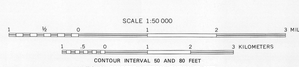
Base from U.S. Geological Survey, 1:62,500
Dillon, 1929; Ute Peak, 1933; Fraser, 1957;
and Montezuma, 1958

Geology generalized from Eppinger and others (1985)

SCALE 1:50 000

CONTOUR INTERVAL 50 AND 80 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



INDEX MAP

MAP SHOWING THE DISTRIBUTION OF SELECTED MINERAL ASSEMBLAGES IN NONMAGNETIC HEAVY-MINERAL CONCENTRATES FROM STREAM SEDIMENTS FROM THE VASQUEZ PEAK WILDERNESS STUDY AREA AND THE WILLIAMS FORK AND ST. LOUIS PEAK ROADLESS AREAS, CLEAR CREEK, GRAND, AND SUMMIT COUNTIES, COLORADO

By

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1985

CORRELATION OF MAP UNITS

Qc	Holocene and Pleistocene	QUATERNARY
Unconformity		
Try	Oligocene(?)	TERTIARY
Td	Paleocene(?)	
Unconformity		
Kp	Upper Cretaceous	CRETACEOUS
Kc		
Kd	Lower Cretaceous	
Jm	Upper Jurassic	JURASSIC
Unconformity		
Ysp Ybr		MIDDLE PROTEROZOIC
Ig		
Xs Xch Xhs Xh Xm		EARLY PROTEROZOIC

DESCRIPTION OF MAP UNITS[1]

Qc SURFICIAL DEPOSITS (QUATERNARY)--Cover unit composed of undifferentiated glacial drift, alluvial cone, alluvial-fan deposits, colluvium, landslide and slumped ground. Includes deposits of suspected Tertiary age remnants of glacial processes

Try RHYOLITE DIKES (OLIGOCENE?)--Small, fine-grained, commonly silicified rhyolite bodies distributed mainly along the Continental Divide north and south of Jones Pass. Locally exhibit porphyritic texture and (or) flowbanding(?) and (or) jasperoid veins

Td AUGITE DIORITE DIKES (PALEOCENE?)--Fine-grained dikes locally containing plagioclase and augite phenocrysts. Dike swarm in Jones Pass area

Kp PIERRE SHALE (UPPER CRETACEOUS)--Dark-gray marine shale; interbedded limestone, siltstone, and sandstone layers

Kc NIOBRARA FORMATION AND BENTON SHALE (UPPER AND LOWER CRETACEOUS)--Dark-gray, thin-bedded, calcareous shale and interbedded limestone

Kd DAKOTA FORMATION (LOWER CRETACEOUS)--Grayish-white, medium-grained sandstone at top and bottom; intervening dark-gray, carbonaceous shale, sandy mudstone, and siltstone

Jm MORRISON FORMATION (UPPER JURASSIC)--Light-gray, greenish-gray, and pale-red claystone containing sandstone and occasional thin, light-gray limestone beds

Ysp SILVER PLUME GRANITE (MIDDLE PROTEROZOIC)--Light-colored, fine- to coarse-grained, weakly porphyritic biotite-muscovite-quartz monzonite with trachytoid texture formed from anhedral phenocrysts, but locally equigranular. Locally contains pegmatite. About 1.4 b.y. old

Ybr MIXED ROCKS (MIDDLE PROTEROZOIC)--Composed of Silver Plume Granite intrusive into remnants of one or more of the older metamorphic rocks. Locally an intrusive breccia

Xg BOULDER CREEK GRANODIORITE (EARLY PROTEROZOIC)--Well-foliated, medium- to coarse-grained biotite-quartz monzonite to quartz diorite. Locally contains inclusions of biotite schist and amphibolite. Foliation is parallel to that of enclosing gneisses. Locally contains pegmatite

Xs SILLIMANITE GNEISS (EARLY PROTEROZOIC)--Coarsely layered sequence of metites to coarse-grained, garnetiferous muscovite-quartz-biotite gneiss and quartz-biotite gneiss that ranges to plagioclase-quartz-biotite gneiss and quartzite. Sillimanite commonly segregated into quartz-sillimanite "eyes" oriented along foliation

