

CROWS NEST RESOURCES

WILLOW CREEK GEOLOGICAL REPORT 1985

GROUP 371 LICENCES -6270, 6271, 6272, 6273, 6274

B. RYAN MAY 1986







May 1, 1986

Ministry of Energy, Mines & Petroleum Resources 617 Government Street Victoria, B.C. V8V 1X4

Attention: Mr. P. Hagen, Coal Administrator

Dear Mr. Hagen:

Enclosed please find our report on the Willow Creek project.

This report was prepared by B. Ryan, Manager, Geology, Crows Nest Resources. B. Ryan PhD graduated with a B.Sc. Geology from the University of British Columbia in 1967 and with a PhD from the same university in 1973. He has worked for a number of exploration companies before joining Crows Nest Resources in 1981.

Dr. Ryan was assisted in the field by S. Cameron, Geologist with Crows Nest Resources.

In my opinion, the above mentioned personnel are fully qualified by training and experience to have conducted the exploration program and to have prepared this report.

Yours truly

H.G. Rushton Vice President - Development

Enclosure



WILLOW CREEK PROJECT

N.E. B.C.

COAL EXPLORATION, 1985

COAL LICENCES:

COAL GROUP #371 C.L. 6270-6274 PEACE RIVER LAND DISTRICT, NORTHEASTERN B.C. B.C. COAL LICENCES HELD BY SHELL CANADA RESOURCES LIMITED; OPERATED BY CROWS NEST RESOURCES LIMITED

NATIONAL TOPOGRAPHIC SERIES: 93 0/9 (MOUNT HULCROSS)

LATITUDE AND LONGITUDE:

55° 35' NORTH LATITUDE 122° 10' WEST LONGITUDE

AUTHOR:

B. RYAN

FIELD WORK:

B. RYAN/S. CAMERON AUGUST, 1985

SUBMISSION DATE:

MAY, 1986

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ENCLOSURE 4 GEOLOGICAL MAP - WILLOW CREEK (1:10,000)

SUMMARY

The Willow Creek property consists of 5 B.C. coal licences within coal group #371.

During August, 1985 reconnaissance-type geological mapping was undertaken over the licence area.

The purpose was to add structural control and locate new outcrops. The results have improved the geological base map for the property. Examination of previous drilling information indicates a limited coal potential for the upper section of the Gething Formation. It is recommended that future exploration be conducted in areas having open pit mining potential within the lower section of the Gething. Results of coal analyses indicate the rank for this coal to be medium volatile bituminous (McKechnie 1955).

1.0 INTRODUCTION

The Willow Creek Property held by Shell Canada Limited and operated by Crows Nest Resources Limited (a wholly owned subsidiary) consists of 5 coal licences covering 1465 hectares. It is located approximately 40 km west of Chetwynd along the Lake Hart Highway (#97).

During 1983, a review of pre-existing exploration activities including drilling programs in 1949 and trenching-mapping in 1981 indicated that additional reconnaissance style mapping was warranted to further evaluate the property's potential. The 1984 program improved the understanding of structural elements present near wellsite Hunt Sands Sunfalls C-18-G and further delineated geological contacts in the area. The 1985 program attempted to locate more outcrops and tighten up the structural interpretation.

1.1 Coal Land Tenure

Shell Canada holds 5 coal licences (Group #371) covering 1465 hectares of land for the Willow Creek project in the Peace River Land District, Northeastern British Columbia (Appendix 1). Licence numbers are 6270 to 6274 inclusive (Enclosure 2). The property is operated by Crows Nest Resources Limited, a wholly owned subsidiary of Shell Canada Limited.

1.2 Location, Geography and Physiography

The Willow Creek property is located south of the Pine River, about 40 kilometers west of Chetwynd and 50 air kilometers southwest of Hudson Hope. The property is centred approximately 55° 35' north latitude and 122° 10' west longitude on NTS Topographic sheet 930/9.

The coal licences are situated along the Willow Creek drainage east of Falls Mountain. The area is characterized by relatively low, rounded northwest-southeast trending ridges and valleys. Elevations in the area range from 670 m at the junction of Willow Creek with Pine River to 1425 m along the ridge top of Falling Mountain.

