PR-PINK MOUNTAIN 71(1)A

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NICKEL HILL MINES LTD.

Report

on the

Coal Deposits of Pink Mountain, B.C.

by

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November 30, 1971

ALRAE ENGINEERING LTD.
VANCOUVER, B.C.
ENGINEERS & GEOLOGISTS

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INTRODUCTION

One hundred coal licences were located in January 1971, by Nickel Hill Mines Ltd. on, and in the vicinity of Pink Mountain, in the Peace River Land District of British Columbia. The area is located between 80 and 120 miles northwest of Fort St. John and lies to the west of the Alaska Highway, on the eastern fringe of the Rocky Mountain Foothills.

Acting on the instructions of Nickel Hill Mines Ltd. Alrae Engineering Ltd. of Vancouver conducted a program of geological mapping, bulldozer trenching and sampling in order to evaluate the number and dimensions of coal seams present and to evaluate the suitability of the coal for mining and marketing. Work was carried out in the period May 26 to September 14, 1971. The work was done under the supervision of Bruce Woodsworth (May 26 to July 23) and F. Guardia, P.Eng. (July 24 to September 14).

The locations of the 100 coal licences are shown on the Location Map (figure 1) and are distributed in five groups as follows:

Pink Mountain Group	37 licences
Stone Group	8 licences
Spruce Mountain Group	11 licences
Cypress Creek Group	32 licences
Chicken Creek Group	12 licences

Due to the very large area to be covered priorities were set for the first year's work. The greater portion of the geological work was conducted on the southern portion of Pink Mountain itself as this was an area of known coal showings and it had excellent access facilities. The Cypress Creek and Spruce Mountain Groups were each accorded 5 days reconnaissance mapping from fly camps put out by helicopter. No work was done on the Chicken Creek or Stone Groups as the former, despite extensive river sections through the favourable Gething Formation has no known coal showings, and the latter group does not appear to have the favourable Formation within minable depth.

This report sets out results of the work done on the Pink Mountain, Spruce Mountain and Cypress Creek Groups and includes descriptions of physical work, the results of mapping and sampling and general conclusions drawn from the work. The report is intended for the records of Nickel Hill Mines Ltd. and for submission to the Department of Mines and Petroleum Resources for assessment work purposes. Costs of the program appear at the end of the report.

LOCATION AND ACCESS

The coal licences lie within an area bounded by 56° 50' N and 57° 20' N latitude and 122° 42' W and 123° 05' W longitude. They lie between 80 and 120 miles northwest of Fort St. John, B.C. and between 8 and 40 miles west of the Alaska Highway.

Roads suitable for standard drive vehicles for most of the year lie within 12 miles of the Cypress Creek Group, 6 miles of the Spruce Mountain Group and 12 miles of the Chicken Creek Group. Thereafter access is by horse or all-terrain vehicle using hunting trails and numerous seismic lines, or by helicopter. The Stone Group straddles the 15-mile dirt access road to Pink Mountain from the Alaska Highway at Mile 147. Pink Mountain itself is served by a narrow but adequate road along most of the length of its summit, put in some years previously by oil and gas exploration outfits. Recently another oil rig access road has been constructed along the southern part of the western flank of Pink Mountain, where drilling is currently in progress.

The recent extension of the P.G.E. Railway from Fort St. John to Fort Nelson passes within 55 miles of Pink Mountain.

The licenses lie on the more easterly of the Rocky Mountain Foothills and occupy country that varies from high alpine grassland (tree line is around 5000' at these latitudes) to densely wooded country in the broad structurally-controlled valleys. Spruce and balsam are dominant species with some stands of jack pine, poplar and alder. Some of the bottom land in the vicinity is used to grow hay and oats and some is open-range cattle grazing. The entire area is popular for hunting moose and caribou.

HISTORY

The nearest deposits of minable coal known to exist in this part of B.C. are located at Portage Mountain and Butler Ridge in the Peace River Area some 65 miles to the south. Intermittent small tonnage extraction of these deposits went on through the first half of this century for local use. No significant extraction has taken place in the last 20 years.

E.J.W. Irish (1) writes .... "--- Thin coal seams outcrop as far north as Halfway River, but none of minable thickness are known. Hage (1944) reported a coal seam more than 5 feet thick at the base of the Lower Cretaceous strata on Pink Mountain. ---" Irish considered that coal seams numerous in the southern half of the Halfway Map area decreased rapidly in number and thickness northwards.

In his report (2) of November 17, 1970, Joseph Sullivan, P.Eng., confirms the existence of a "more than 5 feet thick" coal seam on the southern flank of Pink Mountain and enumerates several intersections of coal in oil and gas wells in the general vicinity of the licences. In addition he observed some coal outcroppings in the road-cut up the southeast part of the mountain.

PROPERTY

100 Coal Licences are registered in the name of Nickel Hill Mines Ltd. in the vicinity of Pink Mountain in the Peace River Land District of British Columbia. The licences were staked under the provisions of the Coal Act of British Columbia and are grouped as follows:

Group	Licence Nos.	No. of Licences
Pink Mountain	1919 - 1955	37
Stone	1956 - 1963	8
Spruce Mountain	1964 - 1974	11
Cypress Creek	1975 - 2006	32
Chicken Creek	2007 - 2018	12

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(1) E.J.W. Irish, 1970, G.S.C. Paper 69 - 11, Halfway Map Area, British Columbia, p. 88.

(2) Joseph Sullivan, November 17, 1971, A Report on the Pink Mountain Coal Deposit in the Halfway River Area, B.C. Submitted to the A.B.C. Syndicate.

PINK MOUNTAIN GROUP

PHYSIOGRAPHY

Pink Mountain and its southerly continuation, Spruce Mountain, form a long prominent ridge isolated from the main mass of hills to the west, and representing the more easterly of the strong anticlinal structures that make up the Eastern Foothills. The present-day topography is largely an expression of underlying structure: the valleys east and west of Pink Mountain are floored by soft marine shales of the Buckinghorse Formation which lie in shallow synclines, while the Pink Mountain ridge itself is mainly formed of the more resistant sandstone and limestone lithologies of the Gething Formation and the Triassic rocks, which are up-folded in the core of the Pink Mountain Anticline.

