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Carnotite Resources of the Moon Mesa and Horse Mesa Areas, Mesa and Montrose Counties, Colorado

By J. H. Stewart

Trace Elements Investigations Report 165

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UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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March 1953

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R. J. Roberts, Salt Lake City	1
TEPCO, Washington:	
Resource Compilation Section	2
Reports Processing Section (Including master)	2
	52

CONTENTS

ILLUSTRATIONS

TABLES

TABLES--Continued

CARNOTITE RESOURCES OF THE MOON MESA AND HORSE MESA AREAS, MESA AND MONTROSE COUNTIES, COLORADO

By J. H. Stewart

ABSTRACT AND SUMMARY

The Moon Mesa and Horse Mesa areas, Mesa and Montrose Counties, Colo., comprise about 19 square miles in T. 49 N., R. 17 W., and the northern part of T. 48 N., R. 17 W., New Mexico principal meridian.

Production of carnotite ore has been entirely from the Moon Mesa area and has totaled about 300 short tons averaging an estimated 0.18 percent U_3O_8 and 1.76 percent V_2O_5. The ore was mined in 1943 and from 1948 through the early part of 1950. No mining has been done since 1950.

The carnotite deposits in the area are in discontinuous sandstone beds near the top of the Salt Wash member of the Jurassic Morrison formation. The deposits in the areas are small and low grade. Features typical of deposits in nearby areas, such as fossil trees and pod-like masses called "rolls", are either absent or poorly developed in the Moon Mesa and Horse Mesa areas. The deposits are either impregnations of sandstone by carnotite and a vanadium-bearing micaceous mineral or concentrations in carbonaceous material.

Three geologic features associated with ore deposits in the Moon Mesa and Horse Mesa areas and that served as guides in the areas are: (1) altered or gray mudstone, (2) light-brown or light-gray sandstone, and (3) sandstones at least 45 feet thick.

Between November 14, 1950, and March 19, 1952, the U. S. Geological Survey drilled 324 holes totaling 55,846 feet in the Moon Mesa and Horse

Mesa areas. As a result of this drilling, five carnotite deposits of ore grade were found.

The indicated and inferred reserves of carnotite-bearing material, and the pounds of contained U_3O_8 and V_2O_5 are summarized in table 1. At a thickness cutoff of 1 foot and a grade cutoff of 0.10 percent U_3O_8 or 1.0 percent V_2O_5, indicated and inferred reserves total about 870 short tons, averaging about 0.09 percent U_3O_8 and 1.3 percent V_2O_5. These reserves include only those in deposits found by Geological Survey drilling. Potential reserves whose existence is based on geologic evidence alone, are predicted to total about 12,500 short tons, averaging about 0.10 percent U_3O_8 and 1.0 percent V_2O_5.

The areas have been disappointing in their small content of carnotite deposits. The scattered, small, and low grade deposits indicate that the Uravan mineral belt is not characteristically developed in the areas.

No additional exploratory drilling in the Moon Mesa and Horse Mesa areas is planned by the Geological Survey. Further exploratory drilling is not warranted because only small, low-grade deposits can be expected in the areas. Jackhammer and wagon drilling by the claim owners is recommended in several parts of the area.

INTRODUCTION

This report appraises the carnotite resources of the Moon Mesa and Horse Mesa areas and summarizes information gained from U. S. Geological Survey diamond-drill exploration.

The explored ground is in Mesa and Montrose Counties, Colo. (fig. 1), and comprises about 19 square miles in T. 49 N., R. 17 W., and the northern part of T. 48 N., R. 17 W., New Mexico principal meridian. For convenience

Table 1.--Summary of reserves, Moon Mesa and Horse Mesa areas, Mesa and Montrose Counties, Colorado.

Thickness cutoff	Reserves	Grade cutoff	Short tons 1/	Percent		Pounds 2/	
				U_3O_8	V_2O_5	U_3O_8	V_2O_5
1 foot	Indicated	0.10% U_3O_8 or 1.0% V_2O_5	240	0.07	1.4	300	6,700
		0.05% U_3O_8 or 0.50% V_2O_5	730	0.05	1.2	700	17,500
	Inferred	0.10% U_3O_8 or 1.0% V_2O_5	630	0.10	1.3	1,300	20,300
		0.05% U_3O_8 or 0.50% V_2O_5	2,000	0.06	0.9	2,400	36,000

1/ Rounded to nearest 10 tons

2/ Rounded to nearest 100 pounds

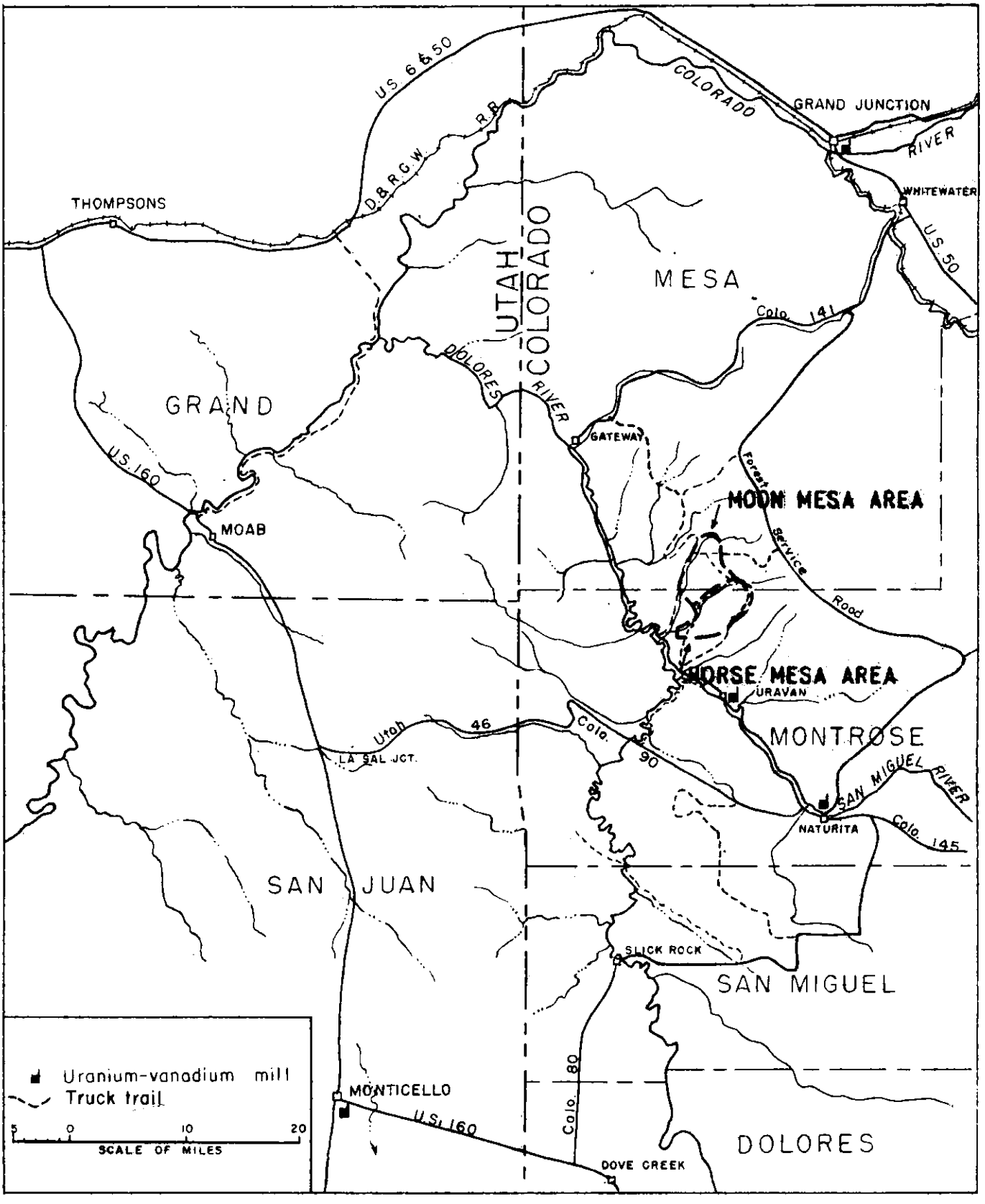

Figure 1.-- Index map of part of the Colorado Plateau showing the location of the Moon Mesa and Horse Mesa areas, Mesa and Montrose counties, Colorado

