GREENS CREEK URANIUM OCCURRENCE, MARQUETTE COUNTY, MICHIGAN

By R. C. Vickers

Trace Elements Memorandum Report 566

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Geology and Mineralogy

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R. C. Vickers

June 1955

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*This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

GEOLOGY AND MINERALOGY

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A. E. Weissenborn, Spokane	1
TEPCO, Denver	2
TEPCO, RPS, Washington, (including master)	2
	45

CONTENTS

ILLUSTRATIONS

TABLE

GREENS CREEK URANIUM OCCURRENCE, MARQUETTE COUNTY, MICHIGAN

By R. C. Vickers

ABSTRACT

Metatorbernite and bassetite are present in altered carbonaceous and quartzose slate of probable upper Huronian age. The slate is part of a small inlier of Huronian rocks between the Gwinn iron district to the southeast and the Marquette iron district to the northwest, Marquette County, Mich. Samples taken from a shallow trench, which was dug in the area of highest radioactivity, contained as much as 0.68 percent uranium. A 4-foot channel sample of the slate contained 0.036 percent uranium.

The presence of dickite in the altered slate suggests hydrothermal activity. However, uranium, copper, and phosphorous are relatively concentrated in unaltered slate which provides a convenient source for these elements and suggests that hydrothermal solutions may have provided only a mechanism for their redistribution and local concentration.

INTRODUCTION

Abnormal radioactivity was found in 1953 during a scintillation counter survey of a small inlier of Huronian rocks along Greens Creek. _/ The survey was made in company with Mr. L. P. Barrett who

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_/ Also referred to as Green Creek.

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suggested that the locality would warrant examination because of the similarity of the geology to the Gwinn district, 10 miles to the southeast, where abnormal radioactivity had been detected by Barrett at several mine dumps. During the summer of 1954 the Greens Creek locality was reexamined by the author, and a shallow trench was dug across the thinly covered radioactive bedrock to determine the cause of the radioactivity. The locality was mapped and sampled, and metatorbernite and bassetite were identified in samples of altered carbonaceous and quartzose slate. This investigation was made by the U. S. Geological Survey on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

Location, accessibility, and general features

The Greens Creek uranium occurrence is in the NW 1/4 sec. 19, T. 46 N., R. 26 W.,_/ Marquette County, Michigan, and is about 9 miles south of Negaunee, Michigan. The location of the occurrence is shown on the index map, figure 1.

_/ Location based on Michigan State Highway Department County Map and also information from the owner of the NW 1/4 sec. 19. According to the U. S. Geological Survey 15-minute Ishpeming Quadrangle map (1952), the location of the occurrence is in the NE 1/4 sec. 24, T. 46 N., R. 27 W.

A road log to the occurrence is as follows:

0.00 Junction M-35 and County Route 565 in Palmer, Mich. Proceed southwest on Route 565.

1.21 Junction with County Route 476; bear left on Route 565.

5.12 On right side of road, white barn and farm house belonging to Mr. G. Roos.

5.45 Turn right onto logging road.

5.90 End of road at a clearing containing small spruce trees.

The uranium locality is about 225 feet S. 25° W. from the end of the road.

The occurrence is on land whose surface rights are owned by Mr. G. Roos, Box 991, RFD, Palmer, Mich. The mineral rights are owned by the Chicago and North Western Railroad.

