TABLE OF CONTENTS

INTRODUCTION

The Groundhog coal field lies in North Central B.C. This extensive sedimentary basin contains several coal seams of probable Cretaceous age, underlying an area of several thousand square miles. The problems of developing these coal fields earlier were accessibility, structure, markets, and a modern loss of the frontier spirit. An excellent railroad be has been pushed right through the heart of the coal fields giving wheeled access today. Rail will be laid in the future. Coal mining would form a good base for settlement of the fields which also offer farm, ranching, and forestry potential. The railroad will allow shipment to other foreign and domestic markets.

A better structural picture than hitherto known was provided by this year's mapping. The area underlying Petrofina's Licences and down the Skeena to the Southeast looks good for mine planning and development.

GEOLOGY

During Jurassic/Cretaceous time a N.W. - S.E. trending basin formed in the Groundhog area of B.C. Coarse clastics were deposited in this trough; with the basal sands section attaining thickness of approximately 3000'. The upper members of this clastic unit can be seen dipping 20° - 30° S-S.W. in the outcrop sections.

After this initial influx of material, quieter times followed allowing the formation of at least 3 coal seams. These seams are all within a few hundred feet of the "basal sands". The lowermost seam is actually in the sandstones and has a good solid sandstone roof. The higher seams are lying in a rapidly alternating sequence of orange weathered modular shales, silts, sands and pebble conglomerates. Higher up this middle "coal shale" section the lithologies vary rapidly allowing time only for their, though numerous, coal horizons. This middle "coal/shale section" is about 5000' thick. (Accurate sections were measured by Kathy Langill but were lost, along with notes and samples in the truck fire of July, 1979).

Finally, an energetic period followed, depositing thick wedges and sheets of chert pebble conglomerates into

the basin. (On Mt. Gunanoot these conglomerates are 2000' thick). It is my opinion that this load compressed the underlying coals and sediments and downwarped the basin enough to create the "Gunanoot Syncline". (Fina's Licences are on the Northern end of this S. plunging syncline).

Subsequent thrust faulting on a regional scale, defined the present major drainage pattern, and where the faults were not parallel to the major limbs of the syncline, they actually cut across the earlier formed local synclinal structure. This is an interesting observation.

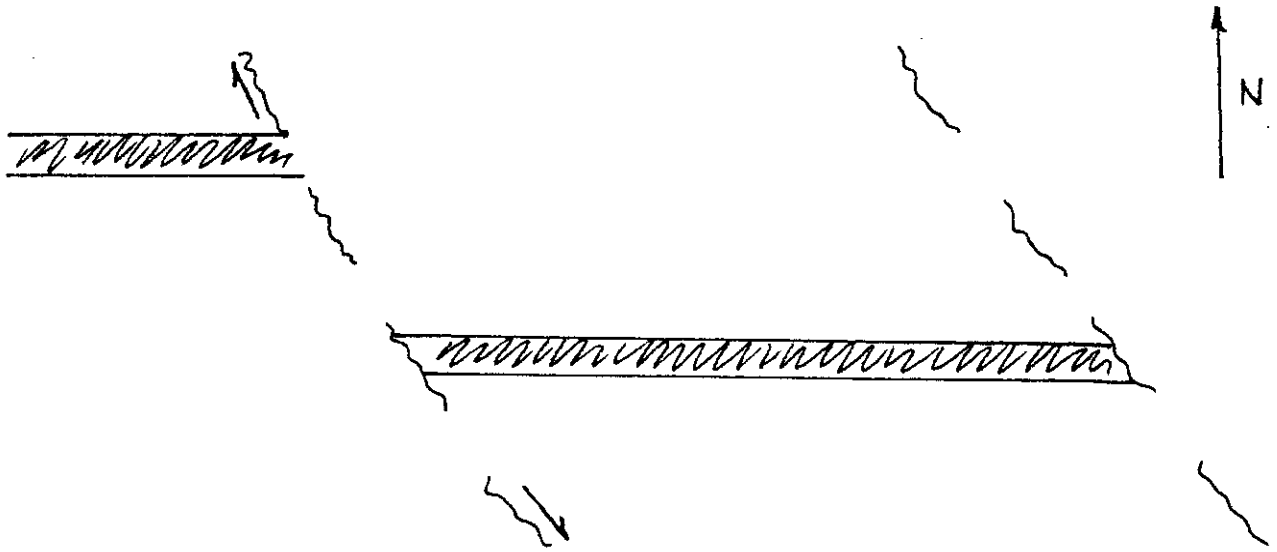
It was during the compression and later thrusting (and possibly with the help of an unknown heat source - intrusives) that the coal was raised to the rank of semi-anthracite. It was at this time too that the ubiquitous slivers of remobilized white quartz were emplaced along cleats in the coal.

STRUCTURE

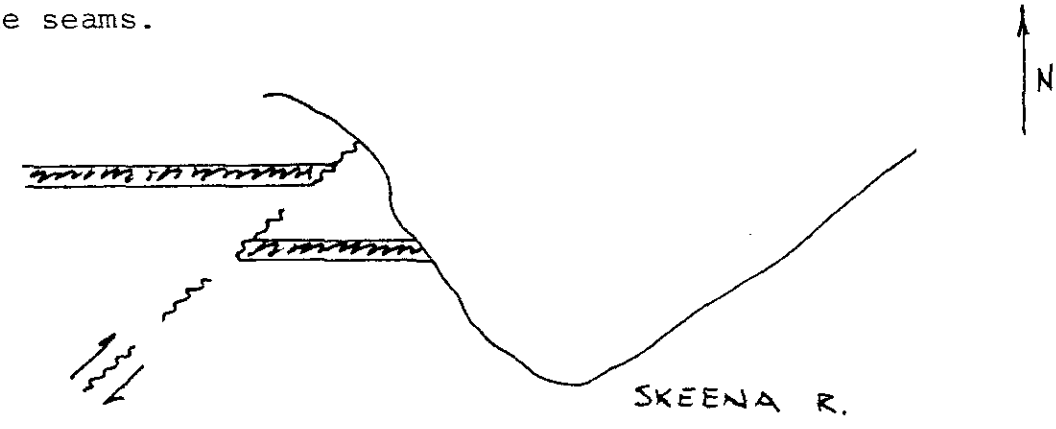
General structure has been touched upon above.

A line can be drawn SE-NW down the centre of the "Gunanoot Syncline" and everything to the SW is so disturbed it can be ignored, it is the soul of the Nass River thrust. To the NE of this line the plate of the Skeena River thrust is relatively undisturbed and the general altitude of beds dipping 20 - 30° SW prevails. As one follows these beds NW and up Tahtsedle Creek across the Cottongrass Meadows, the strike turns West giving the Syncline its Southerly plunge.

It is across the Northern end of the syncline that the coal beds have continuity of discreet blocks cut up by thrust faults trending 30° to the strike of the Srata.



Along the SW side of the Skeena the faulting and bedding are parallel. This should have "doubled up" the coal seams but bedding plane thrusts may also have attenuated the seams.



The Skeena thrust and its imbrications are found in the area in which Esso presently holds numerous licences. This faulting continues NW to "Mt. Uroas".

