

drill hole: MGS-5
MDDP-5
angle & Direction: _____

Grid Name: So. of CHISHOLM

Location: NEAR CENTER OF 36^{SEC} T58N-R20W
513782E, 5256118N (NAD27 UTM)

Page 1 Of 7
Logged by: MS. SUTHERLAND
Date: 7-1-99

footage			rock type and description	%	%	%	FT	BDD	CLEAN	CLEAN	fractures/ ETC.	alteration/ comments
From	to	ft										
0	152		OVERBURDEN					TO CORE AXIS				
152	162		CRETACEOUS:									
			152-154 WHITE KAOLINITE-RICH CLAY w/ 30% RND BROWN									
			GRAINS (<1mm, AL-RICH?) + w/ OCCASSIONAL KAOLINITE									
			CLASTS + VESICULAR CLASTS (12 w/in TOP 1')									
			154-156 ↓ MIXED									
			156-162 MOD-DARK GRAY CLAYED MUDSTONE/SHALE (MORE									
			INDURATED (w/ PRESERVED BDD) WITH DEPTH									
162	483		VIRGINIA FM. (162-205)									
			162-205 (↑ WEATHERED) MOD-DARK GRAY BLACK MUDSTONE/SHALE w/ INTBS					70-80°				THE SILTSTONES ARE PROBABLY BOUMA D'S
			(< 2 cm) OF LIGHT GRAY SLTST. - w/ SHARP TO									
			GRADATIONAL CONTACTS INTO THE MUDSTONE = DISTAL									
			205-242 MOSTLY MOD GRAY MUDSTONE w/ BLACK MUDSTONE ±					80°				
			LIGHT GRAY SLTST. DISTAL AS ABOVE									
			242-259 MOSTLY DK GRAY MUDSTONE w/ LIGHTER GRAY MUDSTONE ± SLTST INTBS									
			@250 6" DOLOMITE BED (XTALLINE, SLIGHT HCL REACTION)									
			259-269 AS AT 205-242									
			269-282 INTERBEDDED SILTSTONES (AND MOD-DK GRAY MUDSTONES									SLTSTN = BOUMA C+D
			SLTSTNS SHOW: GENTLY UNDULATING SHARP BASES, X-BDD, LENSES w/ X-BDD, + LOCAL									
			CONVOLUTIONS (BOUMA C) + SOFT-SEA SLUMP FEATURES INTO THE MUDSTONE									
			INDIVIDUAL BEDS GENERALLY <1"					~80°				
			@279 ~8" LIMESTONE (XTALLINE, STRONG HCL FIZZ)									
			282-483 INTBSD MOD-DK-GRAY MUDSTONE + LIGHT GRAY SLTSTN (BOUMA D?)									w/ BOUMA D
			@302 ~4" LIMESTONE BED									
			@336 ~5" BED w/ X-BEDS (BOUMA C)									
			@349-350 w/ THIN BOUMA C BEDS									
			@362-363 MOSTLY BOUMA C BEDS (CONVOLUTIONS / CRUDLY X-BDD)									
			@371-382 MOSTLY DK GRAY MUDSTONES									
			@401 6" LIMESTONE									ABRAJANO SAMPLES (LISTED INTERMEDIATE ARE INCORRECT ↑ USDA BOX PROBLEM)
			@405 5" "									
			@421-483 w/ SIGNIFICANT 1-2.5' MUDSTN PACKAGES									
			@431 3" LIMESTONE									

@ 482.5-482.8 w/
THIN BOUMA C
INTBS.

@ 440-440.8 "

