National Uranium Resource Evaluation

BLACK RIVER QUADRANGLE
ALASKA

C. C. Hawley and Associates, Inc.
Anchorage, Alaska

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NATIONAL URANIUM RESOURCE EVALUATION
BLACK RIVER QUADRANGLE
ALASKA

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This is the final version of the subject-quadrangle evaluation report to be placed on open file. This report has not been edited. In some instances, reductions in the size of favorable areas on Plate 1 are not reflected in the text.
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ABSTRACT

The Black River Quadrangle, Alaska, was evaluated to identify and delineate areas that have environments favorable for uranium deposits by conducting geochemical and aerial radiometric surveys and by making local detailed surface geologic studies. The favorability determinations were based on criteria developed for the National Uranium Resource Evaluation program. No uranium concentrations were found in the quadrangle, and none of the geologic environments meet favorability criteria. The Cenozoic basins of the region contain continental Tertiary sediments that could host uranium deposits, but they remain unevaluated because of their cover of water-saturated Quaternary alluvium which commonly precludes the use of surface exploration methods.
INTRODUCTION

PURPOSE AND SCOPE OF STUDY

The Black River Quadrangle, Alaska (Fig. 1), was evaluated to identify geologic environments that exhibit characteristics favorable for uranium deposits. An environment is considered favorable if it has potential to contain at least 100 tons of U$_{3}$O$_{8}$ in rocks that have an average grade of no less than 100 ppm. Determination of favorability was based on similarity of an environment's geologic characteristics to those found in close association with known uranium deposits as described by Mickle and Mathews (eds., 1978). The evaluation was conducted by C. C. Hawley and Associates of Anchorage, Alaska, under subcontract to Bendix Field Engineering Corporation (BFEC) for the National Uranium Resource Evaluation (NURE) program, managed by the U.S. Department of Energy (DOE).

The Black River Quadrangle is one of four contiguous quadrangles in east-central Alaska evaluated by C. C. Hawley and Associates during the 1979 field season. Approximately 1.5 man-years were spent in literature search, field work, analysis of data, and preparation of the final report. Field work included geologic mapping, about 2590 line km of aerial radiometric survey, and collection of 576 geochemical samples, including 416 stream-sediment, 140 rock, 18 soil, and 2 water samples. Thin sections for petrographic study were made of three rock samples from a granitic pluton.

PROCEDURES

Two types of aerial radiometric surveys were flown. Systematic fixed-wing coverage parallel to topographic contours or along ridges was done using a geoMetries model DGRS 1002 four-channel gamma-ray spectrometer with a NaI (Tl) detector volume of 4200 cm$^{3}$. The instrument was installed in a Cessna 206 with a recording radar altimeter. Radiometric and altitude data were recorded on an analog chart recorder. Lines were flown an average of 90 m above ground level and at about 160 km/h. Followup surveys, using a geoMetrical GR 410 four-channel spectrometer with a two-channel recorder and a 4200-cm$^{3}$ detector mounted in a Hughes 500D helicopter, were flown at a lower elevation to pinpoint and detail anomalies. The helicopter was also used to make ground radiometric readings.

Uranium analyses were done to BFEC specifications by Rainbow Resource Labs of Anchorage, and 29 element spectrographic analyses of selected samples were performed by TSL Laboratories of Opportunity, Washington. Rock samples were analyzed by fluorometric methods after digestion in hot hydrofluoric acid. The stream-sediment and soil samples and splits of some of the rock samples were analyzed fluorometrically after digestion was used to break down refractory silicate minerals as well as others which contain uranium; analyses by this method closely approximate the total uranium content of the rock sample. The values from the partial, nitric acid digestion indicate the more soluble uranium contents. Results of all analyses are listed in Appendix B.

