Uranium Occurrences in the White Canyon Area, San Juan County, Utah

Trace Elements Memorandum Report 7

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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Dr. Phillip L. Merritt, Assistant Manager
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U. S. Atomic Energy Commission
P. O. Box 30, Ansonia Station
New York 23, New York

Dear Phil:

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Sincerely yours,

1-5 Esper S. Larsen, Jr.

for W. H. Bradley
Chief Geologist

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UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

URANIUM OCCURRENCES IN THE WHITE CANYON AREA, SAN JUAN COUNTY, UTAH

by

H. C. Granger and E. P. Beroni

December 1950

Part II Part I

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Trace Elements Memorandum Report 7

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by

H. C. Granger and E. P. Beroni

ABSTRACT

The White Canyon area is in San Juan County in southeastern Utah and includes an area of about 300 square miles, on either side of White Canyon.

A brief geologic and radiometric reconnaissance for potential uranium ore was made in the fall of 1948 as a result of the reported occurrences of uranium by private individuals, and by members of the Atomic Energy Commission and Geological Survey. During this reconnaissance, 23 mines and undeveloped prospects were examined.

Rocks ranging in age from Permian to Jurassic are exposed in the area and are composed principally of reddish sandstones and shales.

Secondary deposits of uranium and copper are common in the area, but are restricted to the Shinarump conglomerate and to the top of the Moenkopi formation, both of Triassic age. Unidentified secondary yellow uranium minerals and secondary copper sulfides, sulfates, and carbonates are present. The only primary minerals recognized are chalcopyrite and pitchblende. The presence of these primary minerals suggests that the deposits may be, in part, of hydrothermal origin.

INTRODUCTION

The White Canyon area (fig. 1), as defined for the purpose of this report, includes the drainage basins of White and Red Canyons, San Juan County, Utah. This area is bounded roughly by the Colorado River on the northwest, Dark Canyon on the northeast, Elk Ridge on the southeast, and Red Canyon on the southwest. White Canyon drains the larger part of the area.

The uraniferous deposits examined are in White, Frey, and Red Canyons, and Deer Flats (fig. 2). White Canyon heads about 50 miles west of Blanding, Utah, and extends 40 miles westward to its confluence with the Colorado River. Frey Canyon is tributary to White Canyon, and Red Canyon roughly parallels White Canyon about 10 miles to the south. Deer Flats is a broad flat-topped ridge just north and west of the Natural Bridges National Monument.

The White Canyon area is accessible from the east and west by State Highway 95, a graded dirt road. Blanding, Utah, is 50 miles to the east and Hanksville, Utah, is 65 miles to the west across the Colorado River. A ferry at Hite, Utah, provides the only vehicular crossing of the Colorado River on State Highway 95.

The climate is typical of semi-arid country, rainfall ranging from 7 to 15 inches per year. Summer storms are infrequent but heavy, causing flash floods throughout the area. Side roads are commonly impassable after rains. Access to the White Canyon area is difficult during the winter because of snows that may block Bears Ears Pass.