The area is forested by poplar and some birch in lower elevations; fir or spruce are predominant at higher elevations. In wet areas, willows and devil's club are common. The timberline is approximately 1300 m above sea level.

1.3 Access

The property is accessible by the paved, all weather highway #97 (John Hart Highway) connecting Prince George to Dawson Creek via Chetwynd.

The British Columbia Railway line runs south of the Pine River and connects the project area with the Vancouver and Prince Rupert sea ports. The ports are both about 1200 km from the licence block. Accessibility is reasonably good via dirt road on the east edge of the licences (since fall 1981 via the 'David Minerals' bridge over the Pine River). While there are a number of washouts along the road, only minimal equipment work would be required to accomodate 4x4 vehicular traffic. However, most of the licences are accessible by helicopter only, with tew natural landing sites. In addition to the transportation facilities available, power sources are present in the form of a Westcoast Transmission Ltd. natural gas pipeline and two major B.C. Hydro transmission lines which parallel the John Hart Highway immediately northwest of the licences.

2.0 EXPLORATION

2.1 Summary of Previous Work

Initial coal exploration in the area was conducted from 1946 to 1951. N.D. McKechnie (1955) carried out geologic mapping and diamond drilling for the coal division of the B.C. Department of Lands and Forests. During this period a total of 39 holes were drilled comprising 7756 meters of core. The proximate analyses of coal intersections were performed by the Department's laboratory. Regional mapping of the area at a scale of 1 inch to 1 mile was completed by Dr. J.E. Hughes of the B.C. Department of Mines and Petroleum Resources in 1960. H.

In addition, four exploration gas and oil wells were drilled in the vicinity of Willow Creek from 1962 - 1966. They include TGS Sun Falls a-64-B, Hunt Sands Sun Boulder b-74-D, Hunt Sands Sun Falls c-18-G, TGS Falls b-39-G and TGS Falls C-32-F.

Since 1979, Crows Nest Resources has periodically conducted reconnaissance style mapping over the licences.

2.2 Exploration Program: 1985

The purpose of the 1985 program was to locate additional outcrops and try to locate more accurately the traces of some of the major fold axial surfaces. A number of travesses were undertaken up the northeast and southwest slopes of the Willow Creek valley. The underbush is thick and very few new outcrops were located.

2.3 Exploration Costs 1985

Expenditures for the 1985 exploration program are detailed in the "Application to Extend Term of Licence". During 1985 total exploration costs were \$11,790.99 for the Willow Creek project.

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3.0 GEOLOGY

3.1 <u>Regional Geology</u> (Enclosure 3)

The area under consideration lies within the Rocky Mountain Foothills and trends northwesterly along the front of the Rocky Mountains in Northeastern British Columbia. The strata outcropping in the Pine River Valley area are of Mesozoic age, from Middle Triassic to Upper Cretaceous, and were deposited on the shelf of a miogeosyncline. These formations thin eastwards across the Foothills and into the Plains.

Triassic strata are marine in origin and consist of limestone, calcareous shale, siltstone and sandstone. Jurassic sediments are primarily marine shales. The Lower Cretaceous sediments of sandstones, shales and coal measures marked the end of marine deposition.

The coal bearing beds of Lower Cretaceous age outcrop extensively along the foothills of Alberta and Northeastern British Columbia. These sediments have been assigned to the Blairmore, Bullhead and Fort St. John Groups. During the Columbian Orogeny, the sediments were folded, thrusted and uplifted into faulted, elongate, plunging anticlines and synclines.

The intensity of deformation varies from one region to another. The Peace River and Pine River areas are characterized by relatively broad synclines between sharply faulted anticlines. The strata are exposed in a series of folds and thrust belts trending northwest-southeast.

Regional stratigraphic studies have been conducted by the Geological Survey of Canada and published by Stott, 1971 (Figure 2).

