B O W S E R   B A S I N   C O A L S

NORTH CENTRAL BRITISH COLUMBIA

An Information Summary

Bruce D. Vincent
August 11, 1977

COAL GROUP
IMPERIAL OIL LIMITED
CALGARY, ALBERTA

793

TABLE OF CONTENTS

LIST OF FIGURES

L I S T   O F   P L A T E S

SUMMARY

The present Bowser Basin of north-central British Columbia is outlined by the distribution of Upper Jurassic and Lower Cretaceous Bowser Group. The original basin was filled with marine and continental clastic sediments with coal now present along its eastern margin. Included in the basin are the Groundhog and Telkwa coalfields plus numerous other occurrences.

The basin is structurally complex. Faulting, folding, jointing, and in some places igneous intrusions have made coal exploration extremely difficult and have reduced the potential of many areas.

The Groundhog field has been considered to hold large reserves of coal, however, the structural geology, lack of information, and the inaccessibility of the field greatly restricts the present potential. Imperial Oil has applied for 41 coal leases in the northern portion of the field. Four or five seams may be present (5 to 15 feet thick) in some areas of the application but the structural complexity greatly reduces the strip mining potential. The coal of the field appears to be low volatile bituminous to semi-anthracite.

The Hazelton-Telkwa area in the southern portion of the Bowser Basin has many isolated coal occurrences. Mining operations have been conducted in the Telkwa field since 1903. Areas which may prove to hold mineable reserves are a broad syncline near Chisholm Lake and the east limb of a synclinal along the east valley wall of the Thautil River. A number of other occurrences have been reported but none seems attractive. The coal in the Telkwa field is medium volatile to high volatile A bituminous.

Coal is also reported near the Sustilt River, south-east of the main basin. Again the structural geology, inaccessibility, and the probable poor quality of the seams give this area little potential.

BOWSER BASIN COALS

INTRODUCTION

The Bowser Basin of north-central British Columbia is a remanent of a larger sedimentary basin which filled with continental and marine sediments during the Upper Jurassic and Lower Cretaceous. The present basin outline is controlled by the distribution of the rocks of the Bowser Group or Assemblage.

Coal is present along the northeastern, eastern, and southeastern margins of the basin. The Telkwa coalfield has been the site of mining for many years. Potentially economic deposits of coal are present in the Groundhog field and numerous occurrences have been reported from other parts of the basin.

This report is a brief survey of known coal occurrences within the Bowser Basin and an attempt at collecting most pertinent information and contains preliminary judgements on the coal mining potential of several areas.

LOCATION AND ACCESS

The Bowser Basin covers a large area of north-central British Columbia with the main portion extending from the Stikine River on the north to south of the Skeena River. The Bowser Assemblage crops out in the Skeena and Hazelton Mountains which are bounded on the west by the Coast Mountains and on the east by the Ominenca Mountains (Figure 1).

There are few settlements within or near the basin. To the northwest is Telegraph Creek, to the west Stewart, and to the southwest Prince Rupert, Terrace, and Kitimat. In the southern portion of the basin are Hazelton, Smithers, Telkwa and a few smaller communities.

Access to the area is extremely limited. The Canadian National Rail line to Prince Rupert passes through the Hazelton-Telkwa area and with it a major highway (Figure 2). A road is present from Dease Lake south to the Terrace area. A rail line has been proposed and partially constructed by British Columbia Railways between Dease Lake and Prince George. Airport facilities are available at Stewart, Terrace, Prince Rupert, and Smithers. Port facilities are available at Prince Rupert and could be developed at Stewart.

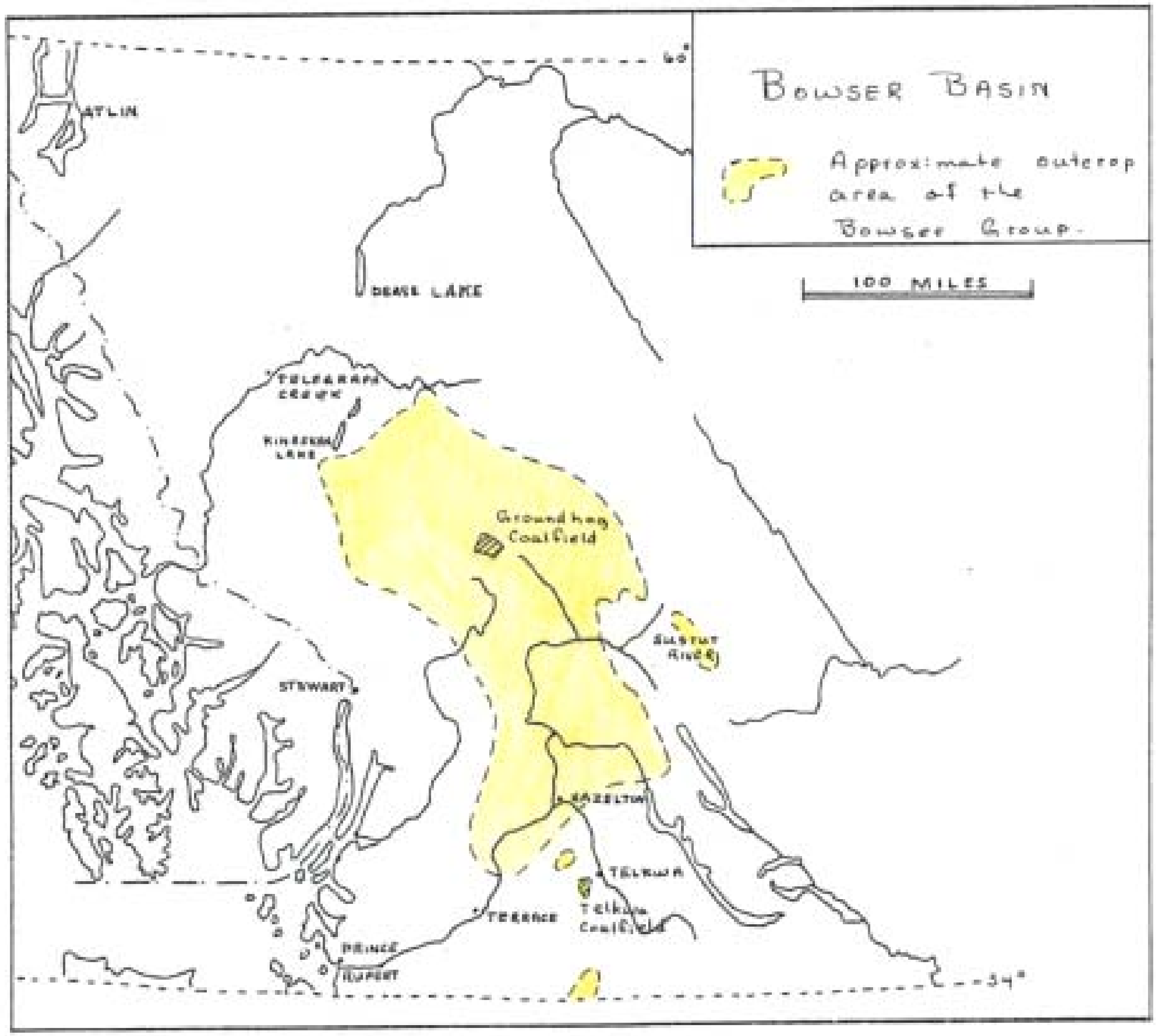


FIGURE 1.

Location map showing the present distribution of the Bowser Group.