Ground geologic examinations were made of selected radiometric or geochemical anomalies, and ground traverses were made across areas of exposed bed rock to lithologically and radiometrically characterize the mapped
FIGURE 1. Location of Black River Quadrangle
geologic units. GeoMetrics GR 310 portable spectrometers and GR 101A
scintillometers were used for ground work. Anomalies from a previous aerial
radiometric reconnaissance (Texas Instruments, Inc., 1976) were field checked,
and interpretations are included on Plate 3.

GEOLOGIC SETTING

The terrain in the eastern and central portions of the Black River
Quadrangle consists of rolling, hilly uplands with areas of more rugged relief
locally, especially along the Canadian border. Lowlands of the western
portion are part of the extensive Yukon Flats physiographic province.
Permafrost underlies much of the quadrangle.

The predominant rocks in the highlands are of marine sedimentary origin,
mainly limestone, quartzite, phyllite, and shale; they range in age from late
Precambrian to Cretaceous (Fig. 2). A small granitic stock occurs on Racquet
Creek near the Canadian border, and basalt flows of Cenozoic age are exposed
locally in the northern portion of the study area; igneous rocks are otherwise
scarce in the quadrangle. River valleys in the region are floored by alluvial
flood-plain and terrace deposits (Qal, Qt)*; the western lowlands are
largely water saturated and mantled by loess (Q1). Continental sedimentary
rocks of Tertiary age probably underlie younger materials in many of the
lowland areas but they are exposed only along a short stretch of the Porcupine
River at the extreme northern edge of the quadrangle.

Throughout the quadrangle, bed rock is poorly exposed because of
vegetation, loess, and alluvial and colluvial cover. Geologic interpretations
are largely based on mapping of frost-riven rubble.

The oldest group of rocks in the study area (pCp) constitutes an
interbedded sequence of red, green, and black phyllite; black and white banded
slate and siltstone; white, brown, and red quartzite; and orange and red
dolomite. This unit is of probable late Precambrian age (Brabb, 1970). In
Canada and in the Charley River Quadrangle to the south the sequence is called
the Tindir Group (Norris, 1979; Brabb and Churkin, 1969). It is probably
correlative with the Belt Series of the U.S. and Canadian Cordillera.

Unconformably overlying the phyllite-bearing unit is a sequence of
carbonate rocks that ranges in age from Cambrian(?) to Devonian (CO1, DC1, S1,
and D1). For the most part, rocks of this sequence consist of locally
dolomitic, light- to dark-gray, fine- to coarse-grained limestone, in which
marine fossils are common. With a few local exceptions, the various units are
in fault contact with each other (Brabb, 1970).

Locally, the carbonate sequence is unconformably overlain by units of
Carboniferous and Permian shale and quartzite. The shale unit (PCs) contains
grayish-black shale, argillite, and dark-gray limestone and local beds of
quartzite and conglomerate. The quartzite unit (Pq) includes both massive

*Letters in parentheses are geologic designations used on Plate 9 and in the
appendices.
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<td>CENOZOIC</td>
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<td>Qal - Alluvial sand and gravel. Qt - River terrace deposits. Ql - Loess.</td>
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<tr>
<td>TERTIARY</td>
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<td>QTs - Poorly consolidated sand and mud. Qtb - Olivene basalt.</td>
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<tr>
<td>CRETACEOUS</td>
<td></td>
<td>Massive quartzite.</td>
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<tr>
<td>JURASSIC</td>
<td></td>
<td>Grayish-black shale and argillite with minor siltstone and quartzite.</td>
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<tr>
<td>PERMIAN</td>
<td></td>
<td>Fq - Massive quartzite and chert pebble conglomerate. PCs - Grayish black shale and argillite and dark gray limestone with local quartzite and conglomerate.</td>
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<tr>
<td>CARBONIFEROUS</td>
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<tr>
<td>DEVONIAN</td>
<td></td>
<td>D1 - Medium gray to grayish-black crinoidal limestone. Del - Massive limestone and dolomite with minor red and green argillite and black chert. S1 - Medium gray to grayish-black fine-grained limestone. Pzv - Mafic volcanic rocks. G01 - Light gray to grayish-black, locally dolomitic limestone.</td>
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<tr>
<td>SILURIAN</td>
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<td></td>
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<tr>
<td>CAMBRIAN (?)</td>
<td></td>
<td>Red, green, and black phyllite; black and white banded slate and siltstone; white, brown, and red quartzite; and orange weathering dolomite and limestone.</td>
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FIGURE 2. STRATIGRAPHIC COLUMN
quartzite and chert-pebble conglomerate; it is only a few hundred meters thick (Brabb, 1970), but because of its resistance to weathering it forms most of the ridge tops in the central part of the quadrangle.

