DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1628-A
PAMPHLET

MINERAL RESOURCE POTENTIAL OF THE BUFFALO PEAKS WILDERNESS STUDY AREA, LAKE, PARK, AND CHAFFEE COUNTIES, COLORADO

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STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and the Joint Conference Report on Senate Bill 4, 88th Congress, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Buffalo Peaks Wilderness Study Area, Pike and San Isabel National Forests, Lake, Park, and Chaffee Counties, Colo. The area was established as a wilderness study area by Public Law 96-560, December 22, 1980.

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

During 1981 and 1982, the U.S. Geological Survey and the U.S. Bureau of Mines conducted field investigations to evaluate the mineral resource potential of the Buffalo Peaks Wilderness Study Area. The study area encompasses 57,200 acres (about 89 mi^2) of the Pike and San Isabel National Forests in Lake, Park, and Chaffee Counties, Colo.

There are six separate areas (A through F) having mineral resource potential. Area A, along the northeast margin of the study area has a moderate resource potential for silver in base-metal veins and bedded replacement deposits. Within area A a small zone near Weston Pass has a high potential for silver resources in veins. The northwest part of the study area (area B) has a low to moderate potential for silver and gold resources in quartz-pyrite veins. Most veins occur outside the study area. Area C is along the southwest margin of the study area, and has a low to moderate potential for silver and gold resources in quartz-pyrite veins. Most veins occur outside the study area. In addition, area C has low potential for uranium resources in veins. Area D has an identified uranium resource and a low to moderate potential for additional uranium resources in uraniferous jasperoids in the Sawatch Quartzite along the southeast margin of the study area. In the rest of area D there is a low to moderate resource potential for lead and barite in fault controlled deposits. Within area D a small zone along the northeast side of the Middle Fork of Salt Creek has a low to moderate resource potential for silver in vein deposits. Anomalous amounts of barium (2,000-10,000 ppm) and lead (30-1,500 ppm) were discovered by the geochemical sampling of stream sediments in areas E and F along the east margin of the study area. However, no bedded replacement or vein deposits of barite or galena were observed during geologic mapping, and therefore a low to moderate resource potential is assigned for barite and lead in areas E and F. The six mineralized areas are largely related to fault systems and to Laramide intrusive activity.

There is little or no indication of oil or gas, or geothermal energy resources in the study area.

INTRODUCTION

Location and geographic setting

The Buffalo Peaks Wilderness Study Area occupies 57,200 acres (about 89 mi^2) within the Pike and San Isabel National Forests in Lake, Park, and Chaffee Counties of Colorado (fig. 1). The study area is reached on the north by U.S. Forest Service road 425 along the South Fork of the South Platte River and over Weston Pass (altitude 11,921 ft) into Big Union Creek on the west. To the south, the study area is accessible from the Otero aqueduct line and the Lenhardy cutoff road. To the west, the Arkansas River and U.S. Highway 24 provide access to the Fourmile Forest Service Road 200 and the Buffalo Meadows

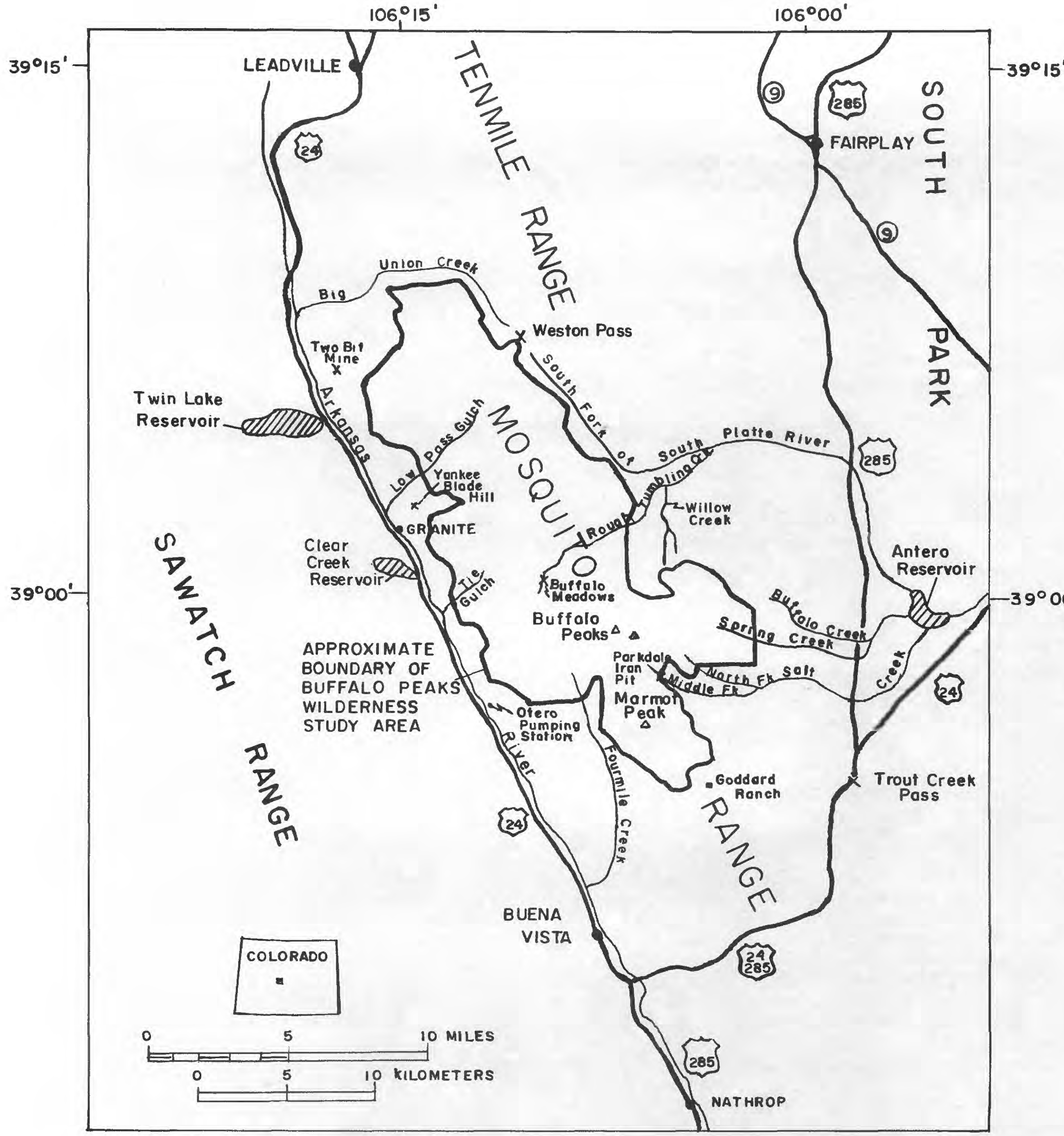

Figure 1.--Index map showing location of the Buffalo Peaks Wilderness Study Area.

trailhead along Fourmile Creek. The Low Pass Gulch road leading north from Granite and extending over Yankee Blade Hill into Hayden Gulch, provides access to the gold mines of the Granite district. On the east side of the Mosquito Range the numerous side roads such as the Buffalo Springs and Salt Creek roads that branch off from U.S. Highway 285 provide access to the southeastern part of the study area.

The study area is within the Mosquito Range, a major divide that separates the Arkansas River and its tributaries from South Park and the tributaries of the South Platte to the east. Elevations of peaks range from 12,892 ft on South Peak near Weston Pass to 13,326 ft on West Buffalo Peak. The Arkansas River valley, which is along a major rift structure that separates the Sawatch Range on the west from the Mosquito Range to the east, has elevations that range from 8,200 to 8,880 ft.

The Mosquito Range is located structurally on the N. 30° W.-striking east flank of the faulted Sawatch anticline (Tweto, 1975). The anticline has a core of Precambrian igneous and metamorphic rocks and an east flank of eroded Paleozoic strata. Paleozoic strata dip 25°-30° E.

Present and previous studies

Present investigations by the U.S. Geological Survey and the U.S. Bureau of Mines included mapping an area of about 125,000 acres in and around the study area. The U.S. Geological Survey investigations include geologic mapping at a scale of 1:50,000 (Hedlund, in press), an aeromagnetic survey (Hedlund, in press), and a geochemical sampling of rocks, stream sediments, and spring water (Nowlan and Gerstel, in press; Nowlan and others, in press). The U.S. Bureau of Mines has reviewed past and present mining activity, and the numerous mines and prospects of the study area were examined and sampled by Wood (1983). During the period of this study no actual mining was observed, although prospecting and claim staking activities in the vicinity of Weston Pass and along Union Gulch were noted.

Previous geologic studies in the study area include the reconnaissance maps by Tweto (1974) and Scott (1975); both maps are at a scale of 1:62,500. More detailed work includes the report on the geology of the Weston Pass mining district (Behre, 1932); a description of the gold veins in the Granite district by E. C. Eckel (unpub. data, 1932) and J. C. Hersey (unpub. data, 1982); and various maps and descriptions of the Salt Creek uraniferous jasperoids that were submitted to J. V. Dodge, owner of the Bronoc-Lady Elk claims by C. M. Armstrong (written commun., 1977, 1978) and Jack Di Marchi and Edward Duke (written commun., 1979). Production records for the Fourmile district are from Vanderwilt (1947). Radioactive mineral occurrences just south of the Buffalo Creek area and at the Josephine mines are reported by Nelson-Moore and others (1978).