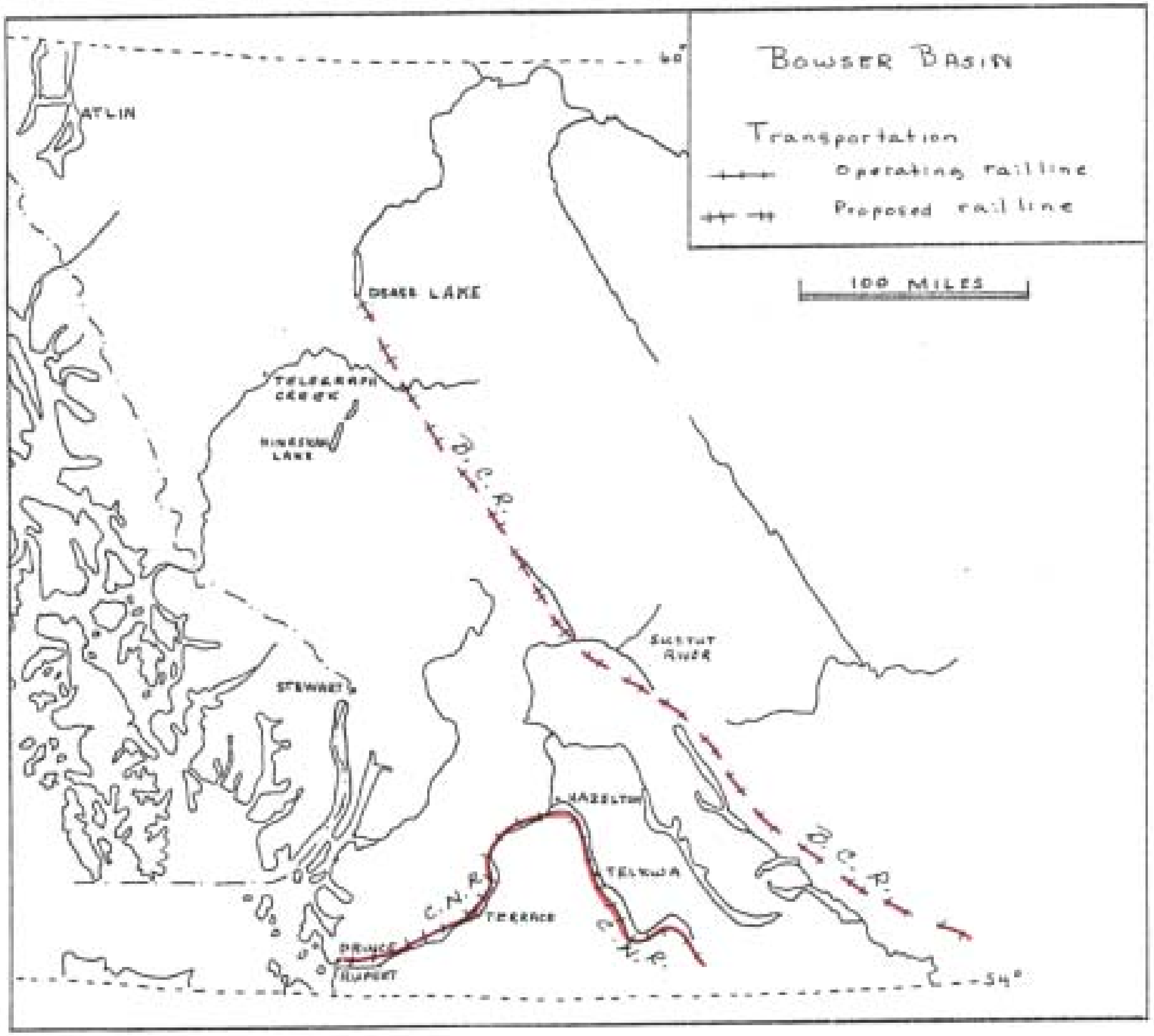


FIGURE 2.

Location map of railroads in the vicinity of the Bowser Basin.

GENERAL GEOLOGY

The coal deposits of the Bowser Basin are within the Upper Jurassic and Lower Cretaceous Bowser Assemblage or Group. The Bowser consists of a number of clastic wedges which were deposited on the west slopes of the rising Ominenca Mountains. The major portion of the basin was under marine conditions however, the northern, eastern, and southern portions of the basins are characterized by fluvial (river) and deltaic sequences.

Along the margins where deltaic and coastal plain sedimentation prevailed, coal is now found in a number of localities (Figure 3). The areas to be discussed in greater detail are the Groundhog, Hazelton-Telkwa, and Sustut River.

The Bowser Group has been denoted by a variety of names in the past which are summarized in Figure 4. Inclusion of the Bowser within the Hazelton or Takla Groups was the most common designation however, these groups, predominantly volcanic, have been restricted to the Upper Triassic to Upper Jurassic. The Bowser Group overlies these groups and in the Hazelton area is succeeded by the Brian Boru volcanics (Eisbacher, 1974 a, 1974 b).

The structural geology of the Bowser Basin is exceedingly complex. Deformation was caused by the Cretaceous and Tertiary uplift of the Coast Crystalline Belt and took the form of shallow decollement, recumbent folds, and thrust faults. The folds and faults have an overall northwesterly trend with structural surfaces dipping to the southwest (Eisbacher, 1974 c).

In the southern portion of the basin, rocks of the Bowser Group have been intruded by numerous small igneous bodies. Adjacent to these there has been low to moderate thermal metamorphism. Coincident with these ingneous intrusions was the intrusion of a number of dykes and sills into the Bowser strata. A great number of mineral deposits have been discovered in veins and dykes within rocks of the Bowser Group.