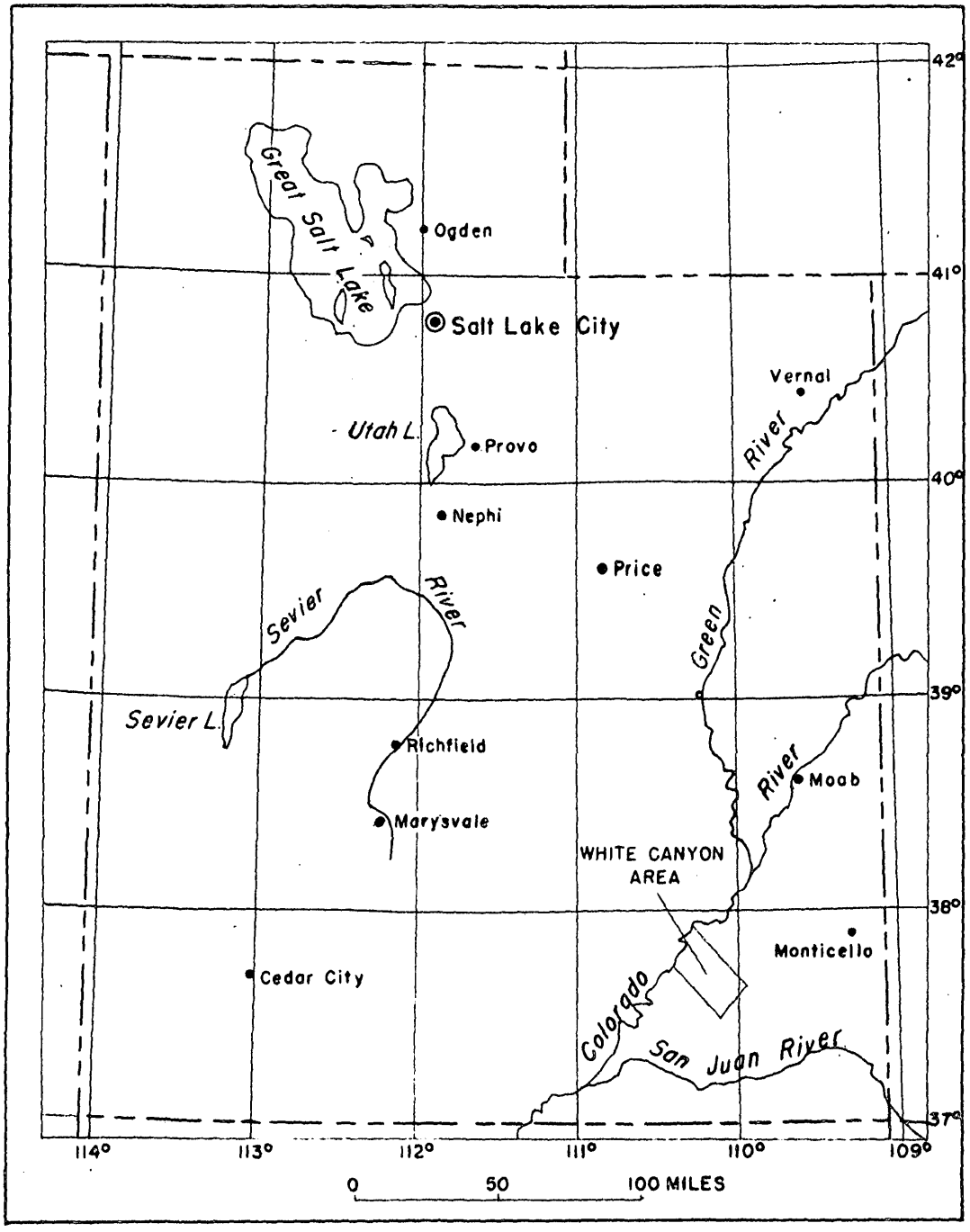

FIGURE 1.—INDEX MAP OF UTAH

Although the White Canyon area was prospected as early as 1880, and numerous samples of ore have been tested, production to date has been negligible. In 1946, the high price of copper prompted the owners of the Happy Jack mine in the lower part of White Canyon to ship two truckloads of ore to the smelter at Garfield, Utah. The ore was rejected because of its high uranium content. Subsequently, a load of uranium ore was rejected at the Atomic Energy Commission's mill at Monticello, Utah, because of its copper content.

In the spring of 1948, these deposits of copper and uranium minerals were brought to the attention of the Trace Elements Office of the Geological Survey and a brief reconnaissance was made /. As a result of

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/ Fischer, R. P., and King, R. U., Investigation of uranium deposits in White Canyon, San Juan County, Utah: U. S. Geological Survey Trace Elements Memorandum Rept. 7-A; September 1, 1948.

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this reconnaissance, the writers made a further investigation of the deposits from September 24 to October 26, 1948.

In the summer of 1948, the Vanadium Corporation of America conducted an exploratory drilling program on Frey Point, and during the early fall of 1948 the Atomic Energy Commission made a brief survey of the White Canyon area to determine its ore reserves.

This report includes only information available prior to November 1948 on 23 localities that were investigated by radiometric studies with field Geiger counters. These localities (fig. 2) include two mines, 14

claims, two localities at which stratigraphic sections were measured, and five exposures (localities 2, 5, 6, 7, and 8) of unmineralized Shinarump conglomerate.

Ore bodies were outlined by the use of either (1) a Victoreen Model 263A beta-gamma survey meter, (2) a Union Mines Development Company cyclotron gamma-ray recorder instrument, or (3) a small instrument manufactured by the Omaha Scientific Company.

Sampling was guided by radioactivity and lithology. Chip or grab samples were cut from outcrops and in mine workings after removing the efflorescent salts from the surfaces. A geologic map of the Happy Jack mine and vicinity was made on a scale of 1 inch to 100 feet (fig. 3).

GENERAL GEOLOGY

The sedimentary rocks of the White Canyon area are nearly horizontal and range in age from Permian to Jurassic. The nearest exposed igneous rocks are in the Henry Mountains, about 10 miles to the west, and in the Abajo Mountains, about 20 miles to the east.

Throughout most of its length, White Canyon consists of a gorge cut in the floor of a wide upper canyon. The narrow inner gorge is cut 100 to 200 feet deep into the resistant Permian Cedar Mesa sandstone which forms the floor of the upper Canyon. The walls of the upper canyon rise 1000 to 1500 feet above this shelf and consist mainly of red sandstones - a nearly complete stratigraphic section of Permian to Jurassic rocks - that form alternating cliffs and slopes. The total width of the upper canyon ranges from 1 to 10 miles, but outlier mesas and buttes are numerous.