COAL QUALITY (See Analyses)

SEAM 1 is the designation for the seam thought to be lowermost in the section lying between competent basal sands.

SEAM 2 is exposed at mouth of Coal Creek and is thought to be correlative of the seam exposed in Inez Creek.

UPPER SEAM 2 is a narrow 3' seam a few feet (5') above Seam 2 exposed at Coal Creek.

SEAM 3 lies 30' above Upper Seam 2 at the mouth of Coal Creek.

RESERVES

SEAM 1 is 8' thick where sampled.

SEAM 2 is about 8' thick at Coal Creek and could be thicker.

UPPER SEAM 2 is 3' thick at Coal Creek and is ignored in these calculations though it might thicken laterally.

SEAM 3 is 6' thick at Coal Creek.

A strike length of 25 miles is used from lower Inez Creek to the mouth of Tahtsedle Creek.

The elevation at Tahtsedle/Spatsizi/Skeena divide is about 4000', at Nass Lake, it is 3500'. Using a line between these points to guarantee safe above water table mining, we have a net elevation gain across the Cottongrass Meadows, (5,400') of about 1500 - 2000' or about 1/3 mile.

The seams are dipping between 20° - 30°; allowing for the decreasing elevations down the creeks by dividing

by a factor of 2 we have a reserve estimate on the three seams of:

$$\left(25 \times (1/3 \times \tfrac{1}{2})\right) \text{ square mile } X\ (8 + 8 + 6) \text{ coal feet}$$

$$= 90 \text{ million tons.}$$

Using 1 sq. mile of coal, 1' thick = 1 m tons.

This reserve is approximate, cannot all be mined but can be appreciably increased by following the strike down the Skeena (where Malloch, 1912, reports 6 - 8' seam in Bhome Creek - possibly our Seam 3).

Also, the mining depth of 1/3 mile used in the calculations is arbitrary and conservative. It is probable that mining at depth will be easier since the limb dips flatten out toward syncline centre, where one feels the seams may well thicken up (see also Richardson and Gildrist in B.C. exploration report 1978) consideration of syncline load compression would have been proportional to compressibility of sediments - coal being highly compressible.

RECOMMENDATIONS

PHASE 1

A few thousand feet of core drilling to sample and check coal continuity, initially across Cottongrass Meadows and down Tahtsedle and Inez Creeks.

PHASE 2

Acquisition of more ground along SW flanks of Skeena River. Further drilling and cat seam trending.

All materials can be trucked in along 110 miles rail bed from near Stikine Crossing.

PERSONNEL

Tony Mould: B.Sc. Geologist

Kathy Langill: (doing M.Sc. Geology)

Jerry Henri: (First Month)

Steve Burrows: (Last Month)

Ashley Melia: (Last Month)

Report by Tony Mould, 1979

Tony Mould

PETROCINA CANADA INCORPORATED

ATTN: Eric Sundgaard

LORING LABORATORIES LTD.

CERTIFICATE of COAL TESTING

FILE Nº.: 17511

DATE: August 17, 1979

SAMPLE Nº	IDENTIFICATION	SAMPLE TYPE	% RECOVERY SINK	% RECOVERY FLOAT		REC'D % H_2O	% H_2O	% VOL. MATTER	% ASH	% FIXED CARBON	% S	B.T.U. /LB.	F.S.I.	
SEAM 1					Air Dried	-	5.75	11.52	30.26	52.47	.48	8856	0	SEAM 3
					Dry Basis	-	-	12.22	32.11	55.67	.51	9396		
SEAM 2					Air Dried	-	3.60	8.99	4.36	83.05	.56	13798	0	UPPER SEAM 2
					Dry Basis	-	-	9.33	4.52	86.15	.58	14313		
SEAM 3					Air Dried	-	4.43	8.28	32.20	55.09	.45	8796	0	SEAM 1
					Dry Basis	-	-	8.66	33.69	57.65	.47	9204		

SAMPLES TAKEN WITH PETROFINA'S HELP.

PETRO FINA CANADA LIMITED

ATTN: E. Sundgard

LORING LABORATORIES LTD

CERTIFICATE of COAL TESTING

FILE NO.: 18000

DATE: October 17, 1979

SAMPLE NO.	IDENTIFICATION	SAMPLE TYPE	% RECOVERY SINK	% RECOVERY FLOAT		REC'D % H_2O	% H_2O	% VCL MATTER	% ASH	% FIXED CARBON	% S	BTU /LB.	F.S.I.	
"COAL SAMPLES"														
# 1	COAL SAMPLES	Raw Coal			As Received	4.58	–	12.00	16.13	67.29	.52	11,350		SEAM 2 ?
					Air Dried	–	3.09	12.19	16.38	68.34	.52	11,527	0	(INEE CREEK)
					Dry Basis	–	–	12.58	16.90	70.52	.54	11,895		
# 2	COAL SAMPLES	Raw Coal			As Received	5.54	–	4.58	9.80	80.08	.42	12,593		SEAM 1
					Air Dried	–	3.18	4.70	10.04	82.08	.43	12,908	0	
					Dry Basis	–	–	4.85	10.37	84.78	.44	13,332		
# 3	COAL SAMPLES	Raw Coal			As Received	5.22	–	6.42	17.36	71.00	.54	11,466		Seam 1
					Air Dried	–	2.53	6.60	17.86	73.01	.56	11,792	0	
					Dry Basis	–	–	6.77	18.32	74.91	.57	12,098		
# 4	COAL SAMPLES	Raw Coal			As Received	1.05	–	37.64	56.59	4.72	4.72	N.I. *		COALY SHALE
					Air Dried	–	0.14	37.99	57.11	4.76	4.76	N.I. *	0	CONCRETION
					Dry Basis	–	–	38.04	57.19	4.77	4.77	N.I. *		
# 5	COAL SAMPLES	Raw Coal			As Received	3.97	–	8.17	35.30	52.56	.48	8,445		SEAM 3
					Air Dried	–	2.78	8.27	35.74	53.21	.49	8,550	0	
					Dry Basis	–	–	8.51	36.76	54.73	.50	8,794		

*=Non Ignition

The coaly shale concretion provided by S. Burrows and A. Molin was only sample of any description from Fault Creek [illegible] have been [illegible] we lost so much info in fire I decided to throw it in

[illegible signature]

GROUNDHOG PROJECT

Robert J Talbot

October 1979

Robert J. Talbot
P. Geol.

TABLE OF CONTENTS

I. SUMMARY

The Groundhog Project consisted of evaluating coal licenses (5191 to 5214 inclusive) on four parcels (and approximately 63.5 km^2) within the Groundhog coalfield in northern British Columbia. The Groundhog coalfield lies in the Cassair Land District and in the Omineca Mining Division of British Columbia within the area bounded by $56^{o}47'$ to $56^{o}48'$ north latitude and $128^{o}07'$ to $128^{o}31'$ west longitude.

The coal occurs within the rocks of the Bowser assemblage in the Upper Skeena River area. Ground examination within the lease block indicates that there are four seams of variable thickness present:

Seam 1 - .9 m (2.9 ft.)
Seam 2 - 1.8 m (6.0 ft.)
Seam 3 - 2.5 m (8.0 ft.)
Seam 4 - 2.7 m (9.0 ft.)

