GR-SKEENA RIVER 81(3)A
IMPERIAL METALS LTD

Imperial Metals Corporation

914 West Hastings Street,
Vancouver, B.C. V6C 1A9
Tel. (604) 669-8959 Telex 04-55590

August 16, 1982

Mr. Paul Hagen
Coal Administrator
Ministry of Energy, Mines &
Petroleum Resources
Parliament Buildings
Victoria, B.C.
V8V 1X4

Dear Mr. Hagen:

In answer to your letter of April 22, 1982 and our telephone conversation of August 16, 1982 enclosed are two copies of work completed on the Groundhog Coal Licences (coal licences #6714 - 6734 inclusive, forfeited). These have just been received from Procan Exploration and I apologise for the delay.

Yours sincerely,

IMPERIAL METALS CORPORATION

Stephen P. Quin,
Mining Geologist

SPQ/jlg

IMPERIAL METALS & POWER

SKEENA RIVER

GROUNDHOG COALFIELD

COAL LEASES

- Holes drilled by WILL TOMSON, 1970
- Holes drilled by HUNT, 1981

SCALE	CONTOUR	DWN AEH	COMPILED BY E HEMINGWAY
1 24000	100 ft	DATE 23/3/81	

L 2191 C.L. 6730
C.L. 6731
C.L. 6733
L 2193
L 2190 C.L. 6727
C.L. 6732
C.L. 6734
L 2189 C.L. 6726
L 2188 C.L. 6725
L 129 C.L. 6728
L 130 C.L. 6729
L 131 C.L. 6721
L 2183 C.L. 6722
L 132 C.L. 6719
L 141 C.L. 6720
L 999 C.L. 6715
L 998 C.L. 6716
L 133 C.L. 6718
L 140 C.L. 6717
L 139 C.L. 6714
L 138
L 2186 TABLE MTN. C.L. 6724
L 2181 C.L. 6723
L 993
L 134
L 135
L 136
L 137

81 - H6
81 - H9
81 - H4
81 - H3
81 - H2
81 - H1
DDH No 2
DDH No 3
DDH No 4
DDH No 5
DDH No 6

NANNYGOAT CR.
VIEW MTN.
LONESOME MTN
LONESOME CR.
SKEENA RIVER
LANGLOIS CR.
MOSS MTN.
ANTHRACITE CR.
EVANS CR.
DAVIS CR.
DISCOVERY CR.
TELFER CR.
BUKE CR.
JACKSON FLATS
CURRIER CREEK

N 140,000
N 120,000
N 100,000
E 100,000
E 120,000

COURTESY OF THE PLACER DEVELOPMENT CO.

PROJECT Groundhog DATE 6/3[illegible] 81

HOLE No. 81-H1 PAGE No. 1 of 14

GEOLOGIST Larry Nicoll LOCATION

DRILLER Tonto AERIAL PHOTO

LOGGER Rick Appleby MAP No.

Top & bottom of run	Rod intervals (meters) From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
1.1	0.0	1.1				0					overburden
1.52	1.1	8.23	7.13			100					shaley sandstone, fine gr., salt + pepper color
2.13						65					massive; cut by occasional 2 mm qtz.
2.74						65					veins C.A. 40^{0}-50^{0}; non-calc; broken in
3.96						33					part with hematite along fracture from
5.49						92					2.13-3.96
8.23						100					6.95-7.15 qtz. vein CA20^{0}
											7.70-8.23 qtz. vein CA 10^{0}
11.23	8.23	18.30	10.07			100					shaley sandstone, v.fine grained, similar to above;
14.32						98					gradational to interbedded sst./mudstone towards
											bottom; cut by repeated qtz.veining in part CA80^{0}
											(dip 10^{0}); core is dark grey to black
											Bedding dips: 30^{0} at 11.23 m
											30^{0} at 14.0 m

PROJECT Groundhog HOLE No. 81-H1 PAGE No. 2 DATE 6/30/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
15.24						100						bedding dips: 20-25 at 16.20
17.37						100						bedding dips: 25-30 at 18.10
18.90						92						
21.94	18.30	26.40	8.1			100						black mudstone with fine gr. greywacke
23.47						100						interbeds; non-calcareous; bedding dips 25°;
24.69						100						broken core from 18.3 to 18.9; occasional coaly
												layers and frags.
27.43						95						
	26.40	26.83	.43									brecciated sandstone; dark grey to black sstn/mudst
												frags in qtz. vein filling; coaly layers in part
												vein contact variable from vertical to 30° layered
												fragmental at top
28.65	26.83	29.15	2.32			90						shaley sandstone, fine grained, similar to above,
30.78						38						rock has been fractured & filled with cross-cutting
												qtz veins CA 20, 35, 60. Veining decreases towards
												bottom

PROJECT Groundhog HOLE No. 81-H1 PAGE No. 3 DATE 6/30/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
32.00	29.15	33.00	3.85			78						carbonaceous mudstone, black, thinly bedded, bedding dipping 10°, slickensides along bedding planes, occasional qtz. veining, core is generally soft & crumbly
	33.00	33.18	.18									coal; soft & broken; appears to be thin vitrain
35.05						100						bands with durain; bedding 15°
	33.18	37.55	4.37									black mudstone with thin sandstone interbeds; bedding dips 30°; non-calcareous. Dipping increases to 40° at bottom
38.10	37.55	43.05	5.50			100						shaley sandstone with thin mudstone interbeds;
41.15						100						dark grey to black; dip 40°. Cut by occasional dolomitic veins CA 40°
44.80	43.05	43.55	.50			96	0001					dirty coal; soft, crumbly, abundant vitrain

PROJECT Groundhog HOLE No. 81-H1 PAGE No. 4 DATE 7/1/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	43.55	44.00	.45				0001					coal; 50/50 vitrain/durain; thinly banded; dip 25°; some slickensides; dirty in part; cut by thin qtz. veins-massive contorted pyrite at 44.0 m
	44.00	45.27	1.27									carbonaceous shale; black, abundant coal frags. and thin, slightly convoluted coaly layers. Thin white qtz. veins which are partially convoluted
47.80	45.27	45.55	.28			100						sandstone; shaley matrix; salt & pepper color; sharp contact with overlying bed (contact 60°)
	45.55	46.15	.60									mudstone, black with interbedded v. fn. gr. sandstn. towards bottom; coaly frags.
	46.15	55.70	9.55									sandstone; med. to dk grey, clay matrix;
53.90						100						interbedded black mudstone near top. Bedding dip 10°; grain size is medium

PROJECT Groundhog HOLE No. 81-H1 PAGE No. 5 DATE 7/1/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
56.99	55.70	73.55	17.85			100						sandstone; med-dk. grey; fine-v.fine grain with
												clayey matrix; interbedded black mudstone layers.
60.04						100						Bedding dips 10°. Some of the mudstone layers
												have slickensides
63.09						100						56.40-qtz. vein (3 mm thick)
												CA 20°
66.14						100			x			57.0-fracture & recemented rock CA 20° (dip 70°)
												63.0 to bottom of unit-increased mudstone
69.19						100						layers, bedding dip 10° 67.30-50/50 mudstone/sndstn
												73.53 thin layer massive pyrite
72.23						100						
	73.55	74.70	1.15				0002					coal-thinly banded vitrain (conchoidal fracture),
												clarain with some dull durain bands; hard;
75.28						100						slickensides - bedding dipping ≃ 10°
	74.70	74.80	.10									dirty coal-dull black, soft, broken

PROJECT Groundhog HOLE No. 81-H1 PAGE No. 6 DATE 7/1/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	74.80	76.85	2.05									carbonaceous mudstone-black, abund., coaly frags. &
												layers; occasional qtz. layers (veins or replacemen
78.33						100						which may contain layered pyrite
	76.85	77.60	.75				0003					coal, soft, broken, 50/50
												vitrain/durain; slickensides
	77.60	83.40	5.80									interbedded carb. mudstone and v. fine gr.
												sandstone; dark grey to black;
81.37						85						slickensides in carb. mudstn; bedding
												dip 10^{o}. Cross-cutting qtz. veins CA 50^{o},30^{o}
												becomes mainly mudstn. from 78.00 to 83.40
84.43						100						
	83.40	87.62	4.22									interbedded sandstone/mudstone; dark gry. to black;
												bedding dips 20^{o}-25^{o}. Non-calcareous
87.47						100						

PROJECT Groundhog HOLE No. 81-H1 PAGE No. 7 DATE 7/1/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	87.62	87.90	.28									carbonaceous mudstn., black
90.52						100						
	87.90	88.65	.75				0004					coal; abundant thin banded vitrain with concoidal
												fracture; somewhat soft & broken in part. Qtz. in
												part. Bedding dip 10^{0}
	88.65	90.20	1.55									carbonaceous mudstone with coaly partings;
												bedding dips 15^{0}
	90.20	94.95	4.75									sandstone; dark grey with shaley
												matrix; qtz. veining CA 35^{0};
												fine grained
91.74						100						-mudstone partings in part
												-bedding dip 25^{0}
93.57	94.95	96.05	1.1			96						shale, black with some
												thin coal partings - dip 40^{0}
96.62												

PROJECT Groundhog HOLE No. 81 H1 PAGE No. 8 DATE 7/1/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	96.05	96.86	.81									dirty coal; soft & broken, with some slickensides
	96.86	97.76	.9									shaley sandstone, v. fine grained, 1 cm laminae; carbonaceous partings;
98.42						95						broken core; qtz. veins crosscutting
100.27						90						
103.93	97.76	105.66	7.9			74						very carbonaceous mudstone, black;
105.76						100						abundant coal specs; slickensides in part; qtz. veins in part; bedding dips 30°
	105.66	108.15	2.49									sandstone, v.-fine grained, shaley matrix with abundant carbonaceous mudstone
108.81						100						laminae; beds dipping 10°; dissem. pyrite in thin bands
	108.15	115.80	7.65									shale; black with carbonaceous frags. and 1-2 cm fn. gr. sandstn. laminae. Bedding dips 20°
111.90						100						113.50-115.80: occasional qtz. veins 25 mm in width; becomes prominent at bottom

PROJECT Groundhog HOLE No. 81 H1 PAGE No. 9 DATE 7/2/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
117.95	115.80	116.40	.60			100						dirty coal: soft, dull with 1/3 vitrain; bedding
												dips 5^{o}-10^{o}
119.78						58						
	116.40	122.60	6.20									laminated black mudstone/fn. gr. sandstn.-laminae
												range in thickness from 4 to 50 cm.; bedding dips
												approx. 10^{o}
123.44	122.60	123.50	.90			100						dirty coal-dull, soft with 1/3 vitrain; occasional
												pyrite bands; dips 10-15^{o}; slickensides
	123.50	125.42	1.92									black mudstone
125.11	125.42	138.00	12.58			100						shaley sandstone; med-dk. grey, fine grained with
												thin shale, laminae (2-3 mm); dissem. pyrite;
												128.0-128.45: 2mm qtz. vein CA 10^{o}
												129.40 - white irregular qtz. (vein or replacement?

PROJECT Groundhog HOLE No. 81 H1 PAGE No. 10 DATE 7/2/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
127.10									x			129.90-130.40: fractured, qtz.
130.14						100						filling CA 20°
												131.65-132.30:white qtz. lens
												137.20-137.70:fine gr. sandstone
133.19						100						with convolute qtz. veining
136.23						100						138.0 gradational contact to mostly black shale
												with thin, v. fn. gr. sandstone laminae
	138.00	155.18	17.18									black shale; thinly laminate; dip -5°;
												carbonaceous partings
139.29						100						often with slickensides
												140.40-141.15-grey thinly bedded
142.34						100						mudstone; soft in part; in part qtz. veining;
145.38						100						142.50-143.90 broken core
148.43						100						
	155.18	155.95	.77									dirty coal, dull black with 1/3
151.48						100	0005					vitrain specs, irregular qtz. veining;
												bedding dip 30°; core is soft, easily
154.53						100						broken

PROJECT Groundhog HOLE No. 81 H1 PAGE No. 11 DATE 7/3/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
157.57	155.95	159.80	3.85			97						shale/fn.gr. sandstone laminae, med. grey to black, cutby contorted qtz. veins; bedding dips 45° - carbonaceous partings
												shale predominates towards bottom
	159.80	161.80	2.0				0006					coal; generally soft, crushed; black with abundant vitrain specs; dip uncertain; dirty (ashy) in part; some pyrite. 160.85 - 161.00 very carb. mudstn. & white qtz.
160.62						100						
	161.80	166.72	4.92									shale/v.fn. gr. shaley sandstn; dk. grey to black, carbonaceous partings; beds
163.67						100						dip 30°; contorted qtz. veining and increased carbonaceous material towards bottom
	166.72	168.75	2.03									carbonaceous black shale, mudstn. in part; thin
166.72						100						qtz. veining; bedding dip 0-10°

PROJECT Groundhog HOLE No. 81 H1 PAGE No. 12 DATE 7/3/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	168.75	188.05	19.30									
169.77						100						shaley sandstone; fine gr., med-dk. grey with
172.81						100						abundant 2-5 mm black shale laminae;
												bedding dips 20-25°. Occasional 2-3 mm white qtz.
178.91						100						vein. 181.00-181.35 med. gr. sandstone, med. gry.
												187.0-bed. dips 15°
181.96	188.05	190.70	2.65			100						black shale with thin v. fine gr. sandstone laminae
												bedding dips 15°
185.0						100						
	190.70	191.30	.60				0007					coal; contains abundant vitrain,
188.05						100						crushed
	191.30	191.55	.25									dirty coal
191.10						100						
	191.55	192.10	.55									carbonaceous shale/mudstone-black with
												thin, very fine gr. sandstn.
194.15						100						laminae; dips 70°
197.20						100						

PROJECT Groundhog HOLE No. 81 H1 PAGE No. 13 DATE 7/3/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	192.10	194.15	2.05									black shale with thin, very fine gr. sandstn. laminae; dips 30°
	194.15	196.20	2.05									carbonaceous shale; contorted qtz. veins, dip 20°
	196.20	196.90	.70				0008					coal; thinly vitrain layers; generally soft, crushed
	196.90	197.68	.78									black shale with v. fn. gr. sandstone laminae; shale is gradational to sandstone; bedding dips 20°
	197.68	202.85	5.17									shaley sandstone; fine gn., salt + pepper color;
~~200.24~~						100						thin shale laminae at top
												thin (1-7mm) qtz. veins CA 20°
												199.40-200.15: 5 cm thick
												qtz. vein, vuggy CA 20°

PROJECT Groundhog HOLE No. 81 H1 PAGE No. 14 DATE 7/3/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
202.99	202.85	210.70	7.85			100						black shale with fn. gr. sandstn.
												laminae (up to 5 mm); fissile;
206.19						100						dip 10°; carbonaceous partings
209.32												
212.44	210.70	216.40	5.70			100						shaley sandstone with black shale
												laminae; similar to above
												unit-gradational contact.
215.48						100						bedding dips 10°
216.40						100						
				End of Hole at 216.40 meters (710 ft.) July 3/81								

PROJECT Groundhog DATE 7/6/81

HOLE No. 81-H-2 PAGE No. 1 of 19

Top of casing @ Ground level

GEOLOGIST J. Kelley LOCATION

DRILLER Tonto AERIAL PHOTO

LOGGER Century Geop. (R. Appleby) MAP No.

(meters)

Top & Bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
0	0	6.10	6.10									casing, unconsol. o.b., muskeg
6.10	6.10	6.33	.23					s.s	x	fg.	dk. gray	heavily fractured and altered, well indurated
												poor recovery, hem., limonite alteration
	6.33	7.72	1.39					s.s	x		dk.gr.,lt.gr.	interlam. fg.-v.f.g. s.s.w/sh. matrix, and
												med-dk. gray silty sh.,lam. subparallel,
												blocky fracture
	7.72	7.92	.20			100		s.s	x	fg.	med. gray	shaley, 25% opaques, vertical fracture, qtz. filled
7.92	7.92	8.58	.66	i				s.s		fg.	med. gray	massive, corpetent, well ind., 20% opaques,
												well sorted, slightly shaley
	8.58	9.07	.49					s.s		fg.	med. dk. gr.	finely laminated s.s., and minor lam. of silty sh.,
												dk. gray
	9.07	9.17	.10					s.s	x	fg.	lt. gray	well indurated, shale filled frac., slightly
												contorted bedding
	9.17	9.53	.36					s.s	x	fg.	lt. med. gr.	finely laminated s.s.,w/silty sh.,slight alteration
	9.53	9.97	.44					s.s	x	fg.	lt. med. gr.	massive, w. shale clasts. occ.
	9.97	10.24	.27					s.s sh.	x	fg. silt	lt.med. gr.	finely lam. ss/w silty sh., bedding planes separate as frac., horizontal

PROJECT Groundhog HOLE No. 81-H2 PAGE No. 2 DATE 7/6/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	10.24	10.62	.38					sh.	x		med. gray	laminated sh. w minor interlam. of lt.gr. f.g. s.s.
	10.62	11.03	.41					s.s.	x	F.g.	med. gray	interlaminated s.s.,w. minor % silty sh., dk. gray,
												fractures easily along bedding planes
10.97						100						
	10.97	12.78	1.81					s.s.	x	vfg f.g.	med.dk.gray	coarsely interlaminated, s.s. and dk.silty shale,
												heavily fractured, lost. some recovery
	13.41	14.62	1.21					s.s	x	f.g.	med. gray	med. interlaminated s.s. and dk. gray silty
												shale, heavily fractured both parallel to bedding
												and obliquely
	14.62	14.63	.01					sh.			black	fissile, very silty
	14.63	14.78	.15					s.s.		f.g mgr.	lt.gray	massive, blocky
	14.78	16.58	1.80					s.s.	x	f.g mgr.	lt-med. gray	med. interlaminated s.s. and silty shale,
												lam. subparallel, max. CA. 10%
16.61						99						
	16.61	17.40	.79					s.s.	x	f.g.	lt-med. gray	shaly, s.s., w periodic med. lam. of dk. gray
												silty shale, heavily fractured
	17.40	17.73	.33					sh.			dk. gray	sandy sh., fissile, w/disseminated pyrite (xtallie)

PROJECT Groundhog HOLE No. 81 H-2 PAGE No. 3 DATE

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	17.73	18.36	.63					s.s		f.g	lt.med. gray	thinly interlaminated s.s. and silty-sty. sh.
	18.36	18.95	.59					s.s	x	f.g.	med. gray	massive, heavily fract., qtz. filled frac.
												both oblique and contorted (semi-brecciated
	18.95	19.2	.25					s.s	x	f.g	med. gray	massive, occ. shale clasts
19.05						100						
	19.05	19.27	.22					s.s	x	f.g mg.	med. gray	massive, occ. shale clasts
19.81						29						
	19.81	20.19	.38					s.s	x	f.g mg.	dk. m. gray	massive, occ. shale clasts
	20.19	20.97	.78					s.s		f.g	med. gray	shaly s.s., occ. laminated w/dk. gray
												silty sh. as minor constituents
	20.97	21.27	.30					s.s		med gr	gray	heavily fractured, shaly
	21.27	22.00	.73					s.s		f.g mgr	gray	massive, abundant silty sh. clasts, subparallel
												to bedding
	22.00	23.21	1.21					s.s	x	f.g	med. gray	massive, w/occ. fissile silty shale laminae(.5 cm th
	23.21	23.28	.07					s.s	x	f.g	med. gray	extremely brecciated by qtz. vein filling
												probably lost core recovery here
	23.28	23.95	.67					s.s	x	f.g	lt.gray	massive, occ. qtz. veining oblique to bedding
												planes
	23.95	24.18	.23					s.s	x	f.g	lt.gray	badly broken, blocky fracture, massive
	24.18	24.20	.02					sh.			black	fissile, silty
	24.20	24.79	.59					s.s	x	f.g	med. gray	fractured grading into intensely brecciated

PROJECT Groundhog HOLE No. 81-H2 PAGE No. 4 DATE 7/6/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												zore at bottom, qtz. veins
	24.79	25.29	.50					s.s	x	fig	gray	highly frac. fig. s.s., 90% qtz. veining intensely
												brecciated
	25.29	25.40	.11					silt-st.		silt	med. gray	poorly indurated silt w/clay matrix
	25.40	25.6	.20					s.s	x	fig vfg	med. gray	well indurated, thin qtz. filled veins oblique
												to bedding planes, highly broken
	25.60	26.10	.50					sh.	x		med. gray	poorly indurated, fissile, v. silty
25.3						100						
	25.3	26.06	.76					sh.	x		dk. gray	very silty, 60% sh., 40% silty, poorly indurated,
												semi-fissile, coarser material ranges to v fig. sd.
	26.06	26.11	.05					Coal	x		bl.	intensely brecciated by qtz. veins, hi % vit,
												very contorted.
	26.11	26.26	.15					sh.			black	fissile, carbonaceous
	26.25	26.39	.13					sh		v fig	lt. gr.	poorly indurated, very high clay content
	26.39	26.73	.35					sh			dk. gray	fissile, slightly silty, carbonaceous
											black	
	26.73	27.37	.64					s.s		med gr.	speck gray	massive, well indurated, occ. small shale
												clasts, 25% opaques
	27.37	27.41	.04					sh.			dk. gray	shale clast
	27.41	27.54	.13					s.s		fig.	med. gray	thinly interlaminated w/dk. gray silty sh.
	27.54	27.90	.36					s.s		med gr	speck gray	massive, friable, well sorted, clean, subrounded sh

