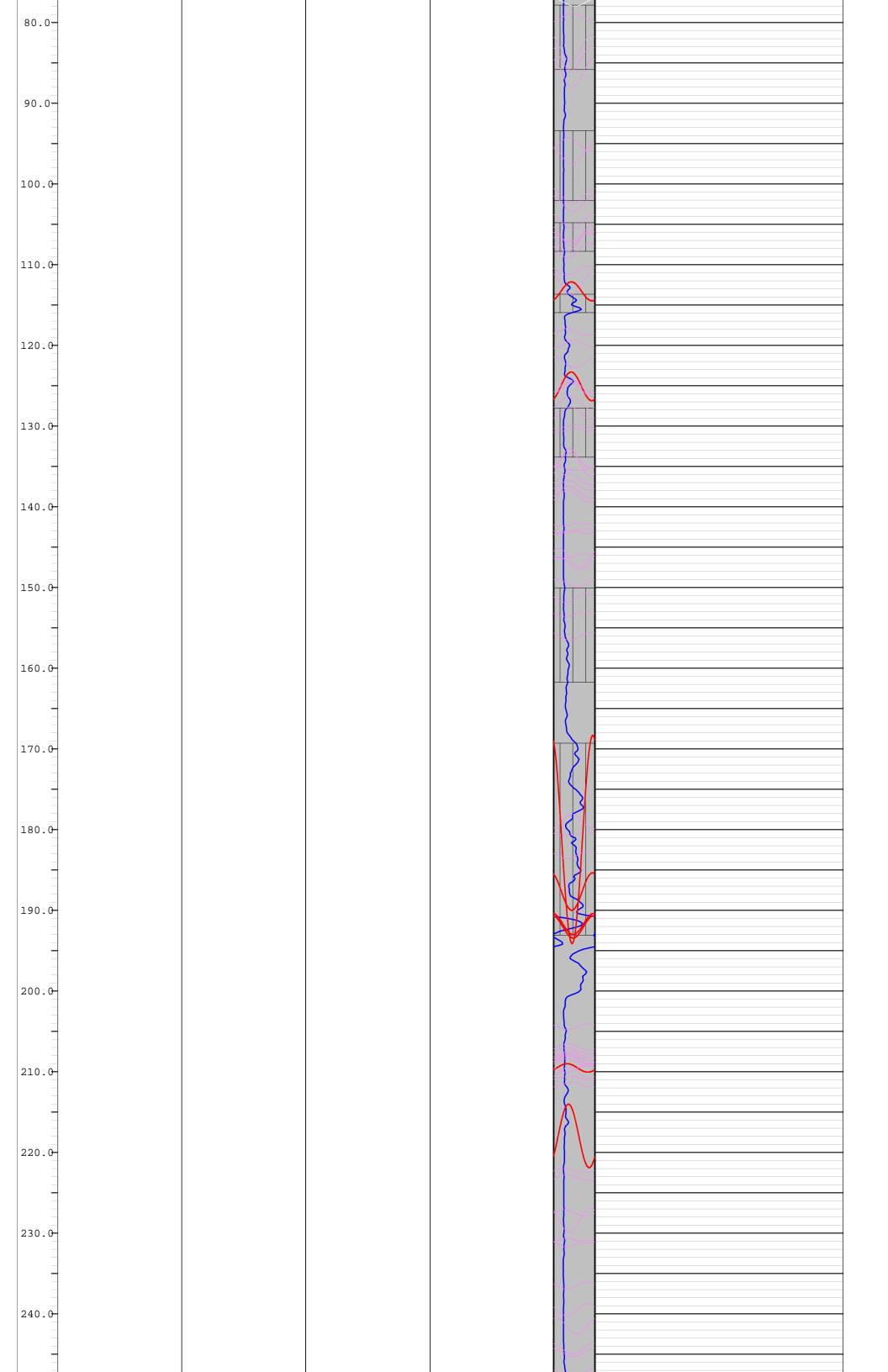


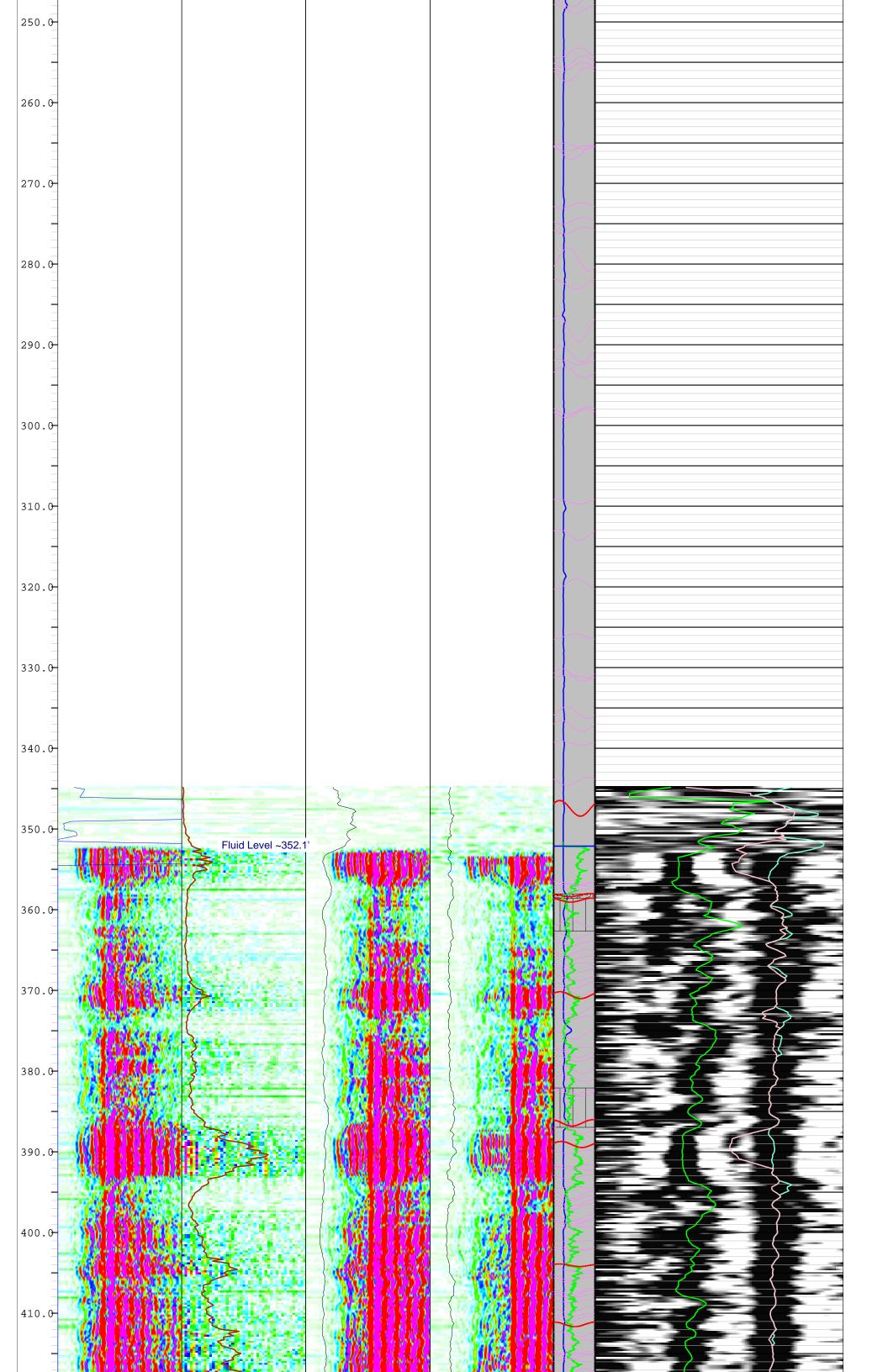
Depth	18 F Yearlin	g Well - Sonic Log Anal	vsis
1in:10f		g mon oonno Eog / mai	J U U

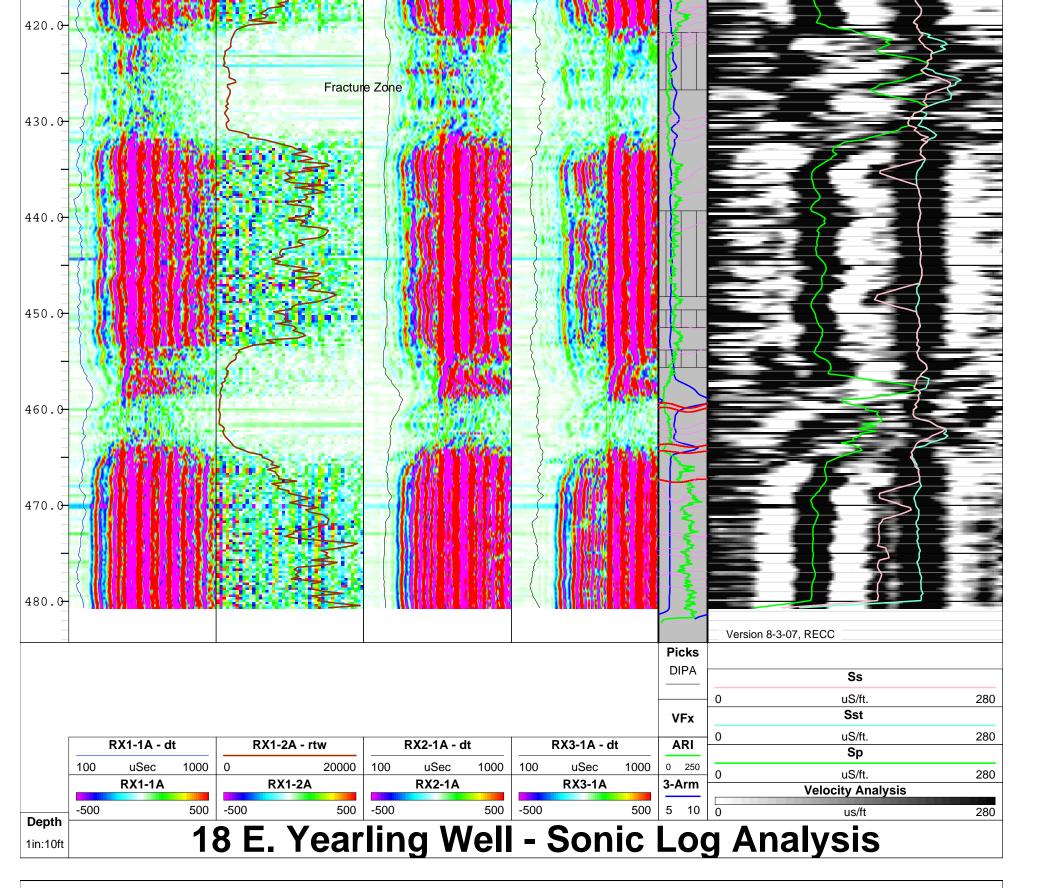
in:10ft			•] / ``	laryoro	
		RX1-1A			RX1-2A RX2-1A			RX3-1A			3-Arm		Velocity Analysis		
	-500		500	-500	500	-500		500	-500		500	5 10	0	us/ft	28
-		RX1-1A - dt RX1-2A - rtw					RX2-1A - c			RX3-1A - d		ARI		Sp	
	100	uSec	1000		20000	100	uSec	1000	100	uSec	1000	0 250	0	uS/ft.	28
L	100	udec	1000	0	20000	100	udec	1000	100	udec	1000			Sst	
												VFx	0	uS/ft.	28
												Picks		Ss	
												DIPA	0	uS/ft.	28
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Sonic Analysis Summary Legend