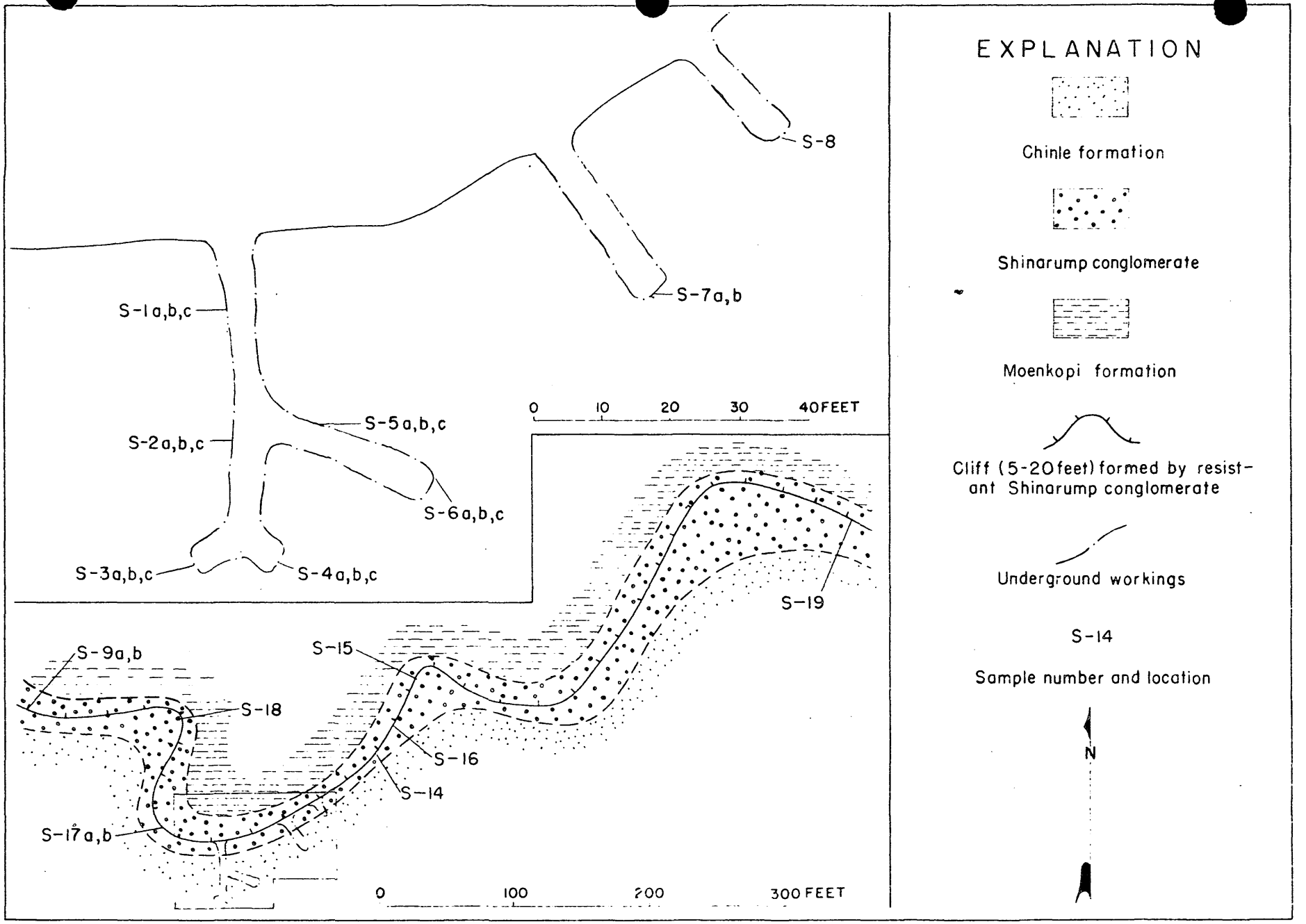

FIGURE 3.— GEOLOGIC MAP AND ASSAY PLAN, HAPPY JACK MINE, WHITE CANYON, SAN JUAN COUNTY, UTAH.

The sedimentary rocks exposed in the area include a nearly complete section from the Cedar Mesa member of the Cutler formation of Permian age to the Kayenta formation of the Glen Canyon group of Jurassic age.

All formations have a nearly identical westward dip of 2 to 3 degrees. At Comb Wash in the Cottonwood Creek area to the east of the White Canyon area, the strata dip eastward from 12 to 25 degrees, forming the "Comb Monocline." There are no measurable joint sets in these rocks except in the Organ Rock member of the Cutler formation.

Two stratigraphic sections were measured in the White Canyon area. Columnar section No. 1 (fig. 4) shows the thickness and radioactivity of the beds in the lower part of the canyon, and columnar section No. 2 (fig. 5) gives the thickness and radioactivity of the beds on the divide between White and Red Canyons.

Permian rocks

Cutler formation

The Cutler formation is the only Paleozoic formation exposed in the White Canyon area. It consists of the Halgaito, Cedar Mesa, Organ Rock, De Chelly and the Hoskinnini members, but the basal (Halgaito) member is not exposed in this area.

Cedar Mesa member.--The Cedar Mesa member of the Cutler formation is a cross-bedded very fine-grained sandstone, generally cemented by calcium carbonate. Fresh exposures are a creamy white and the rock weathers to a light buff or yellow brown, depending on the iron content. This sandstone is very resistant to weathering and forms such features as the Natural Bridges.

At no place in the White Canyon area has the base of the Cedar Mesa member been exposed. According to Gregory _/, the streams in White

_/ Gregory, H. E., The San Juan Country, Utah: U. S. Geol. Survey Prof. Paper 188, p. 43, 1938.

Canyon have cut 200 to 500 feet into the member without exposing its base.

Organ Rock member.--The Organ Rock member of the Cutler formation is a red ripple-marked fine-grained sandstone cemented by iron oxide and calcium carbonate. The lower and more shaly section forms a gentle slope down to Cedar Mesa bench. The upper part of the unit is more resistant as is shown by the cliffs along its outcrop.

