Carnotite Resources of the Spud Patch Area, San Miguel County, Colorado

By Henry Bell, III

1923

Trace Elements Investigations Report 286

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

U.S.

Geology and Mineralogy

This document consists of 46 pages, plus 2 figures.
Series A

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

CARNOTITE RESOURCES OF THE SPUD PATCH AREA, SAN MIGUEL COUNTY, COLORADO*

By

Henry Bell, III

August 1953

Trace Elements Investigations Report 286

This preliminary report is distributed without editorial and technical review for conformity with official standards and nomenclature. It is not for public inspection or quotation.

~~This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.~~

*This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

USGS - TEI-286

GEOLOGY AND MINERALOGY

Distribution (Series A)	No. of copies
American Cyanamid Company, Winchester	1
Argonne National Laboratory	1
Atomic Energy Commission, Washington	1
Battelle Memorial Institute, Columbus	1
Carbide and Carbon Chemicals Company, Y-12 Area	1
Division of Raw Materials, Butte	1
Division of Raw Materials, Denver	1
Division of Raw Materials, Grants	1
Division of Raw Materials, Hot Springs	1
Division of Raw Materials, New York	6
Division of Raw Materials, Richfield	1
Division of Raw Materials, Salt Lake City	1
Division of Raw Materials, Washington	3
Dow Chemical Company, Pittsburg	1
Exploration Division, Grand Junction Operations Office	6
Grand Junction Operations Office	1
Technical Information Service, Oak Ridge	6
Tennessee Valley Authority, Wilson Dam	1
U. S. Geological Survey:	
Alaskan Geology Branch, Washington	1
Fuels Branch, Washington	1
Geochemistry and Petrology Branch, Washington	1
Geophysics Branch, Washington	1
Mineral Deposits Branch, Washington	2
E. H. Bailey, San Francisco	1
N. M. Denson, Denver	1
C. E. Dutton, Madison	1
R. P. Fischer, Grand Junction	2
M. R. Klepper, Washington	1
A. H. Koschmann, Denver	1
R. A. Laurence, Knoxville	1
D. M. Lemmon, Washington	1
J. D. Love, Laramie	1
K. L. Buck, Denver	1
R. J. Roberts, Salt Lake City	1
J. F. Smith, Jr., Denver	1
R. W. Swanson, Spokane	1
A. E. Weissenborn, Spokane	1
TEPCO, Washington:	
Resource Compilation Section	2
Reports Processing Section (Including master)	2
	60

CONTENTS

ILLUSTRATIONS

TABLES

CARNOTITE RESOURCES OF THE SPUD PATCH AREA, SAN MIGUEL COUNTY, COLORADO

By Henry Bell, III

ABSTRACT AND SUMMARY

The Spud Patch area comprises about 8 square miles in T. 43 N., R. 18 and 19 W., San Miguel County, Colo., and is about 4 miles northeast of Egnar, Colo. Claims of the United States Vanadium Co. and the Vanadium Corp. of America cover about half the area. Claims of other owners, public land, and patented agricultural land, comprise the remainder of the area. The area is about 38 miles from the Government mill at Monticello, Utah, and 55 miles from the Vanadium Corp. of America mill at Naturita, Colo.

Between 1940 and 1951, the Spud Patch area yeilded about 24,000 short tons of carnotite ore that probably averaged 0.21 percent U_3O_8 and 2.2 percent V_2O_5.

The deposits are in a broad sandstone lens near the top of the Salt Wash member of the Jurassic Morrison formation. Although the deposits mined have been mainly impregnations of sandstone by carnotite and gray vanadium-bearing clay minerals, some of the richer deposits found by Geological Survey drilling have a finely disseminated black uranium mineral but no carnotite. The deposits commonly are thin irregular tabular layers, which locally thicken to form elongate masses called "rolls". These rolls have a dominant northeasterly trend. Geologic features found to be most useful as guides to ore are listed.

From November 1949 to May 1952, the U. S. Geological Survey drilled 415 diamond-drill holes totaling 67,215 feet in the Spud Patch area. The purpose of this drilling was to find deposits that would make new mines and to appraise the reserves in the unexplored area.

As a result of Geological Survey drilling, indicated and inferred reserves computed at the cutoff of 1 foot or more thick and 0.10 percent U_3O_8 or 1.0 percent V_2O_5 total 20,500 short tons, averaging 0.28 percent U_3O_8 and 2.1 percent V_2O_5. These reserves and those computed at a lower grade cutoff of 0.05 percent U_3O_8 or 0.50 percent V_2O_5 and the pounds of contained metal are summarized in table 1.

Potential reserves, whose existence is based on geologic evidence alone, are predicted to total about 42,000 short tons, averaging 0.25 percent U_3O_8 and 2.0 percent V_2O_5.

No additional exploratory-type drilling by the Geological Survey is planned in the Spud Patch area. Recommendations are offered for additional development-type drilling, preferably by claim owners or lessees in specific areas in the vicinity of deposits discovered by Geological Survey drilling.

INTRODUCTION

The Spud Patch area is about 4 miles northeast of Egnar, San Miguel County, Colo. This area is in secs. 24, 25, and part of sec. 13, T. 43 No., R. 19 W.; secs. 19, 28, 29, 30, 31, 32, 33, and part of secs. 18 and 20, T. 43 N., R. 18 W., New Mexico principal meridian (figs. 1 and 2). About half the area is covered by claims of the

Table 1. Summary of indicated and inferred reserves, 1 foot or more thick, in the Spud Patch area, San Miguel County, Colorado

Reserves	Grade cutoff	Short tons 1/	Percent		Pounds 2/	
			U_3O_8	V_2O_5	U_3O_8	V_2O_5
Indicated	0.10% U_3O_8 or 1.0% V_2O_5	7,000	0.28	2.1	39,000	294,000
	0.05% U_3O_8 or 0.50% V_2O_5	8,800	0.23	1.8	40,500	317,000
Inferred	0.10% U_3O_8 or 1.0% V_2O_5	13,500	0.28	2.1	75,500	567,000
	0.05% U_3O_8 or 0.50% V_2O_5	18,300	0.22	1.7	80,500	622,000

