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IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Branch of Radioactive Materials
Building 25, Federal Center
Denver 25, Colorado

August 25, 1961

Mr. R. R. Coats
U. S. Geological Survey
345 Middlefield Road
Menlo Park, California

Dear Bob:

The memorandum accompanying this note is somewhat later in getting finished and dispatched than it should have been. It was written mainly to preserve a record of what was seen in a rather rapid tour and the tentative and somewhat nebulous ideas stemming from the observations.

Uranium deposits of the kind near Mountain City are sufficiently widespread to suggest that resources of uranium in deposits of this kind might be significant. At the present time, however, too little is known about the critical aspects of the relation of such deposits to their geologic setting and of events that have shaped or taken place in that setting to permit any reasonable definition of that potential.

Although the exploited or discovered deposits near Mountain City are relatively small, study of them would contribute to knowledge of the habits, distribution and relation of such deposits to their setting that would be very useful in helping to understand better the significance of this environment for uranium.

I think that gaining the kind of information that is needed to resolve some of the problems is beyond the scope of what investigations by the AEC are likely to accomplish, even though Bob Cohenour is aware of the problems. I hope that the charter for your project is liberal enough so that you can find an opportunity to help fit the uranium deposits and their possible provenance into the more comprehensive geologic picture that your work will develop.

I am sorry that our visit to the area could not have come at a time when you were there, but timing had to be accommodated in part to the schedule for Mr. Udas of the Indian Atomic Energy Commission.

Best wishes,

Art

Arthur P. Butler, Jr.

Enclosure

Copy to: Director's Reading File
Office of Economic Geology

Branch of Radioactive Materials
Building 25, Federal Center
Denver 25, Colorado

August 10, 1961

Memorandum

To: Record

From: A. P. Butler, Jr. A P Butler Jr.

Subject: Notes on some uranium deposits in Nevada and California north of 38° N. Lat.

Selected uranium deposits in Elko, Washoe, Lyon, Mineral, Esmeralda, and Lander Counties, Nev., Lassen County, Calif., and Juab County, Utah, were examined by J. W. Hasler and the writer between May 17 and 26. G. R. Udas, Principal Geologist, Atomic Minerals Division, Atomic Energy Commission of India, accompanied us. R. E. Cohenour, AEC, guided us effectively at Mountain City.

The principal purpose of the trip was to examine uranium deposits in Tertiary fluviatile and volcanic clastic rocks close to the unconformity between those rocks and older, mostly Mesozoic, granitic rocks, in order to further assess the significance of uranium deposits in this setting. Such deposits are widely but sparsely distributed in western United States. They are represented in Fremont and Teller Counties, Colorado, Stanley Basin, Idaho, and in Nevada and California. Available descriptions--mainly unpublished--of many deposits in Nevada and California are sketchy and examination of the deposits was desirable in order to develop a clearer impression of the significance of deposits in this environment and of these deposits in relation to others in generally similar settings elsewhere. A few deposits of other types near the route of travel were also visited. The trip also gave Mr. Udas an opportunity to observe uranium deposits in a regional setting and immediate environment that differ from those of the Colorado Plateau and Tertiary basins in Wyoming.

The deposits examined fall into two general types:

A. Those nearly concordant with sedimentary structures of clastic and volcanic rocks in which they are enclosed and generally close to the unconformity separating the clastic rocks from older intrusive igneous rocks and metamorphic rocks.

~~tures Had~~ Deposits ~~Deposits~~ closely associated with or localized in fractures and faults.

Deposits belonging to type A that were examined are in northern Elko County, near Mountain City, in Washoe County, Nev., and Lassen County, Calif., about 25 miles north and north-northwest of Reno, respectively. The Carol R mine deposit, about 10 miles east of Hawthorne, Mineral County, may be of the same type.

Mountain City area, Elko County, Nev.

Deposits examined in the vicinity of Mountain City include:

Hot Spot No. 1, N½NE¼ sec. 2, T. 45 N., R. 53 E., 0.45 mi. SW of Mountain City.

