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URANIUM EXPLORATION - POLAR MESA
GRAND COUNTY, UTAH
A REVIEW OF REPORTS
by
Richard P. Darnell

March 20, 1952
Grand Junction, Colorado
URANIUM EXPLORATION - POLAR MESA, GRAND COUNTY, UTAH
A REVIEW OF REPORTS

Names and Addresses of Property Owners:

United States Vanadium Company
Grand Junction
Colorado

Climax Uranium Company
Grand Junction
Colorado

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URANIUM EXPLORATION - POLAR MESA, GRAND COUNTY, UTAH

A REVIEW OF REPORTS

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ABSTRACT

Polar Mesa is situated in Grand County, Utah, on the north flank of the La Sal Mountains and is bounded by the Dolores River on the south and Beaver Creek on the east. The uranium-bearing Salt Wash member of the Morrison formation is exposed on the mesa sides and in part on the top. The Brushy Basin member of the Morrison formation overlies the Salt Wash. Below the Salt Wash, the Summerville and Entrada formations are exposed in descending order around the steep sides of the mesa.

Since mining began in 1918, production on Polar Mesa has been an estimated 25,000 tons of ore averaging about 0.30% U₃O₈. Mineralization is of the carnotite-roscoelite type. Rim outcrops have been thoroughly prospected and all favorable ground is claimed by two mining companies. The western portion has been explored by core drilling, but remaining areas have not been adequately tested. Known ore bodies, largely exhausted, are outlined in previous reports. More recently large ore bodies have been discovered as a result of drilling conducted by mining companies. Ore bodies occur along trends that are thought to be intraformational paleochannels.

It is recommended that core drilling be conducted to prospect for other ore bodies and trace the course of mineralizing solutions over the mesa. Accessibility and drilling conditions are generally favorable, although rough terrain will preclude drilling in some places.

Polar Mesa, comprising an area of 8 square miles, was examined in detail in 1943 (UMDC, 1943). In 1950, 37,000 feet were drilled by the Atomic Energy Commission.

INTRODUCTION

Purpose and Method of Investigation

Reports and maps describing Polar Mesa were studied for the purpose of determining the potential for discovering additional uranium ore reserves. Field investigations were not undertaken, as existing reports adequately describe the geology and exploration completed through 1950.
This report consists of a compilation of data from several sources and a revision of "Interim Report on Core Drilling on Polar Mesa, Green River Desert Area, Utah" (H. S. Stafford, 1950) and a "Field Survey of Polar Mesa Camp (West Gateway district), Green River Desert Area, Utah" (John F. Emerson and Clay T. Smith, 1944). A memorandum dated February 14, 1951, by E. V. Reinhardt to Thomas W. Oster, "Recommendation for Amount of Drilling Yet to be Done on Polar Mesa" and Bureau of Mines Report of Investigations No. 3930, "Exploration of Vanadium Region of Western Colorado and Eastern Utah" (Huleatt, Hazen, Jr., and Traver) provided additional information. Map and drill hole data of the U. S. Vanadium Company, Uravan, Colorado, and Climax Uranium Company, Grand Junction were obtained to delineate areas already explored. A few hours reconnaissance of Polar Mesa in the company of H. S. Stafford, Project Chief of the AEC drilling conducted in 1950, and personal discussions with him and others concerning the area provided helpful information.

Only a part of Polar Mesa was observed, briefly, by the writer under adverse winter conditions when the mesa was covered by snow.

Location and Accessibility

Polar Mesa is in Grand County, Utah (fig. 1), in the southeast corner of T. 24 S., and the northeast corner of T. 25 S., R. 25 S., Salt Lake meridian and comprises an area about 4 by 2 miles. A graded dirt road branching from Route No. 128 at Castle Valley gives main access to the mesa. Another road, not passable in winter, extends from Gateway, Colorado. The Castle Valley road is passable with difficulty when wet or snow covered, but is easily traversed at other times. Polar Mesa is approximately 50 miles by road from Moab, Utah, and about an equal distance from Gateway. Moab is the nearest supply center and the nearest railroad points are Cisco and Thompsons, Utah. There is a landing strip on the mesa suitable for light planes.

Heavy snowfall hinders operations on Polar Mesa, although during the winter of 1951-52, the U. S. Vanadium Company kept main roads open and maintained continuous ore production despite 3 to 4 feet of snow.