Mnemonics and Comments

RX1-1A	= 2D plot of sonic waveform VDL log from receiver 1 (0.6m Rx-Tx spacing) plotted from 100 to 1100 in uSecs
RX1-1A-dt	= first arrival pick (P-wave) on receiver 1 (0.6m Rx-Tx spacing) plotted from 100 to 1100 in uSecs (thin blue line)
RX1-2A RX1-2A-rtw	 = 2D plot of sonic waveform VDL log from receiver 1 (0.6m Rx-Tx spacing) second time window plotted from 1100 to 2100 in uSecs = reflected tube wave analysis log on receiver 1 (0.6m Rx-Tx spacing) plotted from 0 to 20000 (brown line)
RX2-1A	= 2D plot of sonic waveform VDL log from receiver 2 (0.8m Rx-Tx spacing) plotted from 100 to 1100 in uSecs
RX2-1A-dt	= first arrival pick (P-wave) on receiver 2 (0.8m Rx-Tx spacing) plotted from 100 to 1100 in uSecs (thin black line)
RX3-1A	= 2D plot of sonic waveform VDL log from receiver 3 (1.0m Rx-Tx spacing) plotted from 100 to 1100 in uSecs
RX3-1A-dt	= first arrival pick (P-wave) on receiver 3 (1.0m Rx-Tx spacing) plotted from 100 to 1100 in uSecs (thin black line)

- **3-Arm** = 3-arm mechanical caliper of hole diameter plotted from 5-10 inches (blue line)
- **ARI** = Acoustic Reflectance Index or relative rock hardness from ABI Amplitude log. Plotted 0 (soft) to 250 (harder) as green line.
- **VFxs** = Near Vertical Fractures, highly fractured zones and Fanglomerate or Breccia zones
- **Picks** = planar featues picked on optical or acoustic borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip apparent hole axis

Velocity Analysis = gray scale variable density display of velocity semblence waveform; plotted from 0 to 275 uSec/ft.

- **Sp** = apparent P-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft. (light blue line).
- Ss = apparent S-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft. (light green line).
- **Sst** = apparent Stonely-wave slowness from maximum energy peak on semblence velocity waveform in uSec/ft. (yellow line).