Race Track, Tag, Denis, and South Fork and Pixley. These are strung out along the valley of California Creek from the center W side sec. 31, to the SW¼NE¼ sec. 35, T. 44 N., R. 54 E. (unsurveyed).

Rimrock near common corner sec. 26, 27, 34, and 35, T. 46 N., R. 54 E.

Autunite NE¼, SE¼ sec. 30, T. 46 N., R. 54 E. (unsurveyed)

All deposits except the Autunite are generally similar. They are in a sequence of rocks of Tertiary and probably early Tertiary age which includes tuffaceous mudstone, vitric, crystal, and pumiceous tuff, lesser amounts of tuffaceous sandstone, and subordinate lenses of conglomerate and arkose. This sequence is overlain at least locally, and probably generally, by welded felsic tuff. Pebbles and cobbles in the conglomerate consist of differing proportions of older igneous and metamorphic rock and of volcanic rocks.

Thin seams and small pods of carbonaceous trash are irregularly present in the finer grained clastic rocks and are locally abundant.

The sedimentary rocks rest on an irregular surface developed on underlying medium- to coarse-grained granitoid rock. Local relief on this surface ranges from 5 to 30 feet in distances of 100 to 200 feet. The total relief on the surface beneath the sedimentary-volcanic sequence is doubtless much greater but requires district wide or quadrangle mapping to distinguish the effects of post-volcanic deformation from pre-volcanic erosion and determine the total original relief.

In part, as a result of the irregularity of the underlying surface, the thickness of the sedimentary part of the sequence is irregular. It is 3 to 10 feet thick in cuts at the Hot Spot claims west of Mountain City and at least 70 feet thick at the Denis pit 4 miles east of Mountain City.

Although welded felsic tuff probably was once generally present in the area, it is absent in the immediate vicinity of many of the deposits probably as a result of post-volcanic erosion.

All the rocks have been displaced by post-volcanic deformation, and attitudes range from nearly flat to dips of 30 to 40 degrees. Local faults of a few feet to a few tens of feet displacement are exposed in some pits. On a larger scale Tertiary deformation may also be a result of faulting but the complete picture of the structure will only be established by mapping of R. R. Coats now in progress.

Uranium is concentrated in thin, less than 1 foot to 2 or 3 feet thick, irregular lenses and pods in tuffaceous mudstone and arkosic conglomerate. Some of the uranium is in rock containing carbonized plant remains. In the South Fork pit, rock relatively rich in carbon which rests directly on older granitic rock is locally very rich in uranium 0.5 to 1.0 percent U_3O_8, whereas seams of carbon-rich rock a few feet above the unconformity are only slightly radioactive. Secondary minerals containing high-valent uranium are distributed on microfractures in tuff in some deposits, and at the Race Track mine some inconspicuous joints in granite and aplite are mineralized for 3 or 4 feet below the pre-volcanic surface. At most places mineralized rock rests directly on or is only a few feet above the old eroded surface of the granitic rock. At the Denis cut the mineralized beds are 30 or 40 feet above the base of the local section.

The deposits that have been explored or developed appear to consist of groups of masses of mineralized rock rich enough in uranium and close enough together to be mined by shallow open pits 5 to 20 feet deep. Exposures in the pits give the impression that mineralized rock as well as ore is erratically distributed even in the favorable zone. R. E. Cohenour, AEC, thinks that more richly mineralized rock is developed in local topographic and structural lows on the granite surface. Although this may be generally true, in the Pixley-South Fork pit richly mineralized rock is also present along portions of the side slope of such a hollow.

The Race Track workings have yielded at least 1,000 tons of ore containing between 0.1 and 0.2 percent U_3O_8. The Rimrock and Pixley-South Fork pits have each been the source of 500 to 600 tons. Cohenour infers 10,000 tons of rock containing 0.1 percent or more U_3O_8 at the Hot Spot claims.