Names and Addresses of Owners and Operators


U. S. Vanadium Company is the only known claim owner presently conducting mining operations on Polar Mesa. Climax Uranium Company did a limited amount of core drilling to fulfill assessment requirements during 1950 and 1951.
Available Maps and Photo Coverage

Topographic maps in the AEC files, on a scale of 1" = 200 feet, have been made from Lockwood, Kessler, and Bartlett, Inc., photogrammetric sheets. Other maps including a structure contour map of the top of the Entrada formation, on a scale of 1" = 500', accompany the Polar Mesa report by Stafford (1951). A claim map of Polar Mesa made by Minerals Engineering Company is available. Various maps and geologic sections accompany the "Field Survey of Polar Mesa Camp (West Gateway District) Green River Desert Area, Utah" (Emerson and Smith). A list of reports about Polar Mesa are included in the bibliography.

HISTORY OF OPERATIONS

Previous Exploration

Uranium ore was first discovered on Polar Mesa in 1914 and drilling began in 1918. Drilling of 381 holes was done at various times in the past by Harbro Mines, Vanadium Corporation of America, and the U. S. Bureau of Mines. In 1950, the Atomic Energy Commission drilled 37,904 feet of hole. The holes were spaced on 125 to 1,000-foot centers. U. S. Vanadium Company did extensive drilling from 1948 through 1951 on a closely spaced grid pattern, frequently on 50-foot centers. More than 500 holes had been drilled by USV by late 1951. Climax Uranium Company has explored a comparatively small proportion of their property by drilling 14 holes in 1950 and 11 holes in 1951. Climax Uranium Company has indicated the intention to explore their ground more thoroughly whenever exploration being conducted in other districts does not demand prior attention.

Most AEC exploration drilling has been largely confined to public lands as a result of administrative order effective about the time that the AEC drilling program was initiated. This order was rescinded sometime after the completion of the drilling project and is not now in effect.

It is estimated that more than 15,000 tons of ore have been shipped from Polar Mesa from 1948 to 1952. This ore is reported to have an average grade of \( \text{U}_3\text{O}_8 \) in percentages as follows: 0.35\%, 1948; 0.25\%, 1949; 0.34\%, 1950; and 0.39\%, 1951 (2 months only). During 1950 nearly 6,000 tons of ore was mined and it is estimated that production in 1951 was at least as great. The total production of the mesa since mining began is believed to be in excess of 25,000 tons with an average grade above 0.30\% \( \text{U}_3\text{O}_8 \). Actual vanadium content of the ore produced is unknown, but is estimated to be sufficiently high to be an important economic factor. Most ore production has been from a zone along the mineralized outcrops on the rim and from a mineralized area near the northwestern side of the mesa.
GENERAL GEOLOGY

Stratigraphy

The rocks on Polar Mesa are all of sedimentary origin. The Dakota sandstone of Cretaceous age caps the highest ridges. Most of the remaining alluvium-covered surface is underlain by the Brushy Basin shale member of the Morrison formation of Jurassic age. The underlying Salt Wash sandstone member of the Morrison forms the surface in places near the edge of the mesa. The Summerville and Entrada formations of upper Jurassic age are exposed in the steep sides of the mesa below the rim of Salt Wash. (See Table 1)

A partial stratigraphic section described below only includes rocks of importance to uranium exploration. The following is quoted directly from the Union Mines Development Corporation report (1943):

"Morrison formation"

"Salt Wash sandstone member - The Salt Wash sandstone member of the Morrison formation is made up of nearly equal parts of white to light gray sandstone and green and red mudstone beds; occasional coarse grit beds occur in the upper part and a few thin, gray limestone beds are common near the base of the member. The lower one-third of the member is predominantly shale and mudstone and the lower sandstone units are usually finer-grained, thinner, and more calcareous and lenticular than those at the top.

"The basal unit of the Salt Wash is, in nearly every case, a thin, gray limestone bed varying from 1 to 5 feet in thickness. This limestone bed usually contains irregular masses of multicolored chert. The basal limestone unit is missing in a few places which necessitated the use of other lithologic features to differentiate the Summerville and the Salt Wash.

"The principal vanadium-bearing sandstone occurs approximately 200 feet above the base of the Salt Wash. It is a massive, cross-bedded, medium-grained, white sandstone from 10 to 70 feet in thickness. It is very persistent and is almost continuously exposed around the mesa. Mudstone galls and partings occur frequently throughout the unit; considerable wood trash is also present.

"The top bed of the Salt Wash member is a fairly persistent and easily identified coarse-grained sandstone with gritty or conglomeratic phases varying in thickness from 10 to 30 feet. Poorly sorted red, green, and white chert pebbles comprise the gritty phases varying in size from 1/16 to 1/2 inch in diameter.

