Cinnabar Peak Mines Ltd.

1972 WINTER DRILLING PROJECT ON PEACE RIVER CANYON COAL PROPERTIES NORTHEASTERN BRITISH COLUMBIA

93-O-16E - 55°56'N, 122°8'W

By:
G. A. VanDyck

May 17, 1972

September 23, 1976

Mr. L. B. Halferdahl
Halferdahl & Associates Ltd.
18, 10509 - 81st Avenue
Edmonton, Alberta T6E 1X7

Dear Mr. Halferdahl,

Enclosed are the four reports on Cinnabar Peak's Peace River coal property you sent to me August 6th. Please excuse my tardiness in returning these reports but I have been away from the office, in the Yukon, for most of the past month.

We have now reviewed all of the above reports in some detail and have concluded that, on the basis of presently available data, we do not wish to pursue discussions regarding a participation in the project at this time. Should your compilations of the latest field work, still under preparation, indicate any increased reserves of coking coal, surface mineable at reasonable strip ratios, I would certainly be interested in seeing that data.

In answer to your query regarding our Kakwa area coking coal property, it became necessary, because of delays extending well into this post field season, in the granting of an exploration permit, to continue field work on this property, to postpone this work until possibly next year.

Yours very truly,

CYPRUS ANVIL MINING CORPORATION

T. J. Adamson

TJA/cb

MINING GEOLOGY
MINERAL EXPLORATION
INDUSTRIAL MINERALS
OIL SANDS
COAL

halferdahl & associates ltd.
consulting geologists & engineers

August 6, 1976

Mr. T. S. Adamson
Cypress Anvil Mining Corporation
330, 355 Burrard Street
Vancouver, B.C.
V6C 2G8

Dear Tom:

I have finally rounded up copies of each of our previous reports on Cinnabar Peak's Peace River coal property. Some of these have annotations, but hopefully they will not interfere with the data. I have been instructed to request that you return all four in about a month or sooner. If you require copies of any of the figures please let us know as we can run off copies on almost all from our originals far more easily than you can from the prints.

I should be interested in learning if you have received approval for exploration on the Kakwa property. I should welcome an opportunity to discuss any ways in which I might help in that project.

Yours sincerely,

Laurie Halferdahl

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

LBH/par
Enclosures

CINNABAR PEAK MINES LTD.

1972 WINTER DRILLING PROJECT

ON

PEACE RIVER CANYON COAL PROPERTIES

NORTHEASTERN BRITISH COLUMBIA

Geographic Coordinates
55° 56' N
122° 8' W

NTS Sheet 93O/16E

by
G. A. VAN DYCK, B.Sc.

May 17, 1972

L.B. Halferdahl & Associates Ltd.
401 - 10049 Jasper Avenue
Edmonton, Alberta
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INTRODUCTION

In February and March 1972 four test holes were drilled on the Peace River Canyon coal properties of Cinnabar Peak Mines Ltd. in northeastern British Columbia. They were drilled by a truck-mounted Mayhew "1000" rotary drill capable of using air or water. The work included drilling, sampling, coring, and analyzing cuttings and cores. 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. Bulldozers were required from time to time for ploughing snow, preparing sites, and moving drilling equipment.

This report presents the geological and engineering information obtained. Throughout all thicknesses of coal seams are in inches. Information on property, geographic setting, and geology has been briefly summarized. More complete information on them is given in the December 30, 1971 report on the properties by Checklin and Halferdahl.

SUMMARY AND RECOMMENDATIONS

Four holes totalling 1059 feet were drilled to obtain stratigraphic and structural information, and samples from coal seams in the upper part of the Gething Formation on the Peace River Canyon properties of Cinnabar Peak Mines Ltd. Two of the holes encountered overburden thicker than expected and were abandoned in it because of drilling difficulties. The third hole near Moosebar Creek tested a stratigraphic section of 415 feet at the top of the Gething Formation; it intersected the Superior, Trojan, Titan, Falls, and other thinner seams. Of these, the Superior and Trojan appear to have economic interest. The Superior Seam contains 42 inches of coal, and the Trojan 46½ inches but it has been faulted there. The fourth hole near Coalbed Creek tested a stratigraphic section of 121 feet near the top of the Gething Formation below the Superior Seam. It intersected the Trojan and other thinner seams. There the Trojan Seam contains

107 inches of coal in three benches. Previous work shows that the Trojan Seam dips 14° at Coalbed Creek and that dips decrease down dip.

Analyses of a composite sample of core from the Trojan Seam show that fractions separated at specific gravities of 1.40 to 1.60 contain from 3.7 to 5.3 per cent ash, about 27½ per cent volatiles, and have free swelling indexes of 6½ to 7. Yields determined by the laboratory were greater than 80 per cent, but with the inclusion of sandstone and mudstone partings not in the analyzed material, they have been reduced to 60 to 65 per cent. Analyses of core from the Superior Seam show a yield of 54 per cent at a specific gravity of 1.50, with the float fraction containing 6 per cent ash, 29.2 per cent volatiles, and having a free swelling index of 6½. Some thin seams below the Falls Seam at Moosebar Creek and above the Trojan at Coalbed Creek have free swelling indexes from 5½ to 9.

Data from the drill holes and from the 1971 field work indicate measured reserves in the Trojan Seam near Coalbed Creek of 8.9 million tons and indicated reserves within one mile of the measured reserves of 32 million tons. Of these 2.6 million tons are considered strippable with an average surface mine ratio of 15. This reserve will be increased and this ratio reduced by coal recovered from the Superior and the thin seams above the Trojan. Total reserves on the property have been previously estimated at 165 million tons for the Trojan Seam and 85 million tons for the Superior Seam.

It is recommended that a program be undertaken to learn the extent and thickness of the overburden along Johnson Creek, Coalbed Creek, Moosecall Lake, Lower Moosecall Creek where coal seams have been projected to the surface, and other places particularly where drilling is planned. Seismic methods are considered suitable. Additional drilling is required to obtain geological and engineering data on the coal seams on other parts of the property. All drill holes should be logged. The Gates Formation on the property should be checked for coal seams.

L. B. HALFERDAHL & ASSOCIATES LTD.

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.

DRILLING

Four test holes totalling 1059 feet were drilled during the project. The drill sites were located along the west flank and south nose of the southerly plunging anticline in the central structurally disturbed band on the properties south of the Peace River (Fig. 2). The holes are near Moosebar Creek, Johnson Creek, Coalbed Creek, and a place referred to herein as Strawberry Acres. They were chosen where access was easiest and to provide information on the upper part of the Gething Formation. All bedrock thicknesses are corrected for dip and thus footages are stratigraphic thicknesses.

