MINERAL RECONNAISSANCE OF THE PORCUPINE RIVER REGION: A SUMMARY REPORT

By James C. Barker and
Karen H. Clautice

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U.S. DEPARTMENT OF THE INTERIOR

Cecil D. Andrus, Secretary

BUREAU OF MINES

FOREWORD

This is one of a series of summary reports that present the findings of reconnaissance-type mineral assessments of certain lands in Alaska. It is important to remember that Alaska has not been seriously prospected for minerals other than gold--except in a few relatively limited areas. These summary reports include data developed by both contract and Bureau studies; frequently a combination of both. As digests of more detailed reports that are still in preparation, these summaries omit the detailed findings that will be presented in the main reports, but the basic data and conclusions remain the same.

Assessing an area for its potential for buried mineral deposits is by far the most difficult of all natural resource assessments. This becomes more apparent when considering that no two deposits even of the same genesis and host rock conditions are identical. Moreover, judgments prior to drilling, the ultimate test, frequently vary among evaluators and continue to change as more detailed studies add to the understanding.

Included in these reports are estimates of the relative favorability for discovering metallic and related nonmetallic mineral deposits similar to those mined elsewhere. Favorability is estimated by evaluation of visible outcrops, and analyses of sampling data, including mineralogic characteristics and associated elements, in combination with an evaluation of the processes that have formed the rocks in which they occur. Essentially, it is a comparison of a related series of prospects and the environment in which they occur with the mineral deposits and environments in well-known mining districts. Recognition of a characteristic environment allows not only the delineation of a trend but also a rough estimate of the favorability of conditions in the trend for the formation of minable concentrations of mineral materials. This is a technique long used in the mineral industry to select areas for mineral exploration. Qualifying a trend or area as "highly favorable" for the discovery of mineral deposits indicates that the combination of outcrop samples, mineralogic data and geologic conditions that have been observed essentially duplicate the conditions in a recognized mining district elsewhere.

TABLE OF CONTENTS

	Page
Abstract	1
Introduction	2
Acknowledgments	5
General rock types	5
Mineral information	6
Mineral potential	10
On-going studies	10
Conclusions	10
References	12
Appendix - Summary of mineral data	13

ILLUSTRATIONS

Figure		Page
1	Index map of Alaska	3
2	Map of project area	6
3	Rock type map of the Porcupine River region.	7
4	Mineral deposits in the Porcupine River region.	9
5	Energy potential map of the Porcupine River region.	13
6	Mineral potential map of the Porcupine River region.	14

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ABSTRACT

The Bureau of Mines made a reconnaissance in 1976 and 1977 of 5.5 million acres of land in the Porcupine River region.

The study region is divided into three generalized areas by rock types and the mineral deposit types probable in each area. These areas include:

1. Granitic intrusive and metasedimentary host rocks of the Old Crow Mountains: Lead, zinc, copper vein deposits and skarn mineralization occur near the headwaters of White Mountain Creek. Uranium and tin minerals occur within a silicic zone near the upper Rapid River in the Old Crow batholith. Alluvial gravels were found to contain placer tin, tungsten, and rare earth minerals. Base metals, molybdenum, tungsten, uranium and barite occur in the contact zone.

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2. **Mafic/ultramafic igneous rocks and associated sediments** west of the Coleen River: Very little is known about these rocks. Bedded barite, chromite and placer gold have been found in these rocks outside the study region. A few samples taken within the study region contain barite, copper, manganese and gold.

3. Sedimentary rocks: Lead, zinc and barium found in tributaries of the Porcupine River near the U. S. - Canada border may indicate that base metals occur in shales and carbonates. Little is known of the sedimentary rocks in the area drained by the Black River, but lead-zinc deposits are known in similar rocks in Canada. The non-marine sediments in the southern part of the study region are thought to be favorable for uranium deposits but this remains untested. The study region extends into the margins of the Yukon Flats and the Kandik basins, both with unknown petroleum potential.

INTRODUCTION

This summary report addresses 5.5 million acres of land in the vicinity of the Porcupine River, figure 1. A detailed report which includes results of field work conducted during the 1976 and 1977 field seasons, prospect reports and sample data will be prepared later. This investigation is part of continuing mineral availability studies being conducted by the Bureau of Mines, Alaska Field Operations Center. Studies in this area were requested by the Federal-State

