Alberta Research Council
Open File Report 1972-4

MINERAL RESOURCES OF NORTHWEST-CENTRAL ALBERTA

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Edmonton, Alberta
September 28, 1972

Alberta
RESEARCH COUNCIL

Table of Contents

SUMMARY

Mineral resources of northwest-central Alberta (Fig. 1) can be summarized as follows:

COKING COAL

Includes medium to low volatile bituminous coal of the northern Foothill (from Athabasca River to the British Columbia border). Estimated reserves are from 7 to 9 billion short tons, 60 per cent of which is allocated to the northern half of the area.

Total bituminous coal production in the northern Foothills could range from 5 to 10 million tons per year by 1982 if the economic climate proves favorable.

THERMAL COAL

Includes high volatile bituminous and sub-bituminous coal of the Plains area between Grande Prairie and the Foothills (see Fig. 4). Total reserves are estimated to range between 1.5 and 5 billion short tons most of which would have to be recovered by underground mining. Major reserves are concentrated in the Simonette area (400 million to 1 billion tons), near the junction of Kakwa-Smoky Rivers (100 to 500 million tons), and in the Cutbank River-Nose Mountain region (1 to 4 billion tons).

OIL, GAS, AND SULPHUR

Existing reserves are small, being confined to one medium-size gas field (Gold Creek) and one small oil field (Lator). However, the region is essentially unexplored, especially near and within the Foothills, and the geological conditions for hydrocarbon accumulation (especially sour gas) are excellent. Consequently one might expect the reserves of natural gas and sulfur to increase substantially (5 to 10 times the existing reserves) within the next half decade.

OIL SAND

The Peace River oil sand deposit contains 50 billion barrels of heavy crude oil, from which it is estimated that 20 billion barrels can be recovered by "in situ" methods.

IRON ORE

The Peace River sedimentary iron deposit contains 200 million tons of strippable iron ore grading 35 per cent iron. In addition, much larger tonnages too deep fro strip-mining extend beneath the central part of the Clear Hills.

GYPSUM

A deposit containing about 2.6 million tons of gypsum is present in the Rocky Mountains about 60 miles west of Grande Cache. The gypsum content is between 75 and 80 per cent.

INTRODUCTION

This report describes the potential mineral resources of northwest-central Alberta, an area which extends from Hinton near the eastern boundary of Jasper National Park to the Grande Prairie-Peace River districts in the north (Fig. 1). Emphasis is given to that part of the area which is tracersed by the Alberta Resources Railway.

SOURCES OF DATA

Information on the bedrock geology of the Foothills region is mainly from reports published by the Geological Survey of Canada (Greiner, 1955; Irish, 1965) and from unpublished maps supplied by the same agency. Most of the bedrock geology and coal resources data for the Plains area were obtained from helicopter surveys conducted by the Research Council's Geology Division in 1969 and 1970. This material is supplemented by information in reports by Allan and Carr (1946) and Govett (1961), and by unpublished data on gypsum and coal resources in Research Council files.

Information on oil and gas fields is compiles from maps and other material published by the Energy Resources Conservation Board in Calgary.

GENERAL GEOLOGY

The area is divisible into two broad physiographic units which correspond to the major geologic features of northwest-central Alberta:
(1) Rocky Mountains and Foothills, which extend across the southwest portion of the map-area into mortheastern British Columbia. They consist of a series of subparallel, northwest-trending ridges composed of complexly folded and faulted sedimentary strata[1] of Late Precambrian to Cretaceous ages. Maximum elevations range from 10,000 feet in the southwest to 6000 feet along the northeast margin

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[1] Sedimentary strata are rocks composed of organic and mineral detritus deposited in ancient seas, lakes, and rivers -- for examply; sandstone, mudstone (shale), limestone, dolomite, evaporite deposits such as salt and gypsum, and coal (an organic "sediment"). They sould be distinguished from igneous rocks such as granite and basalt which are formed by crystallization of molten rock materials beneath or at the earth's surface.

