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Preliminary Examination of [redacted] Uranium Deposits near Marysvale, Piute County, Utah

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Trace Elements Memorandum Report 33

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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PRELIMINARY EXAMINATION OF URANIUM DEPOSITS NEAR MARYSVALE, PIUTE COUNTY, UTAH

By

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and

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PRELIMINARY EXAMINATION OF URANIUM DEPOSITS NEAR MARYSVALE, PIUTE COUNTY, UTAH

By

Harry C. Granger

and

Herman L. Bauer, Jr.

Abstract

Autunite and other uranium minerals were discovered in 1948 by Pratt Seegmiller about $3\frac{1}{4}$ miles north of Marysvale, Piute County, Utah. Mining operations were begun in the summer of 1949 by the Vanadium Corporation of America on the Prospector and the Freedom claims, and by the Bullion Monarch Mining Company at the Bullion Monarch claims. These claims were examined briefly in December 1949 and January 1950 by the writers.

The uranium deposits of the Marysvale district are in northeasterly striking fault zones in quartz monzonite that intrudes rocks of the "older" Tertiary volcanic sequence. Flows and tuffs of the "younger" Tertiary volcanic sequence unconformably overlie the earlier rocks.

Autunite, torbernite, uranophane, schroeckingerite, and at least one unidentified secondary uranium mineral occur in the upper parts of the deposits. Pitchblende has been mined from the underground workings of the Prospector No. 1 mine. The uranium minerals are associated with dense quartz veins and intensely argillized wall rock. In the upper parts of the deposits pyrite is completely

oxidized. The secondary uranium minerals probably were formed by the alteration of primary pitchblende by circulating meteoric waters.

Introduction

In 1948 deposits of autunite and other uranium minerals were discovered near Marysvale, Piute County, Utah, by Pratt Seegmiller, a resident of Marysvale. The deposits are in the NW$\frac{1}{4}$, sec. 4, T. 27 S., R. 3 W. (Salt Lake principal meridian), 3$\frac{1}{4}$ miles north of Marysvale and 2 miles east of the Sevier River (fig. 1). They may be reached from Marysvale on the south and Elsinore on the north by a graded dirt and gravel road. Marysvale, on U. S. Highway 89, is the southern terminus of a branch line of the Denver and Rio Grande Western railroad.

The uranium deposits are on the south slopes of the Antelope Range, a group of rolling hills that lie across the Sevier Valley, and have been incised by the Sevier River. The Marysvale district is bounded on the west by the Tushar Range and on the east by the Sevier Plateau.

In September 1949 a brief examination of the Marysvale district was made by R. U. King of the Geological Survey, in the company of C. C. Towle, Jr., of the Atomic Energy Commission, and in December 1949 and January 1950 the writers made a more detailed study. All underground workings at the Prospector No. 1, the Freedom No. 2, and the Bullion Monarch fluorite mines were mapped at a scale of 1 inch to 10 feet (figs. 3, 6, and 7), but no map was made of the Bullion Monarch uranium mine. A map at a scale of 1 inch to 20 feet, was

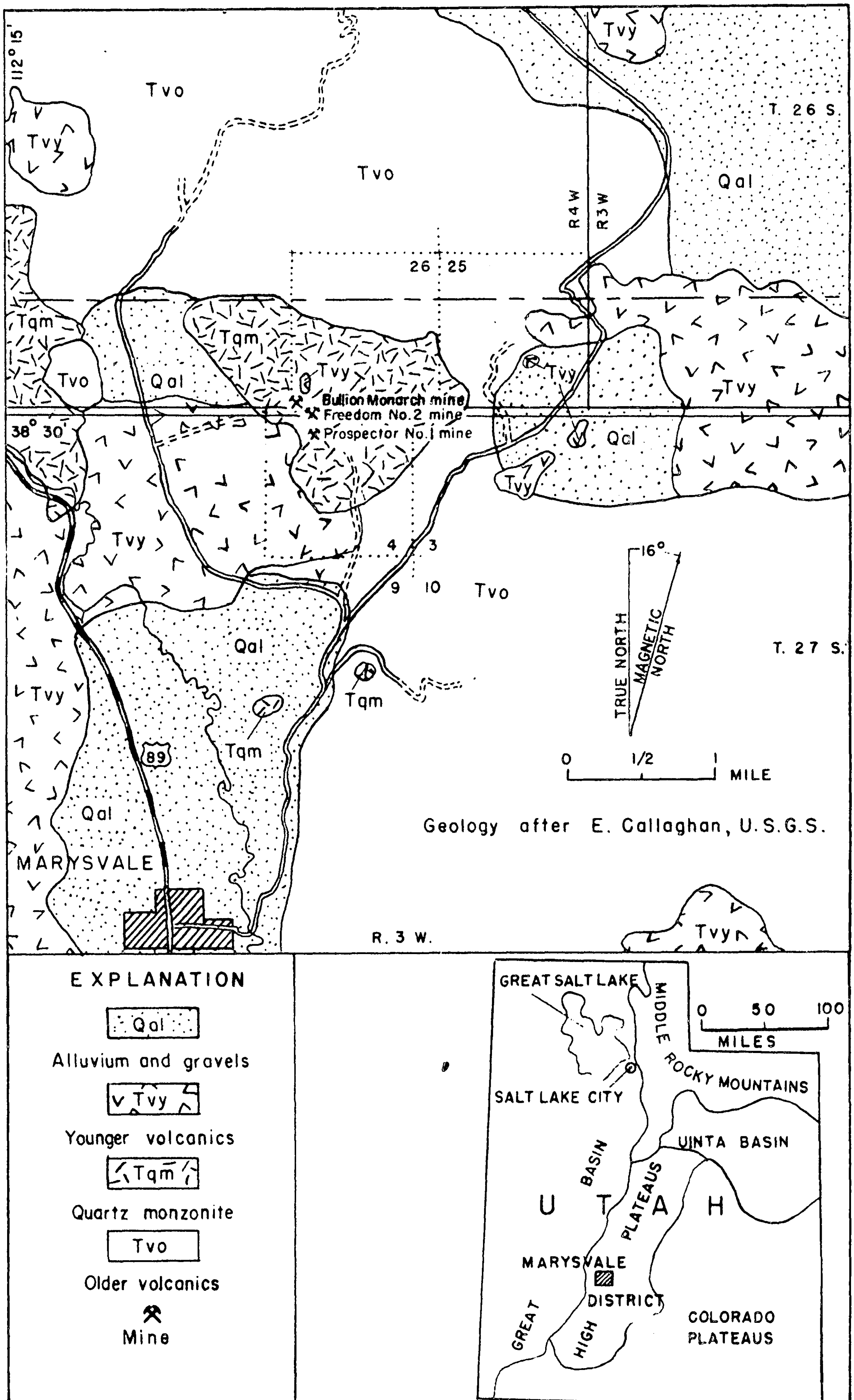

FIGURE I.—INDEX MAP, MARYSVALE DISTRICT, UTAH.

made of the surface near the Prospector No. 1 mine (fig. 2). Three prospect pits on the Prospector No. 1 claim (figs. 4 and 5) were mapped at a scale of 1 inch to 5 feet. Channel samples were taken of all altered and unaltered rocks at the mines studied in order to determine the relationship of alteration to the distribution of uranium minerals. No particular attempt was made to evaluate the grade of these deposits because such studies had been made by W. G. Fetzer and C. C. Towle, Jr., of the Atomic Energy Commission in October 1949 _/.