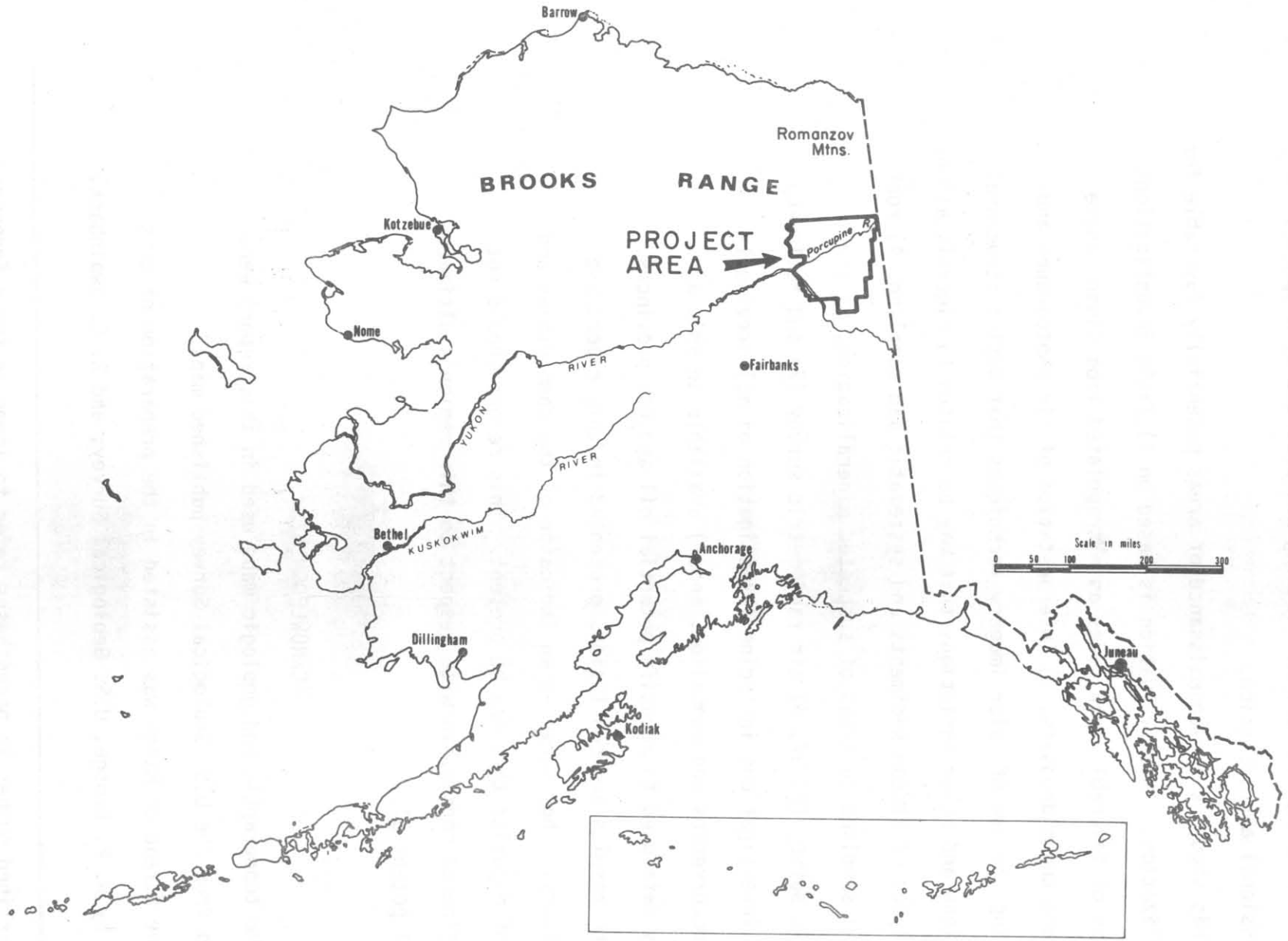

FIGURE 1.- Index map of project area

Land Use Planning Commission. Funding was provided by a special congressional appropriation.

This study is a reconnaissance of areas potentially favorable for mineralization. This evaluation is based on 1) field investigations in areas of favorable rock types as extrapolated from Canada where there are known deposits, 2) interpretation of air photographs and including the use of color imagery techniques that depict structural lineations and color variations that may be related to mineralization, 3) analyses of stream sediments and systematic pan sampling, 4) rock and soil sampling in areas of suspected mineralization, 5) air magnetic survey (2) 3/, 6) air radiometric survey (7) and follow-up ground investigations including investigation of all previously known occurrences and anomalies, and 7) available seismic and gravity data used to identify potential oil and gas provinces.

The results and conclusions presented in this report are preliminary. They serve as an indicator of the commodities and types of deposits that may be present. This report should not be considered conclusive with respect to this region's ultimate mineral potential.

ACKNOWLEDGMENTS

The topographic and geologic maps used in this report were adapted from the U.S. Geological Survey published maps.

The Bureau of Mines was assisted in the preparation of this report by W. P. Brosge, U.S. Geological Survey; and R. C. Swainbank,

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3/ Underlined number in parentheses refer to items in the references listed at the end of this report.

Vice President, Resource Exploration Consultants, who provided air photo interpretation of Landsat, false color imagery and black and white photography. Samples were prepared and analyzed by the University of Alaska, Mineral Industry Research Laboratory, under a Bureau of Mines grant. Uranium and thorium analyses were performed by the Alaska Division of Geological and Geophysical Surveys. The oil and gas evaluation was by D. P. Blasko of the Bureau of Mines.