ACKNOWLEDGMENTS

We gratefully acknowledge the assistance of J. C. Hersey of Gunnison, Colo., for providing the mining history and some of the production figures for various mines in the Granite district. We also thank J. V. Dodge of Canon City, Colo., for providing the mining history and reserve estimate for the Bronc-Lady Elk claims.

GEOLOGY

The Mosquito Range, which is continuous with the Tenmile Range north of Weston Pass, is a part of the N. 30° W.-striking east flank of the large, highly faulted Sawatch anticline (Tweto, 1975). Precambrian igneous and metamorphic rocks comprise the core of this anticline, and east-dipping Paleozoic strata along the east side of the Mosquito Range represent the eastern limb.

Precambrian rocks comprise a little more than three-fourths of the outcrop area and include older Proterozoic migmatite, amphibolite, and granodiorite group of rocks that is intruded by younger Proterozoic Y granitic rocks. The migmatite in the Granite district is probably part of a synformal structure having an axial plane that strikes N. 70° E. and shows closure to the west-southwest. The mineralized faults and rhyolite dikes within this migmatitic gneiss are approximately conformable to the foliation within the gneiss.

The Paleozoic strata include the Cambrian Sawatch Quartzite, about 150 ft thick; the Ordovician Manitou Dolomite, about 190-230 ft thick; the Ordovician Harding Sandstone, as much as 50 ft thick; the Ordovician Fremont Dolomite, about 90 ft thick; the Devonian and Lower Mississippian(?) Chaffee Group with an aggregate thickness of about 100 ft; the Lower Mississippian Leadville Limestone, about 140 ft thick; and the undivided Pennsylvanian Belden and Minturn Formations that are about 7,700 ft thick. Some formations are absent due to normal faulting, such as in the vicinity of Weston Pass, where the Ordovician Fremont Dolomite and beds of the Chaffee Group are absent. Numerous disconformities separate the lower Paleozoic formations; the Cambrian Sawatch Quartzite thins appreciably to the southeast of the study area and is absent through nondeposition or erosion in the vicinity of Trout Creek Pass. Similarly, the Ordovician Harding Sandstone thins northwest of Trout Creek Pass. Vuggy and locally silicified beds of the Mississippian Leadville Limestone are host for some of the bedded replacement ore bodies in the Weston Pass-Union Gulch districts. In places, the dolomitization of the Leadville Limestone to form "zebra-striped" rock was probably an important factor for increasing porosity and providing sites for later ore deposition.

Laramide intrusions include a small biotitic rhyolite plug (61.4±2.2 m.y. old; dated by potassium-argon method) along the east side of Rough and Tumbling Creek and thin rhyolite dikes (65.3±2.4 m.y. old; dated by potassium-argon method) in the Granite district (R. F. Marvin and others, written commun., 1983). Other, and probably later intrusions of rhyolite dikes, in the vicinity of Fourmile Creek, are of Oligocene(?) age.

Deposits of Tertiary and Quaternary age include the thick (1,500-ft) sequence of Oligocene (34-m.y.-old) volcanic rocks in the Buffalo Peaks area, the Miocene and Pliocene Dry Union Formation and the diverse colluvium and glacial deposits of Quaternary age. The Buffalo Peaks Andesite overlies the crystal-rich ash-flow tuffs of the Oligocene Badger Creek

Tuff, but in places the ash-flow tuffs and associated laharic breccias are intercalated with the lower andesite flows.

Faults have had an important influence on the localization of mineral deposits. The silver-bearing base-metal veins of the Weston Pass-Union Gulch districts are along a branched fault system that is coextensive with the large Weston fault. Some of these faults displace older northeast-striking faults that are not mineralized. The quartz-pyrite-gold-tourmaline veins of the Granite-Two Bit districts occupy closely spaced east-northeast-striking faults in migmatite. In area C (fig. 2), along both sides of Fourmile Creek, the quartz-pyrite-gold veins are coextensive with north-northwest-striking fault systems that show evidence of repeated movement. The uraniferous jasperoids at the Parkdale iron pit are probable hydrothermal vein and bedded replacement deposits that are localized along fractures and small faults in the Sawatch Quartzite and underlying Precambrian granite.

GEOCHEMISTRY

Geochemical sampling was done during June and July of 1982 (Nowlan and Gerstel, in press; Nowlan and others, in press). Sampling density was about one site per square mile. At each site, where possible, stream-sediment, stream-water, and two panned-concentrate samples were collected. Spring water was sampled where springs were encountered. Totals of about 80 stream-sediment samples, 160 panned concentrate samples, and 100 water samples were collected.

Stream-sediment samples were analyzed for 31 elements by emission spectrography (Grimes and Marranzino, 1968) and for arsenic, zinc, cadmium, bismuth, and antimony by a modification of the atomic-absorption-spectrographic method described by Viets (1978). Water samples were analyzed for about 25 constitutents using methods outlined by Ficklin and others (1981). One panned-concentrate sample from each site was panned until black minerals started to leave the pan; this concentrate was subjected to a series of heavy-mineral and electromagnetic separations in order to obtain a heavy, nonmagnetic fraction. The heavy, nonmagnetic sample was pulverized and analyzed for 31 elements by emission spectrography. A second concentrate from each site was panned until the light-colored, light-weight minerals were gone; the entire sample was then pulverized and a 10 g portion was analyzed for gold by atomic-absorption spectroscopy (Thompson and others, 1968).

Elemental values at the 90th percentile or greater are generally considered anomalous for the study area, and elemental values between the 75th and 90th percentiles are considered high (table 1). Some elements, such as silver, molybdenum, and tin in stream sediment or bismuth and vanadium in nonmagnetic heavy concentrates, were detectable in so few samples that any detectable amount is considered anomalous. Geochemical patterns are more significant than single-site, single-element anomalies. Elemental patterns that roughly coincide with areas of known mineralization are significant, especially if the elements giving the pattern are elements known to be part of the mineralization. The coincidence of patterns of many variables, even in areas of no known mineralization, is also significant. Nowlan and Gerstel (in press) summarized the geochemical associations and classified parts of the study area as being high or anomalous in various elements (see table 1 of their report).

Significant geochemical patterns are evident in five general areas (see table 2): Weston Pass-Union Gulch districts (area A, fig. 2); Granite-Two Bit districts (area B, fig. 2); Fourmile Creek-Buffalo Peaks districts (area C, fig. 2); southeastern part of the study area (areas D and E, fig. 2); and in the vicinity of the Laramide rhyolite stock between Rough and Tumbling and Willow Creeks (area F, fig. 2). Statistics for analyses of stream-sediment and panned-concentrate samples are shown in table 1 (this report).

The geochemical studies show that, in general, the geochemistry of various parts of the study area reflect known mineralization in adjacent areas outside the study area, even though elemental concentrations generally seem low for being adjacent to known mineralized areas. Stream-sediment samples from the Weston Pass-Union Gulch districts (area A, fig. 2) are anomalous in arsenic (>5 ppm), cadmium (>0.9 ppm), lead (>100 ppm), and zinc (>140 ppm); this anomaly is compatible with its proximity to the silver-bearing base-metal ores of the Weston Pass-Union Gulch districts.

Stream-sediment samples from the vicinity of the Granite-Two Bit districts (area B, fig. 2) have anomalous amounts of cadmium (>0.9 ppm), manganese (>1,500 ppm), nickel (>20 ppm), uranium (>21 ppm), and zinc (>140 ppm); panned concentrates from the vicinity of area B are anomalous in tungsten (>70 ppm). Stream-sediment and samples from the vicinity of area B are high in arsenic (5 ppm), copper (50 ppm), and lead (100 ppm); panned concentrates from the same area are high in boron (15-50 ppm), barium (500-1,500 ppm), manganese (1,000 ppm), lead (100-200 ppm), and thorium (300-700 ppm). Gold was chemically detected in several panned concentrates; the highest value is 0.95 ppm. This association of elements in samples from the Granite-Two Bit districts is compatible with the tourmaline-bearing quartz-pyrite-gold veins of the districts.

Stream-sediment samples for the Fourmile Creek-Buffalo Peaks districts (area C, fig. 2) have anomalous amounts of zinc (>140 ppm) and tin (detectable at 10 ppm). Panned concentrates from area C have anomalous amounts of copper (>14 ppm) and molybdenum (10 ppm). In addition, stream-sediment samples are high in copper (50 ppm), manganese (1,500 ppm), nickel (20 ppm), lead (100 ppm), and uranium (10-21 ppm). Panned concentrates from area C are high in manganese (1,000 ppm), lead (100-200 ppm), and thorium (300-700 ppm). Gold was chemically detected in several panned concentrates; the highest value is 1.0 ppm. The association is compatible with the high-temperature quartz-pyrite-gold veins along Fourmile Creek.