Stratigraphically these seams occur over a thickness of 37 m (120 ft.) to 43 m (140 ft.)

The program consisted of a four day geological ground reconnaissance program in conjunction with air photo interpretation. The mapping was done on a scale of 1:50,000. The project area for the most part was covered with thick brush and trees in the valleys and grasses in the upper flats. The outcrop available for examination was limited creating some problem defining continuity of structures. However, examination of rocks on the lease block indicated that there are several anticline-syncline pairs in the area. The structures are very tight with steeply dipping limbs. It was also noted that there has been faulting in the area, however, the covered intervals and limited time available made it difficult to define the degree and continuity of the faulting. Before the faulting can be defined more precisely detailed mapping is necessary.

Examination of the structures on the geology map indicate that there is strippable reserve available. However, without definition of coal thicknesses and continuity of structures a reserve figure can not be estimated. Before reserves can be estimated, a detailed mapping program on a scale of 1:5000 to define structures and a small diamond drilling program to get some idea of the coal quality is necessary. Available information indicates that the coal quality will be in the following range:

Ash	9.8%
Volatile Matter	7.2%
Moisture	0.5%
Fixed Carbon	82.4%
Sulphur	0.6%
BTU	13,366

The lease blocks have a completed railbed (B.C. Railways) running through them. Having a completed railbed in the vicinity would be a definite bonus should the field ever go into production.

II. RECOMMENDATIONS

At this time it would be recommended that Petrofina maintain its Groundhog leases until the property potential is evaluated in more detail. The prime consideration would be justification of the cost to maintain the leases in good standing as opposed to the risk factor of whether the property would ever go into production. However, without doing some detailed work, the potential of the property can only be guessed at.

Should Petrofina decide to keep its leases in the Groundhop coalfield, it would be recommended that a detailed geological mapping program in conjunction with a limited diamond drilling program be undertaken. The mapping program should consist of a chain and compass project surveying in geological data at a scale of 1:5000. Near the end of the mapping program, a small diamond drill program of 1200 m (approximately 4000 ft.) should be completed. The drilling will give more structural information as well as an idea of the coal quality.

As the lease blocks surround the land presently held by Imperial Oil it would be suggested that this program be completed as a joint venture with Imperial Oil. This would cut costs as well as allow detailed evaluation of the entire parcel of land. It should be noted that without participation by both Imperial Oil and Petrofina there is very little possibility of the land ever being put into production. Should Petrofina keep its original leases there is a potential that additional leases could be picked up on the northeastern side of the map area.

There are two possibilities for doing further work. A detailed geological mapping program will give enough information to evaluate the properties potential. The coal thicknesses and coal quality will have to be based on sections measured in the field and on reported information. The anticipated cost of the mapping program would be approximately $110,000.00. The other alternative would be a small drilling program at anticipated cost of approximately $257,000.00. (See Budget Summary for details). Due to the weather conditions in the area, the project should start by the last week of July to allow time for completion.

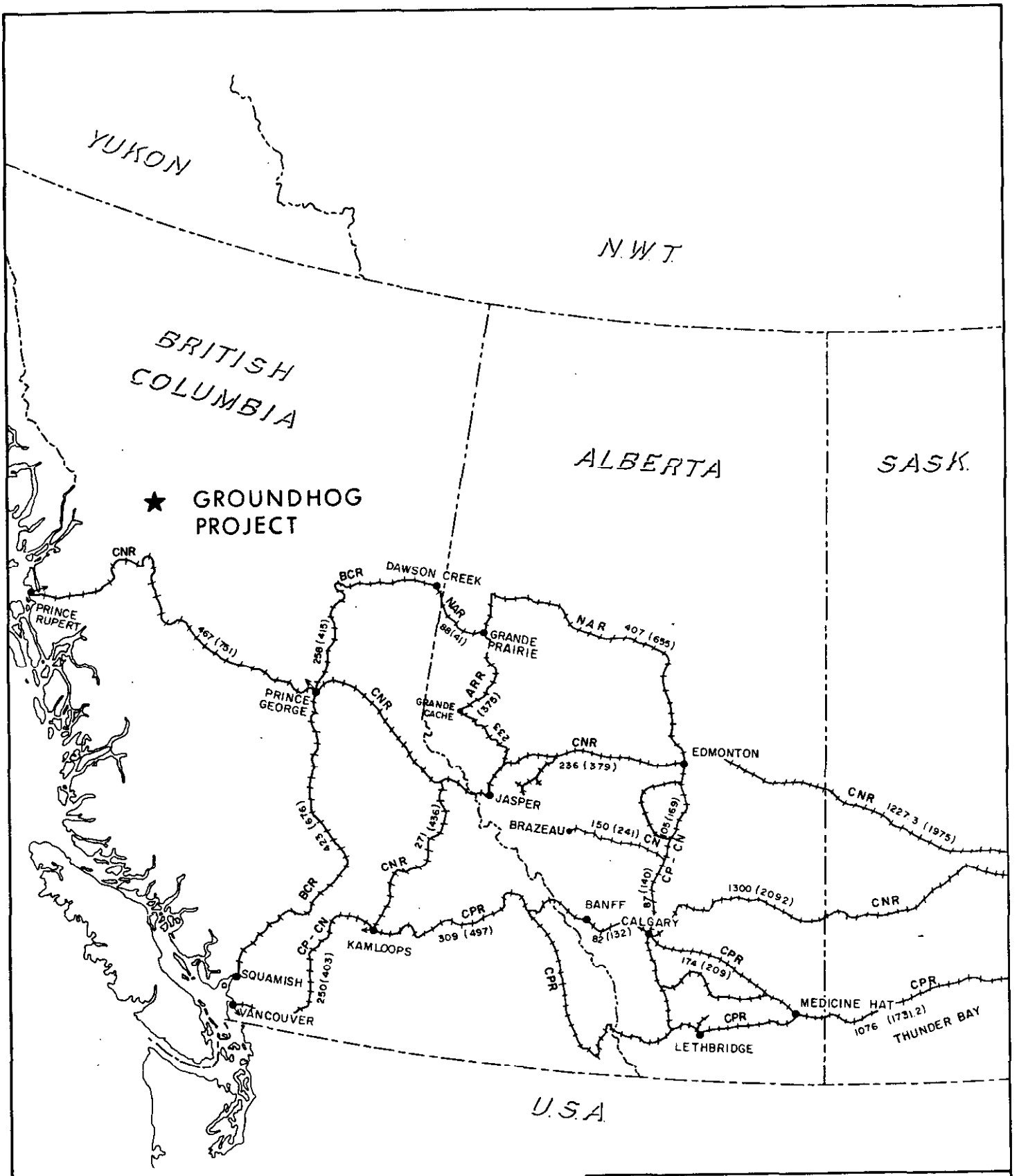
III. LOCATION AND ACCESSIBILITY

The Groundhog property is located in the Skeena Mountains of the Central Plateau and mountain physiographic province of northern British Columbia (latitude $56^{o}47'$ to $56^{o}48'$ and $128^{o}07'$ to $128^{o}31'$) approximately 180 air km (110 miles) northeast of Stewart, British Columbia.

The lease block covers a total area of 63.5 km^2 (24.5 mi^2) that have been divided in four lease blocks (see lease map).