Prepared by Robert E. Crowder Rev 8-3-2007

Sonic Log Analysis

Hole MW-13



Recc

Southwest Exploration Services, LLC

borehole geophysics & video services

Malcolm Pirnie

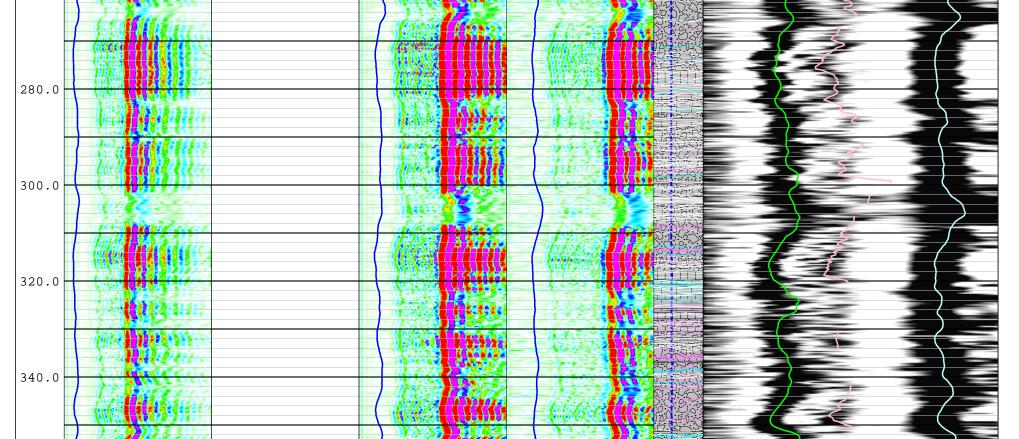
Phoenix, Maricopa County, Az

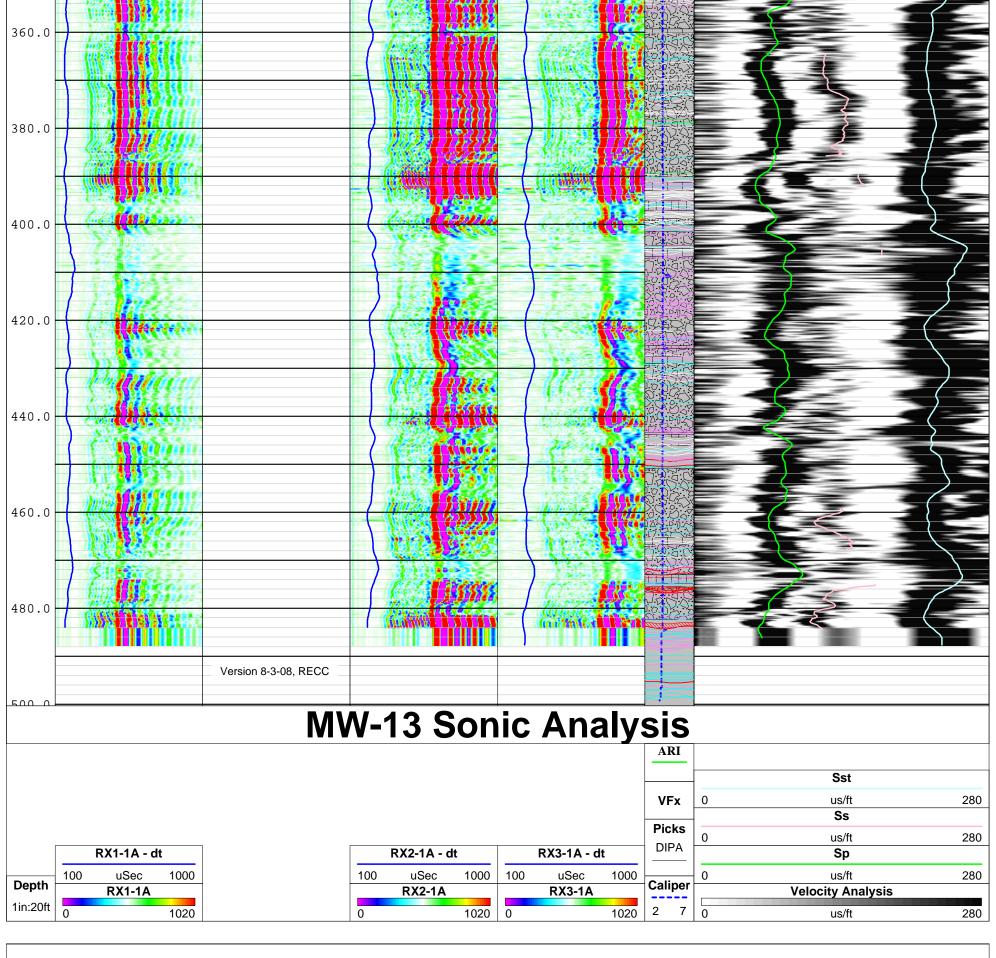
Image Features Rotated 11.5 deg E for Magnetic Declination to True North

Feature Dip is from 0 to 90 deg (0 = Horizontal, 90 = Vertical) Logged: June 13, 2008

Optical and Acoustic Image Features Legend							
In-filled Fracture/joint or vein							
Major fracture - distinct wide fracture/joint continuous around circumference of hole							
Bedding - apparent bedding; rock boundary; banding or foliation feature							
Fluid level in boreohle							
Unclassified - planar feature continuous around circumference - type of feature not determined: may be a: 1) fracture; 2) bedding feature; etc.							
O Distinct probable fracture/joint continuous over a portion of the circumference of hole - usually terminated at another fracture interesection							
Minor fracture - thin or discontinuous fracture/joint around circumference of hole							
Bottom of Casing							
VFx Lithology Legend							
Breccia or Conglomerate 2 Near Vertical Fxs							
a O a O a C Large Vugs/Vesicles (> 6") 2 Wide Near Vertical Fxs							
O O O O O O O O O							
Small Vugs/Vesicles (< 2")							
>2 Near Vertical Fxs							

Depth	RX1-1A			RX2-1A			RX3-1A		Caliper	Velocity Analysis	
1in:20ft	0 1020		0		1020	0		1020	2 7	0 us/ft	280
	RX1-1A - dt			RX2-1A - c	lt		RX3-1A - dt		Picks	Sp	
	100 uSec 1000		100	uSec	1000	100	uSec	1000	DIPA	0 us/ft	280
_										Ss	
										0 us/ft	280
									VFx	Sst	
									ARI	0 us/ft	280
		R #1					A				
			<u>/V-'</u>	13 5	on	IC	Ana	IY:	SIS		
		Fluid Level							00000		
240.0											
			1		11						\geq
		Long Time Window		1-35			S. C. C. S.	1			
	1 States			102		- 1		10			\sim
				and the second sec	al la na state	the second second second		- 20A 2-2	NAG NO ~		
				() ()	((*****	1. Start 1.		1868			





	Sonic Analysis Summary Legend
	Mnemonics and Comments
RX1-1A RX1-1A-dt	= 2D plot of sonic waveform VDL log from receiver 1 (0.6m Rx-Tx spacing) plotted from 100 to 1100 in uSecs = first arrival pick (P-wave) on receiver 1 (0.6m Rx-Tx spacing) plotted from 100 to 1100 in uSecs (thin blue line)
RX2-1A	= 2D plot of sonic waveform VDL log from receiver 2 (0.8m Rx-Tx spacing) plotted from 100 to 1100 in uSecs

= first arrival pick (P-wave) on receiver 2 (0.8m Rx-Tx spacing) plotted from 100 to 1100 in uSecs (thin black line)

RX2-1A-dt

= 2D plot of sonic waveform VDL log from receiver 3 (1.0m Rx-Tx spacing) plotted from 100 to 1100 in uSecs **RX3-1A**

- RX3-1A-dt = first arrival pick (P-wave) on receiver 3 (1.0m Rx-Tx spacing) plotted from 100 to 1100 in uSecs (thin black line)
- = 3-arm mechanical caliper of hole diameter plotted from 5-10 inches (blue line) 3-Arm
- ARI = Acoustic Reflectance Index or relative rock hardness from ABI Amplitude log. Plotted 0 (soft) to 1500 (harder) as green line.
- VFxs = Near Vertical Fractures, highly fractured zones and Fanglomerate or Breccia zones
- Picks = planar featues picked on optical or acoustic borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip apparent hole axis

Velocity Analysis = gray scale variable density display of velocity semblence waveform; plotted from 0 to 280 uSec/ft.