Representative samples of cuttings were collected and retained for each 5-foot interval of bedrock. The cuttings from all coal seams were retained separately, but were extensively mixed with rock cuttings, particularly for seams at more than 200 feet.

The Superior Seam was cored at Moosebar Creek and the Trojan Seam was cored at both Moosebar Creek and Coalbed Creek. Core recovery from the Trojan Seam was 95 per cent in both holes while that for the Superior Seam was about 65 per cent. A VTM core barrel was used.

Side-wall sampling was attempted but satisfactory results were not obtained.

Logging of the drill holes was planned, but was not carried out, because of the small footage which could be logged. Attempts were made to leave the holes in a suitable condition for logging later.

Overburden

As sampling proved difficult in holes with thick overburden two of the drill holes were abandoned after penetrating more than 100 feet of the extensive surficial deposits that cover much of the area drained by Johnson, Coalbed, Burnt Trail and Moosebar Creeks. Topographic characteristics including major terraces at an elevation of 2300 feet and the silts, clays, and gravels now extensively exposed by stream erosion indicate that parts of this area were once occupied by a post glacial lake. The thickness of the deposits

is greater than 200 feet in places along Burnt Trail, Coalbed, and Johnson Creeks. The 234+ feet of overburden at Johnson Creek indicate that the old Johnson Creek channel was much deeper than the present one. Coalbed Creek and the valley occupied by Moosecall Lake and Lower Moosecall Creek may be similar.

TABLE 1: OVERBURDEN AT DRILL SITES

Drill Site	Elevation (feet above sea level)	Thickness of Overburden (feet)	Nature of Overburden
Moosebar Creek	2280	107	silts and clays
Johnson Creek	2000	234+	gravels at top silts and clays
Coalbed Creek	2280	8	gravels
Strawberry Acres	2325	101 16	silts and clays clays, sand and cobbles

Moosebar Creek

The Moosebar Creek drill site is 1000 feet north of the powerline crossing on Moosebar Creek. There the bedrock, which dips 15° SW is overlain by 107 feet of unconsolidated, water-saturated lake silts and clays. A thin gravelly layer rests directly on bedrock. Flowing water encountered at a depth of 50 feet forced a change from circulating air to water. The Moosebar-Gething contact was placed at a depth of 146 feet where black chippy mudstone of the Moosebar Formation grades into resistant thickly bedded to massive sandstone of the Gething Formation. The top 40 feet of the Gething Formation consists of hard, salt and pepper, fine- to medium-grained sandstone which was drilled at only about 2 feet per hour.

The Superior Seam is 38 feet stratigraphically below the top of the Gething Formation and is 42 inches thick. A 24-inch unnamed coal seam lies 98 feet stratigraphically below the contact (60 feet below the Superior Seam).

A coal seam containing 46½ inches of coal and lying 121 feet stratigraphically below the Moosebar-Gething contact is correlated with the Trojan Seam. Drill core from it contained a 4-inch layer of fault gouge, contorted shaly layers, and pronounced slickensides. This seam is separated from a lower 38½-inch coal seam by 15 feet of interbedded siltstone, sandstone, shale, and mudstone. This separation and the slickensides, fault gouge, and contorted shale indicate displacement within the Trojan Seam near Moosebar Creek.

The stratigraphic positions and thicknesses of coal seams encountered below the Trojan Seam are given in Table 4 and shown in Fig. 4. The Mogul Seam was expected 350 feet stratigraphically below the Moosebar-Gething contact as shown by Stott (1968) but was not encountered. The stratigraphic data of McLearn and Kindle (1950) indicate the Mogul Seam should be 450 feet stratigraphically below the Moosebar-Gething contact. Because of poor circulation and core recovery, and a drilling rate of 20 to 30 minutes per foot the hole was completed at 575 feet before reaching the Mogul Seam. It penetrated a stratigraphic section of 415 feet at the top of the Gething Formation. The casing was not pulled in order to facilitate deepening later.

Coalbed Creek

The Coalbed Creek drill site is located on the south bank of Coalbed Creek, immediately west of the crossing of the Mount Johnson access road. It was located very close to an outcrop to avoid thick overburden to the south. Below eight feet of gravelly clays and silts, bedrock was penetrated at a point approximately 30 feet below the Moosebar-Gething contact, as indicated by projecting the dip of 14° SW from an outcropping a few hundred feet southwest.

The Superior Seam was not penetrated because the site is apparently north of the trace of its outcrop. Several coal seams, all less than 14 inches in true thickness were intersected to a depth of 100 feet (Fig. 5).

The Trojan Seam is 133 feet stratigraphically below the Moosebar-Gething contact at Coalbed Creek. The coal is present in three benches totalling 107½ inches in a seam thickness of 129½ inches including partings. Two seams, both less than 6 inches thick were intersected below the Trojan Seam and the bottom of the hole at 133 feet. This represents a stratigraphic thickness of 121 feet of the Gething Formation.

CHARACTERISTICS OF THE COAL

The coal seams sampled herein are shown in Fig. 4 and 5; they are described in Appendix 1. The Trojan Seam at the Coalbed Creek drill site is 129½ inches thick and contains three benches of coal: from top to bottom, 57 inches coal, 6 inches sandstone parting, 20 inches coal, 16 inches sandstone and mudstone parting, 28 inches coal. An outcrop of the Trojan Seam along Coalbed Creek about ½ mile northwest of the Coalbed Creek drill site described and sampled during the 1971 field work contains two benches of coal: from top to bottom, 48 inches coal, 4 inches sandstone parting, 31 inches coal. Thus the Trojan Seam thickens from the outcrop to the Coal bed Creek drill site, but more information is needed to determine whether this thickening is stratigraphic or tectonic. The Trojan Seam appears to have been faulted at the Moosebar drill site where it is only 46½ inches thick.

At Moosebar Creek the Superior Seam contains 42 inches of coal in one bench; it was not intersected at Coalbed Creek because of the location of the drill site.

