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THERMAL COAL RESOURCES OF BRITISH COLUMBIA

SOUTHERN COALFIELDS of the INTERIOR BELT of BRITISH COLUMBIA

January 1, 1975

DOLMAGE CAMPBELL & ASSOCIATES LTD.
VANCOUVER, CANADA

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DOLMAGE CAMPBELL & ASSOCIATES LTD.
CONSULTING GEOLOGICAL & MINING ENGINEERS
1000 GUINNESS TOWER
VANCOUVER 1, B.C.

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SUMMARY AND RECOMMENDATIONS

The Southern Coalfields of the Interior Belt of British Columbia form a belt about 100 miles in width that extends northwestward from Princeton, near the U.S. border, to Prince George. This belt is comprised of scattered areas of Tertiary sedimentary and volcanic rocks that appear to represent erosional remnants of a once continuous deposit of Tertiary rocks that occupied a continental trough east of the present Coast Mountains.

The Tertiary rock group in the Interior Belt is comprised of three sequences of sedimentary rocks, each capped by a volcanic sequence. These three sedimentary sequences are: (i) Paleocene, occurring only in the northern part of the belt, (ii) Eocene, and (iii) Miocene. Significant coal resources occur in the Paleocene and Eocene formations.

Major coal deposits are known to occur in the following areas of Tertiary rocks in the southern interior: Princeton, Tulameen, Nicola, Hat Creek, Quesnel (Cariboo) and Bowron River. Minor coal occurrences are recorded for various other areas. This report discusses the coal potential for each area except those of Hat Creek and Princeton-Tulameen, which are discussed in detail in separate reports.

The coal of the Tertiary Southern Interior is generally high volatile, non-coking sub-bituminous with calorific values ranging from 6000 to 13000 Btu/lb.

The indicated coal reserves in the Tertiary Southern Interior areas, other than the Hat Creek, Princeton and Tulameen deposits, include approximately 80 million short tons at Bowron River (underground) and 20 million short tons at Merritt (also underground) reported.

The potential in situ coal resources in the Tertiary Southern Interior belt, (exclusive of Hat Creek, Princeton and Tulameen), are indicated to be of major size in three areas:

Cariboo (Quesnel)	1400 million short tons
Merritt	378 million short tons
Quilchena	70 million short tons

Some of this coal may be available for surface mining, however, the quantity must be determined by detailed exploration of each of the coalfields, none of which have been comprehensively explored.

RECOMMENDATIONS:

Based on present information, only the Bowron River deposit has a sufficient tonnage of indicated coal to feed a major thermal plant; although, all of this coal must be mined underground.

However, three other Tertiary areas, the Cariboo, the Merritt and the Quilchena, have major thermal coal potential, totalling close to 2 billion tons that remains to be verified.

A dependable inventory of the thermal coal potential of these Southern Interior coalfields requires that they be more comprehensively explored by reconnaissance drilling. Because of the relatively thick and extensive coal seams indicated already in each area, such reconnaissance exploration of these Tertiary areas is fully warranted.

In addition, because there is good geological evidence that major deposits of coal could occur beneath the cap of volcanic rocks on most of the heretofore unexplored areas of interior Tertiary rocks, particularly those along the west-central part of the belt, careful mapping, and some subsequent wildcat drilling of these basins is warranted in order to determine their possible coal potential.

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INTRODUCTION

When discussing the extent, quality and availability of thermal coal resources of British Columbia it is convenient to consider the coal deposits of the Interior Belt, from Prince George to the U.S. border, as a single group. This is a natural grouping since all of the depsoits form a reasonably continuous belt and all share similar geology, a common Tertiary age and a high-ash subbituminous rank.

TERMS OF REFERENCE

Coal deposits in the southern half of the Interior Belt occur exclusively in sedimentary rocks of Tertiary age. Two "basins" of major coal deposition in the southern belt, the Hat Creek and Similkameen coalfields, are reported in detail in separate sections of the coal study; therefore, these deposits are only briefly summarized in this report.

The object of this report is:

a) to list and discuss all of the presently known coal deposits and occurrences in the Southern Interior Belt, and

b) excepting the Hat Creek and Similkameen coal fields, to assess each deposit as a potential source of thermal coal.

LOCATION: (Figures 1a - 1b) (49° N to 56° N)

The southern coalfields of the Interior Belt lie between the U.S. border at the south to the latitude of Prince George at the north. The belt is bounded on the west by the Coast Range mountains and on the east by the Columbia Mountains, on an approximate northwest-trending line from Grand Forks to Salmon Arm to Quesnel and Prince George. These boundaries encompass all of the areas in the Interior of Tertiary age rocks.

Access to most parts of the Southern Interior Belt is generally very good via roads, highways and, in many cases, railroads.

PHYSIOGRAPHY:

Although the general topography of the Interior Uplands (Plateau) is subdued, the local topography in the vicinity of many of the known coal occurrences is comprised of precipitously-eroded valleys. These valleys are incised, in most instances, into relatively flat basins or uplands that are underlain by Tertiary Age volcanic and sedimentary rocks.

Most of the areas of Tertiary rocks, particularly those of sedimentary origin, in the Southern Interior are blanketed extensively by glacio-fluvial overburden deposits, often to hundreds of feet in depth, a fact that greatly hinders the exploration of the potential coal-bearing Tertiary areas.

CLIMATE:

The climate of the Southern Interior Coal Belt of British Columbia is generally a relatively uniform continental one characterized by warm summers, low precipitation, fairly low humidity and generally moderate winters that are commonly interrupted by a few periods each year of sub-zero temperatures due to the invasion of freezing winds carrying polar air from the north-northeast. Throughout most of the winter the polar front lies across the northern end of the Interior Belt in the vicinity of Prince George.

The Southern Interior Coal Belt of British Columbia is essentially entirely within the region commonly referred to as the Dry Belt. Vegetation is distinctly sparse relative to the adjacent parts of the province, with natural grass covering the dry valley bottoms and lower slopes, varied with poplars in the damp areas, and with open forests of Douglas fir, lodgepole pine and yellow pine covering the uplands above 3000 feet.

HISTORY:

Most of the Tertiary coal occurrences in the southern interior of British Columbia were discovered early in the history of pioneer settlement of the province, and many were exploited in a very small way by the first ranchers and settlers.

However, from the early part of the century until the end of the second World War, commercial production was carried out on a sustained basis from three coalfields in the southern interior. These operations were in the Merritt, Tulameen, and Princeton coalfields. A total of 7,089,551 tons of coal were extracted with 2 to $2\frac{1}{2}$ million tons coming from underground mines in each of these three areas.

REFERENCES & AVAILABLE DATA:

The principal author of this report, Mr. Robert S. Adamson, and the principal co-author, Dr. D. D. Campbell have firsthand knowledge of most of the Tertiary areas of the Southern Interior Belt through their work in various exploration and engineering projects throughout the belt during the past 20 years.

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GEOLOGICAL SETTING

REGIONAL GEOLOGY

The south-central interior of British Columbia is distinctively underlain by irregularly shaped areas of generally flat-lying Tertiary rocks of sedimentary and volcanic origin. The northern half of the belt is essentially completely underlain by Tertiary volcanic rocks, beneath which local, small windows of underlying Tertiary sedimentary rocks have been exposed by valley erosion. The southern half of the belt is comprised of a very irregular scattering of areas of Tertiary rocks that range in size from a few square miles up to hundreds of square miles. Because many of these areas of Tertiary rocks occupy valleys (Hat Creek) or broad lowlands (Princeton) they have been referred to as Tertiary "basins" and often regarded as representing the stratigraphic record of separate, finite loci of Tertiary deposition. However, continuing exploration of these areas of Tertiary rocks indicates that the strata around the edges of the areas are almost everywhere truncated either by erosion surfaces or by boundary faults, thus it now appears more likely that the present scattered areas of Tertiary formations represent disconnected erosional remnants of one or more, but not many, continuous troughs of deposition that were filled during Tertiary time.

The hypothetical existence of such a continuous Tertiary continental sea in the interior of the province is further suggested by the fact that all of the explored and mapped Tertiary areas, or "basins", from Princeton to Prince George include all or part of a common stratigraphic succession, namely:

Top:
(6) Volcanics - flat-lying sheet flows (Miocene-Pliocene)
(5) Sediments - commonly absent (Miocene)
(4) Volcanics - relatively flat-lying (Oligocene)
(EROSION, FOLDING, FAULTING)
(3) Sediments - continental, folded, faulted (Eocene)
<u>COAL BEARING</u>
(2) Volcanics - (Eocene and Oligocene)
(1) Sediments - confined to north end of belt (Paleocene)
<u>COAL BEARING</u>

Correlation of the stratigraphy of Tertiary sedimentary areas in south-central British Columbia, (Figure 2), indicates that the Paleocene basal formations are absent south of Bowron River; however, north of Prince George they are widespread and coal-bearing. In northern British Columbia from latitude 56° to 60° north, coal occurs in Paleocene rocks of the Sustut and Sifton Assemblages, which range in age from Upper Cretaceous to Eocene, and apparently is rarer in rocks of Eocene age. The broad distribution of Tertiary sedimentary rocks in the entire Interior Belt of British Columbia suggests that two major lineal basins were present from Upper Cretaceous to Eocene time in the northern half of the province. After some 10 million years of the Paleocene, one of these continental seas that was receiving deposition had extended southward to at least the 49th parallel and was host to volcanic and sedimentary deposition there by Eocene time.

It is of interest in such a regional concept of Tertiary deposition that recent seismological and off-shore drill data from the continental shelf off the west coast of Vancouver Island, (1972, D. L. Tiffin et al), indicate that bathyal deposition onto the shelf from the northeast occurred from the Eocene to the Pliocene of the Tertiary. This deposition included intercalated volcanics, as does the sequence in the Interior Belt on the northeast side of the Tertiary (coastal) landmass, and was interrupted by several periods of uplift and deformation before deposition was terminated in the Pliocene by the major uplift of the Coast Mountains. It is also of interest that the shelf rocks are mainly mudstones, as are most of the finer clastics in the Interior Belt.

If the Tertiary "basins" of the southern Interior Belt do represent the results of deposition into a continuous continental sea, and are therefore erosional remnants, rather than individual separated basins of deposition, the economic implications for the exploration for coal are important. The above-described hypothesis of the origin of the interior Tertiary formations thus implies far more continuity of the coal-bearing Tertiary formations throughout all of the areas underlain by Tertiary rocks than had heretofore been assumed. This possibility is further suggested by the fact that where erosion has stripped the overlying Tertiary volcanic cover coal has been discovered in the underlying strata in the Cariboo, Hat Creek, North Thompson, Nicola, Similkameen, and Okanagan "basins".

This concept of a continuous interior basin of Tertiary deposition, with its implication of possible continuous shoreline swamps in Eocene-Oligocene time, which subsequently developed into the known Interior Tertiary coal occurrences, has been derived from the study of the Tertiary deposits described in this report. The concept did not guide the study.

Tertiary sedimentation was interrupted by, and in part contemperaneous with, four periods of wide-spread volcanic activity. Vulcanism, initiated in the early Tertiary, was terminated in late Miocene-Pliocene times by the extrusion of extensive areas of plateau basalt and the uplift of the Coast Mountains. Frequent faulting, uplift, and rapid erosion accompanied the volcanic activity throughout the Tertiary and no doubt was the dominant cause of the post-depositional structural deformation of the various coalfields in south-central British Columbia.

COAL MEASURES

Coal accumulation occurred throughout the Tertiary in south-central British Columbia during three principal periods of sedimentary deposition; in the Paleocene from mid-Eocene to early Oligocene, and in the Miocene epochs.

The oldest coal-bearing sedimentary rocks are Paleocene in age. To date they are limited in areal extent to a local depression along the Bowron River east of Prince George. No evidence presently exists to indicate that the Bowron graben-like area was part of a much more extensive basin of coal deposition.

The most extensive and most economically-significant sedimentary rocks that contain coal are predominantly of Eocene age. Evidence also suggests that coal formation probably extended to the Oligocene. The Eocene (Oligocene) coal measures probably represent a lengthy locally sustained and locally cyclical period of accumulation within a relatively large scale environment of deposition, such as a series of interlocking littoral-lagoonal basins along the Tertiary sea shore(s). Extending from the 49th parallel northwestward to the Cariboo, it is conceivable that other deposits of this age underlie the extensive plateau lavas of west central British Columbia.

Miocene coaly accumulations have been exposed in the north end of the Interior Belt in valleys of present river systems, specifically the Fraser and its tributaries. Tectonically young, hence little deformed, these carbonaceous sediments generally occur as thin seams of poor quality lignite of limited areal extent.

The following portion of this report describes the geology and coal potential of each of the known coalfields or occurrences in the Southern Interior Belt of British Columbia. For convenience, these descriptions of coal occurrences that follow have been grouped by ages, namely: (1) Miocene, (2) Eocene and (3) Paleocene. Coal reserves and/or resources are included with each group when applicable.

MIOCENE CARBONACEOUS SEDIMENTS

Occurrences of poor quality lignitic "coal" have been included in earlier summaries of coal deposits in the region of the Nechako Plateau from the upper Fraser River north of Quesnel westward to the Coast Range Mountains. These occurrences, which are of Miocene age, have been reported to occur in isolated, restricted basins and in narrow basins draining the Fraser River and its tributaries.

TWEEDSMUIR-NECHAKO OCCURRENCES:

Four occurrences of coal have been reported west of the Fraser River; on the Dean River, on the Bella Coola River, on the Nechako River, and at the east end of Fraser Lake.