1/ Rounded to nearest 100 tons

2/ Rounded to nearest 500 pounds

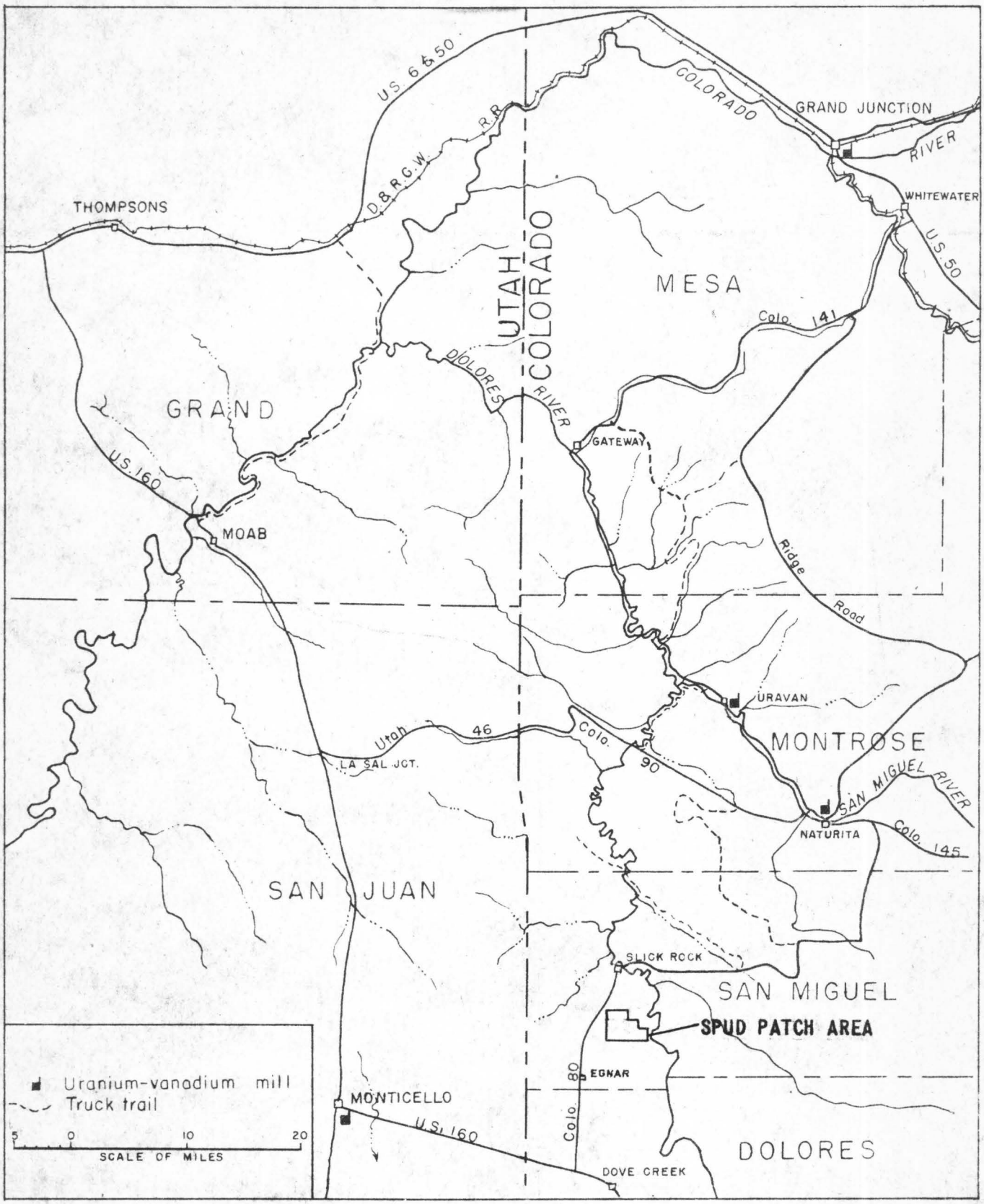

Figure 1. INDEX MAP OF PART OF THE COLORADO PLATEAU SHOWING THE LOCATION OF THE SPUD PATCH AREA, SAN MIGUEL COUNTY, COLORADO

United States Vanadium Co. and the Vanadium Corp. of America. Claims of other owners, public land, and patented agricultural land comprise the remainder of the area. The area explored by the Geological Survey covers about 8 square miles east from Colorado Highway 80 and is accessible by about 2 miles of unimproved road. The nearest milling facilities are the Government mill at Monticello, Utah, and the Vanadium Corp. of America mill at Naturita, Colo., 38 and 55 miles away, respectively.

The area is semi-arid and water is scarce except for melt-water from snow during late winter and early spring. Low shrubs and sage cover the southern part of the area, except where cleared away for agricultural land. Piñon and juniper trees grow where sandstone crops out near canyons, especially in the northern and eastern parts of the area. The area explored by the Geological Survey ranges in altitude from 7,100 to 7,800 feet.

Between 1940 and 1951 the Spud Patch area yielded 24,000 tons (all tons in this report are short tons) of carnotite ore that averaged about 0.21 percent U_3O_8 and 2.2 percent V_2O_5. Table 2 shows the production from the Spud Patch area. Although some mining was done as early as 1937, production amounted to only a few tons until 1940. In 1944 the mines were closed and there was no production until 1948 when a minimum price for ore was established by the Atomic Energy Commission.

The United States Vanadium Co. and the Vanadium Corp. of America have done about 21,000 feet of diamond-drill exploration and twice as much jackhammer and wagon drilling, mostly in the vicinity of the mine workings. From November 1949 to May 1952, the Geological Survey drilled

Table 2.--Production of carnotite ore from the Spud Patch area, San Miguel County, Colorado a/, 1940-51

Year	Short tons	Percent U_3O_8	Percent V_2O_5
1940	1,720	0.21 b/	2.1 b/
1941	3,230	0.19 b/	2.1 b/
1942	4,670	0.18 b/	2.0
1943	9,780	0.19 b/	2.1
1948	840	0.35	3.8
1949	1,120	0.33	2.6
1950	1,930	0.32	2.4
1951 c/	280	0.18	2.8
Undifferentiated	440	0.12	2.3
Total and weighted averages	24,000 d/	0.21	2.2

a/ Data compiled from Metals Reserve Company, the Atomic Energy Commission, and the Geological Survey.

b/ Estimated, complete figures unavailable.

c/ January and February.

d/ Rounded to nearest 100 tons.

415 diamond-drill holes totaling 67,215 feet in the Spud Patch area to find carnotite deposits that would make new mines and to appraise the reserves in the unexplored area.

This report summarizes the results of exploration by the Geological Survey, gives a brief description of the geology, ore deposits and ore reserves, and presents guides to ore and recommendations for additional drilling. Preliminary results were reported in 1950 and 1952 (Bell and Icke, 1950; Bell, 1952; Hilpert, 1952).

GEOLOGY

Sedimentary rocks of the Jurassic Morrison formation are exposed in the part of the Spud Patch area explored by the Geological Survey. These rocks have been gently warped into the northwest plunging Dolores anticline. The Morrison formation in this area consists of two members: the Salt Wash member, which consists of broad sandstone lenses interbedded with red-brown mudstone; and the overlying Brushy Basin member, which consists of variegated shale, mudstone, and thin conglomeratic sandstone beds (Craig and others, 1951).

The largest production of carnotite ore has been from the upper sandstone lens of the Salt Wash member; this lens is called the "main ore-bearing sandstone" and it contains the largest group of carnotite deposits in the Spud Patch area. The outcrop of this lens is shown on figure 2. Carnotite ore has been produced from a second lens of sandstone, below the main ore-bearing sandstone, chiefly from the Norma Jean mines.

The main ore-bearing sandstone is generally light brown or reddish brown, medium to medium-fine grained, and may be stained or speckled with limonite. It is a stream-deposited sandstone ranging in thickness from 30 to 120 feet and is dominantly cross-bedded but may be massive in the thicker parts. The ore deposits tend to be clustered in the thicker, massive or cross-bedded parts, which suggest stream channels. These thicker, massive or cross-bedded parts are shown on figure 2 as favorable and semifavorable arcuate belts of ground.

The ore-bearing sandstone contains thin mudstone lenses, mudstone pebbles and flakes, and fine interstitial mdustone particles. The mudstone that lies above and below the ore-bearing sandstone, as well as the mudstone within the sandstone, is usually red brown. A flood-plain type of deposition is suggested where mudstone lenses are numerous and the sandstone has a red tint and contains large amounts of fine interstitial mudstone particles. These areas are shown on figure 2 as areas unfavorable for ore deposits.