Analyses of Coal

The samples of coal obtained for analyses consisted of cuttings from some seams and cores from others. As the coal cuttings were contaminated with rock cuttings, they were separated at a specific gravity of 1.50 with only the floats being analyzed for inherent moisture, ash, and free swelling index (Table 4). Core samples were crushed and sized into +100 mesh and -100 mesh fractions, which were then analyzed (Table 2). A composite sample of the +100 mesh fractions from the three benches of the Trojan Seam at Coalbed Creek, fractions from this composite sample separated at three specific gravities, and gravity fractions of the +100 mesh size fraction of the Superior Seam at Moosebar Creek were similarly analyzed (Table 3).

The analytical results show that the free swelling indexes of the +100 mesh fractions of the raw coal from the three benches of the Trojan Seam at the Coalbed Creek drill site range from 4 for the top to 8 for the two lower benches, similar to results obtained for the upper and lower benches at the outcrop of the Trojan Seam $\frac{1}{2}$ mile northwest. The free swelling index for the +100 mesh fractions of a composite sample of the three benches improves from $4\frac{1}{2}$ for the raw coal to $6\frac{1}{2}$ or 7 depending on the specific gravity of the fraction analyzed. Faulting of the Trojan Seam at Moosebar Creek is believed responsible for its low free swelling index and high ash content there. Sink-float tests on the composite sample of the Trojan Seam at the Coalbed Creek drill hole show yields from 80 to 87 per cent on the parts of the seam analyzed but calculations show these are reduced to 59 to 64 per cent when the partings are included. The ash content on the composite sample ranges from 3.7 to 5.3 per cent with sulfur in the range 0.43 to 0.67 per cent.

The +100 mesh fraction of the Superior Seam at Moosebar Creek has a free swelling index of $4\frac{1}{2}$ and an ash content of 34.6 per cent. The free swelling index is improved to $6\frac{1}{2}$ and the ash reduced to 6.0 per cent in the float fraction at a specific gravity of 1.50.

TABLE 2: ANALYSES OF RAW COAL FROM DRILL CORES

	Footage (stratigraphic)	Sampled Interval (inches)	Size Fraction	Weight %	Ash	F.S.I.
Moosebar Creek						
Superior Seam	179.8 - 183.3	42	+100	90.09	34.56	4½
			-100	9.91	52.98	2
Trojan Seam	262.8 - 285.2	43	+100	90.62	73.77	N.A.
			-100	9.38	62.72	1
15 Feet Below Trojan Seam	282.0 - 285.2	38½	+100	91.50	72.43	N.A.*
			-100	8.50	77.09	N.A.*
Coalbed Creek, Trojan Seam						
Top Bench	110.8 - 115.7	57	+100	95.05	15.45	4
			-100	4.95	28.89	2½
Middle Bench	116.2 - 117.9	20	+100	93.23	3.69	8
			-100	6.77	31.86	5
Bottom Bench	119.3 - 121.6	28	+100	92.74	17.67	8
			-100	7.26	26.97	6½

+100 MESH FRACTIONS

	Footage (stratigraphic)	Residual Moisture	Volatile Matter	Fixed Carbon	S	B.T.U. per lb.
Moosebar Creek						
Superior Seam	179.8 - 183.3	0.54	30.94	33.96	0.46	8,800
Coalbed Creek, Trojan Seam						
Top Bench	110.8 - 115.7	0.68	24.05	59.82	0.45	12,480
Middle Bench	116.2 - 117.9	0.62	31.44	64.25	0.43	14,890
Bottom Bench	119.3 - 121.6	0.59	26.81	54.93	0.67	12,550

*Cuttings

TABLE 3: ANALYSES OF +100 MESH SPECIFIC GRAVITY FRACTIONS FROM DRILL CORES

Sp. Gr.	Yield	Ash	Volatile Matter	Residual Moisture	F.S.I.
Trojan Seam, Coalbed Creek Drill Hole, Composite Sample *					
-1.40	59.58	3.69	27.82	0.60	7
-1.50	62.97	4.58	27.55	0.60	7
-1.60	64.70	5.27	27.37	0.60	6½
+1.60	100.00	35.82	25.83	0.59	4½
Superior Seam, Moosebar Creek Drill Hole					
-1.50	54.06	6.04	29.24	0.60	6½
+1.50	45.94	67.47	32.89	0.57	-
Total	100.00	34.26	30.94		

* Total seam thickness is 129½ inches. The values herein have been calculated from the analytical reports to include a 6-inch parting between the upper and middle benches and a 16-inch parting between the middle and lower benches. Both partings were not included in the analyzed material. The calculations were based on an average specific gravity of 1.44 for the coal and 2.40 for the partings. The percentages in each row apply to all the material at the specific gravity in that row.

TABLE 4: ANALYSES OF +1.50 SPECIFIC GRAVITY FRACTIONS FROM DRILL CUTTINGS

	Footage (stratigraphic)	Sampled Interval (inches)	Inherent Moisture	Ash	F.S.I.
Moosebar Creek					
Titan Seam	391.9 - 397.5	67	0.80	15.54	½
Falls Seam	439.4 - 441.7	27½	0.68	16.02	½
25 Feet Below Falls Seam	467.1 - 468.0	11	0.61	17.31	-
75 Feet Below Falls Seam	515.4 - 517.9	30	0.65	15.96	8
99 Feet Below Falls Seam	541.0 - 541.7	8½	0.51	11.80	8
Coalbed Creek					
46 Feet Below Moosebar Formation	24.0 - 24.7	8½	0.64	2.48	5½*
55½ Feet Below Moosebar Formation	33.3 - 34.5	9½	0.66	11.09	9
63 Feet Below Moosebar Formation	40.7 - 41.9	14	0.61	12.23	8
78 Feet Below Moosebar Formation	55.5 - 56.6	12½	0.57	7.16	8½

* Core sample

Four seams, none of which exceeded 14 inches in thickness were intersected above the Trojan Seam at Coalbed Creek (Table 4) and have free swelling indexes ranging from $5\frac{1}{2}$ to 9. Two seams below the Falls Seam at Moosebar Creek have free swelling indexes of 8 (Table 4). Although 30 inches were sampled in one of these, the seam contains only $13\frac{1}{2}$ inches of coal (Fig. 4).

RESERVES

In the report of December 30, 1971, reserves in the Trojan and Superior Seams were estimated by projecting their extents from outcrops or traces of outcrops to the boundaries of the property. The estimates follow.