@ 441-451

→ SOME OF THE SLTSTNS ARE CALCAREOUS

@ 451-462 MOSTLY DK GRAY MUDSTN

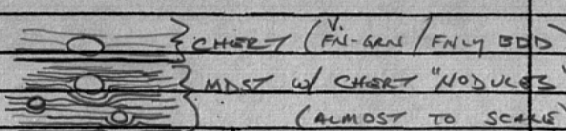
drill hole: MGS-5

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footage						%	%	%		BDD	CLEAV	CLEAV	fractures/	alteration/
From	to	ft	rec	rock type and description			graph	sulf.	FT	S ₀	S ₁	S ₂	ETC.	comments
483	495			LENS OF BIWABIK IF (SUBMEMBER A)										
			SPLIT	A 483-492 STRONGLY MAGNETIC, LIGHT TO MOD GRAY (± BROWNISH/RODDISH BANDS/ZONES) GRANULAR CHERT.										MAGNETIC
				@ 483.5 ~ 2x3 cm blocky pale pink/purple jasper clast										
				@ 485-490.5 w/ pale pink to red rnd "rip-up" clasts (<1.2 cm) +/or thin wavy/lenticular reddish jaspery beds										
				@ ~ 487-488 1/2 with internally thin-bedded magnetite-rich zones up to 3" thick										
			-	A = 492-495 white-lt-gray-mod gray limestone w/ one chert bed (thin @ 493' (3"))										
495	519 1/2		-	LENS OF VIRGINIA FM: 495-504 1/2 → = INTBEDD MOD-DK GRAY MUDSTONE, LT-GRAY SILTSTONE (BOUMA B), CALCAREOUS SILTSTONE AND FIN-GRN LIMESTONE @ 498.5-499.5										
			SPLIT	504 1/2-508 THINLY INTBEDD LIMESTONE, CALCAREOUS SILT + MINOR DARK MUDSTONE										NOT MAGNETIC
				508-519 1/2 INTBEDD LIGHT-DARK MUDSTONE + LIGHTER GRAY COLORED NON-MODERATELY CALCAREOUS SILTSTONE										NOT MAGNETIC
			/	BIWABIK IF @ 518-519 1/2 THE SILTST INTDS ARE MORE COMMON + MORE CALCAREOUS (MOD-STRONG HCL FRZ) - ALSO w/ PYRITE CUBES										
519 1/2	520		"	A MOD-GRN XTALLING LIMESTONE w/ UP TO 20% PYRITE IN <1.5 cm BEDS IN TOP 2"										
520	520.3		"	INTBEDD CHERT + MUDSTONE; SOME MDSTN BEDS CONTAIN RND CHERT "NODULES"; BDD BEDS AROUND THEM										
				 CHERT (FIN-GRN/FINLY BDD) MUDST w/ CHERT "NODULES" (ALMOST TO SCALE)										
520.3	521.8		"	A WHITE (BLACK ON BREAKAGE) FIN-GRN GRANULAR CHERT w/ RND CHERT "NODULES" (AS ABOVE) IN TOP FEW INCHES										
521.8	535.5		"	C THIN-BEDD LT-MOD GRAY TO CREAM COLORED, NON-MAGNETIC, w/ RARE CHERT BEDS Fe-CARB. IRON-FM: PROBABLY C SUBMEMBER										
				@ 521.8-~525 SOMEWHAT "LIGHTWEIGHT"/POROUS, LEACHED/WEATHERED ZONE w/ A ~1" BULL QTZ VEIN (ROUNDED CORE PIECE)										
				@ 531-535 1/2 LOCALLY CALCAREOUS										
535 1/2	538		"	C CONGLOMERATIC CHERT = SUBROUNDED-BLOCKY-LENTICULAR <2 mm (BUT LOCALLY UP TO 5 mm) CHERT FRAGS + MINOR JASPER FRAGS IN A CHERTY ± CALCITE ± SIDERITE MATRIX. LENTICULAR FRAGS ARE SUBPARALLEL BUT DO NOT APPEAR IMBRICATED										MOD. MAGNETIC
				LAST 4" = CLASTS ARE BIG (UP TO 1x1 cm BLOCKY + 1x3 cm LENSE) + MATRIX IS MORE SIDERITIC										
538	540		"	C THIN-BEDD ARGILLACEOUS IF (MOD MAGNETIC IN TOP 1") w/ MINOR IRREGULAR/UNDULATING GRANULAR CHERT BANDS (<2" THICK)										MOD-↓ NON-MAGNETIC
				THIS UNIT APPEARS TO CONTAIN GRAPHITE										
540	545		"	GRANULAR CHERT (WHITE/BLACK ON BREAKAGE) w/ LENSES/LENTICULAR CLASTS OF BROWN SIDERITIC CHERT.										MAGNETIC
				INTBEDD w/ <20% GRAPHITE-BRG. ARGILLACEOUS BEDS.										

