PR-Onion Lake 81(1)A

GEOLOGICAL BRANCH
ASSESSMENT REPORT

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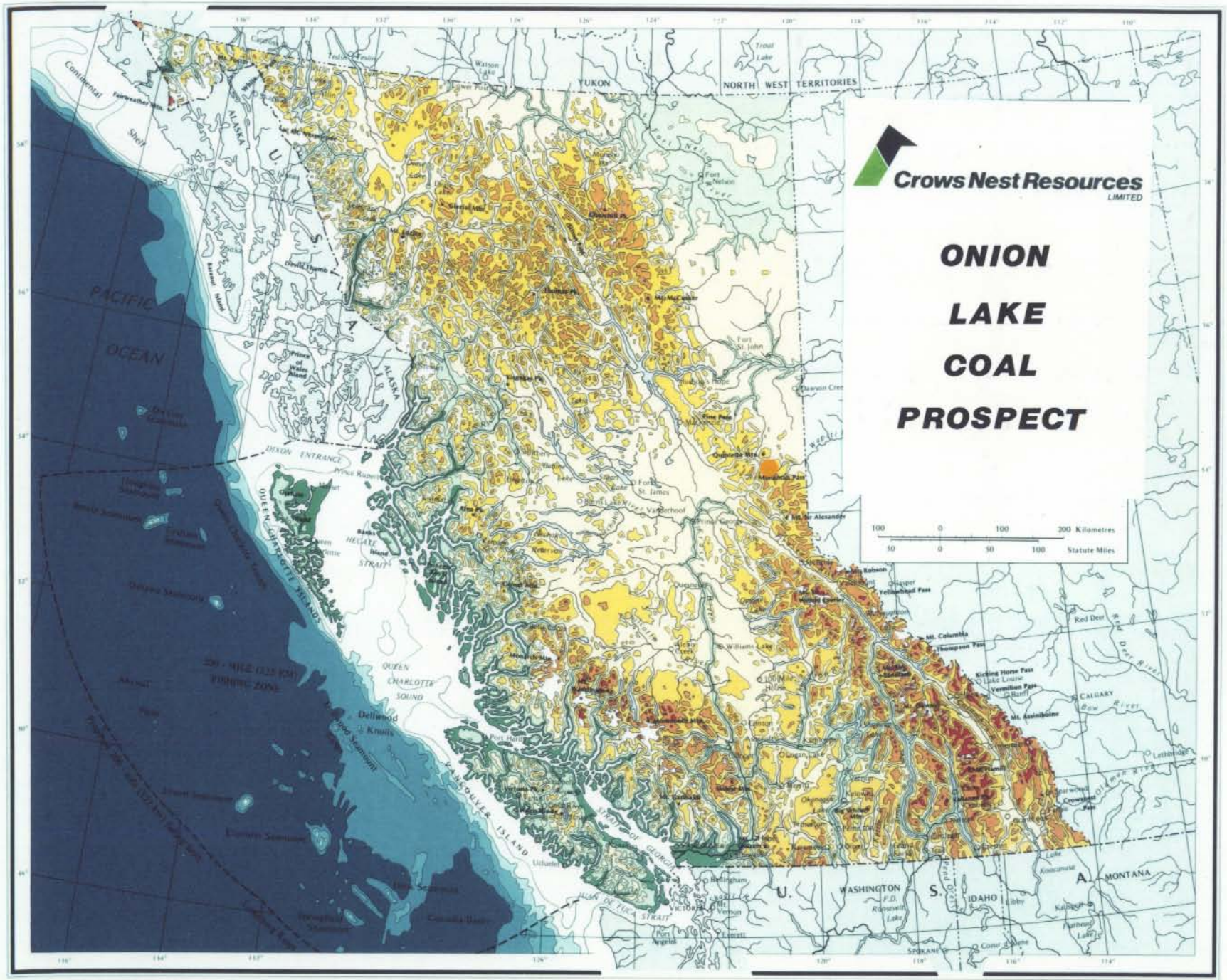
Onion Lake Coal Exploration 1981
Shell Canada Resources Ltd

CL 4220 - 4223

Dec 31/8...
D E Bell

565



PR-Onion Lake 81/19

Crows Nest Resources LIMITED
Eau Claire Place, 525 - 3rd Avenue S.W., Calgary, Alberta (403) 232-4355
P.O. Box 2699, Station M, Calgary, Alberta T2P 2M7 Telex 03-822505

December 30, 1981

Ministry of Energy, Mines and Petroleum Resources
British Columbia

Enclosed please find our report on the Onion Lake Project

Mr. Dennis E. Bell planned and supervised the 1981 geological field program on Onion Lake B.C. Coal Licences held by Shell Canada Resources Limited and operated by Crows Nest Resources Limited. Gary Cox assisted with the field work, and the preparation of this report.

Mr. Dennis E. Bell, B.Sc., graduated in Geology from Dalhousie University in 1965. Since 1968 he has specialized in mapping, structural interpretation, and exploration supervision in the coking coal belt of British Columbia and Alberta. He has worked on projects similar to this property for this company and a number of other major coal companies. Mr. Bell is registered as a Professional Geologist in the Association of Professional Engineers, Geologists, and Geophysicists of Alberta.

Gary Cox, B.Sc., graduated in Geology from the University of Alberta in 1981.

Their work was carried out under the supervision of our District Manager, British Columbia, Mr. Frank Martonhegyi.

Yours very truly,

R. D. Gilchrist, P. Geologist
Senior Geologist

ONION LAKE

COAL EXPLORATION

- 1981 -

Coal Licences - 4220 - 4223 Inclusive and 4749 (5 total)

B.C. Coal Licences held by Shell Canada Resources Limited and Operated by Crows Nest Resources Limited

Peace River Land District Northeast British Columbia

National Topopgraphic Series 93 I/10 W (Wapiti Lake)

Latitude and Longitude: 54 degrees, 44 minutes north
120 degress, 48 minutes west

Consultant and Author: Dennis E. Bell, P. Geol. (Alberta)
Max Air Exploration Limited
P.O. Box 878
Jasper, Alberta, TOE 1EO

Field Work: July and August, 1981

Submission Date: December 31, 1981

5/CGa.1

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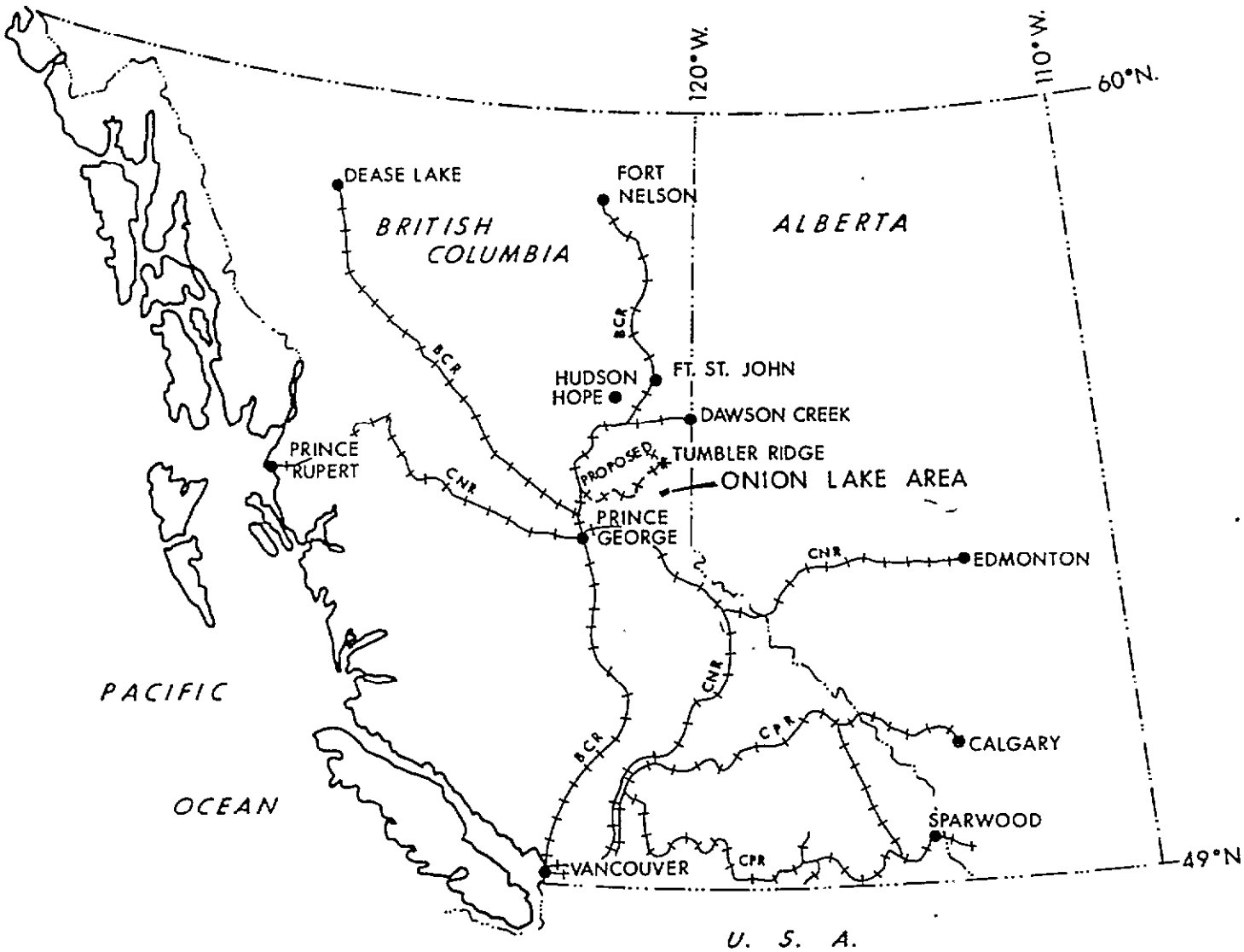


Crows Nest Resources Limited

EXPLORATION

ONION LAKE

NE BC

LOCATION MAP

FIGURE 1

AUTHOR A WHITE	SCALE	ENCLOSURE No
DATE 81 03 05	REVISED	DRAWING No AA-542
To Accompany		

1.0 SUMMARY

During the summer season of 1981, Crows Nest Resources Limited drilled its first hole, an NQ diamond drill core hole, on its Onion Lake, northeast British Columbia coal licences.

The hole was completed as planned in the 1980 report; results were as expected. During 1980, Crows Nest conducted a mapping program on the licences, which cost $39,000. Exploration expenditures for the 1981 drilling program on the Onion Lake coal prespect to date is $193,973.00.

No further mapping was done in 1981. The drill hole was placed to penetrate the coal-bearing section of the Gates Member of the Commotion Formation immediately above the Torrens Sandstone. The Torrens was encountered at 184 m. 26 m. shallower than anticipated at 210 m. Core recovery was generally good, and a geophysical logging suite composed of gamma-neutron, gamma-density-caliper, focused beam (two scales), and directional survey was collected.

The core showed the upper two thirds of the hole to have been placed in a structurally disturbed zone. It therefore, is difficult to state true coal thicknesses, but it would appear there are at least two coal zones containing 4 to 6 m. of coal, excluding partings of 1 to 2 m.

The hole was abandoned by cementing from the bottom to the surface.

Reclamation of the drill site has been completed to the satisfaction of local provincial forestry personnel.

The crew was based in the Petro-Canada Monkman coal camp, a helicopter trip of five minutes from the drill site. The work was totally helicopter-supported from this base.

As the drill results confirm the stratigraphy and structure as presented in Figure 4, page .

2.0 INTRODUCTION

1981 Onion Lake exploration consists of a single diamond drill hole penetrating coal-bearing Gates Member, Commotion Formation strata on the west limb of the Wapiti Anticline. A total of eight working days was lost; four due to geophysical surface electronics break-down, and four to turbulent winds which prevented helicopter operations.

The service helicopter used was a Kenting Helicopters Hughes 500D. The NQ diamond drill rig was a light-weight Boyles Brothers rig. For moves a larger helicopter was hired locally. The Mid-West drill crew functioned efficiently without down-time. Core was checked and then stored at the site. At completion, the core was transported to the base in one trip inside the larger helicopter, thus avoiding possible loss in slinging.

2.1 Coal Land Tenure

Five coal licences (4220-4223 inclusive and 4749) compose Group 242 covering 1425 hectares.

These B.C. Coal Licences are held by Shell Canada Resources Limited and operated by Crows Nest Resources Limited, a wholly owned subsidiary of the licence.

The property is named after Onion Lake, situated 1 km. south.

The following table entitled "B.C. Coal Licences Tenure Standing, Onion Lake", shows all pertinent data. The location of these coal licences is shown on the Onion Lake, Coal Land Disposition, Index and Geological Compilation Map in Appendix A of this report.

TABLE 1

CROWS NEST RESOURCES LIMITED (Exploration)

B.C. COAL LICENCES — BLOCK: ONION LAKE — PROJECT: — YEAR: 1981

TENURE STANDING — GROUP: 0242 — ONION LAKE — DATE: DECEMBER 1981

LICENCE			ACQ/ADM		RENTALS		REQUIREMENT WORK						BUDGET		EXP	POTL	REMARKS
NO.	LEGAL DESCRIPTION	AREA TOTAL AC/HA.	FEES YEAR	FEES $	ANNUAL $	TOTAL TO NEXT ANN. $ 10^3	EXPIRED CURRENT YEAR $ 10^3	LIC. YEAR	$	PRE-FULFILMENT YEAR	$	ANNIVERSARY DATE	CURRENT YEAR AFE	CURRENT YEAR $ 10^3	TOTAL $ 10^3	SHELL CLASS.	
5 LIC		1425		50	7,125	27.3	42.5		31,875.		198,930.	DECEMBER 31	-	-	268.7	Y	LICENCE NOs.
	NTS 93-I-10-K																4220-4223 ARE IN
4220	25,26,35,36	300	78				9,750.	4	7,500.	2 +	41,557						GOOD STANDING
4221	27,28,37,38	300	78				9,750.	4	7,500.	2 +	41,557						UNTIL DEC 31st,
4222	47,48,58	225	78				7,311.	4	5,625	2 +	31,182						1983 + $38.50/HA
4223	49,50,59,60	300	78				9,750.	4	7,500.	2 +	41,557						EXCESS CREDIT.
4749	5,6,15,16	300	79				6,000.	3	3,750.	3 +	43,077						LICENCE NO. 4749
																	IS IN GOOD STAND-
																	ING UNTIL DEC 31st
																	1984 + $31.09/HA
																	EXCESS CREDIT
				WORK DONE	1978-79	1980	1981										
				$	8,438.	39,143	193,973										

BA 312 — 01

2.2 Location, Geogaphy, and Physiography

Onion Lake is a more or less rectangular area measuring approximately 7 km by 3 km and oriented southeast-northwest.

