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ASSESSMENT OF MINERAL AND FUEL RESOURCE POTENTIAL OF THE PROPOSED NORTHERN YUKON NATIONAL PARK AND ADJACENT AREAS

(Phase I)

DEPARTMENT OF ENERGY, MINES AND RESOURCES
GEOLOGICAL SURVEY OF CANADA

DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS

PART I – **Geology, Regional Geochemistry and Mineral Occurrences of Northern Yukon**

PART II – **Mineral and Fuel Resource Assessments**

PART III – **Conclusions**

Prepared for the Interdepartmental Working Committee on
Northern Mineral and Energy Resource Assessments

DEPARTMENT OF ENERGY, MINES AND RESOURCES
GEOLOGICAL SURVEY OF CANADA

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Department of Energy, Mines and Resources
Geological Survey of Canada

Department of Indian and Northern Affairs

PART I

GEOLOGY, REGIONAL GEOCHEMISTRY AND MINERAL OCCURRENCES OF NORTHERN YUKON

PART II

MINERAL AND FUEL RESOURCE ASSESSMENTS

PART III

CONCLUSIONS

Prepared for the Interdepartmental Working Committee on
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Preface

The new northern National Parks policy, introduced by the government of Canada in early 1979, directs that "inventories" of mineral and fuel resource potential be made prior to setting aside lands for park purposes. Responsibility for implementing this policy rests with the Department of Indian and Northern Affairs.

A joint interdepartmental committee called the Working Committee for Northern Mineral and Energy Resource Assessment (MERA) was formed in early 1980 to conduct the required assessments. Committee membership includes representatives from the Department of Indian and Northern Affairs, the Department of Energy, Mines and Resources and Parks Canada Program of the Department of the Environment.

This report presents preliminary (Phase I) assessment results for the proposed northern Yukon National Park, the first in a series of six northern areas currently being considered as potential parks. The other areas in this series, all in the Northwest Territories are: Northern Ellesmere Island; Northern Banks Island; Bathurst Inlet, and Wager Bay.

The Phase I reports are based on office investigation using data and information available at hand. They do not include field investigations conducted specifically for the assessments. In many cases, however, field investigations will be required before more confident judgments can be made concerning the potential of parts of these lands to contain undiscovered mineral and fuel resources. Such investigations will comprise Phase II of the assessment process and may result in significant changes in potential ratings assigned in the course of Phase I studies.

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SUMMARY OF MAIN FINDINGS

1. This report provides preliminary assessments of the potential of the areas covered by the 1978 Northern Yukon Land Withdrawal to contain undiscovered deposits of metallic minerals, coal and oil and gas. The Land Withdrawal area includes the proposed Northern Yukon National Park in the northwest sector of the area.

2. Known occurrences of metallic minerals in the region are few and minor. The lack of deposits of economic significance is, in part, due to the paucity of modern exploration in the region. Since the 1978 Land Withdrawal, no exploration has been conducted, except on the few claims held in the region (Bonnet Lake area) at the time of the closure. Coal seams are known to occur in a number of different geological units. With the exception of seams that were mined at Coal Mine Lake until the mid-1950s for local heating use in Aklavik, none of the coal seams in the region has been exploited. Surface exploration (geology, geophysics) for oil and gas was conducted in the 1960s and early 1970s mainly along the north slope (Yukon Coastal Plain), in the Old Crow Basin area, and in Eagle Plain-Bell Basin to the south of the 1978 Land Withdrawal area. Test wells drilled (Yukon Coastal Plain, Bell Basin) did not encounter significant hydrocarbon zones. The Old Crow Basin structure has not been tested by drilling.

3. This study concludes that a number of areas with significant potential for undiscovered metallic minerals, including uranium, lead-zinc, copper, tungsten and molybdenum are present within the 1978 Land Withdrawal area. For the most part these areas lie outside the boundary of the proposed National Park. However, within the Park, two areas in particular are of interest. The first is a belt of mainly Proterozoic rocks extending northwest through the northern part of the proposed park from the vicinity of Mount Sedgwick to Malcolm River on the edge of Yukon Coastal Plain. The second is a discontinuous belt of Paleozoic (possibility in part Proterozoic) rocks extending easterly from the vicinity of Mount Ammerman on the Yukon-Alaska border across the northern edge of Old Crow Basin. Both these areas are of interest because of their geological characteristics and because of patterns of metallic element distribution recorded in regional stream-silt geochemistry surveys conducted by the Geological Survey of Canada in 1978. In the case of the Ammerman belt interesting copper, molybdenum, tungsten and lead mineralization is known in similar rocks in adjacent Alaska.

4. Evaluation of known coal environments in the study region indicates that two units – the Kayak Formation of Mississippian age and the Reindeer Formation of Tertiary age – may have potential for significant coal seams in addition to those already known. For the most part, the areas of main interest lie outside the park area. In general the probability of economic development of these seams is considered low. The possibility of development of particular seams (on a seasonal basis) for local fuel use could, however be considered if circumstances warranted.

5. Evaluation of potential oil and gas prospects is hampered by a paucity of data. There are, however, indirect (geological, geophysical) indications that the Old Crow Basin structure (within the proposed park) could contain many thousands of feet of Carboniferous to Triassic sediments that could contain oil and gas accumulations. To test this possibility would require additional surface geophysical exploration and the drilling of at least one well in the Basin. Similarly, the North Slope (Yukon Coastal Plain) area, to the northwest and the west of the area tested by previous drilling could contain reservoir rocks and traps for oil and gas. On the basis of the evidence at hand, the Old Crow Basin is assigned a higher potential rating for oil and gas than the Coastal Plain area.

6. Preliminary geochemical analyses of rock samples from Early Paleozoic shales and conglomerates and from Late Paleozoic conglomerates in the Barn Uplift-Bonnet Lake area east of the proposed park boundary but within the 1978 Land Withdrawal, indicate at least local enrichment in phosphate, in places up to 15-20 percent P_2O_5. This, coupled with previously known P_2O_5 enrichment in Cretaceous phosphatic ironstones of northern Richardson Mountains to the north and east, strongly suggests the possibility of potentially economic phosphate beds within the northeast Yukon sector.

PART 1

GEOLOGY, REGIONAL GEOCHEMISTRY AND MINERAL OCCURRENCES OF NORTHERN YUKON

1. INTRODUCTION

Introduction

This review was made in response to the requirements for mineral and energy resource assessment of northern lands being considered for national parks and other conservation purposes. Parts of the area involved in this northern Yukon study have been discussed in preliminary form in two earlier reports (Geological Survey of Canada 1980a; Geological Survey of Canada 1980b). The present study incorporates some of the findings of the earlier work.

The areas involved in this study are shown on Figs. 1 and 2 and Map 1. The actual proposed Northern Yukon National Park area involves about 8200 sq. mi. (21 000 km^2) bounded on the west by the Alaska border, the south by Old Crow Range and the north by the Arctic Coast. The eastern boundary skirts the eastern side of Old Crow Flats, crosses northeast Old Crow Plain and extends across British Mountains to the Arctic Coast west of Shingle Point. The proposed Park is included in a larger area extending from the Alaska border to the Yukon-Northwest Territories boundary and from the Porcupine River north to the Arctic Coast that was withdrawn by the federal government in July, 1978. For purposes of convenience of reference the latter area is referred to as the "1978 Land Withdrawal" in this report.

The region covered in the assessments presented in this report include the two above noted areas as well as that part of Yukon extending south from the Porcupine River to latitude 67°N (Map 1).

This report presents preliminary assessments of the resource potential of northern Yukon for metallic minerals (Part II.1), coal (Part II.2) and oil and gas (Part II.3). Uranium is included with metallic minerals. The assessment methodologies differed somewhat for each of these types of resources. For metallic minerals, a subjective method that yielded assessment ratings of mineral resource potential in relative terms was employed. For a more detailed discussion of this methodology the reader is referred to Geological Survey of Canada 1980b (see "References"). In the case of the present study the assessments rely heavily on the results of reconnaissance geochemical surveys (see Part I.5).

The assessments for oil and gas potential incorporated methodologies developed at the Geological Survey's Institute of Sedimentary and Petroleum Geology and in the Oil and Gas Section, Department of Indian and Northern Affairs, Ottawa. The coal assessments were done at the Institute of Sedimentary and Petroleum Geology, Calgary.

Contributors and Acknowledgements

This report involved work by a number of individuals in various agencies. Primary responsibilities were as follows:

Metallic Minerals: D.C. Findlay, R.T. Bell, W.D. Goodfellow (Geological Survey of Canada, Ottawa); T.W. Caine (Department of Indian and Northern Affairs, Ottawa)

Geochemical descriptions and interpretations: W.D. Goodfellow (Geological Survey of Canada)

Coal: D.K. Norris, (Institute of Sedimentary and Petroleum Geology, Geological Survey of Canada, Calgary)

Oil and Gas: B. Young, (Department of Indian and Northern Affairs, Ottawa); J.E. Brindle, (Institute of Sedimentary and Petroleum Geology, Calgary)

Illustrations and Support Services: R.D. Lancaster, S.B. Green, R. Bretzlaff, M.M. Braham, (Geological Survey of Canada, Ottawa)

Overall Report Preparation: – D.C. Findlay

Advice and background information were provided by officers of Parks Canada Directorate, Department of The Environment, Ottawa, in particular Tom Kovacs and Ian MacNeil. The manuscript was reviewed by D.K. Norris, R.J. Thorpe and G.B. Leech.

2. INFORMATION BASE

General

Four principal types of information were used in the assessments: (1) the geological base; (2) distribution and nature of known mineral and fuel occurrences; (3) geochemical and geophysical data; and, (4) exploration history records, chiefly non-confindential oil and gas assessment records filed with the Department of Indian and Northern Affairs.

Geological Base

The study area is included on a recently-released geological compilation map of northern Yukon Territory (Norris, 1980). The relevant part of this map has been incorporated on Map 1. The detailed geological legend for this base map is given in Appendix 1. Those geological features of the base map that are considered most significant from the point of view of mineral resource potential have been generalized and highlighted on Map 1. This resulted in the disaggregation of the overall geological framework into seven large areas or blocks that represent the major tectonic elements of the northern Yukon part of the Cordillera (Fig. 2.). The regional blocks were then further subdivided into a number of smaller areas designated by number-letter combinations on Map 1; e.g. 1a, 2d, etc) which were used as the primary units on which the mineral assessments were made. For the most part the sub-areas outline groupings of several stratigraphic units or formations. These are shown in generalized format on Map 1 and composite stratigraphic columns for the principal blocks are illustrated in greater detail in Fig. 3 (in pocket). Fig. 3 shows the individual stratigraphic units and formations and the (stratigraphic) locations of mineral occurrences where known.

Because the assessment process must deal with both stratigraphic and geographic variables, in the type of structurally-complex geological framework represented by northern Yukon a number of local areas that may include more than one geologic or stratigraphic "package" are indicated separately on Map 1.

Mineral Occurrences

The location and type of known mineral occurrences are shown on Map 1 and basic information for these occurrences (name, location coordinates, commodities present, etc) is given in Table 1. Brief descriptions of most of the occurrences are included in a later section (I.4).

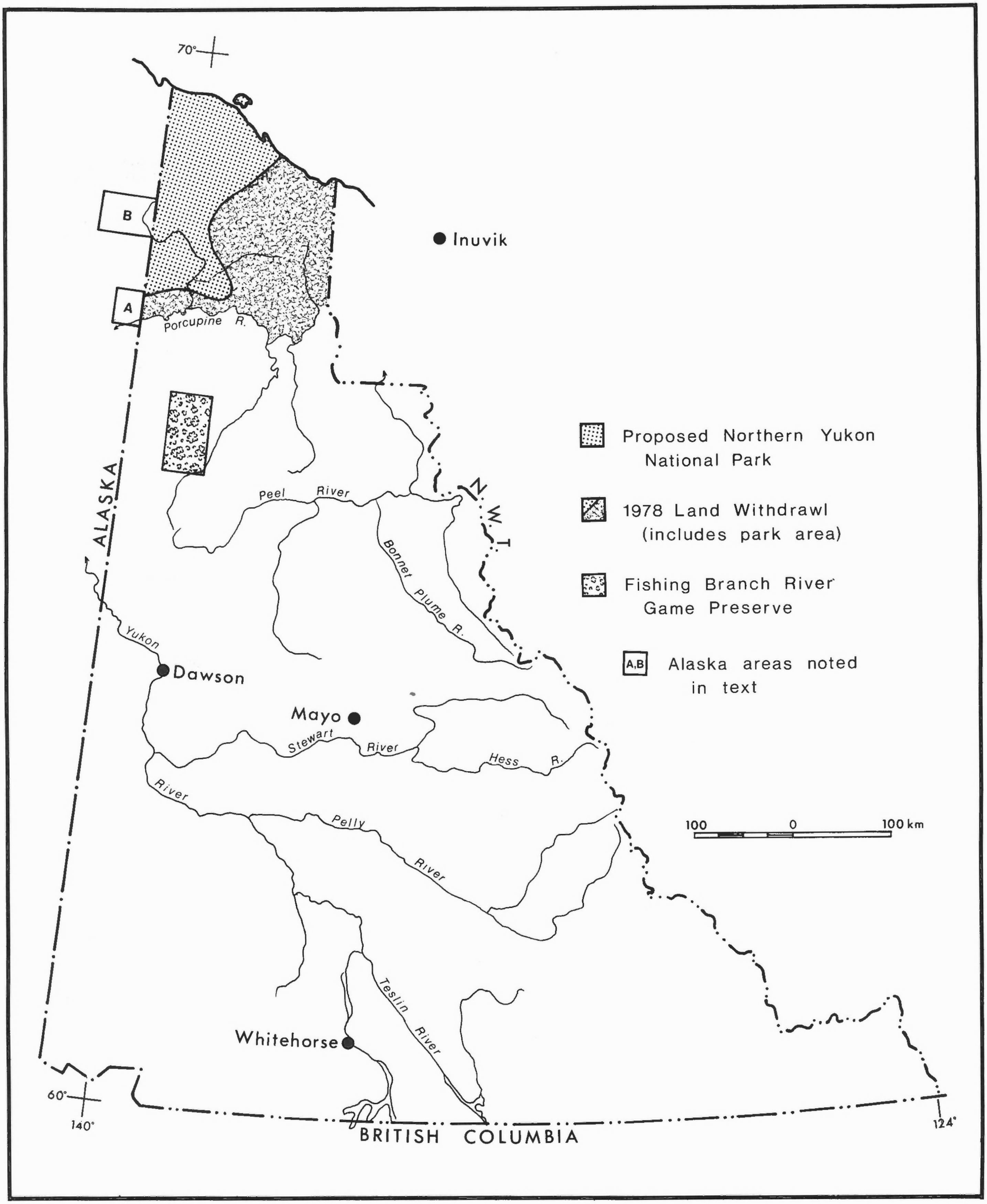

Figure 1. *Location sketch of northern Yukon and adjacent areas in Alaska referred to in this report.*

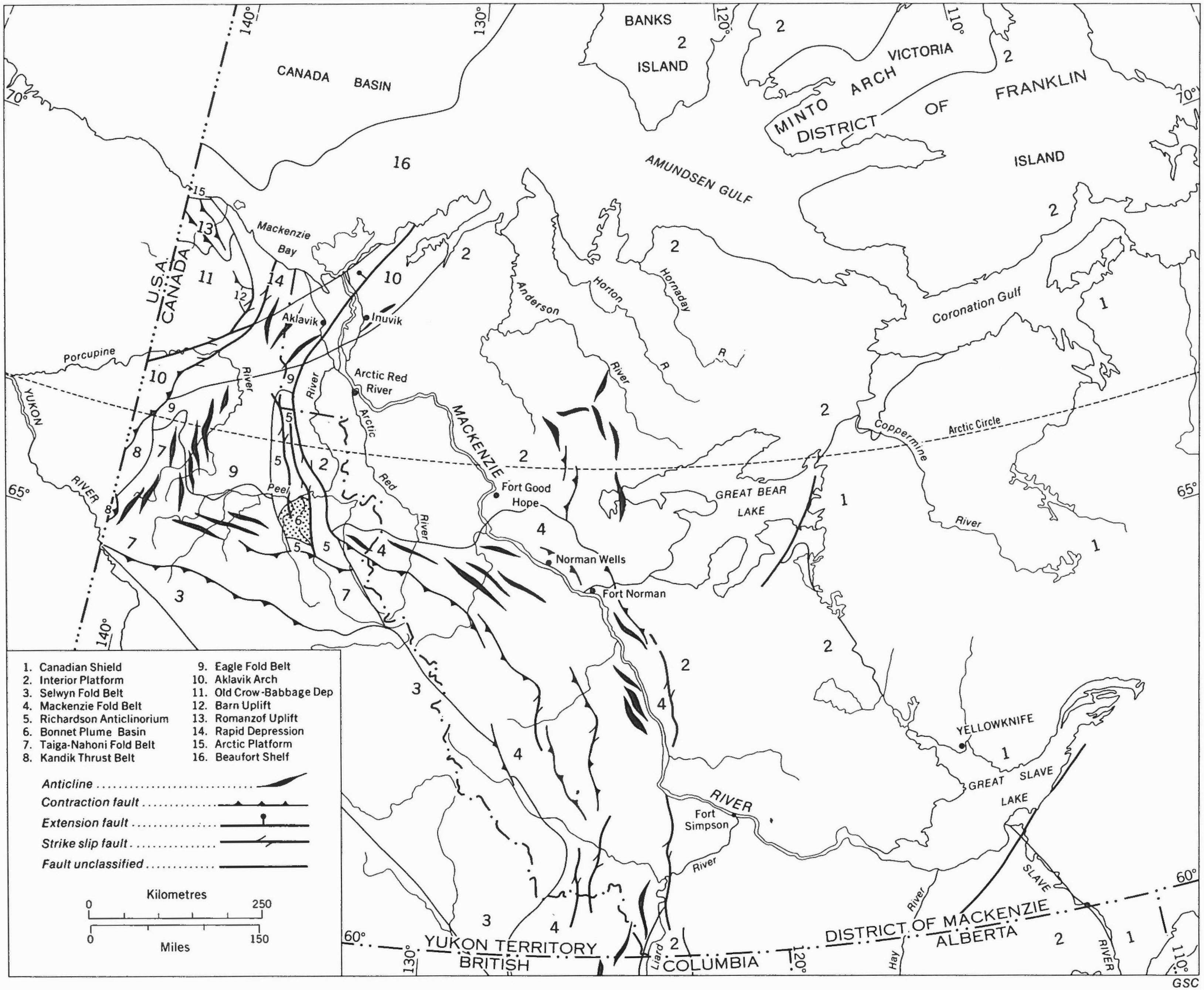

Figure 2. *Tectonic elements of the northern Canadian Cordillera (after Norris and Yorath, 1980)*

Table 1. Mineral occurrences of Northern Yukon[1]

Map No.	Deposit Name	NTS	LAT.	LONG.	Deposit Type	Commodity	Status	Character
1	Sheep Creek	117C/01	69°10	140°09'	Placer	Au	Past Producer (Minor)	Gravel bars on tributary of Firth River
2	Firth River	117C/01	69°09'23"	140°09'23"	Placer	Au	Past Producer (Minor)	Gravel bars on west side of Firth River
3	Babbage	117C/03	69°04'40"	138°21'	Concordant	Coal	Occurrence	Lignite in Tertiary rocks
4	Conglomerate Creek Shingle	117A/14	68°53'	138°02'	Concordant	Coal	Occurrence	High volatile bituminous coal in lower Tertiary rocks
5	Eagle Creek	117A/09	68°45'	136°35'	Concordant	Coal	Occurrence	High volatile bituminous coal in Lower Tertiary rocks (Reindeer Formation)
6[2]	Moose Channel Mine Coal Mine Lake	117A/09	68°42'	136°19'	Concordant	Coal	Past Producer	Sub-bituminous "A" to high-volatile "C" bituminous coal in Tertiary Reindeer Formation
7	Mount Davies Gilbert Iron Formation Rapid/Straddle/Delta/Dawn	117A/08	68°29'	136°27'30"	Concordant	Fe, Phosphate (P) Mn	Deposit with one dimensional data	Quartz-siderite iron formation interbedded with shale. Rare phosphate minerals, including lazulite.
8	Welcome	117A/11	68°38'15"	138°24'10"	Concordant	Coal	Occurrence	Probably in Lower Cretaceous rocks
9	Barn Mountain	117A/11	68°35'	138°10'	Unknown	W, Mo	Occurrence	In calcareous shale (also trace vanadium)
10	Hoidahl Anker Creek (Mt. Fitton area)	117A/11	68°32'23"	138°07'50"	Unknown	W, Au, Mo	Occurrence	Placer W and Au; Mo in quartz vein in granite; also skarn
11	MAM	117A/06	68°27'30"	138°04'30"	Skarn	U, Mo, W	Occurrence	May be structurally controlled skarns and fractures in intrusive rock
12	BOU	117A/06	68°23'	138°10'	Unknown	U, P	Occurrence	In silicified chert – conglomerate – breccia of Endicott Group and sedimentary units of Road River equivalents
13	Bonnet Blow River Headwaters	117A/07	68°17'50"	137°52'10"	Concordant	Coal	Occurrence	In Mississippian Endicott Group
14	BON	117A/07	68°16'30"	137°47'00"	Vein	U, P	Occurrence	Radioactive chert and phosphates in fractures in rudaceous rocks
15	LIN	117A/02	68°09'40"	137°39'	Vein	U, P	Occurrence	Radioactive chert in fractures in rudaceous rocks
16	NET	116O/16	67°49'20"	138°16'00"	Concordant	U, Ba, Sr, Cu Phosphate (P)	Occurrence	Lower Paleozoic radioactive cherts and intra-formational chert-breccia
17	Norris Bell River Trib.	116P/15	67°55'30"	136°57'	Concordant	Coal	Occurrence	Anthracite seams in Early Cretaceous rocks
18	Tack[3]	116O/12	67°35'03"	139°38'15"	Concordant	Coal	Occurrence	Small bed of shaly lignite of Tertiary age
19	British Mountains Synd. Fox/Sunaghun/Frobex/Exfrob	116N/07	67°30'	140°54'	Unknown	Pb, Zn	Occurrence	Galena and sphalerite with quartz in granitic rocks
20	LORD Saleken	116O/03	67°07'	139°16'40"	Mainly discordant in carb.	Zn	Occurrence	Disseminated/vugs/calcite veinlets in silicified limestone breccia
21	Mt. Sedgwick area	117A/13	68°50'	139°05'	Vein ?	U, Cu, Mo W	Occurrence Placer	Radiometric responses from granitic rocks, minor chalcopyrite and molybdenite in fractures. Placer tungsten (scheelite) in streams draining Mt. Sedgwick area

[1] Mainly from CANMINDEX (Canadian Mineral Deposit Index) file, Economic Geology Division, Geological Survey of Canada.
[2] This location is in N.W.T. but is included here for reference information.
[3] Information on this occurrence is sparse and location is uncertain.

