Cinnabar Peak Mines Ltd.

1972 SUMMER EXPLORATION OF PEACE RIVER CANYON COAL PROPERTIES NORTHEASTERN BRITISH COLUMBIA

93-O-16E - 55°56'N, 122°8'W

By:
G.A. VanDyck and K.P. Ridell

August 31, 1972

CINNABAR PEAK MINES LTD.

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OF
PEACE RIVER CANYON COAL PROPERTIES
NORTHEASTERN BRITISH COLUMBIA

Geographic Coordinates
55° 56' N
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NTS Sheet 93O/16E

by

G.A. Van Dyck, B.Sc.

and

K.P. Ridell, B.Sc.

August 31, 1972

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INTRODUCTION

In the summer of 1972 field work on the Peace River Canyon coal properties of Cinnabar Peak Mines Ltd. began on July 3 and ended July 22, with a field crew ranging from 4 to 7 men. Exposures of the Gates Formation were examined to determine whether coal occurrences within the Gates south of the Pine River are present on the property. Thick overburden near Johnson and Coalbed Creeks which caused difficulty during the 1972 winter drilling program was investigated by a hammer seismic survey. Clean-up along 1971 access routes and locating and flagging access to proposed drill sites was also carried out. Accommodation for the crew was rented in Hudson Hope, about 20 miles by road from the properties. Transportation was provided by a rented 4 x 4 truck.

SUMMARY AND RECOMMENDATIONS

The Gates Formation was examined but failed to reveal any major coal occurrences although sediments are locally carbonaceous. A hammer seismic survey conducted over a limited area showed a thick accumulation of overburden northwest of drill hole #2 and suggests a pre-glacial stream channel along parts of Johnson Creek. Access to the northwest corner of the property can be obtained via an old railway right-of-way which leads from Moosebar Creek to the W.A.C. Bennett Dam. A proposed drilling program has been outlined to test the Trojan Seam initially at a spacing of 4000 feet near the trace of the outcrop. The outline includes more closely spaced holes both near the outcrop and farther down dip.

It is recommended that a drilling program be undertaken to obtain additional geological and engineering data on the Trojan Seam and on the Superior Seam which is stratigraphically above it. A stratigraphic test hole located at drill hole #3 should be drilled through the Gething Formation to provide information on coal seams below the Trojan Seam.

PROPERTY, GEOGRAPHIC SETTING, GEOLOGY, AND COAL SEAMS

The property consists of 37 coal licences comprising 21,755 acres and options on 5 leases comprising 1600 acres. These are located on both sides of the Peace River Canyon in northeastern British Columbia, a few miles downstream from the Bennett Dam and from 10 to 20 miles southwest of Hudson Hope. Access to the properties is by highway, logging roads, and other unimproved roads. They are about equally distant from Roberts Bank near Vancouver and Prince Rupert, less than 700 miles. A spur line 40 to 50 miles long will connect them to an existing railroad.

The rocks in and near the Peace River Canyon consist of lower Cretaceous sandstones, shales, mudstones, ironstone, conglomerates, and coal seams in the Minnes, Bullhead, and Fort St. John Groups. The Gething Formation contains the coal seams that are of interest. Much of the property is mantled with varying thicknesses of overburden. Outcrops are mostly along creek beds and ridges. The area can be divided into three bands on the basis of geological structures: a western band with apparently uniform dips mostly less than 20° to the west and southwest and decreasing to the southwest, a central disturbed band with folds and faults, and an eastern band with mostly uniform dips up to 30° to the east.

Twenty coal seams with average thicknesses ranging from 22 to $129\frac{1}{2}$ inches have been correlated, some definitely, others less definitely for as much as 11 miles along their strikes mostly on the properties of Cinnabar Peak Mines Ltd. They underlie much of the properties. Preliminary estimates of total reserves are more than one billion tons: indicated 400,000,000 tons and inferred 680,000,000 tons. Preliminary estimates of potential coking coal reserves in the Trojan and Superior Seams are 250,000,000 tons.

GATES FORMATION

At the Peace River Canyon the Gates Formation overlies the Moosebar Formation and is overlain by marine shales of the Hasler Formation. Sections of the Gates Formation totalling 245 feet and 430 feet have been measured at Steamboat Island and Johnson Creek, respectively (Beach and Spivak, 1944). The following regional description has been summarized mostly from Stott (1968). The Gates holds formation status only in the immediate vicinity of the Peace River Canyon and is reduced to member status to the south where it becomes the lower member of the Commotion Formation. To the north it forms part of the dominantly marine Buckinghorse Formation. The base of the Gates Formation is gradational into the underlying Moosebar mudstones and shales. The boundary is arbitrarily drawn at the base of the first thick and relatively continuous succession of fine-grained sandstone. The upper boundary of the Gates is reported to lie at a persistent stratigraphic position. The thickness of the Gates increases to the southeast with most of the increase due to mudstones of the Moosebar Formation grading laterally into sandstone and carbonaceous sediments that are included in the Gates Member. South of the Peace River Canyon, the lithology of the Gates changes gradually from off-shore marine sandstone and mudstone into delta and flood-plain facies in its upper part at and south of the Pine River. These upper continental beds, characterized by carbonaceous sediments and coal, thicken south of the Pine River.

On the south side of the Peace River Canyon the outcrop pattern of the Gates Formation forms an irregular U open to the north. It was checked for coal seams at a few places. On Coalbed Creek good exposures of the Gates Formation were examined adjacent to the Johnson Creek logging access road. The rocks strike 8° and dip 24° E. About 200 feet of sandstone and mudstone are exposed along the creek banks. At its base the section here consists of about 100 to 150 feet of olive grey mudstones and sandy mudstones with a few sandy units up to two feet thick near the top. Burrowing and trace fossils are present locally. Spherical concretions with marcasite cores are common. The base of this unit is gradational with the Moosebar Formation. Near the

contact a lens of vitrinite 4 inches thick and 2½ feet long was found within the mudstones. Overlying the basal mudstone unit is 30 to 50 feet of sandstone, with beds from ½ inch to 3 feet thick, separated by argillaceous partings. The sandstone is medium grained and locally ripple marked; thick sandstone units contain large-scale cross-bedding. Argillaceous partings and interbeds are chippy and contain discontinuous sandy lenses. Above the sandstone unit is 25 to 40 feet of black chippy mudstone containing a few sandy units. A 5-foot bed of massive sandstone overlies the mudstone and marks the upper limit of exposure of the Gates Formation on Coalbed Creek.

Exposures of the Gates Formation were also found along a north-trending ridge east of Moosecall Lake. There the rocks have variable dips to the east and southeast where they form part of the eastern limits of a southerly plunging anticline. Dark-grey to olive-grey mudstones and sandy mudstones overlie the Moosebar Formation. Locally they are carbonaceous and micaceous. The mudstones are overlain by a resistant sandstone unit forming a 20-foot cliff near the top of the ridge. Regular beds in the sandstone ½ to 1 inch thick, are separated by argillaceous or micaceous partings. The sandstone contains brown laminae ¾ inch apart; it weathers into plates 1 to 2 inches thick. The resistant sandstone is overlain by recessive, poorly exposed, olive grey mudstone.

