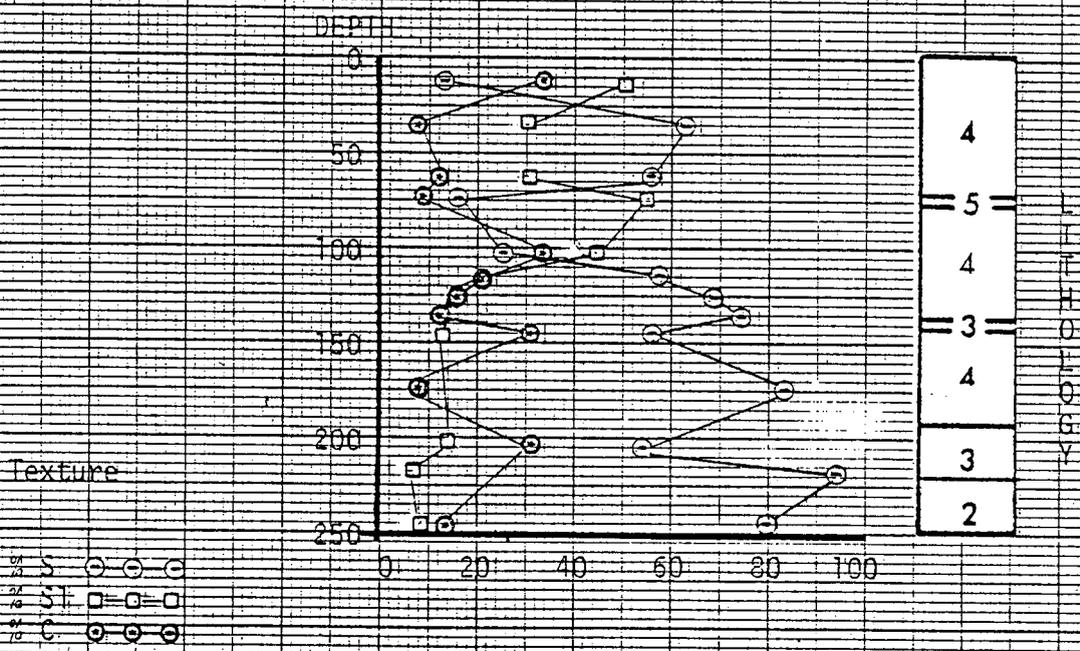
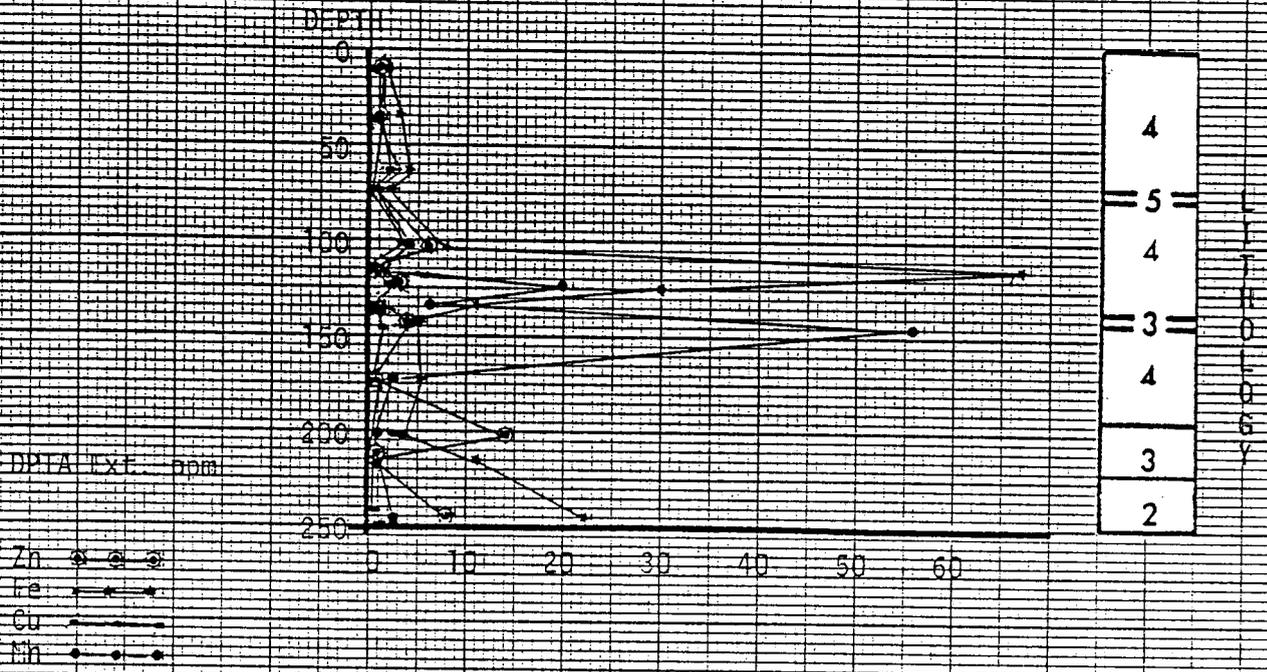
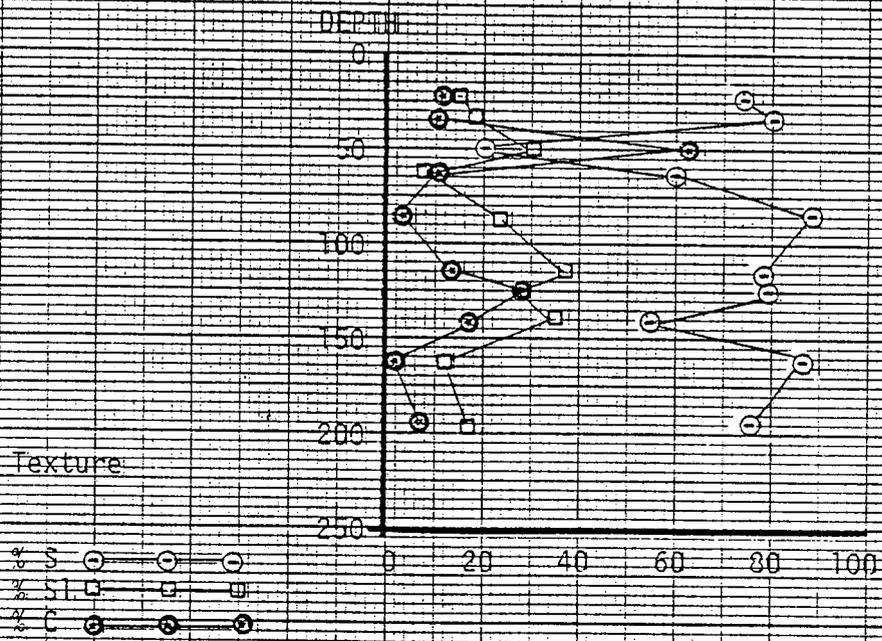
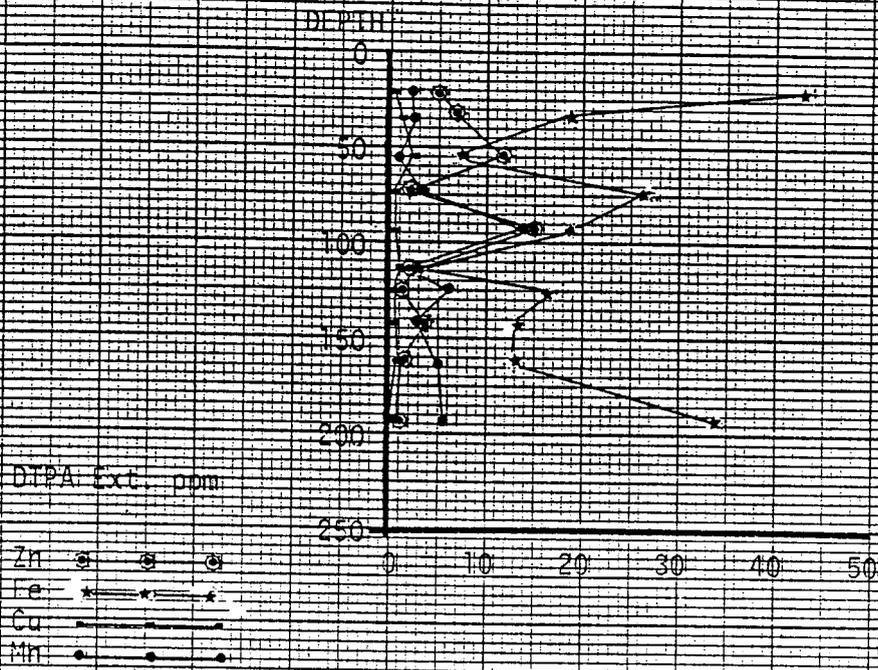


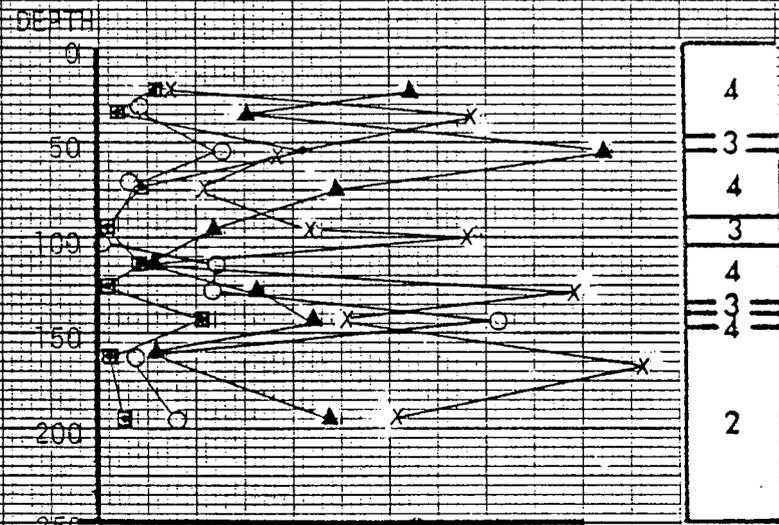
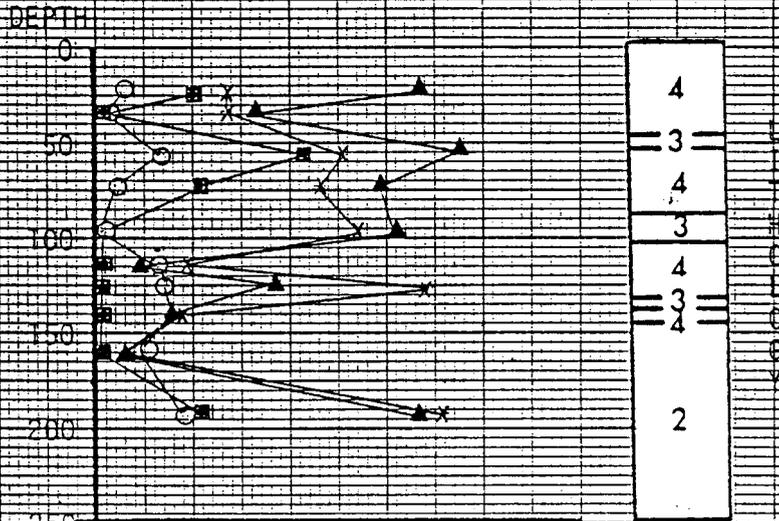
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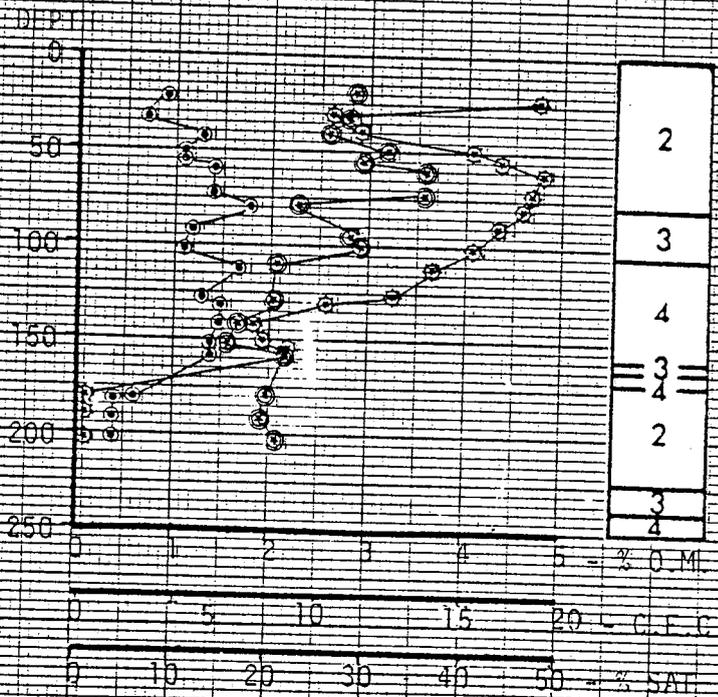
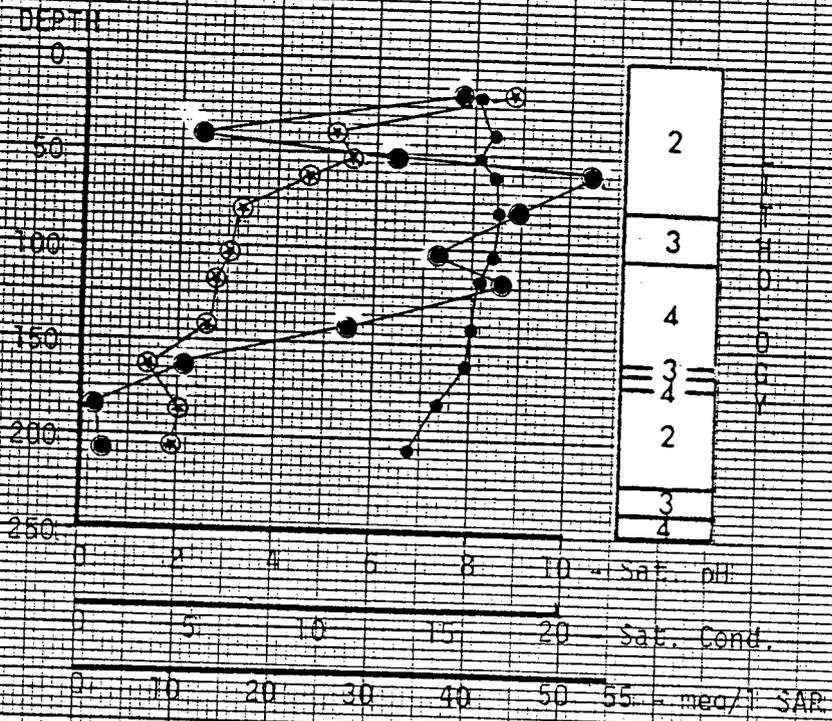
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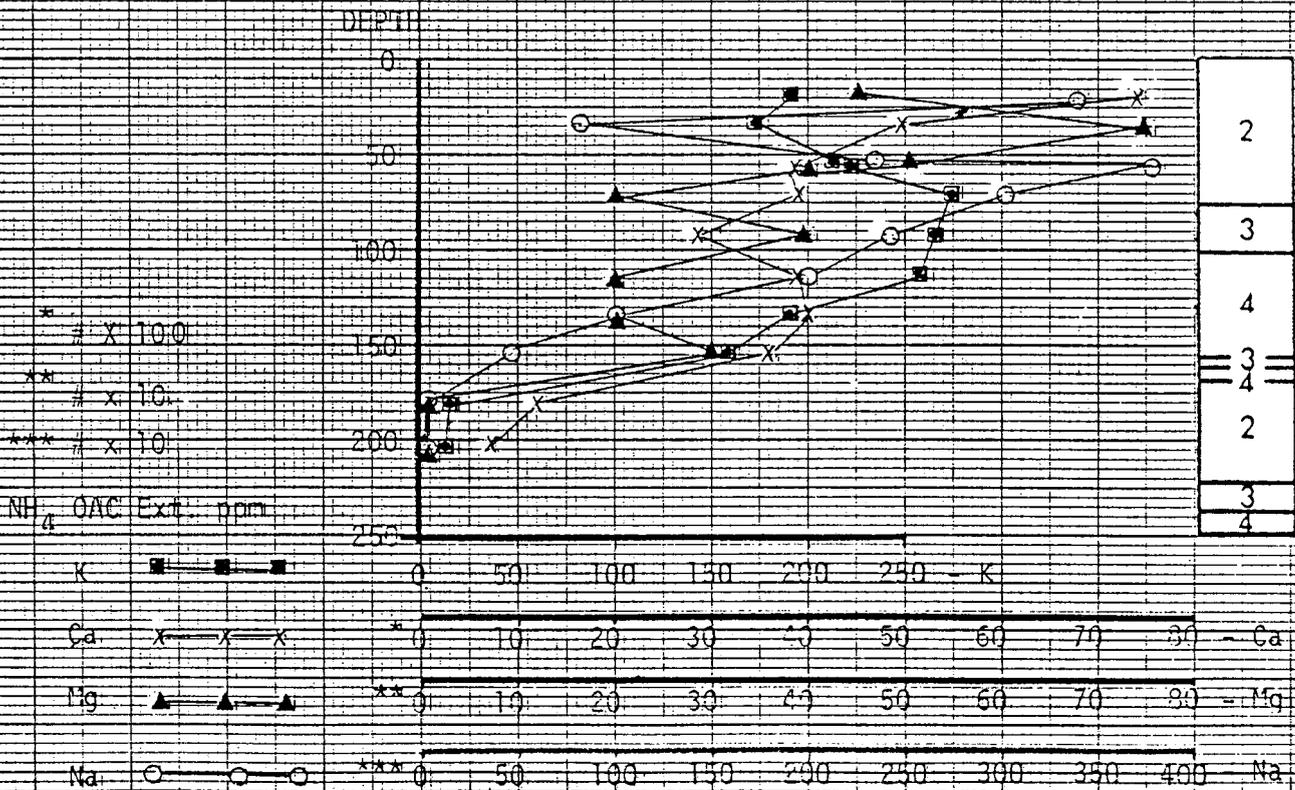
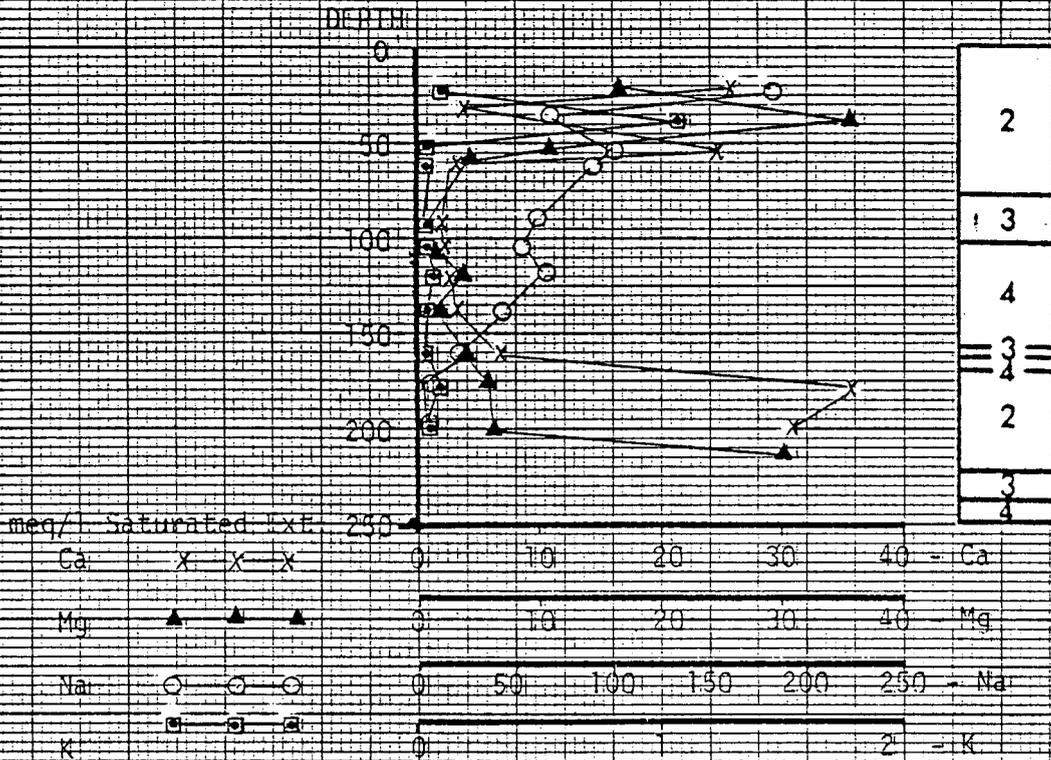
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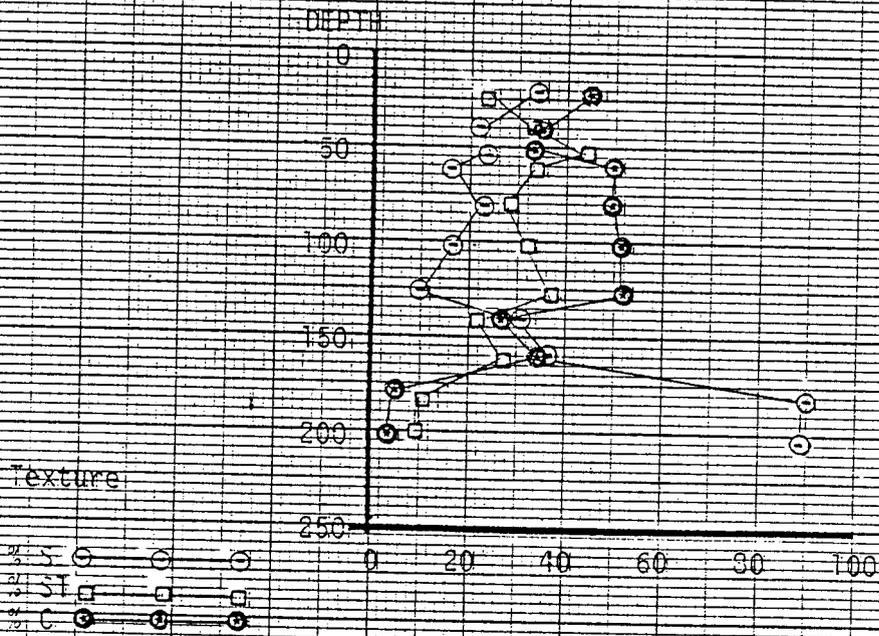
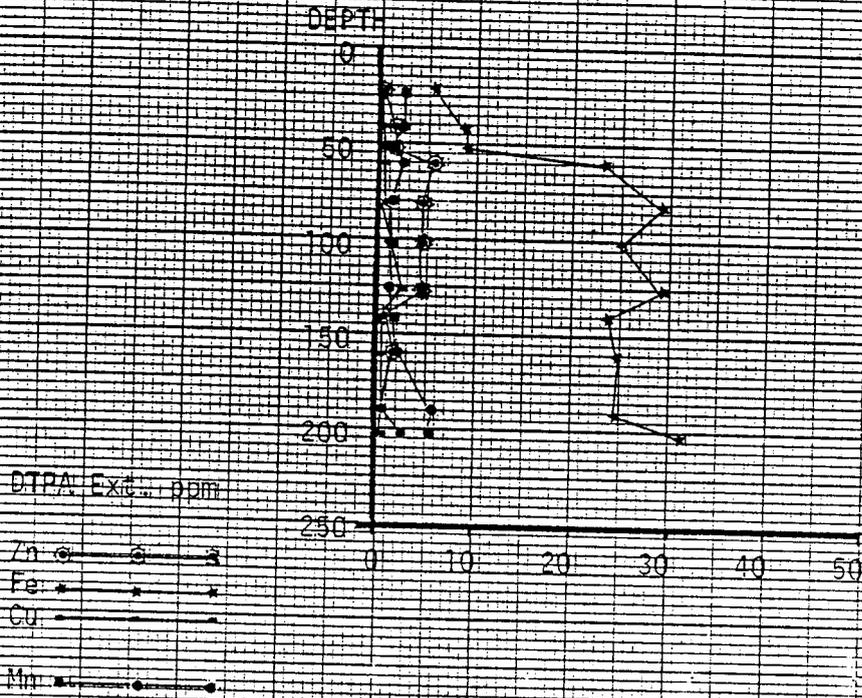
BORE HOLE #3



BORG HOLE #31



BORE HOLE #3



APPENDIX 8

Water Quality Analysis (USGS, Denver)

ALK, TOT (AS CaCO3)	MG/L	410	POTASSIUM DISS	MG/L	6.3
BICARBONATE	MG/L	500	RESIDUE DIS CALC SUM	MG/L	1140
BORON DISSOLVED	UG/L	480	RESIDUE DIS TON/AFT		1.55
BROMIDE	MG/L	0.1	SAR		8.1
CALCIUM DISS	MG/L	44	SILICA DISSOLVED	MG/L	12
CHLORIDE DISS	MG/L	28	SODIUM DISS	MG/L	300
DEPTH (FT. FR. SURFACE)		7.7	SODIUM PERCENT		71
HARDNESS NONCARB	MG/L	0	SP. CONDUCTANCE FLD		1700
HARDNESS TOTAL	MG/L	260	SP. CONDUCTANCE LAB		1720
MAGNESIUM DISS	MG/L	37	SULFATE DISS	MG/L	470
PH LAB		7.5	WATER TEMP (DEG C)		12.0

Sample A
 Location: 38° 52' 38" N 111° 13' 02" W

ALK, TOT (AS CaCO3)	MG/L	250	PH LAB		7.5
BICARBONATE	MG/L	300	POTASSIUM DISS	MG/L	13
BORON DISSOLVED	UG/L	890	RESIDUE DIS CALC SUM	MG/L	6870
BROMIDE	MG/L	3.0	RESIDUE DIS TON/AFT		9.34
CALCIUM DISS	MG/L	310	SAR		14
CHLORIDE DISS	MG/L	390	SILICA DISSOLVED	MG/L	9.6
DEPTH (FT. FR. SURFACE)		38.9	SODIUM DISS	MG/L	1400
HARDNESS NONCARB	MG/L	1800	SODIUM PERCENT		60
HARDNESS TOTAL	MG/L	2000	SP. CONDUCTANCE LAB		8001
MAGNESIUM DISS	MG/L	300	SULFATE DISS	MG/L	3300
			WATER TEMP (DEG C)		13.0

Sample B
 Location: 39° 04' 06" N 111° 01' 42" W
 Ferron Creek Area 10-15 Miles NE

ALK, TOT (AS CaCO3)	MG/L	540	POTASSIUM DISS	MG/L	26
BICARBONATE	MG/L	660	RESIDUE DIS CALC SUM	MG/L	10100
BORON DISSOLVED	UG/L	480	RESIDUE DIS TON/AFT		13.7
BROMIDE	MG/L	1.2	SAR		27
CALCIUM DISS	MG/L	270	SILICA DISSOLVED	MG/L	10
CHLORIDE DISS	MG/L	1400	SODIUM DISS	MG/L	2700
DEPTH (FT. FR. SURFACE)		120	SODIUM PERCENT		75
HARDNESS NONCARB	MG/L	1400	SP. CONDUCTANCE FLD		8000
HARDNESS TOTAL	MG/L	2000	SP. CONDUCTANCE LAB		12454
MAGNESIUM DISS	MG/L	310	SULFATE DISS	MG/L	5100
PH LAB		7.8	WATER TEMP (DEG C)		16.5

Sample C
 Location: 39° 06' 23" N 111° 01' 38" W
 Ferron Creek Area 10-15 Miles NE

ALK, TOT (AS CaCO3)	MG/L	1070	PH LAB		7.8
BICARBONATE	MG/L	1300	POTASSIUM DISS	MG/L	13
BORON DISSOLVED	UG/L	650	RESIDUE DIS CALC SUM	MG/L	5340
BROMIDE	MG/L	4.7	RESIDUE DIS TON/AFT		7.26
CALCIUM DISS	MG/L	120	SAR		21
CHLORIDE DISS	MG/L	880	SILICA DISSOLVED	MG/L	9.2
DEPTH (FT. FR. SURFACE)		10.7	SODIUM DISS	MG/L	1500
HARDNESS NONCARB	MG/L	0	SODIUM PERCENT		76
HARDNESS TOTAL	MG/L	1000	SP. CONDUCTANCE LAB		7940
MAGNESIUM DISS	MG/L	170	SULFATE DISS	MG/L	2000
			WATER TEMP (DEG C)		12.5

Sample D
 Location: 39° 03' 27" N 111° 03' 04" W
 Ferron Creek Area 10-15 Miles NE

ALK, TOT (AS CaCO3)	MG/L	490	POTASSIUM DISS	MG/L	5.8
BICARBONATE	MG/L	600	RESIDUE DIS CALC SUM	MG/L	3240
BORON DISSOLVED	UG/L	230	RESIDUE DIS TON/AFT		4.41
BROMIDE	MG/L	0.8	SAR		1.3
CALCIUM DISS	MG/L	420	SILICA DISSOLVED	MG/L	25
CHLORIDE DISS	MG/L	46	SODIUM DISS	MG/L	140
HARDNESS NONCARB	MG/L	1800	SODIUM PERCENT		12
HARDNESS TOTAL	MG/L	2300	SP. CONDUCTANCE FLD		3500
MAGNESIUM DISS	MG/L	310	SP. CONDUCTANCE LAB		3714
PH LAB		7.0	SULFATE DISS	MG/L	2000
			WATER TEMP (DEG C)		15.0

Sample E
Location: 38° 55' 06" N 111° 09' 52" 01 W

AIR TEMP (DEG C)		2.0	NITROGEN SUSP KJ0	MG/L	0.13
ALK, TOT (AS CaCO3)	MG/L	320	NITROGEN TOTKJ0 AS N	MG/L	0.53
ANALYZING AGENCY		80020	NO2+NO3 AS N DISS	MG/L	0.96
ARSENIC DISSOLVED	UG/L	1	OIL AND GREASE	MG/L	0.0
BICARBONATE	MG/L	380	OXYGEN DISSOLVED	MG/L	11.8
BORON DISSOLVED	UG/L	210	PH FIELD		8.5
CALCIUM DISS	MG/L	94	PH LAB		7.9
CARBON DIS ORGANIC	MG/L	2.7	PHENOLS	UG/L	2
CARBON ORG SUS	MG/L	0.5	PHOS ORTHO DIS AS P	MG/L	0.00
CARBONATE	MG/L	4	PHOSPHATE DIS ORTHO	MG/L	0.00
CHLORIDE DISS	MG/L	40	PHOSPHORUS TOT AS P	MG/L	0.11
CHROMIUM DISSOLVED	UG/L	0	POTASSIUM DISS	MG/L	4.4
FLUORIDE DISS	MG/L	0.4	RESIDUE DIS CALC SUM	MG/L	1100
HARDNESS NONCARB	MG/L	150	RESIDUE DIS TON/AFT		1.50
HARDNESS TOTAL	MG/L	470	RESIDUE DIS TON/DAY		15.2
IRON DISSOLVED	UG/L	10	SAR		3.8
LEAD DISSOLVED	UG/L	2	SELENIUM DISSOLVED	UG/L	4
LITHIUM DISSOLVED	UG/L	80	SILICA DISSOLVED	MG/L	9.7
MAGNESIUM DISS	MG/L	56	SODIUM DISS	MG/L	190
MANGANESE DISSOLVED	UG/L	10	SODIUM PERCENT		47
NITR. NH4 AS NH4 DIS	MG/L	0.01	SP. CONDUCTANCE FLD		1500
NITR. NO2 AS NO2 DIS	MG/L	0.03	SP. CONDUCTANCE LAB		1706
NITROGEN DIS ORG ASN	MG/L	0.39	STREAMFLOW (CFS) - INST		5.1
NITROGEN DISS KJ0	MG/L	0.40	STRONTIUM DISSOLVED	UG/L	1500
NITROGEN NH4 ASN DIS	MG/L	0.01	SULFATE DISS	MG/L	510
NITROGEN NO2 ASN DIS	MG/L	0.01	WATER TEMP (DEG C)		0.0
			ZINC DISSOLVED	UG/L	10

Sample F
Location: 38° 51' 33" N 111° 15' 41" 01 W

AIR TEMP (DEG C)		7.0	POTASSIUM DISS	MG/L	8.2
ALK, TOT (AS CaCO3)	MG/L	390	RESIDUE DIS CALC SUM	MG/L	3960
ANALYZING AGENCY		80020	RESIDUE DIS TON/AFT		5.39
BICARBONATE	MG/L	480	RESIDUE DIS TON/DAY		25.6
CALCIUM DISS	MG/L	230	SAR		6.2
CARBONATE	MG/L	0	SILICA DISSOLVED	MG/L	14
CHLORIDE DISS	MG/L	100	SODIUM DISS	MG/L	590
HARDNESS NONCARB	MG/L	1300	SODIUM PERCENT		43
HARDNESS TOTAL	MG/L	1700	SP. CONDUCTANCE FLD		3300
MAGNESIUM DISS	MG/L	280	SP. CONDUCTANCE LAB		4623
OXYGEN DISSOLVED	MG/L	10.5	STREAMFLOW (CFS) - INST		2.4
PH FIELD		8.3	SULFATE DISS	MG/L	2500
PH LAB		7.9	WATER TEMP (DEG C)		3.0

Sample G
Location: 35° 51' 33" N 111° 16' 39" W

AIR TEMP (DEG C)	19.0	POTASSIUM DISS	MG/L	7.8
ALK.TOT (AS CaCO3)	MG/L 410	RESIDUE DIS CALC SUM	MG/L	2240
ANALYZING AGENCY	80020	RESIDUE DIS TON/AFT		3.05
BICARBONATE	MG/L 496	RESIDUE DIS TON/DAY		8.77
CALCIUM DISS	MG/L 160	SAR		6.3
CARBONATE	MG/L 4	SILICA DISSOLVED	MG/L	8.5
CHLORIDE DISS	MG/L 85	SODIUM DISS	MG/L	420
HARDNESS NONCARB	MG/L 440	SODIUM PERCENT		51
HARDNESS TOTAL	MG/L 850	SP. CONDUCTANCE FLD		2900
MAGNESIUM DISS	MG/L 110	SP. CONDUCTANCE LAB		3039
OXYGEN DISSOLVED	MG/L 10.1	STREAMFLOW (CFS)-INST		1.4
PH FIELD	8.5	SULFATE DISS	MG/L	1200
PH LAB	8.0	WATER TEMP (DEG C)		9.5

Sample H
Location: 38° 51' 33" N 111° 15' 41" W

AIR TEMP (DEG C)	27.5	NITROGEN SUSP. KJO	MG/L	0.48
ALK.TOT (AS CaCO3)	MG/L 310	NITROGEN TOTKJO AS N	MG/L	0.86
ANALYZING AGENCY	80020	NO2-NO3 AS N DISS	MG/L	1.1
ARSENIC DISSOLVED	UG/L 0	OIL AND GREASE	MG/L	0.0
BICARBONATE	MG/L 373	OXYGEN DISSOLVED	MG/L	8.4
BORON DISSOLVED	UG/L 360	PH FIELD		8.5
CALCIUM DISS	MG/L 130	PH LAB		8.2
CARBON DIS ORGANIC	MG/L 4.0	PHENOLS	UG/L	1
CARBONATE	MG/L 5	PHOS ORTHO DIS AS P	MG/L	0.01
CHLORIDE DISS	MG/L 60	PHOSPHATE DIS ORTHO	MG/L	0.03
CHROMIUM DISSOLVED	UG/L 10	PHOSPHORUS TOT AS P	MG/L	0.43
FLUORIDE DISS	MG/L 0.5	POTASSIUM DISS	MG/L	4.8
HARDNESS NONCARB	MG/L 360	RESIDUE DIS CALC SUM	MG/L	1720
HARDNESS TOTAL	MG/L 680	RESIDUE DIS TON/AFT		2.34
IRON DISSOLVED	UG/L 10	RESIDUE DIS TON/DAY		8.27
LEAD DISSOLVED	UG/L 38	SAR		5.2
LITHIUM DISSOLVED	UG/L 140	SELENIUM DISSOLVED	UG/L	5
MAGNESIUM DISS	MG/L 85	SILICA DISSOLVED	MG/L	10
MANGANESE DISSOLVED	UG/L 20	SODIUM DISS	MG/L	310
NITR. NH4 AS NH4 DIS	MG/L 0.03	SODIUM PERCENT		50
NITR. NO2 AS NO2 DIS	MG/L 0.07	SP. CONDUCTANCE LAB		2286
NITROGEN DIS ORG ASN	MG/L 0.36	STREAMFLOW (CFS)-INST		1.8
NITROGEN DISS KJO	MG/L 0.38	STRONTIUM DISSOLVED	UG/L	2100
NITROGEN NH4 ASN DIS	MG/L 0.02	SULFATE DISS	MG/L	920
NITROGEN NO2 ASN DIS	MG/L 0.02	WATER TEMP (DEG C)		19.0
		ZINC DISSOLVED	UG/L	0

Sample I
Location: 38° 51' 33" N 111° 15' 39" W

AIR TEMP (DEG C)	30.0	POTASSIUM DISS	MG/L	5.3
ALK.TOT (AS CaCO3)	MG/L 230	RESIDUE DIS CALC SUM	MG/L	1510
ANALYZING AGENCY	80020	RESIDUE DIS TON/AFT		2.05
BICARBONATE	MG/L 260	RESIDUE DIS TON/DAY		6.85
CALCIUM DISS	MG/L 100	SAR		5.3
CARBONATE	MG/L 9	SILICA DISSOLVED	MG/L	7.3
CHLORIDE DISS	MG/L 50	SODIUM DISS	MG/L	290
HARDNESS NONCARB	MG/L 340	SODIUM PERCENT		52
HARDNESS TOTAL	MG/L 570	SP. CONDUCTANCE FLD		2140
MAGNESIUM DISS	MG/L 77	SP. CONDUCTANCE LAB		2072
OXYGEN DISSOLVED	MG/L 8.2	STREAMFLOW (CFS)-INST		1.7
PH FIELD	8.8	SULFATE DISS	MG/L	840
PH LAB	8.5	WATER TEMP (DEG C)		24.0

Sample J
Location: Station ID: 00331000

AIR TEMP (DEG C)	4.0	POTASSIUM DISS	MG/L	6.0
ALK.TOT (AS CaCO3)	MG/L 410	RESIDUE DIS CALC SUM	MG/L	2500
ANALYZING AGENCY	80020	RESIDUE DIS TON/AFT		3.40
BICARBONATE	MG/L 500	RESIDUE DIS TON/DAY		8.51
CALCIUM DISS	MG/L 190	SAR		6.2
CARBONATE	MG/L 0	SILICA DISSOLVED	MG/L	13
CHLORIDE DISS	MG/L 86	SODIUM DISS	MG/L	440
HARDNESS NONCARB	MG/L 560	SODIUM PERCENT		50
HARDNESS TOTAL	MG/L 970	SP. CONDUCTANCE FLD		4900
MAGNESIUM DISS	MG/L 120	SP. CONDUCTANCE LAB		3155
OXYGEN DISSOLVED	MG/L 10.6	STREAMFLOW (CFS)-INST		1.3
PH FIELD	8.3	SULFATE DISS	MG/L	1400
PH LAB	7.9	WATER TEMP (DEG C)		3.0