The locations of coal reported on the Dean and Bella Coola Rivers are unknown to geologists who have mapped the area in recent years. Sedimentary rocks in the Tweedsmuir Park area, which would be considered favourable for coal deposition, are not present. Therefore, it is concluded that if coal of unknown quality does exist it would be very local in extent and hence of no economic interest.

In the banks of the Nechako River, close to Mt. Greer and about 10 miles south of Fort Fraser, a 4-foot seam of lignite was noted by the Geological Survey in 1878. However, recent mapping failed to locate this outcrop and it may no longer be exposed. In the Nechako River area Late Miocene or Pliocene plateau lavas cover wide areas and include as a basal unit thin beds of soft sandstone and siltstone that are occasionally carbonaceous. It is not uncommon to find carbonaceous sediments throughout this region, but no coal beds of any significant thickness have been found.

At the east end of Fraser Lake, about 75 miles west of Prince George, several narrow seams of lignite are exposed. The widest seam does not exceed 12 inches in thickness, and the host sedimentary rocks cover an area not exceeding a square mile. The sedimentary rocks overlie granitic intrusive rocks and are flanked by younger volcanic rocks that may conceal more of the coal-bearing fomation. Because of the thinness of the coal and the limited extent of the basin the occurrence is not of potential commercial importance.

UPPER FRASER OCCURRENCES

Carbonaceous sedimentary rocks and accumulations of coaly material are intermittently exposed in the valleys of the Fraser River and most of its major tributaries north of Quesnel. Restricted to well-established river systems, they have been interpreted as valley-filling deposits of limited areal extent. Lignite occurrences have been reported from the Fraser River at Quesnel and at Prince George, on Cottonwood Creek and on the Blackwater River. Traces of lignite have been found near the north edge of Summit Lake and four miles northwest of Davie Lake, deposited possibly at a time when the upper Fraser River flowed north into Arctic drainage systems. Other Miocene lignite occurrences have been reported on the Fraser near Giscombe Rapids and from three other very restricted localities.

At Quesnel, Miocene sedimentary rocks unconformably overlie the older, Eocene to Oligocene, coal-bearing beds that comprise the Cariboo deposits which extend from Quesnel southward beyond Alexandria. These Miocene rocks contain lignites which are associated with river and lake deposits and which contain diatomite. Samples selected in 1923 returned the following analysis, (basis unknown): 2.8% moisture, 35.0% ash, 36.8% volatile matter, and 25.4% fixed carbon.

In the Upper Fraser region no extensive coal seams or horizons have been reported from the Miocene sedimentary sequence. Although extensive, deep overburden and thick vegetation may have masked seams of potential economic interest, it is more likely that the lack of extensive accumulations can be attributed to the small, relatively local basins associated with Miocene lignite deposition.

SUMMARY, MIOCENE LIGNITES

Except possibly for minor local consumption, the Miocene lignite deposits in the Southern Interior Belt of British Columbia, judging from known exposures, appear to lack the continuity, extent, and thickness required for them to comprise important sources of thermal fuel. Further, there is no indication from all that is known of the Miocene lignite deposits to suggest that they have any potential to be major energy sources; therefore, they do not warrant further exploration.

EOCENE COALS

I. CARIBOO DEPOSITS

Introduction

The Cariboo deposits comprise several outcrops of coal occurring in a Tertiary basin which extends for a distance of 25 miles from the town of Quesnel southward to Alexandria.

Prior to 1930, little work was done to explore these seams. In 1930, the Cariboo Coal and Clay Co. Ltd. staked the area and initiated preliminary exploration of the Tertiary basin containing the coal occurrences. In addition to coal, exploration for diatomaceous earth, oil, and gas were undertaken. Three holes were drilled and surface pits were dug on coal exposures on the east bank of the Fraser River in the vicinity of Australian Creek. The thickest seam near the Alexandria Ferry crossing at the south end of the basin was explored by an adit. No further work was done in the area until recent years.

In 1971 Masters Explorations Ltd. acquired several coal licenses in the area. Three potential coal areas in the basin were tested by the drilling of 21 short holes (4,825 feet) in 1971 and 1972. The Australian Creek deposit was not drilled. Because of poor results the licenses were subsequently allowed to lapse.

Geological Setting

An area of sedimentary rocks, Eocene in age, extends along the Fraser River for a distance of 25 miles. Ranging in width from two to six miles, it attains a stratigraphic thickness in excess of 1200 feet. Apparently this area was once larger in extent since several remnant outliers occur eight miles south and fourteen miles northwest of the principal basin. The eastern limit of the area remains to be defined. The sedimentary rocks, poorly consolidated, consist of conglomerate, sandstone, greywacke, shale, and coal.

Because of a scarcity of outcrop, the internal structure of the sedimentary sequence is relatively unknown. In general, folds, both parallel and perpendicular to the Fraser River are broad, so that bedding attitudes are gentle. Late Tertiary faults, which cut and partially bound the basin, are of sufficient magnitude to exercise a control on the direction of river flow, (Figure 4).

Volcanic rocks of two ages overlie the sedimentary rocks. Oligocene volcanics, gently folded, are in faulted contact for half the length of the basin west of the Fraser River, (Figure 4) and partially cap the sedimentary rocks to the south. Flat-lying volcanic rocks of Miocene to Pliocene age overlap the sedimentary rocks on the southeast.

Known coal occurrences in the basin are presently restricted to four localities along a five-mile stretch of the river; the remainder of the basin remains unexplored but appears to have good potential for extensive coal resources.

Coal Deposits (Figure 5)

The four coal areas which have been explored, in a reconnaissance fashion, since 1923 are:

a) Australian Creek - Two vertical holes, (DH 30-2 and DH 30-3), were drilled in 1930 to test the continuity of a four-foot coal seam exposed at the surface. In drill hole 30-2 15 feet of coal was (verbally) reported to occur near the surface and 72 feet of coal at 484 feet. In the upper drill hole (DH 30-3) two seams, 100 to 140 feet apart, were apparently intersected. The upper seam was reported to be $7\frac{1}{4}$ feet in thickness, with a 10-inch parting, and the lower seam 8 feet in thickness.

b) Hodson Creek - A 4-foot coal seam exposed at two localities on the west bank of the Fraser River was drilled by Masters Exploration in 1971 and 1972. Seven of thirteen holes drilled intersected one or two seams that included several partings. Coal ranging in thickness from 6 to 40 feet was defined over an area 3000 feet by 500 feet.

c) East Bank - A seam, 4 to 5 feet in thickness which cropped out on the east bank of the Fraser River was drilled in 1930, (DH 30-1). Four seams ranging in thickness from 4 to 14 feet were apparently intersected over a stratigraphic interval of 320 feet. In 1972 Masters Explorations drilled five holes to test the area. A sixth hole, (DH 72-10), was drilled on the west bank, presumably to test a possible extension towards the south. The results of the 1972 drilling are not available.

d) Alexandria Ferry - A coal seam 15 feet in thickness was initially explored by tunnelling in 1930. In 1972 Masters Exploration drilled two holes in the area. The results are unavailable.

The coal measure in the Tertiary sequence in this Cariboo "basin", based primarily on information derived from early (1930) East Bank and Australian Creek drilling, is assumed to extend over a stratigraphic interval of 700 feet.

Coal Reserves

Exploration for coal has been limited to a length of 5 miles along the banks of the Fraser River, an area covering approximately one fifth of the area underlain by coal-bearing sedimentary rocks. The remainder of this area remains unexplored. Within the explored sector, only the Hodson Creek area contains coal defined by relatively close-spaced drilling and surface exposures. In this block, outlined by seven vertical drill holes, are 1,300,000 short tons of subbituminous coal. Because the coal seams dip into the relatively steep west bank of the river, mining the coal by open-cast methods is probably not practical.

Samples of coal were taken from the four Cariboo localities during the early years of exploration and analyzed. No analyses are available from the recent exploration conducted by Masters Explorations. The results of all available analyses are tabulated in Table No. 1. Most of the samples were taken from the surface and in most cases the basis for analysis is not documented. Calorific values are only available from the Australian Creek area, where the upper and lower seams intersected in DH 30-3 were sampled. In general, the coal in the southwestern sector of the Cariboo basin is high volatile, subbituminous with numerous shaley partings in the coal seams.

Other than the Hodson Creek area, no coal reserves have been estimated here for the Cariboo deposits because the exploration to date has not been comprehensive enough and the available data from it is fragmentary. There is some indication that the coal seams in the Cariboo deposits are lensey and include considerable waste partings; however, these assumptions are based on meagre evidence at this time.

The potential coal resource of the entire area north and south from the explored exposures, some 100 square miles, (Figure 4), should be considered as being possibly good, particularly in view of the indication of a 72 foot seam intersected at depth in DH 30-2. If a coal zone near this thickness can be located under suitable topographic circumstances elsewhere in the district a thermal coal source may be developed.

Conclusions

No significant source of surface-mineable thermal coal is presently indicated by available data from any of the four localities in the explored sector of the Cariboo "basin". The remaining 80 percent of the area conceivably may prove to be host to coal deposits with adequate mineable tonnage and suitable grade to support a thermal plant in the area. However, extensive primary exploration will be required to assess this possibility.

TABLE NO. 1

CARIBOO DEPOSITS

COAL GRADE

	Moisture	Ash	Volatile Matter	Fixed Carbon	Sulphur	Calorific Value (Btu's/lb.)
AUSTRALIAN CREEK						
1920 as received	11.5 %	29.5 %	30.6 %	28.5 %		
dry	-	33.2 %	34.6 %	32.2 %		
1923 surface, over 4'	7.1 %	19.7 %	36.1 %	37.1 %		
1930 surface	19.2 %	12.3 %	29.3 %	39.2 %		
Drill hole: Upper seam (- partings)	18.8 %	19.6 %	31.0 %	31.6 %	1.59 %	11,070
Drill hole: Upper seam (+ partings)						6,720
Drill hole: Upper seam (- partings)	17.1 %	7.1 %	30.5 %	45.3 %	1.04 %	10,500
Drill hole: Upper seam (+ partings)						7,940
Drill hole: Lower seam	14.8 %	0.6 %	32.4 %	52.2 %		12,560
HODSON CREEK						
1930 surface	21.0 %	21.7 %	25.5 %	31.8 %		
EAST BANK						
1923 surface	3.6 %	20.6 %	40.2 %	35.6 %		
ALEXANDRIA FERRY						
1923 surface, 3½'-4'	5.1 %	17.6 %	38.9 %	38.3 %		
1930 surface	16.6 %	5.5 %	27.0 %	50.9 %		

II. HAT CREEK DEPOSIT: (Figure 6)

The Hat Creek coal deposit is described in detail in a separate report for this study of the thermal coal resources of British Columbia; however, it is important when assessing the possible coal potential of the remnants of Tertiary sedimentary rocks throughout the Southern Interior Coal Belt to appreciate that the coal reserve indicated in the relatively small Hat Creek "basin" is so large. The valley, entirely covered by overburden, totals about 60 square miles in area and only about 8 square miles at one end have been explored for coal, (Figure 6). Within the explored area an openpit deposit of subbituminous coal in excess of 500 million tons has been indicated by drilling; the remainder of the valley is presently being explored.

If some geological continuity of the coal measures in the Tertiary remnant areas in the Interior Belt can be established, then the exceptionally thick coal layers, (400-1600 feet), at Hat Creek may possibly be repeated elsewhere in the Tertiary sequence, i.e., in other areas of Tertiary rocks in the Interior Belt.

III. THOMPSON RIVER OCCURRENCES

Sedimentary rocks of Eocene age containing coal occurrences extend along the North Thompson River from Kamloops northward for approximately 60 miles. The deposits, occurring in a series of small, isolated, remnant basins, are in two groups; the southern group lies between Kamloops Lake and the city of Kamloops, and the northern group lies clustered along the North Thompson River near the village of Chu Chua.

Chu Chua: (Figure 7)

Coal, mined on a small scale for local consumption for 1921 to 1923, crops out on locally-named Coal Creek, approximately two miles south of Chu Chua. Apparently once part of a large and more extensive basin extending along the North Thompson River, several small remnant basins, including the one on Coal Creek, contain a sedimentary succession of conglomerate, arkose, shale and coal. Unconformably overlying a basement of older granitic and volcanic rocks and in turn capped locally by younger volcanic rocks, the sedimentary rocks are, in general, moderately folded along axes paralleling the river, although other structures are locally in evidence.

Data on the nature of coal occurrences in the Chu Chua area are restricted to the Coal Creek basin. At Coal Creek the sedimentary formation exceeds 2500 feet in thickness. The known coal measure, 600 feet in thickness, has its base 1650 feet above the basement; however coal seams may appear above or below the known coal section but few exposures of sedimentary rocks are available to determine this.

Within the indicated coal measure, three coal zones, which occur over 300 feet of stratigraphic section, have been partially developed and mined on a limited basis. The upper zone, 15'4" in thickness, contains two coal seams, (2'7" and 1'10" in thickness), separated by 10'11" of waste rock. The middle zone, 7'6" in thickness, also contains two seams (1'10" and 1'8" in thickness) which are separated by 4 feet of waste. A third zone, stratigraphically lower in the section, comprises a single seam 3'9" in thickness.

The coal on Coal Creek has been described as hard, black, lustrous, and thinly laminated. Samples selected from underground in 1923 and sent to the Mines Branch in Ottawa for analysis graded as follows:

	Moisture	Ash	Volatiles	Fixed Carbon	Calorific Value
Upper Zone					
top seam	3.6 %	13.8 %	37.9 %	44.7 %	12,040 Btu's/lb.
bottom seam	4.0 %	22.1 %	37.9 %	36.0 %	10,780
Middle Zone					
top seam	4.0 %	24.0 %	36.1 %	35.9 %	10,290
Lower Zone	3.7 %	37.3 %	29.4 %	29.6 %	8,230

The above samples were analyzed on an "as received" basis.