The Groundhog property is approximately 120 km (75 miles) by air or 170 km (105 miles) by road from the community of Iskut.

The Groundhog property can be reached by travelling Highway 16 west from Prince George to the town of Kitwanga. From Kitwanga, Secondary Highway 37 is travelled to the community of Iskut. From Iskut, Highway 37 is travelled 38 km (23 miles) to the junction of Highway 37 and the forestry trunk road. The forestry trunk road is travelled approximately 18 km (10 miles) to the junction of the trunk road and the B.C. Railways railbed. The railbed is then travelled for 152 km (95 miles) to the northern boundary of the lease block.



ARR - ALBERTA RESOURCES RAILWAY (CNR OPERATOR)
BCR - BRITISH COLUMBIA RAILWAY
CNR - CANADIAN NATIONAL RAILWAY
CPR - CANADIAN PACIFIC RAILWAY
NAR - NORTHERN ALBERTA RAILWAY

100 50 0 100 200 STATUTE MILES
100 0 100 200 KILOMETERS

PETROFINA CANADA INC.

GENERAL LOCATION MAP

GR-GROUNDHOG PROJECT 79(2)A *(1)

SCALE 1" = 125 miles	DWN BY	DATE OCT. 1979
APPR BY R. J. TALBOT	FILE No.	

IV. PHYSIOGRAPHY

The Groundhog lease block is represented by four parcels of land approximately 63.5 km^2 (24.5 mi^2) in size situated in the Skeena Mountains of the Central Plateau and mountain physiographic province.

The topography on the northern block is one of gently rolling hills with muskeg areas situated throughout. The topography on the southern blocks is one of rolling hills to high cliffs.

The Groundhog area has a maximum relief of 850 km (approximately 2800 ft.) ranging from 1160 km (approximately 3800 ft.) to 2010 (approximately 6600 ft.). The slopes in the area are of moderate to steep relief varying from 5^o to 33^o.

There are three major creeks (Didene, Grizzly and Tahtsedle) in the immediate vicinity of the lease blocks. These creeks flow eastward as tributaries of the Spatsizi River. In the general area of the Groundhog coalfield there are three rivers with their headwaters near the Groundhog coalfield. The Skeena River originates 24 km (15 miles) northwest of the coalfield and flows southeasterly through the center of the coalfield. The Nass River heads 5 km (3 miles) west of the coalfield and flows southeasterly along its western edge. The Stikine River originates 32 km (20 miles) north of the Groundhog coalfield and flows northeasterly around the Spatsizi Plateau.

The forest cover in the area consists of mixed white and black spruce occasional decideous trees with scrub brush and grasses. Below the 1370 m (4500 ft.) level the flat areas are covered by dense forest and scrub brush, while above the 1370 m (4500 ft.) level there is only scrub brush, decideous bushes and grasses. The overburden in the area is thought to consist of three types: podzolic, glacial tills and organic bogs. The podzolic soils will consist of gray wooded earth developed on glacial till and alluvial lacustrine material.

Fish and wildlife are considered important resources in the area. The wildlife

concentrations are considered moderate and are thought to consist of caribou, goat, sheep, black bear, grizzly bear, moose, wolves, fur bearers and migratory waterfowl. Studies by fisheries indicate that fish volues are low. The varieties thought to be in the area are dolly, varden, rainbow and steelhead trout and coho.

V. GEOLOGY

A. Regional Geology

The Groundhog coalfield lies in the Skeena Mountains of the Central Plateau and Mountain physiographic province. The Skeena Mountains are a distinctive physiographic unit, being formed largely of folded sedimentary rocks of Upper Jurassic and Lower Cretaceous age. The principal rocks are black fine grained argillites, shales and dark greywacke. Limestone or rocks directly of volcanic origin are absent, igneous intrusions are few in number. The rock structures are extremely complex, the major folds averaging about 4 per mile with many overturned and recumbent outlines. Only in parts of the Groundhog Range, Upper Skeena Valley and Eaglenest Range do broad folds predominate. Most of the fold axes are nearly horizontal or plunge gently northwest (Holland 1964 p. 55, 56).

The mountainous areas within the map area are those underlain by the most competent rocks, i.e. conglomerates and sandstones. Areas of low relief are mostly underlain by less competent rocks such as mudstones and shales.

The rocks of the Groundhog coalfield belong to the Bowser Assemblage and are Upper Jurassic to Lower Cretaceous in age. The coalfield lies in the east central portion of the Bowser Basin. During the Upper Jurassic, shales, greywacke and conglomerate accumulated in a marine basin which was open to the west. Uplift in the Coast Mountains during latest Upper Jurassic and Lower Cretaceous resulted in the development of an inland basin. Available information suggests that the occurrence of coal in the Groundhog Range provides some evidence that the basin was filled in part by deltaic deposition (Southern and Armstrong 1966).

B. Stratigraphy

The rocks of the Bowser Assemblage have been divided into four units:

Lower Conglomerate
Lower Shale
Upper Shale
Upper Conglomerate

i. Lower Conglomerate

This unit is composed of coarse clastics mostly thick bedded sandstones and conglomerates. The conglomerate beds are interbedded with thin bedded greywacke or sandstone, siltstone and shale. This unit is more thinly bedded and finer grained near the top and grades into the overlying units. The coal seams in the unit occur near the top. They are thought to be uneconomical. The Lower Conglomerate is non-marine and thought to be 300 to 450 m (1000 to 1500 ft.) thick.

ii. Lower Shale

This unit includes interbedded shales, greywacke and sandstone with coal seams. The beds are mostly non-marine and lenticular being very discontinuous over great distances. Occasional marine sandstones, grey shales and shell coquinas occur. The unit is estimated to be from 450 to 760 m (1500 to 2500 ft.) thick.

iii. Upper Shales

This unit grades upward from the Lower Shales. It does not contain any coal seams. It has shales, sandstone and siltstone beds and some limy beds containing fossil plants. It is thought to be in the order of 1370 m (4500 ft.) thick.

iv. Upper Conglomerate

The Upper Conglomerate consists of conglomerate beds 15 to 60 m (50 to 200 ft.) thick with subangular to rounded pebbles. Sandstone and occasional shale beds are interbedded with the conglomerate. This unit is thought to be in the order of 300 m (1000 ft.) thick.

The above units have further been subdivided into "Lithosomes". The only lithosome of importance is called the coal-bearing lithosome. This is a group of poorly indurated rocks only well exposed in beds of high gradient streams. This unit is composed of the following rock type percentages: muddy rocks: 70 - 75%, carbonaceous units: 15 - 20% and sandstones: 10%. The strata are characteristically medium to thick bedded.

Within the lease blocks themselves there appears to be four coal seams present. The apparent thickness of the seams are as follows:

Seam 1 - 0.9 m
Seam 2 - 1.8 m
Seam 3 - 2.5 m
Seam 4 - 2.7 m

It is not known whether these seams remain at these thicknesses or become thinner or thicker. This cannot be ascertained without drilling. Stratigraphically these seams occur over a thickness of 37 m (120 ft.) to 43 m (140 ft.).