	Reserves Thousands of Tons	
Seam	Indicated	Inferred
Superior	35,904	49,612
Trojan	72,681	93,264

The Coalbed Creek drill hole and outcrop permit part of the reserves in the Trojan Seam to be termed measured. Projections $\frac{1}{2}$ mile from these points indicate an area of about one square mile. With an average thickness of 93 inches of coal, measured reserves are estimated at 8.9 million tons. The indicated reserves within one mile of these measured reserves are estimated at 32 million tons. Additional reserves are undoubtedly present near Moosebar Creek, but until more data from drilling are obtained on the extent of the faulting, reserves there cannot be reliably estimated. Reserves in the Superior Seam within $\frac{1}{2}$ mile from the drill hole at Moosebar Creek are estimated at 2 million tons. The holes drilled in February and March 1972 have changed some of the previously estimated coal reserves from indicated to measured, but have left the total reserves in the Superior and Trojan Seams largely unchanged.

At the Coalbed Creek drill site, whence samples showed an 80 per cent yield in the sink-float tests on 107 inches of coal, the surface mine ratio = 113 x 11.11/ 107 x 0.80 = 14.7. If coal can be recovered from the thin seams above the Trojan Seam this ratio will be reduced. Along Coalbed Creek between Johnson Creek and the fault which crosses Mount Johnson, the Trojan Seam is estimated to underlie 0.3 square miles at depths of less than 150 feet. With an average thickness of 93 inches the estimated strippable reserves are 2.6 million tons. These will be increased by coal recovered from the Superior and thin seams above the Trojan. With an average overburden depth of 100 feet and an 80 per cent yield the average surface mine ratio = 100 x 11.11/ 93 x 0.80 = 15, which will be reduced by any coal recovered from the Superior and the thin seams above the Trojan.

CONCLUSIONS

The drilling program conducted on the Peace River Canyon coal properties of Cinnabar Peak Mines Ltd. has shown that part of the Trojan Seam along Coalbed Creek is thicker than found in the outcrop there, and that at Moosebar Creek it has been cut by a fault. Analyzes show that coal in both the Trojan and Superior Seams near the top of the Gething Formation appears suitable for coking or blending. Reserves in the Trojan Seam on the property are estimated as measured 8.9 million tons, indicated 32 million tons, and inferred 124 million tons. Thick overburden in places, interferred with drilling and sampling.

Previous work on the property has permitted a preliminary estimate of total reserves of one billion tons, most of it in the other 18 seams in the Gething Formation below the Superior and Trojan Seams. Much of the coal is favorably situated for underground mining with few dips exceeding

15°. On the south and west sides of Mount Johnson and near Coalbed Creek, as much as 20,000,000 tons may be suitable for strip mining. The work on the properties recently undertaken is sufficiently encouraging to warrant further expenditures for continuing evaluation of the properties.

Respectfully submitted,

G. A. Van Dyck, B. Sc.

Edmonton, Alberta

May 17, 1972

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

PROVINCE OF BRITISH COLUMBIA ENGINEER

Expiry Date: August 5, 1972

REFERENCES

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.

McLearn, F.H. and Kindle, E.D. (1950) - Geology of northeastern British Columbia; Geol. Surv. Can. Mem. 259, pp. 154 - 176, 213 - 218 and Fig. 11.

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.

———— (1969) - Gething Formation at Peace River Canyon, British Columbia; Geol. Surv. Can. Paper 68-28.

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 drilling on the properties directed by G. A. Van Dyck from February 9 to March 23, 1972, and under my general supervision, and from published and unpublished reports.

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

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

Edmonton, Alberta
May 17, 1972

APPENDIX 1: DESCRIPTIONS OF COAL SEAMS

Superior Seam

Moosebar Creek	Shale	
	Coal, mainly clarain with ½-inch vitrain bands	38
	Coal, granular, dense, durain?	4
	Shale, black, carbonaceous	
	Total seam	42
	Total coal	42
	Thickness cored	49

60 Feet below Superior Seam

Moosebar Creek	Mudstone, black	
	Coal, clarain	24
	Mudstone, black, few coaly partings, slickensides	
	Total seam	24
	Total coal	24
	Thickness cored	41

Trojan Seam

Moosebar Creek	Mudstone (not cored)	
	Coal (not cored)	3½
	Coal and mudstone, mixed	10½
	Fault gouge, silver grey	4
	Coal, clarain, dense and breaks into ½ to 1" blocks	7
	Coal and shale, faulted contorted shale, slickensides	25½
	Sandstone, fine-grained, argillaceous, plant remains along bedding plane	6
	Clay-ironstone concretion	4½
	Total seam	50½
	Total coal	46½
	Thickness cored	57½

All thicknesses are in inches.

Coalbed Creek	Shale, black (not cored)	
	Coal (not cored)	$2\frac{1}{2}$
	Coal, granular, dull, hard	3
	Coal, vitrain	24
	Coal, vitrain and clarain	3
	Coal, clarain, well cleated	27
	Sandstone, brown, fine to medium grained (only 2" cored)	6
	Coal, vitrain	7
	Coal, broken, rubbly, vitrain?	7
	Coal, clarain 70% and vitrain 30%	6
	Mudstone, black, carbonaceous with coaly bands (only 5" cored) and sandstone	16
	Coal, mainly clarain, vitrain bands up to $\frac{1}{4}$-inch	$13\frac{1}{2}$
	Coal, granular, dull, hard	2
	Coal, vitrain	$12\frac{1}{2}$
	Mudstone, black, carbonaceous, with marcasite and carbonaceous plant remains	
	Total seam	$129\frac{1}{2}$
	Total coal	$107\frac{1}{2}$
	Thickness cored	119

APPENDIX 2: REPORTS OF COAL ANALYSES

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 Northgate Building
10049 - Jasper Avenue
Edmonton, Alberta

File No. 5233
Date April 26, 1972
Samples Coal

Certificate of ASSAY

LORING LABORATORIES LTD.

SAMPLE No.	SINK FLOAT ANALYSIS @ S.G. 1.50	
	% FLOAT	% SINK
151	73.1	26.9
152	18.1	81.9
153	33.1	66.9
154	38.7	61.3
162	6.3	93.7
163	2.1	97.9
164	0.3	99.7
166	0.4	99.6
167	0.5	99.5

NOT SUFFICIENT SAMPLE FOR NO'S 159, 165

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.
Pulps Retained one month unless specific arrangements made in advance.

Licensed Assayer of British Columbia

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 Northgate Building
10049 - Jasper Avenue
Edmonton, Alberta

File No. 5233
Date April 26, 1972
Samples Coal

Certificate of ASSAY

LORING LABORATORIES LTD.