Some location descriptions are:

1) Situated on the lower northeast slopes of Bone Mountain, 2270 m, one of the front-range Rockies of northeastern British Columbia.
2) Centered about latitude 54 degrees, 44 minutes north, longitude 120 degrees, 48 minutes west.
3) 140 km west-southwest from Grande Prairie, Alberta.
4) 155 km east-northeast from Prince George, British Columbia.
5) 45 km south-southeast from the proposed townsite of Tumbler Ridge.

Relief in the coal formation part of the licences varies from 1300 m to 1830 m; the majority of the area tends towards the top of this range.

The area, as befits its position on the northeast flank of a front-range Rocky, is rugged and sometimes heavily forested. Much of the higher ground is barren alpine, supporting only lichens and moss. Bone Mountain supports an active sheep range, and any mining plan would have to take this into account.

2.2 (continued)

There is a treeline zone supporting alpine meadow and alpine fir below the barren ground. This is followed by often swampy, often sharply-gullied forest down and northeast to the base of the coal section. Lower yet the forest cover is more patchy. Onion Creek, draining Onion Lake, winds through the southeast corner of the licences, and supports an alluvial-flats environment.

Much of the upper-elevation barren and meadow zone ground is mantled by glacial outwash tills and small moraine-like sand and gravel deposits. This has confused aerial photographic interpretation and left a large amount of ground with no outcrop exposure.

2.3 Access

This 1980 field mapping by two pairs was done from helicopter. There are no trails into the area, although a seismic line running from the Duke block to the east across Onion Creek ends approximately 1 km downslope towards the center of the Onion Valley on the south bank of Gorge Creek (see 1:5,000 map Q22).

Road building to the area from Kinuseo Creek, 12 km to the north, would be difficult, as Onion Creek itself contains a long canyon along this stretch. To avoid this, road access would have to cross Feller's Creek, which also does not have gentle banks. In addition there is a rise of 300 m to 500 m involved.

The Kinuseo Creek Valley, part of the Murray River drainage, contains all-weather 40 kph gravel road access. The Monkman Pass coal camp of Petro-Canada, servicing the Duke coal area, is situated 13 km northeast of the area. The mapping crew stayed as guests in this camp, keeping helicopter time to five minutes either way.

The camp is serviced from Grande Prairie, 158 km northeast down the Redwillow River in Alberta. The turnoff from the Grande Prairie - Dawson Creek highway is 37 km west of Grande Prairie at Beaverlodge, Alberta. The drive is approximately 2-1/2 hours in dry weather.

2.4 Environment

Onion Lake is relatively high, cold, and windy compared to the average ground covering the coal belt in this part of northeast British Columbia. Petro-Canada finds that June 15th is the earliest starting date for post-breakup work. As Onion Lake is higher and right on the front of the mountains, such work should be delayed to July 1st in any year. Snow covers the most prospective ground until late May. 1980's work ended with the descent of the snow line to 1450 m on August 24th.

Bone Mountain supports a large and active sheep range. It also supports a large grizzly population, frequently seen by the staff and pilots of other minerals crews in the area throughout the 1980 season.

3.0 WORK DONE

3.1 Summary of Previous Work

Previous work on Onion Lake consists of two geologic studies; there has been no drilling or other equipment work by any company in the area.

The first iten of geological work is the 1:50,000 regional map which shows essentially the same information as is on the 1;50,000 Coal Land Disposition, Index and Geological Compilation Map included with this report, as appendix A.

The second geologic work is Georgia Hoffman's 1979 "Onion Lake Coal Property" report, also on company file. It describes field mapping of a reconnaissance nature, somewhat fleshing out the 1:50,000 regional map, but includes no work at a smaller scale. The scope did not involve detail mapping leading to drill site selection or structural delineation.

It is notable that the Geological Survey of Canada has not mapped this stretch of northeastern British Columbia on a scale as small as 1:50,000; therefore both reconnaissance and detail mapping necessarily had to start at a more basic level than is usual where a G.S.C. base is available. The delineation and selection of mappable units had to be (and was) first accomplished.

3.2 Scope and Objective of 1981 Exploration

With detail mapping and structural analysis completed in 1980, the 1981 drill hole at Onion Lake was intended to complement the 1980 work.

The hole was completed satisfactorily, and confirmed the stratigraphy and structure as outlined in the stratigraphic section shown in figure 4 of this report

As no previous drilling exists from Onion Lake, the hole was intended to count the number and thickness of seams in the lower half of the coal-bearing part of the Gates Member of the Commotion Formation, above the Torrens sandstone.

The hole was surveyed by the Petro-Canada survey crew which was in the area.

3.3 Work Done in 1981

With the help of average weather, a good base camp, and the experience carried into the area from the other parts of the coal belt, the single-hole program was a success.

The following were carried out in addition to the actual drilling:

1) Site clearing and slashing by a Petro-Canada crew.
2) Geophysical logging by Roke Oil Enterprises of Calgary.
3) Hole cementing by the Mid-West drill crew.
4) Burning and reclamation by separate crew in October.
5) Surveying by a Petro-Canada crew.

The hole was surveyed by the Petro-Canada survey crew which was in the area.

This report includes the 1980 structural cross section updated with the drill hole, and one 1:5,000 geologic base map revised with the position of the hole.

Reclamation work has been completed in order to meet provincial forestry requirements.

3.4 1981 Exploration Expenditure

Details of the 1981 exploration expenditure for the Onion Lake coal prospect are contained in the Application to Extend Term of Licence on the following pages.

The total 1981 Exploration Expenditure for the Onion Lake prospect was $193,973.00.

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

APPLICATION TO EXTEND TERM OF LICENCE

I, LESLIE GRAMANTIK (Name) agent for SHELL CANADA RESOURCES LIMITED (Name)

P.O. BOX 100 (Address) CALGARY (Address)

ALBERTA T2P 2H5

Valid FMC No. 207568

hereby apply to the Minister to extend the term of Coal Licence(s) No(s). 4220 TO 4223 INCL. AND 4749 FIVE LICENCES, GROUP #242 , 1425 HECTARES

for a further period of one year.

2. Property name ONION LAKE, PEACE RIVER LAND DISTRICT

3. I am allowing the following Coal Licence(s) No(s). to forfeit N/A

4. I have performed, or caused to be performed, during the period DECEMBER 30th, 1980 to DECEMBER 29, 19 81, work to the value of at least $ 193,973.00 on the location of coal licence(s) as follows:

CATEGORY OF WORK	Licence(s) No(s).	Apportioned Cost
Geological mapping	—	—
Surveys: Geophysical	—	—
Geochemical	—	—
Other	—	—
Road construction	—	—
Surface work	—	—
Underground work	—	—
Drilling	4222	127,559.00
Logging, sampling, and testing	4222	65,734.00
Reclamation	—	—
Other work (specify)	—	—
Off-property costs	GEOLOGICAL REPORT	680.00

5. I wish to apply $ 193,973.00 of this value of work on Coal Licence(s) No(s). 4220 TO 4223 INCL.

6. I wish to pay cash in lieu of work in the amount of $ N/A on Coal Licence(s) No(s).

7. The work performed on the location(s) is detailed in the attached report entitled ONION LAKE, COAL EXPLORATION, 1981

DECEMBER 22, 1981 (Date)

Gramantik (Signature)

ASSISTANT LANDMAN (Position)

(FORMS AND REPORT TO BE SUBMITTED IN DUPLICATE)

CATEGORY OF WORK

GEOLOGICAL MAPPING Yes ☐ No ☒

		Area (Hectares)	Scale	Duration
Reconnaissance				
Detail:	Surface			
	Underground			
*Other (specify)				

Total Cost $

GEOPHYSICAL/GEOCHEMICAL SURVEYS Yes ☐ No ☒

Method
Grid
Topographic
*Other (specify)

Total Cost $

ROAD CONSTRUCTION Yes ☐ No ☒

Length Width
On Licence(s) No(s).
Access to

Total Cost $

SURFACE WORK Yes ☐ No ☒

	Length	Width	Depth	Cost
Trenching				
Seam Tracing				
Crosscutting				
*Other (specify)				

Total Cost $

UNDERGROUND WORK Yes ☐ No ☒

	No. of Adits	Maximum Length	No. of Holes	Total Metres	Cost
Test Adits					
*Other workings					

Total Cost $

DRILLING Yes ☐ No ☐

		Hole Size	No. of Holes	Total Metres	Cost
Core:	Diamond	NQ	1	236	127,559.
	Wireline				
Rotary:	Conventional				
	Reverse circulation				
*Other (specify)					

Contractor MID-WEST DRILLING
Where is the core stored? CHARLIE LAKE CORE STORAGE FACILITY

Total Cost $ 127,559.

LOGGING, SAMPLING AND TESTING Yes ☒ No ☐

Lithology:	Drill samples	☐	Core samples	☒	Bulk samples	☐
Logs:	Gamma-neutron	☒	Density	☒		
*Other (specify)						$ 13,412.
Testing:	Proximate analysis	☑	FSI	☐	Washability	☐
	Carbonization	☐	Petrographic	☐	Plasticity	☐
*Other (specify)	RESISTIVITY					$ 52,322.
						$ 65,734.

OTHER WORK (specify details) Cost

GEOLOGICAL REPORT 680.

Total Cost $ 680.
On-property costs 193,293.
Off-property costs 680.
Total Expenditures $ 193,973.

Dec 22/87
(Date)

W. S. Hamilton
(Signature)

MANAGER ACCOUNTING - C.N.R.L.
(Position)

*A full explanation of other work is to be included.

4.0 GEOLOGY

4.1 Regional Geology, Stratigraphy, and Structure

The 1981 Onion Lake work consists of one drill hole only with no additional ground work, therefore this 1981 report has undergone little change from the 1980 report.

The results of the 1981 drill hole confirm the conception of stratigraphy and structure expressed in the base map and cross section and no changes are made in the 1981 work.

The following pages are reproduced from the 1980 Onion Lake Report.

Regional Geology

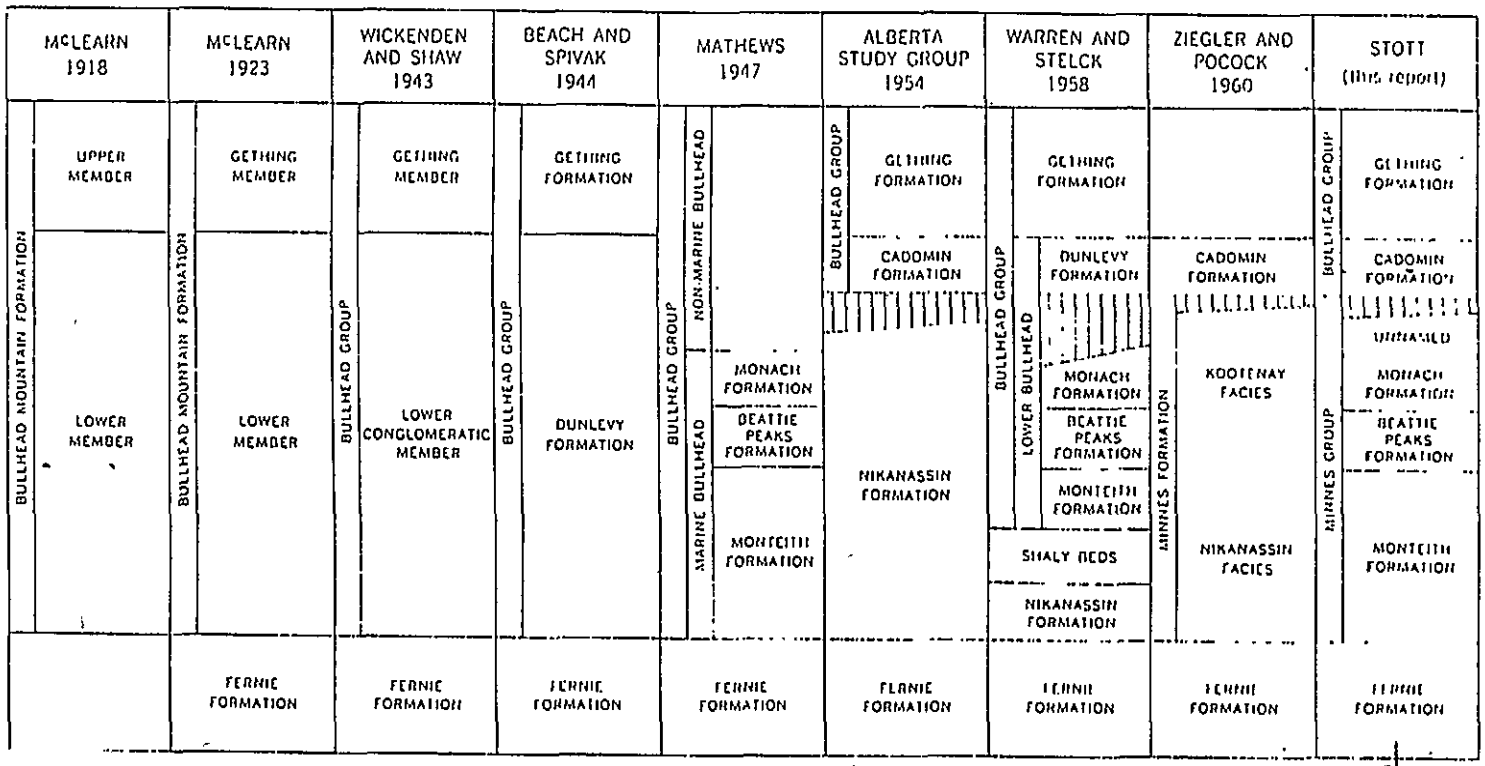
A problem encountered in planning exploration on the Secus Mountain, Onion Lake, and Five Cabin Creek properties was that there existed no Geological Survey of Canada detail 1:50,000 geologic maps covering that portion of the coking coal belt in northeastern British Columbia. The G.S.C. has done detail work to the northwest up the belt, as have other coal exploration companies, but distance and facies changes have confused identification of mappable units in this region.

The generally accepted nomenclature is that of the Survey's Stott (Bulletin 152, 1968) dividing the section of interest into the Bullhead and Minnes Groups, with further subidivisions into formations and members. This is as reproduced on the two following pages in formational diagrams of both groups.

The Petro-Canada staff has fit its intensive Duke Mountain drilling into this nomenclature and also used it for its six drill holes of previous years in the Secus Mountain area.