"Brushy Basin Shale Member - The Brushy Basin shale member of the Morrison formation is completely covered on Polar Mesa (by alluvium), except for a few sandstone lenses in the upper part."
<table>
<thead>
<tr>
<th>System</th>
<th>Series</th>
<th>Group</th>
<th>Formation</th>
<th>Thickness Feet</th>
<th>Character of Rocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cretaceous</td>
<td>Upper Cretaceous</td>
<td>Dakota formation</td>
<td></td>
<td></td>
<td>Gray to buff sandstone with subordinate conglomerate lenses.</td>
</tr>
<tr>
<td>Cretaceous</td>
<td>Lower Cretaceous</td>
<td>Burro Canyon formation</td>
<td>5-60'</td>
<td></td>
<td>Buff and gray conglomeratic sandstone, with pebbles of black and gray chert; gray shale and carbonaceous shale.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>300'</td>
<td>Brushy Basin shale member. - Variegated shale, conglomeratic sandstone, conglomerate with pebbles of quartzite and varicolored chert, with silicified wood and vertebrate bones.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Morrison formation</td>
<td>320'</td>
<td>Salt Wash sandstone member. - White and gray conglomeratic sandstone, cross-bedded, locally carnitote-bearing, interbedded with red and gray sandy mudstone.</td>
</tr>
<tr>
<td>Jurassic</td>
<td>Upper Jurassic</td>
<td>Unconformity</td>
<td></td>
<td></td>
<td>Thin-bedded red and white sandstone and shale, much ripple-marked; some gray limestone locally studded with large chert concretions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Summerville formation</td>
<td></td>
<td></td>
<td>The upper part is a white cross-bedded fine-grained quartz sandstone, massive or in thick beds, with a few red shale partings.</td>
</tr>
<tr>
<td></td>
<td>San Rafael</td>
<td>Entrada sandstone</td>
<td>275-300</td>
<td></td>
<td>The lower part is cross-bedded buff, orange, red, and white sandstone, with quartz grains sorted in two sizes.</td>
</tr>
</tbody>
</table>
"The Brushy Basin shale member consists of variegated shale conglomeratic sandstone, conglomerate containing quartzite pebbles and chert with silicified wood and bones."

Structure

The following concerning the geologic structure of Polar Mesa is quoted from the Union Mines report:

"The Sagers Wash syncline and Cottonwood Canyon graben are the principal structural features in the immediate vicinity. Polar Mesa lies on the south limb of the syncline. The Cottonwood Canyon graben lies a few miles southwest of Polar Mesa. Neither of these features appears to have any control on ore deposition and is important only in its relationship to erosion.

The beds on Polar Mesa have an average dip of about 4° northeast, although attitudes are not consistent throughout the mesa. Inconsistency is very apparent when different formations and intraformational units are projected from outcrops into profile sections across the mesa. A local monoclinal fold produced abnormal dips at the extreme south end of Polar Mesa."

Geology of the Deposits

The mineralogy of ores from Polar Mesa has not been thoroughly studied. The ore consists principally of sandstone impregnated with secondary uranium and vanadium minerals. Carnotite is commonly associated with fossil wood, but also occurs with vanadiferous hydrous micas that were once thought to be "roscoelite type" minerals.

The ore deposits usually occur in a sandstone unit of the Salt Wash called the "Payoff" sandstone which ranges from 10 to 70 feet in thickness and which lies about 200 feet above the basal Morrison, or 265 feet above the Entrada-Summerville contact. Small ore bodies also occur 50 feet above and 50 feet below the main ore-bearing sandstone. There is some mineralization of the sandstones in the basal Brushy Basin and this represents the highest stratigraphic occurrence of uranium on Polar Mesa. The lowest uranium mineralization (stratigraphically) is 82 feet above the base of the Salt Wash.

The ore occurs in large and small irregular bodies, tabular bodies, in structures locally called "rolls," and in a few fossil trees. Individual roll structures may contain from 20 to 800 tons of ore. Roll structures sometimes connect or coalesce so that up to 10,000 tons may be mined from a single ore body. Tabular ore bodies are generally large deposits with a large proportion of low-grade ore. Scattered fossil trees at one occurrence on the south rim contain high-grade ore and are surrounded by mineralized halos of uranium impregnated sandstone which is indicated by drilling results along the west side of the mesa.
According to Stafford (1950), the trend of the deposits on Polar Mesa varies from slightly east of north to northeast. These trends are believed to follow paleochannels so that they may appear to be at considerable variance in some places. It has been inferred (Stafford, 1950) that large ore deposits should occur in relatively thick sand lenses. The thickening of sandstone probably indicates the presence of intraformational paleochannels and scours which could have provided passageway for mineralizing solutions. It has been pointed out (Reinhardt, February 14, 1951) that P. H. Dodd observed "that a Tertiary tectonic feature has been superimposed upon a Jurassic sedimentary feature and has created traps where ore has been deposited." The Jurassic (Salt Wash) feature has already been mentioned. The Tertiary feature is a tilting of the strata over the mesa to an average dip of 3° northeast. The dip is not consistent, but flattens at nine places. The base of the ore-bearing sandstone dips inward to the northwest and to the southeast to form a trough which has almost been closed, thus forming a "saucer" open on one end.