SAMPLE No.	INHERENT H2O %	% ASH	F.S.I.
ANALYSIS OF FLOATS			
151	.64	2.48	5½
152	.66	11.09	9
153	.61	12.23	8
154	.57	7.16	8½
162	.80	15.54	½
163	.68	16.02	1½
164	.61	17.31	Not enough Float for FSI
166	.65	15.96	8
167	.51	11.80	8

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.
ps Retained one month
ess specific arrangements
ade in advance.

Licensed Assayor of British Columbia

L.B. Halferdahl & Associates Ltd.

Upper Trojan Seam, Coal Bed Creek
Tag #155 (114.4' - 119.3')

	+ 100 Mesh	- 100 Mesh
Weight, %	95.05	4.95
Ash, %	15.45	28.89
Volatile Matter, %	24.05	
Residual Moisture, %	0.68	
Fixed Carbon, %	59.82	
Free Swelling Index	4	2½
B.T.U./lb.	12,480	
Sulphur, %	0.45	

April 21, 1972

C.E.S. Sample #8

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada

L.B. Halferdahl & Associates Ltd.

Middle Trojan Seam, Coal Bed Creek
Tag # 156 (119.85' - 121.5')

	+ 100 Mesh	- 100 Mesh
Weight, %	93.23	6.77
Ash, %	3.69	31.86
Volatile Matter, %	31.44	
Residual Moisture, %	0.62	
Fixed Carbon, %	64.25	
Free Swelling Index	8	5
B.T.U./lb.	14,890	
Sulphur, %	0.43	

April 21, 1972

C.E.S. Sample #9

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada

L.B. Halferdahl & Associates Ltd.

Lower Trojan Seam, Coal Bed Creek
Tag #157 (123' - 125.4')

	+ 100 Mesh	- 100 Mesh
Weight, %	92.74	7.26
Ash, %	17.67	26.97
Volatile Matter, %	26.81	
Residual Moisture, %	0.59	
Fixed Carbon, %	54.93	
Free Swelling Index	8	6½
B.T.U./lb.	12,550	
Sulphur, %	0.67	

April 21, 1972

C.E.S. Sample #10

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada

H.B. Halferdahl & Associates Ltd.

Trojan Seam, Coal Bed Creek
Composite of Tags #155, #156 and #157

	+ 100 Mesh
Ash, %	13.88
Volatile Matter, %	26.05
Residual Moisture, %	0.61
Fixed Carbon, %	59.46
Free Swelling Index	4½

Float-Sink Analysis of + 100 Mesh.

Sp. Gr.	Wt. %	Ash %	V.M. %	R.M. %	Cum. F.S.I.
- 1.40	80.52	3.69	27.82	0.60	7
1.40 - 1.50	4.58	20.26	22.88	0.62	7
1.50 - 1.60	2.34	30.21	20.81	0.74	6½
+ 1.60	12.56	68.90	15.06	0.56	
Total	100.00	13.26	25.83		4½

April 21, 1972

C.E.S. Sample # 14

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada

L.B. Halferdahl & Associates Ltd.

Superior Seam, Moose Bar Creek
Tag #158 (182' - 185.4')

	+ 100 Mesh	- 100 Mesh
Weight, %	90.09	9.91
Ash, %	34.56	52.98
Volatile Matter, %	30.94	
Residual Moisture, %	0.54	
Fixed Carbon, %	33.96	
Free Swelling Index	4½	2
B.T.U./lb.	8,800	
Sulphur, %	0.46	

Float-Sink Analysis of + 100 Mesh.

Sp. Gr.	Wt. %	Ash %	V.M. %	R.M. %	F.S.I.
- 1.50	54.06	6.04	29.24	0.60	6½
+ 1.50	45.94	67.47	32.89	0.57	
Total	100.00	34.26	30.92		

April 21, 1972

C.E.S. Sample #11

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada

L.B. Halferdahl & Associates Ltd.

Trojan Seam, Moose Bar Creek
Tag #160 (247.2' - 249')

	+ 100 Mesh	- 100 Mesh
Weight, %	90.62	9.38
Ash, %	73.77	62.72
Free Swelling Index	N.A.	1

April 21, 1972

C.E.S. Sample #12

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada

L.B. Halferdahl & Associates Ltd.

Coal Cuttings
Tag #161 (290.7' - 294')

	+ 100 Mesh	- 100 Mesh
Weight %	91.50	8.50
Ash, %	72.43	77.09
Free Swelling Index	N.A.	N.A.