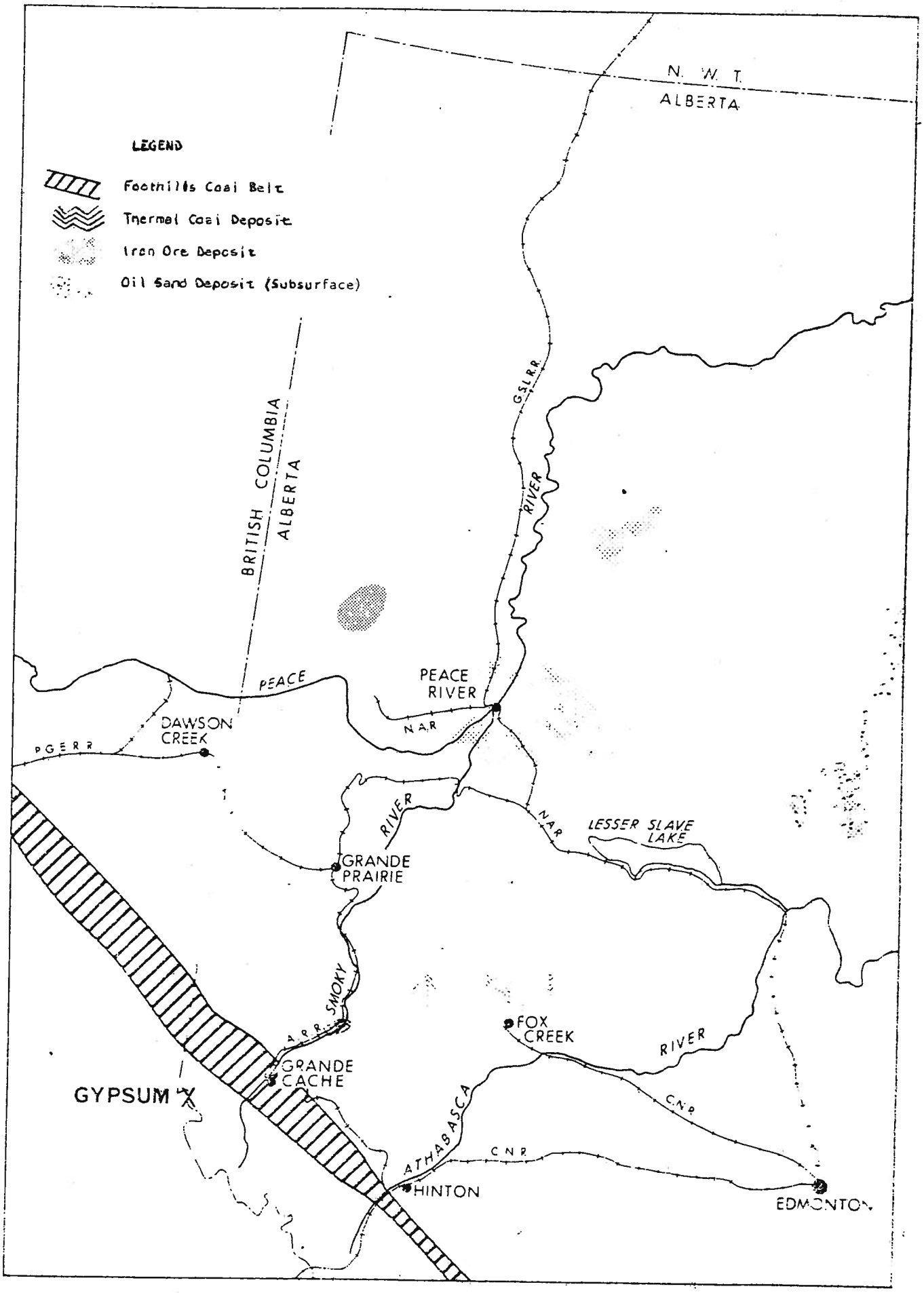

FIGURE 1. Major Mineral Resource Deposits, Northwestern Alberta

where the strata merge with the flat-lying beds of the Plains.

(2) Plains, which is that area outside of the Foothills proper. The "Plains" consist of nearly flat to gently rolling terrain which extends across the norhtern part of the area from Grande Prairie to Valleyview, and south to Fox Creek. The lowlands merge to the south with a dissected tableland consisting of a series of narrow flat-topped ridges and hills separated by the deep valleys of Cutband, Kakwa, Smoky, and Simonette Rivers and major tributary streams.

The strata of the Plains are composed of sandstone, shale, and coal; they dip very gently to the southwest where they merge with the complixly folded and faulted strata of the Foothills. Exposures (outcrops) of these rocks are scarce, except along the valleys of major rivers and streams, and most of the regio is covered by thick unconsolidated deposits of glacial origin -- gravel, sand, and clay[2].