On the Autunite and October claims secondary uranium minerals occur along tight gently dipping fractures in granitic rock 10 or 12 feet from the portal of an adit driven in the granite and younger (?) quartz porphyry, and on joints in a cut 25 feet lower than the adit. The adit cut a non-radioactive pyrite- and molybdenum-bearing zone in quartz porphyry.

The Hot Spot, Race Track, and Tag prospects fall within 100 feet of a straight line trending N. 72° W. The Autunite-October, Hawk and Pixley-South Fork deposits are almost as perfectly aligned in a direction of N. 80° W. and about 1 mile farther north. Whether these alignments are fortuitous or reflect some obscure structural control of distribution is uncertain. Five of the deposits are also situated well down in the valley of California Creek and the position of the deposits may be related in some manner to the form of the pre-volcanic surface.

Washoe County, Nevada, and Lassen County, California

Deposits visited in Washoe County, Nev., and in Lassen County, Calif., include the following:

Type A deposits:

Go Getter and Pup claims, SW¼ sec. 27, T. 24 N., R. 19 E.
Divide claims, SW¼ sec. 26, T. 24 N., R. 19 E.
Jeanne K claims, sec. T. 23 N., R. 18 E.

Type B deposits:

Lowary claims, SE¼SE¼ sec. 36, T. 24 N., R. 20 E.
Red Bluff mine, NW¼ sec. 1, T. 23 N., R. 20 E.

Deposits at the Go Getter-Put and Divide claims are generally similar in geologic surroundings and habit to those in the lower part of the volcanic sequence near Mountain City. They are, however, on or close to ridge and mountain crests rather than in the valleys. The deposit at the Divide claims is partly in a very coarse boulder conglomerate set in a matrix of consolidated vitric and crustal tuff which suggests deposition as a mud flow that incorporated hillside rubble. Radioactive material at both deposits is mainly in thin carbonaceous layers interbedded with tuff and 1 to 5 feet above the irregular contact with underlying granitic rock. At the Divide claims irregularly distributed pods of carbonized plant remains are also slightly radioactive, about 0.15 MR, or 3 to 4 times local background. No uranium minerals were noted.

The deposits are explored by shallow open cuts 15 to 20 feet wide and 100 to 120 feet long but have not been productive.

At the deposit on the Jeanne K claim the rock consists about two-thirds of arkose and about one-third tuff and conglomeratic tuffaceous mud flows. The arkosic rocks include some carbonaceous layers as much as 2 feet thick. The carbonaceous rock is radioactive, and exhibits local bloom of a secondary uranium mineral, possibly schroeckingerite. A few hundred tons of ore were shipped from the deposit.

The Lowary and Red Bluff deposits are vein or fracture controlled deposits. At the Lowary cut light gray lithoidal tuff, probably slightly welded, overlies a gray friable crystal tuff. Uranium is associated with a nearly vertical silicified zone of fracturing in the lithoidal tuff which strikes about N. 30° E. and steeply dipping subsidiary fractures that strike N. 30° W. About 200 tons of ore were shipped in 1957.

The Red Bluff deposit, in the same general setting, consists of mineralized rock adjacent to a normal fault that strikes about N. 20° E., dips 55° W. and cuts welded felsic tuff. Rocks adjoining the fault and fractures branching into the footwall are radioactive and exhibit yellow secondary uranium minerals. The deposit is explored by several open cuts and a crosscut adit and drift. The adit is about 75 feet long and the connecting drift extends more than 100 feet along the strike of the fault. More rock has been moved here than at the Lowary, but only one shipment of about 60 tons of ore containing about 0.6 percent U_3O_8 has come to the writer's attention.

Other deposits

The deposit at the River Road claim, SW¼ sec. 3, T. 7 N., R. 27 E., Lyon County, consists of mineralized gouge and breccia along a westerly trending normal fault which dips S. and drops water-laid tuff and tuffaceous sedimentary rocks in the hanging wall against coarse-grained granitic rock in the footwall. The deposit is explored by an open cut about 100 feet long, a shaft about 15 feet deep near the south end of the cut, and a crosscut 40 feet long from the bottom of the shaft. Although the structure is persistent, brecciated rock and gouge adjoining the fault are only locally radioactive. Megascopically visible uranium minerals are sparse. About 40 tons of ore containing 0.14 percent U_3O_8 were mined and shipped in 1957.