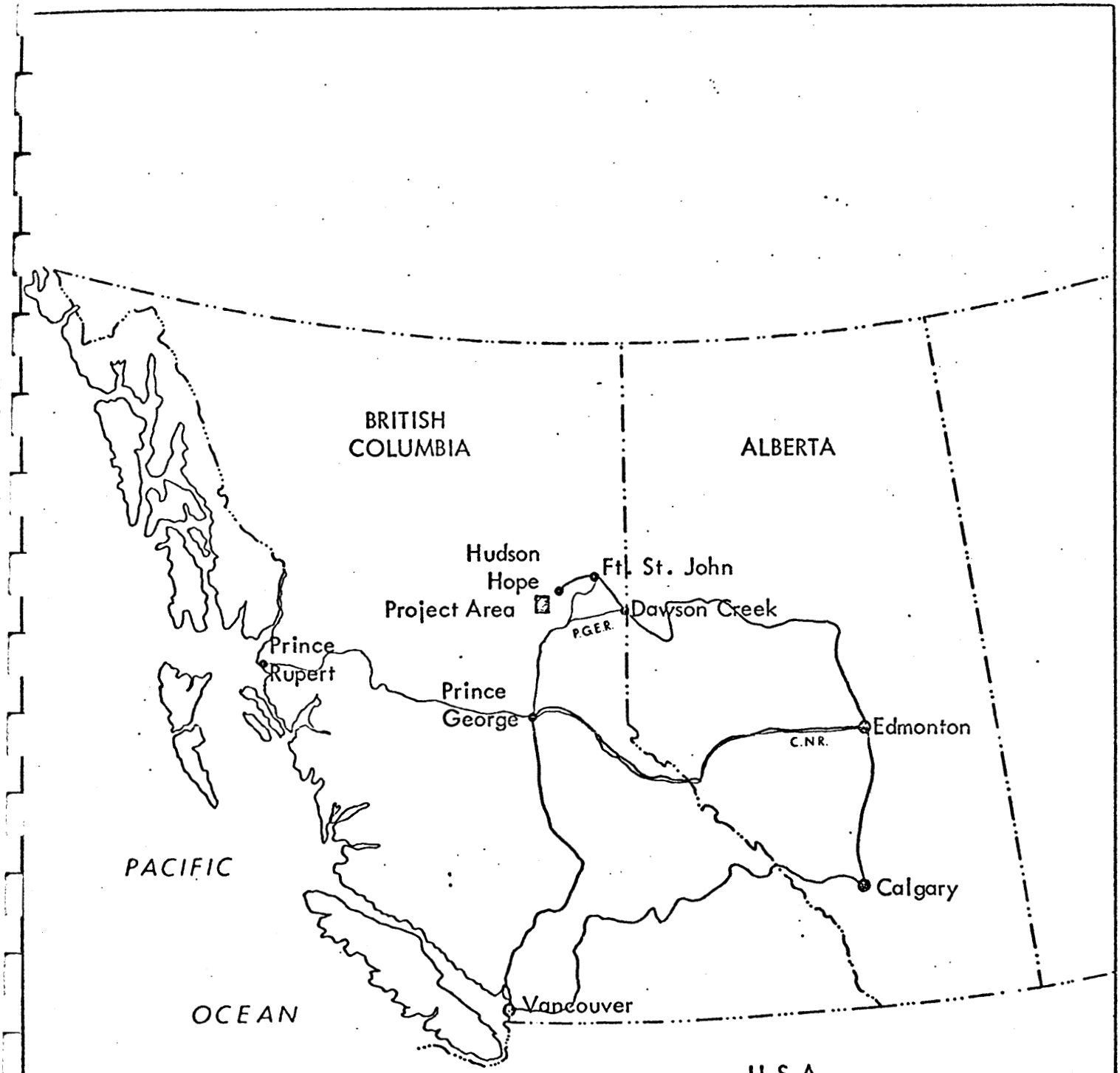
April 21, 1972

C.E.S. Sample #13

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada

APPENDIX 3: FIELD PERSONNEL

Name	Position	Time on Property 1972
A. Flemming	Driller	Feb. 19 - March 23
J. Gorham	Assistant	Feb. 19 - March 4
L. Halferdahl	Geologist	Feb. 9 - Feb. 10
E. Stadnek	Driller's Helper	Feb. 19 - March 23
G. Van Dyck	Geologist	Feb. 9 - Feb. 10 Feb. 16 - March 23



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PROVINCE OF BRITISH COLUMBIA
25 L.B. HALFERDAHL

Expiry Date: August 5, 1972

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EDMONTON, ALBERTA

Fig. 1: Location Map

PEACE RIVER CANYON PROPERTIES

0 100 200 300 400
SCALE IN MILES

Drawn: LBH MAY, 1972

LEGEND AND SYMBOLS TO ACCOMPANY FIGURE 2.

LOWER CRETACEOUS
FORT ST. JOHN GROUP

7 Gates Formation

6 Moosebar Formation

BULLHEAD AND MINNES GROUPS

5 Gething Formation

4 Cadomin and Pre-Cadomin Formations

Coal seam with name, defined and approximate . . . . . — —Tr— —

Superior . . . . . Su
Trojan . . . . . Tr
Titan . . . . . Tt
Falls . . . . . F
Mogul and Little Mogul . . . . . Mg
Castle Point . . . . . Cp
Milligan . . . . . Ml
Grant-King . . . . . GK
Murray - "48" M48

Geological boundary, defined and approximate . . . . . ——————

Strike and dip of bedding, inclined, vertical . . . . . ⊬ ⊬

Fault, defined, approximate . . . . . ∿∿∿

Anticlinal axis . . . . . ⊣ ⊣

Outcrop with lithology, sandstone, siltstone, shale, conglomerate, coal . . . . . x ss,st,sh, cg,c

Drill hole, February-March 1972,
1. Moosebar Creek, 2. Johnson Creek,
3. Coalbed Creek, 4. Strawberry Acres . . . . . ●

Mine adit . . . . . ≻

Line of section in Fig. 3 . . . . . G—— G'

Boundary of restricted mining area . . . . . —·—·—

Boundary of lot, lease, coal licence . . . . . ——————

Boundary of property . . . . . ——————

Road, logging . . . . . = = = = =

unimproved . . . . . - - - - - -

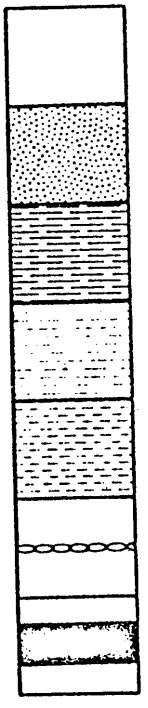
1971 access . . . . . —·—·—·—

Trails, baseline . . . . . ----------

Contour, interval 25' . . . . . —2900—

Map based upon Fig. 4, in December 31, 1971 report on the properties by Checklin and Halferdahl.

LEGEND TO ACCOMPANY COLUMNAR SECTIONS OF DRILL HOLES, FIGURES 4 AND 5



Overburden

Sandstone

Siltstone

Shale

Mudstone

Clay-ironstone concretions

Coal with thickness in inches

Note: See accompanying page for legend and symbols.

Moosebar

Moosebar Creek

PEACE RIVER

AYLARD MINE

Johnson Creek

Johnson Creek

POWERLINE

GAS PIPELINE

F

F'

G

G'

1

2

3

4

Coal bed

Expiry Date: August 5, 1972.

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.