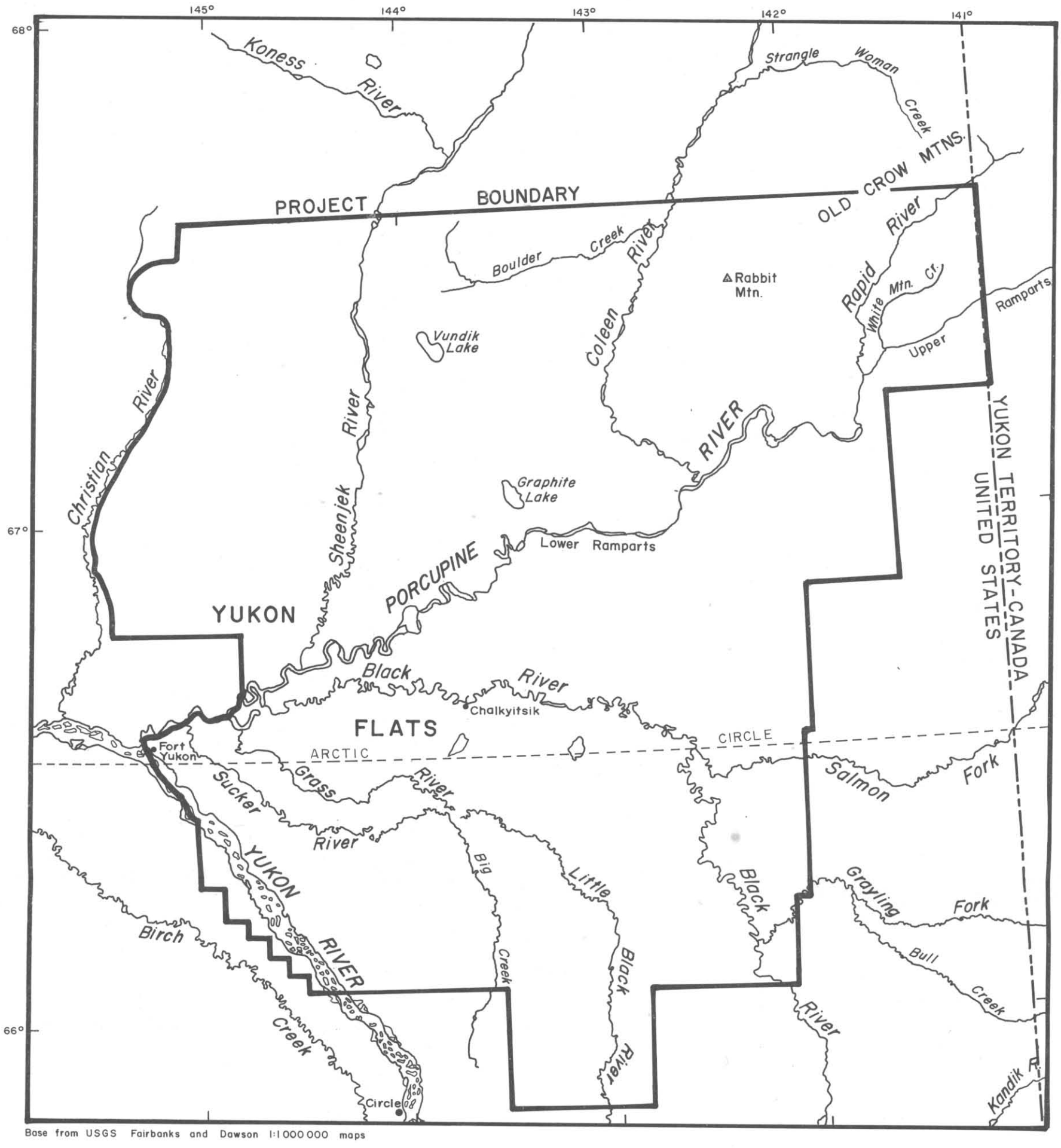
GENERAL ROCK TYPES

The study area (figure 2) is composed of portions of the Yukon Flats and Porcupine Plateau physiographic regions. The area typically consists of subdued terrain with black spruce forest and muskeg. There are no indications of recent glaciation.

Three generalized rock type areas comprise the Porcupine River study area, figure 3.

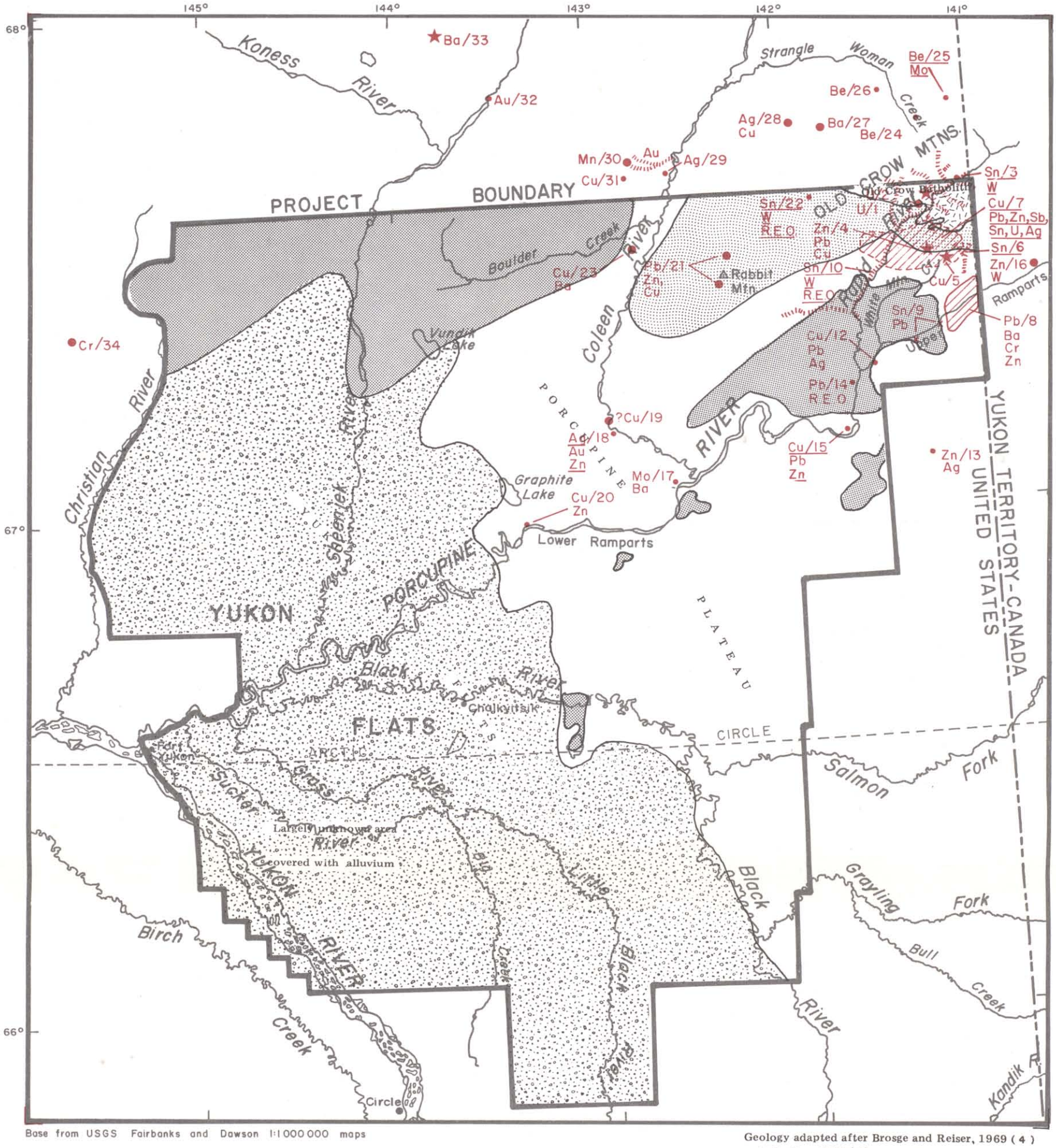
In the northeastern corner of the region, adjacent to the Canadian border, is located the Old Crow batholith. This granitic intrusive is flanked to the south by younger rhyolite sills in contact with and intruding Paleozoic rocks including argillite, phyllite, quartzite and limestone.