Erosion has breached the Gething Formation on the anticline to expose the underlying Jurassic and Triassic strata. The most prominent breach is that cut by the Halfway River which has separated Pink Mountain and Spruce Mountain. A similar breach is seen at the north end of Pink Mountain where a deep transverse valley with streams draining east and west appears to have some fault control. Deep gullies draining the west flank of Pink Mountain have eroded into the core of the anticline, exposing the Triassic and attesting to the assymetry of the anticlinal structure.

The assymetrical box-type anticlinal structure of Pink Mountain has left much of the hard sandstone of the Gething with generally flat-lying dips across most of the summit area, giving rise to prominent cliffs along much of the upper flanks of the mountain and leaving masses of talus obscuring much of the steeper lying strata lower down on the flanks.

Rock outcrops are abundant over much of the mountain above treeline, but most of the outcrop is of the more resistant sandstones, while a great deal of the less resistant, coal-bearing strata are recessive and ill-exposed. Below treeline much of the exposure is obscured by talus and reliable outcrops are usually confined to the creek gullies. The most valuable location for measurable outcrops was in the road-cut on the southeast flank of the mountain.

Evidence of glaciation on Pink Mountain is found in erratic boulders and in isolated pockets of gravel. Such material includes volcanic and granitic rocks and in some instance boulders of Triassic limestone have been dumped on top of the Gething Sandstones.

The strongest glacial features are seen at the south end of Pink Mountain where cliffs form the head of a small cirque. Huge portions of the cliffs (including some coal seams) have been plucked away and deposited intact lower down at the head of a large talus pile. On either side of the talus pile small lateral moraines are discernable.

Pink Mountain derives its name from the pink colouration of the Gething rocks in several localities on the southern part of the mountain. This colouration varies from pink to red, purple, orange, yellow and white and may be traced laterally into normal, unaltered buff and grey sandstones and dark grey siltstones. Although it is mainly the basal rocks of the Gething that are so affected, there are two widely separated localities where the normally very dark Fernie shales of the

Jurassic have been burned red, orange and white.

Where dark siltstones have been altered and bleached they may display a sub-conchoidal fracture and some more platey lithologies may have a distinct ring similar to fired earthenware. At the foot of the main talus slope on the southeast part of the mountain every transition is seen between unaltered Gething sandstone and a vesicular glass which shows clear flow structure and included fragments of Fernie-type shale.

The evidence points strongly to fires burning with intense heat at or close to the bedrock surface. Two combustible substances are present in the Pink Mountain Anticline: coal in the Gething Formation and natural gas in the unexposed Mississippian. In one area near the base of the talus at the southeast end, a coal seam is exposed in the middle of a zone of intense alteration and weathering, stratigraphically close to the base of the Gething. This seam shows some alteration but no sign of having been burned. The writer concludes that gas has leaked to the surface from an anticlinal trap, along axial plane faults and subsequently along bedding, and there has been burned following ignition by lightning or bush fires. Furthermore, burned and discoloured debris found making up much of the lateral moraine on the east side of the cirque, point to a pre-glacial age for much of the burning. However, at the locality where the coal seam is exposed in the burned area, large blocks of red-stained and brecciated sandstone which have been recemented by iron-oxides appear to have been explosively ejected onto existing talus, suggesting some post-glacial burning.

STRATIGRAPHIC RELATIONSHIPS

The following table of formations present in the Trutch Map Area is taken from B.R. Pelletier and D.F. Stott (1963)[1]:

System	Series	Group	Formation and Thickness (feet)	Lithology
Cretaceous	Lower Cretaceous	Fort St. John	Sikanni (350 - 380)	Four units of fine-grained, cross-bedded marine sandstone, separated by sideritic marine shales.
			Buckinghorse (3,000 +)	Dark grey marine shale with sideritic concretions; glauconitic sandstone and pebbles at or near base.
		Bullhead	Gething (0 - 1,180)	Fine-grained, cherty, marine sandstone; minor conglomerate and carbonaceous shale, rare thin coal seams.
			[2]Regional erosional unconformity; bevels rocks of succeedingly older age northward and eastward.	
			Beattie Peaks (0 - 200?)	Thinly interbedded fine-grained marine sandstone, siltstone and shale.
			Monteith (0 - 700)	Alternating units of thick-bedded fine-grained sandstone and silty mudstone; massive, quartzose, fine to coarse-grained sandstone and minor conglomerate.
Jurassic			Fernie (0 - 650)	Black calcareous siltstone and shale with phosphatic chert; rusty weathering marine shales; thinly interbedded sandstone, siltstone and mudstone.
Triassic		Schooler Creek (McLearn, 1921)	Pardonet	Bituminous limestones, and dark grey, platy, calcareous siltstones.
			"Grey Beds" (460 - 1, 150)	Grey limestones, dolomite and coarse sandstones

1: B.R. Pelletier and D.F. Stott, 1963, G.S.C. Paper 63 - 10, Trutch Map Area, British Columbia, 94 G.

2: This table omits reference to the Cadomin Formation which occurs above the regional unconformity and is important in the Halfway Map Area. Here it forms part of the base of the Gething.

The Trutch Map Area Report notes that the Fernie Formation lies disconformably on the Triassic and is gradational into the overlying Cretaceous and Jurassic Monteith Formation. However, a regional unconformity, marking the base of the Gething and Cadomin Formations, successively removes the early Cretaceous Beattie Peaks Formation, the Monteith Formation, the Jurassic Fernie Formation and finally the Triassic strata, as it is traced northwards from the Pine River Foothills Area.

At Pink Mountain the writer notes that the marine shale sequence of the Fernie Formation is abruptly terminated against overlying conglomerate and grit which is possibly equivalent to the Cadomin Formation, and although there is no detectable angular unconformity, the sequence is not gradational as described elsewhere by Pelletier and Stott. It is considered that the unconformity at the base of the Gething and Cadomin Formations is present at Pink Mountain and that the Monteith and Beattie Peaks Formations have been entirely eroded.

The base of the Buckinghorse Formation of the Fort St. John Group at Pink Mountain is marked by a distinctive 12" band of poorly consolidated black chert pebbles, exposed on the mountain access road. Immediately above this band are very dark grey marine shales of the Buckinghorse Formation, which stand in sharp contrast to the underlying, lighter-coloured quartzites, siltstones and sandstones of the Gething Formation.