Sample K
Location: 38° 51' 41" N 111° 15' 07" W

AIR TEMP (DEG C)		26.0	POTASSIUM DISS	MG/L	8.0
ALK,TOT (AS CaCO3)	MG/L	350	RESIDUE DIS CALC SUM	MG/L	3340
ANALYZING AGENCY		80020	RESIDUE DIS TON/AFT		4.54
BICARBONATE	MG/L	390	RESIDUE DIS TON/DAY		5.86
CALCIUM DISS	MG/L	200	SAR		5.5
CARBONATE	MG/L	18	SILICA DISSOLVED	MG/L	12
CHLORIDE DISS	MG/L	77	SODIUM DISS	MG/L	490
HARDNESS NONCARB	MG/L	1100	SODIUM PERCENT		42
HARDNESS TOTAL	MG/L	1500	SP. CONDUCTANCE FLD		4000
MAGNESIUM DISS	MG/L	240	SP. CONDUCTANCE LAB		4161
OXYGEN DISSOLVED	MG/L	9.5	STREAMFLOW (CFS)-INST		0.65
PH FIELD		8.5	SULFATE DISS	MG/L	2100
PH LAB		8.0	WATER TEMP (DEG C)		10.5

Sample L
Location: 38° 51' 41" N 111° 15' 07" W

AIR TEMP (DEG C)		29.0	NITROGEN SUSP KJD	MG/L	1.5
ALK,TOT (AS CaCO3)	MG/L	300	NITROGEN TOTKJD AS N	MG/L	3.2
ANALYZING AGENCY		80020	NO2+NO3 AS N DISS	MG/L	23
ARSENIC DISSOLVED	UG/L	0	OIL AND GREASE	MG/L	0.0
BICARBONATE	MG/L	360	OXYGEN DISSOLVED	MG/L	8.7
BORON DISSOLVED	UG/L	590	PH FIELD		8.5
CALCIUM DISS	MG/L	210	PH LAB		8.3
CARBON DIS ORGANIC	MG/L	13	PHENOLS	UG/L	1
CARBON ORG SUS	MG/L	0.2	PHOS ORTHO DIS AS P	MG/L	0.01
CARBONATE	MG/L	1	PHOSPHATE DIS ORTHO	MG/L	0.03
CHLORIDE DISS	MG/L	110	PHOSPHORUS TOT AS P	MG/L	0.02
CHROMIUM DISSOLVED	UG/L	20	POTASSIUM DISS	MG/L	8.0
FLUORIDE DISS	UG/L	0.7	RESIDUE DIS CALC SUM	MG/L	3550
HARDNESS NONCARB	MG/L	1300	RESIDUE DIS TON/AFT		4.83
HARDNESS TOTAL	MG/L	1600	RESIDUE DIS TON/DAY		6.33
IRON DISSOLVED	UG/L	20	SAR		6.4
LEAD DISSOLVED	UG/L	59	SELENIUM DISSOLVED	UG/L	60
LITHIUM DISSOLVED	UG/L	370	SILICA DISSOLVED	MG/L	11
MAGNESIUM DISS	MG/L	250	SODIUM DISS	MG/L	580
MANGANESE DISSOLVED	UG/L	10	SODIUM PERCENT		45
NITR. NH4 AS NH4 DIS	MG/L	0.00	SP. CONDUCTANCE LAB		4702
NITR. NO2 AS NO2 DIS	MG/L	0.16	STREAMFLOW (CFS)-INST		0.66
NITROGEN DIS ORG ASN	MG/L	1.7	STRONTIUM DISSOLVED	UG/L	2900
NITROGEN DISS KJD	MG/L	1.7	SULFATE DISS	MG/L	2100
NITROGEN NH4 ASN DIS	MG/L	0.00	WATER TEMP (DEG C)		15.0
NITROGEN NO2 ASN DIS	MG/L	0.05	ZINC DISSOLVED	UG/L	10

Sample M
Location: 38° 51' 41" N 111° 15' 07" W

AIR TEMP (DEG C)		22.0	POTASSIUM DISS	MG/L	5.0
ALK,TOT (AS CaCO3)	MG/L	300	RESIDUE DIS CALC SUM	MG/L	1550
ANALYZING AGENCY		80020	RESIDUE DIS TON/AFT		2.11
BICARBONATE	MG/L	324	RESIDUE DIS TON/DAY		7.07
CALCIUM DISS	MG/L	120	SAR		3.2
CARBONATE	MG/L	18	SILICA DISSOLVED	MG/L	8.4
CHLORIDE DISS	MG/L	34	SODIUM DISS	MG/L	210
HARDNESS NONCARB	MG/L	500	SODIUM PERCENT		36
HARDNESS TOTAL	MG/L	790	SP. CONDUCTANCE FLD		2250
MAGNESIUM DISS	MG/L	120	SP. CONDUCTANCE LAB		1990
OXYGEN DISSOLVED	MG/L	7.8	STREAMFLOW (CFS)-INST		1.7
PH FIELD		8.5	SULFATE DISS	MG/L	870
PH LAB		8.3	WATER TEMP (DEG C)		20.0

ALK,TOT (AS CaCO3)	MG/L	270	POTASSIUM DISS	MG/L	48
ANALYZING AGENCY		80020	RESIDUE DIS CALC SUM	MG/L	3870
BICARBONATE	MG/L	330	RESIDUE DIS TON/AFT		5.26
BORON DISSOLVED	UG/L	430	SAR		9.3
BROMIDE	MG/L	0.5	SILICA DISSOLVED	MG/L	21
CALCIUM DISS	MG/L	140	SODIUM DISS	MG/L	760
CHLORIDE DISS	MG/L	20	SODIUM PERCENT		56
HARDNESS NONCARB	MG/L	980	SP. CONDUCTANCE FLD		5000
HARDNESS TOTAL	MG/L	1300	SP. CONDUCTANCE LAB		4884
MAGNESIUM DISS	MG/L	220	SULFATE DISS	MG/L	2500
PH LAB		7.4	WATER TEMP (DEG C)		8.5

Sample O
Location: 38° 52' 24" N 111° 14' 26" W

ALK.TOT (AS CaCO3)	MG/L	230	PH FIELD	8.2
ANALYZING AGENCY		80020	PH LAB	8.1
BICARBONATE	MG/L	280	POTASSIUM DISS	MG/L 4.1
BORON DISSOLVED	UG/L	300	RESIDUE DIS CALC SUM	MG/L 1290
BROMIDE	MG/L	0.4	RESIDUE DIS TON/AFT	1.75
CALCIUM DISS	MG/L	35	SAR	13
CARBONATE	MG/L	0	SILICA DISSOLVED	MG/L 15
CHLORIDE DISS	MG/L	49	SODIUM DISS	MG/L 370
DEPTH (FT. FR. SURFACE)		385	SODIUM PERCENT	83
HARDNESS NONCARB	MG/L	0	SP. CONDUCTANCE FLD	1975
HARDNESS TOTAL	MG/L	170	SP. CONDUCTANCE LAB	1880
MAGNESIUM DISS	MG/L	19	SULFATE DISS	MG/L 660
			WATER TEMP (DEG C)	12.5

Sample P
Location: 38° 50' 45" N 111° 17' 18" 01 W

ALK.TOT (AS CaCO3)	MG/L	330	PH LAB	8.3
ANALYZING AGENCY		80020	POTASSIUM DISS	MG/L 3.2
BICARBONATE	MG/L	370	RESIDUE DIS CALC SUM	MG/L 877
BORON DISSOLVED	UG/L	350	RESIDUE DIS TON/AFT	1.19
BROMIDE	MG/L	0.2	SAR	18
CALCIUM DISS	MG/L	13	SILICA DISSOLVED	MG/L 11
CARBONATE	MG/L	13	SODIUM DISS	MG/L 290
CHLORIDE DISS	MG/L	30	SODIUM PERCENT	92
DEPTH (FT. FR. SURFACE)		720	SP. CONDUCTANCE FLD	1400
HARDNESS NONCARB	MG/L	0	SP. CONDUCTANCE LAB	1374
HARDNESS TOTAL	MG/L	50	SULFATE DISS	MG/L 330
MAGNESIUM DISS	MG/L	4.3	WATER TEMP (DEG C)	13.5
PH FIELD		8.9	YIELD-WELL-INST. G/M	3.5

Sample Q
Location: 38° 50' 45" N 111° 17' 18" 02 W

Sample R
Location: Not in Study Area.

ALK.TOT (CaCO3)	MG/L	520	PH FIELD	8.4
ANALYZING AGENCY		80020	PH LAB	8.2
BORON DISSOLVED	UG/L	580	POTASSIUM DISS	MG/L 2.6
BROMIDE	MG/L	0.3	RESIDUE DIS CALC SUM	MG/L 1350
CALCIUM DISS	MG/L	24	RESIDUE DIS TON/AFT	1.84
CHLORIDE DISS	MG/L	32	RESIDUE DIS 180C	MG/L 1350
FLUORIDE DISS	MG/L	0.7	SAR	14
HARDNESS NONCARB	MG/L	0	SILICA DISSOLVED	MG/L 13
HARDNESS TOTAL	MG/L	180	SODIUM DISS	MG/L 420
IODIDE	MG/L	0.02	SODIUM PERCENT	83
IRON DISSOLVED	UG/L	20	SP. CONDUCTANCE FLD	2180
MAGNESIUM DISS	MG/L	29	SP. CONDUCTANCE LAB	2041
MANGANESE DISSOLVED	UG/L	10	SULFATE DISS	MG/L 520
			WATER TEMP (DEG C)	13.5

Sample S
Location: 38° 52' 25" N 111° 15' 26" 01 W

ALK.TOT (CaCO3)	MG/L	560	PH FIELD	9.5
ANALYZING AGENCY		80020	PH LAB	8.9
BORON DISSOLVED	UG/L	850	POTASSIUM DISS	MG/L 1.4
BROMIDE	MG/L	0.3	RESIDUE DIS CALC SUM	MG/L 774
CALCIUM DISS	MG/L	0.9	RESIDUE DIS TON/AFT	1.04
CHLORIDE DISS	MG/L	27	RESIDUE DIS 180C	MG/L 767
FLUORIDE DISS	MG/L	2.3	SAR	64
HARDNESS NONCARB	MG/L	0	SILICA DISSOLVED	MG/L 9.5
HARDNESS TOTAL	MG/L	5	SODIUM DISS	MG/L 320
IODIDE	MG/L	0.04	SODIUM PERCENT	99
IRON DISSOLVED	UG/L	30	SP. CONDUCTANCE FLD	1300
MAGNESIUM DISS	MG/L	0.6	SP. CONDUCTANCE LAB	1283
MANGANESE DISSOLVED	UG/L	20	SULFATE DISS	MG/L 74
			WATER TEMP (DEG C)	13.0

Sample T
Location: 38° 52' 14" N 111° 15' 52" W

Sample U
Location: Not in Study Area.

ANALYZING AGENCY 80010 BEN. INVERT. TYPE 1 • 45
 INV BENTHIC WET WT 1.86

Sample V
 Location: 38° 51' 26" N 111° 15' 09" 01 W

ANALYZING AGENCY 80010 BEN. INVERT. TYPE 1 • 112
 INV BENTHIC WET WT 1.12

Sample W
 Location: 38° 51' 32" N 111° 15' 38" W

ANALYZING AGENCY 80010 BEN. INVERT. TYPE 1 • 6
 INV BENTHIC WET WT 0.043

Sample X
 Location: 38° 52' 36" N 111° 17' 29" 01 W

ALK. TOT (AS CaCO3)	MG/L	230	PH LAB		9.0
ANALYZING AGENCY		80020	POTASSIUM DISS	MG/L	1.4
BICARBONATE	MG/L	260	RESIDUE DIS CALC SUM	MG/L	348
BORON DISSOLVED	UG/L	180	RESIDUE DIS TON/AFT		0.47
BROMIDE	MG/L	0.2	SAR		25
CALCIUM DISS	MG/L	1.7	SILICA DISSOLVED	MG/L	15
CARBONATE	MG/L	8	SODIUM DISS	MG/L	130
CHLORIDE DISS	MG/L	12	SODIUM PERCENT		98
HARDNESS NONCARB	MG/L	0	SP. CONDUCTANCE FLD		540
HARDNESS TOTAL	MG/L	5	SP. CONDUCTANCE LAB		566
MAGNESIUM DISS	MG/L	0.2	SULFATE DISS	MG/L	51
PH FIELD		8.8	WATER TEMP (DEG C)		13.0

Sample Y
 Location: 38° 46' 33" N 111° 23' 53" 01 W

ALK. TOT (AS CaCO3)	MG/L	340	POTASSIUM DISS	MG/L	2.7
ANALYZING AGENCY		80020	RESIDUE DIS CALC SUM	MG/L	1050
BICARBONATE	MG/L	410	RESIDUE DIS TON/AFT		1.43
BORON DISSOLVED	UG/L	250	SAR		11
BROMIDE	MG/L	0.2	SILICA DISSOLVED	MG/L	11
CALCIUM DISS	MG/L	30	SODIUM DISS	MG/L	330
CHLORIDE DISS	MG/L	13	SODIUM PERCENT		82
HARDNESS NONCARB	MG/L	0	SP. CONDUCTANCE FLD		1600
HARDNESS TOTAL	MG/L	160	SP. CONDUCTANCE LAB		1577
MAGNESIUM DISS	MG/L	20	SULFATE DISS	MG/L	440
PH LAB		8.0	WATER TEMP (DEG C)		18.5

Sample Z
 Location: 38° 46' 26" N 111° 16' 26" 01 W

ALK.TOT (AS CaCO3)	MG/L	790	MAGNESIUM DISS	DETR. DELETED
ANALYZING AGENCY		80020	PH LAB	7.4
BICARBONATE	MG/L	960	POTASSIUM DISS	DETR. DELETED
BORON DISSOLVED	UG/L	870	SILICA DISSOLVED	MG/L 8.8
BROMIDE	MG/L	1.1	SODIUM DISS	DETR. DELETED
CALCIUM DISS	DETR. DELETED		SP. CONDUCTANCE FLD	>8000
CHLORIDE DISS	MG/L	430	SP. CONDUCTANCE LAB	18900
DEPTH (FT. FR. SURFACE)		20.0	SULFATE DISS	MG/L 3.7
			WATER TEMP (DEG C)	16.0

Sample 1A
Location: 38° 52' 32" N 111° 17' 27" 01 W

ALK.TOT (AS CaCO3)	MG/L	300	POTASSIUM DISS	MG/L 8.1
ANALYZING AGENCY		80020	RESIDUE DIS CALC SUM	MG/L 3020
BICARBONATE	MG/L	360	RESIDUE DIS TON/AFT	4.11
BORON DISSOLVED	UG/L	560	SAR	5.7
BROMIDE	MG/L	0.6	SILICA DISSOLVED	MG/L 16
CALCIUM DISS	MG/L	210	SODIUM DISS	MG/L 470
CHLORIDE DISS	MG/L	150	SODIUM PERCENT	4.4
HARDNESS NONCARB	MG/L	1000	SP. CONDUCTANCE FLD	2500
HARDNESS TOTAL	MG/L	1300	SP. CONDUCTANCE LAB	3720
MAGNESIUM DISS	MG/L	190	SULFATE DISS	MG/L 1800
PH LAB		7.4	WATER TEMP (DEG C)	13.0

Sample 1B
Location: 38° 48' 49" N 111° 15' 56" 01 W

ALK.TOT (AS CaCO3)	MG/L	440	PH FIELD	7.6
ANALYZING AGENCY		80020	PH LAB	7.7
BICARBONATE	MG/L	540	POTASSIUM DISS	MG/L 12
BORON DISSOLVED	UG/L	780	RESIDUE DIS CALC SUM	MG/L 6450
BROMIDE	MG/L	13	RESIDUE DIS TON/AFT	8.77
CALCIUM DISS	MG/L	29	SAR	83
CARBONATE	MG/L	0	SILICA DISSOLVED	MG/L 8.7
CHLORIDE DISS	MG/L	910	SODIUM DISS	MG/L 2200
DEPTH (FT. FR. SURFACE)		74.3	SODIUM PERCENT	97
HARDNESS NONCARB	MG/L	0	SP. CONDUCTANCE FLD	9000
HARDNESS TOTAL	MG/L	130	SP. CONDUCTANCE LAB	9124
MAGNESIUM DISS	MG/L	15	SULFATE DISS	MG/L 3000
			WATER TEMP (DEG C)	13.0

Sample 1C
Location: 39° 01' 31" N 111° 08' 05" W
Ferron Creek Area 10-15 Miles NE

ALK.TOT (AS CaCO3)	MG/L	460	POTASSIUM DISS	MG/L 7.2
BICARBONATE	MG/L	560	RESIDUE DIS CALC SUM	MG/L 1530
BORON DISSOLVED	UG/L	510	RESIDUE DIS TON/AFT	2.08
BROMIDE	MG/L	0.1	SAR	7.8
CALCIUM DISS	MG/L	75	SILICA DISSOLVED	MG/L 13
CHLORIDE DISS	MG/L	28	SODIUM DISS	MG/L 370
DEPTH (FT. FR. SURFACE)		7.9	SODIUM PERCENT	65
HARDNESS NONCARB	MG/L	0	SP. CONDUCTANCE FLD	2200
HARDNESS TOTAL	MG/L	430	SP. CONDUCTANCE LAB	2119
MAGNESIUM DISS	MG/L	58	SULFATE DISS	MG/L 700
PH LAB		7.5	WATER TEMP (DEG C)	11.0

Sample 1D
Location: 38° 52' 33" N 111° 13' 03" W

ALK. TOT (AS CaCO3)	MG/L	1080	PH LAB		7.6
BICARBONATE	MG/L	1320	POTASSIUM DISS	MG/L	54
BORON DISSOLVED	UG/L	1100	RESIDUE DIS CALC SUM	MG/L	46800
BROMIDE	MG/L	20	RESIDUE DIS TON/AFT		63.6
CALCIUM DISS	MG/L	240	SAR		154
CHLORIDE DISS.	MG/L	2200	SILICA DISSOLVED	MG/L	7.2
DEPTH (FT. FR. SURFACE)		29.7	SODIUM DISS	MG/L	30000
HARDNESS NONCARB	MG/L	6100	SODIUM PERCENT		90
HARDNESS TOTAL	MG/L	7200	SP. CONDUCTANCE LAB		4220
MAGNESIUM DISS	MG/L	1600	SULFATE DISS	MG/L	12000
			WATER TEMP (DEG C)		14.5

Sample 1E

Location: 39° 03' 54" N 111° 00' 43" W
 Ferron Creek Area 10-15 Miles NE

ALK. TOT (AS CaCO3)	MG/L	860	POTASSIUM DISS	MG/L	15
BICARBONATE	MG/L	1050	RESIDUE DIS CALC SUM	MG/L	8120
BORON DISSOLVED	UG/L	110	RESIDUE DIS TON/AFT		11.4
BROMIDE	MG/L	20	SAR		98
CALCIUM DISS	MG/L	40	SILICA DISSOLVED	MG/L	8.0
CHLORIDE DISS	MG/L	4200	SODIUM DISS	MG/L	3200
DEPTH (FT. FR. SURFACE)		105	SODIUM PERCENT		97
HARDNESS NONCARB	MG/L	0	SP. CONDUCTANCE FLD		3000
HARDNESS TOTAL	MG/L	200	SP. CONDUCTANCE LAB		13649
MAGNESIUM DISS	MG/L	25	SULFATE DISS	MG/L	91
PH LAB		7.8	WATER TEMP (DEG C)		17.0

Sample 1F

Location: 39° 06' 53" N 111° 00' 54" W
 Ferron Creek Area 10-15 Miles NE

ALK. TOT (AS CaCO3)	MG/L	5	POTASSIUM DISS	MG/L	8.3
BICARBONATE	MG/L	6	RESIDUE DIS CALC SUM	MG/L	4200
BORON DISSOLVED	UG/L	2600	RESIDUE DIS TON/AFT		5.71
BROMIDE	MG/L	0.3	SAR		2.0
CALCIUM DISS	MG/L	510	SILICA DISSOLVED	MG/L	18
CHLORIDE DISS	MG/L	45	SODIUM DISS	MG/L	240
DEPTH (FT. FR. SURFACE)		28.9	SODIUM PERCENT		14
HARDNESS NONCARB	MG/L	2800	SP. CONDUCTANCE FLD		4500
HARDNESS TOTAL	MG/L	2800	SP. CONDUCTANCE LAB		4408
MAGNESIUM DISS	MG/L	370	SULFATE DISS	MG/L	3000
PH LAB		4.9	WATER TEMP (DEG C)		12.5

Sample 1G

Location: 38° 52' 49" N 111° 13' 09" W

ALK. TOT (AS CaCO3)	MG/L	400	POTASSIUM DISS	MG/L	9.3
BICARBONATE	MG/L	490	RESIDUE DIS CALC SUM	MG/L	3880
BORON DISSOLVED	UG/L	1100	RESIDUE DIS TON/AFT		5.29
BROMIDE	MG/L	0.5	SAR		4.6
CALCIUM DISS	MG/L	380	SILICA DISSOLVED	MG/L	11
CHLORIDE DISS	MG/L	100	SODIUM DISS	MG/L	480
DEPTH (FT. FR. SURFACE)		12.0	SODIUM PERCENT		34
HARDNESS NONCARB	MG/L	1600	SP. CONDUCTANCE FLD		4100
HARDNESS TOTAL	MG/L	2000	SP. CONDUCTANCE LAB		4300
MAGNESIUM DISS	MG/L	260	SULFATE DISS	MG/L	2400
PH LAB		7.1	WATER TEMP (DEG C)		13.0

Sample 1H

Location: 38° 52' 25" N 111° 13' 00" W

IDENTIFICATION NUMBER: 252901.

STA. NO. 395225111526 01

AG: <S.L. 0.010	AL: Alumina 0.100	B: Boron 0.500	BA: Barium 0.030
BE: <H.L. 0.001	BI: Bismuth 1.000	CA: Calcium 30.000	CD: Cadmium 0.003
CO: <L.H. 0.005	CR: Chromium 0.050	CU: Copper 0.010	FE: Iron 0.010
GA: <G.L. 0.030	GE: Germanium 0.100	K: Potassium 1.000	LI: Lithium 0.070
MG: Magnesium 30.000	MN: Manganese 0.003	MO: Molybdenum 0.010	NA: Sodium 300.000
NI: <A.H. 0.050	PB: <Lead 0.030	SB: Strontium 0.030	SI02: Silicon dioxide 10.000
SN: % Tin 0.100	SR: Strontium 5.000	TI: Titanium 0.005	V: Vanadium 0.010
ZN: <Zinc 0.005	ZR: <Zirconium 0.005		

Sample II
Location: 38° 52' 25" N 111° 15' 26" W

IDENTIFICATION NUMBER: 252902.

STA. NO. 395214111552 01

AG: < 0.010	AL: < 0.050	B: < 0.700	BA: < 0.050
BE: < 0.001	BI: < 1.000	CA: < 1.000	CD: < 0.001
CO: < 0.005	CR: < 0.050	CU: < 0.010	FE: < 0.005
GA: < 0.030	GE: < 0.030	K: < 1.000	LI: < 0.030
MG: < 1.000	MN: < 0.001	MO: < 0.010	NA: 300.000
NI: < 0.050	PB: < 0.030	SB: < 0.030	SI02: 10.000
SN: < 0.050	SR: < 0.100	TI: < 0.005	V: < 0.010
ZN: < 0.005	ZR: < 0.005		

Sample IJ
Location: 38° 52' 14" N 111° 15' 52" W

ALK.TOT (AS CaCO3) MG/L	420	POTASSIUM DISS MG/L	16
BICARBONATE MG/L	510	RESIDUE DIS CALC SUM MG/L	4470
BORON DISSOLVED UG/L	590	RESIDUE DIS TON/AFT	6.08
BROMIDE MG/L	0.4	SAR	2.6
CALCIUM DISS MG/L	470	SILICA DISSOLVED MG/L	13
CHLORIDE DISS MG/L	96	SODIUM DISS MG/L	320
DEPTH (FT. FR. SURFACE)	32.2	SODIUM PERCENT	20
HARDNESS NONCARB MG/L	2400	SP. CONDUCTANCE FLD	5800
HARDNESS TOTAL MG/L	2800	SP. CONDUCTANCE LAB	4777
MAGNESIUM DISS MG/L	400	SULFATE DISS MG/L	2900
PH LAB	7.2	WATER TEMP (DEG C)	12.0

Sample IK
Location: 38° 53' 03" N 111° 13' 13" W

ALK.TOT (AS CaCO3) MG/L	37	RESIDUE DIS CALC SUM MG/L	5080
BICARBONATE MG/L	45	RESIDUE DIS TON/AFT	6.91
CALCIUM DISS MG/L	430	SAR	4.4
CHLORIDE DISS MG/L	48	SILICA DISSOLVED MG/L	19
HARDNESS NONCARB MG/L	2700	SODIUM DISS MG/L	530
HARDNESS TOTAL MG/L	2800	SODIUM PERCENT	29
MAGNESIUM DISS MG/L	410	SP. CONDUCTANCE FLD	6000
PH LAB	7.1	SP. CONDUCTANCE LAB	5525
POTASSIUM DISS MG/L	17	SULFATE DISS MG/L	3600
		WATER TEMP (DEG C)	15.5

Sample IL
Location: 39° 13' 15" N 110° 57' 03" W

APPENDIX 9

Bore Hole Logs

Emery EMRIA core hole No. 1 TD 100'
NE 1/4 sec 23 T. 22 S., R. 6 E.
(logged by T. A. Ryer, Oct. 11, 1978)

Plate 1 - 1 10'-20'

10-18.8 ss, vf-gr, hard, tan (weathered), planar to low angle X-lam, a few
clyst layers @ 13'-14'
18.8-20 clyst, slty, brn

Plate 1 - 2 20'-30'

20-22.3 ss, vf-gr, v. hard, gry, planar to low angle X-lam
22.3-24 sltst, sdy, cly, crumbly
24-29.6 ss, as above
29.6-30 clyst, slty w/ lams of vs ss

Plate 1 - 3 30'-39'

30-33.7 mostly sltst; some slty cltst and clyst upper 1' sdy, slty clept

*10-33.7 constitutes a beach sequence prograded to the NE during the general
sw-ward transgression of the Blue Gate sea
33.7-39 coal (Jcoal; I coal of Lupton, 1916)

Plate 1 - 4 39'-48'

39-39.8 coal (J coal)
39.8-40.6 sltst, cly, grading up to clyst
40.6-42 sltst, cly
42-43 sltst, a bed of vf-gr ss 0.2' thick @ 41.6
43-48 ss, vf-gr, wavy cly lam., soft-sed def. structures, heavily burrowed

Plate 1 - 5 48'-58'

48-50.1 coal, shy streaks in upper half (split of I coal)
50.1-57 ss, vf-gr, same as 43-48
57-58 mostly sltst w/ sd-filled burrows; grades into overlying unit

Plate 1 - 6 58'-68'

58-58.3 sltst, sdy, cly
58.3-59.3 coal (split of I coal)
59.3-68 ss, vf-gr, wavy-lam, thin beds of cly sltst and clyst; a few burrows
in lower part; upper part has lam cover w/ fine carb. frags; top 1' rooted

Plate 1 - 7 68'-78'

68-70 mostly clyst, slty w/ vf-gr ss lams; ss @ 69', wavy-lam.
70-73 ss, vf-gr, interlam w/ sltst; burrows in slty parts
73-77 ss, f-med-gr, X-bedded; sharp lower contact (probably a small distributary
or tidal channel)
77-78 ss, vf-gr, slty w/ wavy lams of carb. debris grading up to sltst full
of sd-filled burrows

Plate 1 - 8 78'-88'

78-80.9 ss, med-gr; top 0.2' f-gr; a layer of clyst 0.1' thick @ 78.2-78.3

80.9-82 coal, badly broken up (split ofl coal)

82-82.9 clept, a few carb frags

82.9-84 coal; upper half shaly coal or coaly sh

84-88 sltst, cly grading up to clyst; slty part shows carb rootlets; top 0.2' carb.

Plate 1 - 9 88'-100'

88-100 (there is approx. 9.5' of core in this box - can,t tell where core is missing - perhaps 2.5' @ approx. 92')

88-91 sltst, cly and slty clyst; possible rooting at top

91-93.5 missing??

93.5-99 ss, coarsening upward from vf- to f-gr, ripple-drift lam, a few small burrows (possible distal splay)

99-100 sltst, sdy, cly, soft, crumbly

*39.8-100 records deposition in a lower delta plain environ., largely brackish-water bay

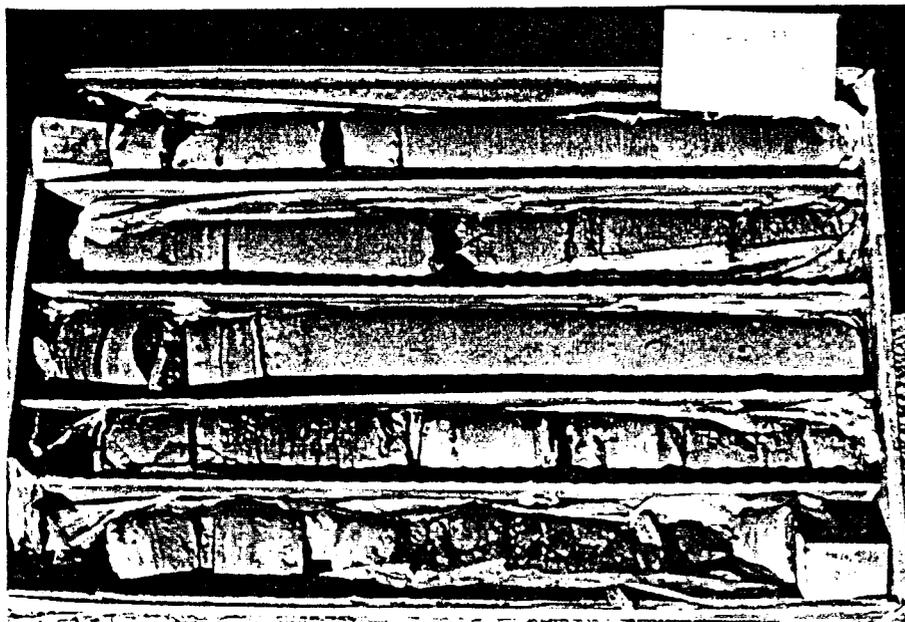


Plate 1 - 1 Footage: 10'-20'



Plate 1 - 2 Footage: 20'-30'



Plate 1 - 3 Footage: 30'-39-'



Plate 1 - 4 Footage: 39'-48'

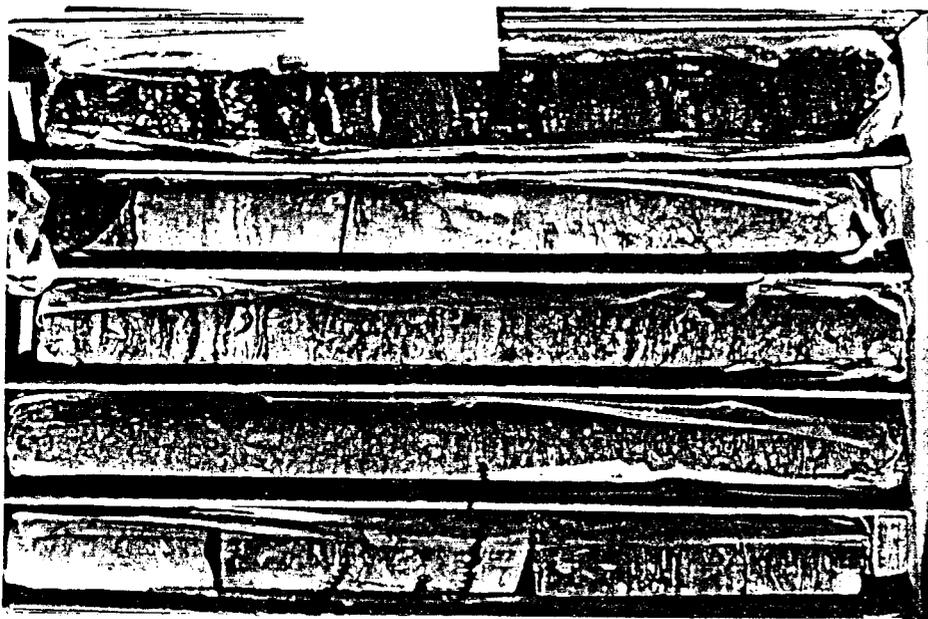


Plate 1 - 5 Footage: 48'-58'

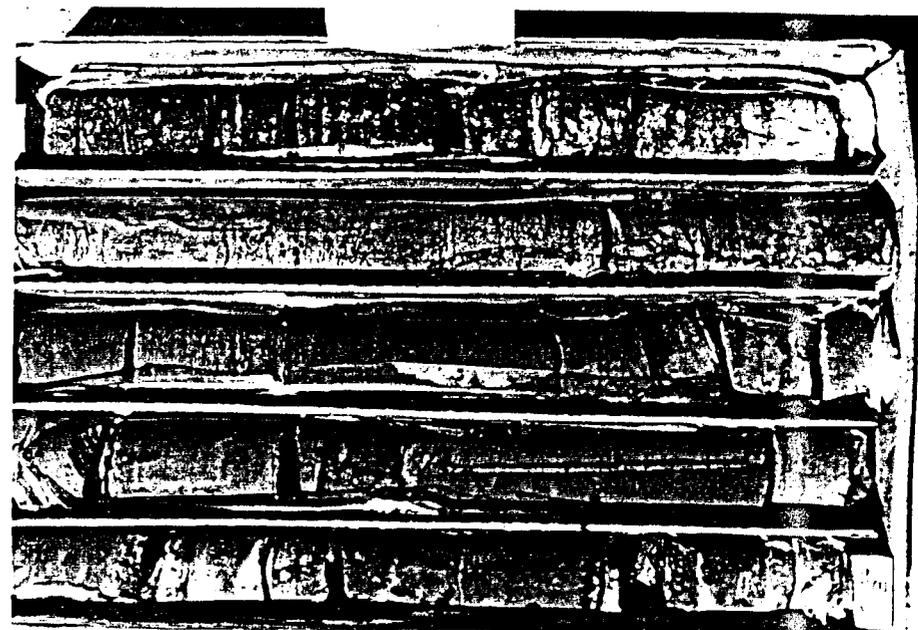


Plate 1 - 6 Footage: 58'-68'



Plate 1 - 7 Footage: 68'-78'

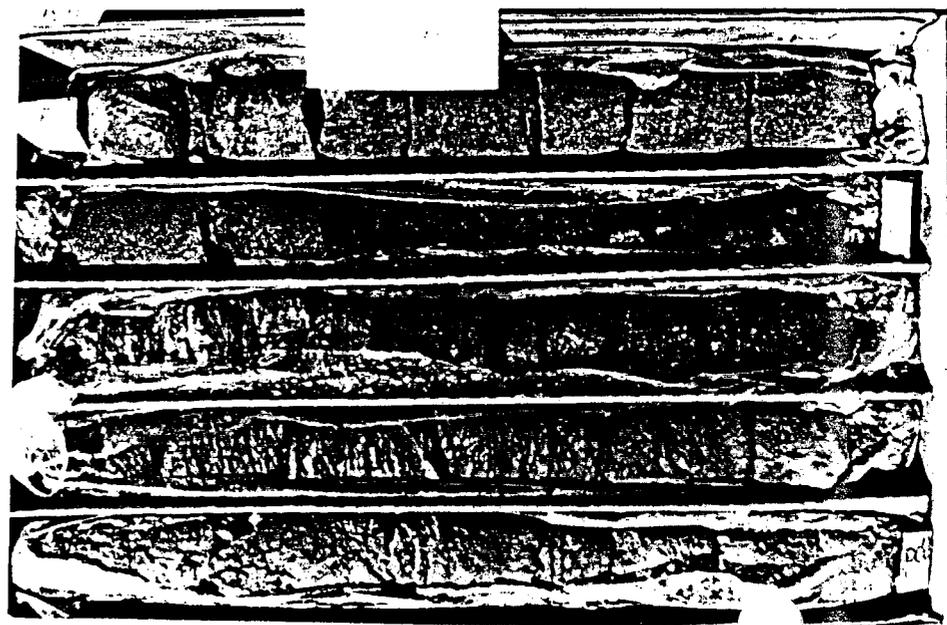


Plate 1 - 8 Footage: 78'-88'

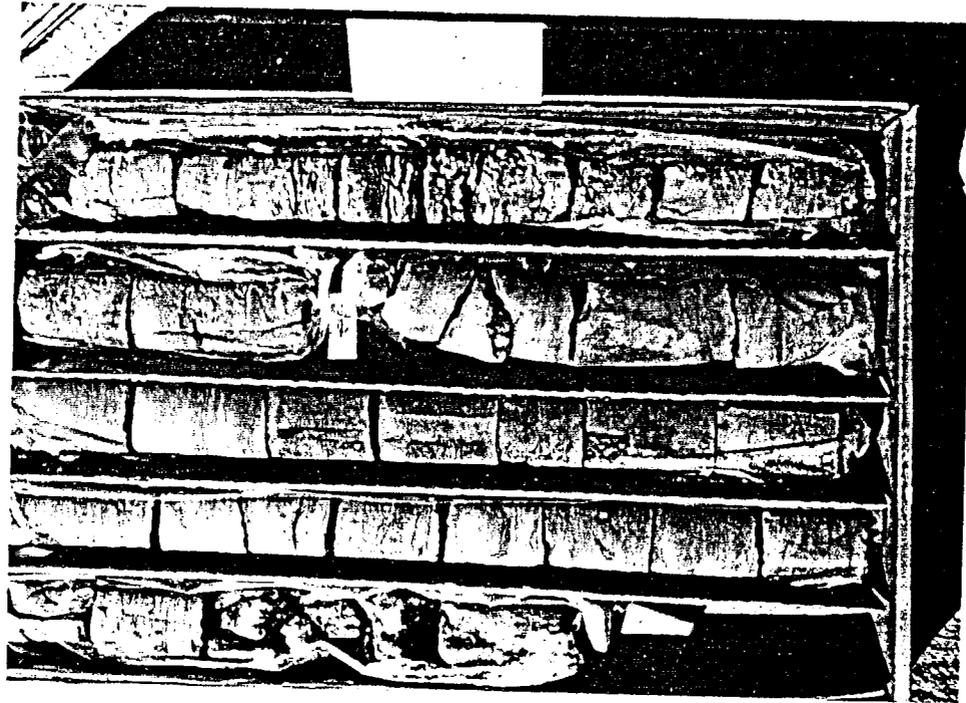


Plate 1 - 9 Footage: 88'-100'

Emery EMRIA core hole No. 2 TD 318'
NW 1/4 sec 26 T. 22 S.; R. 6 E.
(logged by T. A. Ryer, Oct. 12, 1978)

Plate 2 - 1 10'-22'
clst, slty, weathered (Blue Gate Sh Mbr)

Plate 2 - 2 22'-30'
22-25: clst' slty, weathered

*Blue Gate/ Ferron contact @ 25'

25-30 ss, f-gr, tan (weathered), heavily burrowed, the burrows mixing
slt and cly into what was probably originally a clean ss

Plate 2 - 3 30'-42'
ss, f-gr, tan (weathered), a few coaly chips, a few wavy lam.