PROJECT Groundhog HOLE No. 81-H-2 PAGE No. 5 DATE 7/6/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	27.90	28.24	.34					s.s		med gr	speck gray	massive, some x bedding, clean, well sorted,
28.35						96						subrounded, 20% opaques, friable
	28.35	28.43	.08					s.s		med gr.	speck gray	massive, clean, well sorted, subrounded, friable
	28.43	28.55	.12					s.s		med sn.	speck gray	massive, + abundant rounded dk. gray, vfg. s.s. clast
	28.55	29.52	.97					s.s		med gr.	speck gray	massive, clean, well sorted w/occ. vfig. laminae
												and vfg. s.s. clasts
29.57						99						
	29.57	30.95	1.38					s.s		med gr.	speck gray	massive, clean, well sorted w/ laminae of vfg. s.s..
												and occ. zores of rounded clasts of vfg. dk. gr. s.
	30.95	31.86	.91					s.s		med gr.	lt. gray	interlaminated w/dk. gray vfg. s.s.
	31.86	32.31	.45					silt st.		silt	dk. gray	very carbonaceous, w/abundant shell (bivalre)
Box 7												fragments, fragments are completely replaced by
												SiO_2, contorted bedding, bioturbated
	32.31	32.54	.23					silt sh.		silt	dk. gray	very carb., w/abundant shell frag, replaced by
												SiO_2, bioturbated
32.61						98						
	32.61	33.06	.45					silt st.		silt	dk. gray	very carb., w/abundant shell frag., replaced by
												SiO_2, bioturbated
	33.06	34.12	1.06					s.s	x	fig	med. gray	bedded, w/occ. laminae of dk. gray-blk.
												siltstone, and occ. rounded shale clasts
	34.12	34.36	.24					s.s sh.		sh. med gr.	dk. gray	interlaminated med. gr. ss. & dk. gray siltstone

PROJECT Groundhog HOLE No. H2 PAGE No. 6 DATE 7/8/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	34.36	34.91	.55					s.s		med gr.	gray	w/occ. dk. gray siltstone laminae and clasts
	34.91	35.53	.62					silt st.	x	silt	dk. gray	w/occ. laminae of lt.gray fg-red. gr. s.s.
	35.53	35.74	.21					s.s	x	fig	lt.gray	x'bedded w/occ. dk. gray siltstone laminae
35.66						100						
	35.66	35.98	.32					s.s		fg. med	lt.gray	poorly sorted, angular-sub rd. gns., shaly
												w/occ. laminae of dk. gray siltst.
	35.98	36.03	.05					sh. + coal			black	carb. silty, fissile, w/25% bands of vitrain
	36.03	36.23	.20					sh.			black	very carb., fissile w/occ. oblique veins of vitrain
	36.23	36.34	.11					coal	x		black	alternating thin bands of vitrain and bone, x'tallinc
												pyrite also present
	36.34	36.68	.34					sh.			black	fissile, very carbonaceous, silty
Box 8	36.68	37.34	.66					silt st.			black	fissile, carbonaceous, grades to shale
	37.34	38.28	.94					s.s sh.	fg		dk. gray	coarsely interlaminated s.s.&silty shale, bioturbatec
	38.28	38.46	.18					s.s		med gr	gray	x'bedded, shaly, subarg-subrd.
38.71					92							
	38.71	39.00	.29					s.s		med. gr.	gray	x'bedded, shaly, subarg-subrd.
	39.00	39.11	.11					s.s		med.	gray	x'bedded, shaly, subarg-subrd., +ang. clasts of
												dk. gray sh.
	39.11	39.43	.32					s.s		fig	gray	finely interlaminated fig. ss. and dk. gray silty sh.
	39.43	39.51	.08					s.s		med gr.	gray	angular gns, shaly, 25% opaques

PROJECT Groundhog HOLE No. H-2 PAGE No. 7 DATE 7/8/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	39.51	39.55	.04					sh.			bl.	fissile, carbonaceous
	39.55	39.60	.05					s.s		med gr.		carbonaceous, both flecks of vitrain and vitrain
												laminae present, contorted bedding
	39.6	39.82	.22					sh.	x		black	w/occ. thin layers of vit. slickensides present
												on obliquefractures
		41.3						sh.			black	very carbonaceous fissile, slightly silty,
												on oblique fractures
Box 8	41.3	41.38	.08									very carbonaceous fissile, slightly silty,
												slickensides on oblique fractures
	41.38	41.47	.09					sh.			black	crushed, w/abundant vit. fragments
	41.47	42.33	.86					sh.			black	fissile, sl. silty, very carb., slickensides on
												oblique fractures
	42.33	42.46	.13					s.s		fig	dk. gray	finely interlaminated w/dk.gray silty sh
	42.46	42.80	.34					s.s		fig	gray	w/occ. lam. of silty dk. gray sh.
	42.80	43.23	.43					s.s		med gr.	h. gray	x'bedded, contorted, occ. angular clasts of
												dk. gray, silty sh., and oblique SiO_2 lined fractur
	43.23	44.14	.91					s.s		fg. med	med. gray	fig-red gn, w occ. coarse interlaminae of dk.
												gray silty sh., occ. ang. clasts of same
	44.14	44.23	.09					s.s		med	lt. gray	shaly, arg.gns.
	44.23	44.49	.26					s.s sh.		med	banded lt&dk	coarsely interlaminated s.s and dk gray silty shale
	44.49	44.68	.19					s.s		med	lt. gray	w/occ lam. of dk. gray, silty sh.

PROJECT Groundhog — HOLE No. 81-H2 — PAGE No. 8 — DATE 7/8/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	44.68	44.81	.13					s.s sh.	x	med	dk. h. gray	coarsely interlaminated s.s and dk. gray silty shal
44.81	44.81	44.99	.18					s.s sh.	x	med	dk-lt. gray	coarsely interlaminated s.s and dk. gray silty shal
	44.99	45.69	.70					sh.	x		dk. gray	fissile, very silty, w/occ. blebs of fg. ss. (ltgra
Box 10	45.69	46.0	.31					s.s		fig	lt.gray	shaly, ang. gns, w/occ. coarse laminae of dk. gray
												silty sh.
	46.00	47.03	1.03					sh.			black	very silty-sand, fissile
	47.03	47.22	.19					coal	x		black	crushed, alt. vitrain and bony coal, qtz. filled
												fractured, pyrite, both banded and as fracture fil
	47.22	47.72	.50					sh.			black	fissile, carbonaceous
	47.72	47.84	.12					coal				layered, hi % vitrain, very hard, blocky fracture,
												2 cm band of massive x'talline pyrite (lost
												recovery at tops of this zone)
	47.84	47.91	.07					coal				crushed, hi % vitrain, blocky fracture
47.85						?100						
	47.85	48.05	.20					sh.			black	carbonaceous, w/laminae of vitrain up to 2 cm
	48.05	48.70	.65					sh.			black	silty, fissile
	48.70	49.97	1.27					ss.		med.	lt. gray	x'bedded, w/carb. laminae, and occ. dk. gray silt
												sh. coarse lam. (~3 cm)

PROJECT Groundhog HOLE No. H-2 PAGE No. 9 DATE 7/8/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
Box 11	49.97	50.41	.44					s.s		med	lt.gray	w/abundant angular-horizontal clasts of dk. gray siltstone
	50.41	51.03	.62					s.s sh.			banded gray	interlaminated s.s (red gn., shaly) and dk gray silty-sty sh., + occ qtz. filled fractures
50.90						100						
	50.90	51.11	.21					s.s sh.			banded gray	interlaminated s.s (red gn. shaly) and dk. gray silty-sty sh., + occ qtz. filled fractures
	51.11	52.26	1.15					s.s		med fig	lt. gray	massive, w/occ ang. clasts of dk. gray siltstone
	52.26	53.92	1.66					sh.		dk gr.		w/occ thin laminae of fg., lt.gray s.s
53.95						99						
	53.95	54.22	.27					sh.		dk. gr.		w/occ thin laminae of fg., lt.gray s.s
Box 12	54.22	56.57	2.35					sh.			dk. gray	fissile silty-sty, w/occ thin laminae of fg. s.s
	56.57	56.64	.07					clay			med. gray	very carbonaceous, poorly indurated, shows slickensides on fracture planes
	56.64	56.94	.30				H-2-1	coal	x			badly broken, 90% vitrain & durain, cubical fracture, very lustrous faces, some small zones show crushed coal as a matrix, w/v. small cubes of vitrain present, slickensides on fractures
57.						99						
	57.	57.42	.42				H-2-1	coal	x			badly broken, 90% vitrain & dur., cubical fract. slickensides on fractures

PROJECT Groundhog HOLE No. H-2 PAGE No. 10 DATE 7/9/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	57.42	57.44	.02					sh.			black	fissile w/very thin laminae of vitrain
	57.44	58.13	.69					sh.			black	fissile, slightly silty, carbonaceous
	58.13	58.58	.45					sh.			black	w/occ. thin laminae of lt. gray fig. shaley s.s.
Box 13	58.58	60.05	1.47					sh.			black	w/occ. thin laminae of lt gray fig. shaley s.s.
60.05						100						
	60.05	61.82	1.77					s.s sh			banded black	interlaminated s.s, fg., shaly and dk. gray silty sh., occasionally these sh. laminae appear to to be contorted and sometimes appear to be clasts
	61.82	62.3	.48					s.s	x	med	lt.gray	angular-subangular qns, w/thick laminae of dk. gray silty sh, and subrounded large clasts of same
	62.3	62.82	.52					sh.			black	silty, fissile, w/occ. lam. of vitrain
	62.82	62.98	.16					coal sh.			black	interlaminated dk. gray silty shale, carb., poorly indurated, and vitrain. Thickest vitrain 1 cm., qtz. filling on fractures, contorted bedding
63.09						99						
Box 14	63.09	63.14	.05					coal sh.				interlaminated dk. gray silty shale, carb., poorly indurated, and vitrain. Thickest vitrain 1 cm, qtz. filling on fractures, contorted bedding
	63.14	64.36	1.22					sh.	x		black	slightly silty, occ. contorted thin lam. of vitrain
	64.36	66.25	1.89					ss. sh.			banded gr&bl.	interlaminated dk. gray-black silty shale and fig. shaley s.s.
66.14						100						

PROJECT Groundhog HOLE No. H-2 PAGE No. 11 DATE 7/9/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	66.14	66.17	.03					s.s sh.			black	silty, w/occ. thin lam. of fg. lt. gray s.s.
	66.17	66.31	.14					sh.	x		black	silty, w/occ. thin lam. of fg. lt. gray s.s.
		66.40	.09					sh.			black	silty, w/abundant contorted laminae of x'alline
												pyrite
	66.40	67.06	.66					sh.			black	fissile, silty
Box 15	67.06	67.26	.20					sh.				fissile, silty
	67.26	67.46	.20					s.s		med. gr.	lt. gray	angular gns, w/abundant thin black carb. sh. laminae
	67.46	68.12	.66					s.s		fg. med.	lt. gray	massive, subarg-sub.rd., <25% shale
												matrix, well sorted, some x'bedding
	68.12	68.18	.06					s.s		fig.	black,dk.gr.	very shaley, well indurated, w/occ. laminae of above
	68.18	68.63	.45					s.s		med gr.	lt. gray	well sorted, subrounded, clean, 25% opaques
	68.63	68.72	.09					s.s		med. gr.	speck gray	as above,w/angular-subrounded clasts of dk. gray
												silty sh.
	68.72	68.94	.22					s.s		red sh.	lt. gray	clean, well sorted, subangular, finely dissem.
												pyrite x'tals, qtz. filling of void subparallel
												to bedding planes, abundant subrounded clasts of dk
												gray-black, silty sh.
69.19						92						
	69.19	69.38	.19					s.s		med sh.	lt. gray	clean, well sorted, subangular, 25% opaques

PROJECT Groundhog HOLE No. H-2 PAGE No. 12 DATE 7/9/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	69.38	71.46	2.08					ss. sh.	x		banded gr.blk	interlaminated dk. gray silty sh., and lt. gray fg.-red.gn.s.s., occ. qtz. filled fractures oblique to bedding
	71.46	71.77	.31					s.s		med gn	lt. gray	massing, clean, well sorted, subangular
Box 16	71.77	71.82	.05					s.s		med gn		massing, clean, well sorted, subangular
	71.82	72.18	.36					silt st.		silt	black	shaley, w/occ. lam. of fg. lt. gray s.s.
72.24						99						
	72.24	74.15	1.91					s.s silty			black (band)	interlaminated lt. gray fig. s.s. and dk. gray silty shale-shaley silt, mildly bioturbated, occ. v. thin lam. of vitrain, occ. qtz. filled fractures
	74.15	74.36	.21					coal			black	layered vitrain and durain w/qtz. filled fractures abundant, finely dissem. pyrite, mildly crushed, contorted
	74.36	74.59	.23					sh.			dk.	silty w/occ. blebs of vitrain
	74.59	75.26	.67					sh.			black	fissile, silty
75.29						99						
	75.29	75.33	.04									fissile, silty
	75.33	76.06	.73					sh.			black	interlaminated w/occ. lt. gray fig. s.s., shale is very silty
	76.06	76.09	.03					coal	x			crushed, hi % vit.
	76.09	76.19	.10					sh.			black	silty

PROJECT Groundhog HOLE No. H-2 PAGE No. 13 DATE 7/9/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	76.19	76.22	.03					coal	x			crushed, hi% vitrain
	76.22	76.30	.08					sh.			black	carb., fissile, silty
Box 17	76.30	77.08	.78					sh.				carb., fissile, silty
	77.08	77.39	.31					sh.			black	w/occ. thin lam. of fg. s.s.
	77.39	77.49	.10					sh.			gray	poorly ind. fissile
	77.49	78.17	.68					s.s sh.			band. gray	interlam. dk. gray silty sh. and fig. shaley, s.g.
	78.17	78.36	.19					s.s		med gr.	lt. gray	massive, clean, well sorted
	78.36	78.57	.21					sh.			black	silty, interlam. w/fg. lt. gray s.s.
78.33						100						
	78.33	80.54	2.21					sh.			black	silty, interlam. w/fig. lt. gray s.s., occ. qtz.
												replaced fossils (bivalves)
Box 18	80.54	81.32	.78					sh.			black	fissile, sl. silty
81.38						99						
	81.38	85.03	3.65					sh.			black	fissile, sl. silty w/occ. blebs of fig. s.s., and
												rarely, qtz. filling parallel to bedding
Box 19	85.03	87.55	2.52									parallel to bedding grading, downwards into finely
												interlaminated dk. gray silty shale and lt. gray
												fg. s.s.
87.48						100						

PROJECT Groundhog HOLE No. H-2 PAGE No. 14 DATE 7/9/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	87.48	87.81	.33					sh.			black	finely interlaminated w/lt. gray fig. s.s.
	87.81	87.99	.18					s.s		med gn.	lt. gray	ang., shaly, 35% opaques w/occ. clasts of dk. gray silty sh.
	87.99	88.03	.04					sh.			black	carb., erosional contact top
	88.03	88.04	.01					py-rite			gold	layered pyrite, finely x'talline
	88.04	88.41	.37					coal			black	broken, alt. layers < lam. thick of vitrain & durain, hard, cubical fracture, slight qtz. filling of fractures
	88.41	88.49	.08					sh.			dk.	slightly silty, carbonaceous
	88.49	88.53	.04					coal sh.	x		black	broken badly, thin alt. layers of very carb. sh. and vitrain
	88.53	88.59	.06					sh.			black	very carb., silty, w/blebs of vitrain and finely disseminated pyrite
	88.59	89.02	.43					sh.			black	fissile, slightly silty
	89.02	89.28	.26					s.s		fig	lt. gray	massive, shaley
Box 20	89.28	89.53	.25									massive, shaley
	89.53	89.57	.03					sh.			black	carb., poorly indurated
	89.57	89.59	.02					sh.			black	carb., fissile, well indurated
	89.59	90.60	1.01					s.s		fig	lt. gray	shaley, subrounded, well sorted
90.53						100						
	90.53	90.94	.41					s.s		fig	lt. gray	shaley, subrounded, well sorted
	90.94	91.16	.22					sh.			black	fissile

PROJECT Groundhog HOLE No. H-2 PAGE No. 15 DATE 7/9/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	91.16	91.20	.04					sh.			black	very carb., slickensides on fractures parallel to bedding
	91.20	91.26	.06					coal			black	Hi%vit., contorted, qtz. filling in fractures
	91.26	92.90	1.64					sh.			black	sl. sty, w/interlam. of fg-red gn. s.s., occasionally contorted, some carb. lam also
	92.90	93.06	.16					coal sh			black	contorted layers of vitrain, black shale, and qtz.
	93.06	93.43	.37					sh.			black	fissile, sl. silty
93.56	93.43	94.68	1.25			100		s.s		fig	lt. gray	subangular, shaley
Box 21	94.68	95.50	.82					sh.			black	laminae of slightly contorted black shale dips 20° becoming massive towards base
Box 22	95.50	100.45	4.95					s.s		fig	gray	2-3 mm shale laminae, dip 20°
96.61						100						96.25-96.45 qtz. veining, vaggy
												97.20 mudstone clasts in sst
												97.83-99.05 black shale, fractured qtz. veining, broken in part
99.66						83						100.10-100.45 finer grained towards base
	100.45	101.96	1.51					sh.			black	fissile, soft & broken in part; bedding dip 0-20° carbonaceous with slickensides

PROJECT Groundhog HOLE No. 81-H2 PAGE No. 16 DATE 7/10/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
Box 23	101.96	102.30	.34					sh			black	coal/mudstone; black; 5 mm, coaley seams, broken
102.71	102.30	102.75	.45					sh			black	carbonaceous mudstone; coaley partings
								sh			black	fissile
Box 24												
105.76	102.75	108.90	6.15			100		s.s		fig	grey	shaley sandstone, med-dk.gray (black chort?) with
108.81						100						2 mm shale laminae; dip-0°
Box 25	108.90	110.66	1.76					sh.			black	shale; thin sandstone laminae near base; gradation
												contact to sst. with laminae of shale
114.90	110.66	118.03	7.37			100		s.s		v. fngr.	grey	shaley sandstone; v.fn.gr;med. grey; with abundant
												2-10 mm shale partings; dips-0°
												111.70-111.86 Black shale with sst. partings
117.95						100						
	118.03	120.47	2.44					ss sh.			grey, black	inter-laminated shale/sandstone; black with
Box 27												v.fn.gr.,med. grey sst.,sightly contorted laminae;
												shale content increases towards base

PROJECT Groundhog HOLE No. 81-H2 PAGE No. 17 DATE 7/10/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	120.47	121.58	1.11					sh.			black	black shale with 2-3 mms. v.fn. gr. sandstone
121.0						100						laminae; dip 0-10°
	121.58	124.15	2.57					ss.			grey	shaley sandstone; med. grey with black chort (?);
												v. fn. gr. near top grading downwards into fn.-med.
												grained; occasional shale partings, clasts; dip of
Box 28												partings 15°
124.05												
	124.15	129.60	5.45					sh ss				interlaminated black shale/shaly sst, v.fn.gr; med
												126.95-127.84 Shaley sandstone; fn. gr; med. grey
127.10						100						with occasional sst. parting
Box 29												
	129.60	129.77	.17					sh			black	black shale; carbonaceous impart
	129.77	130.14	.37					sh coal			black	carbonaceous shale with thin coal;
						96						slickensides;
												130.00-130.14 Dirty coal

PROJECT Groundhog **HOLE No.** 81-H2 **PAGE No.** 18 **DATE** 7/10/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	130.14	130.73	.59					sh.			black	black shale
	130.73	132.69	1.96					sh ss				interlaminated black shale/grey
												shaley sandstone; fine grained,
												shale laminae are planar to mod. contorted. Dips
												approx. 0^{o}
Box 30	132.69	134.40	1.71					s.s		f.g	grey	shaley sandstone
133.19						100						133.60-133.65 white qtz. vein
	134.40	135.20	.80					sh.			black	shale; soft & broken in part; carbonaceous with
												coaly partings and thin qtz. veins.
	135.20	137.02	1.82					s.s		f.g	grey	shaley sandstone with contorted qtz. veining and
136.24						100						layering; chert clasts 10 mm ø
Box 31												135.95-136.24 cse gr. sstn. matrix, partially
												conglomeritic with clasts up to 5 mm ø (10% clasts)

PROJECT Groundhog HOLE No. 81-H2 PAGE No. 19 DATE 7/10/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	137.02	140.13	3.11					s.s		fg.	grey	shaley sandstone, fine gr., med grey with black
												chert clasts; shaley partings - gradational
												contact to shale
	140.13	141.26	1.13					sh.			black	shale, black, carbonaceous
	141.26	141.95	.69					c				coal; clarain (?); soft & badly crushed; 36%
142.33						100						recovery
												141.90-141.95 dirty coal
Box 32	141.95	142.70	.75					sh.			black	carbonaceous; coaly partings + frags.
145.38						100						
Box 33	142.70	148.56	5.86					sh. ss				laminated black shale/shaley sandstone; fine gr.,
												med. grey; bedding dip 25° - occasional qtz.
												vein
					End of Hole on July 7/81 at 148.56 m (487 ft.)							

PROJECT Groundhog DATE 7/11/

HOLE No. 81 H3 PAGE No. 1 of 21

GEOLOGIST Dale Hart LOCATION

DRILLER Tonto AERIAL 'PHOTO

LOGGER Not logged MAP No.