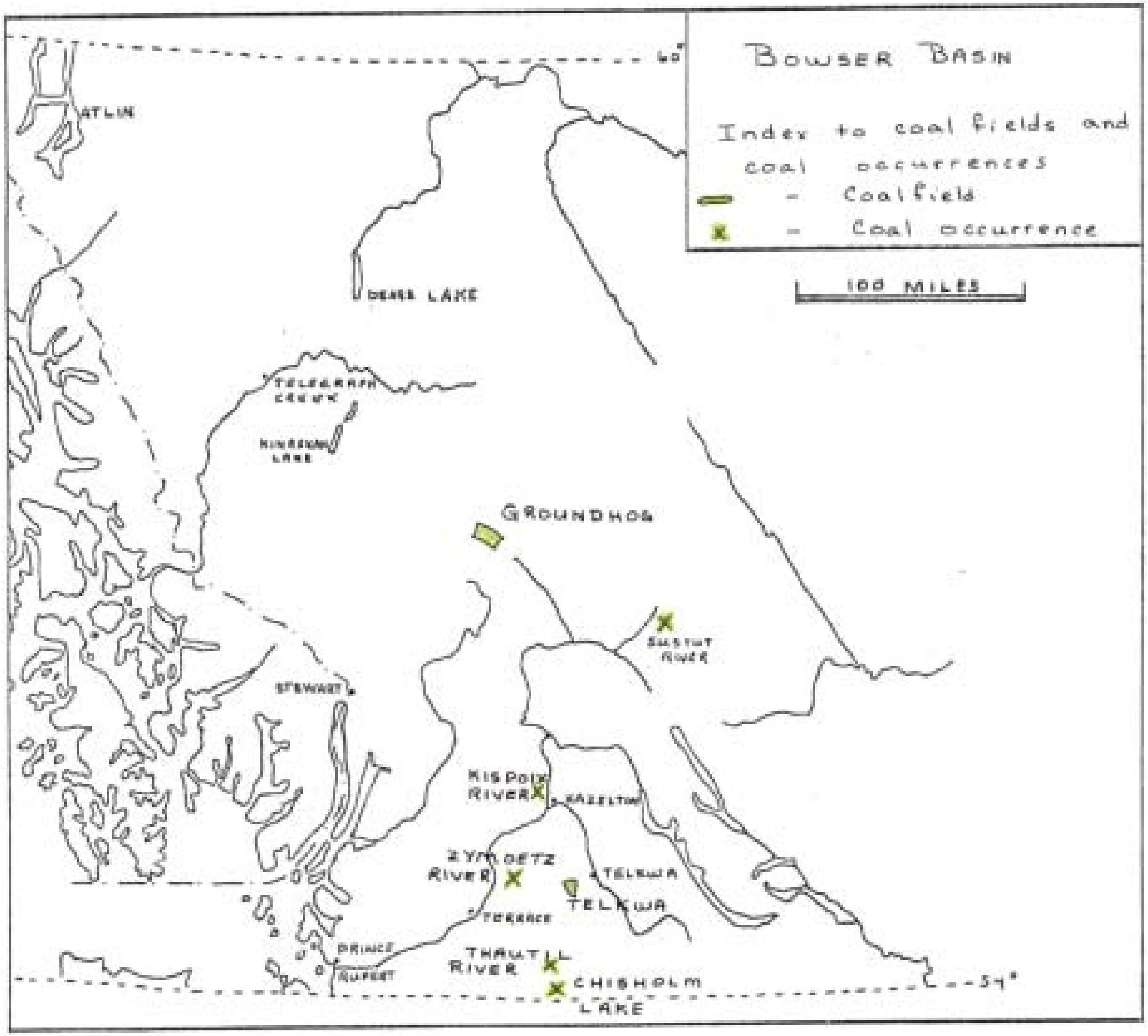


FIGURE 3.

Location map of coalfields and coal occurrences in the Bowser Basin.

AGE \ REFERENCE	Malloch, 1914	Buckham and Latour, 1950	Eisbacher, 1974	Souther, 1972	Lord, 1949	Armstrong, 1944 a, 1944 b	Sutherland-Brown, 1960	Carter and Kirkham, 1969	Duffell and Souther, 1964
Upper Cret.									
Middle Cretaceous	1	2	3	4	5	6	7	8	9
Lower Cretaceous	SKEENA SERIES COAL	(HAZELTON GROUP) Upper Part sandstone, shale, conglomerate COAL	(BOWSER ASSEMBLAGE) JENKINS CREEK FACIES Alluvial plain with lakes GUNANOOT-GROUNDHOG FACIES COAL			Volcanics cong., sst., shale, arkose, tuff, lava | Blairmore flora COAL	BRIAN BORU FORMATION Volcanics (RED ROSE FM.) D. cong., greywacke, shale C. greywacke, siltstones, shale	BRIAN BORU FORMATION andesite greywacke, siltstone, mudstone, conglomerate | ROCKY RIDGE SEDY. MBR. COAL	(BOWSER GROUP) Fossiliferous marine and terrestrial conglomerate, greywacke, and shale
Upper Jurassic	HAZELTON GROUP	(HAZELTON GROUP) Lower Part sandstone, shale	(BOWSER ASSEMBLAGE) Alluvial plain to coal swamp DUTI-SLAMAEESH FACIES Prodelta to delta plain	(BOWSER GROUP) Alluvial fan to marine No coal	Sediments COAL Shallow marine to coastal plain	Upper Jurassic (Kootenay) fauna	B. siltstone, shale A. siltstone, shale, greywacke COAL	COAL | JOHN BROWN SEDY MBR.	No coal
Middle Jurassic	?	?	TAKLA-HAZELTON ASSEMBLAGE	Submarine volcanics	(TAKLA GROUP) Volcanics	(HAZELTON GROUP) Volcanics Argillite, sandstone, limestone	(HAZELTON GROUP) volcanics argillite, quartzite, limestone	volcanics greywacke, siltstone, mudstone, conglomerate	(HAZELTON GROUP) Volcanics with greywacke and argillite
Lower Jurassic			volcanics	marine sediments Conglomerates and volcanics	Volcanics and sediments	Volcanics	volcanics	volcanics	
AREA	GROUNDHOG COALFIELD AREA			KINASKAN LAKE	SUSTUT RIVER	HAZELTON-SMITHERS-TELKWA AREA			NE of TERRACE

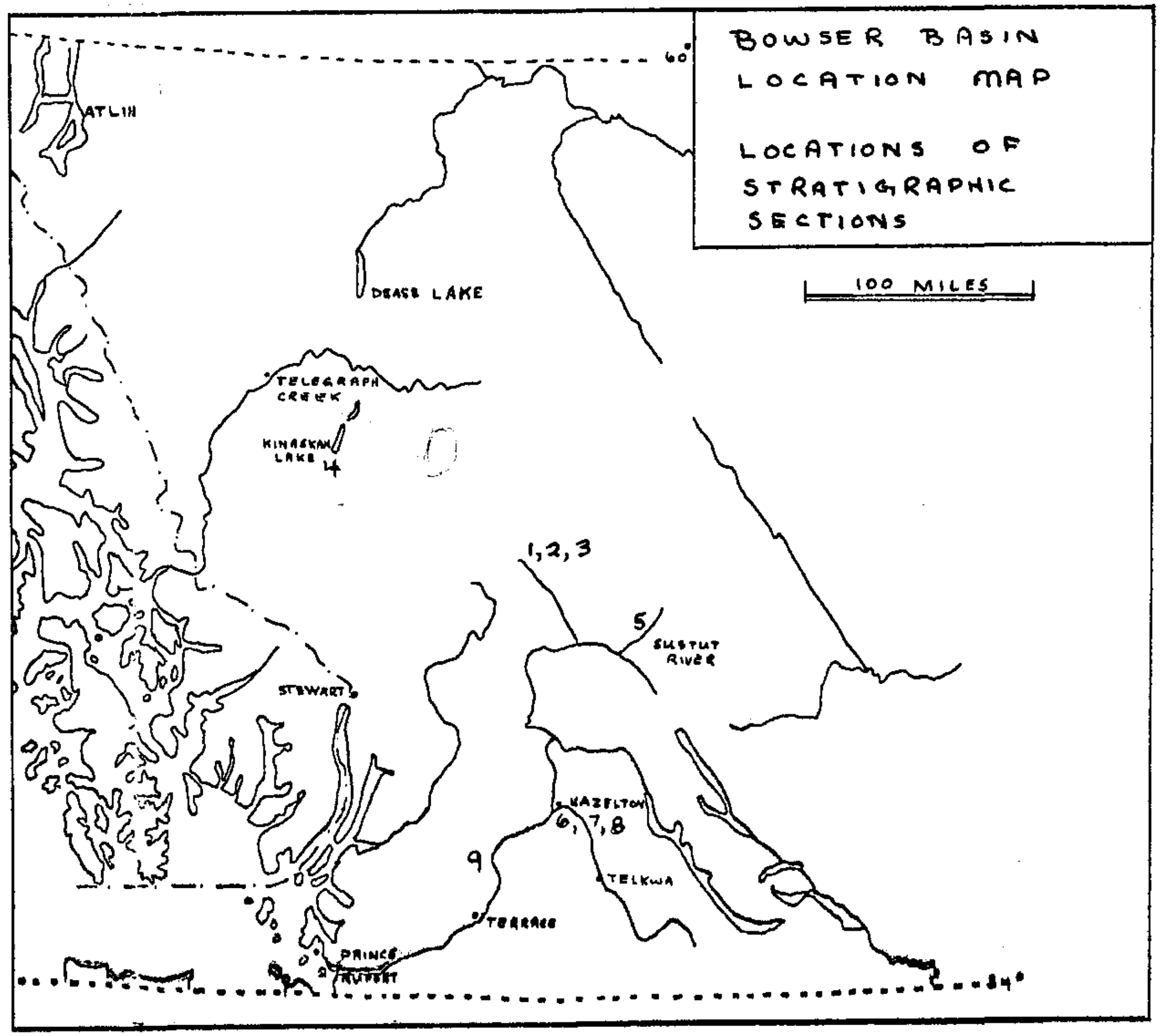


FIGURE 4.

