U. E. McKelvey

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PRELIMINARY REPORT ON GEOBOTANICAL EXPLORATION IN THE YELLOW CAT DISTRICT, GRAND COUNTY, UTAH

Trace Elements Memorandum Report 273

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

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AEC - 324/2

Dr. Phillip L. Merritt, Assistant Director
Division of Raw Materials
U. S. Atomic Energy Commission
P. O. Box 30, Ansonia Station
New York 23, New York

Dear Phil:

Transmitted herewith for your information is one copy of Trace Elements Memorandum Report 273, "Preliminary report on geobotanical exploration in the Yellow Cat district, Grand County, Utah," by Helen L. Cannon, October 1951.

Two geobotanical methods of prospecting for uranium deposits have been applied in the Yellow Cat district, Grand County, Utah. The first is based on the accumulation of uranium in roots and leaves of plants overlying uranium deposits. The plants Juniperus monosperma, Atriplex confertifolia, and Cowania mexicana were sampled to determine their uranium content. The second method is based on the distribution of the selenium-indicator plants of the genera Astragalus and Stanleya. Selenium is associated with uranium and vanadium in the ore deposits, and thus the distribution of the selenium-indicator plants is believed to indicate ground favorable for ore deposits. The areas indicated as favorable by these two methods will be tested by the drilling project that was initiated in early October.

Sincerely yours,

/s/ W. H. Bradley

W. H. Bradley
Chief Geologist

JAN 9 0 2001

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This document consists of 13 pages,
plus 5 figures, Series A
CATEGORY VII (Colorado Plateau
Geology)

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

PRELIMINARY REPORT ON GEOBOTANICAL EXPLORATION IN THE YELLOW CAT DISTRICT, GRAND COUNTY, UTAH

By

Helen L. Cannon

October 1951

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CONTENTS

ILLUSTRATIONS

PRELIMINARY REPORT ON GEOBOTANICAL EXPLORATION IN THE YELLOW CAT DISTRICT, GRAND COUNTY, UTAH

By Helen L. Cannon

ABSTRACT

Two geobotanical methods of prospecting have been applied to the search for uranium deposits in the Yellow Cat district, Grand County, Utah. The first method is based on the absorption and accumulation of uranium by plants from underlying uranium deposits. To demonstrate this method, several hundred samples of *Juniperus monosperma*, *Atriplex confertifolia*, and *Cowania mexicana* were collected in the district and analyzed for their uranium content. Plants containing significant amounts of uranium are considered to indicate mineralized ground.

The second method of prospecting is based on the relation of selenium-indicator plants of the genera *Astragalus* and *Stanleya* to mineralized ground. Chemical analyses show that selenium is associated with the uranium and vanadium in the ore deposits. Distribution maps of the selenium-indicator plants, *Astragalus confertiflorus*, *A. Pattersonii*, *A. Preussii var. arctus*, and *Stanleya pinnata*, are included in this report. Outlines of favorable ground in the Yellow Cat district determined by these data are drawn on the maps.

INTRODUCTION

The accumulation of uranium in certain plants and the distribution of selenium-indicator plants have been found to indicate the presence of near-surface carnotite deposits in certain areas on the Colorado Plateau (Cannon, 1951). This relationship seems especially pronounced in the

Yellow Cat area of the Thompsons district, Grand County, Utah (fig. 1) and for this reason the distribution and uranium-content of plants there have been mapped in an effort to define areas that might contain concealed carnotite deposits. The information acquired has been used in planning drill exploration of the area, to be started in the fall of 1951, but the data are placed on record here so that the predictions may be easily compared with exploration results when they are available.

The field work on which this report is based was carried on in the summers of 1949 and 1950 under the supervision of the author, ably assisted by Mary Durrell, John Harbaugh, Louis Rove, and Richard Stillman. The chemical analyses were made by Claude Huffman and Ruth Kreher of the Trace Elements Section Laboratories. C. F. Withington made many valuable suggestions regarding the preparation of this report. The work was done on behalf of the U. S. Atomic Energy Commission.

GEOGRAPHY

The Yellow Cat district is about 10 miles southeast of Thompsons, Grand County, Utah (fig. 1). The district is accessible by a graded dirt road which leaves U. S. Highway 50, 5 miles east of Thompsons. The area studied, 4 miles long and 1½ miles wide, is in T. 22 S., R. 22 E., Salt Lake principal meridian. The altitude ranges from about 4,800 feet to about 5,100 feet. The climate is semi-arid; the summers are hot and dry, the winters mild, and the annual rainfall averages only about 7 inches. The desert vegetation is predominantly black brush and saltbush. Oak and juniper trees grow on the outcrops of sandstone, where water is available. Ecologically, the alkaline environment is ideal for the development of selenium-indicator plants which are abundant in the district.