The second area is composed of a sequence of mafic and ultramafic igneous rocks with interlayered chert, shale and graywacke. Aeromagnetic data (2) infer that the complex is bounded by faults to the northwest and southeast.



Base from USGS Fairbanks and Dawson 1:1 000 000 maps

FIGURE 2.- Map of project area



Base from USGS Fairbanks and Dawson 1:1 000 000 maps

Geology adapted after Brosge and Reiser, 1969 (4) and Brabb , 1970 (1).

★ Ba/31 Prospect lode

Au Creek placer

x Sn/9 Placer prospect

● Ba/27 Mineral occurrence

• Ag/29 Geochem/Geophysical anomaly

Pb/8 Geochem potential

Underling=Group of anomalous elements

1. Granitic and metasedimentary rock type
   - Granitic
   - Metasedimentary
2. Mafic and ultramafic igneous rock type
3. Sedimentary rock type

FIGURE 3.- Rock type map of the Porcupine River region

The third area consists of sedimentary rocks ranging in age from Precambrian through Tertiary (1, 4). Lower Paleozoic marine shales and carbonates occur predominantly in the eastern portion of this area. These rock units form part of Paleozoic continental margin which extends eastward into Canada. Younger sedimentary rocks, including sandstone, shale and chert occur generally to the south and west along the margin of the Yukon Flats. Tertiary gravels, lignite and minor tuff, partially capped by Quaternary basalt flows occur near Fishhook Bend. Tertiary sedimentary rocks are also thought to underlie Quaternary sediment of the Yukon Flats.

MINERAL INFORMATION

Various metallogenic provinces identified within each of the rock type areas of the Porcupine River region are indicated to be highly favorable for occurrence for mineral deposits of a grade and size mined elsewhere. The following discussion is divided according to the rock type areas and the mineral occurrence data shown on figure 4. A summary of the mineral data listed by map locations on figure 4 can be found in the Appendix.

Mineral Deposits in Granitic Intrusive and Metasedimentary Host Rocks

There is evidence that uranium deposits occur in the granitic batholith. Uranium minerals (arsenuranylite and uranophane) were found in a silicic zone near the Rapid River (no. 1, figure 4).