Mineral occurrences in Northern Yukon are few and information concerning them is sparse. In part at least this is related to the paucity of modern exploration that has been conducted. As a consequence, no deposits of economic significance have been confirmed to date. With the exception of minor placer gold won from Sheep Creek and bars on the Firth River, and local coal production from the western Mackenzie Delta area (Moose Channel Mine)[1], no mineral production has been recorded from the region.

Geochemistry and Geophysics

Regional stream-silt geochemical surveys were carried out by the Geological Survey in 1978 over the northern part of the region (Goodfellow, 1979). These surveys cover the area from the Yukon-Northwest Territories border through to the Alaska-Yukon border and from latitude 68° (northern Old Crow Basin) north to the Yukon Coastal Plain. A discussion of the geochemical methods, results and interpretations is given in a following section (I.5).

Bouguer anomaly (gravity) survey results and local seismic survey results conducted by oil companies over parts of the northern Yukon area (Old Crow Basin, Arctic Coastal Plain) are on file as work records with the Department of Indian and Northern Affairs. These data were incorporated into the oil and gas potential appraisals presented in Part II.3 of this report.

Records of Past Exploration

Little systematic exploration for minerals has been carried out in the region included in this study although reconnaissance prospecting has been conducted in a number of areas. Local indications of mineralization have been investigated in more detail from time to time, including tungsten, copper, molybdenum and uranium associated with mid-Paleozoic granitic plutons (Old Crow Range, Mount Sedgwick, Mount Fitton), phosphatic ironstones of northern Richardson Mountains (Mount Davies-Gilbert area) and uranium associated with Carboniferous conglomerates and Early Paleozoic shales of the Barn Uplift and Driftwood High areas. In the latter connection Aquitaine Canada Limited has been the principal active company although its investigations have been much curtailed since the 1978 Land Withdrawal.

In the case of oil and gas, a number of companies including Gulf Oil Canada Limited, Imperial Oil Limited, Union Oil Company of Canada Limited, Charter Oil Company Limited and Atlantic Richfield Canada Limited have conducted intermittent geological and geophysical investigations in parts of the region since the late 1960s (see Appendix 2). The principal areas of attention have been Old Crow Basin, northern Eagle Plain-Bell Basin in the southeast part of the region, and the Arctic (Yukon) Coastal Plain west of Mackenzie Delta. In the latter two areas a number of test wells were drilled but significant hydrocarbon zones were not encountered (see Oil and Gas Assessments, Part II.3).

3. GEOLOGICAL FRAMEWORK OF NORTHERN YUKON

General

As noted earlier the study region was divided into seven major areas or "blocks" for purposes of the metallic minerals assessment. For the most part the terminology followed in the major subdivisions is that of Norris (1973a, 1973b, 1974), Norris and Yorath (1980) and Norris and Hopkins (1977). Some geographic modifications have been made for descriptive convenience in incorporating the resource potential assessments into the terminology. The seven major blocks, generally arranged in order of the geological ages of their dominant stratigraphic "packages" (oldest to youngest) are:

1. Romanzof Uplift
2. Old Crow – Babbage Depression
3. Western Aklavik Arch
4. Central Aklavik Arch – Richardson Mountains
5. Rapid Depression (Northern Richardson Mountains)
6. Eagle Plain – Bell Basin
7. Arctic Coastal plain (Yukon Coastal Plain).

In the sections following, summary geological descriptions of the various blocks and their principal sub-areas of interest from the point of view of mineral potential are given. These descriptions are based mainly on the work of Norris, Jeletzky (various publications) and others (see References). Expanded descriptions and interpretations of particular features of interest to coal and oil and gas potential are contained in relevant later sections of this report (Parts II.2 and II.3).

1. Romanzof Uplift

Romanzof Uplift comprises the succession of mainly Proterozoic strata (Neruokpuk Formation; – 1a,1aa[2]) that underlie much of northwest British Mountains from about the vicinity of Babbage River to the Alaska border. Lying unconformably on Neruokpuk strata are local remnants of younger assemblages, including a succession of Cambrian agglomerates, basaltic flows, limestone beds and shales in the Aspen Creek-Mountain Creek area near the Yukon-Alaska border (1b). Oolitic and skeletal-oolitic limestone of the Carboniferous Lisburne Group and marine calcareous shales of the underlying (Carboniferous) Kayak Formation (Endicott Group) are present in two narrow belts near Malcolm River in extreme northwest Yukon near the Alaska border (1d). Immediately southwest of the northernmost Carboniferous belt, thin limestone and sandstone beds of the Middle and Upper Triassic Shublik Formation are overlain by marine shale and siltstone of the Jurassic Kingak Formation (1e). In the southeast part of the block, Neruokpuk strata have been intruded by mid-Paleozoic granitic rocks of the Mt. Sedgwick stock (1c)[3]. As noted later, geochemical data suggest that other intrusions may be present in the Neruokpuk terrane to the northwest along the axis of the uplift.

The Neruokpuk of Romanzof Uplift has been subdivided (Norris, 1980) into several mappable units. In general the rocks are folded, slightly metamorphosed and dominated by argillite, sandstone, siltstone and limestone beds. Locally the rocks are cherty and phyllitic. As shown on Map 1, Neruokpuk strata were subdivided into two main areas, for the purposes of this study. The two main areas are generally separated by the contact between units PN2 and PN4/5 as shown by Norris (op. cit.) This separation was based mainly on interpretation of the geochemical data (see I.5, this report). Neruokpuk strata in the northeast section (1aa) are, on the basis of neutral or only slightly basic pH levels in stream waters draining the terrain, interpreted to be a fairly clastic-rich assemblage (sandstone, quartzite, siltstone, shale). In contrast Neruokpuk rocks of the southwest sector (1a), yielding moderately to strongly basic pH values, are

[1] In N.W.T.

[2] Number-letter designations refer to the identification of these units on Map 1.

[3] The granitic rocks of Mt. Sedgwick and other intrusions of northern Yukon (Mt. Fitton, Old Crow Range, etc.) have yielded radiometric ages ranging from 220 Ma to 406 Ma in Canada and up to 431 Ma from similar rocks in adjacent Alaska. According to D.K. Norris (personal communication, 1981) ages close to the Ordovician-Silurian boundary are probably valid for these rocks.

presumed to be more carbonate-rich (limestone, calcareous argillite). As discussed later, the two sectors yield significantly different stream-silt metal patterns.

2. Old Crow-Babbage Depression

This large block lies northwest of the major Kaltag Fault and south of Romanzof Uplift. It is discontinuously bordered on the east by a number of uplift areas (Barn Uplift, Driftwood High) that have exposed lower Paleozoic graptolitic shale, limestone and argillite, in part of Road River Formation (2c), and on the southwest by Proterozoic quartzite, argillite and subordinate dolomite (2a) and mid-Paleozoic granites (2dO, 2dS) of Old Crow Range area. South of Romanzof Uplift and west of the Barn and satellite uplifts are Carboniferous strata of the Lisburne Group and underlying Endicott Group (2e). In the northern part, Endicott (Kayak Formation) strata are represented by "interbedded dark grey, calcareous shale and siliceous, micritic-skeletal limestone, both of which are high in organic matter" (Bamber and Waterhouse, 1971, p. 74). In the eastern uplift areas (Barn) the Kayak is a more clastic sequence (sandstone-shale) that contains basal chert-pebble conglomerate beds and locally, coal seams (op. cit., p. 75, see also Part II.2, this report). The conglomerate beds, presumably representing the Kekiktuk Conglomerate, are of interest because of recently-investigated uranium mineralization associated with them (see I.4, following).

Along the northern edge of Old Crow Basin discontinuous outcrop areas of dark grey shale and limestone (2b) may, in part be Neruokpuk (eastern sector) but to the west toward the Alaska border, have been mapped (Norris, 1980) as Upper Devonian, apparently resting on the small Ammerman granite stock (2dA).

Permian and Triassic strata (2f) locally overlie Lisburne Group carbonates in the Timber Creek-Muskeg Creek area north of Old Crow Basin and along Babbage River, south of Mount Sedgwick. In both these local areas sandstone, shale and quartzite of the Permian Sadlerochit Formation are overlain by limestone and sandstone of the Triassic Shublik Formation. These strata are in turn capped by marine shale and siltstone of the Jurassic Kingak Formation and shale, siltstone, sandstone and locally quartzite of the Lower Cretaceous Mt. Goodenough and associated formations (2g). The Timber Creek-Muskeg Creek area in particular shows interesting stream geochemistry patterns (I.5).

Permian and Triassic rocks are apparently absent in the northeastern and eastern parts of Old Crow-Babbage Depression, where thick sequences of Jurassic through Lower Cretaceous strata (2g) lie directly on Lisburne Group limestone. To the southeast, in the vicinity of the Driftwood High and Kaltag Fault, the Jurassic section is represented mainly by marine sandstone of the Bug Creek Group.

Much of the eastern part of Old Crow Plain is mantled by a veneer of pediment. As indicated on Map 1, scattered outcrops (Norris, 1980) suggest that, in part, the pediment cover is underlain by Jurassic-Cretaceous strata and in part by Lisburne Group carbonates. Seismic and gravity data (see II.3) suggest that the Quaternary lacustrine deposits of Old Crow Basin (2h) could be underlain by a combined total thickness of Permian (Sadlerochit) and Carboniferous (Lisburne Group) strata of as much as 13 000 feet (3950 m).

3. Western Aklavik Arch

Aklavik Arch is a major composite structural high extending northeasterly from the Yukon-Alaska border region through the Mackenzie Delta region to the Beaufort Sea (Norris, 1973a). In the southwest part of the arch complex Proterozoic argillite and quartzite of the Neruokpuk Formation and Quartet Group (3a) as well as Early Paleozoic (Cambrian to Devonian) limestone, dolomite and shale (3b) are exposed. To the northeast along the Arch, successively younger strata are exposed, including Upper Devonian Imperial Formation clastic sediments (sandstone, siltstone, shale) and limestone, shale and dolomite of the Carboniferous Hart River and Ettrain Formations and Endicott Group (3d). In areas to the south of Keele Range (e.g. Ogilvie Mountains) the Hart River and Ettrain Formations are characterized by laminated silty, dolomitic skeletal and skeletal-micritic limestones, commonly with cherty horizons and beds high in organic material and carrying disseminated and concretionary pyrite (Bamber and Waterhouse, 1971). Minor, disseminated pyrite is also present in Ettrain beds of Keele Range (op. cit., p. 58).

Unconformably overlying the Carboniferous rocks in northern Keele Range are Permian calcareous sandstone, limestone and conglomerate of the Jungle Creek Formation (3e). Extending to the northeast along Lord Creek and across the Porcupine River is an extensive belt of Permian rocks, mapped by Norris (1980) as undivided marine shale, siltstone and limestone (3e). In the Porcupine River section at least, these rocks have been correlated with Jungle Creek strata (Bamber and Waterhouse, 1971, p. 61). According to lithological descriptions given by Bamber and Waterhouse, Jungle Creek strata to the southeast, in southern Eagle Plain (Peel River sections), contain thin dolomitic limestones and silty shale beds carrying abundant organic matter and pyrite (op. cit., p. 64).

In the northeast part of the Western Aklavik Arch block, Jurassic and Cretaceous strata generally equivalent to 2e (Old Crow-Babbage Depression) and 4e (Richardson Mountains) are presumed to underlie much of the pediment-covered area of eastern Old Crow Plain (3f). In the northeast they include mainly variable shale, siltstone, sandstone and conglomerate of the Kingak (Jurassic) and Mount Goodenough (Lower Cretaceous) Formations and an unnamed sequence of sandstone, shale and quartzite (unit Kq of Norris, 1980; see Appendix 1). To the southwest, in the vicinity of Lord Creek, Kingak shale, siltstone and sandstone and sandstones of the overlying Porcupine River Formation are exposed. Along the Porcupine River, northeast of Lord Creek marine sandstone and conglomerate of the Sharp Mountain Formation occurs.

4. Central Aklavik Arch-Richardson Mountains

The western part of this region (Richardson Mountains) is underlain mainly by Jurassic and Lower Cretaceous strata (4e) described previously (Porcupine River and associated formations). To the east, a major structural feature or series of structures has exposed older strata at several localities along the trend of White Mountains (White Uplift, Cache Creek Uplift, Rat Uplift). This feature has been interpreted as a composite series of northeast-trending, en-echelon uplifts and adjacent structural depressions that together form the northeast Yukon part of the Aklavik Arch Complex (Norris, 1973a, 1974; Norris and Hopkins, 1977).

Whatever the origin of this part of Aklavik Arch Complex, tectonic activity has exposed Cambrian (to ? Upper Silurian) and Lower and Middle Devonian limestone, dolomite and shale (4a) in the core of White Uplift and Cambrian to Devonian graptolitic shale, limestone and debris flows of Road River Formation (4b) in Rat Uplift to the southeast and south. The lower Paleozoic rocks of White Uplift include Middle Cambrian brecciated dolomite and limestone, as well as Upper Cambrian to Upper Silurian fine crystalline limestone of the Vunta Formation. In southern Rat area a belt of flyschoid sandstone, shale and siltstone of Devonian Imperial Formation is exposed (4c) and these strata also form the northern core of Richardson Anticlinorium in the extreme southeast corner of Map 1. Both the Rat and White areas probably also contain older (Proterozoic) strata (Norris, 1974a) but these have not been differentiated on Map 1. Permian strata (4d) fringe Lower Paleozoic rocks of Rat and White Uplifts and form the bulk of the northeasterly-trending Cache Creek Uplift in the Northern Richardson Mountains. The Permian succession of the Cache Creek-Fish Creek, White and Rat Uplift areas consists of a lower limestone unit with local basal sandstone, a middle calcareous shale and mudstone unit and an upper cliff-forming sandstone unit (Bamber and Waterhouse, 1971).

Jurassic and Cretaceous rocks of Richardson Mountains (4e) extending south to the flanks of Richardson Anticlinorium show considerable lateral facies gradations and contain variable lithologies (Jeletzky, 1974, 1980). In general, the Lower Cretaceous units (Mt. Goodenough, Rat River, Arctic Red and associated formations) as well as the Jurassic succession (Husky, Kingak, Porcupine River Formations and Bug Creek Group) are characterized by sandy siltstone, argillaceous siltstone, thick to thin-bedded quartzose sandstone, and shale. Locally, grit and pebble conglomerate, as well as carbonaceous to coaly beds occur (Jeletzky, 1980, p. 3). From west to east across the central Richardson Mountains significant facies changes occur, particularly in the Jurassic succession, with the western argillaceous lithologies of the Kingak Formation changing to the mainly sandstone lithologies of the Bug Creek Group. Similar changes occur in the overlying Husky-Porcupine River assemblages, with the former comprising the eastern argillaceous equivalent of the dominantly sandstone Porcupine River lithology (Poulton, 1978).

5. Rapid Depression

The Jurassic-Lower Cretaceous succession of Aklavik Arch-Richardson Mountains (4e) extends into northwest Richardson Mountains and the Rapid River-Blow River area. The older Mesozoic succession (5a) includes Jurassic Kingak Formation shale overlain by a Neocomian sandstone and shale zone, Upper Shale-Siltstone Division and Upper Sandstone Division (Jeletzky, 1972; Young, 1972, 1973). These last three units correspond respectively to the Martin Creek-McGuire, Mount Goodenough and Rat River Formations of Jeletzky (1980, in prep.) and Norris, 1980.

Conformably overlying the Jurassic-Lower Cretaceous assemblages of 5a is a thick Aptian-Albian flysch sequence consisting of mudstone, shale, bedded phosphatic ironstone (siderite) and turbidite sandstone (5b). In the Mount Davies-Gilbert area the ironstones contain 15 to 20 per cent iron and 1.5 to 3 per cent phosphorous (P_2O_5) with some individual layers containing as much as 14 to 20 per cent P_2O_5 (see I.4, this report and Table 1, No. 7). Upper Cretaceous and latest Cretaceous-Tertiary rocks are exposed mainly in the extreme northeast part of the area (Fish River), near Blow River and on Yukon Coastal Plain west of Shingle Point. The upper Cretaceous succession includes bituminous, bentonitic and ferruginous shales of the Boundary Creek Formation. Overlying Boundary Creek strata is a molassoid clastic wedge (Fish River Group), consisting of marine mudstone of the Tent Island Formation overlain by coarse terrigenous sandstones of the Moose Channel Formation. The Fish River strata are considered of Late Cretaceous age, with the base of the Tertiary coinciding approximately with the base of the Moose Channel Formation (A.R. Sweet, personal communication, 1980).

6. Eagle Plain - Bell Basin

The northern part of Eagle Plain (Bell Basin) is included in the Eagle Fold Belt structural element of Norris, 1974 (see also Fig. 2, this report). Most of the interior parts of the basin are underlain by Upper Cretaceous marine and non-marine sandstone, siltstone and shale of the Eagle Plain Formation (6b). On the peripheries of the basin older (Lower Cretaceous) marine shale, siltstone and sandstone are exposed (6a). In the western part of the area Socony-Mobil Western Minerals Molar Y.T. P-34 well penetrated about 5000 feet (1520 m) of the upper Lower Cretaceous Aptian-Albian flysch assemblage (siltstone, shale, greywacke) before entering Jurassic Husky and Kingak formations shale and siltstone (Jeletzky, 1975, Fig. 4).

7. Yukon Coastal Plain

Yukon (Arctic) Coastal Plain comprises the narrow seaward-sloping strip of land bordering Beaufort Sea-Mackenzie Bay. Surficial deposits of the plain include hummochy moraine, fluviatile silt, sand and gravel (7a), fluviatile deposits in fans and fan aprons (7b), and marine and estuarine deposits (7c). In the eastern part, fluviatile deposits on floodplains and terraces form the modern Mackenzie Delta (7d). The surficial deposits of the plain are underlain mainly by non-marine sandstone, siltstone conglomerate and local coal of the Tertiary Moose Channel and Reindeer formations and by Upper Cretaceous strata of the Boundary Creek and Tent Island formations (5c).

4. EVIDENCE OF MINERALIZATION

General

As noted earlier, mineral occurrences are few in the study area and, to date, not economically significant. For the most part the occurrences fall into one of six categories as follows.

a. Radiometric anomalies associated with Paleozoic and Mesozoic strata of the Barn Uplift-Driftwood High area (units 2c and 2e of Map 1).

b. Minor tungsten (scheelite, wolframite) and locally minor copper, molybdenum and uranium associated wih mid-Paleozoic granitic rocks of Mount Sedgwick (1c), Mount Fitton (2dF) and Old Crow (2dO) intrusions; for the most part tungsten is in placer occurrences in creeks draining the intrusive areas, but in situ showings are also known, notably near Mount Fitton.

c. Phosphatic ironstones (sideritic) in Lower Cretaceous rocks of northern Richardson Mountains, most notably in the Mount Davies-Gilbert area (unit 5b of Map 1).

d. Minor placer gold in gravels of Firth River, Sheep Creek and Porcupine Creek of Romanzof Uplift (1a).

e. Numerous minor coal seams in rocks ranging in age from Carboniferous to Tertiary: the Moose Channel Mine produced coal for local use in Aklavik, but none of the presently-known occurrences are of economic significance.

f. A few minor lead-zinc occurrences are known (Table 1, Nos. 19 and 20).

In addition to the above, chromite has been recorded in heavy mineral fractions of samples collected from creeks draining an area near the Yukon-Alaska border (Malcolm River-Aspen Creek) and also from the Firth River (Gleeson, 1963).

a. Radiometric Anomalies over Paleozoic and Mesozoic Rocks of the Barn Uplift-Driftwood High area (units 2c, 2e, Map 1)

A number of anomalously radioactive zones have been investigated by Aquitaine Company of Canada Limited in the general Bonnet Lake-southeast Barn Mountains area. The properties include the BON, BOU, LIN and NET claims (Table 1, Nos. 14, 12, 15, 16 respectively). Some of these zones were described by Bell and Jones (1979) who noted that on the BON and LIN properties radiometric anomalies are associated with "deeply-weathered rusty rubble or scree" representing "rudaceous rocks. . .made up of very angular to subrounded cherty fragments in a siliceous and rusty matrix" (p. 397). The area of the BON claims is underlain by Ordovician Road River Formation and Carboniferous (Endicott Group) Kekiktuk and Kayak Formations (Marchand et al., 1979, p. 58). According to Bell and Jones (op. cit.) the radiometric anomalies are probably associated with the basal Carboniferous (?) rocks (Kekiktuk Conglomerate). "No uranium minerals other than radioactive chert on fractures have been identified" (op. cit., p. 397). The uranium is, however, apparently associated with phosphate (see Table 2). The LIN claims, about 15 km southeast of Bonnet Lake cover similar radiometric anomalies, possibly associated with basal Cretaceous strata (Sharp Mountain Fm.?) (op. cit.).

About 30 km northwest of Bonnet Lake and 20 km southeast of Mount Fitton, the BOU claims of Aquitaine company of Canada Limited (Table 1, No. 12) cover radiometric anomalies in an area "underlain by a sequence of folded and faulted sediments ranging in age from Ordovician to Cretaceous" (Marchand et al., 1979, p. 58). The NET claims (Table 1, No. 16) about 30 km south-southwest of Bonnet lake, cover an area of radiometric anomalies underlain by rocks of the Road River and Kingak (Jurassic) Formations (Marchand et al., 1979). Bell and Jones (op. cit.) reported that the radiometric anomalies are associated with "Lower Paleozoic cherts and intraformational chert-breccias" and noted that two samples of this material contained anomalous barium (640 and 2700 ppm), strontium (359 and 20 000 ppm) and phosphorus (P_2O_5; 12.4 and 7.8%)[1].