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
5.18	5.18	11.28	6.10									overburden-poorly lithified pebble congl. with
Box 1												mud matrix
6.10						100						
8.23						100						
11.28	11.28	12.33	1.05			100		sh.			black	shale; slightly soft; silty in part
Box 2	12.33	12.90	.57					md.			black	mudstone; dk. grey-black, soft
Box 3												12.70-12.90-coaly fragments
	12.90	15.90	3.00	i		60		sh. md.			black	shale/mudstone; generally slightly soft; hard in
												part; slightly carbonaceous
17.07						100						15.95-16.8 mudstone; soft, black with 5 mm
												pebbles; fine gr. coaly frags.
	15.90	20.35	4.45					sh.			black	broken in part
												18.25-18.45 coaly partings
												bedding dip 20^{o}
												18.45-18.50 - massive fn. gr. pyrite

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 2 DATE 7/11/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
20.12	20.35	21.12	.77			55		c			coal; slightly dirty, soft & broken
Box 4	21.12	21.18	.06								dirty coal
22.86	21.18	23.76	2.58			100		mud stn		black	occasional thin coaly partings; dip 15°
											22.90-22.95 - soft mudstone
23.46											
	23.76	26.40	2.64								laminated black mudstone/grey siltstn; dips 10-20°
Box 5											mudstone laminae 2-5mm thick are slightly distorted
											25.32-26.51 increase in grain size to fn-med.sstn.
26.40	26.40	28.26	1.86					mud stn		black	mudstone; occasional coal frags. + pyrite blebs
											27.20-27.30 dirty coal with qtz. veins & pyrite
											27.30-27.44 Carb. mudstone with coal partings;
											dip 20°

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 3 DATE 7/11/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
30.32	28.26	30.45	2.19			100		mud silt			black/grey	laminated mudstone/siltstone
Box 6												29.10-29.40 broken rock; carb. mudstone
												29.40-30.45 mudstone
32.6	30.45					83		mud silt			black/grey	laminated mudstn/siltstn; generally the core
												is broken
	33.80	34.10	.30									white qtz. vein CA 40°
Box 9	34.10	40.00	5.90					ss		fg	med. grey	shaley sandstone with black chert cut by
												2 mm qtz. veins CA 40°
35.66						100						35.66-38.71 broken core
												38.25-38.50 breccia:sstn. frags. in
Box 8												qtz; CA ?
38.71												
39.77	40.00	41.00	1.00			100		mud stn.			black	black mudstn; multiple veins CA 20°
												becomes carbonaceous towards bottom;
												dip 30°
41.76	41.00	41.76	.76			33		c				dirty coal; badly broken, crushed;
												pyrite band at bottom

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 4 DATE 7/11/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size		Colour	Description
	41.76	42.57	.81									mudstone; black; carbonaceous
												becomes silty towards base
												dip 20°
Box 9	42.57	46.70	4.13									laminated v. fn. gr. sst./carb. mudstone
												dip 20°
Box 10	46.70	47.85	1.15					ss		mg	grey	occasional mudstone clast
47.85	47.85	50.60	2.75			100		mud stn			black	silty mudstone-shale
	50.60	50.90	.30					c				dirty coal; crushed, broken
50.90	50.90	52.50	1.60			100		sh			black	shale; carbonaceous in part; fissile
Box 11	52.50	53.30	.80					sst mud			black	laminated med gr. sstn/silty mudstone
	53.30	54.60	1.30					sh			black	silty shale; soft in part
53.91	54.60	55.10	.50					c			v. carbonaceous	coal; crushed with qtz. veining

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 5 DATE 11/11/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	55.10	55.55	.45					sh.		black	black carb. silty shale
57.00	55.55	58.75	3.20					sh ss		grey	laminated v. fn. gr. sst/shale, dip 30°
											57.30-58.15 breccia; sst. frags. in qtz. vein,
											partially vuggy CA-0°
	58.75	60.46	1.71					sh.		black	carb. shale, black; coaly partings
Box 12											58.80-59.05 dirty coal - dip 30°
											59.05-59.58 broken core
Box 13	60.46	63.20	2.74					ss		grey	fn. gr. shaly sst., occasional shale parting
											61.80-63.20 laminated sst/shale
	63.20	65.05	1.85					sh		black	carbonaceous shale; numerous coaly partings;
Box 14											dip 20°
											64.03-64.10 siltstn.
											65.20-65.40 dirty coal; irregular thin qtz. veins
	65.05	67.10	2.05					sh ss		grey/black	laminated fn. gr. sst/shale; dip 20°
65.83											

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 6 DATE 7/11/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	67.10	68.20	1.10					ss		fg	grey	shaley sstn; mudstone clasts; irregular qtz. veins
	68.20	68.50	.30					c		fg	black-blk/gry	dirty coal; some slickensides
												upper 5 cm brecciated and injected by qtz. veins.
Box 15												coal grades into highly carbonaceous shale
	68.50	69.10	.60					sh		fg	med grey	poorly inderated silty shale containing horizons
												of brecciated fine/med. grained sandstn. Breccia
												contains some angular and rounded frags. supported
												by qtz. Some broken core
68.97						?100						
	69.10	69.50	.40					sh		fg	drk.grey/blk	silty shale with a marked fissility which makes
												an angle of 15°-18 to horizontal assume to be
												bedding
	69.50	71.75	2.25					sst		mg	salt & pepper grey	grey sst. has been pervaded by ramifying network
												of secondary qtz. veins. Qtz. occasionally carries
												pyrite and its injection is assocd. with small
												scale breccia. Breccia frags.<1 cm. 71.20-71.75
												more highly brecciated. No preferred orientation
												of qtz. veins

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 7 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	71.75	73.50	1.75							fg	grey/black	silty shale uniform grey black. Lithological contac observed between mgr. sst. and shale at 71-75. Boundary dips 20°. Contact is sharp and well defined. 72.15-72.55 shale brecciated and contorted with many qtz. veins. The breccia contains fragments of angular siltstone and coal frags. Carbonaceous content is occasionally high
72.12						99						
	73.50	73.75	.25					sh ss		fg mg	alterntg.bands blk/mottld gry	interlaminated silty shale and mottled (salt + pepper) fine/med. grained sandstn. shale horizons dip 15° shale horizons ≤ lam. but > 2 mm. Some shale forms isolated lenses. sst: shale = 80:20
Box 16												
				j								
	73.75	74.99	1.24					sst		f/md	mottled gry.	massive unit of sst with very occasional horizons of shale graded bedding indicates younging up bore ↑ at 74.74
	74.99	75.28	.71					shl		fg	grey/black	highly carbonaceous silty shale with horizons ≃ 2 mm of coal. Bedding plane has evidence of fossil plant. Impression of stem of plant

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 8 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	75.28	78.49						sh		grey/black	silty shale with marked bedding plane fissility.
											high carbonaceous content shown by thin horizone
											of coal. Fossile plants structures observed
											bedding dips 15°
											occasional siltstone/f gr. sst band < 2 cm strat
											thickness
Box 17											
78.32						100					
	78.49	84.95	6.46					sst	mg	mottled grey,	sst appears cleaner than earlier varieties;
											grades from interlaminated with shale at 78.49→59
											to massive sandstone. Bedding when discernible
											is constant at 15-19° dip
											79.30-79.40 sst. contains banded frags of shale
											set in a carbonaceous dirty sst. matrix.
											The sst exhibits fractures which parallel the
Box 18											cores axis, fractures 50 cm long. Caused
											by expansion of pore water at surface?
											Some secondary qtz. veining
81.37						100					
84.42						100					

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 9 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	84.95	85.53	.58					sh		fg	grey/black	silty shale. Upper 5 cm crushed coal with qtz. veining grading→carbonaceous shale→shale with no sharp boundaries
Box 19												
	85.58	86.76	1.18					c			black	dirty coal with a high shale content
												The coal has been brecciated and pervaded by qtz. veins locally. There are many polished surfaces with slickenslides.
	86.76	87.20	.44					sst			grey	Very broken core, recovery probably around 60% brecciated sandst. and interlaminated carbonaceous silty shale exhibiting slickensliding on polished surfaces. Qtz. veins pervaded shale and sandstone
87.47						60 70*						*reflects the broken nature of the coal band
	87.20	87.70	.50					sh c		fg	black	upper 20 cm fair quality coal broken and crushed grading into coal with a high shale content. Slickensides common.
	87.70	89.10	1.40									-carbonaceous shale with marked fissility parallel to bedding plane dipping 18° local small scale qtz. veining

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 10 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	89.10	92.99	3.89					sh sst		mg fg	black/mtld gr.	interlaminated silty shale and med. grained sst.
												shale laminae < 0.5cm
												ratio sst/shale 90:10
												shale laminae less common at 90.30 m
												90.30m →92.99 no shale bands at all, but occasional
Box 20												lithic frags. of rounded shale. Bedding dips 15°
												'Calcite veining observed, 2 cm wide cuts across
												bedding
90.52						95						*broken coal causes loss
	92.99	94.85	1.86					sh		fg	black/grey	'silty shale marked bedding fissility dipping 18°.
												Carbonaceous content vanes from medium → high.
				i								Fossil plant imprints observed on bedding planes.
												Slickensliding also on bedding planes
												Occasional horizons of a more silty composition
												dark grey color.
	94.85	95.66	.81					c shc		fg	dk grey blk	dirty coal crushed and pervaded by qtz. veins
												some coal shows conchoidal fracture. The
												coal grades into carbonaceous shale

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 11 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	95.66	95.93	.27					sh slt		med fg	black/grey	fissile silty shale, bedding dips 15-17°
												interlaminated with silty sandstone
Box												
21												
	95.93	96.23	.30					sst		mg	mottled gray	sst. containing angular frags. of qtz. white ,
												black, grey. The sst. is dirty and contains a
												high content of carbonaceous material compared
												to previous sst.
	96.23	96.60	.37					slt sh.		fg	black/grey	silty shale/shaley silt. Interlaminations of
												material; silt and silty shale, small scale
												repetitive sequence
96.60						100						
	96.60	97.59	.99					sst		mg	mottled grey	sst.-dirty at upper 5-10 cm. becoming cleaner
												at depth. sst. has been invaded by qtz. veins.
												Two ages of vein filling evident. episodic
												nature of fluid movement assocd. with metam?
	97.59	101.04	3.45					sh.		fg	black	silty highly carbonaceous shale. Marked bedding
												plane fissility. Bedding shallows just over
												10° dips. Horizons of coal 5 cm. wide observed
												usually brecciated.

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 12 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	97.59	101.04	3.45	(cont'd)								graphitic imprints are visible on bedding plane. Slickenslides visible on a fracture plane which cuts across bedding at low angle. Bedding dips approx. 15°
99.66						95						
Box 22												
	101.04	101.93	.89					sh. sst		mg fg	black/grey mottled gr.	interlaminated sequence of fine grained silty shale forming bands and isolated lenses up to 2 cm thick, and fine grained sandstone composed of angular qtz. frags. The sandstone is well sorted 101-35→101.50. The rock has been intruded by a network of milky qtz. veins which support brecciated frags. of a medium grained sandstone. Occasional carbonaceous shale horizon.
	101.93	102.52	.59					sst		f/m	mottled grey	fine/medium sst. Well sorted. No visible bedding parting. Composed of angular frags. ≈ .1 mm Rock host large qtz. veins which contains brecciated coal frags. Two types of qtz.

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 13 DAT ./12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	102.52	105.15	2.63							fg	black/grey	highly carbonaceous silty shale grades into coal
Box 23												The core is very broken, and there seems to be low % recovery of this lithology. Where rock is shale there is a marked bedding plane fissility, where coal is crushed and friable. Fossil plants observed and slickenslides. 105.00→105.15 friable coal.
105.15						88						
	105.15	105.30	.15					sst		fm	mottled grey	well sorted fine med. grained sst. with occasional interlaminated silty shale<.5 cm. thick composed of small angular frags.<.1 mm = sst. Occasional qtz. veins≈.1 cm. wide
	105.30	107.99	2.69					sh.		f	black/grey	Dark shale with pronounced bedding plane fissility Frequency of partings 13 in 15 cm of competent core material. Shale has a silt component. Bedding dips 15-18°. The dip is very constant, variation reflects measurement accuracy

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 14 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	107.99	110.05	2.06				sh.	sh sst		*lt. grey *	① interlaminated well sorted siltstone; ② fine ③ grained silty shale; med/fine sandstone-rarer cross bedding and isolated lenses of lithologies seen in a small scale repetitive sequence. Reworking of shale indicated by large frags. of shale in med. grain sst., frags. up to 5 mm diam-well rounded. Med. g. sst. shows minor graded bedding indicates beds are correct way up. Shale bands vary 1 mm→15cm (max). Possibly leached as color is much lighter. 109.90-110.00 Brecciated fault zone. Large frags.>1 cm < 2 cm supported by qtz. F. zone dips 30°. Bedding ≃horizontal. At 110.05 sharp lithological contact sst. and massive unit shale, contacts dips 6°.
Box 24											
108.80						98					
	110.05	111.40	1.35					sh.		black/grey	silty shale with a high carbonaceous content. Bedding dips 18°. Fracture plane with slickenslide dips 55°.
	111.40	111.90	.50					sst. sh.		banded/grey black	interlaminated sst. with silty shale. sandstone well sorted bedding dips 12°
111.85						100					

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 15 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	111.90	114.67	2.77					sh		f	black dark grey	silty shale highly carbonaceous-grades to small
												bands<5 cm of coal in parts
												Bedding plane fissility marked
												Slickenslides on bedding planes and also on
												steep dipping fractures 55°.
												Carbonised plant debris identified on 6 planes
Box 25												
	114.67	117.54	2.87					sst sh		fg mg		interlaminated ssts* and silty shale.
												Sandstone usually wellsorted, range from silty
												sandstone to medium grained sst. with reworked
												shale frags.
												Med. sst. at 115.10 contains high proportion of
												shale frags.
												The bands of a particular lithology can be up
												to 20cm thick, but are definitely part of an inter-
												laminated sequence.
												Al 115.70 brecciated zone. Angular frags. sst.
												and shale in a qtz. matrix.

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 16 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	117.54	118.70	1.16						f	blk/dk.grey	silty shale. Bedding plane fissility
											Bedding dips 12°. Slickenslides present.
											Grades from med. carbonaceous shale →
											very shaley coal.
											Most carbonaceous material is very incompetent,
											and coal horizons are brecciated and pervaded
											by a ramifying network of qtz. veins
117.95						100					
	118.70	120.49	1.79					sh sst	m/f	banded blk/gr	interlaminated silty shale and fine/med. sst. Very
											similar to that described on p. 14. 81 H3
											120.49 Brecciated zone 10cm wide, angular frags,
											shale and sst. in qtz. matrix
											Flame structures seen, with less competent shale
											forming cusp like bodies at 120.45
	120.49	121.96	1.47					sh	m/f		dominantly shale (silty) unit but with very fine
											interlaminated bands of well sorted dark, grey
120.99						100					siltstone. Grades into highly carbonaceous
											shale at 121.30-121.45? very dirty coal brecciated

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 17 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size		Colour	Description
	121.96	123.03	1.07							f	black	highly carbonaceous silty shale, of uniform color
												and compn. Grades into shaley brecciated coal
Box												which form 3 horizons about 10-15 cm thick
27												i.e. 122.01-122.10 ①
												122.45-122.60 ②
												122.78-122.97
												① + ② are brecciated and qtz. pervades fractures.
	123.03	124.15	1.12					sst.		f	mottled dirty grey	well sorted fine g. sandstone/siltstone with
												numerous carbonaceous horizons ≤ 1 mm
												Some siltstone/sst contains a high proportion
												of angular shale frags.
124.04						100						
	124.15	125.04	.89					sh		f	grey/black	silty shale with bedding plane fissility
												Bedding dip 15°
												Some disseminated pyrite present, not contained
												within a particular horizon
												Slickenslides
	125.04	125.93	.89					sst		mf	mottled dk. grey/grey	interlaminated med. g. sst. and carbonaceous
												siltstone. Siltstone bands 5 mm wide

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 18 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	125.04	125.93	.89	(cont)				sst		fm	mottled grey dk. grey	some qtz. veining parallel to bedding
												qtz. porous and friable
												Some calcite? Dolomite with qtz. Slow reacn.
												with HCl, but rock also hot
Box	125.93	126.56	.63					sh		f	grey/black	silty shale med. carbonaceous
28												grades into high carbonaceous shale
												and shaley coal 126.46→126.50
												coal brecciated and qtz. vein
	126.56	127.70	1.14					sh sst		fm		interlaminated shale (silty) and mg. sst
												lode casts etc. visible as shale is highly
												contorted
127.09												
	127.70	128.73	1.03					sh		f	black/grey	silty shale. Bedding dips 15°. Occasional
												silt and carbonaceous horizons < 3mm
	128.73	128.88	.15					br.			white/grey	brecciated zone, qtz. with angular frags.
												of banded siltstone. Crushed shale either side
												of vein
	128.88	↓						sh		f	black	highly carbonaceous silty shale. Many
		overleaf										horizons ≤ 1cm of brecciated coal with
												qtz. veins
												at 129.00 pseudo stratiform pyrite band + pyrite vein

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 19 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	(cont)											129.30-129.65 Horizon of less well indurate
	128.88	130.78	1.9									shale
												at 130.14 shale is less carbonaceous
												bedding dips 15°
												Slickenslides. Grades back into high carbonaceous
												coal at 130.42-130.65. Very broken core.
130.14						95						
box 29												
	130.78	132.36	1.58					sh sst		fm	banded gray/black	interlaminated siltstone/sst. and silty shale
												Bedding dip 12°
												132.26-132.36 Sedimentary breccia (as opposed to
												Fault breccia). Confused mixture of angular
												siltstones in a shale, sst matrix. + clasts of
												shale, ~2mm. No evidence of graded
												bedding
	132.36	132.70	.34					sh		f	grey/black	silty shale. Bedding dips 15°
	132.70	132.99	.29					ss sh		fm	banded	interlaminated silty shale and med. grained sst.
												with high carbonaceous content for sst.
	132.99	134.53	1.54					sh		f	black	silty shale with occasional coal horizons.
												Carbonaceous content varies med.→high.

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 20 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	134.53	135.00						sst		fm	mottled grey	majority of unit well sorted composed of angular
33.19						98						to subangular grains. Qtz. forms major part
												of rock ≥70%.
												Upper i.e 134.53-.73 contains large rounded
												→subrounded frags. of shale up to 4 cm diam.
36.23						100						some interlaminated bands of siltstone/shale≤1 cm thk
	135.04	135.46	.42					sst sh		fm	banded blk.grey	interlaminated mg. sst. and siltstone/shale
												The banding is very repetitive on a small
												scale. Boundaries between bands are distinct.
												Beds dip 15°
	135.46	139.00	3.54					sst		fm	mottled grey	fine medium grained sandstone, cleaner than
												previous sandstone.
												Majority well sorted but some horizons contain
												very large shale fragments.
												136.36→.40 layer of finely laminated carbonaceous
												shale
												136.50 (conglomeritic band of rounded shale/siltstn.
												frags. in martix of above sst.
36.23						100						

PROJECT Groundhog HOLE No. 81 H3 PAGE No. 21 DATE 7/12/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	139.00	152.74						sst		m	mottled grey	clean well sorted sandstone, m grained, composed
												of angular to subangular frags.
39.28						100						Occasional thin carbonaceous horizons
ox	Box											Occasional thin carbonaceous horizons
32	33											Occasional thin carbonaceous horizons
43.77						100						Occasional thin carbonaceous horizons
45.38						100						Occasional thin carbonaceous horizons
48.43						99						Occasional thin carbonaceous horizons
51.48						100						
	152.74	153.12	.38					sst		m	darker mottled grey	Less well sorted dirty (relatively) sst with
												carbonaceous horizons and many shale frags.
												clasts - are angular to subangular
												contains qtz. and calcite veins
												Where calc and qtz. occur together vein is vuggy
												(voids)
	153.12	153.23	.11					sh		f	dark grey	silty shale
153.30	153.23	153.33	.10			100		sst		m	mottled grey	farily well sorted sandstone with
	153.30	153.96	.66							m	mottled grey	shaley silt horizons
	153.96	154.52	.56									dark shale
							END OF HOLE					

PROJECT Groundhog DATE 7/14/81

HOLE No. 81 H4 PAGE No. 1 of 27

GEOLOGIST D. Hart LOCATION

DRILLER Tonto AERIAL 'PHOTO

LOGGER MAP No.