Plate 2 - 4 42'-52'
ss, f-gr, same as plate 2 - 3

Plate 2 - 5 52'-64'
ss, f-gr, same as plates 2 - 3, 2 - 4; upper part tan (weathered), lower
part gry.

Plate 2 - 6 64'-74'
note: The depositional sequence in boxes 2 - 6 and 2 - 7 does not make
good sense; further, it does not correspond at all to what is de-
scribed from a Consolidated Coal Co. core drilled nearby. I have,
in this log, interchanged the contents of boxes 2 - 6 and 2 - 7.
64-74 ss, f-gr, as above, a few small burrows

Plate 2 - 7 74'-80'
74-77.6 ss, f-gr sharp base
*25-77.6 is a beach sequence prograded towards the NE; genetically
equivalent to interval 10-33.7 of core hole No. 1.
77.6-79.8 coal (this and coal below combined I-J coals)
79.8-80 ss, vf-gr with lam. of slty clst, contorted

Plate 2 - 8 80'-90'
There is approximately 12.5' of core jammed into this box, all coal except
for 2 thin splits of vf ss w/ coaly streaks @ indicated depths of 82.1 and
82.6

Plate 2 - 9 90'-100'
All coal; no indication of which end is top - have labelled box using the
same labelling scheme employed by the driller on previous boxes from
this hole.

Plate 2 - 10 100'-110'

ss, vf, interbedded and interlam w/ sltst, very contorted in lower part, grading up to all sltst w/ some interbedded clept in uppermost 3'

Plate 2 - 11 110'-120'

ss, f-gr w/ clay chips, top 2' ss, vf-gr w/ sltst lam, highlt contorted, a few small burrows

Plate 2 - 12 120'-130'

Box contains approximately 13' of core
120-130 sandstone, fine-grained

Plate 2 - 13 130'-140'

Sandstone, fine-grained; upper 2' has clay, carb. lam., contorted and interbedds of siltstone w/ ss lam.

Plate 2 - 14 140'-150'

140-148 sandstone, f. to vf-gr., sharp lower contact
*interval approximately 110-148 is channel sequence
148-150 sh, coaly, grading upward to sltst w/ coaly frags, rooted

Plate 2 - 15 150'-160'

150-156.9 clyst, slty grading up to sltst and vf-gr ss w/ cly, carb lam.
at top; rooted at top
156.9-157.9 Shale, carb w/ pyrite
157.9-158.8 coal and shaly coal, very badly broken up (split of G coal ?)
158.8-160 Shale, carb

Plate 2 - 16 160'-170'

There is approximately 10.6' of core in box
160-162.5 coal (probably G coal)
162.5-164.5 clyst, slty, and cly sltst
164.5-170 mostly sltst w/ laminae of v.f. ss, lams amount of ss decreasing upward

Plate 2 - 17 170'-180'

170-174.6 ss, vf-gr, interlam w/ sltst, wavy lam, X-bedded, totals about 50% sd.
174.6-175.9 ss, vf-gr w/ clyst chips' X-bedded and ripple-lam, small amt carb debris
175.9-180 ss, vf-gr, same as 170-174.6, but only approximately 20% ss, a few burrows

Plate 2 - 18 180'-190'

180-181 ss, vf-gr same as 170-174.6, approximately 50% ss.
181-190 ss, f-gr w/ wavy lams of clyst and debris; burrowed, clay-walled burrows

Plate 2 - 19 190'-208'

Wood block in box reads "dropped core 190-200"

Core in this box is ss, f-gr same as 181-190 - whole interval was probably this same lithology. Also in the box is approximately 1' of cly sltst - doesn't look like this material belongs in this part of the sequence.

Plate 2 - 20 208'-219'

ss f-gr same as 181-190

Plate 2 - 21 219'-229'

219-221.5 ss, f-gr, lams of carb debris, minor burrowing

221.5-229 ss, f-gr, same as 181-190 but heavily burrowed

Plate 2 - 22 229'-251'

Wood block reads "dropped core 230-240"

Another block reads "core loss between 240-248"

229-230.1 ss, f-gr w/ lams of carb. debris

230.1-230.9 ss, vf-gr, slty, heavily burrowed w/ trace fossil Chondrites
*interval approximately 180-230.9 is delta-front sandstone sequence (No. 4
ss of Ryer study)

230.9- ? missing

? - ? 6' of coal badly broken

? - 249 missing

249-251 clyst, slightly slty

Plate 2 - 23 251'-258'

251-252.3 sh, carb.

252.3-258 clyst, slty, the content of slt decreasing upward

Plate 2 - 24 258'-268'

There is 9' of core in the box

258-261.2 sltst, cly, coaly frags

261.2-263.2 coal (split of A coal)

263.2-265.7 sh, carb, slightly slty

265.7-266.7 coal (split of A coal)

266.7-268 clyst, carb to coaly, slty; coaly stringers

Plate 2 - 25 268'-276'

ss, vf-gr, interlam w/ sltst in proportions indicated:

268-272 approximately 40% ss

272-274 approximately 20% ss

274-276 approximately 40% ss

Plate 2 - 26 276'-285'

276-278 mostly sltst w/ coaly frags, some interbedded v.f. ss.

278-279.3 ss, f-gr, a few wavy clyst lams, carb frags, oyster shell frags

279.3-279.7 ss, f-gr, interlam w/ sltst

279.7-280.2 ss, f-gr, same as 278-279.3

280.2-285 sltst, interlam w/ vf ss, burrowed, sltst total approximately 70%

Plate 2 - 27 285'-294'
interlam vf ss and sltst, very wavy-lam, burrowed, approximately 50%ss

Plate 2 - 28 294'-304'

294-297.2 ss, vf-gr, interlam w/ gray sltst w/ carb frags; contorted lam; burrowed

297.2-304 ss, f-gr, a few sltst lam, small carb frags; clay-walled burrows; a few oyster shell frags; a large coal frag (log?) @ 298'.

Plate 2 - 29 304'-308'

ss, vf-gr interlam w/ sltst and carb debris; burrowed

* interval 268-308 (and perhaps deeper) represents filling of abandoned distributary channel which locally cut the No. 2 delta-front sandstone of Ryer study. Consists largely of repeated sequences 0.2-0.3' thick of vf ss grading up to and interlam w/ sltst- each such sequence may represent deposition during flood stage (ss) followed by return to quite conditions (sltst); ss/ sltst contacts are sharp.

Plate 2 - 30 308'-318'

308-308.5 ss, f-gr w/ carb, cly lam, heavily burrowed

308.5-314.5 ss, f-gr, a few small carb grains, a few oyster shell frags

314.5-318 ss, f-gr, lots of carb wood frags, some quite large; clay chips all contorted

*308-318 may be uppermost part of No. 1 delta-front sandstone of Ryer study; alternatively, may be basal part of abandoned distribution fill, in which case top of No. 1 ss not cored.

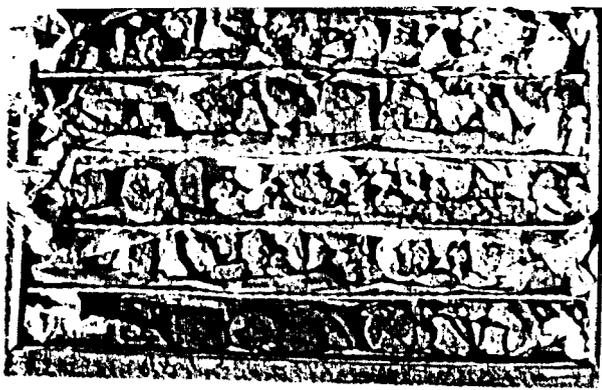


Plate 2 - 1 Footage: 10'-22'



Plate 2 - 2 Footage: 22'-30'

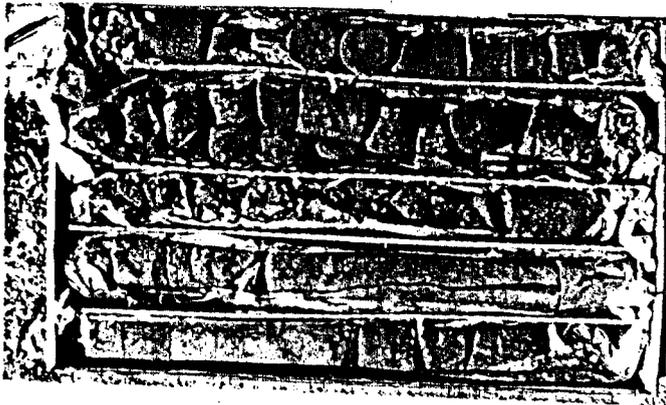


Plate 2 - 3 Footage: 30'-42'



Plate 2 - 4 Footage: 42'-52'



Plate 2 - 5 Footage: 52'-64'

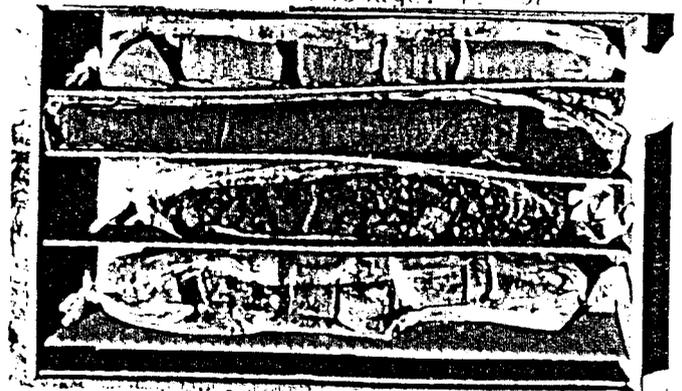


Plate 2 - 6 Footage: 64'-74'



Plate 2 - 7 Footage: 74'-80'



Plate 2 - 8 Footage: 80'-90'

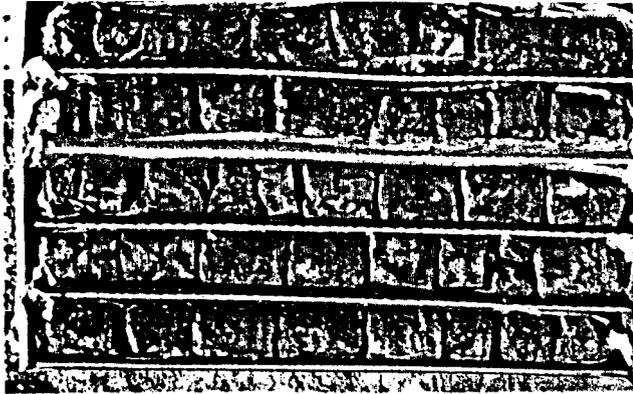


Plate 2 - 9 Footage: 90'-100'

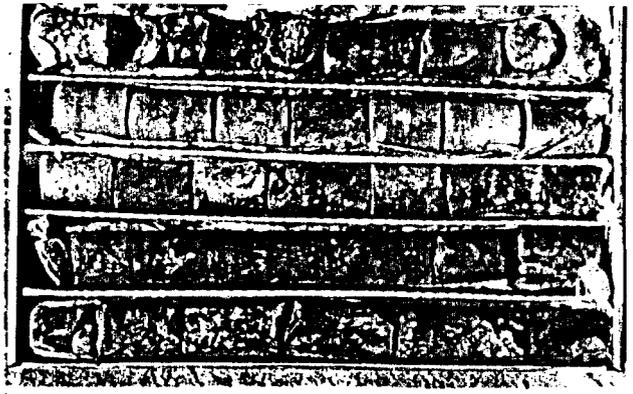


Plate 2 - 11 Footage: 110'-120'

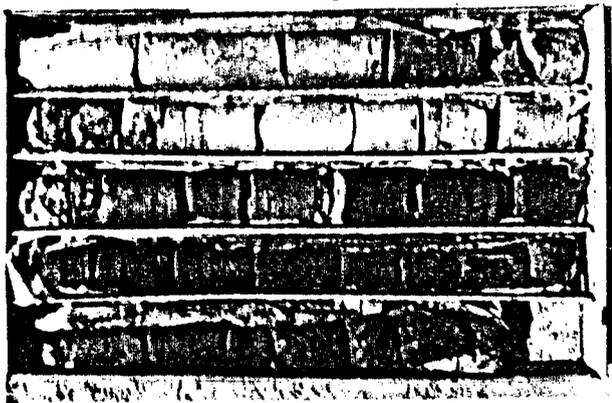


Plate 2 - 12 Footage: 120'-130'

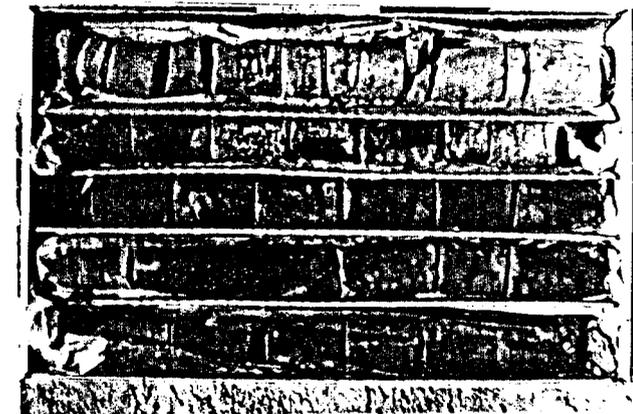


Plate 2 - 13 Footage: 130'-140'

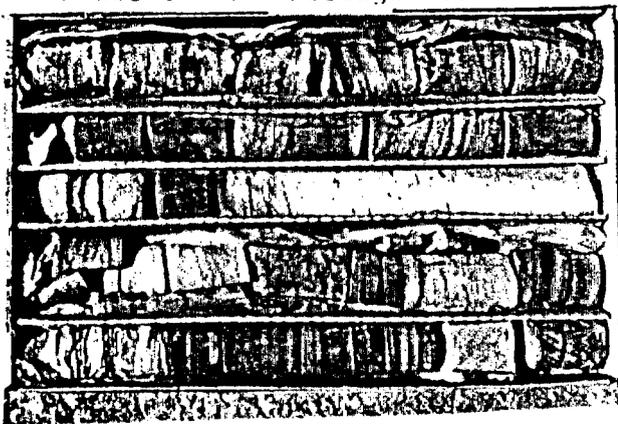


Plate 2 - 14 Footage: 140'-150'

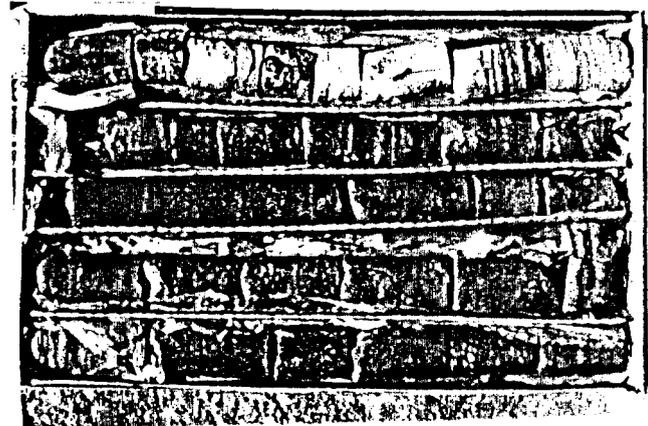


Plate 2 - 17 Footage: 170'-180'

Plate 2 - 18 Footage: 180'-190'

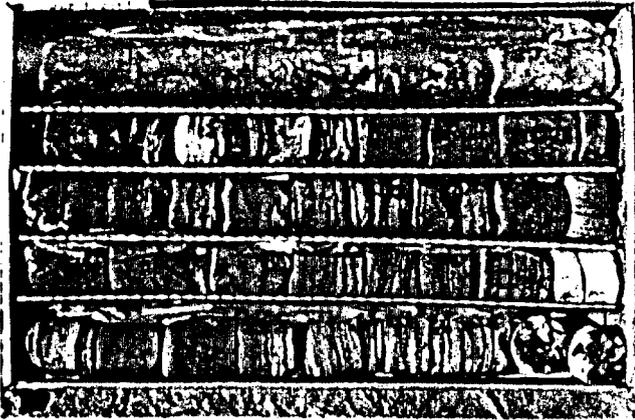


Plate 2 - 19 Footage: 190'-208'

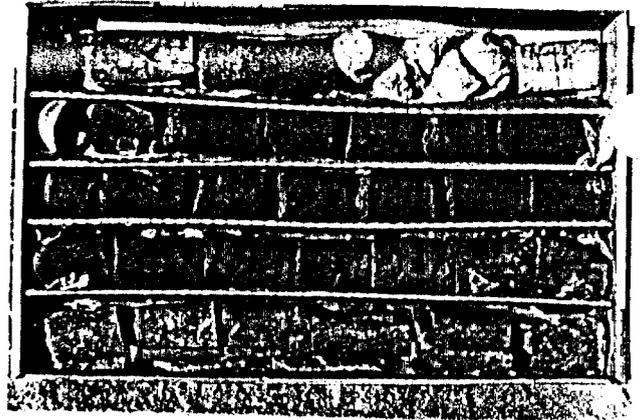


Plate 2 - 20 Footage: 208''219'

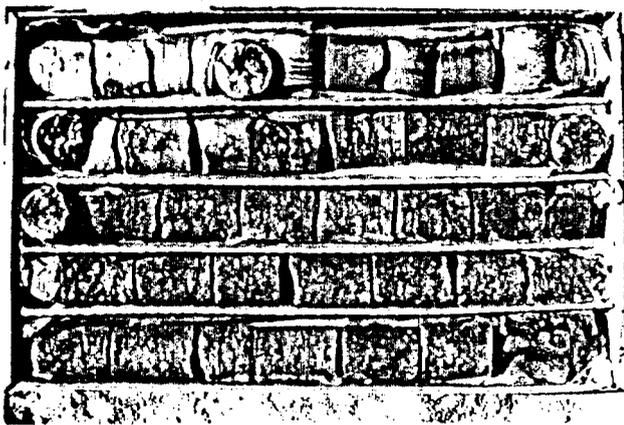


Plate 2 - 21 Footage: 219'-229'



Plate 2 - 22 Footage: 229'-251'

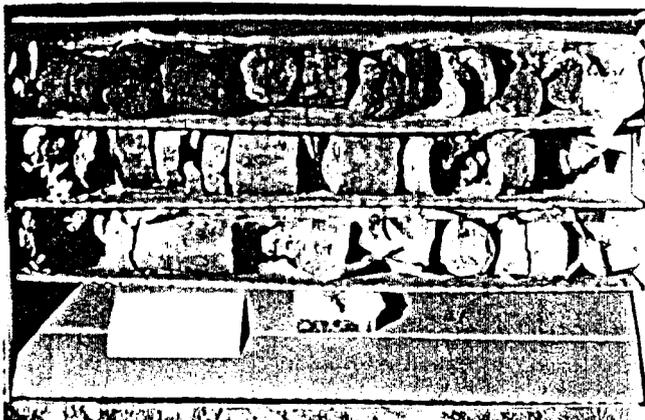


Plate 2 - 23 Footage: 251'-258'



Plate 2 - 24 Footage: 258'-268'

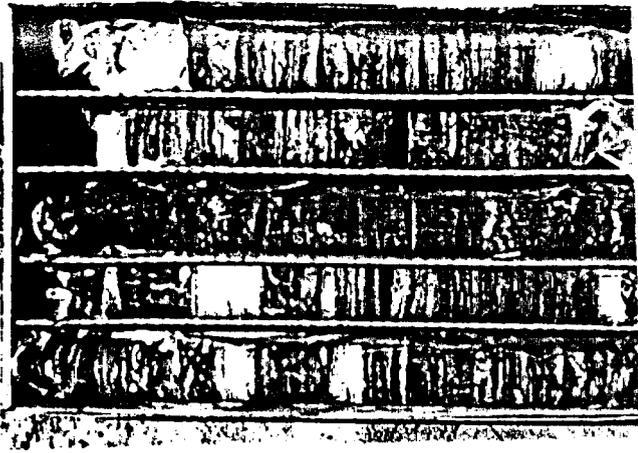


Plate 2 - 25 Footage: 268'-276'



Plate 2 - 26 Footage: 276'-285'

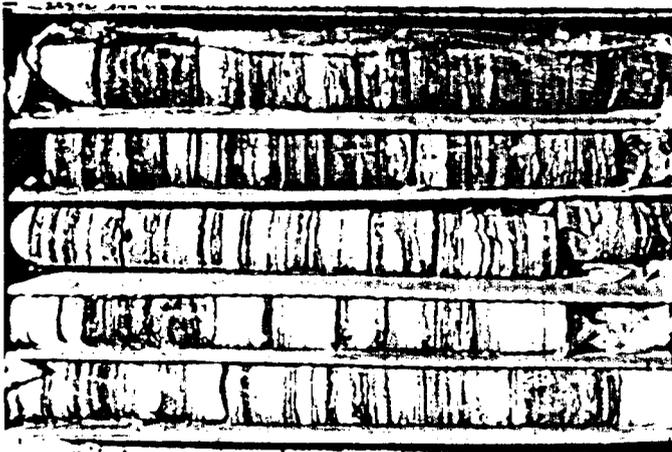


Plate 2 - 27 Footage: 285'-294'

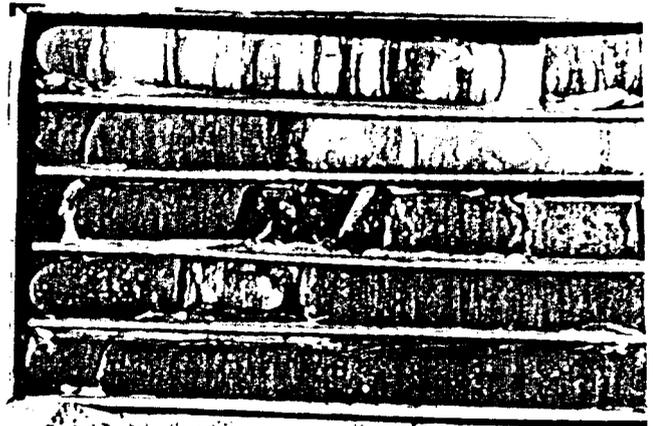


Plate 2 - 28 Footage: 294'-304'



Plate 2 - 29 Footage: 304'-308'

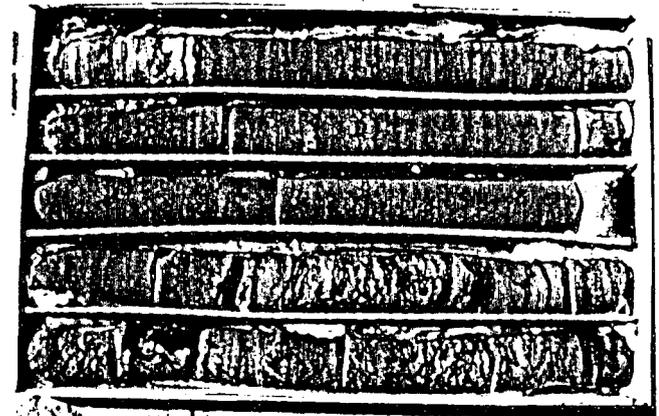


Plate 2 - 30 Footage: 308'-318'

Emery EMRIA core hole No. 3 TD 208'1"
SW 1/4 sec 22 T. 22 S., R. 6 E.
(logged by J. Green, 1978)

Plate 3 - 1 24' 36'2"

- 24'-25' SH, dk brn, calc, sft, silty, carb flks 0.1 mm, benz +
- 25'-27' As abv, sm hd zones, silty
- 27'-27'3" SILTST, wh, calc, arg
- 27'3"-29'6" SH, brn, sm zones v/ silty, more coherent
- 29'6"-33'9" SH, dk gry, silty, benz +
- 33'9"-36'2" SH, dk gry, coherent, silty, calc, uniform, carb flks and platelets, benz +, moisture pH 6

Plate 3 - 2 36'2"-45'6"

- 36'2"-37'8" SH, lighter brn, less silty, calc, benz +
- 37'8"-37'9" SH, gry, brkn, sft, silty, blue fluor, sft, benz +
- 37'9"-40' SILTST, arg, rare grn qtz grains, carb flks, dk gry, benz +, calc
- 40'-40'5" SH, dk gry-brn, sft, silty, calc, benz +
- 40'5"-41' SILTST, arg, dk gry, carb flks, calc, v/ sft
- 41'-42' SH, dk gry-brn, silty, sft, benz +, calc
- 42'-43' As abv, w/ fluor gyp veinlets & veneers on fract up to 30° from hor, gyp fibers perp to veinlet walls
- 43'-43'9" SILTST, dk gry, arg, benz + to shale
- 43'9"-44'10" SH, dk gry, v/ silty, less calc, abund pyr cylinders 0.1 by 1 mm, plant fiber replacement?
- 44'10"-45'6" SILTST, arg, as abv w/ brn limon coating on fract

Plate 3 - 3 45'6"-54'9"

- 45'6"-45'7" SH, dk gry w/ brn ptngs, calc
- 45'7"-47' Fract 33° to hor
- 47'-47'4" SH, dk gry, silty, carb flks, calc, w/ gyp-lined fractures
- 47'4"-48' SH, brn ptngs, v/ friable, calc, brkn
- 48'-50'4" SH, dk gry, sli, silty, more carb, larger flks
- 50'4"-50'6" SH, dk gry, brkn, calc, fissile
- 50'6"-53' Limon fract w/ lmm non-fluor gyp lining
- 53'-54'9" SH, silty, gry, calc, carb, tite, thin fract linings of gyp

Plate 3 - 4 54'9"-65'

- 54'9"-55 SH, gry, brkn, w/ brn calcite as veneer on fract, benz +
- 55'-55'2" SH, as abv, incoherent in water, benz + calc, carb
- 55'2"-57'5" Blue fluor spt
- 57'5"-58'5" SH, as abv, v/ friable
- 58'5"-60'2" SH, as abv, w/ ylw hor fract, sli silty, calc, carb flks
- 60'2"-62'5" SH, dk gry, as abv, more dolc
- 62'5"-63' Ylw fluor on bedding plane fract
- 63'-63'10" SH, as abv, less carb, dol
- 63'10"-64'3" Blue fluor spots
- 64'3"-64'10" SH, dk gry, as abv, w/limon stained fract, calc
- 64'10"-65' SH, dk gry, brkn, brn stained fract @ 75° to hor

Plate 3 - 5 65'-74'11"

- 65'-70'6" SH, dk gry, carb, calc, sli, silty, fissile, tite, homog
- 70'6"-71'8" SH, as abv, less calc
- 71'8"-72'4" Foss on bedding plane, 2 mm dia
- 72'4"-74'11" SH, dk gry, carb, sli, silty, dolc, fissile, benz -

Plate 3 - 6 74'11"-85'

- 74'11"-76' SH, dk gry, carb, dolc, homog, tite but fissile
- 76'-80'2" SH, as abv, dk gry, carb, calc to dolc, uniform, fissile, benz -, fluor -
- 80'2"-84' SH, dk gry, dolc, carb flks
- 84'-85' SH, as abv, tite but fissile, calc to dolc, carb flks

Plate 3 - 7 85'-97'

- 85'-88'9" SH, dk gry, fiss, uniform, dolc, carb flks, brittle
- 88'9"-95' Marker in error
- 95'-97' SH, as abv, fiss, brittle, uniform, calc to dolc, rare carb flks
>0.1 mm, abund finely divided carb spks <0.01 mm

Plate 3 - 8 97'-104'4"

- 97'-99'4" SH, dk gry, homog, fissile, brittle, silvery, calc-dolc, carb flks
- 99'4"-104' SH, as abv, tendency to break in slivers, calc-dolc, carb flks
- 104'-104'4" SH, dk gry, calc-dolc, splintery, uniform, benz -, fluor -, carb flks

Plate 3 - 9 104'4" 114'

- 104'4"-105'3" SH, dk gry, as abv, calc to dolc
- 105'3"-106'11" SH layer, gry, v/ sft, w/ pale clay matrix containing carb flks and curved golden brn bio? flks 0.1 - 0.5 mm, dolc
- 106'11"-109'3" Cream fluor patch of calcite in fibrous veinlets w/ fibers perp to veinlet walls
- 109'3"-112' Cream-tan fluor patch to 109' 3"
- 112'-113'9" SH, dk gry, dolc, carb flks, fissile
- 113'9"-114' SH, as abv, w/ wh fract filling of calcite, sli fluor

Plate 3 - 10 114'-123'9"

- 114'-116' SH, dk gry, as abv, homog, fiss, brittle, moisture in core @ pH 8
- 116'-120' SH, as abv, dolc, sli carb flks, fissile parallel to bedding
- 120'-122' SH, tr pyr?
- 122'-123'9" SH, dk gry, dolc, sli carb matl

Plate 3 - 11 125'-133'6"

- 125'-126'3" SH, dk gry, dolc, fiss, brittle, no silt, sm carb, moisture @ pH 8
- 126'3"-131'3" Hi angle frac \pm 80°
- 131'3"-133'2" SH, as abv, somewhat harder, dolc
- 133'2"-133'6" Wh patch

Plate 3 - 12 133'6"-143'3"

- 133'6"-135'2" SH, dk gry, as abv, homog, less fissile, sli silty, more competent
- 135'2"-136'4" Fluor spot, poss gyp in bedding plane seams
- 136'4"-137'5.5" Fluor spot
- 137'5.5"-138' Wh gyp seam, fibrous perp to seam wall
- 138'-138'11" SH, dk gry, sli silty, more competent, cores do not break when lifted, dolc
- 138'11"-139'1" CLAY seam, benz -, "fat" clay, light clay, w/ 0.1 mm bio? flks to 139'1"

Plate 3 - 12 cont'd.

- 139'1"-139'8" SH, dk gry, as abv, sli silty, non- fissile
139'8"-140'6" Fluor patch, 2 x 1/4 cm, non-fib calcite
140'6"-141'1" SH, dk gry, competent, tite, little carb, dolc silty
141'1"-142'3" Fluor gyp 1.5 cm x 1/4 cm lentic veinlets, wh parallel to bedding

Plate 3 - 13 142'3"-152'1"

- 142'3"-143'3" SH, light gry zone to 143'5" containing highly fluor wh calcite surrounding brn calcite
143'3"-144'4" SH, dk gry, homog, silty, tite, calc, non-fissile
144'4"-145'8" Gyp stringer, fibers perp to veinlet wall
145'8"-145'10" Calcite and gyp veinlets
145'10"-147'4" SH, as abv
147'4"-148'7" Gyp veinlet not parallel to bedding plane
148'7"-149'2" SH, dk gry as abv, but brkn to 148'9"
149'2"-150' SH, lgt gry, calc, w/ calcite seams up to 149'6"
150'-152'1" SH, dk gry, hd, tite, silty, sli carb

Plate 3 - 14 152'1"-161'11"

- 152'1"-160'9" SH, dk gry,hd, sli silty, sli carb, dolc, less fissile
160'9"-161'11" Calcite veinlet, irreg

Plate 3 - 15 161'11"-171'5"

- 161'11"-164' SH, dk gry, as abv
164'-165'8" Calcite veinlet, discontinuous 2 -18 mm long
165'8"-168'8" SH, as abv, sli silty, hd, tite, homog, dolc
168'8"-169'3" SH, as abv, sli silty w/ pods of SS, gry
169'3"-169'11" SH, mttld, cm patches of SS, gry-brn, mg - fg (1/4 mm max) carb matl, pyr, dolc
169'11"-170'3" Fluor patch 3/4 3 1/4 cm
170'3"-171'5" BLK carb patch 1 3,4 cm

Plate 3 - 16 171'5"-180'

- 171'5"-171'8" SS, gry-brn, fg-mg, massive, indist bedding, dolc, pyr, mttld carb mtl, secondary qtz faces, subang, relatively porous
171'8"-173'4" Lentic COAL lens 1/4 1 cm parallel to bedding and oval carb patches about 1 cm dia
173'4" 175'4" SS, gry-brn, fg-mg, w/ secondary q tz faces, massive more calc, sm grains w/ blk inclus, very poor, bedding 5 - 7° hor
175'4"-178'3" SS, fg-mg, subang, sm carb, por, tr pyr
178'3"-179'9" SS, gry-brn, por, fg-mg, sm carb, sm pyr, sli dolc, subang grains, massive
179'9"-180' COAL parting, 3 cm seam, water droplets stand on surf due to poss oily coating, reddish film on COAL
180'-180'5" SS, as abv, dolc

Plate 3 - 17 180'5"-189'9"

- 180'5"-181' Bright yellow fluoresence in carb lam
181'-181'1" SS, as abv, sli, pyr w/ carb parting, brner color
181'1"-181'9" Carb partings to 181'2". ylw fluor
181'9"-182" Carb lam

Plate 3 - 17 cont'd

182'-182'11" SS, brn, fg-mg, dolc, por, massive, tr oil?