The Alberta Resources Railway runs from Brule on the main CNR line in the south northward along the eastern margin of the Foothills to Grande Cache. From Grande Cache the reilway follows the deeply incesed valley of the Smoky River for some distance, then swings north across relatively flat glaciated terrain to Grande Prairie.

MINERAL RESOURCES

The mineral resources of the region can be grouped into three categories:

(1) coal
(2) oil, natural gas, and by-products
(3) metallic and industrial minerals

of which the first two are by far the most economically important. Development of these resources is still at an early stage, and the evaluation given below must be considered a preliminary review, based on very sparse data in many cases.

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2 Deposited during the Pleistocene ice age, about 10,000 to 12,000 years ago.

Coal

Coal deposits are widely distributed in northwest-central Alberta, falling into two main categories:

(1) medium to low volatile bituminous (coking) coals of the Foothills;

(2) high volatile bituminous and sub-bituminous (thermal) coals of the Plains.

Foothills (Coking) Coal

Coal-bearing strata of Early Cretaceous age are exposed along the strike of the northern Alberta Foothills from Brule on the Athabasca River to the British Columbia border, a distance of approximately 100 miles. These strata also extend northwards into British Columbia as far as the Peace River (Fig.1) beyond which point mineable coal seams generally are absent from Foothills strata.

The coal-bearing strata are complexly folded and faulted, forming a series of subparallel outcrop belts which extend along the northeast margin of the Rocky Mountains (Fig.2). The strata contain as many as five mineable coal seams ranging from 5 to 25 feet thick, although the number, thickness, and quality of seams can vary widely from one locality to another.

Remarkably little information has been published on the coal beds of the northern Alberta Foothills, although much exploratory drilling has been carried out in recent years by private companies. Available information is contained largely in maps and reports published by the Geological Survey of Canada and is primarily concerned with descriptions of widely sacttered outcrop sections. Consequently, it is possible to calculate only the grossest estimates of coal reserves, bases on very general assumptions involving seam distribution, thickness, and mineability.

One approach is to determine the area in the norhtern Alberta Foothills (from the Athabasca River to the British Columbia border) underlain at or near the surface by Lower Cretaceous coal-bearing strata. Available maps indicate that this area is approximately 800 square miles. If it is assumed that 8.7 million short tons of coal are potentially mineable in each square mile[3], then the inferred reserves for the northern Foothills are approximately 7 billion short tons. Approximately 4.5 billion tons are allotted to the northern half of this area (from just south of Grande Cache to the British Columbia border), and 2.5 billion tons to the southern half (from the Athabasca River to just south of Grande Cache.).