of drilling operation, the explored ground was arbitrarily divided into two areas--Moon Mesa area being northwest and Horse Mesa being southeast, respectively, of the South Fork of Mesa Creek (fig. 2). The areas are bordered on the north by Blue Mesa and on the south by Atkinson Mesa. Altitudes range from about 5,100 to 6,700 feet. The ground is covered with a sparse to thick growth of juniper, pinyon, and sagebrush. The only perennial stream, Mesa Creek, flows along the west side of the Moon Mesa area. Several other streams in the areas carry water after rainstorms or during the melt of snow in winter and spring.

The areas are dominantly public land but include about 20 privately owned mining claims and some patented agricultural land.

The Moon Mesa and Horse Mesa areas are accessible by a network of unimproved truck trails that connect with Colorado Highway 141 (fig. 1).

All production of carnotite ore was from the Black Jumbo and Black Jumbo No. 2 claims on the northern part of the Moon Mesa area. The ore was mined in 1943 and from 1948 through the early part of 1950. No mining has been done since 1950. The mining produced about 300 tons, with an estimated average grade of 0.18 percent U_3O_8 and 1.76 percent V_2O_5. (Tons in this report are short tons.) The period, source, and amount of this production are shown in table 2.

No diamond drilling had been done in the Moon Mesa and Horse Mesa areas before Geological Survey exploration started in November 1950. A few jackhammer holes had been drilled by claim owners near ore deposits in the northern part of the Moon Mesa area.

Table 2.--Production of carnotite ore from Black Jumbo and Black Jumbo No. 2 claims, Moon Mesa area, Mesa County, Colorado, 1943-50 a/

Year or Period	Ore (short tons)	Percent		Pounds	
		U_3O_8	V_2O_5	U_3O_8	V_2O_5
1943	28	0.27b/	2.66	56	1,484
1944-47	0	----	----	---	-----
1948	102	0.22	2.18	455	4,434
1949	155	0.13	1.31	395	4,076
1950	29	0.17	1.80	97	1,053
Totals and weighted averages	314	0.18	1.76	1,003	11,047

a/ Data for 1943 from files of U. S. Geological Survey, Grand Junction, Colo.; all other data from Grand Junction Operations Office, Production Division, Atomic Energy Commission, Grand Junction, Colo.

b/ Estimated

GEOLOGY

Sedimentary rocks of Morrison, Burro Canyon, and Dakota formations are exposed in the areas of drilling on Moon Mesa and Horse Mesa. The Morrison formation of Upper Jurassic age is composed of two members. The lower member, the Salt Wash sandstone, consists of sandstone and interbedded mudstone. The upper member, the Brushy Basin shale, consists mostly of mudstone but includes some interbedded sandstone. The overlying Burro Canyon formation of Lower Cretaceous age and Dakota formation of Upper Cretaceous age are composed of sandstone, conglomerates, and a minor amount of shale. The regional stratigraphy of these formations is given by Craig, et al. (1951).

The formations dip 3°-5° SW. on the northeast flank of a syncline whose axis crosses the extreme southwestern part of the Horse Mesa area.

All carnotite deposits mined to date and most of the known carnotite deposits occur in sandstone beds, called the "ore-bearing sandstone", in the upper part of the Salt Wash sandstone. Usually the ore-bearing sandstone contains only one bed but locally it contains two and possibly three distinct beds that are separated by mudstone beds. Individually these sandstone beds range from a knife-edge to 100 feet in thickness and average about 35 feet thick.

The ore-bearing sandstone in the Moon Mesa area generally is composed of two or possibly three thin discontinuous beds (section A-A', fig. 2), whereas the ore-bearing sandstone of the Horse Mesa area is generally composed of a single thick continuous bed (section B-B', fig. 2).

The ore-bearing sandstone is light brown or pale gray near ore deposits, whereas away from ore deposits it is reddish brown. It is dominantly

medium- to medium-fine grained, and generally cross-bedded or massive. Some thin to thick lenses of mudstone and irregular patches of mudstone pebble conglomerate are found in the sandstone beds. Carbonaceous material is distributed irregularly throughout the sandstone. This carbonaceous material consists of fossil tree trunks, branches, leaves, and finely divided particles as well as seams of coaly material.

The ore-bearing sandstone near the ore deposits in the extreme western part of the Moon Mesa area and in the western half of the Horse Mesa area rarely contains pyrite and no limonite, whereas elsewhere the ore-bearing sandstone near ore deposits contains limonite but no pyrite. This occurrence of pyrite and limonite is believed to be related to the degree of oxidation in the sandstone, as the limonite is considered to be the oxidation product of the pyrite as well as other ferrous minerals. Thus, the presence of pyrite in a sandstone suggests that oxidation was weak, whereas the presence of limonite suggests that oxidation was intense.

The pyrite-bearing sandstones are saturated by ground water. This association of ground water and pyrite is believed to be due to the protection that ground water provides against oxidation. The ground water probably does not contain enough oxygen to oxidize the pyrite to limonite.

The unoxidized sandstones that lie near ore deposits are pale gray. The oxidized sandstones that lie near ore deposits are discolored by limonite to a light brown. The limonite occurs as spots (1 to 2 mm in diameter) and as a general stain throughout a part or all of the sandstone. The reddish-brown sandstones which lie away from ore deposits either do not contain limonite or the limonite is masked by the color of the sandstone.

Interstitial mudstone and mudstone seams, pebbles, and flakes within the ore-bearing sandstone are dominantly red. Field relations suggest that

this was their original color. Near ore deposits, however, this mudstone has been altered partly or entirely to gray. This alteration of color apparently was caused by the mineral-bearing solutions that formed the deposits, or by other solutions that followed the same channels as the mineral solutions, because the alteration is most intense around ore deposits. Away from deposits the red interstitial mudstone colors the sandstone a reddish brown, whereas near deposits the altered mudstone contributes to a pale gray or light brown color.

In other carnotite-producing areas of southwestern Colorado, the mudstone directly below the ore-bearing sandstone is altered to gray near ore deposits. In the Moon Mesa area this alteration is so rare and poorly defined that a relationship to the deposits was not determined. As this alteration of color is believed to be formed by mineral-bearing solutions or other solutions that followed the same channels, the lack of extensive alteration suggests that solutions did not have easy access to the sandstone. Without easy access the solutions would be expected either not to form deposits or to form only small and low grade deposits like those known in the areas. In the Horse Mesa area, however, this alteration of the mudstone directly below the ore-bearing sandstone is as prominent as that associated with large deposits in other areas of southwestern Colorado. The deposits, however, are as small and low grade as those on Moon Mesa. Perhaps the extensive alteration in the Horse Mesa area is best explained by the presence of continuous beds that would facilitate the movement of solutions, in contrast to the small amount of alteration in the Moon Mesa area, where the discontinuous beds probably hindered the passage of solutions through the ore-bearing sandstone. The absence of large ore deposits in the Horse Mesa area, however, cannot be satisfactorily explained.