FORMATIONAL DIAGRAM
LOWER CRETACEOUS SERIES
BULLHEAD & MINNES GROUP

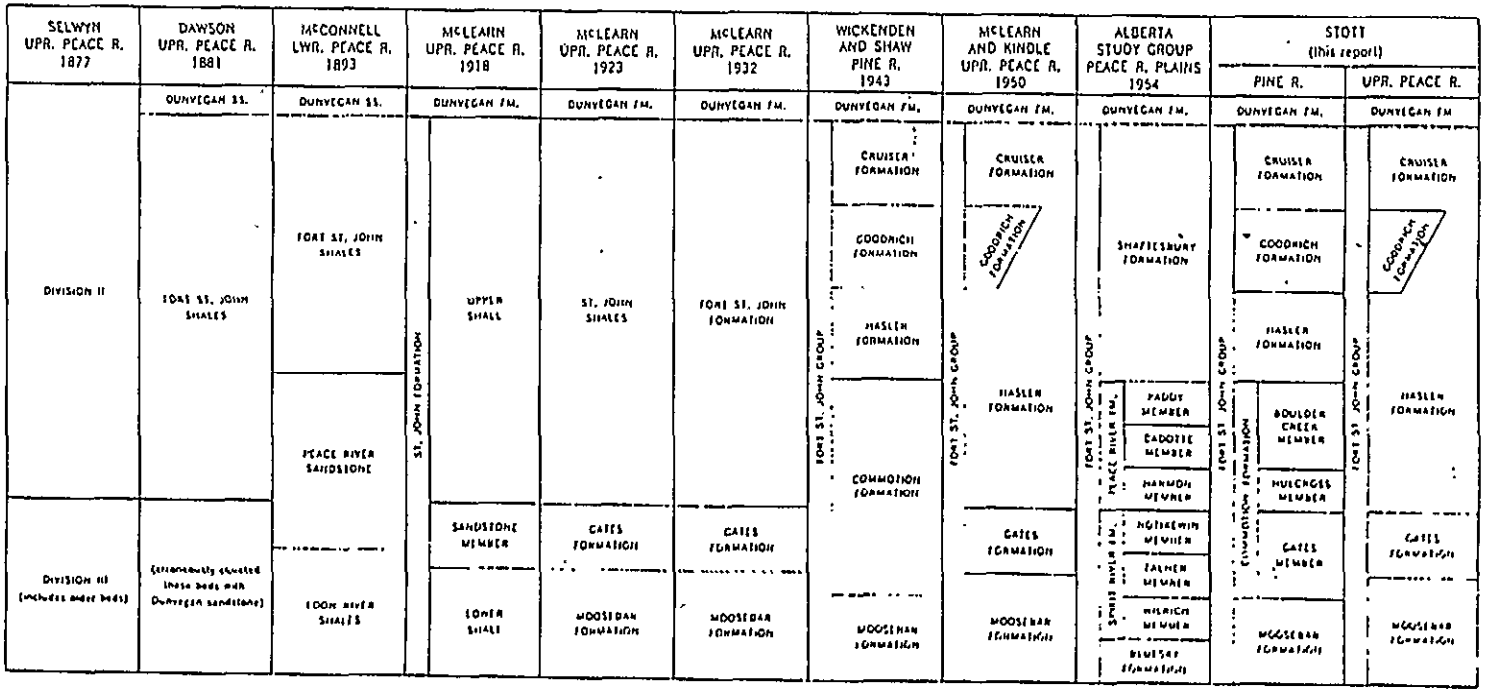
FIG. 2



This nomenclature (Stott, Geological Survey of Canada Bulletin 152) is used in this report and on all maps and sections.

FORMATIONAL DIAGRAM
UPPER/LOWER CRETACEOUS SERIES
FORT ST. JOHN GROUP

FIG. 3



This Pine River nomenclature (Stott, Geological Survey of Canada Bulletin 152) is used in this report and on all maps and sections but with the modifications as shown in Fig. 4.

4.1 (continued)

The 1980 Crows Nest mapping crew decided to continue this nomenclature, to fit in with the work of G.S.C. and Petro-Canada as Crows Nest and Petro-Canada may continue to exchange some parts of their information in the future. The Secus Mountain area in particular is one logical mining area, but it is divided into intertwined fashion between the two companies.

The 1980 mapping crew divided the total section yet further into units mappable through all three Crows Nest properties and throughout the Petro-Canada licences (including the Duke Mountain Block). Should Petro-Canada institute a detailed mapping program on any of its properties in this region of northeast British Columbia (it has not done so in the past, including within the Duke Mountain block), continuity between the companies exploring and developing in the same belt can be maintained.

The Onion Lake and Secus Mountain 1:50,000 compilation maps (enclosures) and 1:25,000 compilation maps were constructed by overlaying the 1:5,000 grids on the topography, and placing the formations and members as measured on these grids from the 1:5,000 maps and sections.

Stratigraphy

Minnes, Bullhead, and lower Fort St. John Group strata in the region stretching from Secus Mountain through Onion Lake and Five Cabin Creek contain an unusually high proportion of conglomerate. Identification and mappability of the two target units, the Gething Formation in the Bullhead Group and the Gates Member of the Commotion Formation of the Fort St. John Group, has been hindered by the vastly increased footages of conglomerate they contain, compared to the remainder of the better-studied part of the coal belt to the northwest (which also contains the type section for the nomenclature).

In fact, not only the Gates and Gething contain many thick conglomerates, but the Minnes, Cadomin, and Boulder Creek also contain unusually thick units of conglomerate. This character is unique to this part of the coal belt, and Stott treats it with some attention in his 1968 bulletin.

The most noticeable conglomerate thicknesses have been centered around Mt. Belcourt, one of the four foothills in the Secus area. To the northwest, at Onion Lake and Five Cabin Creek, the total mass of conglomerate is less and it has less effect on the mappability of the standard nomenclature, but the number of conglomerate occurrences remains high.

Secus Mountain itself, situated right next to Mt. Belcourt, has a long, striking west slope composed of dip-slope units of conglomerates, deeply incised by small canyons and gorges, all of it basically exposed and barren. The general concept and question of how to divide and follow the conglomerates has thus become known in the local mapping trade as "the Secus Mountain conglomerates."

The effect of the conglomerates has been to defeat identification of the standard formations and members, to the point that over the years various crews making quick geological examinations with the idea of locating drill sites to prospect the Gething and Gates ended up often by drilling a completely wrong formation.

The problem is mostly centered along the part of the belt containing Five Cabin Creek, Onion Lake, and Secus Mountain, which are all located along the innermost line of inner foothills. Those properties situated along the outer side of the inner foothills (i.e. the Duke Mountain Block of Petro-Canada, as well as the Belcourt and Saxon properties of Denison Mines) on the east flank of the Wapiti Anticline have less conglomerate.

The Geological Survey maintains an active interest in "the Secus Mountain Conglomerates", and the crew was visited for one day by one of their geologists (D. Gibson), who wished to see the division of the units by the crew.

Since the mapping was completed and the 1:5,000 maps and structural cross-sections finished in November of 1980, the logs (drill core and geophysical) of the six Petro-Canadian holes at Secus Mountain have been acquired by Crows Nest. The positions and altitudes of the holes have never been surveyed (this will be done in 1981), but the author can see that they fit the sections closely, and therefore the basic interpretation and conception of the stratigraphy are valid.

The Stratigraphic Section

As it appeared that an academic style of mapping by the Geological Survey and reconnaissance-level mapping by coal company geologists had not in the past produced a workable division of units in the stratigraphic section, Crows Nest Resources' 1980 crew decided instead, as it was the first crew on the west side of the Wapiti Anticline to do detail mapping, to use a different approach.

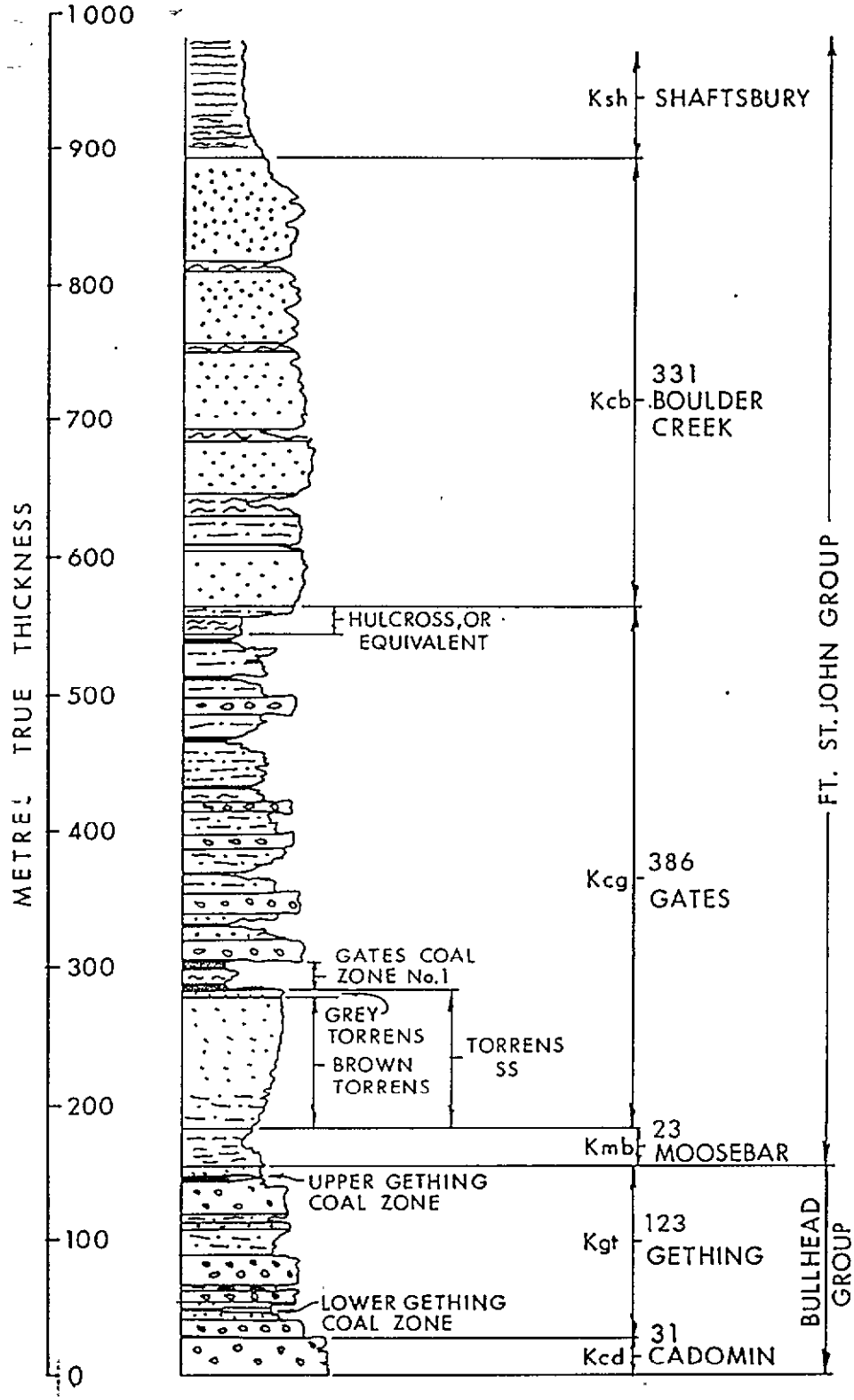
The concept was to concentrate instead on building up a structural framework containing the whole of the sequence from Minnes up through Boulder Creek, and while so doing to attempt to divide the total section into smaller and smaller units, eventually sandwiching possible coal horizons into smaller and smaller spaces.

This entailed leaving aside most notions of academic interest, (such as paleoenvironments and unconformities), and also leaving aside the notion that particular coal beds should be followed. As coal beds are usually recessive and unexposed, the problem came to be to find identifiable units close by in the section.

The mapping was thus carried out from the point of view of the most basic principle: if enough exposures are looked at, and each exposure is compared to all others on the most fundamental geological points such as grain size, bedding characteristics, and so on, then eventually it would be possible to follow certain (and also probably prominent) units close to the coal horizons and so locate drill sites no matter what the discussions on the formal nomenclature would have to say concerning the identify and origin of the units. In other words, the whole problem could be by-passed.

Being able to separate and follow the prominent units in the total stratigraphic section became, then, essentially the study of "the Secus Mountain Conglomerates". The stratigraphic descriptions following the next couple of pages of the stratigraphic section are oriented to this question.

The two pages of stratigraphic section are meant to be used by the reader for six different locations: four within the Secus Mountain area, and one each at Onion and Five Cabin Creek. The nomenclature remains the same, but the reader must substitute the appropriate thickness for each location from the table. The sketch presented is for the 7,000 South structural cross-section on the west slope of Secus Mountain itself.



Marine : shales, siltstones, some minor sandstone and pebbles ; recessive.

Non-marine : sandstones, minor conglomerates, siltstones, mudstones, sometimes coaly, relatively prominent

Marine shale

Sandstones, conglomerates, siltstones, mudstones, coal. Neither prominent nor recessive.

Sandstone ; particularly prominent and distinctive ; transitional marine to non-marine environment.

Grey marine shale ; very recessive

Non-marine sandstones and conglomerates, minor siltstones, mudstones, coal ; often prominent.

Non-marine massive conglomerates, minor coarse sandstones ; extremely prominent

— COAL
— SHALE
— SANDSTONE
— CONGLOMERATES
— SANDSTONE, SILTSTONE MUDSTONE INTERBEDDED

Crows Nest Resources Limited
EXPLORATION
N.E. BRITISH COLUMBIA

STRATIGRAPHIC SECTION
FIG. 4

AUTHOR: D.E. BELL	SCALE: 1 : 5000	ENCLOSURE No.
DATE: 81 03	REVISED:	DRAWING No. AA-534

STRATIGRAPHIC THICKNESSES BY AREA

UNIT		Kcd	Kgt	Kmb	Kcg	Kbc	Torrens ss*	TOTALS
SECUS MOUNTAIN	7,000 S	31	123	23	386	331	50	894
	000 N/S	77	104	23	396	204	51	804
	4,000 N	SAXON THRUST PLATE: T = Top Plate (Dumb Goat); B = Bottom Plate (Whatley)						
		T 152 / B 165	T 260 / B 184	T 23 / B 23	T 435 / B -	T 77 / B -	T 43 / B 79	T 947 / B -
	9,000 N	96	58	23	362	61	64	600
ONION LAKE		36	100	30	Top Missing	Missing	Gray 6.5 Brown 166	-
FIVE CABIN CREEK								

* NOTE: Torrens sandstone figures includ: Transition Beds

TABLE NO. 2

Stratigraphic Descriptions

Minnes Group

The Minnes Group is the term used for any section stratigraphically beneath the Cadomin Formation, the base of the overlying Bullhead Group. Minnes strata throughout this portion of northeastern British Columbia have not been mapped in detail, and the group is undivided.

The Minnes Group is composed of a sequence of both marine and non-marine sediments; often coal or coaly beds occur, but they are rarely thicker than one or two meters, and seem to have little extent laterally.

The nature of the Minnes section immediately beneath the Cadomin at any particular location is often different from the last. At Onion Lake there are massive, thick conglomerates beneath the Cadomin; along the 30 km of Secus it varies from conglomerates to interbedded sandstones, siltstones, and shales, with coal often showing up.

Cadomin Formation

The 1980 Crows Nest Resources crew used a definition of the Cadomin somewhat different than that used by both past coal company workers and the Geological Survey. It was found that by restricting the name to a particular conglomerate within the overall succession, it was possible to divide the question of "the Secus Mountain Conglomerates" into Minnes conglomerates, Cadomin conglomerates, and Gething conglomerates.