These radiometric occurrences, and others that may be present in the same general region (see I.5 – "Geochemistry", this report) are of interest as indicators of potential uraniferous environments in Paleozoic and Mesozoic strata of the southern Barn Mountains region. As far as known to date, however, no economic uranium mineralization has been found.

b. Mineralization Associated with Paleozoic Granite Plutons

Tungsten, copper, molybdenum and minor uranium minerals have been reported in association with mid-Paleozoic granitic intrusions such as those at Mount Sedgwick, Mount Fitton and Mount Hoidahl in the British and Barn Mountains. For the most part the principal "mineralization" (chiefly scheelite ± wolframite, minor gold) is in placers in creeks draining the areas underlain by the plutons (Gleeson, 1963; Cathro, 1969) but in a few instances, bedrock showings have been reported. Bell and Jones (1979) noted strong radiometric responses from granitic rocks of the Mount Sedgwick pluton (unit 1c) and its contact zones, as well as observing that disseminated chalcopyrite and molybdenite are present in fractures and shear zones in the granitic rocks. Scheelite (tungsten) is also known in gravels in streams draining the Mount Sedgwick area (Table 1, No. 21).

To the southeast in Barn Mountains, placer scheelite and minor gold and molybdenum have been recorded in creeks in the vicinity of the Mount Fitton stock and a gossan zone with pyrite mineralization was investigated by Archer Cathro and Associates in the early 1970s. Gleeson (1963) reported placer wolframite, scheelite and a little gold from near Mount Fitton (Hoidahl-Anker Creek Table 1, No. 10) and noted molybdenum flakes in nearby granitic rocks. Placer occurrences of tungsten and gold were also reported from nearby Mason and Annette creeks[2] (Western Miner, June 1952, p. 86). Vokes (1963, p. 228) reported tungsten and molybdenum-bearing skarns from the Mount Fitton area. In Old Crow Range, tungsten (scheelite) was recorded in heavy-mineral fractions of stream samples collected from creeks draining the area underlain by Old Crow Batholith (2dO) (Gleeson, 1963).

None of the reported "occurrences" known in this category are of particular significance in themselves and accurate information on many of them is scanty. However the apparent presence of widespread tungsten and other metals in creeks draining area underlain by the granitic stocks and their enclosing locally skarnified rocks suggests that these geological environments are of particular interest from a prospecting viewpoint. This viewpoint is supported by stream-silt geochemistry results over the northern areas in Barn and British Mountains (see I.5 "Geochemistry", this report).

c. Phosphatic Ironstones, Northern Richardson Mountains

The Lower Cretaceous flyschoid, sandstone-shale sequence (unit 5b, Map 1) of Northern Richardson Mountains contains phosphatic ironstone (siderite) beds locally grading 15-20% iron (Table 1, No. 7). The Mount Davies Gilbert (Delta Iron) occurrences were described previously (Geological Survey of Canada 1980b) and the following is excerpted from this earlier publication (p. 27).

> "Cretaceous sediments consisting of interbedded black shale, sandy shale, and siderite are exposed in the northern part of the Richardson Mountains along Cache Creek, Fish River, Boundary Creek, and Rapid Creek, between latitude 68°25' and 68°35'. Sections containing numerous siderite beds range in thickness from 500 to 1500 feet and contain 15 to 20 percent iron and 1.5 to 3 percent phosphorus (P_2O_5), with some individual layers containing as much as 14 to 20 percent P_2O_5. Thirteen specimens from the iron-rich beds analyzed at the Geological Survey of Canada averaged 22.5 percent iron, 13 percent P_2O_5 (phosphorus pentoxide) and 2.9 percent manganese (Young, 1972, 1973; Young et al., 1976; Young, personal communication, 1976).
>
> The siderite occurrences are of little interest as an iron resource because of their low grade, the intimate admixture of clay and phosphate minerals and their remote location. It is technically feasible to produce iron from this material, however, the processing methods are complicated and also costly because they involve high energy consumption."

In 1974 two claim blocks (DELTA, DAWN) were staked in the Cache Creek – Mount Davies-Gilbert area by Welcome North Mines Limited. In a joint venture with Bethlehem Copper Corporation Limited, Welcome North conducted geological mapping and sampling over ironstone sections in the Fish Creek and Rapid Creek areas. In the Fish River section average assays (16 samples) were total Fe – 20.5%; Mn – 2.2%; P – 2.1%. In the Rapid Creek area assays (5 samples) averaged: total Fe – 16.7%; Mn – 0.73%; P – 3.0% (Sinclair et al., 1976).

In addition to phosphate, iron and manganese the ironstones contain local assemblages of exotic phosphate-silicate minerals, including lazulite[3], wardite, kulanite,

[1] Samples 9 and 10, Table 1, Bell and Jones (1979), p. 398. In this table the samples are identified as from the TAB claims (R.T. Bell, personal communication, 1980).
[2] "Lode" occurrences of wolframite and gold were also reported (op. cit.) but, as far as known, these have never been verified.
[3] Now the official mineral of Yukon Territory.

brazilianite, arrojadeite and others that are in demand by mineral collectors (Mandarino and Sturman, 1976; Mandarino et al., 1977).

d. Placer Gold

Apart from minor placer gold reported from creeks in the Mount Fitton area (previous section) the only other localities from which placer gold has been recorded in northern Yukon region is in gravels of Firth River and Sheep Creek, a left limit[1] tributary of the Firth in central British Mountains. Little information is available concerning the Firth River occurrences (Table 1, No. 2) beyond reports that minor gold was recovered from gravel bars along the left limit of the river (see below). At the Sheep Creek location (Table 1, No. 1) placer claims on Sheep and an upper right-limit tributary, Porcupine Creek, have been explored intermittently over the past few years. The available information on these occurrences was summarized in Geological Survey of Canada 1980b and the account following is taken from that publication (p. 52).

> "According to hearsay, placer gold was recovered from the bars of the Firth River as early as 1899 (Sandy, 1948). A small staking rush took place in the winter of 1947-48. However, there is little recorded production of placer gold from the Firth River. Sixty ounces were reputedly recovered in 1935 (Sandy, 1948). Minor amounts were recovered in 1973 (Sinclair and Gilbert, 1975) and as much as 55 ounces was produced in 1979 from a location at 69°10'N, 140°09'W on Sheep Creek, a left limit tributary of the Firth River (G. Gilbert, pers. comm., 1980).
>
> According to Sandy (1948), the gold on the Firth River occurs in gravel benches and bars for a distance of 30 miles below the mouth of Joe Creek. The gold occurs mainly as small, well-worn, flattened grains about the size of rolled oats. The source of the gold is uncertain. The area was not covered by Laurentide glaciation and D.K. Norris (pers. comm., 1980) considered the probable source to be sedimentary rocks of the underlying Neruokpuk Group. Sandy (1948) reports rumours of 'quartz samples streaked with gold' and observed quartz stringers with 'iron and specks of copper' in the area but no bedrock source for the placer gold has been documented."

e. Coal

The distribution and character of the three principal coal-bearing units (Mississippian Kayak Formation, Lower Cretaceous "coal-bearing division" and lower Tertiary Reindeer Formation) in northern Yukon are discussed in a following section (II.2 Assessment of Coal Potential). Table 1 lists a number of specific showings, the locations of which are shown on Map 1. The Coal Mine Lake locality (Moose Channel Mine, Table 1, No. 6) is included here for reference, although it is located in N.W.T. The mine produced coal for local use for many years up until 1956. The coal was classified as sub-bituminous "A" to high volatile "C" bituminous, with a calorific value of 11 080 B.T.U. per pound (Young, 1975).

Smaller high-volatile bituminous coal seams were also reported in Lower Tertiary Reindeer Formation rocks on Eagle Creek (Table 1, No. 5; Young, 1975, p. 44 and Table 5, this report). Other coal localities (mainly lignite) have been reported in Lower Tertiary (Reindeer Formation) or Upper Cretaceous (Moose Channel Formation) rocks near Arctic Coastal Palin (Table 1, Nos. 4 and 3) but information on these occurrences is sketchy.

Coal (anthracite) was reported (Norris, 1974b) in Early Cretaceous strata along a tributary of Bell River (Table 1, No. 17). It occurs ". . . in seams up to one foot thick as interbeds in dark grey fine grained sandstone deformed into tight folds" (op. cit., p. 348). Anthracite seams have also been reported in Mississippian Kayak Formation strata at several localities, mainly in Romanzof and Barn Uplift areas (Norris, 1974b, p. 348; Norris, 1972b, p. 95; see also Table 5, this report).

f. Lead-Zinc

In northern Keele Range, southeast of Old Crow, minor sphalerite in a small outcrop of silicified limestone breccia carrying calcite veinlets was reported, along with similar mineralization in float (Table 1, No. 20). Claims (LORD) were staked in the showing area in 1974 (Brascan Resources Limited) and geological mapping, soil geochemistry and limited trenching (blasting) was carried out. (Sinclair et al., 1975, p. 85). As far as known, no further work was done on the property.

Lead-zinc mineralization has also been reported northwest of Old Crow near the Alaskan border (Table 1, No. 19). Claims were staked (British Mountains Syndicate) in 1963 over an occurrence ". . .reported to cover an extensive area containing lead-zinc mineralization with low precious metal values" (Green and Godwin, 1964, p. 18). Mineralization reportedly consists of galena and sphalerite with quartz in granitic rocks of the Old Crow Batholith (2d0).

Mineral Occurrences in Alaska Near the Yukon Border

A number of metallic mineral occurrences have been reported from two areas in Alaska close to the Yukon border (Fig. 1). In the Porcupine River – Old Crow Mountains area ("A" of Fig. 1) several showings of uranium, tin, copper, lead and zinc are present in granitic rocks of Old Crow Intrusion and in metasedimentary rocks near the intrusive contacts (Barker and Clautice, 1978). In the latter case, in situ copper, lead, zinc and minor tin mineralization occurs near the southern margin of Old Crow Intrusion in a Paleozoic metasedimentary sequence that includes phyllite, argillite, quartzite and limestone that has been invaded by rhyolite dykes and sills. The rhyolite is thought to be younger than the Old Crow granitic rocks.

In this same general area gravels in rivers and streams draining Old Crow Mountains contain tin, tungsten, niobium and rare earth minerals (op. cit., p. 10).

Southwest of Firth River in the Eastern Brooks Range of Alaska (Area "B" of Fig. 1) several types of mineral occurrences are associated with the Bear Mountain intrusion and enclosing volcanic and metasedimentary rocks of the upper Coleen River area (Barker, 1978). Surface sampling of a highly weathered volcanic breccia indicated copper, molybdenum, tungsten and lead ". . .in amounts sufficient to warrant more investigation" (op. cit., p. 7). Samples contained up to 770 ppm W, 740 ppm Mo and 420 ppm Pb (p. 22). On Galena Creek (draining Bear Mountain) lead, zinc, and copper mineralization occurs in a vein system up to several feet thick exposed over a distance of about 2000 feet (p. 7). "In addition, small widely scattered veinlets of galena (lead) and sphalerite (zinc) were found disseminated in metamorphic siltstone over an area of about 160 acres" (p. 7).

The Bear Mountain area mineralization is of particular interest in connection with the Yukon situation because of the presence on the Yukon side of the border of the mid-Paleozoic Ammerman granitic intrusion (Map 1 unit 2dA), its enclosing Upper Devonian argillite-shale assemblage (Map 1 unit 2b) and the strong geochemical response for lead in stream-silt samples from creeks draining the area (see I.5 "Geochemistry", this report).

[1] A tributary flowing in from the observer's left side, when facing downstream.

Table 2. Geochemistry of rock samples from mineral properties and geochemically anomalous areas in the Blow River and Demarcation Point map-areas, northern Yukon

Element	Property Names: BON (14)[1]		BOU (12)	LIN (15)		MAM (11)			Sedgwick Batholith		Cambrian Volcanic Rocks (1b)[2]		Barn Uplift Shale (2c)
Oxide(%)	(1)[3]	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
SiO_2	49.6	57.8	34.0	72.2	71.1	60.4	---	---	65.0	---	46.0	45.0	78.3
Al_2O_3	13.9	8.5	4.1	1.0	1.6	2.9	---	---	15.5	---	11.3	12.1	9.9
TiO_2	0.23	0.16	0.10	0.02	0.06	0.16	---	---	0.55	---	2.0	2.6	0.64
Fe_2O_3	0.20	1.5	13.6	0.20	4.9	1.7	---	---	1.1	---	3.3	5.9	0.0
FeO	0.30	0.0	0.50	0.0	0.20	13.8	---	---	2.8	---	7.3	8.4	2.6
MgO	0.07	0.06	0.21	0.07	0.07	3.0	---	---	1.7	---	13.2	6.4	1.5
CaO	9.6	12.0	23.3	15.60	12.31	15.7	---	---	4.1	---	9.2	6.6	0.07
Na_2O	0.0	0.10	0.0	0.0	0.20	0.50	---	---	2.7	---	1.9	0.71	0.0
K_2O	0.53	0.29	0.44	0.4	0.12	0.80	---	---	4.5	---	0.18	0.64	2.1
MnO	0.002	0.16	0.03	0.0	0.0	1.04	---	---	0.6	---	0.22	0.18	0.0
P_2O_5	14.20	13.20	19.0	12.0	9.40	0.31	---	---	0.28	---	0.20	0.26	0.16
CO_2	0.10	0.20	0.50	0.2	0.20	0.70	---	---	1.2	---	0.50	3.7	0.0
H_2O	5.4	3.6	3.8	0.5	1.4	0.7	---	---	0.0	---	5.4	5.9	3.7
S	0.2	0.1	0.0	0.0	0.0	0.10	---	---	0.0	---	0.0	0.0	0.0
Element (ppm)													
Zn	36	133	356	46	158	126	167	186	31	233	88	117	163
Cu	20	58	533	6	10	3	7	20	4	250	89	112	55
Pb	28	28	18	11	10	4	63	176	10	63	1	2	19
Ni	20	84	243	5	57	1	2	2	4	31	530	588	53
Co	3	159	12	1	18	18	15	15	10	23	65	74	2
Ag	0.6	2.6	0.2*	0.2*	0.2*	0.2*	0.2*	0.7	0.2*	2.5	0.5	0.1	0.1
Mo	2*	2*	5	2*	2*	1035	833	25909	5	9	1*	1*	4
W	1*	4	1*	1*	1*	360	13000	---	1*	14	---	---	---
U	448	388	195	73.6	45.8	78.3	1160	1685	5.7	106	---	---	---
F	6900	7100	12000	7500	6600	350	700	315	705	205	---	---	---
Sr	34000	19000	1540	70	50	---	---	---	616	---	---	---	---
Ba	3900	2510	571	91	91	---	---	---	1370	---	---	---	---
B	109	107	50*	50*	50*	---	---	---	50*	---	---	---	---
Cr	338	185	241	5*	5*	---	---	---	5*	---	---	---	---
Zr	113	126	102	37	83	---	---	---	161	---	---	---	---

[1] Refers to property listing no., Table 1 and Map 1

[2] Refers to sub-area unit, Map 1

[3] See "Rock Descriptions", following

Notes: * at or below the detection limit
--- element not determined

5. REGIONAL GEOCHEMISTRY OF NORTHERN YUKON

by

W.D. Goodfellow

Introduction

Reconnaissance geochemical surveys of the Blow River (117A), Davidson Mountains (117B), Demarcation Point (117C), and Herschel Island (117D) map-areas were carried out during the summer of 1978 as part of the Uranium Reconnaissance Program. During the course of this work, stream sediment and water samples were collected at 2094 sites over an area of approximately 10 500 square miles (4050 km^2) giving an average sample density of one per five square miles. The minus -80 mesh fraction of stream sediment was subsequently analyzed for Zn, Cu, Pb, Ag, Co, Ni, Mn, Fe, Ba, Mo, W and U; the waters were collected unacidified and determined for U, F and pH. The results were released in tabular form with accompanying symbol-plot maps in GSC Open File 565[1] (Goodfellow, 1979).

Surficial Geochemical Distribution of Elements

Groups of three elements chosen on the basis of common geochemical associations were plotted on 1:500 000 – scale geological base maps for the northern Yukon using the system of parallel, vertical and horizontal lines to represent each element (Maps G-1, G-2, G-3, G-4, in pocket). Only areas containing element concentrations greater than the 95 percentile for the total data set were outlined on each map. The number of elements comprising each group was restricted to three to avoid confusion resulting from overprinting. In addition to the three elements, the major pH ranges are stippled on each map to assist interpretation of the surficial geochemistry. The four geochemical maps are discussed in the following sections.

Zinc, Lead and Silver (Map G-1):

In general, there is an anomalous trend of all three elements that runs from Barn Uplift in the southeast where Paleozoic rocks are exposed, to the northeastern margin of Romanzof Uplift in the northwest where Proterozoic phyllite and quartzite occur. The Barn Uplift shows coincident and extensive Zn, Pb and Ag anomalies in areas underlain by Lower Paleozoic black carbonaceous shale and mid-Paleozoic granitic stocks located on the northwest side of the Uplift. The Ordovician shales host no known mineralization, although there is potential for stratiform shale-hosted Pb-Zn deposits similar to those that occur in rocks of the same age and composition situated in the Selwyn Basin further to the south. An unmineralized sample of shale taken from this area contains normal contents of most base metals (Table 2).

The mid-Paleozoic granitic rocks at Mount Fitton, on the other hand, host known skarn-type Mo-W-U mineralization (e.g. MAM property, see Table 1, No. 11). Mineralization is mainly molybdenite, scheelite and uraninite that occur disseminated throughout a calc-silicate skarn zone. Three rock samples taken from this property contain U, W and Mo ranging up to 1685 ppm, 13 000 ppm and 25 909 ppm respectively (Table 2).

To the northwest, on the northern border of the Sedgwick batholith, a coincident Pb-Zn anomaly may indicate vein-type Pb-Zn and possibly Ag mineralization. Considering the lower mobility of Ag observed for this area, the high detection limit and the low sample density, the absence of Ag in the stream sediment does not necessarily indicate the lack of Ag mineralization.

The eastern margin of the Romanzof Uplift, underlain by Proterozoic phyllite and quartzite of the Neruokpuk Formation (Pn2; Unit laa of Map 1) is outlined by a trend of coincident Pb + Zn ± Ag anomalies. Although no mineralization has been discovered to date, the element associations

Rock Descriptions to accompany Table 2

(1) Rusty-weathering radioactive chert-pebble conglomerate with a sandy phosphatic matrix. Mineral hosting uranium not identified. Taken from the Kayak Formation of Carboniferous age. (117A 779001)[2]

(2) Rusty-weathering chert-pebble conglomerate with a sandy matrix cemented with apatite. Cream coloured uranium mineral present in the matrix identified as hinsdalite. From the Kayak Formation of Carboniferous age. (117A 779003)

(3) Rusty, brecciated, silicified siltstone with high radioactivity restricted to a limonitic, phosphatic matrix. Probably from Mississippian Kayak Formation or Kekiktuk Conglomerate.

(4) Pale grey, brecciated, intensely weathered chert with uranium mineralization associated with apatite in fractures. From the unnamed Cretaceous quartzite. (117A 779005)

(5) Essentially the same as previous sample. (117A 779006)

(6) Radioactive contact between the Mount Fitton granite and the enclosing rocks, mostly Ordovician-Silurian pyritic shale. (117A 779014)

(7) Skarn zone near the margin of the Mount Fitton granite containing wolframite, scheelite, molybdenite and uranium mineralization. (117A 779011)

(8) Essentially the same as the previous sample. (117A 779012)

(9) Intensely weathered granite from the Sedgwick batholith. (117A 779019)

(10) Rusty brown pyritic silicified zone within the Sedgwick batholith. Highly radioactive. (117A 779020)

(11) Dark green altered basalt from the Cambrian volcanic pile near the Alaska border. (117C 789006)

(12) Brown-weathering green amygdaloidal basalt of Cambrian age. (117C 789020)

(13) Dark grey to black carbonaceous shale of Ordovician-Silurian age. (117A 789011)

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[1] Subsequently a folio of small-scale (1:2000 000) coloured compilation maps for individual elements was released as Geological Survey of Canada Open File 730.

[2] Refers to National Topographic Series map sheet and sample number.

and linear nature of the anomalies suggest that they may reflect poorly-exposed felsic intrusions similar to those occurring at Mount Sedgwick and Mount Fitton further to the southeast.

Other areas that are anomalous in one or more of these elements, include areas underlain by the Lisburne Group of Carboniferous age (Unit 1d, Map 1), the Permian clastics situated north of White Mountain (Unit 4d, Map 1) and the Ammerman stock (Unit 2dA, Map 1) located on the Alaska border just north of the Old Crow basin. The Ammerman stock is of particular interest considering the large and intensive Pb anomaly reflected in streams draining this area.

Uranium, Molybdenum and Fluorine (Map G-2):

The northwest anomaly trend described above for base metals is also outlined by the distribution of U, Mo and, to a lesser extent, F. The coincidence of U and Mo anomalies is high in areas underlain by the granitic plutons that occur near Mount Fitton and Mount Sedgwick. This is not surprising considering U, Mo and W mineralization occurs associated with the Mount Fitton stock (e.g. MAM property Table 1, No. 11 and Table 2) and Mo and W mineralization as well as anomalous uranium have been reported for the Sedgwick batholith (Table 2 and "Evidence of Mineralization" this report). Although not shown on Map G-2 streams draining both of these plutons are highly anomalous in W, ranging up to 32 ppm (Table 3, in pocket). The absence of a U or Mo anomaly in streams draining the Ammerman stock suggests a different type of mineralization, mostly Pb-bearing, associated with this pluton.

The trend of Mo, U and F anomalies continues northwest of Mount Sedgwick along the eastern margin of the Romanzof Uplift, where phyllite and quartzite of the Neruokpuk Formation (Pn2) are exposed. Anomalous elements associated with this formation include Mo, U, W, Ag, Pb, Zn, Cu, Mn and Fe (Table 3, in pocket). Tungsten levels are particularly high, ranging up to 55 ppm. Although mineralization has not been recorded from this area, the element associations, as well as the linear character of the anomalies extending northwest of Mount Sedgwick and Mount Fitton, suggest strongly that the area may be underlain by mineralized plutons.