The carnotite deposits in the Moon Mesa and Horse Mesa areas usually are found in sandstone beds that are at least 45 feet thick. These thick beds are probably the parts most easily accessible to solutions, and thus they might be expected to contain most of the deposits.

ORE DEPOSITS

The ore consists mainly of sandstone impregnated with uranium- and vanadium-bearing minerals. Rich concentrations of ore minerals in fossil plant remains are rare in the Moon Mesa and Horse Mesa areas, whereas they are common in other parts of southwestern Colorado. Weak concentrations of uranium and vanadium are common in carbonaceous material and in mudstones.

Carnotite, $K_2(UO_2)_2(VO_4)_2 \cdot 3H_2O$, is the principal uranium-bearing mineral in ore deposits in the oxidized sandstone. It occurs disseminated in the sandstone. The principal vanadium-bearing mineral is a finely divided micaceous clay mineral which occurs as an aggregate of minute flakes coating the sand grains.

Uranium- and vanadium-bearing carbonaceous material is the principal part of the ore deposits in the unoxidized sandstone. The minerals in this carbonaceous material are not identified but are probably considerably different from those in the oxidized sandstone.

The deposits occur in small irregular tabular or lens-shaped masses. In detail, the tabular masses lie nearly parallel to the sandstone bedding. The ore generally is found in thinly bedded sandstones, whereas, in other areas of southwestern Colorado the ore is found in cross-bedded or massive sandstones. "Rolls", which are thicker parts of tabular layers that form pod-like or elongate crescent-shaped masses, are very poorly developed on Moon Mesa and Horse Mesa as compared to roll occurrences in other parts of

southwestern Colorado. Fossil trees are rare. Too few rolls and fossil trees are found in the deposits to determine if these features have a predominant direction. The only lineation noted is a rough east-west grouping of deposits in the northern part of Moon Mesa.

The ore deposits in the Moon Mesa and Horse Mesa areas are small and low grade in comparison with other carnotite producing areas of southwestern Colorado.

A detailed discussion of the geology and character of the carnotite deposits of southwestern Colorado and adjoining states is given by Fischer (1942).

GUIDES TO ORE AND FAVORABLENESS OF GROUND FOR CONTAINING DEPOSITS

Three geologic features are associated with ore deposits in the Moon Mesa and Horse Mesa areas. These features offer a larger target for drilling than do the deposits themselves, and thus are useful as guides to ore. These features are subtle and should be evaluated together in appraising the ground being prospected, as no single one is sufficiently well defined to be used alone. These features are listed below in their order of usefulness:

1. Interstitial mudstone and mudstone seams, pebbles, and flakes within the ore-bearing sandstone have been altered from red to gray in the vicinity of ore deposits. The amount of altered mudstone generally decreases outward from the deposits.

2. The sandstone in the vicinity of deposits is dominantly light brown or pale gray, with little of the reddish cast that is common a few hundred feet away from deposits.

3. The sandstone in the vicinity of deposits generally is at least 45 feet thick. Away from deposits it generally is thinner.

A discussion of the guides used in other parts of southwestern Colorado is given by Weir (1952). Two guides listed by Weir as useful in other areas of southwestern Colorado did not prove to be useful in the Moon Mesa and Horse Mesa areas. One of these is the alteration of the uppermost few feet of mudstone beneath the ore-bearing sandstone near ore deposits. This alteration in the Moon Mesa area was so rare that it could not be shown to be related to the ore deposits. In the Horse Mesa area the alteration was extensive but did not seem to be altogether associated with the deposits. The second guide useful in other areas of southwestern Colorado but not in the Moon Mesa and Horse Mesa areas is an abundance of carbonaceous material near ore deposits. In the Moon Mesa and Horse Mesa areas the carbonaceous material is equally abundant near and away from deposits.

Parts of the Moon Mesa and Horse Mesa areas are considered unfavorable and parts semifavorable for containing deposits. This appraisal was based on a comparison of geologic features such as the thickness, color, and continuity of the ore-bearing sandstone and the amount of altered mudstone below the ore-bearing sandstone in the Moon Mesa and Horse Mesa areas with that in other carnotite producing areas of southwestern Colorado. Where geologic features similar to those in the Moon Mesa and Horse Mesa areas were found in other areas of southwestern Colorado, such as parts of Outlaw Mesa and Blue Mesa, the deposits were small and low-grade, indicating unfavorable and semifavorable ground. Thus, by analogy, the Moon Mesa and Horse Mesa areas are considered unfavorable and semifavorable.

This appraisal was tested by moderate-spaced drilling--holes spaced from 200 to 500 feet apart--in the parts of the areas most likely to contain deposits. The small, low-grade deposits found by this drilling substantiates the appraisal.

GEOLOGICAL SURVEY EXPLORATION

In the Moon Mesa area the Geological Survey began diamond-drill exploration on November 14, 1950, and continued through December 3, 1950, when drilling was recessed for the winter. Exploration was resumed on April 2, 1951, and completed, after one short recess, on February 8, 1952. In the Horse Mesa area drilling started on May 19, 1951, and was completed, after one short recess, on March 19, 1952. The drilling was done on parts of four separate contracts: (1) November 14, 1950, to December 3, 1950 (Finch, 1951); (2) April 2, 1951, to November 5, 1951; (3) November 3, 1951, to January 26, 1952, (Stewart, 1952); and (4) January 16, 1952, to March 19, 1952.

Drilling was planned principally to test the favorableness of the ore-bearing sandstone between Atkinson Mesa and Blue Mesa lying within the projected boundaries of the Uravan mineral belt (Fischer and Hilpert, 1952). To test the ground most economically the drilling was limited to parts of the area where the ore-bearing sandstone lies within 450 feet of the surface and where the surface topography provided easiest access for drill rigs. Within these limitations the holes were spaced either on a 1,000-foot grid or with lines of holes parallel to the projected boundaries of the Uravan mineral belt. The holes along the lines were spaced 1,000 to 2,000 feet apart. This wide-spaced drilling used about 40 percent of the total footage. In the most favorable ground discovered by the wide-spaced drilling, moderate-spaced drilling was done to search for deposits. This moderate-spaced drilling required about 45 percent of the total footage. About 15 percent was used to outline, approximately, the deposits found by the wide- and moderate-spaced drilling.

About 20 percent of the footage and about 25 percent of the holes drilled in the Moon Mesa and Horse Mesa areas are on private claims or patented agricultural land. The remaining footage and holes were drilled on public land.

Mineralized rock was penetrated by 47 of the 324 holes drilled. Of these 47 holes, 5 are in ore (material 1 foot or more thick containing 0.10 percent or more U_3O_8 or 1.0 percent or more V_2O_5, based on chemical assay and gamma-ray data). The holes in ore are in five separate deposits, which are small and low-grade. Besides these deposits, 22 other deposits were discovered that do not meet the grade and thickness cutoffs for ore, but 2 of these contain material that qualifies as a reserve at the lower grade cutoff of 0.05 percent or more U_3O_8 or 0.50 percent or more V_2O_5. The remainder of the deposits are too thin or low grade to qualify in the standardized reserve calculations of the Geological Survey.

The drilling indicates that the Uravan mineral belt (Fischer and Hilpert, 1952) is not characteristically developed in the Moon Mesa and Horse Mesa areas, and can not be delimited from adjoining ground on either side of the belt. In these areas the deposits do not have the spacing, size, or grade that is generally characteristic of the belt. The deposits in the Moon Mesa and Horse Mesa areas have a spacing, size, and grade similar to those located in ground outside the belt, and near to where the belt is well developed, such as in parts of the Outlaw Mesa area.