At the Carol R mine in sec. 31, T. 8 N., R. 32 E., Mineral County, a limonite-stained layer along bedding of gray devitrified tuff which dips 65° NNW is radioactive and microfractures in tuff for about a foot under the layer are sparsely coated with yellow and green secondary minerals of uranium. The radioactive beds are about 60 feet stratigraphically above a coarse-grained granitic rock. Along a concealed contact they also adjoin a flow-banded partly glassy felsic rock which also appears to overlie the granitic rock. Other than the lack of carbonaceous material the deposit resembles Type A deposits in Elko and Washoe Counties. Geologists of the Atomic Energy Commission (written communication, Oct. 1959) report carnotite in gouge [?] in fractures overlying basalt.

Fine-grained water-laid beds in the Siebert tuff of Spur are all locally mineralized with uranium at places from 1.5 to 2.5 miles west of Tonopah and about 1 mile south of U. S. Highway 95.

The geology of the deposits is described by Davis and Hetland (1956). In a cut 8 to 10 feet deep examined during this visit gray to white fine-grained oolitic layers from 0.1 foot to 1.0 foot thick are interbedded with lesser amounts of white, non-gritty beds of clay and are nearly flat-lying. Some beds are mottled with spherical limonite stains and some layers less than 0.5 foot thick are limonite-stained. A 5.5-foot thickness of beds on the SE wall of the cut in the vicinity of a fracture that dips 45° SE have a radioactivity of 1.0 to 1.5 MR. Similar beds in other cuts for a 0.5 mi. to the SW dip 5 to 15° SW and are non-radioactive to moderately radioactive (0.8 MR). According to Davis and Hetland (1956), results of exploration suggest that distribution of uranium is related to a northerly trending zone of fracturing, but whether there is also some stratigraphic control too remains unclear.

Apex mine, Lander County.--Several thousand tons of ore have been produced from a complex of underground workings in the Apex Mine (at one time also known as the Early Day) in NW¼ sec. 1, T. 18 N., R. 43 E., about 3 miles south of Austin, Nev. The deposit has been developed by two adits and their connecting drifts and an inclined shaft for a vertical distance of perhaps 150 feet. Fine-grained phyllitic and quartzitic rocks are in intricate intrusive and fault contact with a moderately coarse-grained granitic rock. Both the igneous and metamorphic rocks are cut by aplite dikes which are also involved in some of the faults. The dikes trend a little north of east. According to Thurlow and Reyner (1956) fractured metamorphic rock close to the contact with the igneous rock is the principal locus of uranium. Judging from maps made by the AEC a considerable amount of ore is in such rock along the walls of the larger dike, but fractures at large angles with the dikes are also mineralized. Introduced minerals are fine-grained and inconspicuous so that mineralized rock is not readily distinguishable.

Lowboy Mine:--The Lowboy mine in secs. 13 and 24, T. 18 N., R. 44 E., is developed by an open cut about 300 feet long trending about NW an inclined shaft (inaccessible at time of visit), an adit about 60 feet long near the SE end of the cut, and a stub adit near the NW end. The general geologic features are similar to those at the Apex Mine. Fine-grained gray metamorphic rock adjoins granitic rock to the northeast along a contact that is locally faulted. Some fractures and faults striking at 45° and 90° to the trend of the major contact are locally mineralized. In the southwest adit about one foot of rock in the footwall of a fault striking N. 40° W. and dipping 15° to 20° SE is moderately radioactive, 1.5 MR. Ore and gangue minerals are inconspicuous. The over-all pattern of uranium distribution, other than proximity to a contact with granite, is obscure despite fairly good exposures.