CONGLOMERATIC @ 544-545 w/ LENTICULAR CHERT FRAGMENTS (AS AT 535 1/2-538) THAT INCREASE IN GRAIN SIZE WITH DEPTH, REACH MAXIMUM SIZE (UP TO 1x1/2 cm) BY 544 1/2 THEN DECREASE IN SIZE DOWN HOLE.

Upper Silty BDD

drill hole: MGS-5

Grid Name: _____

angle & Direction: _____

Location: _____

561-562 1/2 (w/ MGT BAND),
563 1/2 - 564,Page 3 Of 7Logged by: MJSDate: 7-1-99/7-28-99

footage					%	%	%		BDD	CLEAV	CLEAV	fractures/	alteration/
From	to	ft	rec	rock type and description		graph	sulf.	FT	S ₀	S ₁	S ₂	ETC.	comments
545	564		SPLIT	INTERBEDDED: 1) GRANULAR TO CONGLOMERATIC CHERT (AS DESCRIBED ABOVE) AT: 546-547, 550-552 (CONGL w/ JACAR + MGT CLASTS), 554 1/2 - 555 1/2 + 2) THIN-BEDDED GRAPHITE-BEARING ARGILLACEOUS/SIDERITE IF AT: 545-546, 547-550 (w/ CHERT @ 548 1/2 - 3"), 552-554 1/2 (w/ SEVERAL THIN GRAN. CHERT BEDS (<1")), 555 1/2 - 561 (MORE GREENISH ANKALITE +/- SIDERITE) w/ SEVERAL WIDELY-SPACED CHERT BEDS UP TO 3" THICK SCATTERED THRU-OUT, 562 1/2 - 563 1/2								MAGNETIC, NON-WKLY MAGNETIC	
564	589		"	MOSTLY GREENISH (SILICATES) GRANULAR CHERT (VARIABLY MAGNETIC; NON TO STRONG) w/ THIN-BDD SIDERITE ZONES; PROBABLY WAVY BEDDING OVERALL, WITH BROWNISH Fe-CARBONATE MOTTLES STARTING AT 574. LOCALLY CONTAINS: 1) GRAPHITE ON BDD PLANES 2) LENTICULAR "RIP-UP" CLASTS 3) SMALL SCALE WAVY BDD SIDERITE-RICH BANDS 4) MGT-RICH BANDS WITH DIFFUSE TO SHARP BOUNDARIES, ALSO IRREG/BIFURCATING LENSES.									
589	601		"	WHITE TO GREEN GRANULAR CHERT w/ MGT-RICH BEDS (BOTH w/ CHERT GRANULES +/- OR THIN DISK-LIKE CHERT "LENSES") + COMMON THIN-BDD Hem-Fe-CARB BEDDED SETS UP TO 6" THICK STRONGLY MAG. ← WK TO MOD. MAGNETIC									SHOW SOME SOFT-SID FOLDS DUE TO COMPACTION + SOME CRUDE IMBECATION.
601	613		"	THIN TO MOD. THIN-BDD RED-BROWN ± WHITE FN-GRN GRANULAR CHERTY TACONITE w/ COMMON THIN (<1mm) REDDISH HEMATITIC BEDS. MOD - STRONGLY MAGNETIC @ 605 2 1/2" PIECES w/ X-BEDS @ 606 1/2 - 610 LOCALLY WEATHERED/LEACHED w/ POROUS-VUGGY BEDS									
613	616		"	DARK COLORED GRANULAR CHERT ± FINE GRAINED CHERTY (RED) BEDS + LENSES. @ 614 - 615 GOOD RND GRANULES UP TO 1.5 X .7 MM = CONGLOMERITIC ZONE.									
616	622		"	INTERBEDDED: BEN MGT-SIDERITE BEDS (INTERNALLY THIN BDD <3mm + LOCALLY LENTICULAR AND BENT); SETS ARE 1/2 - 4" THICK + GRANULAR (FN-MED) BLACK CHERT (WHITS ON DRILLED FACE); INTERNALLY = THICK BDD; SETS ARE 2" - 12" "									BOTH OR MOD - STRONG MAGNETIC
622	638		"	AS ABOVE BUT: CHERT IS DOMINANT (70%) + THE GRANULAR CHERT BEDS CONTAIN GOOD RND GRANULES UP TO 2mm ACROSS (LOCALLY LENSIFORM CLAST UP TO 2.5 X 1 cm) AND SOME BIFURCATED/SUMPT/BENT/PINCH OUT FN-GRN CHERTY BEDS @ 633.5 - 634 CONGLOMERITIC w/ CLASTS OF ALL SHAPES, SIZES + LITHOLOGIES (CHERTS, MGT) @ 634 - 638 WAVY BDD									
638	655		"	THIN BDD (<1cm) RED-BRN Hem-Fe-CARB-MGT TACONITE w/ SCATTERED GRANULAR CHERT BEDS UP TO 6" THICK @ 644 1/2 - 650 MOSTLY GRAN CHERT @ 650 - 655 MOSTLY THIN-BDD ARGILLACEOUS TACONITE									WK-MOD MAG.
655	656 1/2		"	I = GRANULAR CHERT w/ ALGAL MATS (± RHODOSPIRITS?) @ 656 - 656.3. NO CONES BUT AS THIN BDD LAGGS MATS (MJS SAW AS AT GLACIER NAIL PARK)									