_/ Fetzer, W. G., and Towle, C. C. Jr., A concept of ore reserve potentialities at the Marysvale uranium deposits, Piute County, Utah; U. S. Atomic Energy Commission, Grand Junction, Colo., Dec. 3, 1949

History

Gold, alunite, and fluorite have been mined intermittently in the Marysvale district. The gold is in quartz veins, and the alunite is in fissure veins and replacement deposits in the older volcanic rocks. Fluorite occurs in veins that cut quartz monzonite and are closely related to the uranium deposits.

The uranium deposits were discovered by Pratt Seegmiller of Marysvale, who identified autunite while prospecting for mineral specimens in the spring of 1948. At that time he staked the Freedom Nos. 1 to 7 claims. Later Rex Smith and the Anderson brothers of Elsinore, Utah staked the Prospector Nos. 1 to 4 claims. These claims, although now leased by the Vanadium Corporation of America, are being developed by the original claim locators.

The Bullion Monarch fluorite and uranium mines are on claims owned by J. W. Sargent of Marysvale and are under lease to the Bullion Monarch Mining Company, Salt Lake City, Utah.

The initial development work on the Freedom and Prospector claims consisted of bulldozer trenching and stripping of talus from the radioactive areas. Subsequently, inclined shafts were sunk on the Prospector No. 1 and the Freedom No. 2 claims, and an open pit was made on the Bullion Monarch claims. Since the field work for this report was completed, exploration of these and other deposits has continued.

The first ore mined was trucked to Naturita, Colorado, for experimental processing, but later ore was stockpiled near the mines. Since March 1950, the ore has been purchased by the American Smelting and Refining Company at a stockpiling depot established in Marysvale under the authority of the Atomic Energy Commission.

Geology

The Marysvale district is underlain by igneous rocks, for the most part latite and rhyolite breccias and flows, similar to the volcanic rocks that underlie much of the High Plateaus of Utah. Stocks of quartz monzonite intrude rock of an older volcanic sequence and are overlain unconformably by a younger sequence of volcanics. The older and younger volcanic sequences correspond to

Callaghan's _/ "earlier Tertiary" and "later Tertiary" rocks. The

_/ Callaghan, Eugene, Volcanic sequence in the Marysvale region in southwest-central Utah; Am. Geophys. Union Trans., 20th Ann. Mtg., Pt. 3, pp. 438-452, 1939.

older volcanic rocks consist chiefly of latite and andesite tuffs, breccias, and flows. Calcic latite flows and breccias predominate in the Antelope Range. The alunite deposits of the Marysvale area are found only in the older extrusive rocks and have been described by Butler and Gale _/, Loughlin _/, Callaghan _/, Thoenen _/,

_/ Butler, B. S., and Gale, H. S., Alunite, a newly discovered deposit near Marysvale, Utah: U. S. Geol. Survey Bull. 511, 64 pp., 1912.

_/ Loughlin, G. F., Recent alunite developments near Marysvale and Beaver, Utah: U. S. Geol. Survey Bull. 620, pp. 237-270, 1915.

_/ Callaghan, Eugene, Preliminary report on the alunite deposits of the Marysvale region, Utah: U. S. Geol. Survey Bull. 886, pp. 91-134, 1938.

_/ Thoenen, J. R., Alunite resources of the United States: U. S. Bur. Mines Rept. Inv. 3561, 48 pp., Feb. 1941.

Bell _/, and others.

_/ Bell, G. L., Unpublished reports: U. S. Geological Survey, 1945.

A small area of intensely silicified rock is exposed near the Prospector No. 1 shaft. The top of this outcrop corresponds closely to the erosional contact between the younger and older volcanic rocks.

The intrusive rocks form stocks less than two miles wide and have been mapped as quartz monzonite and associated rocks by Callaghan _/.

_/ Callaghan, Eugene, op. cit., 1939

One specimen taken near the uranium deposits on the Prospector and Freedom claims was found to be diorite. The Bullion Monarch fluorite mine is in a light-colored porphyritic rock that is presumed to be a border facies of a quartz monzonite stock. Although the composition and texture of the rock in the individual stocks varies, it will be referred to in this report as quartz monzonite, following the usage of Callaghan _/.

_/ Callaghan, Eugene, op. cit., 1939.

The quartz monzonite stock, which contains the known uranium deposits, is cut by dense quartz veins in northeasterly striking fault zones that are not known to extend into the younger volcanic rocks. Other younger faults, however, cut all the rocks exposed in the district.

The younger volcanic rocks unconformably overlie the older volcanics and the monzonitic rocks. They consist of rhyolite, quartz latite, and latite flows and tuffs. Within a few yards of the uranium deposits, the younger volcanic rocks overlie quartz monzonite. These younger volcanics contain glassy and pumiceous fragments, as much as 2 inches long, surrounded by an aphanitic ground mass showing flow structure. Calcite crystals coat the walls of some of the vugs in the rhyolite.

Ore deposits

Structure.--The uranium-bearing veins are in nearly vertical fault zones that strike N. 55° - 65° E. Quartz veins in the fault zones are variable in strike and are discontinuous, locally forming en echelon patterns (figs. 3 and 6).

In the Prospector No. 1 shaft, the most prominent vein follows an intensely iron-stained gouge zone that strikes N. 65° E., and dips nearly vertically. The general trend of the fault zone is evidently parallel to this vein, but subsidiary veins that generally strike N. 80° E. to N. 85° W. and dip northerly about 75° to 85° are common. Other less numerous subsidiary veins strike about N. 40° - 50° E. and dip generally 70° to 85° SE. At 50 feet from the collar, fault striations on the south wall of the Prospector shaft plunge 65° NE.

The prominent vein in prospect pits Nos. 1 and 2 (fig. 4) strikes N. 55° - 60° E. and is nearly vertical. The junction of this vein with the fault zone exposed in the shaft cannot be seen, perhaps indicating that the vein does not extend into the south margin of the fault zone. Two sets of striations on slickensided surfaces along the south wall of prospect pit No. 2 plunge 25° NE. and 33° SE. On the south wall of prospect pit No. 1, fault striations plunge 32° SE. in contrast to striations on the north wall that plunge 50° SW.

A gouge zone, one foot thick, in prospect pit No. 3 (fig. 5) dips 85° NW. and is evidently an extension of the fault zone exposed in the Prospector shaft. Striations on a slickensided surface in the gouge plunge 45° S. 60° W. Twenty feet west of the pit, the gouge grades into brecciated quartz.