Correlation chart of the Bowser Group showing present and past stratigraphic nomenclature. Portion between red lines is now considered the Bowser Group.

pg. 11

GROUNDHOG COALFIELD

LOCATION AND ACCESS

The centre of the Groundhog Coalfield is at 57° N latitude and 128° 30'W longitude, 150 miles north of Hazelton and 95 miles east of Stewart. The northwesterly - trending field covers an area about 50 miles long and 30 miles wide.

The area is accessible only by aircraft. The nearest road is 67 miles to the west along the Bell - Irving River.

The Government-owned British Columbia Railroad has begun construction of a line from Prince George to Dease Lake passing through the centre of the Groundhog field. Construction has been halted at the present time however, the construction camps have been left intact. The right-of-way has been cleared to McEvoy Flats (southern portion of the field) and it is believed the line has been laid to within 30 miles south of that point.

LEASES AND RESERVED AREAS

Imperial Oil Limited applied for 41 coal leases covering 28,410 acres on March 17, 1976. The leases are in the northern portion of the known Groundhog field in NTS map areas 104 H/2 and 7. See Figure 5.

A joint venture comprised of the National Coal Corporation, Placer Development Limited, and Quintana Minerals Corporation controlled 90 coal leases (62,370 acres) about 20 miles southeast of Imperial's application in 1970. A more recent lease map has not been available to see if they still control the leases.

On December 10, 1969, an Order-In-Council created a reserve on mineral and placer claims 10 miles wide, 5 miles on either side of the proposed B.C.R. right-of-way. This reserved area (Figure 6) includes a large portion of the Groundhog field and approximately 31 out of the 41 leases applied for by Imperial Oil.

If Imperial Oil is granted the coal leases for which it has applied, the cost will be $28,410 annually for rent plus a $3.00 per acre work obligation.

LEGEND FOR FIGURE 5.

Quaternary and Recent
- unconsolidated glacial and fluvial deposits.

Upper Jurassic – Lower Cretaceous
Bowser Group

18 3 9 Strike and dip of bedding (known, steep, gentle)

Axis of anticline, syncline

Trend of complexly folded beds

Geological boundary

Proposed route of British Columbia Railroad line

Coal leases held by National Coal Corp., 1970

Coal leases applied for by Imperial Oil, 1976

X Coal occurrence reported by Imperial Oil

63 10.5 Coal occurence reported in GSC Bull. 16 with thicknesses. Number is one in GSC Bulletin.

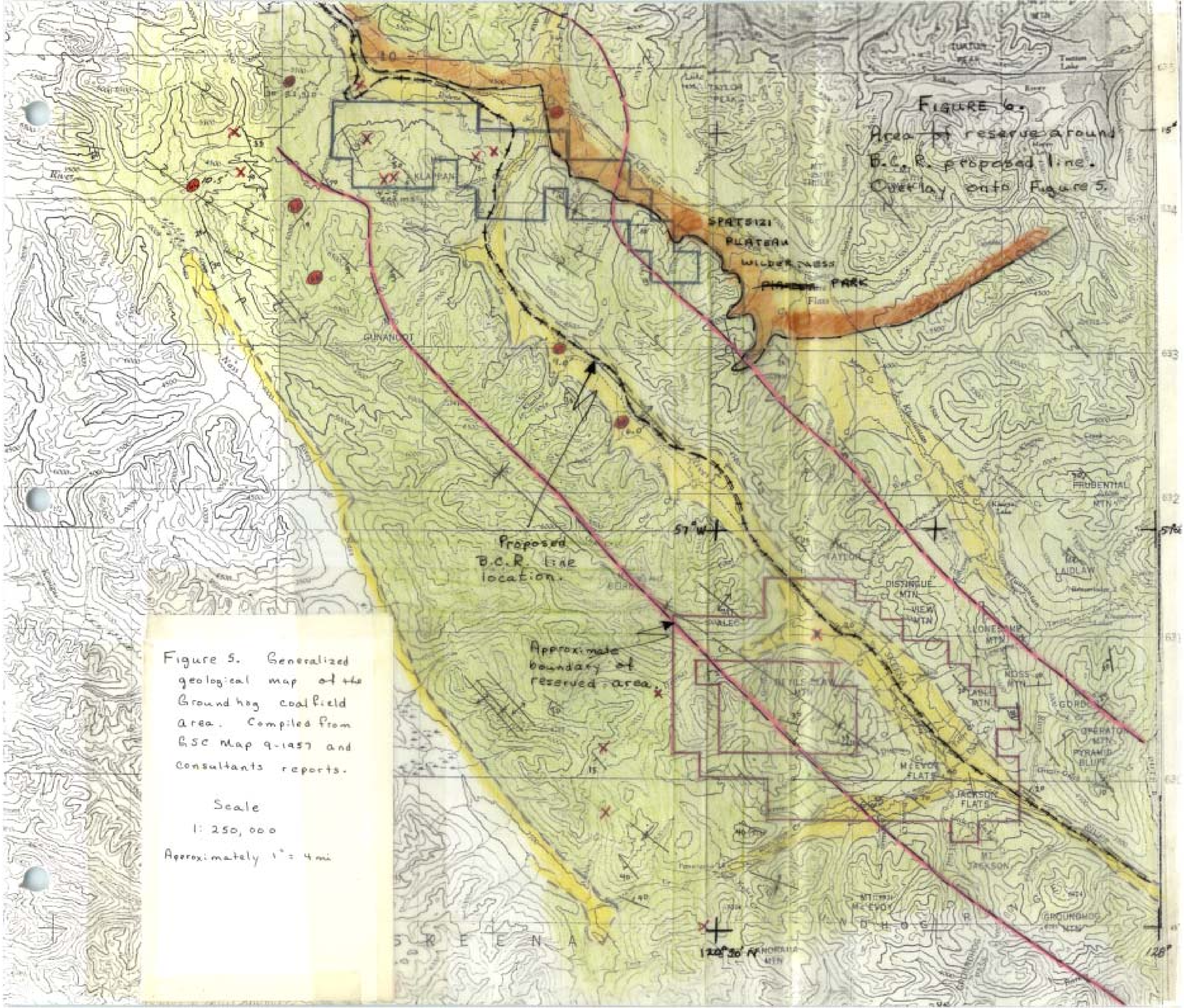


Figure 6.
Area of reserve around
B.C.R. proposed line.
Overlay onto Figure 5.

Figure 5. Generalized geological map of the Groundhog coalfield area. Compiled from GSC Map 9-1957 and consultants reports.