UPPER
SLATYUC
16.

G?

H?

UC-
S/I

drill hole: MGS-5Grid Name: MESABIDEEP DRILLING PROJECTPage 4 Of 7angle & Direction: ALSO MDDP-5VERTICAL

Location: _____

Logged by: MJSDate: 7-28-99

footage				rock type and description	%	%	%	FT	BDD S ₀	CLEAV S ₁	CLEAV S ₂	fractures/ ETC.	alteration/ comments
From	to	ft	rec										
656	657		SPLIT	THIN-BDD, WK-MOD MAGNETIC ARGILLACEOUS TACONITE ± CHL	ALONG	SOME	BDD	PLANES					
657	657.3		"	JASPER GRANULITE IN GRANULAR CHERT									
657	662		"	THIN-BDD (REGULAR ± WEAKLY WAVY) RED-BRN TO GREEN TO BLACK									WK-MOD MAG
				ARGILLACEOUS IF w/ MINOR GRANULAR CHERT BEDS UP TO 6" THICK									
				@ 662-664 MOSTLY " ± SLATY BEDS + Fe-CARB BEDS									
				@ 664- THIN BDD STUFF'S COLOR IS MORE GREENISH (ALSO MORE MAGNETIC)									MOD-STRONG MAG.
				+ SLIGHTLY UNDULATING BEDS ARE MORE COMMON.									
682	686		"	GRANULAR CHERT w/ JASPERY GRANULE ZONES ± ALGAL MATS @ 682--683									
				DOES NOT AGREE w/ MOREY'S LOG, WHICH SAYS THIS HORIZON IS AT 691.0-692.5'... COULD THIS BOX HAVE BEEN DROPPED? OR CORE PUT IN UPSIDE DOWN???									
686	690		"	GRANULAR CHERT w/ THIN REDDISH-BRN SLATY TACONITE SETS (INTERNALLY THIN BDD) UP TO 6". WAVY BDD OVERALL?									
690	697		"	THIN-BDD REDDISH BROWN + GREEN ARGILLACEOUS TACONITE									
				w/ CHL ALONG BDD ± SCATTERED GRANULAR CHERT BEDS UP TO 3"									
				@ 694 1/2-695 1/2 MOSTLY GRANULAR CHERT									
697	697 3/4			@ 697 3" JASPERY BEDS-POSSIBLE ALGAL MATS									
697	698 1/2		1/4	SCRAMBLED? @ 697.3-698.2 CHLORITIC (SLICKENSIDED) ± GRAPHITE? w/									
				JASPERY GRANULE CHERT @ 3 HORIZONS (SCRAMBLED?)									
698	701 1/2		1/4	@ 698.2-701 1/2 THIN-BDD (<2") MIX OF GRAY GRAN CHERT (<2"), RED JASPER (<1cm), OOLITIC JASPER (<2"), BRN CARB (<1/2"), HORN +/OR MGT									
				BEDS (<1cm) + GRAY ARGILLACEOUS BEDS (<1cm)									
701 1/2	737			REG-BDD GRAN/OOLITIC WHITE CHERT (1/2-4") w/ COMMON THIN TO REG BDD BRN CARB BEDS ± MGT-RICH BEDS									ALSO w/ INTRAFORM. CONGL-702 1/2, 717-719 1/2,
				THAT ARE GENERALLY ASSOC. w/ THE BRN BEDS									
				@ 721-724 D 90% - BRN CARB. BEDS (THIN-REG-LENTICULAR) w/ IRREG CHERT BANDS (SOFT SED DEFORMED)									
				@ 724-737 60-70% - " " " (" " ") " " (OOLITIC) " " " " "									
				@ 732 3" ZONE w/ JASPER FRAGS + OOLITES									
				@ 736-737 " " " " " " "									
737	745 1/2			REG-BDD GRAN/OOLITIC WHITE CHERT (6-11") w/ CARB ± MGT BEDS THAT ARE THIN-REG-LENTICULAR-IRREG-WAVY									
745 1/2	759			THIN-REG BDD RED-BRN CARBONATE BEDS (LOCALLY IRREG-LENTICULAR)									
				w/ DARK MGT-BEARING BEDS + GRANULAR CHERT BEDS (<3") w/ SCATT INTRAFORM CONGL									
759	815			REG-THIN BDD GRAN CHERT w/ COMMON INTRAFORM CONGL. MIXED WITH 2"-12" ZONES OF THIN BEDDED HEMATITIC (RED) + MAGNETITE-BRN (BLACK) BEDS									
				± JASP ± BRN CARBONATE BEDS CHERT IS ALSO OOLITIC LOCALLY w/ GRAN. MGT. IRREG-LENTICULAR BEDS SCATTERED THRU-OUT									
				@ 778-803 RED JASPERY BEDS COMMON!									
				@ 803-815 w/ GREEN THIN-BDD Fe-SILICATE BEDS									
				↓ GRAD!									