- = apparent P-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft. (light blue line).
- = apparent S-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft. (light green line).
- = apparent Stonely-wave slowness from maximum energy peak on semblence velocity waveform in uSec/ft. (yellow line).

Prepared by Robert E. Crowder Rev 8-1-2008

Sp

Ss

Sst

Sonic Log Analysis

Hole MW-14



Recc

Southwest Exploration Services, LLC

borehole geophysics & video services

Malcolm Pirnie

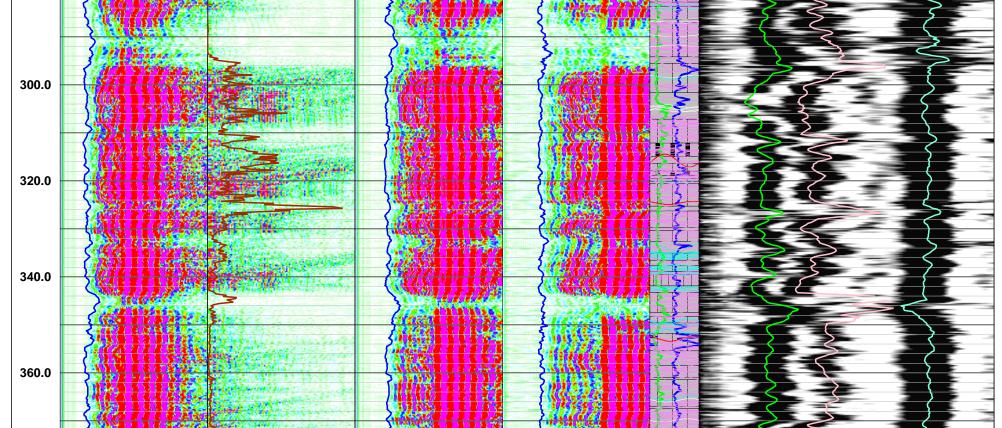
Phoenix, Maricopa County, Az

Image Features Rotated 11.5 deg E for Magnetic Declination to True North

Feature Dip is from 0 to 90 deg (0 = Horizontal, 90 = Vertical) Logged: June 10, 2008

	Optical and Acoustic Image Features Legend							
6	In-filled Fracture/joint or vein							
•	Major fracture - distinct wide fracture/joint continuous around circumference of hole							
•	Bedding - apparent bedding; rock boundary; banding or foliation feature							
•	Fluid level in boreohle							
`	Unclassified - planar feature continuous around circumference - type of feature not determined: may be a: 1) fracture; 2) bedding feature; etc.							
0	Distinct probable fracture/joint continuous over a portion of the circumference of hole - usually terminated at another fracture interesection							
•	Minor fracture - thin or discontinuous fracture/joint around circumference of hole							
•	Bottom of Casing							
	VFx Lithology Legend							
	Breccia or Conglomerate 2 Near Vertical Fxs							
٥ O o O	Large Vugs/Vesicles (> 6") 2 Wide Near Vertical Fxs							
	Medium Vugs/Vesicles (2-6") Drilling Induced Fxs							
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Small Vugs/Vesicles (< 2")							
	>2 Near Vertical Fxs							

Depth		RX1-1A			RX1-2A			RX2-1A			RX3-1A		Calipe	r	Velocity Analysis	
1in:20ft	-256	uSec	255	-256	uSec	255	-256	uSec	255	-256	uSec	255	4 6	5 0	us/ft	30
		RX1-1A - d	t	R	X1-2A -	rtw		RX2-1A - 0	dt		RX3-1A - d	t	ARI	-	Sp	
	0	uSec	1020	0		10000	0	uSec	1020	0	uSec	1020		0	us/ft	280
													Picks DIPA		Ss	
														- 0	uS/ft	280
															Sst	
													VFx	0	us/ft	280
260.0	Q	REFERENCE			Fluid Lev	el	5	Rent								لمحج
	5		100000						Nebali Mebali			e anna Year a				
280.0	Ş	NAMES OF T						}			}		And the second			



380.0						
420.0		Hole Bridged @ ~424.5' on June 10th. Relogged Sonic on June 13th. Long time window not collected				
440.0		on Repeat Sonic.				
460.0 480.0						
- 500 0		Version 8-3-08, RECC	N-14 Son	ic Analy		
					VFx Picks DIPA	Sst 280 0 us/ft 280 Ss 280 280
	RX1-1A - dt	RX1-2A - rtw	RX2-1A - dt	RX3-1A - dt	ARI	0 uS/ft 280 Sp
	0 uSec 1020	0 10000	0 uSec 1020	0 uSec 1020		0 us/ft 280
Depth	RX1-1A	RX1-2A	RX2-1A	RX3-1A	Caliper	Velocity Analysis
1in:20ft	-256 uSec 255	-256 uSec 255	-256 uSec 255	-256 uSec 255	4 6	0 us/ft 30
					I	