Sulfide minerals have been noted in ore from Polar Mesa; their former presence is indicated by limonite stain or limonite surrounding partly oxidized iron-sulfide minerals.

Significant geologic criteria and mineralogic associations favorable to ore discovery include: abundant carbonaceous trash, alteration of red mudstones to gray, highly radioactive fossil trees, and alteration of iron sulfides to limonite, indicating an oxidizing chemical environment as expressed by typical limonite coloring diffused within the ore-bearing sandstone.

The western side of the mesa has already been proven to be well mineralized by uranium and vanadium; other parts, especially on rims, are moderately to weakly mineralized.

Assay results of numerous samples taken by Union Mines Corporation personnel are reported by Emerson and Smith (1943).

SUMMARY AND CONCLUSIONS

Production records show that Polar Mesa has been an important uranium producer and exploration drilling indicates considerable potential. The mesa is favorably situated (accessibility, water, transportation, etc.) from the standpoint of mining economics. Nearly all geological criteria now recognized as favorable for the concentration of uranium are readily discernible in mines and on outcrops. Mineralized deposits appear to be in intraformational paleochannels where thickening of the Salt Wash sandstone is apparent. Mineralization occurs over considerable vertical extent, but only one zone has been proved to be important. Large ore bodies have been mined and others have been indicated by drilling. Therefore, it is reasonable to conclude that still other similar deposits may exist on Polar Mesa, or that extensions of known ore bodies may be found.
RECOMMENDATIONS

The Atomic Energy Commission conducted exploration drilling during 1950 on Polar Mesa (p. 4). The results of that drilling were, in general, unfavorable, but it should be emphasized that available ground for drilling was not the most geologically favorable area. With the nullification of previous limitations so that claimed ground may now be explored, a much more promising area for drilling is opened. All those areas suggested as favorable by Stafford should be drilled and additional areas are recommended herewith for core drilling. Parts of areas as outlined (Plate I) are not altogether feasible for drilling because of topography, rubble, and obstacles not discernible from maps.

Five areas, designated A, B, C, D, and E (Plate I) are recommended for core drilling. A few holes adjacent to mines in localities outside the limits of areas indicated on the map are suggested in order to adequately explore the mesa.

Area A

The western part of Area A should be drilled. It is believed that this area is geologically and topographically the most favorable part of the mesa. The extreme western side of Area A has been adequately explored by the U. S. Vanadium Company since the completion of AEC drilling on Polar Mesa in 1950. The results of the drilling by USV in this location were very favorable and it is understood that three new mine shafts will be sunk to exploit the area.

The first drilling should be started not more than 200 feet east of existing USV holes. AEC holes Numbers P-15, P-16, and P-17 (Plate I) were drilled in this area and indicated favorable mineralization. Additional holes should be drilled on approximately the same line. Spacing of holes should allow for at least one new hole between existing holes.

No definite drilling pattern or spacing is proposed, but it is suggested that holes be spaced about 250 feet apart. Holes on 250-foot centers should intercept ore bodies of the size and shape similar to those on the west side of the mesa. Offset holes should be drilled only to attempt to delineate mineralized paleochannels or ore trends. It is believed that private enterprise will block out ore bodies in detail and this should be kept in mind whenever it may appear desirable to drill offset holes.

The major part, possibly as much as approximately two-thirds, of the entire drilling contract footage should be placed in area A. Mining on Polar Mesa has demonstrated that ore bodies are large in the vicinity of the northwestern rim and exploration drilling has indicated the presence of other large ore bodies.
Area B

An entire area, designated B, outlined by Stafford has been completely drilled by U. S. Vanadium Company since completion of the last AEC drilling contract on Polar Mesa. A new area B (Plate I) should be drilled where feasible, possibly near existing roads. Parts of the area have already been drilled by Climax Uranium Company.