Coal seams in the Chu Chua area are relatively thin, do not lie close enough together to be considered as a mineable zone, and underlie Tertiary areas of very limited size. In addition, continuity of seams within each area is suspect because of suggested generally tumultuous depositional conditions during swamp formation. For these reasons, a thermal plant predicated upon coal from the Chu Chua region is not considered to be viable.

Kamloops: (Figure 7)

Coal occurs in sedimentary rocks of Eocene age near Kamloops. The sedimentary formation comprises conglomerate, shale, sandstone, and minor tuffaceous material. Located 2½ miles southwest of Kamloops, the thickest seam in the sequence is only a foot in thickness. A total thickness of 2½ feet occurs in 50 feet of stratigraphic section.

As the seams in the Kamloops area are known to be thin and occur in a few isolated Tertiary basins of limited areal extent, the coal is of no commercial interest.

IV. NICOLA COALFIELD: (Figures 8, 9 & 10)

Introduction:

The Nicola coalfield comprises several isolated Tertiary sedimentary areas which occur within an area 20 miles in diameter. Two, the Merritt and Quilchena area, are known to contain coal.

The Quilchena area was explored by the Diamond Vale Coal Co. from 1904 to 1906. However, other than by local ranchers for domestic production, no coal has been produced on a commercial basis from the area.

The Merritt area produced 2,660,000 tons of coal from 1906 to 1963. The bulk of this coal was produced by underground methods during the period 1908 to 1929 from two locations near the southwestern periphery of the "basin". Four other localities in the area were explored but produced only small tonnages.

The British Columbia Department of Mines drilled six holes (4508 feet) in the Merritt area in 1945 - 1946. Five holes were located east of the old Diamond Vale mine, situated near the centre of the "basin", and a sixth hole was drilled in the eastern part.

From 1960 to 1962 Imperial Metals and Power Ltd. carried out exploration in the Coal Gulley - Coldwater Hill areas southwest of Merritt in the general vicinity of the most extensive mine workings in the district. The program consisted of drilling 15 rotary holes and one diamond drill hole.

Geological Setting

The regional geology of the Nicola district is shown on Figure 8. Several irregularly shaped remnants of Eocene age sedimentary rocks lie unconformably on a basement of Upper Triassic volcanic rocks of the Nicola Group. The sedimentary rocks comprise shale, sandstone, conglomerate, and coal. Younger volcanic rocks locally cap the sedimentary sequence throughout the district.

The geology of the Merritt area, shown on Figure 9, because of its lengthy coal exploration and production history, is better known than any of the other areas. The Merritt "basin", for the most part occupying a depression in the basement volcanics, covers an area approximately 3 miles by 7 miles in extent. Although few exposures are available, several bore holes drilled in the area, coupled with more plentiful outcrops around the periphery, outline the geology in general terms. From the available data it is evident that the geology is complex. Marked changes in lithology and texture caused by relatively rapid deposition of sediments into the basin is indicated. The depositional structure has been further complicated by subsequent severe faulting and folding of the Tertiary sequence.

Coal Deposits: (Figure 9)

Several coal deposits are known to occur in the Nicola district. Six lie in the Merritt area; the other occurs in the Quilchena area. These coal areas are summarized as follows:

a) Quilchena Creek - One seam, approximately five feet in thickness, crops out on the eastern flank of the Quilchena Creek valley about two miles south of Nicola Lake. Although the Diamond Vale Coal Co. apparently carried out extensive drilling in the basin from 1904 to 1906 and reported their results to be satisfactory, no coal of economic significance was developed. Imperial Metals and Power Ltd. mapped and prospected the area on a reconnaissance basis in the early 1960's; however, no significant coal was indicated from this work. Because of the limited outcrop exposure, the Quilchena area cannot be viewed as having been adequately explored. A few widely-spaced reconnaissance drill holes would determine whether additional coal seams exist and would usefully assess the structure and lithology of the "basin".

b) Fairley Prospect - One seam of unknown thickness occurs a short distance north of the town of Merritt. The steeply-dipping seam was reported to comprise severly sheared, friable, and dirty coal. The Sunshine Mine established on the seam many years ago produced 247 tons of coal.

c) Normandale Prospect - Another seam, vertically-dipping and four feet in thickness, occurs $4\frac{1}{2}$ miles east of Merritt near the edge of the "basin". The coal produced from this prospect is reported to have been 730 tons.

d) Glover Prospects - Several small prospect workings lie 4 miles east of Merritt, although no coal is presently visible at this locality. No record of coal production from the Glover area is known.

e) Coal Gulley Mines - Situated southwest of Merritt near the edge of the "basin", the Coal Gulley area has hosted several producing underground mines. Production ceased in 1929.

Exploration carried out by Imperial Metals and Power Ltd. in 1960 consisted of drilling four rotary holes. An additional five holes were drilled in the old river channel that separates the Coal Gulley area from Coldwater Hill. Three of the four holes intersected coal. Intersections ranged from 13 to 28 feet in one seam and 4 to $6\frac{1}{2}$ feet in another seam.

The coal beds in the Coal Gulley area lie within tight folds along axes which trend northwest and plunge southeast. Seven seams, with a total coal thickness of 73 feet, are distributed throughout a stratigraphic interval of 770 feet. The seams vary in thickness from 2½ to 26 feet; six are in excess of 5 feet. Dips of seams range from 20 to 70 degrees.

f) Coldwater Hill Mines - Coal was produced up to 1929 from two seams on Coldwater Hill located a half mile east of the Coal Gulley area. Small tonnages were produced on a salvage basis for local consumption from 1953 to 1963.

Imperial Metals and Power drilled six short rotary holes in the area in 1960. Four holes intersected coal seams ranging in thickness from one to 3½ feet.

On Coldwater Hill six seams of coal ranging in thickness from 10 inches to 6 feet 8 inches occur within a stratigraphic interval of 450 feet. Total coal thickness is 21 feet; however, only two seams are over 5 feet in thickness. It is these two seams, presumably, from which production was achieved. The dip of the mineable seams is 30° to the northeast.

Because of the intervening old river channel, the differing structural geology, and marked variation in coal stratigraphy, correlation of coal seams between Coldwater Hill and Coal Gulley is not possible. The Coldwater Hill seams may occur within, above, or below the Coal Gulley coal section.

g) Diamond Vale Mine - Small scale underground production was attained from two seams located near the centre of the Merritt area just east of the town. A total of 46,398 tons of coal was produced intermittently from this operation until closure in 1945.

The coal in the Diamond Vale mine area occurs in five seams that extend over 307 feet of stratigraphic section. Coal seams, which dip to the southwest at 27° range in thickness from 1 foot 4 inches to 5 feet, with a total coal thickness of 17 feet 3 inches.

One half mile east of the mine workings, five holes were drilled in 1946 by the B. C. Department of Mines. The object of this program was to extend the productive Diamond Vale seams updip closer to the surface. As a result of this drilling it became evident that complex stratigraphy and structure prevent tracing seams beyond the mine workings by use of widely spaced drilling.

Coal Reserves

Imperial Metals and Power Ltd. have stated that sufficient mineable reserves have been developed in the Coal Gulley - Coldwater Hill areas to support an underground mining operation of 380,000 tons of clean coal per year for 20 years. Because of the complex geology and the lack of closely spaced drilling no established coal reserves have been defined elsewhere in the Nicola district.

Analytical data on coal sampled from various localities in the Merritt basin indicates that quality varies between deposits and seams. Analyses derived from five sources on an "as received" basis is summarized as follows:

a) Coal Gulley (1960): Moisture 4.4%-7.4%, Ash 7.9%-22.0%, Volatile matter 32.3%-34.2%, Fixed carbon 40.4%-54.9%, Sulphur 0.4%-0.6%, Calorific values 10,240 to 13,040 Btu per lb.

b) Coldwater Hill (1954): Moisture 5.6%, Ash 11.4%, Volatile matter 34.4%, Fixed carbon 47.6%, Sulphur 0.7%, Calorific value 12,060 Btu per lb.

c) Fairley Prospect (1926): Moisture 2.8%, Ash 4.6%, Volatile matter 37.5%, Fixed carbon 55.1%, Sulphur 0.4%, Calorific value 13,175 Btu per lb.

d) Diamond Vale (1910): Moisture 2.66%, Ash 4.36%, Volatile matter 37.84%, Fixed carbon 55.14%.

e) East Diamond Vale drilling (1946): Moisture 2.2%-2.9%, Ash 9.5%-28.6%, Volatile matter 27.8%-34.0%, Fixed carbon 38.9%-54.1%, Sulphur 0.33%-0.93%, Calorific value 9,651 to 13,400 (average 11,644) Btu per lb.

The rank of the coal in the Merritt basin is classified as a high volatile "B" bituminous coal with very low coking characteristics, (FSI=2).

Conclusions

It is evident that in the Nicola coalfield, particularly within the Merritt area, several coal seams exist that are in excess of five feet in thickness, (possibly seven to ten), and would be extractable by underground mining methods. For the most part the Merritt and Quilchena areas are largely unexplored.

Because of the possible complex nature of the basin geology and the restricted continuity indicated along coal seams, the development of substantial reserves in any given area would require relatively close spaced exploratory diamond drilling. Reserve blocks upon which underground mines might be developed would tend to be small and local in extent. Consideration of a large coal-fired thermal plant based on substantial reserves in the Nicola district are therefore not deemed to be practical.

V. SIMILKAMEEN COALFIELDS (Figure 11)

An evaluation of the Similkameen Coalfields, which include the Tulameen and Princeton basins, has been presented in a separate report as part of the overall study of the thermal coal resources of British Columbia. As in the case of Hat Creek, it is of possible significance when considering other Tertiary areas in the southern interior that the relatively small Tulameen and Princeton areas have been proven to contain major thermal coal resources.

VI. OKANAGAN OCCURRENCES (Figure 2)

Along the Okanagan Valley as far south as the international boundary and extending east to Arrow Lake are several small outliers of Tertiary rocks. Coal has been reported to occur as small lenses in the White Lake basin 8 miles south of Penticton and in a basin near Midway, B. C.

The White Lake basin contains coal in sedimentary rocks of Eocene age associated with conglomerate and sandstone. A single hole drilled in the centre of the basin failed to intersect coal.

Because of the restricted areal extent of these isolated Okanagan areas and the lensy nature of coal in two of them, it is concluded that they are not of economic interest as major thermal coal sources, hence do not warrant further exploration.

PALEOCENE COAL

Coal of early Tertiary age occurs on the Bowron River 35 miles east of Prince George. Analyses on fossil pollen grains by Dr. G. E. Rouse of the University of British Columbia in 1969 indicates that the age of the coal measure lies between middle Paleocene and mid-Eocene with a chance of early Paleocene.

BOWRON RIVER DEPOSIT

Introduction

Discovered in 1871 by G. M. Dawson, coal occurrences were initially explored prior to 1914. The deposit lay dormant until 1946 from which time a series of companies have conducted sporadic exploration activities, each contributing to the overall knowledge of the coal occurrences. During this period, extending to 1970, several hundreds of feet of underground entries were driven from two adits and at least 42 holes were drilled.

In 1971 the property was optioned to Bethlehem Copper Corp. Ltd. by the current license holders Northern Coal Mines Ltd. Bethlehem drilled five diamond drill holes totalling 7474 feet.

The property presently consists of three coal licenses, numbered C.L. 148, 162, 163, and 16 adjoining licenses which have been applied for but not yet approved.

Access to the property, which is situated in the flat-bottomed valley of the Bowron River, is provided by six miles of gravel road which runs southerly from the newly-constructed Provincial Highway No. 16, joining the highway at a point 32 miles east of Prince George. The nearest railroad connection to the property is located in Prince George, from which point rail transportation is available to the seaports of Prince Rupert and Vancouver.

Geological Setting

The pre-Tertiary rocks that underlie the Bowron River area, (Figure 12), comprise a sequence of sedimentary and volcanic rocks of Mississippian age called the Slide Mountain Group. This group consists of greenstone, flow breccias, argillite, cherts, and minor limestone that have been moderately folded. Occurring within a northwest-striking graben structure of regional magnitude, Tertiary sedimentary rocks that contain coal unconformably overlie the Mississippian basement assemblage. In the vicinity of the known coal deposits, the graben attains an average width of $1\frac{1}{2}$ miles, but extends northwestward and southeastward beneath overburden for an unknown distance.

The local geology, (Figure 13), has been derived from photogeologic evidence, from outcrop exposures on the banks of the Bowron River, from underground workings, and from 22,000 feet of diamond drill core. The Tertiary sedimentary rocks occupy a northwest-trending lineal basin approximately 10 miles in length and $1\frac{1}{2}$ miles in width and attain a thickness in excess of 2200 feet. The sequence, consisting of shale, sandstone, breccias, and coal beds, for the most part dips eastward from 20 to 60 degrees; however, because of limited drill hole information east of the underground workings the basin may be more structurally complex than indicated.

Coal Section

Coal of economic interest occurs within a stratigraphic section ranging in thickness from 60 to 200 feet. The coal measure, which maintains a dip to the east at angles varying from 20 to 60 degrees, occupies the basal 250 feet of the sedimentary sequence. Most clearly established along the western margin of the basin by underground workings and closely spaced drilling, the coal measure has been extended eastward by widely spaced drilling to cover an area 14000 feet by 5000 feet. It remains open to projection to the north, east, and south.