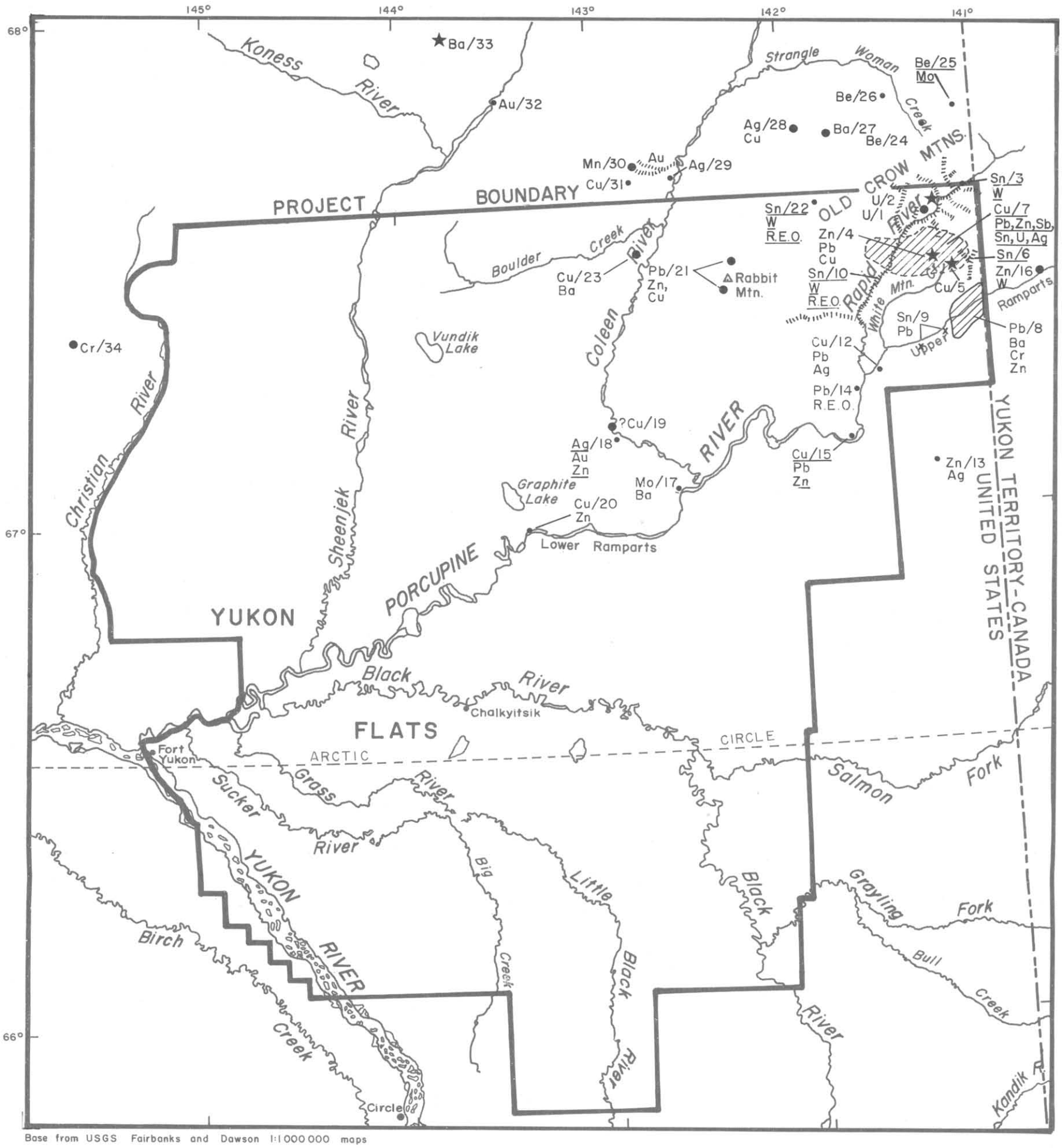


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FIGURE 4.- Mineral deposits in the Porcupine River region

This zone also appears mineralized to an unknown extent with tin. One mile from this occurrence, analysis of soil samples also indicates uranium mineralization (no. 2). Stream sediment samples and airphoto interpretation of rock structures indicates other areas of tin/uranium mineralization several miles north and west of this occurrence (refer to Appendix).

The extensive alluvial gravels of the Rapid River and tributaries draining the batholith were found to contain tin, tungsten, niobium and rare earth minerals (nos. 3, 6, 10). The grades were not determined. Alluvial gravels of the Strangle Woman Creek to the north should also be considered possible placer deposits.

In the area of the batholith margin and adjacent rhyolite, sampling indicates an environment favorable for porphyry or stockwork types of deposits of copper, lead, zinc, molybdenum, tungsten, and uranium (no. 7).

Base metal (lead, zinc and copper) vein and skarn mineralization was found near the headwaters of White Mountain Creek (nos. 4 and 5) in the region of the rhyolite and metasedimentary rock contact. Similar occurrences of lead, zinc and tungsten are known to occur in Canada several miles east of the border. This suggests that other similar deposits may occur in the area. Barite occurs as a vein on the contact with the granite to the north.

Mineral Deposits Associated With Mafic and Ultramafic Igneous Rocks

This rock sequence, known as the Christian complex, is found in the northwestern portion of the study region, figure 3. Very

little is known about this complex of rocks and previous exploration has been negligible. Occurrences of chromite, bedded barite and placer gold are found elsewhere within this sequence of rocks, but outside the boundaries of the region covered in this report (nos. 29, 30, 31, 32, 33, and 34). Within the study region anomalously high amounts of barium, copper, manganese and gold were found in tributaries to the Coleen River (nos. 20 and 23). The barium and copper anomaly on the Coleen River near Boulder Creek (no. 23) coincides with well-defined intersecting structural lineaments recognized from aerial photography.

The few known occurrences and the deposit types characteristically associated with similar mafic/ultramafic rocks elsewhere suggest that the Christian complex may include deposits of chromium, iron, nickel, cobalt and platinum metals. The sequence of interbedded mafic volcanic rocks, radiolarian cherts and shales is a common environment for copper with gold and possibly zinc in solid sulfide deposits. Placer deposits of platinum and gold may occur in the alluvial gravels derived from the Christian complex. The bedded barite occurrences north of the study area (no. 33) and the anomalous amounts of barite found within the area suggest that barite deposits may occur associated with or near the Christian complex. Other commodities that may occur within this area include manganese, asbestos and jade. This area should be investigated.