Area D (fig. 2) has uraniferous jasperoids and several silver-bearing veins. A pattern of anomalous boron (>50 ppm), molybdenum (10-20 ppm), lead (>200 ppm), and thorium (>700 ppm) in panned concentrates is present in an area that includes areas D and E (fig. 2). Stream-sediment samples from areas D and E and vicinity are high in copper (50 ppm), manganese (1,500 ppm), molybdenum (5 ppm or greater), nickel (20 ppm),

Table 1.--Statistics for analyses of stream-sediment and panned-concentrate samples from the Buffalo Peaks Wilderness Study Area, Colorado

[Leaders (---) indicate not applicable; dash (-) indicates value of zero; N, element not detected; L, element present in amount less than lower limit of determination; G, element present in amount greater than upper limit of determination; valid, number of unqualified values. Minimum, maximum, mean, and standard deviation are for the unqualified data]

Element	Minimum deviation	Maximum deviation	Mean deviation	Standard deviation	Number of samples			
					N	L	G	Valid
Stream sediments								
ppm								
Ag	3	3	3.000	---	84	-	-	1
As	5	10	5.770	1.8800	31	41	-	13
Ba	150	700	409.000	128.0000	-	-	-	85
Bi	2	2	2.000	.0000	5	51	-	29
Cd	.2	9	.661	.9760	-	-	-	85
Co	5	30	9.480	4.3800	-	-	-	85
Cu	10	70	28.100	11.3000	-	-	-	85
Mo	5	7	5.500	1.0000	81	-	-	4
Ni	5	30	14.000	7.3700	-	-	-	85
Pb	15	300	75.800	48.3000	-	-	-	85
Sn	10	30	20.000	14.1000	83	-	-	2
Th	200	500	150.000	104.0000	57	13	-	15
Zn	40	190	95.400	29.5000	-	-	-	85
Nonmagnetic panned concentrates								
percent								
Fe	.1	3	.315	.389	-	2	-	76
Mg	.05	5	.332	.715	-	20	-	58
Ca	3	30	11.800	6.660	-	-	-	78
Ti	.1	2	1.130	.637	-	-	18	60
B	20	150	38.400	32.700	52	7	-	19
Ba	50	10,000	724.000	1,790.000	-	5	1	72
Be	2	15	2.610	2.260	32	13	-	33
Bi	50	200	100.000	86.600	75	-	-	3
Co	10	70	17.800	17.100	61	1	-	16
Cr	20	200	53.000	32.300	1	7	-	70
Cu	10	30	13.300	5.880	36	27	-	15
La	100	2,000	987.000	613.000	-	-	8	70
Mn	200	2,000	699.000	370.000	-	-	-	78
Mo	10	150	31.300	48.500	68	2	-	8
Nb	50	100	59.500	13.600	30	28	-	20
Ni	10	30	17.500	7.070	70	-	-	8
Pb	20	1,500	142.000	263.000	-	-	-	78
Sc	15	50	22.700	5.450	-	-	-	78
Sn	20	70	35.000	17.200	53	7	-	18
Sr	200	1,500	600.000	394.000	61	-	-	17
Th	200	2,000	532.000	497.000	27	7	-	44
V	20	200	38.600	41.500	18	11	-	49
W	100	200	125.000	50.000	71	3	-	4
Y	200	2,000	877.000	390.000	-	-	-	78
Sr	2,000	2,000	2,000.000	.000	-	-	76	2
Raw panned concentrates								
ppm								
Au	.05	4.7	.820	1.420	67	1	-	10

Table 2.--Partial semiquantitative spectrographic analyses, fire assays, and atomic absorption analyses of selected samples from the Buffalo Peaks Wilderness Study Area, Colorado

[Source of data: USBM, U.S. Bureau of Mines; USGS U.S. Geological Survey; PID, released data from private industry; N.A., not analyzed; L, below limits of detection; -, not reported. Conversion factor 1 oz/ton = 34.3 g/t]

Locality No.	Source of data	Mine	Number of samples	Gold (oz/ton)	Gold (ppm)	Silver (oz/ton)	Silver (ppm)	Copper (ppm)	Lead (ppm)	Zinc (ppm)	eU_3O_8 (ppm)
Area A.	(Includes parts of the Weston Pass and Union Gulch districts)--Siver-bearing base-metal ores occur as bedding replacement and fissure vein deposits in chiefly the Leadville Limestone. Prior to 1916 the total Ag production is estimated at about 125,000 oz of which over half was from the Ruby-Cincinnati group of mines. Some veins were especially in Zn and Pb but the production figures for these metals are not known. There has been very little mining in these districts since 1918.										
2	USGS----	Ruby-Cincinnati group	2	-	L	-	5	300	5,000	7,000	N.A.
				-	L	-	50	300	70,000	30,000	N.A.
2	--do----	Collin-Campbell-------	1	-	L	-	.15	100	15,000	15,000	N.A.
2, 3, 4, 5.	USBM----	Weston Pass mines-----	11 (average)	<0.005	-	<0.2-0.5	-	50	240	N.A.	N.A.
6, 7, 8	--do----	Union Gulch mines-----	22 (average)	<.005	-	<.2-.5	-	70	270	N.A.	N.A.
1	USGS----	Mines near Rich Creek Campground.	1	-	L	-	L	7	50	200	N.A.
1	USBM----	----do----------------	8 (average)	<.005	-	<.2	-	40	N.A.	N.A.	N.A.
Area B.	(Includes parts of the Granite--Two Bit districts)--Au placers were discovered in the vicinity of Granite in 1859 and the quartz-pyrite-gold veins on Yankee Blade Hill in the early 1860's. The total production value prior to 1878 has been variously estimated at about $750,000 (E. B. Eckel, unpub. data, 1932) to $2,000,000 (J. C. Hersey, written commun., 1982). Probably the best production figure ranges from 65,000 to 97,000 oz of Au. Most of the Au came from the mines on Yankee Blade Hill and from the mines north of Low Pass Gulch (Belle of Granite mine). Au production after 1880 was insignificant.										
11	USGS----	Two Bit mine dump-----	1	-	0.45	-	100	1,500	700	500	N.A.
12	--do----	Two Bit mine extension (trench).	1	-	.10	-	10	200	700	500	N.A.
11, 12	USBM----	Two Bit Gulch district mines.	11 (average)	<.005	-	<.2-.8	-	60	120	N.A.	N.A.
4	USGS----	Granite tunnel dump-	1	-	1.7	-	.15	200	200	L	N.A.
4	USBM----	----do----------------	14 (average)	<.005	-	<.2	-	50	150	40	N.A.
4	--do----	----do----------------	9 (average)	.201	-	.08	-	170	2,500	850	N.A.
3	PID-----	Diverse (4) mines of Yankee Blade Hill.	18 (average)	1.74	-	.8	-	280	590	560	N.A.
3	USBM----	Diverse mines of Yankee Blade Hill.	35 (average)	<.005-.254	-	<.2-1.3	-	100	160	N.A.	N.A.
3		Mine 114 (Wood)-------	1	.31	-	.4	-	N.A.	N.A.	N.A.	N.A.
6	USGS----	The Belle of Granite mine dump.	1	-	1.0	-	2.0	500	500	500	N.A.

7	--do----	Mine No. 4------------	1	-	.5	-	L	15	70	L	N.A.
5	USBM----	Free Gold, Yosemite, Hattie Jane.	33 (average)	<.005-10	-	<.2-.3	-	140	160	N.A.	N.A.
8	--do----	Mines of Spring Creek	14 (average)	<.005-.5	-	<.2-.5	-	80	20	N.A.	N.A.
9	--do----	Mines of upper Low Pass Gulch.	5 (average)	<.005	-	<.2	-	80	100	N.A.	N.A.
10	--do----	----do----------------	1	<.005	-	<.2	-	100	100	N.A.	N.A.
				Mines in Tie Gulch							
1, 2	--do----	Unknown---------------	5 (average)	<.005-.016	-	<.2-.2	-	25	N.A.	N.A.	N.A.

Area C. (Includes parts of the Fourmile and Buffalo Peaks mining districts)--The quartz-pyrite-gold veins along Fourmile Creek and extending to the Arkansas River have been extensively explored but most deposits are small and have yielded only small amounts of Au. The Little Annie group of mines probably produced 53 oz of Au from 1935 through 1937 and 39 oz of Ag in 1940 (Vanderwilt, 1947, p. 45). The other mines in the district are relatively small, although there has been extensive exploration along the quartz veins of the Bonanza-Midway claims.

5, 6	--do----	Josephine mines-------	8	<.005	-	<.2-.2	-	80	N.A.	N.A.	1, 2, 6, 1, 3.
2	USGS----	Divines Gusto No. 1---	1	-	.25	-	L	L	L	L	N.A.
4	--do----	Little Annie mine-----	1	-	L	-	L	20	70	L	N.A.
4	USBM----	Little Annie mine group.	15	<.005-.396	-	<.2	-	30	N.A.	200	N.A.
1	USGS----	Bonanza-Midway claims	1	-	L	-	L	2	50	L	N.A.
1	USBM----	----do----------------	17	<.005-.058	-	<.2	-	45	N.A.	N.A.	N.A.