Within the coal-bearing section three seams have been identified on the west bank of the Bowron River. The upper seam reaches 8 feet in thickness, the middle seam 11 feet, and the lower seam 9 feet. The upper two seams have been partially explored by 1200 feet of underground workings developed from two adit entries.

The continuity of these seams over the extent of the area explored by drilling has not been established with a reasonable degree of reliability down dip from the edge of the basin. Some difficulty has been experienced by workers on the property in correlating individual seams between drill holes. Individual seams may be discontinuous and seam thicknesses appear to vary markedly, ranging from 5 to 24 feet. However, as these holes are widely spaced, little conclusive evidence regarding continuity of coal within the basin can be established until further, more systematic drilling is carried out.

Coal Reserves

The exploratory programs which have been conducted on the deposit to date have tested in a preliminary way an area some 14000 by 5000 feet within the Bowron River basin. More definitive work has been concentrated along a section of the western rim of the basin that covers an area 8000 feet along strike and 2500 feet down dip.

Coal reserve calculations were carried out by Northern Coal Mines incorporating all drill hole data. With widely-spaced drill hole information contributed by Bethlehem Copper Corp. Ltd., the total coal in place was calculated to be 81.4 million tons. This figure represents in situ coal; however, because of the apparent lack of continuity of individual coal seams no estimate of mineable coal was made. Based upon the drilling density the above reserve figure is catergorized as follows:

Proven Reserves	7.3 million tons (the Upper 8 ft. seam)
Probable Reserves	51.2 million tons
Possible Reserves	22.9 million tons
	81.4 million tons

There appears to be no possibility, within the area of established coal reserves, of utilizing surface mining methods. The deposit must therefore be accepted as an underground operation with the related higher mining costs and possibly lower mining recoveries.

The ultimate reserve potential of the Bowron River basin remains to be determined. There is no reason to believe the coal measure will not continue for some distance northwest and southeast of the explored section of the graben structure.

The rank of the coal is classified as high volatile B Bituminous by A.S.T.M. standards. The coal has a high lustre and is hard and dense. Coal from underground workings on the property has yielded a coke button with a free-swelling index of one near the surface and three in progressively deeper workings.

Analyses of coal samples were obtained by Northern Coal (on an air dry basis) and by Bethlehem Copper Corp. Ltd. (on a dry basis).

The Northern Coal samples taken from two localities on the Upper or Main Seam graded as follows:

a) No. 1 adit: 0.40% Moisture, 9.8% Ash, 43.0% Volatile matter, 46.8% Fixed carbon, 0.80% Sulphur, and 11,070 Btu per lb.

b) No. 2 adit (200 from surface): 5.7% Moisture, 4.0% Ash, 39.1% Volatile matter, 51.2% Fixed carbon, 0.80% Sulphur, and an undetermined Calorific Value.

The above samples were taken from the Main or Upper seam. The company also analyzed samples from underground workings on the Middle seam, (11 feet in thickness), and from the Lower seam which was presumably sampled at the surface. These samples returned the following analyses:

a) Middle seam, near surface: 5.5% Moisture, 2.8% Ash, 39.7% Volatile matter, 52.0% Fixed carbon, 1.20% Sulphur, and an undetermined Calorific Value.

b) Middle seam (400' from surface): 4.92% Moisture, 2.77% Ash, 36.5% Volatile matter, 55.8% Fixed carbon, 0.85% Sulphur, and 12,550 Btu per lb.

c) Lower seam: 14.1% Moisture, 2.6% Ash, 28.6% Volatile matter, 54.7% Fixed carbon, 1.50% Sulphur, and 12,470 Btu per lb.

Bethlehem Copper Corp. Ltd. analyzed coal from four of five holes drilled. Their fifth hole located 3200 feet east of the Bowron River intersected volcanic rock. The samples returned average values as follows:

a) From 19 samples: 24.63% Ash, 36.73% Volatile matter, 42.0% Fixed carbon, 1.39% Sulphur, and 11,000 Btu per lb.

b) From 11 samples: 19.3% Ash, 37.15% Volatile matter, 43.22% Fixed carbon, 1.63% Sulphur, and 11,064 Btu per lb.

The discrepancy between ash content in the Bethlehem Copper Corp. drilling which tested the deeper portion of the basin near the centre of the graben and the western, more intensely explored edge of the basin has not been explained. Conceivably, shale partings in coal zones may be more prevalent toward the basin centre and were included in the analyses.

Conclusions

The Bowron River coal deposit appears to be a promising source of coal suitable for thermal plant power generation. However, it will be necessary to employ underground mining methods in the exploitation of the deposit.

Although approximately 80 million tons have been indicated in situ by drilling and good possibilities exist to extend the deposit along strike, the continuity of seams as expressed on surface should be viewed with reservation. Mineable coal may be non-existent deeper in the basin or restricted to 50% recovery if the basin structure is complex. Otherwise, hydraulic methods might be employed to extract the coal with attendent lower costs and higher recoveries, provided that reasonable continuity can be shown to exist along seams by increased, more systematic diamond drilling.

COAL POTENTIAL

On the basis of the available data it is evident that coaly accumulations in sedimentary rocks of Miocene age have no potential for commercial exploitations, except possibly for small local markets. Sufficient evidence is at hand, however, to indicate that in sedimentary "basins" of Eocene and Paleocene age offer very good potential to define additional reserves to those presently developed in the Hat Creek, Merritt, Tulameen, and Princeton areas, providing that sufficient and systematic exploration can be funded and implemented.

Eocene sedimentary areas, with substantial sectors that have been relatively unexplored, known to contain coal seams in excess of 5 feet in thickness are the Cariboo, Hat Creek, Merritt, Tulameen, and Princeton. A summation of the potential coal which ultimately could be proven to exist in these Eocene "basins" is outlined as follows:

Basin	Area (sq. miles)	Average Coal Thickness (feet)	Tonnage Potential (10^6 S.T.)	Calorific Value (Btu per lb.)
Cariboo	82.4	15	1,400	6,700- 7,900
Hat Creek	57.0	2000	Being Explored	6,000
Merritt	33.4	10	378	10,000-13,000
Quilchena	12.0	5	70	-
Tulameen	6.0	24.5	187	10,000
Princeton	54.5	76	4,700	10,000
			6,735	

Until proven otherwise by detailed exploration, the coal resources potentially mineable in Eocene sedimentary rocks of the Southern Interior Belt of British Columbia must be regarded as exploitable only by underground mining methods. Therefore, 50% of this potential tonnage or approximately 3 billion tons may be viewed as potentially recoverable.

Paleocene coal in southern British Columbia is presently restricted to a graben which channels the Bowron River valley. Coal reserves of 80 million tons have been defined within a section of the graben. Based on the known geology it is reasonable to assume that potential coal resources exist within the graben in equal quantities to the northwest and southeast of the blocked-out reserve. The total potential in situ coal resources in the Bowron River basin, including the calculated reserve, is estimated to be 240 million tons ranging in grade from 11,000 to 12,500 Btu per lb.

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CONCLUSIONS

Large tonnages of coal which could eventually fuel one or more major thermal plants are potentially available in Tertiary rocks of the Southern Interior Belt of British Columbia. To date, a total of 778.5 million tons of open pit coal have been classified as established reserves. Most of these reserves exist in the Hat Creek deposit but important tonnages could be available from the Similkameen Coalfields (Tulameen and Princeton). Approximately 100,000,000 tons of coal extractable by underground mining methods occur as established (in situ) reserves in the Bowron River and Merritt deposits.

Although coaly accumulations are known to occur in three different ages of Tertiary sedimentary rocks, only the Eocene and Paleocene deposits are viewed as potentially important. Miocene sedimentary rocks contain only sparse, very-local concentrations of poor- quality lignitic coal. They are of no commercial interest.

Eocene sedimentary formations, host for the very large unexploited Hat Creek deposit and three "basins", (Merritt, Tulameen, and Princeton), which collectively produced in excess of 7 million tons of coal, offer the most attractive targets for exploration. Six Eocene areas or "basins" have only been partially explored, basically where it was very convenient to find and directly exploit coal.

One Paleocene deposit, on the Bowron River, is known. Opportunities to outline additional established reserves exist, although it is highly likely that all coal eventually developed along the Bowron River graben will be mineable only by underground methods.

It appears from the geological evidence that there is a reasonable basis for assuming that all of the areas of Eocene sedimentary rocks in the southern interior of British Columbia are erosional remnants of rocks deposited in one continuous continental sea. If this is the case then the coal potential for all of the areas, even those capped by late volcanic rocks, could be very great, especially considering the large thermal coal reserves and/or resources presently indicated in the Hat Creek, Tulameen, Princeton, Cariboo, Quilchena and Merritt "basins". The geological evidence also suggests that such large coal potentials, in the Eocene formations at least, occur only in those areas along the west or central portion of the belt, rather than the east, thus suggesting a spatial relation to an ancient shoreline.

In summary, although no immediate surface coal reserves are indicated in the Southern Interior Coal Belt, (excepting Hat Creek, Princeton and Tulameen), of sufficient magnitude to support a major thermal plant, there are three areas that may have that potential, namely; Cariboo, Merritt and Quilchena. In addition, the Bowron River deposit certainly has sufficient reserves, but they require underground mining.

It is apparent, therefore, that the Merritt, Quilchena and Cariboo coalfields warrant more comprehensive exploration as potential major sources of surface and underground thermal coal. Also that the other Tertiary areas along the west-central side of the Southern Interior Coal Belt of British Columbia warrant reconnaissance mapping and possible wildcat drilling to determine their possible (buried) coal potential.

Respectfully submitted,

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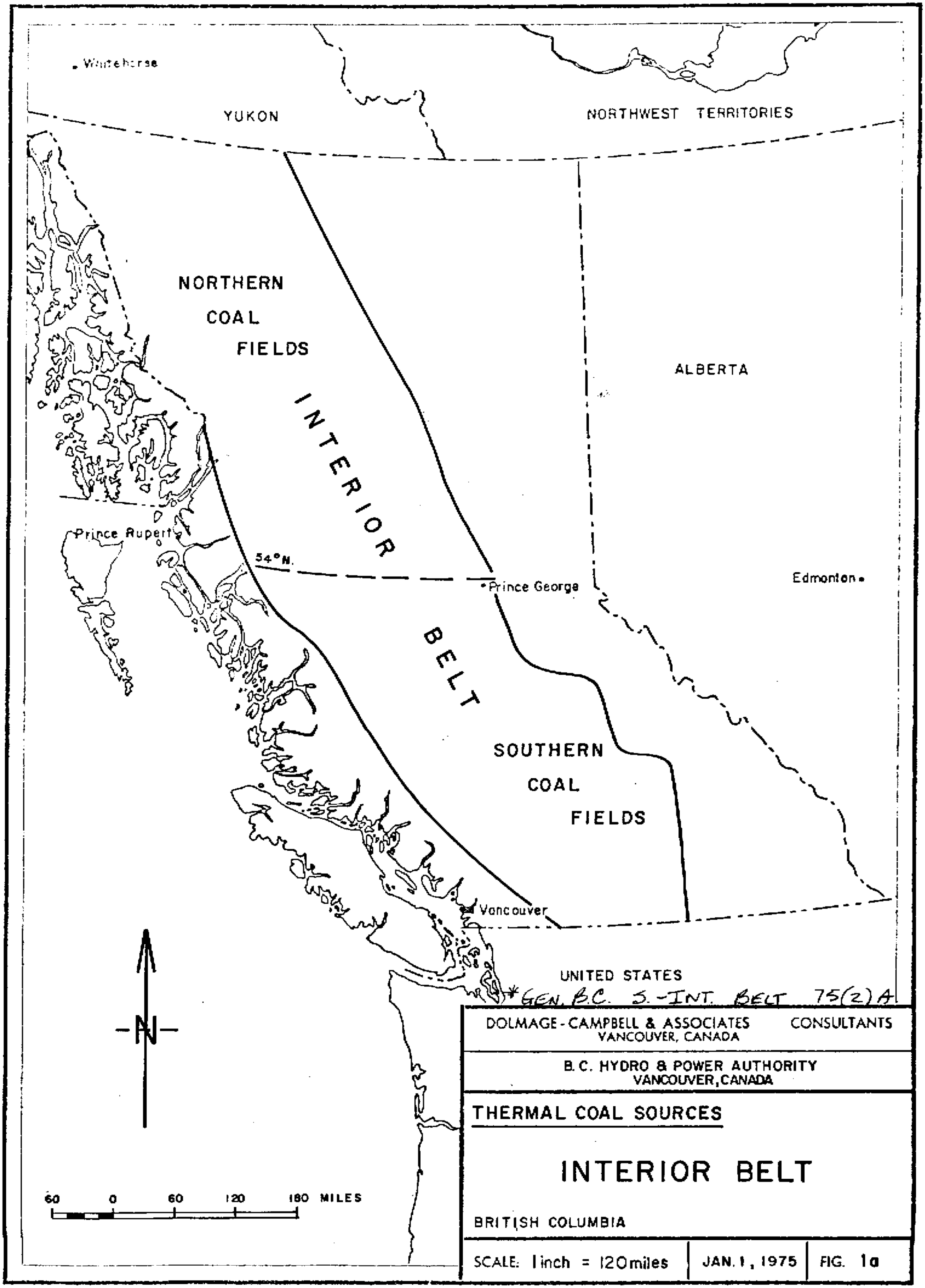