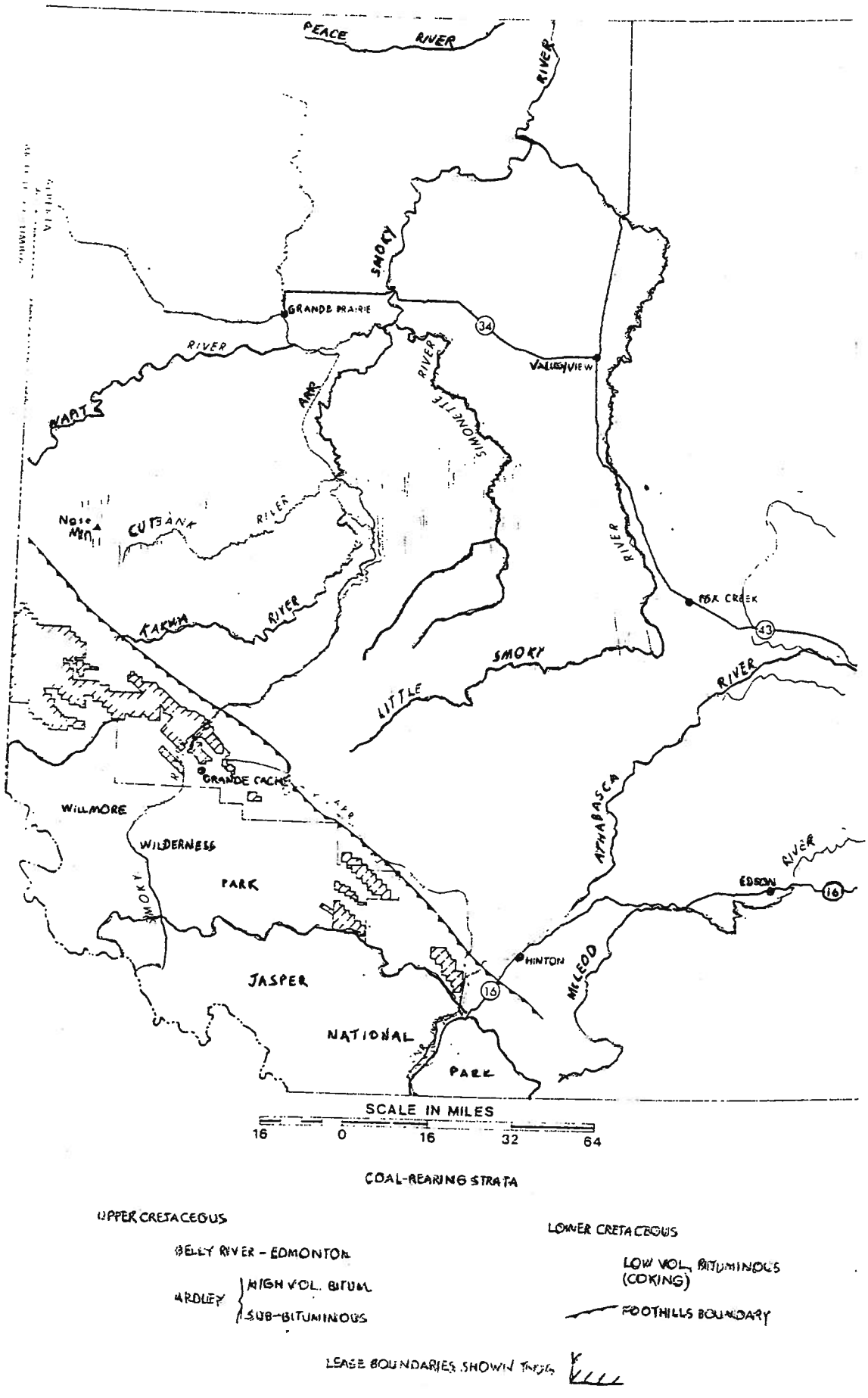
PEACE RIVER
RIVER
SMOKY
GRANDE PRAIRE
34
RIVER
VALLEYVIEW
WAPITI
SIMONETTE
RIVER
CUTBANK
RIVER
RIVER
FOX CREEK
43
SMOKY
LITTLE
RIVER
GRANDE CACHE
WILLMORE
WILDERNESS
PARK
ATHABASCA
RIVER
EDSON
16
HINTON
MCLEOD
JASPER
NATIONAL
PARK
SCALE IN MILES
16 0 16 32 64
COAL-BEARING STRATA
UPPER CRETACEOUS
BELLY RIVER - EDMONTON
ARDLEY
HIGH VOL. BITUM.
SUB-BITUMINOUS
LOWER CRETACEOUS
LOW VOL. BITUMINOUS (COKING)
FOOTHILLS BOUNDARY
LEASE BOUNDARIES SHOWN THUS

FIGURE 2.

A crude check on these estimates can be obtained from reserve estimates published by McIntyre Coal Ltd. 2 to 3 years ago.[4] The total reserve estimates of coal in place for the McIntyre leases in the Crande Cache area are 1.4 billion tons (of which only 300 million tons are described as "proven"). The McIntyre leases cover approximately 120 square miles. Thus, if if assumed that the same amount of potentially mineable coal per square mile exists within Lower Cretaceous strata throughout the northern Foothills, then the total coal reserves for this area can be estimated at 9.3 billion short tons. This is the same order of magnitude as the estimate given in the preceding paragraph (7 billion short ton which suggests that these estimates can be used as a first approximation to the potential bituminous coal reserves of the northern Alberta Foothills.

Perhaps a more realistic and useful approach to assessing the bituminous coking coal resources of the northern Foothills can be found in drawing analogies with the projected annual coal production of the McIntyre Coal Ltd. mine at Grande Cache (2 million tons per year). The distribution of coal seams, rock structure and terrain are grossly similar for Lower Cretaceous coal-bearing strata throughout the northern Foothills. Extensive exploration work on these strata has been carried out at many localities, and much of the potential coal-bearing terrain has been leased by various companies (Fig.2), including Consolidation Coal Company, Canadian Superior Oil Company, Denison Mines Ltd., Manalta Coal Ltd., Pacific Petroleum Ltd., etc. Informal discussions with company personnel indicate that reserves and mining conditions are favorable in several areas, and it is possible that several mines could be opened in this area if markets and additional transporation facilities become available with the next decade. Coal production probably would range between 0.5 and 2 million tons per year for each mine, depending on reserves and local mining conditions. Consequently, total coal production in the northern Alberta Foothills could range from 5 to 10 million tons per year by 1982 if the economic climate proves favorable and if government policy permits development.