On Moosebar Creek less than 100 feet in the lower part of the Gates Formation is exposed. The Moosebar-Gates contact is gradational as at other localities. The beds strike 140° and dip 15° SW. The mudstones of the Gates Formation tend to be sandier than those of the Moosebar Formation. Black, spherical concretions with marcasite-rich cores are locally abundant. Cylindrical burrows ½ to ¾ inch in diameter and up to 8 inches long, perpendicular to beds, are found locally near the contact. At the forks on Moosebar Creek is a resistant argillaceous, carbonaceous sandstone unit 3 feet thick.

Along Burnt Trail Creek the only exposure of the Gates Formation is one sandstone outcrop. The Gates Formation was not completely checked in the northwestern and western parts of the property, nor the northerly part of the band east of the pipeline.

OVERBURDEN

Parts of the areas drained by Johnson, Coalbed, Burnt Trail, and Moosebar Creeks, are covered with surficial deposits. Overburden thicknesses greater than 100 feet and even 200 feet in one place along Johnson Creek hindered drilling and sampling in the 1972 winter drilling program. In order to obtain information on the thickness of overburden to aid in selecting drill sites and mine planning, a hammer seismic survey was conducted on part of the property near Johnson Creek.

Six lines were run; they are located on Fig. 6. Lines 1,2,3, and 4 are near similarly numbered drill holes of the 1972 winter drilling program, previously named Moosebar Creek, Johnson Creek, Coalbed Creek, and Strawberry Acres, respectively. Line 4A was the initial experimental line, and line 5 was run along the logging road west of Johnson Creek more or less perpendicular to line 2. A Huntec FS-3 Facsimile Seismograph with 400 feet of cable was used. Energy was provided by an 18-pound hammer striking a 12-inch iron plate. Adequate response was obtained where the plate rested on well-consolidated silt. Near drill hole #1 where the silt was poorly consolidated, the energy was inadequate to penetrate to bedrock.

Minimum Spread Requirements

Reflection profiling:	bedrock depth 50' to 100' : spread 50' to 150'	
	bedrock depth 100' to 200' : spread 100' to 250'	
Refraction:	200'	

Subsurface Coverage

Reflection spread at 100' intervals

Refraction spread at beginning and end of line and as required along line

Minimum Number of Hammer Blows

Reflection : 2 blows every 10 feet

Refraction : 1 blow every 5 feet to 20 feet beyond critical distance and 1 blow every 10 feet thereafter.

Interpretation of the seismic data involved sorting out sets of multiples in order to distinguish bedrock reflections from intra-overburden reflections. As many as three multiples can be expected from a shallow primary reflection within the overburden. The multiplying surface appears to be the base of the weathered zone. Cross sections (Fig. 4 and 5) were plotted for each line run: each point represents a reflection corrected for Δt and smoothed for near surface irregularities. Dipping beds have not been migrated. Velocities encountered were

weathered zone : 1000 to 1500 ft./sec.

silt-unconsolidated : 1500 to 2500 ft./sec.

silt-consolidated : 4500 ft./sec.

mudstone (Moosebar) : 5500 ft./sec.

The interpretations of lines 1,3,4, and 4A are shown in Fig. 4 and of line 5 in the lower part of Fig. 5. In relating the seismic data to the 1972 winter drilling data, the only criteria for distinguishing bedrock from intra-overburden reflections was the relative dip of each primary reflection and its set of multiples. With this relation established, both reflections could be continuously correlated in about 75 per cent of the records. Road cuts along line 5 show well consolidated silt which could well produce intra-overburden reflections.

The interpretation of line 2 is shown in the upper part of Fig. 5. The dips encountered suggest an increase in the depth to bedrock. An intra-overburden reflection, perhaps caused by gravel or well consolidated clay, or silt, appears along the line at or near the point where the depth to bedrock begins to increase. Interpretation would be ambiguous beyond this point if it were not for the well defined dips near the end of the line.

The seismic data, geology, and topography have been combined in Fig. 6 to show bedrock contours and thicknesses of overburden along and near part of Johnson Creek. Fig. 6 indicates a northerly trending pre-glacial bedrock channel which enters the present Peace River opposite Grant Flat. This channel has subsequently been filled with glacial-lacustrine silt, and partly re-excavated in places by the present Johnson Creek. Moosebar Creek and parts of Coalbed Creek are post-glacial streams. Except along the pre-glacial Johnson Creek stream channel the thickness of overburden is generally about 100 feet or less.

PROPOSED DRILL SITES AND ACCESS

A railway right-of-way leading from Moosebar Creek to the W.A.C. Bennett Dam was located and flagged almost to Aylard Creek. The trail will be useful in providing access to the northwest corner of the property. One drill hole was located and flagged on the east side of Mogul Creek about 1000 feet northeast of the railway right-of-way. Other areas for proposed drill sites between drill hole #1 and drill hole #2 were examined. Current logging in the area is continuing to open up the area and access will be relatively easy.

The proposed drilling is outlined in Appendix 1, and the locations of drill holes are shown in Fig. 2. The property is divided into two areas separated by the normal fault cutting through Mount Johnson in a northerly direction. Holes have been outlined on a spacing of about 4000 feet with more closely spaced holes intended to follow the evaluation of initial results. The footage to the Trojan Seam has been estimated with the aid of cross sections.

CONCLUSIONS

The Gates Formation outcrops on the Peace River Canyon coal properties south of the river in the form of a broad U open to the north. The sandstones and mudstones are locally carbonaceous and a minor occurrence of coal was noted on Coalbed Creek.

Hammer seismic techniques were successful in determining the overburden thickness except where intra-overburden reflections obscure the bedrock reflections. Thick overburden associated with a pre-glacial erosional channel was revealed. The overburden probably does not greatly exceed 100 feet in other areas.

Proposed access to the northwest part of the property follows an old railway right-of-way. Other areas can be easily reached by short additions to existing roads and trails. Proposed drilling which is warranted from the 1971 exploration and the 1972 winter drilling, has been outlined on a reconnaissance basis with estimated depths to the Trojan Seam ranging from 250 to 1650 feet.

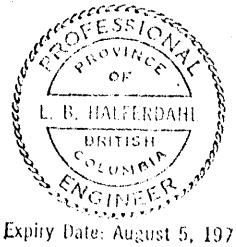
Respectfully submitted,

G. A. Van Dyck, B.Sc.

K.P. Ridell, B. Sc.

L.B. Halferdahl, Ph.D., P. Eng.