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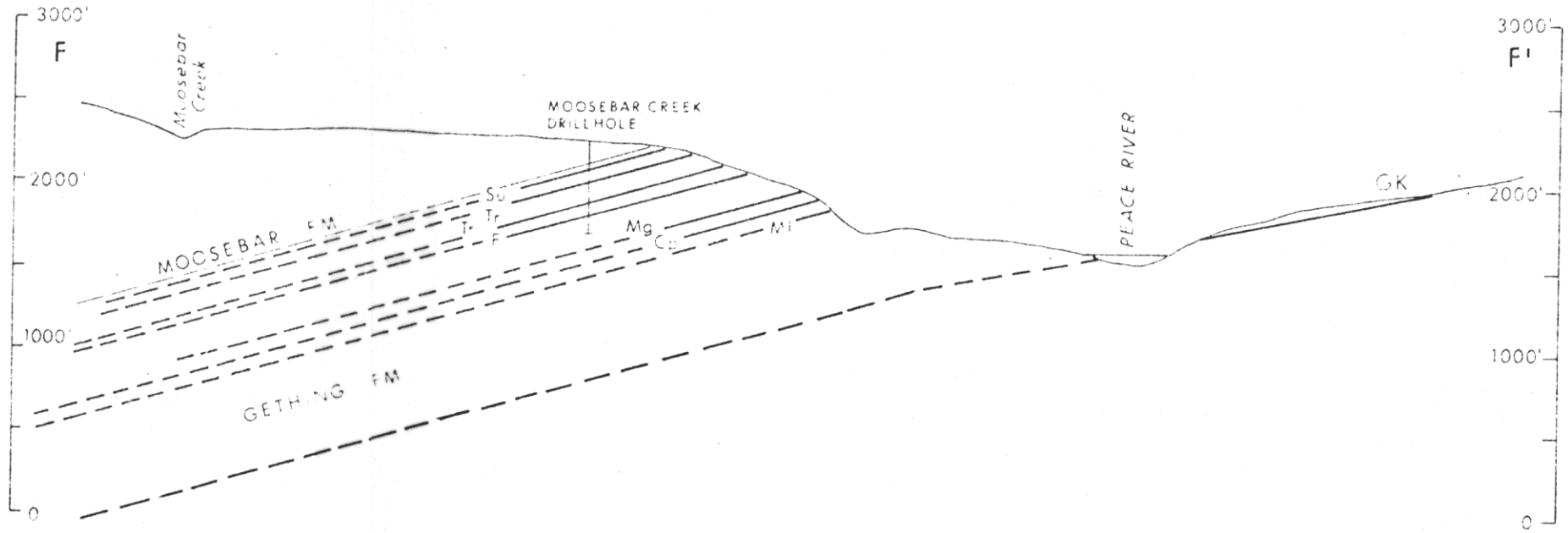
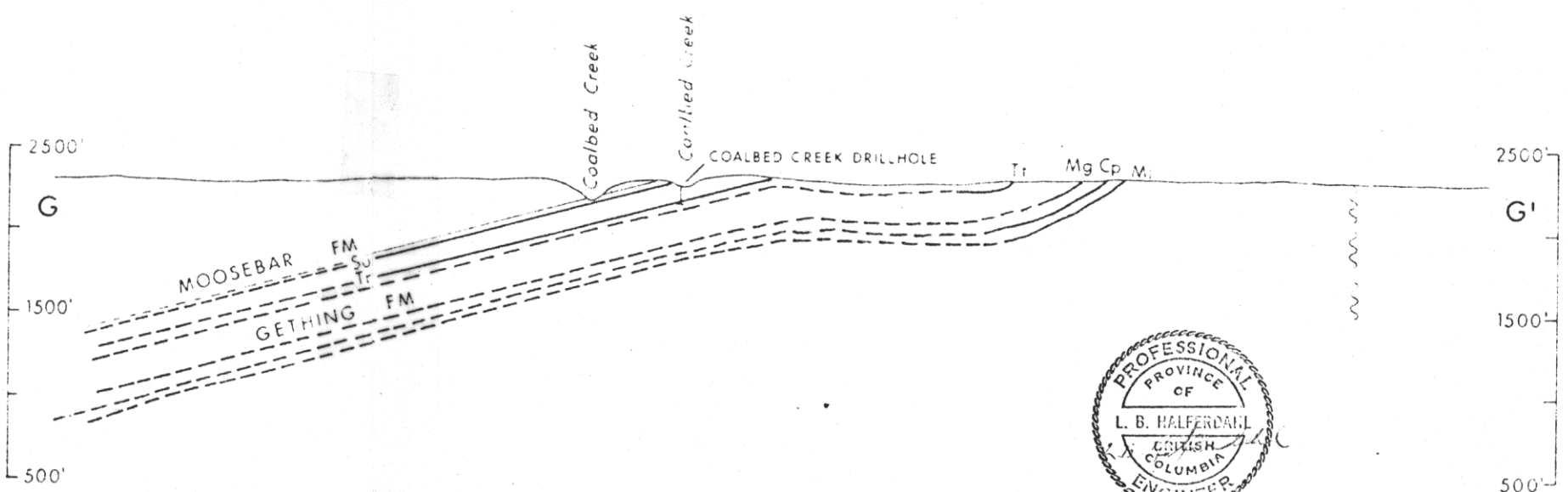
EDMONTON, ALBERTA

Fig. 2 Geology, Coal Seams and Drill Hole Locations
PEACE RIVER CANYON PROPERTIES

1000 0 1000
SCALE IN FEET

DRAWN: G.V.D. MAY, 1972





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LEGEND

Geological contact .....

Fault .....

Coal seam with name .....

Superior	Su	Mogul and Little Mogul	Mg
Trojan	Tr	Castle Point	Cp
Titan	Tt	Milligan	Ml
Falls	F	Grant-King	GK

Only selected coal seams are shown in their approximate positions.

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.