Plains (Thermal) Coal

Thermal coal is found at many localities within the broad band of Upper Cretaceous strata that extends across the northern part of the area from the British Columbia border to the Simonette River and eastwards (Fig.2). These

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3 Equivalent to the amount of coal in a horizontal seam 10 feet thick underlying one square mile of terrain.

4 These reserve estimated apparently have been revised downward by company officials, particularly those reserves described as "proven".

deposits were mined on a local scale in the general vicinity of Grande Prairie (Halcourt area) in the 1940's, but it is only recently that interest in them as a potential energy source has revived.

The strata are grouped into two units in figure 2, of which the younger Ardley coal zone[5] appears to contain the best-developed seams. The thickest deposits apparently extend about the flanks of Nose Mountain (near the headwaters of Cutbank River), on the Kakwa and Smoky Rivers near their junction, and on Simonette River to the east. The grade of "rank" (i.e., calorific value) of these coal deposits decreases gradually in an eastward direction. Thus, the coal seams on Smoky River westward to Nose Mountain generally rank as high volatile bituminous, and those to the east on Simonette River and near Fox Creek as sub-bituminous, with a lower average calorific value. Several companies currently are exploring or intend to explore these deposits in some detail.[6]

Extending to the north of the area underlain by the Ardley coal zone, older Upper Cretaceous coal-bearing formations (shown as Edmonton-Belly River strata in Fig.2) underlie much of the flat, glaciated Plains region in the general Grande Prairie-Valleyview area. These beds contain scattered coal seams of variable thichness, generally covered by thick deposits of unconsolidated glacial materials (sand, gravel, clay). The seams apparently are thinner and less widespread than those of the Ardley zone to the south.

Undoubtedly, there is a huge amount of sub-bituminous and high volatile bituminous thermal coal contained within the Upper Cretaceous strata of north-west central Alberta, especially in the Ardley coal zone shich extends westward from Fox Creek to Nose Mountain near the British Columbia border. In the Fox Creek area on the east, shallow drilling by the Research Council's Coal Division has proven up reserves of 350 million tons of strippable coal over an area of 66 square miles. These coal beds extend to the south beneath the cover of younger Tertiary strata where they probably contain large additional reserves accessible to underground mining.

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5 The term "Ardely" is taken from correlative coal-bearing strata which extend southward through central Alberta. The coal beds mined at Wabamun are from the Ardely zone.

6 A paper describing the Upper Cretaceous coal deposits of this area is to be published shortly in Research Council Information Series Report No. 60.

Data on which to base reserve calculations for the western part of the area are confined largely to scattered outcrop observations along the major river and stream valleys: the continuity and mineability of coal seams in this area remains speculative. Gross assessments for these deposits are as follows (Fig 3):

Simonette area: near the junction of Simonette River and Deep Valley Creek several coal-bearing intervals are exposed, ranging in thickness from 7 to 20 feet. The deposits, which are flat-lying or gently dipping, lie close to the surface (within 500 feet) over an area of at least 50 square miles, dipping southward beneath the cover of younger Tertiary strata. Reserves are estimated to tange between 400 million and 1 billion short tons, although much of this would have to be recovered by underground mining.

Smoky-Kakwa area: several coal seams ranging from 3 to 6 feet thick have been observed along the Smoky and Kakwa Rivers near the junction of the two streams. The beds are nearly flat-lying but the topographic relief is high (500 to 1000 feet) and it is doubtful that much (if any) of this coal can be strip-mined. Reserves probably range from 100 to 500 million short tons, depending on the average thicknesses assigned to individual seams and their inferred extent.

Cutbank River-Nose Mountain: Several coal-bearing intervals are exposed along the upper reaches of the Cutbank River and about the flanks of Nose Mountain near the eastern margin of the Foothills. These range from 5 to 15 feet thick and appear to underly a relatively large area (100 to 200 square miles) of rugged topographic relief (1000 to 1500 feet). Reserves are inferred to range between 1 and 4 billion short tons, most of which would have to be recovered by underground mining. However, the coal quality is high, and the structure of the beds appears favorable to underground mining.