UC-15?
I?

UC-14

0-22-00
NO
MAGNET
OR
HAND
LENSE.

drill hole: MGS-5

Grid Name: _____

angle & Direction: _____

Location: _____

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NO MAGNET OR HAND LENSE!

footage				rock type and description	BDD TYPE	BDD THICKNESS	BDD \angle (to C.A.)	COLOR	OXIDES	MAGNETISM	ALT	TEXTURES	comments
From	to	ft	UNIT										
815	833		LS	THIN-BDD (<1 cm) BRN-GREEN SLATY IF BUT WITH COMMON GRANULAR CHERT BEDS (\pm INTERFORM CONGL.) UP TO 4" THICK \rightarrow @ 828-833 <30% CHERT	THIN	<1 cm	80	BRN-GRN WHITE CHERT					
833	864		LS	THIN-BDD BRN TO DARK GREEN CARB-SIL SLATY IF w/ MINOR CHERT BEDS (<1") @ 854 1/2 - 855 CHALCEDONIC CHERT (V. FN) @ 857 1/2 - 861 CHERT BEDS ARE COMMON \downarrow GRAD	THIN	<1 cm	80						
864	885		LS	THIN-BDD BRN-GRN CARB-SIL SLATY IF w/ MINOR INTSDDS OF DARK-GRAY TO BLACK SLATE + RARE CHERT BEDS	THIN			GRN + BRN \pm BLACK					
885	887 1/2		LS	THIN-BDD BLACK SLATE = INTERMEDIATE SLATE	THIN			BLACK					
887 1/2	925		LS	" " BRN-GRN CARB-SIL SLATY IF INTIMATELY INTSDD w/ BLACK SLATE @ 913-913 1/2 w/ K-BEDS... (OR SOFT-SUD DEFORMED BEDS?) @ 915-925 BLACK SLATE	"			BRN + GRN					
925	947		LS	THIN-BDD BRN TO GRN CARB-SIL SLATY IF w/ MINOR "CHERTY" BEDS @ 934-942 INTSDD w/ BLACK SLATE (<10%) @ 947 2" THIN-BDD CHALCEDONIC CHERT @ 943-945 w/ GRAPH-RICH BEDS (<2%) UP TO 3 mm THICK									
947	996		LC-S	GRANULAR MED-BDD CHERT w/ FE-CARB RICH BEDS (THIN TO MED) W/ WAXY-BD SETS UP TO 2" THICK + IRREG. PATCHES + IRREG. "STAINERS", LOCAL INTERFORM. CONGL. IN BOTH GRAN. CHERT + FE-CARB BEDS. @ 949-964 ANTHRACOLITE (OBSIDIAN-LIKE CARBON) IN IRREG. VEINS (<7 mm: BOTH SEMI-CONFORM. + CONFORMABLE), IRREG. PATCHES + DISSEM IN ALT. PATCHES = REMOBLIZED @ 969-994 ANTHRACOLITE (AS ABOVE) BUT LESS COMMON + MORE WIDELY DISPURSED. @ 975-996 w/ FE-CARB MOTTLES WKLY MAGNETIC ZONES IN LAST 2'.	MED					NIL			6/3/04 \downarrow