GETHING FORMATION

In the course of the present mapping an attempt was made to measure and describe a complete section through the Gething Formation. Figure 2 is a compilation from three localities; a road cut on the access road up the southeast flank of the mountain, cliffs at the south end and at the saddle located approximately one mile south of the summit of the mountain. Due to a series of persistently recessive beds close to the base of the formation the section is not complete and although most thicknesses measured are thought to be reliable the thicknesses of the coal seams on the diagram are shown as those measured on the actual section, which, in some cases, for reasons discussed later, are thought to represent local tectonic thickening of the seams.

The overall thickness of the Gething Formation on Pink Mountain was measured to be close to 1020 feet. Details of the lithologies are listed on Figure 2, but for the purposes of mapping the Gething was divided into seven units (figs. 2 and 3) as follows:

Unit	Thickness feet	Lithology
A. Top Sandstone	95	Massive to well-bedded med. grained quartzitic and arkosic sandstone.
B. Upper Coal Unit	156	Alternations of quartzite, siltstone and mudstone with several thin coal seams and partings in lower portion.
C. Marker Grit	40	A distinctive massive, medium-to coarse-grained light grey to buff, arkosic sandstone with grit and pebble beds and coarse plant remains.
D. Main Coal Unit	431	Alternations of well-bedded to massive sandstone, quartzite, siltstone and mudstone with coal seams and partings.
E. Cliff Sandstone	94	Locally massive, medium-to coarse-grained sandstones with grit and conglomerate beds.

F. Lower Coal Unit 178 Alterations of sandstone, quartzite and siltstone with coal seams.

G. Basal Grit 25 Very coarse-grained quartzitic grit with minor chert-pebble conglomerate lenses (may be equivalent to Cadomin Formation).

Mapping of these units, away from trenches, road-cuts and cliffs, where relationships of lithologies rather than individual beds may be seen, is rendered very difficult by the erosional resistance of most of the many similar sandstones throughout the unit. Despite abundant outcrops over much of the mountain top, it is rarely possible to recognize individual beds, especially in areas of minor folds. Consequently Figure 3 only shows differentiation within the Gething where individual units have been positively identified.

STRUCTURE

Pink Mountain and its continuations at Chicken Creek and Spruce Mountain mark one of several sharp narrow anticlines that define the eastern edge of the Foothills. These structures have a northwesterly trend and most have a length many times in excess of their width. The exposure of the Gething Formation which marks the Pink Mountain structure is some 2.5 miles wide but 30 miles long.

The Pink Mountain Anticline in general is an assymetrical box-type structure with moderate to steeply dipping flanks and low easterly dips across the broad apical region. However, this broad structure is complicated by numerous minor folds with axes parallel to the principal anticlinal axis and by faults of similar trend.

Minor folds are readily observed on the southeast flank of Pink Mountain where the road-cut provides good reliable outcrops. A shallow synclinal structure complicated by several sharp small-scale flexures gives rise to the roughly circular outcrop of the Marker Grit. East of this structure a highly assymetrical anticline affects the entire Gething Formation. This anticline is locally and abruptly overturned to the east in the region immediately north of the lower of the southerly switchbacks on the access road.

Similar folds are seen on the southern part of the west flank of the mountain. The most prominent of these is the small synclinal structure in the landslide area south of the gas drilling operation, where the Main Coal Unit has been downfolded into the Lower Gething rocks. The flanks of this syncline are moderate to very steeply dipping whereas the core has very gentle dips.

These minor folds are generaly very irregular at the south end of the mountain and abrupt reversals of dip may be seen over distances of a few feet. Study of air photographs suggests that although the subsidiary folds are continued northwards in the unmapped portions of the flanks of Pink Mountain they become more regular in attitude.

Faults parallel to the axis of the principal anticline are thought to exist where shown on Figure 3 although dips and throw were not measureable in the field. Air photographs suggest more faults than these exist and one fault-like lineament is seen passing through the areas of red-stain and burning mentioned earlier.

A major fault appears to cross the anticlinal structure under the valley of the Halfway. On the extreme southwest of Pink Mountain a ridge underlain by moderately dipping Gething rocks is isolated from the main mass of the mountain by a straight gully that appears to be aligned with an area on Spruce Mountain where the Buckinghorse Formation abuts directly against near horizontal Gething rocks. The latter situation could either result from faulting as indicated or be the result of a thrust as shown on the mapping of Spruce Mountain by the G.S.C. However, such a thrust is absent on the east flank of Pink Mountain, where mapped.

COAL SEAMS

Several coal seams and partings previously unsuspected were found in the course of the mapping and trenching on Pink Mountain. The majority of these are shown on Figure 2 with the stated thickness being that actually measured in compiling the section. However, it is apparent that thicknesses measured are very local and are largely controlled by local structural features previsouly described. In addition the situation is made more complex by several of the better coal showings having a readily demonstrable cross-cutting relationship to the surrounding strata.

The seam P-1 was identified at three localities on the road-cut on the east flank of the mountain. At its most southerly exposure it was measured to be approximately 22 feet thick but one contact was seen to be highly irregular due to squeezing into joints in the stratigraphically overlying sandstone. Significantly this exposure is on the overturned flank of the anticlinal structure referred to above. The next exposure of the seam is some 1300 feet to the north, where the seam is almost vertical and 8 feet wide and unlike the first exposure, which appeared to be a mass of bright coal with little detectable dirt or ash seams, shows original stratification and some dull muddy partings. The third exposure is a further 450 feet to the north. Here the seam is 7 feet wide and dips steeply to the east. It is composed of irregular lenses, blebs and particles of bright coal and much shale. The entire seam at this point appears to be brecciated in a manner that has allowed admixture of the coal with overlying and underlying strata. A trench bulldozed out some 1600 feet further along strike hit a zone of reddening and oxidation similar to that noted elsewhere and attributed to burning of gas seepages, and the seam was not found. Instead its stratigraphic position was occupied by a dark red soft clayey seam that might represent the non-combustic residue of the coal. The same seam exposed in a bulldozer trench on the west flank of the mountain was found to be only 18" thick.