RESERVES

The terms "indicated" and "inferred" reserves are applied to the uranium- and vanadium-bearing material in the deposits that are known from exposures in the natural outcrops, mine workings, or drill holes. These

reserves are subdivided by thickness and grade cutoffs, and the method used in calculating them is explained below.

In addition to the known deposits, other deposits are probably present which have not yet been found. These deposits are predicted solely on interpretation of geologic evidence. The term "potential" reserves is applied to the material in these deposits. Potential reserves are described on page 26.

Although reserves are not classified in this report according to their availability for mining, consideration was given to the 1952 mining and milling practices in selecting the higher grade and thickness cutoffs. This was done to obtain figures for a category of reserves that would express as nearly as possible the tonnage and grade of the material that might actually be mined from these deposits under 1952 conditions. A summary of indicated and inferred reserves in this category, and in a lower-grade category, is given in table 1. More detailed figures expressing the calculated tonnage and grade of the indicated and inferred reserves for each reserve unit, or block, and for each grade cutoff, are given in tables 3 and 4. The ground containing reserve blocks 1, 2, 3, and 4, which contain indicated and inferred reserves, and several geologic sections showing the position of the mineralized rock in the ground is shown on figure 3. The ground containing the reserve blocks 5, 6, and 7, which contain only inferred reserves, is shown in figure 2.

Indicated and inferred reserves

Definitions

Known reserves are classed as indicated and inferred. Owing to the erratic variations in thickness and grade of carnotite ore within short

Table 3.—Indicated and inferred reserves of the Moon Mesa area, Mesa County, Colorado.
(Based on U. S. Geological Survey exploration, 1950-52.)

Block No.	Location	Indicated						Inferred					
		1 foot or more thick						1 foot or more thick					
		Grade cutoff 0.10% U_3O_8 or 1.0% V_2O_5			Grade cutoff 0.05% U_3O_8 or 0.50% V_2O_5			Grade cutoff 0.10% U_3O_8 or 1.0% V_2O_5			Grade Cutoff 0.05% U_3O_8 or 0.50% V_2O_5		
		Short tons 1/	Percent U_3O_8	Percent V_2O_5	Short tons 1/	Percent U_3O_8	Percent V_2O_5	Short tons 1/	Percent U_3O_8	Percent V_2O_5	Short tons 1/	Percent U_3O_8	Percent V_2O_5
1	Veto No. 27 claim	40 2/	0.15	1.2	180 2/	0.07	1.2	100 2/	0.15	1.2	250 2/	0.07	1.2
2	Veto Nos. 27 and 105 claims	70	<0.02	1.7	270	<0.02	1.1	180	<0.02	1.7	480	<0.02	1.1
3	Nava claim	90	0.07	1.4	240	0.07	1.4	90	0.07	1.4	530	0.05	1.3
4	Public land	40 2/	0.08	1.0	40 2/	0.08	1.0	110 2/	0.08	1.0	110 2/	0.08	1.0
Totals and weighted averages		240	0.07	1.4	730	0.05	1.2	480	0.07	1.4	1,370	0.04	1.2

1/ Rounded to nearest 10 tons
2/ Lime assay greater than 6%
< Less than

Table 4.—Inferred reserves [1/] of the Horse Mesa area, Mesa and Montrose Counties, Colorado. (Based on U. S. Geological Survey exploration 1951-52.)

Block No.	Location	1 foot or more thick					
		Grade cutoff 0.10% U_3O_8 or 1.0% V_2O_5			Grade cutoff 0.05% U_3O_8 or 0.50% V_2O_5		
		Short tons [2/]	Percent U_3O_8	Percent V_2O_5	Short tons [2/]	Percent U_3O_8	Percent V_2O_5
5	Patented agricultural land	0	—	—	240	0.07	0.3
6	Patented agricultural land	150	0.19	0.8	150	0.19	0.8
7	Public land	0	—	—	240	0.08	0.3
Totals and weighted averages		150	0.19	0.8	630	0.10	0.4

1/ As each reserve block contains only one drill hole, no indicated reserves were calculated (see page 22).

2/ Rounded to nearest 10 tons

distances, and the general lack of abundant sample data for individual reserve blocks, the amount of reserves that can be calculated within a small limit of error, and thus be classed as "measured", is so small as to be nearly negligible. Therefore, reserves that might be classed as measured are included with indicated reserves.

Indicated reserves / are those for which the grade is computed from

/ The definitions used here for indicated and inferred reserves are abstracted from the definitions adopted by the Bureau of Mines and the Geological Survey in April 1943.

drill-hole samples, exposures in mine workings and natural outcrops, gamma-ray logs, and production data, and for which the tonnage is computed by projections for a reasonable distance on geologic evidence from points of exposure (drill holes, mine workings, and natural outcrops). Inferred reserves are those for which quantitative estimates are based largely on broad knowledge of the geologic character of the deposits and for which there are few, if any, samples or measurements.

Because of the variation in thickness and grade of ore and the scarcity of sample data, the indicated reserves in any single reserve block might actually amount to as much as twice or a little as half the calculated tonnage. For this reason indicated reserves are not computed for single holes in ore-grade material that have not been offset or cannot be connected with known deposits or mine workings. The limit of error in the tonnage figures for inferred reserves, of course, is apt to be higher than for indicated reserves. The possible limit of error in the calculated or estimated grade for both indicated and inferred reserves probably is somewhat smaller than the possible limit of error in the tonnage figures.

Thickness cutoff

Although mining practices vary from place to place in the region as well as with individual operators, under 1952 mining conditions most ore bodies of average grade are being mined to where they pinch to a layer about 1 foot thick. Layers of material less than 1 foot thick are mined in places if the grade is high. The tonnage of minable material less than 1 foot thick is small with respect to the total reserves and for that reason reserves less than 1 foot thick are not calculated.

Grade cutoffs

The deposits contain two metals of economic importance, uranium and vanadium. The oxides of these metals, U_3O_8 and V_2O_5, occur in an average ratio of about 1:16 in the Moon Mesa and 1:4 in the Horse Mesa area as determined from assays of the Geological Survey drill core in the areas. The ratios are based on a small number of samples and should not be expected, therefore, to be in close agreement with later more complete information. The different ratios in the two areas, however, probably express, in part, a geographic difference and, in part, a mineralogic difference. The mineralized material in the Moon Mesa area is composed of carnotite and a micaceous vanadium-bearing clay mineral. In the Horse Mesa area the mineralized material is of unknown mineralogy and probably confined to carbonaceous material. This mineralogical difference might be expected to cause at least a part of the difference in the ratios. The ratio from production data in the Moon Mesa area is 1:10 whereas the assays of the Geological Survey drill core from the same area give a ratio of 1:16. The difference in these two ratios is probably caused by the mining

practices used in the area of selectively mining the higher grade uranium and vanadium ores. This material gives a lower ratio than the lower grade material calculated at the higher grade cutoff (See below.) used by the Geological Survey.

Within the deposits the two metals are so erratically distributed that a single sample, such as that obtained from a drill hole, is not necessarily representative of the metal ratio or grade of the material near the point sampled. Knowing this by experience, the miner will drive toward a drill hole that shows a good value in vanadium, even though the uranium content of the sample might be negligible. Thus the material in the vicinity of this sample must be classed as a reserve, even though the sample shows a value for only one metal. Furthermore, with the 1951 price schedules (Atomic Energy Commission, 1951) for ore, the vanadium content of ore containing the Moon Mesa metal ratio (1:16) constitutes about two-thirds of the market value of the ore. The vanadium content of the ore containing the Horse Mesa ratio (1:4) constitutes about one-fourth of the market value of the ore. Thus both metals must be considered in reserve appraisals and in selecting grade cutoffs.