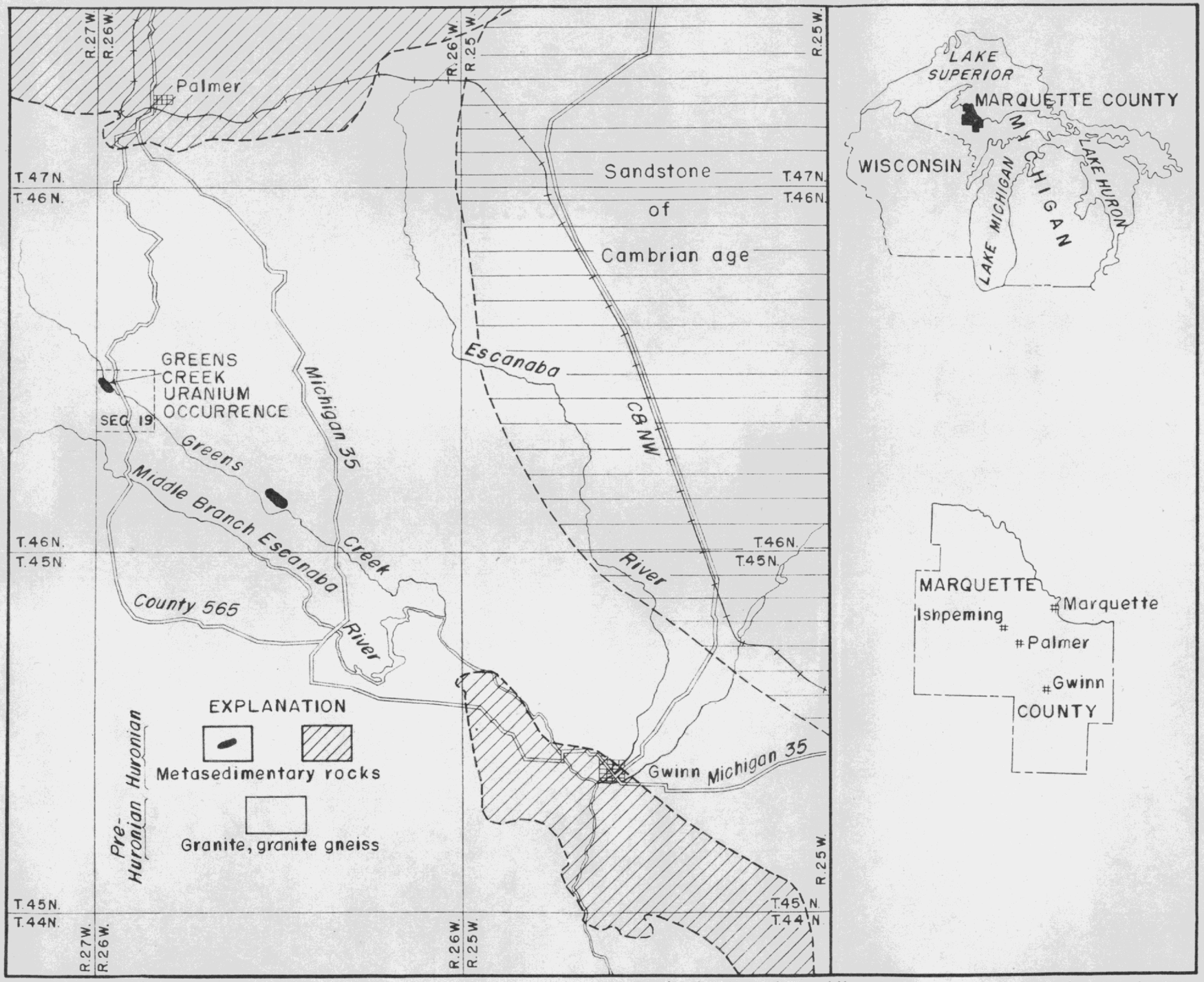
The area is of low relief, wooded, and contains swampy ground. Outcrops are not abundant except adjacent to the creek. Most of the bedrock is covered by glacial sand and gravel.

Acknowledgments

Laboratory and X-ray equipment of the Department of Geology, University of Wisconsin, was used for the study of rock and mineral specimens, and the use of these facilities is greatly appreciated.

GEOLOGY

Although the presence of ferruginous slate along Greens Creek has been known to iron prospectors since the early 1900's, this small isolated belt of Huronian rocks has not been reported in any of the known published geologic maps or reports.



Base from Michigan State Highway Department County map.

Geologic data from Allen & Barrett, 1915; Van Hise & Leith, 1911; and Michigan Geological Survey map, 1936.

Figure 1. Index map showing location of the Greens Creek uranium occurrence and general geology of the area.

The rocks in the area consist mainly of granite and granite gneiss of pre-Huronian age containing a small belt of slate and quartzite believed to be of upper Huronian age. The Huronian rocks have a known strike length of about 800 feet and a thickness of about 300 feet. The total extent of the Huronian rocks outside the mapped area (fig. 2) is unknown because of extensive swamp and low ground to the northwest and the cover of glacial sand and gravel to the southeast.

The similarity of lithology and structural trends of the Huronian rocks shown in figure 2 to the rocks in the Gwinn district (fig. 1) and to the Huronian rocks in a small area about midway between the Gwinn district and the uranium locality (fig. 1), suggests that the three areas may have been downfaulted or downfolded along the same structure. Before erosion, these areas may have been part of a continuous belt of Huronian rocks.

If the Huronian rocks at the uranium locality are not overturned, the stratigraphic section consists of gneissic granite overlain by about 100 feet of graphitic quartzose ferruginous slate followed by 150 to 200 feet of quartzite. The bedding strikes in general N. 60° W. and dips 60°-80° NE. The northeast edge of the Huronian rocks is believed to be in fault contact with pre-Huronian granite.