Grayish-black shale and argillite, and minor siltstone and argillite (KJs) and massive quartzite (Kq), were deposited unconformably on top of the Paleozoic and Precambrian rocks in the eastern half of the quadrangle. The shale unit contains Jurassic and Cretaceous pelecypods (Brabb, 1970).

Anomalously low Bouguer gravity values in the lowlands possibly correlate to basement lows filled with relatively unconsolidated Tertiary (?) sediments (Barnes, 1977). Coal-bearing sediments of Tertiary age occur in several areas around the margins of the Yukon Flats basin and in the topographic trough along the Tintina Fault to the south (Mertie, 1937; Brabb and Churkin, 1969). The only similar rocks exposed within the margins of the study area are poorly consolidated upper Tertiary and Quaternary (QTs) sandstone and mudstone which occur along a short section of the Porcupine River at the northern edge of the quadrangle (Brabb, 1970). It is likely, however, that continental Tertiary sedimentary rocks underlie the Quaternary cover of the lowlands, especially in the deeper parts of the basins.

Exposures of igneous rocks are rare in the Black River Quadrangle. A small quartz monzonite stock of Precambrian or younger age (pCg) intrudes the Precambrian phyllite unit near Racquet Creek on the Canadian border (Brabb, 1970). The stock has been altered and slightly metamorphosed (plagioclase phenocrysts have been completely altered to sericite); pyrite, limonite, and calcite occur on grain boundaries and in fractures. Brabb (1970) mapped three mafic igneous bodies (pCi) intruding the phyllite (Pl. 9), but these mafic rocks were not located in this survey. A small exposure of mafic volcanics of Paleozoic (?) age (Pzv) is located on Bull Creek in the southeastern corner of the quadrangle.

Continental flood basalts of Tertiary and Quaternary age (QTb) are exposed locally in the northern part of the quadrangle (Brabb, 1970), and it is likely that similar rocks underlie the unconsolidated Quaternary material elsewhere in the lowlands. Tiinkdhul Lake, in the west-central portion of the study area, is a possible caldera associated with the basaltic volcanism.

ENVIRONMENTS FAVORABLE FOR URANIUM DEPOSITS

None of the geologic environments in the quadrangle were found to be favorable for the occurrence of uranium deposits.

ENVIRONMENTS UNFAVORABLE FOR URANIUM DEPOSITS

In the Black River Quadrangle, unfavorable environments include plutonic igneous rocks (Classes 300-399, Mathews, 1978), volcanogenic rocks (Classes 500-599, Pilcher, 1978), marine black shale (Class 130, Jones, 1978), and limestone (Class 230, Jones, 1978).
PRECAMBRIAN GRANITE

The uranium content of the small quartz monzonite stock in the east-central part of the quadrangle is not anomalous for a felsic intrusive. Rock samples had a maximum value of 7 ppm U$_3$O$_8$. All stream-sediment samples draining the pluton contain less than 1 ppm U$_3$O$_8$. No airborne radiometric anomalies are associated with this pluton, and its radiometric parameters are below those of most of the plutons in the Circle Quadrangle to the southwest (Hinderman, 1981). The granite is not exceptionally felsic or alkaline and shows no hydrothermal alteration. It therefore meets few of the favorability recognition criteria (Mathews, 1978).