The fault zone at the Freedom No. 2 mine strikes N. 60° E. and dips nearly vertically, and becomes indistinct in the lower parts of the shaft. The pattern of subsidiary veins is strikingly similar to that in the Prospector No. 1 mine. One set strikes generally east and dips vertically to 65° N.; the other strikes about N. 30° - 40° E., and dips vertically to 65° NW.

On the Bullion Monarch claim a prominent breccia zone, cemented by fluorite, strikes N. 55° E. and dips nearly vertically, although locally the dip may range from 75° NW. to 75° SE. Several subsidiary veins horsetail from the breccia zone at N. 65° - 75° E., and dip from vertical to 73° SE. A fault surface on the north wall of the fluorite mine has striations plunging 70° SW. Mullions on this surface indicate the north wall was upthrown in relation to the south wall.

Joints are numerous in the rocks near the uranium mines, but rarely are consistent in strike and dip. One joint set, however, strikes N. 65° - 80° E., and dips 80° - 82° SE.

Mineralogy.--Five or more secondary uranium minerals are associated with the quartz veins in the oxidized parts of the Marysvale deposits. Autunite, torbernite, schroeckingerite, uranophane, and a yellow unidentified uranium mineral were found in the deposits in January 1950. Since then, pitchblende has been identified in drill cores and in the deeper workings in the Prospector No. 1 mine. Locally, pyrite, fluorite, uraniferous hyalite, and gypsum, are present and a black stain probably manganese oxide, is common near the margins of vein zones. There appears to be an interrelationship between particular uranium minerals and depth below the surface, degree of alteration, and the presence of quartz veins.

Autunite, calcium uranium phosphate, is the most common secondary uranium mineral in the upper parts of the deposits. It occurs, for the most part, as grains or flakes in fractures and on the surfaces of crystals of altered feldspars in moderately and intensely argillized quartz monzonite. The autunite grains commonly are very thin, transparent or translucent yellow to yellow-green, fluorescent, subhedral flakes lying with their flat side parallel to the surface on which they occur. Less commonly autunite coats fractures in the quartz veins and weakly argillized quartz monzonite. Small, well-formed autunite crystals, scattered among uranophane crystals, were observed on several fractures in the quartz veins.

Torbernite, a copper uranium phosphate that is isomorphous with autunite, is much less abundant than autunite. Its mode of occurrence is similar to that of autunite, but it is most commonly found in weakly argillized quartz monzonite, more than 10 feet below the surface. It forms bright green, non-fluorescent flakes in rock that contains disseminated pyrite. A few specimens, obtained from moderately and weakly argillized rock, show flakes in which yellow fluorescent autunite grades into a green, non-fluorescent mineral, that is probably torbernite.

Schroeckingerite, hydrous uranium carbonate, is present in significant quantities on the Bullion Monarch property, but has not been identified on the Prospector or Freedom claims. It occurs as fracture fillings and blebs, as much as 10 mm. in diameter, in strongly altered quartz monzonite in the uppermost parts of the deposit. Schroeckingerite was found also in rhyolite of the Bullion Canyon volcanics in the spring of 1950.

Uranophane, a calcium uranium silicate, for the most part is in fine, hairlike, non-fluorescent, yellow, radiating crystals or dense crustiform masses of crystals on fracture surfaces in the dense quartz veins or silicified quartz monzonite. Autunite crystals are commonly interspersed with the uranophane crystals and produce a weak fluorescence in the crusts.

A yellow mineral or aggregate common near the surface as oval, cryptocrystalline crusts coated with fluorescent hyalite, has not been identified positively, but may be an intimate mixture of autunite and uranophane.

Pyrite is disseminated throughout the weakly argillized quartz monzonite, but is rare in the moderately argillized quartz monzonite and is lacking in intensely argillized rock. Oxidation undoubtedly accounts for this variation.

Purple fluorite occurs in or adjacent to the dense quartz veins as semi-continuous veins, as blebs as much as 5 inches long, or as leaf-like lenses 2 to 3 inches in maximum dimension. The isolated blebs are commonly massive purple fluorite and the lenses are a fine-grained, dark purple, almost black, fluorite.

In the Bullion Monarch fluorite mine, both white and purple fluorite cements brecciated fragments of wall rock. Here the fluorite is commonly granular and has a colloform surface.

Black stains, probably manganese oxide, are common along the margins of the vein zones. In the Freedom No. 2 mine, a 1- to 2-inch black vein follows the north wall of the shaft for 30 feet and may be manganese-stained fault gouge.

The selenite variety of gypsum, although scarce, occurs locally as thin plates along fractures in weakly argillized quartz monzonite.

Wall-rock alteration.--The rocks within the vein zone in the Prospector No. 1 and the Freedom No. 2 mines have been altered to clay minerals. Three degrees of argillization have been mapped in these mines (figs. 3 and 6), and have been designated as weakly, moderately, and intensely argillized quartz monzonite. It is possible, however, that the moderately and weakly argillized zones, as mapped, actually represent different types of alteration rather than different degrees of argillization.

The weakly argillized zone, where observed, is greenish when moist, suggesting that some chlorite is present. The biotite and hornblende are partly altered, and this alteration may be in part responsible for the greenish cast of the rock. The disseminated pyrite is nearly fresh. The rock retains the original monzonitic texture and grades into moderately argillized quartz monzonite. An arbitrary boundary between the argillized and non-argillized rock is drawn along a narrow band of iron staining.

The moderately argillized rock locally borders quartz veins, but more commonly is separated from them by intensely argillized rock. The moderately argillized rock is white to buff and contains scattered specks of limonite. Although partly obscured, the original monzonitic texture is visible. Biotite and hornblende are partly or completely altered to limonite, and the disseminated pyrite is for the most part oxidized.

The intensely argillized rock is generally highly fractured, bleached nearly white, and soft, though locally it may be silicified in part. The feldspars are almost wholly argillized, and the biotite, hornblende, and pyrite, are commonly completely altered. This intense alteration also has nearly destroyed the original monzonitic texture of the rock.

The intensely and moderately argillized zones are poorly defined, and their contacts are gradational. The weakly argillized zones, on the other hand, have a well defined though arbitrary boundary with the moderately argillized zone, the narrow band of iron staining.

The alteration in these argillized zones may not be wholly the effect of hydrothermal solutions. It is suggested that after hydrothermal solutions argillized the wall rock and deposited disseminated pyrite, meteoric waters further argillized the quartz monzonite and destroyed the pyrite in the intensely and moderately argillized rock.

Localization.--Uranium, in the near surface parts of the Marysvale deposits, occurs along northeast-striking fault zones and is localized by structure and rock types. Evidence obtained to date indicates that the fault zones, the altered zones, and the uranium deposits are nearly coextensive, and that the wider parts of the fault zones are most favorable for ore bodies of secondary uranium minerals.