Scale
1: 250,000
Approximately 1" = 4 mi

GEOLOGY

The Groundhog field is located along the northeastern margin of the Bowser Basin. The coal-bearing strata is the Upper Jurassic-Lower Cretaceous Bowser Group.

The Bowser in the Groundhog field was originally divided into the lower, barren Hazelton Group and the upper, coal-bearing Skeena series (Malloch, 1914). (See Figure 4 for the stratigraphy). Buckham and Latour (1950) retained the bifold classification and called the whole succession the Hazelton Group. Eisbacher (1974) has divided the Bowser into three facies or depositional environmental packages. From the base they are the Duti-Slamgeesh facies, the Gunanoot-Groundhog facies, and the Jenkins Creek facies with coal occurrring in the lower two facies.

Briefly stated, the geology of the Groundhog field is extremely complex. The exploration, mapping, and correlation of coal seams is greatly complicated because of deformation by folding and faulting.

Normal, high angle reverse, and thrust faults are all present within the field. Some of the thrust faults are known to extend many tens of miles NW-SE direction.

Folding is particularly intense. Asymetrical folds over turned to the northeast are common. Symetrical folds are present, chevron folds occur in belts, and up to five recumbent folds may be stacked above one another in some areas. Associated with some of the tighter folds are flow cleavage and thrust faulting (Thompson et al, 1970; Black, 1968).

Jointing is intense and often very prominent. Buckham and Latour (1950) emphasized the abundance of minor folds, minor faults, overturned beds, and the difficulty of seam correlation. The orientation of the strata may change rapidly over a short distance from gentle dips to near vertical to overturned.

The deformation described above is somewhat similiar in style to that in the Crowsnest Pass region but more intense. It could be expected that structural thickening of coal seams has occurred in the cores of some folds as it has in the Crowsnest Pass. It would be necessary to find an outcrop exhibiting this first and explore from there.

COAL

The coal in the Groundhog field is low volatile bituminous to semi-anthracite in rank. Most areas have not been sufficiently investigated to determine the number of seams present or to correlate seams between thrust sheets or outcrop areas.

Most of the coal seams exhibit well-developed systems of intersecting joints which result in the coal being broken into small fragments, a problem in mining and transportation. Vienlets or stringers of quartz are present in all seams; less commonly calcite and occassionally pyrite vienlets are present (Buckham and Latour, 1950).

There are no written reports available concering the area of Imperial's lease applications. A number of photographs taken by Imperial Oil geologists are included (Plates 1 to 9) with six of them being in the vicinity of Imperial's leases. E. A. Sorochuk formerly of Imperial, states several coal seams, 5 to 15 feet thick, are present in the application area with strata dipping at 10^{o} to 65^{o}. One photograph shows four or five seams present in one area (Plate 3). Sorochuk also suggested about two square miles of the area might be amenable to strip mining.

Good coal analyses are scarce for the Groundhog area and non-existant within Imperial's lease application. Buckham and Latour (1950) listed all analyses done in the early exploration of the field.

One of the better reports is an exploration summary for the joint venture mentioned above by Thompson et al. (1970). Six drill holes were cored and sampled for analyses in the block of leases southeast of Imperial's block. Coal analyses were done on the float fraction of the samples separated between 1.40 and 1.75 specific gravity. The fraction of the samples separated by floatation was between 23.7% and 98.8%. The qualtiy may be summarized as follows:

Ash	4.91%	to	19.76%
Sulphur	0.43%	to	0.84%
B.T.U./lb.	11,746	to	14,012
Fixed Carbon	70.79%	to	88.89%
Volatile Matter	5.70%	to	9.45%

These are probably representative of the field as a whole.

Thompson et al. speculated about reserves and suggested the area they were studying (119 square miles) was underlain by 4.1 billion tons of coal. This was done by assuming there was an average of 25 aggregate feet of coal which means approximately 35 million tons per square mile. For each of their six drill holes, estimates of strip mineable coal was made. The estimates ranged from minor coal to 31 million tons per square mile.

Similar figures might be used for the area under application by Imperial. From a cursory survey of coal occurences and topography, it appears the potential for strip mining may be very limited within the leases Imperial hopes to acquire.

SUMMARY

Imperial Oil has applied for 41 coal leases in a very poorly known portion of the Groundhog field.

The structural geology is very complex and strip mining potential is probably low. Further information should arise from the mapping party conducted by Dr. Richards of the Geological Survey of Canada, Vancouver, during the summer of 1977.

No further work should be done until more information is available about the lease application area. Other influencing factors are whether the B.C.R. line will be built through the Groundhog field and whether the reserve area will stay in effect on either side of the rail line right-of-way.

HAZELTON - TELKWA AREA

INTRODUCTION

Numerous isolated outcrop areas of the Bowser Group occur in the Hazelton-Telkwa area (Figure 7). Coal has been mined at Lake Kathlyn and near Telkwa.

Most geological maps of the area designate the coal-bearing strata as the upper sedimentary division of the Hazelton Group. The latest version has included this division in the Bowser Group with it overlain by the Brian Boru Formation (Eisbacher, 1974 a).

The Bowser strata have been severely deformed by numerous faults and folds. Mining operations have been hampered in the past by these structural complications. Numerous igneous bodies have intruded the Bowser in the area causing locally intense thermal metamorphism and drastically altering coal qualities.

Following is a discussion of coal occurrences of the Hazelton-Telkwa area by specific areas as shown on Figure 7.

Telkwa Field

Dowling (1915) reported coal mining began in the Telkwa field in 1903. Sporadic activity by various companies continued until at least 1975. Over the highly-disturbed basin seams ranged from 2.5 to 10.0 feet thick.

Buckley Valley Colleries Limited operated underground from 1951 to 1966. Strip mining of a 5.5 to 6.0 foot thick seam was begun in 1967 (Sutherland Brown, 1967). Canex Placer Limited drilled 14 holes in 1969 in the field and did no further work (B.C. Coal Task Force, 1976). By 1975 Buckely Valley Colleries was mining 300 tons a year for local domestic use (B.C. Dept. Mines, 1976). The Company has recently applied for more land for coal exploration and development (B.C. Gazette, 1977).

The coal of the Telkwa field is medium to high volatile A bituminous with a calorific value of 12,000 to 14,000 B.T.U./pound. Coal analyses from previous mines are presented in Figure 8 as representative of the field.

Reserves of the field are probably low because of previous operations, lenticularity of seams, and faulting.

	BUCKLEY VALLEY COLLIERIES LTD. mine on Goathorn Cr			TELKOAL CO. LTD. mine on south bank of Telkwa River			
	mine run	lump	slack	lump	stoker	blacksmith*	slack
<u>proximate analysis</u> (as received)							
moisture %	4.0	4.0	4.5	3.5	4.0	4.0	5.0
ash %	11.0	11.1	12.0	8.6	8.0	3.1	12.5
volatile matter %	24.8	27.0	26.6	27.3	28.4	32.6	26.6
fixed carbon %	60.2	57.9	56.9	60.6	59.6	60.3	55.9
BTU/pound	12,715	12,720	12,320	13,205	13,180	14,100	12,160
swelling index	1-2.5			1		2.5-4	1
<u>ultimate analysis</u>							
carbon %	73.7			76.2			
hydrogen %	4.1			4.2			
nitrogen %	0.8			0.8			
sulpher %	1.0	0.7	1.0	0.9	0.8	1.2	0.9
oxygen %	5.4			5.8			
Classification	Medium volatile to high volatile A bituminous			Medium volatile to high volatile A bituminous			

*Blacksmith coal was preferentially mined from the top 3 foot bench of the seam.