An exposure of coal of excellent appearance, measuring 50 feet in strike length and appearing to have a seam thickness of between 35 and 40 feet thick, was located some 200 feet southwest of the lower switchback on the south end of the mountain. An attempt was made to bulldoze out an exposure of this coal along strike but it was
f
found that the coal was merely a bulge formed by the coalescence of three seams none of which exceeded 6" in thickness.

The coal seam referred to in earlier reports as being in excess of 5 feet thick is located on the north side of the saddle south of the mountain summit. The seam was exposed by widening the existing road-cut and it was found to be 12 feet thick and to lie 41 feet above the base of the Gething. A widening of the road-cut on the south side of the saddle revealed an entirely similar looking coal, 20 feet wide as exposed, but cutting across bedding at almost 90°. Similar smaller coal "injections" were seen nearby occupying joint fractures in the siltstones. These exposures on the south side of the saddle are in rocks that are stratigraphically somewhat higher than the seam exposed on the north side of the saddle, but it is probable that the coal is derived from the same seam.

Numerous other instances of coal swells occurring laterally along seams and of coal apparently being squeezed across stratification along joints and bedding, have been recorded in the mapping. Such phenomena are related to locally intense deformation in strata of widely differing competence, under which the coal becomes highly mobile and can be injected into the more competant rocks. The effects of such irregularities on the cost of exploration and mining cannot be overstressed.

COAL ANALYSES

Samples of coal exposed at surface were taken from seams that appeared to be of minable widths, as follows:

Sample No.	Seam (as indicated on Fig. 2	Seam width sampled (feet)	Description
534	P - 1	22 (approx)	Sampled 42 feet horizontally in crushed and friable coal with minor shaley lenses.
536	P - 1		Coherent coal lumps from above, lacks highly crushed material that has admixed shale.
535	P - 2	3.5	Broken friable coal with clay wash from surface weathering.
537	"P - 10"	10 (approx)	15 feet horizontally across highly crushed, friable and dirty coal. The exposure is apparently a lense formed by coalescence of 4 seams (see fig. 2)
538	Bottom) seam)	12	0 - 15' horizontally
539	")	"	15 - 25' "
540	")		25 - 30' "
541	Bottom) seam)	20	Two samples taken across 20 feet wide coal, cross cutting strata. Believed to be derived
542	injection)	"	from same seam as samples 538 - 540. Each sample 10 ft. wide.

These samples were submitted to Coast Eldridge of Vancouver for analysis. The results of analyses are as follows:

Sample No.	Condition	Surface Moisture	Inherent Moisture	Ash	Volatile Matter	Fixed carbon	Calorific Value (B. T. U's per pound)	Sulphur	Free Swelling Index
534	as rec'd	11.02%	14.54%	8.87%	30.72%	34.85%	8,533	4.64%	-
	air dried	-	16.34%	9.97%	34.53%	39.16%	9,590	5.22%	0
536	as rec'd	5.62%	10.26%	5.01%	31.37%	47.74%	10,453	5.59%	-
	air dried	-	10.87%	5.31%	33.24%	50.58%	11,075	5.92%	0
535	as rec'd	12.80%	17.34%	9.60%	30.89%	29.37%	7,238	0.69%	-
	air dried	-	19.89%	11.01%	35.43%	33.67%	8,300	0.79%	0
537	as rec'd	12.67%	5.08%	6.72%	29.59%	45.94%	10,692	5.60%	-
	air dried	-	5.82%	7.70%	33.88%	52.60%	12,243	6.41%	0
538 -	as rec'd	16.12%	7.78%	3.00%	22.90%	50.19%	9,215	5.04%	-
540 (average)	air dried	-	9.33%	3.56%	27.83%	59.79%	10,969	5.99%	0
541 & 542	as rec'd	5.27%	5.96%	1.49%	25.53%	61.73%	11,839	6.11%	-
(averaged)	air dried	-	6.29%	1.58%	26.96%	65.17%	12,498	6.45%	0

Whereas the general properties of these samples indicate that the Pink Mountain coals may be of acceptable coking standard, the exceptionally high sulphur in all but one of the samples, renders them unmarketable in their present state.

In order to test the possibility of the sulphur being a surface phenomena, Nickel Hill Mines diamond drilled into the P - 1 seam to obtain a fresh sample with better than 100 feet of cover. Such a sample would also provide a more reliable Free Swelling Index than surface material. The sample of core from seam P - 1 was analysed by Commercial Testing and Engineering Co. as follows:

Proximate Analysis - Seam P - 1

	As received	Dry Basis
% Moisture	0.48	-
% Ash	5.32	5.35
% Volatile matter	29.30	29.44
% Fixed carbon	64.90	65.21
	100.00	100.00
B.T.U.	14,509	14,579
% Sulphur	7.14	7.17
Free Swelling Index		5 1/2

The fresh sample showed significantly higher sulphur than surface material.

Tests conducted on the dried sample determined that the sulphur was 0.45% pyritic sulphur and 0.61% volatile sulphur. The remainder was considered to be in organic form. Sink-float tests conducted on the material produced no appreciable reduction in sulphur content.

Generally acceptable levels of total sulphur are found at Portage Mountain, just 80 miles from Pink Mountain, and it is concluded that high sulphur content of coal seams at Pink Mountain is associated with natural gas leaks in the Pink Mountain Anticline: the coal seams acting as filters for sulphur contained in the sour gas of this area. However, it should be noted that sulphur content of 6.99% was detected by Fraser Laboratories in the one sample collected from the Cypress Creek Group and that relatively low sulphur was found in Seam P - 2 just 30 stratigraphic feet from Seam P - 1.

DIAMOND DRILLING

In order to obtain a fresh sample of coal for testing, a diamond drill hole was put down through Seam F - 1 on the Pink Mountain access road at the location shown on Figure 4. The hole was drilled for 207 feet at a dip of 50° and azimuth 270° and was collared in the Marker Grit. BQ wireline equipment was used and the contract undertaken by the Rupert Drilling Company.

Average recovery was 70% despite considerable blocking in the sandstone, siltstone, mudstone alterations. Recovery in the coal was between 60% and 70%. The use of mud in coring coal was not successful and best results were obtained with moderate head pressure and low water pressure.