The ore bodies are narrower in the lower parts of the Freedom No. 2 and the Prospector No. 1 shafts, possibly because the inclined shafts depart from the plunge of the ore shoots. The intersection of the vein exposed in prospect pits Nos. 1 and 2 with the vein in the Prospector shaft plunges nearly vertically or steeply to the southwest. The wide, fractured, and altered zone at the collar of the shaft may be localized by this intersection. The nearly vertical plunge of the intersection may also determine the plunge of the ore bodies, although the lack of evidence prevents any definite conclusions.

The secondary uranium minerals have a zonal distribution determined by the chemical composition of the rock type with which each is associated. Autunite is most prevalent in the intensely and moderately argillized quartz monzonite, whereas torbernite is more abundant in the pyrite-bearing weakly argillized quartz monzonite. Uranophane and the unidentified yellow mineral are generally in or near fractures in the dense quartz veins or wall rock silicified by hydrothermal action.

Although little is known about the schroeckingerite, it is believed to occur very near the surface where the quartz monzonite stock is in erosional contact with the younger volcanic rocks. The pitchblende is reported to occur as thin stringers in and near the dense quartz veins where weathering has been less intense.

Uranium is most abundant in the intensely argillized rock. In the ore zone in the Prospector No. 1 mine, the intensely argillized rock assays about 0.38 percent uranium, the quartz veins 0.16 percent, the moderately argillized rock 0.08 percent, and the weakly argillized rock 0.05 percent. The ore in the Freedom No. 2 mine is of much lower grade. In the ore body the intensely argillized rock assays 0.19 percent uranium, the quartz veins 0.09 percent, moderately argillized rock 0.04 percent, and weakly argillized rock 0.03 percent. Perhaps the true uranium content of the quartz veins is lower than the assays show because of unavoidable contamination by intensely argillized rock during sampling.

Locally, near the margins of altered rock are narrow zones or "veins" of black-stained quartz monzonite. These "veins" are usually 1 to 2 inches wide and contain over 1 percent manganese (table 1). Inasmuch as fresh rock contains about 0.08 percent manganese, and intensely and moderately altered rock contains only 0.01 to 0.02 percent manganese, it is evident manganese is leached from the argillized rock and redeposited near the margins of the vein zones, probably by meteoric waters.

Table 1.—Description and analyses of samples

Field number	Location	Material	eU (percent)	U (percent)	P_2O_5 (percent)	Mn (percent)
HG-1-1	Bullion Monarch fluorite mine.	Fluorite breccia.	0.004	0.003	0.50	0.022
2		Feldspar porphyry.	0.005	0.002	0.40	0.023
3		Fluorite breccia.	0.002	0.002	0.49	0.030
HG-2-4	Prospect pit No. 1.	Quartz monzonite, moderately argillized.	0.020	0.006	1.00	0.006
5		Quartz monzonite, silicified.	0.034	0.016	1.08	0.045
6		Dense-quartz vein material.	0.064	0.016	0.72	0.037
7		Quartz monzonite, intensely argillized.	0.052	0.021	0.82	0.012
8		Quartz monzonite, moderately argillized.	0.010	0.004	0.99	0.007
HG-3-9	Prospector No. 1 mine.	do.	0.015	0.012	0.99	0.057
10		Dense-quartz vein material.	0.059	0.023	0.73	0.021
11		Quartz monzonite, moderately argillized.	0.017	0.010	1.10	0.114
12		do.	0.021	0.011	1.04	0.020
13		do.	0.010	0.005	1.01	0.035
14		Black (Mn?) vein material.	0.037	0.019	0.86	1.24
15		Quartz monzonite, moderately argillized.	0.020	0.010	0.99	0.031
16		Black (Mn?) vein material.	0.041	0.032	0.43	1.83
17		Quartz monzonite, weakly argillized.	0.024	0.018	0.81	0.028
18		do.	0.010	0.005	0.58	0.097
19		Quartz monzonite, intensely argillized.	0.040	0.045	0.45	0.132
20		Quartz monzonite, weakly argillized.	0.068	0.063	0.62	0.015
21		do.	0.17	0.22	0.44	0.010
22		Quartz monzonite, intensely argillized.	0.24	0.27	0.73	0.009
23		do.	0.11	0.080	0.68	0.027
24		do.	0.32	0.38	0.78	0.012
25		do.	0.42	0.63	0.59	0.022
26		do.	0.32	0.60	0.67	0.017
27		do.	0.47	0.56	0.54	0.015

Table 1.--Description and analyses of samples--Continued

Field number	Location	Material	eU (percent)	U (percent)	P_2O_5 (percent)	Mn (percent)
HG-3-28	Prospector No. 1 mine.	Quartz monzonite, moderately argillized.	0.088	0.060	0.68	0.104
29		do.	0.093	0.062	0.82	0.020
30		do.	0.18	0.15	0.79	0.013
31		do.	0.57	1.14	0.77	0.012
32		Dense-quartz and gouge, iron stained.	0.21	0.14	0.84	0.016
33		do.	0.037	0.023	0.34	0.019
34		Quartz monzonite, intensely argillized.	0.058	0.049	0.47	0.008
35		do.	0.070	0.074	0.55	0.009
36		do.	0.059	0.076	0.47	0.022
37		Quartz monzonite, moderately argillized.	0.054	0.058	0.75	0.011
38		Quartz monzonite, intensely argillized.	0.44	0.60	0.86	0.016
39		Quartz monzonite, silicified.	0.11	0.055	0.62	0.017
40		Dense-quartz vein material.		Lost in transit.		
41		Quartz-monzonite, intensely argillized.	0.78	1.36	0.99	0.012
42		do.	0.49	0.43	0.70	0.011
43		do.	0.45	0.53	0.80	0.012
44		do.	0.13	0.039	0.82	0.015
45		Quartz-monzonite, silicified.	0.080	0.058	0.65	0.017
46		Quartz-monzonite, intensely argillized.	0.087	0.025	0.66	0.013
47		do.	0.13	0.062	0.66	0.029
48		Quartz-monzonite, moderately argillized.	0.046	0.074	0.89	0.016
HG-3-49	200 feet N. 14°W. of Prospector No. 1 shaft.	Quartz-monzonite, fresh.	0.006	0.003	0.60	0.073
HG-3-50	125 feet N. 62°W. of Prospector No. 1 shaft.	do.	0.003	0.004	0.70	0.073