Summary: Thermal coal reserves found in Upper Cretaceous strata of north-west-central Alberta are tentatively estimated to range between 1.5 and 5.5 billion short tons, most of which would have to be recovered by underground mining. The quality or rank of the coal increases from east to west: thus, near the eastern margin of the Foothills the deposits are comparable in calorific value (high volaitle bituminous) to the high grade thermal coal deposits found in the "Coal Branch" area of the central Alberta Foothills.

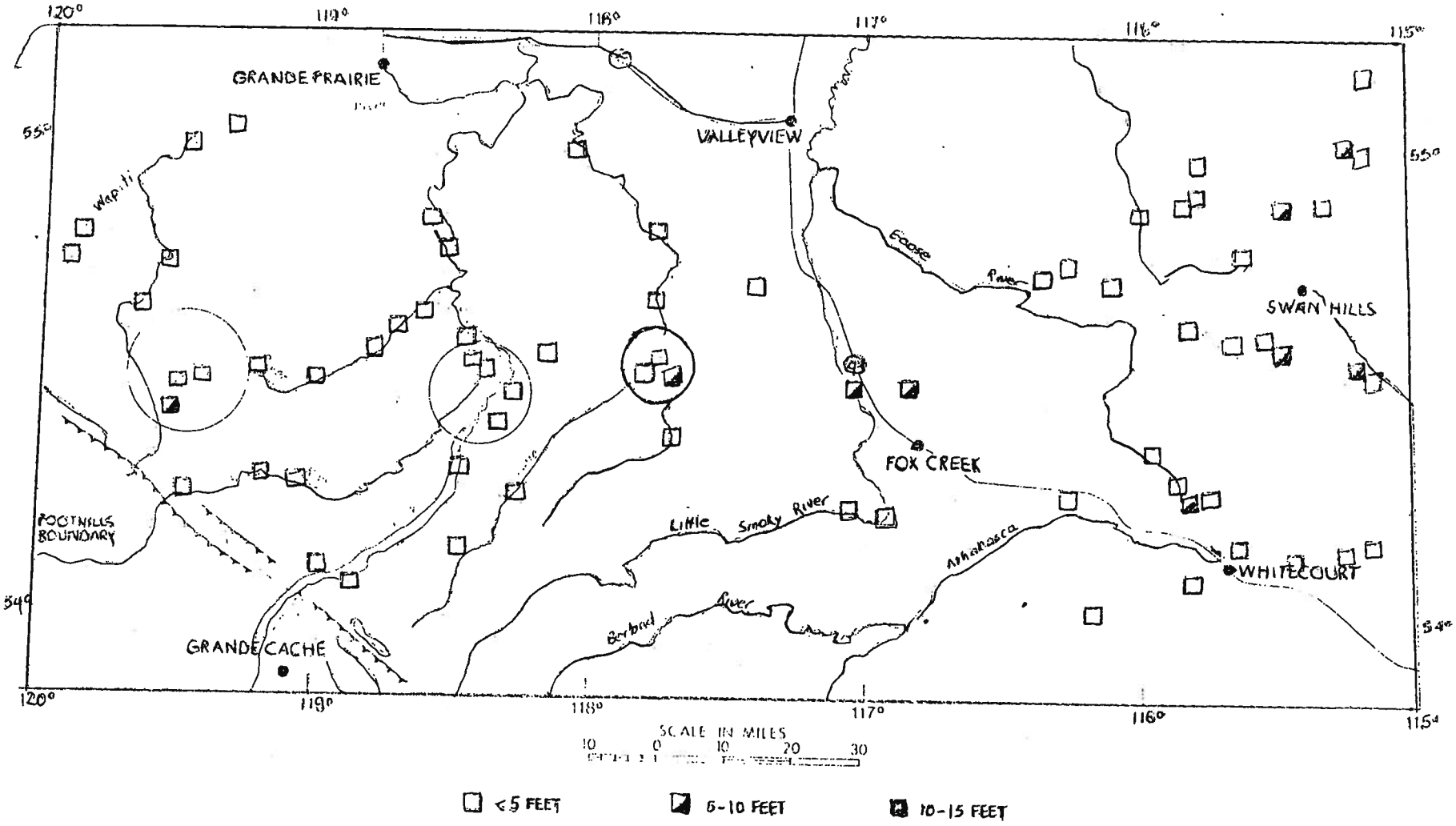


FIGURE 3. Distribution and Thicknesses of Coal Outcrop Sections, Northwest-Central Alberta (circled areas refer to estimates of thermal coal reserves given in the accompanying report)

These estimates do not take into account potential coal deposits of the Peace River district proper, such as the near-surface deposits formerly mined south of Grand Prairie. However, these deposits appear to be small compared to those described above (100 million tons or less), and it seems unlikely that they would be developed for other than local or domestic uses.