TRENCHING

A Caterpillar D-7 bulldozer was available throughout the project and was used to locate and clearly expose coal seams for mapping and sampling and to expose bed-rock sections relevant to establishing the stratigraphic sequence. Wherever possible work was confined to the existing road cut for it was found that much of the best information could be obtained by widening the cut, which exposed the geology and improved the road. 5 trenches were cut in other locations to search for coal or critical marker horizons. Every effort was made to keep disturbance of the ground to a minimum.

Total linear distance of trench cut, including the road widening, was approximately 12,000 feet. Assuming an average width of 18 feet and average depth of 5 feet, total volume of soil and rock cut amounts to 40,000 cubic yards.

The locations of trenches are shown on Figure 4.

SPRUCE MOUNTAIN GROUP

A brief examination of Spruce Mountain was made in the period August 30 to September 5, 1971 by W. Olsson and a helper. The work was done from a fly camp put in by helicopter from the Pink Mountain base.

Spruce Mountain is structurally continuous with Pink Mountain and shows a similar distribution of structures and lithologies. At the north end cliff exposures are left by the erosion of the Halfway River, and the Lower Gething Formation has been breached to expose the shales and limestones of the underlying Jurassic and upper Triassic. The anticline plunges gradually southwards so that progressively higher beds in the Gething are traversed until at Robertson Creek the Gething is no longer exposed.

Minor sharp structures superimposed on the main anticline, similar to those of Pink Mountain, are clearly seen in the cliffs at the north end and sparce exposures on the southern part of the mountain suggest these continue southwards. At the north end, on the west flank, steep dips are encountered, whereas in the central part of the cliffs away from the subsidiary folds, dips are generally flat lying, reflecting the box-type anticlinal structure of Pink Mountain. However, on the east flank flat-lying sandstones of the Gething were seen to abut abruptly against the dark shales of the Buckinghorse Formation indicating a major fault or thrust.

No exposures of coal were found on Spruce Mountain.

CYPRESS CREEK GROUP

As only a few days were available for examination of this group, geological reconnaissance was restricted to an area on the south-western margin of the group where an anticline breached by several deep gullies provided good exposure. The examination was conducted by Wayne Ash, P.Eng., and a helper in the period August 30 to September 5, 1971 from a fly camp put in by helicopter.

The anticlinal structure mapped, unlike that on Pink Mountain, is symmetrical and lacks the box-like cross section. The anticline is cored by limestones of the Triassic and the Fernie Formation, above which some 800 feet of Gething Formation rocks are exposed. The upper Gething rocks have been removed by erosion and it is likely no upper Gething is present on the Group except on the eastern edge where near vertical dips are seen from the air.

The centre of the claim group was not mapped but a large area exists in which subdued dips are general in what is probably the middle and lower Gething Formation.

A coal exposure was found on the southwestern edge of the group with a position apparently equivalent to one of the Main Coal Unit seams on Pink Mountain. Due to heavy talus the width of the seam was not established but an impure sample of coal was collected. Like Pink Mountain seams sulphur was anomalously high, assaying 6.99%.

COSTS

Costs of the program outlined in this report are as follows:

Engineering, crew wages and assays	$ 40,357.79
Travel and accommodation	27,392.16
Equipment rental, repair and maintenance	12,801.64
Field supplies	6,899.30
Sundries	1,453.04

Vehicles and transportation	$ 8,539.81
Drilling and drill mobilization	4,134.47
Bulldozer trenching and road maintenance	9,708.63
TOTAL:	$111,286.84

CONCLUSIONS

One hundred coal licences in five groups are held by Nickel Hill Mines in the vicinity of Pink Mountain, B.C. In the summer of 1971 a program of geological mapping, trenching and coal sampling was conducted on the Pink Mountain Group and brief geological reconnaissance was made on the Spruce Mountain and Cypress Creek Groups. The other two groups were not examined.

On Pink Mountain the coal seams are found in a sequence of deltaic sediments, predominantly sandstones and siltstones, known as the Gething Formation. The Gething, which is of Lower Cretaceous age is underlain disconformably by marine shales of the Jurassic and overlain conformably by the marine Buckinghorse Formation. A section through the Gething was measured to be 1020 feet thick on Pink Mountain, where the formation is exposed in the core of a long anticlinal structure, known as the Pink Mountain Anticline. The anticline in cross section has an assymmetrical box shape with steep dips on the flanks and shallow easterly dips across the apical region.

The anticlinal fold on Pink Mountain is complicated by minor folds on the flanks that are often sharp and narrow, giving rise to rapid changes in dip and steep to locally overturned limbs. In addition axial plane faults are known to exist but have not been mapped in detail.

Many of the coal exposures observed are found in regions of complex folding and it is seen that the coal, being highly incompetant relative to the sandstones, has flowed under tectonic stress to form large lenses and in some instances to cut across the bedding. Although some coal exposures are very wide; ranging from 12 feet to 40 feet, no idea of average width of the main seams was obtained. Exploration and development costs will be high under such circumstances.

Testing of the coal was done on surface samples and one fresh core sample. The tests showed that the coal is likely to fall within the specifications for coking coal with the exception of the sulphur, which makes the coal unmarketable. Sulphur content ranges from 5.22% to 7.17%, with the exception of one seam which returned 0.79%. The sulphur content is extremely high for coals from the Cordillera and stands in marked contrast to the low sulphur coals of the Peace River, some 80 miles south. Tests run on the core sample showed that 85% of the total sulphur was organic sulphur and could not be significantly reduced by sink-float techniques.

It is suggested that the sulphur is derived from the sour natural gas of the region which is known to exist in Mississippian strata in the Pink Mountain Anticline. Gas seeping to surface up axial plane faults and along bedding would have some of the sulphur content filtered off by the coal. That such gas seepages have occurred over a prolonged period is indicated by evidence for extensiveburning that has profoundly altered, and in some cases actually melted, large tonnages of near surface rocks on the south end of Pink Mountain. It is believed these fires are the result of natural ignition of seepages of fossil gas deposits.

If the sulphur is derived from seepage of natural gas, it is likely to be a local phenomenum and would suggest that marketable coals may yet be found to exist on Pink Mountain and associated licence groups.