Near ore deposits the mudstone within, above, and below the ore-bearing sandstone, is dominantly gray. Field relations suggest that the original mudstone color was red brown but near ore deposits the color has been altered to gray, perhaps by the solutions that emplaced the deposits or by solutions that later followed the old courses of the ore-bearing solutions largely in the thicker more permeable parts of the ore-bearing sandstone.

Carbonaceous material is common in the ore-bearing sandstone and in many places is associated with the ore deposits. This material

consists of small fragments of leaves or rushes and of coaly material. Fossil tree trunks found in other parts of the Colorado Plateau are not common in the Spud Patch area, and richly mineralized logs are rare.

The Uravan mineral belt, described by Fischer and Hilpert (1952), extends from the vicinity of Gateway through Uravan and southward to the Slick Rock mining district in Colorado. The Spud Patch area lies within this belt of closely spaced carnotite deposits.

ORE DEPOSITS

The ore deposits were formed by impregnation of sandstone with uranium-bearing minerals and vanadium-bearing clay minerals. The deposits occur as irregular tabular layers at one or more stratigraphic positions. Ore bodies, defined as those parts of a deposit that are minable, are as much as 200 feet long, 5 to 40 feet wide, and 1 to 20 feet thick. The long axes of most of the ore bodies have a general northeasterly trend. Several of the larger deposits discovered by Geological Survey drilling have been described individually in preliminary reserve statements (Bell and Cramer, 1952).

Carnotite $K_2(UO_2)_2(VO_4)_2 \cdot 3H_2O$ -- the principle uranium-bearing mineral that has been mined in the Spud Patch area, is yellow, occurs disseminated in the sandstone, and is closely associated with vanadium-bearing clay minerals including the hydromica formerly called "roscoelite". These vanadium-bearing clay minerals are finely divided and micaceous. They occur as aggregates of minute flakes coating the sand grains and filling interstices between the grains. These minerals color the

sandstone a gray to dark greenish-gray that darkens as the vanadium content increases. Minor amounts of blue and green copper stains have been noted, particularly near the Paystreak mine.

Deposits discovered by Geological Survey drilling on public land in the southern part of sec. 32 contain uranium in an unidentified dark mineral associated with the vanadium-bearing clay minerals. No carnotite has been seen in these deposits, and the uranium mineral may be very finely disseminated uraninite. Finely divided pyrite is found associated with these deposits, particularly where carbonaceous material is abundant.

The largest production of carnotite ore in the Spud Patch area has come from the main ore-bearing sandstone. The Moqui Jug and Depression claims have yielded about 6,000 tons. About 3,000 tons has been produced from the Mayday mine. A second lens of sandstone below the main ore-bearing sandstone has yielded about 5,000 tons of carnotite ore from the Norma Jean group of mines. This lens is deeply buried throughout most of the Spud Patch area. The deposits in this lens, although commonly of high grade, have a spotty distribution and make difficult targets for drilling.

The grade of the ore produced from the largest group of deposits in the main ore-bearing sandstone has been about 0.16 percent U_3O_8 and 2.1 percent V_2O_5, a ratio of about 1 part U_3O_8 to 13 parts V_2O_5. This ratio is somewhat lower than that for most deposits in the Uravan mineral belt. The ore deposits discovered by the Geological Survey in the southern part of sec. 32 appear to have a ratio of 1 part U_3O_8 to 8 parts V_2O_5.

The ore deposits occur in irregular tabular or lens-shaped masses. The tabular layers lie nearly parallel to the sandstone bedding, although they do not follow the bedding in detail. Locally, where the deposits thicken and have sharp, well-defined boundaries, they are called "rolls", but these are poorly developed and not as common in the Spud Patch area as in other parts of the Colorado Plateau. The rolls have a dominant northeasterly trend in the Spud Patch area. Commonly, ore deposits comprise one or more ore bodies that are connected by thin tabular layers of mineralized rock. These layers, too thin to be mined, although in places they are high in grade, may extend outward from ore bodies from a few feet to 100 feet or more.

These deposits are thought by some geologists to have been precipitated from ground-water solutions migrating along the thicker and more permeable parts of the ore-bearing sandstone. The precipitation of the ore minerals may have been localized by sedimentary structures in the sandstone.

GUIDES TO ORE

Some geologic features of the ore-bearing sandstone have been recognized as useful guides to ore, and to sandstone that might possibly contain ore deposits. These features are subtle and should be evaluated together in appraising the ground being prospected, as no single one is well enough defined to be used alone. A more detailed discussion of the guides to ore deposits is given by Weir (1952).

The geologic features most useful as guides to ore deposits in the Spud Patch area are listed in the order of usefulness:

1. The mudstone immediately beneath the ore-bearing sandstone, and the mudstone pebbles and seams within this sandstone, are gray in the vicinity of ore deposits.

2. The sandstone in the vicinity of deposits ranges from 40 to 100 feet thick, and is dominantly light brown. A few hundred feet away from deposits, however, the ore-bearing sandstone commonly has a noticeable reddish cast due to the presence of interstitial red mudstone.

3. Carbonized plant remains and fragments of coaly material are more abundant near ore deposits than in ground away from ore.

Using these criteria, ground favorable for ore deposits can be determined with widely spaced drill holes. Useful guides to material of ore grade are the thin layers of mineralized rock that commonly extend outward from ore bodies, sometimes as much as 100 feet or more. Radioactive anomalies have been detected along the top of mudstone seams. In other areas anomalies have been measured as much as 300 feet from ore bodies (Rogers, 1950). These anomalies prove useful as guides to ore.

GEOLOGICAL SURVEY EXPLORATION

The Geological Survey diamond-drilled 415 holes totaling 67,215 feet to explore the Spud Patch area for ore deposits. Drilling was done between November 1949 and May 1952 under three drilling contracts.

Of the 415 holes drilled, 201 holes, comprising 41 percent of the total footage, were used to appraise the possibilities of finding ore in unexplored ground. These holes were all drilled at a wide spacing, about 700 feet apart. The remaining 214 holes, comprising 59 percent of the total footage, were used to find and delimit roughly the ore deposits in the ground evaluated as favorable for ore deposits on the basis of the geologic criteria used to guide exploration for carnotite deposits. These closely and moderately spaced holes were about 50 to 300 feet apart.

Of the 415 holes drilled, 89 holes are in mineralized material; of these, 20 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). All the drill holes that are in ore and 55 of the other holes that are in mineralized material below the cutoffs for ore are in sec. 32 south of the Mayday mine in ground appraised as favorable for ore deposits. In this favorable ground, most of the moderately and closely spaced holes were drilled in public land in order to find and delimit ore deposits that could be leased to private operators. The deposits found on privately owned claims have been left for the claim owners to develop.

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 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. 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 table 3. The area containing the reserve blocks, and geologic sections showing the position of the mineralized rock in the ground, are shown in figures 2 and 3.

In addition to the known deposits, there probably are other deposits which have not yet been found. These deposits are predicted solely on interpretation of geologic evidence, for there is no physical proof of their existence. The term "potential" reserves is applied to the mineralized material in these deposits.

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 actually might be mined from these deposits under 1952 conditions. A summary of indicated and inferred reserves in this category and in an additional lower-grade category is given in table 1.