Mineral Deposits in Sedimentary Rocks

The area underlain by sedimentary rocks is shown in figure 3. Presently, little is known of the southern portion of this area. A

survey was made of all tributaries to the Coleen and Porcupine Rivers in the northern portion of this area. Minor barium (nos. 13, 15, 17 and 20) in the area of the upper Porcupine River indicates the possibility of base metal mineralization in the lower Paleozoic shales and carbonates which extend into the unexplored southern portion of the area. Lead-zinc deposits are known in rocks of similar age and composition in Canada. On the Coleen River, in the vicinity of the Coleen Mountain, copper and anomalous silver, zinc and gold (nos. 18 and 19) are reported.

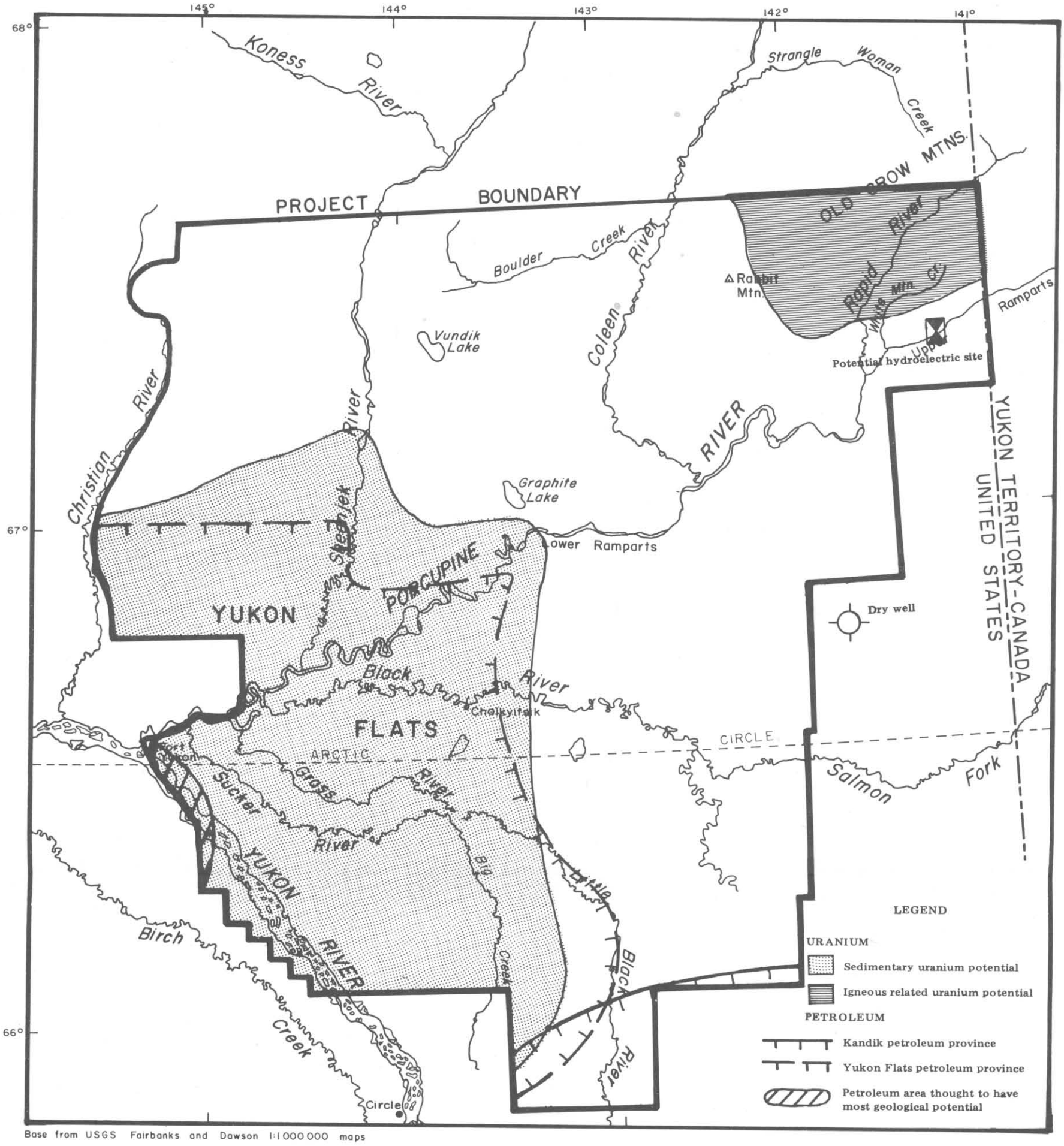
A recent airborne radiometric survey has revealed radioactive anomalies in areas along the margins of the Yukon-Porcupine Flats (7). This area is known to contain non-marine sediments of probable Tertiary age which could act as host for sedimentary type uranium deposits. Scattered occurrences of lignite are known within these Tertiary rock units but there are no known deposits of higher rank coals.

The Kandik and Yukon Flats petroleum provinces are shown in figure 5. The study region includes a small portion of the Kandik Mesozoic and Paleozoic province and the eastern third of the Yukon Flats Tertiary basin. No oil or gas seeps have been reported in either of these areas. Oil shale, bituminous limestone, organic-rich rocks and reef-like carbonates outcrop within the Kandik province. Three dry wells have been drilled within this province southeast of the study region.