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												core starts at 6.25m. Tricorne down to this depth
	6.25	6.33	.08					sh.		fg	black	silty black shale
	6.33	6.76	.43					sst		mg	dirty grey	poorly sorted sst, with components varying from fg→coarse gr. Contains abundant angular shale frags, as well as many rounded fragments. The sandstn. is dark and has a high shale/carbonaceous content. Shell fragments broken, worn and not in situ present. Possible bioturbation as core appears to be 'disturbed'. Disseminated pyrite present.
	6.76	7.74	.98					sh.		fg	black	silty shale. Without many fissile partings
	7.74	8.10	.36					sh, silt		vfg fg.	black/grey	interlaminated. Thin horizons of well sorted siltst alternating with thick bands of v.f.g. shale. Bedding dips 15°. At 8.00→8.04 qtz. vein parallel to bedding. Other small veins oblique to bedding

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 2 DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	8.10	8.25	.15					sh		fg	black	silty shale-Bedding dips 15° ≈. Very uniform and
												very well sorted
8.23	Box 1					100						
	8.23	11.30	3.07					sh		fg	black	silty shale-bedding dips 15° ≈. Very uniform and
												very well sorted + occasional secondary pyrite in ble
Box 2												which cut across bedding
11.27						100						
	11.27	14.26	2.99					sh		fg	black	silty shale-bedding dips 15° ≈. Very uniform and
												very well sorted + occasional secondary pyrite in
												blebs which cut across bedding
14.32						98						
	14.32	14.77	.45					sh		fg	black	silty shale-bedding dips 15° ≈. Very uniform and
												very well sorted + occasional secondary pyrite in
												blebs which cut across bedding
	14.77	15.38	.61					sh		fg	black	similar unit to above but contains fossil
												fauna-replaced bivalve shells. Dominance of
												upturned shells (↑up). Little evidence of post
												depositional deformation. Number of shells
												increase from rare at 14.77→abundant at 11.02.
												Possible worm buttoms? Pyrite
	15.38	15.52	.14					sh		fg	med. grey	poorly indurated silty shale

(CONT'D)

PROJECT Groundhog HOLE No. 81 H4 (cont) PAGE No. 2a DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	15.52	15.69	.17					shell silt		fg	light grey	predominantly shell material. Some organisms
												appear to be completely intact and have been
												infilled with siltstone. Not in situ.
	15.69	16.47	.78					sh		fg	dk. grey	silty shale with occasional shell frags. at
												top and bottom of unit. Med. carbonaceous
												content.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 3 DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	16.47	16.57	.10					shell debris		fg	light grey	dominantly shell frags (replaced by qtz.)
Box												in a siltstone/shale matrix. Unit has a light
3												color due to abundance of qtz.
	16.57	16.82	.25					coal			black	dirty coal with shale laminations. Coal has
												been brecciated and is pervaded by network of
												qtz. veins. Thin laminae of vitrain with
												blocky fracture. Pyrite blebs present.
	16.82	17.19	.37					sh		fg	black	carbonaceous silty shale with many fissile partings
17.37						93						parallel to bedding. Slickensliding on plane oblique
												to bedding
	17.37	18.32	.95					sh		fg	black	carbonaceous silty shale with many fissile partings
												parallel to bedding. Slickensliding on plane
												oblique to bedding. Broken core.
	18.32	20.02	1.70					sst sh		vf f	black + grey	interlaminated silty shale and fine grained
Box 4												sandstone. Ratio sst-shale 80:20. Some isolated
												shale fragments up to 1cm diam.
	20.02	20.53	.51					sst sh		vf m		interlaminated medium gr. well sorted clean sst
20.42						100						and vfg shale (silty). sst has salt + pepper
	20.42	20.56	.14									appearance. Shale bands up to 2cm thick. Bedding
												dips 17^0
	20.56	20.81	.25					sh		f	blk/dk.grey	silty shale. Bedding dips 15-18^0. Well sorted.
									(C	O N	T ' D)	

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 3a(cont) DATE 7/14/81

Top & Bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	20.81	21.37	.56					sh sst	vf-f	blk+lt. grey	mg. sst well sorted with frequent thin laminae of silty shale.
	21.37	22.30	.93					sst	m	mottled light grey	slightly coarser. Cleaner sst. than above, well sorted containing angular to subangular

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 4 DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	(cont)								f	blk/dk. grey	interlaminated with occasional but wide silty
											shale bands. sst cross bedded
	22.36	22.48	.12					sh	f	med. grey	silty shale band with fine grn. sst band<1cm wide
	22.48	22.27	.79					sst	m	mottled lt. grey	clean well sorted med. g. sst composed of
											angular-subangular grains. Very occasional
											horizons of silty bedded shale. Occasional
23.46						93					horizons of large fragments of silty shale in m sst
											matrix. Frags elongate, rounded ≤5cm
	23.46	24.50	1.04					sst	m	lt. grey	clean well sorted sst angular-subangular frags.
	24.50	25.81	1.31					sh sst	f vf	banded dk. lt. grey	frequently interlaminated dirty fine grained sst
Box 5											and silty shale. Perturbation of bedding
					i						perhaps due to 'bioturb^{g} organisms'
											Bedding dips 15^{o}. Bands range <1cm>3cm.
	25.81	26.02	.21					sst	m	med. grey	dirty sst with occasional shale frags.
	26.02	26.74	.72					sh sst	fm	banded	interlaminated unit. Med. grained well sorted
26.51						100					clean sst and frequent bands of thin silty shale
	26.51	26.53	.02								clean sst and frequent bands of thin silty shale
	26.53	26.86	.33					sh silt		dark grey	interlaminated carbonaceous fine grained
											siltstone and carbonaceous silty shale
	26.86	27.39	.53					sh		drk. grey	silty shale. Med. carbonaceous content

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 5 DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	(cont)											at 26.11-26.15 qtz. vein breccia ll to bedding;
												dips 15° = bedding
	27.39	27.54	.15					sh		vf	black	silty carbonaceous shale. Very high C content
												and rock is very fissile. Crumbles when struck
												with hammer
	27.54	28.51	.97					sh c			black	very dirty coal-grading frequently into highly
												carbonaceous shale. Frequent thin horizons
												of vitraneous coal ≤ 1cm. Coal often
												brecciated and pervaded by qtz. veins
	28.51	29.29	.78					sh		f	black	highly carbonaceous silty shale with very
												occasional thin horizons < 1cm of vitrain
												broken core
29.56				i		91	*					*probably due to recovery of dirty coal.
	29.56	30.33	.77					sh		f	black	silty shale-med. carbonaceous content
	30.33	30.60	.27					sh br			black+white	brecciated zone. qtz. veined lenses of vitrain
												set in shale matrix. Evidence of deformed
	30.60	30.71	.11					c		f	black	broken dirty coal. Thin bands lenses of vitrain.
	30.71	31.29	.58					c sh		f	black	carbonaceous silty shale with frequent horizons
												of thin coal. Coal horizons usually brecciated
												+ qtz. veined.
	31.20	31.71	.51					sh		f	black	carbonaceous shale (silty) with occasional thin coal
												horizons.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 6 DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	31.71	32.66	.95							f	black dk/gry	silty shale, well sorted, uniform color.
												fissile. B dips 16°. Med-high carbonaceous
												component. Very occasional thin coal <5cm
	32.66	32.95	.29			?						very broken highly carbonaceous shale
32.30						100						
	32.30	33.66	1.36									very broken highly carbonaceous shale
	33.66	35.36	1.70					sh silt			black/dk gry	interlaminated dark carbonaceous siltstone
Box 7												vfg sst and silty shale. Frequency of
35.35						100						alternation is high and bands are thin.
												Much evidence of contorted bedding
	35.35	36.64	1.29					sh silt			black/dk gry	Interlaminated dark carbonaceous siltstone
												vfg sst and silty shale. Frequency of alternation
												is high and bands are thin. Much evidence of
												contorted bedding.
	36.64	36.78	.14					sst		m	grey	med. g. well sorted sst
	36.78	36.85	.07					silt		f	dk. grey	dark carbonaceous siltstone
Box 8	36.85	37.07	.22					sst		c m	mottled gry	dirty poorly sorted m/g to coarse sst with shale
												frags. 1mm visible with naked eye. Carbonaceous
												in part and with isolated lenses of coal and
												assocd. qtz. veins.
	37.07	38.46	1.39					sst		m	mottled gry	clean sst well sorted. Angular-subangular grns.

(cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 6a DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
38.40						100						Contains shale frags. highly round and often high sphericity.
	38.40	39.14	.74					sst	1	m	mottled gry	n.b. at 39.00→39.14. Many very rounded shale frags. ≤5cm in clean sst matrix.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 7 DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	39.14	39.18	.04					sh		f	black	highly carbonaceous silty shale
	39.18	39.25	.07					sst		f	grey	well sorted siltstone/sandstone
	39.25	39.35	.10					sh		f	black	silty shale with thin horizon of f/g sst.
												Evidence of burrowing preserved.
	39.35	40.21	.86					sst		m	grey	well sorted clean sst, occasionally tending
												to coarse grained. Particles subangular→rounded.
												shale laminae infrequent. Occasional horizons
												of very well rounded shale fragments.
	40.21	40.44	.23					sh sst		f f/m	banded black+grey	interlamination of silty shale and f/g sst.
												Bands up to 3cm wide. 50:50 Ratio.
	40.44	40.98	.54					sst		m	mottled gry	well sorted med→coarse grained clean sst.
												Cross bedding visible.
	40.98	41.32	.34					sst sh		f vf	banded	interlaminated silty black shale and well
												sorted f/g sst. Ratio sst-sh 60:40
												Bands ≤ 3cm wide.
	41.32	41.43	.11					sst		m	mottled gry	moderately sorted clean sandstone. Cross
												bedded, with infrequent shale bands up
41.45						99						to 3cm wide
	41.45	42.92	1.47					sst		m	mottled gry	moderately sorted clean sandstone. Cross bedded,
												with infrequent shale bands up to 3cm wide
42.97						98						
											(cont)	

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 7a DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	42.97	44.24	1.27					sst		m	mottled gry	moderately sorted clean sandstone. Cross bedded, with infrequent shale bands up to 3cm wide.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 8 DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	44.24	44.46	.22					sh sst	f f/m	banded	interlaminated. Dirty well sorted m/g sst and silty shale very well sorted. Bedding dips 15°
	42.46	42.49	.03					q	c	milky white	friable qtz. in vein that lls bedding
	42.49	45.08	2.59					sh s	f	black	very carbonaceous silty shale grades frequently to shaley coal bands. Frequent vitrain bands ≤ 1cm thick wide. The vitrain is brecciated and qtz. veining is prevalent.
Box 9											
44.80						100					pyrite present in blebs assoct. with qtz.
	44.80	47.03	2.23					sh	vf	dk. grey	silty shale. Fissile parting frequent. Beds dip 14°. Some slickensliding. Carbonaceous component med-high.
	47.03	48.07	1.04					silt sh	f vg	dk.gr./blk.	interlaminated dk. carbonaceous silstone/vf fg. sst
Box 10				i							and well sorted silty shale. Thin laminae of each lithology predominate. Much contortion of bedding. Contortion is syn sedimentary as units above and below are unaffected.
47.85						100					
	47.85	48.20	.35					silt sh	f vf	dk. grey/blk	Interlaminated. Dk. carbonaceous siltstone/vf fg s and well sorted silty shale. Thin laminae of each lithology predominate. Much contortion (cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 8a DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												of bedding. Contortion is syn sedimentary as
												units above and below are unaffected.
	48.20	48.64	.44					sh sst		f f/m	banded	similar to above
	48.64	49.68	1.04					sh c		f	black	dirty shaley coal bands within carbonae
												shale (silty) unit. Coal bands highly brecciated
												+ qtz. veined.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 9 DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	49.68	50.83	1.15					sh		f	black	med. carbonaceous silty shale. Well sorted
												Fissile partings-slickenslides. Bedding 15°
50.89						98						
	50.89	51.00	.11					sh		f	black	med. carbonaceous silty shale. Well sorted
												Fissile partings-slickenslides. Bedding 15°.
	51.00	52.08	1.08					silt sh		f vf	dirty gry/blk	interlminated dirty well sorted siltstone and
Box												fine grained silty shale. Cross bedding and
11												contorted bed forms seen.
	52.08	53.06	.98					sst		m	medium mottled grey	well sorted med. g. sst, cross bedded,
												with occasional thin silty shale bands.
	53.06	53.16	.10					sh		m	dark grey	silty shale
	53.16	54.04	.88					sst		m	light mottled gry	well sorted sst cross bedding common
												Frag. subangular-subrounded. Infrequent
53.94						100						wide (3-5cm) shale horizons.
	53.94	55.73	1.79					sst		m	light mottled grey	Well sorted sst, cross bedding common. Frag.
												subangular-subrounded. Infrequent wide (3-5cm)
												shale horizons.
	55.73	56.28	.55					sh sst		f m	dark grey	dark grey unit of thick interlaminated bands
												of fine grained dark sst and silty shale. Very
Box 12												broken core. Some qtz. veining.
												(cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 9a DATE 7/14/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	56.28	57.03	.75					sst		m	band	med. g. sst with occasional wide bands
56.99						100						of shale (silt). Bands up to 5cm.
	56.99	57.92	.93									med. g sst with occasional wide bands of shale
												(silt). Bands up to 5cm. Cross bedding
												+ qtz. veining.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 10 DATE 7/15/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	57.92	60.12	2.20					sh sst		f f	banded blk+grey	interlaminated unit of fine grained dark grey
Box 13												well sorted sst and well sorted uniform
												silty shale. The laminae vary from very
												thin <1cm up to 16cm. The unit could be broken
												up into separate lithologies but the overall
												impression is one of interlamination
60.04						100						
	60.04	60.80	.76					sh sst		f f	banded blk+grey	Interlaminated unit of fine grained dark grey
												well sorted sst and well sorted uniform
												silty shale. The laminae vary from very
												thin <1cm up to 16cm. The unit could be broken
												up into separate lighologies but the overall
												impression is one of interlamination.
	60.80	62.30	1.50					sst sh		m f	banded	dominantly cross bedded medium grnd. sst
Box 14												well sorted, with frequent but thinner horizon
												of silty shale. sst relatively clean.
	62.30	63.25	.95					sst sh		f/m f	band dk.gry+black	interlaminated: dk fine grnd. sst, well sorted,
				i								and dark silty shale. Ratio ss sh 50:50
												Med. carbonaceous content. Beds dip 18°
63.09						100						Individual laminae <3cm thick
											(cont)	

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 10a DATE 7/15/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	63.09	63.50	.41					sst sh		f/m f	band dk.gry+blk	individual laminae ≈3cm thick
	63.50	65.71	2.21					silt sh		vf f	dk.grey+ blk. bands	interlaminated. The unit is finer grained than above, and laminae are thinner and alternate more frequently. The siltstone/vf sst is a dark grey black color. sst sh 60:40
65.83						96						
	65.83	66.03	.20					silt sh		vf f	dk.grey+ blk. bands	interlaminated. The unit is finer grained than above, and laminae are thinner and alternate more frequently. The siltstone/vf sst is a dark grey black color. sst sh 60:40

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 11 DATE 7/15/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	66.03	67.09	1.06					sh		f	black	very silty shale, with siltstone horizons. Med. carbonaceous content.
	67.09	67.79	.70					sh sst		f f/m	band dk.gry and blk.	dominantly silty shale with thin frequent horizons of dirty fine q well sorted sst
	67.79	67.92	.13					qz sh			white+grey	brecciated silt/shale. Much qtz. veining with no preferred orientation. Zone is very broken up and relatively poorly indurated. Slickenslides
	67.92	68.75	.83					sst		f/m	dk. grey	well sorted dark fine/med. sst with occasional bands of silty shale. Some qtz. veining
	68.75	68.91	.16					sh		f	grey/black	silty shale-fissile.
68.88				i		100						Beds dip 16°. Some slickensliding
	68.88	69.32	.44					sh		f	grey/black	Beds dip 16°. Some slickensliding
	69.32	70.74	1.42					siltn sh		f	grey/black	silty shale, well sorted, with frequent very thin laminae of dark siltstone/sst. Some slickenslides on bedding planes associated with qtz. Qtz. is an unusual green color-similar to green agate. Shale:silt/ss
	70.74	72.04	1.30					sh		f	black	silty shale, well sorted 60:40 with infrequent silt horizons. Med-high carbonaceous component. Beds dip 15-17°.
Box 16												

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 12 DATE 7/15/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
71.92						100						Page 11 i.e silty shale
	71.92	72.84	.92					sh		f	black	silty shale, well sorted 60:40 with infrequent
												silt horizons. Med-high carbonaceous component.
												Beds dip 15-17°.
	72.64	73.22	.38					sh		f	black	highly carbonaceous silty shale, with many
												fissile partings and occasional coal fragments
												in lenses up to 1cm thick
	73.22	73.55	.33				*	coal		f	black	very dirty brecciated coal, with many qtz. veins
												and some pyrite. Coal frags. are vitrain in a
												high carbonaceous shale matrix
	73.55	74.87	1.32				*	coal		f	black	higher quality coal. High proportion of vitrain.
												Crumbles into blocky frags. when struck. Very
												low specific gravity. Shale content variable but
				i								mostly low→very low. Recovery is good in
												comparison to previous seam. Steel grey lustre
	74.87	75.33	.46				*	c sh		f	black	highly carbonaceous shale/very shaley
												coal. Poorly indurated and soft
Box 17												
75.12						100						
	75.12	75.17	.05					c		f	black	vitrain-blocky fracture, low s.g.
												(cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 12a DATE 7/15/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	75.17	75.81	.64					c		f	black	brecciated coal, lenses of high quality coal. Much qtz. veining. High quality bands have blockey fracture.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 13 DATE 7/15/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	75.81	76.04	.23					sh		f	black	highly carbonaceous silty shale, very fissile.
												Contains lenses of blocky coal enclosed in qtz.
												envelope
	76.04	76.26	.22					c sh		f	black	poor quality shaley coal, highly brecciated and
												pervaded by qtz. veins with no preferred orientati
	76.26	76.95	.69					sh		f	black	silty shale m/carbonaceous content
												Occasional thin fg. sst (dark) horizons
	76.95	78.23	1.28					sh		f	black	silty shale-carbonaceous content
												varies from med-high. Very occasional lenses
												of block coal, brecciated and qtz. veined. Bed
												dips 16°. Shale is fissile
78.32				i		96						
	78.32	78.41	.09					sh			black	Silty shale-carbonaceous content varies from
												med-high. Very occasional lenses of block
												coal, brecciated and qtz. veined. Bed dips 16°.
												Shale is fissile
	78.41	79.83	1.42					sh silt		f	black	interlaminated dark f/g sst/siltstone and silty
												shale. Cross bedding common
	79.83	80.38	.55					sst		m	mottled lt. grey	well sorted clean sst-cross bedded
												Infrequent thin shaley horizons
												(cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 13a DATE 7/15/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	80.38	81.05	.67					sst sh		m f	banded	interlaminated silty shale and med. grey m/f g. sst. Alternation of laminae very frequent and bands very narrow 2 mm-1.5cm

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 14 DATE 7/15/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size		Colour	Description
	81.05	81.46	.41					sst		m	mottled lt. grey	Clean moderately well sorted sst
Box												Contains some large rounded shale fragments→2cm
18												diam. (max).
81.37						100						
	81.37	82.19	.82					sst sh		m f	banded dk.+ lt. grey	Interlaminated on a fine scale. Laminae thin and
												very frequent (repetitive) alternation. Some
												bedding contortion.
	82.19	84.44	2.25					sst		m	mottled lt. grey	Well sorted, clean, mg. sst. Compn. - angular-
												subangular qtz. + opaques. Upper 20cm has
												infrequent wide laminae of shale.*At 83.35→83.42
												very large shale fragment poorly rounded, complete
				i								surrounded by sst, some pyrite
84.42						100						
	84.42	84.60	.18					sst			mottled lt. grey	Well sorted, clean, mg. sst. Compn. - angular-
												subangular qtz. + opaques. Upper 20cm has
												infrequent wide laminae of shale.*At 83.35→83.42
												very large shale fragment poorly rounded, complete
												surrounded by sst, some pyrite
	84.60	86.56	1.96					sst		m	banded lt. and dk.gry	Interlaminated. sst and silty shale. Occasional
												bands of brecciated coal < 1cm. Repetitive
												(cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 14a DATE 7/15/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												and frequent alternation & laminae (thin) 50:50
	86.56	87.45	.89					sst		m	mottled lt. grey	Clean well sorted sst with occasional thin silty shale laminae. Contorted and cross bedded structures.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 15 DATE 7/15/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
87.47						99						
	87.47	90.59	3.12					sh sst		vf	banded med/dk. gry	Interlaminated. Dk. fine/med. grain sst moderately
90.52						100						well sorted and dark silty shale. Individual
Box 20												bands ≤6cm. Moderately high carbonaceous content
												Shale to sst 60:40
	90.52	90.84	.32					sh sst		vf	banded med/dk grey	Interlaminated. Dk. fine/med. grain sst moderately
												well sorted and dark silty shale. Individual
												bands ≤6cm. Moderately high carbonaceous content
												Shale to sst 60:40. Slickenslides
	90.84	93.38	2.54					sh		f	dk.grey/black	Well sorted silty shale. Rare silt horizons,
												usually thin. Fissile. Beds dip 15°. Med.
93.56						94						carbonaceous content. Some pyrite. Occasional
Box 21												boney brecciated coal horizons ≤1cm thick.
	93.56	93.76	.14	i				sh		f	dk.grey/black	Well sorted silty shale. Rare silt horizons,
												usually thin. Fissile. Beds dip 15°. Med.
												carbonaceous content. Some pyrite. Occasional
												boney brecciated coal horizons ≤1cm thick.
	93.70	96.74	3.04					sh sst			banded	Interlaminated dirty silts/f.g. sst. and silty
												shale. 50:50. Some horizons.
96.61						100						Contains large frags. of shale in sst matrix.
												(cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 15a DATE 7/15/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												Appears as if sst has been injected into shale fra
	96.74	97.30	.56					sh sst		f	banded	Qtz. vein at 97.10. Oblique to bedding
Box	97.30	99.85	2.55					sst		m	mottled lt. grey	Clean, moderately well sorted sst. Occasional
22												wide interlaminated bands of silty shale.
												X bedding. 98.68→98.72 horizon at large.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 16 DATE 7/16/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	(cont)							sst		m	mottled lt. grey	Rounded shale clasts 1.5 cm diam.
99.66						100						
	99.66	99.76	.10					sst		m	mottled lt. grey	Rounded shale clasts 1.5 cm diam.
	99.76	100.08	.32					sh sst		f m/f	banded	Interlaminated m/fg sst + shale. Thin repetitive interlaminated.
	100.08	100.63	.55					sst		m	light mottled gry.	Clean sst containing a few horizons with rounded shale fragments in a clean well sorted matrix
	100.63	100.97	.34					sst sh		m f	banded lt + dk gry.	Interlaminated. Thin repetitive interlaminae. sst comparatively dirty
	100.97	102.17	1.20					sh		f	black	Silty shale. Fissile. Carbonaceous content content varies med-high. At 101.21-101.26. Poor quality broken coal. Bedding dips 14°
	102.17	102.76	.59					c		f	black	Very dirty coal with a high silty carbonaceous shale content. Also much qtz. veining + some pyrite. Broken core. Slickenslides.
Box 2												
102.71						100						
	102.71	102.85	.14					sh		f	black	Poorly indurated silty shale. Contain a high % of crushed coal (powder)
	102.85	104.43	1.58					sh		f	black	Silty shale, very well sorted. Contains frequent thin qtz. veins ll and oblique to bedding.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 17 DATE 7/16/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	104.43	104.99	.56					c		f	black	Fairly hard crushed coal with a med shale content. Is crushed and brecciated. Horizons of vitrain with blocky fracture and steel grey lustre. Some slickensliding.
	104.99	105.80	.80					sh		f	black	Highly carbonaceous silty shale with a few brecciated lenses of shaley coal that contain many qtz. veins.
105.76						100						
	105.76	106.63	.87					sh		f	black	Highly carbonaceous silty shale with a few brecciated lenses of shaley coal that ocntain many qtz. veins.
	106.63	108.48	1.85					sh sst		f m/f	band lt. + dk. grey	Interlaminated. Thin repetitive interlaminae of dk. sst and silty shale. sst often contains small fragments of shale. Erosive bases to sst laminae can often be seen. Some complicated bed forms resemble c flaser beddin.
	108.48	108.78	.30					sst		c	lt.grey	Poorly sorted sst with clast ranging from 3mm down to <.1mm. The larger clasts are angular-rounded composed of reworked sst and silty shale. Much dissimilated pyrite.
108.80						99						Occasional shale + dirty coal horizons.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 18 DATE 7/16/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	108.80	108.93	.13							c	lt. grey	Poorly sorted sst with clast ranging from 3mm down to <.1mm. The larger clasts are angular-rounded composed of reworked sst and silty shale. Much dissimilated pyrite. Occasional shale + dirty coal horizons.
	108.93	110.24	1.31					sst		m	mottled lt. grey	Clean, well sorted sst. Composed of angular-subangular frags. of qtz.
	110.24	110.35	.11					sst sh		f/m f	banded	Interlaminated laminae of shale thin and contorted, 1 lense of coal <1cm thick assocd. with qtz. envelope.
	110.35	111.11	.76					cgl		c	spotted	Conglomeratic unit containing subangular-round fragments of (i) Shale (ii) Clean sst m/g (iii) Slightly dirty sst f/mg set a clean sst matrix f/m g Some pyrite. No great size variation in c.g.l frags. Possible channel lag deposits
	111.11	111.84	.73					sst		m/c	mottled lt. grey	Clean moderately well sorted sst, with occasional more c.g.l like horizons, which further supports lag deposit idea. Occasional horizon wit
11.85						99.5						
	111.85	113.55	1.70					sst		m/c	mottled lt. grey	large shale fragments 2cm in diam. (cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 18a DATE 7/17/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	113.55	114.81	1.26					sst sh		f/m f	banded	Interlaminated. Frequent alternation at thin-medium laminae. sst grades to silty sst down core