Samples obtained from drill cores were assayed by the Geological Survey. The assays obtained are reported in table 4 in terms of percent of the oxides U_3O_8 and V_2O_5. Rock units containing uranium or vanadium in amounts less than 0.020 percent U_3O_8 or 0.10 percent V_2O_8 are considered to be barren and are either omitted from table 4

Table 3. Indicated and inferred reserves of the Spud Patch area, San Miguel County, Colorado

		Indicated and inferred reserves 1 foot or more thick (Attributed to USGS drilling 1949-1952)								
		Indicated				Inferred				
		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		
Block No.	Location (claims)	Short tons	Percent U_3O_8	Percent V_2O_5	Short tons	Percent U_3O_8	Percent V_2O_5	Short tons	Percent U_3O_8	Percent V_2O_5	Short tons	Percent U_3O_8	Percent V_2O_5
1	Public land	2,860	0.30	1.9	3,500	0.25	1.7	490	0.30	2.0	840	0.19	1.4
2	Public land	410	0.14	1.9	630	0.11	1.5	710	0.25	2.0	870	0.21	1.8
3	Public land	2,970	0.32	2.6	3,860	0.25	2.2	3,320	0.31	2.5	4,480	0.24	2.0
4	Public land	0	--	--	0	--	--	2,760	0.30	1.9	3,720	0.24	1.6
5	Public land, Venus, and Sarvis No. 7	40	0.15	1.0	40	0.15	1.0	1,540	0.30	2.0	2,080	0.24	1.7
6	Mars and Venus	0	--	--	0	--	--	380	0.30	2.0	510	0.23	1.7
7	Sarvis No. 7	220	0.15	0.5	220	0.15	0.5	200	0.30	2.0	280	0.23	1.7
8	Public land	530	0.12	1.2	530	0.12	1.2	320	0.15	1.5	450	0.12	1.3
9	Jupiter	0	--	--	0	--	--	2,500	0.25	2.0	3,210	0.20	1.7
10	Sarvis No. 6	0	--	--	0	--	--	450	0.30	2.0	700	0.23	1.7
11	Paystreak No. 10 and World	0	--	--	0	--	--	350	0.15	1.9	525	0.12	1.5
12	Paystreak No. 5	0	--	--	0	--	--	215	0.15	1.9	300	0.12	1.6
13	Marne	0	--	--	0	--	--	215	0.15	1.9	300	0.12	1.6
	Rounded totals and weighted averages	7,000	0.28	2.1	8,800	0.23	1.8	13,500	0.28	2.1	18,300	0.22	1.7

or are reported as less than 0.020 percent U_3O_8 or less than 0.10 percent V_2O_5.

Drill-core samples believed to contain at least 0.020 percent U_3O_8 or 0.10 percent V_2O_5 were tested by a preliminary radioactivity analysis before being assayed. Those having a content of at least 0.035 percent equivalent U_3O_8 were assayed by chemical methods. The percent equivalent U_3O_8 is shown in table 4 for those samples which were assayed but showed less than 0.020 percent U_3O_8.

Gamma-ray logs were made of almost all the holes drilled by the Geological Survey. All gamma-ray anomalies on the logs of probed drill holes have been evaluated in terms of percent equivalent U_3O_8. No corrections have been made for the difference in physical characteristics of materials used in experiments for determining empirical calibration data and the physical characteristics of unbroken rock surrounding drill holes. The drill holes are assumed to have uniform diameters. Differences in thickness of mineralized rock reported by assay and by the gamma-ray log for the same drill hole are attributed largely to poor core recovery and to the geometric differences of the rock sample for assays and gamma-ray measurements. The equivalent U_3O_8 interpreted from gamma-ray intensity are reported in table 4.

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 distances, and the general lack of sufficient sample

Table 4. Assay data, Spud Patch area, San Miguel County, Colorado

Geological Survey exploration 1949-52. Assays by the Geological Survey.

Rock units containing less than 0.020% U_3O_8, less than 0.020% equivalent U_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.

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

Assay data listed under blocks 1-13 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.

Collar elevations obtained by plane-table and hand-level survey methods.

e Equivalent

< Less than

OFFICIAL USE ONLY

Table 4. Assay data, Spud Patch area, San Miguel 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, Public land										
174 (7633)	218.1	219.3	1.2	0.36	2.57	1.8	1.18	217.3	218.2	0.9
	219.8	220.1	0.3	0.065	1.98	0.7	0.020	221.2	221.9	0.7
	266.7	267.5	0.8	0.039	0.22	4.5	0.065	246.3	247.1	0.8
191 (7630)	199.2	199.5	0.3	0.084	0.15	5.5	0.096	55.7	56.4	0.7
	215.0	215.5	0.5	0.034	0.10	3.4	0.092	71.3	72.0	0.7
	263.9	265.0	1.1	0.026e	0.75	10.3	0.280	121.9	122.8	0.9
	267.5	269.3	1.8	0.41	4.59	3.0				
277 (7633)	270.9	271.5	0.6	0.030e	< 0.10	Undet	0.021	267.4	268.2	0.8
							0.023	272.5	274.3	1.8

Table 4. Assay data, Spud Patch area, San Miguel 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, Public land--Continued										
285 (7632)	210.0	211.6	1.6 [1/]	< 0.020	0.85	0.12	0.071	211.6	212.9	1.3
	211.6	212.2	0.6 [1/]	< 0.020	2.76	0.50	0.020	212.9	213.2	0.3
	212.2	213.2	1.0	0.024e	2.13	1.8	0.130	213.2	214.2	1.0
	213.2	213.9	0.7	0.038e	1.00	3.8				
	213.9	214.9	1.0	0.031	0.89	4.8	0.155	221.4	224.0	2.6
	221.3	221.9	0.6	0.079	0.20	4.4	0.550	274.1	275.1	1.0
	221.9	222.4	0.5	0.13	1.39	2.7				
	222.4	223.7	1.3	0.069	1.02	5.0				
	272.5	274.1	1.6	0.23	1.81	6.1				
289 (7635)							0.025	233.4	234.0	0.6

1/ These samples assayed by American Smelting and Refining Co.

Table 4. Assay data, Spud Patch area, San Miguel 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, Public land--Continued										
336 (7628)	216.3	216.7	0.4	< 0.020e	1.80	0.4	0.041	266.3	267.2	0.9
	216.7	217.2	0.5	< 0.020e	0.79	3.4	0.055	267.2	268.5	1.3
							0.205	268.5	269.6	1.1
	266.7	267.5	0.8	0.021e	0.52	0.3	0.040	269.6	271.0	1.4
	267.5	267.7	0.2	0.044	0.28	1.0	0.565	271.0	272.4	1.4
	267.7	268.9	1.2	0.032e	0.36	Undet	0.300	272.4	273.2	0.8
							0.495	273.2	274.4	1.2
	269.3	269.4	0.1	0.14	0.81	1.4	0.057	274.4	275.3	0.9
	269.4	270.5	1.1	0.12	0.74	2.8				
	270.5	270.8	0.3	< 0.020e	0.27	Undet				
	271.7	272.0	0.3	0.060	0.35	6.6				
	272.0	272.8	0.8	0.38	0.96	1.0				
	272.8	273.0	0.2	0.93	5.24	0.3				
	273.0	274.0	1.0	0.33	1.67	6.2				
	274.0	274.9	0.9	0.56	0.93	9.4				
	274.9	275.4	0.5	0.41	0.21	10.0				
	275.4	275.9	0.5	0.044	0.42	13.8				
	275.9	276.2	0.3	< 0.020e	0.21	Undet				