RECOMMENDATIONS

As the origin of sulphur in the Pink Mountain coal deposits is critical to advisability of further work on the Pink Mountain Group additional research must be conducted on general distribution of sulphur in coals and the chemistry involved in natural gas being a possible source of the sulphur. Simultaneously, research on possible ways of reducing the various forms of sulphur present should be conducted.

Should the results of research indicate gas leakages are the source and likely to be of local origin, exploration of coal deposits should be conducted away from known areas of leakage and in areas of least structural complexity, which are otherwise amenable to coal extraction techniques. It is believed that such areas are generally recognizable on air photographs and by air reconnaissance and do not require laborious geological mapping initially. Using knowledge gained in the Gething of Pink Mountain, such areas should be tested by diamond drilling, using percussion drilling as fill-in.

If research into the origin of the sulphur indicates that the sulphur was deposited at the same time as the coal and is not derived from natural gas at a later stage, then high sulphur coals are likely to be widespread and it is unlikely that further work on the licences can be justified.

Respectfully submitted,

F.J.L. Guardia, P. Eng.

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GEOLOGICAL BRANCH
ASSESSMENT REPORT

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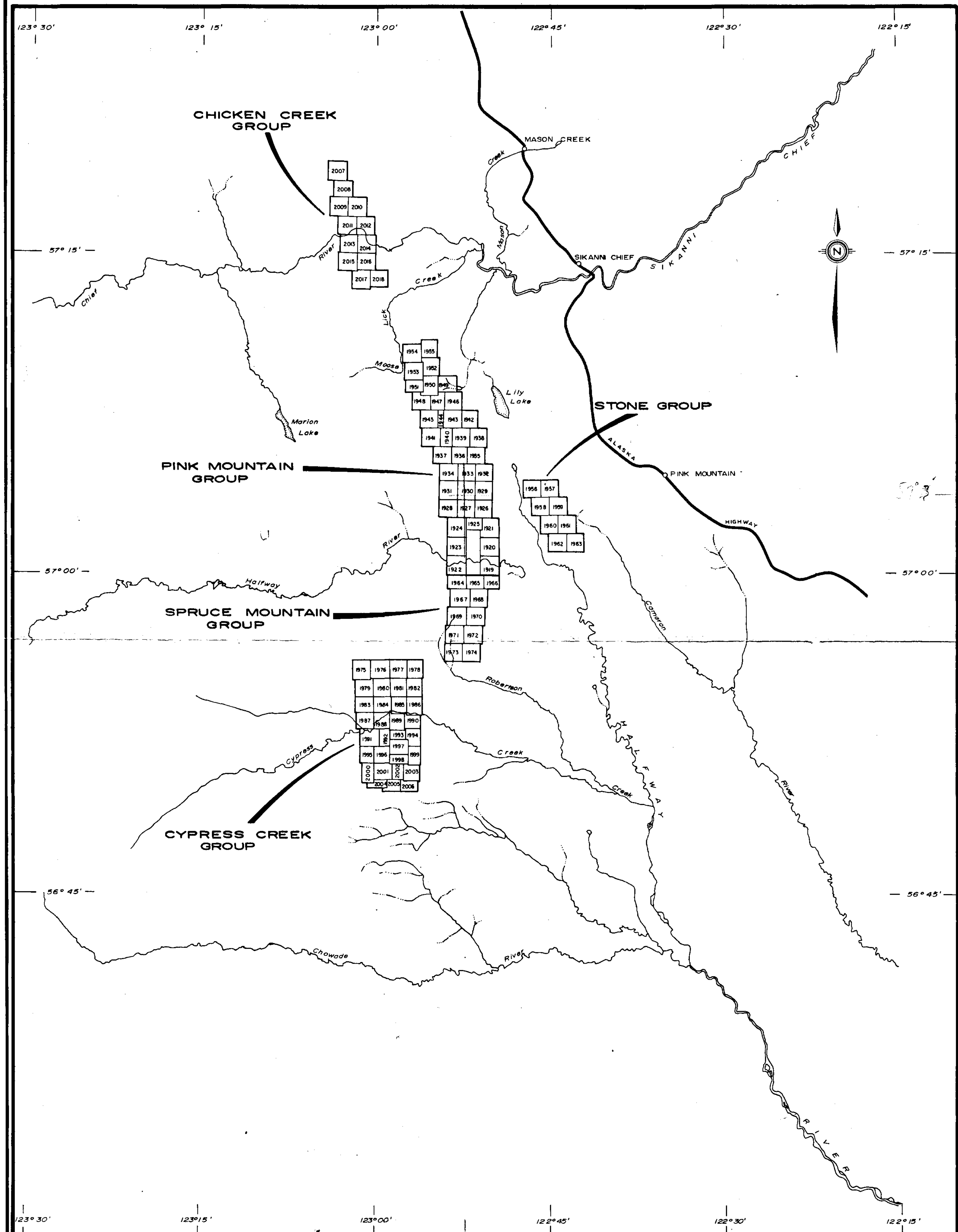