FIGURE 8 Analysis from closed mines which operated in the Telkwa field (from Swartzman, 1953).

Chisholm Lake

The Bowser Group is exposed in a broad syncline from north of Chisholm Lake to McBride Lake. Geological maps do not show any faults within the syncline. Coal was first reported from the west limb of the syncline in 1909 (Dowling, 1915). Over 5.5 feet there was 3.05 feet of coal.

If the area is undisturbed as maps suggest (Armstrong 1944 a), there may be strip mineable reserves present in the syncline. Coal leases have been held and dropped on the northern portion of the syncline however, no reports appear to be in the B.C. Department of Mines open files.

Thautil River

The Thautil River occur ence is called the "Clark Fork of the Morice River" by Dowling (1915) and the following description is from his report.

A synclinal axis runs parallel to and just east of the Thautil River. The Bowser Group is present in the east limb of the syncline and the west limb has been eroded.

The east limb is in a dip-slope situation and two seams were observed there. The lower seam is about 3 feet thick and the upper seam is 10 feet thick dipping to the west at about 30°.

The reserves are probably not large because of the small areal extent of the remaining Bowser strata. Coal leases have also been held and subsequently dropped on this land also.

Small isolated outcrops of coal-bearing Bowser rocks occur to the north but are too small to be considered.

Zymoetz River

Another usolated outcrop area of Bowser strata covers an area 31 miles west of Smithers on the Zymoetz River. (The prospect is also known as Coal Creek). Initial exploration was conducted in the first quarter of this century and subsequent work was done by Western Coal and

Coke Limited in 1968 and Kaiser Resources in 1970 (Dowling, 1915; Dolmage Campbell, 1975).

There are five or six seams present in the lower 300 feet of the Bowser of that area. The two lower seams (the No. 1 and No. 2) are 25 to 100 feet apart stratigraphically and have the most potential. The No.1 (the lowest) has been measured to have 10.2' of clean coal over 17.2' and the No. 2, 3.5 over 7.2'. Two of the seams above the No. 2 are 2 to 3 feet thick. The thickness of the seams appears to vary considerably over the basin (Sargent, 1969; Gormley, 1970; Dolmage Campbell; 1975).

In the vicinity of the coal outcrops the strata strike at 030 and dips 25° toward the northwest. Elsewhere in the basin the orientations of bedding are more variable. Some faulting was noted (Gormley, 1970).

Gormley estimated the basin contains a potential coal resource of 35 million tons. Analyses of coal outcrop samples showed the coal to be bordering between high volatile A and B bituminous with a calorific value of 14,000 to 15,000 BTU/lb.

The Zymoetz River appears to have good potential. Much more exploration will have to be conducted. Any resulting mining operations will probably be by underground methods.

Lake Kathlyn

Coal was mined in the Lake Kathlyn area between 1934 and 1936. There are 20 seams, most of which are between 6 and 12 inches. Two are up to 4 feet thick and two more up to 2.0 feet thick. The coal is semi-anthracite with calorific values of 9,000 to 10,000 BTU/lb. (Kindle, 1954).

The seams appear very thin and may have been crushed during faulting. The area has little further potential.

Kispoix and Skeena Rivers

A number of coal occurrences have been reported along the Kispoix and Skeena Rivers and their tributaries. The Bowser Group is generally highly disturbed by faulting and overturned beds are common. Numerous dykes and sills have intruded the area (Kindle, 1954).

There are a few, poor coal seams. The thickest appears to be about 5 feet thick. Some structural thickening has occurred but the original seams were only about 1 foot thick.

Summary

In the Hazelton - Telkwa area, the Chisholm Lake and Zymoetz River areas are the most attractive for any future exploration. Substantial reserves could be expected considering the reserves known in adjacent areas.

Problems which may be expected are the structural deformation, the igneous intrusions, and the variable nature of the coal seams. An extremely attractive feature of the area is the proximity to the C.N.R.'s mainline to Prince Rupert.

SUSTUT RIVER

An outcrop area of the Bowser Group is located near the Sustut River, a tributary of the Skeena, southeast of the main portion of the Bowser Basin. Coal has been reported to be present in the Bowser strata and in the Tertiary Sustut Group. The outcrops are within 15 miles of the proposed B.C.R. line but access is generally non-existant.

Lord (1949) assigned the coal to the Takla Group. It would now be accepted as part of the Bowser Group. The coal bearing succession consists of 5000 feet of shallow marine, fossiliferous sediments interbedded with minor volcanics, carbonaceous strata, and coal.

Dowling (1915) reported two seams of dirty coal, each 3 feet thick. Lord (1949) stated the coal occurs in four "carbonaceous layers" with the "layers" ranging from 10 feet thick to 200 feet thick and consisting of thin-bedded shale with scattered coal seams up to 5 inches thick. The strata dip at angles from 30° to 75° (Lord, 1949) (Figure 9). Other areas have a seam of 10 feet and another of 4 feet.

The Tertiary coal is seldom more than 5 inches thick and a few feet wide.

The area is structurally complex with closely-spaced faults and folds and the strata dip at steep angles. The coal exposures are minutely fractured and covered by rubble. Coal seams have probably been crushed by faulting.

The remoteness of the area, structural deformation, and probable thinness of the seams do not make the Sustut River coal outcrops attractive.

Despite these unfavorable features of the prospect, Dolmage Campbell (1975) and Associates considered the area warranted a thorough, preliminary examination. They suggested work should begin at the cluster of occurrences near Red Creek (see Figure 9) and extend toward the northwest.

Figure 9.

Geological map of the Sustut River coal occurrences (from Lord, 1949).

Cx - coal outcrop

CENOZOIC

TERTIARY AND QUATERNARY

11	*Basalt; minor pyroclastic rocks*

TERTIARY

KASTBERG INTRUSIONS

10	*Feldspar and feldspar-quartz porphyries; porphyritic granodiorite and quartz diorite*

MESOZOIC

CRETACEOUS AND TERTIARY

UPPER CRETACEOUS AND PALEOCENE

SUSTUT GROUP

9A, 9B	9A. *Sandstones, conglomerates, and shales; minor dacitic tuff and coal; 9a, interlayered dacitic tuff* 9B. *Mainly conglomerate*

JURASSIC AND/OR CRETACEOUS

UPPER JURASSIC AND/OR LOWER CRETACEOUS

OMINECA INTRUSIONS

8	*Granodiorite, quartz diorite, and allied rocks*

JURASSIC (?)