Associated with Seam 3 is a dark grey to black greywacke (fresh surface) and a highly fracture fissile shale. The greywacke occurs stratigraphically immediately above the coal seam. The fissile shale occurs between Seam 3 and 4, stratigraphically 3 m (10 ft.) below Seam 3 and approximately 9 m (30 ft.) above Seam 4. The distance between Seams 3 and 4 is 12 m (approximately 40 ft.)

At the present time only Seams 3 and 4 appear to be continuous and thick enough to be economical.

C. Structure

The Groundhog property represents four parcels of coal bearing lands. For discussion of the geological structures the blocks will be designated by geographic location, i.e. North area, South area, and Southeast area. For

example, the southeast area refers to the lease block furthest to the south and east.

Generally, throughout the map area, mapping indicated that there are many anticline-syncline structures throughout the area. The limbs of the structures vary from moderate dipping to very steeply dipping. As a result of the steepness of the limbs and the tight structures there has been a certain degree of faulting. Some of the faulting will be a result of tension releases along jointing plains and some of the faulting will have been responsible for the steepness of the structures. The jointing patterns are very regular, smooth surfaces, occurring approximately every .2 m. Due to the regularity of the jointing, in several areas, it has become so pronounced that it has overcome the bedding. In several cases, where faulting was indicated on the air photos, ground examinations in the area indicated that the apparent faulting was a result of jointing causing slump blocks. In these areas, there were slickensides occurring on joint planes indicating that there was some movement. The sharp valleys occurring perpendicular to strike are a result of the joints that parallel the valleys.

On the South area, there are coal zones present in each lease block. Ground examination and air photo work show that these zones are the same and therefore are thought to be continuous between each block. The coal occurs on the southwest limb of an anticline. In most cases, the limb is dipping from 15^{o} to 30^{o} to the southwest. The beds are striking at an average of 290^{o}. There has been faulting in the area (See Geology Map). However, due to the covered interval it is not possible to say how extensive the faulting is. The beds in the immediate area of the fault are dipping from 60^{o} to 70^{o} to the southwest. Displacement on the fault appears to be in the order of 3 m. The northeast limb of the anticline was found to be dipping at 60^{o}. The general shape of the anticline is monoclinal.

In the Southeast area there are a series of tight anticline-syncline pairs with very steeply dipping limbs. The axis of the structures are trending at 300 to 310^{o}. The limbs dip at 50^{o} to 70^{o}. There is some minor faulting on

this block thought to be a result of tension releases along jointing as a result of the tightness of the structures.

In the North area, the topography is quite a bit flatter than on other parts of the property. One of the reasons for this is the fact that the limbs of the anticline-syncline pairs are now dipping moderately (from 20^{o} - 46^{o}). The axis are trending at 295^{o}. The structures in this area appear to be more continuous than those in other areas of the lease block. There was no evidence of faulting in this area. Occasional slickensides were noted along the joint plains but movement was minor. It is thought that the movement was a result of tension releases along jointing.

In general, it should be noted that there are several anticline-syncline structures. However, because of the covered intervals, without detailed mapping it is not possible to speculate on their continuity. From the movement noted along the jointing and from the faulting that was evident, it should be expected that there will be at least one major fault in the area.

With the numerous structures present and the possibility of section repeats due to faulting there is a possibility that there will be a reasonable amount of strippable reserve on the property. However, without detailed mapping to delineate structures and drilling for further structure information and coal quality, it is not feasible to estimate any type of reserve.

i. Correlations

As shown by the geology map the coal is exposed in two areas of the property; the southern area and the northern area. Stratigraphic and structural information present indicates that the seams occurring in both areas are the same.

Schematic structure profiles have been drawn to show what the anticipated geology will be.

Profile A to A^1

The profile shows that there are several small anticline-syncline pairs that are bringing the coal seams closer to surface presenting possible stripping situations. Correlations of these seams are helped by the presence of a dark grey to black gaywacke present at all locations where the coal is exposed.

Profile B to B^1

This profile shows the correlation between the southern area and the northern area. It is felt that the 2.5 m coal seam (Seam 4) is the same seam in all locations. In the southern area it has been repeated by faulting. The 1.8 m coal seam (Seam 3) corresponds to the .9 m coal seam from the southern area. The difference in thickness is accounted for by lack of definition of upper and lower boundaries. The stratigraphy in the immediate areas of the coal seams corresponds in all locations.

VI. EXPLORATION PROGRAM

Should Petrofina decide to do further work on the Groundhog prospect the following is required:

1. Detailed Geological Mapping
2. Drilling (Diamond)

There are two options available to Petrofina. In the first instance, just detailed geological mapping will give enough information to justify holding or giving up leases. The other alternative is to do geological mapping with a small follow-up drilling program, near the end of the season. Due to these alternatives, the mapping program will be costed separately from the drilling. Should the two be run at approximately the same time, the total costs will be reduced by incorporating common costs:

A. Geological Mapping Summary Budget (See Detailed Budget)

Camp Costs	$22,955.00
Support Vehicles	11,900.00
Mapping	12,900.00
Communications	3,600.00
Labour Costs	58,800.00
Total	$110,155.00

B. Drilling Program Summary Budget (See Detailed Budget)

Camp Costs	$28,086.00
Fuel & Vehicle Support	3,514.00
Logistic Support	18,640.00
Geophysical Logging	9,025.00
Drilling Costs	142,320.00
Surveying Costs	3,600.00
Reclamation	3,150.00
Labour Costs	9,000.00
Office Costs	6,500.00

B. Drilling Program Summary Budget - Continued

Lab Analysis	33,600.00
Total	$257,435.00

C. Geological Mapping

1. Amount of time necessary to complete project.

Mobilization and Demobilization	10 days
Mapping Time	60 days
Total days	70 days

Total months to project completion:

$$\frac{70}{30} = 2.3 \text{ months}$$

2. Manpower

Geological Coordinator	1
Senior Geologists	2
Junior Geologists	2
Total Men	5

D, Camp Costs

Camp costs have been based on a three month minimum as this is the best rate that can be obtained for the summer season.

1 Staff Quarters (office, kitchen, toilet facilities) $1,000.00/mon. for 3 months	$3,000.00
1 Six man sleeper $850.00/mon. for 3 months	2,550.00
1 12 KU light plant $850.00/mon. for 3 months	2,550.00
Camp Maintenance $200.00/mon. for 3 months	600.00
Camp Set up	500.00
Mobilization & Demobilization f.o.b. Prince George $1,000.00/unit each way	4,000.00
Catering $17.50 per man/day for 5 men/70 days	6,125.00
Food transport, f.o.b. Smithers - $150.00/week for 10 weeks	1,500.00
Propane - 20 gals./day for 70 days at 50¢/gal.	700.00
Propane tank rental - $150.00/mon. for 3 months	450.00
Fuel for light plant 10 gals./day for 70 days at $1.40/gal.	980.00
Total camp cost	$22,955.00

E. Support Vehicles

2 - 4 x 4 trucks with winch (including kilometer allowance) $1000.00/month/truck for 3 months	$6,000.00
Truck Maintenance - $200.00/mon. for 3 months	600.00
ATU Rental - $1,000.00/mon. for 3 months	3,000.00
Fuel - 100 litres/day for 70 days at 26.5¢ per litre	1,850.00
Fuel Storage - 4000 litre tank at $150.00/month for 3 mon.	450.00
Total cost	$11,900.00