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 19 DATE 7/16/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	114.81	115.06	.19					sst		f	dk. grey	Well sorted, dk. silty sandstone. Very occasional thin shale laminae.
114.90						100						
	114.90	115.49	.59					sst		f	dk. grey	Well sorted, dark silty dandstone. Very occasional thin shale laminae.
	115.49	117.82	2.33					sst sh	f	f/m f	banded	Interlaminated frequent alternation of lithologies. Laminae thin/medium width. sst clean + well sorted. Erosive base to sst, much decimeter scale x bedding
Box 26												
117.95						95						
	117.95	118.99	1.04					sst sh		f/m f	banded	Interlaminated frequent alternation of lithologies. Laminae thin/medium width. sst clean + well sorted. Erosive base to sst, much decimeter scale x bedding
	118.99	119.84	.85					sst sh		f/m f	banded lt. +dk. gry	Interlaminated. Frequent alternation of lithologies sst comparatively dirty and moderately well sorted, shale is silty.
Box 27												
				i								
	119.84	120.48	.64					sh		f	black	Silty shale, bedding dips 15°. Fissile partings
	120.48	121.09	.61					sh sst			banded lt + dk. gry	Interlaminated. Frequent alternation of thin lithological units. X bedding and isolated (cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 19a DATE 7/16/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												lenses common. Some confused bedding.
120.99						100						
	120.99	126.10	5.11					sh		f	black	Silty shale very well sorted. Beds dip 16°.
												Some polished surfaces with slickenslides
	126.10	127.07	.97					sst		f/m	med. to lt. grey	Med. g. sst containing occasional very large
Box 28												fragments of rounded subrounded shale

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 20 DATE 7/16/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	126.10	127.07	.97	(contd.	from overleaf)					f/m	med. to lt. grey	Largest fragment-5 cm diam. and has an oxidized
127.09						99						rim. Occasional bands of
	127.09	128.27	1.18							f/m	med to lt. grey	silty shale ≤ 2cm wide
	128.27	128.96	.69					sst sh				sst sh 70:30 Lithologic bands thin/medium width
												2.5cm. Frequent alternation. sst clean + well
												sorted.
	128.96	130.11	1.15					sst			lt. mottled grey	Well sorted, m/g sandstone with occasional
												thin shale bands. X bedding and erosive bases to
												minor units common
130.14						98						
	130.14	131.90	1.76					sst		f/m	lt. mottled grey	Well sorted, m/g sandstone with occasional thin
												shale bands. X bedding and erosive bases to
												minor units common. Contorted and irregular
				i								bed forms. Some sst is darker
	131.90	133.20	1.30					ss sh		f vf	banded	Fine interlam. grained dk silty sandstn. and
												silty shale. Lithologic band thickness varies
133.90						100						<1cm >10cm
	133.19	133.63	.44					ss sh		f vf	banded	Fine interlam. grained dk silty sandstn. and
												silty shale. Lithologic band thickness varies
												<1cm >10cm
												(cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 20a DATE 7/16/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	133.63	134.06	.43					sst		f/m	med. grey	Poorly indurated dirty sst. Two brecciated
Box												zones at 133.63 and 134.98 with much qtz.
30												veining.
	134.06	135.65	1.59					sh		f	dk. grey	Silty shale, with occasional silt horizons
												135.50-135.65. Coarser component, white flecks.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 21 DATE 7/16/81

Top & Bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	135.65	136.15	.50					sst		f/m	med/ lt. grey	Well sorted clean sst. Clasts angular-
												angular.
136.23						97						
	136.23	139.33	3.10					sst		m	lt. med/grey	Poorly sorted clean sandstone. Contains a wide
												range of clast sizes. Largest clasts are
												reworked rounded frags. of a darker sst. Some
139.28						100						shale frags. also, usually isolated and surrounded
												by sst
	139.28	141.35	2.07					sst		m	lt. med/grey	Poorly sorted clean sandstone. Contains a wide
												range of clast sizes. Largest clasts are
												reworked rounded frags. of a darker sst. Some
												shale frags. also, usually isolated and surrounded
												by sst
Box 32												Few shale horizons at 140. 90->141.05 and sst is
												dirtier.
	141.35	142.33	.98					sh		f	black	Well sorted silty shale. Med. carbonac. component.
												Some silty horizons. Some broken core.
142.33				i		100						Some broken core.
	142.33	145.44	3.11					sh		f	black	Well sorted silty shale. Med. carbonac. component
												Some silty horizons. Some broken core.
												(cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 21a DATE 7/16/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
145.38						100						
	145.38	147.58	2.20					sh		f	black	Well sorted silty shale. Med. carbonac. component. Some silty horizons. Some broken core.
	147.58	147.73	.15					sst		f/m	dk. grey	Dirty silty sandstone with high carbonaceous content
	147.73	148.48	.75					c			black	Vitrain with blocky fracture, steel grey lustre in a matrix of crushed brecciated coal.
148.43						100						Some qtz. veining. Some shaley horizons.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 22 DATE 7/16/81

op & ottom f run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	148.43	148.68	.25					sh		f	black	silty shale highly carbonaceous.
	148.68	149.13	.45					c			black	Very shaley coal. High quality vitrain with blocky fracture + qtz. veins separated by shale laminae. Qtz. veins very deformed
	149.13	149.63	.50					sh		f	black	Highly carbonaceous silty shale. Some qtz. veins and coal laminae.
	149.63	150.35	.72					c			black	Coal separated by frequent shale laminae. Coal has blocky fract. & steel grey lustre. Low s.g. Some coal is high quality.
	150.35	150.98	.63					sh		f	black	Silty shale highly carbonaceous & broken in part.
	150.98	151.83	.85					c			black	Vitrain with frequent shale laminated. Some coal is crushed (powdery) and qtz. injected.
	151.83	152.60	.80					sh		f	black	Highly C^{s} silty shale with occasional coal laminae and silty horizons. Core very broken.
	152.60	153.50	.90					sh/c		f	black	Highly carbonaceous silty shale grades into coal with blocky fracture, qtz. filled
	153.50	153.61	.11					sh		f	black	Shale (silty) with infrequent thin coal laminae + qtz. veins.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 23 DATE 7/16/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size		Colour	Description
	153.61	154.64	1.03					sh		f	dk. gry. black	Silty shale with occasional silt (dark horizons).
154.52						100						Some contorted bed forms where interlaminated
	154.52	155.88	1.36					sh			dk. gry. black	with silt.
	155.88	156.46	.58					sst sh			banded drk.+ med. grey	Interlaminated dark siltstone/fg. sst and silty
Box 35												shale.
	156.46	157.01	.55					sst sh			banded lt. gr.+dk.gry.	Interlaminated md/g clean well sorted sst with
												thin laminae of silty shale. Some erosive
												bases to ssts and some qtz. veining. Bands
												vary from 0.5cm> to 2cm. Qtz. vein parallel
												to bedding are crenulated.
	157.01	157.71	.70					sst		m/c	mottled lt. grey	Clean m-c/g sst with occasional horizons
				i								containing rounded silty shale fragments.
157.57						100						Shale horizons possibly bioturbated.
Box	157.57	159.00	1.43									Distortion perhaps due to sedimentary loading?
6												
	159.00	159.22	.22					sst sh		f	banded rock	Complicated horizons of m/fg sst and rounded
												shale fragmts. and shale laminae. Erosive contact
												and possible bioturbation.
												Some pyrite.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 24 DATE 7/16/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	159.22	160.64	1.42					sst		m-f	mottled med. grey	Fairly dark, well sorted sandstone. The units contain many isolated lenses/blebs of shale which bear no resemblance to bedding? Possible shale filled burrows? sst exhibits x bedding at 160 Possible drop structure. Occasional shale laminae.
160.62						100						
	160.62	161.44	.82					sst			mottled med. gray	Fairly dark, well sorted sandstone. The units contain many isolated lenses/blebs of shale which bear no resemblance to bedding? Possible shale filled burrows? sst exhibits x bedding at 160.50. Possible drop structure Occasional shale laminae.
	161.44	162.94	1.50					sst sh		mf f	banded md. + dk. grey	Interlaminated. Med. dark well sorted sst and silty shale. X bedding in sst. Some large shale clasts/frags. 5 cm.
	162.94	163.34	.40					sh		f	dk. gry.blk	Silty shale. Poorly indurated at 163.26-163.64.
	163.34	163.70	.36					sst sh		mf f	banded med.+ dk. grey	Interlaminated. Frequent alternation of relatively wide lithologic bands. sst is med. dark. Some contorted bedding + erosive bases. (cont)
163.66						100						

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 24a DATE 7/16/81

op & ottom f run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size		Colour	Description
	163.66	166.70	3.04					sst sh		mf f	banded med + dk. grey	Interlaminated. Frequent alternation of relatively wide lithologic bands. sst is med. dark. Some contorted bedding + erosive bases. At 164.13 qtz. vein dips 55° assoc'd. slickenslides. Qtz. filled fault.
166.71						100						
	166.71	169.78	3.07					sst sh			banded med + dk. grey	Interlaminated. Frequent alternation of relatively wide lithologic bands. sst is med. dark. Some contorted bedding + erosive bases. At 164.13 qtz. vein dips 55° assoc'd. slickenslides. Qtz. filled fault.
169.76	Box 39					100		sst sh				
	169.76	172.58	2.82					sst sh			banded med + dk. grey	Interlaminated. Frequent alternation of relatively wide lithologic bands. sst is med. dark. Some contorted bedding + erosive bases. At 164.13 qtz. vein dips 55° assoc'd. slickenslides. Qtz. filled fault.

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 25 DATE 7/17/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	172.58	172.91	.33					c sh		vf	black	Banded coal contain very frequent horizons of shale
	Box 39					100						or low quality brecciated and veined coal. Clean
	172.81	174.37	1.56					c sh		vf	black	coal has block fracture and steel grey lustre-
												vitrinite. Unit overall is low quality because
	174.37	175.91	1.54					sh		f	black	of frequent shale partings. Highly carbonaceous
												silty shale with occasional thin vitrain lenses/
												bands. Some pyrite and thin qtz. veins.
	175.86	Box 40				100						
	175.86	178.97	3.11					sh			black	Banded coal contain very frequent horizons of shale
												or low quality brecciated and veined coal. Clean
												coal has block fracture and steel grey lustre-
												vitrinite. Unit overall is low quality because
												of frequent shale partings. Highly carbonaceous
												silty shale with occasional thin vitrain lenses/
												bands. Some pyrite and thin qtz. veins.
	178.90	179.11	.21									Banded coal contain very frequent horizons of shale
												or low quality brecciated and veined coal. Clean
												coal has block fracture and steel grey lustre-
												of frequent shale partings. Highly carbonaceous
												(cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 25a DATE 7/17/81

Top & Bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												silty shale with occasional thin vitrain lenses/
												bands. Some pyrite and thin qtz. veins.
	179.11	179.28	.17					c			black	Brecciated coal with high shale content +
												many qtz. veins.
	179.28	180.06	.78					sh		f	dk. grey black	Highly carbonaceous silty sh. Some thin coal
												horizons and many thin qtz. veins.
	180.06	180.37	.31					sh		f	banded	Shale (silty) with laminations of silty sst.
												Complex bed forms, much contortion.
	180.35	180.77	.42					sst sh		f/f	banded med. dk. grey	Interlaminated sst + sh. Frequent alternation
												of thin laminae. Complex bed forms, x bedding,
												flame structures, etc. Ratio 50:50

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 26 DATE 7/17/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	180.77	181.80	1.03					sst		m	mottled lt. grey	Clean well sorted sst. Occasional shale
Box 41												horizons (thin) showing 'flame structures'
	181.95	184.96	3.01					sst		m	mottled lt. grey	182.44 horizon of rounded shale frags.
												2 cm diam. in sst matrix ≍ conglomeratic
185.00	Box 42					98						
	185.00	185.33	.33					sst sh		mf	banded lt.+ dk. grey	Interlaminated sst + silty shale
	185.33	188.08	2.75					sst		m	mottled lt. grey	Very clean well sorted sst. Occasional
188.05						100						very thin shale horizons. sst appears to be
												injected into shale at 185.65.
	188.05	191.11	3.06					sst		m	mottled lt. grey	Very clean well sorted sst. Occasional very
												thin shale horizons. sst appears to be injected
												into shale at 185.65.
												Cgl. horizons of shale frags. well rounded at
												190.91
191.10						100						
Box 43												
	191.10	194.16	3.06					sst		m	mottled lt. grey	Cgl. horizons of shale frags. well rounded at
												190.91
194.14						100						
												(cont)

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 26a DATE 7/17/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	194.16	195.23	1.07					sst		m	mottled lt. grey	Cgl. horizons of shale frags. well rounded
												at 190.91.
	195.23	195.42	.19					cgl		c	spotted dk. + lt. grey	Conglomeratic horizons of well rounded shale
	Box 44											pebbles-3cm diam.
	195.43	196.97	1.54					sst		m/f	banded	Dominantly dk. sst but with frequent shale
												interlaminae, usually thin

PROJECT Groundhog HOLE No. 81 H4 PAGE No. 27 DATE 7/17/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	196.97	196.29	.68					sh silt/sst		vf f	banded dk. grey	Interlaminated silty sandstone, relatively dark and very dark fine grained silty shale. Frequent alternation of lithologies and complicated lithologic boundaries.
197.19						100						
	197.19	198.75	1.56					sh silt/sst		vf f	banded dk. grey	Interlaminated silty sandstone, relatively dark and very dark fine grained silty shale. Frequent alternation of lithologies and complicated lithologic boundaries.
	198.75	199.12	.37					sst		m	light grey	Clean well sorted sst.
	199.12	199.88	.76					sh silt/sst		vf f	banded lt.+ dk. grey	Interlaminated silty sst (dark) and dark fine g/silty shale. Complicated lithologic boundaries. Erosive bases, etc.
	199.88	200.38	.50					sst		m	lt. gry. with dk. gry.bands	Dominantly sst with occasional wide bands ≤ 5cm of silty shale
200.24						100						
	200.24	203.34	3.10					sst		m	lt. grey with dk. gry.bands	Dominantly sst with occasional wide bands ≤ 5cm of silty shale
203.24						100						
	203.24	204.77	1.53					sst		m	lt. grey	sst with more frequent shale bands
					204.77	E N D O F H O L E						

PROJECT Groundhog DATE 7/19/81

HOLE No. DDH 5 (81-H5) PAGE No. 1 of 13

GEOLOGIST D. Hart LOCATION

DRILLER Tonto AERIAL PHOTO

LOGGER MAP No.

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
15.88	Start of run							o/b				
	15.88	17.37	1.49			?						Very broken core. Overburden made up of
17.37					*	100	*					boulders of lithologies seen in previous
					measuring back to establish start of run							boreholes, i.e., shale, sst, coal, etc. Also
												Devil's Claw Conglomerate. These are set
												in an unconsolidated matrix. Probably
	17.37	18.42	1.05					o/b				glacial origin
19.20						58						
	19.20	20.06	.86	i				sh		f	black	Very broken at first. Silty shale. Fissility
20.42						70						med. Some slickenslides on bedding planes
	20.42	23.17	2.75					sh		f	black	Some slickenslides + occasional silty horizons.
23.46	Box 2					90						
	23.46	27.77	4.31					sh		f	black	Very broken at first. Silty shale. Fissility
												med. Some slickenslides on bedding planes
												Some slickenslides + occasional silty horizons.
												(cont)

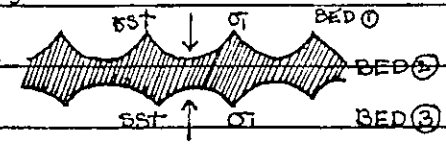
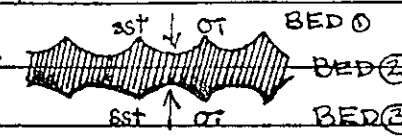
PROJECT Groundhog HOLE No. 81 H5 PAGE No. 1a DATE 7/19/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
27.73	Box 3					100						
	27.73	29.81	2.08					sh		f	black	Very broken at first. Silty shale. Fissility med. Some slickenslides on bedding planes
												Some slickenslides + occasional silty horizons.
29.56						100						
	29.56	31.18	1.62					sst sh		f	band med./dk gry.	Dominantly silty shale with frequent thin interlaminae of med. gray silty sst.

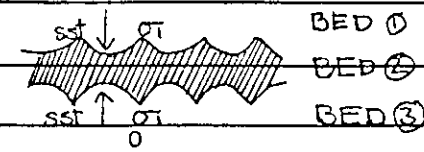
PROJECT Groundhog HOLE No. 81 H5 PAGE No. 2 DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	31.18	32.74	1.56					sh sst		f f/m	banded dk. + med. gray	Interlaminated. Frequent alternation of thin
32.61	Box 4					100						lithologic units. Complicated bed forms/contacts
												etc. Flame structures, erosive bases, x bedding
	32.61	33.70	1.09					sh sst		f f/m	banded dk. + med. gray	Interlaminated. Frequent alternation of thin
												lithologic units. Complicated bed forms/contacts
												etc. Flame structures, erosive bases, x bedding
	33.70	35.67	1.97					sst		f/m	mottled lt. gray	Relatively clean, well sorted sst. Containing
	Box 5											very occasional thin laminae of silty shale.
												Where shale is present, flame structures, etc.
												often seen.
35.65						100						
	35.65	38.71	3.06					sst		f/m	mottled lt. gray	Relatively clean, well sorted sst. Containing
												very occasional thin laminae of silty shale.
												Where shale is present, flame structures, etc.
												often seen.
38.70	Box 6					100						
	38.70	41.75	3.05					sst		f/m	mottled lt. gray	Relatively clean, well sorted sst. Containing
												very occasional thin laminae of silty shale.
												Where shale is present, flame structures, etc.
												often seen.
												(cont)

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 2a DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
41.75				i		100						
	41.75	42.62	.87					sst		f/m	mottled lt. gray	Relatively clean, well sorted sst. Containing very occasional thin laminae of silty shale. Where shale is present, flame structures, etc. often seen.
	42.62	44.80	2.18					sh sst		f m	band lt. + dk. gray	Interlaminated. Frequent alternation of wider lithologic units i.e. ≤ 2cm. Classic flame structure seen throughout section. Also cusp structures e.g. 
Box 7												
44.80						100						
	44.80	47.86	3.06					sh sst		f m	band lt. + dk. gray	Interlaminated. Frequent alternation of wider lithologic units i.e. ≤ 2cm. Classic flame structure seen throughout section. Also cusp structures e.g. 

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 3 DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
47.85	Box 8					100						
	47.85	49.37	1.52					sh sst		f m	band lt. + dk. gray	Interlaminated. Frequent alternation of wider lithologic units i.e. ≤ 2cm. Classic flame structures seen throughout section. Also cusp structures. e.g. 
	49.37	50.36	.99					sh		f	black	Silty shale. Bedding dips 15°. Occasional laminae of dk. silty sandstone.
	50.36	51.06	.70					sh		f	black	Highly carbonaceous silty shale with many qtz. veins very thin parallel to bedding.
	51.06	51.82	.76					c		f	black	Very crushed coal. Coal in form of small particles ≤ 1mm, which gives appearance of being shaley. Crushing with hammer and close inspection reveals almost no shale.
51.89						97						
Box 9												
	51.89	53.05	1.16					c		f	black	Very crushed coal. Coal in form of small particles ≤ 1mm, which gives appearance of being shaley. Crushing with hammer and close inspection reveals almost no shale. (cont)

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 3a DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	53.05	53.84	.79					sh		f	black	Silty shale, med→high carbon^{s} content. Some thin horizons of vitrain.
	53.84	54.49	.65					c sh		f	black	Vitraineous coaly bands set in a shale matrix. Much qtz. veining, parallel and oblique to bedding.
? 53.64						100						
	53.64	53.76	.12					c sh		f	black	Much qtz. veining, parallel and oblique to bedding.
	53.76	54.12	.36					sh		f	black	Highly carbon^{s}. Silty shale. Bedding plane fissility.