Area C

All of Area C (Plate I) includes previous proposals, and is extended to the northeast onto privately held ground. It is feasible to drill most of this section of the mesa, but parts of it in the extreme northeast may not be justified because of the need for expensive road construction and preparation of drill sites. Union Mines geologists recommended drilling adjacent to the Polar King group workings. This was accomplished in part by Climax Uranium Company during 1950 and favorable results were reported for Mineral Polar claims Nos. 16 and 40. Therefore, drilling northeast of Polar King is recommended. Drilling of Polar No. 3 was recommended by UMDC and this has been practically accomplished.

Area D

At least a few holes on one line should be drilled in area D where feasible, although drilling through the Brushy Basin will be necessary.

Area E

Area E appears to have been more or less adequately drilled by the AEC. Inasmuch as at least two holes indicated some mineralization, it is recommended that intermediate holes, and additional holes be drilled, where feasible, near existing roads in the area surrounding holes AEC Nos. 60 and 69.

The Union Mines report recommends drilling near the Jumbo claims. The area back of these claims merits testing between AEC holes Nos. 45 and 104. Drilling results by both AEC and Climax Uranium Company on Mineral Polar Claim No. 19 were unfavorable, but not enough drilling was done to conclude that the area does not offer possibilities of finding extensions of the Jumbo ore. A few holes could be placed to advantage in further testing that area, which is included in Area E.

Other areas recommended in the UMDC report are adjacent to mine workings and it is presumed much of this drilling will be completed by mine owners. Other small areas mentioned in the UMDC report need not receive particular attention for the present drilling program.
Type of Drilling and General Recommendations

Core drilling only should be applied to Polar Mesa and should be conducted in two phases, if practical. The first phase should place holes on 1,000 or 500-foot centers to locate favorable ground and the second phase on 250-foot centers to locate and delineate mineralized areas.

A minimum of 30,000 feet and a maximum of 50,000 feet of drilling is considered adequate to thoroughly explore the mesa. However, it may be necessary to drill 30,000 feet in area A alone. In areas apart from A the remaining footage should be distributed proportionately, or as may be deemed necessary after drilling is under way, depending on the results of the first holes drilled.

Depth of Holes

Drilling depths would range from about 50 to 400 feet deep. The average hole depth would be approximately 200 feet. Many holes would range from 150 to 275 feet, and would be collared in the Brushy Basin.

As only scattered fossil mineralized wood and small unimportant ore bodies have been found below the main ore zone, drill holes should be calculated according to the formula used by the previous drilling program (Stafford, 1950), "Depth equals collar elevation minus the elevation of the Entrada sandstone plus 245 feet." Subsurface elevations can be determined from the structure contour map (in AEC files) of the top of the Entrada. Collar elevations may be obtained from the photogrammetric sheets (Lockwood, Kessler, and Bartlett, Inc., original tracings) which are in AEC files. The above formula would allow the holes to bottom about 10 feet below the main ore zone.

Water Supply

Water is available from three Bureau of Land Management reservoirs and four small dams constructed by the AEC on Polar Mesa. The reservoirs are not a dependable water supply as they are usually full only after snow thaws or after heavy, infrequent rains. The only reliable water source is 8 miles from the AEC camp where the Fisher Valley irrigation ditch, which diverts water from the head of Beaver Creek, crosses the main access road south of Polar Mesa. Prior arrangements with the owners of the water rights of the Fisher Valley ditch would be necessary to obtain water from this source.

Accessibility

Main access roads exist on the mesa and connecting roads to drill sites should not be difficult or expensive to construct in area A. In other areas, road building will be expensive and difficult, probably even
to the point of precluding some recommended drilling. Stafford, in charge of the previous AEC drilling program has stated that "large tractors will be required for road building and that boulders 'as big as a house' are likely to be encountered." (Personal communication) Blasting will be required. Drilling would not be feasible during winter months as snow to a depth of 3 to 4 feet normally covers the mesa.
Emerson, John F., and Smith, Clay T., October 14, 1944, Field Survey of Polar Mesa Camp (West Gateway District), Green River Desert Area, Utah; Union Mines Development Corporation.


Reinhardt, E. V., February 14, 1951, Recommendation for Amount of Drilling Yet to be Done on Polar Mesa; USAEC memorandum to T. W. Oster, Chief, GJEB.

Stafford, H. S., December 6, 1950, Interim Report on Core Drilling on Polar Mesa, Green River Desert Area, Utah; USAEC (not distributed).
LEGEND

- Paved roads
- Improved roads
- Main rivers
- Cities & Leading towns

Fig 1
INDEX MAP
POLAR, MESA
Grand County, Utah