Table 1.—Description and analyses of samples—Continued

Field number	Location	Material	eU (percent)	U (percent)	P_2O_5 (percent)	Mn (percent)
HG-3-51	150 feet S. 83°W. of Prospector No. 1 shaft.	Cryptocrystalline quartz and quartz breccia.	0.001	0.002	0.36	0.029
HG-3-52	40 feet south of prospect pit No. 3.	Quartz monzonite, fresh.	0.004	0.001	0.80	0.083
HG-3-53	Prospector No. 1 mine.	Fluorite in gouge.	0.13	0.094	0.51	0.025
HG-4-54	Freedom No. 2 mine.	Quartz monzonite, fresh.	0.005	0.002	1.25	0.092
55		Quartz monzonite, fractured.	0.006	0.004	1.15	0.105
56		Quartz monzonite, moderately argillized.	0.005	0.004	1.25	0.082
57		Quartz monzonite, fractured.	0.007	0.005	0.97	0.480
58		Quartz monzonite, weakly argillized.	0.007	0.006	1.50	0.106
59		Dense-quartz vein material.	0.033	0.029	1.10	0.202
60		Quartz monzonite, weakly argillized.	0.022	0.025	1.30	0.022
61		do.	0.028	0.028	1.30	0.355
62		Quartz monzonite, moderately argillized.	0.055	0.056	1.15	0.020
63		Quartz monzonite, intensely argillized.	0.41	0.41	0.90	0.015
64		Quartz monzonite, moderately argillized.	0.084	0.068	1.23	0.022
65		Quartz monzonite, intensely argillized.	0.053	0.058	1.15	0.011
66		Quartz monzonite, moderately argillized.	0.018	0.012	1.30	0.017
67		Quartz monzonite, weakly argillized.	0.031	0.029	1.07	0.012
68		Quartz monzonite, moderately argillized.	0.037	0.026	1.25	0.018
69		Quartz monzonite, weakly argillized.	0.053	0.046	1.25	0.017
70		Quartz monzonite, intensely argillized.	0.032	0.019	1.45	
71		Quartz monzonite, weakly argillized.	0.053	0.045	1.25	
72		Dense-quartz vein material.	0.13	0.15	0.70	
73		Quartz monzonite, intensely argillized.	0.31	0.26	0.93	
74		Quartz monzonite, intensely argillized.	0.036	0.029	1.55	

Table 1.—Description and analyses of samples—Continued

Field number	Location	Material	eU (percent)	U (percent)	P_2O_5 (percent)	Mn (percent)
HG-4-75	Freedom No. 2 mine.	Dense-quartz vein material.	0.079	0.080	1.08	
76		Quartz monzonite, intensely argillized.	0.16	0.27	0.97	
77		Quartz monzonite, weakly argillized.	0.033	0.026	1.62	
78		Quartz monzonite, intensely argillized.	0.17	0.22	1.00	
79		Dense-quartz and fluorite vein material.	0.14	0.11	0.40	
80		Quartz monzonite, intensely argillized.	0.24	0.36	1.02	
81		Dense-quartz vein material.	0.097	0.11	1.15	
82		Black (Mn?) vein and gouge.	0.090	0.040	0.73	
HG-5-83	Prospector No. 1 claim, prospect pit No. 3.	Fault gouge.	0.017	0.010	0.69	0.01
84		Quartz monzonite, intensely argillized.	0.019	0.021	0.90	0.005
85		do.	0.015	0.015	0.45	0.003
86		Dense-quartz vein material.	0.033	0.046	1.03	0.006
87		Quartz monzonite, intensely argillized.	0.019	0.017	0.39	0.005
88		do.	0.020	0.030	0.41	0.007
89		do.	0.020	0.021	0.39	0.004
90		do.	0.10	0.19	0.20	0.005
91		do.	0.018	0.019	0.53	0.005
92		Fault gouge.	0.026	0.010	0.38	0.007
93		do.	0.031	0.020	1.10	0.013
HG-6-94	Prospector No. 1 claim, prospect pit No. 2.	Quartz monzonite, weakly argillized.	0.007	0.002	0.63	0.093
95		Black (Mn?) vein material.	0.023	0.020	1.35	1.35
96		Quartz monzonite, moderately argillized.	0.11	0.11	0.30	0.021
97		Quartz monzonite, intensely argillized.	0.50	0.79	0.49	0.008
98		Dense-quartz vein material.	0.085	0.078	0.39	0.012
99		Quartz monzonite, intensely argillized.	0.32	0.46	0.25	0.007
100		Quartz monzonite, weakly argillized.	0.032	0.035	0.55	0.159

Table 1.—Description and analyses of samples—Continued

Field number	Location	Material	eU (percent)	U (percent)	P_2O_5 (percent)	Mn (percent)
HG-3-101	Prospector No. 1 mine.	Dense-quartz vein.	0.018	0.018	0.58	0.302
102		Quartz monzonite, moderately argillized.	0.007	0.004	0.65	0.048
103		Quartz monzonite, moderately argillized.	0.011	0.011	0.45	0.060
104		Quartz monzonite, silicified.	0.021	0.018	0.45	0.124
105		Quartz monzonite, moderately argillized.	0.025	0.023	0.63	0.035
106		Quartz monzonite, weakly argillized.	0.13	0.22	0.17	0.006

Assays for P_2O_5 content in the rocks ranged from 0.17 percent to 1.62 percent (Table 1), but there are no marked differences in P_2O_5 content between altered and unaltered rocks. Significant redistribution of phosphates in these deposits is therefore not indicated.

Grade.--Rocks in and near the uranium mines were tested for radioactivity with a Beckman MX-5 portable beta-gamma counter. Average beta-gamma readings on outcrops were taken with the probe held 3 inches above the rock for at least a half minute. Rhyolite, or rhyolite float, at 14 stations occupied near the Prospector No. 1 mine, gave average rate meter readings of 3 divisions on the 0.2 scale. Quartz monzonite at 11 stations away from noticeable alteration other than weathering, gave average rate meter readings of 4 divisions on the 0.2 scale. Altered rock at eleven stations along the outcrop of the vein zone gave counts noticeably higher than those in unaltered rock. In the Prospector mine, meter readings were recorded at 10-foot intervals with the probe held at waist height in the middle of the shaft and drift (Table 2).

Channel and grab samples were cut with a single jack and moil from individual types of rocks. Care was exercised that each sample would be as free as possible from contamination by other rock, and the surfaces were cleaned before sampling. A total of 106 rock samples were taken from three mines, three prospect pits, and outcrops near the mines (figs. 2 through 7).

Table 2.--Geiger-counter traverse in the Prospector No. 1 mine

Distance from collar of shaft	Readings in divisions on the 2.0 scale Beckman MX-5 geiger counter 1/	
	Minimum	Maximum
0	0.5	2.6
10	1.5	4.0
20	6.2	9.3
30	13.7	16.1
40	14.8	17.1
50	15.5	18.5
60	12.8	15.5
70	10.5	12.7
80	7.9	11.0
90	6.0	8.5
100	6.0	9.5
110	6.0	9.2
120	2.1	4.7
126	3.0	7.5
Distance from crosscut in east drift, 1st level		
0	1.0	4.0
10	1.5	5.0
20	1.8	4.5
30	1.5	4.2

1/ Beta-gamma probe held for 30 seconds at waist height in middle of shaft or drift.

Samples were assayed for uranium, phosphorous, and manganese (table 1) to determine the relationship between uranium and these other elements.