The age of the slate and quartzite in the Greens Creek area is believed to be upper Huronian because of the following considerations:

a. The slate is locally high in carbonaceous material and is similar to the carbonaceous slates of the Michigamme formation of upper Huronian age in the Marquette trough. No rocks in northern Michigan containing abundant carbon have been reported which are definitely older than upper Huronian.

b. The bedding and cleavage of the slate are parallel to the structural trends of upper Huronian rocks in the Gwinn district, 10 miles to the southeast.

c. The slate and quartzite are of a low metamorphic rank and in this respect are similar to other upper Huronian rocks in the Marquette and Gwinn districts.

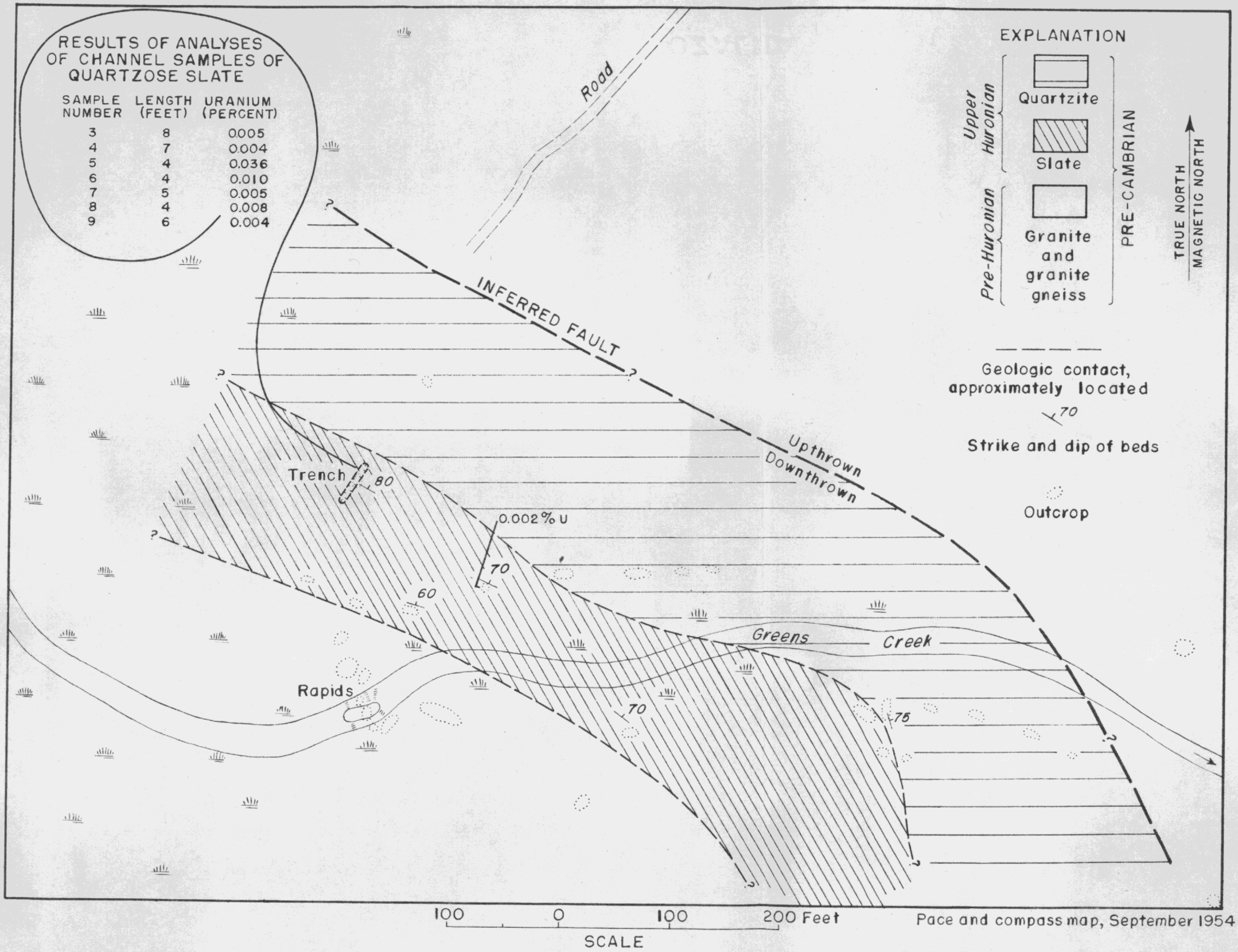


Figure 2. Geologic map of the area adjacent to the uranium occurrence near Greens Creek, NW 1/4 NW 1/4 sec. 19, T. 46 N., R. 26 W., Marquette County, Michigan.