The problem has been that if the geologist includes all thick massive conglomerates in the Cadomin, he will have almost no Gething before the Moosebar is encountered. Georgia Hoffman, in her 1979 "Onion Lake Coal Property", states that "the Cadomin is ... unusually thick ... in the Onion Lake area". Also, in regard to the Cadomin-Gething part of the problem, she states "mapping problems ... indicate that a more consistent unit for this area is the Bullhead Group as a whole". The trouble is that if all conglomerates are called Cadomin, then there is very little left to call Gething, and the Gething is what is supposed to be drilled as it contains coal.

Crows Nest Resources' crew restricts the name Cadomin to a unit mostly conglomeratic which stands apart in a set of fundamental mapping characteristics from all other conglomerates within the Minnes-Bullhead-Fort St. John succession. The conglomerate must be light-gray weathering, ring hard to the pick, be so tough that the rock breaks off through the pebbles, cobbles, and boulders, rather than around them, and must always form the basic backbone for the whole succession (Minnes to Boulder Creek) in the topography and structure.

In addition, it must contain particular shades of rosey pink, a jade-like green, and a particular smooth, light gray in the constituents. Cadomin sandstones contain these particular colours, within the sand grain sizes. This character of the Cadomin is the same, in the author's view, as he has seen in the Cadomin from the Alberta town of Cadomin north through the coking coal belt as far as the Peace River. It is very like the Cadomin anywhere through the Luscar and McIntyre Mines properties.

All section below this unit, including conglomerates, is called Minnes. The conglomerates tend to be less tough, browner in overall aspect, slightly less topographically prominent, and they do not ever contain the pink and green constituents.

The top of the Cadomin is taken at that centimeter where the tough, light-gray, massive conglomerate or sandstone gives way to something softer and browner; it may be a conglomerate or a sandstone, but it will be much browner, pebbles and cobbles can be more easily extracted, and the pick hits with a thud.

Gething Formation

In addition to colour and hardness, Gething conglomerates bear another relation to the Cadomin beds beneath: whatever the average largest constituent size in the Cadomin, the Gething will have similarly large sizes, but always slightly smaller. For example, if the Gething has boulders to 20 cm in length, expect 25 cm in the Cadomin beneath.

Up to half of the Gething at any point along the length of the region can be expected to be conglomerate, occuring in one or more massive, prominent units. Gething cliffs can often be followed for several kilometers at a time.

It would appear that in the stretch covering Five Cabin Creek all the way southeast through Secus, there may be expected to be only two coal zones - an upper and a lower - within the Gething. The crew did not find any place where it seemed there could be room for more than that, and each of these zones probably contains no more than a meter or two each. (The lately-acquired Petro-Canada drill logs from Secus are now known to bear this out.)

The Gething is thus judged to be less prospective at this point, and therefore the first drilling on these properties by Crows Nest Resources will be aimed at the Gates Member of the Commotion, lying some distance above.

Moosebar Formation

The Moosebar Formation is notable mostly because of its very characteristic recessive effect on the topography. It is thicker in the Sukunka area to the northwest, is thinning southwards towards Onion Lake, where it is 30 m, and is thinnest in the Secus area. At Secus the crew used 23 m for the Moosebar in constructing the cross-sections, as the actual marine beds in two complete exposures (complete exposures of the Moosebar are almost unheard of, and warrant special examination anytime) were that thickness. The exposure measured at Onion Lake (in The Gorge) is the only other complete exposure known in the region.

Coal crews through the years have followed "the Moosebar recession" in the topography, and through Crows Nest Resources licences the effect remains.

Commotion Formation

The Commotion Formation is divisible into a coal-bearing Gates Member, a marine Hulcross Member overlying the Gates, and then the Boulder Creek Member, an often-coaly sandstone unit.

The Hulcross was found to be almost non-identifiable in the Secus area (it was found near the peak of Mt. Belcourt). A section this high has not been identified in the Onion Lake area, but it is thick at Five Cabin Creek and thickens northwestward.

Mapping was generally stopped in the base of the Boulder Creek, as there is no prospective coal known above the Gates.

Gates Member, Commotion Formation

The Gates Member is perhaps the most consistent in thickness of all the units between Secus Mountain area and Onion Lake; the range appears to be 362 to 435 m. It is composed of alternating sequences of conglomerates, sandstones, siltstones, mudstones, and coal beds. As a general rule the coal seams, while remaining numerous, get uninterestingly thinner towards the top of the member. Individual conglomerate units, while massive and often prominent, are thinner and more well-bedded than Gething and Cadomin conglomerates. The constituents remain the same, but at smaller diameters. The crew found that it could not distinguish between Gates conglomerates individually, but it could generally differentiate them from Gething conglomerates.

Torrens Submember, Gates Member, Commotion Formation

The Torrens Submember consists of an extremely distinctive sandstone occurring at the bottom of the Gates. It is the most prominent unit in the succession besides the Cadomin. Typically, the top five or ten meters of Torrens may be folowed for kilometers at a stretch. The upper unit within the Torrens is a hard gray sandstone, which overlies and is always thinner than the underlying softer brown main part of the unit. The brown sandstones have an extremely distinctive weathering which etches out a particular cross-bedding. The sequence from Moosebar through the Torrens and into the coal above is very reminiscent of the Weary Ridge - Moose Mountain - coal member sequence in southeast British Columbia.

The combination of distinctive topography, distinctive outcrop and distinctive colouring make the Torrens an ideal marker.

Transition Beds, Gates Member, Commotion Formation

The Transition Beds are both part real outcrop and part a notion of conception. The name is applied by the crew to those beds which are "transitional" or "passage" from the marine Moosebar into the terrestial cross-bedded Torrens sandstones above.

They are composed of very evenly-bedded siltstones and very fine sandstones, which grade upwards into the Torrens. The cross-bedding and increased grain sizes appear imperceptibly. Nothing else in the sequence is as evenly bedded.

This unit is quite recessive, and always forms the gentler ground where the Moosebar is rising up to the Torrens prominence above. It is not included in the Moosebar as that name is reserved for the striking moosebar topographic recession.

Gates Coal Zone No. 1, Gates Member, Commotion Formation

Mapping (and the logs of the Petro-Canada holes) shows that the thickest coal in the Gates may be found in the 20 to 30 meters above the Torrens Sandstone. In places the coal lies directly on top of it. Sometimes there is one thick bed (estimated at 14 m at one ridge on Mt. Belcourt); more often there are two or more thinner beds.

No further seam or zone designations have been made above this lowermost No. 1 Zone, as in the 1980 season the crew did not conduct more than a few traverses to describe the Gates to that level of detail. This can be done as drilling and future work progresses. Any drilling will be placed to end in the Torrens, and so the seams above the No. 1 Zone can be catalogued at the same time.

First Gates Conglomerate, Gates Member, Commotion Formation

Very often there is a somewhat prominent Gates conglomerate forming a massive unit above the Coal Zone No. 1. It is often mappable through a kilometer at a time, and forms a convenient top to the recessive coal zone. It has been mapped where appropriate.

Boulder Creek Member, Commotion Formation

The Boulder Creek is a prominent sandstone unit above the Gates. The contact (where the Hulcross is not present) is drawn at the beginning of hard, generally gray-weathering, massive, often pebbly sandstone.

The Boulder Creek can often also be followed through many kilometers, and forms the cap on the mapping. Only once was its top mapped, although often it can be seen from the air to be giving away to Shaftesbury shales.

Geological Structure

The Crows Nest Resources-operated areas in the Five Cabin Creek-Onion Lake-Secus Mountain region of northeastern British Columbia were licenced because of their possibility of containing considerable mileage of the two known prospective formations, the Gething and the Commotion.

The region is approximately 90 km in length. To cover this distance in 64 days of field season, counting all time lost to mobilization and demobilization, weather in a northern Rocky Mountain climate, and incidental losses, the two mapping pairs decided to take a structural approach to the mapping, treating the belt as a whole. This meant acquring actual, measured thickness on the formations and their parts individually. In this manner, drilling with reasonable expectations of being at about the right sites could be planned for the future with no extra effort - the proper positions would become revealed.

Efforts were concentrated in the beginning at traverses across the formations, from Minnes up to Boulder Creek. As the units became clearer, they were extended longitudinally. In this fashion, by chain-measuring selected good exposures across the sequence, and then rapidly following their longitudinal extensions in the topography, the thicknesses for the formations and their parts as expressed in the cross-sections became apparent.

There is a natural rhythm apparent in the thickening and thinning of the formations along the belt.

In the latter part of the season, efforts were directed at refining the sections in the lower part of the Gates, so that the excellent Torrens marker can be used as a guide for the Gates Coal Zone No. 1 immediately above it.

Structural Setting

The problem in mapping on the Onion Lake licences is lack of good outcrop exposure. This is partly due to a glacial mantle, partly due to topography, and partly due to its northeasterly-facing direction (which results in heavy forest and deep overburden).

The basic approach was to box in, volumetrically, the area that could contain coal, whittling down that which is unknown. The thrust limiting the succession along the southwestern long side was mapped in to 200 m horizontal accuracy. The Cadomin and Torrens along the northeastern long side were mapped by chain at selected locations. Where any outcrop was found in the mostly-covered ground elsewhere, it was located as accurately as possible (usually to within 10 m) and examined very carefully. The sequence continues northwest and southeast out of the licences into Petro-Canada licences, and so these property lines define the section at either end of the property.

It is judged at this time that, while continued detail traversing is of course desirable, most of the major features that will be found have been found.

In general, there is indeed room for a considerable amount of Gates to be present. This may be seen on the cross-section. Also, however, there appears to be a system of faulted folds almost completely hidden from view. This is due to the close proximity of the Rockies' front-range thrust, which experience shows causes contorted folding northeast of it within 1 km all through this belt of northeastern British Columbia. The hidden part of Onion Lake is about that width.

Maping the thrust position showed that the fault is bevelling the available Commotion section so that there is much more room at the south end of the property than the north. This would mean that the fold axes in the 1 km distorted zone should be converging with the fault to the north (rather than south). From the several partially exposed folds found within the zone, this indeed appears to be the case.

The first drill hole has been planned to penetrate the undisturbed Gates section (hopefully it is undisturbed) along the northeastern long side of the property. If seams of mineable thickness are found, then continued work may be planned with a better idea of the section.

4.2 Geologic Results, 1981 Drill Program

The site of the single diamond drill hole at Onion Lake in 1981 was chosen to intercept the coal-bearing Gates Member above the Torrens sandstone, in order to count the number of seams and their thicknesses. It was also chosen as it is in one of the few areas of the Onion Lake property that had sufficient outcrop to place the hole with relative surety of undisturbed structure. The problem was that Onion Lake as a whole has insufficient outcrop exposure and known structural complexity, as outlined in the 1980 report. The intention was to place the hole in what was possibly undisturbed structure.

The correct section was drilled in a 236-m. hole. The top of the Torrens sandstone was drilled at 184 m., 26 m. shallower than the anticipated 210 m. The author has since talked to A. White, the 1980 Crows Nest assistant geologist on the property, and it may be that the interbedded conglomerate and sandstone shown outcropping in the 1980 cross section as lowermost Gates above the top of the Torrens is actually grey Torrens and thus the 44-degree dip of the anticline's limb is correct, the 26 m. error in projection being largely accounted for.

4.2.1 1981 1:5,000 Geologic Base Map

As there was no ground work in 1981 additional to that done in 1980, the complete set of four 1:5,000 geologic base maps is not reproduced in this 1981 report. One of the four, Q 22, 1980 Crows Nest No. HG-70A, has been up-dated with the position of the 1981 drill hole, ON81-1, and is included in this report in the appendices. No other changes are made to the map.

On the following page the Abbreviations Legend for the 1:5,000 geologic base map and cross section is reproduced. It was too large to print on the maps and section.

5/CGa.23

TABLE 3

ABBREVIATIONS LEGEND

GEOLOGICAL BASE MAPS

SCALE 1:5 000

1.	Sizes	cm	centimeters true thickness
		m	meters true thickness
2.	Lithologic Types	cg, cgs	conglomerate, -s
		md	mudstone
		sh	shale
		slt	siltstone
		ss	sandstone
		qzt	quartzite, -itic
3.	Grain Sizes	bld, blds	boulder, -s
		cb, cbs	cobble, -s
		pb, pbs	pebble, -s
		cs	coarse-grained sandstone
		ms	medium-grained sandstone
		fs	fine-grained sandstone
		vfs	very fine-grained sandstone
4.	Bed Thickness	fiss	fissile
		flgy	flaggy
		msv	massive
		plty	platey
5.	Bedding	bd, bds	bed, -s
		intbd	interbedded
		x-bd	cross-bedded
6.	Colours	blk	black
		brn	brown
		grn	green
		gry	gray
		rsty	rusty
		lt	light
		drk	dark
7.	Miscellaneous	otc, otcs	outcrop, -s
		occ	occasional
		mnr	minor
		cov	covered
		rcv	recessive
		res	resistant
		hd	hard
		ovln	overlain
		unln	underlain
		wth,wthg	weathers, weathering

4.2.2 1981 1:5,000 Structural Cross Section

As the results of the 1981 Onion Lake drill hole were as planned, the only change to the 1980 1:5,000 structural cross section was to add the hole. This up-dated section is included in the appendices.

The hole location was surveyed by a Petro-Canada contracted survey crew in the area at the time, and it has been projected onto the plane of the section using the average strike for the property, as determined in the 1980 stereographic analysis. The hole successfully penetrated the target zone, the First Gates Coal Zone, immediately above the Torrens Sandstone. In general terms, the hole penetrated the lower half of the coal-bearing part of the Gates Member.

The hole is drawn on the section in its true position and orientation; the only apparentness is that in the angle between the hole dip and the 44-degree average dip of the units. Details are printed on the gamma-neutron and strip logs.

It is now interpreted that the "interbedded conglomerate and sandstone" shown immediately above the Torrens sandstone on the 1980 section is actually the grey Torrens, the top unit of the Torrens, and thus the 44-degree average dip holds true, as the 26 m. error in depth projection to the Torrens is largely eliminated.

5/CGa.28

5.0 1981 DRILL PROGRAM

Crows Nest Resources drilled one NQ diamond drill hole on the Onion Lake property in 1981 as part of a four-hole series. One hole was drilled at Five Cabin Creek and the other two were on the Secus Mountain property. General hole data are tabulated for the hole series ("General Drill Hole Data 1981") on the two following pages.

ON81-1 (Onion Lake 1981 No. 1) was situated to penetrate the Gates Member of the Commotion Formation above the Torrens sandstone on the west limb of the Wapiti Anticline, as described in the 1980 report. The Torrens was found at 183.6 m. 26.4 m. shallower than anticipated.

The site is located in deep timber below the tree line. Water was a problem, and was pumped up from a small stream 700 m. distant.

There is no road or trail access to Onion Lake. The hole was totally helicopter supported by Hughes 500D and Bell 212. Due to its position slightly downwind from a line of high cirques lining the east side of Bone Mountain, a total time of four days was lost on this drill hole to turbulence.