Assays show that fluorite and associated wall rock in the Bullion Monarch fluorite mine contain about 0.002 percent uranium (table 1). Similarly, fresh quartz monzonite near uranium-bearing veins contains nearly 0.003 percent uranium. Rock within the uranium-bearing vein zones, on the other hand, ranges from 0.004 to 1.36 percent uranium.

__Origin__.--Fetzer and Towle __/ speculated that the quartz monzonite was the source of the uranium and that hydrothermal alteration conditioned the rock for "dissolution and subsequent reprecipitation of uranium from descending waters." The presence of secondary minerals in the Marysvale deposits and their relationship to hydrothermal veins suggested to the writers as early as December 1949, that they were derived from primary minerals of hydrothermal origin. Recently J. W. Gruner identified pitchblende in the Prospector No. 1 vein below the 70-foot level while making mineral studies for the Atomic Energy Commission.

The secondary uranium minerals undoubtedly formed by alteration of primary pitchblende by circulating meteoric waters. The oxidation of the pyrite probably produced sulfate-rich solutions that could

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__/ Fetzer, W. G., and Towle, C. C., Jr., op. cit.

dissolve pitchblende. These acid solutions also probably acquired phosphate during the argillization of the quartz monzonite that was then used in forming autunite and torbernite. The type of the wall rock apparently controlled the deposition of uranophane on fractures in the dense quartz veins and schroeckingerite near the Mount Belknap rhyolite of the younger volcanic series. The quartz presumably furnished the silica necessary for the uranophane, whereas the calcite in vugs in the rhyolite may have furnished the carbonate necessary to precipitate schroeckingerite. The schroeckingerite may be younger than the autunite and other minerals and related to very recent weathering of the veins. It may have been formed by the alteration of other secondary minerals.

Description of properties

Prospector group.--Four unpatented claims are included in the Prospector group. They are owned by the original claim locators, Rex Smith and Leonard and Merle Anderson, and leased by the Vanadium Corporation of America.

Development work in January 1950 was limited to the Prospector No. 1 claim (fig. 2) where the ore bodies had been explored by a shaft inclined at 29° (fig. 3), three prospect pits (figs. 4 and 5), and six (?) diamond drill holes which are described by Fetzer and Towle [1]. The shaft on the "main" ore body, was about 115 feet

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[1] Fetzer, W. G., and Towle, C. C., Jr., op. cit., pp. 7-9.

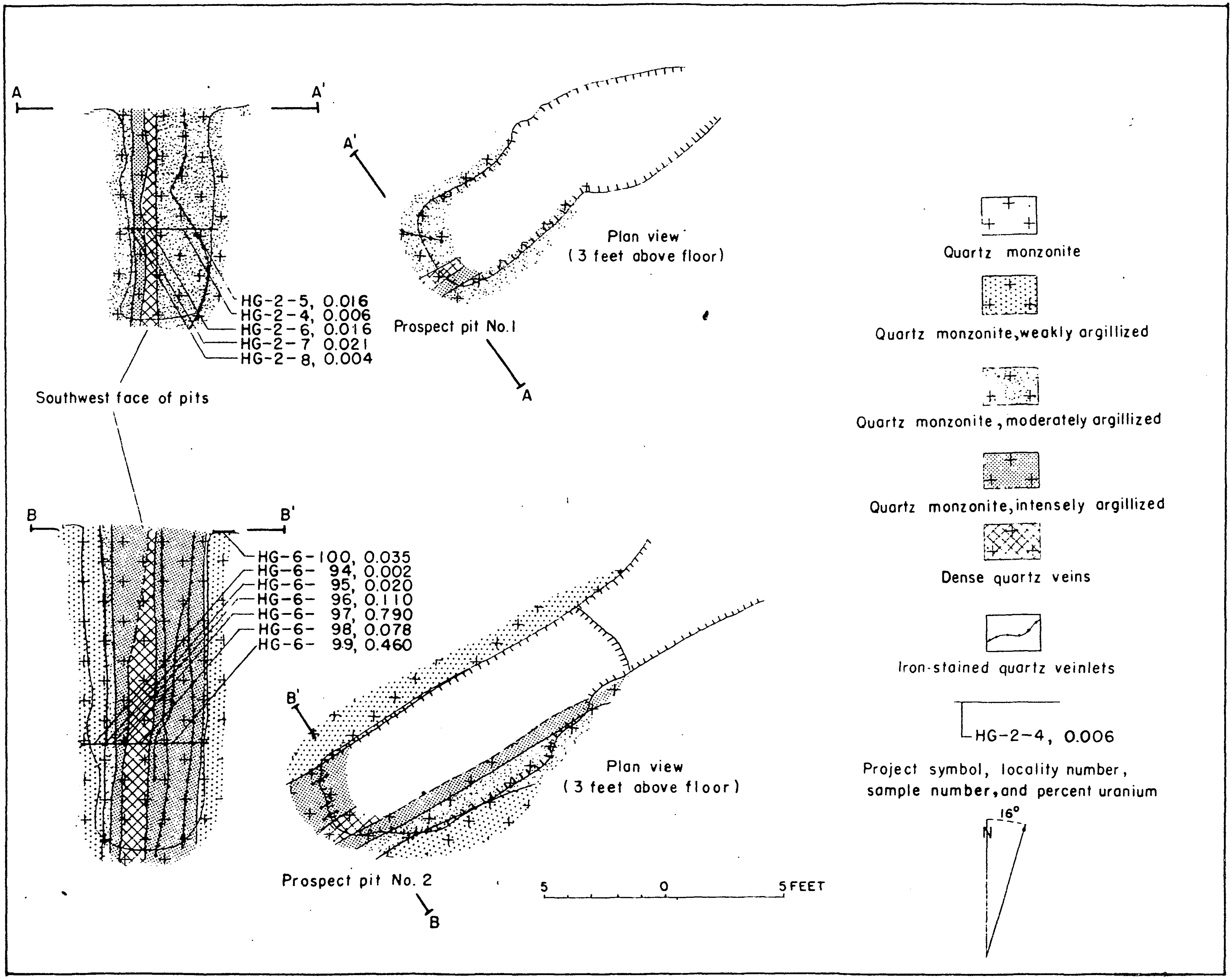

FIGURE 4.— GEOLOGIC PLAN MAPS AND SECTIONS, SHOWING LOCATIONS OF SAMPLES IN PROSPECT PITS NO. I AND NO. 2, PROSPECTOR NO. I CLAIM, MARYSVALE, PIUTE COUNTY, UTAH.