Area D. (Salt Creek area uranium)--Mineral occurrences within the Salt Creek area of the Fourmile and Buffalo Peaks mining districts. U was first discovered by J. Amrine in the mid-1950's at the Parkdale iron pit near the head of Middle Fork of Salt Creek. The U is in a vuggy jasperized ironstone and in jasperized breccias that probably formed by hot spring activity. As much as 52 tons of uraniferous jasperoid was shipped to a mill at Rifle, Colo. This ore shipment averaged in excess of 0.1 percent U_3O_8. No other work was done on the property until 1976 when J. V. Dodge of Canon City, Colo., acquired the property and began a detailed study of the prospect. As a result of this work (2,805 ft of rotary drill cuttings, geophysical studies, and an open pit) an estimated resource of 4,000 tons per vertical foot of U ore averaging 0.04-0.05 percent U_3O_8 was established in an area of 1,200 by 40 ft at the Parkdale iron pit. The thickness of this deposit is at least 3-4 ft as indicated by test pits and trenches.

1	USGS----	Parkdale Iron Pit-----	2	-	L	-	L	5	30	2,000	287, 288
				-	L	-	L	L	50	3,000	
1	USBM----	Parkdale iron pit and other prospects.	12	<.005	-	<.2-.3	-	55	135	1,300	135, 36, 241, 243.
4	--do----	Prospects of Middle Fork of Salt Creek.	7	<.005	-	<.2-.5	-	60	N.A.	N.A.	N.A.

and zinc (120-140 ppm). Panned concentrates from areas D and E and vicinity are high in boron (15-50 ppm) and manganese (1,000 ppm). Uranium is uniformly present in amounts less than the 75th percentile (<0.5 ppm) in stream-sediment samples from areas D and E, but water samples from area E are anomalous in uranium (1.5-6.8 micrograms per liter).

Two geochemical anomalies are present where there is little or no evidence of mining activity. Panned concentrates from area F (fig. 2), in the vicinity of the Laramide rhyolite stock between Rough and Tumbling and Willow Creeks, have anomalous amounts of barium (as much as 10,000 ppm) and lead (as much as 1,500 ppm). The panned concentrates are also anomalous in chromium (>70 ppm), iron (>0.5 percent), magnesium (>0.5 percent), molybdenum (>30 ppm), niobium (>50 ppm), tin (>30 ppm), strontium (>500 ppm), thorium (>700 ppm), titanium (>2 percent), and tungsten (>100 ppm). Stream-sediment samples from area F are anomalous in uranium (>21 ppm). In addition, stream-sediment samples from area F are high in arsenic (5 ppm), cadmium (0.68-0.92 ppm), manganese (1,500 ppm), nickel (20 ppm), and zinc (120-140 ppm); panned concentrates from area F are high in boron (15-50 ppm), calcium (15 percent), copper (10 ppm), and manganese (1,000 ppm). Water samples from some springs and streams around the stock are highly anomalous (Nowlan and others, in press). The waters contain concentrations of sulfate as high as 1,000 mg/l, copper as high as 14 μg/l, molybdenum as high as 15 μg/l, cobalt as high as 10 μg/l, and nickel as high as 1,500 μg/l.

The other geochemical anomaly in an area of little or no past or present mining activity is in Buffalo Meadows (fig. 2) where molybdenum (30-150 ppm) and tungsten (100 ppm) in panned concentrates are anomalous. The highest amount of gold in any sample from this study (4.7 ppm or about 0.13 oz/ton) was found in panned concentrate from Buffalo Meadows. This geochemical anomaly is near a north-northwest-striking fault in granite. Isolated anomalous values occur throughout the study area, but the coincidence of high gold, molybdenum, and tungsten in panned concentrates from Buffalo Meadows is probably the isolated anomaly of most consequence.

In the vicinities of areas D, E, and F (fig. 2) are several areas of anomalous barium (2,000-10,000 ppm) and lead (30-1,500 ppm) values in panned concentrates. The barium and lead anomalies occur along or near faulted outcrops of the Belden and Minturn Formations. The silver values are low, less than 1 ppm. No barite deposits were verified by geologic mapping.

GEOPHYSICS

A residual aeromagnetic map (Hedlund, in press) is derived from the U.S. Geological Survey aeromagnetic map (1982) that is published at a scale of 1:62,500. The survey was flown at an elevation of 1,000 ft above ground along northeast-southwest oriented flight lines spaced 0.5 mi apart.

The aeromagnetic map shows the magnetic expression of some of the major rock types in the study area. For example, an arcuate magnetic low of -103 to -253 gammas occurs over the migmatite in the Granite district and a similar magnetic low of +9 to -129 gammas occurs over the migmatite of the Goddard Ranch area. Low gamma values are also observed over the Paleozoic strata and Cenozoic valley-fill deposits. Strong positive anomalies of as much as +400 and +570 gammas occur over Precambrian dioritic intrusions and the magnetite-enriched parts of the Silver Plume granitic rocks at the higher elevations. The rhyolite stock near the mouth of Rough and Tumbling Creek has no magnetic expression. Sharply defined, closed, negative anomalies are locally paired with small positive anomalies over the basaltic andesite flows of West and East Buffalo Peaks. These dipoles probably indicate the presence of negatively polarized flows in this area.

The aeromagnetic survey did not indicate the presence of any hidden mineralized areas. Many of the magnetic anomalies were checked on the ground with a Scintrex SM-5[1] magnetometer, but the ground survey failed to reveal any correlation with alteration zones or igneous plutons of possible Laramide age.

MINING DISTRICTS AND MINERALIZED AREAS

Six areas having mineral resource potential (A-F) have been delineated in the Buffalo Peaks Wilderness Study Area (fig. 2). These areas do not necessarily correspond to specific mining districts but do encompass areas of similar mineralization. The study area is within, or adjacent to parts of the following mining districts: Weston Pass, Granite, Buffalo Peaks, Fourmile, Two Bit, and Union Gulch (Henderson, 1926). There are no active mines within the study area, but about 2,000 acres of the Buffalo Peaks Wilderness Study Area are covered by mining claims on file with the U.S. Bureau of Land Management (Wood, 1983). Table 3 summarizes information about mines and prospects in the study area. The various mineral resources within the described areas are discussed in order from A to F and not necessarily in order of decreasing mineral potential.

Weston Pass-Union Gulch districts (includes area A)

The silver-bearing base-metal veins of this area (fig. 2) are along the Weston fault zone that extends southeast along the South Fork of the South Platte River at the northeast margin of the study area. This fault zone, of probable Laramide and Pliocene-Miocene age, includes the Weston-Buffalo Creek faults, numerous branches of the Weston fault, and an older east-northeast-trending fault system. Area A extends southeast to workings about 0.5 mi south of Rich Creek Campground.

The Weston Pass-Union Gulch districts were active from 1890 to 1902 with a brief period of renewed mining during World War I. It is estimated that the past production value of $125,000 for the Weston Pass district is equivalent to about 125,000 oz of silver; the value of the base metals is not known. The Ruby-Cincinnati Group of mines was the leading producer (about 30,000 oz of silver) followed by the Gates, Collin Campbell, and Payrock mines. Most of the production came from oxidized ore bodies in the

[1]The use of trade names is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

zone of supergene enrichment, generally at depths of less than 300 ft (Behre, 1932). Cerussite, anglesite, smithsonite, and hemimorphite were common minerals in this oxidized zone that also contained cerargyrite and native silver(?). The enriched silver ores from the Ruby-Cincinnati mine averaged about 15 oz of silver per ton, but some rich pockets at the Payrock mine contained as much as 35 oz of silver per ton (Behre, 1932). Many of the enriched supergene ore bodies have been exhausted, most mines are now caved or flooded, and the protores have only 0.1-0.5 oz of silver per ton.

The ore minerals occur as disseminations, vug fillings, and bedded replacement bodies within brown, silicified fault breccias chiefly within the Leadville Limestone but also in the Manitou Dolomite. Most faults strike N. 30°-40° W. and dip 20°-55° NE; underground, overturning of the beds and thrust faulting was observed by Behre (1932, p. 62). Some of the silicified shatter zones are as much as 8 ft wide. The hypogene ore minerals included sphalerite, argentiferous galena, traces of chalcopyrite, and probably arsenpolybasite. Ores from the Ruby Tunnel contain as much as 1,500 ppm arsenic that is concentrated in a silver-bearing sulfosalt, such as the pearceite-polybasite group. Some of the sphalerite-rich ores contain as much as 70 ppm cadmium.

In summary, the northwest-striking faults of the Weston fault system are favorable sites for further exploration, especially where they intersect older northeast-striking faults and carbonate strata.