URANIUM OCCURRENCE

During 1953 a scintillation counter survey was made of all the known outcrops of Huronian rocks in the Greens Creek area. Slight abnormal radioactivity was detected at all outcrops of slate (0.05 mr/hr, background 0.03 mr/hr), and high radioactivity (as much as 1.0 mr/hr) was found over a small area containing a small outcrop and abundant float of slate. A selected sample of the radioactive slate contained 0.78 percent equivalent uranium but less than 0.05 percent uranium. Other samples of the slate taken at the surface also showed a large discrepancy between the equivalent uranium and uranium contents. Laboratory study of specimens of slate showed that most of the radioactivity and uranium were associated with small pellets (2 mm in diameter) and thin films of carbonaceous material. Some of the individual pellets were estimated on the basis of radioactivity to contain as much as 1 percent uranium.

Because of the unusually high radioactivity associated with carbonaceous material in Precambrian rocks, the occurrence was reexamined during 1954 for the purpose of collecting additional samples and learning more about the nature of the occurrence. A shallow trench about 38 feet long was dug perpendicular to the strike of the beds in the area of highest radioactivity. Bedrock was exposed throughout the trench at depths of less than 3 feet. A scintillation counter survey of the slate exposed by the trench showed that the highest radioactivity was associated with a zone about 1 foot wide. A selected sample from this zone contained 0.61 percent equivalent uranium and 0.68 percent uranium. Channel samples were taken of the slate in the trench, and the results of analyses are shown in table 1 together with results of analyses of four samples taken from the surface during 1953. As can be seen from table 1 the surface samples were out of equilibrium probably because of uranium having been leached by ground waters. Most of the samples taken from the trench were in equilibrium except sample no. 1, which contained slightly more uranium than equivalent uranium. This may be due to small amounts of uranium added to the slate by ground water.

Mineralogy

At least two uranium minerals are present at the Greens Creek uranium occurrence, metatorbernite and bassetite. The most abundant uranium mineral, metatorbernite, occurs as small light-green microcrystalline masses and minute micaceous scales in altered areas in the slate. The identification was made by microchemical

Table 1. Results of analyses of samples from the Greens Creek uranium occurrence, Marquette County, Michigan

Sample no.	eU (percent)	U (percent)	Length (feet)	Description
Surface samples taken in 1953				
4-53	0.78	-0.05		Selected sample of slate containing radioactive carbonaceous pellets.
5-53	.041	.001		Slate float
142-53	.046	.006		Slate float
143-53	.002	.002		Slate outcrop, 150 feet southeast of trench.
Analyses by S. Furman, R. DuFour, and J. Wahlberg, U. S. Geological Survey.				
1	0.61	0.68		Selected sample of metatorbernite-bearing slate from trench.
3	.005	.007	8	Samples numbered 3--9 are channel samples of the slate taken from the trench in consecutive order from northeast to southwest.
4	.004	.004	7	
5	.036	.036	4	
6	.010	.009	4	
7	.005	.006	5	
8	.008	.008	4	
9	.004	.004	6	
Analyses by Roosevelt Moore and Percy Moore, U. S. Geological Survey.				

tests and X-ray powder photographs. In contrast to the black graphitic quartzose slate host rock, the altered areas are bleached white to buff and are stained with small amounts of limonite. The clay mineral dickite is locally abundant. Small amounts of pyrite and malachite were also identified in the altered areas. Many of these alteration zones are lens shaped and are commonly 2 to 3 inches long, 1 to 2 inches wide, and from one-eighth to one-half inch thick. A northwestward extension of the trench, for about 3 feet along the strike of the altered zones, disclosed an area in the slate about 1 foot in diameter that was greatly altered and contained abundant visible metatorbernite. A yellow non-flourescent uranium mineral was also observed. Microchemical tests of this mineral showed the presence of phosphorous, uranium, and iron, and the absence of copper. X-ray powder photographs showed that the mineral was similar in structure to metatorbernite. The mineral has been tentatively identified as bassetite $Fe(UO_2)_2(PO_4)_2 \cdot 8H_2O$.

ORIGIN AND CONCLUSIONS

The origin of this occurrence is obscure. The uranium minerals were not localized along fractures, and all of the slate in the trench, exclusive of the altered areas, had an abnormally high uranium content (0.004 to 0.009 percent). In addition to the high uranium content of the unaltered slate, the slate also contained relatively high amounts of phosphorus and copper (0.05 to 0.5 percent).

The altered zones containing dickite in the black slate suggest hydrothermal activity. Although no primary uranium minerals have been identified, the author believes that pitchblende originally was deposited under reducing conditions in the slate concomitantly with the oxidation of the carbon, which resulted in a bleaching of the slate. The uranium may have been leached from the adjacent slate by hydrothermal solutions or weathering processes.

Small amounts of material containing more than 0.1 percent uranium are present at this locality; and because of the limited amount of information available concerning the size and shape of the deposit, exploration may be warranted to determine the limits of the occurrence and the character of the uranium minerals at depth.

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