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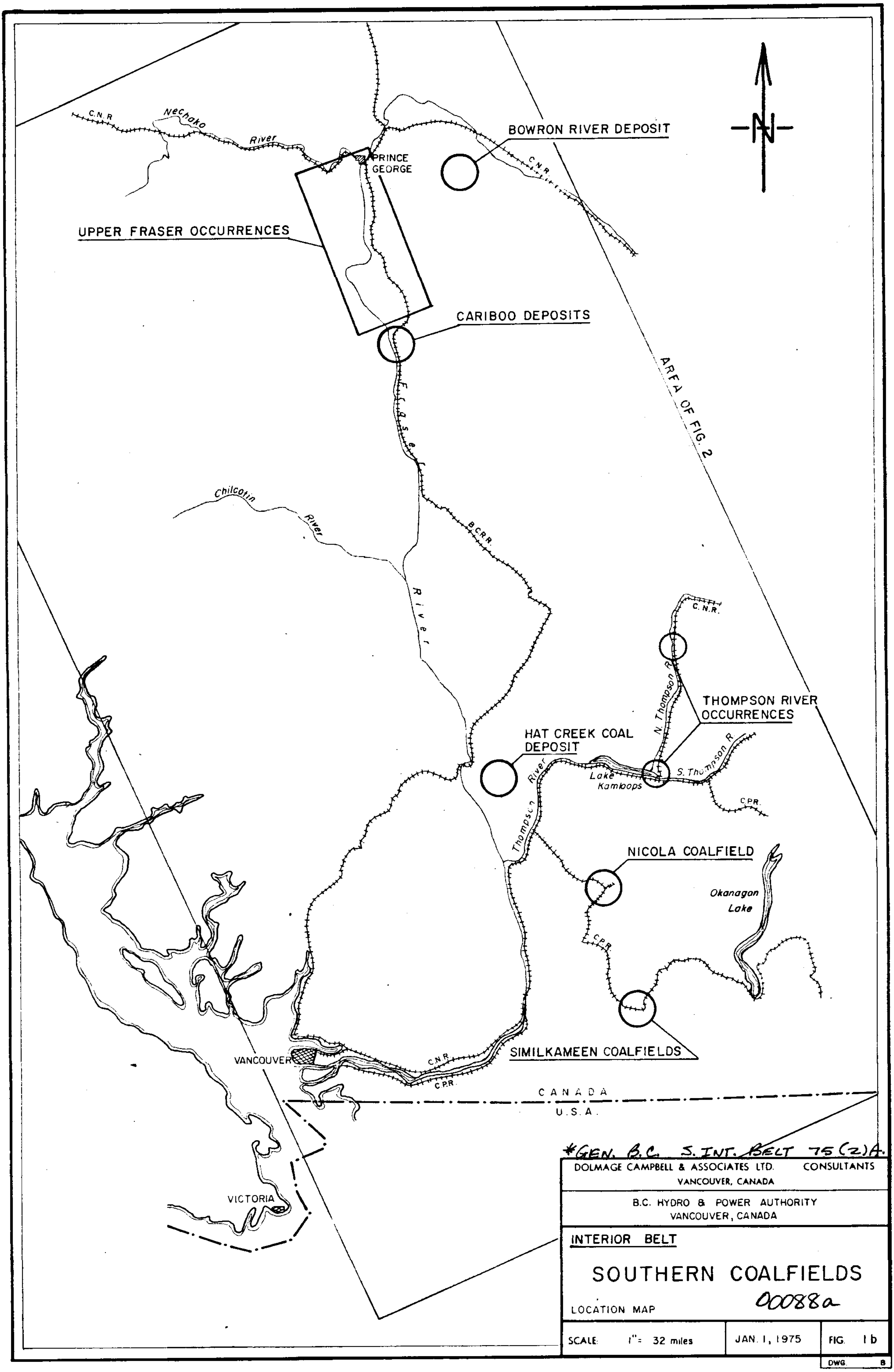
VANCOUVER, CANADA

THERMAL COAL SOURCES

INTERIOR BELT

BRITISH COLUMBIA

SCALE: 1 inch = 120 miles | JAN. 1, 1975 | FIG. 1a



*GEN. B.C. S. INT. BELT 75(2)A.

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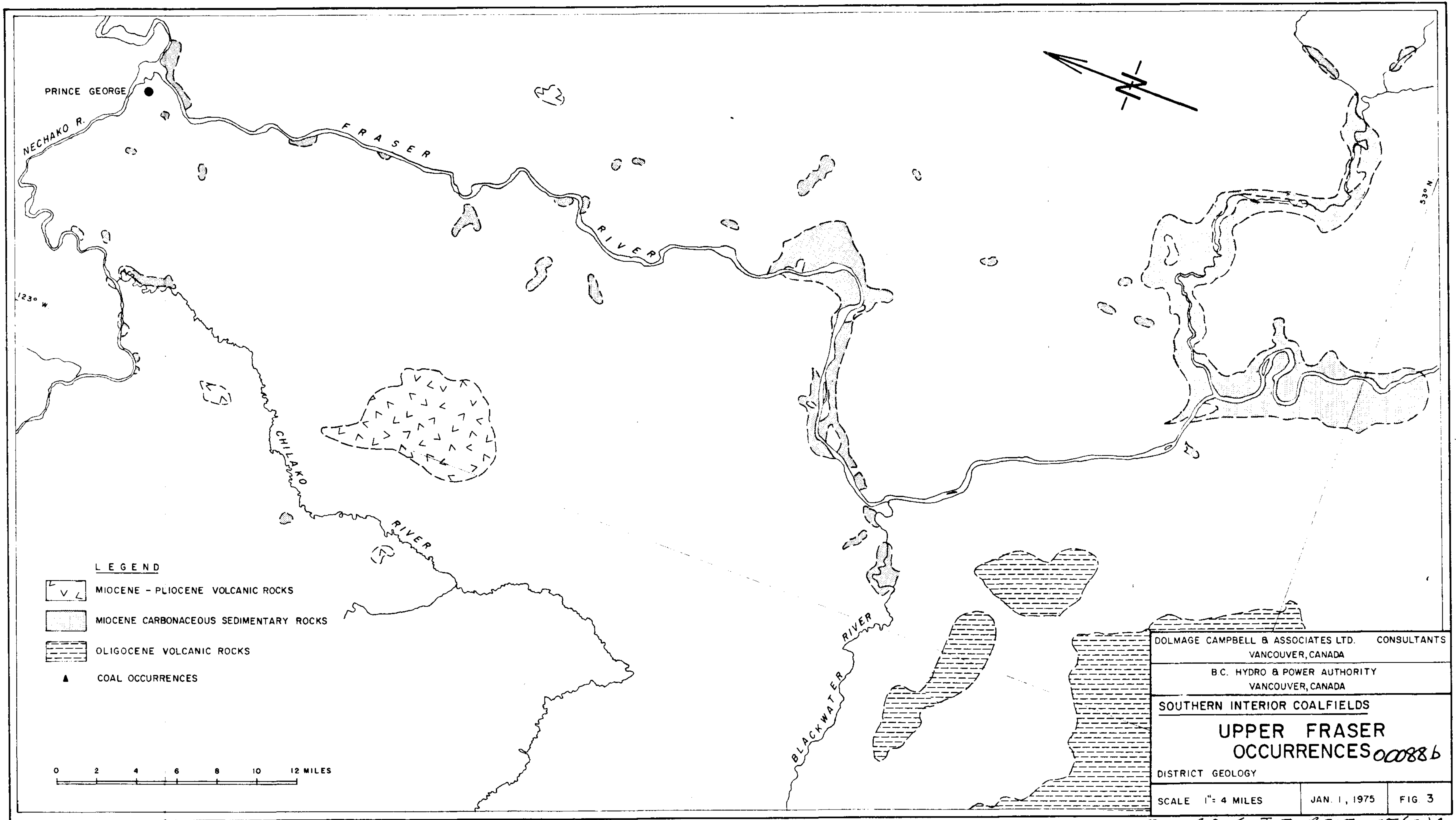
INTERIOR BELT

SOUTHERN COALFIELDS

LOCATION MAP 00088a

SCALE: 1" = 32 miles	JAN. 1, 1975	FIG. 1b

DWG. 8



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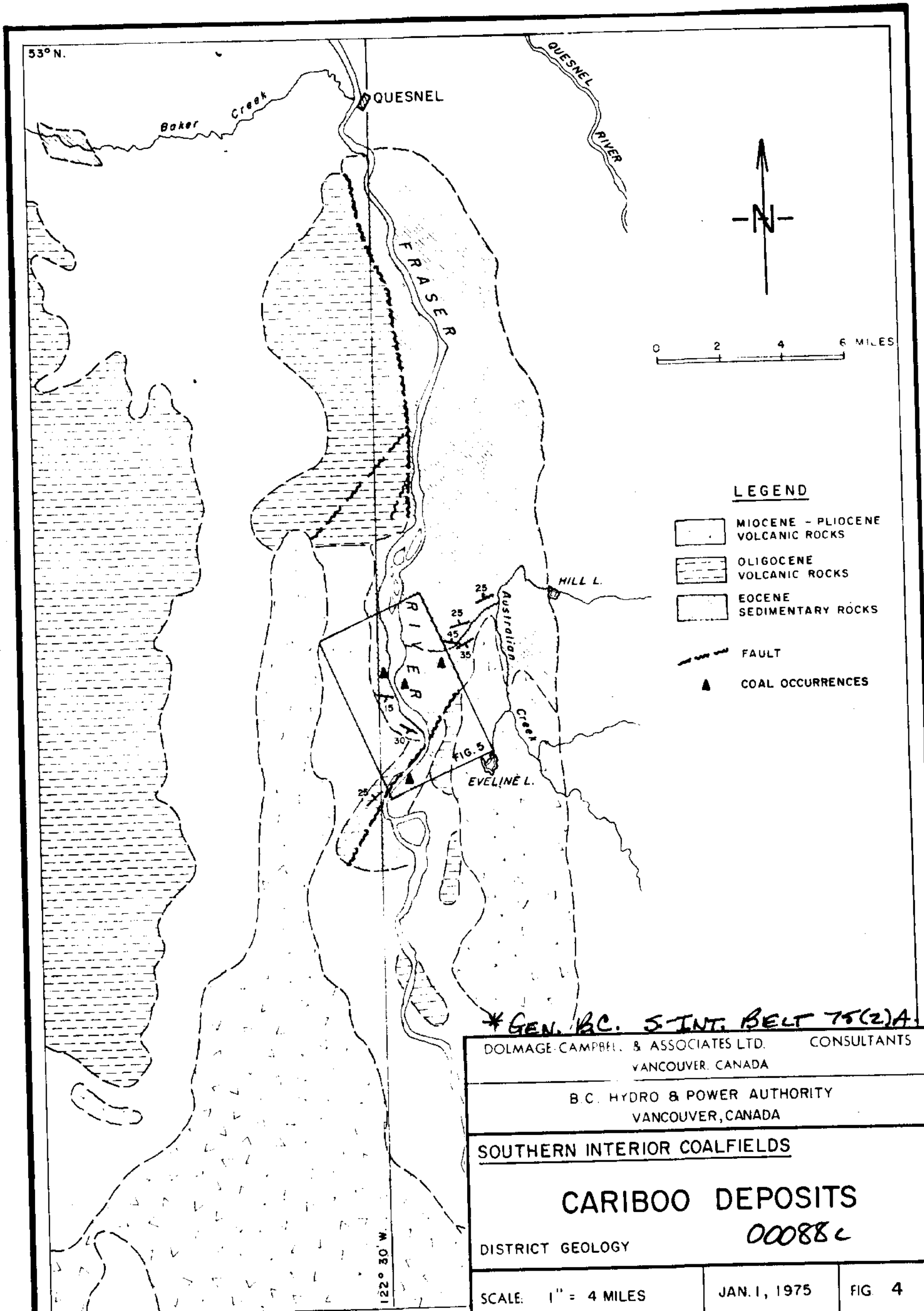
SOUTHERN INTERIOR COALFIELDS

UPPER FRASER OCCURRENCES 00088b

DISTRICT GEOLOGY

SCALE 1" = 4 MILES	JAN. 1, 1975	FIG 3

* GEN-B.C. S.-INT. BELT 75(2)A.



*GEN. B.C. S.INT. BELT 75(2)A.