Several local stratigraphic and mapping projects have been completed within the area - both by the Geological Survey of Canada and by the British Columbia Ministry of Energy, Mines and Petroleum Resources. These are documented by Hughes (1964, 1967), McLearn and Kindle (1950), McKechnie (1955) and Spivak (1944).

3.2 Local Stratigraphic Descriptions

3.2.1 Bullhead Group

The Bullhead Group contains two formations: A basal conglomerate, the Cadomin Formation and the coal-bearing Gething Formation.

3.2.1.1 Cadomin Formation

The laterally extensive (Peace River to Blairmore, Alberta) Cadomin Formation forms a distinctive marker in lower Cretaceous sediments. In its type region near Cadomin Alberta, it is typically a massive resistant unit of conglomerate. In the Pine River area, however, it is commonly marked by a hard, resistant, coarse-grained to gritty and sometimes conglomeratic, light to medium-grey weathering sandstone. The resistant nature of the Cadomin makes it a good marker for geologic mapping, as it often forms ridges or stands in relief from other strata in the area.

An erosional unconformity at the base of the Cadomin Formation, separates it from the underlying Minnes Group. Although there are local angular relationships with the underlying beds the rocks on either side of the contact are generally structurally concordant (Stott, 1971).

3.2.1.2 <u>Gething Formation</u>

The Lower Cretaceous Gething Formation of the Bullhead Group is underlain by the Cadomin Formation and overlain by the Moosebar Formation. It is comprised of a thick sequence of predominantly non-marine fine-grained sediments and coal. Shales, siltstone, fine-grained sandstones and coal seams are the characteristic lithologies found in the formation.

In the Peace and Pine River areas the Gething Formation is 450 to 550 m thick. The section in the Peace River Canyon as measured by Stott (1969) is 550 m thick.

Numerous coal seams occur within the Gething Formation. Their best development appears to be in the Pine River and Haster Creek areas. To the northwest and southeast along the foothills coal belt, the seams generally are thinner and more discontinuous. The coal of the Gething Formation seams is reported to be of low to medium volatile bituminous rank with fair to good coking characteristics.

3.2.2 Moosebar Formation

The Gething Formation is conformably overlain by the Moosebar Formation of the Fort. St. John Group.

The predominantly marine sediments consist of dark grey mudstones and shales with minor beds of argillaceous sandstone and ironstone bands. Thin layers of bentonite can occasionally be found.

The upper contact of the Moosebar Formation is gradational from marine shales through a sequence of interbedded shales and sandstones (passage beds) into the basal sandstone member of the Gates Formation. The contact is placed within the passage beds at the base of the first thick succession of sandstone. The lower contact, with the Gething Formation is abrupt and is easily picked on downhole geophysical logs. The contact is commonly marked by a one to two metre pebble conglomerate or sandstone. It is interpreted as representing the initial deposits of the transgressing Moosebar Sea, marking the end of a prolonged period of alluvial deposition in the area. This pebble conglomerate or pebble sandstone is the equivalent of the Bluesky Formation found in the plains and is therefore commonly called the Bluesky Conglomerate. The five metres above the conglomerate is generally siltier than the main body of the Moosebar and contains a glauconitic zone near the top.

The Moosebar Formation is generally recessive, with outcrops exposed in road cuts and stream and river banks only.

3.3 Project Geology

3.3.1 Stratigraphy

The Willow Creek area is underlain by strata of the Gething and Moosebar Formations. Poor exposure and structural repetition have made complete measurement of the Gething section impossible.

In 1948, N.D. McKechnie conducted an extensive diamond drill exploration program in the Willow Creek area. The program concentrated on the upper section of the Gething Formation on both limbs of the major anticlinal structure (Pine River Anticline), often locating the collar of the borehole in the Moosebar Shales. Results of these investigations reveal limited economic potential for the upper section with only one or two coal seams approaching a thicknesses greater than 1 meter. The upper section consists of a monotonous sequence of shales, siltstones and sandstones. Only a few boreholes investigated the middle section of the Gething (i.e.in the vicinity of DDH-W-29, DDH-W-27, DDH-W-6 and DDH-W-5) Although coal intersections are highly variable, there appears to be a greater potential for thick coal seam development in the middle and lower section of the Gething. The core of the anticline has yet to be drilled and extensive cover limits surface exploration of this area. Thus the middle and lower part of the Gething Formation have yet to be effectively prospected. Investigations in 1984 focused upon surface exposures around the north end of the axis of the Pine River anticline and along the western flank of the structure. Only two seams of coal greater than 1.0 meter were observed. Mapping in 1985 located additional outcrops of Gething sandstones, siltstones and mudstones on the slopes adjacent to Willow Creek. Outcrops were few and the bush thick.