Oil, Gas and Sulfur

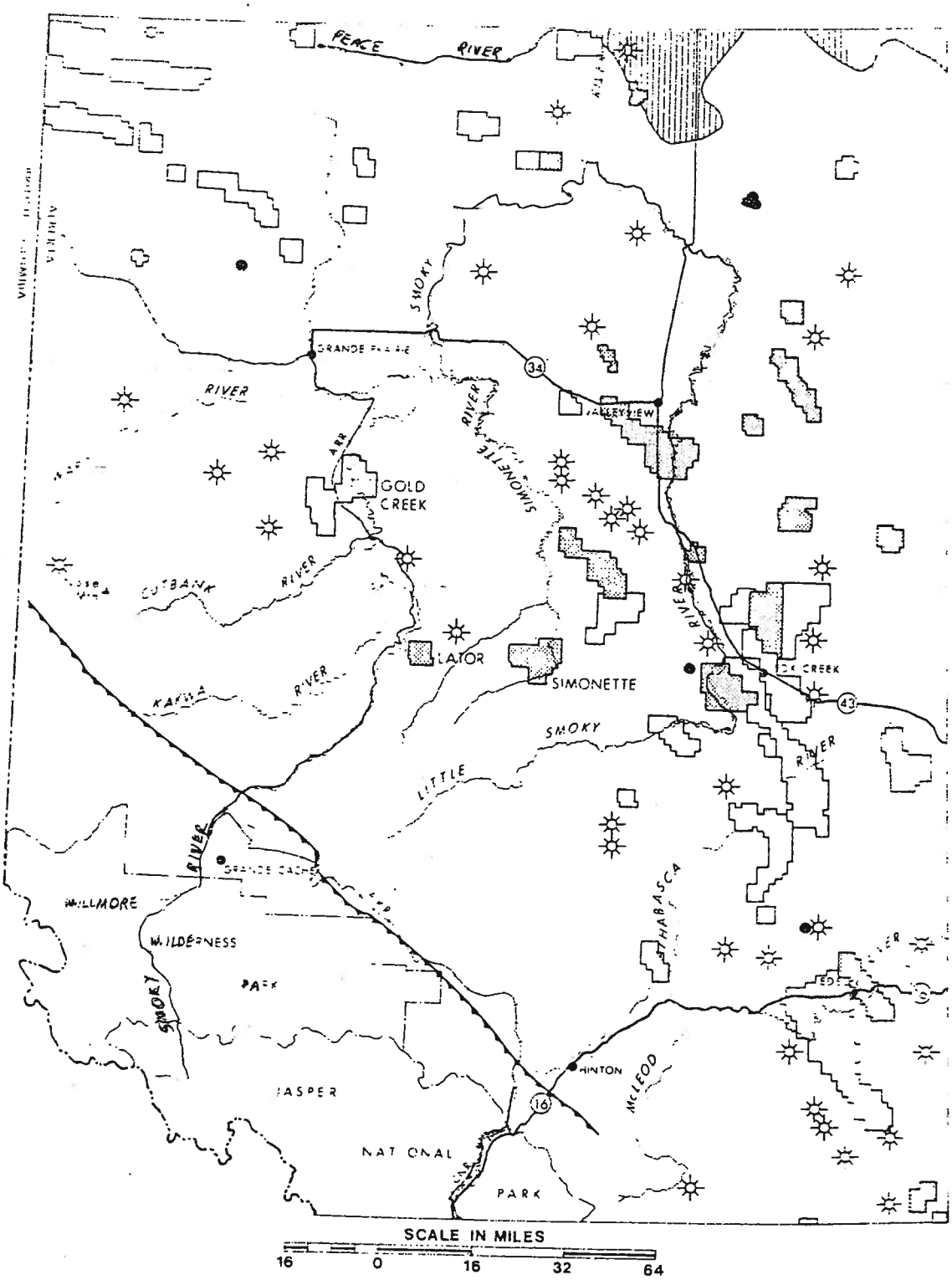
Convential Reserves

One gas field and one small oil field have been developed in the area between Hinton and Grande Prairie, west of the 6th Meridian (Fig.4). The gas field (Gold Creek) consists of seven pools producing from Devonian and Lower Cretaceous strata. As of December 31, 1970 the marketable gas reserves totalled 332 billion cubic feet of which 11 billion cubic feet were produced in 1971. The gas recovered from Devonian strata contains 7.6 per cent H_2S and yeilded 12,138 long tons of sulfur in 1971.