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 4 DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	54.12	54.52	.40					c		black	Blocky vitrain separated by frequent shale bands. Overall low grade.
	54.52	56.41	1.89					sh sst	vf f	banded lt. + dk. grey	Interlaminated: Frequent alternation of med/thin lithologic units. sst relatively dk. color. Complex relations between laminae.
	56.41	56.80	.39					sst	f/m	mottled lt. grey	Clean well sorted sst, with occasional med. lamin. of silty shale. X bedding. Pyrite disseminated in sst.
Box 10											
56.78						100					
	56.78	57.96	1.18					sst	f/m	mottled lt. grey	Clean well sorted sst, with occasional med. lamin. of silty shale. X bedding. Pyrite disseminated in sst.
	57.96	59.88	1.92					sh sst	vf f/m	banded lt. + dk. grey	Interlaminated. Frequent alternation of thin/med lithology units. Shale: sst=50:50. Throughout section of core one lithology might be dominant at 80:20 for 20cm, but overall 50:50. Some isolated shale lenses in sst, also large clasts.
	59.88	59.96	.08					sh	f	black	Silty shale with occasional thin silt horizons/sst f gr. Flaser bedding of silt/sst. (cont)
59.89	Box 11					100					

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 4a DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	59.89	60.32	.43					sh		f.	black	Silty shale with occasional thin silt horizons/sst f gr. Flaser bedding of silt/sst. Interlaminated. Frequent alternation of thin/med. lithologic units. Bedding complex relations. Erosive bases, sst filled micro channels, x bedding.
	60.32	63.06	2.74					sh sst		f f/m	banded lt. + dark	
63.02						100						

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 5 DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	63.02	63.55	.53					sh sst		f f/m	banded lt. + dark	Interlaminated. Frequent alternation of thin/med. lithologic units. Bedding complex relations. Erosive bases, sst filled micro channels, x bedding.
	63.55	63.92.	.37					sst		m	dk. grey	Dirty m/g sst with high carbons content.
	63.92	64.40	.48					c			black	Shaley coal. Vitrain separated by frequent shale parting and qtz. veins.
	64.40	65.17	.77					sh		f	dk. grey→ black	Silty shale, med. carbonaceous content.
	Box 12											
	65.17	65.52	.35					sh sst		f	banded lt. + dark grey	Dominantly shale but with frequent thin laminae of dk. silty sst.
	65.52	66.15	.63					sst sh		f/m f	banded lt + dk. grey	Interlaminated. Thin shale laminae in clean well sorted sst. sst shale 70:30
66.13						100						
	66.13	69.14	3.01	i				sst sh		f/m f	banded lt + dk. grey	Interlaminated. Frequent alternation of thin/med. lithologic unit. Bedding relatively constant at 15°-18°. Some x bedding and complex contortions of shale within sst≈biotur?
69.18	Box 13					98						
	69.18	69.63	.45					sst sh		f/m f	banded lt + dk. grey	Interlaminated. Frequent alternation of thin/med. (cont)

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 5a DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												lithologic unit. Bedding relatively constant
												at 15°-18°. Some x bedding and complex
												contortions of shale within sst≈biotur^{n}?
	69.63	72.32	2.70					sst		m	med. grey + dk. grey bands	Moderately clean, well sorted sst. With
												frequent horizons of shale~much contorted
												≈bioturbatn. Some fossil fauna. Contains
												many dissected shale horizons.
												Shale : sst 20 : 80

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 6 DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
72.23						100						
	72.23	74.55	2.32					sst		m	med. grey + dk. grey bands	Moderately clean, well sorted sst. With frequent horizons of shale-much contorted ≈Bioturbation. Some fossil fauna. Contains many dissected shale horizons. shale : sst 20 : 80
	74.55	75.32	.77					c			black	Very shaley dirty coal. Many polished surfaces with slickenslides. Some qtz. veining and brecciation of blocky bands.
Box 14												
75.28						100						
	75.28	75.31	.03					c			black	Very shaley dirty coal. Many polished surfaces with slickenslides. Some qtz. veining and brecciation of blocky bands.
	75.31	76.12	.81					sh		f	black	Silty shale, med. carbons content. Well sorted Contains occasional thin laminae of silty/sst dk.
	76.12	78.35	2.23					sh sst		f f/m	banded dk. + md. grey	Interlaminated. Frequent alteration of v. thin laminae. sst is relatively dark colored and tends to siltstone. Some complex bed forms; possible dewatering structures. (cont)

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 6a DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												Shale: sst 70:30
78.32	Box 15					100						
	78.32	78.99	.67					sh sst		f f/m	banded dk. + med. grey	Interlaminated. Frequent alteration of v. thin laminae. sst is relatively dark colored and tends to siltstone. Some complex bed forms; possible dewatering structures.
												Shale: sst 70:30. sst component increases
	78.99	79.57	.58					c			black	Bands of clean blocky vitrain separated by horizons of very shaley coal. Some qtz. veining and brecciation.
	79.57	80.36	.79					sh		f	black	Silty carbonaceous shale. Qtz. veins ll to bedding very thin.

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 7 DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	80.36	80.87	.51					sst sh	fm f	banded lt. + med. grey	Interlaminated. Complex lithologic boundaries; dewatering structures? Bioturbation? The deform is not tectonic, as horizons above and below are undeformed.
	80.87	81.44	.57					sst	m	light grey	Clean, well sorted sst, containing angular subangular qtz. frags/opaques? Some cross bedding and infrequent shale horizons
81.37	Box 15					100					Contains occasional conglomeratic bands of reworked
	81.37	82.98	1.61					sst	m	light grey	shale frags-well rounded
	82.98	83.31	.33					sst sh	m f	banded	Interlam: Frequent altn. of med. laminae. Shale predominates.
	83.31	84.45	1.14					sst	m	mottled lt. grey	Clean, Very well sorted sst. Occasional large rounded shale fragment.
84.42						100					
	84.42	86.30	1.88					sst	m	mottled md/lt. grey	Fairly clean, well sorted sst. Occasional med/wide silty shale laminae. Fairly constant bedding and simple lithologic boundaries
	86.30	87.46	1.16					sst	f	mottled med. grey	Dark silty sst with occasional very thin shale horizons. X bedding
87.47	Box 17					99					
											(cont)

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 7a DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	87.47	89.17	1.70					sst		f	mottled med. grey	Dark silty sst with occasional v thin shale horizons. X bedding

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 8 DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	89.17	90.56	1.39				ss	silt/ sh		f vf	banded med. + dk. grey	Interlaminated. Frequent thin horizons of dk. silt/sst in shale (silty)
90.52						100						
	90.52	93.50	2.98					sh		f	black	Shale (silty). M/Carbon^{s} content. Occasional silt/sst horizons. Could be termed interlaminated at certain horizons.
93.56						98						
	93.50	96.96	3.46					sh		f	black	Shale (silty). M/Carbon^{s} content. Occasional silt/sst horizons. Could be termed interlaminated at certain horizons. Shale very silty in patches. Marked bedding plane fissility. Med. Carbon^{s} content.
	96.96	97.01	.05					brc			lt. grey + white veins	Brecciated zone of shaley rock with high qtz. vein content. No preferred orientation of qtz. veins.
Box 19												
	97.01	97.34	.33	i				sh		f	med. speckd grey	Shale with very high silt content
	97.34	97.82	.48					silt		f	med. speckd grey	Siltstone (dark) with frequent isolated shale lenses
	97.82	99.16	1.34					sst sh		fm f	banded lt.+ dk. grey	Interlaminated. Frequent altn. of med. wide lithologic bands. sst is fairly well sorted (cont)

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 8a DATE 7/20/81

Top & Bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												and relatively dark colored.
	99.16	99.78	.62					sh		f	black	Silty shale. Very well sorted. Occasional
99.66	Box 20					100						silt/sst horizons
	99.66	100.80	1.14					sh		f	black	Silty shale. Very well sorted. Occasional
												silt/sst horizons

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 9 DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	100.80	102.78	1.98					sst		f	med.dk.grey	Very uniform well sorted, v. fine grained sst. The sst has a large silt component which gives rise to (relatively) dark color.
102.71						100						Disseminated pyrite. Disturbance of bedding
	102.71	105.72	3.00					sst		f	med.dk. grey	probably result of bioturbation? Some epigenetic (diagenetic) pyrite disseminated.
Box 21												
105.76						98						Many fracs. parallel core axis≈pore water-depressarization.
	105.76	108.92	3.16					sst		f	med.dk. grey	Very uniform well sorted, v. fine grained sst. The sst has a large silt component which gives rise to (relatively) dark color. Disseminated pyrite. Disturbance of bedding probably result of bioturbation? Some epigenetic (diagenetic) pyrite disseminated. Many fracs. parallel core axis≈pore water-depressarization.
108.80						100						
	108.80	111.88	3.08					sst		f	med.dk. grey	Very uniform well sorted, v. fine grained sst. The sst has a large silt component which gives rise to (relatively) dark color. (cont)

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 9a DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr.	size	Colour	Description
												Disseminated pyrite. Disturbance of bedding
												probably result of bioturbation? Some
												epigenetic (diagenetic) pyrite disseminated.
												Many fracs. parallel core axis≈pore water-
												depressarization.
111.85												
	111.85	113.99	2.14					sst		f	med.dk. grey	Very uniform well sorted, v. fine grained
												sst. The sst has a large silt component
												which gives rise to (relatively) dark color.
												Disseminated pyrite. Disturbance of bedding
												probably result of bioturbation? Some
												epigenetic (diagenetic) pyrite disseminated.
												Many fracs. parallel core axis≈is pore water-
												depressarization.
	113.99	114.21	.22					sh		f	dk. grey	High carbonaceous silty shale with a
												high silt component.
	114.21	114.93	.72					c		f	black dk grey	Banded coal separated by large partings.
												of high/med. carbon^{s} silty shale. Coal
												is vitrain, but often brecciated and qtz. veined.
												(cont)

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 9b DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr.	size	Colour	Description
114.90	Box 23					100						
	114.90	116.69	1.79					c			black dk. grey	Banded coal separated by large partings of high/med. carbon^{s} silty shale. Coal is vitrain, but often brecciated and qtz. veined. Shale parting up to 15 cm isolated
	116.69	116.95	.26					sh		f	dk. gry blk.	Silty shale
	116.95	117.25	.30					sst sh		m f	banded lt.+ med. grey	sst (dark) with interlaminae of poorly indurated mudstone/shale. Med. carbonaceous content.
	117.25	117.94	.69					c		l	black	Very shaley coal, brecciated and qtz. veined. Frequent thin shale partings.
117.95	Box 24					99						
	117.95	117.97	.02					c			black	Very shaley coal, brecciated and qtz. veined. Frequent thin shale partings
	117.97	119.31	1.34					silt sh		f	dk÷med. grey	Med. carbon^{s} silty shale/shaley siltstone.
	119.31	121.10	1.79					sst		mc	lt. mottled grey	Clean well sorted (in part) sst. Occasional wide→thin silty shale laminae. Horizons of med/large rounded reworked shale frags. in sst matrix. ssts varies: clean→med. dirty
120.99						100						
	120.99	121.28	.29					sst		mc	lt. mottled grey	Clean well sorted (in part) sst. Occasional (cont)

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 9c DATE 7/20/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												wide→thin silty shale laminae. Horizons of
												med/large rounded reworked shale frags. in sst
												matrix. ssts varies: clean→med. dirty
	121.28	121.84	.56					sh sst		f m	banded lt.+ dk. grey	Interlaminated. Dark sst well sorted. Frequent
												alternation of med. wide lithologic units. Shale
												is carbonaceous
	121.84	121.99	.15					sh		f	black	H. carbonaceous silty shale. Some pebble drop
												structures
	121.99	124.07	2.08					sh sst		f m	banded lt.+ dk. grey	Frequent alternation of thin lithologic units:
124.04	Box 26					100						Bed dips 12°. Sharp lithologic contacts.
	124.04	126.47	2.43					sh sst		f m	banded lt.+ dk. grey	Frequent alternation of thin lithologic units:
												Bed dips 12°. Sharp lithologic contacts.
												124.52-124.61. Qtz vein brecciated host rock
												oblique to beddg. Some calcite in vein.

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 10 DATE 7/22/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	126.47	127.29	.82					sst		f	med. grey	Badly broken core. Fairly well scrted fg sst with a high silt content. Poorly indurated in places.
127.09						100						
	127.09	128.01	.92					sst sh		f vf	banded lt.+ dk. grey	Badly broken interlaminated core. Much breccia and qtz. veining. Silty shale tends to highly carbonaceous at 127.90
	128.01	129.06	1.05					c			black	Banded coal. Brecciated and qtz. veined bands of vitraineous coal separated by frequent silty carbonaceous shale partings. Low quality
	129.06	129.96	.90					sh		vf	black	Highly carbonaceous silty shale with occasional thin laminae of brecciated/qtz. vc^{d} coal
	129.96	130.27	.31					sh		f	black	Highly carbonaceous silty shale with rare sst horizons having an erosive basal contact
130.14	Box 27					100						
	130.14	131.43	1.29					sh		f	black	Highly carbonaceous silty shale with rare sst horizons having an erosive basal contact
	131.43	133.21	1.78					sh sst	vf	vf f	banded med.+ dark grey	Interlaminated. Frequent alternation of med/thin lithologic units: sst is a very dark color but well sorted. Shale > sst
	133.19	134.06	.87									

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 11 DATE 7/22/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size		Colour	Description
	134.06	134.50	.44					sh sst		f f	banded	Interlaminated. Thin silty shale laminae in a clean well sorted (in part) sst. Some cross bedded horizons contain shale clasts; rounded-> subrounded diam = ≤0.5 cm.
	134.50	134.71	.21					sst		m	mottled lt. grey	Clean, well sorted sst
	134.71	135.14	.48					sst sh		f/m f	banded lt.+ dk grey	Interlaminated. Frequent alternation of thin bands sst > sh. Beds dip 12⇔15°
	Box 28											
	135.14	135.48	.34					sst		m	mottled lt. grey	Clean well sorted sst
	135.48	136.24	.76					sst sh		m f	banded lt. + dk. grey	Interlaminated. Frequent alternation of thin>wide lithological units. X bedding. Pebble drops structures & other complex bed forms. >sst sh.
136.24						100						Possible bioturbation
	136.24	137.05	.81	i				sst sh		m f	banded lt. + dk. grey	Interlaminated. Frequent alternation of thin ⇒wide lithological units. X bedding. Pebble drops structures & other complex bed forms. sst > sh.
	137.05	137.31	.26					sst		m	mottled med. -> lt. grey	Fairly clean, well sorted sst. Large angular shale clast at 137.23
	137.32	138.61	1.30					sst sh		m f	banded	Interlaminated. Very thin laminae silty shale. Some horizons of small subangular clasts. (cont)

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 11a DATE 7/22/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												silty shale. sst >> sh.
	138.01	139.41	.80					sst		m	mottled lt. grey	Well sorted clean sst. At 139.80 very large angular silty shale frags. ≈10cm diam. Accompanied by smaller rounded shale frags. Infrequent shale laminae (very thin)

PROJECT - Groundhog HOLE No. 81 H5 PAGE No. 12 DATE 7/22/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size		Colour	Description
139.28						100						
	139.28	140.72	1.44					sst		m	mottled lt. grey	Well sorted clean sst. At 139.80 very large angular silty shale frags ≈10cm. diam. Accompanied by smaller rounded shale frags. Infrequent shale laminae (very thin)
	140.72	141.71	.99					sh		f	dk. grey	Silty shale. Many thin qtz. veins parallel to bedding i.e <1mm. Med-low carbons content.
	141.71	142.31	.60					sh sst		f f/m	banded med. + dk. grey	Interlaminated. Dark silty sst and silty shale. Frequent alternation of thin lithologic bands. Complex beds form ~wavy bedding etc.
142.33						99						
	142.33	143.51	1.18					sh sst		f f/m	banded med. + dk. grey	Interlaminated. Dark silty sst and silty shale. Frequent alternation of thin lithologic bands. Complex beds form wavy bedding, etc.
	141.51	145.32	3.81					sst		m	mottled sst	Clean, very well sorted sst. Occasional dark patches ≈higher silt content. Some isolated rounded shale clasts. Fractures ll c axis≈pore pressure.
145.38						98						
	145.38	148.49	3.11					sst		m	mottled sst	Clean, very well sorted sst. Occasional dark patches higher silt content. Some isolated rounded shale clasts. Fractures ll c axis≈pore pressure

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 12a DATE 7/22/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
Box 31												
	148.49	150.47	1.98					sst		fm	lt. mottled grey	Finer gr. sst, well sorted, slightly darker than above. More frequent shale horizons Very thin. Beds dip 10°
	150.47	151.47	1.00					sst sh		m/f f	banded dk.+ md. grey	Interlaminated. Frequent alternation of lithological bands. Fine g sst dark and black silty shale. Bedding ≈ horizontal.

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 13 DATE 7/23/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	151.47	151.94	.47					sst sh	m/f f	banded dk.+ med. grey	Interlaminated. Frequent alternation of lithological bands. Fine g sst dark and black silty shale. Bedding≈horizontal. Some flame structures.
Box 32											
	151.94	153.43	1.49					sst	f→m	md. grey	Well sorted. Some silty shale horizons. Grades to darker color sst at 152.90. Some isolated shale flame like bodies.
	153.43	154.12	.69					sst sh	m f	banded med + dk. grey	Interlaminated. Frequent alternation of med. wide bands. Flames.
	154.12	154.63	.51					sst	f→m	lt.→md. grey	Fair sorting. Clean silty.
154.52	Box 32					100					
	154.52	155.21	.69					sst silt sh	m f vf	band various greys	Interlaminated sst/siltstone/shale. Variation in color and grain size throughout unit.
	155.21	157.59	2.38					sst	m	med. lt. mottled grey	Clean very well sorted sst. Large fracture at small <le to C.A. Qtz. filled. Occasional silty horizon. Very thin
157.57						100					
	157.57	159.59	2.02					sst	f	dk.→med. grey	Well sorted silty sst, with a high shale content giving darker patches. Complex (cont)

PROJECT Groundhog HOLE No. 81 H5 PAGE No. 13a DATE 7/23/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
159.40						100						isolated shale bodies. Flames/microfaulting
							T. D. =	159.40	or	523	ft.	

PROJECT Groundhog **DATE** 7/24/81

HOLE No. DDH #6 81 **PAGE No.** 1 of 13

GEOLOGIST D. Hart **LOCATION**

DRILLER Tonto **AERIAL PHOTO**

LOGGER R. Appleby **MAP No.**

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
23.46												Casing to this depth (i.e. 77 ft.)
	23.46	24.88	1.42					sst		m	lt. mottled grey	Poor recovery, broken core. Clean, well sorted
												sst
												Some qtz. veins and vein breccia
25.29	Box 1											
	25.29	26.88	1.59					sst		m	lt. mottled grey	Poor recovery, broken core. Clean, well sorted
												sst. Some qtz. veins and vein breccia
26.51						100						
	26.51	27.89	1.38					qtz. sst		m	lt. med. mottled gry.	sst. with large steeply dipping qtz. veins
												Qtz. veins offset, possibly indicating two
												episodes of faulting.
28.34												
	28.34	29.55	1.21					sh		f	dk. grey	Silty shale with b. plane fissility. Some
												(cont)

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 1a DATE 7/24/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												slickensliding. Med. carbonaceous content.
29.56	Box 2					99						
	29.56	30.58	1.02					sh		f	dk. grey	Silty shale with b. plane fissility. Some slickensliding. Med. carbonaceous content.
												Broken core.
30.47						100						
	30.47	32.22	1.75					sh		f	med. dk.→gry	Silty shale. Med.→low carbonas content.
												Badly broken core. Slickensliding on polished surfaces.
31.69						100						

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 2 DATE 7/24/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	31.69	32.45	.76					sh		f	dk. grey	Silty shale. Beds dip steeply. At 31.94 vein breccia≈small fault. Bed dips 55°-65°
32.61	Box 3											
	32.61	35.95	3.34					sh		f	dk. grey	Silty shale with occasional siltstone horizons Bedding shallows to 10°-15° from 50°-65°. Polished surfaces and slickensliding. Some poorly indurated horizons
35.65						100						
	35.65	36.52	.87					sh			dk. grey	Silty shale with occasional coal bands (very thin). Bedding sub horizontal.
	36.52	38.80	2.28					sst		m→c	mottled grey	Fairly clean, well sorted sst. Unit is highly qtz. veined and the core is very broken in veined horizons. Some carbons horizons.
38.70	Box 4					100						Bedding dips 10°. Veins up to 1cm wide.
	38.70	39.14	.44					sst		m→c	mottled grey	Bedding dips 10°. Veins up to 1cm wide.
	39.14	39.81	.67					sst		c	mottled grey	Clean, poorly sorted sst contains range of clasts size. Contains horizons of rounded clasts of shale and reworked/bleached sst ~.3mm diam. rounded-sub rounded. (cont)

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 3 DATE 7/24/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	41.54	41.68	.14					sst sh		m f	mottled lt.gry. Some dk. bands	Med/g sst with occasional med/wide bands silty shale. sst > sh 90:10
41.75												Some qtz. veining, + vein breccia ~ fault
	41.75	43.81	2.06					sst sh		m f	mottled lt.gry. Some dk. bands	Some qtz. veining, + vein breccia ~ fault
	43.81	44.98	1.17					sst sh		f/m f	banded lt.+ dk. grey	Interlaminated. Frequent alternation of thin lithologic units. Complex lithologic boundaries. At 44.30 beds dip steeply and have wavy structure. Beds dip 60°-75°; the complex wavy pattern reflects syn sedimentary folding ≈ slumping, micro faults also seen. At 44.90 beds shallow to ≈30°. Some slickensliding on bedding planes. sst is dark, tends to silty.
44.80	Box 6					100						
	44.80	45.91	1.11	i				sst sh		f/m f	banded lt.+ dk. grey	Interlaminated. Frequent alternation of thin lithologic units. Complex lithologic boundaries. At 44.30 beds dip steeply and have wavy structure. Beds dip 60°-75°; the complex wavy pattern reflects syn sedimentary folding ≈ slumping, micro faults also seen. At 44.90 beds shallow to ≈30°. (cont)

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 3a DATE 7/24/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												Some slickensliding on bedding planes. sst is
												dark, tends to silty
	45.91	47.31	1.40					sh		f	dk. grey	Very silty shale. Some qtz. veining. Fault
												qtz. veins, slickenslides horizontal.
	47.31	47.89	.58					c			black	Shaley coal, brecciated and qtz. veined.
												Polished surfaces with slickenslides.
	47.89	48.02	.13					sst		f	med. grey	Silty sst with much qtz. veining + some calcite
47.85						100						
	47.85	47.95	.10					sst		f	med. grey	Silty sst with much qtz. veining + some calcite
	47.95	48.56	.61					sst sh		f/m f	banded med.+ dk. grey	Interlaminated. Frequent alternation of dirty sst
												and silty shave. Wavy bed forms.