Moderate U and F anomalies are present in streams draining the BON and BOU uranium properties (Table 1, Nos. 14 and 12). Here, the U mineralization occurs in the matrix of chert-pebble conglomerates and breccias of the Kayak Formation. The mineralization consists of uranium phosphates such as hinsdalite and, as a result, contains very high contents of P, F, Sr and Ba (Table 2). Considering the chemical stability of uranium phosphates in the surface environment, it is not surprising that there is only a weak geochemical response from these occurrences. Streams draining the Kayak Formation are, nevertheless, high in U when compared with other formations of Carboniferous age (Table 3).

Other areas showing Mo and/or F geochemical responses include those underlain by the Lisburne Group (Unit 1d, Map 2), the Boundary Creek Formation (Unit 5C, Map 1) and the Cretaceous phosphatic iron formation (Unit 5b, Map 1). The large Mo and F anomaly in streams draining the Lisburne Group near the Alaska border is as yet unexplained. Possible sources for this anomaly would include phosphatic shales high in these elements or mineralized felsic igneous rocks. The high F associated with the Cretaceous rocks situated west of the Yukon – NWT border is derived from apatite that occurs in both the phosphatic shales of the Boundary Creek formation and the phosphatic iron formation.

Near the Driftwood High, in an area underlain by Paleozoic shales, the streams sediments contain high U and Mo, probably reflecting U mineralization that occurs associated with phosphatic shales immediately to the south (e.g. NET property, Table 1, No. 16).

Copper, Cobalt and Nickel (Map G-3):

In general, there is a belt of Cu ± Ni ± Co anomalies extending from the Barn Uplift to the eastern margin of the Romanzof Uplift. The streams draining the Lower Paleozoic shales forming the core of the Barn Uplift are anomalously high in Cu over the whole area and locally high in Co and Ni. Two areas of coincident Cu ± Co ± Ni anomalies are present. One is situated near the Mount Fitton stock and the other to the southwest, just north of the BOU U property (Table 1, No. 12) The sources of these anomalies are unknown.

The eastern margin of the Romanzof Uplift, comprising phyllite and quartzite of the Neruokpuk Formation, is enriched in Cu over large areas and locally in Co and Ni. Although the sources of these anomalies are unknown, the possibility of mineralized plutons occurring in the area must be considered.

Other areas where coincident Cu ± Co ± Ni anomalies occur include the Cambrian mafic volcanic pile of basaltic composition situated near the Alaska border (Unit 1b, Map 1). Although not considered to have much economic potential, the Ni content can range up to 588 ppm (Table 2).

Isolated areas that are anomalous in Cu include: the Timber-Muskeg Creek outlier, underlain mainly by Cretaceous shale and quartzite; the Driftwood High, comprising Cambro-Ordovician shales; and, a locality near the southeast margin of the map-area underlain by clastics of the Sadlerochit Formation[1]. Mineralization is not known in these areas although they must be considered to have some potential for Cu. The Sadlerochit Formation is of particular interest considering the common occurrence of Cu mineralization in sandstones described elsewhere.

Iron, Manganese and Barium (Map G-4)

Barium anomalies with corresponding Mn and Fe are common in areas underlain by phyllite and quartzite of the Neruokpuk Formation (Pn2) in northeastern Romanzof Uplift. As with other anomalous elements in this area, the source of these anomalies has not been determined.

The Barn Uplift contains high Mn in areas underlain by Lower Paleozoic shale and anomalous Fe and Ba near the northern contact with the Mount Fitton stock. In this area, the high Fe and Mn reflect pyritic calc-silicate skarns associated with the MAM property (Table 2).

The streams draining the Cambrian mafic volcanic pile situated near the Alaska border and the Timber-Muskeg Creek outlier contain high contents of Fe and Mn. Several other isolated Mn anomalies are distributed throughout the map-area, the most important of these being in areas underlain by lower Paleozoic shales just north of the Old Crow basin, and by Cretaceous shale and phosphatic iron formation between the Barn Uplift and the Yukon-NWT border. In the latter case the high Mn probably reflects Mn tied up in siderite that forms a major constituent of the phosphatic iron formation. Although there are some high Fe contents in streams draining the phosphatic iron formation (Table 3), the overall response is generally low. The low pH of the streams in this area (Map G-4) would favour the retention of Fe in the stream water thereby preventing it from becoming part of the stream sediment.

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[1] Not evident from generalized geochemical map G-3 but is apparent from raw geochemical data plots of this area. See Goodfellow, 1979.

Influence of Environment Factors on the Surficial Geochemistry

Unlike most of the Yukon and Canada, northern Yukon was not subjected to continental glaciation during Pleistocene time. As a result, surface weathering has been extensive and prolonged over millions of years, most likely throughout Cenozoic time. The rocks are therefore highly weathered, oxidized and leached of most of their base metals, particularly those that occur most commonly as sulphides. Elements that would be stable under these conditions would include those that form resistant oxides such as scheelite and cassiterite and those that form stable minerals in the oxidized state such as uranyl phosphates similar to those occurring at the BON property.

Since the geochemical response measured in stream sediments and waters reflects strongly the geochemistry of the underlying rock formations, rocks that are leached of most of their economically important elements at the surface will produce a suppressed response in the drainage system. This would be the case whether the elements are disperesed by clastic processes such as in areas of high relief (e.g. Romanzof Uplift and Barn Uplift) or hydromorphically such as in areas of low relief where most elements are transported in solution.

Evidence for a suppressed response in the stream system, at least when compared to glaciated areas of the Yukon, was provided from detailed studies of streams draining the BON and BOU U occurrences. In both cases, the U response in the stream sediments and water was low and the dispersion train was very short, generaly less than two miles. On a regional scale, as shown on Map G-2, these occurrences are barely outlined by the geochemistry. The LIN property (Table 1, No. 15) was not detected by stream sediment geochemistry, which was not surprising, considering the low sample density.

Taking these factors into account, care must be exercised when assigning levels of priority for the various elements considered likely to form mineral deposits in the northern Yukon. Although the surficial geochemical response might be low when compared to other terrains that have not been weathered intensively, the mineral potential may be just as significant, although deposits may be more difficult to discover using conventional exploration techniques.

Summary and Conclusions

On the basis of regional geochemistry and the location of mineral occurrences, several stratigraphic formations that are represented in the northern Yukon and are considered to have mineral potential are discussed below:

1. The Neruokpuk Formation phyllite and quartzite (Pn2, Unit 1aa, Map 1) exposed on the eastern margin of the Romanozof Uplift. This package of clastic rocks is moderately to highly anomalous in most of the elements determined, particularly Mo, W, U, Ag, Zn, Cu, Pb, Ni, Co and Ba. Although the source of these anomalies is unknown, their element associations and linear character suggest that plutons similar to those exposed to the south at Mount Fitton and Mount Sedgwick may be present to the north as part of an arcuate belt of intrusive bodies extending through the region. If this interpretation is correct, the potential for Mo, W U and certain base metals must be considered relatively high in the light of similar mineralization associated with granitic stocks and enclosing skarn rocks near Mt. Fitton.
2. The Road River Formation comprising Lower Paleozoic shales exposed in the Barn Uplift, Driftwood High (Unit 2C, Map 2) and forming a belt along the northern margin of Old Crow basin (Unit 2b, Map 1). Areas within these lower Paleozoic shales are anomalous in Zn, Pb, Ag, Mo, U, F, Ba, Mn and Fe. Stratiform Pb-Zn mineralization similar to deposits occurring in the Road River Formation of the Selwyn Basin (e.g. Howards Pass deposits) may occur in these areas.
3. The Cambrian limestones and bioherms (Unit 4a, Map 1) located north of White Mountain are intersected by streams that are very anomalous in Pb. Considering the character of these rocks, they must be considered to have potential for Mississippi Valley – type Pb-Zn mineralization.
4. The Lisburne Group of Carboniferous age exposed over a large area comprises lithologies that consist mostly of massive limestone considered unlikely to host Pb-Zn mineralization. However, locally where coincident Pb-Zn anomalies occur such as north of the Timber-Muskeg Creek outlier, dolomitic lithologies more likely to host base metals may occur. The large Mo-F anomaly over these rocks near the Alaska border is unexplained but may reflect a shallow intrusive body hosting Mo mineralization.
5. The Ammerman stock situated on the Alaska border just north of the Old Crow basin is rated as having a high potential for Pb considering the extensive Pb anomaly surrounding this pluton. This area is of particular interest in the light of known mineralization (Cu, Pb, Zn, Mo, W) associated with a similar belt of rocks on the Alaska side of the border (see "Evidence of Mineralization", this report).
6. The Permian Sadlerochit Formation, composed of clastics and intersected by streams anomalous in Cu in several areas must be rated as having potential for sandstone-hosted copper deposits.

PART II

MINERAL AND FUEL RESOURCE ASSESSMENTS

I. METALLIC MINERALS

Methodology

Assessments of mineral potential were made for individual sub-areas outlined on Map 1 using techniques developed in earlier studes (Geological Survey of Canada 1980a, 1980b) modified to incorporate the regional geochemistry data available for northern Yukon. Unlike earlier studes (e.g. Geological Survey of Canada 1980b) the process used here did not attempt to assign ratings or judgments on the potential for economic development of undiscovered mineral deposit-types that may be present in the area. In part, this is because the data base, in terms of presently-known deposits, is too sparse to allow the application of economic development models at this stage.

The assessment process thus involved subjective judgements as to the potential for occurrence of deposits containing the various metals and commodities considered, without regard to the potential such undiscovered deposits may have for eventual economic development.

A two-stage rating process was used in this study. First, the local geological environments as outlined in the various sub-areas of Map 1 were considered from the viewpoint of whether or not they show recognizable geological characteristics (rock types present, lithological characteristics, depositional or intrusion environments, etc) that suggest a potential for particular deposit-types or commodities. Second, the geochemical response over the sub-areas or over particular rock units within the sub-areas was rated according to the degree to which the geochemical results were judged to reflect abnormal metal concentrations in the environment. In this latter process, allowances were made for differences in geochemical response or subdued responses that might be due to the effects of environmental factors such as deep weathering (absence of glaciation), variations in physiography and drainage gradients and the like. Because of such modifications the relative interpreted values or ratings for geochemical response did not always coincide with the relative direct response as portrayed on maps G-1, G-2, G-3 and G-4. The rating system was as follows:

G/L where G = interpreted geochemical rating
and L = lithostratigraphic rating.

The lithostratigraphic rating incorporated judgments of the potential of the environment to contain deposits of various commodities (gold, silver, lead, zinc, etc) and was influenced, where applicable, by evidence of known mineralization. The scales used in the rating scheme were:

Geochemical Interpretation	Lithostratigraphic Rating
0 - Nil	N - Nil
1 - Weak	L - Low
2 - Weak-Moderate	LM - Low-Moderate
3 - Moderate	M - Moderate
4 - Moderate-Strong	MH - Moderate High
5 - Strong	H - High

It should be emphasized that, in both cases, ratings assigned were relative. For example a rating of 3/M for zinc would mean that, relative to other zinc responses in the study region the one in question is interpreted as moderate and relative to other lithostratigraphic environments of the study region, the one in question is considered to have a moderate potential to contain zinc mineralization. The translation of relative ratings to absolute ratings is subjective and difficult because it requires the use of "control" responses (geochemical), environments or models that can be used as yardsticks or calibrators. In the case of the northern Yukon study such controls are not available, in terms of major known deposits in well-documented geological environments or in terms of documented geochemical responses to significant or major mineral deposits. Thus, the assessment ratings derived for the various metals and commodities considered in this study can be considered as indicative only; their resolution and refinement to yield more accurate and predictive values requires considerably more detailed geological and geochemical information than is presently available.

Summary of Assessment Results

Table 4 summarizes assessment ratings derived for the twelve metals or commodities considered. For convenience, the results of assessments for coal, discussed in a following section, are also included in Table 4. On Table 4 sub-areas or parts of sub-areas where commodity potential of moderate or higher ratings were derived, have been highlighted. It should be cautioned that the ratings are not intended to imply point-source potential; they indicate only that at one or more unspecified localities within the sub-area in question, it is considered that a moderate or greater potential exists for the presence of undiscovered mineral deposits of the commodity being considered.

Discussion of Assessment results (Table 4)

1. Romanzof Uplift

The most significant general mineral potential of Romanzof Uplift is associated with the belt of clastic Neruokpuk rocks (Unit 1aa, Map 1) extending northwest of the Mount Sedgwick area. This was assigned primarily on the basis of the stream-silt geochemistry results. As noted previously anomalous geochemical trends for uranium, copper, silver, lead, zinc, barium, molybdenum and tungsten were interpreted as representing possible additional undetected granitic intrusions of the Mount Sedgwick type. These may be shallow-level intrusions that do not outcrop or are covered by surficial materials. Alternately, they may be represented by very small cupolas of granitic material similar to the Hoidahl stock in the Barn Uplift area to the southeast (see Map 1) that were not detected on the scale of mapping to date.

There is also a possibility that Neruokpuk strata may host mineralization in themselves. Because of the clastic nature (quartzite, phyllite) of the northeast sector of the belt, sandstone-type uranium, copper or lead mineralization are possibilities. Because of the geochemical element associations and distribution patterns however, it is considered that the possible existence of mineral occurrences with economic potential is more likely to be associated with undetected granitic intrusions or associated features such as vein stockworks or acidic (rhyolitic) dykes.

The general Mount Sedgwick area at the southern end of Romanzof Uplift has associated uranium, copper and tungsten indications, although no significant mineral showings have been found. Geochemically, the area shows significant response for uranium and lead, and lesser responses for the other elements present over Neruokpuk terrane to the

Table 4. Summary resource assessment ratings for northern Yukon, by commodity

Regions and sub-areas / Commodity	U	Au	Ag	Cu	Ni	Pb	Zn	Ba	Fe	Mn	Mo	W	C	Remarks
1. Romanzof Uplift														
1aa	3/M*	/M*	4/LM	5/LM	2/L	2/M ?	3/M ?*	5/M ?*	3/LM	4/LM	4/M*	/M*	/N	Possible blind or near-surface intrusion in this area. Similar geochemical responses to Wernecke Mtn. breccias, Central Yukon
1a	0/LM	/M*	0/L	2/LM	1/L	3/LM	0/LM	2/M	1/L	1/LM	2/LM	/L	/N	Minor W and Cr in creeks (heavy mineral samples); may have originated from 1b
1b	1/L	/L	0/L	4/M*	3/M*	0/N	1/L	0/L	2/L	2/L	0/N	/LM	/N	Minor W and Cr in heavy mineral creek samples
1c (Mt. Sedgwick)	4/M*	/M*	0/M ?	2/M	1/N	3/LM	2/LM	2/L	0/N	1/N	2/M	/MH*	/N	W known in creeks. Minor Cu and U occurrences?
1d	2/M	/LM	0/L	1/LM	1/L	2/LM	1/M	2/LM	1/N	1/N	0/N	/N	/M*	Coal in Kayak Fm.
1e	1/L	/L	2/LM	1/L	1/N	1/LM	1/LM	2/LM	2/L	2/L	0/L	/N	/L	
2. Old Crow-Babbage Depression														
2a	/LM	/L	/LM	/LM	/N	/LM	/LM	/LM	/LM	-	/LM	/LM	/N	Possible U, Mo and W in rocks affected by Old Crow granite, Pb, Zn, Ag in dolomites?
2b	1/M	/L	0/LM	1/LM	1/L	3/MH*	2/MH	1/M	2/LM	3/LM	0/LM	/M*	/N	Possibilities of volcanic rocks in section (geochemical). Moderate Pb, Zn, Mn response
2c	4/M*	/LM	0/LM	5/M*	4/LM ?	4/MH*	4/MH*	3/MH*	2/L	5/LM	4/LM	/M*	/N	Strong geochemical response in Barn Uplift area; weaker response in Driftwood High area, except for Mo, which is strong. Some response associated with Mt. Fitton pluton
2d0 (Old Crow Range)	/M*		/M*	/M*	/N	/M*	/L	0/N	/N		/M*	/MH*		(2d0) Reported Pb-Zn min (Table 1, 19); placer W in creeks. Known Pb, Zn, Cu, U, Sn, Mo on Alaska side
2dS (Schaeffer)														(2dS) – No data.
2dA (Ammerman)	2/M	/2	0/M	0/M	0/N	5/H*	2/L	0/N	0/N	1/L	0/MH		/N	2dA – Strong Pb geochemical response
2dF (Mt. Fitton)	3/M*		2/M	2/M	1/L	5/M*	2/L	1/L	L/N	1/L	5/H*	5/MH*		2dF – Placer W, Au in area; reported Mo and W in skarn; strong Cu, Zn, Pb, geochemical responses in Mt. Fitton area

Table 4. (continued)

Regions and sub-areas / Commodity	U	Au	Ag	Cu	Ni	Pb	Zn	Ba	Fe	Mn	Mo	W	C	Remarks
2e	1/MH	1/L	2/LM	1/LM	1/N	3/M*	3/M*	2/LM	2/L	1/L	4/LM			W and N.W. sector: local moderate – strong Pb and Zn. Strong Mo near Alaska border
2e[1]		1/L	2/LM	0/LM	3/N	4/M*	4/M*	1/LM	2/L	2/L	1/LM	/LM	/M*	SE sector: Moderate – strong Fe west of Mt. Fitton area
2g+f Timber Creek Muskeg Creek area	1/L		0/L	1/L	1/N	1/LM	2/LM	1/L	4/LM	4/LM	0/L			Timber-Muskeg Creek area: Strong Fe, Mn and Co response weak Ni, Zn. Strongly acidic waters. Possibility of phosphatic ironstones as 5b?
2f remainder	2/L	/L	0/L	1/L	1/N	1/LM	2/LM	2/L	3/LM	0/L	0/L	/L	/N	
2g remainder	2/L		2/L	1/L	3/N	2/LM	2/LM	1/L	3/LM	2/L	2/L			
3. Western Aklavik Arch														
3a	/LM	/LM	/L	/LM	/N	/LM	/LM	-	/L	-	/L	/L	/N	Possibility of U, Cu and Co environments in intrusive breccia. Some Pb – Zn potential (dolomites)
3b	/LM	/LM	/LM	/LM	/L	/M	/M	-	/L	-	/L	/L	/N	In part similar to 2c. Possible U, Au, Ag, Cu, Pb, and Zn environments
3c	/LM	-	-	/LM	-	-	-	-	-	-	/LM	/LM	/N	No information; possible U, Cu, Mo and W in associated skarns
3d	/LM	/L	/LM	/LM	/L	/M*	/M*	-	/L	-	/N	/N	/LM	Possible Pb, Zn, Coal environments
3e	/M*	/LM	/L	/LM	/N	/LM	/LM	-	1/L	-	/N	/N	/N	Possible U, Cu, Au environments in Permian conglomerates of Jungle Creek Formation. Possible Pb – Zn in Jungle Creek Formation.
3f, g, and h	/LM	/N	/N	/L	/N	/L	1/1	-	/L	-	/N	/N	/M*	Coal in Lower Cretaceous rocks? Possible U in sandstones?
4. Central Aklavik Arch – Richardson Mountains														
4a	/N	/L	/LM	/LM	/N	/M*	/M*	-	/N	-	/L	/LM	/N	Possible Ag, Pb, Zn in brecciated carbonate rocks. W in skarns? No geochemical data but strong Pb and moderate Zn from an area immediately to north

Table 4. (continued)

Regions and sub-areas / Commodity	U	Au	Ag	Cu	Ni	Pb	Zn	Ba	Fe	Mn	Mo	W	C	Remarks
4b	/L	/N	/LM	/LM	/N	/M*	/M*	-	/N	-	/L	/L	/N	Possible Pb, Zn environments in Road River shales
4c	/L	/L	/LM	/LM	/N	/M*	/M*	-	/L	-	/L	/L	/N	Possible Pb, Zn (± Ag) environments in Imperial Formation
4d	2/L	/N	3/LM	0/L	3/L	3/M*	4/M*	2/M	0/L	0/L	0/N	/N	/N	Possible Pb – Zn – Ag environment in Cache Creek High area
4e	0/L	/N	0/N	0/L	0/L	2/LM	0/N	0/N	0/N	1/L	0/N	/N	/M*	Coal in Lower Cretaceous. Possible Pb in ss; but geochemical response may be coming from Cache Creek rocks
5. Rapid Depression														
5a	1/LM	/N	3/N	1/L	1/N	1/L	1/L	2/L	2/L	4/LM	/N	/N	/M*	Possible coal in Lower Cretaceous
5b	2/LM	/L		2/L	3/N	1/L	2/L	2/L	5/MH*	4/LM	2/L	/L	/LM	
5c	1/M	/L	0/N	2/L	2/N	1/N	1/N	3/N	2/L	1/L	2/L	/N	/MH*	Moderate Co, Zn, Ni, Mo and strong Mn from area SW of Mackenzie Delta, in part underlain by 5c (Tent Island Fm.) but mainly unconsolidated deposits. May be transported response. Coal in Reindeer and Moose Channel Fms.
6. Eagle Plain – Bell Basin														
6a	/L	/L	/N	/N	/N	/L	/N	-	/L	-	/N	/N	/LM ?	No geochemical data. Coal in Eagle Plain Fm.
6b	/LM	-	-	-	-	-	-	-	-	-	-	-	-	

*Denotes areas considered to have moderate or greater potential for the commodity shown.

Regions and sub-areas (1a, 1b, etc.) – see Map 1.

2e[1] refers to areas underlain by Carboniferous Lisburne and Endicott Groups generally northeast and east of Old Crow Basin.
Commodity symbols: U – uranium; Au – gold; Ag – silver; Cu – copper; Ni – nickel; pb – lead; Zn – zinc, Ba – barium; Fe – iron; Mn – Manganese; Mo – molybdenum; W – tungsten; C – coal.

$^{1}/_{M}$ = weak geochemical (interpreted) response/moderate lithostratigraphic potential rating. (see text) northwest. In general, this entire northeast sector belt, from Mount Sedgwick to the Yukon Coastal Plain shows characteristics of a tungsten-molybdenum-(uranium plus or minus other metals) metallotect.