Edmonton, Alberta
August 31, 1972



Expiry Date: August 5, 1973

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Checklin, G.A. and Halferdahl, L.B. (1971) - 1971 geological exploration of Peace River Canyon coal properties northeastern British Columbia; L.B. Halferdahl & Associates Ltd., Edmonton; 37 pp., 9 appendices, 12 figures, 5 tables, unpublished.

Beach, H.H., and Spivak, J. (1944) - Dunlevy-Portage Mountain map-area, B.C.; Geol. Surv. Can. Paper 44-19.

McLearn, F.H., and Kindle, E.D., (1950) - Geology of northeastern British Columbia; Geol. Surv. Can. Mem. 259, pp. 76-77.

Stott, D.F. (1968) - Lower Cretaceous Bullhead and Fort St. John Groups, between Smoky and Peace Rivers, Rocky Mountain Foothills, Alberta and British Columbia; Geol. Surv. Can. Bull. 152.

Van Dyck, G.A. (1972) - 1972 winter drilling project on Peace River Canyon coal properties northeastern British Columbia; L.B. Halferdahl & Associates Ltd., Edmonton; 16 pp., 3 appendices, 5 figures, 4 tables, unpublished.

CERTIFICATE

I, Laurence B. Halferdahl, with business and residence addresses in Edmonton, Alberta, do hereby certify that

1. I am a registered Professional Geologist and Professional Engineer in the Province of Alberta and a licensed Professional Engineer in the Province of British Columbia.

2. I am a graduate of Queen's University, Kingston, Ontario (B.Sc. in 1952 and M. Sc.in 1954 in Geological Sciences in the Faculty of Applied Science) and of The Johns Hopkins University, Baltimore, Maryland (Ph.D. in 1959 in the Department of Geology).

3. From 1957 to 1969 I was on the staff of the Research Council of Alberta as a mineralogist and geologist where I was in charge of the mineralogy laboratory and conducted various field and laboratory investigations.

4. Since 1969 I have been a consulting geological engineer conducting and directing property examinations and evaluations, and exploration programs for metallic minerals, industrial minerals, and coal.

5. The data in this report were obtained from published and unpublished reports and from work carried out on the properties directed by K. Ridell and G.A. Van Dyck from July 3 to July 22, 1972 and under my general supervision.

6. I have not received nor do I expect to receive any interest, directly or indirectly, in the property described in this report.

L.B. Halferdahl

Edmonton, Alberta
August 31, 1972

L.B. Halferdahl, Ph.D., P. Eng.

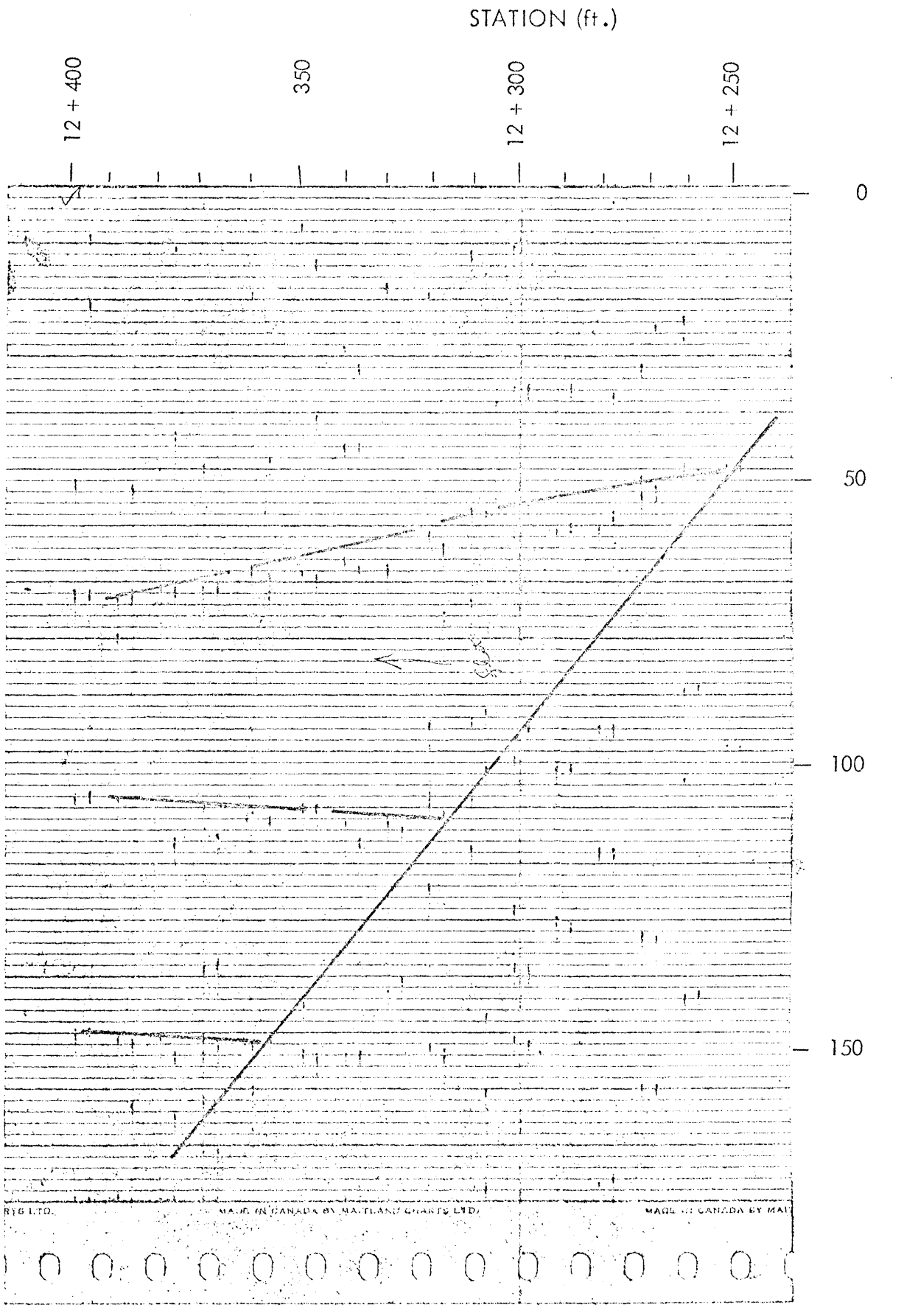
APPENDIX 1 : PROPOSED DRILLING

Class	Location		Estimated Footage to Trojan Seam	
Area West of Fault				
A	NE corner licence	1035	350	
A	SW corner licence	1026	250- 300	
A	N centre licence	1026	550	
A	Centre licence	1030	1800*	
A	NW corner licence	1021	800	
A	NE corner licence	1022	850	
A	E centre licence	1020	1100	
A	Centre licence	1019	300	
				6050
B	S centre licence	1035	1350	
B	Centre licence	1029	950	
B	E centre licence	1027	1200	
B	Centre licence	1021	1500	
B	NE corner licence	1041	1650	
				6650
C	W centre licence	1034	350	
C	SE corner licence	1030	300	
C	NW corner licence	1030	600	
C	E centre licence	1026	650	
C	Centre licence	1023	350 - 400	
C	E centre licence	1022	1090-1150	
C	N centre licence	1020	950-1000	
				4450
D	SE corner licence	1029	1100	
D	NW corner licence	1029	1050	
D	N centre licence	1027	1600	
D	SW corner licence	1020	1600	
				5350
Area East of Fault				
A	NE corner licence	1031	500	
A	SW corner licence	1047	500	
				1000