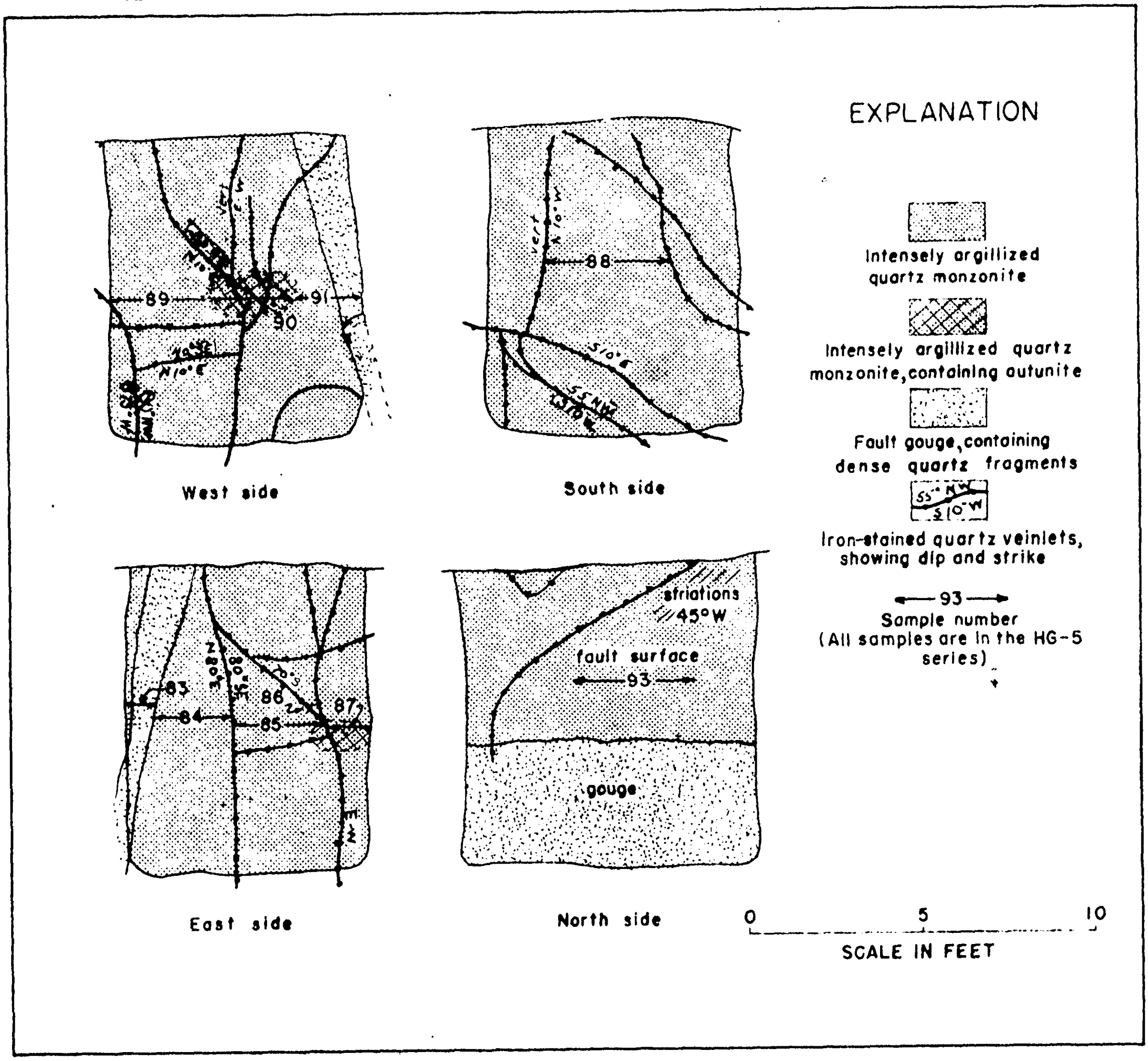

FIGURE 5.— GEOLOGIC SECTIONS SHOWING LOCATIONS OF SAMPLES IN PROSPECT PIT No. 3, PROSPECTOR No. 1 CLAIM, MARYSVALE, UTAH.

long with a 2-foot crosscut to the northeast on the 56-foot level. The crosscut exposed a vein on which the owners mined 7 feet southwest and 30 feet northeast. In January 1950 the owners were drilling a diamond-drill hole directed S. 53° E. at minus 48° near the face of the northeast drift.

The shaft was started on a fractured, intensely altered part of the vein zone, now suspected to mark the intersection of the main, or Prospector vein, with the branch vein explored by prospect pits Nos. 1 and 2. A prominent, nearly vertical, quartz vein extends from about 45 feet to the bottom of the shaft with several discontinuous subsidiary veins roughly parallel to it.

The width of intensely argillized quartz monzonite ranges from over 10 feet at the collar, to less than 2 feet at the bottom of the shaft. The uranium content of the ore is correspondingly lower at the bottom of the shaft where a width of 6 feet assays 0.015 percent uranium in contrast to nearly 0.5 percent at the collar. Hence, it is evident that the shaft either does not follow the ore body or the ore body is very inconsistent in grade along the strike. It is probable that an ore shoot may be found to coincide with the intersection between the ore body, exposed in prospect pits Nos. 1 and 2, and the Prospector vein zone, followed by the inclined shaft; in which case the ore shoot is either vertical or plunges steeply to the southwest.

Prospect pits Nos. 1 and 2 are on a 6-inch dense quartz vein and associated argillized rock. This is designated as the "Branch" ore body. In prospect pit No. 1 the vein is fractured and bordered by a 1-inch selvage of iron-stained fault gouge. Sample assays (table 1) show that the ore values in prospect pit No. 1 are much lower than in prospect pit No. 2.

In prospect pit No. 3 the Prospector vein is represented by 1 foot of gouge containing fragments of quartz vein material. About 20 feet southwest of the pit the gouge grades into quartz breccia. Wall rock on the southeast or footwall of the gouge is intensely argillized, perhaps more by weathering than from hydrothermal alteration. The grade of ore in the pit is about 0.03 percent uranium, much lower than that at the collar of the inclined shaft.

No evidence of uranium minerals or veins was noted in the silicified rock (fig. 2) just west of the Prospector No. 1 mine, yet the vein zone in quartz monzonite along the east border of the silicified rock is known to contain autunite. The outcrop length of the Prospector vein, therefore, extends from this silicified rock at least as far as prospect pit No. 3, a distance of about 300 feet. Forty-seven samples from the Prospector No. 1 mine and 11 samples from prospect pit No. 3 ranged in grade from 0.005 to 1.36 percent uranium (table 1).

The Branch vein in prospect pit No. 2 is known to extend as far southwest as prospect pit No. 1 (fig. 2). Projecting this vein to the Prospector vein, the outcrop length is at least 150 feet. Five samples ranged from 0.004 to 0.021 percent uranium in prospect pit No. 1 compared to 0.002 to 0.79 percent uranium for 7 samples in prospect pit No. 2 (table 1).

Freedom group.--The Freedom group includes 7 unpatented claims owned by Pratt Seegmiller, Marysvale, and leased by the Vanadium Corporation of America.

Initial exploration consisted of overburden removal by bulldozer, digging prospect pits along radioactive zones on the Freedom Nos. 1 and 2 claims, and the diamond drilling described by Fetzer and Towle _/.

_/ Fetzer, W. G., and Towle, C. C. Jr., op. cit., pp. 7-9.