The thickness of the Organ Rock member, according to Gregory _/,

_/ Gregory, H. E., op. cit., p. 46.

ranges from 250 to 421 feet. The writers measured a section as thin as 218.5 feet in White Canyon (fig. 4).

De Chelly member.--The De Chelly member of the Cutler formation is present only in the lower 20 miles of White Canyon and is a prominent bed on the walls of Red Canyon. It is divided into a lower light-colored conglomerate composed of quartz, sandstone, and limy pebbles, and an upper red fine-grained sandstone.

Where the De Chelly member was measured in White Canyon, it was 82.5 feet thick (fig. 4).

Hoskinnini member.--Although it is not certain that the Hoskinnini member extends into the White Canyon area, beds of sandstone, shale, and conglomerate fitting the description of the Hoskinnini are present in the

proper stratigraphic position in the lower 10 miles of White Canyon. If these beds are not the Hoskinnini member, they probably belong to the Moenkopi formation. They consist of interbedded fine-grained red sandstones and sandy red shales above a basal bed of conglomerate.

The total thickness of this member at the only locality at which a stratigraphic section was measured is 29 feet (fig. 4).

Triassic rocks

Moenkopi formation

The Moenkopi formation, generally considered to be Lower Triassic in age, is characterized in the White Canyon area by thin lenses of red ripple-marked sandstone in red shales. The formation forms a slope between the more resistant Shinarump conglomerate above and the Permian beds below. The thickness of the formation in measured sections ranges from 155.5 to 329 feet (figs. 4 and 5).

The contact between the Triassic and Permian strata is a slightly uneven erosion surface and is discerned with difficulty throughout most of the area. An unconformity at the upper contact of the Moenkopi formation represents a mid-Triassic erosion interval. Over a large part of the area this unconformity is obscure, although locally it may be marked by channel scours and pits with a relief of several feet.

In many places the topmost bed of the Moenkopi formation is a very fine-grained white silty sandstone or siltstone (fig. 5), and, where the overlying Shinarump conglomerate contains uranium and copper minerals, the Moenkopi also may be mineralized.

Shinarump conglomerate

The Shinarump conglomerate rests unconformably on the Moenkopi formation and is regarded by Gregory _/ as the basal conglomerate of the

_/ Gregory, H. E., op. cit., p. 49.

Upper Triassic Chinle formation. Because of its resistance to weathering, it caps many points and mesas, and throughout the area low cliffs have formed above the Moenkopi slope. Above the cliffs the upper surface of the Shinarump conglomerate rises steeply to exposures of the overlying Chinle formation.

The lithology of the Shinarump conglomerate is relatively uniform throughout the White Canyon area. It is a cross-bedded coarse- to medium-grained sandstone composed of subangular to rounded quartz grains with interbedded lenses of sandy conglomerate and light-colored sandy siltstone. The conglomerate pebbles are mainly subangular to rounded white and pink quartzite, although a few lenses contain sandstone and limestone pebbles. Carbonized wood fragments are not uncommon. Near the head of White and Red Canyons, the Shinarump conglomerate is about 50 feet thick and on Elk Ridge it thickens to a maximum of 120 feet.

In many places in the lower part of White Canyon the Shinarump conglomerate may be missing. At localities Nos. 5 to 8 (fig. 2) the Shinarump conglomerate was tentatively identified and traced for several hundred feet along its outcrop. At these localities the Shinarump (?) conglomerate is a white to buff cross-bedded medium-grained sandstone

ranging in thickness from 15 to 35 feet. At locality 4 (fig. 2) this formation consists of a buff sandstone containing clay lenses and is 4 feet thick (fig. 5).

The Shinarump conglomerate and the bed of fine white silty sandstone or siltstone at the Shinarump-Moenkopi contact are the only strata in the White Canyon area that were found to contain radioactive deposits.

Chinle formation

The Chinle formation lies conformably on the Shinarump conglomerate. The basal part of the Chinle formation is a varicolored buff to maroon shale and siltstone. The siltstone is overlain by a resistant light-colored cross-bedded sandstone similar to the sandstones in the Shinarump conglomerate. Above this sandstone are thick beds of lavender, buff, and greenish calcareous shales, red siltstones, and red, white, and lavender silty sandstones that weather to form rounded and gullied slopes. The upper part of the formation consists of interbedded red sandstones and less resistant shales. The entire formation is very calcareous and includes some lenses of limestone and limestone-pebble conglomerate. According to Gregory _/, the shales "weather in the manner of marls."

_/ Gregory, H. E., op. cit., p. 49.

Two sections of the Chinle formation were measured. In lower White Canyon the thickness is 547.5 feet (fig. 4) and in upper White Canyon it is 683 feet (fig. 5).

Jurassic rocks

Wingate formation

The Wingate formation was not examined in detail because it is inaccessible in the White Canyon area. It is a massive cliff-forming red sandstone, and caps such high points as Bears Ears, Jacob's Chair, the Wooden Shoe Buttes, and the divide between Red and White Canyons.

Kayenta formation

Remnants of sandstone of the Kayenta formation cap the Wingate formation in isolated spots, but are inaccessible in the area studied.

ORE DEPOSITS

The uraniferous deposits of the White Canyon area occur in the Shinarump conglomerate or the white silty sandstones and siltstones at the top of the Moenkopi formation. The deposits are lenticular and contain unidentified secondary uranium minerals and copper sulfides, sulfates, and carbonates. In addition, chalcopyrite and pitchblende are present _/.