Table 4. Assay data, Spud Patch area, San Miguel 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, Public land--Continued										
337 (7628)	209.7	210.2	0.5	< 0.020e	0.68	1.8	2.200	209.9	210.9	1.0
	210.2	210.5	0.3	0.21	1.26	2.6	0.220	210.9	212.3	1.4
	210.5	211.0	0.5	0.91	5.16	3.2				
	211.0	211.4	0.4	0.38	3.27	4.5	0.029	285.3	287.4	2.1
	211.4	212.5	1.1	0.18	0.34	3.9				
							0.407	290.1	291.1	1.0
	265.5	265.8	0.3	0.025e	0.28	Undet				
	265.8	266.3	0.5	0.024e	0.56	3.6				
	266.3	266.4	0.1	0.022e	0.39	Undet				
	270.0	271.7	1.7	0.14	1.29	10.4				
349 (7636)	270.2	270.9	0.7	0.022e	0.14	Undet	0.057	269.3	270.3	1.0
	271.0	271.5	0.5	0.025e	0.44	Undet	0.045	271.5	272.6	1.1
	271.5	273.0	1.5	< 0.020e	0.50	5.3				
	273.0	273.3	0.3	0.023e	0.71	4.0	0.035	273.6	275.0	1.4
	273.3	273.5	0.2	0.028	0.70	1.7				
	273.5	274.0	0.5	< 0.020e	0.38	Undet				
	274.5	274.8	0.3	< 0.020e	0.44	Undet				
351 (7623)							0.021	263.4	264.0	0.6
							0.039	264.0	264.7	0.7
							0.032	267.4	268.2	0.8
354 (7630)	274.2	274.5	0.3	0.048	0.14	3.9	0.083	273.8	274.3	0.5

Table 4. Assay data, Spud Patch area, San Miguel 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)
Block 2, Public land										
371 (7650)	220.1	220.3	0.2	0.023e	0.72	< 0.1	0.020	219.2	220.5	1.3
373 (7641)	214.3	214.9	0.6	0.19	1.73	< 0.1	0.39	213.5	214.8	1.3
	214.9	215.2	0.3	0.16	0.75	0.2				
	215.2	215.4	0.2	1.02	5.67	0.1				
	215.4	215.5	0.1	0.072	1.11	0.1				
380 (7638)	239.6	239.7	0.1	0.026e	0.21	Undet	0.26	239.1	240.3	1.2
	239.7	240.2	0.5	0.41	2.71	0.8				
402 (7645)	211.1	211.8	0.7	< 0.020e	0.87	0.7	0.055	212.5	213.5	1.0
	211.8	212.1	0.3	0.025e	2.18	0.8				
	212.1	212.4	0.3	< 0.020e	1.15	3.2	0.074	221.4	222.4	1.0
	216.3	216.8	0.5	< 0.020e	0.36	Undet				
	220.5	220.8	0.3	0.070	< 0.1	2.1				
	221.3	221.8	0.5	0.074	0.49	0.8				
410 (7642)	206.1	206.4	0.3	< 0.020e	2.90	0.1				
	206.4	207.1	0.7	< 0.020e	1.19	0.1				
	207.1	207.3	0.2	< 0.020e	0.85	8.5				
	207.3	208.2	0.9	< 0.020e	1.96	0.8				
	208.2	208.5	0.3	0.022e	0.19	Undet				
	208.5	208.7	0.2	< 0.020e	0.30	Undet				

Table 4. Assay data, Spud Patch area, San Miguel 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 3, Public land										
299 (7577)	196.6	196.8	0.2	0.78	13.20	0.4	2.180	196.2	197.3	1.1
	196.8	197.2	0.4	0.45	2.11	4.1	0.470	197.3	199.4	2.1
	197.2	198.0	0.8	0.86	3.92	3.1	0.177	199.4	200.3	0.9
	198.0	199.3	1.3	0.43	2.81	5.9				
	199.3	201.4	2.1	0.12	0.31	8.5	0.036	201.9	202.8	0.9
333 (7575)							0.390	182.6	183.2	0.6
334 (7577)	182.7	183.4	0.7	0.49	2.89	7.8	0.195	181.3	182.0	0.7
341 (7580)	180.8	181.1	0.3	0.021e	< 0.10	Undet	0.020	179.0	179.7	0.7
	189.6	190.1	0.5	0.042	0.28	2.5	0.094	187.7	188.6	0.9
	190.1	190.6	0.5	0.21	1.14	3.0	0.412	188.6	189.8	1.2
	190.6	191.1	0.5	0.16	0.86	4.0				
	191.1	191.5	0.4	0.32	4.87	2.3				
	191.5	192.0	0.5	0.073	1.28	3.7				
	192.0	192.3	0.3	0.027e	1.75	1.4				
	192.3	193.2	0.9	< 0.020e	1.11	2.0				
	193.2	194.1	0.9	< 0.020e	1.11	1.2				

Table 4. Assay data, Spud Patch area, San Miguel 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 3, Public land--Continued										
352 (7582)	184.9	185.8	0.9	0.035	0.16	3.9	0.024	182.1	184.2	2.1
	185.8	186.3	0.5	0.043	1.86	0.2	0.210	184.2	185.2	1.0
	186.3	186.8	0.5	< 0.020e	0.49	Undet	0.040	185.2	186.9	1.7
	186.8	187.1	0.3	< 0.020e	0.43	Undet	0.670	186.9	188.1	1.2
	187.1	187.9	0.8	< 0.020e	0.51	0.7	2.710	188.1	189.0	0.9
	187.9	188.3	0.4	0.25	1.53	1.7	0.082	189.0	190.3	1.3
	188.3	189.6	1.3	0.43	1.23	2.3				
	189.6	190.3	0.7	1.04	4.20	3.0	0.031	192.1	193.5	1.4
	190.3	190.5	0.2	0.11	1.88	1.4	0.020	193.5	194.0	0.5
	190.5	191.0	0.5	0.052	1.60	3.6				
	191.0	191.6	0.6	0.031e	2.53	1.5				
	191.6	191.9	0.3	0.030e	0.74	7.7				
	191.9	192.2	0.3	0.026e	1.58	1.0				
	192.2	193.3	1.1	< 0.020e	0.80	1.0				
	193.3	194.2	0.9	< 0.020e	0.63	1.4				
	194.2	194.5	0.3	< 0.020e	0.53	0.2				
353 (7585)	189.5	189.8	0.3	< 0.020e	0.58	0.8	0.200	189.3	190.1	0.8
	189.8	190.4	0.6	0.11	1.43	1.5				
	190.4	190.7	0.3	0.039	3.87	0.3	0.028	191.3	192.5	1.2
	197.0	197.3	0.3	0.025e	1.81	0.7	1.710	197.3	198.8	1.5
	197.3	197.8	0.5	0.10	7.68	0.5	0.025	198.8	201.2	2.4
	197.8	198.5	0.7	0.83	9.19	0.5	0.051	201.2	202.0	0.8
	198.5	199.4	0.9	0.85	6.40	0.4				
	199.4	199.9	0.5	0.34	0.81	2.9				
	199.9	200.3	0.4	0.021e	0.17	Undet				