A 30° inclined shaft (fig. 6) was sunk for 93 feet to the northeast on the most prominent ore zone. A short drift on the 45-foot level cut barren rock. A cross cut on the 42-foot level was being extended to the northwest in January 1950.

The shaft was started on two or three nearly vertical quartz veins which split and whose strike and dip are different in different parts of the mine workings. The general trend of the major veins, however, is N. 60° E., and nearly vertical. Both prominent quartz veins and uranium ore are lacking near the bottom of the shaft.

An exposure of autunite-bearing ore crops out about 40 feet southwest of the collar of the Freedom shaft. Although nothing is known about the shape or plunge of this ore body, it is evident that the shaft was started near the northeast margin of ore, for the northeast part of the shaft is not in ore.

The exposure of the uranium-bearing vein zone is about 120 feet long on the surface, but it is probable that removal of overburden would expose ore even farther to the southwest. Twenty-nine samples cut in the Freedom No. 1 mine assayed between 0.002 and 0.41 percent uranium. (table 1).

No study was made of the prospect pits on the Freedom property.

Bullion Monarch group.--The Bullion Monarch Mining Company of Salt Lake City, Utah, controls several claims adjoining the Freedom group. The Bullion Monarch fluorite mine (fig. 7) is leased from J. W. Sargent of Marysvale.

Mine workings in the fluorite mine consist of an adit, following a 2-foot wide fluorite breccia vein for 100 feet, and a stope from 37 to 67 feet from the portal. The grade of fluorite was evidently too low to permit continued mining, and the mine is now idle.

Although the uranium content of the fluorite vein is only a few thousandths of a percent (table 1), other parts of the vein, farther northeast, may contain uranium ore. The structural similarity between the vein in this mine and the veins on the Prospector and Freedom properties and the presence of fluorite in these veins leads to this conclusion. The difference in rock types, quartz monzonite in the uranium mines and feldspar porphyry in the fluorite mine, may, in some way, have caused the differences in mineral deposition.

The Bullion Monarch Mining Company was exploring a large exposure of uranium ore just east of the fluorite mine in January 1950. At that time

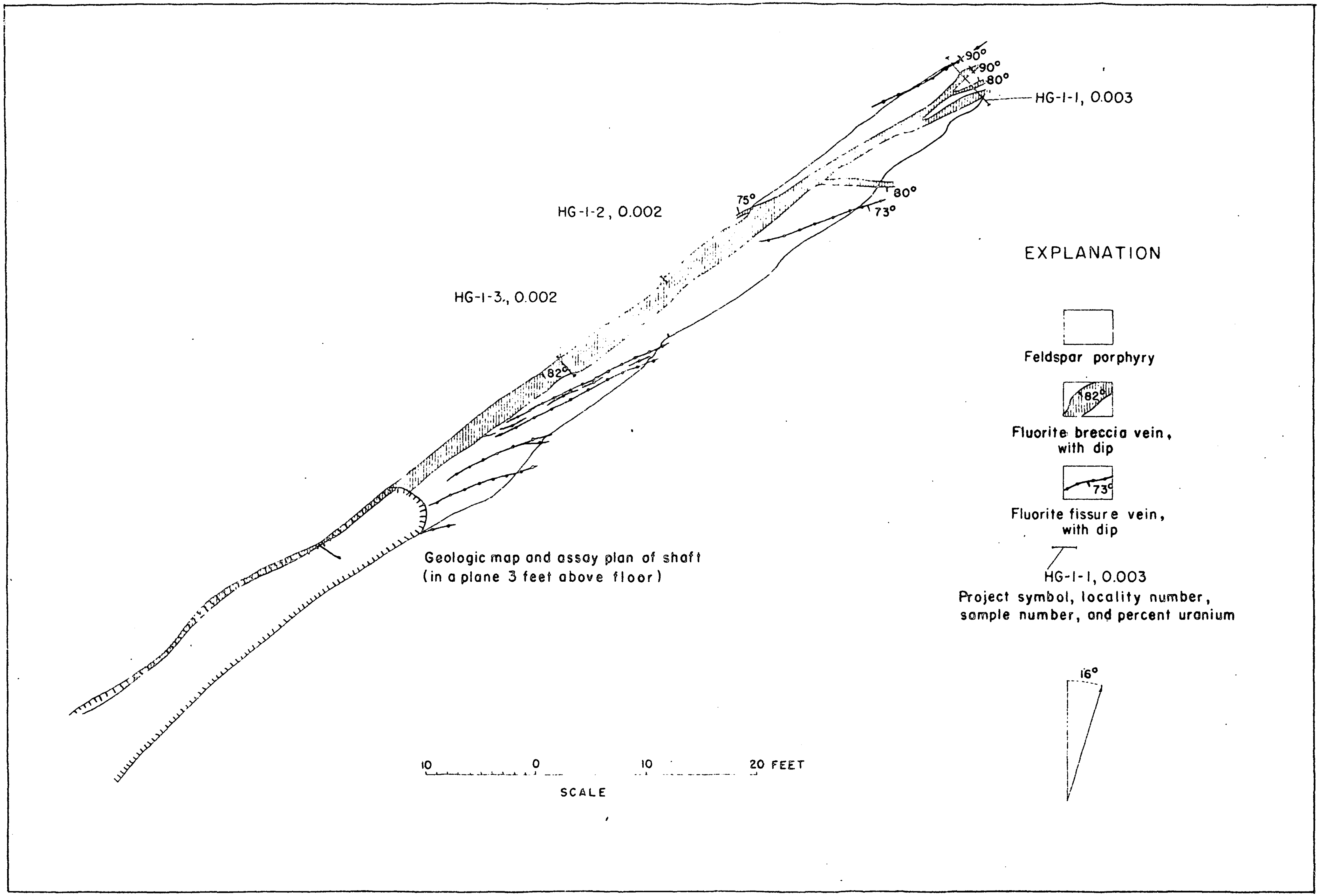

FIGURE 7.— GEOLOGIC MAP AND ASSAY PLAN OF BULLION MONARCH FLUORITE MINE, MARYSVALE DISTRICT, PIUTE COUNTY, UTAH

no consistent structural control was evident in the ore body, but it is probable that a northeasterly striking vein zone, similar to those on the Prospector and Freedom properties, will be found below the rocks affected by near surface oxidation.

Conclusions and suggestions for prospecting

The secondary uranium minerals in the Marysvale deposits occur in or near quartz veins in highly altered, bleached, and iron-stained quartz monzonite along northeast-striking faults. Prospecting should be carried on along known faults of this trend and in areas where outcrops or float of dense vein quartz and bleached and altered rock occur. Abnormal radioactivity should also be used as a guide, especially in areas of shallow overburden.

The evident close structural and mineralogic relationships between the predominantly fluorite- and predominantly uranium-bearing veins suggest that further investigation of fluorite deposits may lead to discovery of hitherto unknown uranium deposits. Study of the structure of the uranium deposits in quartz monzonite may also lead to discovery of deposits in rocks of other types.