_/ After this report was written, Gruner and Gardner in their annual report to the Atomic Energy Commission for the period June 8, 1949, to July 1, 1950, reported they had identified the following minerals from the Happy Jack mine: pitchblende, schoepite-becquerelite, johannite, torbernite, uranophane (?), pyrite, gersdorffite, chalcopyrite, covellite, malachite, cyanotrichite, antlerite, and chalcanthite.

Mineralogy

Most of the uranium and copper minerals noted in the ore deposits of the White Canyon area are secondary, and the copper minerals are predominantly sulfates and carbonates. The rocks exposed at the surface usually contain both malachite and azurite. The malachite occurs as disseminated specks, as lenses parallel to the cross-bedding, as coatings in fractures, and as masses partly replacing carbonized wood fragments. Azurite is not as common as the malachite and was not observed in association with carbonized wood. The sheltered parts of the exposed sandstone and the walls of the Happy Jack mine are commonly coated with efflorescent sulfates. Within the Happy Jack mine, chalcanthite and brochantite are associated with alums and an unidentified greenish finely crystalline uranium mineral that has a yellow-green fluorescence. This uranium mineral also occurs as disseminated specks in the sandstone. The bedding planes of a fine-grained platy white sandstone in the Happy Jack mine are coated with gypsum and small clusters of fine yellow crystals that fluoresce a golden yellow. Alums and other white sulfates compose the bulk of the efflorescent minerals outside the mine workings. Erythrite (?) is a constituent of some of these coatings, and small quantities of hydrous iron oxides are present almost everywhere.

Primary copper minerals were observed at the Happy Jack mine where chalcopyrite is associated with bornite, covellite, and chalcocite as interstitial fillings in the sandstone. One lens of sandstone in the basal Shinarump is black because of the high percentage of covellite.

Many fractures in the covellite are highly radioactive. This radioactivity is caused by microscopic specks and flakes of an amber-to-brown mineral that is believed by the writers to be the primary uranium mineral pitchblende.

Although only malachite and a few efflorescent sulfates were noted at some of the deposits, the general mineral assemblage is believed to be similar throughout the area. The relative abundance of individual minerals, however, may vary widely.

Localization

Most of the uraniferous deposits are flat-lying, roughly lenticular deposits in the sandstones, shales, and conglomerates in the basal Shinarump conglomerate and upper part of the Moenkopi formation, but in a few places the entire Shinarump conglomerate is uraniferous.

No structural control was observed that could account for the localization of uranium and copper minerals. A few of the deposits in the Shinarump conglomerate are in old erosional channels cut in the surface of the Moenkopi formation, and all the deposits are in, or are adjacent to, a porous coarse-grained sandstone or conglomerate. These facts suggest that the paths of the mineralizing solutions were controlled, at least in part, by channelways in porous beds and along bedding planes.

The presence of carbonized fossil wood apparently has had an important bearing on the localization of the deposits. Fragments of fossil wood have served, almost without exception, as centers for the

precipitation of malachite. Malachite has partly replaced and filled cavities in the wood, and formed an aureole in the sandstone around the wood. Fossil-wood fragments are also more radioactive than the adjacent sandstone, and apparently they aided in the localization of uranium as well as copper minerals.

Origin

None of the uranium and copper deposits of the White Canyon area show any direct relation to igneous rocks, and Gregory / classifies

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/ Gregory, H. E., op. cit., p. 107.

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these deposits as of the "red beds" type. No primary fissure veins or zones of hydrothermal alteration were seen in the area; however, the common occurrence of chalcopyrite and bornite in hydrothermal deposits suggests that there may have been primary mineralization at the Happy Jack mine. The presence of these minerals associated with pitchblende suggests even more strongly that these deposits may be hydrothermal in origin.

Size and grade

The copper and uranium deposits are roughly lenticular and the exposures commonly range up to 200 or 300 feet in length and 5 to 10 feet in thickness (table 1). The Posey deposit is exceptional, for it is 800 to 900 feet long and radioactive throughout much of a 50-foot section of Shinarump conglomerate. The third dimension is difficult to assess

because only surface exposures were seen, except at the Happy Jack mine where an adit has been driven 50 feet into the deposit, and at the Four Aces mine, where Gregory _/ states the workings extend 180 feet.

_/ Gregory, H. E., op. cit., p. 107.

Sixty rock samples were collected in the White Canyon area, half of them from the Happy Jack mine. Samples taken from outcrops were generally chip samples taken at a point or points near the center of the radioactive exposure.

The average grade of ore varies widely within the same deposit because of the spotty concentration of uranium minerals. Many of the samples collected during this investigation assayed several tenths of a percent uranium, although samples assaying only a few thousandths were no less common (table 2).

Table 1.--Dimensions of uraniferous deposits
White Canyon area, San Juan County, Utah.