The hole was abandoned by cementing to the surface. The site was cleared and slashed to the satisfaction of local forestry personnel. No work remains to be done.

TABLE NO. 4

GENERAL DRILL HOLE DATA 1981

Secus Mountain, Onion Lake, and Five Cabin Creek

Note: All four holes drilled by Mid-West Drilling using two Boyles Brothers lightweight helicopter-transportable NQ-3 diamond drill rigs.

	Drill Hole and Area			
	South Secus	Dumb Goat	Onion Lake	Five Cabin Creek
Total Depth (m)	194	257	236	241
Bearing (true degrees)	059	051	049	227
Dip (degrees from horizontal)	69	64	57	57
Casing depth (m)	6.1	7.9	6.1	3.0
Altitude (m)	1,323.66	1,689.69	1,580.29	1,752.81

5/CGa.30

Depth of Top of Torrens Sandstone

	South Secus	Dumb Goat	Onion Lake	Five Cabin Creek
Projection (m)	152.0	200.0	210.0	210.0
Actual (m)	145.5	213.0	183.6	209.9
Error (m)	-6.5	+13.0	-26.4	-0.1

5/CGa.31

5.1 Geophysical Logging

Roke Oil Enterprises Ltd. of Calgary used a helicopter-transportable geophysical logging unit for the 1981 Onion Lake drill hole. The total load was approximately 550 kg. and was slung in two trips by the Hughes 500D helicopter used for the drilling.

The log suite for Onion Lake consisted of gamma-neutron, gamma-sidewall densilog (L.S.D.)-caliper, 5-cm. and 20-cm. focused beam, and directional survey.

All logs were completed to the bottom of the hole; there was no appreciable cave-in of the sidewall rock. The focused beam surface electronics broke down, causing a four-day delay in the completion of the hole. No other significant delays or problems occurred.

5.1.1 Gamma-Neutron

This log was run with the drill crew maintaining the fluid level at the surface and the rods in the hole to its bottom. This avoided the possibility of the hole caving partially or completely upon withdrawal of the string, with the result that no logs are obtained. It makes little difference with the gamma-neutron if the log is run through the rods. For consistent interpretation, the gamma-neutron must be run in fluid and not air, and so the water level was maintained with the pumps at the surface.

On the left side of the depth track the coal beds have been drawn based on interpretation of the gamma-neutron alone. As a following step, the same coal beds were drawn in from the density log down the right side of the same depth track, traced on a light table. The general effect is that coal thicknesses are slightly reduced on the density log, a normal occurrence as the density provides better detail. At this beginning level of exploration, however, no attempt was made to resolve interpretations smaller than approximately 20 cm. Thin coal beds are shown by a dashed line across the depth track; they also have been traced through from the density log.

5.1.2 Gamma-Sidewall Densilog (L.S.D.)-Caliper

These three logs were run on the same depth track. Detail sections separately-run, of the thicker coal beds are presented on an expanded scale of 20:1 after the bottom of the logs. The caliper shows some minor caving throughout the hole, but none that is significant.

5.1.3 Focused Beam

The focused beam runs logged all coal beds. The drill crew maintained the fluid level at surface. On the 20-cm. log, separately-run detail sections of the thicker coal beds are presented on an expanded scale of 20:1 after the bottom of the log.

5.1.4 Directional Survey

The Onion Lake hole commenced at a dip of 59 degrees from the horizontal and decreased to 56 degrees at its bottom. A dip of 60 degrees had been planned.

The hole bearing commenced at 047 degrees true, and increased regularly to 52 degrees at total depth. A direction of 050 degrees had been planned, to coincide with the stereographically-determined average up-dip direction in the 1980 mapping. The correction for strike component in determining true thicknesses from the apparent thicknesses in the hole is therefore only a negligible one-tenth of one per cent and so may be disregarded.

5.2 Diamond Drill Core Logging ON81-1

The core from the 1981 Onion Lake drill hole was examined briefly on the drill site, than stacked while geophysical logging and cementing was completed. The core was then carried back to base camp in a single trip inside a Bell 212 helicopter brought in for the drill move. This procedure avoided the possibility of losing core being slung during multiple trips by the smaller service helicopter and the cost involved in flying geological personnel back and forth to the site for logging at the drill site.

The core logs show that recoveries are very satisfactory. There has been no problem in correlating amongst the geophysical logs, surface outcrop, and the core logs.

Coal samples were sent to the Crows Nest Resources Fernie laboratory for analysis.

The remaining core was sent to the provincial core storage facility of the B.C. Ministry of Energy, Mines, and Petroleum Resources in Charlie Lake, B.C., as the province decided to add it to its collection of core from relatively unexplored areas.

5.3 Stratigraphic Section Log ON81-1

A geologist's Stratigraphic Section log of the 1981 Onion Lake drill hole has been prepared at a vertical scale of 200:1 (appendices) from the written core log description. Bedding-to-core angles are printed down the right side of the depth track.

Structural disturbance exists from the surface down to the 4.5 m. coal seam approximately 25 m. above the top of the Torrens Sandstone. From this point down, bed thicknesses, which are apparent on the Stratigraphic Section log, must be multiplied by 0.98 for dip component correction to find true thicknesses. From the surface to this point, various corrections would have to be used to find true thicknesses, as the bedding-to-core angles vary widely. At two points the angles are zero and the drill was drilling directly down beds.

Small differences in the depths to beds between the Stratigraphic Section log and geophysical logs are due to interpretation and the fact that the core, from which the Stratigraphic Section log was made, inevitably involves drilling loss, as recorded in the written core log description.

6.0 1981 CORE SAMPLE ANALYSES

Due to proximity of the close of field season to this report date, the diamond core coal sample analyses of ON81-1 are unavailable and will be reported in the next report.

Core samples of all coal beds over 1 m. in thickness as measured along core were sent to the Crows Nest Resources Fernie laboratory for analysis.

The remainder of the core was shipped to the provincial core storage facility in Charlie Lake, B.C., at the request of the province.

7.0 RECOMMENDATIONS

The initial exploration of Onion Lake coal licences is now complete. The geologic mapping of 1980 enabled the accurate planning of an initial drill hole, now completed in 1981. The lower half of the prospective Gates Member of the Commotion Formation has been shown to contain coal seams.

Onion Lake is hampered by lack of outcrop. There is sufficient to outline the prospective coal-bearing area to, generally, within 200 m., but there is a paucity of outcrop within. The 1981 drill hole has confirmed the basic stratigraphy and structure as shown in figure 4 of this report. Crows Nest now has several directions from which to choose in further exploration.

The 1981 drill hole penetrated the projected section, but the bedding-to-core angles and the fracturing show that the upper two-thirds of the hole is in a slightly disturbed zone. The next drill hole could be placed along strike, in order to attempt to drill the same section undisturbed.

Alternately, or at the same time with a third hole, the upper part of the coal-bearing Gates, beneath the Boulder Creek, may be targeted, down-dip to the southwest from the 1981 hole, in an attempt to count the number of coal seams and their thickness. This, however, appears to continue into the disturbed zone, as shown on the structural cross section.

A third alternative is to drill a "wildcat" hole, or several, on widely-spaced portions of the property, in an attempt to identify the section.

In-fill mapping can be continued from 1980. Trenching appears to be of little value at Onion Lake.

5/CGa.43

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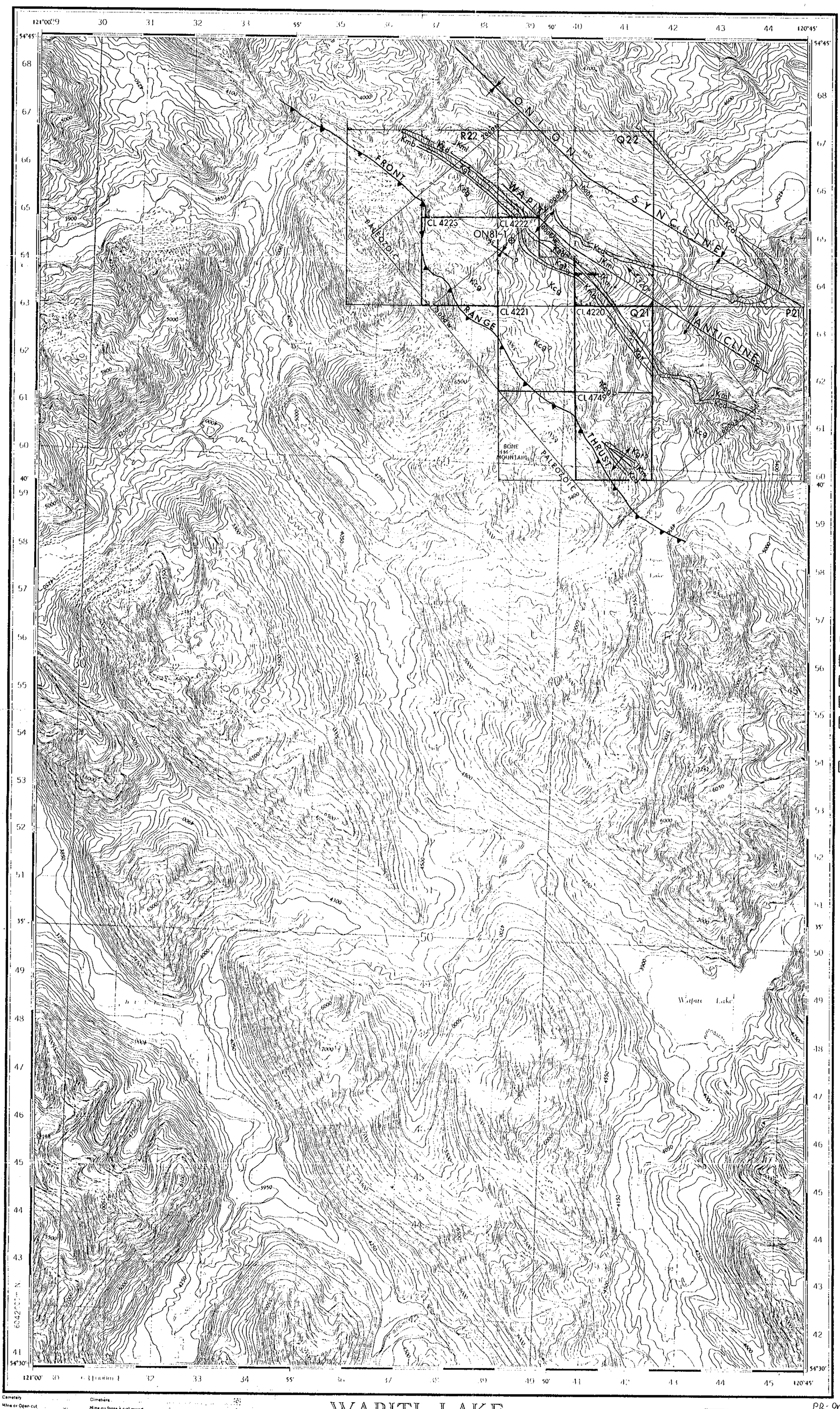

GEOLOGICAL LEGEND

LOWER CRETACEOUS

- Kcg — COMMOTION FORMATION (Gates Member) — FORT ST. JOHN GROUP
- Kmb — MOOSEBAR FORMATION — FORT ST. JOHN GROUP
- Kgt — GETHING FORMATION — BULLHEAD GROUP
- Kcd — CADOMIN FORMATION — BULLHEAD GROUP

JURRASSIC-CRETACEOUS

- JKmi — MINNES GROUP

GEOLOGICAL SYMBOLS

- ANTICLINE
- SYNCLINE
- THRUST FAULT
- 1981 DRILL HOLE

U.T.M. ZONE 10

INDEX MAP

121°15' — 120°30' — 55°00'

931/14E	931/15W	931/15E
931/11E	931/10W	931/10E
931/6E	931/7W	931/7E

54°15'

Cemetery	Cimetière	Railway, normal gauge, single track	Chemin de fer, voie unique (écartement normal)
Mine or Open cut	Mine ou fosse à ciel ouvert	Horizontal control point, with elevation	Point géodésique, avec cote
Lighthouse	Phare	Bench mark, with elevation	Repère de nivellement, avec cote
Power transmission line	Ligne de transport d'énergie	Spot elevation, precise, approximate	Point coté, précis, approximatif
River with bridge	Rivière avec pont	Roads:	Routes:
Stream, intermittent or dry	Cours d'eau intermittent, ou à sec	hard surface, all weather	pavée, toute saison
Lake intermittent, indefinite	Lac intermittent, rive imprécise	hard surface, all weather	pavée, toute saison
Marsh or Swamp	Marais ou marécage	loose surface, all weather	de gravier, toute saison
Depression contours	Courbes de cuvette	loose surface, dry weather	de gravier, période sèche
		cart track	de terre
		trail or portage	sentier ou portage

WAPITI LAKE

PEACE RIVER DISTRICT

BRITISH COLUMBIA

SCALE 1:50,000 ÉCHELLE

Metres 1000 500 0 1000 2000 3000 4000 Mètres

CONTOUR INTERVAL 100 FEET
Elevations in Feet above Mean Sea Level

ÉQUIDISTANCE DES COURBES 100 PIEDS
Élévations en pieds au-dessus du niveau moyen de la mer

Transverse Mercator Projection
North American Datum 1927

Projection transverse de Mercator
Réseau géodésique nord-américain unifié 1927

MAGNETIC DECLINATION 26°15' EAST AT CENTRE OF MAP 1965
Annual change decreasing 4.1'

DÉCLINAISON MAGNÉTIQUE AU CENTRE DE LA FEUILLE EN 1965 26°15' EST
Variation annuelle décroissante 4.1'

PR-Onion Lake 81(2)*A *1

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Crows Nest Resources Limited

EXPLORATION

ONION LAKE

N.E. B.C. ✓

COAL LAND DISPOSITION, INDEX AND GEOLOGICAL COMPILATION MAP

WAPITI LAKE 93 I/10W

AUTHOR D. BELL	SCALE 1:50,000	ENCLOSURE No. Appendix A
DATE MARCH 83	REVISED: 83-12-03	DRAWING No. HK-70A
To Accompany		