Granite-Two Bit districts (includes area B)

The mines within area B were among the earliest producers of gold in Colorado. Placer gold was discovered near Granite in 1859 and the vein deposits on Yankee Blade Hill were exploited in the early 1860's. Most of the lode mines were developed to depths of 100-380 ft in the oxidized parts of the vein systems, and the veins were worked almost continuously from about 1862 to about 1878. Thereafter, the rich lead and silver discoveries at Leadville drew most of the mining activity away from Granite. In 1908, the Granite Tunnel Company was organized and work began on a tunnel driven south from Low Pass Gulch in order to develop the veins of Yankee Blade Hill to a greater depth. The veins persisted to depths of 500-800 ft below ground level, and as many as 19 veins were cut by the adit over a distance of 2,054 ft (J. C. Hersey, written commun., 1982). Numerous samples taken during this exploratory work indicated an average gold content of about 2 oz/ton, but some ore shoots averaged a much higher grade.

The total past production figures are largely estimates and range from about 65,000 to 97,000 oz of gold. Most of this production came from Yankee Blade Hill and from the Belle of the Granite mines between 1862 and 1878. The following table shows a breakdown of the production figures for the principal mines in the Granite district.

The quartz-pyrite-gold veins are steeply dipping and strike predominantly N. 70°-80° E. within the Precambrian migmatite. The veins are slightly discordant to the foliation in the migmatite and occur in swarms on Yankee Blade Hill and there are as many as 19 veins in a 2,054-ft interval. Some veins are as much as 3,000 ft long, 1-3 ft wide, but show numerous pinch-outs along the strike. A few veins extend eastward into the study area but most are outside, within 1 mi of the boundary. The gneissic and migmatized wallrocks are commonly silicified adjacent to the veins but the outer envelope is commonly altered to chlorite and sericite. The veins have a relatively simple mineralogy and have appreciable amounts of pyrite but minor amounts of galena (lead, about 900 ppm), sphalerite (zinc, about 650 ppm), and chalcopyrite (copper, about 280 ppm). The gold to silver ratio is about 2.5:1 and the silver values range from about 0.7 oz/ton to about 0.64 oz/ton. The gold values are highly variable and range from 0.005 to 10 oz/ton; most veins from Yankee Blade Hill average about 1.7 oz/ton. Boron geochemical anomalies (50-200 ppm) are associated with many of the veins and indicate the presence of tourmaline in many of the deposits.

Mine	Estimated ounces (troy) of gold produced
Yankee Blade--------------------	23,000
The Belle of Granite-----------	24,000
Magenta-------------------------	9,600
Robert George-------------------	4,800
New Year------------------------	3,800
Bunker Hill---------------------	3,300
Washington----------------------	2,800
D.C.C.--------------------------	1,200
Gopher--------------------------	960
California----------------------	380
Yosemite-Keystone---------------	350
B and B-------------------------	400
Hattie Jane---------------------	46
Total------------------	64,635

The quartz-pyrite-gold veins are probably related to the intrusion of east-northeast-striking rhyolite dikes during the Laramide orogeny (potassium-argon age of dikes is 65.3±2.4 m.y., R. F. Marvin and others, written commun., 1983). At the Yosemite-Keystone mine, a rhyolite dike locally forms the south footwall of the vein, and about 2,200 ft south of the Belle of Granite mine a rhyolite dike contains partially oxidized pyrite cubes a few millimeters across. In the vicinity of the silver-bearing veins at the Two Bit mine, a thin rhyolite dike is sheared along a vein, thus suggesting some postdike mineralization.

In summary, the quartz-pyrite-gold veins of the Granite district, which is adjacent to the study area, are characterized by intensive silicic and chloritic wallrock alteration, the presence of anomalous boron, a relatively low base-metal content, a gold to silver ratio of 2.5:1, and a spatial association with rhyolite dikes. The gold content of the veins varies from 0.005 to about 2 oz/ton, whereas the silver values range from about 0.07 to about 0.64 oz/ton. The quartz-pyrite-gold veins crop out mainly within migmatitic gneiss in the Granite district, chiefly outside of the study area.

Table 3.--Mineral deposits and mineral occurrences of the Buffalo Peaks Wilderness Study Area, Colorado

[Prospect or mine number corresponds with locality shown on map. All prospects and mines within the study area were inactive at the time of fieldwork in 1981 and 1982. Au, gold; Ag, silver; Cu, copper; Pb, lead; Zn, zinc; U, uranium. Conversion factor: 1 oz/ton = 34.3 g/t]

Prospect No.	Name	Commodity	Development	Geology	Production	Reference
Area A.	(Includes parts of the Weston Pass and Union Gulch districts)--Silver-bearing base metal ores occur as bedding replacement and fissure vein deposits in chiefly the Leadville Limestone. Prior to 1916 the total silver production is estimated at about 125,000 oz of which over half was from the Ruby-Cincinnati group of mines. Some veins were especially rich in Zn and Pb but the production figures for these metals are not known. There has been very little mining in these districts since 1918.					
[1]1	Mines near Rich Creek Campground.	Ag, Zn--	Several shafts and numerous prospect pits.	Highly jasperized fault breccias that strike N. 60°-65° E. are displaced by a series of small N. 50° W.-striking fractures and faults. The northwest fractures are weakly mineralized and contain as much as 200 ppm Zn.	Unknown------------------------------	None.
2	Ruby-Cincinnati group.	Ag, Zn Pb.	Incline, shafts, and numerous prospect pits. Over 1,400 ft of workings.	Ore in discontinuous masses in vuggy, jasperized zones within limestone beds. Ores localized along northwest-trending Weston fault zone.	Oxidized ore in zone of supergene enrichment yielded about 3,000 tons of ore. Grade varied from 0.2 to 15 oz of Ag per ton. Production was valued at about $100,000.	Behre (1932, p. 69-70, 73); Chapman and Stephens (1929, p. 207).
2	Collin-Campbell mine.	--do----	Shaft about 300 ft deep.	Ore bodies in silicified breccia zones within limestone.	Three to four carloads of ore valued at about $20,000.	Behre (1932, p. 70, 73).
3	Mines of the Gates claim.	--do----	Shafts and prospects----	Oxidized sphalerite, galena, and silver sulphoarsenides along northwest-striking fissure veins. Some ore bodies enriched with sphalerite.	Probably small-----------------------	Behre (1932, p. 71, 73).
4	Payrock group of mines.	--do----	Several small shafts and tunnels.	Ag-bearing base-metal sulfides along N. 30°-35° W.-striking fault.	Unknown; probably small-------------	Behre (1932, p. 71).
5	Unknown-----------	--do----	Several prospect pits.	Small gossan and jasperized vein-----------------	Insignificant.	
6	----do-----------	--do----	Two adits trend N. 80° E. into Weston fault.	Small amounts of pyrite in Belden shales---------	Unknown------------------------------	None.
7	----do-----------	--do----	Trench and fault------	Sparse amounts of sulfides along N. 20° E.-striking fault breccia. Small silicified gossan zone.	----do------------------------------	Do.
8	----do-----------	--do----	Caved adit trends S. 60° E.	Sparse amounts of sulfides along northeast striking fault.	----do------------------------------	Do.
Area B.	(Includes parts of the Granite and Two Bit districts)--Au placers were discovered in the vicinity of Granite in 1859 and the quartz-pyrite-gold veins on Yankee Blade Hill in the early 1860's. The total production value prior to 1878 has been variously estimated at about $750,000 (E. B. Eckel, unpub. data, 1932) to $2,000,000 (J. C. Hersey, written commun., 1982). Probably the best production figure ranges from 65,000 to 97,000 oz of Au. Most of the Au came from the mines on Yankee Blade Hill and from the mines north of Low Pass Gulch (Belle of Granite mine). Au production after 1880 was insignificant.					
1	B and B mine-------	Au, Ag--	Two inclined shafts-----	Quartz-pyrite-Au vein within granite apophysis in migmatite. Vein strikes east-northeast and can be traced for about 700 ft.	Past Au production small, about 400 oz.	E. B. Eckel (unpub. data, 1932).
2	Unknown------------	--do----	Shaft and series of four shallow pits aline N. 70° E.	Quartz-pyrite-Au vein near intersection with N. 20° W.-striking fault.	Probably negligible-----------------	Do.