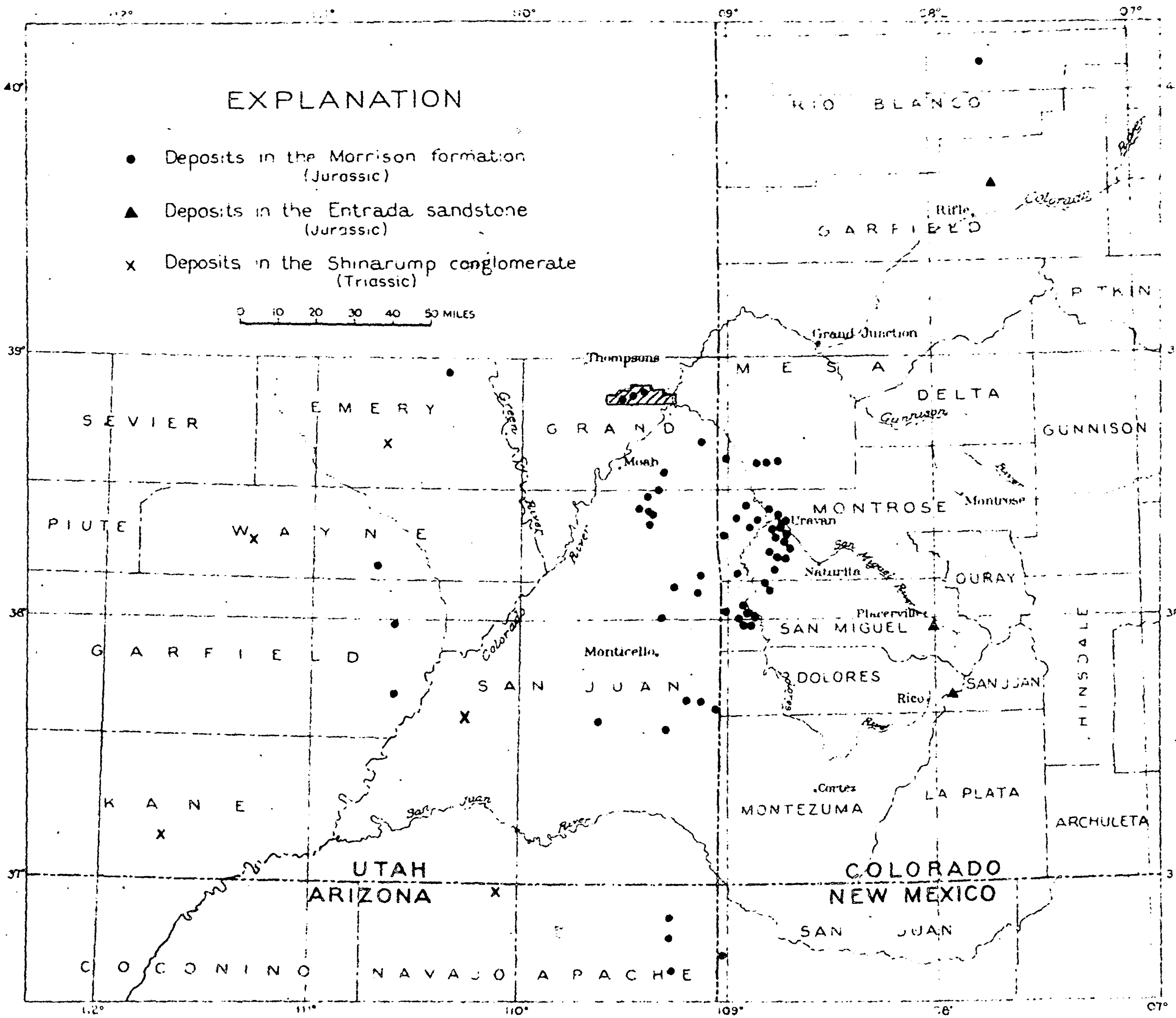

Figure 1.--Index map of part of Colorado, Utah, Arizona, and New Mexico, showing the location of the Yellow Cat district, Grand County, Utah.

GEOLOGY

The exposed rocks in the Yellow Cat district consist of the Brushy Basin shale member and the underlying Salt Wash sandstone member of the Upper Jurassic Morrison formation. The rocks dip 2 to 4 degrees northward off the flank of the Salt Valley anticline. The rocks crop out in a step-like series of flat-topped mesas developed on the sandstone beds of the Salt Wash member.