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 4 DATE 7/24/81

Top & Bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	47.95	48.56	.61								banded med.+ dk. grey	Slickenslides on planes oblique to bedding
	48.56	49.51	.85					sst		m	lt. mottled	Moderately clean, well sorted sst. Contains many ptymoidal qtz. veins≈1cm wide. No predom. orientation. Some calcite associated with qtz.
	49.41	50.92	1.51					sst		m	white veins in banded sst grey	Dominantly m/g sst, well sorted. Occasional wide silty shale bands. Intense large scale shale horizons-polished fractures with slickenslides. Very broken core. Some large shale frags.
	50.92	51.41	.49					sh		f	md. grey	Silty shale. Bed dips 20°. Some qtz. veining.
	52.41	54.05	1.64					sst		m	lt. gry.+ white veined	M/g^{d}, clean, well sorted sst. Much qtz. veining. Random orientation of pervasive network. Sst contains small pits≈fossil burrows?
53.94						100						
	53.94	54.54	.60					sst		m	lt.gry.+ white veined	M/g^{d}, clean, well sorted sst. Much qtz. veining. Random orientation of pervasive network. Sst contains small pits≈fossil burrows?
	54.54	57.02	2.48					sst sh		f/m f	banded lt.+ dk. gry.	Interlaminated. Frequent alt. of thin/med bands. (complex)

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 4a DATE 7/24/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												Complex lithological boundaries common.
												sst > sh 70:30
56.99	Box 8					100						
	56.99	57.40	.41					sst sh		f/m f	banded lt.+ dk. grey	Interlaminated. Frequent alt. of thin/med. bands.
												Complex lithological boundaries common.
												sst > sh 70:30
	57.40	58.72	1.32					sst qtz		m-c	lt. grey white veins	M-c grained, clean, well sorted sst. Contains several large wide qtz. veins that are oblique to bedding. Veins consist of poorly xstalline qtz. and angular sst frags. ≃ fault breccia Beds dip 15°. Vein dips approx. 70

PROJECT Groundhog HOLE No. 81-H5 PAGE No. 5 DATE 7/24/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	58.72	59.29	.57					sst sh	m vf	banded lt. + dk. grey	Interlam: lithologic units wide > 10cm. Shale is poorly indurated and broken.
	59.29	59.41	.12					sst sh	m f	med. grey	sst containing fragments of shale in which contains sst filled moulds.
	59.41	59.94	.53					sst	m	dk. grey	Carbn^{s} ssts with poorly indurated silty shale horizons
60.04	Box 9										
	60.04	60.56	.52					sst sh	f/m f	banded dk.+ med. grey	Interlaminated dark sst/silty and shale.
	60.56	61.44	.88					sh	f	dk. grey/ black	Poorly indurated silty shale-carbonaceous med. at first grades to high at depth. Very broken core. Slickensliding.
	61.44	61.76	.32					qtz. sh	f	blk+white	Shale pervaded by an astonishing network of qtz. veins. Microfaulting. Veins 1cm→1mm
	61.76	62.11	.35					sh	f	black	High carbon^{s} silty shale. Very broken
	62.11	63.59	1.48					sst	m	mottled lt. grey	Fairly dirty sst. Much qtz. veining has reduced competence. Infrequent shale horizons.
63.09						100					
	63.09	63.17	.08					sst	m	mottled lt. grey	Fairly dirty sst. Much qtz. veining has reduced competence. Infrequent shale horizons.
	63.17	63.27	.10					sh	f	black	Brecciated coaly silty shale

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 6 DATE 7/24/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	63.27	63.95	.68					sst	f	dark grey	Dirty silty sst with isolated bodies of silty shale. Some qtz. veining.
	63.95	64.51	.56					sst silt	f vf	banded lt.med +dk. grey	Interlaminated. Frequent alt^{n} of thin lithologic bands. sst is silty dark and very thin. Beds dip 12^{o}
	64.51	64.72	.21					sh c		black	Very shaley broken coal. Shale > coal. Coal forms thin (qtz. pervaded) bands.
	Box 10										
	64.72	65.89	1.17					sh	f	black	Well sorted, black, med carbona^{s}, shale Fissility fair. Blebs of qtz. isolated in shale
	65.89	66.24	.35					sst	f	dk/med.grey	Very silty sst, occasional shale bands
66.13						100					
	66.13	68.14	2.01					sst	f	med. grey	Fairly dirty, well sorted silty sst. Occasional wide shale bands. Some qtz. veining and broken core
	68.14	68.25	.11					qtz. sh	f	blk+white	Highly qtz. veined (+ vein pyrite) silty shale. Small coal particles in stringers.
	68.25	69.31	1.06					sh	f	dk. grey	Silty shale. Occasional thin coal bands, poorly indurated in part. Bedding varies 15^{0} → 30/35 Slickenslides
69.18	Box 11					100					
											(cont)

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 6a DATE 7/24/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size		Colour	Description
	69.18	69.59	.41					sh		f	dk. grey	Silty shale. Occasional thin coal bands, poorly
												indurated in part. Bedding varies 15°→30/35°
												Slickenslides
	69.59	71.00	1.41					sst		m	mottled lt. grey	Fairly clean, well sorted med/coarse sst
												Qtz. veining common

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 7 DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	71.00	71.91	.91					sh		f	md/dk grey	Silty shale. Highly qtz. veined. Broken core
	Box 12											poorly indurated in part
	71.91	72.46	.55					sst		m	light grey	Moderately clean, well sorted sst. 1 wide shale
												horizon at 72.25→72.29
72.23						100						
	72.23	72.94	.71					sst		m	light grey	Moderately clean, well sorted sst. 1 wide shale
												horizon at 72.23→72.29
	72.94	73.66	.72					sh		f	md. grey	Badly broken core. Messy unit of brecciated
												silty shale, pervaded by qtz. veins. Many
												slickenslides. Poorly indurated in part. Some
												sst horizons
	73.66	73.88	.22					sh		f	black	Highly carbonaˢ shale. Many polished surfaces~
												grades to shaley coal in part
	73.88	74.02	.14					c			black	Shaley coal, many polished surfaces, with
												slickenslides
	74.02	75.55	1.53					sh		f	dk. grey black	Highly carbonˢ shale. Very broken core
												Poorly indurated. Many polished surfaces.
	75.55	75.77	.22					c		f	black	Shaley coal. Highly deformed with many polished
75.28						100						surfaces & slickenslides.
	75.28	76.30	1.02					c			black	Extremely broken core. Reduced almost to powder.
												(cont)

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 7a DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												Coal particles have steely grey lustre.
												High shale content in part.
	76.30	76.56	.26					sh		f	dk. grey	Silty shale, highly carbonaceous
												Bed dips 35°

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 8 DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	76.56	76.97	.41					c			black	Highly broken core. Coal low s.g., steel lustre;
Box 13												highly deformed and broken
	76.97	77.11	.14					sh		f	dk. grey	High carbons shale. Qtz. veined
	77.11	77.90	.79					c			black	Highly broken core. Coal low s.g., steely lustre,
												some blocky fracture. many polished surfaces
												Occasional indurate shale parting.
	77.90	78.41	.51					sh		f	dk/med. grey	Silty shale, med. carbonaceous content.
												Broken core
77.72	Box 14					100						Result of very broken core (78.41) 77.72≃0.70m
	77.72	78.05	.33					sh		f	dk.med. grey	Silty shale, med. carbons content. Broken core.
												Poorly indurated in part
	78.05	79.80	1.75					sh sst		f m	banded med./ dk grey	Interlaminated. Frequent alternation of thin
												lithologic units. Sharp boundaries. Beds dip
79.24						100						steeply~60→65°. sst relatively dirty. Slickenslid
												on silty shale fissile planes. Broken core.
	79.24	81.06	1.82					sh sst			banded med./ dk. grey	Interlaminated. Frequent alternation of thin
												lithologic units. Sharp boundaries. Beds dip
												steeply~60→65°. sst relatively dirty. Slickenslic
												on silty shale fissile planes. Broken core.
												(cont)

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 8a DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	81.06	81.32	.26					sh sst		f fm	banded	Interlaminated sst + silty shale. Lithologic bands.
	81.32	81.46	.14					sst sh		m f		Interlaminated. Frequent alternation thin bands. sst is dirty.

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 9 DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	81.46	81.58	.12					sst		c	mottled	Relatively clean sst, with rounded shale fragment
												≤5cm diam. Some shaley content below shale
												frag. horizon
81.37						100						
	81.37	81.45	.08					sst			mottled	Relatively clean sst, with rounded shale fragment
												≤5cm diam. Some shaley content below shale
												frag. horizon
	81.45	81.65	.20					sh		f	black	Well sorted, shale. Poorly indurate. Bed dip 65-70°
	81.65	82.39	.74					sh sst		vf f	banded med.+ dk. grey	Interlaminated. Frequent alternation of thin lithologic bands. sst is dirty. Beds dip 70°
	82.39	83.46	1.07					sst		m	lt. mottled grey	sst, fairly well sorted, moderately clean. Some qtz. veining, and occasional shale horizon. Slickensliding on shale horizons.
	83.46	84.25	.79	i				sh		f	dk. grey	Poorly indurate silty shale, very brecciated and contorted ≈ fault zone.
83.81	Box 15					100						
	83.81	83.98	.17					sh		f	dk. grey	Well indurated silty shale.
	83.98	84.30	.32					qtz sh		f	White+gry.	Highly qtz. veined silty shale. Qtz. friable and yellow
												(cont)

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 9a DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	84.30	85.57	1.27				s	sh slt/s	sst	vf f	banded dk+ med. grey	Interlaminated. Frequent alternation of thin bands. Some qtz. veining with vein breccia. Microfaulting.
	85.57	86.15	.58					sst		c	light	Clean, well sorted sst. Contains large fragment (occasional) ≤7cm diam. Poorly indurate.

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 10 DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	86.15	86.34	.19					c/ sh		f	black	Shaley coal, very deformed and broken up.
	86.34	86.52	.18					sst		c	md. grey	Well sorted, clean sst. Qtz. veins at base.
	86.52	86.88	.36					c			black	Highly polished broken coal.
	86.88	87.04	.16					sh			grey+white	Brecciated shale. Qtz veins. Thin coal horizon < 1cm
	87.04	87.64	.60					sh		f	black/grey	Highly fissile, broken, silty shale. Wavy bedding, not uniform dip
87.47	Box 16					100						
	87.47	88.36	.89					sh		f	dk. grey	Silty shale with qtz. veined horizons
	88.36	88.46	.10					c			black	Coal. Many polished surfaces and slickenslides
	88.46	88.74	.28					sh		f	dk. grey	Silty shale
	88.74	89.40	.66					c			black	Low s.g. Steely lustre. Many polished surfaces with slickenslides. Very broken core. Med. shale content.
	89.40	90.12	.72					sst		f	dk.-> med. grey	Dirty sst with frequent shaley horizons Some qtz. veining + brecciation
89.91	Box 17					100						
	89.91	90.76	.85					sst		f	dk.-> med. grey	Dirty sst with frequent shaley horizons. Some qtz. veining + brecciation.
90.52						100						
	90.52	90.94	.42					sst		f	dk.-> med. grey	Dirty sst with frequent shaley horizons (cont)

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 10a DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												Some qtz. veining + brecciation.
	90.94	92.37	1.43					sh		f	black	Highly carbonaceous, very fissile silty shale.
												Very broken core.

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 11 DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
	92.37	92.79	.42					c			black	Coal. Many polished surfaces with slickenslides.
												Steel grey lustre and low spec. grav. Very
92.65						100						broken core. Some blocky frags.
	92.65	93.31	.66					c			black	Coal. Many polished surfaces with slickenslides.
												Steel grey lustre and low spec. grav. Very broken
												core. Some blocky frags.
	93.31	93.56	.25					sh		f	black	Highly carbons shale with thin qtz. bands
												parallel to bedding
	93.56	94.19	.63					sh sst		f fm	banded md+ dk. grey	Interlaminated~dirty silty sst.
	94.19	95.32	1.13					sst		f/m	med. grey	Moderately clean, moderately well sorted
												Frequent silty dark thin horizons
95.39	95.32	95.39	.07			100		sst sh		f/m f	banded lt.+ dk. grey	Interlaminated. Frequent alternation of thin/wide
												lithologic units. Bed contact sharp, dip at
												18^{o}-20^{o}. sst is dark, shale tends to siltstone.
	95.39	96.63	1.24					sst sh		f/m f	banded lt.+ dk. grey	Interlaminated. Frequent alternation of thin/wide
												lithologic units. Bed contact sharp, dip at 18^{o}-20^{o},
												sst is dark, shale tends to siltstone.
96.61						100						
	96.61	97.40	.79					sst sh			banded lt.+ dk. grey	Interlaminated. Frequent alternation of thin/wide
												lithologic units. Bed contact sharp, dip at 18^{o}-20^{o},
												(cont.)

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 11a DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr.	size	Colour	Description
												+ some erosive bases to units. + somelarge isolated
												shale frags: subrounded
	97.40	98.88	1.48					sst		f	dk. grey	Dk. grey, well sorted sst. Occasionally lighter
												colored horizons give impression of interlamination
	99.88	99.89	.01					sst		f/m	lt/med.gry	Interlaminated sst with frequent very thin bands
												of silty dark sst. sst: sh 80:20 Bed dips 18°.
	99.82	101.66	1.84					sh		f	black	Highly carbonaceous silty shale. Marked fissility.
												Beds dip 45°

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 12 DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Gm. Fr. size	Colour	Description
	101.66	101.94	.28					c sh	f	black/white	Lenses of brecciated qtz. veined coal in a shale matrix.
	101.94	102.67	.73					sh	f	black	Highly carbonaceous silty shale. Some lenses of coal + qtz.
	102.67	102.94	.27					qtz sh	f	black+white	Anastomosing network of qtz. veins with pyrite. Veins pervaded lenses of coal in shale.
102.7	Box 20										
	102.71	102.85	.14					qtz sh	f	black+white	Anastomosing network of qtz. veins with pyrite. Veins pervaded lenses of coal in shale
	102.85	104.93	2.08					sh	f	black	Carbonaceous silty shale with many thin qtz. veins parallel to bedding. Beds dip 10°. Occasional thin lenses of coal < 1cm
	104.93	105.76	.83					sst sh	f/m f	dirty med. grey	Dominantly dirty well sorted sst; frequent contorted complex lamina of silty shale Possible bioturbn
105.76						100					
	105.76	105.94	.18					sst sh	f/m f	dirty med. grey	Dominantly dirty well sorted sst; frequent contorted complex lamina of silty shale. Possible bioturbn
	105.94	106.12	.18					sst	m	lt. grey	Clean, well sorted sst
	106.12	107.05	.93					sst sh	m f	banded lt+ dk. grey	Interlaminated. Clean sst + silty shale. Thin/med (cont)

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 12a DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												laminae. Beds dip 35°
	107.05	108.10	1.05					sst		m	lt. mottled grey	Moderately clean, well sorted sst. Occasional angular shale fragments
	108.10	108.74	.64					sst		m	lt. grey	Clean sst contains bands of conglomeratic nature. Large rounded shale pebbles in a sst matrix. The pebbles appear to have a preferred orientation, ~definitely bedded
												 dips 35°
	108.74	108.89	.15					sst		m	lt. mottled grey	Moderately clean, moderately sorted sst, with occasional large isolated shale fragments in sst. Some wide shale bands.
108.80						100						
	108.80	111.79	2.99					sst		m	lt. mottled grey	Moderately clean, moderately sorted sst, with occasional large isolated shale fragments in sst. Some wide shale bands.
111.85												
	111.85	112.90	1.05					sst		m	lt. mottled grey	Moderately clean, moderately sorted sst. with occasional large isolated shale fragments in (cont)

PROJECT Groundhog HOLE No. 81-H6 PAGE No. 12b DATE 7/25/81

Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												sst. Some wide shale bands + some fossil burrows
												in shale
	112.90	115.13	2.23					sh sst		f f/m	banded dk+ med. grey	Interlaminated. Frequent alternation of med.
												lithologic units. Dip very steep, but varies
												50→75°
												Some complex structures and contacts.
												sst has a yellowy color. Shale > sst
114.90						100						Wavy bedding, erosive basal contacts, etc.
	114.90	118.12	3.22					sh sst		f f/m	banded dk+ med. grey	Interlaminated. Frequent alternation of med.
												lithologic units. Dip very steep, but varies
												50→75°. Some complex structures and contacts.
												sst has a yellowy color. Shale > sst. Wavy bedding,
												erosive basal contacts, etc.
117.95	Box 23					100						
	117.95	121.03	3.08					sh sst		f f/m	banded dk+ med. grey	Interlaminated. Frequent alternation of med.
												lithologic units. Dip very steep, but varies
												50→75°. Some complex structures and contacts.
												sst has a yellowy color. Shale > sst. Wavy bedding,
												erosive basal contacts, etc.
120.99	Box 24					100		sh sst		f f/m	banded dk+ med. grey	Interlaminated. Frequent alternation of med.
												(cont)

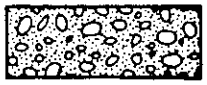
PROJECT Groundhog HOLE No. 81-H6 PAGE No. 12c DATE 7/25/81

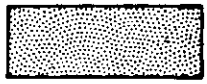
Top & Bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Fr.	Grn. size	Colour	Description
												lithologic units. Dip very steep, but varies
												50→75°. Some complex structures and contacts.
												sst has a yellowy color. Shale >sst. Wavy bedding,
												erosive basal contacts, etc.
	120.99	124.12	3.13					sh sst		f f/m	banded dk.+ med. grey	Interlaminated. Frequent alternation of med.
												lithologic units. Dip very steep, but varies
												50→75°. Some complex structures and contacts.
												sst has a yellowy color. Shale >sst. Wavy bedding,
												erosive basal contacts, etc.
124.04						100						

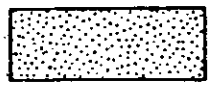
PROJECT Groundhog HOLE No. 81-H6 PAGE No. 13 DATE 7/25/81

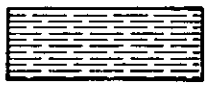
Top & bottom of run	Rod intervals From	To	Thick.	Adj. intervals From	To	% Rec.	Sample No.	Rock Type	Features Grn. Fr. size	Colour	Description
	124.04	127.18	3.14					sh sst	f f/m	banded dk.+ med. grey	Interlaminated. Frequent alternation of med. lithologic units. Dip very steep, but varies 50-75°. Some complex structures and contacts, sst has a yellowy color. Shale > sst. Wavy bedding, erosive basal contacts, etc.
127.09						100					
	127.09	130.16	3.07					sh	f	black	Silty shale. Med-high carbons content. Some 1cm wide qtz. veins parallel to bedding and oblique to bedding. Slickenslides
130.14	Box 26					100					Some silty horizons
	130.14	131.73	1.59					sh	f	black	Some silty horizons
	131.73	133.19	1.46					sh	f	black+white	Shale with many brecciated/qtz. veined horizons. Fissility marked on bedding planes. Carbonacs content= med-high
								TD = 437 = 133.19			

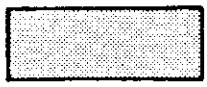
KEY to GROUNDHOG STRATIGRAPHIC SECTIONS.