ONION CANYON
ONION SYNCLINE
First Waterfall
Erosion has placed Onion Creek down down the approximate centre of the syncline's axial trace. At this point, the gravel flats give way to the beginning of Onion Canyon, in the waterfall beds of the Boulder Creek.
This northeastern lower slope of Bone Mtn is covered by dense brush & forest with patchy tree cover over the harder units
End of seismic line. As of 1980, this is closest trail to Onion Lake property
This northeastern lower slope of Bone Mtn is covered by dense brush and forest, with patchy brush over the harder units.
6 066 000 N
6 065 000 N
6 064 000 N
1,000 N
small ledge CADOMIN qtz ss
Helicopter pick up in grassy trough
CADOMIN
GETHING
MOOSEBAR
TRANSITION BEDS
TORRENS SS
CL 4223
CL 4222
CL 4221
CL 4220
NO OUTCROP GORGE CREEK
Gorge is alder and boulder-cked; Ground visibility almost zero.
brn MINNES cb & bld-cg relatively hd, lg cbs, weathers similar to GETHING
Heavy brush, no outcrop visible from air
WAPITI
Major GETHING and CADOMIN units visible on cliffs
Almost continuous MINNES bd-cg
Cliffs of brn MINNES Cg
Waterfall is top unit of CADOMIN
top unit of CADOMIN hd grey pb ss
Cliff face of MINNES cg brn, med-hd.
TORRENS brn, plty x-bd ss
GATES intbd cg & ss
MOOSEBAR, thickness 30m completely exposed in this gorge. It is overlain by lower TRANSITION BDS under trees near top of the bank. At base of bank is top ss unit of GETHING SS.
ON81-1
1,580.29m
049° TRUE at 57° DIP
An obsure fault in GETHING cg and ss
Dip-slope GETHING ss, platey
MSV cliffs of GETHING cg
5m GETHING SS
1m GETHING cg
bottom unit CADOMIN typical hd gry cb-cg ~10m true thickness
dip slope CADOMIN
dip-slope CADOMIN
15m intbd brn ss, slt, & sh
2m flaggy brn ss
1m flaggy brn ss
This heavily forested slope has patchy CADOMIN outcrop throughout
Pond
Swamp
Water Supply in CRK
Swamps, helicopter sites
Heavy forest some swamp
alpine fir & brush at treeline zone. Dense grizzly grazing
Swamp, helicopter site
No outcrop
GETHING
MOOSE BAR
MINNES GRP
ANTICLINE
GETHING
CADOMIN
MINNES GRP
Kgt
Kcd
JKmi
Kmb
Kcg
dip slope CADOMIN
No outcrop on this grassy knob; why is it here? The pebbly gravel of which it is composed appears to be of glacial origin
Heavy forest
No outcrop CREEK GORGE
Swamp
Heavy forest No outcrop visible from helicopter
CADOMIN
Heavy forest
1,000 S
1,000 W
2,000 S
000 E/W
1,000 E
120°51'
54°44'
120°48'
54°44'

ON81-1 SURVEY CO-ORDINATES

UTM NORTHING:	6,064,643.44
UTM EASTING:	638,777.06
ELEVATION:	1,580.29

Scale 1:5000

Metres 100 0 100 200 300 400 500 Metres

LEGEND

Improved road
Secondary road
Track or trail
Cut line
Tree area
River
Stream
Intermittent stream
Swamp
Contours
Horizontal control
Vertical control
Spot elevation
Iron Pin

CONTOUR INTERVAL: 5 METRES
DATE OF PHOTOGRAPHY: SEPTEMBER 1975
DATE OF SURVEY: 1977 - 1978
DATE OF MAPPING: 1977 - 1978

SURVEY NOTE
The Horizontal and Vertical Co-ordinates were established by D.W. Watson, B.C.L.S. using conventional and E.D.M. survey equipment. Horizontal and vertical co-ordinates and elevations are derived from Trig. Stations ... Elevations are above Mean Sea Level were established by trig. levelling, vertical angles being read at both ends of each course simultaneously.

LOWER CRETACEOUS

Ksh	Shaftesbury
Kcb	Boulder Creek
Kcg	Gates (includes overlying Transition Beds & Torrens Sandstone)
Kmb	Moosebar
Kgt	Gething
Kcd	Cadomin

JURASSIC - CRETACEOUS

JKmi	Minnes Group (undivided)

Thrust fault, position exposed
Thrust fault, position approximate
Fault other than thrust
Anticline
Syncline

Isolated outcrop, sketched to extent and size:
Strike & dip where strike line of symbol touches outcrop outline
Strike & dip where strike & dip lines of symbols intersect
Patchy, indeterminate outcrop
Outcrop with exposed contact
Chain-and-compass line (tick marks are stations) with outcrop sketched to size and limits along chained line; strike & dip where strike line of symbol touches chained line
Chain & compass line; attitudes refer to strike & dip at nearest tick (chain station)

NOTE: See Report for Legend of Abbreviations

KEY MAP

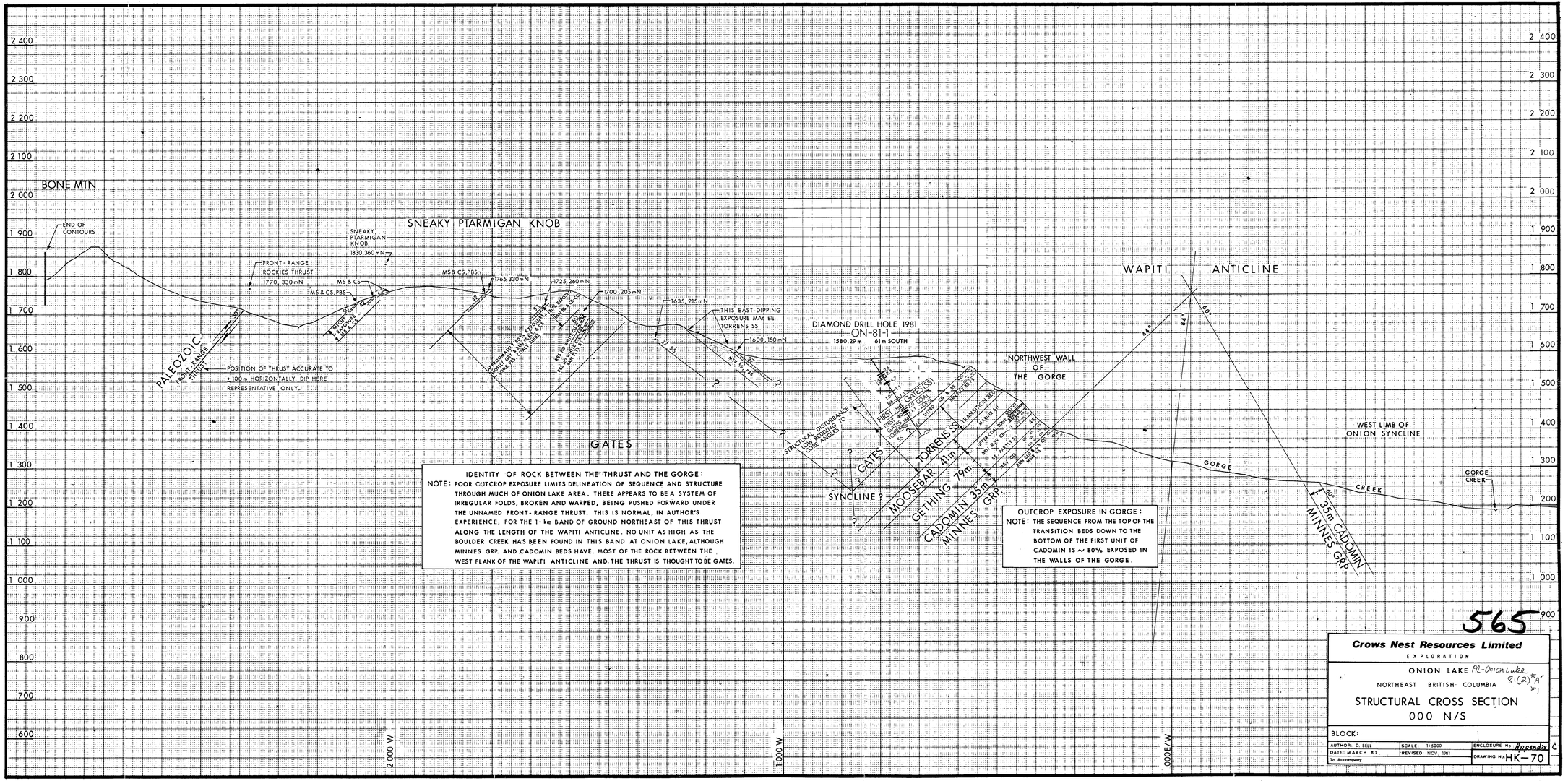
PR-Onion Lake 81(2)A *1

Crows Nest Resources Limited
EXPLORATION

ONION LAKE
N.E. BRITISH COLUMBIA

N.T.S. 93 I		Q22
AUTHOR: D. BELL	SCALE: 1:5000	ENCLOSURE No: Appendix B
DATE: MAR/81	REVISED: NOV. 1981	DRAWING No: HG-70A
To Accompany		

565



IDENTITY OF ROCK BETWEEN THE THRUST AND THE GORGE:

NOTE: POOR OUTCROP EXPOSURE LIMITS DELINEATION OF SEQUENCE AND STRUCTURE THROUGH MUCH OF ONION LAKE AREA. THERE APPEARS TO BE A SYSTEM OF IRREGULAR FOLDS, BROKEN AND WARPED, BEING PUSHED FORWARD UNDER THE UNNAMED FRONT-RANGE THRUST. THIS IS NORMAL, IN AUTHOR'S EXPERIENCE, FOR THE 1-km BAND OF GROUND NORTHEAST OF THIS THRUST ALONG THE LENGTH OF THE WAPITI ANTICLINE. NO UNIT AS HIGH AS THE BOULDER CREEK HAS BEEN FOUND IN THIS BAND AT ONION LAKE, ALTHOUGH MINNES GRP. AND CADOMIN BEDS HAVE. MOST OF THE ROCK BETWEEN THE WEST FLANK OF THE WAPITI ANTICLINE AND THE THRUST IS THOUGHT TO BE GATES.

OUTCROP EXPOSURE IN GORGE:

NOTE: THE SEQUENCE FROM THE TOP OF THE TRANSITION BEDS DOWN TO THE BOTTOM OF THE FIRST UNIT OF CADOMIN IS ~ 80% EXPOSED IN THE WALLS OF THE GORGE.

565

Crows Nest Resources Limited

EXPLORATION

ONION LAKE Alt-Onion Lake 81(2)A' #1

NORTHEAST BRITISH COLUMBIA

STRUCTURAL CROSS SECTION

000 N/S

BLOCK:

AUTHOR: D. BELL	SCALE: 1:5000	ENCLOSURE NO: Appendix C
DATE: MARCH 81	REVISED: NOV. 1981	DRAWING NO: HK-70
To Accompany		

Appendix D

PR-Onion Lake 81(3)A #1

565

CROWS NEST RESOURCES LIMITED

PROJECT:	NORTH EAST, B.C. ONION LAKE		
AREA:	ONION LAKE	N.T.S.	93 I/10W
HOLE I.D:	ON 81-1		
ZONE:	10		
GRID TYPE:	U.T.M.		
EASTINGS:	638,777.06		
NORTHINGS:	6,064,643.44		
ELEVATION (m):	1,580.29		
TOTAL DEPTH DRILLED:	236.m	DRILLER:	MID WEST DRILLING
AZIMUTH:	049° TRUE		
INCLINATION:	57°		
DRILL TYPE:	DIAMOND CORE	OVERBURDEN:	6.1 m
CORE DIAMETER:	NQ	CASING LEVEL:	6.1
LENGTH CORED:	236 m	WATER LEVEL:	SURFACE
LOGS RUN:	GAMMA-NEUTRON, GAMMA-SIDEWALL DENSILOG (L.S.D.) FOCUSED BEAM (TWO), CALIPER, AND DIRECTIONAL SURVEY		
LOGS USED:	GAMMA-SIDEWALL DENSILOG		
LOGGED BY:	ROKE, RECORDED BY: J. FATERNESS	LENGTH LOGGED:	234.5
CORE EXAMINED BY:	G. COX, P. DUDZINSKI, J. MacDONALD		
DATE EXAMINED:	JULY 16, 1981		

CORE SHEET LEGEND

CR	- Core recovered	Elev Bot	- Elevation of bottom of main lithology
CI	- Core interval	Lith % R	- % recovery of main lithology
M-M %/R	- % recovery between marker blocks	Geop Pick	- Pick using geophysical logs
Mn Lith	- Main lithology	Lith % R	- Recovery for each main lithology from geophysical logs
Sm Des	- Seam designation		
MTh	- Measured thickness in m.	C/B	- Core to bedding angle
ETh	- Expected thickness in m.	EL	- Elevation of reading

PROJECT: NORTH EAST, B.C. ONION LAKE | AREA: ONION LAKE | HOLE no: ON 81-1 | BOX nos: | GEOP. PICK | PAGE: 1 OF

Marker Bl. [1]	CR / Cl [2]	M-M %R [3]	Mn Lith (Sm Des) [4]	M Th / ETh [5]	Elev. Bot. [6]	Lith %R [7]	Geop Pick [8]	Lith %R [9]	Minor Lith	Th	REMARKS Lithology, Sedimentary-Tectonic Structures	Sample No. [10]	C/B El. [11]	C/P Az Code [12]
											Hole is spudded in the undifferentiated Gates member of formation of the Fort St. John Group.			
8			SST.	17.2							Note 20 feet of casing, light grey, very course grained grading into granule conglomerate interbeds. Frequent calcium veins, infrequent carbonaceous stringers, poor slickensides.			
													37° 9.8 m	
11	3.00 / 3.00	100%									- stick to rubble, iron staining on fractures - 10.75m to 11.18 m rubble, iron stained -11.50 m poor slickensides, semi-stick			
					17.2 m		17.2	100			-13.60 m poor slickensides, stick		21° 13.69 m	
14	3.03 / 3.00	101%	CONGL.	7.9							Granular, light and dark grey, blue and green clasts, carbonaceous stringers throughout.		0° 16.75 m	
17	2.99 / 3.00	100%			25.1 m		25.1	100			rubble to stick, 17.2 m to 17.79 m rubble, slickensides throughout		0° 17.49 m	FAULT ZONE
20	3.05 / 3.00	102%	SST.	13.6							course to medium grained, light grey, carbonaceous stringers. stick to semi-stick, some calcium veins.			
23	3.00 / 3.00	100%									Iron staining on fractures. - 26.20 m to 26.30 m conglomerate, interbedded		35° 20.42 m	
26	3.00 / 3.00	100%									- 28.11 m grades to very fine grain sandstone - stick to semi-stick, calcium veins throughout		53° 24.1 m	
29	2.93 / 3.00	98%									Minor iron staining Slickensides at 28.20 m to 28.35 m, semi-stick.		43° 26.2 m	
32	3.00 / 3.00	100%									30.30 m to 31. 95 m medium grained, light grey, sandstone, stick to semi-stick, calcium veins to .002 m thick		53° 29.3	
35	2.98 / 3.00	99%									-31.95 m to 33.40 m siltstone, grey, stick to semi-stick, minor calcium veins to .003 m thickness.		60° 34.7 m	
38	3.00 / 3.00	100%			38.70		38.7	100			Medium grey, stick to semi-stick, minor calcium veins, slickensides 38.8 m to 39.20 m, semi-stick			
38	3.00 / 3.00	100%	SLTSTN								Last 0.03 m turns to rubble.		60° 34.7 m	
41	3.01 / 3.00	100%			41.5		41	122						
44	2.46 / 3.00	82%	Coal	0.5 / 0.5	41.55	100					- 0.5m bright with dull bands, hard, semi-stick to stick			