In the northwest part of Romanzof Uplift, Cambrian volcaniclastic rocks and limestone (Unit 1b, Map 1), extending from Alaska across the border into Yukon, yielded strong copper, nickel and cobalt geochemistry responses and chromite was previously recovered from heavy-mineral fractions of stream samples (Gleeson, 1963). The possibility exists that ultramafic rocks occur in this volcanic pile, but if so, they may be mantled by other strata. Examination of the area by several workers, including the present authors, failed to reveal ultramafic rocks in the section. It is probable that the copper, nickel and cobalt geochemical responses are attributable to magnesium-rich flows in the section, but the possibility of hidden ultramafic zones with associated copper-nickel mineralization cannot be ruled out. This minor element association may also suggest potential for volcanic-hosted massive sulphide deposits.

The areas discussed here lie entirely within the boundaries of the proposed Northern Yukon National Park.

2. Old Crow-Babbage Depression

A number of sub-areas in this region were rated as having moderate or greater mineral potential for several commodities. Generally from northwest to southeast these are: (1) Lisburne Group terrane of the general Firth River area near the Alaska border and to the southeast in Barn Uplift and Driftwood High areas (Unit 2e, Map 1 and Table 4); (2) Permian, Triassic and Cretaceous outliers of the Timber-Muskeg Creek area southeast of Firth River; (3) a belt of Devonian and possibly older (Road River Formation) shale, argillite and limestone extending from the Ammerman granite at the Alaska border across the north edge of Old Crow Basin (Unit 2b, map 1); (4) Road River Formation black shales and associated units of the Barn Uplift and Driftwood High areas northeast and east of Old Crow plain (Unit 2c, Map 1); and (5) the various Devonian granitic plutons, particularly Ammerman, Old Crow and Mount Fitton-Hoidahl (Unit 2d, Map 1).

As noted previously, Lisburne Group limestone lithologies do not, in general, appear to be favourable for stratiform-type lead-zinc mineralization but local areas where dolomitization and/or brecciation has occurred are potential target areas. Insufficient detailed stratigraphic/lithologic information is available to assess this but, in general, Lisburne strata in the northwest part of the region (Unit 2e of Table 4) near the margins of Romanzof Uplift and similar rocks to the east and southeast in the general Barn Uplift-Driftwood High belt (Unit $2e_1$ of Table 4) seem more favourable than Lisburne terrane in the interior parts of Old Crow Plain. Local moderate to strong lead-zinc geochemical responses were obtained in the northwest sector and in the Barn Uplift area.

The belt of ?Cambrian to Devonian[1] shales extending east from Ammerman Stock (Unit 2dA) at the Alaskan border is of considerable interest because of scattered Pb, Zn, Co and Mn responses, the very strong Pb response from the Ammerman stock vicinity and the mineralized volcanic breccia found in an apparently similar geological environment on the Alaskan side of the border (see "Mineral Occurrences in Alaska Near the Yukon Border", this report).

Black shales and associated lithologies of the Road River and related strata of Barn Uplift-Driftwood High belt (Unit 2c, Map 1) are of general metallogenic interest because of their important base metal mineralization elsewhere in Yukon (Selwyn Basin). Areas underlain in part by these rocks in the Barn-Driftwood belt yielded moderate to strong geochemical responses for a variety of elements, including U, Cu, Ni, Pb, Zn, Ba, Mn and Mo. Doubtless some of this response, particularly that for uranium, molybdenum and copper, is attributable to associated younger rocks of the same area (Unit 2e Endicott Group, Kayak Formation, Kekiktuk Conglomerate; Unit 2dF Mount Fitton-Hoidahl mid-Paleozoic granitic rocks) but in any case the general Barn-Driftwood belt remains an area favourable for a variety of possible mineral deposit types, including tungsten in the Mount Fitton-Hoidahl segment. Most of the known mineral occurrences in this part of northern Yukon lie in the general Barn-Driftwood belt (see Map 1). The possibility of placer gold should also be considered in streams draining this geologically complex area.

The Lisburne Group northwest sector, the Timber-Muskeg Creek area and the Ammerman-north Old Crow Basin belt (Units 2dA, 2b) all are contained within the present proposed National Park area. The Barn Uplift-Driftwood High belt lies to the east of the proposed eastern boundary of the Park but within the 1978 Land Withdrawal Area.

3. Western Aklavik Arch

No geochemical data are available for this region. Geological analysis suggests that, in general, it does not contain as many potentially favourable mineral environments as the northern areas. Exceptions occur in the case of the extensive Cambrian to Devonian shale-carbonate terrane southwest and south of Bluefish Basin (Unit 3b) and in the faulted package of Lisburne-Endicott group (Ettrain and Hart River Formations) strata of northern Keele Range along the northwest margin of Eagle Plain (Unit 3d). Because of reported dolomitic lithologies and, in the case of the Unit 3b assemblage, similarities with the Road River Formation, a moderate potential for stratiform-type lead-zinc mineralization was assigned. The reported LORD sphalerite showing (Table 1, No. 20) may occur in Endicott Group silicified limestone. A lesser potential for sandstone-hosted uranium, copper, lead-zinc and possibly gold (paleoplacer) exists in conglomerate and sandstone of the Permian Jungle Creek Formation and associated units (Unit 3e) overlying Carboniferous Endicott Group strata (Unit 3d) of northern Keele Range.

The subareas discussed above lie outside both the proposed National Park area and the southern boundary (Porcupine River) of the 1978 Land Withdrawal Area.

4. Central Aklavik Arch-Richardson Mountains

Geochemical data are available only for the northeast sector of this area in the vicinity of the White Uplift-Cache Creek Uplift. Cambrian brecciated carbonate rocks (dolomite, limestone) forming the core of the White Uplift (Unit 4a) were assigned a moderate potential for lead-zinc mineralization and a lesser (low-moderate) rating for silver. In part this is based on a strong Pb geochemical response and moderate Zn response from localities fringing the Uplift on the northwest, northeast and north. It is possible, however, that these geochemical anomalies are coming from Cache Creek (Permian) strata of the Cache Creek Uplift (Unit 4d). Coincident with the zinc anomaly over Cache Creek rocks north of White Uplift is an unexplained moderate nickel anomaly.

Road River shales of Rat Uplift area to the east and southeast of White Uplift (Unit 4b) were assigned a moderate potential for lead-zinc mineralization, based on the geological analogy with other Road River environments elsewhere in Yukon, but this assignment is speculative. No geochemical data are available for the Rat area. Similar moderate potential ratings were assigned for lead and zinc in

[1]Probably mainly Upper Devonian

Permian Cache Creek rocks (Unite 4d) and Devonian Imperial Formation strata (Unit 4c) south of Rat Uplift. Again, no geochemical data are available from this belt.

All of the Central Aklavik Arch-Richardson Mountains region lies east of the proposed National Park area. Except for the part lying east of the Yukon-N.W.T. boundary (Rat Uplift and northeast part of Cache Creek Uplift) most of the region lies north of the Porcupine-Bell River drainage within the 1978 Land Withdrawal Area.

5. Rapid Depression

With the exception of the belt of Cretaceous shales, sandstones and conglomerates (Unit 5b) that contain the widespread phosphatic ironstones of northeast Richardson Mountains (see Mt. Davies-Gilbert area, "Evidence of Mineralization" I.4, this report) little mineral potential is assigned to strata of Rapid Depression. Moderate Co, Zn, Ni, Mo and strong Mn responses were found in an area southwest of modern Mackenzie Delta (Unit 7d) that is in part underlain by Cretaceous or Tertiary clastics of the Tent Island Formation (Fish River Group) and associated formations (Unit 5c). These anomalies are difficult to interpret but since much of the near-coastal plain area here is mantled by unconsolidated (lacustrine, fluvioglacial) material it seems possible that they represent transported responses from surficial materials. A possibility exists, however, of uranium mineralization associated with sands of Cretaceous and/or Tertiary strata of the Fish River Group (Tent Island Formation, Boundary Creek Formation) by analogy with uraniferous rocks of the equivalent Smoking Hills Formation to the east in the Anderson Plain Northwest Territories coastal region (see Geological Survey of Canada 1980b, p.51).

6,7. Eagle Plain-Bell Basin and Yukon (Arctic) Coastal Plain

All of this region lies outside the proposed park but is within the 1978 Land Withdrawal.

Strata underlying these regions, as well as those of Old Crow Basin (2h) are of interest from the viewpoint of oil and gas potential and are discussed in a following section.

2. COAL

by
D.K. Norris[1]

Sources of Information

The following appraisal of the coal resource potential of northern Yukon Territory is based on reconnaissance mapping and stratigraphic studies comprising the Operation Porcupine project of the Geological Survey in 1962 as well as follow-up investigations of stratigraphic intervals of particular economic interest to the mining and oil industries. Principal sources of information were reports on the Carboniferous and Permian stratigraphy by Bamber and Waterhouse (1971), structural investigations by Dyke (1974, and unpublished data), stratigraphic analysis of the Lower Cretaceous clastic succession by Jeletzky (1960), regional structural and stratigraphic studies by Norris (1977, 1979) and F.G. Young's report on the Upper Cretaceous and lower Tertiary succession in the vicinity of Big Fish River (Young, 1975).

Definition of the Area

The area under consideration comprises that part of Yukon Territory between latitude 67°N and the coastline of southern Beaufort Sea and the Mackenzie Delta. Although geological mapping in addition to drilling would indicate the presence of coal-bearing formations offshore, the coal resource potential there is considered, for all practical purposes, as zero and will not be discussed further. The principal sub-areas in which coal bearing strata occur in northern Yukon are outlined on Map 1, and details are shown in text Figs. 4, 5, 6 and 7.

The Coal-Bearing Formations

There are three coal-bearing formations in northern Yukon Territory; the Mississippian Kayak, the Lower Cretaceous "coal-bearing division" and the lower Tertiary Reindeer Formation. The Kayak is largely confined to Romanzof and Barn Uplifts (Figs. 4, 5,). The "coal-bearing division" on the other hand, is widespread but known to contain coal only in northern Richardson Mountains (Fig. 6). Coal in the Reindeer Formation is confined to the lowermost lithostratigraphic assemblage, the Aklak Member. Onshore it is limited to the northwest flank of the Mackenzie Delta in the immediate area of the border between Yukon Territory and District of Mackenzie (Fig. 7) and to near the mouth of Babbage River (Map 1).

Main Geological Elements and Subelements

Northern Yukon Territory is made up of a number of tectonic elements and subelements (Norris and Yorath, 1980) exerting a fundamental control on the structural grain, Holocene physiography and areal distribution of the coal-bearing formations. Among the more important of these tectonic features insofar as the coal potential of the region is concerned, is the Aklavik Arch Complex (Fig. 2 and Map 1). It trends northeast, comprises rocks ranging in age from Precambrian to Late Cretaceous, and locally forms the northern Richardson Mountains. The Lower Cretaceous coal of the "coal-bearing division" occurs on its northwest flank in Bell River drainage.

To the northwest of the Aklavik Arch complex is the Old Crow-Babbage Depression, generally a structural and physiographic low, but clearly having a long antecedent history of differential uplift, bevelling, depression and sedimentation. On its east flank is Barn Uplift, exposing sedimentary rocks as old as Ordovician and Silurian (Map 1, 2c), and including the Mississippian Kayak Formation (2e). On its north flank is Romanzof Uplift with the sedimentary and volcanic formations in its core, locally covered with younger Phanerozoic clastics and carbonates, including and coal-bearing Kayak (1d). The remaining terrane northwest of the Aklavik Arch Complex and northeast of the Old Crow-Babbage Depression and Romanzof Uplift lies within Rapid Depression, a post-Paleocene structural sag mostly with late Early Cretaceous (Albian) and younger sedimentary rocks exposed (5a, 5b). It contains lower Tertiary coal in its northeastern part, adjacent to the border between Yukon Territory and District of Mackenzie as well as in its axial region in the lower Babbage River area (5c).

Geoscientific Base

The areal distribution of the three coal-bearing formations is derived from Open File maps of the Geological Survey (Norris, 1977, 1979, 1980) at scales of 1/250,000 and 1/500 000. Final coloured 1/250,000 scale maps of the region are in press and will comprise Geological Survey of Canada Maps 1514A (Herschel Island – Demarcation Point), 1516A (Blow River – Davidson Mountains), 1518A (Old Crow), 1519A (Bell River) and 1520A (Ft. McPherson).

[1]Geological Survey of Canada; Institute of Sedimentary and Petroleum Geology, Calgary.

Table 5. Coal-Bearing Formations – Northern Yukon Territory

Formation	Age	Locality	Area underlain by coal measures (km^2)	Max. no. of seams reported	Max. seam thickness observed (m)	ASTM rank[1]	Resource potential rating*	GSC Loc.	Stratigraphic control	Reference	Fig. (this rept.)
Reindeer	L.Tert. (Paleocene)	Deep Ck.	6	2	<1	HVB-C[2]	L	C-11263	117A27	Norris, 1972	6
		Eagle Ck.	13	>2	1	HVB-A[3]	L	-	-	Young, 1975	7
"Coal-bearing Division"	L.Cret. (Neocomian)	Bell R.	-	>2	<1	Anthr.[4]	N	C-27167	1056NC	Norris, 1974b	-
Kayak	U. Miss. (Visean)	Hoidahl Mtn.	18	>2	<1	Anthr.	L	C-4305	346NC	Norris, 1972, 1974b	5
		Barn Mts.	77	1	1	Anthr.	M	-	117A7	Dyke, unpubl.	5
		Romanzof Uplift	47	1	<1	Anthr.	M	C-11877	873NC	Norris, 1972, 1974b	4

*Assessment rating scale is after that of Geological Survey of Canada 1980b
[1] ASTM – American Society for Testing and Materials
[2] HVB-C – High Volatile Bituminous-C (11 500-13 000 Btu per lb)
[3] HVB-A – High Volatile Bituminous-A (> 14 000 Btu per lb)
[4] Anthr. – Anthracite

Coal Deposit Models

The Mississippian sedimentary succession of Romanzof and Barn uplifts contains a basal, (fluviatile?) chert- and quartzite-pebble conglomerate which grades upwards through coal-bearing clastics of the lower Kayak Formation into marine shale with interbedded limestone of the upper Kayak to carbonates of the lower Lisburne Group. It is interpreted to identify a northerly marine transgression during the Mississippian onto a northwest-trending high or land area in the position of the present Arctic Coastal Plain. The succession is, therefore, diachronous and gets younger in the direction of transgression. Thus the basal, fluviatile (?) and terrigenous clastics grade laterally and vertically into marine shale and limestone. They probably represent a migrating, onlapping sequence of shoreline, terrigenous clastics (Bamber and Waterhouse, 1971) with associated marginal coal swamps.

The coal-bearing Aklak Member of the Paleocene Reindeer Formation is dominated by delta plain facies (Young, 1975) with cycles of sandstone, mudstone and coal prograding northward into an early Tertiary sea, also in the position of the Arctic Coastal Plain.

The sedimentology of the Lower Cretaceous "coal-bearing division" is to date unstudied.

Structural Geometry of the Coal Deposits

There are marked differences amongst the structural geometries of the Kayak and Reindeer Formations and the "coal-bearing division". The Kayak is characterized by open folding, generally on northwest-trending axes and commonly is cut by strike faults, high-angle reverse faults and thrust faults. The "coal-bearing division", on the other hand, is acutely folded and faulted. The measures in both are repeated, as on the west flank of Barn Uplift, with concomitant increase in the area of coal measures accessible to prospecting for coal. The Reindeer Formation, in contrast, occurs in gently-dipping panels bounded by nearly vertical, planar faults. It may be upturned adjacent to these faults (Norris, 1972). The seam exploited in the Reindeer Formation at Coal Mine Lake (Table 1, No. 6) on the northwest flank of the delta is vertical and the amount of coal which could be mined without going to excessive depth is limited.

Results of Coal Assessment

Only the Kayak and Reindeer Formations warrant additional evaluation because in general they are not acutely deformed and because their coal seams appear to have some lateral continuity. The "coal-bearing division", on the other hand, is acutely deformed and its thin, discontinuous seams would no doubt prove to be uneconomic. Some characteristics of all three formations are listed in Table 5.

The Kayak and Reindeer Formations where they are prospective for coal are identified on Figures 4, 5, 6 and 7. They can be separated into two groups on the basis of contrasting rank of their coals. The Reindeer seams are high volatile bituminous and the Kayak is anthracitic, both ranks being best suited for thermal electric power generation. However, the relatively small areas underlain at the surface by them (not exceeding 77 km^2 in any one area) and the lack of thick, demonstrably continuous seams are parameters unfavourable to the presence of economically recoverable coal.

On the basis of the information at hand, the resource potential of the coals of northern Yukon Territory would at best be classified as moderate (M). There is, therefore, the possibility of significant additional resources being present and as yet undiscovered. The coals would be classified as Speculative Resources in terms of the scheme used by the Department of Energy, Mines and Resources (Bielenstein et al., 1979) and would not qualify for meaningful estimates of resource potential based on available data.

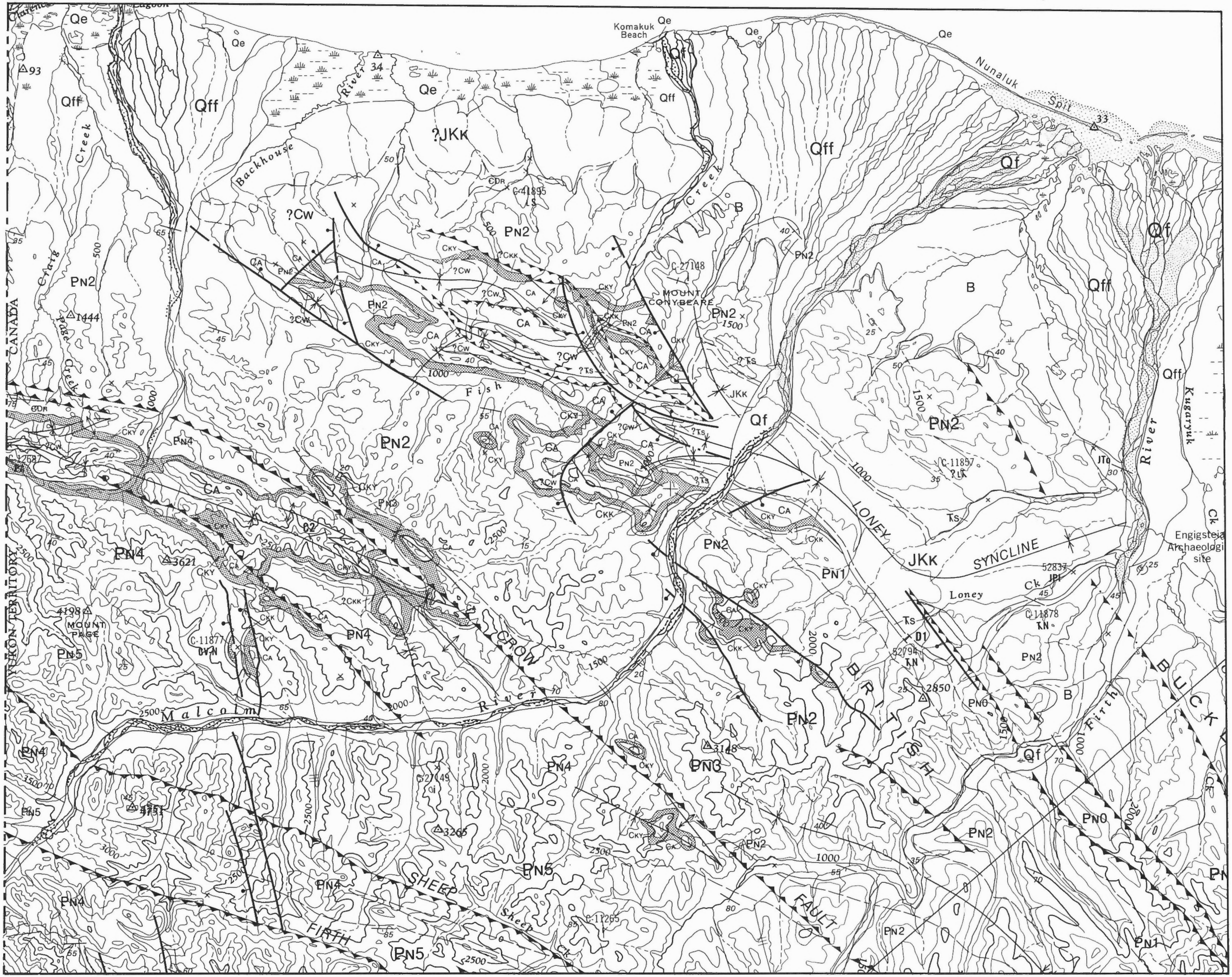


Figure 4. *Areal distribution of Kayak Formation in Romanzof Uplift (after Norris, 1977). Scale 1/250 000.*