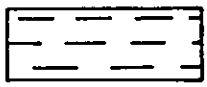
Overburden 

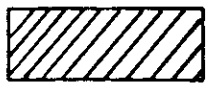
Sandstone 

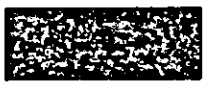
Massive Sandstone 

Shale (or Mudstone) 

Siltstone 

Interlaminated Shale
(with Sandstone or Siltstone) 

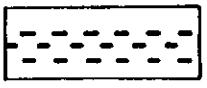
Cross-bedding 

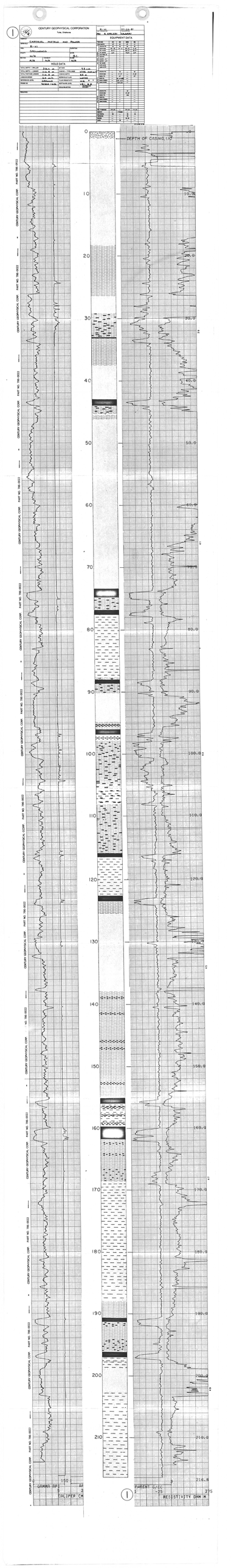
Brecciated Coal with Quartz 

Coal 

Interlaminated Sandstone, Siltstone
and Shale 

Carbonaceous Shale (or Mudstone) 

Coal or Carbonaceous partings 


CENTURY GEOPHYSICAL CORPORATION
Tulsa, Oklahoma
COMPANY: CAPENHILL NATURAL GAS POWER
WELL: B-101
FIELD: CAMPANELLA
COUNTY: N/A
STATE: N/A
PERMANENT DATUM: GL
ELEV.: N/A
LOG MEASURED FROM: GROUND LEVEL
DRILLING MEASURED FROM: N/A
HOLE DATA
DIGITAL RECORD
BIT SIZE: 9.5 cm
TOTAL DEPTH - DRILLER: 216.4 m
TOTAL DEPTH - LOGGER: 216.8 m
BOTTOM LOGGED INTERVAL: 216.4 m
TOP LOGGED INTERVAL: N/A
TYPE FLUID IN HOLE: WATER
SALINITY, PPM CL: N/A
DENSITY: N/A
LEVEL: FULL
SOURCE OF SAMPLE: FLOWLINE
RM @ MEAS. TEMP.: 0.5 @ 24°C
RMF @ MEAS. TEMP.: N/A @ N/A
SOURCE: RMF: N/A RMC: N/A
RM @ BHT: 0.5 @ 24°C
TIME SINCE CIRC.: 2 HRS
MAX. REC. TEMP.: 24°C
EQUIP. LOCATION: N/A
RECORDED BY: J. KAPLAN
WITNESSED BY: L. MARTIN
EQUIPMENT DATA
RUN NO. 1
TYPE LOG GR RES
DEPTH DRILLER 216.4
DEPTH LOGGER 216.8
BTM LOG INTERVAL 216.8
TOP LOG INTERVAL 0
CASING DRILLER 10.0 @ 216.4
CASING LOGGER 10.0 @ 216.8
BIT SIZE 9.5 cm
TYPE FLUID IN HOLE WATER
DENSITY / VISCOSITY N/A
PH / FLUID LOSS N/A
SOURCE OF SAMPLE FLOWLINE
RM @ MEAS. TEMP. 0.5 @ 24°C
RMF @ MEAS. TEMP. N/A @ N/A
RMC @ MEAS. TEMP. N/A @ N/A
SOURCE RMF / RMC N/A / N/A
RM @ BHT 0.5 @ 24°C
TIME SINCE CIRC. 2 HRS
MAX REC. TEMP. 24°C
EQUIP. LOCATION N/A
RECORDED BY J. KAPLAN
WITNESSED BY L. MARTIN
REMARKS
RUN NO. BOTTOM TOP
BIT SIZE 9.5 cm
CASING SIZE 10.0 cm
WEIGHT / FT. N/A
TYPE JOINT N/A
DEPTH DRILLER 216.4 0
DEPTH LOGGER 216.8 0
BTM LOG INTERVAL 216.8 0
TOP LOG INTERVAL 0 0
TYPE FLUID IN HOLE WATER
DENSITY / VISCOSITY N/A
PH / FLUID LOSS N/A
SOURCE OF SAMPLE FLOWLINE
RM @ MEAS. TEMP. 0.5 @ 24°C
RMF @ MEAS. TEMP. N/A @ N/A
RMC @ MEAS. TEMP. N/A @ N/A
SOURCE RMF / RMC N/A / N/A
RM @ BHT 0.5 @ 24°C
TIME SINCE CIRC. 2 HRS
MAX REC. TEMP. 24°C
EQUIP. LOCATION N/A
RECORDED BY J. KAPLAN
WITNESSED BY L. MARTIN
REMARKS
RUN NO. BOTTOM TOP
BIT SIZE 9.5 cm
CASING SIZE 10.0 cm
WEIGHT / FT. N/A
TYPE JOINT N/A
DEPTH DRILLER 216.4 0
DEPTH LOGGER 216.8 0
BTM LOG INTERVAL 216.8 0
TOP LOG INTERVAL 0 0
REMARKS
DEPTH OF CASING
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
216.8
GAMMA API
150
0
CALIPER CM
2
THREAT C/cc
-25
0
25
RESISTIVITY OHM M
CENTURY GEOPHYSICAL CORP PART NO. 196-0022

②

CENTURY GEOPHYSICAL CORPORATION
Tulsa, Oklahoma

COMPANY	IMPERIAL METALS AND POWER
BOREHOLE	81-H2
AREA	GROUNDHOG
ELEVATION	
COUNTY	N/A
STATE	B.C.
SECTION	N/A
TOWNSHIP	N/A
RANGE	N/A

HOLE DATA

TOTAL DEPTH — DRILLER	148.4	BIT SIZE	9.5 cm
TOTAL DEPTH — LOGGER	147.9	CASING — TYPE & SIZE	STEEL 0.64 cm
TOTAL FOOTAGE LOGGED	147.9	CASING DEPTH	61 m
LOGGING SPEED	6.0 m/s	BOREHOLE FLUID	WATER
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	N/A @ °F
PROBE NO	9030A-406	SOFTWARE LEVEL	V8.1 * A
		SCALE SELECTION	M OPERATOR / P CLIENT

REMARKS

BOREHOLE	81-H2
DATE	07-07-81
UNIT/OPERATOR	P811 R. APPLEBY
FIELD OFFICE	CALGARY

EQUIPMENT DATA

PROBE MODEL		[illegible]	[illegible]	[illegible]	[illegible]	
PROBE DIAMETER		1.87"	2.0"	1.87"	1.8"	
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI	
	DETECTOR SIZE	.875" x 1.25"	[illegible]	.875" x 4.0"	1" x 3.0"	
	STD K FACTOR	[illegible]	—	[illegible]	[illegible]	
	STD DEADTIME	1 μsec	—	[illegible]	1 μsec	
	CALIB MODEL LOC		—			
	CALIB DATE		—			
	K FACTOR x 10		—			
	DEADTIME μsec		—			
	TEST READING		—			
	WATER FACTOR		—			
	CASING FACTOR		—			
DENSITY	DETECTOR TYPE	—	NaI	—	NaI	
	DETECTOR SIZE	—	1" x 1.5"	—	1" x 3.0"	
	SOURCE TYPE	—	Cs^{137}	—	Cs^{137}	
	SOURCE NO	—	VL-1-480	—		
	SOURCE STRENGTH	—	125 mCi	—		
	SOURCE SPACING	—	20 cm	—		
NEUTRON	DETECTOR TYPE	—	—	He^3	—	
	DETECTOR SIZE	—	—	1.0" x 8.0"	—	
	SOURCE TYPE	—	—	AmBe	—	
	SOURCE NO	—	—		—	
	SOURCE STRENGTH	—	—		—	
	SOURCE SPACING	—	—		—	
SNGL PT RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L	
RESISTIVITY		—	8" FOCUSED	—	—	
SELF POTENTIAL		YES	—	YES	YES	
TEMPERATURE		—	—	YES	—	
DEVIATION		—	—	NO YES	—	
CALIPER		—	YES	—	—	

CT 112 REV. 2-11-80

②

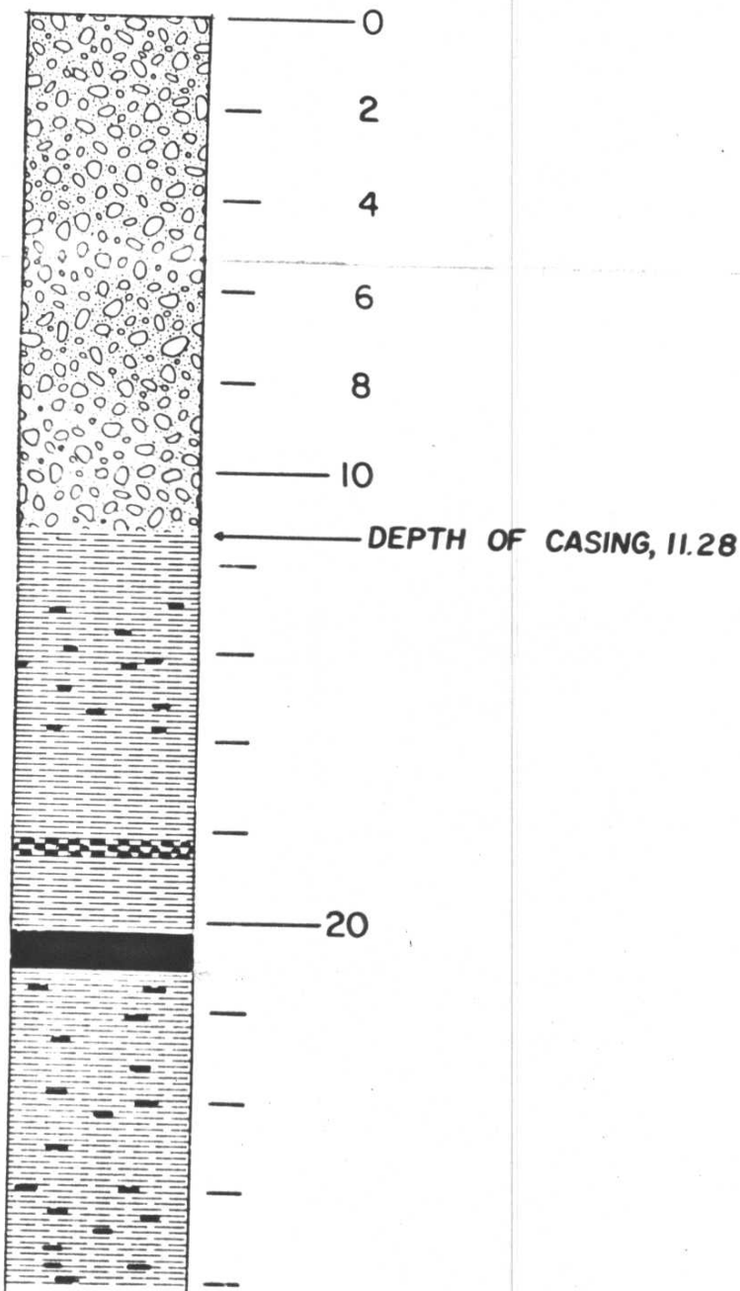
3

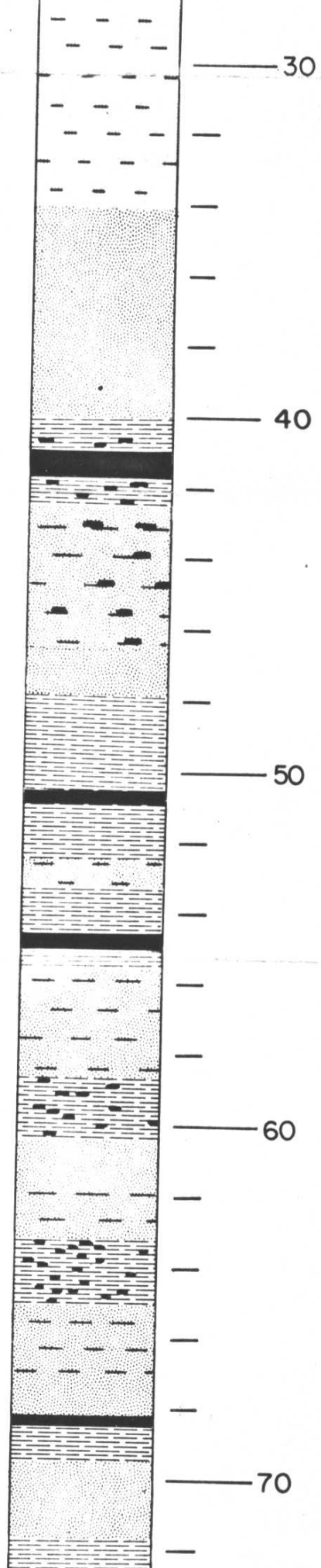
	borehole 81-H3	date
	unit/operator	field office
company	EQUIPMENT DATA	
borehole		
area	elevation	
county	state	
section / township	range	

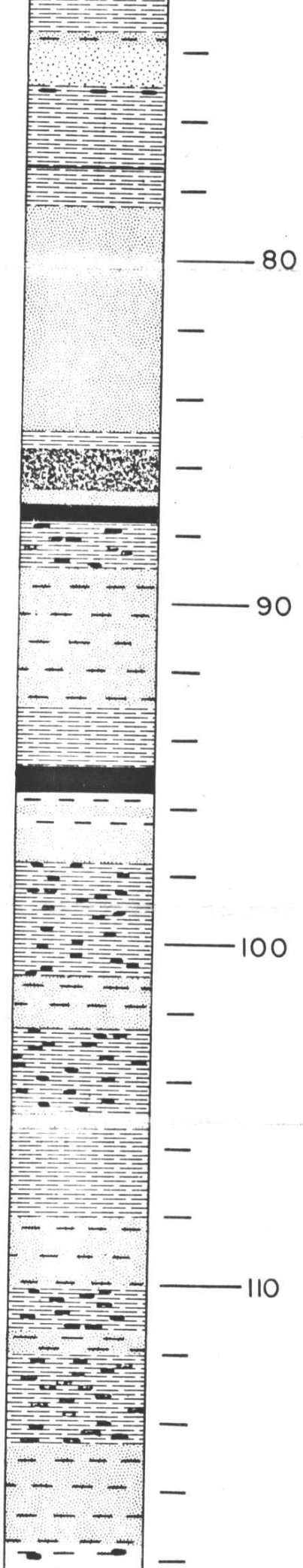
HOLE DATA

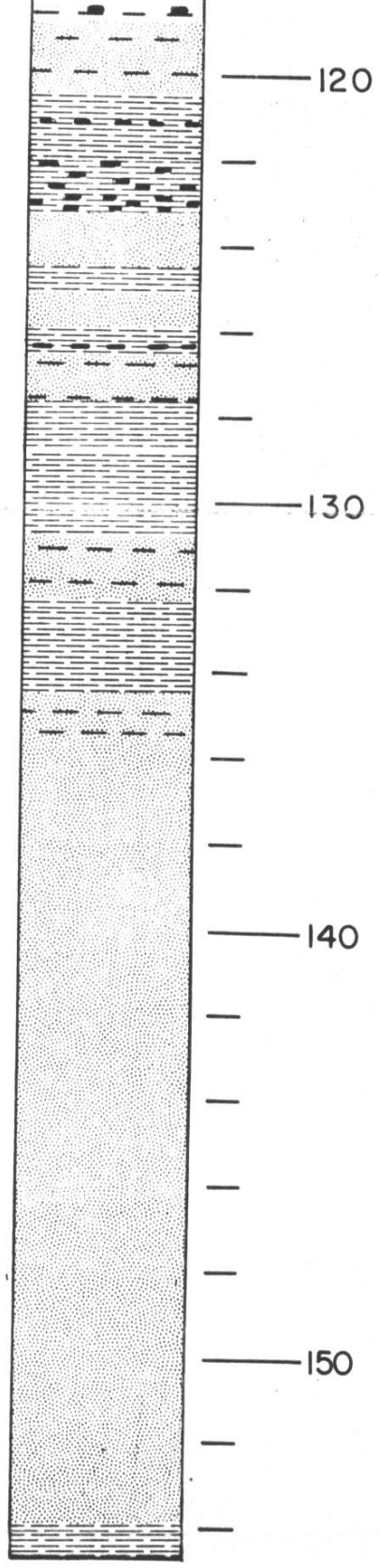
total depth - driller :	bit size :
total depth - logger :	casing - type & size :
total footage logged :	casing depth :
logging speed :	borehole fluid :
reference level :	fluid resistivity :
probe no. :	software level :
	scale selection / operator / client

remarks :




30
40
50
60
70


80
90
100
110



3

3

4

COMPANY: IMPERIAL METALS AND POWER

BOREHOLE: 81-H4

AREA: GROUNDHOG

ELEVATION:

COUNTY: N/A

STATE: B.C.

SECTION: N/A

TOWNSHIP: N/A

RANGE: N/A

HOLE DATA

TOTAL DEPTH — DRILLER	204.8 m	BIT SIZE	9.5 cm
TOTAL DEPTH — LOGGER	204.0 m	CASING — TYPE & SIZE	0.64 cm
TOTAL FOOTAGE LOGGED	144.0 m	CASING DEPTH	6.6 m
LOGGING SPEED	6.0 m/s	BOREHOLE FLUID	WATER
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	N/A ° °F
PROBE NO.	9030A-406	SOFTWARE LEVEL	V8.1 #A
		SCALE SELECTION	☐ OPERATOR ☑ CLIENT

REMARKS: ONLY 144.0 m COULD BE LOGGED. STARTING FROM 60.0 m; ENDING AT 204.0

PRIL R. APPLEBY CALGARY ALTA.

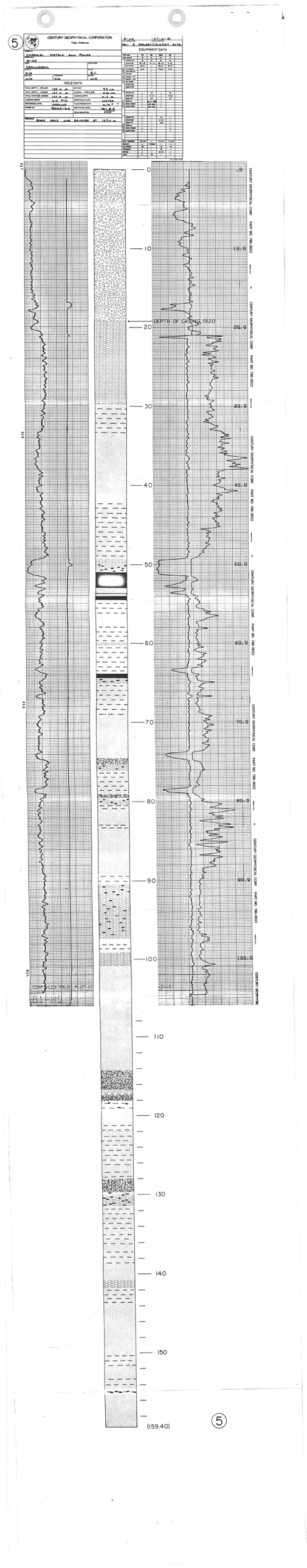
EQUIPMENT DATA

PROBE MODEL		[illegible]	[illegible]	[illegible]	[illegible]	
PROBE DIAMETER		1.5"	2.0"	1.5"	1.6"	
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI	
	DETECTOR SIZE	[illegible]	[illegible]	[illegible]	[illegible]	
	STD. K-FACTOR	[illegible]	—	[illegible]	[illegible]	
	STD. DEADTIME	1 µsec	—	1.15 µsec	1 µsec	
	CALIB. MODEL LOC.		—			
	CALIB DATE		—			
	K-FACTOR × 10⁻³		—			
	DEADTIME µsec		—			
	TEST READING		—			
	WATER FACTOR		—			
	CASING FACTOR		—			
DENSITY	DETECTOR TYPE	—	NaI	—	NaI	
	DETECTOR SIZE	—	[illegible]	—	[illegible]	
	SOURCE TYPE	—	Cs¹³⁷	—	Cs¹³⁷	
	SOURCE NO.	—	[illegible]	—		
	SOURCE STRENGTH	—	125 mCi	—		
	SOURCE SPACING	—	20 cm	—		
NEUTRON	DETECTOR TYPE	—	—	[illegible]	—	
	DETECTOR SIZE	—	—	[illegible]	—	
	SOURCE TYPE	—	—	AmBe	—	
	SOURCE NO.	—	—		—	
	SOURCE STRENGTH	—	—		—	
	SOURCE SPACING	—	—		—	
SINGL. PT RESISTANCE		[illegible]	—	[illegible]	[illegible]	
RESISTIVITY		—	[illegible] FOCUSED	—	—	
SELF POTENTIAL		YES	—	YES	YES	
TEMPERATURE		—	—	YES	—	
DEVIATION		—	—	NO/YES	—	
CALIPER		—	YES	—	—	

CT-110 REV [illegible]

0
DEPTH OF CASING, 6.25
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
385
383
381
379
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
204.0
CENTURY GEOPHYSICAL CORP. PART NO. 786-0022
0
150
GAMMA API
5
CALIPER CM
PARENT G/CC
1
-25
3
27
RESISTIVITY OHM M

4


5
CENTURY GEOPHYSICAL CORPORATION
Tulsa, Oklahoma
EQUIPMENT DATA
HOLE DATA
DEPTH OF CASING 19.20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
(159.40)
5

⑥

CENTURY GEOPHYSICAL CORPORATION
Tulsa, Oklahoma

COMPANY	IMPERIAL METALS AND POWER
BOREHOLE	81-H6
AREA	GROUNDHOG
ELEVATION	
COUNTY	N/A
STATE	B.C.
SECTION	N/A
TOWNSHIP	N/A
RANGE	N/A

HOLE DATA

TOTAL DEPTH — DRILLER	133.2 m	BIT SIZE	9.5
TOTAL DEPTH — LOGGER	66.5 m	CASING — TYPE & SIZE	0.64 cm
TOTAL FOOTAGE LOGGED	66.5 m	CASING DEPTH	23.5 m
LOGGING SPEED	6.0 m/s	BOREHOLE FLUID	WATER
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	N/A @ °F
PROBE NO.	9030A-414	SOFTWARE LEVEL	VR1 * A
		SCALE SELECTION	OPERATOR ✓CLIENT

REMARKS: BORE HOLE WAS BRIDGED OUT AT 66.5 m.

BOREHOLE	81-H6
DATE	07-24-81
UNIT OPERATOR	P811 B. APPLEBY
FIELD OFFICE	CALGARY ALTA

EQUIPMENT DATA

PROBE MODEL		9010	9030	[illegible]	9080
PROBE DIAMETER		1.87"	2.0"	1.87"	1.6"
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5	.875" x 4.0"	.5" x 3.0"
	STD K FACTOR	1.58 x 10	—	568 x 10	1.82 x 10
	STD DEADTIME	1 μ sec	—	1.18 μ sec	1 μ sec
	CALIB MODEL LOC		—		
	CALIB DATE		—		
	K FACTOR x 10		—		
	DEADTIME μ sec		—		
	TEST READING		—		
	WATER FACTOR		—		
	CASING FACTOR		—		
DENSITY	DETECTOR TYPE	—	NaI	—	NaI
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"
	SOURCE TYPE	—	Cs[137]	—	Cs[137]
	SOURCE NO	—	VR-1-480	—	
	SOURCE STRENGTH	—	125 mCi	—	
	SOURCE SPACING	—	20 cm	—	
NEUTRON	DETECTOR TYPE	—	—	He³	—
	DETECTOR SIZE	—	—	1.0" x 6.0"	—
	SOURCE TYPE	—	—	AmBe	—
	SOURCE NO	—	—		—
	SOURCE STRENGTH	—	—		—
	SOURCE SPACING	—	—		—
SNGL PT RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L
RESISTIVITY		—	8" FOCUSED	—	—
SELF POTENTIAL		YES	—	YES	YES
TEMPERATURE		—	—	YES	—
DEVIATION		—	—	NO / YES	—
CALIPER		—	YES	—	—

⑥