PROJECT: NORTH EAST, B.C. ONION LAKE | AREA: ONION LAKE | HOLE no: ON81-1 | BOX nos: | GEOP. PICK | PAGE 2 OF

Marker Bl. [1]	CR / Cl [2]	M-M % R [3]	Mn Lith (Sm Des) [4]	M Th / ETh [5]	Elev. Bot. [6]	Lith % R [7]	Geop Pick [8]	Lith % R [9]	Minor Lith	Th	REMARKS Lithology, Sedimentary-Tectonic Structures	Sample No. [10]	C/B El. [11]	C/P Az Code [12]
				.93 / 1.0	42.55	93					0.55 bright with dull bands, hard, semi-stick. 0.38 dull with bright bands, hard, stick.			
47	3.00 / 3.00	100%		.4 / 1.2	43.75	33					0.20 m of powder coal dull with bright flecks 0.2 m hard dull coal, rubbly			
			Coal & Carb. Shale	2.31 / 2.6	46.35	89					1.84 m bright, soft, rubbly, slicks throughout. 0.47 m highly carbonaceous, black silty shale, semi-stick to rubble, highly slickensided.			FAULT ZONE
			Coal	.4 / 1.2	47.55	33					0.40 m powder coal.			
50	1.73 / 3.00	58%		1.01 / 2.45	50.0	41	49.0	64			0.51 m hard bright coal with dull bands, semi-stick .50 soft bright coal with dull bands, rubbly			
			SLTSTN	4.1 /							Dark grey carbonaceous stringers, stick to semi-stick calcium and carbonaceous interbeds.			
				/	54.1	<	53.1	100			.25 m to 51.31 m soft, bright powder to rubble, slickensides at 52.90 m rubble, highly slickensided.			
				1.4 / 1.4	55.5	100	54.5	100			1.40 m soft bright with dull bands, rubble to powder.			
				0.65 /	56.15		55.6	59			Dark grey, carbonaceous stringers, stick to semi-stick, slickensides on stringers.			
56	2.90 / 3.00	97%	Coal	.25 / 1.25	57.4	20					.25 m dull powder coal NOTE: Heavy core loss. 0.35 m rubbly, highly slickensides. 0.45 m of carbonaceous shale, coal stringers, rubble.			
59	1.70 / 3.00	57%	SLTSTN	9.42 /							Dark grey carbonaceous stringers at 61.56 m 0.3 m of soft bright coal rubble.			
60	0.90 / 1.00	90%		/							0.20 m (to 64.0) coal, soft dull, rubble			
61	1.00 / 1.00	100%		/							Siltstone becomes carbonaceous at 64.50 m			
64	2.05 / 3.00	68%		/							64.50 m to 66.0 m rubbly, slickensides throughout.			
65	1.00 / 1.00	100%		/							67.55 m rubbly			
68	2.24 / 3.00	75%		/										
				/										
				/										

PROJECT: NORTH EAST, B.C. ONION LAKE | AREA: ONION LAKE | HOLE no: ON 81-1 | BOX nos: | GEOP. PICK. | PAGE 3 OF

Marker Bl. [1]	CR / Cl [2]	M-M %R [3]	Mn Lith (Sm Des) [4]	M Th / ETh [5]	Elev. Bot. [6]	Lith %R [7]	Geop Pick [8]	Lith %R [9]	Minor Lith	Th	REMARKS Lithology, Sedimentary-Tectonic Structures [10]	C/B / El. [11]	C/P / Az / Code [12]
			SLTSTN		67.52							18° / 65.7	
			CARB. SHALE	1.905	69.425						Siltstone .01 m. becomes more carbonaceous towards base, stick to broken stick.	78° / 68.89	
			COALY SHALE	.29	69.715		68.7				Massive.		
			COAL	.07	69.85			96			Bright and dull coal. some shaley coal, rubble to mesh.		
				.25	70.115						Dull with occasional bright bands, broken stick to rubble.		
				.13	70.5						Dull, stick.		
71	2.37 / 3.0	79%		.4	71.0	<					Dull, broken stick to rubble.		
			SHALEY COAL	.06	71.1						Rubble.		
			COAL	.34	71.5						Dull, rubble to mesh.		
			COALY SHALE	.1	72						Broken stick.		
			COAL	.17	72.65						Dull, rubble to mesh.		
			COALY SHALE	.07	72.75						Dull with occasional bright wisps.		
			COAL	.05	72.86						Dull, rubble to mesh.		
				.14	73.0						Dull, stick		
				.66	73.95						Broken stick to mesh.		
				.15	73.10						Broken stick.		
				.51	74.41		73.6				Dull, broken stick to mesh.		
			COALY SHALE	1.28	75.69			99			Unit more carbonaceous at top, stick.	27 / 75.85	

PROJECT: NORTH EAST, B.C. ONION LAKE | AREA: ONION LAKE | HOLE no: ON 81-1 | BOX nos: | GEOP. PICK | PAGE 4 OF

Marker Bl. [1]	CR / Cl [2]	M-M % R [3]	Mn Lith (Sm Des) [4]	M Th / ETh [5]	Elev. Bot. [6]	Lith % R [7]	Geop Pick [8]	Lith % R [9]	Minor Lith	Th	REMARKS Lithology, Sedimentary-Tectonic Structures	Sample No. [10]	C/B El. [11]	C/P Az Code [12]
77	5.26 / 6.0	88%	SLTSTN	3.345	80.72						Coal wisps present, occasional calcite stringers, bedding displaced Soft sediment deformation present, gradational basal contact.			
80	3.045 / 3.0	102%	CARB. SHALE	1.73	81.475						Broken stick to stick.		18 / 80.1	
			COALY SHALE	.39	83.235						Broken stick to rubble			
83	2.855 / 3.0	95%	CARB. SHALE	1.76	98.0						Becomes less carbonaceous towards base, gradational lower contact. Stick to broken stick.		28 / 85	
86	3.045 / 3.0	102%	SLTSTN	14.77	100.36						Calcite stringers throughout, calcite breccia up to .03 m thick. 13 calcite filled fractures, zone of displaced bedding, with fine to medium sandstone interbands, stick to broken stick.		10 / 89.35	
89	2.915 / 3.0	97%	CARB. SHALE	2.36	100.74		99.5				Massive, stick to broken stick.		10 / 95	
92	3.025 / 3.0	101%	COAL	.38	101.35			95			Dull with occasional bright bands, broken stick.		30 / 100	
95	2.89 / 3.0	96%	COAL	.57	106.9		100.5				Dull with occasional bright bands, rubble to mesh.		22 / 105	
98	2.88 / 3.0	96%	CARB. SHALE	4.295	107.11		105.2	91			Occasional coal bands and wisps, one bed containing fossil shell fragments, stick to broken stick.			
101	2.995 / 3.0	100%	SHALEY COAL	.21	113.11		105.9	30			Rubble to mesh			
104	2.56 / 3.0	85%	FINE SST.	6.0	113.34						With interbedded carbonaceous shale, shows soft sediment deformation stick to broken stick		22 / 110.43	
107	2.16 / 3.0	72%	COAL	.23	116.17						Rubble to mesh.			
110	3.275 / 3.0	109%	CARB. SHALE	2.83	116.2						With interbedded siltstone shows soft sediment deformation and bioturbation, stick to broken stick.		37 / 115.1	
113	3.28 / 3.0	109%	COALY SHALE	.03	116.375		115.4	97						
116	3.01 / 3.0	100%	COAL	.175	117.135						Dull with broken bands, broken stick			
			COAL	.76	117.495		116.3	104			Bright with dull bands, a few fragments of shaley coal, rubble to mesh.			
			COAL	.36	117.585						Rubble			
			CARB. SHALE	.09	121.56									

PROJECT: NORTH EAST, B.C. ONION LAKE | AREA: ONION LAKE | HOLE no: ON 81-1 | BOX nos: | GEOP. PICK | PAGE 5 OF

Marker Bl. [1]	CR / Cl [2]	M-M % R [3]	Mn Lith (Sm Des) [4]	M Th / ETh [5]	Elev. Bot. [6]	Lith % R [7]	Geop Pick [8]	Lith % R [9]	Minor Lith	Th	REMARKS Lithology, Sedimentary-Tectonic Structures [10]	Sample No.	C/B El. [11]	C/P Az Code [12]
119	2.88 / 3.0	96%	CARB. SHALE	3.975	121.56						Interbedded fine sandstone and siltstone, stick to broken stick.		32 / 120.46	
				.37	121.93						Broken stick to rubble.			
				.18	122.11		121.0	106			Stick.			
122	3.17 / 3.0	106%	COAL	.11	122.22						Some coaly shale fragments.			
				.56	122.78						Dull with bright bands, some bands of shaley coal, broken stick.			
				.18	122.96						Bright coal mesh.			
			SHALEY COAL	.15	123.11		122.0	100			Broken stick.			
			CARB. SHALE	.10	123.21						Rubble.			
				.68	123.83						With coal wisps, lower contact gradational, stick to broken stick.			
			SLTSTN	.47	124.36						Broken stick			
			COALY SHALE	.05	124.41		123.5	87			Broken stick			
			COAL	.2	124.61		123.7	100			Dull, Mesh.			
			COALY SHALE	.11	124.72						Broken stick.			
			CARB. SHALE	1.435	126.155						With siltstone interbeds, stick.			
125	2.81 / 3.0	94%		.1	126.255								23 / 124.88	
128	3.715 / 3.0	124%		.52	126.775						Rubble.			
131	2.27 / 3.0	76%		9.73	136.505		125.5	120			Stick. TOP OF FIRST GATES SANDSTONE.			
134	3.01 / 3.0	100%	FINE TO MED. SST.	1.065	137.57						With interbedded non-carbonaceous shale and siltstone. One massive sandstone layer, shale moderately jointed stick to broken stick.			

PROJECT NORTH EAST, B.C. ONION LAKE | AREA ONION LAKE | HOLE no ON 81-1 | BOX nos | GEOP. PICK | PAGE 6 OF

Marker Bl. [1]	CR / Cl [2]	M-M % R [3]	Mn Lith (Sm Des) [4]	M Th / ETh [5]	Elev. Bot. [6]	Lith % R [7]	Geop Pick [8]	Lith % R [9]	Minor Lith	Th	REMARKS Lithology, Sedimentary-Tectonic Structures Sample No. [10]	C/B El. [11]	C/P Az Code [12]
137	3.24 / 3.0	108%	MED. TO COURSE SST.	1.065	137.57						One calcite filled fracture, stick		
			FINE TO MED. SST.	1.67	139.24						Shale .2 m, interbedded siltstone and shale stick to broken stick.		
140	2.97 / 3.0	99%	SLTSTN	3.54	142.78						With interbedded fine to medium sandstone, unit becoming course towards base, stick	20 / 140	
143	3.07 / 3.0	102%	MED. TO COURSE SST.		153.02		152.0	102			Grey with coal wisps and calcite stringers, 149.06 m to 150.13 m minor calcite veins and slickensides.		
146	2.905 / 3.0	97%									stick, 152. 69m to 153.02 m rubble to semi-stick.		
149	3.08 / 3.0	103%											
152	3.06 / 3.0	102%											
			SLTSTN	2.59							Grey carbonaceous with coal stringers, semi-stick to stick.		
											154.07 m to 154.68 m semi-stick and abundant calcium veins and slickensides.		
155	3.06 / 3.00	102%									154.80 m to 155.0 m rubble to powder, some coal. 155.06 m to 155.19 m highly slickensided coal, rubble.		
					155.61		154.9	89			155.40 to 155.61 fine-grained light grey sandstone.		
											Dull with bright bands, hard, semi-stick, slickensides. - 155.66 m to 155.78 m powder coal.		
											- 156.15 m to 156.29 m bright, semi-stick to rubble (light weight).		
157	1.76 / 2.0	88%									-156.29 m to 157.57 m dull with bright bands, brown tinge, semi-stick to rubble, slickensides throughout, soft light weight.		
											-157.57 m to 158.0 m bright coal, semi-stick, slickensides, soft, light weight, - 157.84 to 158.0 rubble to powder, slickensides.		

FIRST GATES CONGLOMERATE ZONE

FIRST GATES COAL ZONE

PROJECT: NORTH EAST, B.C. ONION LAKE | AREA: ONION LAKE | HOLE no: ON 81- | BOX nos: | GEOP. PICK | PAGE 7 OF

Marker Bl. [1]	CR / Cl [2]	M-M %R [3]	Mn Lith (Sm Des) [4]	M Th / ETh [5]	Elev. Bot. [6]	Lith %R [7]	Geop Pick [8]	Lith %R [9]	Minor Lith	Th	REMARKS Lithology, Sedimentary-Tectonic Structures	Sample No. [10]	C/B El. [11]	C/P Az Code [12]
158	1.00 / 1.00	100%	COAL		158.0		156.9	119						
			SLTSTN	.65	158.65		157.6	93			Dark grey, slickensides, carbonaceous, stick to semi-stick.			
			COAL	4.52							-158.65 m to 158.79 m rubble, highly slickensided. -158.79 m to 159.69 m bright, light weight, semi-stick, slickensides.			
											-159.19 m to 159.92 m dull coal with calcium (brown stain) and iron (weathered pyrite) staining, semi-stick to rubble.			
											159.92 m to 160.26 m bright coal, brown tinge, semi-stick to rubble, slickensides.			
											160.26 m to 160.47 m powder coal.			
											160.47 m to 161.0 m dull coal (red tinge), semi-stick to rubble Slickensides.			
161	2.72 / 3.00	91%												
											161.0 m to 161.57 m bright (red tinge), semi-stick to rubble, some calcium, slickensides throughout.			
											161.57 m to 162.15 m powder to rubble, bright and dull bands.			
164	2.42 / 3.00	81%			163.17m		161.8	108			162.15 m to 162.41 m bright, semi-stick to rubble, slickensides light weight.	66°	163.70	FIRST GATES COAL ZONE
			SST.	.83	164.0 m		162.9	75			Light grey, medium to course grained, coal stringers throughout stick to semi-stick.	55°	166.8	
167	3.07 / 3.00	102%	COAL	.41	164.41m		163.3	102			164.0 m to 164.41 m coal semi-stick to rubble, bright, slickensides red tinge, light weight.	54°	167.2	
			SST.	3.01	167.42m		166.5	94			164.41 m to 164.61 m medium grained sandstone, coal stringers.			
											164. 61 m to 164.68 m coal bright, and dull bands, minor displacement at 166.30 m stick.			
170	2.88 / 3.00	96%	COAL	.27							0.27 m bright and dull bands, semi-stick to rubble slickensides. Highly carbonaceous siltstone, 0.26 m stick.	69°	169.9	
				.42							-0.16 m bright, semi-stick to stick.			