The Brushy Basin shale member consists of a basal conglomerate 10 to 25 feet thick, overlain by about 300 feet of shale beds interbedded with sandstone lenses. The shale beds have been removed from most of the area by erosion but are exposed in a steep escarpment along the northern edge of the district. The underlying Salt Wash sandstone member consists of four or more sandstone beds, 20 to 50 feet thick, separated by layers of mudstone of variable thickness. The shales or mudstones are predominantly red but are generally blue in the vicinity of ore deposits.

The uranium-vanadium deposits are in the basal conglomerate of the Brushy Basin member and in several sandstone beds of the Salt Wash member. These beds are referred to as the "ore-bearing sandstones." Most of the known deposits are within 20 feet of the surface or have been exposed at the rims by erosion. The deposits are in sinuous or pod-like masses and probably have been localized along old stream channels by ground waters or other solutions after the sandstone beds were deposited.

Although uranium and vanadium are the major metals of economic importance in the deposits, chemical analyses of ore bodies in the Yellow Cat district show that selenium is present also. Averaged analyses of channel samples from three major deposits are given in table 1.

TABLE 1

Vanadium, uranium, and selenium content of three sandstone deposits of the Yellow Cat district
Claude Huffman, analyst.

Samples	V_2O_5	U	Se
Channel samples across three ore bodies (percentages averaged)	4.3	0.8	0.12
Channel samples across enclosing barren sandstone of three ore bodies (percentages averaged)	<0.1	<0.01	<0.001

PLANT RELATIONS

Plants growing in the Yellow Cat district are related chemically to the ore deposits in two ways. First, the plants growing over uranium-vanadium deposits accumulate unusual amounts of vanadium and uranium that can be detected by analyzing the leaves or roots. Second, the distribution of selenium-indicator plants is probably accordant with that of the uranium-vanadium deposits, a relation that was first reported by Beath (1943).

Accumulator plants

The absorption of metallic elements in various species of plants growing in the district has been investigated. The uranium content of plants was found to bear a more constant ratio to the deposits in the underlying rocks than the content of any associated element. Composite samples of the leaves of the widely distributed juniper (*Juniperus monosperma*), saltbush (*Atriplex confertifolia*), and cliffrose (*Cowania* mexicana) were collected. Their uranium content is shown graphically on the maps.

The usefulness of this method of prospecting is limited by the depth to which plant roots in this climate will penetrate. Juniper roots have been recognized in mines 20 to 30 feet below the surface of the ground, and can be used in prospecting to those depths. Saltbush roots, on the other hand, extend only 5 to 10 feet below the surface and accordingly are of value only in prospecting for very shallow ore bodies. Although cliffrose also absorbs uranium possibly from depths of 20 or 30 feet, it is not abundant nor widespread and thus has little use in geobotanical prospecting. Junipers, therefore, are the accumulator plants of most value in the search for ore deposits.

Two areas were chosen in which to make detailed studies of the uranium content of plants. On Yellow Cat Mesa saltbush samples were collected at intervals of 50 feet along several traverses. The results are shown in figure 2.

The McCoy group was chosen as a second area for sampling and the results are shown in figure 3. Junipers were sampled at intervals of 50 feet along several traverses, and saltbush was substituted where juniper was not available. Results of reconnaissance sampling in other areas are shown on a smaller scale in figures 4, 5, and 6, which cover the entire district.

Indicator plants

Selenium-indicator plants growing on the sandstones, clays, and alluvium of the district derive selenium from the uranium-vanadium ores either directly or from soluble secondary salts present in wash or detrital material. Distribution maps of the principal selenium-indicator plants have been prepared for the district (figs. 4, 5, and 6), and zones of concentration of these plants have been outlined as favorable areas.

The following plants require a considerable amount of selenium in the soil and have been mapped as indicative of mineralized ground: Astragalus Pattersonii, A. Preussii var. arctus, A. confertiflorus, and Stanleya pinnata. Of the Astragalus genera, A. Pattersonii appears to be the best indicator of ore at depth. This plant sends roots down as much as 30 feet, and is found on both alluvium and on sandstone. A. P. var. arctus, a closely related species, is also capable of extracting selenium directly from the ore deposits and is a good indicator plant, although it is restricted in distribution by a less extensive root system. This difference in distribution is well illustrated in the McCoy group, shown in figure 3, where A. P. var. arctus is restricted to the shallow rim deposits. The selenium occurring in the ore bodies is not converted by A. confertiflorus which requires selenium in a more soluble form. It is restricted in growth to the leached blue clays from which the plant also extracts considerable ferrous iron. A. confertiflorus may be useful in certain areas along the Brushy Basin cliffs, where it grows in seleniferous seeps which issue from the Salt Wash beds. S. pinnata is a tall, conspicuous, yellow mustard that requires considerable sulfur, selenium, and moisture in order to grow. The plant is most prevalent on the mineralized areas of the lower sandstone beds that crop out across the southern part of the area.