Reserves 1 foot or more thick are classified by two grade cutoffs. The higher cutoff--0.10 percent U_3O_8 or 1.0 percent V_2O_5--corresponds to the Atomic Energy Commission purchase cutoff for uranium and the commonly used mill cutoff for vanadium. Reserves are figured also on a lower cutoff--0.05 percent U_3O_8 or 0.50 percent V_2O_5--on the possibility that conditions in the future might demand or permit the mills to accept lower-grade ore.

Calculation of tonnage

The methods used for calculating the volume, and hence the tonnage, of a reserve unit 1 foot or more thick is based upon the premise that the reserve unit is a uniformly tapered mass. The average thickness of the drill-hole samples that can be combined within the specified grade class is assumed to be the average thickness of the reserve unit.

By definition, the tonnage of the indicated reserves "... is computed by projection for a reasonable distance on geologic evidence." In some places in the Moon Mesa area, indicated reserves are projected where correlation of samples is good between drill holes that are not more than 50 feet apart. On the other hand, indicated reserves are not projected more than 13 feet beyond sample point, where the edge of the deposit has not been located or where correlation of data between sample points is lacking. Reserves are classed as inferred rather than indicated if the projection exceeds these lengths. Inferred reserves are projected to the assumed limits of the deposits, as determined by geologic evidence and interpretation.

A constant of 14 cubic feet per ton is used to calculate tonnage.

Calculation of grade

The average grade of the indicated reserves is calculated by weighting the assay values of all samples that qualify as reserves within the grade and thickness limits. As strict grade cutoffs are used, it is generally expected that the average grade assigned to the reserve blocks will be somewhat higher than the average grade of the ore that will be eventually mined from them, owing to the unavoidable dilution of the ore with waste

and low-grade material during mining. On the other hand, the tonnage assigned to these blocks should be somewhat lower than the tonnage mined from them, owing to increment of waste and low-grade material.

Whenever a discrepancy was found between a uranium assay for a sample interval and the percentage of equivalent uranium, as shown by the gamma-ray log, an attempt was made to adjust this difference by using the average grade of the deposit, as based on other drill-core assays and/or production figures.

Reserve blocks

Masses or units of mineralized rock that constitute an indicated or inferred reserve, as defined by the thickness and grade cutoffs, are called reserve blocks. The geometric limits of reserve blocks are determined by the rules used in calculating reserves. (See above.) The exact position of the blocks are not shown on figures 2 and 3, though the carnotite-bearing ground that contains the blocks is designated by block numbers. Where mineralized layers overlap, even though they contain two or more masses of reserves, a single block number is assigned, and the total tonnage of these masses, as well as their weighted grade, is shown on tables 3 and 4.

Potential reserves

Potential reserves include the material in deposits that have not yet been found, but which are predicted solely on geologic evidence. Thus, deposits are expected in the semifavorable ground in the Moon Mesa and Horse Mesa areas. In any particular patch of semifavorable ground,

potential reserves were estimated by a consideration of the size and grade of known deposits in relation to the spacing of the holes and to the extent of the outcrop of the ore-bearing sandstone. For an equal area and spacing of holes, a higher reserve was calculated for the semifavorable ground that had a higher number of holes in mineralized material or a larger amount of mineralized outcrop. Thus, a higher potential reserve was calculated for the semifavorable ground on the northern part of the Moon Mesa area and in the extreme southwestern part of the Horse Mesa area than for an equal area in the larger section of semifavorable ground that is crossed by the South Fork of the Mesa Creek. In addition to the reserves in the semifavorable ground, a much smaller potential reserve is expected in the unfavorable ground.

A potential reserve of 12,500 tons of material 1 foot or more thick and averaging 0.10 percent U_3O_8 and 1.0 percent V_2O_5 is predicted to be in the semifavorable and unfavorable ground in the Moon Mesa and Horse Mesa areas. This reserve is calculated for only the explored ground, for which a classification of favorableness was determined (fig. 2). The ground lying within the Atkinson Mesa area in the southeastern part of figure 2 has been explored by drilling of the Atkinson Mesa project, and reserves for this ground will be given in another report. The deposits of the potential reserves are expected to be scattered and to average about 50 tons each.

PLANS AND RECOMMENDATIONS

Diamond-drill exploration by the Geological Survey in the Moon Mesa and Horse Mesa areas indicates that only deposits comparable in size and grade to the known ones can be expected. The known deposits are scattered,

small, and low-grade. For this reason, no additional exploratory drilling is planned in the area by the Geological Survey.

Drilling by claim operators can best be used to develop the known ore deposits and to search for other deposits in the immediate vicinity of known deposits. Thus, some drilling should be done near deposits in the semifavorable ground that partly contains the Black Jumbo claims, and also in the semifavorable ground that contains blocks 1, 2, and 3. Offset holes should be drilled around holes that cut mineralized material, on the chance that minable ore deposits may be present. Extensions of the known deposits should be defined by additional close-spaced drilling. As the depth to the ore in these areas is 60 feet or less, the ground can be explored best by jackhammer and wagon drilling.

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Table 5.--Assay data, Moon Mesa area, Mesa County, Colorado

Geological Survey exploration 1950-52. Assays by the Geological Survey 1950-52. Samples in sandstone unless otherwise noted.

Assay data listed under "block" (i.e. Block 1) are within the blocks of calculated reserves.

Assay data listed under "other holes" are within areas from which no reserves were calculated because the samples recovered were too thin or too weakly mineralized to qualify for the selected grade and thickness cutoffs.

Gamma-ray data obtained by probing drill holes with a radiometric logging unit. Radioactivity expressed as percent equivalent U_3O_8. Values less than 0.020% eU_3O_8 are omitted from this table.

Rock units containing less than 0.020% U_3O_8, less than 0.020% eU_3O_8, and less than 0.10% V_2O_5, as determined by assay of drill core, are considered to be barren. Barren holes and rock units are omitted from this table.

Most collar elevations obtained by plane-table survey methods; others by less accurate methods shown with asterisk.

$<$ Less than

e Equivalent

a Most of sample or gamma-ray activity in mudstone

b No mineralized sample, or sample deficient, probably because of incomplete core recovery

c Sample or gamma-ray activity in the Brushy Basin shale member of the Morrison formation

d Gamma-ray activity above the cored zone

Table 5.—Assay data, Moon Mesa area, Mesa County, Colorado—(Continued)

Hole No. and collar elev. (feet)	Assay data: Depth in feet From	To	Thickness (feet)	Percent U_3O_8	Percent V_2O_5	Percent $CaCO_3$	Gamma-ray data: Percent eU_3O_8	Depth in feet From	To	Thickness (feet)
Block 1, Veto No. 27 claim										
9 (6137)	52.70	53.00	0.30	0.021	0.59	10.3				
	53.00	53.40	0.40	0.039	2.71	3.1	0.13	52.8	53.7	0.9
	53.40	53.80	0.40	0.052	1.04	9.9				
	53.80	54.80	1.00 a/	<0.020	0.34	5.5				
15 (6141)	No assay b/						0.044	55.1	56.3	1.2
16 (6133)	54.10	54.70	0.60	0.021	0.72	5.1	0.14	53.8	55.5	1.7
	54.70	55.70	1.00	0.15	1.18	9.0				
	55.70	56.05	0.35	0.044	0.37	12.2				
	56.60	56.80	0.20	0.034e	0.44	Undet				
18 (6139)	50.80	51.30	0.50	0.073	1.57	3.2	0.18	50.0	50.8	0.8
	51.30	52.70	1.40	<0.020e	0.26	Undet				
98 (6148)	55.85	56.45	0.60	0.031e	0.11	Undet	<0.023	55.8	56.7	0.9
100 (6144)	No assay a/ b/						0.073	42.7	43.6	0.9
	51.60	51.80	0.20	<0.020e	0.68	4.7				