LOWER SLATY

drill hole: MGS-5

Grid Name: _____

angle & Direction: _____

Location: _____

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footage				rock type and description	BDD	BDD	BDD <	COLOR	OXIDES	MAGN-	ALT	TEXTURES	comments
From	to	ft	UNIT		TYPE	THICKNESS	(to C.A.)			ETISM			
1189	1197 1/2		LC-1A	GRANULE CHERT - JASPER UNIT w/ DIFFUSE STEEL GRAY MAG/HEM ZONES ± THIN-BDD BRN HEM-MGT-Fe CARB SETS SCATTERED THRU-OUT. @1195 1/2 = 3" ZONE w/ ALGAL STROMATOLITES. @1196-1197 FM-GRN GRANULAR HEMATITE w/ V. FN HEM-RICH BEDS + THIN RED CHALCEDONIC JASPER BEDS. ↓ GRAD	MOD					W/LK-(STRONG)			
1197	1209			FINE-GRAINED Fe-CARB. GRANULES IN A CHLORITIC MATRIX = Fe-CARB MUDSTONES. CONTAINS HEMATITIC INT BEDS (V. THIN) IN TOP 1'. CONTAINS WIDELY SCATTERED THIN GRANULAR TO CHALCEDONIC CHERT BEDS. SOME BDD PLANES LOOK GRAPHITIC (OR IS IT JUST CHLORITE?) RARE RED JASPER GRANULES SEEN ONCE IN A WHILE. @1208-1209 MAY CONTAIN V. FN GRN RNDSD QTZ GRAINS?? @1209 1" CHALCEDONIC GRAY CHERT w/FINE-BINDING = STROMATOLITES	MASS								MOD. CALCAREOUS
1209	1213			BROWN MOTTLED ROCK CONSISTING OF MED+GRN BRN Fe-CARBONATE GRANULES IN A WHITISH CHALCEDONIC MATRIX. @1212 1/2-1213 ALSO CONTAINS RND DETRITAL QTZ GRAINS									MOD. CALCAREOUS
1213	1214 1/2		LC-1A	WHITISH CHALCEDONIC CHERT (BRECCIATED + HEALED) w/ FAINT V. FN BINDING = STROMATOLITE MATS?									
1214 1/2	1252			POKEGAMA FM = MASS-BDD, FM-GRN SS = RND DETRITAL QTZ GRAINS ± CHL GRAINS. @1215-1215 1/2 w/ 1/2 CLASTS OF Fe-CARB IF ± QTZITE + CHL CLASTS (<2x0.7 cm) @1224-1228 REG-BDD w/ COMMON CHLORITIC MUDSTONES "RIP-UP" CLASTS. @1228-1238 MICACEOUS MUDSTONES @1238-1252 AS AT 1214 1/2-1224 w/ SCATT. CHLORITIC MUDSTONE RIP-UPS	THICK REG THIN REG								

FOH = 1252

EOH=1252