182'11"-185'3" Diffuse patchey fluor

185'3"-186'5" Large carb seam parallel to bedding w/ banded lam 0.1 mm wide
seperating COAL lam w/ reddish film

186'5"-187'5" Patches of carb matl

187'5"-189'9" Diffuse carb oam 5 - 25⁰ to hor to 189'9"

Plate 3 - 18 189'9"-198'9"

189'9"-191'9" SS, brn, fg-mg, subang, non calc, carb partings, grains w/
minute pyr inclus, massive, por, non-fluor, faint bedding planes 20⁰ max to hor

191'9"-195' SS, as abv but sli clac, pyr, loosly cemented, v/ por, secondary
qtz faces on grains

195'-197'10" SS, as abv, massive, dissem pyr, calc

197'10"-198'9" SS w/ clear and milkey grains, pyr in clear grains, v/ por
variable calc

198'9"-199'4" Carb lam 55⁰ to hor, stylolite-like to 198'10"

Plate 3 - 19 201'2"-208'1"

201'2"-201'8" SS, brn, massive, fg-mg, pyr, homog, por w/ carb partings w/ COAL
layers mm thick, slickensides, reddish film

201'8"-203' Carb partings 40⁰ to hor, wavy lentic in SS. as abv

203'-207'3" SS, as abv, mod calc, massive, unif, por, sm pyr

207'3"-207'6.5" SS, carb patches, non-calc, por as abv

207'6.5"-208'1" SH, mttld, carb, silty, non-calc, non-flour, benz -

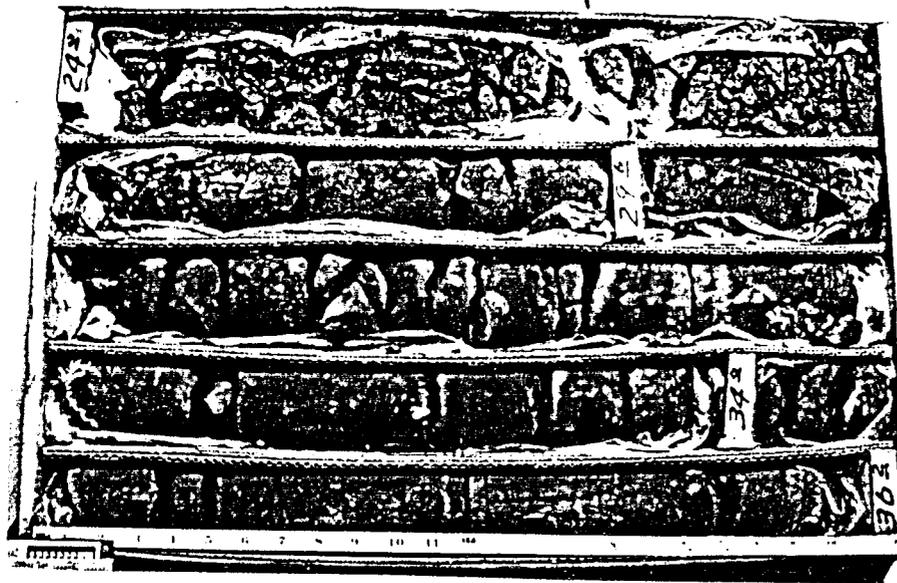


Plate 3 - 1 Footage: 24'-36'2"



Plate 3 - 2 Footage: 36'2"-45'6"

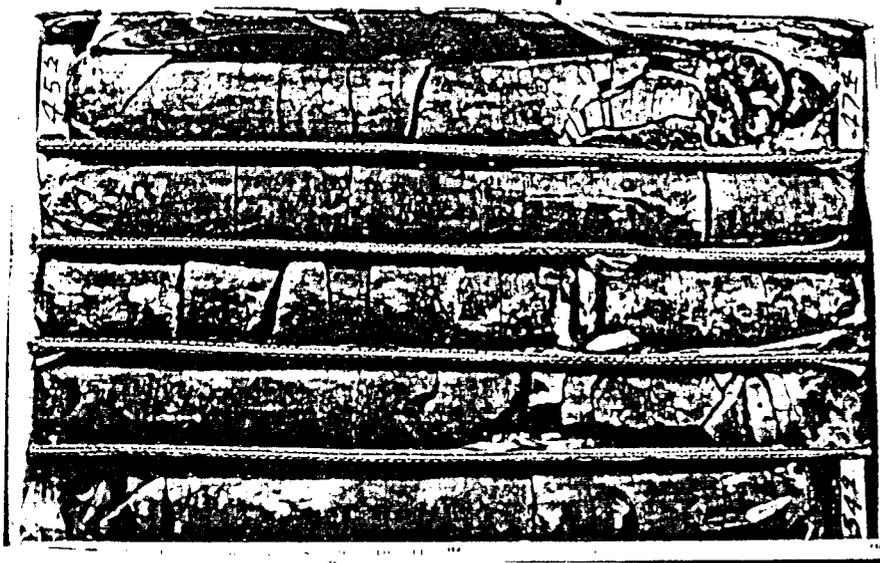


Plate 3 - 3 Footage: 45'6"-54'9"

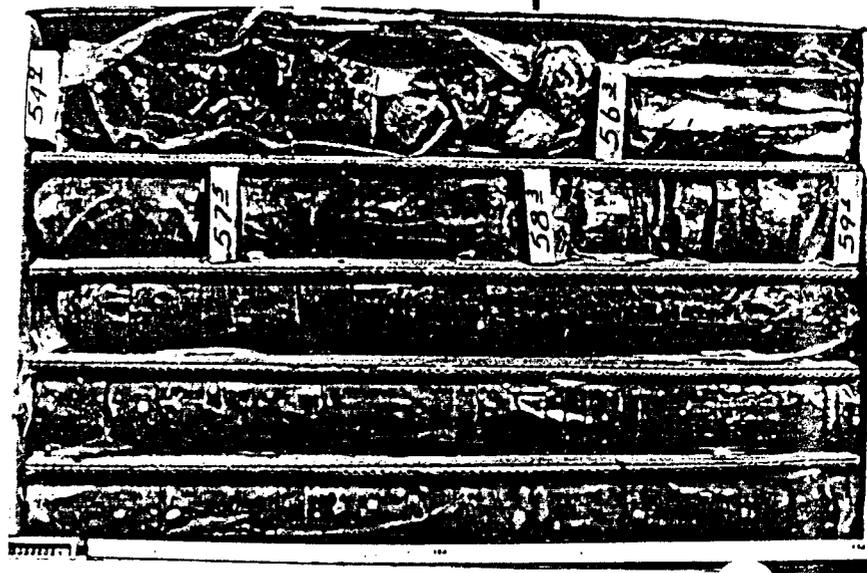


Plate 3 - 4 Footage: 54'9"-65'

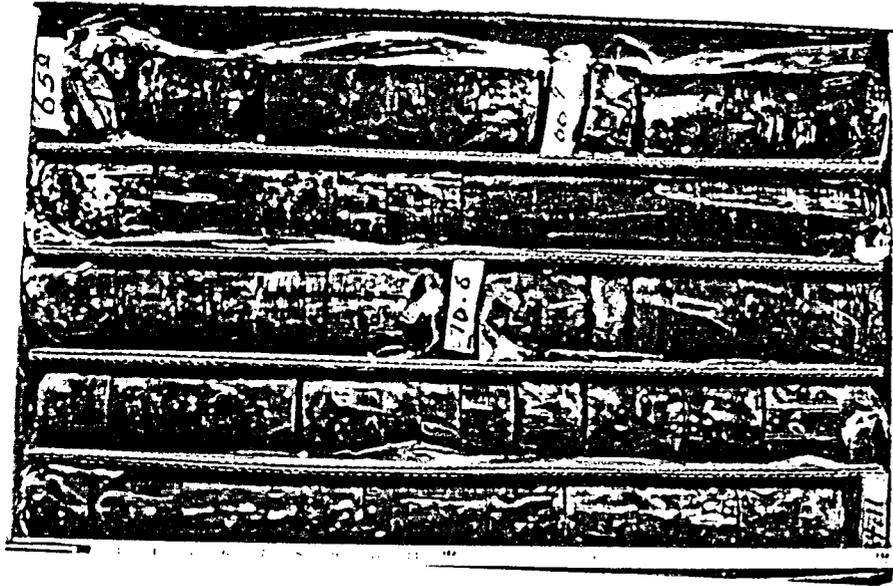


Plate 3 - 5 Footage: 65'-74'11"

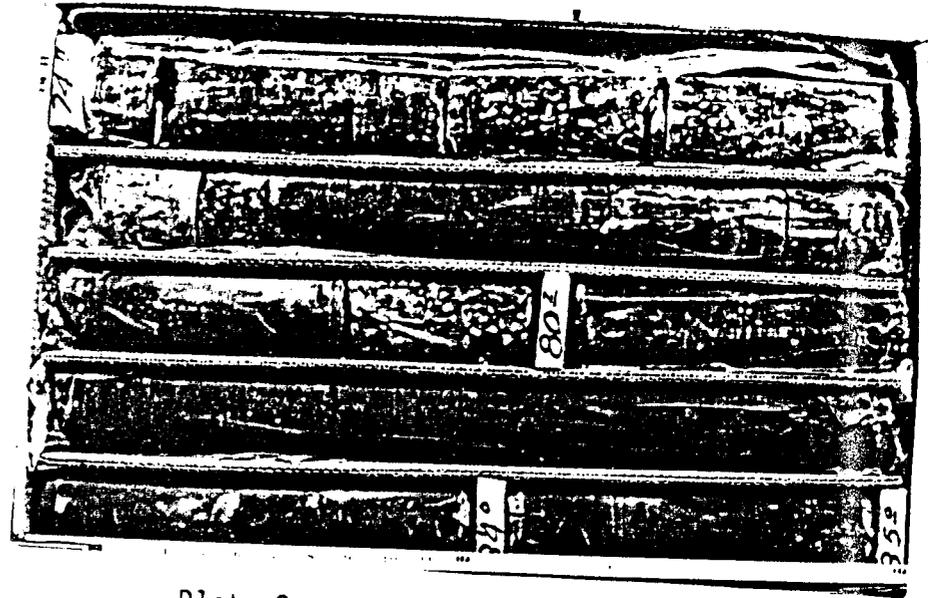


Plate 3 - 6 Footage: 74'11"-85'

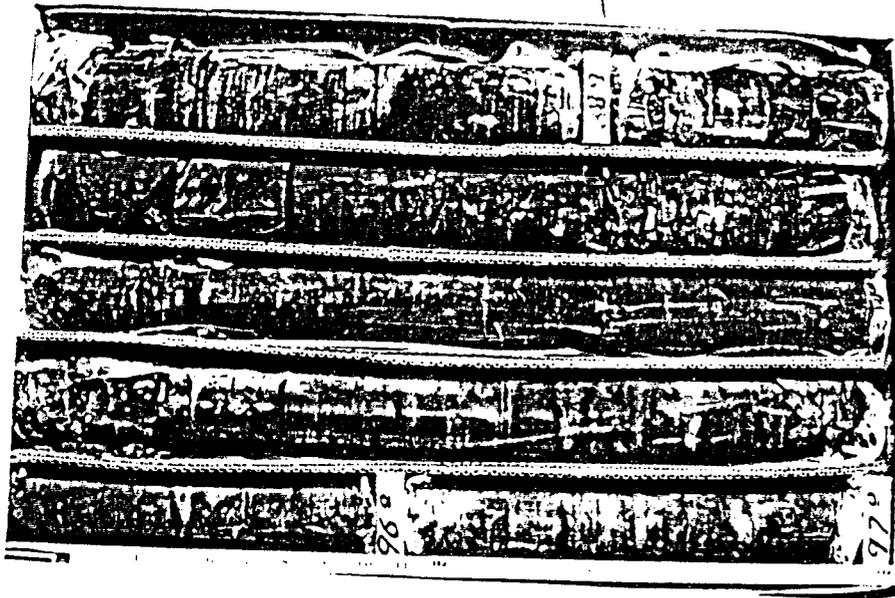


Plate 3 - 7 Footage: 85'-97'

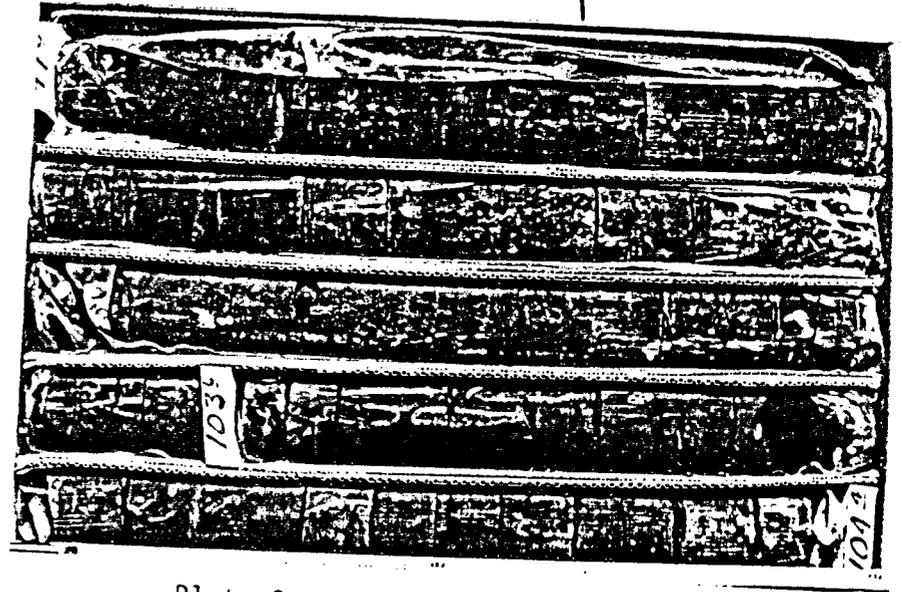


Plate 3 - 8 Footage: 97'-104'4"



Plate 3 - 9 Footage: 104'4"-114'



Plate 3 - 10 Footage: 114'-123'9"

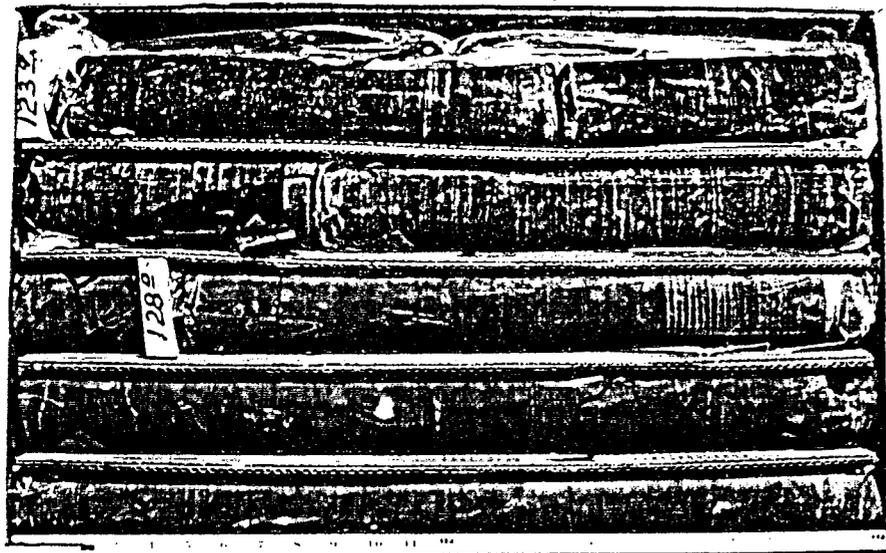


Plate 3 - 11 Footage: 125'-133'6"

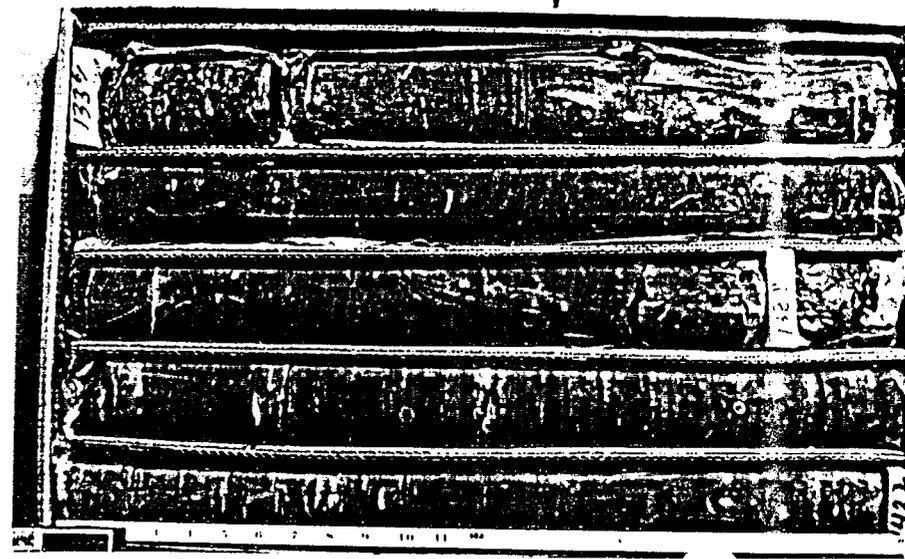


Plate 3 - 12 Footage: 133'6"-143'

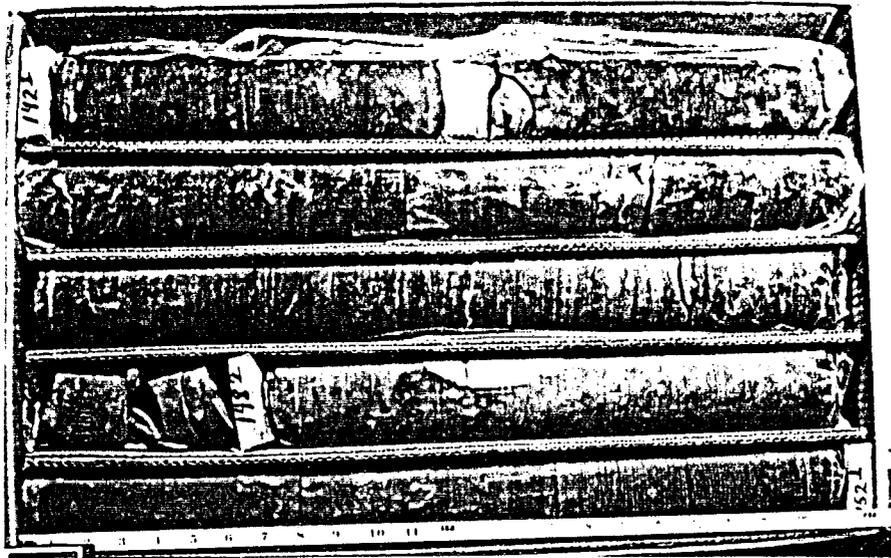


Plate 3 - 13 Footage: 143'3"-152'1"

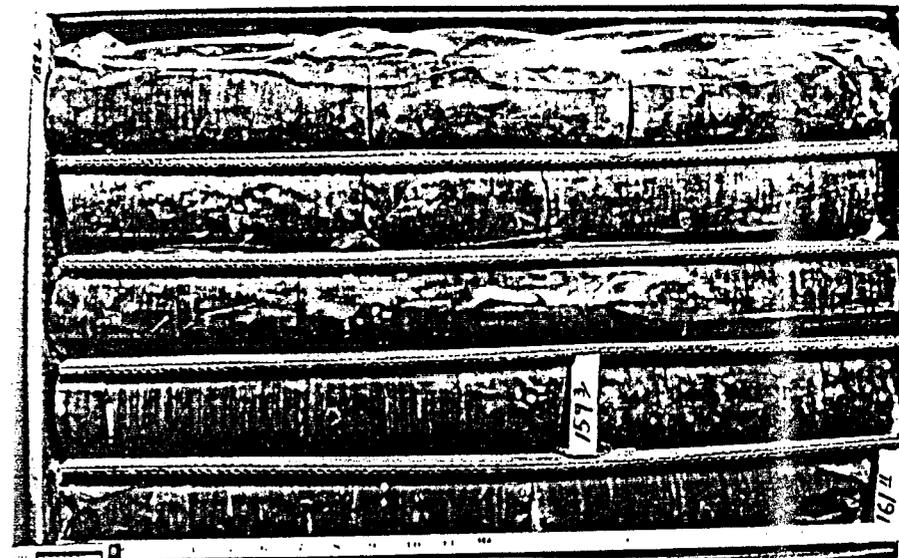


Plate 3 - 14 Footage: 152'1"-161'11"

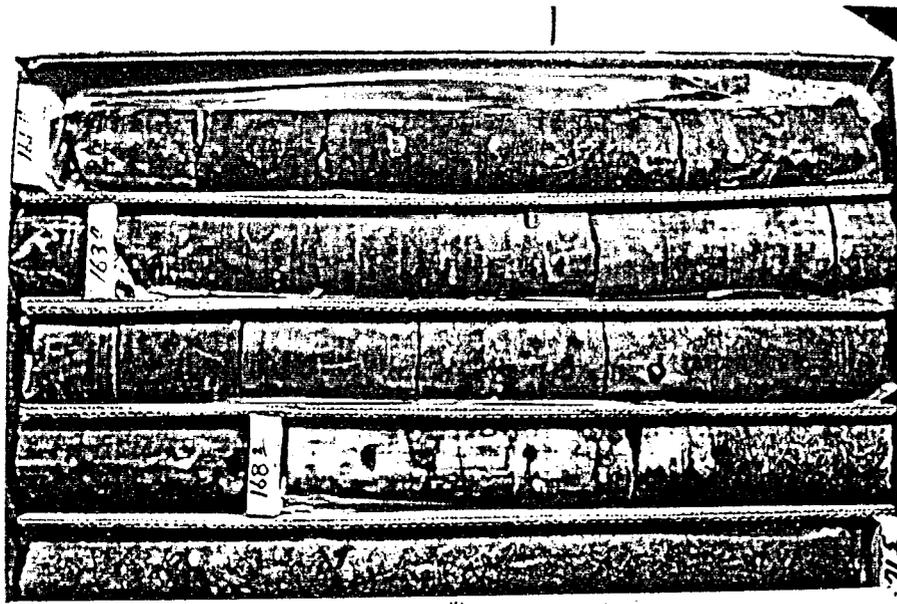


Plate 3 - 15 Footage: 161'11"-171'5"

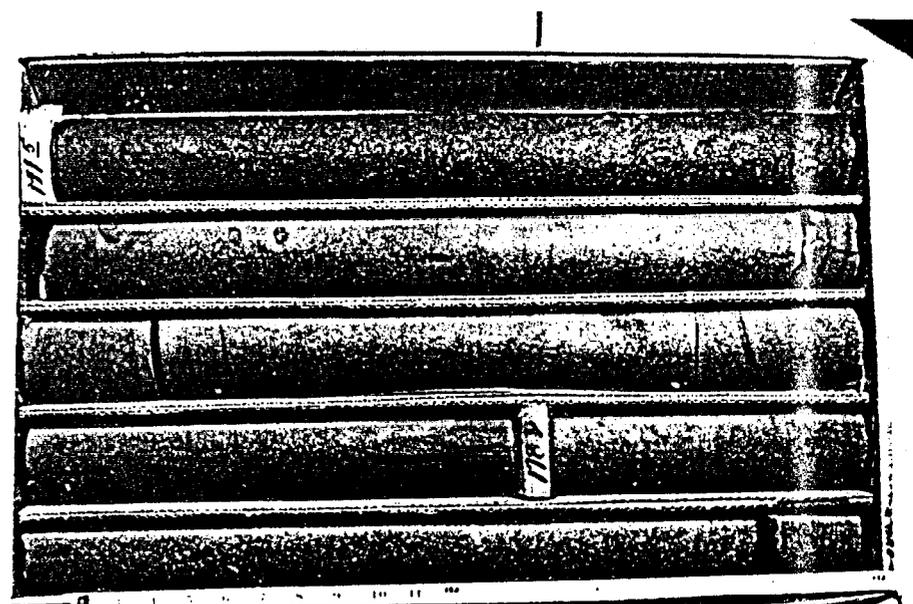


Plate 3 - 16 Footage: 171'5"-180'

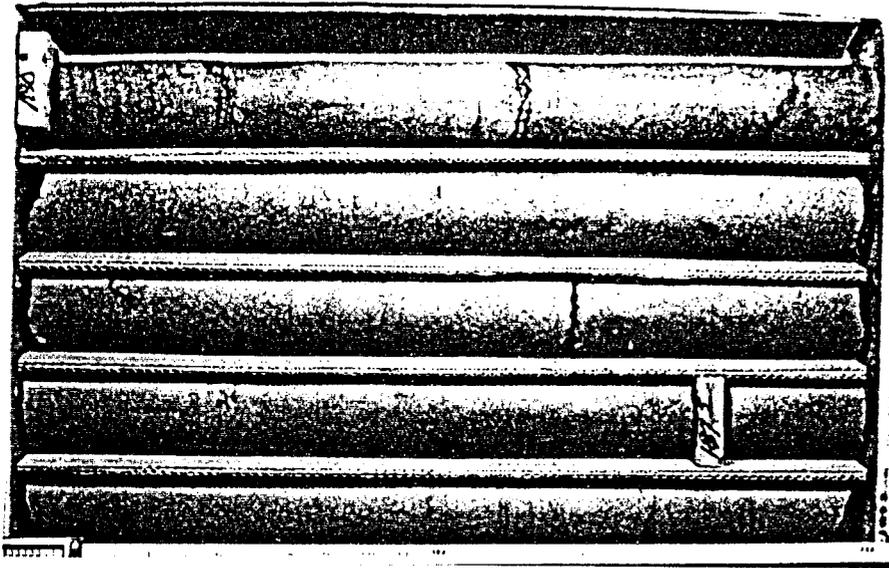


Plate 3 - 17 Footage: 180'5"-189'9"

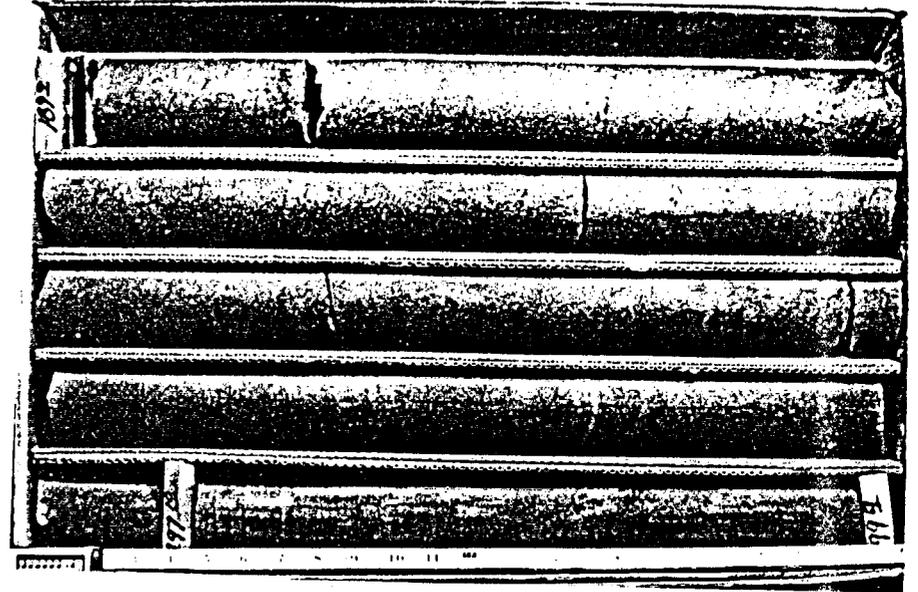


Plate 3 - 18 Footage: 189'9"-199'4"

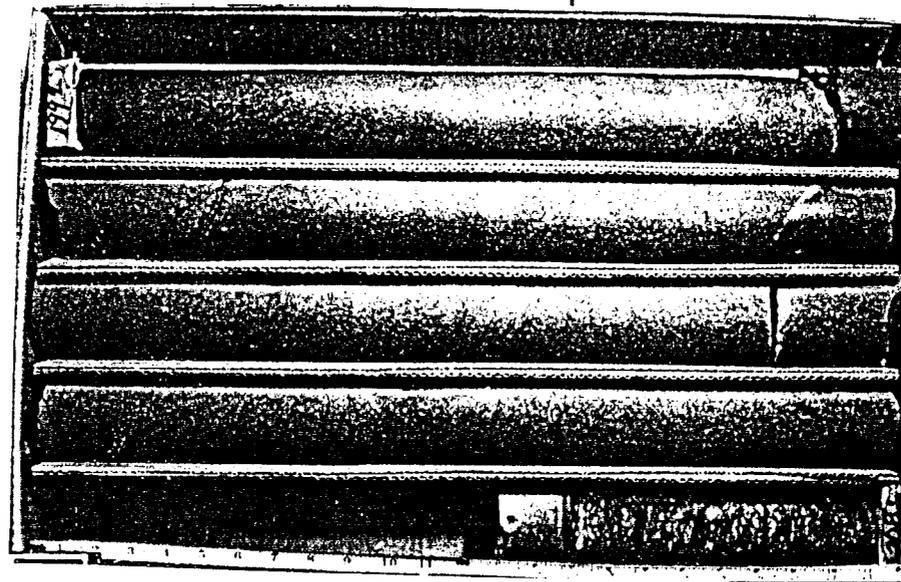


Plate 3 - 19 Footage: 201'2"-208'1"

Emery EMRIA core hole No. 4A TD 200'6"
SW ¼ sec 34, T 22 S, R 6 E
(Logged by J. Green, 1978)

Plate 4A - 1 8'-17'9"

- 8'-10' SS, fg, brn w/ limonite flecks and carb layers up to 10°
from horiz, por
- 10'-12'6" SS, fg, subang, poorly sorted, brn w/ limonite flecks,
por, non-calc grading
- 12'6"-12'11" SILTST, brn w/ carb layers and patches up to 1.5 x 1.5cm
- 12'11"-13'3" As abv w/ gray carb zones
- 13'3"-13'10" SILTST, brn, prom carb layer
- 13'10"-14'6" As abv, prom carb layer
- 14'6"-14'7" SH, grnish, w/ musc flakes less than 1mm, non-calc
- 14'7"-16'2" SS, dker brn, homog grading to spkld SS, mg
- 16'2"-16'7" SS, as abv w/ high angle carb-lined fract ($\pm 30^\circ$) to
- 16'7"-17' As abv w/ carb SH, brkn
- 17'-17'9" SS, fg, gry, non-calc, subang, w/ musc, benz

Plate 4A - 2 18'2"-27'4"

- 18'2"-18'4" SH, brn, silty
- 18'4"-19'1" SS, fg, lgt brn, subang, laminae $\pm 5^\circ$ to horiz, non-calc
both SS and lam
- 19'1"-19'4" SS, fg, brn, shaly, non-calc
- 19'4"-19'7" CLAY seam, sm musc, sft, benz⁺, non-calc
- 19'7"-20'6" SS, as abv w/ blk carb zones
- 20'6"-21'4" SILTST and SH, brn, non-calc
- 21'4"-21'9" SS, fg, brn, dolc w/ lam, non-calc, brn, sm musc
- 21'9"-22'10" SH, carb grading to SILTST, reddish, irreg w/ brn layers
- 22'10"-24'8" SS, w/ nr vert Fe-stained fract 22'8
- 24'8"-25'4" SS, fg, as abv w/ rare orange grains, dolc, carb lam
- 25'4"-27'4" SS, med-fg, dk gry, dolc, lam @ 0-20° horiz, to SS, fg, dolc, arg

Plate 4A - 3 27'4"-37'1"

- 27'4"-29'4" SS, fg, lgt gry w/ contorted carb lam, sharp breaks, non-calc,
sm lgt brn zones
- 29'4"-29'8" SS, as abv, ang grains, carb and carb lam, sm musc, sli dolc
- 29'8"-30'8" SS, as abv w/ carb current marks lam sm at 15° to horiz
- 30'8"-34' SS, as abv w/ about a dozen carb partings @15° to horiz, sli dolc
- 34'-37'1" SS, fg, w/ 0.01mm pyr, dolc, tite, turnc currnet marks, w/ SS,
more rndded grains, dk inclusion in grains, sm musc

Plate 4A - 4 37'1"-46'6"

- 37'1"-39' SS, fg, wh-lgt gry, currnet bedding up to 20° from horiz,
sm trunc, dk gry carb layers, massive bedding, dolc
- 39'-39'8" SS, as abv, subang graings, rel pure, wh, massive, dolc
- 39'8"-42' SS, as abv, w/ fract 83° to horiz
- 42'-44'6" SS, massive as abv
- 44'6"-45'9" SH partings nr horiz w/ musc flakes on surf, SS as abv,
but sli brner
- 45'9"-46'2" SS, as abv, dolc w/ nr vert brn stained fract w/ ylw fluor
in long wave UV
- 46'2"-46'6" SH, carb, blk w/ slickensided COAL, sft, non-calc

Plate 4A - 5 46'6"-55'10"

- 46'6"-48' SH, dk brn, incoh w/ blk COAL incl, non-calc
- 48'-48'6" SILTST, gry-brn, non-calc, competent
- 48'6"-52'6" SH, dk gry, brkn, non-calc becoming dker
- 52'6"-53' COAL, slickensides, brkn
- 53'-54'6" As abv but more competent, sli shaly, non-calc
- 54'6"-55'10" COAL, as abv w/ granular seam & w/ marcasite xls 0.05mm

Plate 4A - 6 55'10"-65'7"

- 55'10"-56'10" COAL, blk, massive, non-calc, small vert fract
- 56'10"-57'8" Transitional to SH, carb w/ vitreous coaly, semas and pyritised plant remains
- 57'8"-60' SH, dk gry mttld, non-calc w/ silty zones
- 60'-61'10" SH, as abv, silty zones, sli dolc
- 61'10"-62' SH, gry, silty, non-calc w/ carb lam, contorted
- 62'-65'7" SS, vfg, gry-brn w/ brn carb lam and patches, dolc, rare green grains

Plate 4A - 7 65'7"-75'2"

- 65'7"-66'11" SS, fg, lgt brn gry, dolc, w/ carb stringers/lenses
- 66'11"-68' SS, as abv, dolc, w/ irreg "spidery" fract filled w/ carb mtl, current bedding
- 68'-71'6" SS, fg, subang, brn spkld, rare musc, sli dolc
- 71'6"-72' SS, as abv, but v/ arg, carb, dolc, (wh strks @71'9")
- 72'-73' SS, fg, brn, dolc, w/ carb lam
- 73'-74'10" SS, as abv w/ close spaced wavy carb lam
- 74'10"-75'2" SS, fg, buff, sm musc, w/ coaly frag less than 0.2mm

Plate 4A - 8 75'2"-85'2"

- 75'2"-76'1" SS, light tan, fg, shot w/ carb wavy stringers 0.1mm
- 76'1"-77'2" COAL, highly slickensided, brkn irreg
- 77'2"-78'6½" SS, fg, pale brn w/ abund carb inclus and layers, brkn along bedding planes, non-calc
- 78'6½"-79' Fluorescence
- 79'-80' SS, fg, gry, non-calc w/ wh patches SILTST grading to SH, gry, friable, mttld, non-calc, sli silty
- 80'-85'2" SS, brn w/ blk strks, patches of carb mtl outlines @ 81'2", subang grains loosely cemented, grins @ 83' rich in minute pyr inclus., massive, porous, dolc

Plate 4A - 9 85'2"-95'

- 85'2"-85'10" SS, fg, brn, massive, hd, spotted, dolc
- 85'10"-88' SS, as abv, w/ carb partings @15° to horiz
- 88'-88'10" As abv w/ high angle fract calcite veneered and sm clay pods, benz+
- 88'10"-90'8" SS, fg, brn w/ bluish spots, massive, dolc, por high angle fract w/ clay surf
- 90'8"-92'2" As abv w/ carb outlined spots, lcm dia
- 92'2"-92'7" SS, as abv, mttld, w/ pods of COAL in intricate patterns (see photo)
- 92'7"-93'7" COAL, w/ slickensided partings
- 93'7"-95' As abv, but brkn, ylw stain and at 94'8"

Plate 4A - 10 95'-105'2"

- 95'-100' COAL, massive, easily brkn, wh incrustations on sm fract, slickensides, tr marcasite?
- 100'-100'4" SH, dk gry, carb, brkn, non-calc
- 100'4"-101'1" SH, kerogen? brn, pyr, v/ sli dolc, sli silty
- 101'1"-101'2" SH, sft, incoh
- 101'2"-103'6" COAL, var shaly, w/ slickensided partings, light gry SH @ 104'
- 103'6"-105'2" Marcasite (?) wafers on parting surf less than 0.2mm xls of COAL, massive

Plate 4A - 11 105'2"-114'8"

- 105'2"-108'6" COAL, massive, sm hi angle fractures and slickensides
- 108'6"-108'9" SH, carb, silty, non-calc
- 108'9"-109'7" SS, fg, lgt gry-brn, silty esp. @ 110'5"
- 109'7"-110'8" SS, fg, brn patches, sm pyr and green grains
- 110'8"-114'8" SS, as abv, w/ brn stain on fract, non-calc grading to SS, brnish w/ dk indist silty layers/lenses, scant pyr and green grains subang qtz grains, non-calc

Plate 4A - 12 114'8"-124'2"

- 114'8"-118' massive SS, fg, brn-gry, tr pyr, w/ pink grains at 116' 8" non-calc,
- 118'-119'9" SS, as abv, sli calc
- 119'9"-124' SS, fg to mg, abund carb partings, esp @ 121'5" calc
- 124'-124'2" SS, mg, pyr, massive w/ carb lam, sm trunc

Plate 4A - 13 124'2"-133'6"

- 124'2"-126'5" SS, gry, dolc cement, fg to mg, qtz grains w/ xl faces (secondary?), sm green grains, carb incl, pyr, current bedding defined by carb mtl 0 to 30° to hor, tr musc less than or equal to 0.1mm
- 126'5"-129' SH, dk gry, sli silty, carb dissem, dolc, homog, tite
- 129'-129'1" Scattered bright blue short UV spks to 129'5"
- 129'1"-130'8" SH, as abv, sli silty, dolc
- 130'8"-132' Lentic, blk coaly lens concave up, 3cm wide
- 132'-133'6" Lentic more calc patches 2 x 4cm

Plate 4A - 14 133'6"-142'7"

- 133'6"-137'3" Sh, dk gry, silty, dolc, w/ wh to lgt gry mtl in dolc SS lenses
- 137'3"-138'9" SH, wh to brn, dolc, cherty @138'-138'2" interval w/ slickensides, fg, tite, fract coated w/ calcite xls
- 138'9"-139' SS, wh, fg, dolc, subang qtz grains w/ fn 1/2mm SH lam
- 139'-141' SS, as abv, w/ carb silty layers, dolc
- 141'-142'4" SS, fg, wh contorted parallel lam and blk carb lam, dolc
- 142'4"-142'7" SH, silty, sft

Plate 4A - 15 142'7"-151'5"

- 142'7"-143'10" SS, gry, wh, dolc, w/ fn carb lam and current bedding marks
- 143'10"-144'8" SS, wh, fg, w/ parallel 1cm lam
- 144'8"-146' COAL, blk, vert fract, pure, slickensides, non-calc
- 146'-148'9" As abv w/ vert fract
- 148'9"-148'11" Trans to carb SH, silty, sli dolc
- 148'11"-151'3" SS, fg, wh, w/ carb matl in fract, dolc
- 151'3"-151'5" SH, dk layer, silty, fissile

Plate 4A - 16 151'5"-160'3"

- 151'5"-152'9" SILTST, gry, w/ rare coaly strks, dolc
- 152'9"-155' SH, silty, contact irreg, carb w/ SS, fg, dolc w/ convoluted current marks
- 155'-158' Interbeds of SH, blk, fissile, sli dolc w/ SS, fg, gry, containing calc SILTST, carb
- 158'-158'6" Sm hi angle fract in SILTST, carb, contorted
- 158'6"-159' SH, dk gry, sli fissile, more calc
- 159'-159'7" SS, fg, more clac w/ sm intricate convoluted carb lam w/ gypsum in plates in fractures
- 159'7"-160'3" Discontinuity to more fg gry SS, calc

Plate 4A - 17 160'3"-169'2"

- 160'3"-163'4" SS, fg, gry w/ dker silty lam mm-cm thk, lam irreg and contorted
- 163'4"-164'3" SH, partings, slickensided
- 164'3"-166'2" SS, as abv, calc
- 166'2"-166'3" With pyr and rare pink-brn grains, calc
- 166'3"-167'8" SH, silty, zone w/ SS, fg, w/ dolc mttld curved SH clasts in SS
- 167'8"-168'10" Dolc, carb clay seams
- 168'10"-169' Vert fract
- 169'-169'2" SS, fg, w/ carb silty seams/lam w/ rare pyr/hem grains

Plate 4A - 18 169'2"-178'1"

- 169'2"-169'11" SS, lgt gry, fg, homog, massive, calc, secondary xl faces?
- 169'11"-170'5 $\frac{1}{2}$ " SS, w/ variegated carb silty and shaly layers-contorted sm jet blk carb layers 3cm wide, wavy contacts
- 170'5 $\frac{1}{2}$ "-173'11" Wh xln mtl on carb seam w/ brilliant purple fluorescence
- 173'11"-178' SH, silty, blk, dolc, fiss, benz- to SS, brnsh, homog, fg, pyritic, por, calc, w/ occas carb stringers $\frac{1}{2}$ cm wide, rare carb skeletal matl within qtz grains
- 178'-178'1" Carb stringer to SS, wh, variegated w/ carb stringers

Plate 4A - 19 178'1"-187'7"

- 178'1"-178'3" SH, carb, calc
- 178'3"-178'5" SS, v/ lgt brn w/ wavy dk stringers contorted
- 178'5"-179'6" SS, brn, massive, fg, calc, w/ wh spks outlined by blk carb mtl
- 179'6"-181' Fluor patch (short wavelength UV)
- 181'-182'10" SS, brn, fg, w/ dk carb stringers and clasts, clasts are internally layered @187'7", wavy coaly seams at 180'6" and 181'6"
- 182'10"-186' SS, dker brn, fg, grains w/ minute inclus pyr, sli dolc
- 186'-187'7" SS, variegated, lgt brn w/ drk carb clasts, sli dolc

Plate 4A - 20 187'7"-197'8"

- 187'7"-188' SH, carb, dolc
- 188'-189'9" SS, gry, fg, calc, w/ blk carb stringers
- 189'9"-190' SH, blk carb partings
- 190'-193' SS, as abv, fg, w/ blk carb partings/seams, calc cement
- 193'-193'1" SS, fg, por, calc, subang grains, wh, sm blue fluor in SH partings
- 193'1"-194'9" SS, variegated, dk gry and wh SS, silt carb lam
- 194'9"-196'9" SH, parting, lcm thk, fluorescent
- 196'9"-197'8" SS, fg, v/ dk gry and SH

Plate 4A - 21 197'8"-200'6"
197'8"-200' SH, w/ COAL seams, w/ silty layers
200'-200'6" SH, dolc, silty cross cutting layers

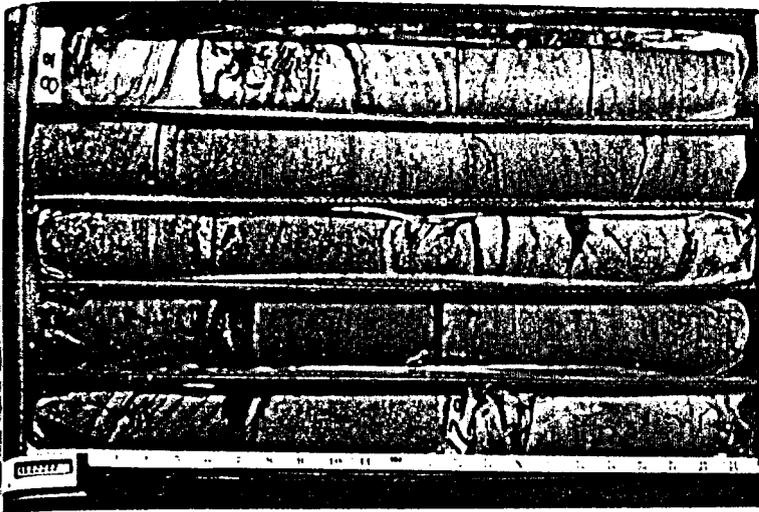


Plate 4a - 1 Footage: 8'-17'9"