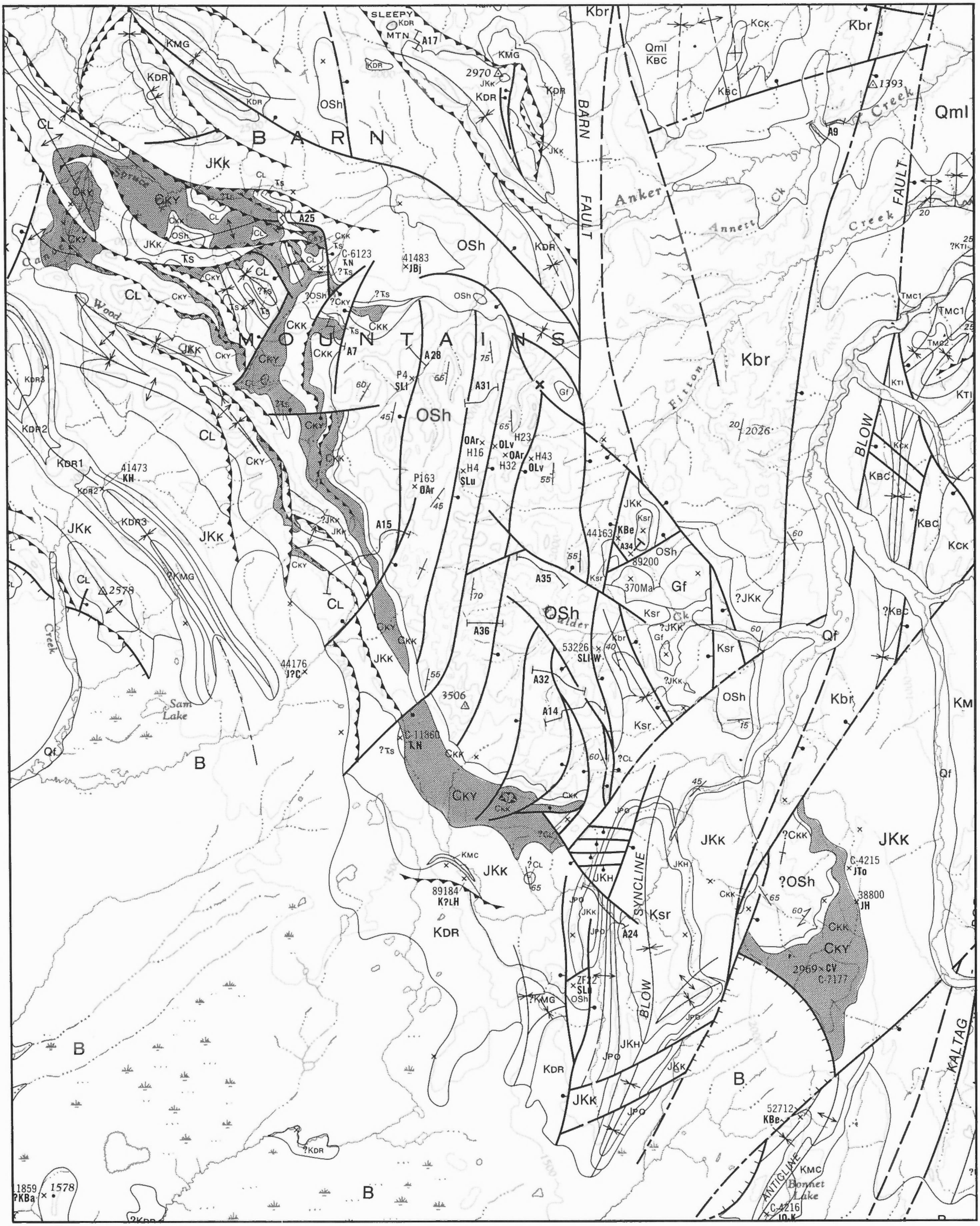


Figure 5. *Areal distribution of Kayak Formation in Barn Uplift and vicinity (after Norris, 1977). Scale 1/250 000.*

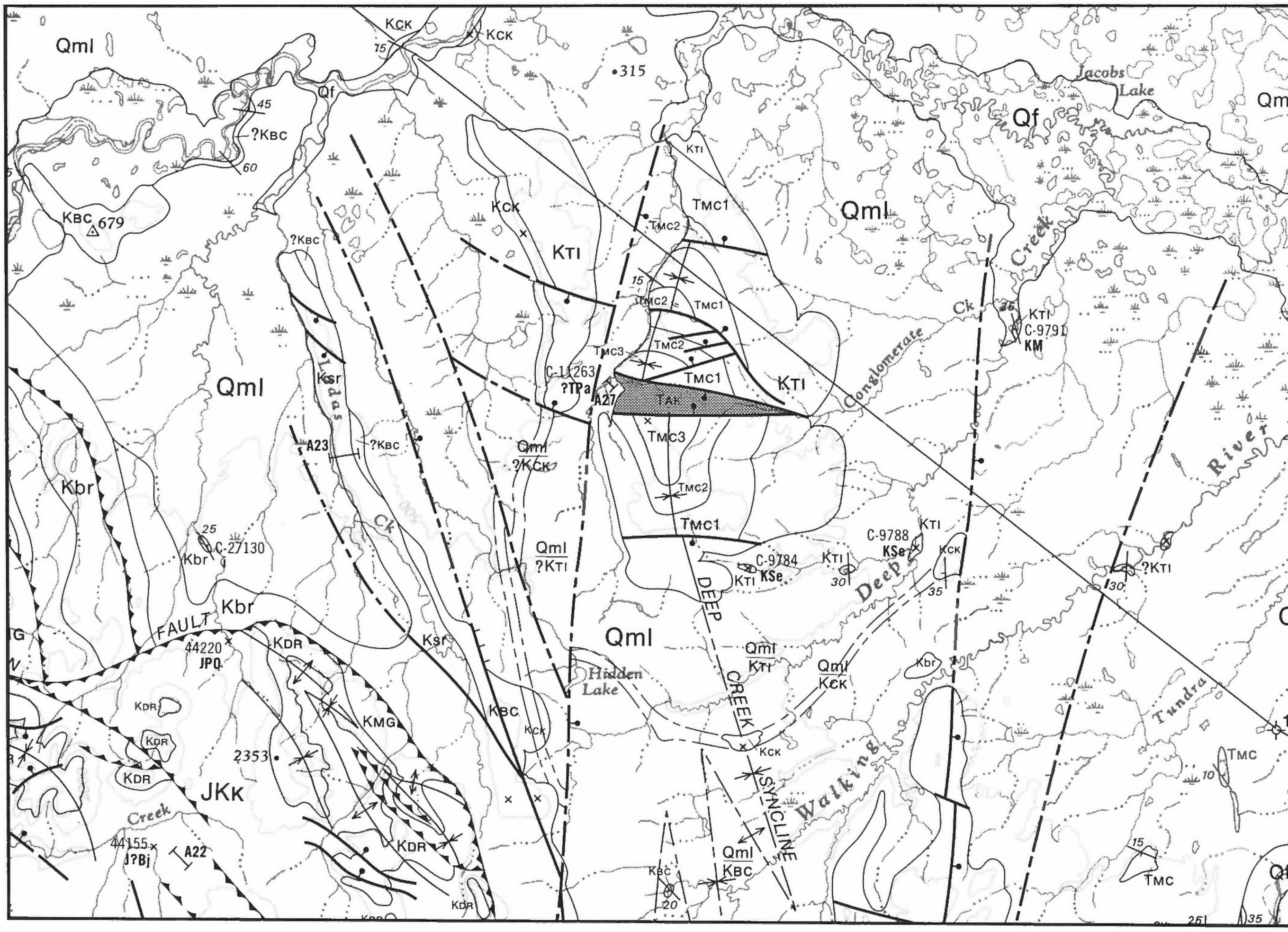


Figure 6. *Areal distribution of Reindeer Formation in axial region of Rapid Depression (after Norris, 1977). Scale 1/250 000.*

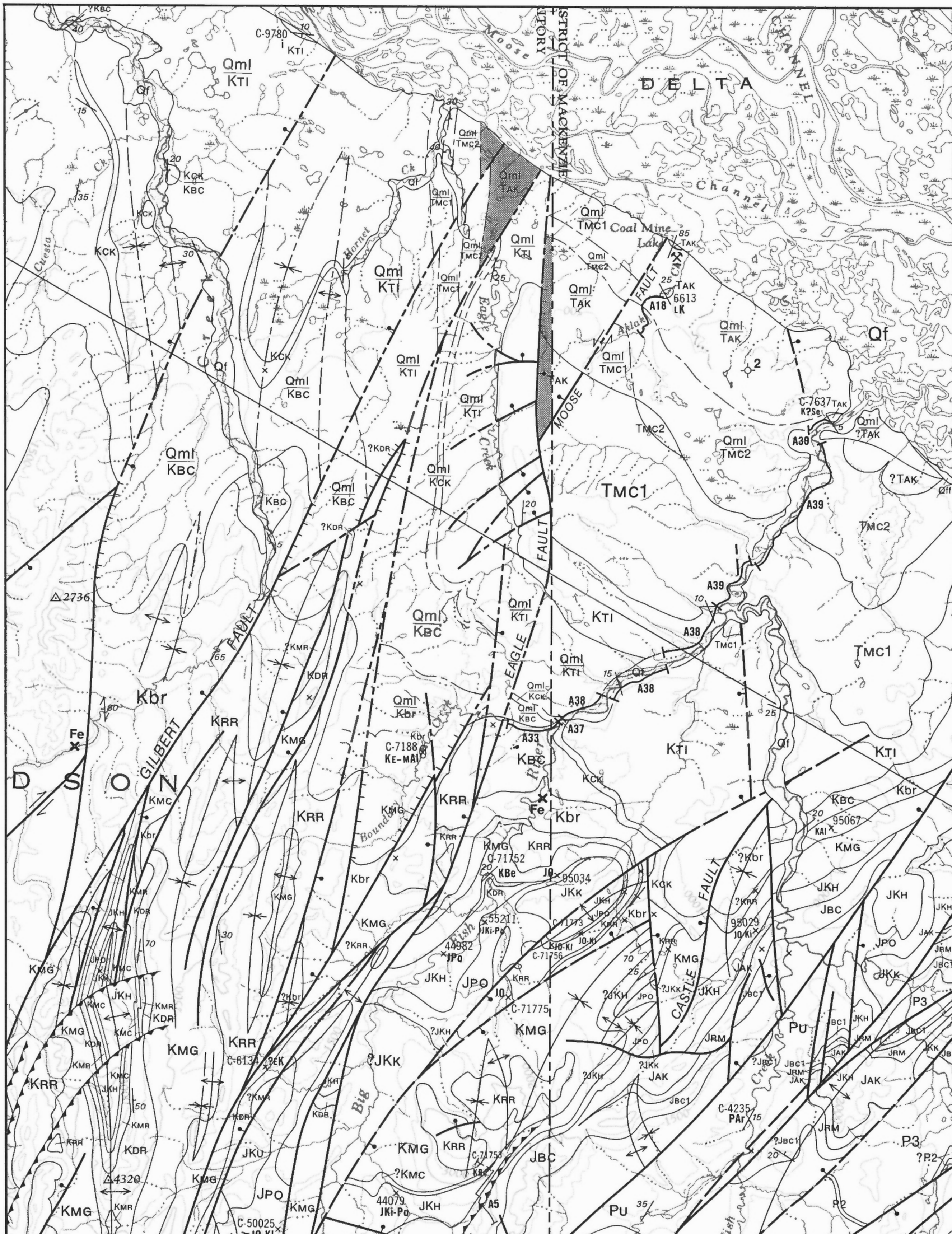


Figure 7. *Areal distribution of Reindeer Formation in Yukon Territory adjacent to Mackenzie Delta (after Norris, 1977). Scale 1/250 000.*

3. OIL AND GAS
by
Bruce Young[1]

Introduction

This qualitative assessment of the oil and gas potential of northern Yukon covers the 1978 Land Withdrawl Area but focusses particularly on the proposed Northern Yukon National Park area (Fig. 1, Map 1). The assessment is based on information submitted to the Department of Indian and Northern Affairs by the oil industry. The various reports consulted during this study are listed in Appendix 2.

Stratigraphy and Structure

The stratigraphy of the northern Yukon resembles that of northern Alaska more than adjacent regions of northwestern Canada (Figure 8). For this reason, reservoir potential, trapping possibilities and hydrocarbon source maturation and migration potential are based on analogous situations found or hypothesized for Alaskan hydrocarbon assessments. For descriptions of the stratigraphy and sedimentology of northern Yukon and an overview of the main structural elements, refer to Part I.3 of this report.

Figure 9 illustrates the regional development of several unconformities that play an important role in assessing the oil and gas potential of northern Yukon. These will be referred to in subsequent discussions on potential reservoir development and trapping mechanisms.

Review of Hydrocarbon Potential

Potential for hydrocarbons being found in the northern Yukon area is considered excellent due to the presence of stratigraphic conditions and trapping mechanisms comparable to those found in the Prudhoe Bay field of Alaska (Fig. 8). The Prudhoe Bay field contains three separate pools, found in the Lisburne Group (Mississippian-Pennsylvanian), the Sadlerochit Formation (Permian-Triassic) and the Kuparak River Formation (Lower Cretaceous). Estimated in-place reserves for the field are 20 billion barrels.

In the northern Yukon area, the Lisburne and Sadlerochit are widely represented and Cretaceous units are present that could be approximate equivalents of the Kuparak River Formation (Norris, 1980).

Oil and gas were discovered in the 1960's in Mississippian to Permian clastics and in Lower Cretaceous sandstones in the Eagle Plain Basin immediately south of the area under study. These discoveries remain uneconomic at the present time, however.

Hydrocarbon Source Potential

Potential source rocks for the northern Yukon area are the Kayak Shale, Shublik Formation, Kingak Shale and Cretaceous mudstones and shales. Devonian shales are not considered favourable sources in the northern section, however, to the south where the section has not been metamorphosed, they could contain potential source beds.

At Pinnacle Bend on the west bank of the Porcupine River, and at several other localities on the river shore between Pinnacle and Berry Creek, small but active gas seeps were observed (Appendix 2, Report 780-01-03-001). These seeps deposit an oily film on the water surface.

Potential Hydrocarbon Reservoirs and Traps

Potential for Lower Paleozoic reservoir development and trapping is confined to the Dave Lord Ridge – Bell Basin area. The carbonate-to-shale facies transition for the Ogilvie and Gossage carbonates (Devonian) to Prongs Creek shales (Devonian) occurs through this area. A similar transition can be found in the Road River section (Ordovician-Silurian). Porosity would be enhanced along the leading carbonate edge of this transition either by an increase in leached framebuilding organisms or by selective Dorag-type dolomitization. The trap could be the updip termination of the porous carbonate against laterally equivalent shales.

The best potential for the Mississippian section is in the Lisburne Group. Because of extensive dolomitization of pelletoidal limestones, intercrystalline, vuggy and fracture porosity development is widespread and capable of providing a reservoir for large quantities of oil and gas.

The Sadlerochit Formation (Permian-Lower Triassic) created the most interest in the Alaska North Slope discoveries. The formation is regarded as a prime prospect for future hydrocarbon discoveries in the northern Yukon. Primary and secondary porosity can be found in both the conglomerate and sandstone units as well as locally enhanced porosity development in laterally equivalent carbonates. Clastic rocks of this age have yielded oil and gas discoveries at Prudhoe Bay Alaska, and in the Eagle Plain Basin, Yukon.

The Pre-Upper Triassic unconformity could be of major importance, because Upper Triassic rocks appear to bevel and seal older strata and provide broad areas where updip traps might be expected along the edges of the pre-Upper Traissic structure. Local enhancement of porosity of pre-Upper Traissic weathering could improve the reservoir potential in underlying strata such as those of the Sadlerochit Formation or the Lisburne Group.

The Cretaceous sequence has excellent potential as a reservior but is too shallow in most areas to be of economic importance. Possible structural traps in Old Crow Basin and Arctic Coastal Plain could, however, create potential for large oil and gas resources. Tertiary reservoirs occur mainly offshore but some potential might exist along the Arctic Coastal Plain if favourable trapping conditions were present. Similar Tertiary sands are said to show oil staining in onshore exposures in Alaska (Appendix 2, Report 028-01-03-030).

A variety of structural traps have been documented in the northern Yukon area. Broad anticlinal features, domes, high angle normal and reverse faults and horst and graben structures have all been delineated either by surface work or by seismic and or gravity studies.

Specific Oil and Gas Prospects

1. Old Crow Basin

The hydrocarbon potential of Old Crow Basin depends in part on the thickness of sedimentary section beneath the Quaternary cover deposits. There has not been any exploratory drilling in the area. Overland Exploratory Services conducted a gravity survey in 1973 for Gulf Oil Canada Limited (Appendix 2, Report 002-08-03-068). Model studies had to be conducted using assumed densities and density logs from wells from other areas. On the basis of these preliminary studies the positive and negative features of the Bouguer map were interpreted to represent extreme changes in the thickness of sediments where they infill structural lows in the Neruokpuk Formation, the Lisburne Group or in the effective basement. It was also interpreted that the topography on the basement is controlled by faults with some displacements possibly reaching 10 000 feet (3050 m). If these assumptions prove correct, there are two basin-like areas within the prospect where very thick sediments may be encountered (Map 2).

Map 2 shows a well developed west-northwest to east-southeast lineation. Gulf Oil Canada Limited believes that the prominent structural lows trending east-west across the area are grabens which contain thousands of feet of younger sediments. The adjacent structural highs may represent

[1]Oil and Gas Resources Evaluation Division, Department of Indian and Northern Affairs, Ottawa

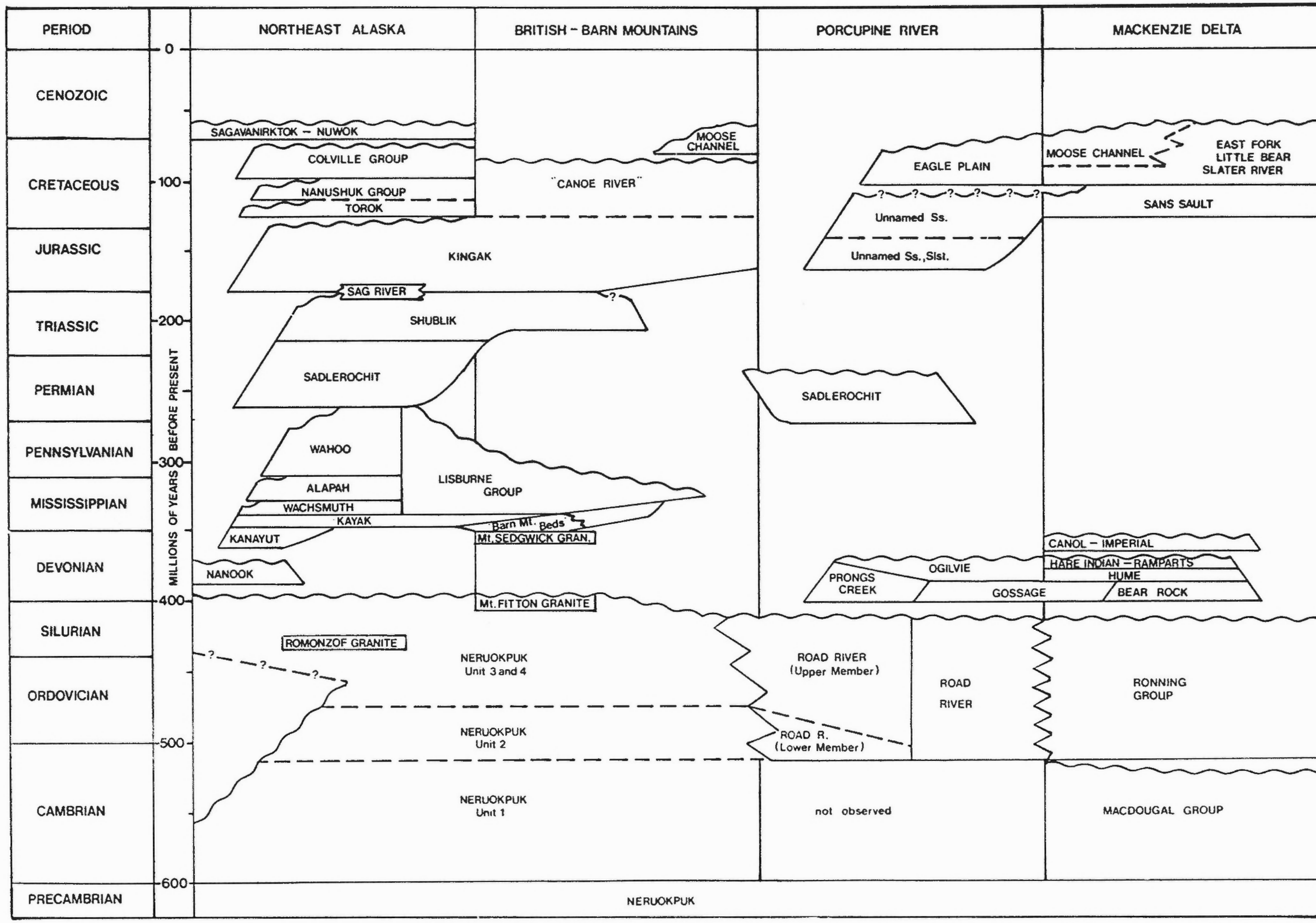


Figure 8. *Correlation table, Precambrian to Cenozoic rocks of northeast Alaska, northern Yukon and Lower Mackenzie Basin (from J.C. Sproule, 1971, Report 100-01-03-004, see Appendix 2).*

uplifted limestone blocks and/or basement highs. The additional sedimentary thickening needed above the limestone to account for the large gravity changes ranges from 6000 to 13 000 feet (1830 to 3960 m). A seismic program conducted by Velocity Surveys Limited in 1969 for Northern Oil Explorers Limited (Appendix 2, Report 695-9-3-10) further indicates "...a depth of section sufficient to accomodate a source and reservoir for hydrocarbons".

In summary, broad stratigraphic and structural traps in the Lisburne Group limestone and dolomite, Sadlerochit Formation (Permian-Lower Triassic) or Cretaceous clastics, along with Mississippian or Permian source rocks, could result in significant oil and gas resources being contained within Old Crow Basin.