F. Mapping Costs

Office Supplies $300.00/month for 3 months	$ 900.00
Survey Equipment	1,000.00
Drafting - $2,000.00/mon. for 3 months	6,000.00
Creation of 1:5000 formline map	5,000.00
Total Cost	$12,900.00

G. Communications

Telephone - $200.00/mon. for 3 months	$ 600.00
Radio - $500.00/mon. for 3 months	1,500.00
Travel Expenses - $500.00/mon. for 3 months	1,500.00
Total cost	$3,600.00

H. Labour Costs

Supervising Geologist - $3,000.00/mon. for 6 months	$ 18,000.00
2 - Senior Geologists - $2,400.00/mon. for 6 months	28,800.00
2 - Junior Geologists - $1,500.00/mon./man. for 4 months	12,000.00
Total cost	$ 58,800.00

VII. DRILLING PROGRAM

Total Drillholes	Depth Drillhole (m) (ft.)	Total Depth
6 Drillholes (coal and structural information)	Variable	1200 m (4000 ft.)

Total Meterage	1200 m
Geological error (20%)	240 m
	1440 m

Drilling Rate

1 rig 6 m/hr. = $\frac{1440}{6}$ = 240 operating hours

Drilling hours -	240
Downtime (20%)	48
Total Drilling	288

Moves - 6 drillholes - 6 drill moves

Moving and Set-up Time

8 hrs. per move for 9 moves = 72 hours

Total hours to project completion

Drilling Hours	288
Moving Hours	72
Project set up & down	100
Total Hours	460

Total days to project completion (24 hours/day)

$\frac{460}{24}$ = 19 days

Total months to project completion (30 working days/month)

$$\frac{19}{30} = .6 \text{ months}$$

As it would be expected that the drilling program would be completed during the mapping program the camp and all costs will be run through on a one month minimum.

A. Manpower

Drillers	2
Helpers	2
Water Jack	2
Cat Operator	1
Geophysical Logger	1
Geologist	1
Cook	1
Cook's Helper	1
	11 men
10% overflow	1
Total Men	12 men

B. Budget Summary

Camp Costs	$ 28,086.00
Fuel & Vehicle Support	3,514.00
Logistics Support	18,640.00
Geophysical Logging	9,025.00
Drilling Costs	142,320.00
Surveying Costs	3,600.00
Reclamation	3,150.00
Labour Costs	9,000.00
Office Costs	6,500.00
Lab Analysis	33,600.00
Total cost	$257,435.00

C. Camp Costs

1 Kitchen-diner-storage	
$3,051/mon. for 1 mon.	$ 3,051.00
2 Eight man sleepers	
$1,032/mon./unit for 1 mon.	2,064.00
1 Wash trailer	
$1,046/mon. for 1 month	1,046.00
1 Office	
$350/mon. for 1 month	350.00
Generator 20 KV	
$1,500/mon. for 1 month	1,500.00
Camp Maintenance	
$300/mon. for 1 month	300.00
Camp Set-up	1,000.00
Move Camp in f.o.b. Prince George	
5 trucks/30 hours round trip/$45/hr.	6,000.00
Move Out	6,000.00
Sub-Total	21,311.00
Cook $55/day for 19 days	1,045.00
Cook's Helper $45/day for 19 days	855.00
Sub-Total	1,900.00

Camp Costs - Continued

Catering $17.50/man day for 228 man days	$ 3,990.00
Food Transport f.o.b. Smithers $150.00/week for 3 weeks	450.00
Propane - 30 gal./day for 19 days at .50/gal.	285.00
Propane tank rental - $150/mon for 1 month	150.00
Sub-total	4,875.00
TOTAL CAMP COSTS	$28,086.00

D. Fuel and Vehicle Support

Fuel - Gas & Diesel	
400 litres per day for 19 days at 26.5¢/litre	2,014.00
Fuel Storage	
2 - 4000 litre tanks at $150/mon./tank for 1 mon.	300.00
Truck Rental (including kilometre allowance)	
4 x 4 with winch $1,000/month for 1 month	1,000.00
Truck Expenses	
$200.00/month for 1 month	200.00
Total Cost	3,514.00

E. Logistics Support

Move in Dozer f.o.b. Smithers	
15 hrs. at $45/hr.	$ 675.00
Move Out	675.00
Dozer Support	
D8 with winch $65/hr. for 19 days	
Minimum 14 hr./day	17,290.00
Total Cost	$ 18,640.00

F. Geophysical Logging

Truck and Engineer		
Caliper		
Slimline Neutron		
Sidewall Density		
Gamma - Neutron		
Focus Beam	$475/day for 19 days	$9,025.00

G. Diamond Drilling and Drilling Supplies

Mobilization and Demobilization	
$4,000/rig in and out	$4,000.00
Drilling Cost	
$93.50/metre (28.50 ft.) for 1440 m	134,640.00
Casing, cost of materials $1.00/metre for 1440 m	1,440.00
Core boxes $7.00/box for 320 boxes	2,240.00
Total Drilling Costs	$ 142,320.00

H. Surveying Costs

Four man survey party $400/day for 5 days	$ 2,000.00
4 x 4 Ground Support $1,000/mon. for 10 days	330.00
4 x 4 Operating Costs $500/mon. for 10 days	170.00
Subsistence 17.50/man/day for 20 man days	350.00
Survey Equipment	500.00
Survey Materials	250.00
Total costs	3,600.00

I. Reclamation

Drillsite reclamation - 6 sites at $150/site	$ 900.00
Erosion Control - 30 miles at $15/mile	450.00
Reseeding and Fertilizing $60/mile for 30 miles	1,800.00
Total costs	3,150.00

J. Labour Costs

Supervising Geologist	
$3,000/month for 3 months	$9,000.00

K. Office Costs

Drafting $2,000/month for 2 months	$ 4,000.00
Communications - $1,000/mon. for 1 month	1,000.00
Office Supplies $500/month for 1 month	500.00
Travel Expenses	1,000.00
Total cost	$ 6,500.00

L. Lab Analysis

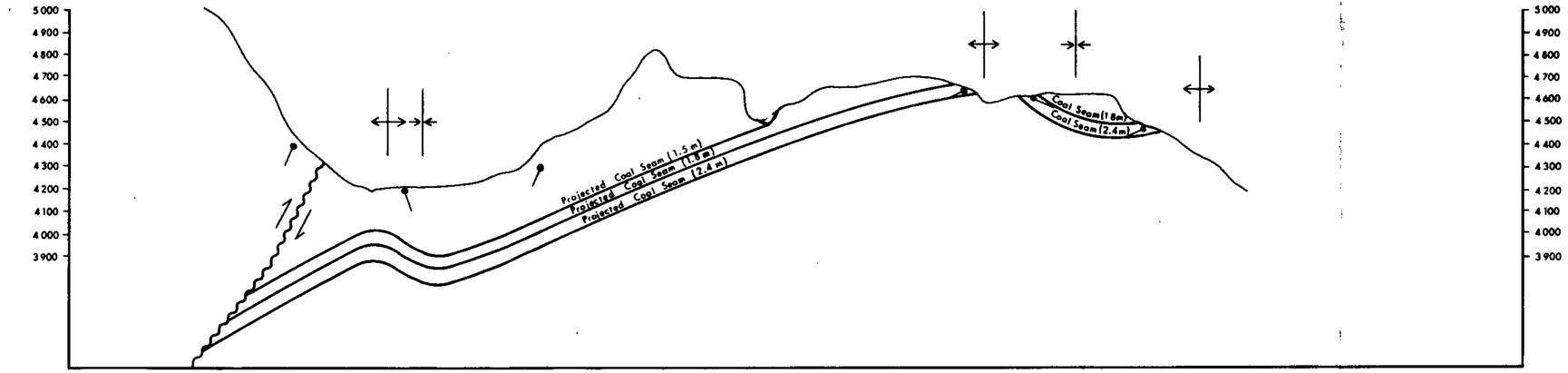
As per flow sheet for coal analysis:

- supplied on request

-- $1,400/sample

6 drillholes - 4 samples per hole - 24 samples

Total cost $33,600.00



LEGEND

- DIP
- SYNCLINE
- ANTICLINE
- PROJECTED COAL ZONE
- THRUST FAULT
- RELATIVE DIRECTION OF FAULT DISPLACEMENT

Horizontal Scale : 1:50 000
Vertical Scale : 1:500

PETROFINA CANADA INC

GROUNDHOG PROJECT

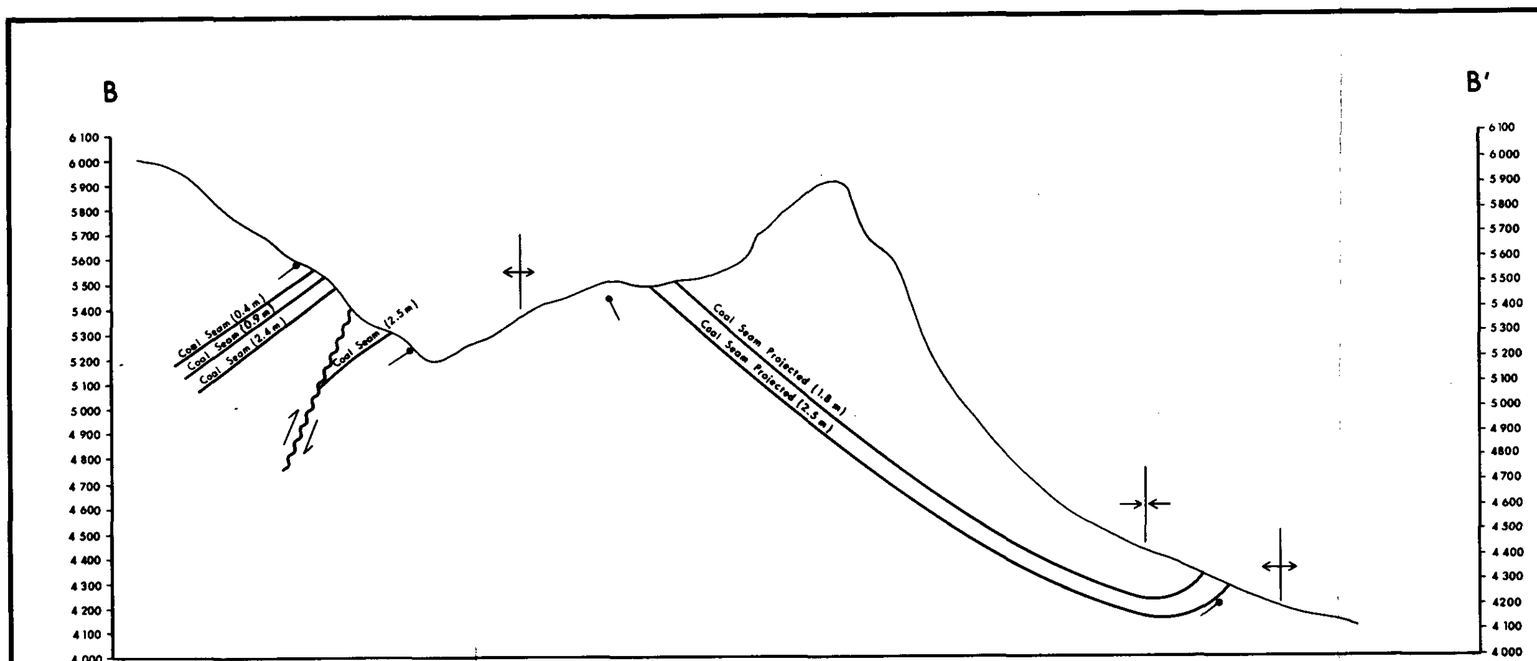
SCHEMATIC STRUCTURAL PROFILE

A–A'

SCALE :	DRN BY : R.J. Talbot	DATE : NOV. 1979
APPR BY :	FILE No. 3	

GR-GROUNDHOG PROJECT 79(2)A *(1)

[redacted]