DESCRIPTION OF FAVORABLE AREAS

The following descriptions apply to favorable areas shown on figure 4.

Selenium-indicator plants are widespread in the vicinity of the old Yellow Cat mines and extend for a distance of 1 mile both north and south from the Yellow Cat Campsite. Concentrations of the principal indicators are common on the ore-bearing sandstones. Plants requiring less selenium cover the remaining sandstones, mudstones, and alluvium. The area has been well prospected and there are many small mines and diggings around which the plants are growing. There are, in addition, certain areas of favorable ground worthy of particular mention.

The distribution of A. Pattersonii on the flat northeast of the Campsite suggests two mineralized areas extending 1,000 feet or more away from the mines. In each case, the patch follows the direction of the mineralized channel in which a known ore body lies. A. Pattersonii is also associated with A. P. var. arctus on the sandstones of the down-faulted block in the southwest part of the area. The ground appears to be favorable on Memphis Hill and also on the alluvium to the north. The plants show no particular relation to the individual beds nor to the fault and extend in a wide but interrupted band across the graben and north to the "A" 2 mine.

A. P. var. arctus is the most prevalent of the significant indicator plants in the area covered by figure 4. The plant grows along one of a series of sandstone beds for a distance of over 1,000 feet south of Yellow Cat Mesa, and appears to indicate an extension of the mineralized ground mined near the road. Plants of A. P. var. arctus are present on the red mudstones about 1,500 feet northwest of the Yellow Cat Campsite. Although the association of A. P. var. arctus with shales and thin sandstones may prove to have little significance in prospecting, one area east of the Campsite where the plants are concentrated along a strip outcrop of shale has been tested. The shale carries a secondary fluorescent uranium mineral similar in appearance to schroeckingerite. A shaft has been put down and an ore body encountered in the underlying thick sandstone at a depth of slightly more than 15 feet. It is possible that soluble uranium and selenium migrate upward into the shales and that plants on shales and thin sandstones may be significant in prospecting for ore bodies at depth. A similar occurrence of A. P. var. arctus along a sandstone outcrop west of the School Section mine follows the outcrop where the sand has graded into a shale. This occurrence may also indicate ore at depth.

Saltbush containing more than 0.6 ppm U grow in the southeast section of Yellow Cat Mesa (shown on larger scale on figure 2) and also in a small area in the northwest part.

S. pinnata is associated with the lower ore-bearing sandstones in the southwest part of the area.

The following descriptions apply to favorable areas shown on figure 5.

A. Pattersonii grows profusely around the Cactus Rat deposits and extends to the northwest along the Brushy Basin cliffs for a short distance. A possible extension of the Cactus Rat mineralized channel to the north is indicated. A second favorable area along the Brushy Basin cliffs is suggested near the Yellow Cat road fork at the west edge of the area.

A. P. var. arctus and S. pinnata are prevalent in two areas to the south, on the outcrops of one of the lower ore-bearing sandstones.

The following descriptions apply to favorable areas shown on figure 6.

Many patches of A. Pattersonii occur on exposed sandstones, and alluvium and dune sand in this area, and indicate ore at a probable depth of 10 to 30 feet in the underlying rocks. One such patch extends from the schroeckingerite deposit east of the McCoy group to the conglomerate-capped rim 2,000 feet to the south. The entire area appears to be favorable ground.

Areas of mineralized ground are indicated in the McCoy group (see also fig. 3) by accumulator plants and by A. Pattersonii.

The junipers and cliffrose in the Flat Top group are also high in uranium. Isolated patches of A. Pattersonii on the exposed sandstone bed south of the Flat Top deposits are of particular significance since the Flat Top deposits are curiously devoid of selenium plants. The plants in this whole area may be restricted by some other chemical factor, at present unknown.

A. P. var. arctus grows profusely on the clays and alluvium along the conglomerate outcrop at several places. Berry Hill and Windy Point appear to be particularly favorable. The distribution of A. P. var. arctus on the sandstone immediately underlying the conglomerate suggests that the sandstone is a more favorable bed in this area than the conglomerate. These plants grow extensively on the sandstone from Berry Hill to the Brushy Basin cliffs.

S. pinnata is present in noticeable quantities only on the lower ore-bearing sandstone exposed in the district. This restriction is marked and can be seen on all three sheets of the Yellow Cat district. Further work on the chemistry of the ore-bearing sandstones may suggest a controlling chemical factor not now understood.

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