3	Yankee Blade group, including the Yankee Blade, Magenta, Robert George, New Year, Washington, Gopher, California and other smaller mines.	--do----	Numerous shafts, tunnels, adits, and prospects many of which are caved. At least eight mines have had production.	A closely spaced series of about 18 quartz-pyrite-Au-tourmaline veins that strike east-northeast. Intense silicification and chloritization of the wallrocks, chiefly migmatite. Appreciable supergene enrichment of the Au. Minor amounts of chalcopyrite, galena, and sphalerite.	Estimated Au production is as follows: Yankee Blade (23,000 oz), Magenta (9,600 oz), Robert George (4,800 oz), New Year (3,800 oz), Bunker (3,300 oz), Washington (2,800 oz, Gopher (960 oz), and California (380 oz).	E. B. Eckel (unpub. data, 1932); J. C. Hersey, (unpub. data, 1982).
4	Granite tunnel----	--do----	Tunnel trends S. 55° E. and is about 2,054 ft long.	Tunnel intersects as many as 18 veins on Yankee Blade Hill. Native Au occurs in vuggy quartz veins in association with minor sphalerite, galena, and chalcopyrite. Pyrite is relatively common. Many east-northeast-striking veins persist over a length of about 2,000 ft but show branching and pinch-outs along strike.	Tunnel was driven to drain and consolidate the old shallow mines on Yankee Blade Hill and to explore various veins and ore shoots below the old mines at a depth of 500-800 ft. The Granite Tunnel Company was organized in 1908.	Do.
5	Yosemite-Keystone, Hattie Jane, and Free Gold mines.	--do----	Yosemite (two caved adits and small prospect pits), Hattie Jane (several small pits and a 36-ft shaft), Free Gold (adit about 400 ft long.	Quartz-pyrite-Au veins along east-northeast-striking fissure veins in migmatite. Abundant limonite along some of the veins.	Yosemite mine has produced about 530 oz of Au in the 1930's. The Hattie about 46 oz of Au and 8 oz of Ag. Production from the Free Gold mine is unknown but probably small.	E. B. Eckel (unpub. data, 1932).
6	The Belle of Granite.	--do----	Developed by 450-ft-deep shaft with six levels and over 3,000 ft of workings.	Quartz-pyrite-Au vein 16 in. to 5 ft wide strikes east-northeast in migmatite. Abundant pyrite but minor amounts of sphalerite and galena. Vein is about 1,000 ft long.	Production prior to 1912 was about 24,000 oz of Au valued at $500,000.	E. B. Eckel (unpub. data, 1932); J. C. Hersey, (unpub. data, 1982).
7	"Mine No. 4"------	--do----	Shaft----------------	Quartz-pyrite-Au vein strikes east-northeast within migmatite. Small gossan has yielded about 0.015 oz of Au per ton.	Unknown----------------------------	None.
8	Mines of Spring Creek.	--do----	Numerous prospect pits and small adits.	Quartz-pyrite-Au veins that strike east-northeast.	----do-----------------------------	Do.
[1]9	Unknown; mines of upper Low Pass Gulch.	--do----	Small adits and prospect pits.	Quartz-pyrite-Au vein strikes N. 40° W. in granite. Minor sphalerite and galena.	Unknown----------------------------	Do.
[1]10	Unknown; mines of Low Pass Gulch.	--do----	Trench and prospect pits.	Reddened quartz vein in granite is only a few inches thick. Vein strikes N. 20° W. and is about 15-20 ft long. Radioactivity is about two times background. Some smoky quartz.	No production----------------------	Do.
11	Two Bit mine------	Ag, Au--	Shaft-----------------	Ag-bearing base-metal vein strikes N. 75° E. Minor amounts of chalcopyrite, galena, and sphalerite in dump. Chloritized granite wallrock. The presence of 300 ppm antimony in analyzed samples suggests the presence of Ag sulfosulfosalts. As much as 100 ppm Ag in some vein material.	Unknown----------------------------	Do.
12	Two Bit extension.	--do----	Trench and caved incline.	Abundant manganese oxides along quartz vein in granite. Vein strikes N. 65° E. and locally follows faulted rhyolite dike. Traces of sphalerite and chrysocolla.	----do-----------------------------	Do.
				Mines in Tie Gulch		
1	Unknown-----------	Au, Ag--	Two shafts and adit-----	Limonite-stained quartz veins along northwest-striking fault. Trace of Au and Sg.	----do-----------------------------	Do.
2	----do------------	--do----	Shaft and adit---------	----do--	----do-----------------------------	Do.

Table 3.--Mineral deposits and mineral occurrences of the Buffalo Peaks Wilderness Study Area, Colorado--Continued

Prospect No.	Name	Commodity	Development	Geology	Production	References
Area C.	(Includes parts of the Fourmile and Buffalo Peaks mining districts)--The quartz-pyrite-Au veins along Fourmile Creek and extending to the Arkansas River have been extensively explored but most deposits are small and have yielded only small amounts of Au. The Little Annie group of mines probably produced 53 oz of Au from 1935 through 1937 and 39 oz of Ag in 1940 (Vanderwilt, 1947, p. 45). The other mines in the district are relatively small, although there has been extensive exploration along the quartz veins of the Bonanza-Midway claims.					
1	Bonanza-Midway claims.	Au-----	Numerous shafts and prospect pits.	Several quartz veins that strike northwest are persistent over a length of about 3,000 ft. Veins are as much as 3 ft thick and dip steeply to the southwest. Some veins are highly brecciated with hematitic alteration.	Unknown----------------------------	Do.
2	Divines Gusto No. 1.	--do----	Small incline trending N. 40° W.	Small gossan in migmatite within granite; altered zone is about 3 ft wide, strikes N. 70° E. and dips 25°-30° N.	----do-----------------------------	Do.
3	Unknown----------	--do----	Two prospect pits------	Quartz-pyrite-Au vein strikes northwest in chloritized granite. Quartz vein poorly exposed.	----do-----------------------------	Do.
4	Little Annie mine group.	Au, Ag, Cu, Pb, Zn.	Two caved adits and numerous prospect pits.	Quartz-pyrite-Au veins in granite strike northwest. Sparse amounts of magnetite, barite, amethyst quartz, and manganese oxide gangue.	Production small; about 53 oz of Au between 1935 and 1937 and 39 oz of Ag in 1940.	Vanderwilt (1947, p. 45).
5	Josephine mines---	U, Au---	Shaft, tunnel about 305 ft long, and numerous prospect pits; mines caved during construction of Otero pumping station.	Quartz pyrite vein strikes west-northwest and is about 800 ft long. Slightly radioactive, about twice background. Samples show 1-6 ppm U_3O_8 (table 2).	Unknown----------------------------	Nelson-Moore and others (1978).
6	----do-----------	U-------	Shafts, opencuts, trenches.	Peridotite porphyry dikes at contact with granite are radioactive. Dikes strike N. 20° W. and locally contain abundant granite xenoliths.	----do-----------------------------	None.
7	Unknown (Frost Mining Co. claims).	Au------	Over 850 ft of trenching and a 125-ft adit.	Small northwest-trending shear in diorite stock. No visible Au. Probable source for Au placer operation at mouth of Buffalo Creek. This placer claim (Amanda Ann) covers 13.8 acres.	----do-----------------------------	Do.
Area D.	(Salt Creek area uranium)--Mineral occurrences within the Salt Creek area of the Fourmile and Buffalo Peaks mining districts. U was first discovered by J. Amrine in the mid-1950's at the Parkdale iron pit near the head of Middle Fork of Salt Creek. The U is in a vuggy jasperized ironstone and in jasperized breccias that probably formed by hot spring activity. As much as 52 tons of uraniferous jasperoid was shipped to a mill at Rifle, Colo. This ore shipment averaged in excess of 0.1 percent U_3O_8. No other work was done on the property until 1976 when J. V. Dodge of Canon City, Colo., acquired the property and began a detailed study of the prospect. As a result of this work (2,805 ft of rotary drill cuttings, geophysical studies, and an open pit) an estimated resource of 4,000 tons per vertical foot of U ore averaging 0.04-0.05 percent U_3O_8 was established in an area of 1,200 by 40 ft at the Parkdale iron pit. The thickness of this deposit is at least 3-4 ft as indicated by test pits and trenches.					
1	Parkdale iron pit of the Bronco claims.	U, Zn---	Open pit, trenches and numerous prospect pits.	Vuggy jasperoid with opaline-quartz vug linings. Various samples have assayed 243, 400, 241, 287, 135, 80, and 36 ppm U_3O_8 and 0.2, 0.3 and 0.13 percent Zn. The thorium content is only 13 ppm. The extent of the mineralized ground is only tentative owing to the soil cover.	About 52 tons of uranium ore--------	C. M Armstrong (unpub. data, 1977); Jack DiMarchi and Edward Duke (unpub. data, 1979).
2	COMINCO property---	U, Pb, Zn.	Two trenches and numerous prospect pits.	Vuggy jasperoid developed in the Manitou Dolomite. No appreciable radioactivity but nearby granite has 80 ppm equivalent U and is more radioactive than the jasperoids.	No production----------------------	None.
3	Unknown-----------	Ag, Zn Pb.	Dozer cut, shaft and prospect pit.	Gossan along northeast-striking fault. Cherty dolomite of the Manitou is slightly pyritized and altered.	Negligible-------------------------	Do.
4	----do------------	Ag------	Trench, shafts, and numerous prospect pits.	Slightly mineralized northwest-striking fault within the Belden Formation. A few analyses indicate a maximum of about 0.5 oz of Ag per ton.	----do-----------------------------	Do.

[1]Occurrence inside the wilderness.

Fourmile-Buffalo Peaks districts (includes area C)

The quartz-pyrite-gold veins of this area are localized along north-northwest-striking faults that extend from Marmot Peak westward to the Arkansas River and northward to Buffalo Creek; the southern limit is not shown (fig. 2). Most of these veins extend less than 2 mi outside of the study area.