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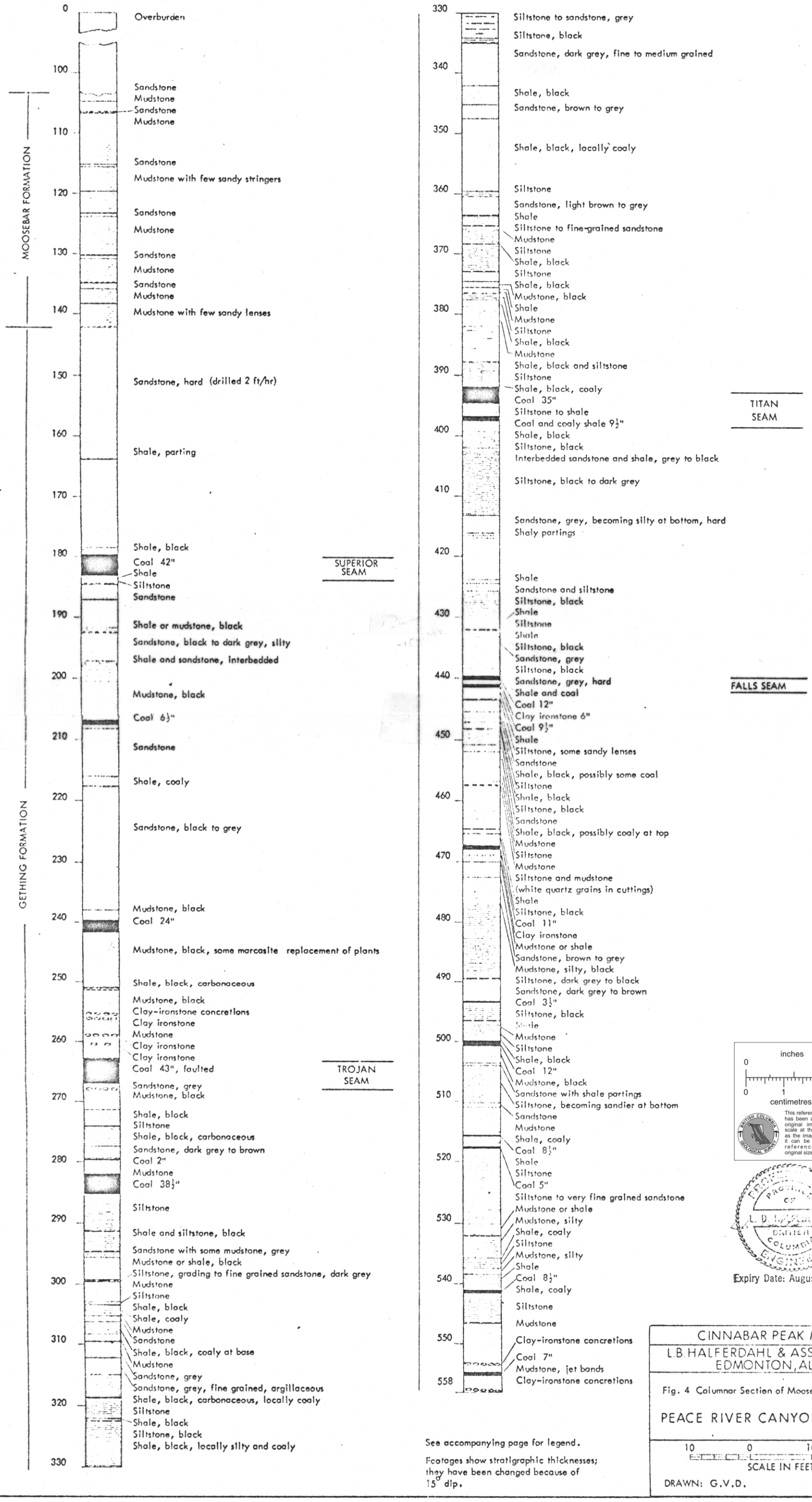
Fig. 3 Cross Sections from Fig. 2

PEACE RIVER CANYON PROPERTIES

1000 0 1000
SCALE IN FEET

DRAWN: G.V.D. MAY, 1972



Expiry Date: August 5, 1972

See accompanying page for legend.

Footages show stratigraphic thicknesses; they have been changed because of 15° dip.

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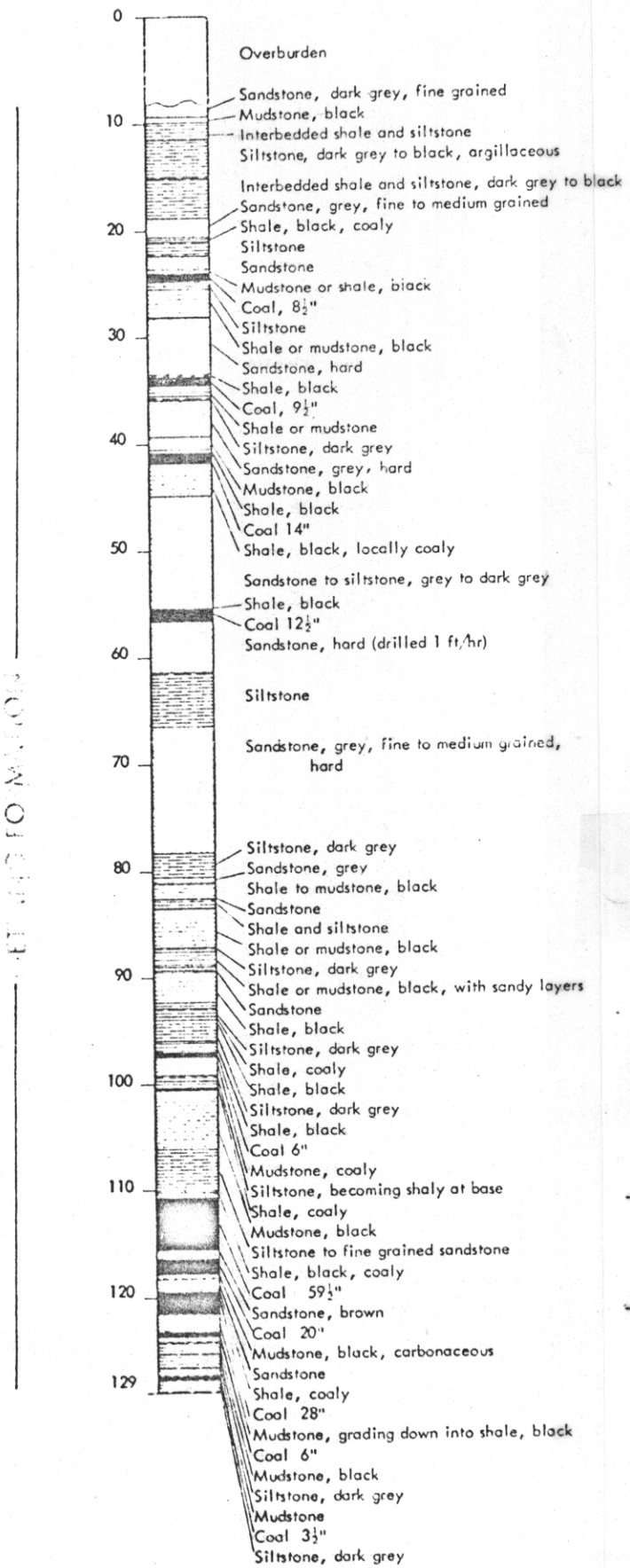
Fig. 4 Columnar Section of Moosebar Creek Drill Hole

PEACE RIVER CANYON PROPERTY

10 0 10 20
SCALE IN FEET

DRAWN: G.V.D. MAY, 1972



TROJAN

SEAM

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.

See accompanying page for legend

Footages show stratigraphic thicknesses; they have been changed because of 14° dip.

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Fig. 5 Columnar Section of Cosbon Creek Drill Hole
PEACE RIVER COAL ON PROPERTIES

0 10 20 30 40
SCALE IN FEET

DRAWN: E.V.D. MAY, 1972