Sonic Analysis Summary Legend

Mnemonics and Comments

RX1-1A	= 2D plot of sonic waveform VDL log from receiver 1 (0.6m Rx-Tx spacing) plotted from 100 to 1100 in uSecs
RX1-1A-dt	= first arrival pick (P-wave) on receiver 1 (0.6m Rx-Tx spacing) plotted from 100 to 1100 in uSecs (thin blue line)
RX1-2A	= 2D plot of sonic waveform VDL log from receiver 1 (0.6m Rx-Tx spacing) second time window plotted from 1100 to 2100 in uSecs
RX1-2A-rtw	= reflected tube wave analysis log on receiver 1 (0.6m Rx-Tx spacing) plotted from 0 to 10000 (brown line)
RX2-1A	= 2D plot of sonic waveform VDL log from receiver 2 (0.8m Rx-Tx spacing) plotted from 100 to 1100 in uSecs
RX2-1A-dt	= first arrival pick (P-wave) on receiver 2 (0.8m Rx-Tx spacing) plotted from 100 to 1100 in uSecs (thin black line)
RX3-1A	= 2D plot of sonic waveform VDL log from receiver 3 (1.0m Rx-Tx spacing) plotted from 100 to 1100 in uSecs
RX3-1A-dt	= first arrival pick (P-wave) on receiver 3 (1.0m Rx-Tx spacing) plotted from 100 to 1100 in uSecs (thin black line)

- 3-Arm 3-arm mechanical caliper of hole diameter plotted from 2-12 inches (blue line)
- = Acoustic Reflectance Index or relative rock hardness from ABI Amplitude log. Plotted 0 (soft) to 1500 (harder) as green line. ARI
- VFxs = Near Vertical Fractures, highly fractured zones and Fanglomerate or Breccia zones
- = planar featues picked on optical or acoustic borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip Picks apparent hole axis

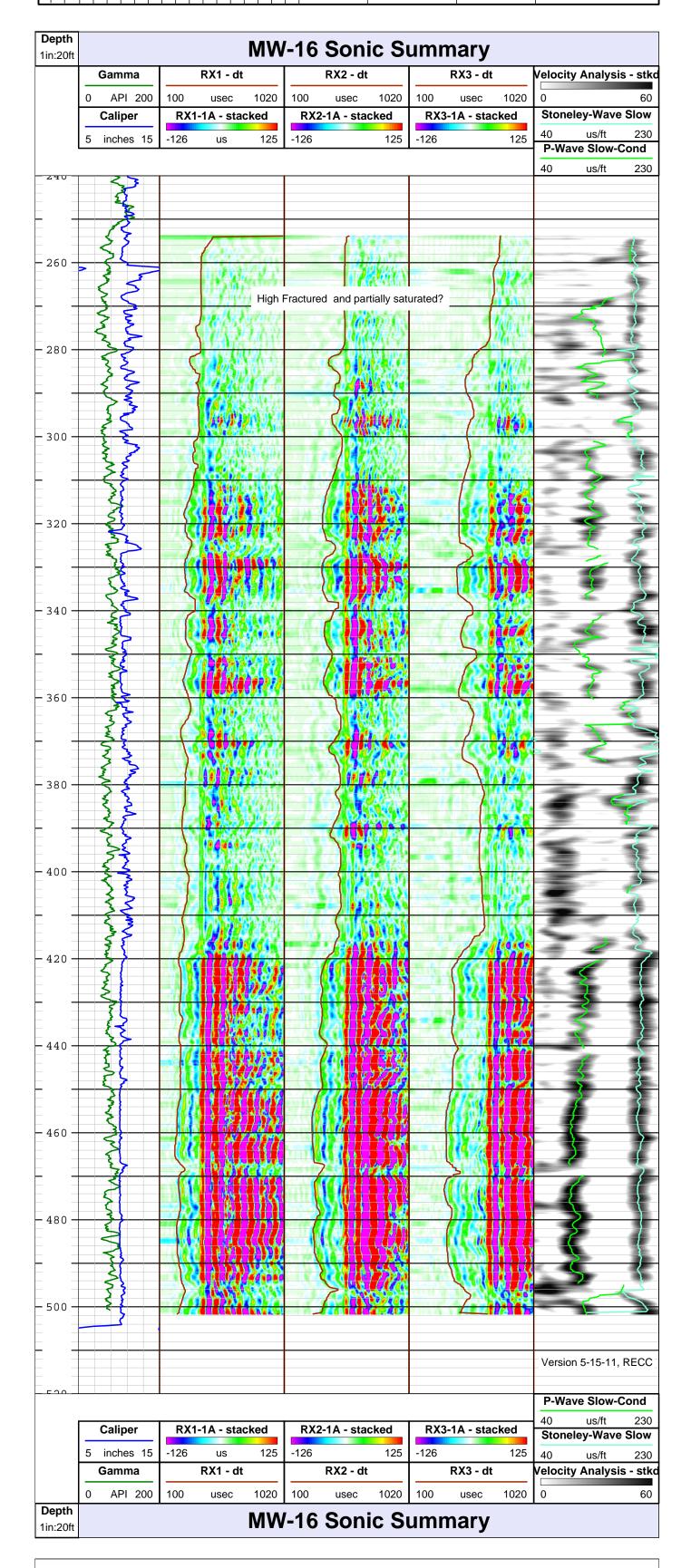
= gray scale variable density display of velocity semblence waveform; plotted from 0 to 280 uSec/ft. Velocity Analysis

- = apparent P-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft. (light blue line).
 - = apparent S-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft. (light green line).
- Sst = apparent Stonely-wave slowness from maximum energy peak on semblence velocity waveform in uSec/ft. (yellow line).