LEGEND

- DIP
- SYNCLINE
- ANTICLINE
- PROJECTED COAL ZONE
- THRUST FAULT
- RELATIVE DIRECTION OF FAULT DISPLACEMENT

Horizontal Scale : 1:5 000
Vertical Scale : 1:500

PETROFINA CANADA INC

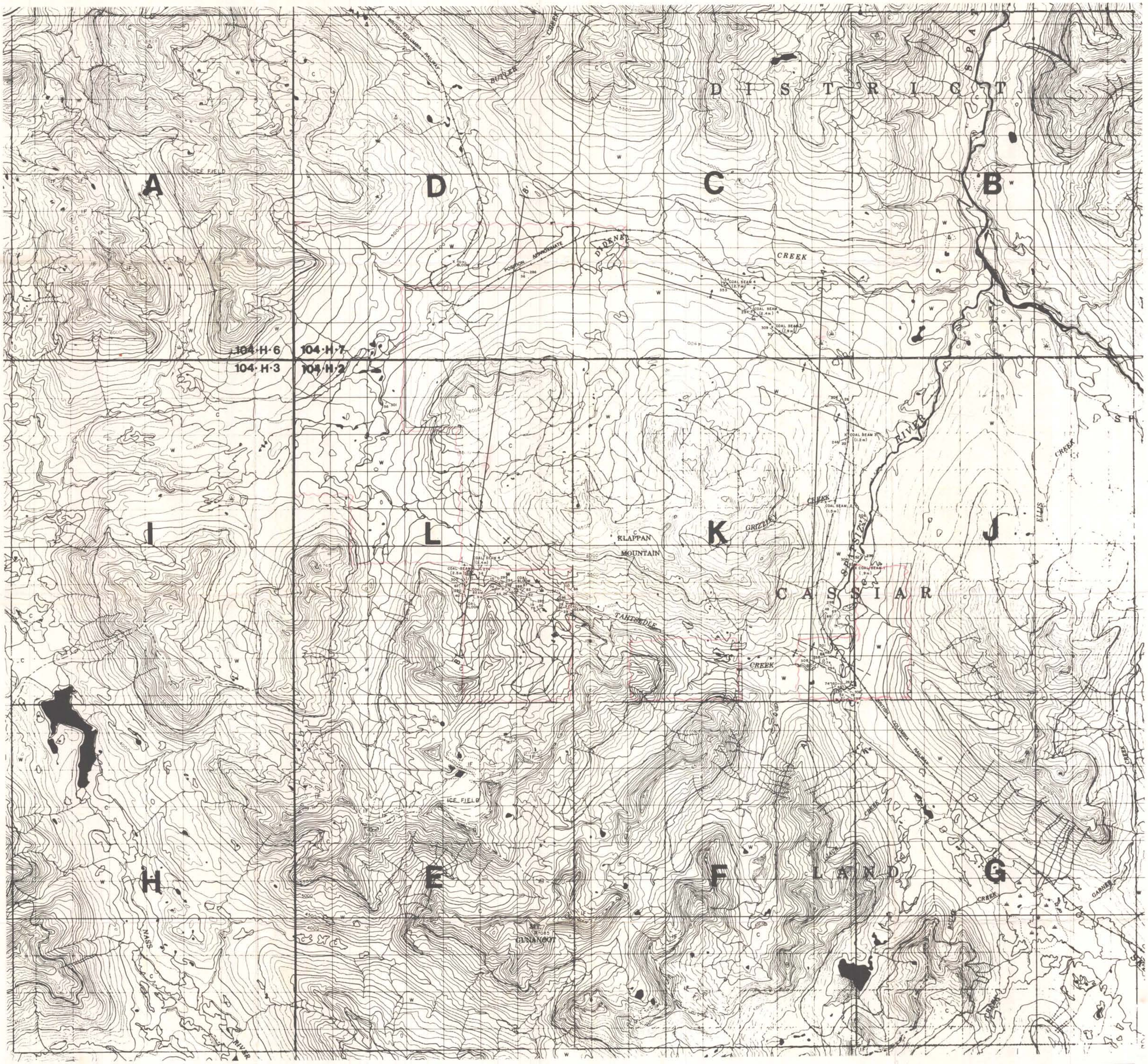
GROUNDHOG PROJECT

SCHEMATIC STRUCTURAL PROFILE
B – B'

SCALE	DWN BY : R.J. Talbot	DATE : NOV. 1979
APPR BY :	FILE No. 4	

GR- GROUNDHOG PROJECT 79(2)A *(1)

102



1 : 50,000

Miles 1 0 1 2 3

Kilometers 1 0 1 2 3 4 5

LEGEND

- JOINT PLANES
- DRILL HOLE LOCATION
- SCHEMATIC STRUCTURE PROFILE A — A'
- SYNCLINE
- ANTICLINE
- DIP & STRIKE

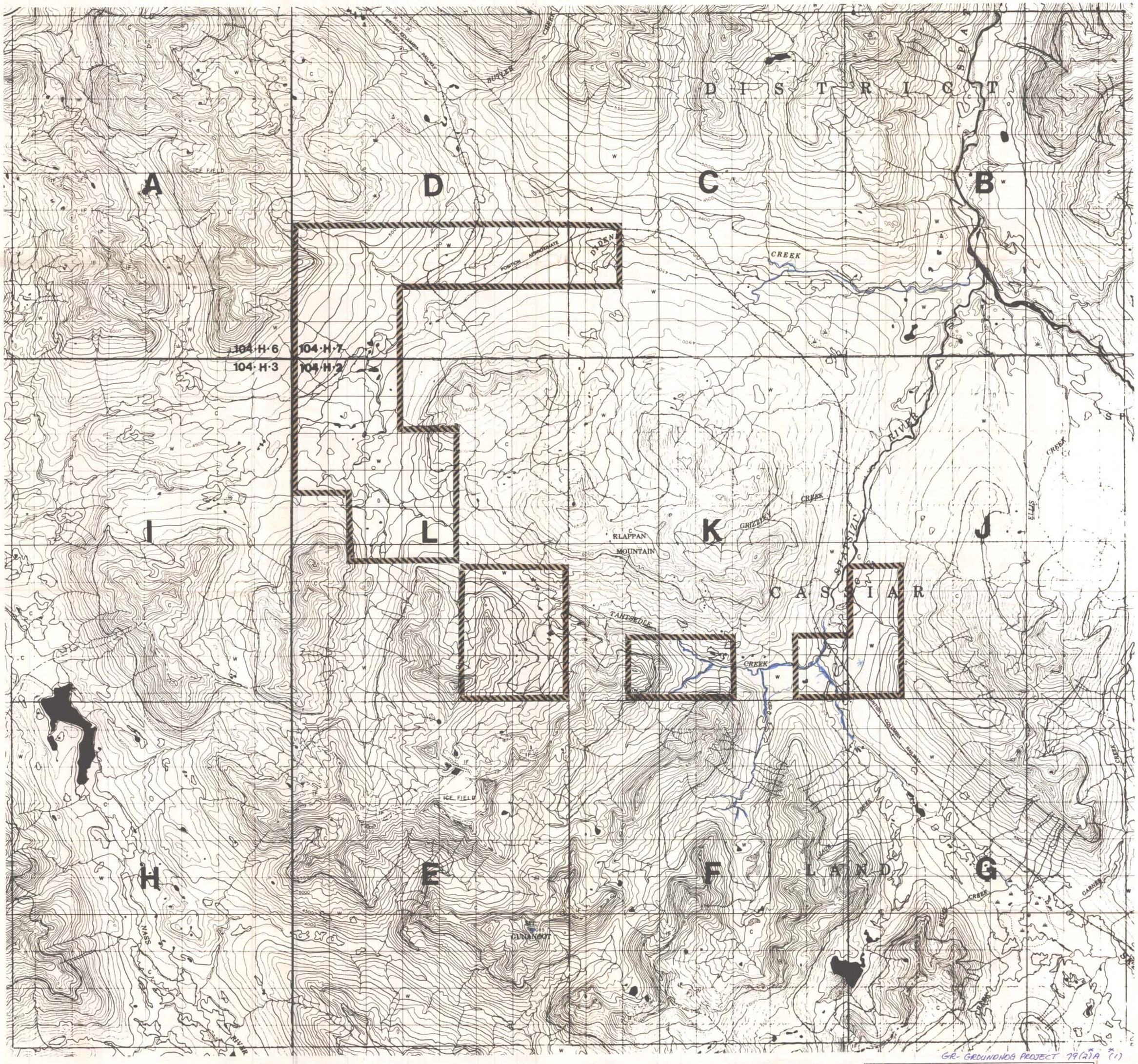
PETROFINA CANADA INC.

GROUNDHOG PROJECT

GEOLOGY MAP 102 (2) H01

SCALE : 1: 50 000	DWN. BY : R. J. TALBOT	DATE : OCT. 5 / 79
APPR. BY :	FILE No.	

GR-GROUNDHOG PROJECT 79(2*)A*(1)



1 : 50,000

Miles 0 1 2 3

Kilometers 1 0 1 2 3 4 5

PETROFINA LEASE BOUNDARY

GR- GROUNDHOG PROJECT 79(2)A *(1)

PETROFINA CANADA INC.

GROUNDHOG PROJECT

COAL LICENCES

5191 to 5214
INLUSIVE

SCALE: 1: 50 000	DWN. BY: R.J TALBOT	DATE: OCT. 5/79
APPR BY:	FILE No. 2	

102

M02