Table 5.—Assay data, Moon Mesa area, Mesa County, Colorado—(Continued)

Hole No. and collar elev. (feet)	Assay data: Depth in feet From	To	Thickness (feet)	Percent U_3O_8	V_2O_5	$CaCO_3$	Gamma-ray data: Percent eU_3O_8	Depth in feet From	To	Thickness (feet)
101 (6128)	25.60	25.80	0.20	<0.020e	0.20	Undet				
	26.80	27.20	0.40	<0.020e	0.16	Undet				
	27.90	28.20	0.30	<0.020e	0.29	Undet				
	No assay b/						0.036	35.5	36.4	0.9
102 (6133)	56.60	58.00	1.40	<0.020e	0.29	Undet	0.039	58.2	59.0	0.8
104 (6137)	No assay b/						0.16	33.7	34.6	0.9
	No assay b/						0.025	34.6	36.0	1.4
	No assay b/						0.082	36.0	36.8	0.8
	No assay b/						0.12	38.9	39.5	0.6
	No assay b/						0.033	54.0	55.4	1.4
Block 2, Veto No. 27 and Veto No. 105 claims										
95 (6156)	48.80	49.60	0.80	<0.020e	2.59	0.1	0.029	46.9	49.0	2.1
	49.60	50.10	0.50	<0.020e	0.76	0.1	0.022	49.0	50.2	1.2
	50.10	50.60	0.50	<0.020e	1.05	0.5				
	50.60	51.10	0.50	<0.020e	0.42	Undet				
121 (6159)	40.00	40.40	0.40	<0.020e	1.59	0.1				
	41.30	41.80	0.50	<0.020e	1.61	0.1	0.035	41.3	42.2	0.9
	45.40	46.70	1.30	<0.020e	0.76	0.3				

Table 5.--Assay data, Moon Mesa area, Mesa County, Colorado--(Continued)

Hole No. and collar elev. (feet)	Assay data: Depth in feet From	To	Thickness (feet)	Percent U_3O_8	V_2O_5	$CaCO_3$	Gamma-ray data: Percent eU_3O_8	Depth in feet From	To	Thickness (feet)
122 (6158)	43.40	44.00	0.70	<0.020e	1.35	0.1				
123 (6155)	49.40	50.10	0.70	<0.020e	0.40	4.3	0.028	49.8	51.6	1.8
Block 3, Nava claim										
33 (6052)	48.50	48.80	0.30	<0.020e	0.42	Undet				
	48.80	49.30	0.50	0.15	2.55	0.4	0.16	48.1	49.5	1.4
	49.30	50.45	1.15	0.060	1.02	1.4				
	50.45	51.10	0.65	<0.020e	1.19	2.1				
89 (6050)	No assay b/						0.059	49.5	50.5	1.0
91 (6049)	No assay b/						0.40	44.4	45.4	1.0
	No assay b/						0.28	45.4	45.8	0.4
	48.60	49.20	0.60	0.039	1.69	2.2	0.33	45.8	46.7	0.9
	49.20	49.50	0.30	0.021e	0.50	3.4	0.023	46.7	49.7	3.0
125 (6048)	50.10	50.60	0.50	0.085	0.65	0.5	0.13	49.3	50.2	0.9
	52.80	53.90	1.10	0.023e	0.12	Undet	0.044	51.9	52.7	0.8

Table 5.--Assay data, Moon Mesa area, Mesa County, Colorado--(Continued)

Hole No. and collar elev. (feet)	Assay data: Depth in feet From	To	Thickness (feet)	Percent U_3O_8	Percent V_2O_5	Percent $CaCO_3$	Gamma-ray data: Percent eU_3O_8	Depth in feet From	To	Thickness (feet)
126 (6046)	No assay b/						0.25	42.8	44.1	1.3
	45.70	46.70	1.00	0.021e	0.38	Undet	0.095	44.1	45.0	0.9
	47.10	47.40	0.30	<0.020e	0.18	Undet				
	47.90	48.30	0.40	<0.020e	0.19	Undet				
129 (6052)	No assay b/						0.030	52.0	52.8	0.8
136 (6047)	No assay b/						0.020	50.9	52.4	1.5
	No assay b/						0.087	52.4	53.3	0.9
Block 4, Public land										
72 (5955)*	102.30	103.40	1.10	0.080	1.01	25.2	0.031	100.5	102.5	2.0
173 (5960)*	No assay b/						0.025	95.6	97.0	1.4
174 (5950)*	92.70	93.40	0.70	<0.020	0.66	3.5				
Other holes, Public land										
77 (5930)*	150.70	151.50	0.80	0.034e	1.33	1.3	Not probed			
	151.75	152.50	0.75	0.041	0.27	Undet				

Table 5.—Assay data, Moon Mesa area, Mesa County, Colorado—(Continued)

Hole No. and collar elev. (feet)	Assay data						Gamma-ray data			
	Depth in feet		Thickness (feet)	Percent			Percent eU_3O_8	Depth in feet		Thickness (feet)
	From	To		U_3O_8	V_2O_5	$CaCO_3$		From	To	
156 (5735)*	No assay c/ d/						0.056	12.4	13.8	1.4
157A (5710)*	218.80	218.90	0.10	<0.020e	0.35	Undet				
160 (5770)*	195.95	196.50	0.55	0.028	0.11	12.0	0.075	197.7	199.2	1.5
	196.50	196.90	0.40	0.16	<0.1	11.5				

Table 6.--Assay data, Horse Mesa area, Mesa and Montrose Counties, Colorado

Geological Survey exploration 1950-52. Assays by the Geological Survey 1950-52. Samples in sandstone unless otherwise noted.

Assay data listed under "block" (i.e. Block 1) are within the blocks of calculated reserves.

Assay data listed under "other holes" are within areas from which no reserves were calculated because the samples recovered were too thin or too weakly mineralized to qualify for the selected grade and thickness cutoffs.

Gamma-ray data obtained by probing drill holes with a radiometric logging unit. Radioactivity expressed as percent equivalent U_3O_8. Values less than 0.020% eU_3O_8 are omitted from this table.

Rock units containing less than 0.020% U_3O_8, less than 0.020% eU_3O_8, and less than 0.10% V_2O_5, as determined by assay of drill core, are considered to be barren. Barren holes and rock units are omitted from this table.

Most collar elevations obtained by plane-table survey methods; others by less accurate methods shown with asterisk.

< Less than

e Equivalent

a No mineralized sample, or sample deficient, probably because of incomplete core recovery

b Most of sample or gamma-ray activity in mudstone

c Sample or gamma-ray activity located in the Brushy Basin shale member of the Morrison formation

Table 6.--Assay data, Horse Mesa area, Mesa and Montrose Counties, Colorado--(Continued)