VOLCANIC ROCKS

Volcanic rocks in the Black River Quadrangle are of intermediate to mafic composition. Related rock and stream-sediment samples contain less than 1 ppm U$_3$O$_8$. Few uranium deposits are associated with mafic volcanics. Because of this and the lack of geochemical anomalies, the volcanic units are considered unfavorable for uranium deposits.

MARINE BLACK SHALES

None of the marine black shales of the quadrangle appear to have been deposited in a stable shelf environment like that of the uraniferous Chattanooga Shale (Jones, 1978), and no phosphatic minerals were observed. Rock samples contain a maximum of 6 ppm U$_3$O$_8$. The marine black shales are considered unfavorable for uranium occurrences.

LIMESTONE

No geochemical anomalies are associated with the limestones and dolomites which crop out in the eastern highlands of the quadrangle. The carbonates are relatively impermeable. They were not deposited in a saline lake or a sabkha environment like that of the uranium-bearing Todilto Limestone (McLaughlin, 1963; Perry, 1963). There is little karst topography in the region such as that associated with uranium deposits in the USSR (Jones, 1978). The limestone and dolomite of the Black River Quadrangle are not considered favorable for uranium deposits.

UNEVALUATED ENVIRONMENTS

Tertiary sediments in the quadrangle have a depositional environment similar to that of the uranium-bearing Tertiary sediments in the western United States and meet some of the favorability criteria for sandstone-type uranium deposits (Class 240, Austin and D'Andrea, 1978). The sediments were deposited in a continental intermontane basin; they contain organic material and intercalated tuffs and acidic volcanics (Eakins and Forbes, 1976).
Surficial blockage of gamma radiation by water, vegetation, and Quaternary deposits poses difficulties in detecting radiometric anomalies. Permafrost and fine-grained loess may make water and stream-sediment sampling ineffective by blocking ground water from reaching the surface. In the absence of definitive subsurface information, the Tertiary sedimentary environments of the region are classified as unevaluated.

RECOMMENDATIONS TO IMPROVE EVALUATION

A comprehensive drilling program would be necessary to evaluate the uranium potential of the Tertiary basins in the Black River Quadrangle. Two lines of drill holes would probably be adequate. One should begin near Salmon Village and proceed to the west through the Tiinkdhul Lake area, where a gravity low (Barnes, 1977) indicates a possible deep accumulation of unconsolidated sediments. The second line should begin east of the Little River in the southwest part of the study area and proceed due east across the loess deposits to the western edge of the quadrangle.

The drilling could probably be done most efficiently and economically by using tractor-mounted rotary drills. Cuttings should be sampled at 10-ft intervals for uranium analyses and petrographic determination of lithology and oxidation state. Holes should be spaced at 1-km intervals and should penetrate to the basement rocks or to 1500 m (specified depth of the evaluation) if the basement rocks are not reached.
SELECTED BIBLIOGRAPHY


EXPLANATION

AREAS FAVORABLE FOR URANIUM DEPOSITS

There are no areas favorable for uranium deposits in the Black River Quadrangle.

PLATE 1. AREAS FAVORABLE FOR URANIUM DEPOSITS
There are no uranium occurrences in the Black River Quadrangle.
BLACK RIVER, ALASKA

PLATE 3. INTERPRETATION OF AERIAL RADIOMETRICS
PLATE 4. C.C. HAWLEY AND ASSOCIATES AERIAL RADIOMETRICS
PLATE 5. STREAM–SEDIMENT GEOCHEMISTRY
PLATE 7. ROCK GEOCHEMISTRY
PLATE 8. SOIL AND WATER GEOCHEMISTRY
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G. Proposed and Current Withdrawals.

A. Areas Administered by the U.S. Fish and Wildlife Service (closed to mineral entry).


W. Areas Selected by the State of Alaska Pursuant to the Alaska Statehood Act.

W-1 Lands with State Selection Applications Filed.

PLATE II. LAND STATUS
BLACK RIVER, ALASKA

PLATE 13. TOPOGRAPHIC MAP