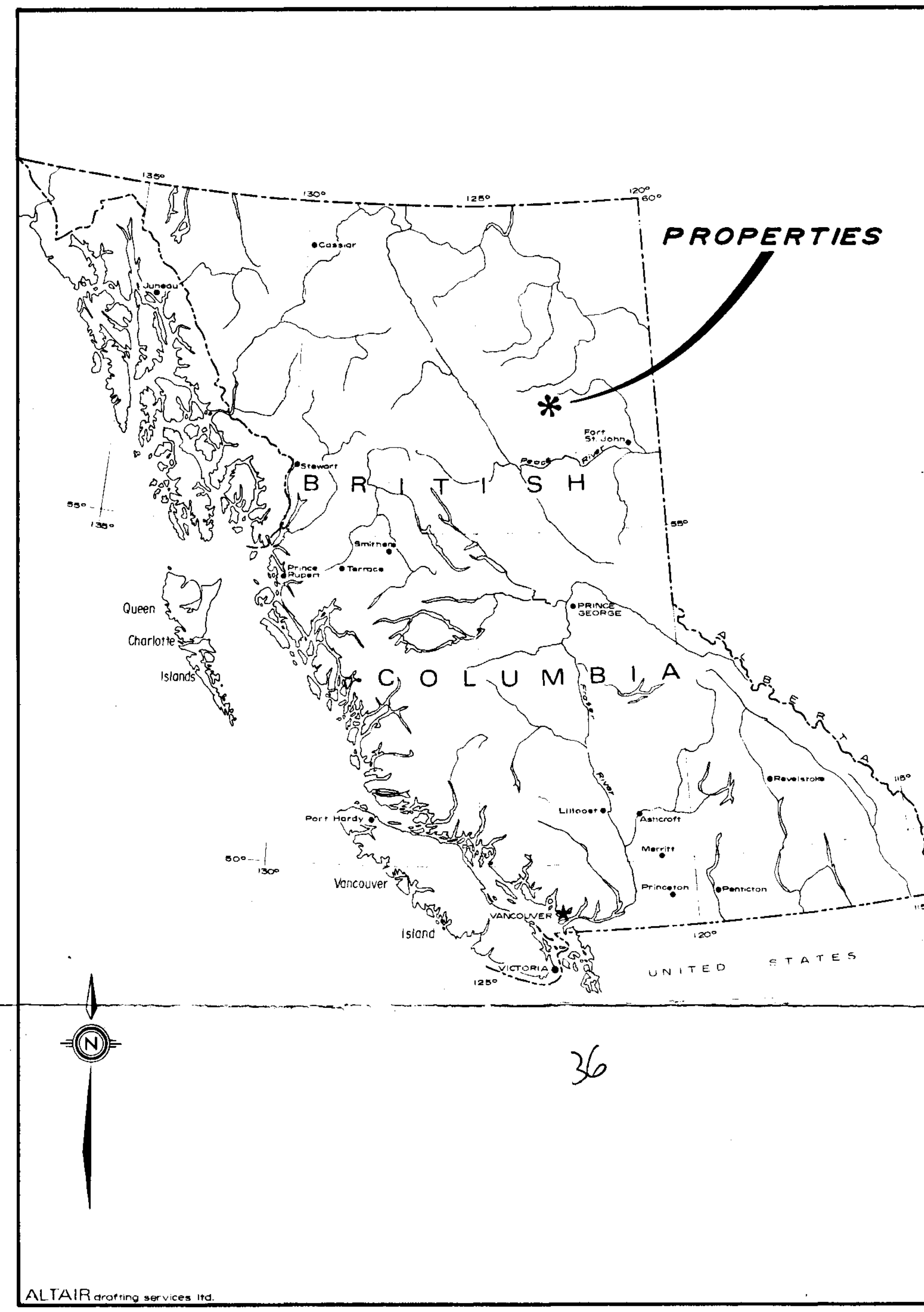

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PR-Pink Mt. 71(2)A

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FIGURE 1

ALRAE ENGINEERING LTD. CONSULTING ENGINEERS & GEOLOGISTS, VANCOUVER, CANADA	
NICKEL HILL MINES LTD.	
PINK MOUNTAIN LOCATION MAP (1)	
SCALE : 1" = 4 Miles	DESIGNED : F.G. DRAWN : ALTAIR
DATE : NOV. 1971	CHECKED :
REVISED :	MAP No

FIGURE 2

ALRAE ENGINEERING LTD. CONSULTING ENGINEERS & GEOLOGISTS. VANCOUVER, CANADA	
NICKEL HILL MINES LTD.	
PINK MOUNTAIN (2) MEASURED STRATIGRAPHY	
SCALE: 1" = 20'	DESIGNED: F.G. DRAWN: ALTAIR CHECKED:
DATE: NOV 1971	
REVISED:	MAP Nº

* NOTE: there are no logs available for P1 - lith or otherwise - so this is the only useful section

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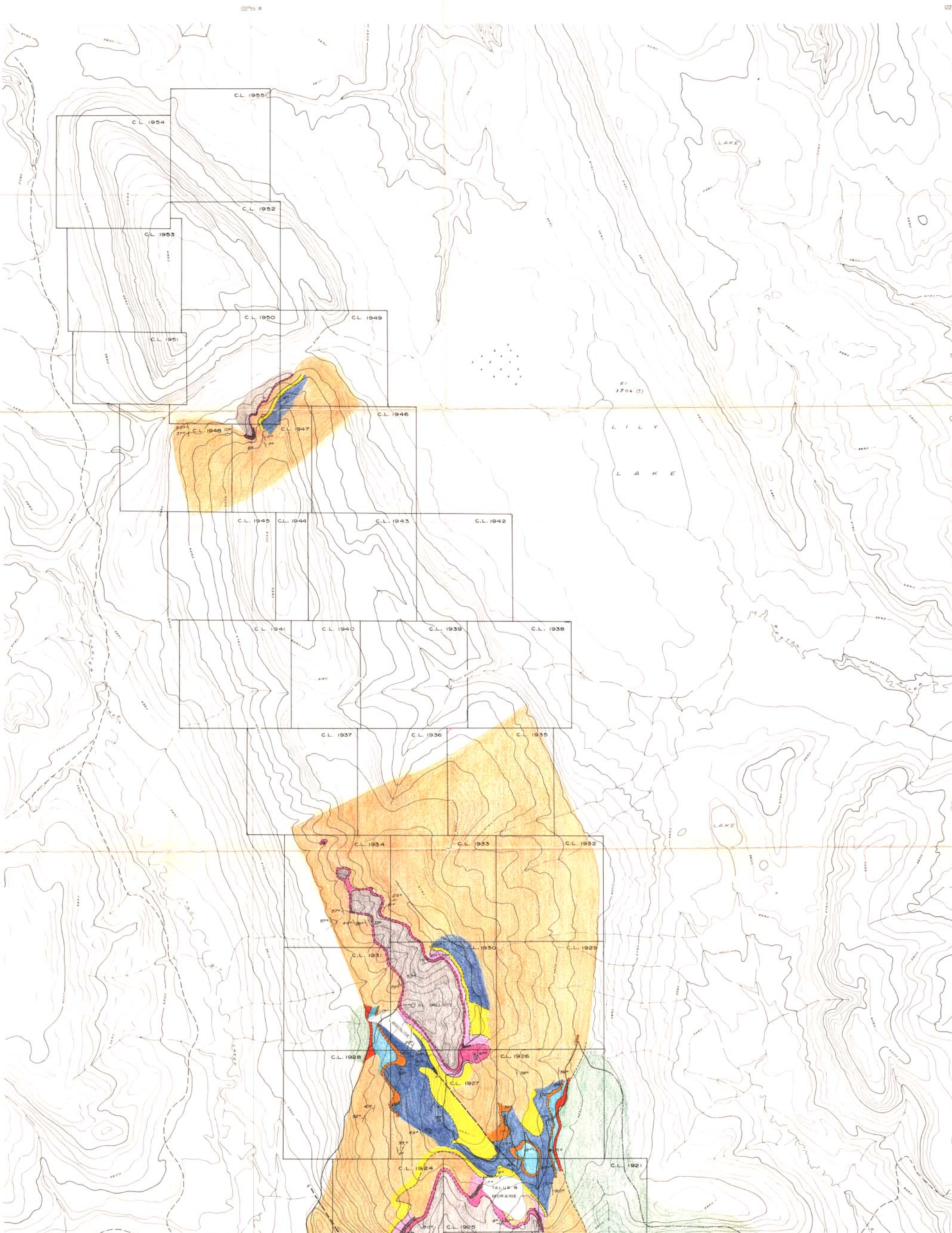