Hole No. and collar elev. (feet)	Assay data: Depth in feet From	To	Thickness (feet)	Percent U_3O_8	Percent V_2O_5	Percent $CaCO_3$	Gamma-ray data: Percent eU_3O_8	Depth in feet From	To	Thickness (feet)
Block 5, Patented agricultural land										
137 (5235)*	242.80	243.15	0.35	0.020e	<0.1	Undet	0.071	242.6	244.5	1.9
	243.15	244.00	0.85	0.081	<0.1	3.4				
	244.00	244.60	0.60	0.033	0.24	1.2				
	244.60	244.85	0.25	0.12	0.42	1.6				
	244.85	245.10	0.25	<0.020e	0.31	Undet				
	255.30	255.90	0.60 a/	0.057	0.42	1.1	0.049	252.8	253.5	0.7
	255.90	256.10	0.20 a/	0.063	2.16	0.3	0.19	253.5	254.6	1.1
	256.35	256.60	0.25	0.028e	0.17	Undet				
							0.075	258.7	259.8	1.1
	260.00	260.25	0.25 a/	0.043	0.11	1.3	0.16	259.8	261.3	1.5
	260.25	260.50	0.25 a/	0.022e	0.15	Undet				
	260.50	260.75	0.25 a/	0.043	0.13	2.2				
	260.75	261.00	0.25 a/	0.068	0.15	2.4				
	261.00	261.25	0.25 a/	0.10	0.20	1.4				
	261.25	261.50	0.25 a/	0.084	0.18	1.2				
	261.50	261.75	0.25 a/	0.023e	0.10	Undet				
	No assay a/						0.027	293.7	294.4	0.7
Block 6, Patented agricultural land										
142 (5200)*	230.40	231.50	1.10	0.19	0.40	2.1	0.40	230.6	231.6	1.0
	231.50	231.75	0.25	0.023e	0.15	Undet				
	233.25	233.50	0.25	0.033	0.29	1.4				

Table 6.—Assay data, Horse Mesa area, Mesa and Montrose Counties, Colorado—(Continued)

Hole No. and collar elev. (feet)	Assay data: Depth in feet From	To	Thickness (feet)	Percent U_3O_8	V_2O_5	$CaCO_3$	Gamma-ray data: Percent eU_3O_8	Depth in feet From	To	Thickness (feet)
Block 7, Public land										
59 (5280)*	No assay a/ c/						0.031	130.9	131.8	0.9
	No assay a/ c/						0.020	131.8	132.8	1.0
	No assay a/ c/						0.026	132.8	134.1	1.3
							0.035	134.7	135.6	0.9
	137.35	137.70	0.35 c/	0.035	<0.1	0.3	0.053	135.6	136.7	1.1
	138.20	138.85	0.65 c/	0.024e	<0.1	Undet	0.030	136.7	138.8	2.1
							0.050	138.8	141.2	2.4
	139.85	141.10	1.25 c/	0.029e	0.12	Undet	0.13	141.2	142.4	1.2
	141.10	142.20	1.10 c/	0.026e	<0.1	Undet	0.039	142.4	142.7	0.3
	142.20	143.70	1.50 c/	0.07	<0.1	0.3	0.16	142.7	143.5	0.8
	143.70	143.90	0.20 c/	0.17	<0.1	1.2	0.046	143.5	144.6	1.1
	143.90	144.60	0.70 c/	0.046	<0.1	1.7				
	145.80	146.10	0.30 c/	0.051	<0.1	20.8				
	No assay a/						0.025	260.5	261.5	1.0
Other holes, Patented agricultural land										
57 (5230)*	No assay a/ b/ c/						0.027	118.0	118.7	0.7

Table 6.—Assay data, Horse Mesa area, Mesa and Montrose Counties, Colorado--(Continued)

Hole No. and collar elev. (feet)	Assay data: Depth in feet From	To	Thickness (feet)	Percent U_3O_8	Percent V_2O_5	Percent $CaCO_3$	Gamma-ray data: Percent eU_3O_8	Depth in feet From	To	Thickness (feet)
Other holes, Patented agricultural land										
58 (5240)*	No assay a/ b/ c/						0.050	181.6	182.6	1.0
	No assay a/ b/ c/						0.025	182.6	182.9	0.3
	No assay a/ b/ c/						0.034	182.9	187.5	4.6
	No assay a/ b/ c/						0.024	187.5	189.2	1.7
	No assay a/ b/ c/						0.027	189.2	192.8	3.6
	No assay a/ c/						0.020	193.7	195.3	1.6
	No assay a/ c/						0.025	195.3	196.9	1.6
	No assay a/ b/ c/						0.021	201.9	203.3	1.4
	No assay a/						0.025	203.3	205.3	2.0
	No assay a/						0.027	206.0	207.0	1.0
73 (5300)*	285.70	285.90	0.20	0.27	<0.1	0.25	0.052	287.7	288.8	1.1
	287.10	287.35	0.25	0.027e	<0.1	Undet	0.030	288.8	290.8	2.0
	288.10	288.35	0.25	0.028e	<0.1	Undet				
135 (5190)*	227.70	227.90	0.20	0.035	0.20	7.5				
	227.90	228.10	0.20 b/	3.70	2.18	0.5	0.085	226.7	227.5	0.8
	228.10	228.35	0.25	0.025e	<0.1	Undet				
136 (5200)*	No assay a/						0.046	244.4	245.2	0.8

Table 6.--Assay data, Horse Mesa area, Mesa and Montrose Counties, Colorado--(Continued)

Hole No. and collar elev. (feet)	Assay data: Depth in feet From	To	Thickness (feet)	Percent U_3O_8	Percent V_2O_5	Percent $CaCO_3$	Gamma-ray data: Percent eU_3O_8	Depth in feet From	To	Thickness (feet)
139A (5240)*	No assay a/						0.023	235.8	236.6	0.8
	No assay a/						0.022	242.7	244.0	1.3
	No assay a/						0.040	246.1	247.0	0.9
	252.50	253.00	0.50	0.027e	<0.1	Undet				
	253.00	253.50	0.50	0.022e	<0.1	Undet				
Other holes, Public land										
52 (5090)*	128.00	128.20	0.20	<0.020e	0.51	1.2				
53B (5130)*	170.90	171.40 b/	0.50	0.025e	0.12	Undet				
60 (5280)*	No assay a/						0.022	293.1	294.3	1.2
	305.20	305.40	0.20	0.13	0.22	16.9	0.035	304.3	305.5	1.2
65 (5300)*	240.90	242.10	1.20	0.032	<0.1	25.5	0.042	239.3	240.7	1.4
	242.35	242.85	0.50	0.043	0.11	20.1				
68A (5400)*	343.70	344.40	0.70	0.12	0.37	28.3	0.25	336.9	337.7	0.8
76 (5380)*	No assay a/						0.047	359.2	360.8	1.6

Table 6.--Assay data, Horse Mesa area, Mesa and Montrose Counties, Colorado--(Continued)

Hole No. and collar elev. (feet)	Assay data: Depth in feet From	To	Thickness (feet)	Percent U_3O_8	Percent V_2O_5	Percent $CaCO_3$	Gamma-ray data: Percent eU_3O_8	Depth in feet From	To	Thickness (feet)
83 (5930)*	176.40	177.00	0.60	0.063	0.15	0.6	0.34	178.6	179.6	1.0
106 (6320)*	No assay a/						0.026	89.4	90.4	1.0
130 (5100)*	No assay a/						0.025	134.3	135.9	1.6
132 (5130)*	182.75	183.00	0.25	0.021e	0.18	Undet	0.034	182.7	184.2	1.5
	183.20	183.60	0.40	0.066	<0.1	1.0				
133	253.40	253.50	0.10 b/	0.27	3.38	0.3	0.061	252.3	253.3	1.0

INDEX OF MINING CLAIMS

1 Last Chance No. 1
2 Last Chance No. 2
3 Black Jumbo
4 Black Jumbo No. 2
5 Black Jumbo No. 3
6 Veto No. 18
7 Veto No. 16
8 Veto No. 104
9 Veto No. 129
10 Veto No. 122
11 Veto No. 25
12 Veto No. 27
13 Veto No. 105
14 Veto No. 119
15 Veto No. 123
16 Veto No. 29
17 Veto No. 28
18 Nava
19 Broza
20 Broza No. 2
21 Broza No. 3
22 Broza No. 4

GEOLOGIC SECTION A - A'

GEOLOGIC SECTION B - B'