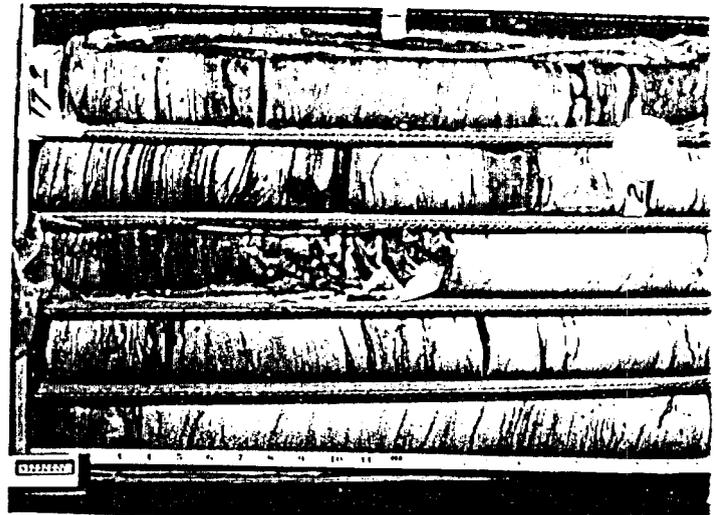


Plate 4a - 2 Footage: 17'9"-27'4"



Plate 4a - 3 Footage: 27'4"-37'1"

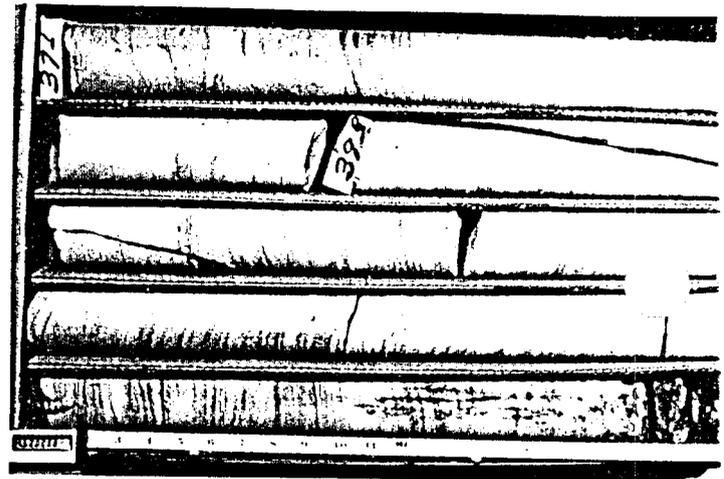


Plate 4a - 4 Footage: 37'1"-46'6"



Plate 4a - 5 Footage: 46'6"-55'10"

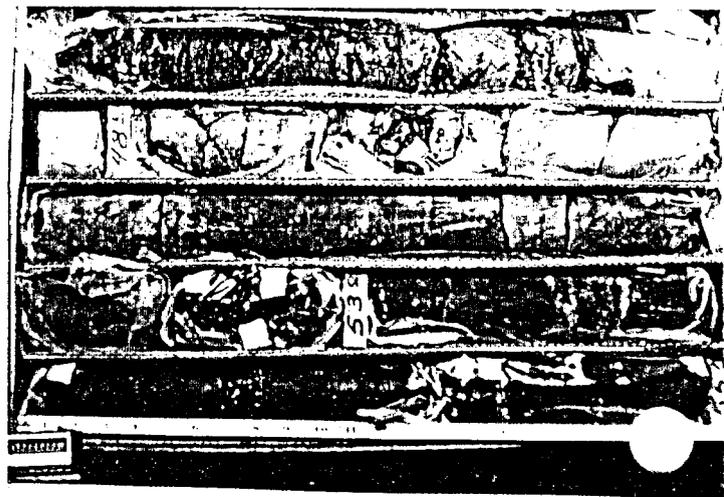


Plate 4a - 6 Footage: 55'10"-65'7"

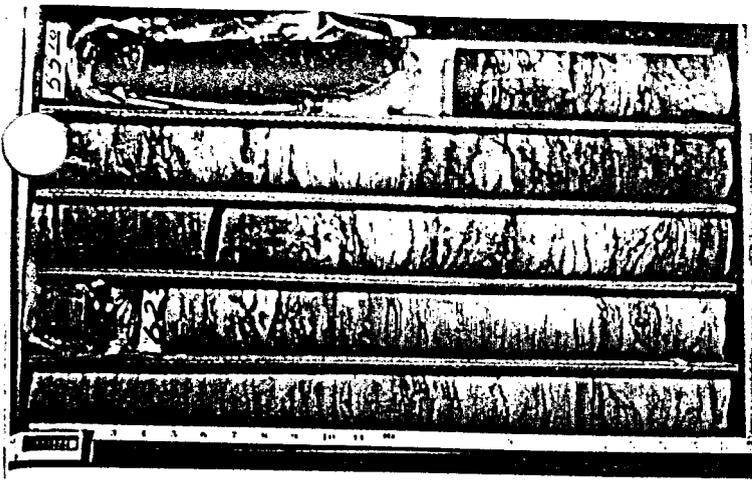


Plate 4a - 7 Footage : 65'7"-75'2"

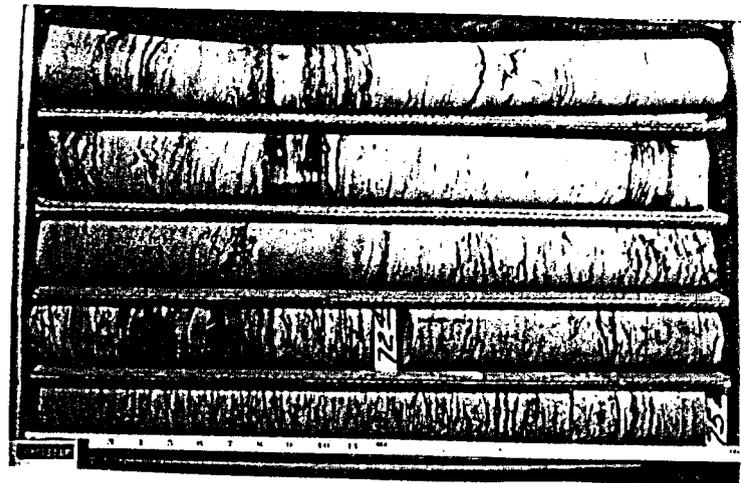


Plate 4a - 8 Footage: 75'2"-85'2"

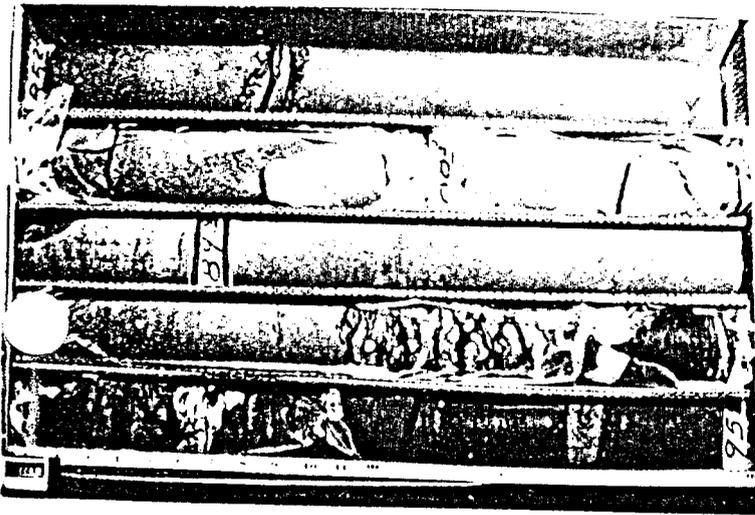


Plate 4a - 9 Footage: 85'2"-95'

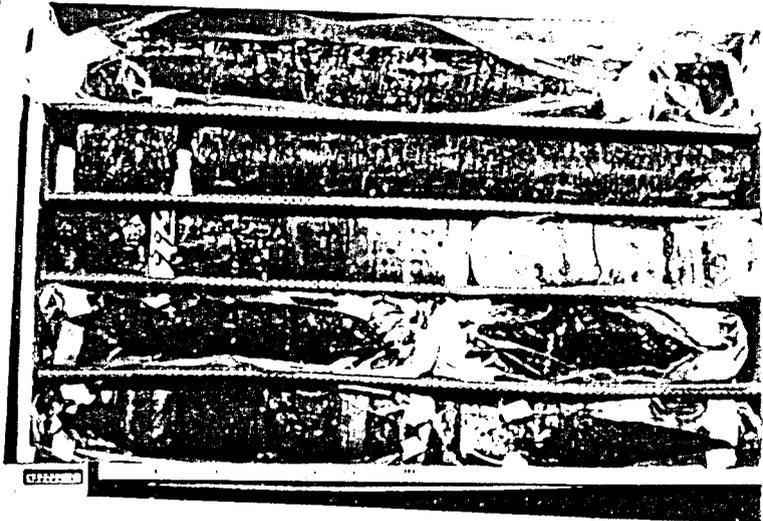


Plate 4a - 10 Footage: 95'-105'2"

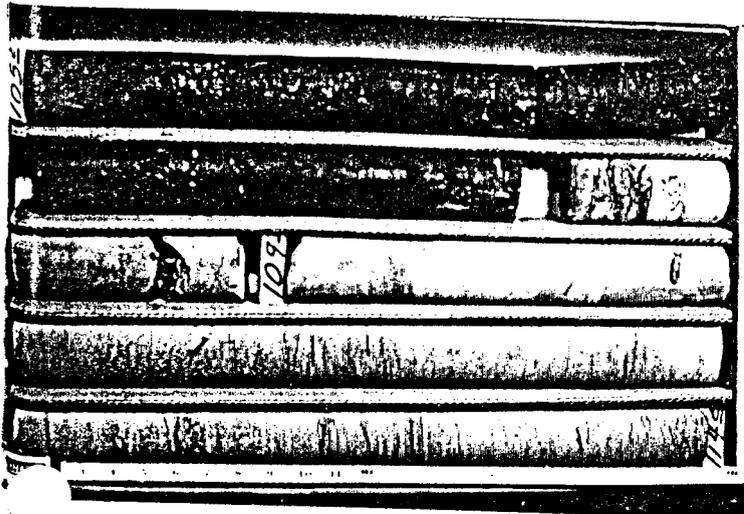


Plate 4a - 11 Footage: 105'2"-114'8"

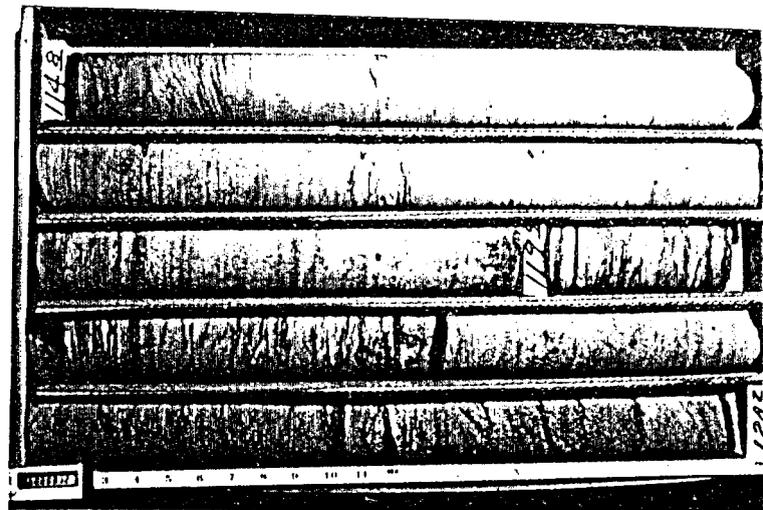


Plate 4a - 12 Footage: 114'8"-124'2"

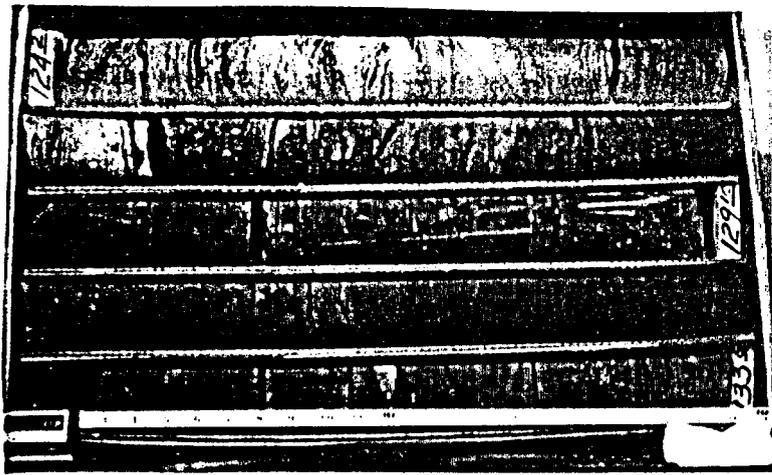


Plate 4a - 13 Footage: 124'2"-133'6"



Plate 4a - 14 Footage: 133'6"-142'7"

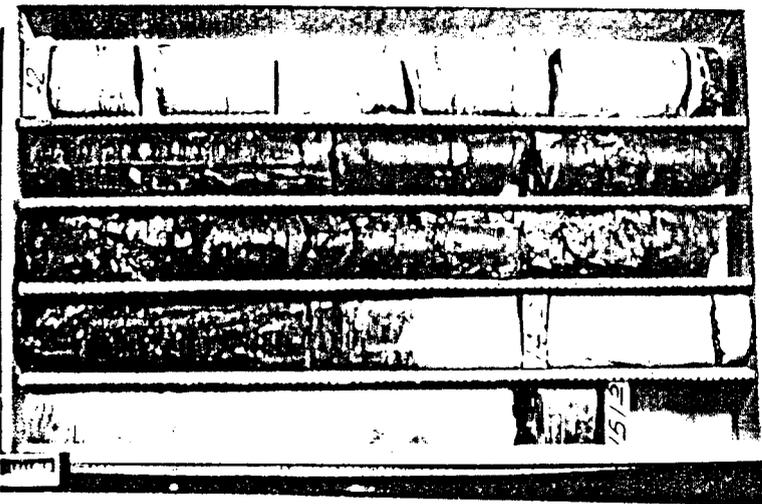


Plate 4a - 15 Footage: 142'7"-151'5"



Plate 4a - 16 Footage: 151'5"-160'2"



Plate 4a - 17 Footage: 160'3"-169'2"



Plate 4a - 18 Footage: 169'2"-178'1"

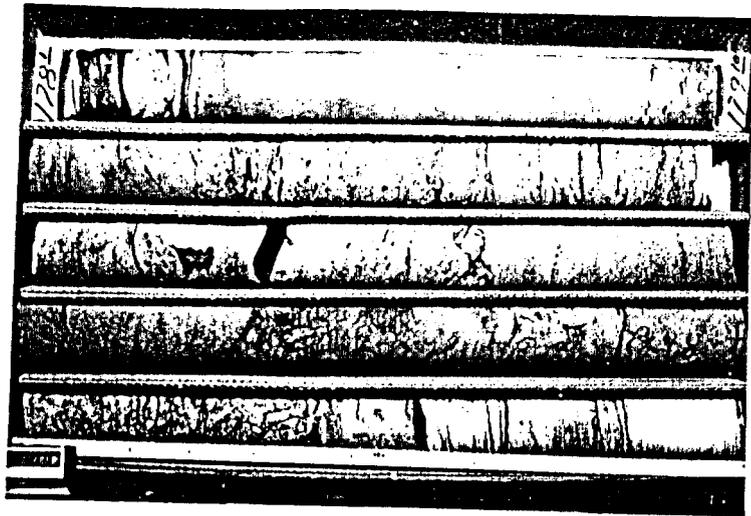


Plate 4a - 19 Footage: 178'1"-187'7"



Plate 4a - 20 Footage: 187'7"-197'8"

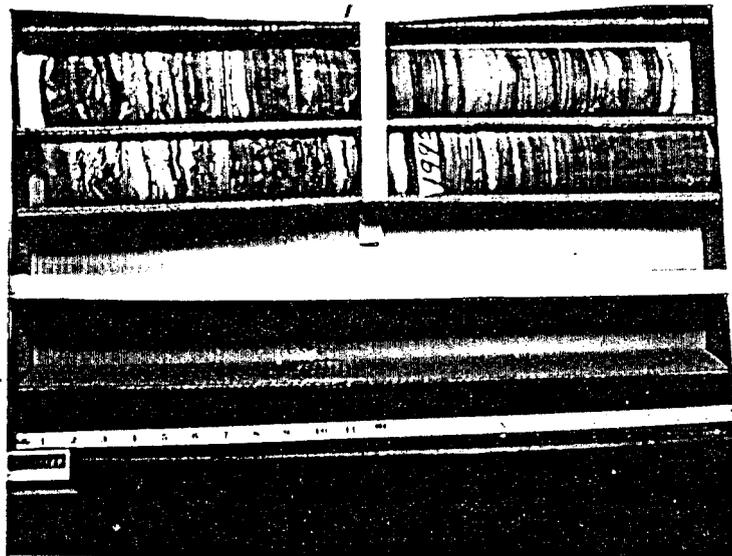


Plate 4a - 21 Footage: 197'8"-200'6"

Emery EMRIA core hole No. 5 TD 300'
Sw ¼ of SW ¼, sec 3, T 23 S, R 6 E
(Logged by J. Green, 1978)

Plate 5 - 1 8'5"-17'9"

- 8'5"-9'10" SS, tan, fg, sli amt carb matl, non calc, por, well sorted
- 9'10"-10'7" SS, as abv w/ carb lam diffuse 25° to horiz
- 10'7"-11'4" SS, dk brn, massive, w/ blk mttld carb spks, por
- 11'4"-13'6" SS, lgt brn, fg, por, w/ scant carb mtl grading to dker
brn SS, carb inclusions, non-calc
- 13'6"-14'1" SS, lgt tan, mg w/ sm grains up to 1 mm dia at 14' w/ sm
feldspar frags, mod well sorted, por
- 14'1"-15'3" SH, lgt gry, w/ brn ptngs, broken, "fat" clay
- 15'3"-16' CLAY, lgt, gry, plastic, sli silty non-calc
- 16'-17'2" SH, dk gry, sft, hi carb, brkn, non-calc, sli silty
- 17'2"-17'9" SH, lgt brn gry, as abv, non-calc

Plate 5 - 2 17'9"-27'3"

- 17'9"-18' SH, dk brn, dissem carb, sft, non-calc
- 18'-18'6" V/ dk gry, hi carb, crumbly, non-calc
- 18'6"-18'9" SH, gry brn, brkn, sft, crumbly, non-calc, sm carb
- 18'9"-20'2" SH, gry, w/ lim prings parallel to bedding, sli silty,
sft, non-calc, transitional
- 20'2"-22'6" SH, lgt gry, "fat" clay matrix, sft, non-calc w/ sm
brn patches, non-swelling clay
- 22'6"-22'11" SH, brn, sft, non-calc, indist. layering
- 22'11"-23'3" SH, as abv, incoherent, crumbly brkn, non-calc, non-swelling
- 23'3"-25'3" SH, gry, sft, non-calc, wh spks, sli silty
- 25'3"-27'3" SH, gry, more coherent, non-calc, sm high angle fract
w/ brn zone @ 26'3"

Plate 5 - 3 27'3"-37'

- 27'3"-27'7" SH, dk gry, non-calc, sft, sli silty
- 27'7"-28'6" SH, brn, brkn, silty
- 28'6"-29'7" SS, fg, brn, w/ thin 1-3mm thk carb layering parallel
to bedding, lam dk brn-blk, wavy, calc
- 29'7"-29'11" SH, dk gry as abv (possibly misplaced core section?)
- 29'11"-33' SS, fg, brn, sm silt sizes, sm hi angle fract, fract surf
uncoated, calc
- 33'-35' SS, lghter brn, calc, fg, sm carb matl
- 35'-35'6" SS, fg, lght gry brn, carb flks, dolc
- 35'6"-36'5½" SS, brn, fg, carb flks and lam, wavy, parallel to bedding
massive, dolc
- 36'5½"-36'8" SH ptng (3mm), to SS, lght gry-brn w/ carb lam, dolc
- 36'8"-37' SS, brn, dolc, fg, carb mtl, somewhat por

Plate 5 - 4 37'-47'11"

- 37'-37'5" SS, fg, lgt brn-gry, calc, por, sm flks carb matl
- 37'5"-39'2" SS, brn, w/ dk brn to blk lam parallel to bedding, dolc
- 39'2"-39'4" SS, fg, lgt gry, calc, por, less carb flks grading
- 39'4"-43' SS, brn, as abv, dolc w/ lgt gry layered SS, fg at 39'9"
- 43'-46' SS, dker brn, w/ abund carb lam parallel to bedding about
5mm apart, rare clay stringers, dolc
- 46'46'6" SS, dk brn, fg, w/ hi angle fract up to 90°, carb, fract
surf w/ "oily" appearance, i.e., water stands in droplets
- 46'6"-47' SS, brn, as abv, w/ carb lam, dolc

Plate 5 - 5 47'1"-57'2"

- 47'1"-48'9" SS, brn, fg, w/ carb bedding plane lam nr horiz, dolc, por
- 48'9"-49'1" As abv, more calc
- 49'1"-50'2" SS, brn, dolc, por, w/ hi angle 60° carb veneered fract to 49'6"
- 50'2"-52'10" SS, fg-mg, dolc, w/ hi angle fract coated w/ dk calc matl
- 52'10"-53'4" SS, fg, sm silt sizes, sli arg, dolc
- 53'4"-54'1" SS, pink to dk red, lam w/ carb spks up to 2mm dia, sm 0.5mm wh lam seams parallel to bedding, sm wh specks, abund musc lmm max, non-calc
- 54'1"-55'4" As abv, v/ dk red, blk carb spks, lam, non-calc
- 55'4"-57'2" SS, as abv, brighter red

Plate 5 - 6 57'2"-69'

- 57'2"-59' SS, fg, pink w/ wh lam more calc than dker lam, musc flks, brkn
- 59'-61'3" As abv
- 61'3"-63' SS, fg, brkn, non-calc, red-light pink lam 5° from horiz, hi angle fract 85°, bleached sli wavy surf, to 62'10"
- 63'-65' SS, as abv, non-calc, v/ dk red, brkn
- 65'-65'6" SILTST, gry, arg, w/ blk spks, non-calc, brkn
- 65'6"-65'9" SS, fg to silty, red, non-calc
- 65'9"-67' SS, as abv, w/ brn Leisgang zoned patch to 65'11", hi angle 80° fract w/ dk red fract surf
- 67'-67'6" SS, silty, arg, red, brkn, crumbly to 67'6"
- 67'6"-67'9" SH, silty, gry, to SILTST, dk gry, arg, non-calc
- 67'9"-67'10" SH, layer, red, 3/4mm thk, non-calc, silty in SILTST, as abv
- 67'10"-68' CLAY, wh, fat, non-calc, benz+, to 68'
- 68'-69' CLAY, lgt brn, sft, non-calc, sli silty, sm lavender mttling

Plate 5 - 7 69'-79'

- 69'-71'8" CLAY, gry-brn, silty, non-calc, sft, wavy
- 71'8"-72'5" CLAY, as abv, w/ dk clay chips to 72'
- 72'5"-72'10" CLAY, wh, non-calc, expanded dia (2.5'), scour lenses layers 23° to horiz
- 72'10"-73' CLAY, brn, v/ sft, crumbly, sli silty, non-calc
- 73'-77'2" SILTST, pinkish, mttid, non-calc, current bedding, lenses, scour zones, wh stks on surf, massive
- 77'2"-77'7" SILTST, red, ylw sli wavy bedding layers, arg, sft, cm thk
- 77'7"-77'8" SILTST, red ylw, arg w/ tan clay 3/4cm thk, non-calc
- 77'8"-77'9" CLAY, silty, non-calc, dk gry, contact
- 77'9"-79' SILTST, gry, sli carb, non-calc, healed hi angle fract 80°, scour features, massive

Plate 5 - 8 79'-94'

- 79'-81' SS, fg, variegated gry-wh, sm layers 1cm apart, current bedding scour feat, massive, non-calc
- 81'-82'4" As abv, but brkn to 81'3" then massive, sm shaley bedding plane breaks
- 82'4"-83' SS, dk gry carb layers, bedding @ 12° to horiz
- 83'-88'9" SH, dk gry, clay-rich, scour lenses, patches, non-calc, sm red patches
- 88'9"-89' SH, v/ dk gry, spkld, tr eff, carb
- 89'-89'6" Missing core
- 89'6"-90'2" SILTST, arg, gry-brn w/ limon films on pting surf transitional
- 90'2"-92'6" SILTST, wh w/ grnish stain, non-calc, massive
- 92'6"-93'7" As abv, hi angl fract
- 93'7"-94' SILTST, wh, in irreg contact w/ SILTST, gry (sm brn) in scour mark contact

*Core missing 89' to 89'6" also in the 85 to 89 foot interval.

Plate 5 - 9 94'-104'

- 94'-94'3" SH, brn, calc, brkn
- 94'3"-95' SH, gry silty, non-calc, hi angl fract @ 94'7", surf uncoated
- 95'-98'6" SH, as abv, silty
- 98'6"-99' SH, dk gry, clayey, carb, non-calc, sft, non silty
- 99'-101'7" As abv w/ reddish prtngs, non silty
- 101'7"-102'7" SH, trans to silty SH, brn zone
- 102'7"-103' SH, silty, gry, w/ reddish clayey zone containing minute spks
- 103'-104' SH, silty, trans to lgt gry, dolc w/ dk layers 38cm wide less than 4° to horiz

Plate 5 - 10 104'-113'4"

- 104'-104'6" SH, med gry, sli dolc, silty, trans to dker gry
- 104'6"-105'2" SH, silty
- 105'2"-106' SILTST, reddish, arg to 105'7"
- 106'-106'6" SILTST, brn, tr musc, to 106'6" non-calc trans
- 106'6"-107' SILTST, lgt gry, non-calc
- 107'-108'3" Hi angl fract
- 108'3"-109'3" SILTST, wh, rel pure, calc, scour/current marks
- 109'3"-110'3" SILTST, gry, uniform, massive, becoming dker and variegated calc
- 110'3"-111' Seam of calcite
- 111'-111'8" SH, gry, silty, carb, calc, fibrous gyp veinlets
- 111'8"-112' SH, dk gry, carb, non-calc
- 112'-113'1½" SH, blk, carb, non-calc, 1mm gyp veinlet @112'7"
- 113'1½"-113'4" Carb pting, water stands in droplets, to SH, carb, gry-brn

Plate 5 - 11 113'4"-122'1"

- 113'4"-114'6" SH, hi carb, coaly, blk, non-calc
- 114'6"-114'11" SH, v/ silty, lgt gry, non-calc, w/ hi angl carb lined fract
- 114'11"-116'6" SS, silty, lgt gry
- 116'6"-117' SS, pure, wh, fg, non-calc
- 117'-120' SS, brn, fg, w/ carb mttling, current bedding planes at 15° to horiz, also sm red mttling
- 120'-122'1" SS, lgter brn w/ dk layering, gyp veinlet @45° to horiz, dk carb strks mod to hi angl, layers terminate @120'11", abund scour feat

Plate 5 - 12 122'1"-131'1"

- 122'1"-122'6" SS, gry-brn, non-calc, bdding 15-30° to horiz defined by brn to blk carb layers
- 122'6"-124' Limon patch 5 x 8 mm
- 124'-124'9" SS, as abv w/ blk non-calc layers, carb ptngs not wettable, lam mm-cm apart
- 124'9"-126' SS, as abv, but w/ brn lam
- 126'-127'3" SS, reddish brn w/ current bedding 15° to horiz, dolc cement
- 127'3"-128'6" SS, as abv w/ gyp lined fract to 127'7"
- 128'6"-129'1" SS, lgt brn, uniform, non-calc, to 129'
- 129'1"-129'6" SS, v/ calc, brn fg, w/ gyp in hi angl 70° fract to 129'9"
- 129'6"-131'1" SS, fg, gry brn, w/ brn lam at hor, non-calc

Plate 5 - 13 131'1"-140'3"

- 131'1"-132' SS, lgt brn w/ brn lam 0-20° horiz, current bedding, non-calc
- 132'-132'7" Fract @45° carb coated
- 132'7"-134' Brn Leisgang patch, limon, oval, non-calc to 132'8"
- 134'-136' SS, as abv, brn lam 70-35° w/ carb ptngs, por, non-calc
- 136'-137'6" SS, massive, por, sli dolc
- 137'6"-139'6" COAL, blk, slickensides, blocky, non-wettable, splintery
- 139'6"-140'3" SH, brn, w/ carb flks, non-calc, tr pyr

Plate 5 - 14 140'3"-148'

140'3"-141' SH, gry-brn, non-calc, w carb flks, tr pyr
141'-142'6" SH, lgter gry-brn w/ red ferrug fract surf, wh spots, non-calc
142'6"-145'9" SH, dk brn, v/ carb to 145'9", non-calc
145'9"-147'5" SH, dk gry, w/ yiwish fract, gyp seam @ 147'6", sli silty
147'5"-148' SH, lgter gry-brn, sli silty, non-calc easily brkn

Plate 5 - 15 148'-157'8"

148'-148'2" SH, dk gry, sli silty, non-calc
148'2"-149'6" SS, fg, gry, dolc, massive, homog
149'6"-153' SS, fg, gry, dolc, current marks defined by dk carb lam
153'-155'10" SS, layered, w/ wh & dk gry layers rich in carb, lam
typical of scour in channel fill, lam @ 155'3" blk, horiz, 1.5cm wide
155'10"-157'8" SS, brn, fg-mg, scour marks w/ gry interbeds to 156'7"
grns subang, sm w/ minute blk inclus, limon staining, dolc

Plate 5 - 16 157'8"-167'4"

157'8"-160' SS, lgt brn, subang, sli dolc, v/ poorly sorted, massive, dk
brn zones around fract, lcm borders, channel scour marks
160'-161' SS, as abv, dk brn, sli dolc, sm limon stain, channel scour
161'-167'4" SS, as abv, light brn, max qtz grain size lmm, tr blk chert (?)

Plate 5 - 17 167'4"-176'10"

167'4"-167'10" SS, brn, lam @30° to horiz, v/ sli dolc, por
167'10"-167'11" SS, as abv, dk brn ferrug zone
167'11"-174'10" SS, brn, massive, fg-mg, poorly sorted, por, non-calc
lam 10-40° to horiz, channel scour
174'10"-175'8" SS, as abv, w dk brn patch
175'8"-176'10" SS, gry, calc, fg, w/ silt sizes, w/ irreg dk brn lam

Plate 5 - 18 176'10"-186'2"

176'10"-177'4" SS, calc, fg, w/ silt sizes, calc, oval 6cm patch @ 177'
177'4"-178'7" SS, brn, dk lam @ 24° to horiz, calc, to 178'7"
178'7"-179'10" SS, fg, gry, uniform, calc
179'10"-184' SS, brn, fg, w/ limon lam 5-30° to horiz, sm x-bedding,
limon flks, massive, v/ sli dolc
184'-186' SS, brn as abv, limon flks
186'-186'2" Carb layer lcm thick nr horiz, non-calc

Plate 5 - 19 186'2"-195'7"

186'2"-187'6" SS, brn, w/ limon / carb lam 2-7° to horiz, massive
187'6"-187'10" SS, mg-cs grn, wh feldspar (?) alt, poor sorting, non-calc,
por to 187'10"
187'10"-190' SS, fg-mg, brn, sli dolc, w/ brn lam @ 189'6"
190'-190'1" SS, brn-gry, cs, non-calc, por
190'1"-190'11" SS, mg, sli dolc, limon, trans to SS, cs, sli dolc,
por @ 190'10" to SS, fg, dk brn @ 190'11", pyr
190'11"-192'10" SS, brn, cs, pyr, limon
192'10"-193'9" Frac, carb, irreg parallel to bedding in SS, brn, sli dolc
193'9"-195' SS, gry, mg, w/ carb lam & flks
195'-195'3" SH; blk, coaly, layers 20° to horiz
195'3"-195'7" COAL, blk, incoh, slickensides

Plate 5 - 20 195'7"-206'4"
 195'7"-196'6" COAL, blk, competent, tr marcasite on cleat surf, non-calc, brittle
 196'6"-196'10" SS, gry, non-calc, tite
 196'10"-197'7" COAL, as abv
 197'7"-199'11" COAL, shaley, dk gry, w/ COAL stringer @ 199'7"
 199'11"-201'6" COAL, blk, pure, massive, tr marcasite on cleats, non-calc
 201'6"-202'8" COAL, dk gry, shaley, competent, non-calc trans
 202'8"-204'2" MUDSTN, lgt cream-brn, incoh, non-calc, crumbly
 204'2"-206'4" Sharp contact, COAL, sft, slickensides, massive

Plate 5 - 21 206'4"-214'6"
 206'4"-208'9" COAL, blk, massive, non-calc, sm marcasite on fract surf
 108'9"-209'3" SH, carb, sft, crumbly, dk-med gry
 209'3"-212'6" COAL, frag
 212'6"-213'6" COAL, as abv, but massive
 213'6"-214'6" Vert fract in COAL, as abv

Plate 5 - 22 214'6"-221'4"
 214'6"-217' COAL, massive but brkn, slickensides, tr marcasite
 217'-217'10" COAL, as abv, but frag to 217'6"
 217'10"-218' COAL, trans
 218'-219'8" SS, gry, carb, dolc, w rare grn grains, subrndd
 219'8"-219'10" SS, brn-gry w/ carb layers outlined by dker brn borders, non-calc
 219'10"-221'4" SS, trans to lgt gry, w lgt/dk lam, nr horiz, up to 1cm thk, massive, non-calc

Plate 5 - 23 221'4"-231'6"
 221'4"-223'6" SS, tan, var brn, massive, fg, sli dolc
 223'6"-223'7" V/ dk brn carb layers 2cm wide nr horiz, non-calc
 223'7"-228' SS, tan, fg, sli dolc, massive, por, lam up to 10° to horiz, but predom nr hor
 228'-228'6" SS, as abv, lgtter brn to cream, as abv
 228'6"-230'7" SS, fg, brn, w/ brn lam nr horiz, massive, homog
 230'7"-231'6" SS, mttld, closed spaced, lgt brn indist layers, sli dolc, irreg brn layers/lenses/patches nr horiz

Plate 5 - 24 231'6"-241'3"
 231'6"-233' SS, lgt brn, fg-mg, trunc bedding, lam up to 40°, non-calc
 233'-238'3" SS, fg, gry-brn, homog, por, subrndd grns w/ faint brn lam, nr horiz, tr pyr, v/ sli dolc
 238'3"-238'8" SS, w/ dk brn carb seams, 2cm wide, nr horiz, sm @ 15° to horiz, non-calc limon stain
 238'8"-239'7" SS, lgt gry-brn, fg, homog, por, sli dolc
 239'7"-239'9" SS, w/ blk seams, carb, 9-10° to horiz, tr pyr (?), trans to SS, brn, w/ lgt gry indistinct lam, massive, non-calc
 239'9"-241'3" SS, gry, fg, non-calc, por, homog, massive, w/nr horiz dk gry lam

Plate 5 - 25 241'3"-251'

- 241'3"-241'7" SS, fg, lgt gry-tan w/ gry lam, non-calc
- 241'7"-242' SS, as abv, w/ wider brn lenses/lam (½cm)
- 242'-243' SS, lgt brn, fg, tr musc
- 243'-247' SS, as abv, w/ blk carb irreg seams, massive, tr musc, non-calc
- 247'-250' SS, fg, dker brn-gry, massive, non-calc w/ mttld irreg blk carb markings, sm circular up to 1cm dia, tr musc
- 250'-250'8" SS, dk gry, carb, non-calc, thin blk lam parallel to horiz bdding
- 250'8"-251' SILTST lgt gry, dolc, w/ blk non-mag, wavy, closely-spaced lam

Plate 5 - 26 251'- 260'6"

- 251'-252'9" SILTST, gry, sli dolc, w/ abund carb partings, rel fissile, easily brkn, abund carb flks in SILTST matrix
- 252'9"-253' SILTST, wh, w/ dk gry carb lam, wavy, nr parallel to horiz, bedding, SH, dk gry, 1 cm thk, dolc, SS, fg, lgt brn, w/ wavy wisps of dk carb matl, scour feat & x-bdding, dolc
- 253'6"-259'9" SS, as abv, subrndd grns, lgt brn, fg, w/ carb spks enhanced @ 254'9"
- 259'9"-260'6" COAL seamlet 3mm wide & irreg patch 1cm dia athwart dk lam to 259'11" in SS, fg as abv, dolc

Plate 5 - 27 260'6"-269'9"

- 260'6"-264' SS, med gry-brn, fg, massive, channel scour, trunc bdding, non-calc, w/ carb lam 0-15° to horiz, tr pyr nr carb mtl
- 264'-267' Hi angl fract to 265', sm limon on fract surf
- 167'-268' SS, as abv, sli more brn, subrndd-subang grns, dolc w/ mm thin carb lam, massive
- 268'-269'9" SS, as abv, w/ thin carb bedding plate lam at max 25° to horiz, dolc, scour feat, sm pink grns

Plate 5 - 28 269'9"-278'11"

- 169'9"-273'3" SS, lgt brn-gry, fg, homog, massive, w/ carb wisps, dolc
- 273'3"-276' Carb patch, 3cm wide, convex upward, parallel to horiz bdding, irreg, in SS, as abv
- 276'-278'10" SS, as abv, dolc, massive, homog
- 278'10"-278'11" SH, seam 3mm, carb, parallel to horiz bdding, sft, non-calc

Plate 5 - 29 278'11"-283'6"

- 278'11"-280' SS, lgt brn-gry, fg-mg, dolc, massive w/ sm hi angl fract, more por
- 280'-281' SS, as abv, w/ hi angl fract and carb lam up to 15° to horiz, dolc
- 281'-283'6" SS, brn-gry, homog, dolc, w/ blk spks

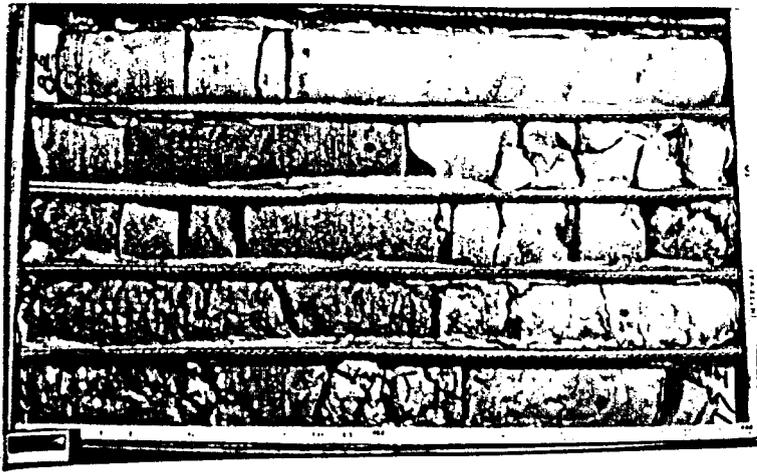


Plate 5 - 1 Footage: 8'5"-17'9"