PROJECT: NORTH EAST, B.C. ONION LAKE | AREA: ONION LAKE | HOLE no: ON 81-1 | BOX nos: | GEOP. PICK | PAGE: 8 OF:

Marker Bl. [1]	CR / Cl [2]	M-M % R [3]	Mn Lith (Sm Des) [4]	M Th / ETh [5]	Elev. Bot. [6]	Lith % R [7]	Geop Pick [8]	Lith % R [9]	Minor Lith	Th	REMARKS Lithology, Sedimentary-Tectonic Structures	Sample No. [10]	C/B / El. [11]	C/P / Code [12]
	3.03			1.01							-o.26 bright rubble, red tinge.		94°	
173	3.00	101%	COAL		169.3	90	168.4	89			-0.75 m dull with bright bands, rubble.		173.25	
				12.99							169.3 to 169.78 m coaly siltstone. (Coal rubble to powder, bright) semi-stick.		76°	
			SLTSTN										175.3	
	2.57										Siltstone grey to dark grey, slickensides and stick.			
176	3.00	86%									173.31 m to 176.90 m COAL interbeds, bright, semi-stick to rubble.			
	3.05										Dark grey slightly carbonaceous siltstone with		59°	
179		102%									COAL interbeds, semi-stick to stick to 175.62 m.		178.4	
	2.97												87°	
182	3.00	99%									176.19 to 176.92 m grey siltstone, semi-stick, slickensides.		180.2	
	2.94										Minor calcium.		84°	
185	3.00	98%									181.17 m to 182.29 m shaly siltstone, stick, slickensides		182.5	
	2.97				182.29						Pyrite nodules			
188	3.00	99%				100								
				1.85	184.14						Very fine-grained, light grey, stick.		84°	
			SST.			100	183.3	100			184.14 m yo 184.42 coal, stick to semi-stick.		184.5	
				.28							Dull and bright bands, slickensides.			
			COAL		184.42	100	183.6	93			TOP OF TORRENS SANDSTONE			
				51.58							Course grained with conglomerate interbeds, light grey stick.			
			SST.											
											184.63 m .03 m COAL stringer.		83°	
											185.25 m pebble conglomerate, dark and light grey,		186.0	
											blue and green clasts to 185.96.			
	3.04										187.09 m to 187.2 m as above.		80°	
191	3.00	101%	SST.								187.35 to 187.94 m as above.		187.40	
	3.00										188.03 m to 188.64 m as above			
194	3.00	100%									188.95 m to 189.72 m last .55 m grades to granular conglomerate.			
	3.00										189.72 m to 189.86 m carbonaceous shale and			
197	3.00	100%									sandstone laminations.			
	2.94										Medium to course-grained, light grey, stick.		80°	
200	3.00	98%											200	
	3.00										194.85 m cross-bedding.			
203	3.00	100%									197.95 m dark grey siltstone laminations			
											stick to semi-stick, slickensides, minor calcium to 198.98m			

FIRST GATES COAL ZONE

TORRENS SANDSTONE GRADING INTO TRANSITIONAL BEDS

PROJECT	NORTH EAST, B.C. ONION LAKE	AREA	ONION LAKE	HOLE no	ON 81-1	BOX nos		GEOP. PICK		PAGE	9	OF	9

Marker Bl. [1]	CR / Cl [2]	M-M % R [3]	Mn Lith (Sm Des) [4]	M Th / ETh [5]	Elev. Bot. [6]	Lith % R [7]	Geop Pick [8]	Lith % R [9]	Minor Lith	Th	REMARKS Lithology, Sedimentary-Tectonic Structures	Sample No. [10]	C/B / El. [11]	C/P / Az / Code [12]
											Medium to grained, light grey to grey, stick good slickensides, throughout, minor calcium veins throughout.		73° / 203	
											202.8 m to 203.0 m semi-stick.		78° / 206	
206	3.00 / 3.00	100%									205.8 m to 206.0 m semi-stick. 208.75 m calcium filled fractures.		75° / 209	
209	3.00 / 3.00	100%									211.0 to 211.60 m semi-stick, slickensides. calcium filled fractures at 212.40 m.		90° / 212	
212	3.00 / 3.00	100%									214.60 m to 216.90 m interbedded sandstone, siltstone and shale, light grey and dark grey bands.		46° / 216	
215	3.00 / 3.00	100%									stick to semi-stick, some rubble. 215.2 m to 216.28 m fault gouge, semi-stick.		90° / 218	
218	3.00 / 3.00	100%									216.40 m calcium filled fractures, some slickensides on fractures.		85° / 221	
221	3.00 / 3.00	100%									223.20 m semi-stick, minor pyrite, poor slickensides to 224.6		88° / 224	
224	3.00 / 3.00	100%	SST.								224.75 m to 225.25 m fracture zone, interbedded siltstone and fine grained sandstone, some calcium veins.			
227	2.90 / 3.00	96%									229.77 m some mudstone clasts.		84° / 230	
230	2.99 / 3.00	100%									232.70 m to 232.87 m interbedded shale, siltstone and sandstone, pyrite.		85° / 233	
233	3.00 / 3.00	100%									233.60 m to 233.87 m rubble zone, some calcium filled fractures, poor slickensides.			
											234.46 m to 233.87 m interbedded fine grained sandstone and siltstone, semi-stick, dark grey.			
236	3.00 / 3.00	100%			236						235.80 m to 236.0 m interbedded siltstone and sandstone, dark grey.			

TORRENS SANDSTONE GRADING INTO TRANSITIONAL BEDS

Appendix F

PR-Onion Lake 81 (3)A *1

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ROKE DIRECTIONAL SURVEY

OIL ENTERPRISES LTD.

ON81-1

COMPANY CROWS NEST RESOURCES
DRILLHOLE ONION LAKE #1
LOCATION
FIELD
PROVINCE BC N.E. B.C.

LATITUDE
DEPARTURE
ELEVATION
MAGNETIC DECLINATION 25° E
CORRECTION OF

DATE SURVEYED 13 JULY 81
SURVEY BY FAGERNESS
WITNESSED BY BELL
CALCULATIONS BY
FOR GRID

BEARING FROM MAGNETIC NORTH, SLANT ANGLE FROM VERTICAL

Number	Cable Depth	Slant Angle	Slant Angle Bearing	Number	Cable Depth	Slant Angle	Slant Angle Bearing	Number	Cable Depth	Slant Angle	Slant Angle Bearing
0	0	31.2	22	11	165	32.9	25	22			
1	15	31.3	22	12	180	33.1	25	23			
2	30	31.5	23	13	195	33.3	26	24			
3	45	31.5	23	14	210	33.6	26	25			
4	60	31.7	23	15	225	33.8	26	26			
5	75	31.8	22	16	234	33.9	27	27			
6	90	32.0	23	17				28			
7	105	32.2	24	18				29			
8	120	32.2	24	19				30			
9	135	32.4	24	20				31			
10	150	32.7	24	21				32			

AR-Onion Lake 81 C33A #1

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ON81-1 UTM COORDINATES

NORTHING 6,064,643.44

EASTING 638,777.06

ELEVATION 1,580.29

Appendix E

STRATIGRAPHIC SECTION

DESIGNATION: ON81-1 | PART 1 OF 1

PROJECT: ONION LAKE, N.E. B.C.

AUTHOR: D. BELL | DATE: 19 81 JULY

AREA:

SOURCE OF DATA: ONION LAKE DRILL HOLE #1,1981 DIAMOND CORE GEOLOGY LOG ON81-1

LOCATION: WEST LIMB, WAPITI ANTICLINE

HD-90C

NOTES:
1. HOLE SPUDDED IN GATES MEMBER 182.3m ABOVE TORRENS SS.
2. STRUCTURE IS DISTURBED DOWN TO COAL SEAM 4.52 M THICK AT 158.66. BELOW THIS DEPTH CORE THICKNESSES ARE APPARENT BY A CALCULATED 11 DEGREES: THEREFORE EACH THICKNESS MUST BE MULTIPLIED BY 0.98 FOR TRUE THICKNESS. ABOVE THIS DEPTH TO SURFACE FACTOR IS 0.6 TO 0.8

SCALE [m]	CONTROL POINT	INTERVAL	LITHOLOGY	STRIKE & DIP	DESCRIPTION MAIN	DESCRIPTION AMPLIFIED	SAMPLE
0							
5		6.1 CASING			Sandstone	Light grey,very coarse,conglomerate interbeds	Calcium veins,iron stains on fractures,poor slickensides, stick to semi-stick,some rubble
				37°/9.8m			
				21°/13.69			
15		17.20		9°/16.75			
				0°/17.49			
20				30°/20.42			
					Conglomerate	Granular,light and dark grey, blue and green clasts, carbonaceous stringers	Rubble to stick,slickensides
25		25.10		53°/24.1			
				43°/26.2			
30				53°/29.3			
					Sandstone	Light grey, coarse to medium grain carbonaceous stringers	Stick to semi-stick,some calcium iron stains on fractures
35				60°/34.7			
				48°/37.9			
40		38.70		36°/40.7			
		41.50					
45		8.5m			COAL		
50		50.00					
					Siltstone	Dark grey, carbonaceous interbeds	Stick to semi-stick,very minor calcium
55		54.10			COAL		
		1.4m 55.50			Siltstone	Dark grey, carbonaceous stringers	Stick to semi-stick,some slickensides
		56.15			COAL		
60		1.95m 58.10					
					Siltstone	Dark grey, carbonaceous stringers	Stick to rubble,some slickensides
65		126.8 m UNDIFFERENTIATED GATES		18°/65.7			
		67.52		70°/68.89	Shale	Carbonaceous	Stick to semi-stick
70		69.71					
		4.7m			COAL		
75		74.41		27°/75.95			
					Shale & Siltstone	Interbedded, carbonaceous stringers	Stick to rubble
80				18°/80.01			
		83.24					
85				28°/85			
				10°/89.35	Siltstone	Dark grey	Stick to semi-stick,some calcium
90							
95				10°/95			
		98.00			Shale	Carbonaceous	Stick to semi-stick
100		100.36 .99m		30°/100	COAL		
		101.35			Shale	Carbonaceous	Stick to semi-stick
105				22°/105			
		106.9 .21m 107.11			COAL		
110				22°/110.43	Sandstone	Carbonaceous interbeds	Stick to semi-stick
		113.11					
115				37°/115.4	Shale	Carbonaceous,siltstone interbeds	Stick to semi-stick
		116.2 1.38m 117.58			COAL		
120				32°/120.46	Shale	Carbonaceous,siltstone interbeds	Stick to semi-stick
		122.11			COAL		
125		1.0 m 123.11		21°/124.38	Shale	Carbonaceous,coaly	Semi-stick
		126.8 126.77					
130				20°/131.17	Sandstone	Grey,medium to coarse grain	Stick
		26.2m FIRST GATES CONGLOMERATE ZONE		31°/135.7			
135							
		139.24		20°/140.	Siltstone	Interbedded with fine sandstone	Stick
140		142.78					
				38°/145.98	Sandstone	Grey,medium to coarse grain	Stick
145		FIRST GATES		46°/148.6			
		55.5m		38°/152.1			
150		153.0	153.07	28°/152.9			
					Siltstone	Grey, carbonaceous	Semi-stick to stick calcium veins
155		155.61					
		2.39m 158.0			COAL		
160		158.66			Siltstone	Dark grey, carbonaceous	Stick to semi stick,slickensides
		4.52m			COAL		
165		163.17		66°/163.7			
				56°/166.4			
		167.42		54°/167.2	COAL		
170		1.88m 169.3		69°/169.9			
		29.2 FIRST GATES COAL ZONE		94°/173.25			
175				76°/175.3	Siltstone	Grey to dark grey, some carbonaceous interbeds	Stick to rubble,slickensides
				59°/178.4			
180				87°/180.2			
		182.3	182.2		TOP OF TORRENS SANDSTONE		
				88°/182.2	Sandstone	Very fine grain, light grey	Stick
		184.4		84°/184.5			
185				81°/186.0			
				80°/187.4			
190				74°/197.8			
195				84°/197			
				76°/199.5			
200				68°/200.			
				73°/203			
205		53.7m TORRENS SANDSTONE GRADING INTO TRANSITION BEDS		78°/206	Sandstone	Light grey, medium grain	Minor calcite, stick. Stick to semi-stick from 215.2 to 216.28
				75°/209			
210				90°/212			
				46°/216			
215				90°/218			
				85°/221			
220				68°/224			
225							
				84°/230			
230				85°/233			
235		236.0	236.0				

HD-90C

Appendix F

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PR-Onion Lake 81 (3) #1

ROKE

GAMMA RAY NEUTRON LOG

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FILE NO.
LSD
SEC
TWP
RGE
W___ M

COMPANY: CROWS NEST RESOURCES LTD.
WELL: ONION LAKE # 1 ON81-1
LOCATION: WEST LIMB, WAPITI ANTICLINE
FIELD: N.E. B.C
PROVINCE: BRITISH COLUMBIA

Other Services: DIR, GR-DENS-CAL, FBL

Permanent Datum: GROUND LEVEL Elev.
Log Measured from: GROUND LEVEL Above Perm. Datum
Well Depths Measured from: GROUND LEVEL

K.B.
CSG
G.L.
METRIC

Run No.	ONE
Date	13 JULY 1981
First Reading	234.5 M
Last Reading	0
Footage Logged	234.5
Depth Reached	235
Depth Driller	236
Casing Roke	6.1
Casing Driller	6.1
Fluid Type	WATER
Liquid Level	FULL
Min. Diam.	NQ
Rm @	
Operating Time	1½ HOURS
Truck No.	FU #3

Recorded By: FAGERNESS
Witnessed By: BELL

EQUIPMENT DATA

GAMMA RAY		NEUTRON	
RUN NO.	ONE	RUN NO.	ONE
TOOL MODEL NO.		LOG TYPE	NEUTRON/NEUTRON
DIAMETER	3.18 CM	TOOL MODEL NO.	
DETECTOR MODEL NO.		DIAMETER	3.18 CM
TYPE	SCINTILLATION	DETECTOR MODEL NO.	
LENGTH	10.16 CM	TYPE	PROPORTIONAL
DISTANCE TO N. SOURCE	2 M	LENGTH	15.24
		SOURCE MODEL NO.	MRC-N-SS-W
GENERAL		SERIAL NO.	127
HOIST TRUCK NO.	FU # 3	SPACING	38.1 CM
INSTRUMENT TRUCK NO.	FU # 3	TYPE	AmBe
TOOL SERIAL NO.	RGRN 125A002	STRENGTH	3 CURIES

LOGGING DATA

GENERAL				GAMMA RAY				NEUTRON			
RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED M/MIN	T.C. SEC.	SENS SETTINGS	ZERO DIV. L OR R	API G. R. UNITS PER LOG DIV	T.C. SEC.	SENS SETTINGS	ZERO DIV. L OR R	API N. UNITS PER LOG DIV
1	0	234.5	4	3	500	0	15	3	5000	0	170

REMARKS: LOGGED THROUGH NQ DRILL RODS
HOLE DRILLED AT 60°

GAMMA RAY	DEPTHS	NEUTRON
GAMMA RAY INCREASES → API 15 ; 0 … 150		NEUTRON INCREASES → API 170 ; 0 … 1700 … 3400