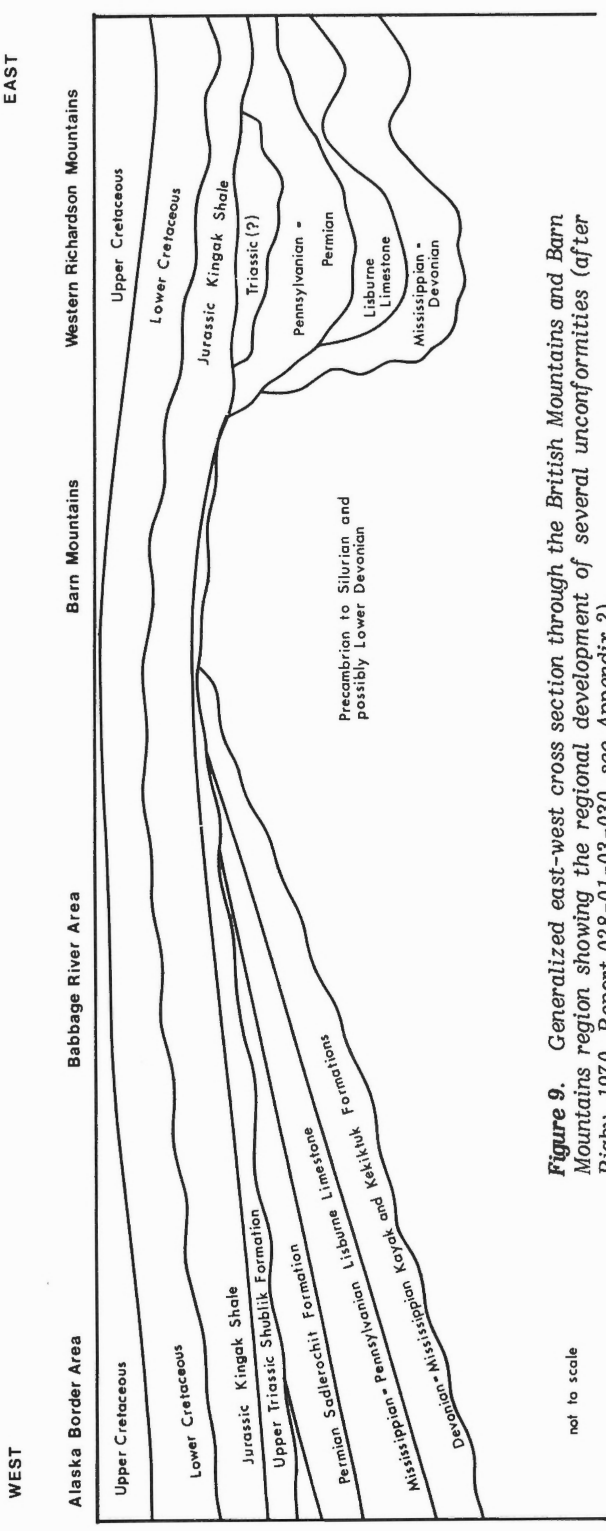


Figure 9. *Generalized east-west cross section through the British Mountains and Barn Mountains region showing the regional development of several unconformities (after Rigby, 1970, Report 028-01-03-030, see Appendix 2).*

2. Arctic Coastal Plain

Three wells have been drilled in the Arctic Coastal Plain area (Map 2). I.O.E. Blow River YT E-47 was drilled in 1970 and bottomed in the Middle Jurassic at 14 000 feet (4279 m). The well was drilled on a large domal structure and no significant hydrocarbon zones were encountered. Pacific Imp. et al Roland Bay YT L-41 was drilled in 1972 and bottomed in the Lower Jurassic at 9030 feet (2750 m). No significant hydrocarbon zones were encountered. I.O.E. Spring River YT N-48 was drilled in 1970 and bottomed in the Upper Paleozoic at 7009 feet (2140 m). No significant hydrocarbon zones were encountered. In these wells, the Triassic section was either not reached or was absent due to either a "bald" structure or depositional pinchout. Thus a potential for stratigraphic and structural traps in the Lisburne and Sadlerochit strata sourced by Mississippian and Permian – Triassic shales – may still be postulated (Map 2).

An important consideration however, is that geologists at the Geological Survey's Institute of Sedimentary and Petroleum Geology consider the sediments in the Arctic Coastal Plain area to be over-mature. If this is the case, the oil and gas potential assigned to the propsect would be reduced. Further studies into this aspect are required.

Thick, porous sandstones and conglomerates of the Lower Tertiary Moose Channel Formation outcrop along the lower Babbage River in the northern part of the Richardson Mountains. These potential reservoir rocks could be present in structures not yet tested onshore, as well as in large structures in the offshore areas. (Appendix 2, Report 246-01-03-063). Cretaceous shales might have been a source for hydrocarbons.

3. Bell Basin

Only the northern part of Bell Basin falls within the area included in this study. Reservoirs could be present in this area in either the Permian clastics or in an Upper Cretaceous conglomerate. Three types of traps exist, stratigraphic updip pinch-outs, anticlinal and faulted closures.

A seismic program was conducted by Century Geophysical Corporation of Canada in 1971 for Westcoast Petroleum Limited. (Appendix 2, Report 780-6-2-4). Interpretation of the data indicated the presence of two significant anomalies in the Silurian – Ordovician section. The first is fault controlled and runs parallel to the Yukon Thrust Fault. It is possible that this block is a large horst dipping to the northeast. The second is an east-trending anticline.

The Westcoast et al Porcupine YT F-72 well was drilled in the area in 1974 and bottomed in the Ordovician (Cambrian?) Franklin Mountain Formation equivalent. No significant hydrocarbon zones were encountered but it should be noted that the Permian section was absent.

Economic Considerations

An important development that is likely to take place within the next few years, is the construction of a pipeline from the Mackenzie Delta area in N.W.T. to southern Yukon (Dempster "Lateral" extension). The route of the pipeline would pass near the present area and could have a significant effect on the economic viability of any oil and/or gas discoveries in the northern Yukon area.

Summary

The northern Yukon area is considered to be propsective for significant oil and gas resources. Hydrocarbon potential ratings range from moderate to high. Favourable reservoir, source and trap conditions, and in the case of Old Crow Basin, depth of section, have all be documented or interpreted.

PART III

CONCLUSIONS

1. Metallic Minerals

Within the proposed Northern Yukon National Park three sub-areas are of particular interest from the point of view of mineral potential. These are: (1) the northeastern Romanzof Uplift Neruokpuk belt, extending from Mount Sedgwick northwest through the Buckland Hills (Map 1, 1aa); (2) the Timber Creek-Muskeg Creek outlier (Map 1, 2f-2g) and (3) the north Old Crow Basin – Ammerman – Timber Creek belt (Map 1, 2dA, 2b). Of these (1) and (3) are of most interest, based on available information (mainly geochemical data) and, in the case of (3), on possible similarities with the Bear Mountain area in Alaska.

Consideration should be given to additional field investigations in those areas. Field work would include detailed geology, stratigraphic-controlled rock geochemical sampling and, where applicable detailed stream-silt geochemistry, including heavy mineral sampling and analysis.

Outside the proposed park, but within the boundaries of the 1978 Land Withdrawl a number of sub-areas have been identified with at least moderate mineral potential. Of these, the most significant is the Barn Uplift-Driftwood High belt fringing the northeast and eastern borders of Old Crow Plain. Possible metalliferous environments here include: (1) uranium in Paleozoic (Ordovician-Silurian, Mississippian) shales and conglomerates; (2) uranium, tungsten, copper and molybdenum associated with granitic rocks and enclosing skarn rocks of the Mount Fitton-Hoidahl area (north Barn Uplift) and (3) stratiform lead-zinc mineralization in Road River Formation and equivalent shales. On the basis of present information it cannot be concluded that the Barn-Driftwood belt and other sub-areas identified within the 1978 Land Withdrawal have a high potential for future economic mineral development. A great deal more on-the-ground information is needed, however, before such a conclusion could be reasonably defended or attacked.

2. Coal

Of the three known coal-bearing measures of northern Yukon, only the Kayak Formation (Mississippian) and Reindeer Formation (Tertiary) are considered to have potential (moderate), mainly because of their relatively undeformed nature. With the exception of coal-bearing Kayak strata of northern Romanzof Uplift in the general area of Malcolm River, known coal environments lie outside the boundaries of the proposed National Park. Although coal in both the Kayak and Reindeer measures is suitable for thermal electric power generation, and local heating use, the remoteness of the region and the lack of significant identified resources would appear to make major economic coal developments unlikely.

3. Oil and Gas

Three areas considered to have significant oil and gas potential have been identified. One of these (Old Crow Basin) lies entirely within the proposed National Park area. A second (Arctic Coastal Plain) may extend, in part, into the area covered by the extreme northern part of the proposed park. It should be noted, in the latter case, that there is some difference of opinion between the Geological Survey of Canada and the Department of Indian and Northern Affairs concerning hydrocarbon potential of this region. The Geological Survey has concluded, because of over maturation of sediments, that the Arctic Coastal Plain prospect area would not receive a particularly high potential rating.

The case of Old Crow Basin would be particularly difficult to substantiate because of difficulties of access due to the traditional use of the Old Crow Flats lands by the Old Crow Indians for trapping and hunting purposes and because of the ecologic sensitivity of the Flats region. As has been noted in the body of this report, the subsurface stratigraphic, structural, lithologic and thickness characteristics of the Old Crow Basin sedimentary section were interpreted mainly from seismic and gravity records and no direct evidence from drilling is available. Nevertheless, any assessment of the value of these lands must take into account the possibility at least of significant oil and/or gas resources being present in Old Crow Basin. To further refine this assessment would require additional geophysical studies and probably the drilling of at least one well within the basin.

The question of the Arctic (Yukon) Coastal Plain lands may be more critical, in the long run, from the point of view of access to and egress from, possible offshore exploration of the Beaufort Sea region. This topic is beyond the scope of the present report but the question of preserving access corridors through the north slope is presumably one that needs to be considered in the overall question of disposition of these lands.

REFERENCES

Bamber, E.W. and Waterhouse, J.B.
1971: Carboniferous and Permian stratigraphy and paleontology, northern Yukon Territory, Canada (Appendix: B.L. Mamet and C.A. Ross); Canadian Petroleum Geology Bulletin, v. 19, no. 1 (March) p. 29-250.

Barker, James C.
1978: Mineral investigations of certain lands in the eastern Brooks Range: a summary report; United States Department of the Interior – Bureau of Mines, Open File Report No. 63-78, 25 p.

Barker, James C. and Clautice, Karen H.
1978: Mineral reconnaissance of the Porcupine River region: a summary report; United States Department of the Interior – Bureau of Mines, Open File Report No. 87-78, 20 p.

Bell, R.T. and Jones, L.D.
1979: Geology of some uranium occurrences in Western Canada; in Current Research, Part A, Geological Survey of Canada, Paper 79-1A, p. 397-399.

Bielenstein, H.U., Christmas, L.P., Latour, B.A., and Tibbetts, T.E.
1979: Coal resources and reserves of Canada; Canada, Department of Energy, Mines and Resources, Report ER 79-9.

Cathro, R.J.
1969: Tungsten in Yukon; Western Mining, v. 42, No. 4, p. 23-40.

Dyke, L.D.
1974: Structural investigations in Barn Mountains, Northern Yukon Territory; Geological Survey of Canada, Paper 74-1A, p. 303-308.

Gleeson, C.F.
1963: Reconnaissance heavy-mineral study in northern Yukon Territory; Geological Survey of Canada, Paper 63-32, 10 p.

Geological Survey of Canada
1980a: Preliminary mineral resource appraisal of parts of Yukon and Northwest Territories including proposed Northern Parks areas; Geological Survey of Canada, Open File 691, 86 p.

Geological Survey of Canada
1980b: Non-hydrocarbon mineral resource potential of parts of northern Canada: Preliminary resource assessments of parts of northern Yukon, mainland Northwest Territories and the Arctic Islands, including islands in Hudson Bay; Geological Survey of Canada, Open File 716, 376 p.

Goodfellow, W.D.
1979: Regional stream sediment and water geochemical reconnaissance date, northern Yukon Territory, NTS 117A and parts of 117B, C and D; Geological Survey of Canada, Open File 565.

Green, L.H. and Godwin, C.I.
1964: The Mineral Industry of Yukon Territory and northwestern District of Mackenzie, 1962; Geological Survey of Canada, Paper 64-36, 94 p.

Jeletzky, J.A.
1960: Uppermost Jurassic and Cretaceous rocks, east flank of Richardson Mountains between Stony Creek and Lower Donna River, Northwest Territories; Geological Survey of Canada, Paper 59-14, 31 p.

Jeletzky, J.A.
1972: Stratigraphy, facies and paleogeography of Mesozoic and Tertiary rocks of Northern Yukon and Northwest Mackenzie District, N.W.T. (NTS 107B, 106M, 117A, 116-O(N½)); Geological Survey of Canada, Paper 72-1A, p. 212-215.

Jeletzky, J.A.
1974: Contribution to the Jurassic and Cretaceous geology of Northern Yukon Territory and District of Mackenzie, Northwest Territories; Geological Survey of Canada, Paper 74-10, 23 p.

Jeletzky, J.A.
1975: Jurassic and Lower Cretaceous paleogeography and depositional tectonics of Porcupine Plateau, adjacent areas of northern Yukon and those of Mackenzie District; Geological Survey of Canada, Paper 74-16, 52 p.

Jeletzky, J.A.
1980: Lower Cretaceous and Jurassic rocks of McDougal Pass area and some adjacent areas of north-central Richardson Mountains, northern Yukon Territory and Northwestern District of Mackenzie, N.W.T. (N.T.S. – 116P/9 and 116 P/10): A reappraisal; Geological Survey of Canada, Paper 78-22, 35 p.

Jeletzky, J.A.
1980: Four new Lower Cretaceous Formations in Richardson Mountains, northern Yukon Territory and District of Mackenzie, N.W.T. (in preparation)

Lysk, K.M., Bohmer, E.E., and Phelps, W.L.
1977: Alaska Highway Pipeline Inquiry; Minister of Supply and Services, Canada.

Mandarino, J.A. and Sturman, B.D.
1976: Kulanite, a new barium iron aluminum phosphate from the Yukon Territory, Canada; Canadian Mineralogist, v. 14, p. 127-131.

Mandarino, J.A., Sturman, B.D., and Corlett, M.I.
1977: Penikisite, the magnesium analogue of kulanite from Yukon Territory; Canadian Mineralogist, v. 15, pt. 3, p. 393-395.

Marchand, M., Morin, J.A., Craig, D.B., and Debicki, R.L
1979: Mineral Industry Report, 1977, Yukon Territory; Department of Indian and Northern Affairs, Report EGS 1978-79, 124 p.

Norris, D.K.
1972: Structural and stratigraphic studies of the tectonic complex of northern Yukon Territory, north of Porcupine River; Geological Survey of Canada, Paper 72-1B, p. 91-99.

1973: Tectonic styles of northern Yukon Territory and northwestern District of Mackenzie, Canada; in M.G. Pitcher, ed., Arctic Geology, The American Association of Petroleum Geologists, Memoir 19, p. 23-40.

1974a: Structural geometry and geological history of the northern Canadian Cordillera; Canadian Society of Exploration Geophysicists, Proceedings of the 1973 National Convention, Calgary, Alta., p. 18-45.

1974b: Structural and stratigraphic studies in the northen Canadian Cordillera; Geological Survey of Canada, Paper 74-1A, p. 343-349.

Norris, D.K. (cont.)

1977: Geological maps of Yukon Territory and Northwest Territories; Geological Survey of Canada, Open File 499.

1979: Geological maps of northen Yukon Territory; Geological Survey of Canada, Open File 621.

1980: Geology, northen Yukon Territory and northwestern District of Mackenzie (map), scale 1:500 000; Geological Survey of Canada, Open File 715.

Norris, D.K. and Hopkins, W.S. Jr.

1977: The geology of the Bonnet Plume Basin, Yukon Territory; Geological Survey of Canada, Paper 76-8, 20 p.

Norris, D.K. and Yorath, C.J.

1980: The North American Plate from the Arctic Archipelago to the Romanzof Mountains; in the Ocean Basins and Margins, Volume 5, Chapter 3; Plenum Press, New York, London, Washington.

Poulton, T.P.

1978: Internal correlations and thickness trends, Jurassic Bug Creek Formation, northeastern Yukon and adjacent Northwest Territories; Geological Survey of Canada, Paper 78-1B, p. 27-30.

Picklyk, D.D., Rose, D.G., and Laramee, R.M.

1978: Canadian Mineral Occurrence Index (CANMINDEX) of the Geological Survey of Canada; Geological Survey of Canada, Paper 78-8, 27 p.

Sandy, R.W.

1948: Placer gold on the Firth River, routes to the area; Western Miner, v. 21, no. 6, p. 85-86.

Sinclair, W.D. and Gilbert, G.W.

1975: Placer operations – Firth 1973; in Mineral Industry Report, Yukon Territory, 1973, Department of Indian and Northern Affairs, Report EGS 1975-7, p. 146.

Sinclair, W.D., Maloney, J.M., and Craig, D.B.

1975: Mineral Industry Report, Yukon Territory, 1974; Department of Indian and Northern Affairs, Report EGS 1975-9, 216 p.

Sinclair, W.D., Morin, J.A., Craig, D.B., and Marchand, M.

1976: Mineral Industry Report, 1975, Yukon Territory; Department of Indian and Northern Affairs, Report EGS 1976-15, 210 p.

Vokes, F.M.

1963: Molybdenum deposits of Canada; Geological Survey of Canada, Economic Geology Report 20, 332 p.

Young, F.G.

1972: Cretaceous stratigraphy between Blow and Fish Rivers, Yukon Territory; Geological Survey of Canada, Paper 72-1A, p. 229-235.

Young, F.G.

1973: Jurassic and Cretaceous stratigraphy between Babbage and Blow Rivers, Yukon Territory; Geological Survey of Canada, Paper 73-1A, p. 277-281.

Young, F.G.

1975: Upper Cretaceous stratigraphy, Yukon Coastal Plain and northwestern Mackenzie Delta; Geological Survey of Canada, Bulletin 249, 83 p.

Young, F.G., Myhr, D.W., and Yorath, C.J.

1976: Geology of the Beaufort – Mackenzie Basin; Geological Survey of Canada, Paper 76-11, 65 p.

APPENDIX 2

List of Industry Reports Consulted In the Preparation
of Northern Yukon Oil and Gas Assessments

002-08-03-068	Gravity Survey of the Old Crow Flats Area of the Yukon Territory. 1973. For Gulf Oil Canada Limited by Overland Exploration Services (1969) Limited.
007-06-03-118	Report on Reflection Seismic Programs in the West Coast Plain Areas of the Yukon and Northwest Territories 1972, Imperial Oil Limited.
028-01-03-030	Stratigraphy of the British Mountains, Barn Mountains, Old Crow Flats Area, Northern Yukon Territory. 1970. For Union Oil Company of Canada by J.K. Rigby.
028-01-03-053	Geologic Investigations in the Northern Richardson Mountains, Yukon and Northwest Territories. 1973. For Union Oil Company of Canada by J.K. Rigby.
100-01-03-004	Geologic Report, Old Crow – Babbage River, Yukon Territory. 1971. For Charter Oil Company Limited by J.C. Sproule and Associates Limited.
100-01-03-005	Geologic Report, Barn Mountains Area, Yukon Territory. 1974. For Charter Oil Company Limited by J.C. Sproule and Associates Limited.
246-01-03-063	Geological Report, Dave Lord Area and Arctic Coastal Area. 1974. Atlantic Richfield Canada Limited.
695-06-02-009	Report on a Seismic and Gravity Survey, Old Crow Area. 1971. For Northern Oil Explorers Limited by Globe Universal Sciences Canada Limited.
695-09-03-010	Report on a Seismic Survey, Old Crow Area. 1969. For Northern Oil Explorers Limited by Velocity Surveys Limited.
780-01-03-001	Geological Report on the Bell River – Porcupine River Permit Block, Yukon Territory. 1970. Westcoast Production Company Limited.
780-08-03-002	Bell River Area, Yukon, Report on Gravity Survey. 1970. For Westcoast Production Company Limited by Precision Geophysical Limited.
780-06-02-004	Bell River Area, Yukon, Report or Seismic and Gravity Survey. 1971. For Westcoast Petroleum Limited by Century Geophysical Corporation of Canada (Seismic) and Precision Geophysical Limited (Gravity).
780-06-02-006	Old Crow Area, Yukon Territory, Report on a Seismic Survey. 1972. For Westcoast Petroleum Limited by Globe Universal Sciences Canada Limited.

Parks Canada Parcs Canada

Northern Yukon – A Natural Area of Canadian Significance

Cover photo:

Each year, the Porcupine herd of barren-ground caribou migrates in the Northern Yukon.

QS - 7056-030-EE-A1

Les rapports sur les réserves projetées pour des parcs nationaux sont également publiés en français.

Northern Yukon – A Natural Area of Canadian Significance

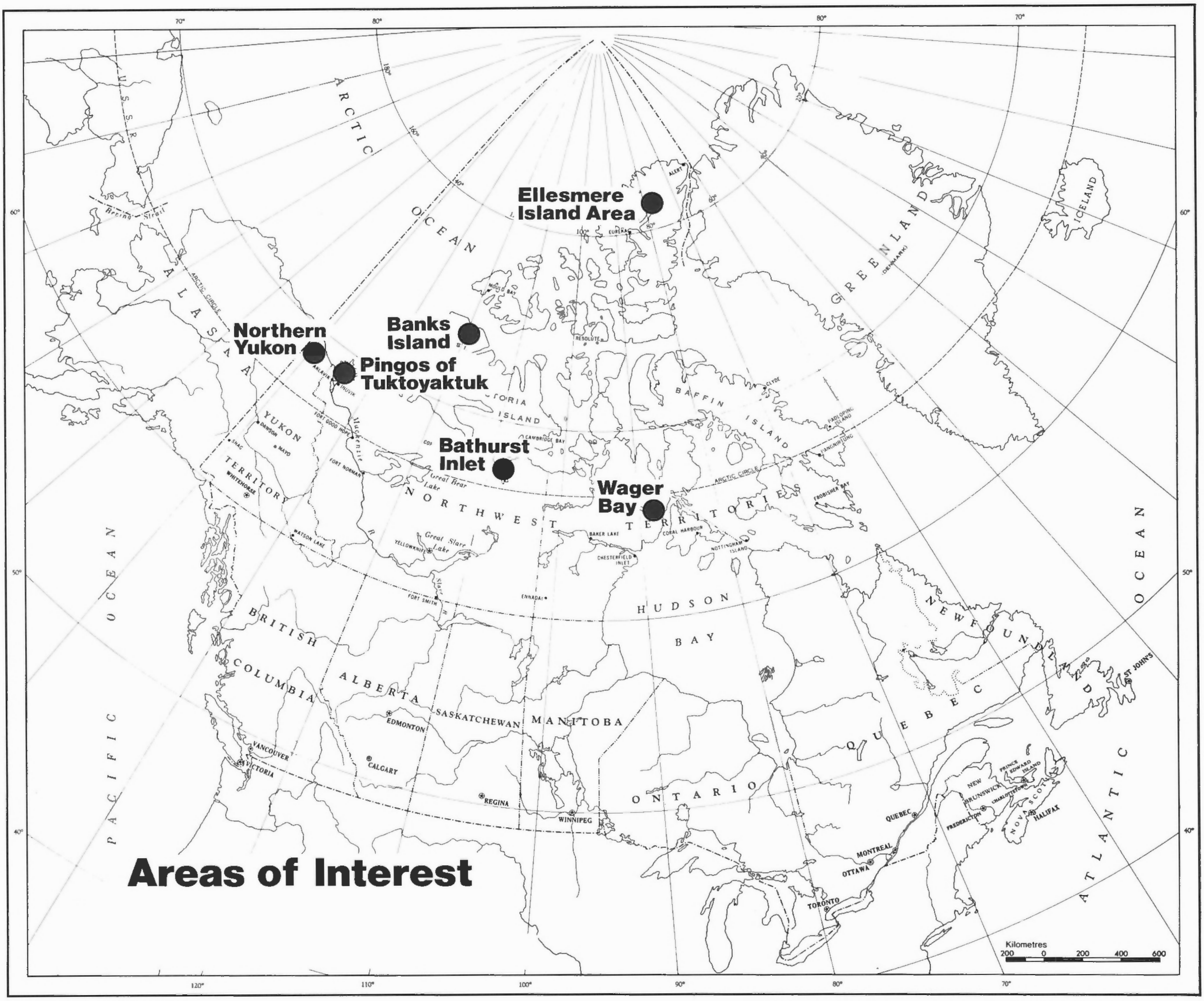
Contents

Introduction

Natural Areas of Canadian Significance are areas which have been identified for preservation in a natural state and are representative of the major natural environments of Canada. They are special places which should be protected as a part of the heritage of all Canadians, now and in the future. The identification and protection of our important natural heritage areas cannot await or accommodate the advances of competing land uses. Action is required while the opportunities exist if the heritage of the past is to be passed on to the future.