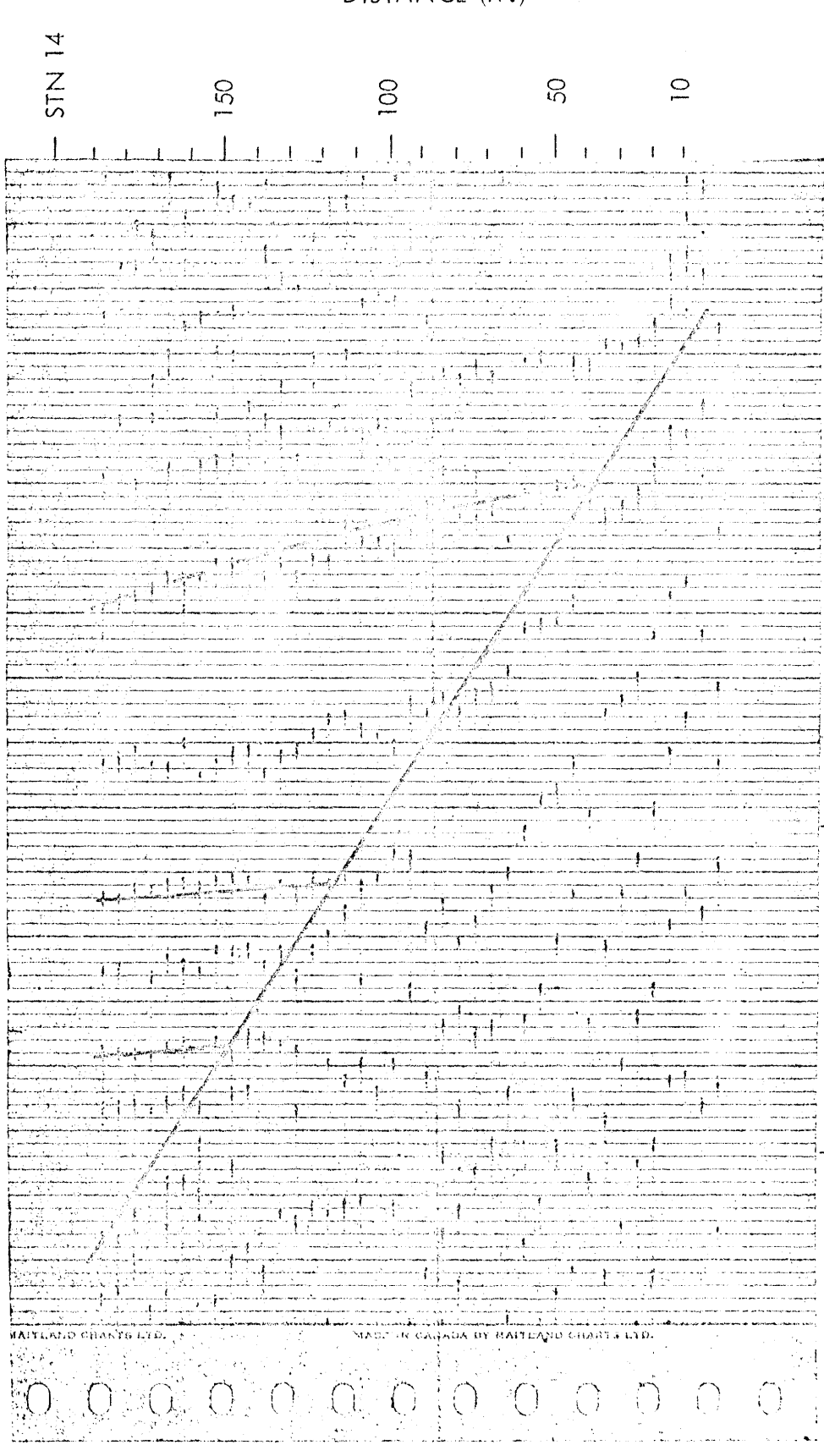
* Stratigraphic test hole through Gething Formation

Class	Location		Estimated Footage to Trojan Seam	
B	SW corner licence	1031	500	
B	NW corner licence	1047	500	
				1000
TOTAL				24,500