6, 7	6. *Peridotite pyroxenite dunite and serpentine. May be in part or entirely of pre-Takla age* 7. *Olivine gabbro*

JURASSIC

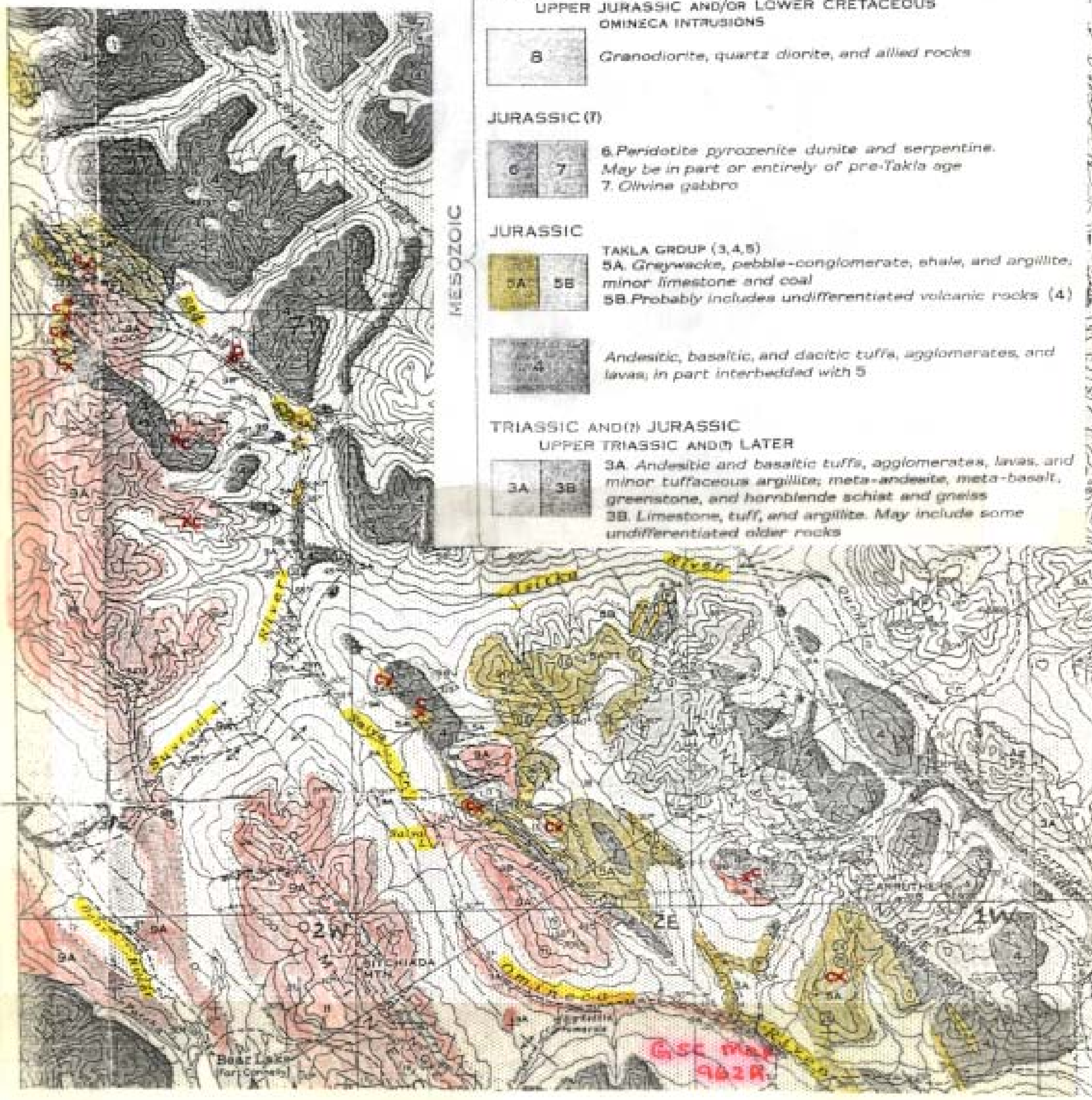
TAKLA GROUP (3,4,5)

5A, 5B	5A. *Greywacke, pebble-conglomerate, shale, and argillite; minor limestone and coal* 5B. *Probably includes undifferentiated volcanic rocks* (4)
4	*Andesitic, basaltic, and dacitic tuffs, agglomerates, and lavas; in part interbedded with 5*

TRIASSIC AND(?) JURASSIC

UPPER TRIASSIC AND(?) LATER

3A, 3B	3A. *Andesitic and basaltic tuffs, agglomerates, lavas, and minor tuffaceous argillite; meta-andesite, meta-basalt, greenstone, and hornblende schist and gneiss* 3B. *Limestone, tuff, and argillite. May include some undifferentiated older rocks*



Selected Bibliography

Armstrong, J. E.

1944 a: "Smithers, Coast District, British Columbia"; G.S.C. Paper 44-23

1944 b: "Hazelton, British Columbia"; G.S.C. Paper 44-24

Black, J.M.

1968: "Groundhog Coal Survey"; Consultants Report, 9p.

Boyd, J. T. and Associates

1967: "Groundhog Coalfield"; Consultants Report for Coastal Coal Company, 25 p.

B. C. Coal Task Force

1976: "Coal in British Columbia - A Technical Survey"; Victoria, 241 p.

B. C. Department of Mines and Petroleum Resources

1976: "Mining and Exploration in British Columbia, 1975"

B. C. Gazette

1977: "Coal Licenses", p. 962, June 30, 1977, Victoria

Buckham, A. F. and Latour, B. A.

1950: "The Groundhog Coalfield, British Columbia"; G.S.C. Bulletin 16, 82 p.

Carter, N.C. and Kirkham, R. V.

1969: "Geological Compilation Map of the Smithers, Hazelton, and Terrace Areas"; B.C. Department of Mines Petroleum Resources Map 69-1

Dolmage Campbell and Associates Limited

1975: "Thermal Coal Resources of British Columbia, Volume V, Northern Coalfields of the Interior Belt of British Columbia"; 27 p.

Dowling, D. B.

1915: "Coal Fields of British Columbia", G.S.C. Memoir 69, 350 p.

Duffell, S. and Souther, G.

1964: "Geology of Terrace Map-area"; G.S.C. Memoir 329, 117 p.; G.S.C. Map 1136 A

Eisbacher, G.H.

1974a: "Sedimentary History and Tectonic Evolution of the Sustut and Siftin Basins, North-central British Columbia", G.S.C. Paper 73-31, 57 p.

1974b: "Deltaic Sedimentation in the Northeastern Bowser Basin, British Columbia"; G.S.C. Paper 73-33, 13 p.

1974c: "Evolution of Successor Basins in the Canadian Cordillera"; in Dott, R. H., Jr. and Shaver, R. H. (Ed.), "Modern and Ancient Geosynclinal Sedimentation"; S.E.P.M. Spec. Pub. 19, p. 274-291

Geological Survey of Canada

1957: "Operation Stikine: Stikine River Area, British Columbia, G.S.C. Map 9 - 1957

Gormley, G.P.

1970: "Kaiser Resources Limited, Coal Creek - Telkwa Project, 1970 Field Work Report"; 31 p.

Hutchinson, W. W.

1967: "Prince Rupert and Skeena Map-area, British Columbia"; G.S.C. Paper 66-33, 27 p.

Kindle, E. D.

1954: "Mineral Resources, Hazelton and Smithers Areas, Cassiar and Coast Districts, British Columbia"; G.S.C. Memoir 223 (Revised Edition), 148 p.

Lord, C. S.

1948: "McConnel Creek Map-area, Cassiar District, British Columbia"; G.S.C. Memoir 251, 72 p.; G.S.C. Map 962 A.

Malcolm, D. C.

1966: Consultant's Report to Buckley Valley Collieries Limited concerning Telkwa Field

Malloch, G. S.

1914: "The Groundhog Coalfield, B.C.", G.S.C. Summ. Report 1912, p. 69-101.

Nicholls, J. H. H.

1952: "Analyses of Canadian Coals and Peat Fuels"; Can. Dept. Mines Techn. Surv., Mines Branch, No. 831, 409 p.

Sargent, H.