Table 4. Assay data, Spud Patch area, San Miguel 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 3, Public land--Continued										
355 (7581)	187.8	188.1	0.3	< 0.020e	0.50	2.0	0.024	181.3	182.0	0.7
	188.1	188.5	0.4	0.039	0.19	4.9				
	188.5	188.9	0.4	0.051	1.59	0.7	0.025	186.5	187.3	0.8
							0.048	187.3	188.5	1.2
356 (7584)	196.1	196.6	0.50	0.046	1.46	1.2	0.555	195.7	196.4	0.7
	196.6	197.1	0.50	0.32	2.44	2.3				
	197.1	197.5	0.40	< 0.020e	0.17	Undet				
	197.5	197.8	0.30	0.021e	< 0.10	Undet				
Block 4, Public land										
190 (7677)	297.4	297.8	0.4	0.033e	0.10	Undet	0.400	289.4	289.9	0.5
	297.8	298.2	0.4	1.69	0.37	0.3				
343 (7668)							0.028	285.5	286.5	1.0
363 (7638)	278.4	278.6	0.2	0.15	0.70	1.9	0.045	278.4	279.3	0.9
	278.6	279.1	0.5	< 0.020e	0.27	Undet	0.16	279.3	280.1	0.8
	279.1	279.6	0.5	0.22	< 0.1	22.5				
							0.029	283.1	284.2	1.1
370 (7644)	276.0	276.3	0.3	0.30	0.30	11.2	0.47	275.6	276.4	0.8
	276.3	276.4	0.1	0.022e	0.19	Undet				
							0.038	278.1	279.4	1.3
378 (7647)	278.1	278.3	0.2	0.10	2.71	0.3	0.055	277.4	278.2	0.8
	280.6	280.7	0.1	0.079	1.28	0.3	0.15	280.1	280.7	0.6
							0.026	288.1	289.0	0.9

Table 4. Assay data, Spud Patch area, San Miguel 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 4, Public land--Continued										
405 (7642)							0.040	275.1	275.8	0.7
408 (7640)	250.8	250.9	0.1	0.059	1.49	0.2	0.030	261.2	262.4	1.2
	281.5	281.7	0.2	0.020e	0.45	Undet	0.11	281.5	282.4	0.9
	281.7	282.0	0.3	0.095	0.60	3.2	0.041	282.4	283.8	1.4
	282.0	282.5	0.5	0.027e	0.36	Undet				
							0.029	284.8	285.9	1.1
	283.0	283.7	0.7	0.028e	0.34	Undet				
413 (7647)							0.022	278.5	279.1	0.6
414 (7642)	178.8	180.1	1.3	< 0.020e	0.11	Undet	0.17	283.2	283.8	0.6
							0.021	283.8	285.1	1.3
	283.5	283.7	0.2	0.21	< 0.1	1.6				
Block 5, Public land, Venus and Sarvis No. 7 claims										
303 (7571)	189.9	190.6	0.7	0.047	0.23	10.5	0.025	186.7	187.3	0.6
	190.6	190.9	0.3	0.097	0.87	3.7	0.033	187.3	188.2	0.9
							0.026	188.2	188.9	0.7
							0.098	188.9	190.0	1.1
							0.082	193.3	193.9	0.6
304 (7577)	190.4	191.2	0.8	0.031e	0.32	Undet	0.039	190.8	191.7	0.9
310 (7559)	182.6	182.9	0.3	0.49	2.89	7.8	0.300	182.5	183.2	0.7

Table 4. Assay data, Spud Patch area, San Miguel 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 5, Public land, Venus and Sarvis No. 7 claims--Continued										
393 (7572)	122.3	122.5	0.2	< 0.020e	1.79	< 0.1	0.30	123.4	124.1	0.7
	123.8	124.3	0.5	0.57	3.62	0.1				
	129.2	130.4	1.2	< 0.020e	1.00	3.0				
411 (7574)	131.6	131.8	0.2	< 0.020e	1.47	0.1				
412 (7570)	127.6	127.9	0.3	< 0.020e	0.66	0.1				
Block 6, Mars and Venus claims										
50 (7546)	126.9	127.4	0.5	< 0.020e	0.69	0.2	0.025	128.1	129.1	1.0
	130.0	130.3	0.3	0.046	< 0.10	12.0				
	130.3	130.5	0.2	0.072	0.10	14.7				
150 (7544)	126.9	127.2	0.3	< 0.020e	4.56	0.1				
153 (7546)	131.9	132.4	0.5	< 0.020e	3.75	0.9				
189 (7548)	130.2	130.5	0.3	< 0.020e	2.79	0.1				

Table 4. Assay data, Spud Patch area, San Miguel 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 7, Sarvis No. 7 claim										
74 (7559)	156.7	157.5	0.8	< 0.020e	0.12	Undet	Not probed			
	158.7	159.7	1.0	0.034	0.50	4.3				
	160.2	161.2	1.0	0.19	0.66	3.6				
	161.2	163.9	2.7	< 0.020	0.17	4.8				
199 (7558)	162.5	163.2	0.7	0.038	0.19	3.5	0.140	162.2	163.1	0.9
							0.078	163.1	163.6	0.5
	164.0	164.5	0.5	0.027e	0.12	Undet	0.082	163.6	164.4	0.8
							0.049	164.4	165.2	0.8
	165.2	165.5	0.3	0.026e	0.15	Undet	0.073	165.2	166.0	0.8
	165.5	165.9	0.4	0.17	0.21	5.6				
204 (7563)	162.3	163.5	1.2	< 0.020e	0.15	Undet	0.038	163.5	165.1	1.6
	163.5	164.3	0.8	0.038	0.19	4.3	0.120	165.1	166.2	1.1
							0.045	166.2	167.6	1.4
	164.5	165.5	1.0	< 0.020e	0.16	Undet	0.510	167.6	168.5	0.9
	165.5	166.5	1.0	0.033e	0.27	Undet	0.150	168.5	169.7	1.2
	166.5	167.5	1.0	0.11	0.35	7.0	0.021	169.7	170.8	1.1
	167.5	168.8	1.3	0.033	0.32	7.5				
	168.8	169.3	0.5	0.024e	0.12	Undet				
210 (7559)	165.0	165.3	0.3	0.069	2.38	0.4	0.023	132.5	133.2	0.7
	165.6	166.6	1.0	0.028e	0.24	Undet	0.023	163.2	164.2	1.0
							0.095	165.4	166.3	0.9
221 (7560)	160.1	160.8	0.7	0.033e	0.13	Undet	0.022	126.4	127.2	0.8
							0.043	159.4	160.4	1.0

Table 4. Assay data, Spud Patch area, San Miguel 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)
Block 8, Public land										
110 (7542)	143.8	144.0	0.2	< 0.020	0.86	10.4	0.118	141.6	142.4	0.8
	145.1	147.3	2.2	0.023	0.25	6.1	0.093	143.5	144.1	0.6
	147.3	147.4	0.1	0.61	5.34	0.60	0.076	144.1	145.4	1.3
	147.4	148.4	1.0	0.048	0.25	7.5	1.000	145.4	146.0	0.6
	148.9	149.2	0.3	0.045	0.26	6.5				
137 (7542)	154.5	154.9	0.4	0.19	0.20	25.1	0.61	154.7	155.6	0.9
	154.9	155.6	0.7	0.26	0.66	11.7				
	155.6	155.9	0.3	0.035	0.33	22.3				
139 (7542)	147.1	147.7	0.6	< 0.020e	1.92	0.2				
	148.4	148.7	0.3	Undet	2.15	0.1				
142 (7541)	154.1	154.7	0.6	0.032e	1.82	3.5	0.047	153.6	155.4	1.8
	154.7	154.9	0.2	0.103	0.76	0.14	2.540	155.4	156.1	0.7
	155.2	155.5	0.3	0.020	0.22	7.32				
	156.1	156.3	0.2	< 0.020	0.30	4.46				
	156.3	156.6	0.3	0.401	7.90	1.60				
	156.6	156.9	0.3	0.057	0.38	7.0				
	156.9	157.4	0.5	0.047	0.20	8.03				
	157.4	157.6	0.2	0.140	0.32	8.20				
151 (7545)	149.8	150.4	0.6	< 0.020e	1.85	0.1				