MINERAL POTENTIAL

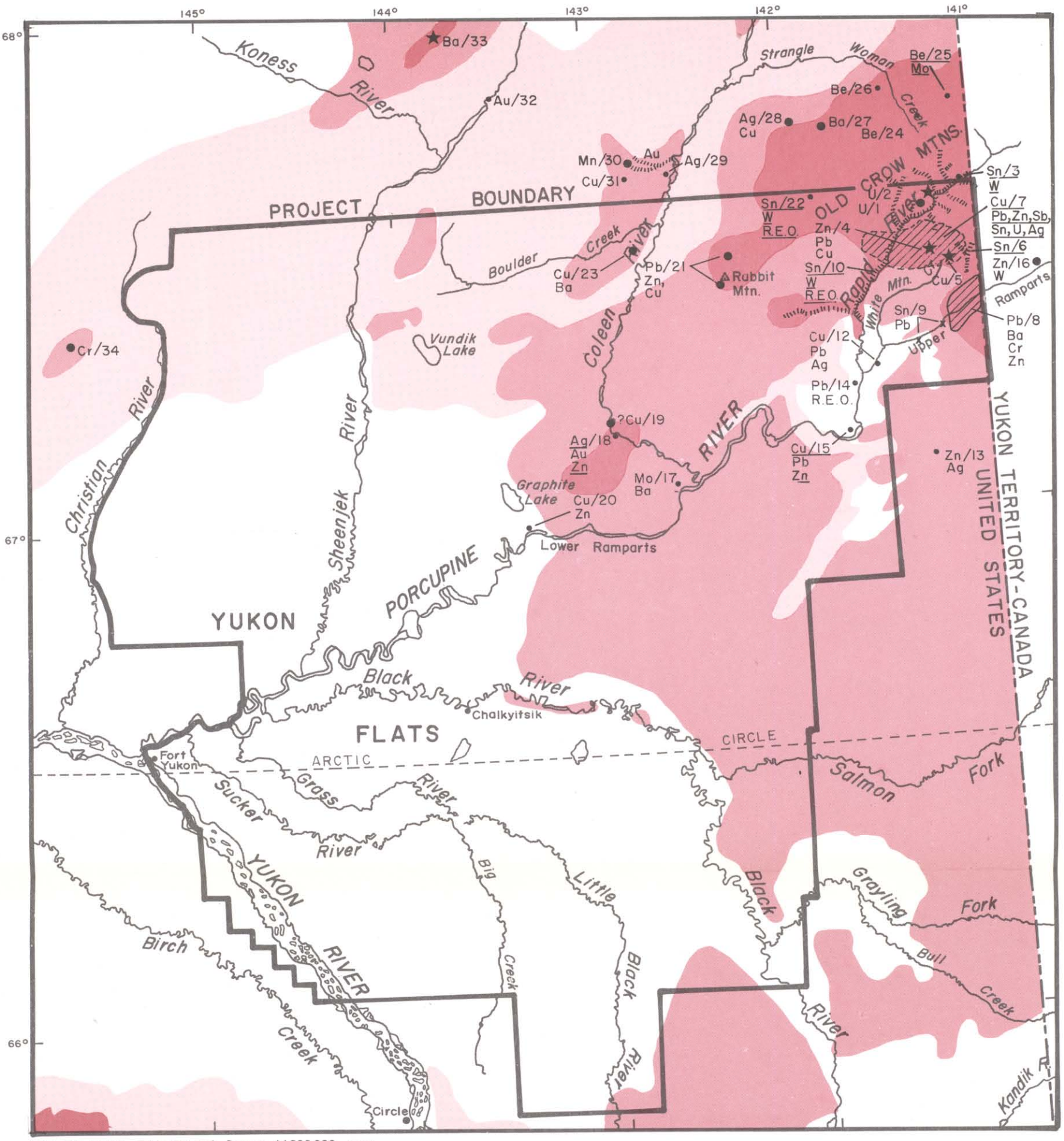
Energy resource areas including petroleum and uranium are shown in figure 5. Too little information is currently available to rate these areas as to low, moderate or high potential.

Estimates of the favorability for discovering mineral deposits are presented in figure 6. These are based on the very limited data



Base from USGS Fairbanks and Dawson 1:1 000 000 maps

FIGURE 5.- Energy potential map of the Porcupine River region



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Highly favorable for metallic and related nonmetallic deposits

Favorable for metallic and related nonmetallic deposits

Less favorable for metallic and related nonmetallic deposits

Unfavorable for metallic and related nonmetallic deposits except for deposits in sedimentary basins, including uranium

FIGURE 6.- Mineral potential map of the Porcupine River region

available on this region. The areas shown as less favorable may in some cases merely be areas where data are lacking. The Bureau of Mines will attempt to more accurately define the favorable areas through additional field examinations and monitoring of exploration by industry in adjacent lands in Canada and Alaska.

ON-GOING STUDIES

During the 1978 field season, follow-up investigation of the lead, zinc, and copper occurrences along the Porcupine River are planned. Also planned are reconnaissance studies of lead, zinc, silver and barite deposits within sedimentary areas along the Black River. The tin and uranium in the granitic area will be investigated in more detail but this may have to be deferred until 1979.

CONCLUSIONS

The upper Porcupine River Region (about 5.5 million acres of land) contains several areas that appear highly favorable for mineral deposits. Based on data currently available, these areas include:

1. Granitic and metasedimentary rock type areas
   - -The Rapid River, which is favorable for placer deposits of tin, tungsten, niobium and rare earth elements.
   - -The area of lead, zinc and copper mineralization near the headwaters of White Mountain Creek.
   - -The uranium mineralization at the headwaters of the Rapid River where there may also be copper, lead, zinc, molybdenum and tungsten mineralization.