Name of claim	Ore body		
	Maximum thickness	Outcrop length	Outcrop width
Happy Jack.	15	700	
Four Aces.	12	300	
Red Canyon No. 1.	5	250	
Scotty.	6	75	
Posey.	50	800	250
Hideout No. 1.	5	200	
Scenic No. 4.	6	200	
Bear.	4	100	
Saddle.	4	50	
White Canyon No. 1.	10	150	
Frey Canyon No. 4.	4	100	
Scenic No. 2.	10	50	50

Table 2.--Description and analyses of samples, White Canyon area, San Juan County, Utah

Sample number	Location	Material	Length (in feet)	Type	Equivalent Uranium (percent)	Uranium (percent)	Copper (percent)
S-1-a	Happy Jack mine 1/.	Conglomeratic sandstone	2	Vertical chip	0.180	0.090	0.81
1-b	do.	do.	2	do.	0.086	0.087	1.67
1-c	do.	do.	2	do.	0.200	0.230	3.95
2-a	do.	do.	2	do.	0.550	0.280	9.60
2-b	do.	do.	2	do.	0.290	0.330	3.63
2-c	do.	do.	2	do.	0.140	0.110	4.52
3-a	do.	do.	2	do.	0.330	0.200	8.92
3-b	do.	do.	2	do.	0.060	0.053	0.27
3-c	do.	do.	2	do.	0.310	0.290	6.75
4-a	do.	do.	2	do.	0.350	0.300	4.96
4-b	do.	do.	2	do.	0.089	0.086	0.69
4-c	do.	do.	2	do.	1.050	0.600	3.34
5-a	do.	do.	2	do.	0.330	0.290	9.37
5-b	do.	do.	2	do.	1.110	0.510	9.03
5-c	do.	do.	2	do.	0.350	0.270	3.73
6-a	do.	do.	2	do.	0.240	0.230	5.65
6-b	do.	do.	2	do.	0.480	0.470	4.99
6-c	do.	do.	2	do.	0.091	0.078	0.22
7-a	do.	do.	2.5	do.	0.570	0.530	4.02
7-b	do.	do.	2.5	do.	0.170	0.100	0.57
8	do.	do.	4	do.	0.590	0.710	0.78
9-a	do.	Silty sandstone.	2	do.	0.075	0.039	0.03
9-b	do.	Conglomeratic sandstone.	3	do.	0.098	0.014	0.06

1/ Samples cut in the walls of the main adit were divided into 3 parts. A sample marked 'a' represents the lower 2 feet, 'b' represents the middle 2 feet, and 'c' represents the upper 2 feet on the 6-foot walls of the drift.

Table 2.--Description and analyses of samples, White Canyon area, San Juan County, Utah--continued.

Sample number	Location	Material	Length (in feet)	Type	Equivalent Uranium (percent)	Uranium (percent)	Copper (percent)
S-10	Four Aces mine	Decomposed sandstone from mine dump.	-	Grab.	0.007	0.003	0.78
11	do.	Fine white platy sandstone.	2	Vertical chip.	0.004	0.002	1.41
12	do.	Sandstone and shale.	-	Grab.	0.003	0.002	9.60
13	do.	Conglomerate and siltstone.	5	Vertical chip.	0.004	0.003	0.80
14	Happy Jack mine.	Conglomeratic sandstone.	5	Chip.	0.075	0.010	0.13
15	do.	Shale.	3	do.	0.028	0.023	0.22
16	do.	Conglomeratic sandstone.	7	do.	0.015	0.003	0.12
17-a	do.	Fine silty sandstone.	2	do.	0.014	0.016	0.28
17-b	do.	Fine silty sandstone.	2	do.	0.085	0.085	0.38
18	do.	Conglomeratic sandstone and siltstone.	2.5	do.	0.140	0.140	0.06
19	do.	Conglomeratic sandstone.	2.5	do.	0.017	0.004	0.07
20	Red Canyon No.1 claim	Sandstone	2	Chip.	0.082	0.071	6.90
21	do.	Conglomeratic sandstone	4	do.	0.018	0.013	9.44
22	do.	do.	2.5	do.	0.062	0.044	3.88
23	do.	do.	1.5	do.	0.980	0.940	0.85
24	do.	do.	4	do.	0.012	0.002	0.06
25	Scotty claim	Indurated sandy conglomerate.	-	Grab.	0.003	0.003	0.33
26	do.	Gypsiferous sandy siltstone.	-	do.	0.005	0.003	0.04

Table 2.--Description and analyses of samples, White Canyon area, San Juan County, Utah--continued.

Sample number	Location	Material	Length (in feet)	Type	Equivalent Uranium (percent)	Uranium (percent)	Copper (percent)
S-27	Posey claim.	Coarse sandstone.	3	Chip.	0.027	0.020	0.52
28	do.	Platy sandstone.	5	do.	0.180	0.220	1.45
29	do.	Conglomeratic sandstone.	3.5	do.	0.550	0.410	6.80
30	do.	do.	1.5	do.	0.057	0.034	5.22
31	Scenic No. 4.	Efflorescent salts.	-	Grab.	0.100	0.140	0.09
32	Hideout No. 1.	Sandstone.	-	Grab.	0.081	0.064	7.42
33	do.	Fine silty sandstone.	-	do.	0.024	0.026	0.09
34	Scenic No. 4.	Sandstone.	9	Chip.	0.006	0.004	0.09
35	do.	Conglomerate and sandstone.	6	do.	0.019	0.020	1.32
36	Bear claim.	Conglomeratic sandstone.	3	Chip.	0.280	0.260	0.08
37	Saddle claim.	Conglomerate and shale.	4	Chip.	0.094	0.061	1.99
38	White Canyon No. 1.	Shale and sandstone.	5	Chip.	0.210	0.250	0.55
39	do.	Sandstone.	3.5	do.	0.960	0.580	6.98
40	do.	Gray shale.	5	do.	0.011	0.003	0.09
41	Frey Canyon No. 4.	Conglomeratic sandstone.	4.5	Chip.	0.021	0.011	0.06

Table 2.--Description and analyses of samples, White Canyon area, San Juan County, Utah--continued.