Table 4. Assay data, Spud Patch area, San Miguel 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 8, Public land--Continued										
152 (7545)	160.8	161.2	0.4	0.12	0.38	7.0	0.130	160.1	160.8	0.7
	162.4	163.2	0.8	< 0.020e	1.17	9.0	0.038	184.2	184.7	0.5
206 (7544)							0.032	164.6	165.5	0.9
211 (7548)							0.087	159.0	159.8	0.8
							0.036	169.6	170.3	0.7
Block 9, Jupiter claim										
315 (7535)	124.0	124.2	0.2	< 0.020e	0.42	Undet	0.220	125.0	126.2	1.2
	124.2	124.7	0.5	0.056	0.81	0.2				
	124.7	125.6	0.9	0.40	2.90	0.1	0.036	131.6	132.5	0.9
	125.6	127.6	2.0	2.52	5.67	0.6				
	127.6	127.7	0.1	1.15	3.16	0.4				
	127.7	128.3	0.6	0.16	1.83	0.2				
	131.7	132.0	0.3	0.038	3.20	0.1				
	132.0	132.1	0.1	0.096	2.49	0.7				
Block 10, Sarvis No. 6 and Venus claims										
297 (7501)	88.0	89.0	1.0	< 0.020e	1.75	0.1				
	89.0	89.4	0.4	< 0.020e	2.31	0.4				
	91.0	92.0	1.0	< 0.020e	2.39	3.0				

Table 4. Assay data, Spud Patch area, San Miguel 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 11, Paystreak No. 10 and World claims										
260 (7457)	45.3	45.8	0.5	< 0.020e	1.36	< 0.1				
	45.8	46.3	0.5	< 0.020e	0.75	< 0.1				
	46.3	46.4	0.1	< 0.020e	0.51	< 0.1				
267 (7475)	59.6	59.7	0.1	< 0.020e	2.48	0.4				
	60.2	60.7	0.5	< 0.020e	0.79	< 0.1				
Block 12, Paystreak No. 5 claim										
3 (7472)	83.6	84.4	0.8	< 0.020e	0.30	0.66				
248 (7473)	63.7	64.1	0.4	0.039	1.99	0.4	0.320	63.0	63.7	0.7
	81.1	81.7	0.6	0.096	1.83	0.5	0.190	81.0	81.8	0.8
254 (7469)	62.8	63.5	0.7	< 0.020e	0.33	Undet				
Block 13, Marne claim										
79 (7480)	88.2	88.9	0.7	< 0.020e	0.21	5.4	Not probed			
209 (7474)	90.0	90.6	0.6	0.029e	0.16	Undet	0.660	89.9	90.7	0.8
	92.9	93.2	0.3	0.60	3.76	0.6	1.060	92.1	92.6	0.5

Table 4. Assay data, Spud Patch area, San Miguel 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 13, Marne claim--Continued										
220 (7478)							0.023	87.2	88.8	1.6
229 (7485)							0.022	94.0	95.1	1.1
Other holes, Public land										
131 (7598)	228.3	228.6	0.3	0.11	0.28	0.55	0.065	225.7	226.4	0.7
	228.6	228.8	0.2	0.054	0.24	0.90				
138 (7530)							0.020	142.6	143.2	0.6
227 (7642)							0.080	218.7	219.5	0.8
							0.064	224.3	225.0	0.7
272 (7616)							0.025	166.9	170.3	3.4
							0.028	173.7	174.3	0.6
274 (7603)	225.1	225.6	0.5	0.10	1.71	6.3	0.340	224.6	225.2	0.6
339 (7636)							0.035	214.6	215.5	0.9
346 (7617)	173.8	174.1	0.3	0.057	0.43	0.3	0.059	173.7	174.4	0.7

Table 4. Assay data, Spud Patch area, San Miguel 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)
Other holes, Public land--Continued										
357 (7540)							0.060	141.5	142.4	0.9
365 (7624)							0.033	247.0	247.8	0.8
367 (7666)	275.3	275.4	0.1	0.021e	0.21	Undet	0.023	274.6	275.3	0.7
	275.4	275.9	0.5	< 0.020e	0.68	0.8				
369 (7663)							0.029	288.2	289.0	0.8
374 (7674)	275.3	275.6	0.3	0.065	0.43	0.6	0.031	275.4	277.8	2.4
	277.3	277.5	0.2	0.040	0.32	1.4	0.078	299.8	300.6	0.8
	300.0	300.3	0.3	0.36	0.36	11.4				
379 (7571)							0.051	265.4	266.1	0.7
401 (7655)							0.040	249.6	250.5	0.9
Other holes, Sarvis No. 7 claim										
291 (7518)							0.026	126.0	126.6	0.6

Table 4. Assay data, Spud Patch area, San Miguel 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)
Other holes Sarvis No. 6 and Venus claims										
195 (7511)							0.094	90.8	91.3	0.5
							0.033	117.2	118.0	0.8
205 (7513)	135.5	135.6	0.1	0.24	0.13	14.8	0.020	85.9	86.7	0.8
298 (7518)	98.6	99.3	0.7	< 0.020e	0.56	1.5	0.059	103.2	103.9	0.7
	99.3	100.0	0.7	< 0.020e	6.43	0.4				
	100.0	100.5	0.5	< 0.020e	0.64	< 0.1				
	101.0	101.2	0.2	< 0.020e	1.27	12.6				
Other holes, Venus claim										
308 (7560)							0.020	177.0	178.0	1.0
Other holes, Sarvis No. 8 claim										
327 (7507)							0.021	125.1	125.8	0.7
Other holes, Mardi claim										
253 (7452)	24.1	25.4	1.3	< 0.020e	0.52	0.6				
	25.4	25.7	0.3	< 0.020e	0.32	Undet				

Table 4. Assay data, Spud Patch area, San Miguel 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)
Other holes, Paystreak No. 7 and Paystreak No. 9 claims										
243 (7452)							0.049	83.5	84.3	0.8
							0.040	85.9	86.8	0.9
246 (7432)	88.2	88.9	0.7	0.075	0.72	8.4	0.190	87.0	87.9	0.9

data for individual reserve blocks, the amount of reserves that can be calculated within a small limit of error, and thus can 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

---

_/ 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.

---

from drill-hole samples, gamma-ray logs, and production data, and for which the tonnage is computed by projection for a reasonable distance on geologic evidence from points of exposure (drill holes). 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.