Prepared by Robert E. Crowder Rev 8-1-2008

Sp Ss

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							NTS:	COMMENTS:
				TOTAL DEPTH		20 FT	10"	2
	SURFACE	STEEL	12"	20 FT	ACE	SURFACE	15"	-
TO	FROM	WGT.	SIZE	TO		FROM	BIT	NO.
		RECORD	CASING RECORD		D	RECOR	BOREHOLE RECORD	RUN
7:00 AM	-	LOG TIME: ON SITE/OFF SITE	LOG TIM	MALCOLM PIRNIE C. LEGG	MALCOLN		SED BY	WITNESSED BY
ALT 50 MM SONIC - 3RX		RING/SN	TOOL STRING/SN	ELL	K. MITCHELL	ng Eng.	RECORDED BY / Logging Eng.	RECORD
TRUCK # 400		3 TRUCK	LOGGING TRUCK	ACKET	YELLOW JACKET		t/RIG#	DRILLER / RIG#
0.25		SAMPLE INTERVAL	SAMPLE		254 FT	AL	TOP LOGGED INTERVAL	TOP LOC
N/A		IMAGE ORIENTED TO:	IMAGE C		504 FT	'AL	BTM LOGGED INTERVAL	BTM LO
Deg C		C. TEMP.	MAX. REC. TEMP.		504 FT		,OGGER	DEPTH-LOGGER
254 FT		L	LEVEL		500 FT		ORILLER	DEPTH-DRILLER
N.A		ITY	DENSITY	NIC	50 MM SONIC		G	TYPE LOG
N/A		VITY	SALINITY		1			RUN No
FRESH WATER		TYPE FLUID IN HOLE	TYPE FLI		03-30-11			DATE
G.L.						М	DRILLING MEAS. FROM	DRILLIN
D.F.		TUM	ABOVE PERM. DATUM		GROUND LEVEL	GRO	LOG MEAS. FROM	LOG ME.
K.B.		Ň	ELEVATION	_			PERMANENT DATUM	PERMAN
		ĴΈ	RGE	TWP		SEC		
ABI-40 NEUTRON								
GUARD RESISTIVITY OBI-40					LOCATION	LOC		
E-LOGS-GAMMA-TEMP			PER	CALIPER	MORE:	Μ		
OTHER SERVICES		IC-3 RX	M SON	TYPE OF LOGS: 50 MM SONIC-3 RX	VPE OF I	T		
ARIZONA	STATE /	ST/		MARICOPA	COUNTY	CO		
				PHOENIX	FIELD	FIE		
				MW-16	WELL ID	WE		
			RNIE	MALCOLM PIRNIE	COMPANY	СО		
rices	serv	& video	/sics	horehole geophysics & video services	boreho			
tion	ora	Exploration LC		Southwest Services, I	Sou)	TTO	

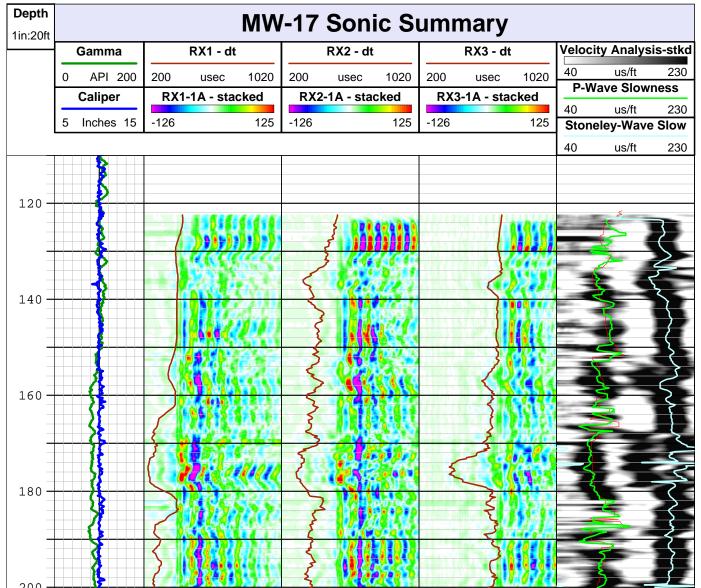


Full Waveform Sonic Summary Legend

Mnemonics and Comments

	amma ray log plotted from 0 to 200 API units (green line) achanical caliper of hole diameter plotted from 5-15 inches (blue line)
RX1-1A-stacked = col	lor variable density display of 0.6m Rx waveform; stacked over 5 waveforms and ed from 100 to 1020 uSec.
RX1 - dt = Manua	al P-wave travel time pick. Plotted 100 to 1020 uSec (brown line).
RX2-1A-stacked = col	lor variable density display of 0.8m Rx waveform; stacked over 5 waveforms and ed from 100 to 1020 uSec.
RX2 - dt = Manua	al P-wave travel time pick. Plotted 100 to 1020 uSec (brown line).
	lor variable density display of 1.0m Rx waveform; stacked over 5 waveforms and ed from 100 to 1020 uSec.
RX3 - dt = Manua	al P-wave travel time pick. Plotted 100 to 1020 uSec (brown line).
P-Wave Slowness =	 kd = gray scale variable density display of velocity semblence waveform of the stacked waveforms; plotted from 40 to 230 uSec/ft. apparent P-wave transit time or slowness from maximum energy peak on emblence velocity waveform in uSec/ft (green line).
Stoneley-Wave Slow	= apparent Stoneley-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft. (light blue line).
Prepared by Robert E. Cr Ver 6-15-11	rowder