1969: "Report on Work Done in 1968, Coal Creek, Zymoetz River, Smithers Area, B.C."; for Western Coal and Coke Limited, 6 p.

Souther, J. G.

1972: "Telegraph Creek Map-area, British Columbia"; G.S.C. Paper 71-44, 38 p.; G.S.C. Map 11-1971

Sutherland Brown, A.

1960: "Geology of the Rocher Deboule Range", B.C. Dept. Mines - Petroleum Resources Bull. 43, 78 p.

Swartzman, E.

1953: "Analysis Directory of Canadian Coals", Dept. Mines Tech. Surveys, Mines Branch, No. 836, Ottawa, 204 p.

Thompson, W. D. Jenkins, D. M., and Roper, M. W.

1970: "Exploration of the Groundhog Coalfield, Upper Skeena River, British Columbia"; consultants report, 84 p. plus appendix.

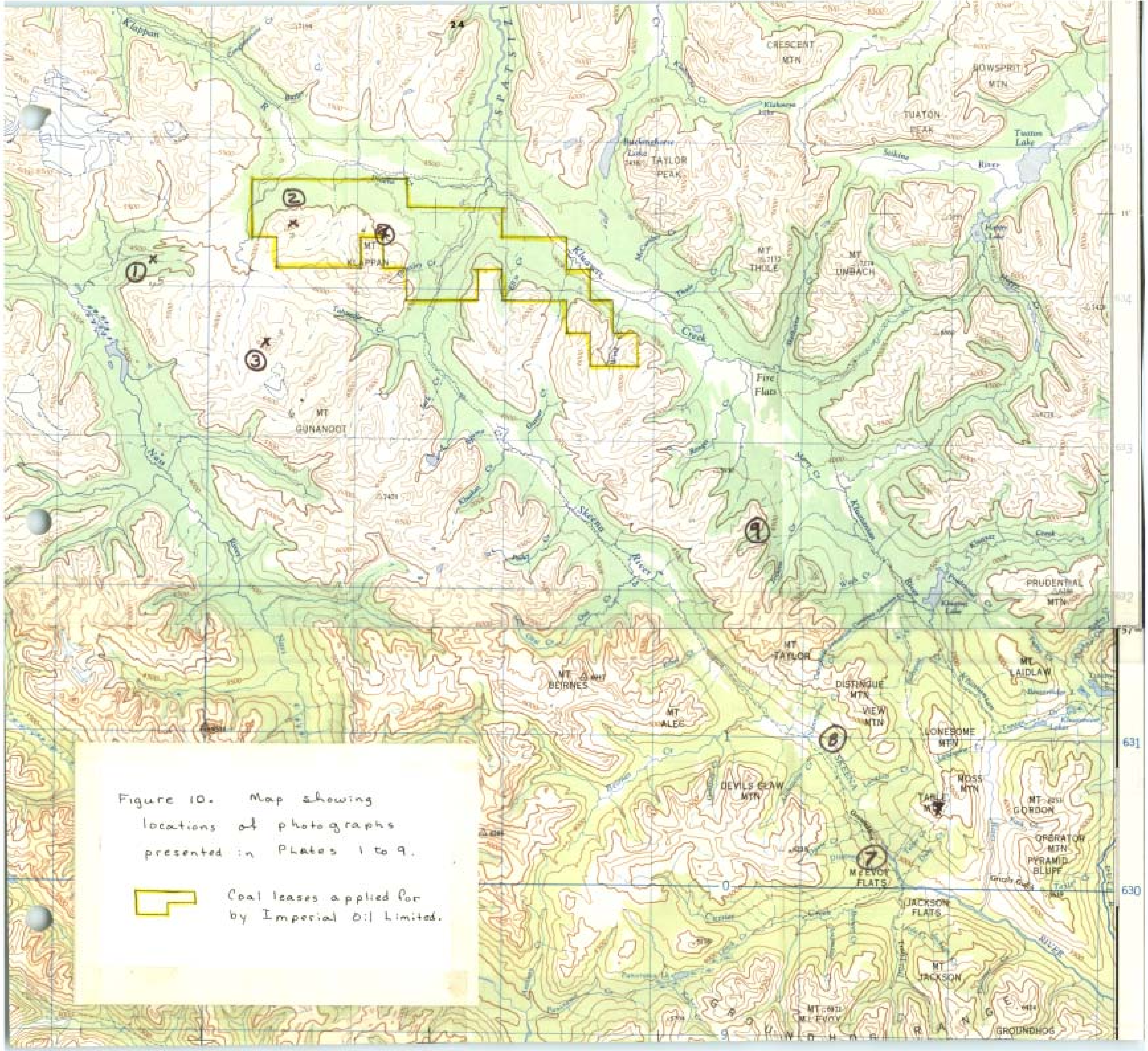


Figure 10. Map showing locations of photographs presented in Plates 1 to 9.

Coal leases applied for by Imperial Oil Limited.

Plate 1. Aerial view of Location 1 (Figure 10) looking west. (Notes and photographs from 1971 trip to area by Imperial Oil geologists.)

Plate 2. Coal seams in headwaters of Klappan River. Dips - 70° SW. Location 1.

Plate 3. Coal seams exposed on north face of Mt. Klappan. View is toward the south Location 2.

Plate 4. "Upper Barren Zone" on shoulder or spur north of Mt. Gunanoot. Mt. Klappan is immediately out of the picture on the right Location 3. Looking north.

Plate 5. Panorama taken of Location 4 looking south from Location 2. Coal seams observed at Locatio2 present on Mt. Klappan (at extreme left) and plunge to the right under the valley. Note the lack of trees and major streams

793
pg. 31

Plate 6. Panorama taken from Location 3 looking south towards Mt. Gunanoot. Strata observed are mainly "Upper Barren" in foreground and background. Coal series occurs at depth below alpine valley.

Plate 7. Looking southeast at Jackson Flats (Location 7) from the top of Table Mountain. Mt. Jackson on left, disected by Trail Creek. Leach Creek flows in from southwest while Skeena River flows in from right of picture. Note dense tree growth and valley is swampy.

Plate 8. Looking west northwest at Skeena River valley (Location B). Plates 7 and 8 illustrate the topography of the coal leases held by National Coal Corp. in 1970.

Plate 9. Recumbent fold in "Upper Barren Zone" near Jenkins Creek. Looking north at Location 9.

FIGURE 7 . .
Map of Bowser Group outcrops in the Hazelton - Telkwa area.
Igneous intrusions
Coal-bearing Bowser Group
X Coal occurrence
Coal mine
Fault
Syncline
793 ①
Scale 1:250,000 or approximately 1 Inch to 4 Miles
Scale of Kilometres
DRIFT
KISPIOX and SKEENA RIVERS
Hazelton
New Hazelton
SKEENA
MOUNT THOMLINSON
SIDINA MOUNTAIN
NINE MILE MOUNTAIN
ROCHER DEBOULE RANGE
CASSIAR DISTRICT
COAST LAND DISTRICT
LAKE KATHLYN
Smithers
Telkwa
ZYMOETZ RIVER
TELKWA FIELD
TREE FARM
LICENCE 1
THAUTIL RIVER
CHISHOLM LAKE
PROVINCIAL
FOREST
HOUSTON
DISTRICT MUNICIPALITY
CORONA PK
MT. LORING
MORICE LAKE
OWEN HILL
PIMPERNEL MTN.
OOTSA HARVESTING
PULP FOREST
EAGLE PK
MT. KENDRICK