Because of the variations in the 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 as little as one-half the calculated tonnage. The limit of error of the total tonnage for several blocks, however, is apt to be considerably lower, perhaps not more than 25 percent of the calculated tonnage. The limit of error in the tonnage figures for inferred reserves, of course, is apt to be higher than for the 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. Reserves, therefore, are calculated with a thickness cutoff of 1 foot. 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 value, uranium and vanadium. The oxides of these metals, U_3O_8 and V_2O_5, occur in an average ratio of about 1:8 as estimated from the assays of the Geological Survey drill core from the Spud Patch area. Within the deposits, however, the two metals are so erratically distributed that a single sample, such as is obtained from a drill hole, is not necessarily representative of the grade or metal ratio of the material near the point sampled. Knowing this by experience, the miner will drive to 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 for ore (Atomic Energy Commission, 1951), the vanadium content of ore containing the normal metal ratio constitutes about one-fourth 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 used (ore-grade material)--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 mill cutoff for vanadium used by the major processing companies. Reserves also are figured 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 method 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 tabular 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 indicated reserves". . . . . is computed by projection for a reasonable distance on geologic evidence." In most places in the Spud Patch area, indicated reserves are projected between drill holes that are not more than 50 feet apart. On the other

hand, indicated reserves are not projected more than 25 feet beyond sample points, where the edge of the deposit has not been located. Reserves are classed as inferred rather than indicated if the projection exceeds these lengths. Inferred reserves are projected to the assumed limits of the deposit, as determined by geologic evidence and interpretation.

Although a single drill hole in ore obviously permits the designation of some tonnage of indicated reserves, there is no reasonable basis for projecting an indicated reserve block more than a few feet from a single hole. Rather than calculate such an indicated reserve block separately, or assign a small arbitrarily selected amount of indicated reserves to a single hole, the reserve block is projected to its assumed limits and the ore calculated and classed as inferred.

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

Calculation of grade

The average grade of indicated reserves in a single block generally is calculated by weighting the assay grades by lengths of samples. If the deposit has been mined in part, the grade of the ore produced is also considered in establishing the grade of the adjoining reserve block. In reserve blocks containing only one or two drill holes, however, if the core assays (table 4) are appreciably higher than the average grade of the ore mined nearby, it is assumed that the drill penetrated abnormally high-grade parts of the body, and an estimated grade is given (table 3). Although the grade of the samples in an inferred block is given (table 4), the grade of reserves assigned to this block is obtained from the records of production from nearby mines or from the area as a whole.

Strict grade cutoffs are used in calculating reserves 1 foot or more thick. Except as noted in the following paragraph, no material belonging to a class with a lower cutoff is included with material of a higher cutoff class, even though the weighted average grade of the whole is above the cutoff grade of the higher class.

A layer of barren rock or material that is below the ore-grade cutoff and not more than 1 foot thick lying between two layers of ore-grade material, the three layers totaling 1 foot or more in thickness is included in calculating reserves, thereby increasing the thickness of one and decreasing the grade proportionately. For example, if two layers, each 6 inches thick and containing 0.30 percent U_3O_8, are separated by 1 foot of barren material, the three layers are calculated together, yielding 2 feet of ore averaging 0.15 percent U_3O_8.

Although some of the waste might be picked out by hand in mining, most of it would go to the mill with the ore. If the waste is more than 1 foot thick, it probably would be blasted separately from the ore layers in mining, and thus ore layers more than 1 foot apart are calculated as separate ore bodies.

Reserve blocks

Reserve blocks are masses or units of mineralized rock that constitute an indicated or inferred reserve as defined by thickness and grade cutoffs. The geometric limits of reserve blocks are determined by the rules and used in calculating reserves. The exact position of the blocks are not shown on figure 3, although the mineralized 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 number is assigned, and the total tonnage and weighted average grade of these masses are shown in table 3.

The mineralized rock contained in two reserve blocks, shown in table 3, has been reported previously in preliminary reserve statements (Bell and Cramer, 1952).

Potential reserves

Potential reserves include the material in deposits that have not been found, but which are predicted solely on geologic evidence.

About 42,000 tons of potential reserves, in material 1 foot or more thick and containing 0.10 percent or more U_3O_8 or 1.0 percent or more V_2O_5 are predicted for the Spud Patch area. These reserves have an estimated average grade of about 0.25 percent U_3O_8 and 2.0 percent V_2O_5, and are estimated to contain about 210,000 pounds of U_3O_8, and 1,680,000 pounds of V_2O_5. About 26,000 tons of these reserves are predicted to be in favorable ground in secs. 29, 30, 31 and 32. About 16,000 tons of these reserves are in small deposits of 500 tons or less in other favorable and semifavorable areas which have not been explored with moderately or closely spaced drilling.

PLANS AND RECOMMENDATIONS

No additional drilling in the Spud Patch area is planned by the Geological Survey. All the large deposits, those containing more than 500 tons, in the favorable ground west of the Mogui Jug and

Depression claims and south of the Mayday mine, probably have been found and only smaller deposits of 500 tons or less remain undiscovered. In other less favorable areas probably only small scattered deposits remain undiscovered.

The deposits found by Geological Survey drilling in public land that probably are of sufficient size to make new mines are considered by the Atomic Energy Commission (informal communication) to be outlined sufficiently for leasing. The most promising deposits found by Geological Survey drilling in private claims (the Jupiter, Sarvis No. 5, and Sarvis No. 6 claims) are being, or likely will be, developed by private enterprise.

If drilling in the vicinity of Geological Survey discoveries is undertaken by claim owners or leasees, or is planned at a later date by the Geological Survey, it is believed that extensions of known ore bodies and deposits are most likely to be found in the following areas shown on figure 3:

1) Block 3, in the ground south and southwest of drill holes 353 and 356.
2) Block 4, in the ground between drill holes 190 and 408.
3) Block 5, in the ground between drill holes 303, 310, and 411.
4) Block 7, in the ground surrounding this block, and particularly in the ground south and west of drill hole 204.
5) Block 10, in the ground surrounding drill hole 297.
6) Sarvis No. 6, Sarvis No. 7, and Sarvis No. 8 claims in the ground between drill holes 195, 291, and 327.

LITERATURE CITED

Atomic Energy Commission, 1951, Domestic Uranium Program Circular 5, revised, part 60 Domestic Uranium Program, Washington, D. C.

Fischer, R. P., and Hilpert, L. S., 1952, Geology of the Uravan mineral belt: U. S. Geol. Survey Bull. 988-A.

Weir, D. B., 1952, Geologic guides to prospecting for carnotite deposits on Colorado Plateau: U. S. Geol. Survey Bull. 988-B.

UNPUBLISHED REPORTS

Bell, Henry, January 1952, Interim report on exploration in the Spud Patch area, San Miguel County, Colorado: U. S. Geol. Survey Trace Elements Memo. Rept. 294.

Bell, Henry and Cramer, M. A., January 1952, Preliminary reserve statement 21, reserve blocks A and B, Spud Patch area, San Miguel County, Colorado: U. S. Geol. Survey Trace Elements Memo. Rept. 259.

Bell, Henry, and Icke, H. M., July 1950, Preliminary appraisal of diamond-drill exploration in the Spud Patch area, San Miguel County, Colorado: U. S. Geol. Survey Trace Elements Memo. Rept. 112.

Craig, L. C., Holmes, C. N., Cadigan, R. A., Freeman, V. L., Mullens, T. E., and Weir, G. W., November 1951, Preliminary report on the stratigraphy of the Morrison and related formations of the Colorado Plateau region: U. S. Geol. Survey Trace Elements Inv. Rept. 180.

Hilpert, L. S., July 1952, Preliminary report on exploration in the Spud Patch area, San Miguel County, Colorado: U. S. Geol. Survey Trace Elements Memo. Rept. 303.

Rogers, A. S., November 1950, Distribution of leached radioactive material in the Legin group area, San Miguel County, Colorado: U. S. Geol. Survey Trace Elements Memo. Rept. 171.