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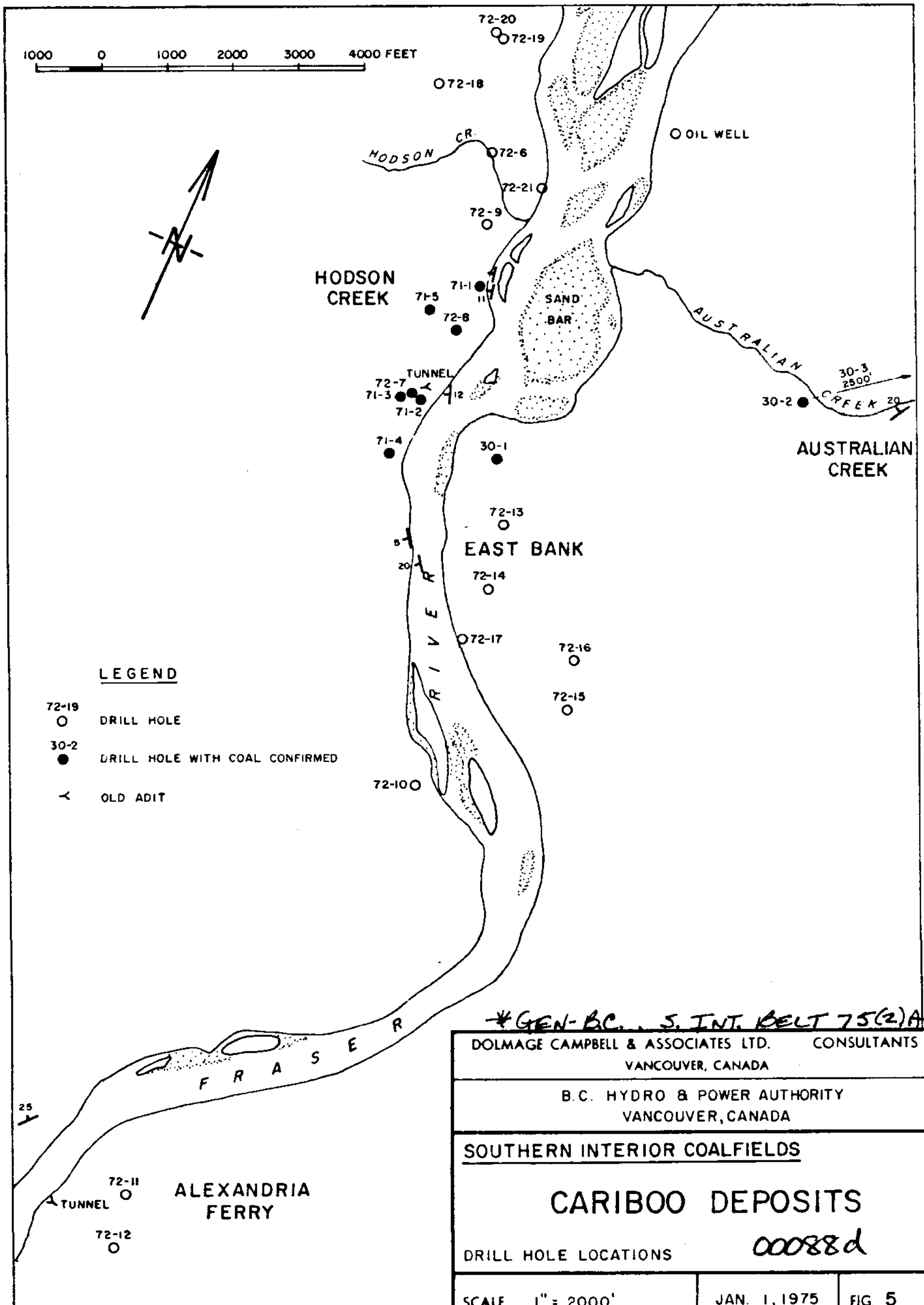
SOUTHERN INTERIOR COALFIELDS

CARIBOO DEPOSITS

00088c

DISTRICT GEOLOGY

SCALE: 1" = 4 MILES	JAN. 1, 1975	FIG. 4



*GEN-BC. . S. INT. BELT 75(2)A.

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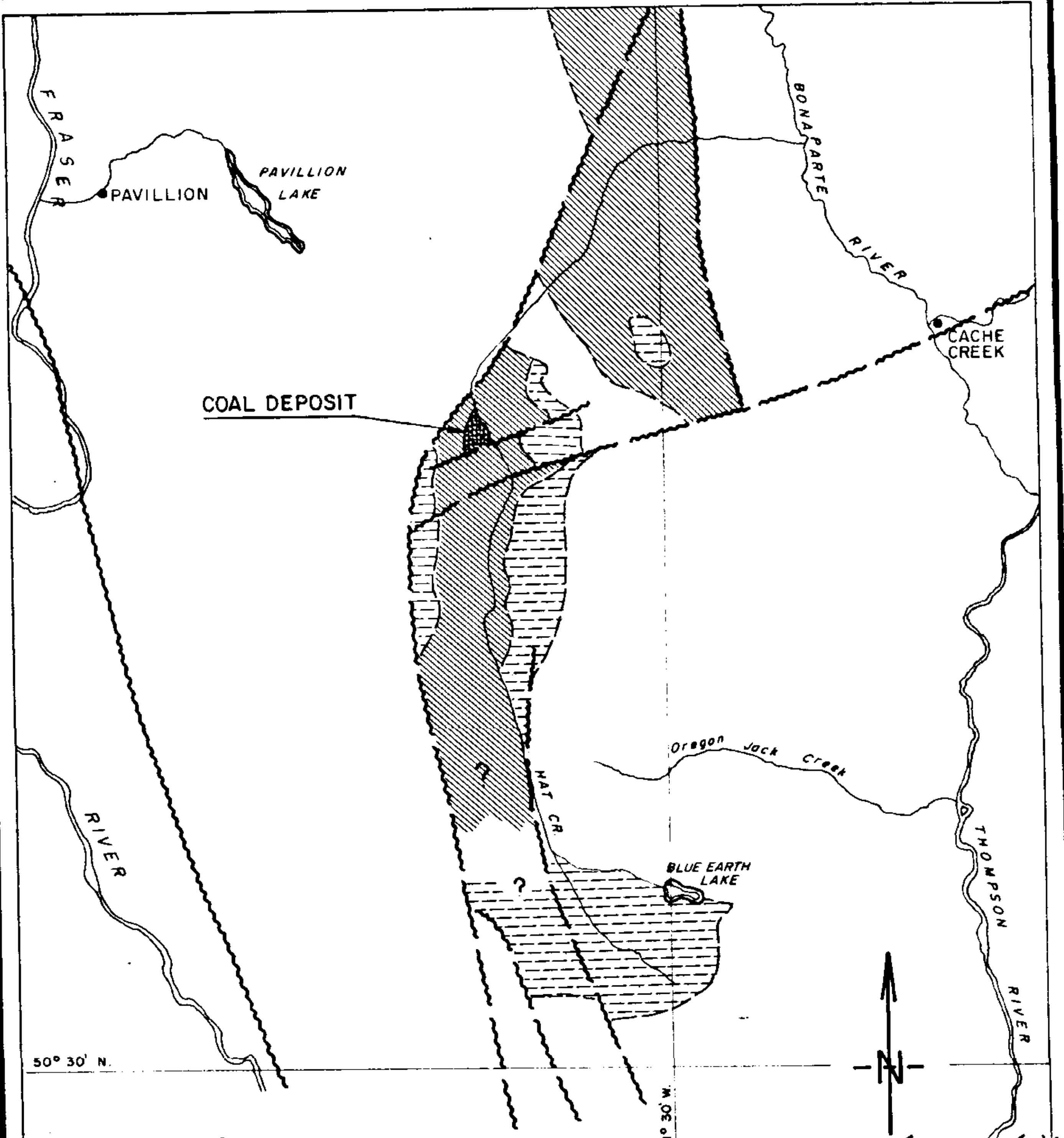
SOUTHERN INTERIOR COALFIELDS

CARIBOO DEPOSITS

DRILL HOLE LOCATIONS 00088d

SCALE. 1" = 2000'	JAN. 1, 1975	FIG. 5

VANCAL - 72



* GEN - B.C. S.-INT. BELT 75(2)A.

LEGEND

OLIGOCENE VOLCANIC ROCKS

EOCENE SEDIMENTARY ROCKS

FAULT

0 2 4 6 8 MILES

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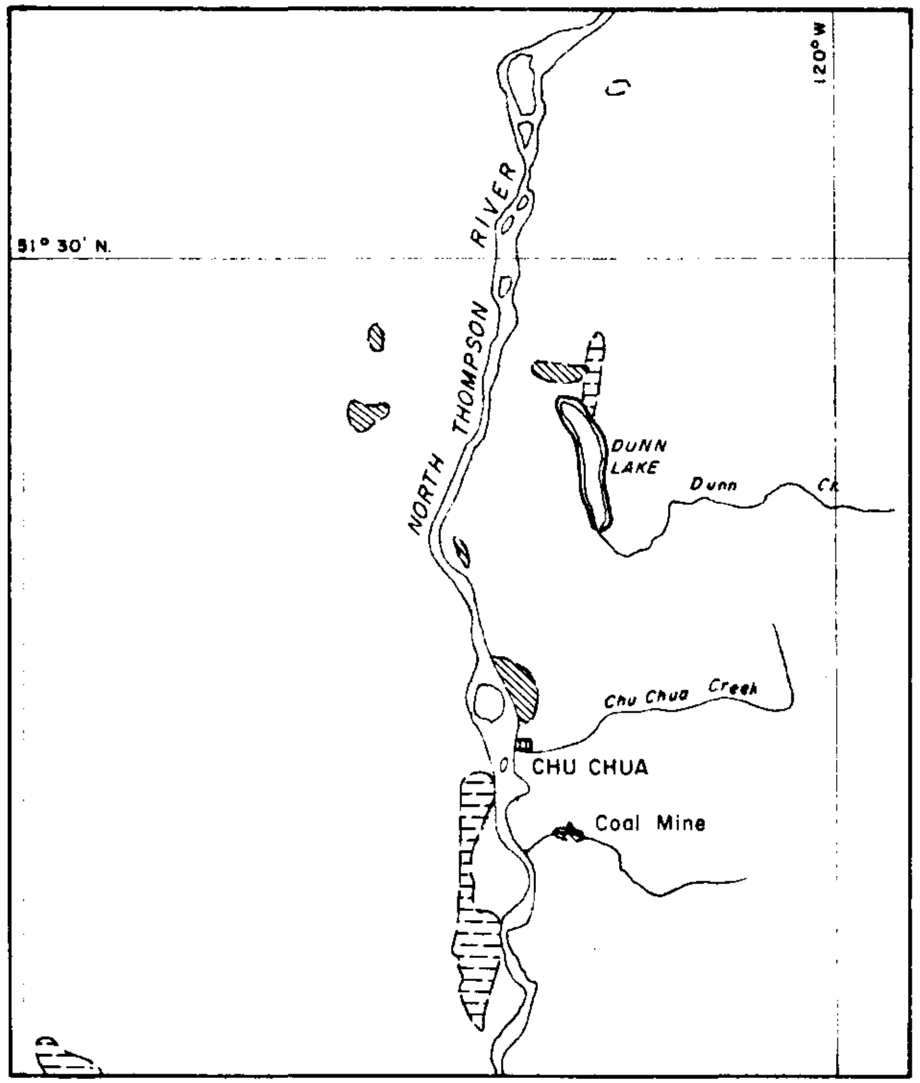
SOUTHERN INTERIOR COALFIELDS

HAT CREEK

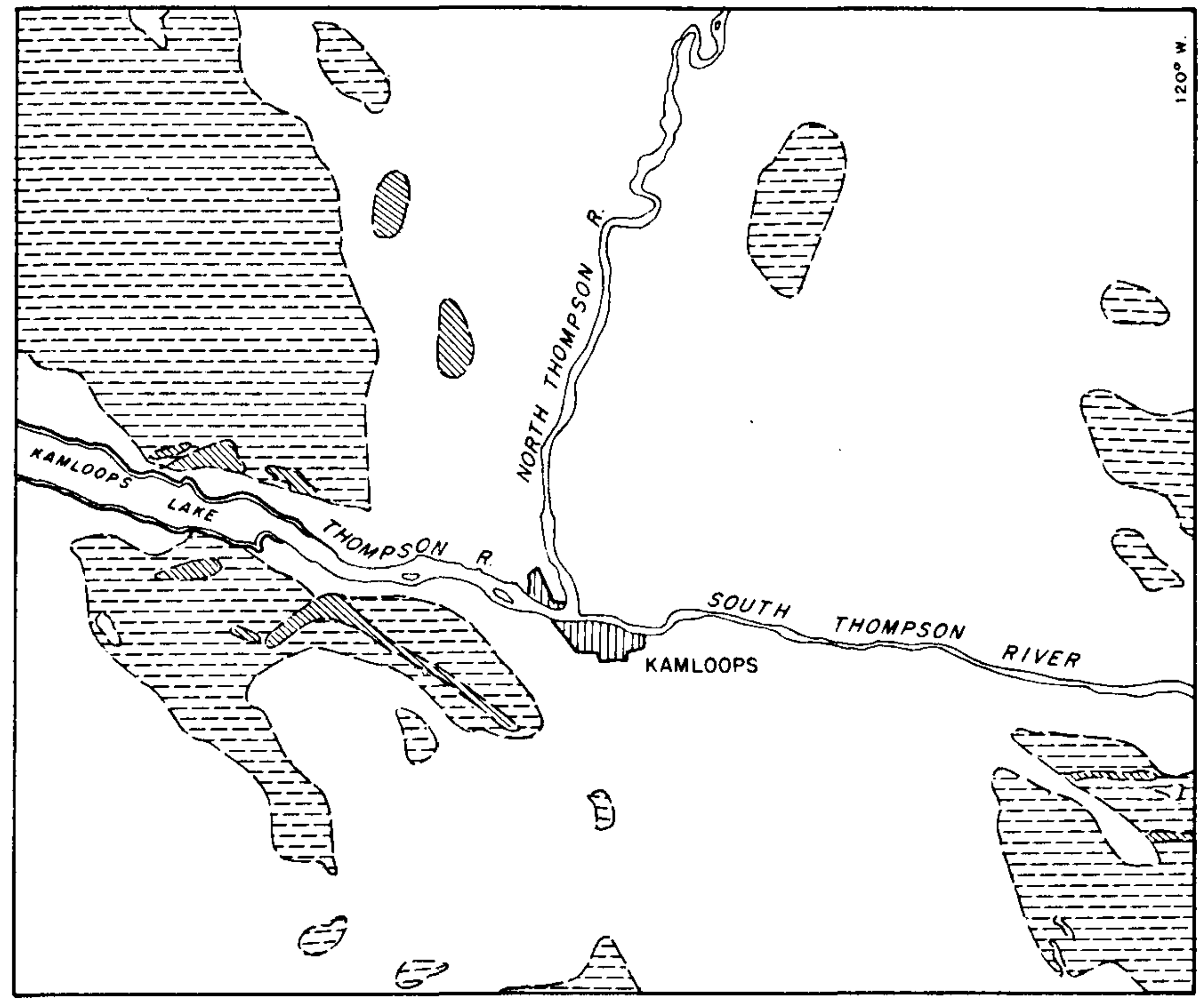
DISTRICT GEOLOGY 00088e

SCALE: 1" = 4 MILES	JAN. 1, 1975	FIG. 6

CHU CHUA AREA (FIG. 7a)



KAMLOOPS AREA (FIG. 7b)



N

4 0 4 8 12 MILES

LEGEND

- OLIGOCENE VOLCANIC ROCKS
- EOCENE SEDIMENTARY ROCKS
- COAL OCCURRENCES

* GEN - B.C S. INT. BELT 75(2) 4.