LEGEND

		Overburden
BUCKINGHORSE FORMATION		
GETHING FORMATION	A	Top sandstone
	B	Upper coal unit
	C	Marker grit
	D	Main coal unit
	E	Cliff sandstone
	F	Lower coal unit
	G	Basal grit
		Undifferentiated
FERNIE FORMATION		
PARDONET FORMATION & GREY BEDS		

- Geological boundary - defined
- Geological boundary - assumed
- Geological boundary - interpreted from air photos
- Fault
- Dip of strata
- Vertical strata
- Horizontal strata
- Overturned strata
- Surveyed road
- Unsurveyed road

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FIGURE 3

ALRAE ENGINEERING LTD.

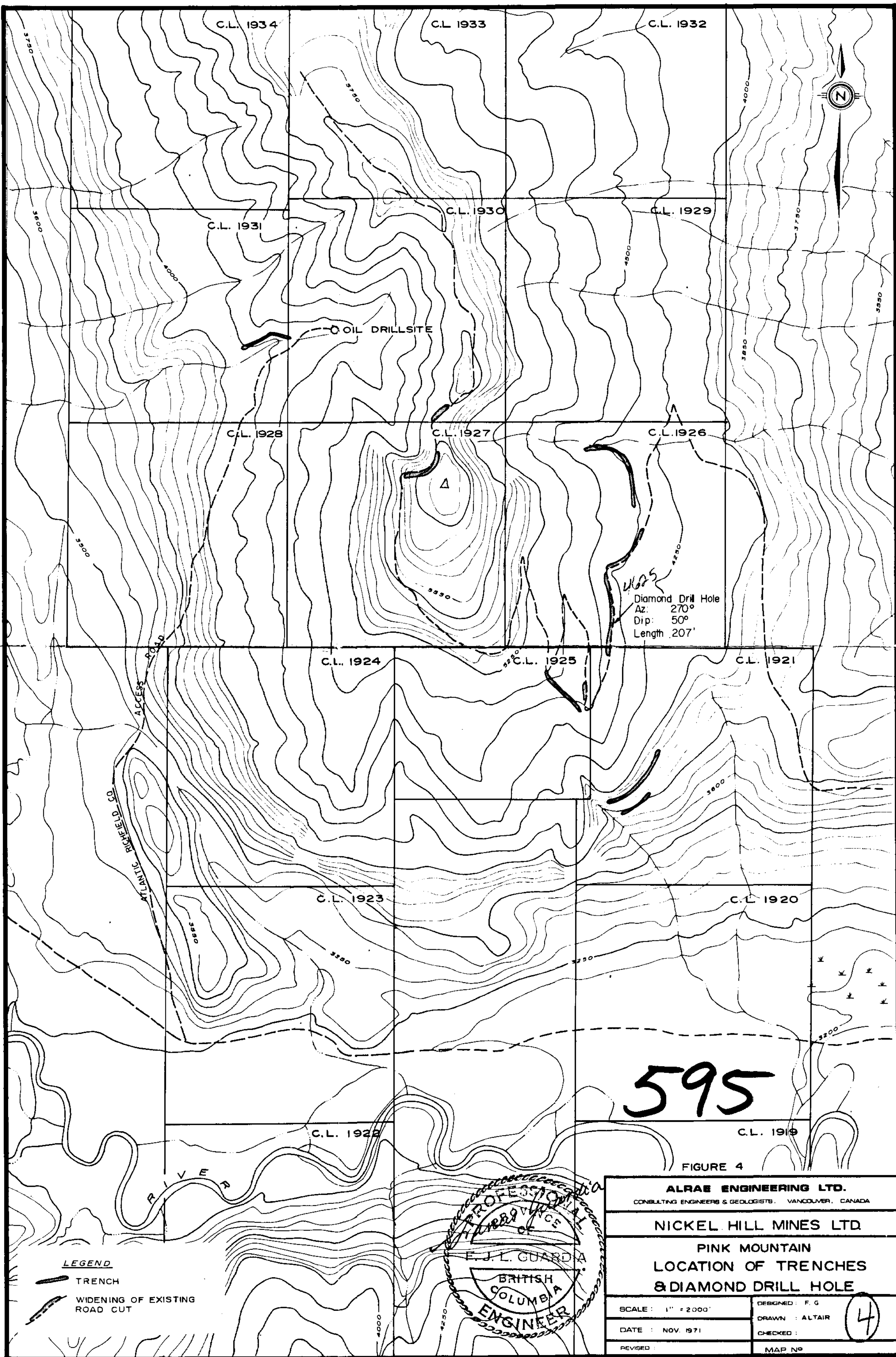
CONSULTING ENGINEERS & GEOLOGISTS, VANCOUVER, CANADA

NICKEL HILL MINES LTD.

PINK MOUNTAIN

GEOLOGY (3)

SCALE : 1" = 2000'	DESIGNED : F. G.
DATE : NOV. 1971	DRAWN : ALTAIR
	CHECKED :
REVISED :	MAP Nº



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