In addition to the Gold Creek gas field, several shut-in gas wells are present in the area southwest of Grande Prairie towards the Foothills. These have gas reserves estimated at 71 billion cubic feet but are considered too remote at present for economic development.

The oil dield (Lator) consists of three oil wells and on suspended well as of August 31, 1972. Production is from Cretaceous sandstones, but reserve estimates are not available. The nearest oil diled to Lator is the Simonette field to the east (Fig.4), which has estimated reserves of approximately 37,000,000 barrels (December 31, 1970).

The potential for finding additional oil and has deposits in the area described above (between Hinton and Grande Prairie) is conjectural. The density of exploration (wildcat) wells is relatively low compared to that of the more accessible regions to the north and east, where the depths to producing formations are shallower and drilling costs are lower. Only 95 wildcat wells have been drilled in the area south of township 71 and west of the 6th Meridian, and most of these are concentrated in the northern part (Fig.4). Furthermore, only 50 of these wells have penetrated the deeper Paleozoic strata which produce much of the oil and virtually all of the sour gas in other parts of Alberta. Thus, the region remains essentially unexplored by drilling, especially in the southwest along the Foothills region.



OIL AND GAS FIELDS

OIL FIELD

OIL WELL

OIL SANDS

GAS FIELD

GAS WELL

FOOTHILLS BOUNDARY

WELL DENSITY
West of 6th Meridian

1 WELL PER TOWNSHIP

2 TO 4 WELLS PER TOWNSHIP

FIGURE 4.

In spite of the lack of drilling data, some general observations indicate that the future oil and gas potential of this area is excellent:

(1) The munber and thickness of potential producing formations is greater than in any other part of the province. In addition to the Cretaceous and Devonian formations whcih produce most of Alberta's oil and gas, Triassic, Permo-Penn, and Mississippian formations are well developed in the subsurface.

(2) Many of the wildcat wells have produced gas ans sulfur showings and a few have yeilded oil showings. Although most are noncommercial, these showings indicate the widespread pressence of hydrocarbons in the subsurface.

(3) The general structure of the area is similar to those parts of the western Plains and Foothills in central and southern Alberta which produce commercial quantities of sour gas and light crude.

In summary, the hydrocarbon potential of the Hinton-Grande Prairie region seems excellent, especially the potential for sour gas (and sulfur). Undoubtedly, much of this potential will be tested and developed within the next five years as the demand for and price of natural gas increase. However, it is impractical on the basis of existing knowledge to attempt to predict the size and distribution of these resources at the present time.

Oil Sand

A large deposit of oil sand underlies 1500 square miles near the town of Peace River. The deposit is contained within Lower Cretaceous sandstone strata at depths ranging from 1500 to 2600 feet. In situ reserves are approximately 50 billion barrels of crude oil, of which 20 billion barrels can recovered as "synthetic" crude oil.

Development of the deposit by "in situ" recovery methods currently is being studied by Shell Canada Limited.

Metallic and Industrial Minerals

There are few metallic or industrial mineral resources in northwest-central Alberta which can be developed on a large scale. The two most promising deposits are:

Peace River Iron Deposit

The Peace River iron deposit is situated in the Clear Hills region about 100 miles north of Grande Prairie (Fig.1). The deposit consists of thin but widespread bodies of oolitic sandstone 5 to 20 feet thick with an average iron content of 35 per cent. Reserve estimates based on detailed drillhole data indicate that approximately 200 million tons of strippable ore are present along the flanks of the Clear Hills. In addition much larger tonnages are buried at depths considered too great for strip-mining.

The southern margin of the deposits is 35 miles from the NAR line at Hines Creek, which extends eastward to the town of Peace River.

Gypsum

A deposit of gypsum is exposed on the Alberta-British Columbia boundary about 60 miles west of Grande Cache (Fig.1), within the confines of Willmore Wilderness Park. Results of exploration drilling in 1963 (by Domtar Chemicals Ltd) indicated reserves of 2.6 million tons grading between 75 and 80 per cent gypsum.

Current consujption of raw gypsum in Alberta (imported from British Columbia and Manitoba) is estimated to be in excess of 100,000 tons. It is mainly in wallboard manufacture and as an additive in cement.