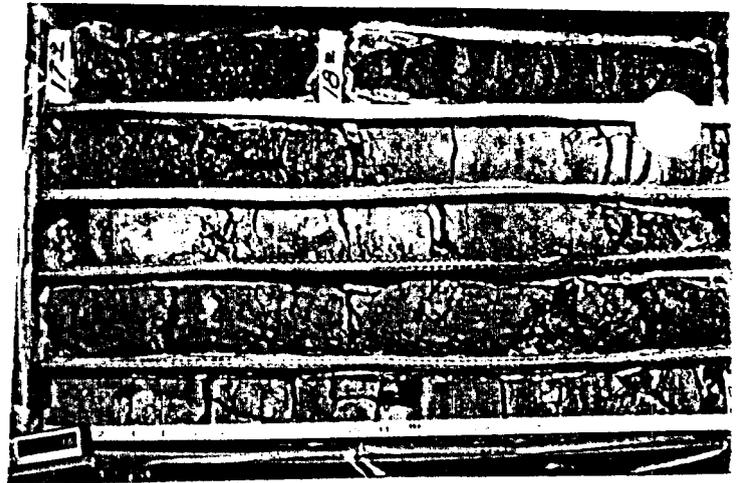


Plate 5 - 2 Footage: 17'9"-27'3"



Plate 5 - 3 Footage: 27'5"- 27'



Plate 5 - 4 Footage: 37'-47'1"



Plate 5 - 5 Footage: 47'1"-57'2"



Plate 5 - 6 Footage: 57'2"-69'

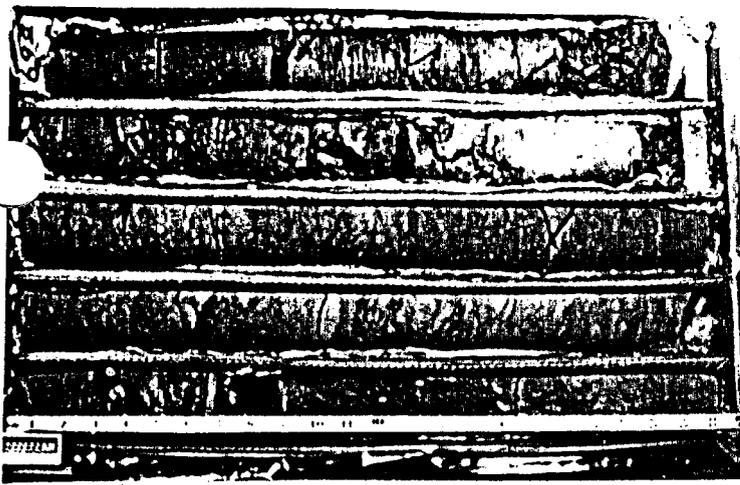


Plate 5 - 7 Footage: 69'-79'

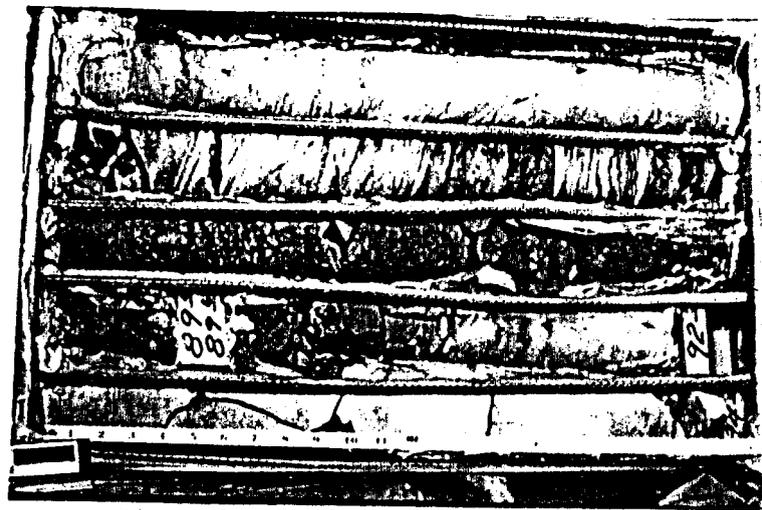


Plate 5 - 8 Footage: 79'-94'

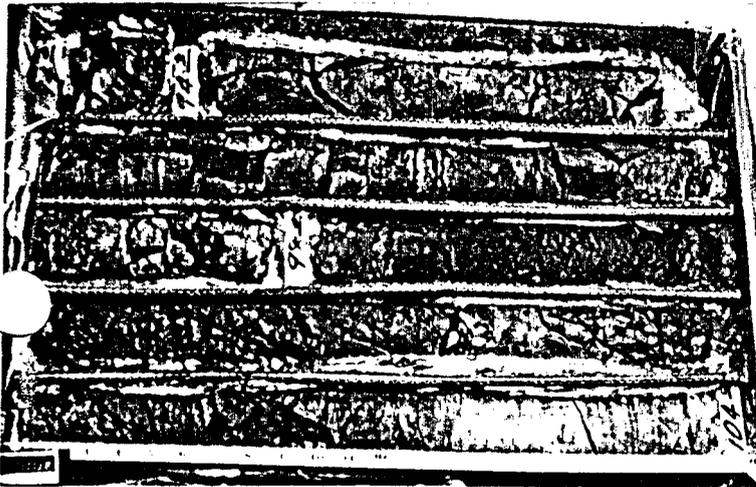


Plate 5 - 9 Footage: 94'-104'

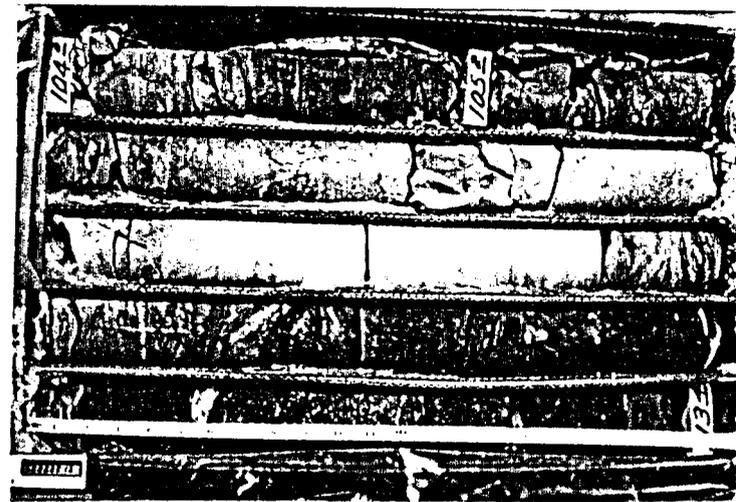


Plate 5 - 10 Footage: 104'-113'4"

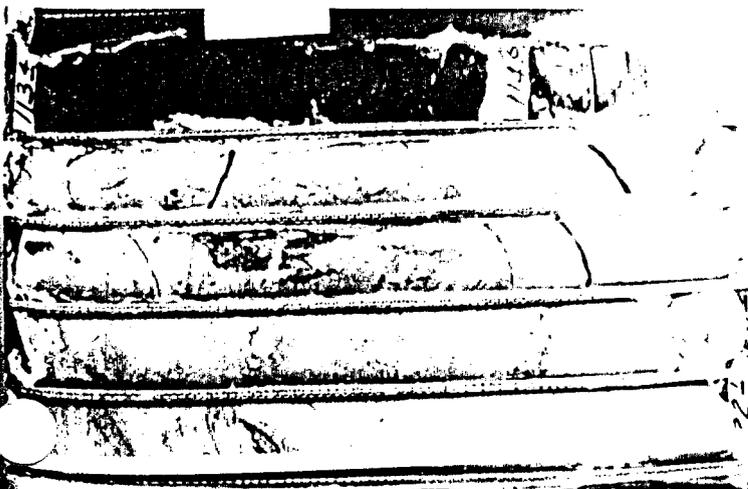


Plate 5 - 11 Footage: 113'4"-122'1"

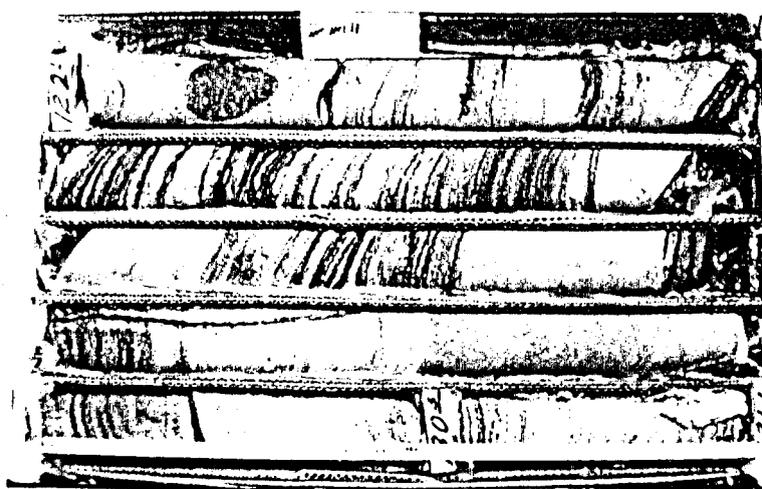


Plate 5 - 12 Footage: 122'1"-131'1"



Plate 5 - 13 Footage: 131'1"-140'2"

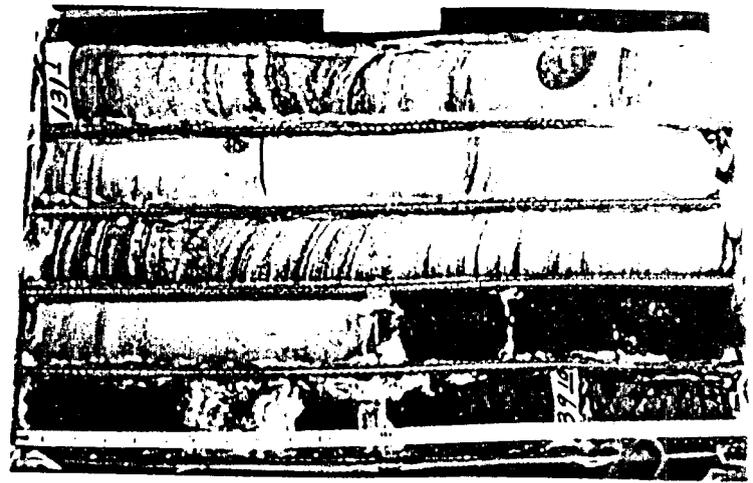


Plate 5 - 14 Footage: 140'2"-148'



Plate 5 - 15 Footage: 148'1"-157'8"

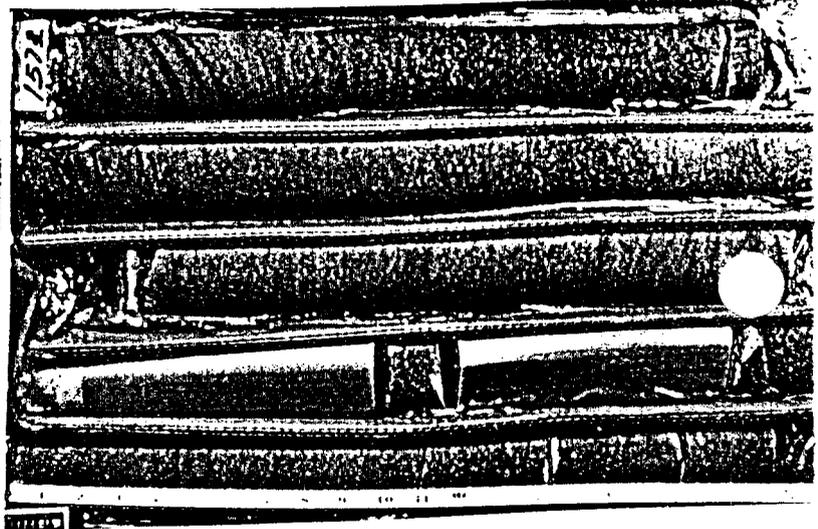


Plate 5 - 16 Footage: 157'8"-167'4"

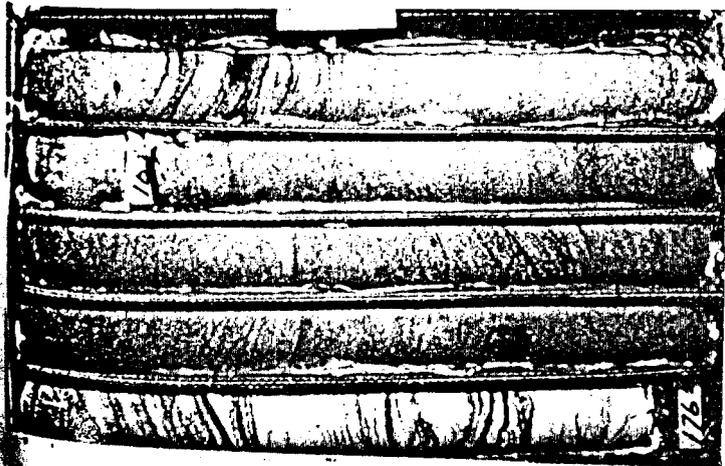


Plate 5 - 17 Footage: 167'4"-176'10"



Plate 5 - 18 Footage: 176'8"-186'2"

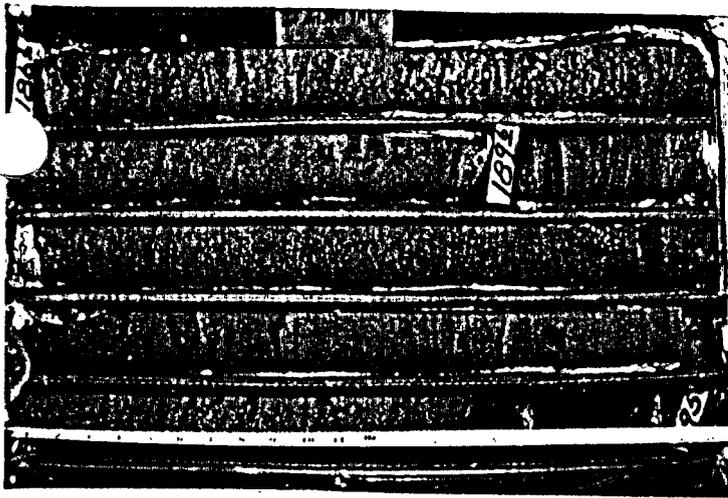


Plate 5 - 19 Footage: 186'2"-195'7"

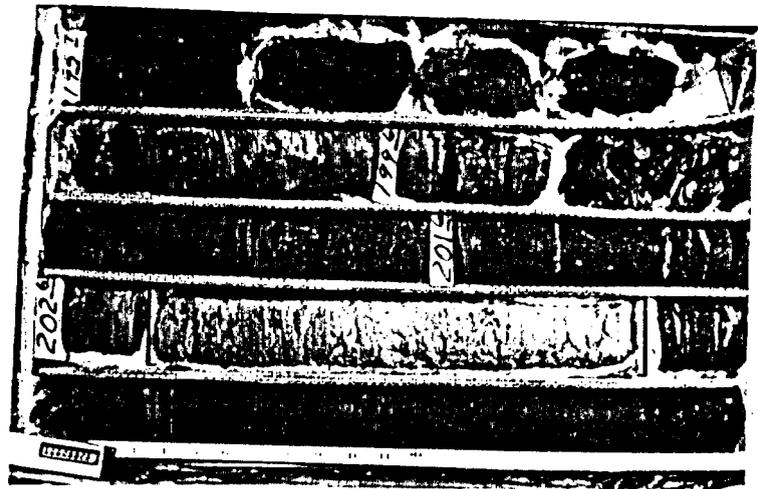


Plate 5 - 20 Footage: 195'7"-206'4"



Plate 5 - 21 Footage: 206'4"-214'6"

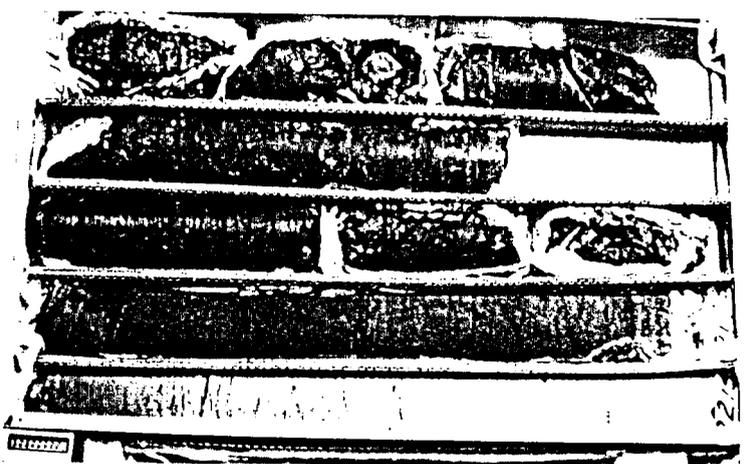


Plate 5 - 22 Footage: 214'6"-221'4"



Plate 5 - 23 Footage: 221'4"-231'6"

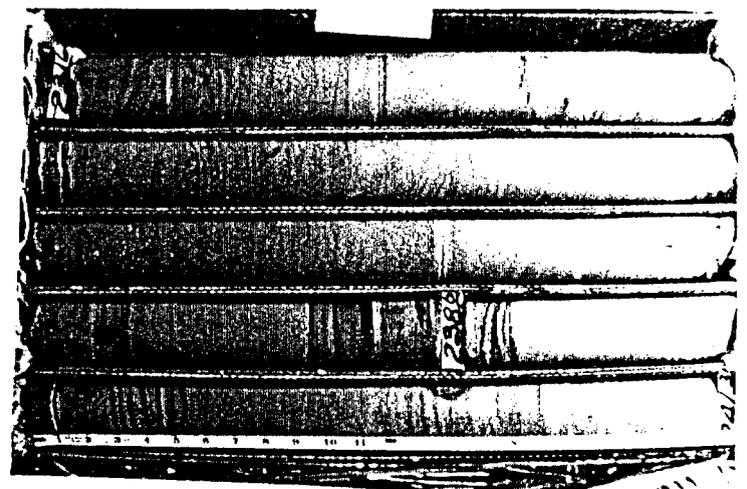


Plate 5 - 24 Footage: 231'6"-241'3"



Plate 5 - 25 Footage: 241'3"-251'

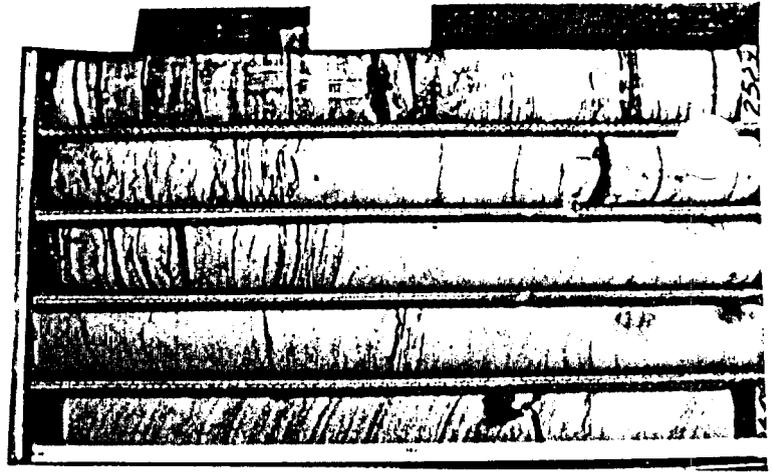


Plate 5 - 26 Footage: 251'-260'6"

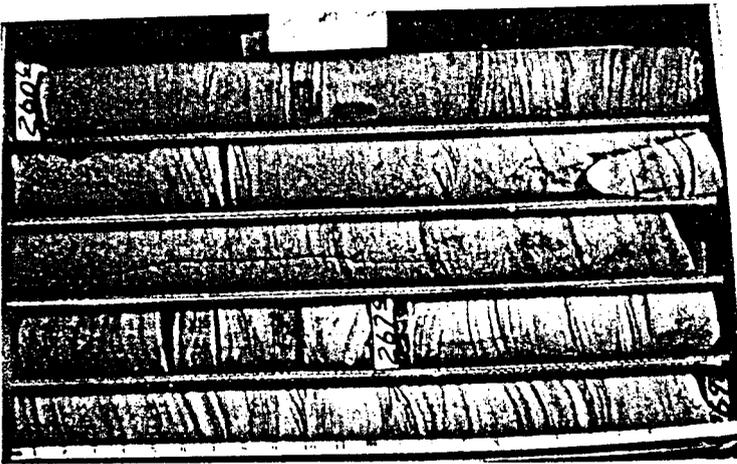


Plate 5 - 27 Footage: 260'6"-269'9"

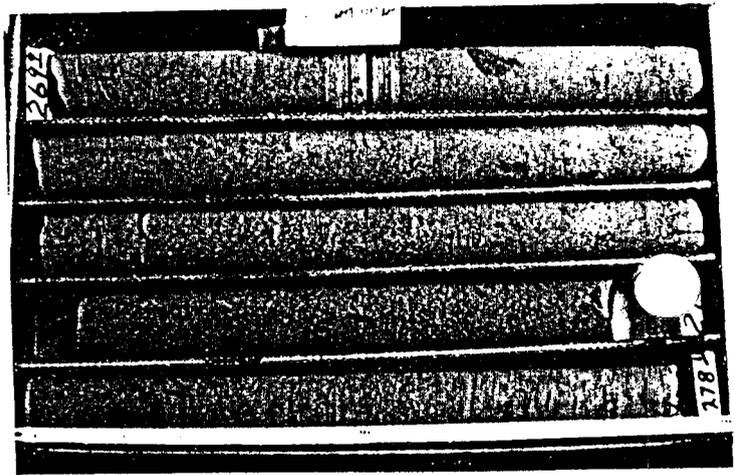


Plate 5 - 28 Footage: 269'9"-278'11"

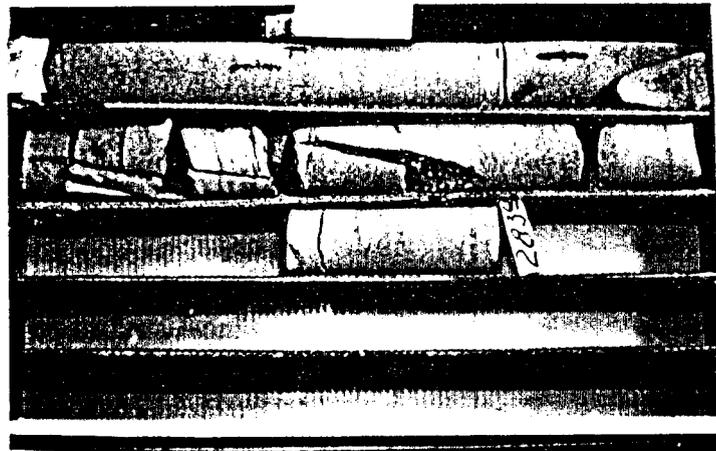


Plate 5 - 29 Footage: 278'11"-283'6"

Emery EMRIA core hole No. 5a TD 100'
SE 1/4 sec 3 T.23 S., R. 6 E.
(logged by J. Green, 1978)

Plate 5a - 1 10'-30'

There is only 9' of core in the box - no record of missing interval;
box contains mostly cylst; 2 thin carb layers; top 1' ss, f-gr, tan
(weathered)

Plate 5a - 2 30'-40'

30'-30'9" cylst, slty, carb
30'9"-37'6" sltst, grading rapidly upward to ss, vf-gr, tan and gry, w/ some
interbedded sdy sltst; wavy-lam; a few possible burrows; rooted (overbank
splay deposit?)
37'6"-40' cylst, slightly slty, some sltst as below

Plate 5a - 3 40'-50'

cylst, slightly slty w/ a few beds of cly sltst up to 0.3' thick in upper 3'

Plate 5a - 4 50'-60'

50'-52'5" sltst w/ detrital plant frags
52'5"-54'3" coal grading up to 0.3' of coaly sh at top
54'3"-56' sltst; sdy in middle part; a few possible burrows
56'-56'6" clyst, slty
56'6"-57'7" ss, vf-gr, interlam w/ sltst; wavy-lam
57'7"-60' cylst, slightly slty

Plate 5a - 5 60'-70'

60'-60'9" coaly sh
60'9"-70' ss, fines upward from f-gr to vf-gr w/ cylst lam, wavy contorted
lam w/ carb detrial plant debris

Plate 5a - 6 70'-80'

70'-70'4" ss, f-gr; sharp basal contact
*60'9"-70'4" is an upward-fining small channel sequence
70'4"-78'4" sltst, cly w/ coaly frags grading up to sltst, sdy, wavy-lam,
burrowed, gradibg up to coaly sltst at top

Plate 5a - 7 80'-90'

There is 9' of core in the box - probable loss of some coal
80'-87'3" coal (I coal)
87'3"-90" ss, vf-gr, rooted; top 0.3' is carb sltst

Plate 5a - 8 90'-100'

There is only approx. 7'5" of core in the box
90'-90'3" clyst, slty
90'3"-92'1" ss, vf gr, slty, laminae of sltst and clyst, detrial plant frags;
a few rootlets; a few possible burrows
92'1"-100' core probably missing from this interval: clay, soft; lowermost
1' slty, harder



Plate 5a - 1 Footage: 10'-30'



Plate 5a - 2 Footage: 30'-40'

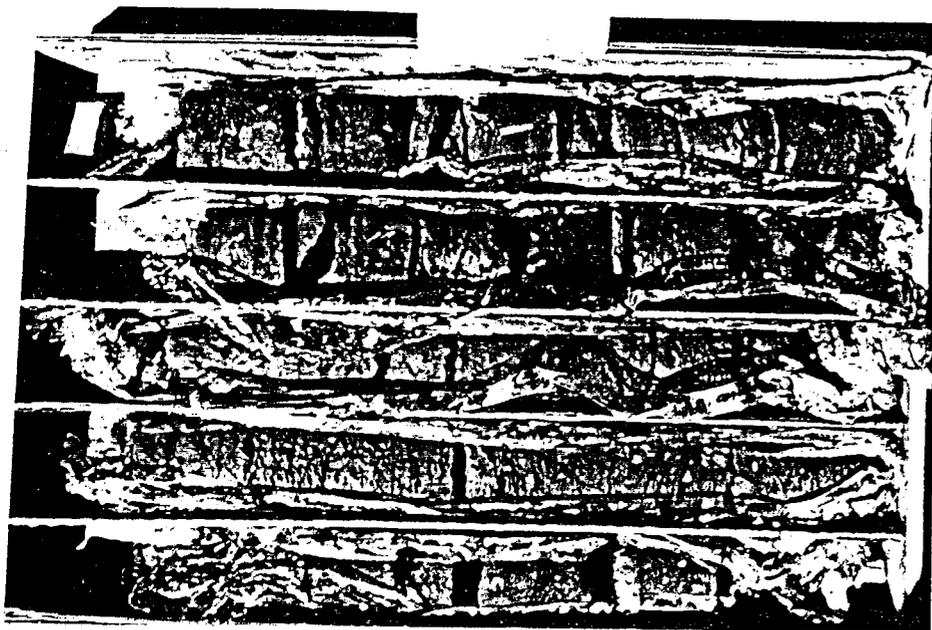


Plate 5a - 3 Footage: 40'-50'



Plate 5a - 4 Footage: 50'-60'



Plate 5a - 1 Footage: 10'-30'



Plate 5a - 2 Footage: 30'-40'

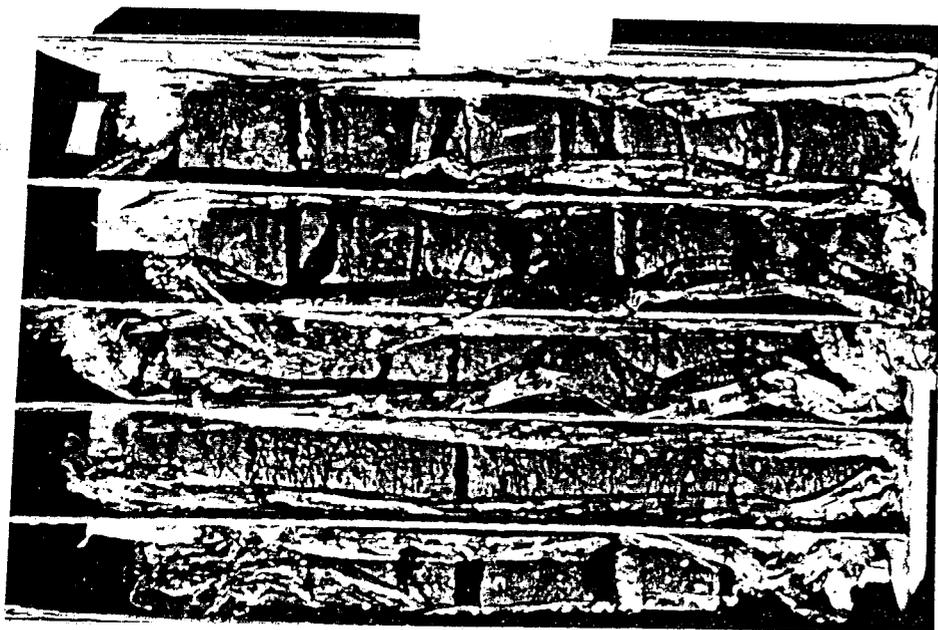


Plate 5a - 3 Footage: 40'-50'



Plate 5a - 4 Footage: 50'-60'

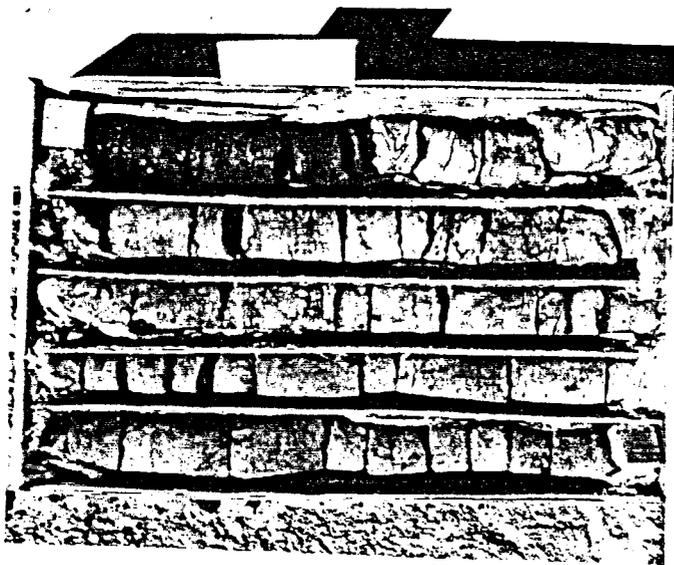


Plate 5a - 5 Footage: 60'-70'

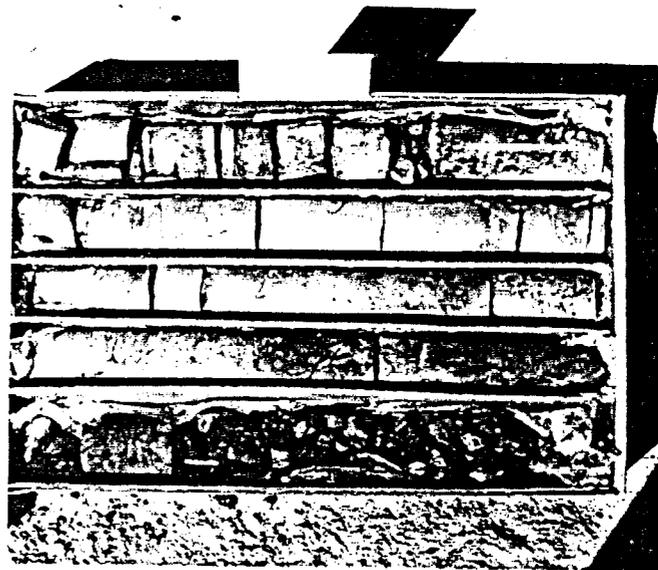


Plate 5a - 6 Footage: 70'-80'

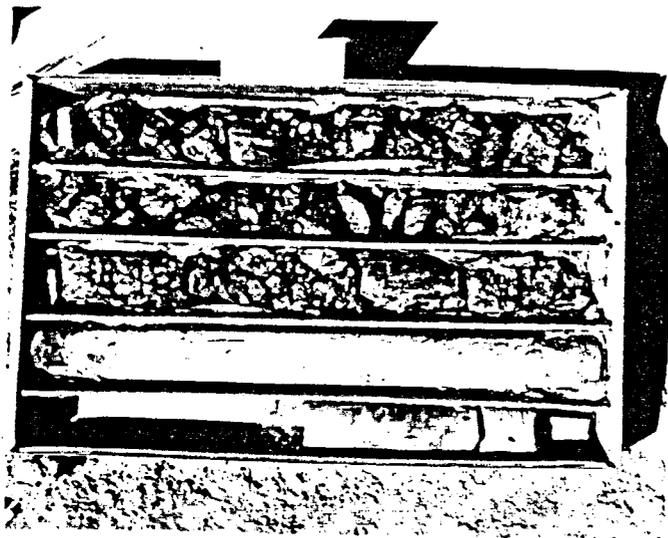


Plate 5a - 7 Footage: 80'-90'

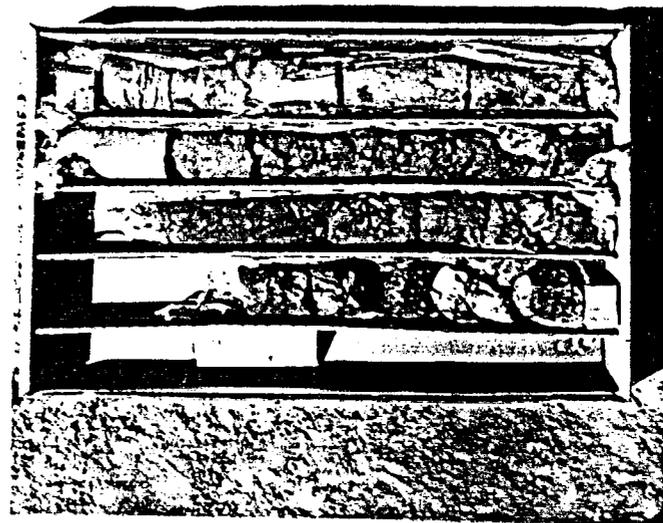


Plate 5a - 8 Footage: 90'-100'

Emery EMRIA core hole No. 6 TD348'9"
NE 1/4 sec T. 5 S., R. 6 E.
(logged by J. Green, 1978)

Plate 6 - 1 7'-17'5"

- 7'-9'5" SS & SH, interbedded, intense weathered, lgt brn, to gry-brn w/ caliche and abund. roots
- 9'5"-14' SH, dk lam, intense weathered, 1st brn, vfg-fg w/ abund. roots
- 14'-17'5" SH, thin interbedded clayey SS, brn

Plate 6 - 2 17'5"-28'

- 17'5"-20'3" SH, w/ thin interbeds of clayey SS, lgt brn and gry-brn, intense weathered, vfg-mg, (graded) w/ roots and stalks, clay-lined fract
- 20'3"-25'10" SS, lgt brn to gry-brn, mod weathered, v/sli fract, mg-coarse g, well sored, subang-subrddd grains
- 25'10"-27'11" SS, w/ layer of granule-sized grains, low angle x-bding
- 27'11"-28' SS, lgt brn, homog, massive

Plate 6 - 3 28'-37'7"

- 28'-29'1" SS, lgt brn, well sorted
- 29'1"-30'10" SS, w/ sm granule-sized grains, w/ scattered coal frag.
- 30'10"-35' SS, as next abv, becoming dns - mod hrd.
- 35'-37'7" SS, as abv, bedding @5-7°

Plate 6 - 4 37'7"-46'9"

- 37'7"-45' SS, lgt brn-gry brn, sli to mod weathered mod hd, mg coarse g, well sorted, mod to poorly cemented
- 45'-46'6" SS, as abv, bedding @5°
- 46'6"-46'9" SS, as abv.

Plate 6 - 5 47'-56'

- 47'-48'8" SS, red brn layer, as abv, hd w/ carb seam
- 48'8"-51' SS, brn to red-brn w/ thin ½-5cm alt. carb seams
- 51'-53'11" COAL, bitum, blk, fresh sli to mod fract, w/ few seams sulfides, hd
- 53'11"-54'2" SH, clayey, sft to 54'2"
- 54'2"-55' COAL, as abv.
- 55'-56' COAL, fract.

Plate 6 - 6 56'-65'4"

- 56'-57' COAL, as abv, sli por, sft @ bottom contact
- 57'-59'11" SS, SILTST, vfg, w/ clay strks, lgt to dk gry, fresh, v/sli fract
- 59'11"-62' SS w/ layer clayey SH, slickensides, brkn to 60'5"
- 62'-63'6" SS, dk gry, w abund slump struct & thin seams carb & sulfide (marcasite)
- 63'6"-65'4" SH, lgt-dk gry, silty & sdy, poorly lam.