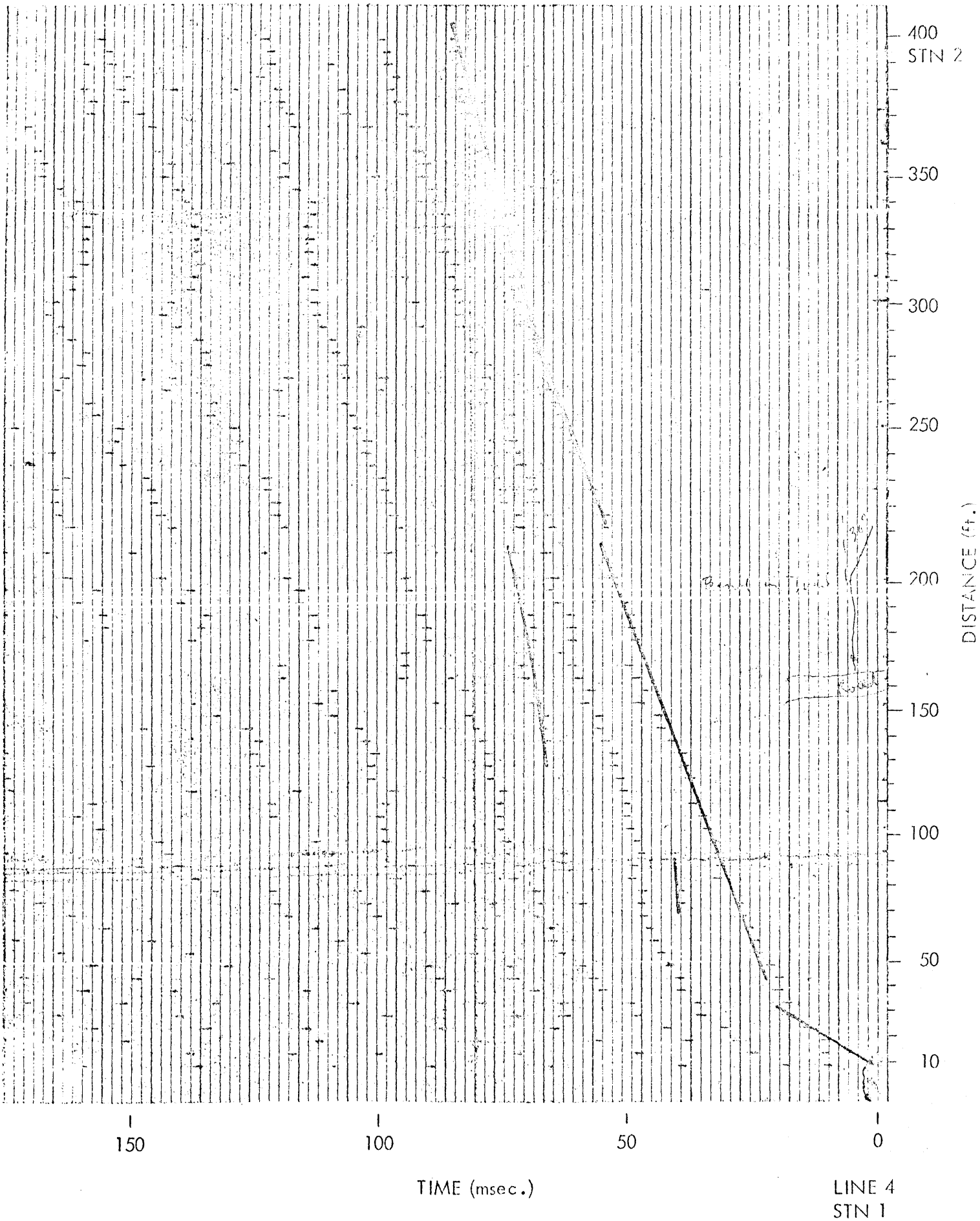
APPENDIX 2 : SELECTED SEISMIC RECORDS

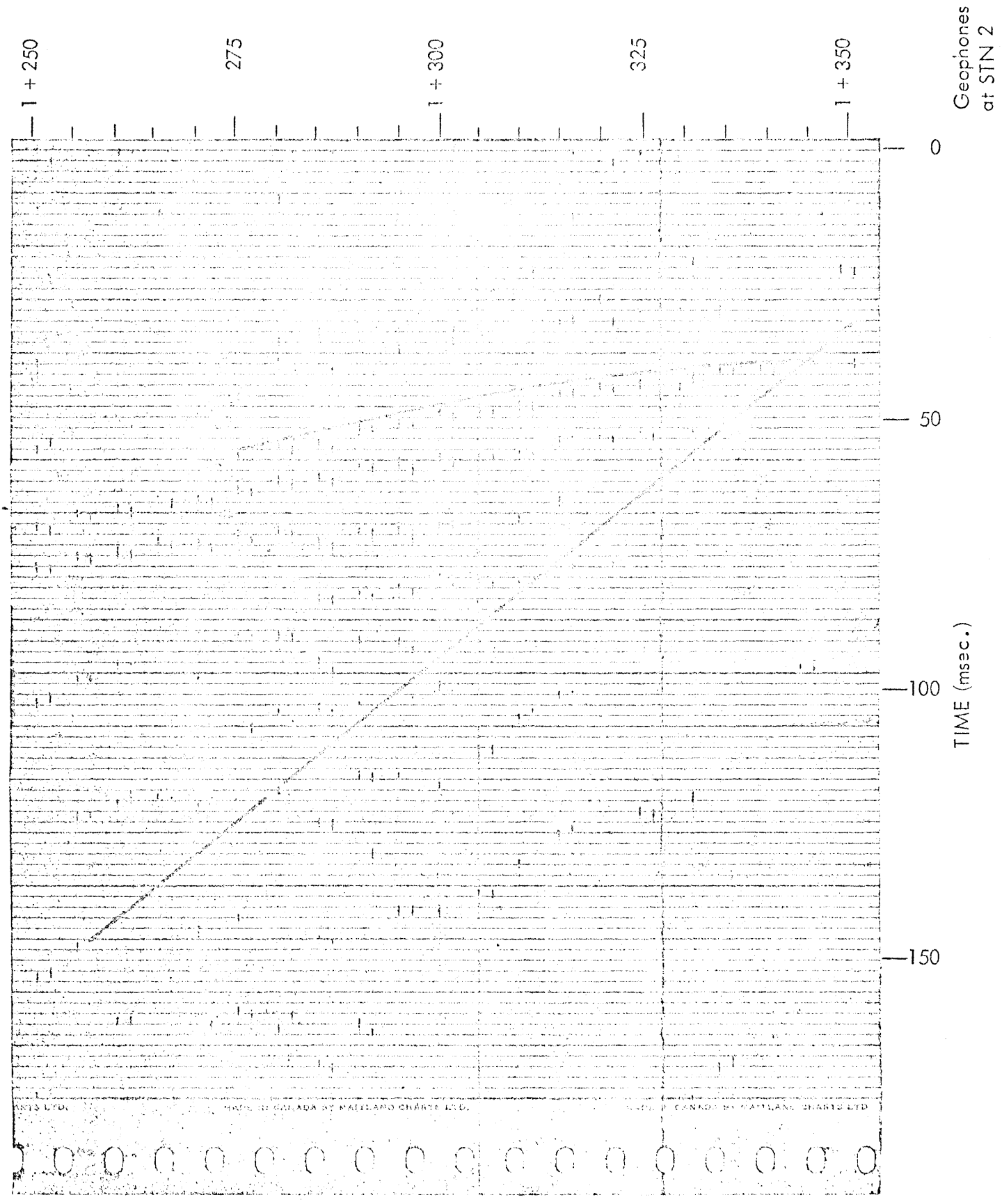


LINE 2
STN 12 + 200



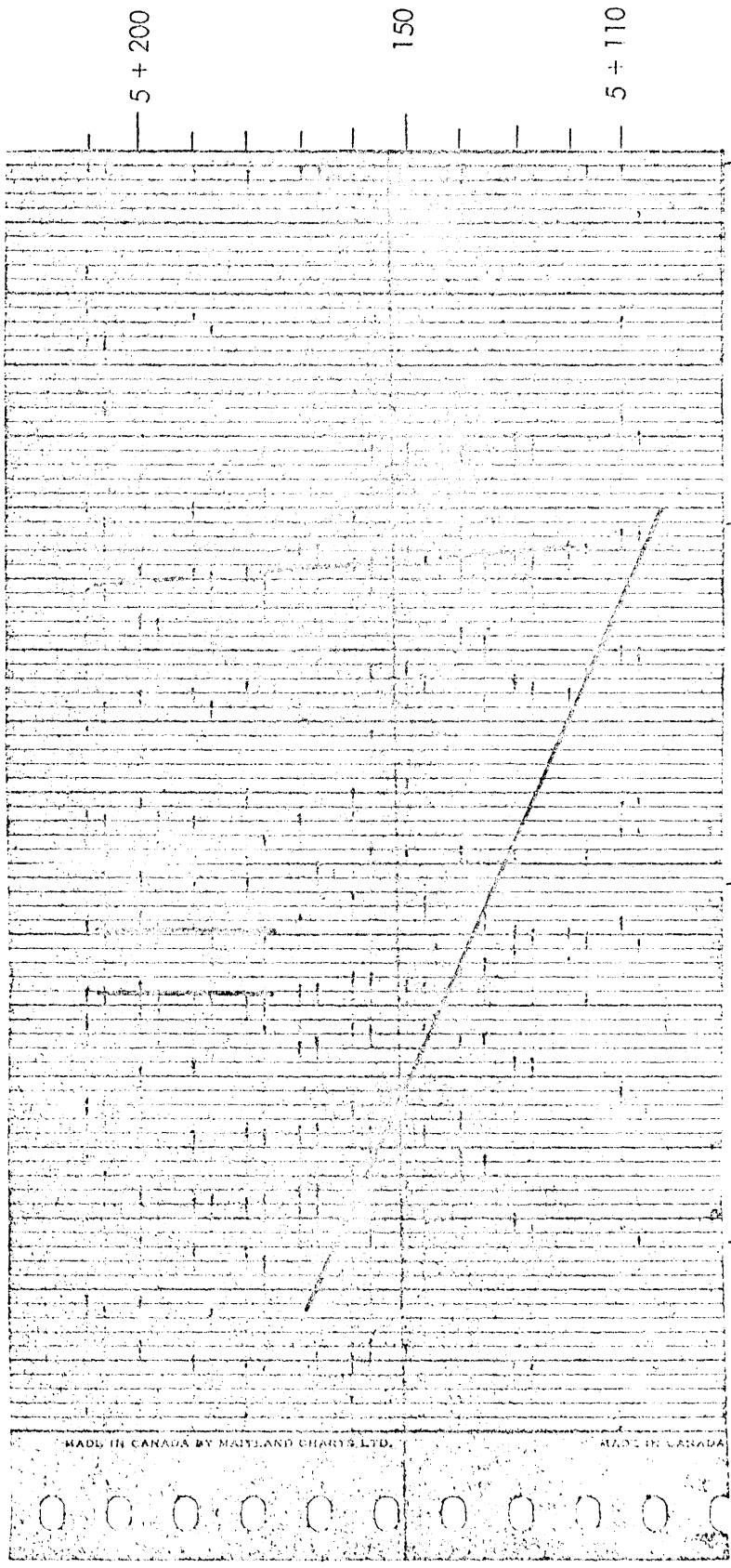
LINE 2
STN 14 + 200
Refraction


400
STN 2
350
300