1000 0 3000 FEET
HORIZONTAL SCALE
200 0 600 FEET
VERTICAL SCALE
DATUM IS MEAN SEA LEVEL

EXPLANATION

APPROXIMATE TOP OF ORE-BEARING SANDSTONE

APPROXIMATE BASE OF ORE-BEARING SANDSTONE

BOUNDARY OF FAVORABLE, SEMIFAVORABLE, AND UNFAVORABLE GROUND UNDERLAIN BY ORE-BEARING SANDSTONE

GROUND UNDERLAIN BY CARNOTITE-BEARING ROCK FOUND BY GEOLOGICAL SURVEY DRILLING PROJECTED TO INFERRED OUTER EDGES OF MINERALIZED LAYERS, SOME OF WHICH OVERLAP AND ARE NOT CONNECTED BETWEEN ADJACENT DRILL HOLES; INCLUDES RESERVE BLOCK WHERE SHOWN

LAND SECTION CORNER FOUND IN FIELD, OTHER CORNERS LOCATED APPROXIMATELY

22 LAND SECTION NUMBER

PROSPECT PIT OR MINE WORKINGS IN MINERALIZED ROCK

(7) CLAIM BOUNDARY AND INDEX NUMBER, BOUNDARY LOCATED APPROXIMATELY

Figure 3 OUTLINE OF FIGURE 3

BOUNDARY BETWEEN DRILLING AREAS

DIAMOND-DRILL HOLE, GEOLOGICAL SURVEY, 1950-52. CLASSIFICATION BY GRADE (BASED ON CHEMICAL ASSAY AND GAMMA-RAY DATA) AND THICKNESS. DRILL HOLES LOCATED BY PACE AND COMPASS, AND PLANE-TABLE SURVEY METHODS. (NUMBERS ON DRILL HOLE STANDPIPES IN THE MOON MESA AREA HAVE PREFIX MO AND IN THE HORSE MESA AREA HAVE PREFIX HM)

o79 BARREN

WEAKLY MINERALIZED (CONTAINS LESS THAN 0.10% U_3O_8 AND 1.0% V_2O_5 BUT 0.020% OR MORE U_3O_8 OR 0.10% OR MORE V_2O_5 BY CHEMICAL ASSAY OR REGISTERS GAMMA-RAY VALUES WITHIN THE RANGE FROM 0.020% TO 0.099% eU_3O_8), OR LESS THAN 1 FOOT THICK IF HIGHER GRADE

ORE-BEARING (CONTAINS 0.10% OR MORE U_3O_8 OR 1.0% OR MORE V_2O_5 BY CHEMICAL ASSAY, OR REGISTERS GAMMA-RAY VALUES OF 0.10% OR MORE eU_3O_8, AND 1 FOOT OR MORE THICK)

EXPLANATION (GEOLOGIC SECTIONS)

MUDSTONE AND FINE-GRAINED SANDSTONE

CONGLOMERATIC SANDSTONE

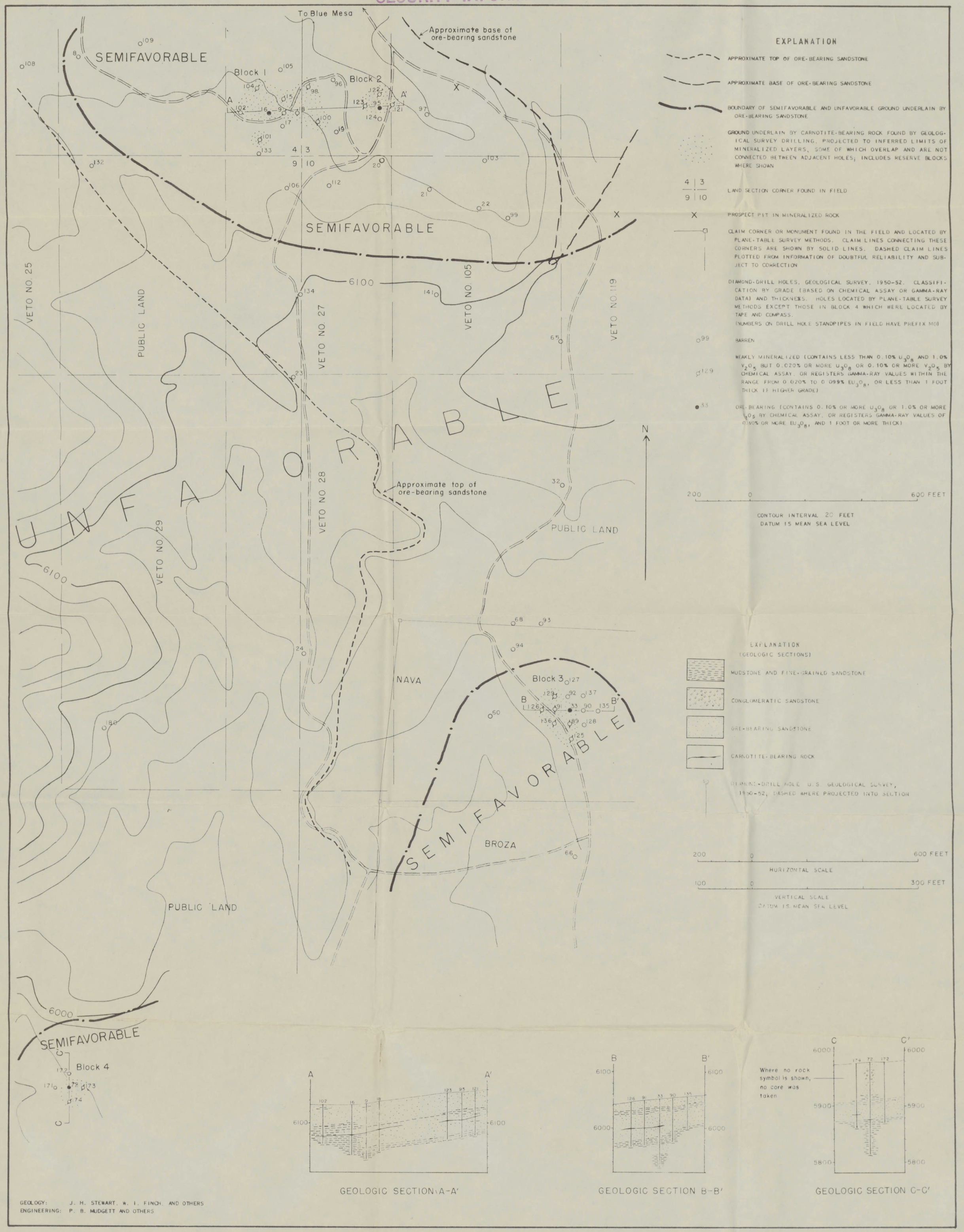
ORE-BEARING SANDSTONE

CARNOTITE-BEARING ROCK

69 DIAMOND-DRILL HOLE U.S. GEOLOGICAL SURVEY, 1950-52; DASHED WHERE PROJECTED INTO SECTION

GEOLOGY: J. H. STEWART, W. I. FINCH, AND OTHERS
ENGINEERING: P. B. MUDGETT AND OTHERS

Figure 2. --GEOLOGIC MAP AND SECTIONS OF THE MOON MESA AND HORSE MESA AREAS, MESA AND MONTROSE COUNTIES, COLORADO



GEOLOGIC SECTION A-A'

GEOLOGIC SECTION B-B'

GEOLOGIC SECTION C-C'

GEOLOGY: J. H. STEWART, W. I. FINCH, AND OTHERS
ENGINEERING: P. B. MUDGETT AND OTHERS

Figure 3.--DETAIL GEOLOGIC MAP AND SECTIONS OF A PART OF THE MOON MESA AREA, MESA COUNTY, COLORADO