Plate 6 - 7 65'4"-74'7"

- 65'4"-70' SH, silty, sdy, lgt to dk gry, fresh, sli fract, checks & crumbles when exposed to air, poorly lam w/ few strks sulfides becoming mod hd.
- 70'-71' SH, dk gry, as abv
- 71'-72'2" SH, as abv, w/ marcasite xls
- 72'2"-74'7" SH, dk gry-brn, w/ clayey slickensides along bdding @ 5°

Plate 6 - 8 74'11"-84'6"

74'11"-77' SH, gry, w/ abund scat frag COAL

77'-80'10" SH, gry, w/ few random thin COAL lenses to 80'

80'10"-82' SH, carb, w/ calcite-filled fract w/ increase of vfg sd strks

82'-84'6" SS, silty, lgt gry, sm fract

Plate 6 - 9 84'6"-94'

84'6"-87' SS, silty, lgt gry, fresh, v/sli fract to unfract, mod hd to hd, med massive

87'-91'11" SS, as abv, w/ abund x-bdding, ripple and slump struct and w/ abund strks carb

91'11"-92'8" SS, w/ hd cemented concretions (phosphate) to 92'1"

92'8"-92'9" SS, lgt to dk gry (mttld) fg, well cemented, hd, wavy to concentric fract

92'9"-94' SS, brn, as abv to 93'3"

Plate 6 - 10 94'-102'7"

94'-99' SS, layered, fg, lgt-dk gry (mttld)

99'-102'7" SS, as abv, w/ abund x-bdding & convoluted slump struct

Plate 6 - 11 102'7"-112'4"

102'7"-105' SS, cream-gry layered, as abv, w/ freq seams & lenses carb matl

105'-109'1" SS, grading to SILTST, dk gry, vfg, w/ abund phosphatic nodules, w/ convoluted SS strks

109'1"-112'4" COAL, blk, massive, sm slickensides, bitum, fresh

Plate 6 - 12 112'4"-121'8"

112'4"-115'6" COAL, blk, bitum, fresh, sli to mod fract, alternately grading por to dns, hd, clean

115'6"-117'8" COAL, locally oily

117'8"-120' COAL, w/ layer carb, slt dk brn, in part alt to COAL to 118'3"

120'-121'8" COAL, as abv

Plate 6 - 13 121'8"-131'9"

121'8"-122'8" COAL, blk, bitum, clean, v/fract between 120'5" & 122'

122'8"-125' COAL, w/ layer carb SH

125'-127' SS, silty, vfg-mfg, firm, hd, lgt gry, fresh, well cemented sli to unfract

127'-127'7" SS, w/ clayey SH seam to 127'7"

127'7"-131' SS, as abv, grading to SS, carb @ 129'9"

131'-131'9" SH, coaly, blk

Plate 6 - 14 131'9"-141'

131'9"-133'9" SILTST, sky, vfg-fg, dk gry, fresh, mod hd to hd, poorly bdd-massive

133'9"-135' SILTST, w/ slickensided fract @ 35°-45° to 134'3"

135'-139' SILTST, as abv, dns, well indurated, locally sm concretions

139'-141' SILTST, dk gry, w/ few irreg clay seams

Plate 6 - 15 141'-150'5"

141'-145'1" SILTST, sky, as abv, w/ increasing sfter clayey SH zones, apparent bdding @ + 5°

145'1"-145'10" SILTST, w/ hd cemented brkn layer of SS, open-gyp filled fract

145'10"-150'5" SS, vfg-mg, lgt-dk gry, fresh hd, w/ carb strks

Plate 6 - 16 150'5"-160'1"

- 150'5"-151' SS, vfg-mg, lgt to dk gry, fresh, hd, w/ stratified thin irreg strks & lenses carb mtl
- 151'-154' SS, w/ hd, brkn nodules w/ secondary calcite
- 154'-158' SS, as abv, alternately grading to SILTST, w/ local hd cemented concretions, brn to gry brn, ½ to 10cm dia
- 158'-160'1" SS, as abv w/ few scat irreg lenses COAL carb SH

Plate 6 - 17 160'1"-169'7"

- 160'1"-161' SS, brn, w/ lenses carb SH
- 161'-164' SS, as abv, w/ apparent bedding @ 2-5°
- 164'-167'6" SS, locally calc, lgt brn-gry, mod hd vfg
- 167'6"-169'7" SS, dk gry, carb w/ clayey SILTST, fract w/ slickensides @ 35-45°

Plate 6 - 18 169'7"-178'6"

- 169'7"-170'5" SILTST, dk gry, arg, carb, brkn
- 170'5"-171'6" SS, brn, fg massive
- 171'6"-173' SS, brn, w/ calcite filled fract @ 55°
- 173'-175' SS, w/ increasing calc zones
- 175'-176' SS, vfg-mg, hd
- 176'-178'6" SS, w/ few random turbidity & slump struct

Plate 6 - 19 178'6"-188'

- 178'6"-184' SS, fg-mg, v lgt gry, fresh, mod hd, massive, unfract, clean uniform grained
- 184'-188' SS, as abv, w/ abund scat frag of COAL & carb mtl, homog, massive

Plate 6 - 20 188'-197'2"

- 188'-189'10" SS, lgt brn, homog, massive, carb lam, w/ interbed strat @ 55°
- 189'10"-194' SILTST, sdy gry to dk gry, fresh, mod hd, locally sft & clayey w/ slickensided surf
- 194'-197'2" SILTST, w/ irreg layers & nodules of v/hd cemented SS, vfg, brn

Plate 6 - 21 197'2"-205'9"

- 197'2"-199' SILTST, sdy, dk gry, w/ irreg layers/nodules v/hd SS, gry-brn
- 199'-203' SILTST, as abv w/ few random scat frag COAL
- 203'-205'9" SILTST, grading to carb SILTST, sli fissile

Plate 6 - 22 205'9"-215'1"

- 205'9"-206'11" COAL, blk, fresh, mod hd, claen, v/sli fract
- 206'11"-208'10" SILTST, gry carb
- 208'10"-209'4" SILTST, gry, w/ slickensided clay seam @ 45-50°
- 209'4"-210'1" SILTST, as abv
- 210'1"-210'9" SILTST, as abv, w/ irreg lenses COAL to 210'9"
- 210'9"-215'1" SILTST, as abv, grading to fn silty SS w/ abund scat COAL frags

Plate 6 - 23 215'1"-224'6"

- 215'1"-217' SS, silty, vfg-fg, carb lm
- 217'-219'6" SS, as abv, w/ clayey, carb SILTST, dk gry, as interbdd coalescing lenses & layers, mod hd, sli fract, bedding @ 4-5°
- 219'6"-220'2" SS, as abv, w/ thin irreg COAL seam to 220'2"
- 220'2"-224'6" SS, silty, vfg-fg, lgt gry, fresh, hd, unfract

Plate 6 - 24 224'6"-234'2"

224'6"-224'10" SS, silty, vfg-fg, lgt gry, w/ scat frag COAL & strks SS, fg-mg
224'10"-225' SILTST, seam, clayey to 225'
225'-226' SS, as next abv
226'-230'2" SILTST, lgt to dk gry, fresh, hd, v/sli fract to unfract, massive
230'2"-231'6" SILTST, as abv, w/ irreg seams/lenses of carb SILTST & COAL
frag to 231'6"
231'6"-234'2" SILTST, as next abv

Plate 6 - 25 234'2"-243'10"

234'2"-237' SILTST, as abv, w/ few scat fin xls of gyp
237'-241' SILTST, locally clayey
241'-243'10" SILTST, alternatingly grading to carb SILTST & clayey SH,
dk gry to gry-blk

Plate 6 - 26 243'10"-253'7"

243'10"-244'10" COAL, blk, clean, mod hd, v/ sli fract
244'10"-252' SILTST, sdy, clayey w/ alternating layers of SILTST, sdy v/
lgt gry to dk gry, fresh, fissile (shaly) sft to mod hd
252'-253'7" SH, w/ freq thin lenses sdy SH, sft to mod hd

Plate 6 - 27 253'7"-263'4"

253'7"-255' SH, clayey, w/ alternating layers sdy SILTST & shell debris
255'-256' SH, as abv, w/ lenses of COAL frag
256'-261' SILTST, gry to dk gry, fresh, thinly bdd, med hd to hd, sli fract
261'-263'4" SILTST, as abv, w/ frag random, thin interbds & lenses sdy

Plate 6 - 28 263'4"-272'10"

263'4"-264'8" SILTST, gry to dk gry, layered, hd, sli fract
264'8"-267' SILTST, as abv w/ scat xls & lanses of marcasite (?) to 265'2"
267'-271' SILTST, w/ freq gradations & irreg lenses carb SILTST, dk gry
to gry blk, mod hd
271'-272'10" SILTST, dk gry, as abv, w/ layers sdy SILTST, carb & oily

Plate 6 - 29 273'10"-282'10"

273'10"-275'6" SILTST, gry w/ layers of sdy SILTST, oil stained (?) w/ thin
strks marcasite xls, sm few scat frag shell debris
275'6"-282'10" SILTST, gry, w/ increasing COAL bearing lenses in SS, fg-mfg

Plate 6 - 30 282'10"-292'4"

282'10"-283'4" SILTST, and interbdd sd bds w/ abund COAL & oily residue,
layers of shell and coal frag
283'4"-285'2" COAL, bitum, blk fresh, mod hd, sli fract @ 50-75°
285'2"-288' SILTST, interbds, lgt gry, mod hd to 285'4", SILTST as abv
286'1-3", SILTST, as abv, 287'3-10"
288'-292'4" COAL, clean, grading por to dns, unfract to v/sli fract

Plate 6 - 31 292'4"-301'

292'4"-292'11" COAL, as abv
292'11"-294'11" COAL, fract & brkn @ lower contact, nr vert fract
294'11"-299' SILTST, sdy & SS, silty, vfg-fg, irreg coalescing lenses/
layers, lgt-dk fry, fresh, mod hd, indurated w/ minor cement
299'-301' SILTST, as abv, w/ abund lenses & scat frag COAL & carb SH

Plate 6 - 32 301'-311'

301'-307' SS, vfg-mfg, v lgt gry to gry wh, fershly thkly bdd to massive
v/sl fract

307'-311' SS, as abv, w/ freq irreg scat seams & frag of COAL & SILTST,
carb w/ random pyr and/or marcasite mineralization

Plate 6 - 33 311'-320'3"

311'-316'6" SS, lgt brn, w/ abund grains & strks carb mtl @ 316'6", bdding @5-7°

316'6"-318'10" SS, as abv, w/ increasing abund pods/frags SILTST

318'10"-319'10" SS, brn, por along bdding, @ + 20-22°

319'10"-320'3" SS, gry, fg, w/ carb patches

Plate 6 - 34 320'3"-329'9"

320'3"-322'4" SS, lgt brn, homog massive

322'4"-328' SS, as abv, w/ increase in marcasite & pyr mineralization
within frag/seams SILTST

328'-328'3" SS, as abv & few scat shell frag

328'3"-328'11" SILTST, clayey w/ lg xls pyr to 329'11"

328'11"-329'9" SS, lgt brn as next abv, massive

Plate 6 - 35 329'9"-339'3"

329'9"-330'2" SS, lgt brn, fg

330'2"-333'10" SS, as abv, w/ abund frag (up to 7 cm) SILTST

333'10"-336'6" SS, as abv, w/ 5-7 cm seams SILTST & lg xls pyr @ 335'2" & 335'

336'6"-339'3" SS, brn, w/ carb patches

Plate 6 - 36 339'-348'9"

339'-344' SS, lgt brn, w/ dk brn-blk carb ptngs w/ abund scat lg frag shells

344'-348'9" SS, fg, as abv, few random carb SILTST frags

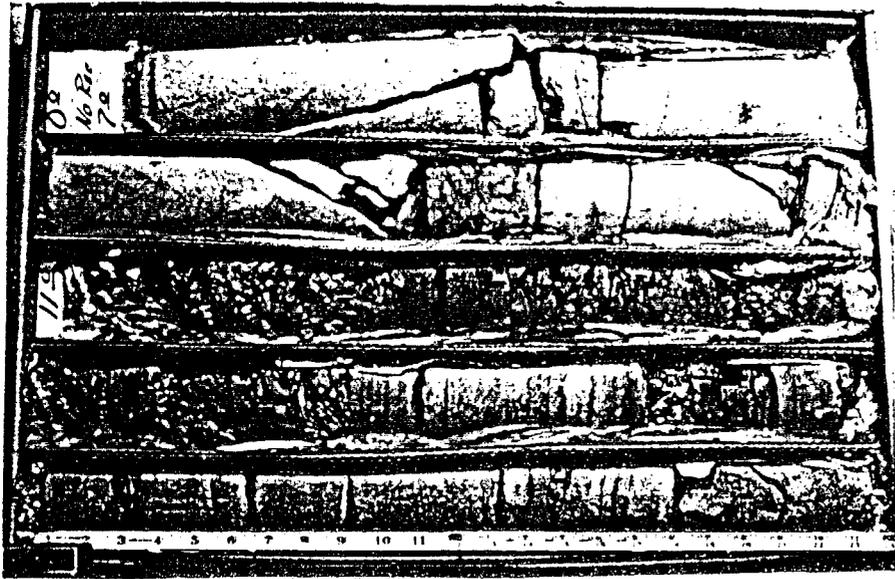


Plate 6 Box 1
Footage: 7' - 17'5"

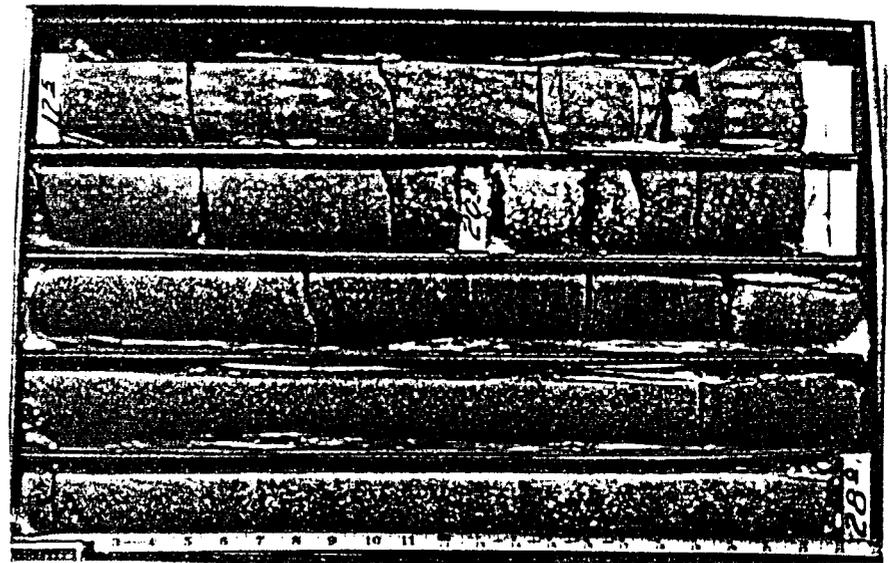


Plate 6 Box 2
Footage: 17'5" - 28'

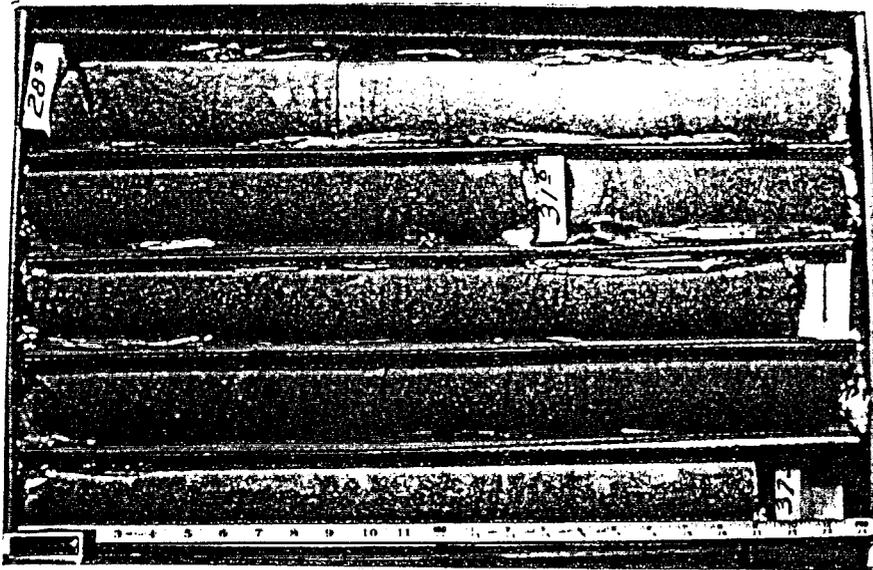


Plate 6 Box 3
Footage: 28' - 37'7"

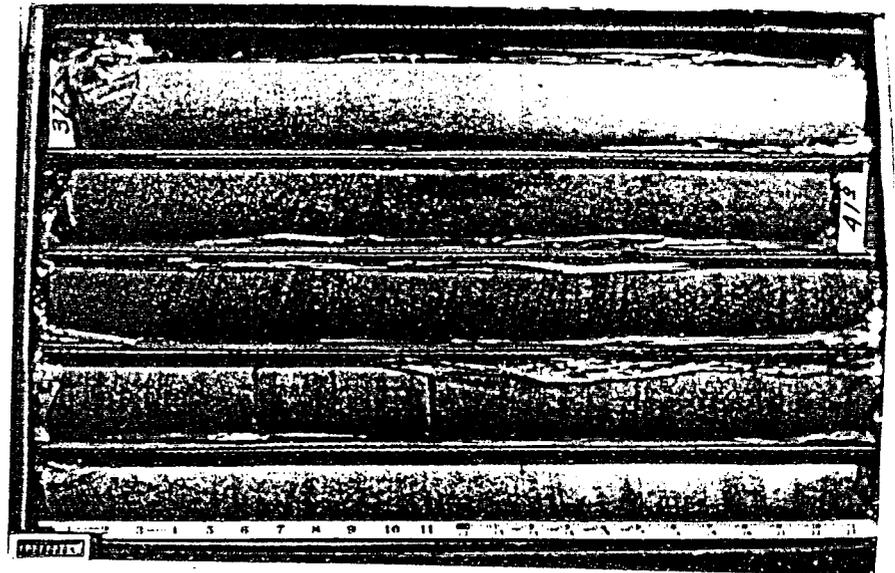


Plate 6 Box 4
Footage: 37'7" - 46'9"

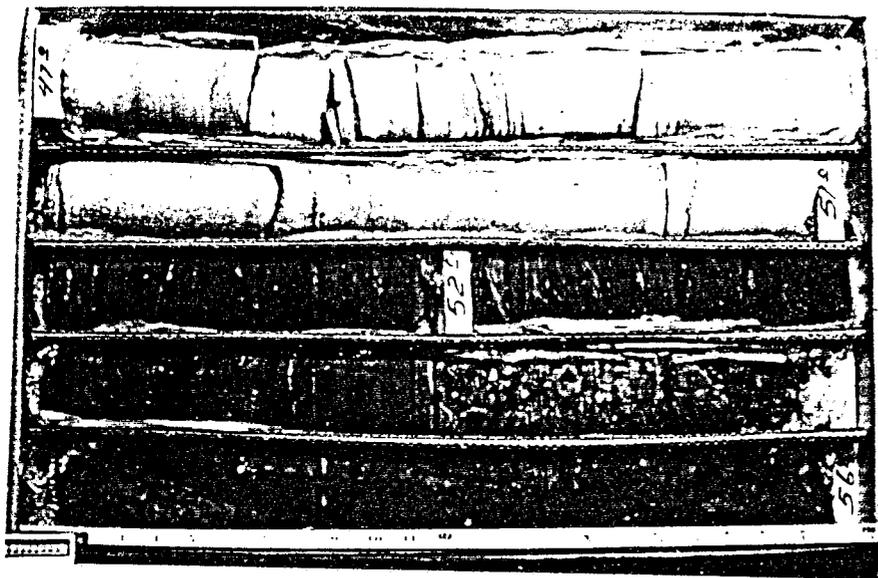


Plate 6 Box 5
Footage: 47' - 56'

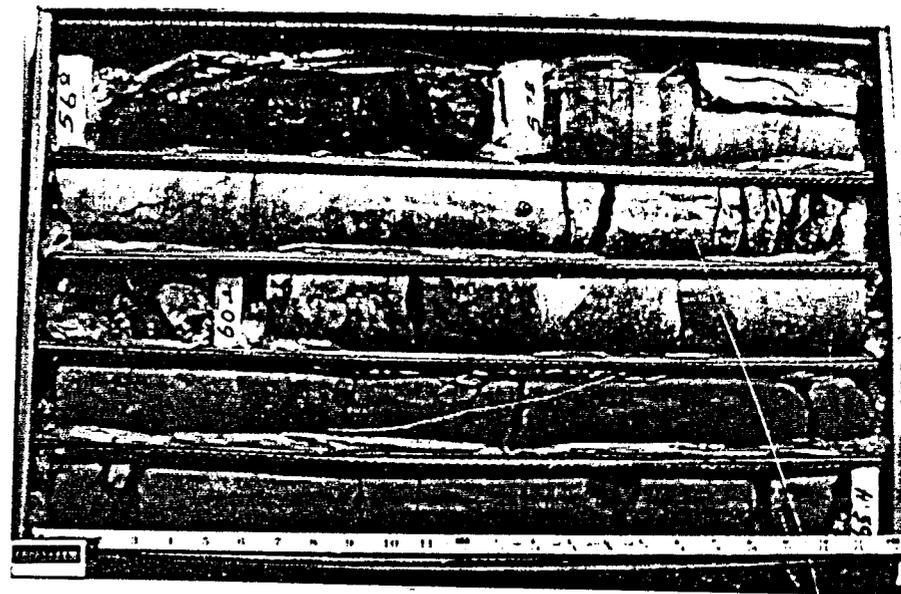


Plate 6 Box 6
Footage: 56' - 65'4"

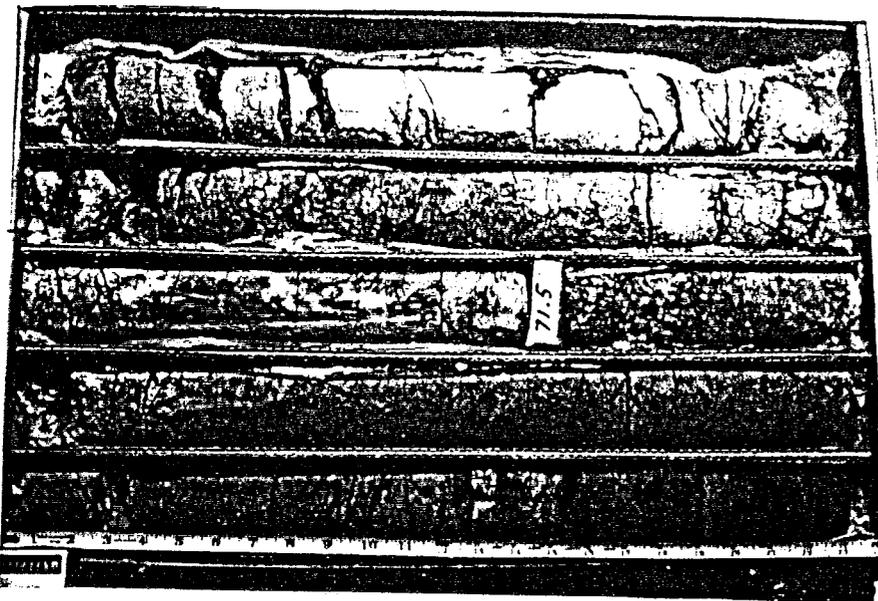


Plate 6 Box 7
Footage: 65'4" - 74'7"

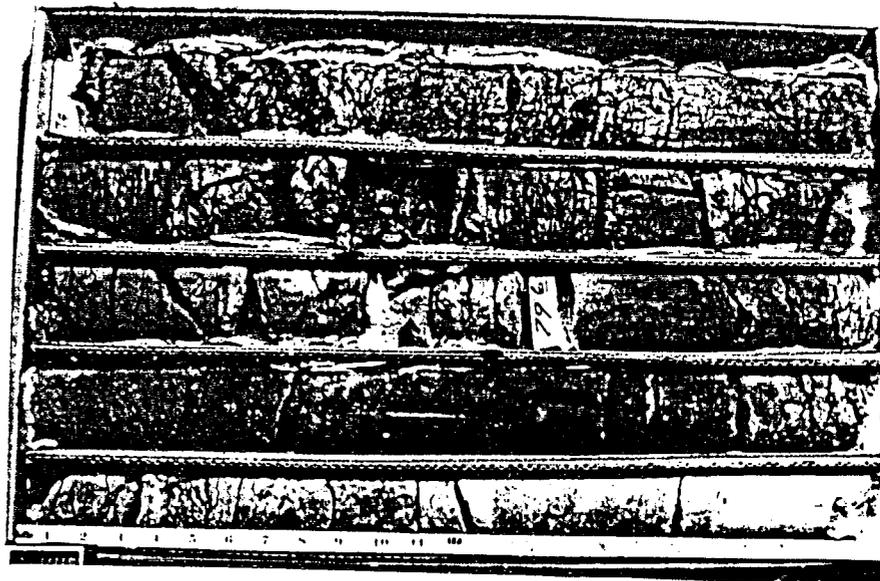


Plate 6 Box 8
Footage: 74'11" - 84'6"

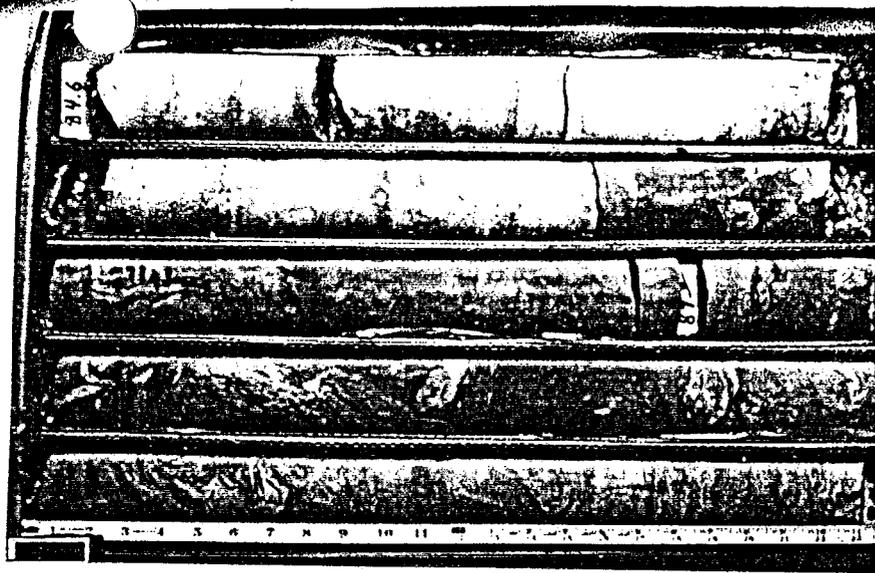


Plate 6 Box 9
Footage: 84'6" - 94'

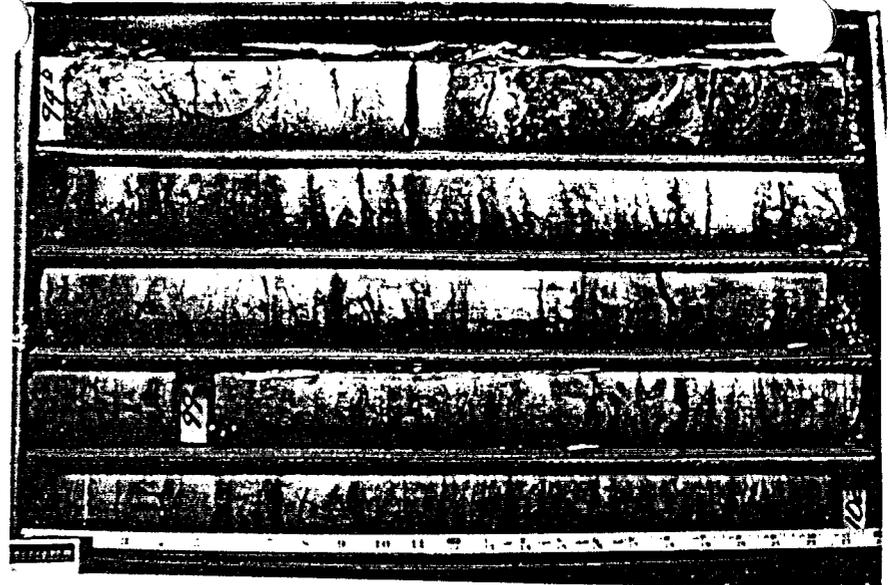


Plate 6 - Box 10
Footage: 94' - 102'7"

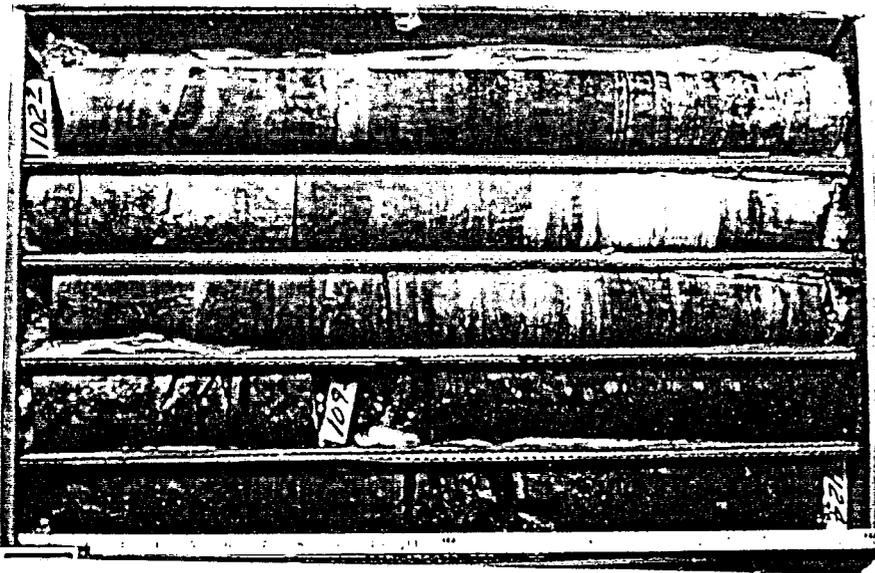


Plate 6 Box 11
Footage: 102'7" - 112'4"

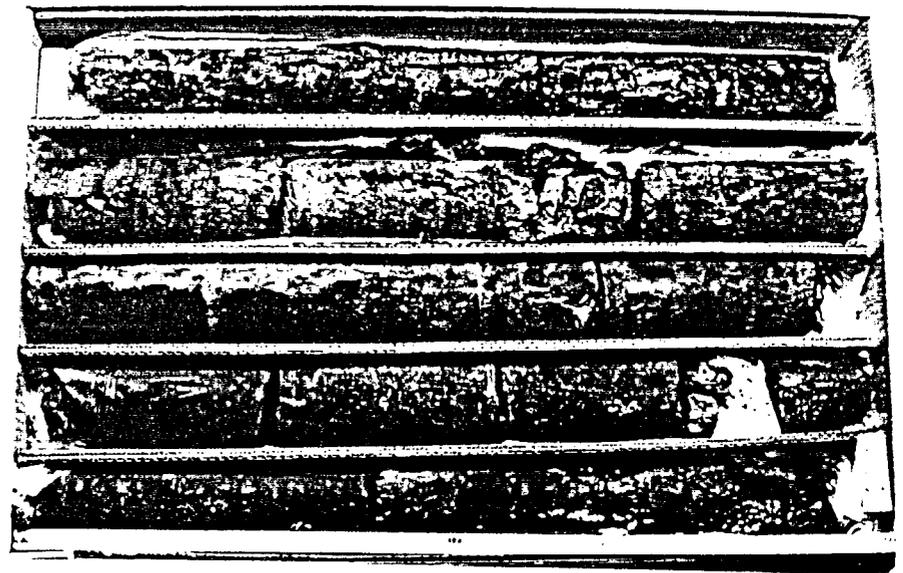


Plate 6 Box 12
Footage: 112'4" - 121'8"

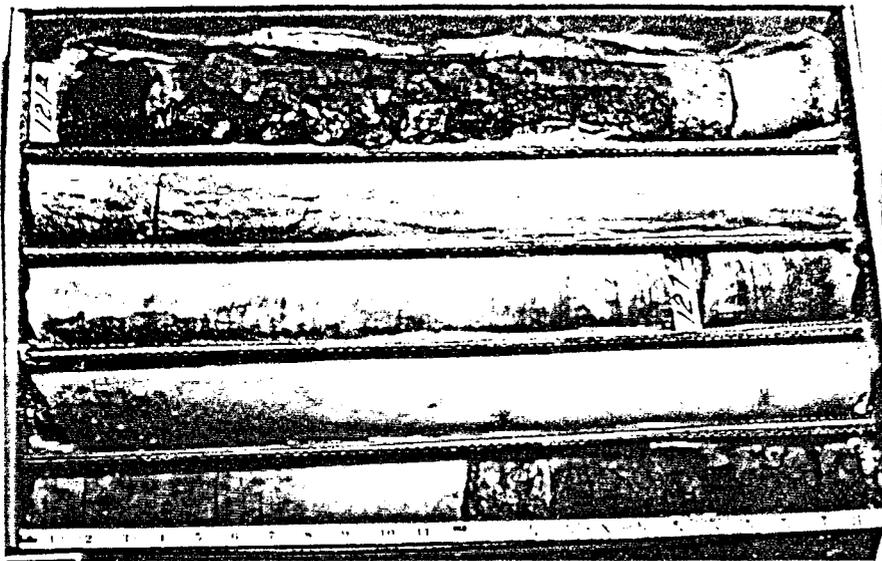


Plate 6 Box 13
Footage: 121'8" - 131'0"



Plate 6 Box 14
Footage: 131'9" - 141'

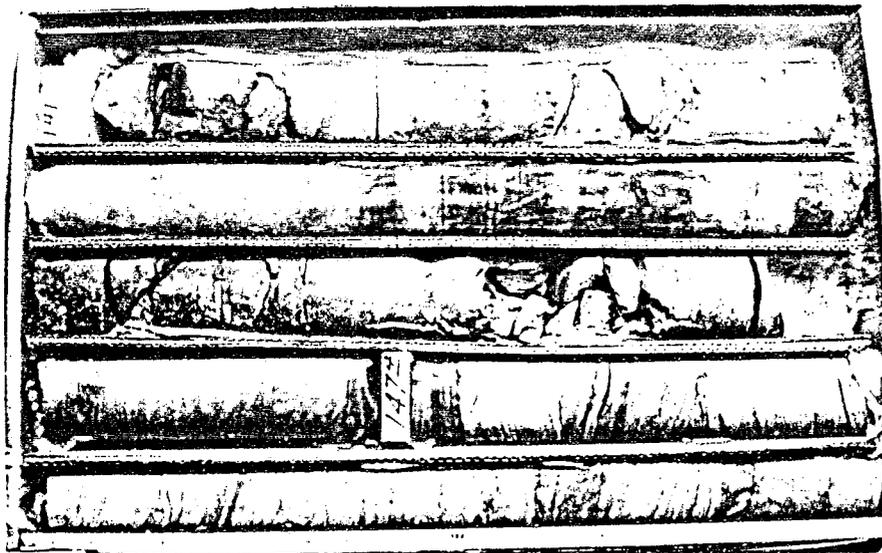


Plate 6 Box 15
Footage: 141' - 150'5"

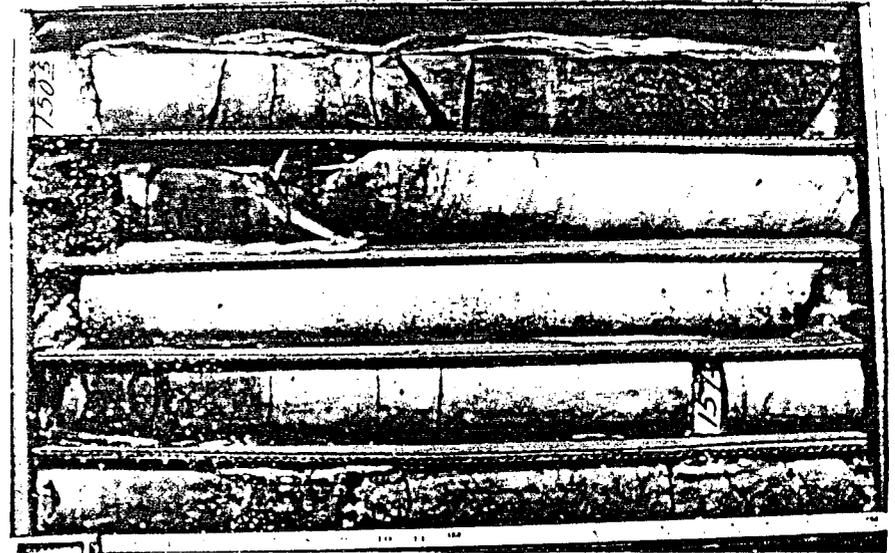


Plate 6 Box 16
Footage: 150'5" - 160'1"

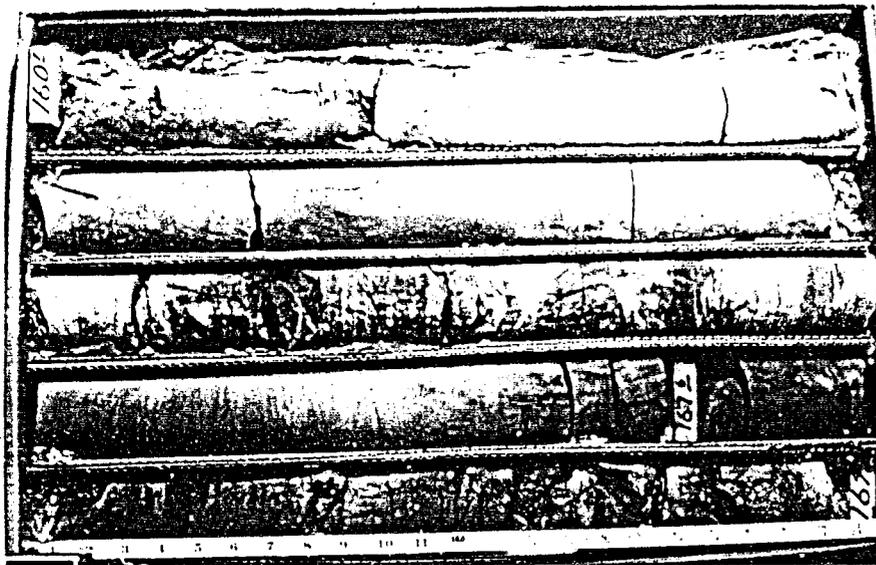


Plate 6 Box 17
Footage: 160'1" - 169'7"

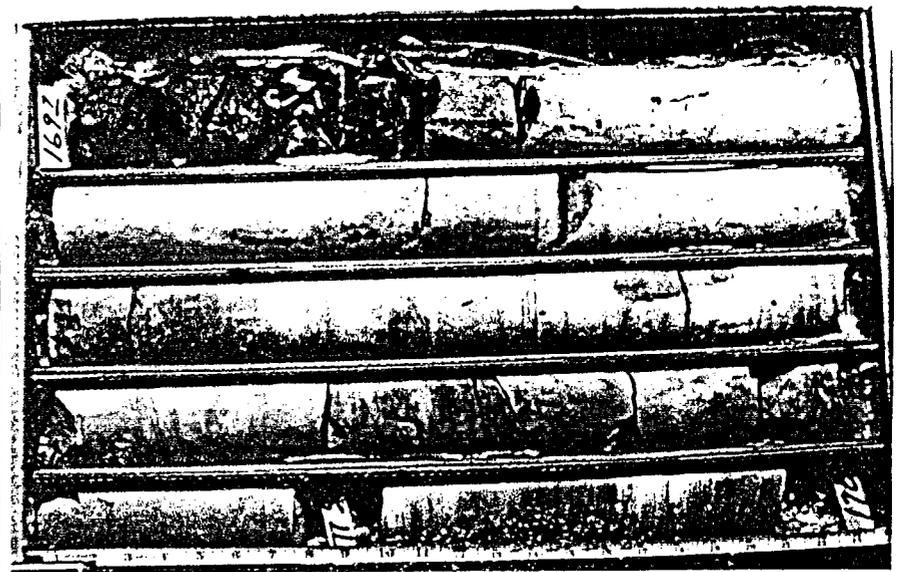


Plate 6 Box 18
Footage: 169'7" - 178'6"



Plate 6 Box 19
Footage: 178' - 188'