Production records are mainly from Vanderwilt (1947, p. 45). Because the largest mine in the Fourmile district is the Little Annie, and most prospects are small, it is inferred that the production figures cited by Vanderwilt are for the Little Annie mine. The Little Annie mine operated from 1935 through 1937 and produced about 78 tons of ore yielding 53.5 oz of gold. In 1940, the operation was renewed but the production figures are unknown.

The quartz-pyrite-gold fissure veins at the Little Annie mine and at mines about 1.5 mi southeast strike N. 40°-50° W., dip steeply to the southwest, and are persistent over a length of about 2,000 ft. The quartz veins are branched, show abrupt pinch-outs, are generally less than 2 ft thick and locally are brecciated and have hematitic alteration. Pyrite cubes as much as 0.4 in. across are locally common, but specularite, galena, sphalerite, and chalcopyrite are present in only sparse amounts. Fire assays for gold from the dump material at these caved mines indicate gold values of 0.04-0.07 oz/ton; silver values are generally less than 0.2 oz/ton.

Other metal occurrences near the study area include: (1) Divines Gusto No. 1 mine in the SW1/4 sec. 7, T. 13 S., R. 78 W.—a gossanized quartz-pyrite-gold vein that strikes N. 70° E. in a migmatite lens within granite. The vein is about 35 ft long and 3 ft wide and contains about 0.25 ppm gold. (2) A series of trenches and an adit explore a N. 40° W.-striking quartz vein in a diorite plug along Buffalo Creek. Samples from this vein contained as much as 0.07 oz gold per ton, 0.2 oz silver per ton, and 0.2 percent copper. (3) Josephine mine group—A slightly uraniferous (1, 2, and 6 ppm equivalent U_3O_8) quartz-pyrite vein strikes N. 60° W. for 150 ft near the Otero pumping station. The vein is most radioactive at the intersection with hornblende schist xenoliths in granite. Fire assays indicate less than 0.05 oz of gold per ton by fire assay and less than 0.2 oz of silver per ton in vein samples. Other uranium-bearing quartz-gold veins in this area have been reported by Nelson-Moore and others (1978, p. 364-365). Extensive prospecting along the peridotite porphyry dikes a few feet north of the Otero pumping station road was for an unidentified mineral occurrence, probably uranium or elements of the platinoid group. Some of the dikes are slightly radioactive, especially along the contact with granite, but the dikes do not constitute a uranium resource. (4) Veins along Tie Gulch—chiefly hematite stained quartz veins just to the north of area C (fig. 2) that strike northwest, cut Precambrian granite, and are contiguous with large displacement faults of the Rio Grande-Arkansas Valley rift system. Fire assays of the vein indicate 0.005 oz of gold per ton and 0.2 oz of silver per ton.

Unlike the gold veins of the Granite district, the veins along Fourmile Creek and Tie Gulch lack anomalous concentrations of boron, strike north-northwest within the granitic rocks, contain fewer base metals, commonly contain magnetite and specularite, show high concentrations of bismuth, molybdenum, and tin and are not associated with rhyolite dikes. Most of the veins are outside the study area and generally have low gold values, 0.04-0.07 oz/ton.

Salt Creek area of the Fourmile-Buffalo Peaks districts (includes area D)

The vuggy, uraniferous jasperoid deposits at the Parkdale iron pit are along the study area boundary at the head of the Middle Fork of Salt Creek. This deposit was discovered by J. L. Amrine in the mid-1950's; shortly thereafter, about 52 tons of uraniferous jasperoid averaging 0.12 percent U_3O_8 and 0.20 percent V_2O_5 were shipped to the mill at Rifle, Colo. (Nelson-Moore and others, 1978, p. 365). The property remained idle until about 1976 when J. V. Dodge staked numerous claims that encompass much of the uraniferous jasperoid outcrops. A subsequent evaluation of the property indicated a reserve of about 4,000 tons of uraniferous jasperoid per vertical foot averaging 0.04 percent U_3O_8 within an area of 1,200 by 40 ft (C. M. Armstrong, written commun., 1977, 1978). Only about 3-4 ft of jasperoid is exposed in the Parkdale iron pit and in nearby trenches, but according to J. V. Dodge (oral commun., 1982) a drilling program conducted by Noranda Exploration, Inc., indicated that the uraniferous jasperoid is as much as 45 ft thick at the Parkdale iron pit.

At least 12 radioactive anomalies are known within or near the top of the Cambrian Sawatch Quartzite that forms a N. 40° W.-striking ridge in the district. The anomaly associated with the vuggy jasperoid at the Parkdale iron pit is as much as 40 times background. No uranium mineral was identified in this study; fission-track maps show that uranium is dispersed as an amorphous colloid through the ferruginous jasper. Opaline-quartz vug linings fluoresce yellowish green under ultraviolet light but do not contain significant amounts of uranium as compared with the jasperoid. Some vugs are also filled with manganosiderite but this carbonate is not radioactive, and like the opal, represents a later vug filling. Analyses of the radioactive jasperoid for uranium indicate the following values of equivalent U_3O_8 in parts per million: 36, 135, 241, and 243. A gamma-ray analysis of the most radioactive sample indicates equivalent uranium values of 287 and 288 ppm ±10 ppm and ^{232}Th values of less than 10 ppm (C. A. Bush, written commun., 1983). Fission-track map studies of the jasperoid indicate only 80 ppm uranium in some samples, and the uranium particles are extremely small, that is, micron size (R. A. Zielinski, oral commun., 1983). Semiquantitative spectrographic analyses of the uraniferous jasperoid indicate the presence of at least 20 percent iron, although C. M. Armstrong (written commun., 1977, 1978) has reported as much as 40 percent iron in some samples. The 12 fire assay analyses for gold and silver indicate less than 0.005 oz of gold per ton, and most silver values range from 0.2 to 0.3 oz of silver per ton. Other element concentrations in the radioactive jasperoid are: 5,000 ppm manganese, 150 ppm vanadium, 2,000-3,000 ppm zinc, 30-50 ppm lead, 5-55 ppm copper, 30-50 ppm nickel, and 30-50 ppm cobalt. A separate radiometric analysis indicates only 10-13 ppm thorium.

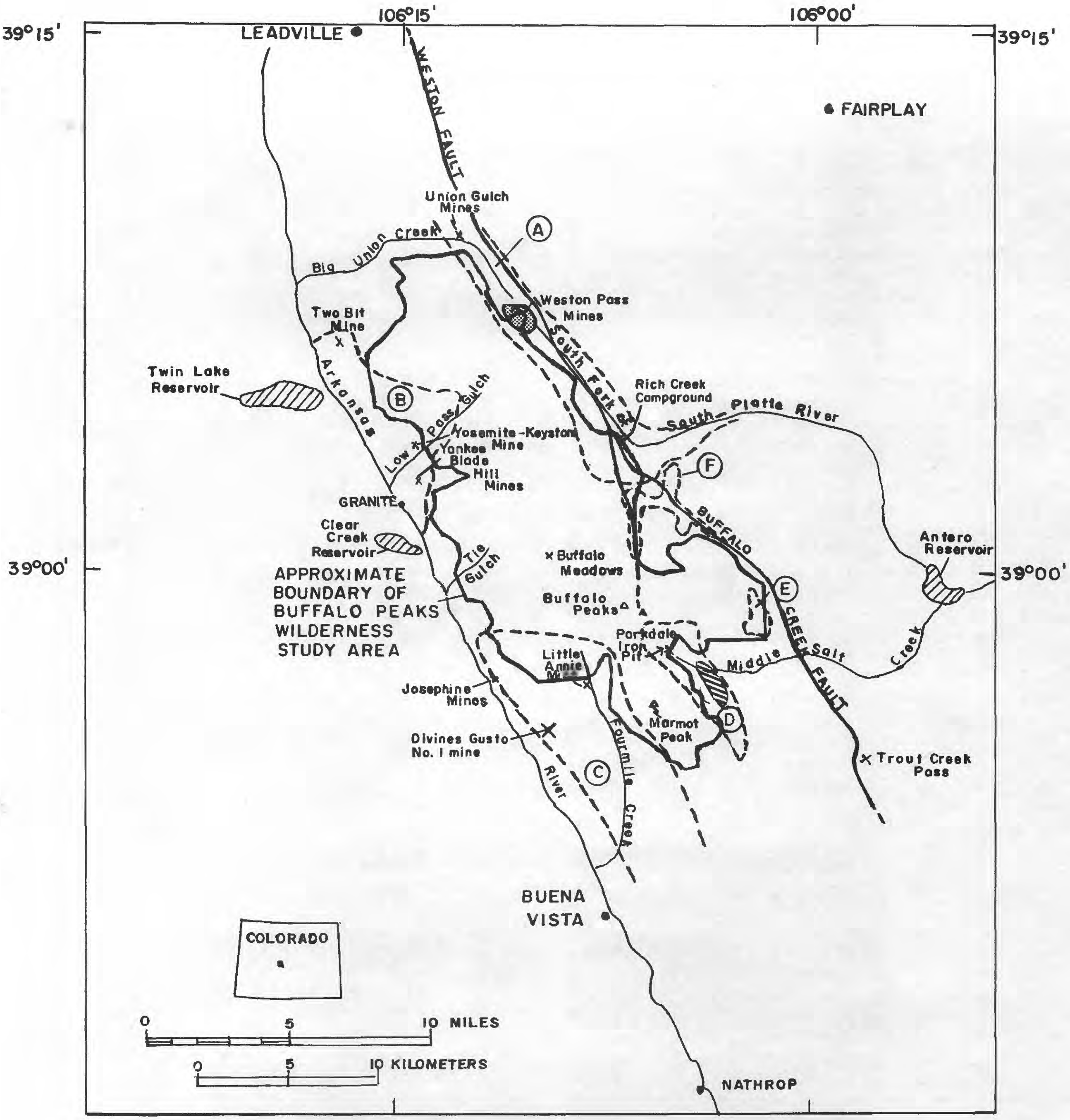

Figure 2.--Map showing areas having mineral resource potential in the Buffalo Peaks Wilderness Study Area, Colo.