Sample number	Location	Material	Length (in feet)	Type	Equivalent Uranium (percent)	Uranium (percent)	Copper (percent)
S-42	Frey claim.	Sandy siltstone.	3	Chip.	0.013	0.008	0.24
43	Scenic No. 2.	Sandstone.	2	Chip.	0.090	0.053	8.20
44	do.	Conglomeratic sandstone.	2	do.	0.063	0.059	5.34
45	do.	do.	1.5	do.	0.038	0.036	8.68

DESCRIPTION OF PROPERTIES

Happy Jack (formerly Blue Dike) mine

The Happy Jack (formerly Blue Dike) mine (figs. 2 and 3) is in White Canyon about 8 miles east of Hite Crossing. It is on an unpatented claim owned by Grant and Fletcher Bronson and Joe Cooper. In October 1948 the mine consisted of three adits totalling 120 feet in length. The main adit was about 50 feet long and had a 25-foot branch drift. The other adits were 27 and 18 feet long.

The ore deposit is in the basal 15 feet of Shinarump conglomerate, which consists mainly of cross-bedded sandstone and conglomeratic sandstone with lenses of sandy siltstone. The cross-bedded sandstone is composed of coarse subangular to rounded quartz grains. Pebbles in the conglomerate consist of quartz and quartzite.

Radioactivity was detected for about 700 feet along the outcrop. The uranium content of the samples taken ranges from 0.003 to 0.710 percent, and the copper content from 0.03 to 9.60 percent (table 2).

Four Aces (formerly Dolly Varden) mine

The Four Aces (formerly Dolly Varden) mine (fig. 2), along the south wall of White Canyon about 5 miles east of Hite Crossing, is owned by Joe Cooper and Grant and Fletcher Bronson. Several adits, inaccessible during the examination, have penetrated 10 to 20 feet into the Shinarump conglomerate, and Gregory _/ states that one of them extends 180 feet.

_/ Gregory, H. E., op. cit., p. 107.

At the Four Aces mine the Shinarump conglomerate is 25 feet thick, and material in about one-half of this thickness is weakly radioactive. At the western end of the uranium deposit the basal part consists of a peculiar conglomerate containing quartzite and limestone pebbles and some fragments of carbonized wood. At the east end of the deposit, the conglomerate grades into cross-bedded coarse-grained sandstone.

The Shinarump conglomerate is weakly radioactive at places along 300 feet of exposure. Assays of samples from the Four Aces claim indicate that the uranium content of the deposit is very low, about 0.002 percent. The copper content, however, ranges from 0.78 to 9.6 percent.

Scotty claim

The Scotty claim (fig. 2) is in Red Canyon about 13 miles northwest of Red House Spring and is owned by J. Wiley Redd of Blanding, Utah. No development of the property has been undertaken.

The Shinarump conglomerate on the Scotty claim has an intermittent basal conglomerate that is 2 to 3 inches thick. About 38 feet of sparsely conglomeratic cross-bedded sandstone, containing lenses of shale and siltstone, overlies the basal bed.

The largest radioactive zone is a gypsiferous sandy siltstone lens about 6 feet thick and 75 feet long. A sample from this lens assayed 0.003 percent uranium and 0.04 percent copper (table 2).

Red Canyon No. 1 claim

The Red Canyon No. 1 claim is along the northeast wall of Red Canyon about 10 miles northwest of Red House Spring (fig. 2). J. Wiley Redd is the owner. No development work has been undertaken at the deposit.

The Shinarump conglomerate on this claim is composed of nearly 20 feet of cross-bedded sandstone and conglomeratic sandstone. Malachite-stained carbonized fossil wood fragments are the most radioactive material measured. They occur at places for 250 feet along the basal 5 feet of Shinarump conglomerate. Samples from the Red Canyon No. 1 claim contained from 0.002 to 0.94 percent uranium and 0.06 to 9.44 percent copper.

Posey claim

The Posey claim (fig. 2), owned by J. Wiley Redd, is along the southwest wall of Red Canyon about 9 miles west of Red House Spring. The deposit is undeveloped.

At this locality the Shinarump conglomerate is 40 to 50 feet thick and is composed of cross-bedded sandstone and conglomeratic sandstone. It caps a divide, about 250 feet wide and 800 feet long, between two short canyons that are tributary to Red Canyon. Copper and uranium minerals occur throughout the entire thickness of the formation (table 2). Samples assayed from 0.02 to 0.41 percent uranium and as much as 6.8 percent copper (table 2).

Hideout No. 1 claim

The Hideout No. 1 claim (fig. 2) is on the east rim of Deer Flats and is owned by the Shumway brothers of Blanding, Utah. No development work had been started at the time of this examination.