250
200
150
100
50
10
DISTANCE (ft.)
150
100
50
0
TIME (msec.)
LINE 4
STN 1


STATION (ft.)
1 + 250
275
1 + 300
325
1 + 350
Geophones at STN 2
0
50
100
150
TIME (msec.)

LINE 4
STN 2

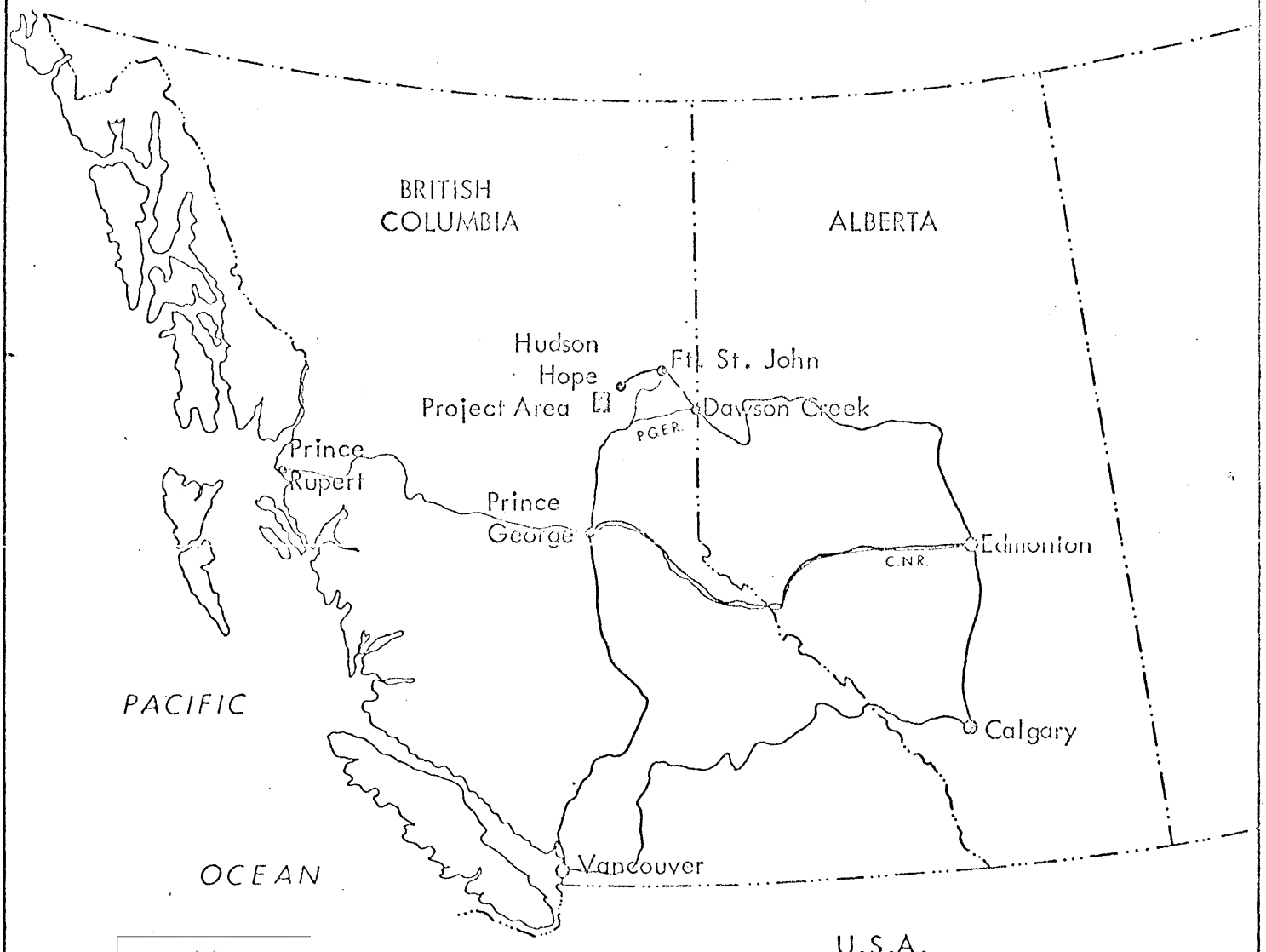
STATION (ft.)