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SOUTHERN INTERIOR COALFIELDS

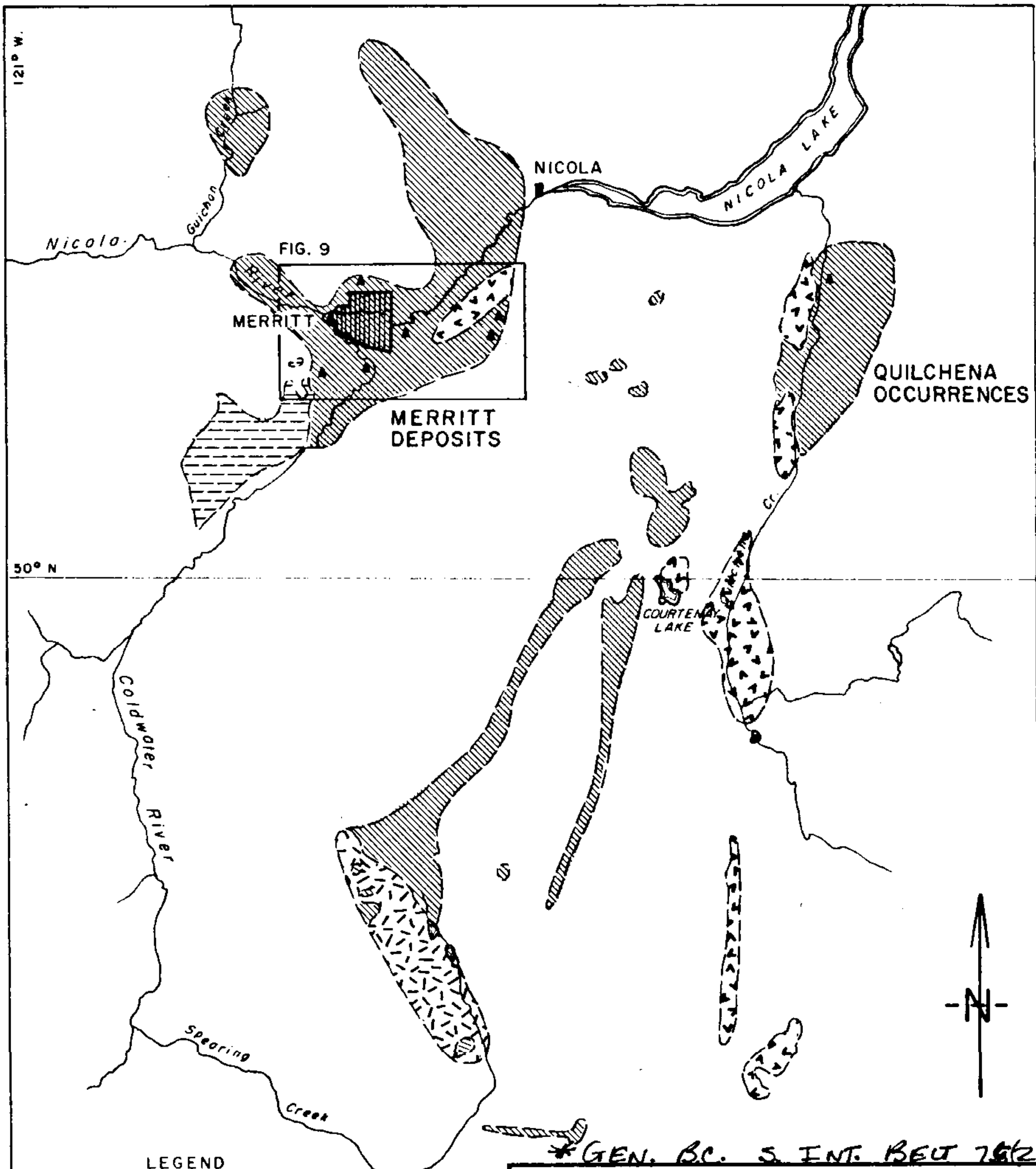
THOMPSON RIVER OCCURRENCES

DISTRICT GEOLOGY 00088 f

SCALE 1" = 4 MILES	JAN. 1, 1975	FIG. 7

DWG 8

VANCAL . 72



LEGEND

- MIOCENE - PLIOCENE VOLCANIC ROCKS
- OLIGOCENE VOLCANIC ROCKS
- EOCENE SEDIMENTARY ROCKS
- EOCENE - OLIGOCENE VOLCANIC ROCKS
- ▲ COAL OCCURRENCES

4 2 0 2 4 6 MILES

*GEN. B.C. S. INT. BELT 76(2)A

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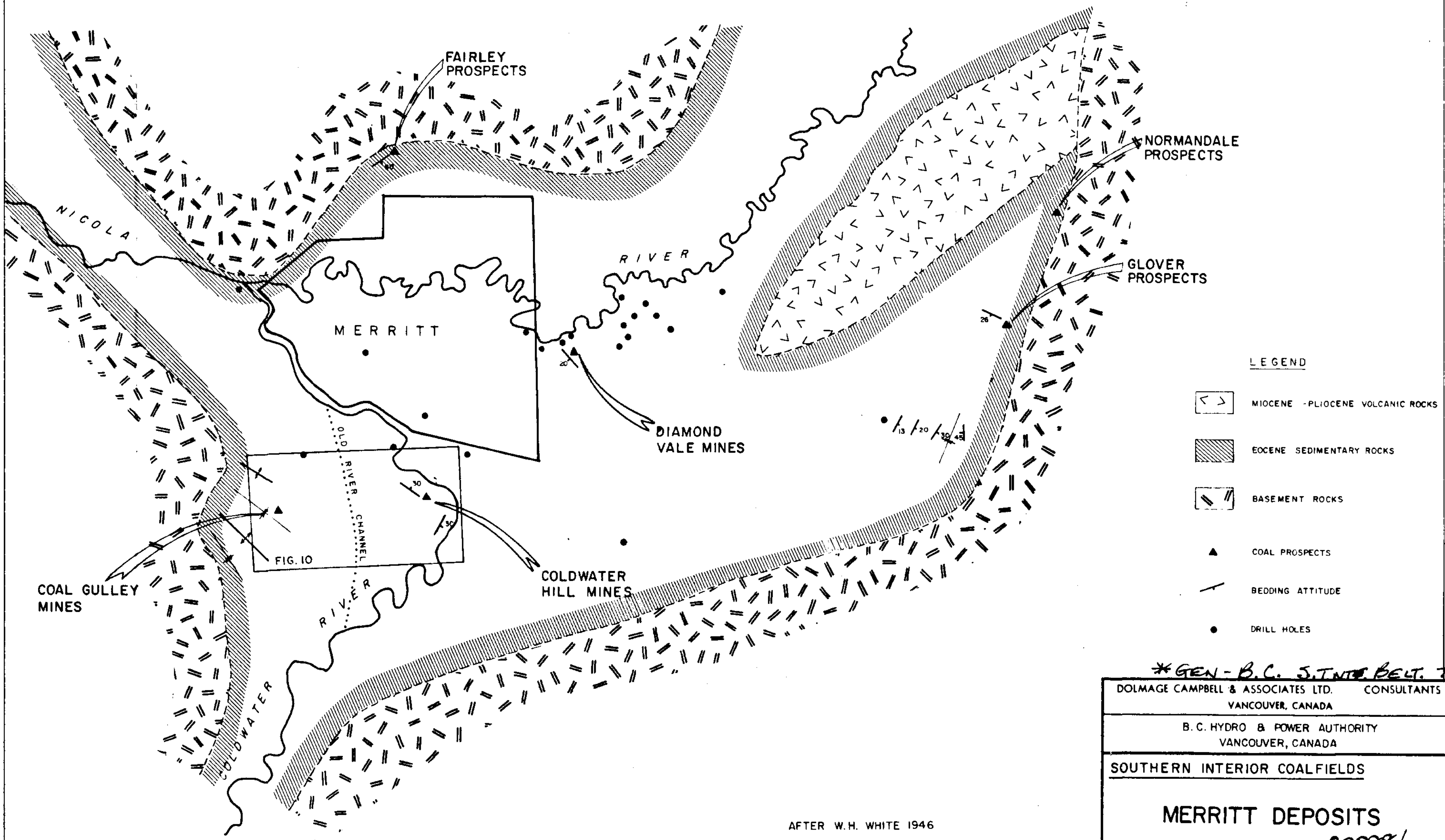
SOUTHERN INTERIOR COALFIELDS

NICOLA COALFIELD

DISTRICT GEOLOGY 000889

SCALE 1" = 4 MILES	JAN. 1, 1975	FIG 8



*GEN - B.C. S.INTE.BELT. 75(2)A.

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SOUTHERN INTERIOR COALFIELDS

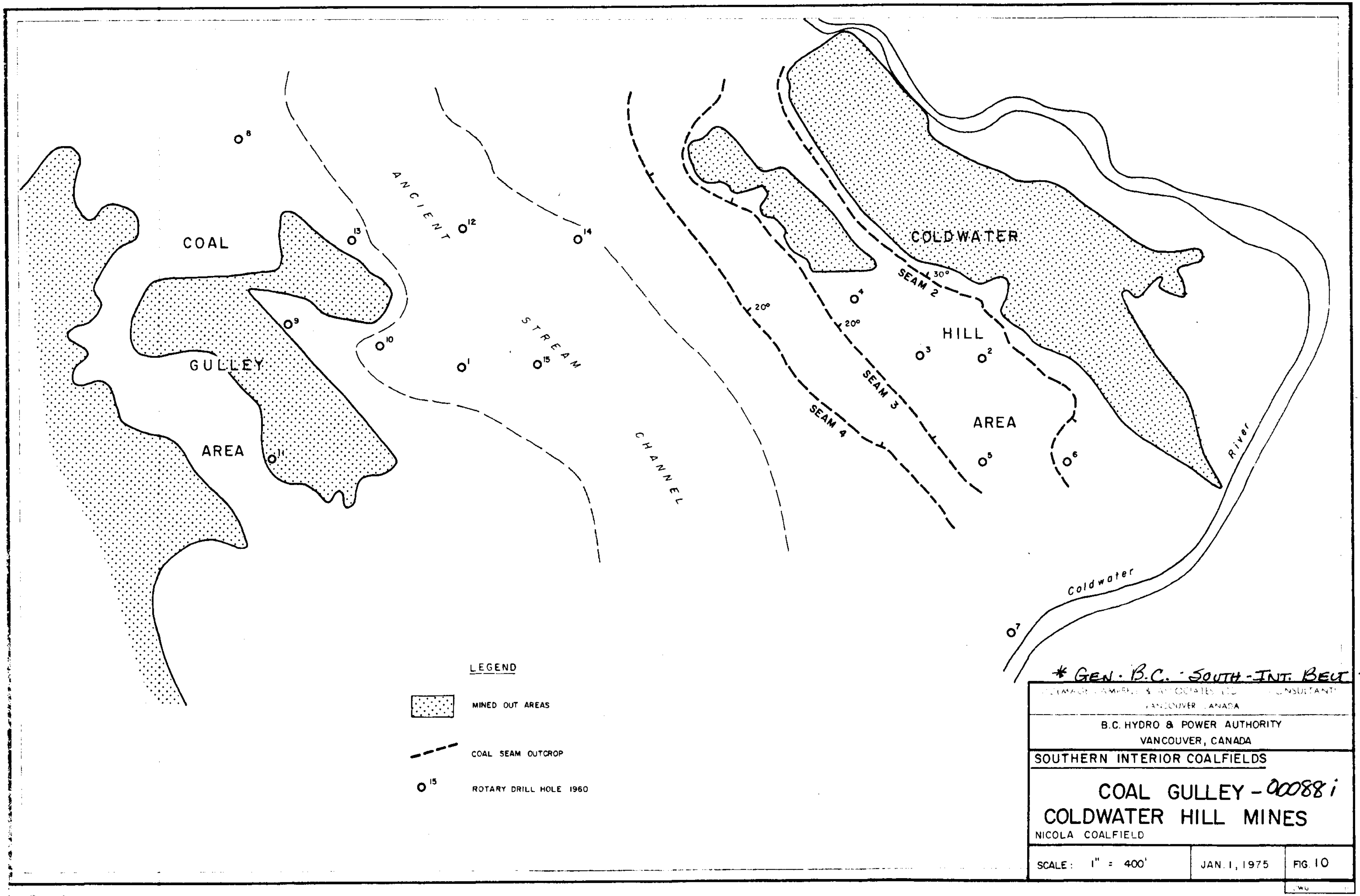
MERRITT DEPOSITS

NICOLA COALFIELD 00088h

SCALE 1" = 3000'	JAN. 1, 1975	FIG. 9

DWG. 8

VANCAL - 72



* GEN. B.C. - SOUTH - INT. BELT 75(2)4.