The Shinarump conglomerate consists of 16 to 20 feet of sandstone and conglomeratic sandstone. A bed of white siltstone exposed at the base of these sandstones may be the upper member of the Moenkopi formation. This siltstone lens and the basal part of the sandstone contain the copper and uranium minerals. The deposit is about 5 feet thick and 200 feet long. A sample from the Hideout No. 1 claim assayed 0.064 percent uranium and 7.42 percent copper (table 2).

Localities No. 13 and 14

At localities No. 13 and 14 (fig. 2) on the rim of Deer Flats, the Shumway brothers have two claims, the names of which are not known. No development work on these claims had been undertaken at the time of examination.

The copper and uranium mineral deposits are not continuous, but are localized in a series of copper-stained radioactive spots, 2 or 3 feet across, along the exposure of basal Shinarump. No samples were taken on these claims.

Scenic No. 4 claim

The Scenic No. 4 claim (fig. 2), owned by the Shumway brothers, is on the west side of Frey Point. No development work has been undertaken at this claim.

The deposit, in the Shinarump conglomerate, is in about 6 feet of sandstone and conglomerate that fill a scour channel about 200 feet long in the Moenkopi formation. About 30 feet of sandstone, conglomeratic sandstone, and lenses of siltstone overlie the channel filling. A thick layer of efflorescent sulfate minerals (table 2) coats a sheltered siltstone exposure near the base of the Shinarump conglomerate. The sulfates include alums and a fluorescent uranium mineral. A pink mineral, erythrite (?), also is present. Two samples from the Scenic No. 4 claim assayed 0.004 and 0.02 percent uranium and 0.09 and 1.32 percent copper (table 2).

Bear claim

The Bear claim (fig. 2), on the north rim of Frey Point, is owned by the Shumway brothers of Blanding, Utah. No development work has been done on the Bear claim.

The Shinarump conglomerate on this claim is 23 feet thick and is composed almost entirely of cross-bedded sandstone. A few pebbles are scattered through the basal part of the formation. The radioactive rock is about 4 feet thick and 100 feet long. A sample assayed 0.26 percent uranium and 0.08 percent copper (table 2).

Saddle claim

The Saddle claim (fig. 2), owned by the Shumway brothers, Blanding, Utah, is on the north rim of Frey Point near the Bear claim. No development work has been undertaken.

The Shinarump conglomerate on the Saddle claim is slumped, but available exposures show that it is at least 15 to 20 feet thick. It consists of a basal conglomerate, 6 feet thick, capped by cross-bedded sandstone. The conglomerate is stained with malachite and is radioactive for about 50 feet along the strike. A sample assayed 0.061 percent uranium and 1.99 percent copper (table 2).

White Canyon No. 1 claim

The White Canyon No. 1 claim (fig. 2), on the northeast rim of Frey Point, is owned by the Shumway brothers, Blanding, Utah. The claim is undeveloped except for two shallow prospect pits. A gray radioactive siltstone forms the basal part of the Shinarump conglomerate. This siltstone has a maximum thickness of 10 feet, and a length of about 150 feet. Parts of the sandstone immediately above it are also radioactive. One sample from the White Canyon No. 1 claim assayed 0.58 percent uranium and 6.98 percent copper (table 2).

Frey Canyon No. 4 claim

The Frey Canyon No. 4 claim (fig. 2), owned by the Shumway brothers, Blanding, Utah, is at the head of Frey Canyon. No development work has been done on the claim.

Although the upper contact is slumped, the Shinarump conglomerate is at least 20 feet thick. The greatest radioactivity observed on this claim is in about 4 feet of shales and shaly sandstone, 150 feet long, in the basal Shinarump. A sample assayed 0.011 percent uranium and 0.06 percent copper (table 2).

Scenic No. 2 claim

The Scenic No. 2 claim (fig. 2), along the south wall of Frey Canyon near its confluence with White Canyon, is owned by the Shumway brothers, Blanding, Utah. No development work has been done on the property.

The Shinarump conglomerate is exposed on a point about 50 feet long and 50 feet across. It is 10 feet thick and radioactive throughout most of its thickness. It is composed of sandstone, conglomeratic sandstone, and small siltstone lenses. Malachite stains are common. A sample of conglomeratic sandstone assayed 0.059 percent uranium and 5.34 percent copper (table 2).

Frey and Frey No. 2 claims

The Frey and Frey No. 2 claims (fig. 2), along the south wall of Frey Canyon, are owned by A. E. Shumway, Blanding, Utah.

The Shinarump conglomerate on the Frey claim is 40 feet thick and on the Frey No. 2 claim is 10 feet thick. The lithology is similar to that of other claims in the area, but the deposits are of small size and the radioactivity is very low. A sample from the Frey claim assayed 0.008 percent uranium and 0.24 percent copper.

CONCLUSIONS AND SUGGESTIONS FOR PROSPECTING

Information resulting from the study of the White Canyon area indicates that the Shinarump conglomerate and upper Moenkopi formation are the only strata containing radioactive deposits of commercial size and grade in this area. The radioactive minerals commonly are associated with copper minerals and carbonized fossil-wood fragments. Prospecting, therefore, should be conducted in or near the Shinarump conglomerate and should be guided by copper stain or carbonized wood fragments. It seems possible that mining development might also be guided profitably by these same criteria.