Thomas Range, Juab County Utah.--The Yellow Chief mine, Thomas Range, is one of the larger deposits and possibly the largest deposit that has been discovered in sedimentary rocks closely associated with a sequence of volcanic rocks of Tertiary age in the United States. Garn Moody, one of the owner-operators, estimates that total production by the end of May 1960 would be close to 50,000 tons of ore with a content between 0.15 and 0.2 percent U_3O_8.

The deposit consists of tuffaceous arkose and some conglomerate partly impregnated by probable supergene minerals of high valent uranium. The rocks containing the uranium are overlain by silic tuffs, welded tuffs, and flows. The mineralized ground being mined is bounded laterally by faults and its full extent is not known.

The deposit has been studied and will be described in more detail by M. H. Staatz in a report now being written.

General comparisons with other areas

The deposits of Type A examined in Nevada and California are generally similar in habit, form, and size. They are in similar positions in generally similar geologic environments. Position in the environment is similar to that of deposits in the vicinity of Tallahassee Creek, Colo., and near Stanley, Ida. In contrast to the deposits near Stanley, which are developed in beds of arkose that persist well beyond the limits of the deposits, those in Nevada are in beds with a large or major volcanic component which are rarely persistent beyond the limits of the deposit.

Except for the undeveloped Hot Spot deposit near Mountain City, the Nevada deposits are only one-third to one-half the size of the larger deposits near Stanley and one-sixth to one-twentieth the size of the larger deposits near Tallahassee Creek. The grade of the ore mined is about 10 to 50 percent less than the grade in other areas.

On the other hand one of the deposits in the Sierra Nevada thought to be of similar type is estimated by the AEC to have 30,000 tons of reserves. Moreover, the Yellow Chief deposit in the Thomas Range which is in rocks that are part of a predominantly volcanic sequence is probably at least 50,000 tons in size.

Conclusions

The deposits of Type A are of interest, (A) for the possible contribution that study of them might make to a better understanding of uranium deposits, and (B) for their possible economic potential.

Study of the deposits in relation to their environment and the events to which that environment has been subjected may reveal what relation there may be between volcanic activity and uranium deposits and contribute to understanding of the processes whereby uranium is brought to the surface of the earth or extracted from rocks at the surface and concentrated into deposits.

The potential economic significance of deposits of this type is obscure but might be important. Most of the deposits examined are small--less than 1,000 tons of ore. They are related to discontinuous beds or lenses of relatively small scale. These features are repeated in many places but direct evidence is scant as to whether or not they may be developed somewhere in the environment at a scale necessary for large deposits such as those in continental fluviatile sandstones. In the Mountain City area, at least, the alignment of deposits suggests some degree of structural control that may impose a strict limit on number, distribution and size of sites suitable for deposits.

On the other hand a number of features suggest that deposits of this type may be of substantial economic significance. The deposits are fairly numerous and widely if sparsely distributed not only in Nevada and California but also in Idaho and Colorado. These features suggest that the deposits may be a more common characteristic of their environment than has been clearly recognized. The size of the Yellow Chief deposit and the size of the body of rock enclosing it coupled with the widespread distribution of other deposits suggests that cover of younger rocks may have concealed or obscured some of the favorable portions of the environment elsewhere.

The economic significance of deposits of this type can be resolved best by study of the deposits in relation to the total picture of their geologic environment. This can probably be done most effectively by studying the deposits in conjunction with or in the course of mapping projects such as that now in progress in the vicinity of Mountain City, Nevada.

General mapping is necessary to determine the distribution and arrangement of different lithologies in the Tertiary sequence, the configuration of the pre-volcanic surface, and the pattern of deformation from which it may be possible to discern relations between such features and the occurrence and distribution of deposits. Better definition of these relations is necessary before the known deposits can be used as a guide to interpreting the potential for uranium resources in Tertiary sequences of interbedded sedimentary and volcanic rocks.

References

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Thurlow, E. E., 1956, Uranium deposits at the contact of metamorphosed sedimentary rocks and granitic intrusive rocks in Western United States: U. S. Geol. Survey Prof. Paper 300, p. 88-89.