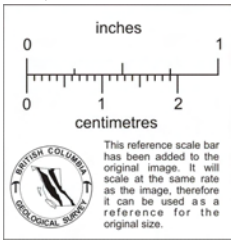


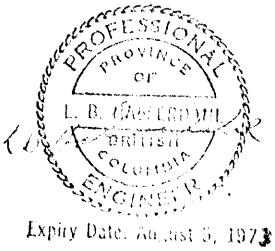
LINE 5
STN 5

APPENDIX 3 : FIELD PERSONNEL

Name	Position	Time on Property 1972
M. Chamberland	Laborer	July 7 - July 21
L. Halferdahl	Geologist	July 3 - July 9
K. Karpiak	Laborer	July 4 - July 21
B. Redpath	Assistant	July 3 - July 22
G. Remfert	Laborer	July 7 - July 21
K. Ridell	Geophysist	July 3 - July 14
G. Van Dyck	Geologist	July 5 - July 22







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EDMONTON, ALBERTA

Fig. 1: Location Map

PEACE RIVER CANYON PROPERTIES

0 100 200 300 400
SCALE IN MILES

Drawn: LBH

August, 1972

GRANT FLAT

RIVER

PEACE

Moosebar Creek

Creek

Johnson Creek

Johnson Creek

Burnt Trail Creek

Scalped Creek

POWER LINE

LINE 1

LINE 2

LINE 3

LINE 4

LINE 4A

LINE 5

1600

1700

1800

1900

2000

2100

2200

2300

100

200

300

400

N

LEGEND

Bedrock contour (feet) 2100

Overburden thickness (feet) 300

Elevation (ft.) of bedrock from seismic data with station number 7 1900

Logging road .....

Drill access road .....

Drill hole with number 3

inches 0 1

0 1 2 centimetres

This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA L. B. HALFERDAHL

Expiry Date: August 5, 1973

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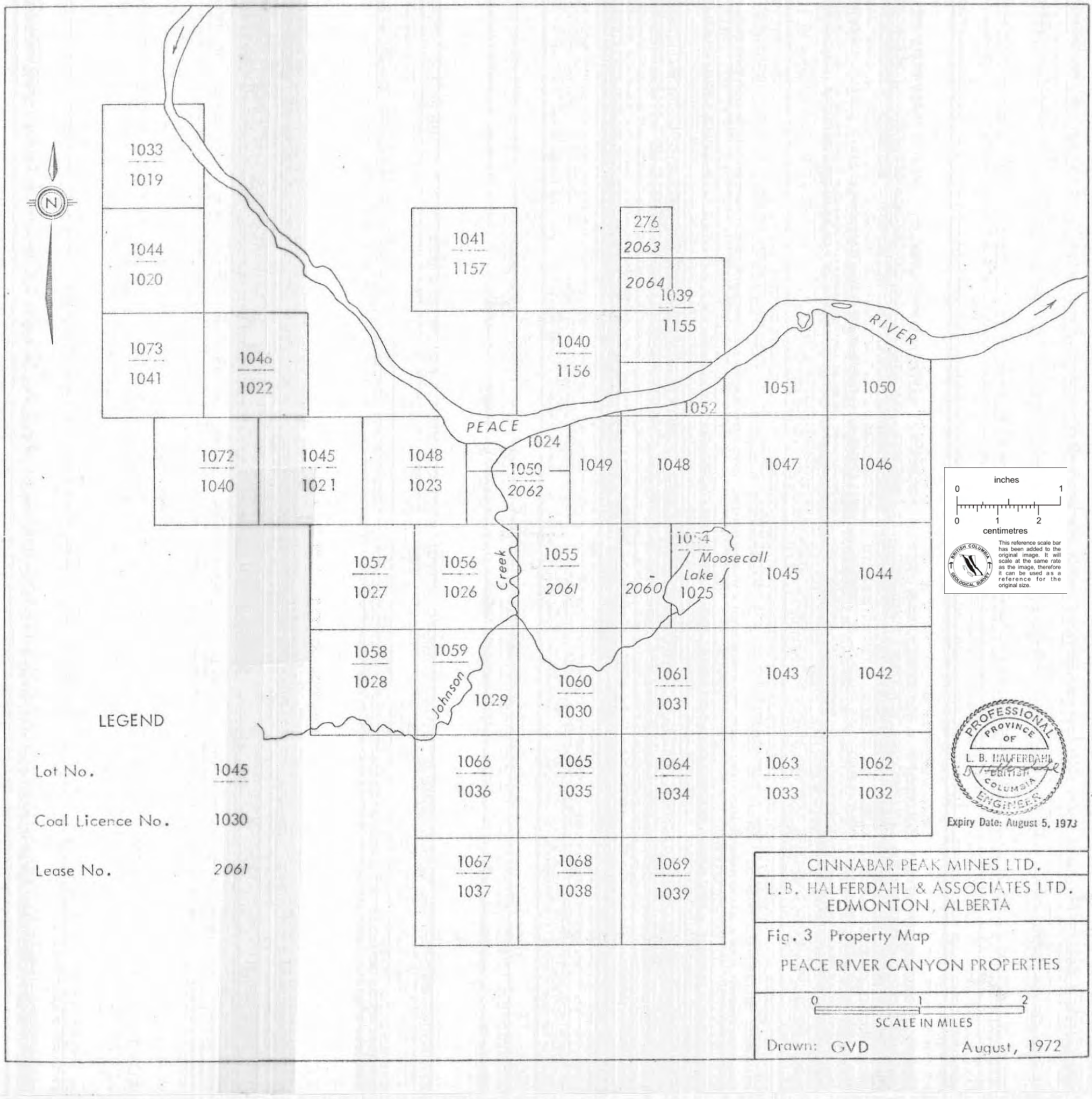
Fig. 6 Bedrock Topography near Johnson Creek