Of course, there are many, many different landscapes in Canada, each with its own unique features that inspire love and pride in the hearts of Canadians. To identify the variety of Canada's landscapes, Parks Canada has divided the country into 48 natural regions. It is the aim of Parks Canada to set aside, in each of the 48 regions, an area of outstanding scenery or distinct features, that best portrays the region. So far only 18 of the natural regions have representative parks. Of the 30 regions without parks, 15 are at least partly in the Yukon and the Northwest Territories. Parks Canada, in its effort to further the completion of the national system of parks, has recently identified 6 of the more impressive natural heritage areas worthy of consideration for new parks. They are:

1. Northern Yukon
2. Wager Bay
3. Bathurst Inlet
4. Banks Island
5. Ellesmere and Axel Heiberg Islands
6. Pingos of Tuktoyaktuk


Ellesmere Island Area
Banks Island
Northern Yukon
Pingos of Tuktoyaktuk
Bathurst Inlet
Wager Bay
Areas of Interest
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
HUDSON BAY
GREENLAND
ICELAND
BAFFIN ISLAND
VICTORIA ISLAND
NEW BRUNSWICK
PRINCE EDWARD ISLAND
NOVA SCOTIA
Kilometres
200 0 200 400 600

The Site

The Northern Yukon is a land of spectacular scenery and abundant wildlife. In this extreme northwestern corner of the country, Parks Canada has identified an area worthy of protection that would cover about 20 500 km^2 (8 200 sq. miles). The area lies adjacent to Alaska, about 800 km (500 miles) northwest of Whitehorse, and would include part of the only extensive landscape in Canada that was not glaciated during the last Ice Age. Although no roads or permanent communities exist within the area of interest, parts of it are important in varying degrees to the local Indians and Inuit.

This unglaciated land is part of the Canadian portion of a larger region that provided a northern refuge for many plant and animal species during the height of the Ice Age. As such, it contains evidence of international importance in the study of man, nature and their interrelationships.

The landscape also provides habitat for many different species of wildlife, including the Porcupine barren-ground caribou herd and the northernmost population of Dall's sheep in Canada.

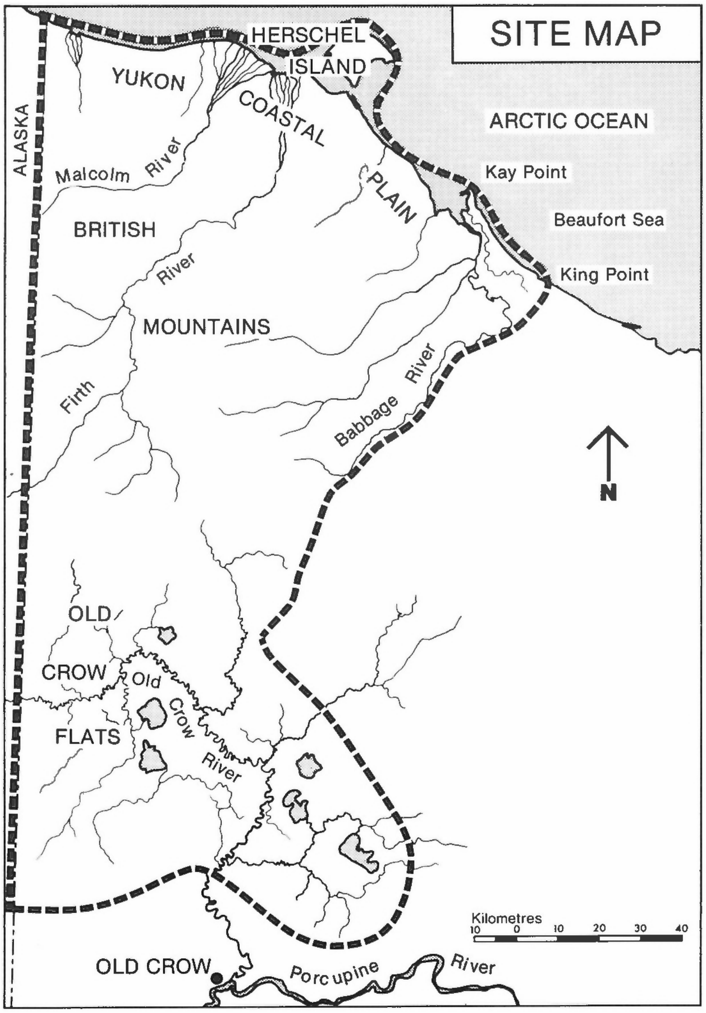
No final boundaries have been determined for this area of interest.

1 Slumping coastline, near Stokes Point

2 Old Crow River

3 Firth River

1


SITE MAP
HERSCHEL
ISLAND
ARCTIC OCEAN
YUKON
COASTAL
PLAIN
ALASKA
Malcolm River
BRITISH
River
MOUNTAINS
Kay Point
Beaufort Sea
King Point
Firth
Babbage River
N
OLD
CROW
FLATS
Old Crow River
Kilometres
10 0 10 20 30 40
OLD CROW
Porcupine River

2

3

The Land

Included within the area are portions of each of the many different landscapes found in the northern Yukon, providing the visitor with spectacular and varied scenery.

The Old Crow Flats in the southern part is a level basin rimmed by mountains. Its surface is covered with hundreds of lakes, whose striking geometric shapes are the product of prevailing winds and wave action on their peat shores, and give the Flats the appearance of a giant jigsaw puzzle. This vast wetland is one of the continent's major waterfowl habitats.

North of the Flats, a rolling plateau leads up to the British Mountains, part of the only extensive, non-glaciated mountain range in Canada. Reaching a maximum height of about 1 700 m near the Alaskan border, these treeless mountains are characterized by their rounded peaks and the smooth slopes of their river valleys. Major rivers such as the Firth, Malcolm and Babbage flow northward through the mountains on their way to the Arctic Ocean.

The gently undulating surface of the Yukon Coastal Plain emerges abruptly and dramatically from the British Mountains at an elevation of about 300 m, and slopes gradually to the Arctic Ocean. Its flat surface is completely treeless and is dominated in the western portion by the massive fan deltas of the Firth and Malcolm Rivers.

The coastline itself is an area of steep cliffs, bays, lagoons, extensive spits and barrier beaches.

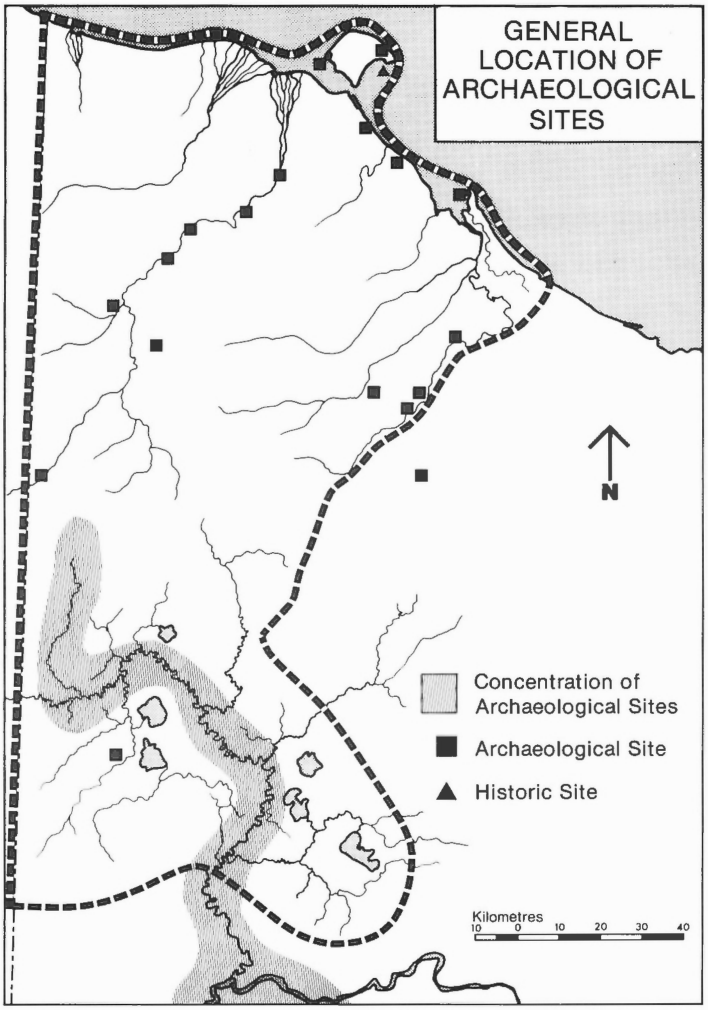
Offshore near the coast lies the Yukon's only island, Herschel Island, approximately 110 km^2 in area. The unusual landscape, rich vegetation, wildlife and remains of a varied human past make this Island worthy of protection.

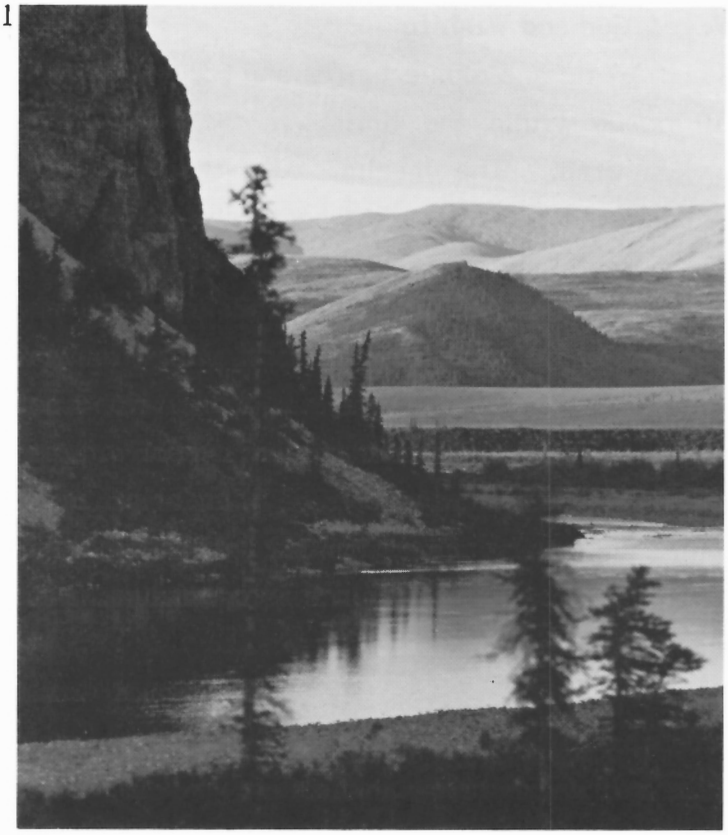
The entire northern Yukon is unique in Canada as it is the only extensive area that escaped glaciation during the last Ice Age. As a result, the area provided a refuge for many species of plants and animals, and in the absence of the scouring effects of glacial ice, evidence of this life has survived in tact to the present day.

Once, the Old Crow Flats was a cool, grassy plain, inhabited by woolly mammoths, large-horned bison and giant beavers. The fossilized bones of these awesome creatures are well-preserved and make the wetlands an important link in the effort to piece together the story of our earliest history.

Hundreds of archaeological and palaeontological sites have already been identified in the area, and scientists recently unearthed what are thought to be the oldest human remains yet discovered in the western hemisphere. This and other evidence has confirmed that man was in this area more than 30 000 years ago.

The area is among the most important in North America for the study of prehistoric man and his relationship with the plants and animals that shared his world, and offers exciting possibilities for future discoveries.



1 

1 British Mountains

2 Old Crow Flats

2 

Vegetation and Wildlife

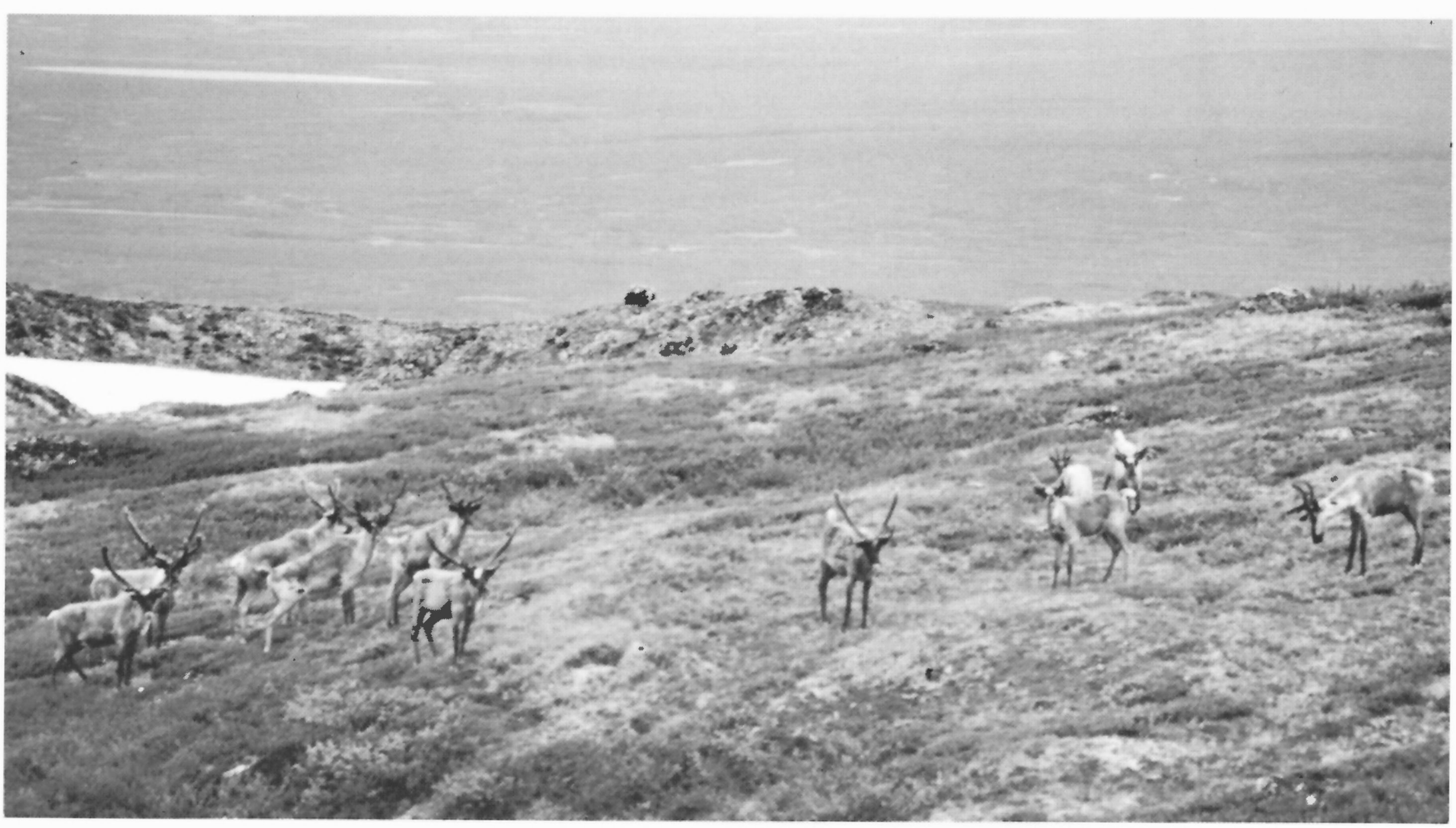
Arctic and alpine tundra and boreal forest all occur within the limits of the Northern Yukon area. The treeline runs through the middle, and Canada's most northerly extent of the boreal forest is found in the Firth River valley, reaching to within a few kilometres of the Arctic Ocean.

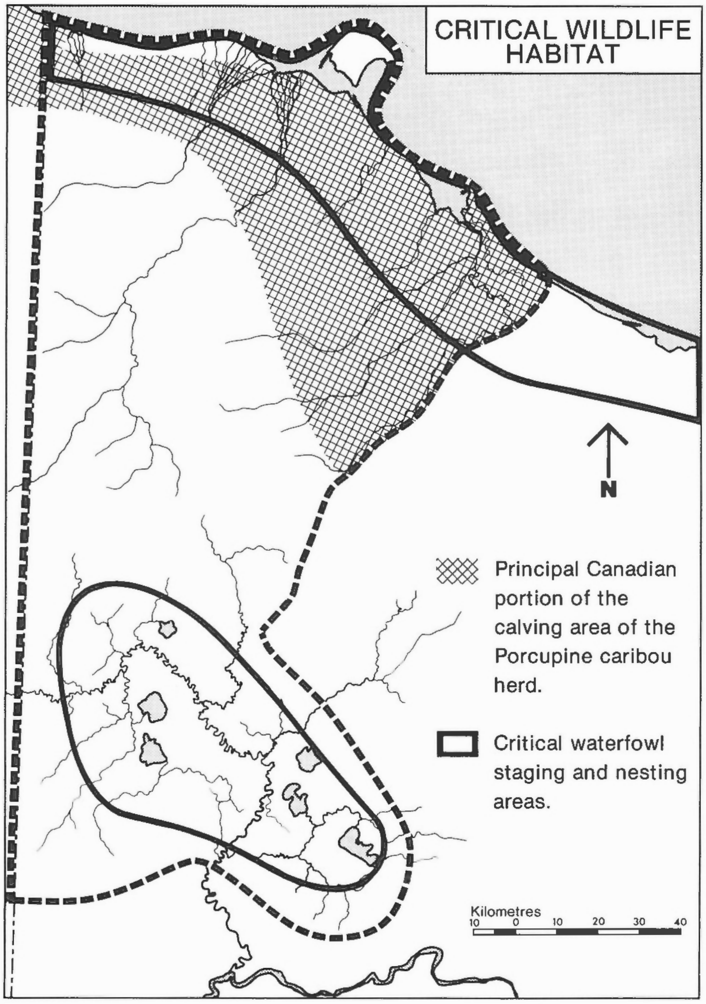
The area provides important habitat for a wide variety of species, including critical range for the Porcupine barren-ground caribou herd, which winters in the Yukon interior, and calves in the northern Yukon and Alaska. Other species present in the area include black, grizzly and polar bear, Arctic fox, wolf and muskrat. The area also contains Canada's most northerly distribution of moose and Dall's sheep.

Birdlife is particularly abundant and includes golden and bald eagles, rough-legged hawks, gyrfalcons, ospreys and peregrine falcons. The barrier beaches and shallow waters along the coast, and the Coastal Plain, are critical staging and moulting areas for tremendous numbers of waterfowl, and the wetlands of the Old Crow Flats are among the most important waterfowl habitats in North America.

White whales, ringed and bearded seals and the occasional bowhead whale and walrus are present along the coast. The Firth River is the main Arctic char spawning stream of the northern Yukon.

1 Porcupine barren-ground caribou

1




2

2 North America's three bear species are found within the proposed boundaries

3 The wetlands of Old Crow Flats are a major North American waterfowl area

3

Human History

The western Yukon Coast was occupied by a group of Mackenzie Inuit, whose main village was located on Herschel Island. This Island later took on a new role as Canada's first Arctic Ocean outpost, and its deep protected harbour attracted many large whaling fleets that were sailing nearby waters in search of the bowhead. By the 1890's whaling operations had pushed the winter population of the Island up to 2 000. During this period the Inuit gathered around the settlement of Herschel and were soon decimated by the effects of epidemic diseases. After the collapse of the whaling industry in 1906, Herschel became a trading centre until the growth of other Arctic settlements caused it to be abandoned in the late 1930's.

Today, small numbers of Inuit from the mainland settlements trap Arctic fox and hunt caribou along the coast, and take polar bear and seal from Herschel Island. Some also travel up the Firth River valley to hunt and fish.

The area south of the treeline was originally occupied by the Kutchin Indians, whose lives were largely influenced by the migration of the caribou, until the 19th century when the establishment of fur trading posts brought an abrupt end to their isolation. The settlement of Old Crow, to the south of the Northern Yukon area, is the only Yukon community north of the Arctic Circle. Today its people use portions of the area to hunt and trap.

1

1 Whaler's grave on Herschel Island

2 Mammoth Teeth -
Old Crow River (D. Showalter)

3 Klokut Dig on Porcupine River (W. Irving)

4 Inuit Camp at Catton Point (D. Showalter)

2

3

4

1 Aspen Creek in the British Mountains

2 The Old Crow Flats

3 Herschel Island was originally occupied by Mackenzie Inuit

1

2

3

If you would like to receive or contribute information on any of the six areas or to comment on their establishment as parks, please write to Parks Canada at one of the following addresses:

Director,
Parks Canada Prairie Region,
114 Garry Street,
WINNIPEG R3G 1G1
Manitoba.

or

Director,
National Parks Branch,
Parks Canada,
400 Laurier Avenue, West,
OTTAWA K1A 0H4
Ontario.