							NTS:	COMMENTS:
				TOTAL DEPTH		20 FT	10"	2
	SURFACE	STEEL	12"	20 FT	ACE	SURFACE	15"	1
TO	FROM	WGT.	SIZE	TO		FROM	BIT	NO.
		RECORD	CASING RECORD		D	RECOR	BOREHOLE RECORD	RUN
7:00 AM	_	LOG TIME: ON SITE/OFF SITE	LOG TIM	MALCOLM PIRNIE: C. LEGG	MALCOLM		SED BY	WITNESSED BY
ALT 50 MM SONIC - 3RX	+	RING/SN	TOOL STRING/SN	ILL	K. MITCHELL	ng Eng.	RECORDED BY / Logging Eng.	RECORD
TRUCK # 400	Г	TRUCK	LOGGING TRUCK	ACKET	YELLOW JACKET		₹/RIG#	DRILLER / RIG#
0.25	0	SAMPLE INTERVAL	SAMPLE		150 FT	AL	TOP LOGGED INTERVAL	TOP LOC
N/A	7	IMAGE ORIENTED TO:	IMAGE O		220 FT	'AL	BTM LOGGED INTERVAL	BTM LO
Deg C		C. TEMP.	MAX. REC. TEMP.		223 FT		,OGGER	DEPTH-LOGGER
150 FT	1		LEVEL		228 FT		ORILLER	DEPTH-DRILLER
N.A	7	TY	DENSITY	VIC	50 MM SONIC		Ğ	TYPE LOG
N/A	7	ITY	SALINITY		1			RUN No
FRESH WATER	Ŧ	TYPE FLUID IN HOLE	TYPE FLU		04-02-11			DATE
G.L.						Μ	DRILLING MEAS. FROM	DRILLIN
D.F.	I	IUM	ABOVE PERM. DATUM		GROUND LEVEL	GRO	LOG MEAS. FROM	LOG ME.
K.B.	K	Z	ELEVATION	_			PERMANENT DATUM	PERMAN
		Ĥ	RGE	TWP		SEC		
GUARD RESISTIVITY OBI-40 NEUTRON	700				LOCATION	LOC		
3-ARM CALIPER E-LOGS-GAMMA-TEMP	πω		PER	CALIPER	MORE:	Μ		
OTHER SERVICES	20	[C-3 RX	M SONI	TYPE OF LOGS: 50 MM SONIC-3 RX	PE OF I	T		
ARIZONA	STATE A	ST/		MARICOPA	COUNTY	СО		
				PHOENIX	FIELD	FIE		
				MW-17	WELL ID	WE		
			RNIE	MALCOLM PIRNIE	COMPANY	СО		
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ices	servi	& video	/sics à	borehole geophysics & video services	boreho			
tion	orat	Exploration LC	- L L L	Southwest Ex Services, LLC	Sou	J	TIN	
)			



200		Same A	2							S				
220 -			>			~	0.27			2				Ş
- 240 -													n 6-15-11,	
ſ		Caliper	RX	1-1A - sta	cked	RX2	2-1A - sta	cked	RX3	-1A - sta	cked	40	eley-Wave	230
	5	Inches 15	-126		125	-126		125	-126		125	P-W 40	ave Slow us/ft	230
		Gamma		RX1 - dt	1		RX2 - dt			RX3 - dt			ty Analys	
Denth	0	API 200	200	usec	1020	200	usec	1020	200	usec	1020	40	us/ft	230
Depth 1in:20ft					MW	-17	Son	ic S	umr	nary				

Full Waveform Sonic Summary Legend Mnemonics and Comments

Gamma	= natural gamma ray log plotted from 0 to 200 API units (green line)
Caliper	= 3-arm mechanical caliper of hole diameter plotted from 5-15 inches (blue line)
Camper	
RX1-1A-sta	
KAI-IA-Sta	acked = color variable density display of 0.6m Rx waveform; stacked over 5 waveforms and plotted from 100 to 1020 uSec.
RX1 - dt	= Manual P-wave travel time pick. Plotted 100 to 1020 uSec (brown line).
RX2-1A-sta	acked = color variable density display of 0.8m Rx waveform; stacked over 5 waveforms and
	plotted from 100 to 1020 uSec.
RX2 - dt	= Manual P-wave travel time pick. Plotted 100 to 1020 uSec (brown line).
RX3-1A-sta	
	plotted from 100 to 1020 uSec.
RX3 - dt	= Manual P-wave travel time pick. Plotted 100 to 1020 uSec (brown line).
Velocity A	nalysis stkd = gray scale variable density display of velocity semblence waveform of the
	stacked waveforms; plotted from 40 to 230 uSec/ft.
P-Wave Slo	
	semblence velocity waveform in uSec/ft (green line).
Stopolov M	Novo Slow
Stoneley-V	Vave Slow = apparent Stoneley-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft. (light blue line).
	semblence velocity waveform in usec/n. (light blue line).
Prepared by	v Robert E. Crowder
Ver 6-15-11	
V G I U - I U - I I	