PEACE RIVER CANYON PROPERTY

1000 0 1000 2000 3000

SCALE IN FEET

DRAWN: K.R. AUG. '72


1033
1019
1044
1020
1073
1041
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1041
1157
276
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2064
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1156
RIVER
1051
1050
1052
PEACE
1072
1040
1045
1021
1048
1023
1024
1050
2062
1049
1048
1047
1046
1057
1027
1056
1026
Creek
1055
2061
2060
1054
Moosecall
Lake
1025
1045
1044
1058
1028
1059
Johnson
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1037
1068
1038
1069
1039
LEGEND
Lot No. 1045
Coal Licence No. 1030
Lease No. 2061
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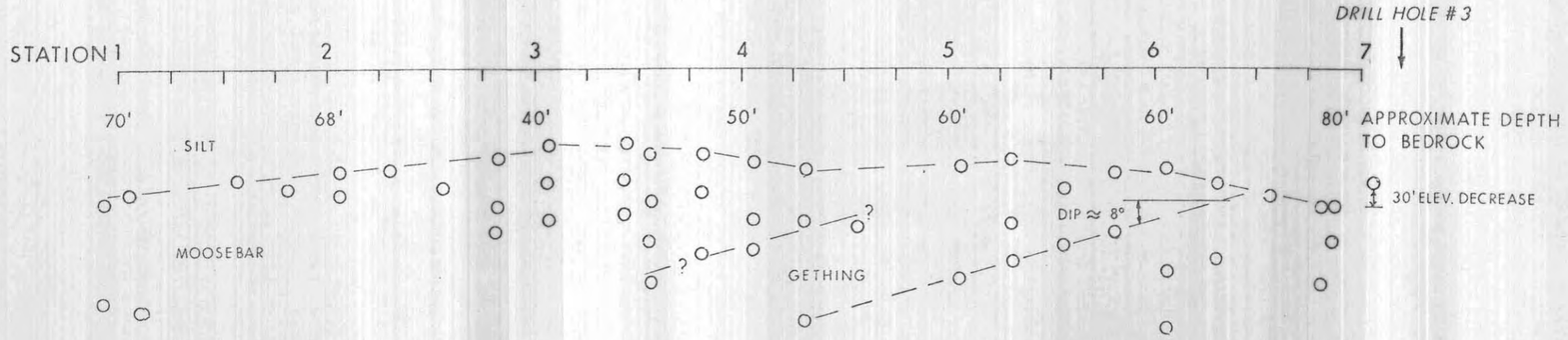
EDMONTON, ALBERTA
Fig. 3 Property Map
PEACE RIVER CANYON PROPERTIES
0 1 2
SCALE IN MILES
Drawn: GVD August, 1972



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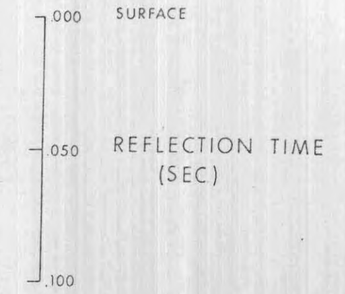
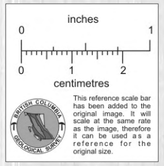
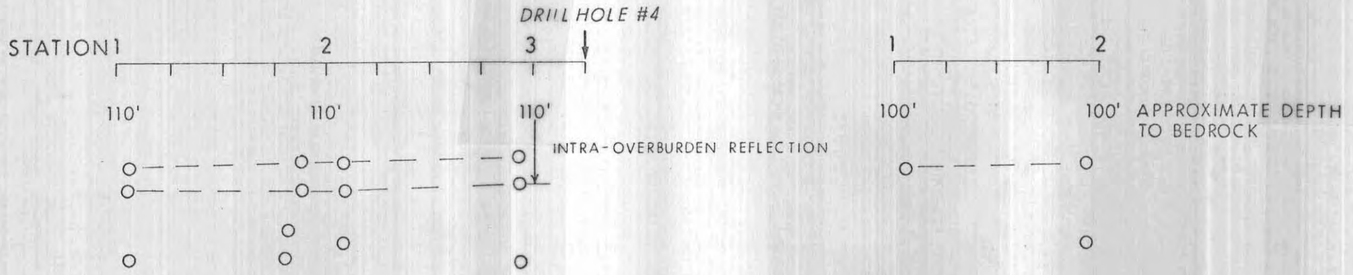
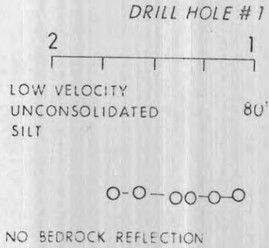


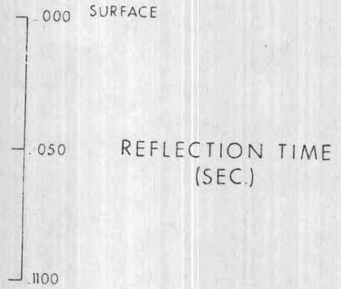




LINE 4

LINE 4A





LINE 1

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
L. B. HALFERDAHL

Expiry Date: August 5, 1973

CINNABAR PEAK MINES LTD.

L B HALFERDAHL & ASSOCIATES LTD
EDMONTON, ALBERTA

Fig 4 Seismic Cross Sections, Lines 1, 3, 4 & 4A

PEACE RIVER CANYON PROPERTIES

0 250 500 750
HOR SCALE IN FEET

DRAWN K.R. AUG '72

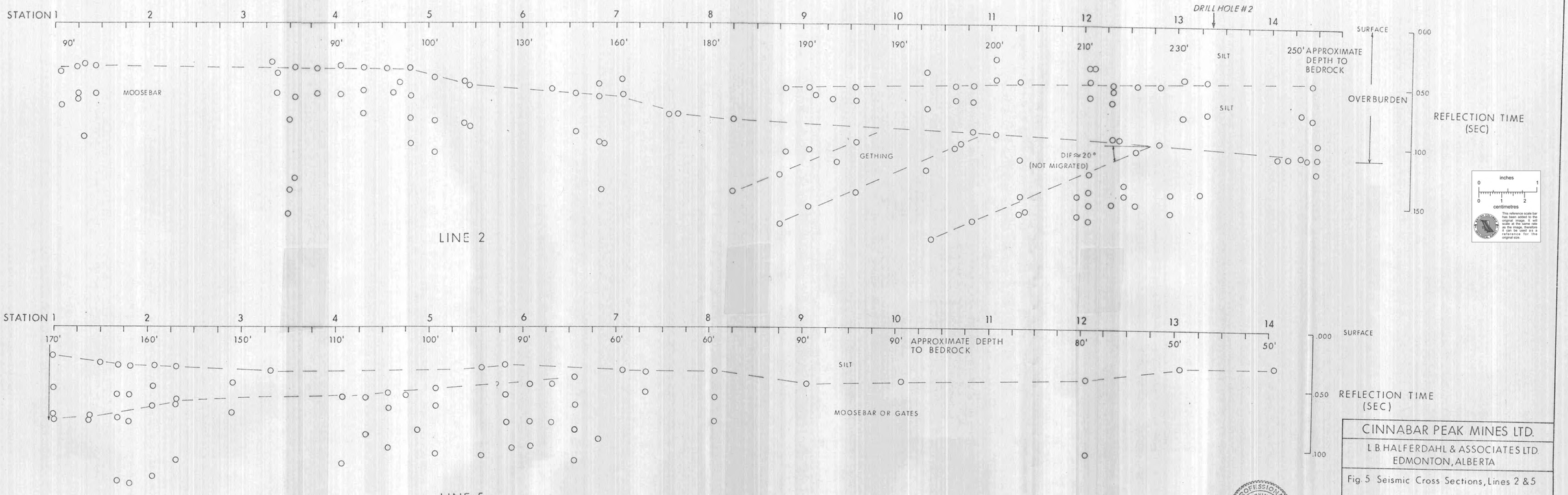


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Fig. 5 Seismic Cross Sections, Lines 2 & 5

PEACE RIVER CANYON PROPERTIES

0 250 500 750
HOR SCALE IN FEET

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