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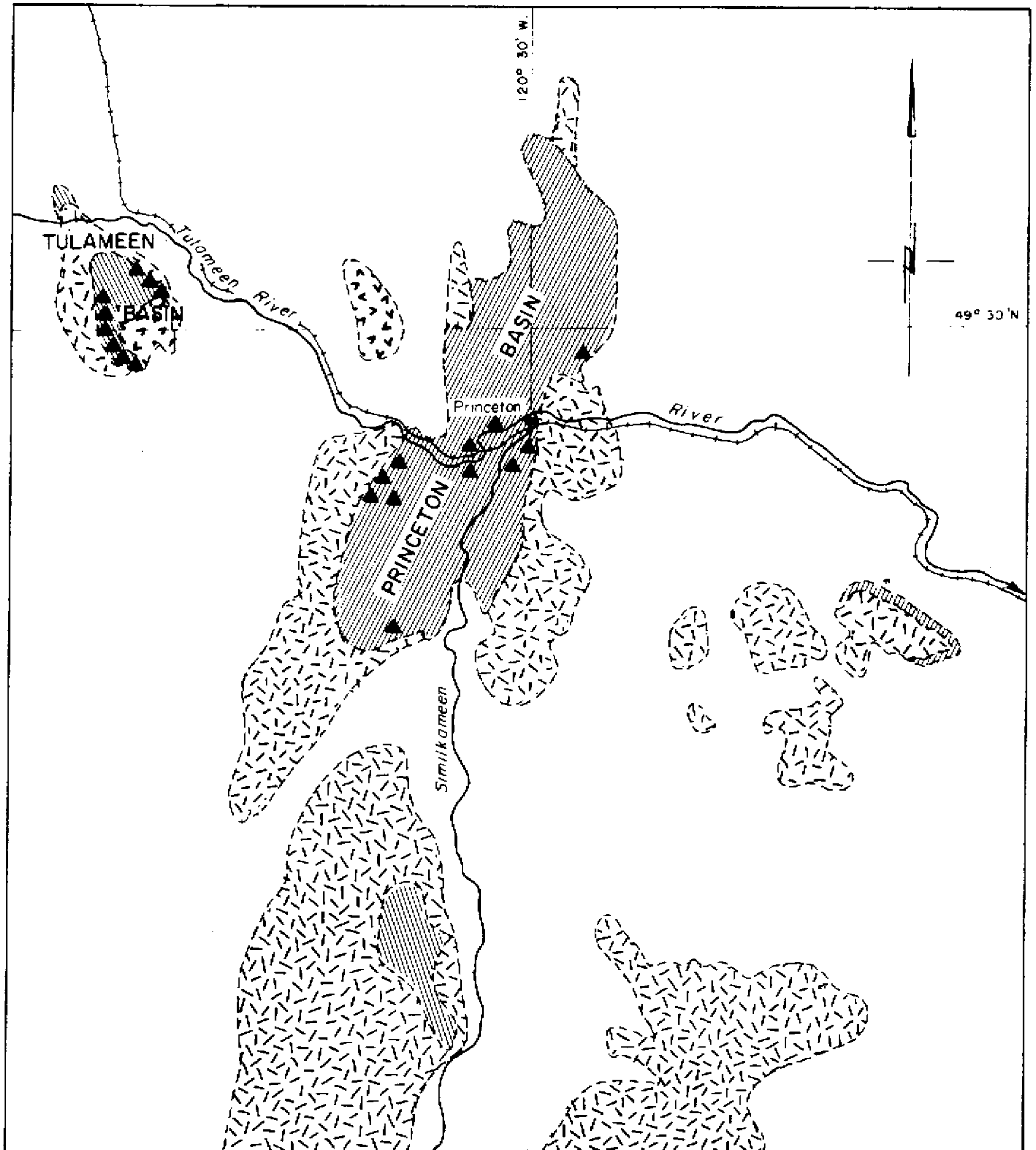
SOUTHERN INTERIOR COALFIELDS

COAL GULLEY - 00088 i
COLDWATER HILL MINES
NICOLA COALFIELD

SCALE: 1" = 400' | JAN. 1, 1975 | FIG. 10



LEGEND

- MIOCENE - PLIOCENE VOLCANICS
- EOCENE SEDIMENTARY ROCKS
- EOCENE VOLCANICS
- BASEMENT ROCKS
- ▲ COAL DEPOSITS

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SOUTHERN INTERIOR COALFIELDS

SIMILKAMEEN COALFIELDS

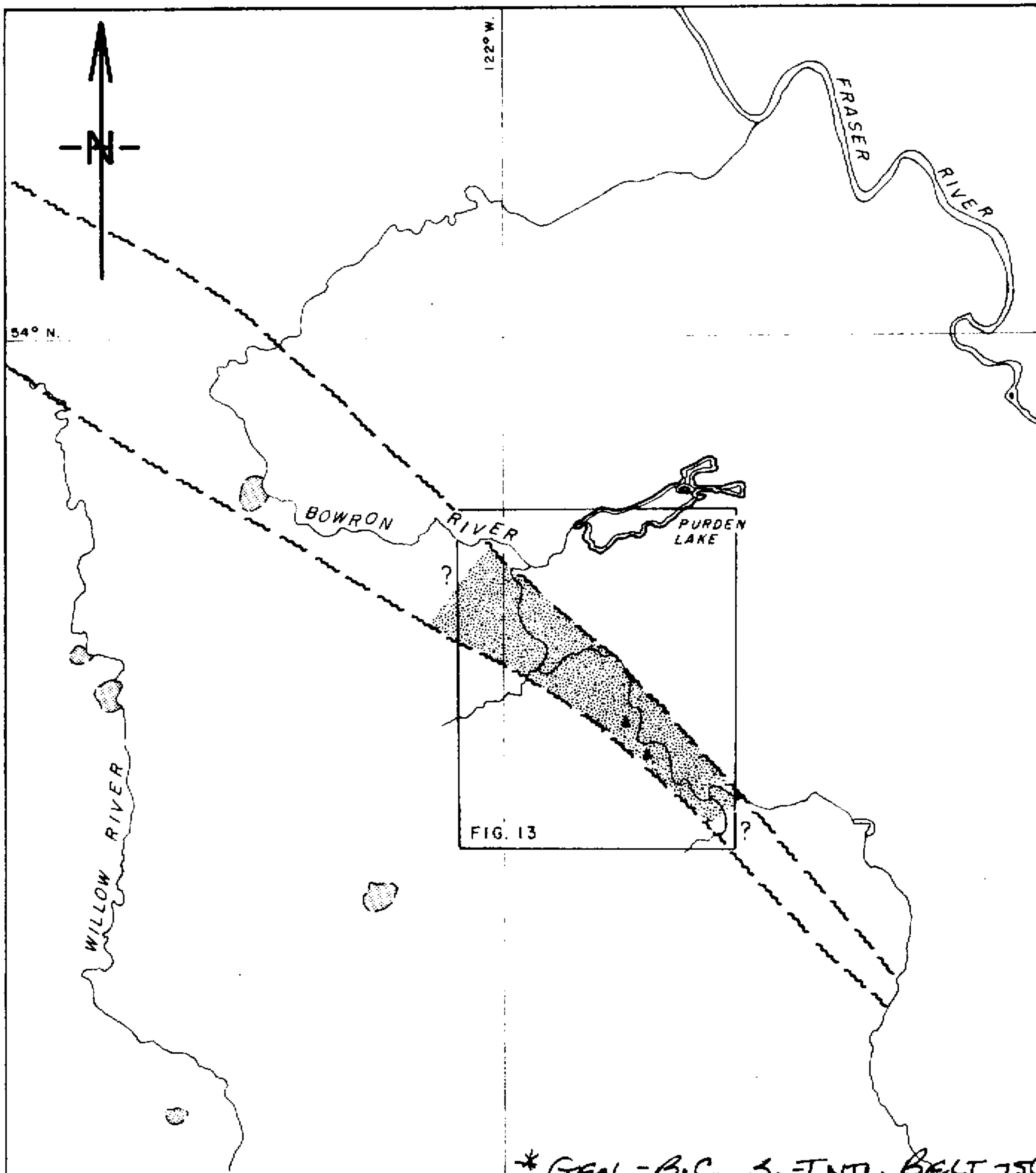
DISTRICT GEOLOGY

SCALE: 1" = 4 mi.	JAN. 1, 1975	FIG. 11

VANCAL - 72

* GEN - B.C. S.-INTERIOR SECT. 75(2)A

DWG. 674 A



LEGEND

- MIOCENE CARBONACEOUS SEDIMENTARY ROCKS
- PALEOCENE SEDIMENTARY ROCKS
- BASEMENT ROCKS
- ▲ COAL OCCURRENCES

0 2 4 6 8 MILES

*GEN - B.C. S. INT. BELT 75(2)A.

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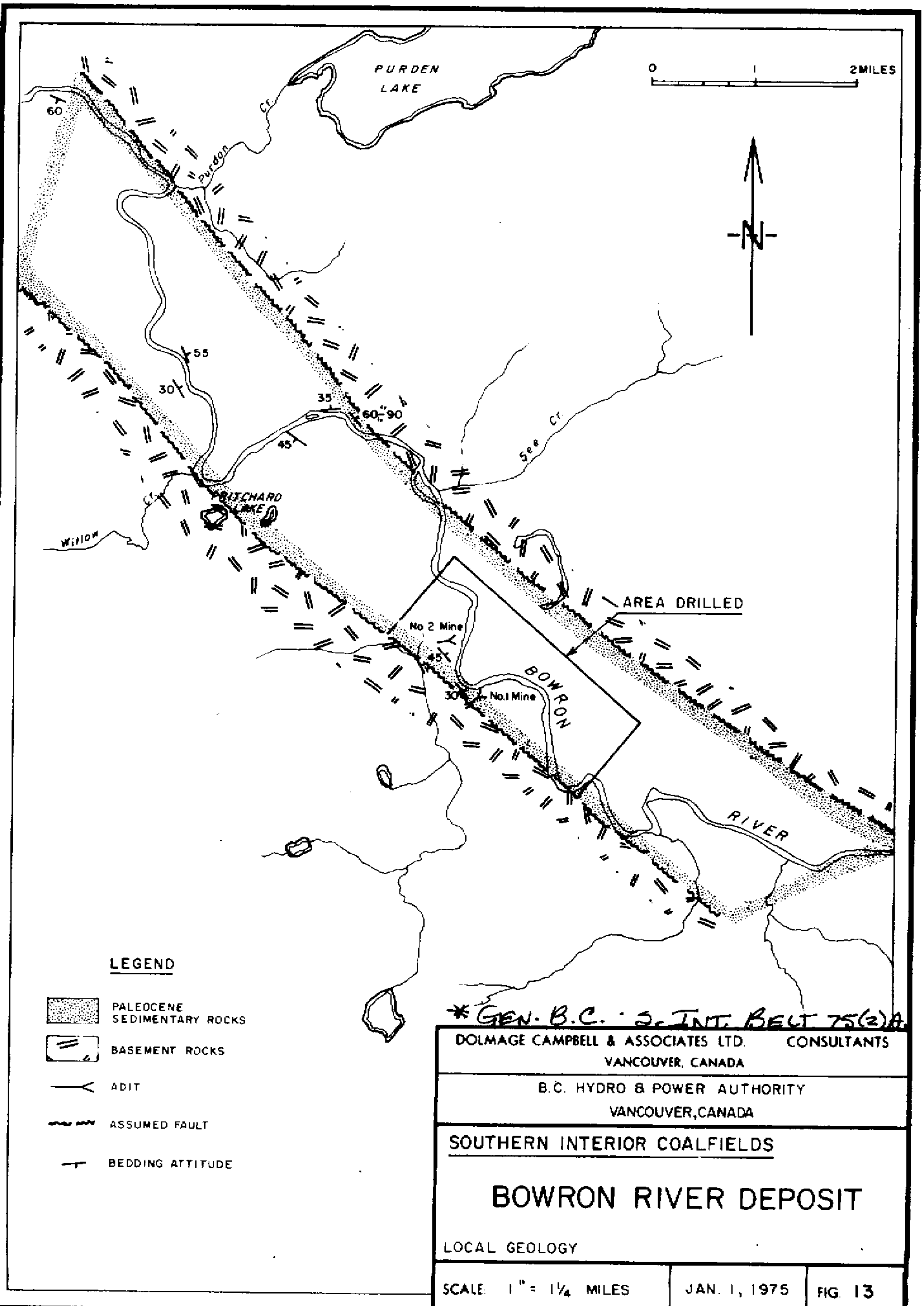
SOUTHERN INTERIOR COALFIELDS

BOWRON RIVER DEPOSITS

DISTRICT GEOLOGY

SCALE 1" = 4 MILES	JAN. 1, 1975	FIG. 12



*GEN. B.C. - S. INT. BELT 75(2)A.

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SOUTHERN INTERIOR COALFIELDS

BOWRON RIVER DEPOSIT

LOCAL GEOLOGY

SCALE 1" = 1¼ MILES	JAN. 1, 1975	FIG. 13

10 0 10 20 30 40 MILES

LEGEND

Miocene to Pliocene		Volcanics
Miocene		Sedimentary rocks
Oligocene		Volcanics
Eocene		Sediments
Eocene to Oligocene		Volcanics
Paleocene		Sediments
Paleozoic to Mesozoic		Basement rocks

88 (1)

* GEN B.C. - S. INT. BELT 75(2)A

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SOUTHERN COALFIELDS

TERTIARY GEOLOGY

INTERIOR BELT

SCALE : 1" = 16 MILES | JAN. 1, 1975 | FIG. 2