3.3.2 Structural Geology

Enclosure 4 illustrates the geology of Willow Ureek at a scale of 1:10,000. The southwest part of the map area is dominated by the Falling Mountain syncline, a broad open structure cored by Gates Formation sediments. N.D. McKechnie, in 1948, intensively prospected the Gething - Moosebar formational contact along the northeast limb of this structure. This northeast limb is truncated by a west dipping thrust fault which trends sub-parellel to the fold axis through the central part of the claim licences. Moosebar and Gething sediments are repeated in the footwall of this thrust fault and have been folded into the doubly plunging canoe-shaped Pine River anticline. The northeast limb of this anticline is truncated by an east dipping thrust fault trending parallel to the fold axis. Although east dipping thrusts are relatively rare in northern Rocky Mountain geology, there is considerable evidence for their existence within the Pine Pass property immediately northwest of Willow Creek. Once again, Gething and Moosebar strata are exposed in the hanging wall of this thrust and constitute the southwest limb of a broad syncline trending northwest-southeast on the northern edge of the coal licences.

The repetition of Gething stratigraphy by thrust faulting increases the potential for economic coal development within the licence block. In addition, data from some of the 1948 drilling activity indicates possible thickening of coal seams associated with folding close to the major thrust faults.

The location of the Willow Creek normal fault is based upon McKechnie's investigations (1955). He estimates a dip slip displacement of approximately 200 m. McKechnie proposed a total of 11 faults of various orientations. The probable lack of seam continuity and difficulty in correlation influenced this fault interpretation. In the absence of much new field data the structural interpretation in this report has been simplified.

Coal seams mapped on adjacent Licences (Morton and Jones 1981) are projected onto Enclosure 4 as also are some of the strike dip measurements that originally appeared on McKechnie's map.

4.0 COAL QUALITY

Coal quality from drill core analysis of the 1948 program indicates coal rank in the Willow Creek area is medium volatile bituminous, with moderate - low sulphur values. In addition, most seams exhibited coking characteristics through FSI values may be erratic. These analytical results appear to represent selective sampling of the dried drill core samples, as the ash content is generally 6 - 10% without the benefit of gravity washing techniques.

The Morton and Jones (1981) and McKechnie (1755) reports indicate that for the top 400m of Gething section coal seams seem to be concentrated in the 45m to 90m internal and 200m to 270m internal. These two intervals within the Gething stratigraphy offer the best potential for open pit mining.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Drilling results from the 1948 program indicates that there are limited economic coal occurrences within the upper section of the Gething in the Willow Creek area. Seam continuity and correlation also appear to be inconsistent within this section (McKechnie, 1955 p. 13). As there is little information on coal potential in the middle and lower part of the Gething, it is recommended that further exploration be concentrated where this part of the section occurs close to the surface.

Areas satisfying this condition and exhibiting open-pit mining potential include the west limb of the Pine River anticline and along the west side of the west dipping thrust fault in the central part of the coal licences. It is suggested that the program initially comprise field mapping, backhoe assisted trenching and future drillhole site selection in these areas.

There are a number of areas where open pit potential may exist. These areas located on Enclosure 4 represent areas where the dip is probably sub-parallel to topography and where one of the 2 coal rich intervals of Gething are postulated to outcrop. Drilling is required to see if any of these areas actually do have any open pit mining potential. The quality in the Willow Creek area indicates that the metallurgical resource potential is only moderate. The low raw ash values of some of the seams indicate that there is a resource potential for high CV low ash thermal coal.

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