EXPLANATION FOR FIGURE 2

AREA A--Moderate resource potential for silver in base-metal deposits; includes small area of high resource potential at Weston Pass indicated by stipple pattern

AREA B--Low to moderate resource potential for gold and silver in vein deposits

AREA C--Low to moderate resource potential for gold and silver in vein deposits and low resource potential for uranium in veins

AREA D--Low to moderate resource potential for uranium including a small low-grade uranium identified resource area around the Parkdale iron pit. Low to moderate resource potential for barite and lead in vein deposits. A small area along the northeast side of the Middle Fork of Salt Creek has low to moderate resource potential for silver in vein deposits; indicated by diagonal line pattern

AREAS E AND F--Low resource potential for barite and lead in vein deposits as defined by geochemical studies

Not all the jasperoids are radioactive and just south of the Parkdale iron pit a north-striking fracture zone of silicified, nonradioactive breccia forms a linear jaspery ridge that merges with the bedding replacement type of jasperoid at the pit. Trenches near the Parkdale pit are in a poorly exposed white, altered, biotite tuff of probable Oligocene age that possibly filled a paleovalley (Scott, 1975). The tuff is nonradioactive and has a very limited outcrop in the vicinity of the jasperoids.

Several hypotheses have been proposed for the origin of the uraniferous jasperoids: (1) the downward migration of acidic, meteoric waters have leached uranium from tuff during post-Oligocene time and have redeposited the uranium at the contact with the silica-rich Sawatch Quartzite, and (2) acidic hydrothermal fluids have leached uranium from the underlying fractured biotite granite (equivalent U_3O_8 = 80 ppm) and redeposited silica and uranium as a ferruginous gel at relatively low temperatures. The change of pH to alkaline conditions at the contact with the overlying Manitou Dolomite may have promoted precipitation of the uranium. Of the two hypotheses the hydrothermal source seems most probable since the fault-controlled jasperoids contain anomalous amounts of base metals, especially zinc, and the underlying Precambrian granite is anomalously radioactive.

In summary, the vuggy uraniferous jasperoids of the Parkdale iron pit straddle the study area boundary. At least 11 other smaller radioactive uranium-bearing jasperoids occur in the Sawatch Quartzite of area D (fig. 2) but the deposits lack continuity. The jasperoids contain less than 0.005 oz of gold per ton and the silver values range from less than 0.2 to 0.3 oz/ton. The deposits are not considered potential resources for iron ore because of their small size, although some jasperoids have as much as 40 percent iron, which would be a suitable grade for a taconite deposit if the deposits were closer to a processing facility.

The numerous small prospects along the east side of the Middle Fork of Salt Creek (area D, locality 4) have been extensively sampled by Wood (1983). These fault controlled deposits have negligible gold (0.005 oz/ton) but do contain minor amounts of silver (0.2-0.5 oz/ton).

A geochemical survey near the head of the North Fork of Salt Creek has indicated relatively high barium (5,000-10,000 ppm) and lead (30 to 1,500 ppm) anomalies in panned concentrates. These anomalies appear to be close to the northwest-striking fault that extends through locality 4.

Areas E and F

A geochemical survey (Nowlan and Gerstel, in press) has delineated two areas (E and F) of anomalous barium and lead values in stream-panned concentrates. The source areas of barite and galena were not discovered during this study.

Area E (fig. 2), in the vicinity of Spring Creek, yielded barium values of 2,000 and 10,000 ppm in analyzed stream-panned concentrates (Nowlan and Gerstel, in press). Other metals detected are 30 ppm lead, 10 ppm copper, and generally less than 500 ppm zinc.

Area F is elongate along the projection of the Buffalo Creek fault and also curves around the south edge of the rhyolite stock of Rough and Tumbling Creek (fig. 2). High barium values (3,000 to 10,000 ppm) are obtained from stream-panned concentrates along Willow Creek, about 2,000-3,000 ft east of the stock (Nowlan and Gerstel, in press). Some of these concentrates are also high in lead (70-1,500 ppm), and pyrite is observed in some samples. This area may be coextensive with area A and may represent an epithermal type mineralization that is synchronous with the ore deposition in the Weston Pass district to the northwest.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

A moderate resource potential was assigned to areas that met the following criteria (a low potential was assigned those areas that met only some of the criteria):

1. A favorable geologic environment such as the presence of numerous faults in a favorable host rock and the presence of Laramide and (or) Tertiary plutons.
2. Evidence of mineralization in adjacent areas along similar structural trends and favorable host rocks.
3. Anomalous metal values in rock and vein samples and in stream-sediment concentrates as determined from a geochemical study.
4. Aeromagnetic anomalies, such as extreme high and low gamma values in areas of broad magnetic gradients, may indicate the presence of hidden ore bodies.
5. Alteration halos related to hydrothermal fluids, for example, the chloritization of migmatite in the Granite district, the formation of vuggy jasperoids in the Salt Creek area. The dolomitization of Leadville Limestone to form "zebra-striped" rock in the Weston Pass-Union Gulch districts was probably important for favoring increased porosity and providing sites for later ore deposition.
6. The mineralized rock in and near the study area is of sufficient volume, grade, and accessibility so as to indicate a potential for the occurrence of resources.

These criteria are briefly discussed for the six mineralized areas, A through F.

There are no active mines within the study area, but about 2,000 acres of the Buffalo Peaks Wilderness Study Area are covered by mining claims (Wood, 1983). The various mineral resources within the described areas A-F are chiefly along the periphery of the study area and are discussed in order of decreasing resource potential. There is little or no indication for oil or gas or geothermal energy resources in the study area.

The six mineralized areas are:

Area A: This area is rated as having a moderate potential for silver resources in base-metal-bearing fissure veins and bedded replacement deposits. A very small part of this area at Weston Pass has a high resource potential because silver-bearing veins at the Gates mine extend into the study area. This assessment is based on the large number of faults that displace favorable carbonate strata in the vicinity of known fault-controlled silver-bearing base-metal deposits. The extension of the Weston Pass mineral deposits to the northwest and southeast seems likely, and the intersection of the Weston fault zone with older northeast-striking faults would provide favorable structures for such deposits. Moreover, the presence of numerous silicified shatter zones and the favorable porosity provided by the dolomitized "zebra-striped" Leadville Limestone indicate possible sites for ore deposition.

Area B: This area has a low to moderate resource potential for gold and silver in vein deposits, but an extension of the precious-metal veins into the study area appears speculative.

Area C: The area has a low to moderate potential for gold and silver resources in veins. Most veins are outside of the study area, and the veins that are within the boundary are of low grade, that is, 0.04 oz of gold per ton and less than 0.02 oz of silver per ton.

Areas E and F: A geochemical survey has delineated several areas of anomalous barium and lead values in panned-stream concentrates. The sources of the probable barite-galena deposits were not discovered during this study, and therefore these areas have a low to moderate potential for the occurrence of barite and lead resources.

Area D: The uraniferous jasperoids of the Middle Fork of Salt Creek can be classified as an identified resource of low-grade uranium in the Parkdale iron pit area and the area has a low to moderate potential for additional uranium resources. The uraniferous jasperoids of the Bronco-Lady Elk claims have been thoroughly studied (J. V. Dodge, written commun., 1982) and a geologically inferred resource of about 4,000 tons per vertical foot of uraniferous jasperoid averaging 0.04 percent U_3O_8 and 0.20 percent V_2O_5 is suggested for an area of about 1,200 by 40 ft. The low-grade and the absence of precious metals make the uraniferous jasperoids at the Parkdale iron pit a low-grade uranium resource. The area of low-grade silver-bearing veins along the east side of the Middle Fork of Salt Creek (locality 4, tables 1 and 2) has a low to moderate resource potential for silver. The anomalous barium and lead values from panned concentrates at the head of the North Fork of Salt Creek suggest the presence of concealed barite-galena veins. On the basis of geochemical data, the resource potential for barite and lead in veins and bedded replacement deposits is low to moderate. Some of the jasperoid has as much as 40 percent iron, which would be a suitable grade for a taconite deposit if it was closer to a processing facility or if larger volumes of jasperoid were present.

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