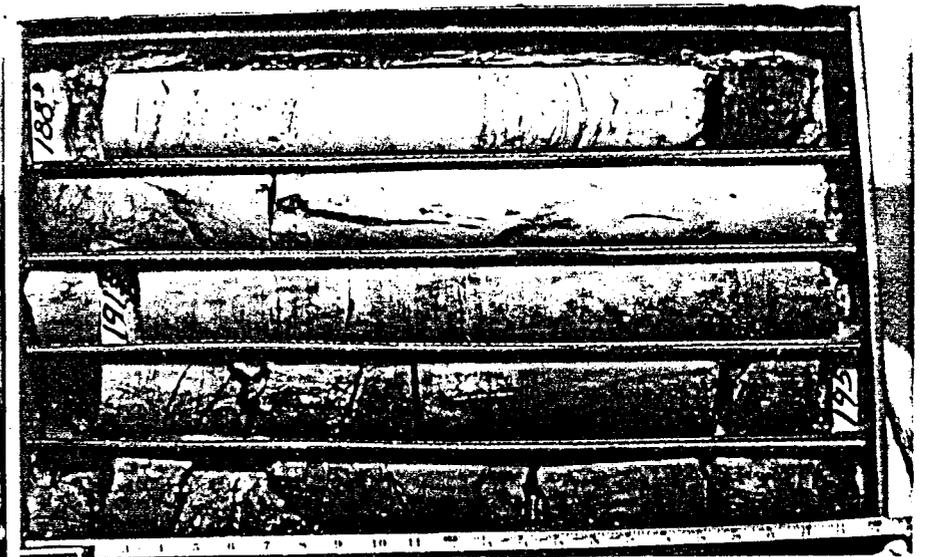


Plate 6 Box 20
Footage: 188' - 197'2"

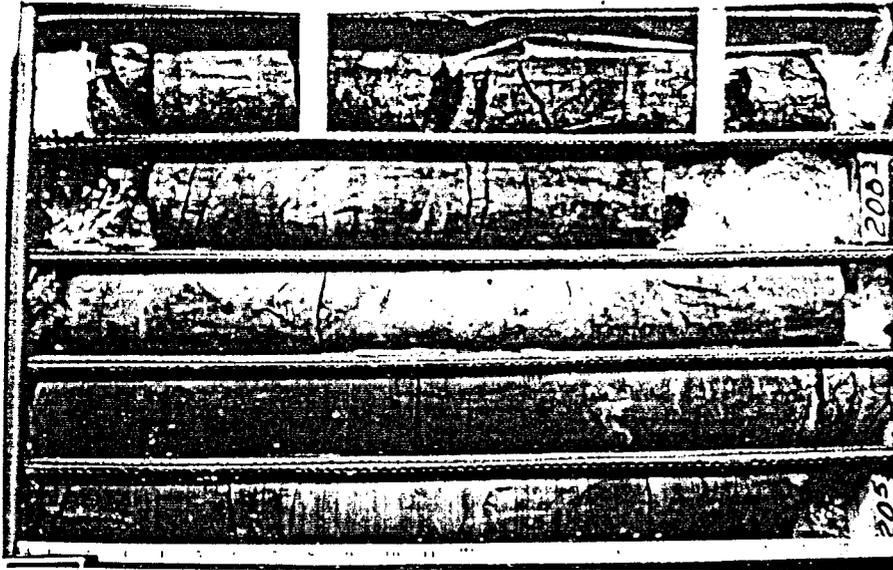


Plate 6 Box 21
Footage: 197'2" - 205'9"



Plate 6 Box 22
Footage: 205'9" - 215'1"

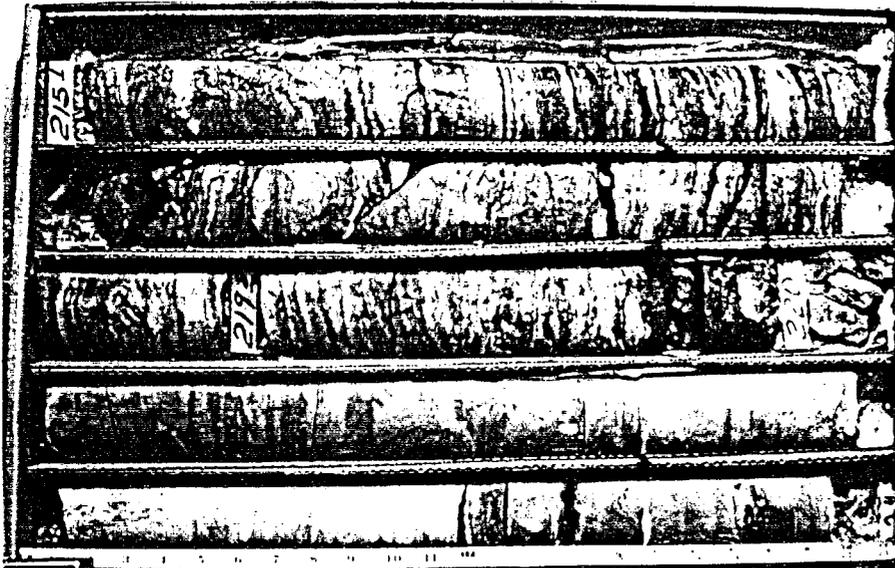


Plate 6 Box 23
Footage: 215'1" - 224'6"



Plate 6 Box 24
Footage: 224'6" - 234'2"

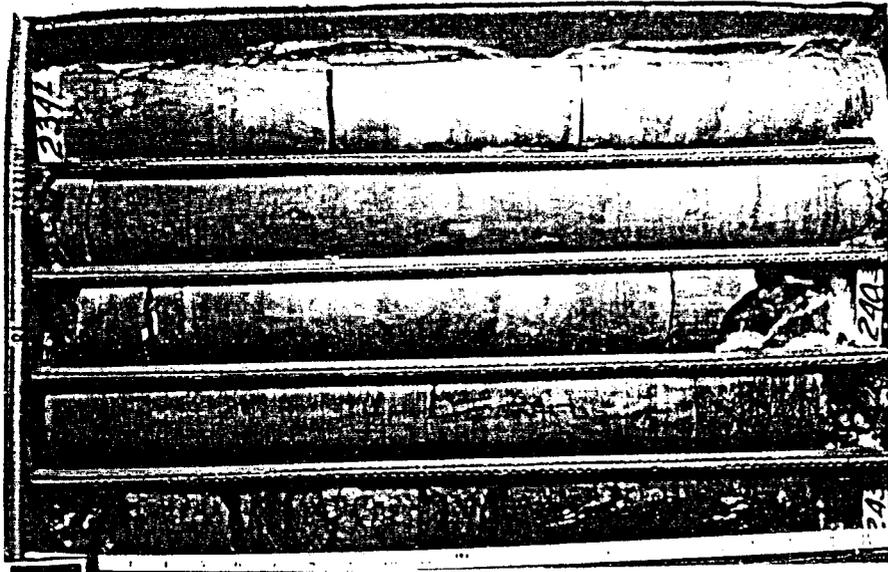


Plate 6 Box 25
Footage: 234'2" - 243'10"

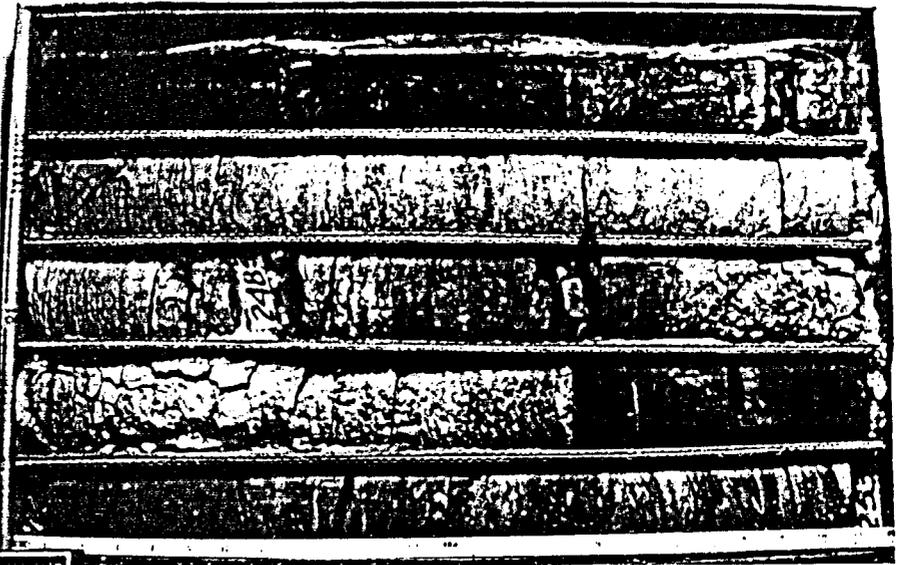


Plate 6 Box 26
Footage: 243'10" - 253'7"



Plate 6 Box 27
Footage: 253'7" - 263'4"

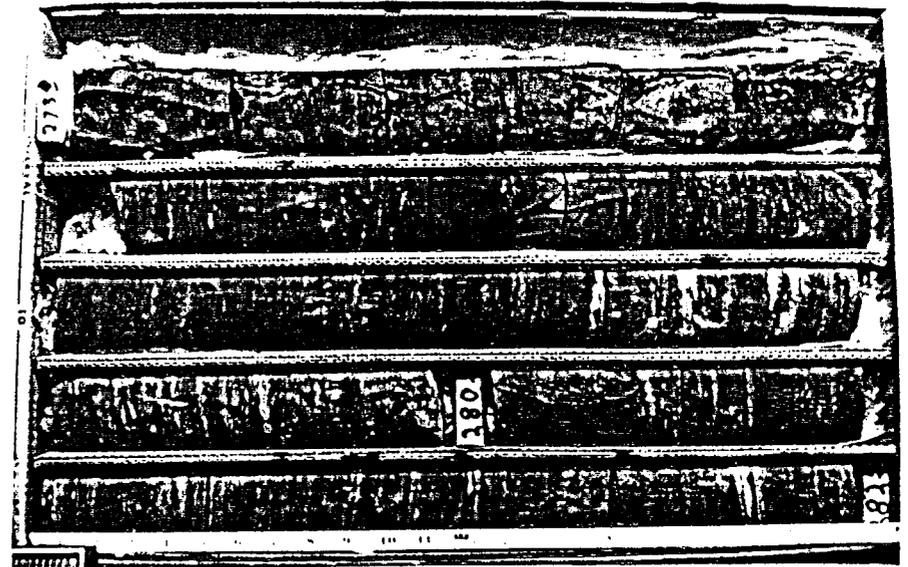


Plate 6 Box 28
Footage: 263'4" - 272'10"

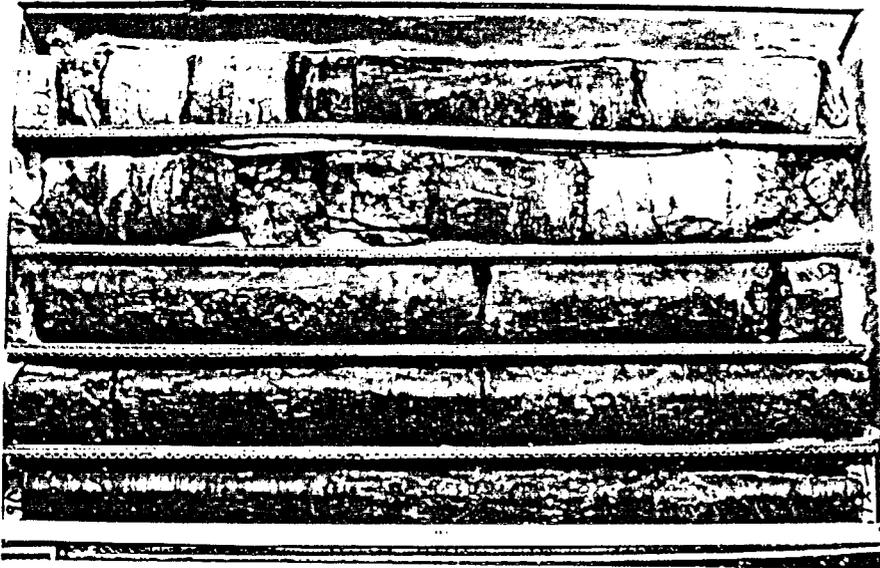


Plate 6 Box 29
Footage: 273'9" - 282'10"

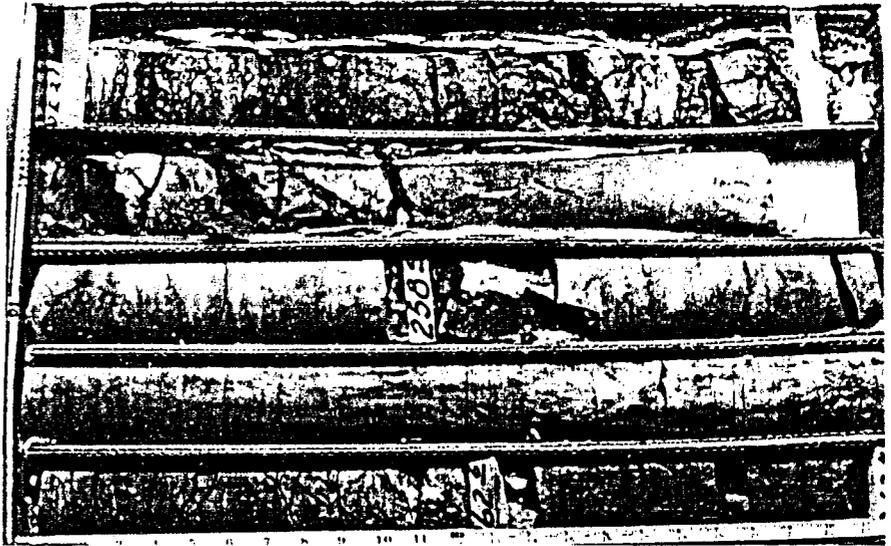


Plate 6 Box 30
Footage: 282'10" - 292'4"

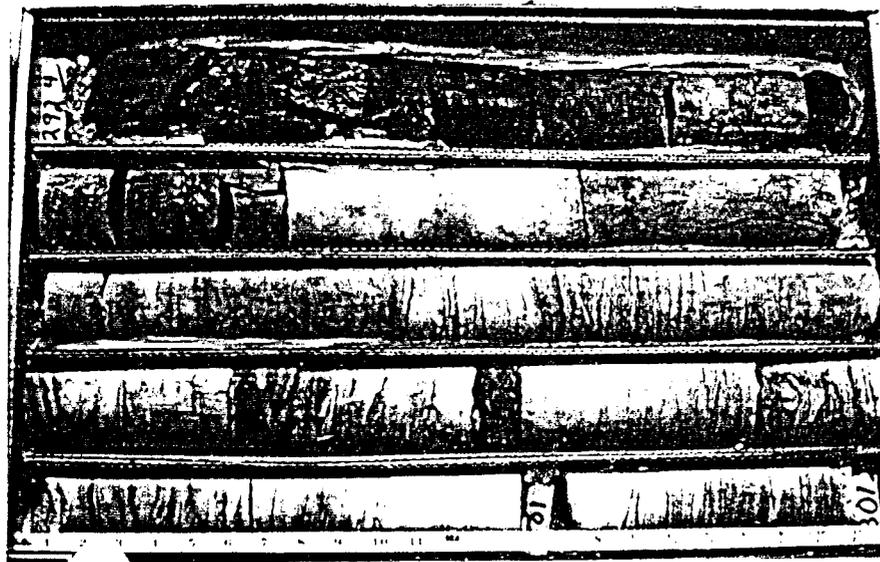


Plate 6 Box 31
Footage: 292'4" - 301'



Plate 6 Box 32
Footage: 301' - 311'



Plate 6 Box 33
Footage: 311' - 320'3"



Plate 6 Box 34
Footage: 320'3" - 329'9"



Plate 6 Box 35
Footage: 329'9" - 339'3"



Plate 6 Box 36
Footage: 339'3" - 348'9"

APPENDIX 10

Minor Trace Elements Geochemistry

Arsenic (As)

Arsenic in normal soils ranges from 1 to 40 ppm and is 10 ppm dry weight in most plant species. The element is particularly concentrated by Pseudotsuga menziesii (Douglas Fir), which is found only at elevations above 9000' in Utah (Warren et al., 1968). Average As values for the Ferron formation (Affolter et al., 1978 - Table) are on the order of 10 ppm. One sample of coaly shale (D200632) at a depth of 64.6 - 64.9 meters has the highest As value measured in the study, 54 ppm. However, this sample is deep in the section (some 30 meters below the I seam) and would not be exposed in the area to be reclaimed unless strip mining continues down to the C seam. As values in the Ferron sandstone above the I seam are less than 15 ppm and for three samples taken above the I seam in bore hole #6 average 11 ppm. Even this value is considered to be high. Toxicity depends on soluble arsenites not total As concentrations. Estimates of As toxicity vary widely; for example seafood can contain as much as an order of magnitude higher values than most soils.

Bromine (Br)

Bromine levels in normal soil range from 10 to 40 ppm. No problem appears to exist in the Emery area although we would recommend a test run for the bromine anion in soil units high in other "volatile" species such as selenium.

The average for 15 water quality analyses for bromide by the USGS (1979) is .40 ppm, with most values being less than 1.0 pp. The high standard deviation results from the following three values (in ppm Br):

- 13 ppm Blue Gate Well #1 (D-21-7) 4 AAC-1
- 20 ppm (D-20-8) 22 CAA SRU-5 413 Seismic Test
- 20 ppm SRU-9 Site 943 Seismic Test Hole

Possibly some leachable Br can collect in the residual water of seismic test holes. We do not know if the explosive charge contributed to the high bromine content.

Cadmium (Cd)

The chloride, nitrate, and sulfate of cadmium are highly soluble. Cadmium concentrations similar to mercury, are cumulative in animal tissues. The amount of cadmium in nutrient solutions (0.2 ppm) causing

growth retardation in the most sensitive plants (beets, beans and barley) is far above ammonium bicarbonate DTPA extractable cadmium in Emery overburden materials (Heil and Deutsch, 1979) with the exceptions of some coal samples. In the case of bore hole #6, high Cd values occur in the top of a larger coal seam (Figure). Of significance is the corresponding increase in selenium and other volatiles and molybdenum, as well as aluminum and nickel relative to the enclosing sandstones. These high values do not appear as major anomalies in the lower associated coals.

In contrast to soluble Cd, the total Cd in ashed coal samples (Affolter et al., 1978) is an order of magnitude higher, reaching 8 ppm in certain Ferron sandstone coal seams (sample D200650). However, accompanying or sympathetic increases in Fe and Mo are not present.

It appears the Cd toxic levels are no problem. Upper portions of coal seams contain high concentrations of elements whose effects can be beneficial if properly diluted into a resultant soil cover.

Chlorine (Cl)

Chloride concentrations in irrigation water in excess of 1300 ppm Cl produces defoliation, ideback, chlorosis, bronzing and burning in sensitive crops such as citrus. Although most of the dissolved chloride in the 24 water samples analyzed by the USGS (1979) is far less than this value, the average is 4.9 with a standard deviation of 0.84. The Cl concentration in a few samples is extremely high:

Chlorine Values in Emery Area Streams and Wells (USGS, 1979)

1. D-21-6 35AAC Blue Gate Well #3	4100ppm
2. D-20-8 22Caa SRU-5 413 Seismic Test	2200 ppm
3. SRU-9-919 D-19-8 4DBC	1400 ppm

High chlorine values are not necessarily indicated by high conductivities. In bore hole #3 conductivity decreases with depth. Near surface values approximate 17 mhos dropping to about 5mhos at 210 feet. However, bore holes 4 and 5 show abrupt conductivity spikes at 95 and 145 feet (16.5 and 16 mhos) respectively. The high conductivity is probably attributable however, not to salty water, but probably marcasitic coal leachates.

Chromium (Cr)

Although some crops such as barley are sensitive to Cr, most can tolerate levels over 15 ppm in solution. To animals, the hexavalent form is more toxic than trivalent. The highest Cr value in analyzed stream waters is .02 ppm in Christiansen Wash (USGS, 1979). Heil and Deutsch's maximum value of 0.11 ppm Cr is in sample 6-14 with an average of .03 ppm. Ashed coal from the Ferron formation (Affolter et al., 1978) shows a wide variation in Cr ranging from 4.4 to 75 ppm. The latter anomaly occurring at about 188 feet in bore hole #6 in a coaly shale layer within the I seam. As with Cr in soils and sagebrush ash from the Powder River Basin (Connor et al., 1976), values of 75 ppm are not unusual. Only a small fraction of this Cr is water soluble.

Cobalt (Co)

Because of the low levels of Co that normally exist in rocks and soils, excess of Co is rare. The element is not reported in crushed rock extracts (Heil and Deutsch, 1979) or in water (USGS, 1979) in the Emery area. The maximum value of Co in ashed coaly shale from the Ferron formation at a depth of about 197 feet is 8.9 ppm. The sample (D200639) is from a stratum overlying the combined A and C coal beds (Affolter et al., 1978).

Fluorine (F)

F is generally a problem only in acid soils and offers no hazard in the Emery area. Uptake is not a function of the total F content in soil but pH, and the Ca and P concentrations. The average F concentration in 12 shale samples from the Ferron sandstone is 430 ppm with a range of 240 to 850 ppm (Affolter et al., 1978). No F values are given by Heil and Deutsch (1979). Water soluble F is less than 0.7 ppm with the exception of a 2.3 value for a water sample collected from the back of the Consolidated Coal Mine.

Iodine (I)

Toxic levels of I in nutrient solutions are in excess of 1 ppm. No data are available for Emery waters, soils and ash, or from rocks, soils or sagebrush.

Lead (Pb)

Since plants can take up to 350 ppm Pb (in the ashed stems) without showing adverse effects (Shacklette 1960) and since all Pb concentrations (including ashed samples) in the Emery area samples are below 100 ppm,

no hazard to plants is foreseen. The water analyses (USGS, 1979) do not report Pb but are assumed to be less than 0.2 ppm Pb²⁺.

Lithium (Li)

As with lead, naturally occurring instances of lithium toxicity to plants are rare except for citrus which is sensitive to Li. The average Li content for 20 Ferron coal samples is 23 ppm; in 12 Ferron shales, it is 88 ppm. The maximum amount of dissolved lithium occurs in Christiansen Wash and is 0.37 ppm.

Mercury (Hg)

Mercury in animals and plants is believed to be mostly organic (mostly methyl Hg) derived by conversion of inorganic Hg to methyl or dimethyl Hg by anaerobic bacteria in the bottom muds of streams. Since the USGS water quality analyses do not report Hg, no interpretation on this potentially toxic element is presented. The arithmetic mean of total (inorganic) Hg in 12 Ferron shales is 0.32 ppm. The pot tests by Heil (1979) do not cite Hg.

Nickel (Ni)

Soil developed from basaltic greenstones are very high in Ni (50 to 75 ppm) with plants growing on this base reaching concentrations of from 50 to 75 ppm. Normal Ni contents of plants growing on typical western U.S. soils range from 0.1 to 5 ppm. Toxicity of Ni in plants does not exist even at the higher concentrations present on greenstone soils. The range of Ni values reported by Heil and Deutsch are from 0.4 to 10 ppm; the latter maximum value also being the average in 12 Ferron shales cited by Affolter et al., 1978.

Thallium (Tl)

Thallium is a highly toxic element to animals when exceeding 700 ppm in an assimilable form. One authority states that artificially applied Tl to soils can be taken up by plants with toxic soil levels being 35 ppm. However, this statement is too general since much higher levels of Tl have been found in Rock Mountain region plants. In general Tl concentrations reported in the literature appear to be below 10 ppm in most plants analyzed in this region. Tl levels are very low in Emery area substances, below the 100 ppm detection limit in ashed shale and coal samples of the Ferron formation.

Tin (Sn)

Sn is a non-essential non-toxic element in plants. Soils and nutrient solutions containing up to 40 ppm available Sn do not adversely affect plant growth. No toxicity to mammals is reported unless in the plus 1000 ppm range. Fish die in water containing 100's of ppm Sn. Sn concentrations is as high as Ferron shale/coal in the Emery area below the minimum detection limit of 20 ppm.

Vanadium (V)

Although certain plant species can grow in soils containing over 100 ppm, they exhibit dwarfing and chlorosis. One authority recommends a limiting value of 0.5 ppm V in nutrient solutions for optimum plant growth. Toxic values in small animals are 25 ppm. The total V concentration in Ferron shales averages 50 ppm well below that of the "average" shale; in coal the V average is 7 ppm.

APPENDIX 11

Laboratory Analyses and Procedures

LABORATORY ANALYSES AND PROCEDURES

Moisture Retention was determined by ceramic plates (Richards, et al., 1954, Diagnosis and Improvement of Saline and Alkali Soils, USDA Agriculture Handbook No. 60, 29, 30 and 31:109-110).

Particle-Size Analyses were determined by pipeting analysis (Richards, et al., 1954, Diagnosis and Improvement of Saline and Alkali Soils, USDA Agricultural Handbook No. 60, 41:122-124).

Disturbed Hydraulic Conductivity was determined by the use of plastic tubes (Richards, et al., 1954, Diagnosis and Improvement of Saline and Alkali Soils, USDA Agricultural Handbook No. 60, 34b:112-113).

pH of 1:15 Soil Suspension (Richards, et al., 1954, Diagnosis and Improvement of Saline and Alkali Soils, USDA Agriculture Handbook No. 60, 21b:102), (C. A. Black, et al., Methods of Soil Analysis, Part 2, Agronomy No. 9, American Society of Agronomy 60-3,4:922-923) and (Bear, et al., Chemical of Soils, 1964).

pH Reading in CaCl_2 Solution (C. A. Black, et al., Methods of Soil Analysis, Part 2, Agronomy No. 9, American Society of Agronomy 60-3.5:923).

Saturation Extract taken from saturation soil paste using Bariod filter press and measuring soluble salts by use of electrode conductivity bridge (Richards, et al., 1954, Diagnosis and Improvement of Saline and Alkali Soils, USDA Agricultural Handbook No. 60, 2 and 3:84-88, 27:107 and 4:89-90), C. A. Black, et al., Methods of Soil Analysis, Part 2, Agronomy No. 9, American Society of Agronomy 62-1:933-988) and (Bear, et al., Chemical of Soils, 1964).

Carbonates and bicarbonates were determined by acid titration and chlorides were determined by the Mohr volumetric method (Richards, et al., 1954, Diagnosis and Improvement of Saline and Alkali Soils, USDA Agricultural Handbook No. 60, 82:145-146 and 84:146), C. A. Black, et al.,

Methods of Soil Analysis, Part 2, Agronomy No. 9, American Society of Agronomy 62-3.4.1:945-947 and 62-3.5.1:947-948), (M. J. Taras, et al., Standard Methods for the Examination of Water and Wasteway, Thirteenth Edition, for carbonate and bicarbonate only 102:52-56), (Bear, et al., Chemical of Soils, 1964), and (Brown, Skougstad and Fishman, Techniques of Water Resources Investigation of USGS, Chapter A1, "Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases," Book 5 - Laboratory analysis for chloride only, p. 69).

Sodium, Potassium, Calcium and Magnesium were determined by atomic absorption (Perkin-Elmer, Analytical Method for Atomic Absorption

Spectrophotometry, 1973) and Brown, Skougstad and Fishman, Techniques of Water Resources Investigation of USGS, Chapter A1, "Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases," Book 5 - Laboratory Analysis, 66, 109, 133 and 143).

Nitrate was determined by phenoldisulfonic acid (Richards, et al., 1954, Diagnosis and Improvement of Saline and Alkali Soils, USDA Agricultural Handbook No. 60, 15:100), (C. A. Black, et al., Methods of Soil Analysis Part 2, Agronomy No. 9, American Society of Agronomy 84-5.3:1216-1219) and (M. J. Taras, et al., Standard Methods for the Examination of Water and Wasteway, Thirteenth Edition, 133:233-237).

Exchangeable Sodium and Potassium were extracted by ammonium acetate solution. Cation-Exchange Capacity was extracted by ammonium acetate and sodium acetate (Richards, et al., 1954, Diagnosis and Improvement of Saline and Alkali Soils, USDA Agricultural Handbook No. 60, 18:100-101 and 19:101) and (C. A. Black, et al., Methods of Soil Analysis, Part 2, Agronomy No. 9, American Society of Agronomy 72-3:1033, 72-3.2.1:1033-1034 and 57-1:891-895).

Exchangeable Sodium Percentage was determined by calculation (Richards, et al., 1954, Diagnosis and Improvement of Saline and Alkali Soils, USDA Agricultural Handbook No. 60, 20a:101).

Gypsum determined by increase in soluble calcium plus magnesium content upon dilution (Richards, et al., 1954, Diagnosis and Improvement of Saline and Alkali Soils, USDA Agricultural Handbook No. 60, 22c:104).

Gypsum Requirement (Richards, et al., 1954, Diagnosis and Improvement of Saline and Alkali Soils, USDA Agricultural Handbook No. 60, 22d:104-105).

Boron was determined by extracting with hot water (Bear, et al., Chemical of Soils, 490-494) and (C. A. Black, et al., Methods of Soil Analysis, Part 2, Agronomy No. 9, American Society of Agronomy 75-4:1062-1063).

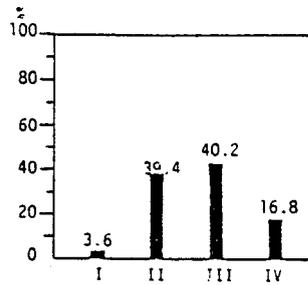
Trace Metals were determined by atomic absorption either by flame or graphite furnace (Perkin-Elmer, Analytical Method for Atomic Absorption Spectrophotometry, 1973), Brown, Skougstad and Fishman, Techniques of Water Resources Investigation of USGS, Chapter A1, "Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases, Book 5 - Laboratory Analysis, 50-157) and (M. J. Taras, et al., Standard Methods for the Examination of Water and Wasteway, Thirteenth Edition).

Organic Carbon - The Walkley-Block method is used, and diphenylamine is the indicator. (Methods of Soil Analysis, Part 2, Agronomy No. 9 American Society of Agronomy 90-3:1372-1375).

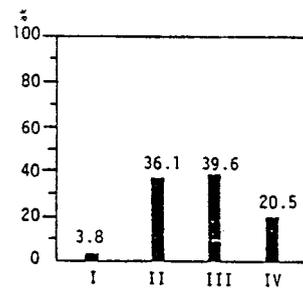
Bulk Density - Cl₂d method. Density measured by water displacement. (Methods of Soil Analysis, Part 2, Agronomy No. 9, American Society of Agronomy 30-4:381-383).

APPENDIX 12

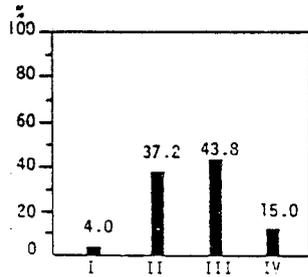
Coal Analyses



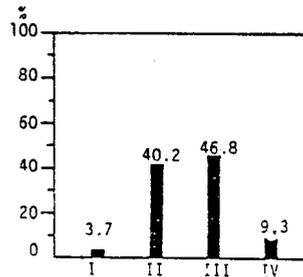
53.2 - 56.3 Feet
16.2 - 17.3 Meters



93.9 - 99.5 Feet
28.6 - 30.3 Meters



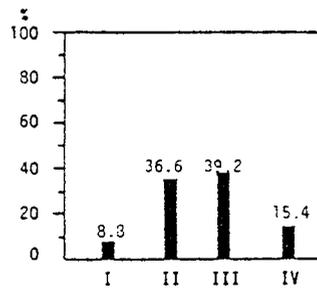
101.2 - 108.7 Feet
30.8 - 33.1 Meters



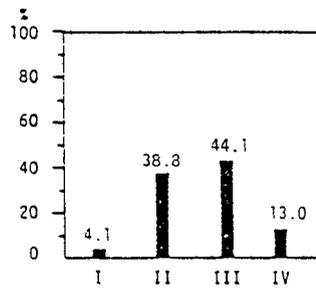
144.0 - 149.0 Feet
43.9 - 45.4 Meters

Proximate Analysis of Coal as Received. Bore Hole # 4a,
Key -

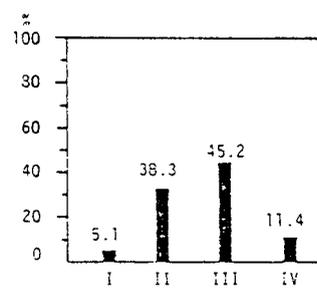
I - Moisture
II - Volatile Matter
III - Fixed Carbon
IV - Ash



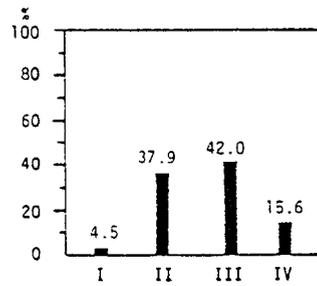
137.5 - 139.5 Feet
41.9 - 42.5 Meters



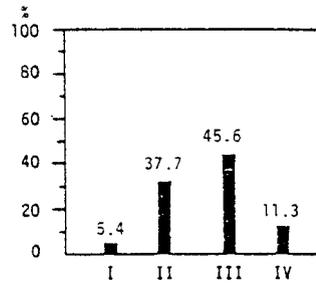
199.5 - 202.3 Feet
60.3 - 61.6 Meters



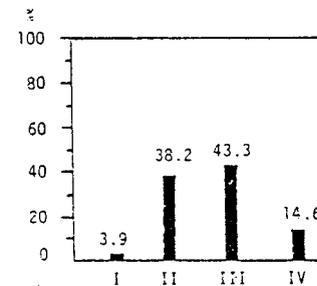
212.0 - 215.7 Feet
64.6 - 65.7 Meters



204.0 - 208.3 Feet
62.1 - 63.4 Meters



203.5 - 211.8 Feet
63.5 - 64.5 Meters



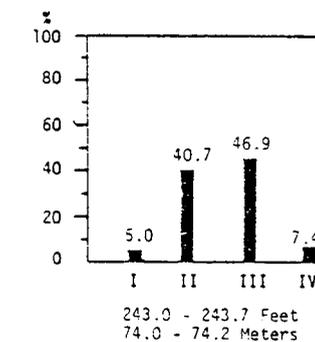
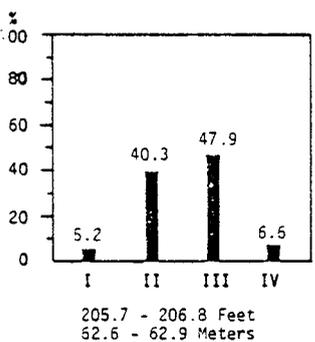
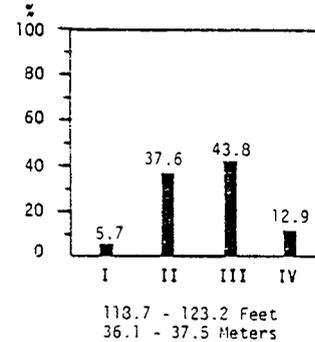
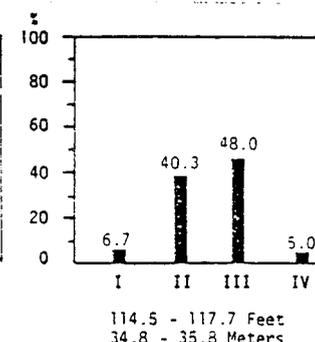
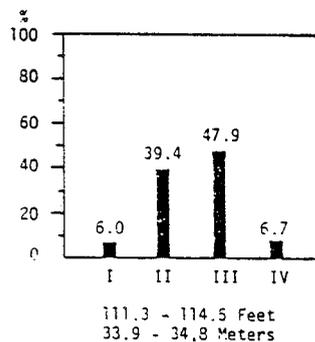
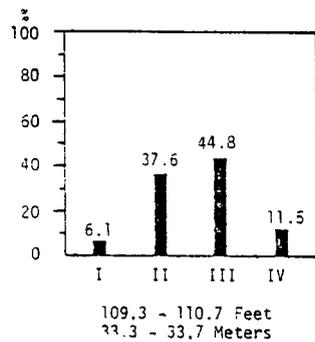
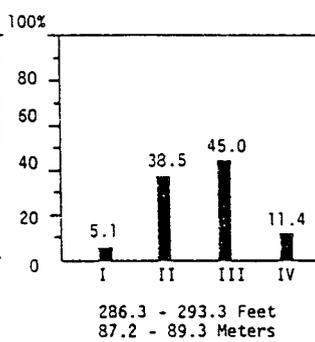
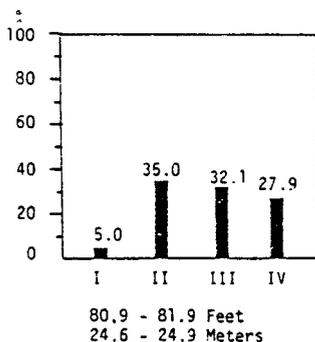
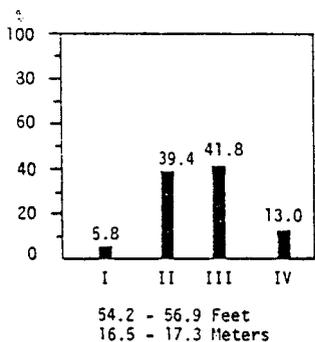
216.0 - 219.0 Feet
65.8 - 66.7 Meters

Proximate Analysis of Coal as Received. Bore Hole # 5.
Key -

I - Moisture
II - Volatile Matter
III - Fixed Carbon
IV - Ash

Proximate Analysis of Coal as
Bore Hole #5.

Key: I - Moisture
II - Volatile Matter
III - Fixed Carbon
IV - Ash



Proximate Analysis of Coal as Received. Bore Hole #6.

Key: I - Moisture
II - Volatile Matter
III - Fixed Carbon
IV - Ash

EMRIA

(Energy Mineral Rehabilitation Inventory and Analysis)

EMRIA is a coordinated approach to field data collection, analyses, and interpretation of overburden (soil and bedrock), water, vegetation, and energy resource data. The main objective of the effort is to assure adequate baseline data for choosing reclamation goals and establishment of lease stipulations through site-specific preplanning for surface mining and reclamation.

This report is prepared through the efforts of the Department of the Interior, principally by the Bureau of Land Management through Geoscientific Systems and Consulting (contractor). Assistance is also provided by other Federal and State agencies.

Reports under this effort are:

EMRIA Report Number, Year

1-75	Otter Creek, Montana	10-77	Beulah Trench, North Dakota
2-75	Hanna Basin, Wyoming	11-77	Pumpkin Creek, Montana
3-75	Taylor Creek, Colorado	12-77	Hanging Woman, Montana
4-75	Alton, Utah	13-77	White Tail Butte, Wyoming
5-76	Bisti West, New Mexico	14-77	Potter Mountain, Wyoming
6-76	Foidel Creek, Colorado	15-77	Henry Mountain, Utah
7-76	Red Rim, Wyoming	16-77	Emery, Utah
8-67	Bear Creek, Montana	17-77	Kimbeto, New Mexico
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