2. Mafic/ultramafic rock type areas.

   Based on a few samples taken within the area and on deposits associated elsewhere with mafic and ultramafic rocks, this poorly known area could contain chromium, platinum, nickel, copper, gold, barite, manganese and asbestos.

3. Sedimentary rock type areas.

   -Base metal mineralization, including copper, lead and zinc is indicated along portions of the upper Coleen and Porcupine Rivers. The upper Black River may also be favorable.

   -Sedimentary uranium may exist in the Tertiary non-marine sedimentary rocks.

   -The southern and southwestern portions of the study region extend into the margins of oil and gas provinces.

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APPENDIX: SUMMARY OF MINRAL DATA
(refer to figure 4 for map locations)

Map Location No.	Commodity	Remarks
1.	Uranium, tin	Secondary uranium minerals in silicified shear zone; a grab sample contained 1600 ppm uranium. Creek draining this region contained 21% tin and abundant rare earth minerals in a sluice concentrate. Lead and zinc are highly anomalous in area.
2.	Uranium	A tundra covered permafrost area detected by radiometrics approximately 2400 X 600 feet contained between 16 and 52 ppm uranium in 10 soil samples.
3.	Tin, tungsten	Stream sediments in this area indicate up to 100 ppm tin and 700 ppm tungsten by spectrographic analysis.
4.	Zinc, copper, lead	Sphalerite, chalcopyrite, bornite and magnetite occur in a small "skarn" deposit. Numerous small occurrences of lead and zinc minerals are found in this area.
5.	Copper, lead	Chalcopyrite and galena occur in a silicified shear zone in black phyllite. Mineralized float rock occurs scattered over a 100 X 1200 foot tundra area. Minor zinc and silver values were also detected.
6.	Tin	Concentrate sampling indicates a potential for tin and rare earth placers on upper Sunaghun Creek.
7.	Copper, lead, zinc, (antimony, silver, uranium, tin)	Widespread and highly anomalous analyses of stream sediments, soil and rock samples in the metasedimentary rocks adjacent to the southern contact of the Old Crow batholith.
8.	Lead, barium, zinc, chromium	Area of dolomite, shale and pyritic quartzite is regionally anomalous in these elements. Anomalous lead values occur in a large, highly weathered zone which is devoid of all vegatation.

Map Location No.	Commodity	Remarks
9.	Tin, lead	Concentrate sampling indicates potential placer values in a three mile section of a high ancient channel of the Porcupine River. At least 10 miles of such channels exist in this vicinity.
10.	Tin, tungsten uranium, rare earths	Sluice sampling of the Rapid River indicates very extensive placer deposits of these minerals exist. Currently, there is not subsurface data on average grade or yardage.
11.	Barium, antimony	Geochemical analyses of pan concentrate samples indicate these elements are anomalous.
12.	Copper, lead, silver	These elements are highly anomalous in stream sediments and rock samples, (up to 500 ppm copper, 200 ppm lead and 7ppm silver).
13.	Zinc, silver	Geochemical anomaly reported (3).
14.	Rare earths, lead	Creek draining Permian siltstone is anomalous in these elements.
15.	Copper, zinc, lead	Rock samples of iron stained limestone and shales are anomalous, (up to 500 ppm copper, 500 ppm lead, 2000 ppm zinc). Vanadium and nickel are also high.
16.	Tungsten, zinc, lead	Occurs in vein or possibly skarn deposit, little information available.
17.	Molybdenum, barite	Lower Paleozoic carbonaceous limy shales contain carbon lenses, 70 ppm molybdenum and greater that 1% barium and manganese.
18.	Silver, gold zinc	Anomalous stream sediment samples.
19.	Copper	Reported prospect, exact location uncertain (5).
20.	Copper, zinc	Brecciated ferruginous and manganiferous sandstone and argillite with secondary quartz, (up to 300 ppm copper, 1500 ppm zinc).

Map Location No.	Commodity	Remarks
21.	Lead, zinc, copper	Small sulfide-bearing zones in black phyllites.
22.	Tin, tungsten, rare earths	Anomalous amount of these elements occur in pan concentrates.
23.	Copper, barium	Minor copper and iron stain in talus of river bluff of shale quartzite. Nine percent barite in pan concentrate sample.
24.	Beryllium, tin	Stream sediment anomaly reported (3).
25.	Beryllium, molybdenum	Stream sediment anomaly reported (3).
26.	Beryllium	Stream sediment anomaly reported (3).
27.	Barium	Vein occurrence of barite near granite schist contact (3).
28.	Copper, silver	Vein in schist reportedly contains 1500 ppm copper and 2.5 ppm silver (3).
29.	Gold	Several gold placer claims staked in the 1950's (6). Anomalous gold (.1-.2 ppm) reported in a rock sample nearby (3).
30.	Manganese	One-inch vein of psilomelane in red ferruginous argillite (5).
31.	Copper	Geochemically anomaly in a rock sample reported (3).
32.	Gold	Pan concentrate sample reported to contain 1800 ppm gold.
33.	Barium	Lenses or beds of massive barite, the largest of which is 18-feet thick and 100 feet along strike, are interbedded with cert, shale, and mafic intrusive sills.
34.	Chromium	Small occurrences of podiform (?) chromite occurring in peridotite.