Xch CALCIUM-RICH GNEISSES (EARLY PROTEROZOIC)--Range from hornblende gneiss to diopside-hornblende gneiss interlayered with biotite gneiss. Hornblende and calc-silicate gneisses range from plagioclase-quartz-hornblende gneiss through diopside-rich gneiss to marble; layering generally more conspicuous than foliation. Biotite gneiss is fine-grained, well-foliated, plagioclase-quartz-biotite gneiss; contains subordinate, fine-grained, disseminated sillimanite. Probably derived from interbedded sediments

Xhs AMPHIBOLITE AND CALC-SILICATE GNEISS (EARLY PROTEROZOIC)--Amphibolite containing numerous layers of calc-silicate gneiss, calcium-rich gneiss, felsic gneiss, and occasional layers of marble. Stratigraphic relationship of amphibolite to unit is lithologically similar to the calcium-rich gneisses (Xch)

Xh HORNBLENDE GNEISS AND AMPHIBOLITE (EARLY PROTEROZOIC)--Predominately unlayered amphibolite containing minor amounts of hornblende gneiss, felsic gneiss, and calc-silicate gneiss. Unit is the largest body, near Hagar Mountain, is shown

Xm UNRECOGNIZED METAMORPHIC ROCKS (EARLY PROTEROZOIC)--Predominantly a biotite gneiss containing lesser amounts of sillimanite, calcium-rich gneiss, felsic gneiss, and occasional layers of marble. Biotite gneiss ranges from a sillimanite-quartz-muscovite-biotite gneiss to a quartz-biotite gneiss containing subordinate sillimanite and feldspar

APPROXIMATE BOUNDARY OF ROADLESS OR WILDERNESS STUDY AREA

CONTACT--Approximately located

FAULT OR SHEAR ZONE--Approximately located. Zones of shattered rock and(or) abundant gouge, usually 4 feet(1.2 m) wide where concealed. U, upthrown side; D, downthrown side

THRUST FAULT--Approximately located. Dotted where concealed, sawteeth on upper plate

CATACLASTIC ROCK AND(OR) MYLONITE

SHAFT

SAMPLE LOCALITY--Numbers correspond to those in table 1 and on figure 2

Sample containing pyrite

Sample containing 1 or 2 of the following minerals: scheelite/powellite, gahnite, tourmaline

Sample containing 3 or more of the following minerals: scheelite/powellite, gahnite, tourmaline, pyrite

Sample containing 1 or more of the following minerals: galena, molybdenite, chalcopyrite, fluorite, sphalerite

Sample containing minerals from both △ and □ groups

Sample not containing any of the above minerals

[1]The minerals in composite rock names are arranged in order of decreasing amounts; that is, a biotite-muscovite-quartz monzonite is a quartz monzonite containing more biotite than muscovite.

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral values, if any, that may be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a geologic survey of the Vasquez Peak Wilderness Study Area (A236) and the Williams Fork (021\A) and St. Louis Peak (023\A) Roadless Areas in the Arapaho National Forest, Clear Creek, Grand, and Summit Counties, Colorado. The Vasquez Peak Wilderness Study Area was established by Public Law 96-560, December 22, 1980. The Williams Fork and St. Louis Peak Roadless Areas were classified as further planning areas during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

INTRODUCTION

The U.S. Geological Survey and the U.S. Bureau of Mines conducted field studies from 1979 through 1983 to assess the mineral resource potential of the Vasquez Peak Wilderness Study Area (acreage: 16,000), the Williams Fork Roadless Area (acreage: 74,020), and the St. Louis Peak Roadless Area (acreage: 12,800). Included were geological, geochemical, and geophysical studies by the U.S. Geological Survey and investigation of known prospects and mines by the U.S. Bureau of Mines.

This map shows the distribution of minerals, including scheelite, powellite, tourmaline, fluorite, gahnite, and sulfides, that were observed in the nonmagnetic fraction of heavy-mineral concentrates from stream sediments. These minerals are possible indicators of mineralization. The samples were collected during a reconnaissance geochemical survey by Barton and Turner (1983).

This mineralogical information was used in preparing other reports on the area of study, including a mineral resource potential report (Theobald and others, 1983) and a report on alteration and fluorite occurrences (Eppinger and Theobald, 1985).

The area of study is located in north-central Colorado in the Arapaho National Forest, north of Interstate Highway 70, west of U.S. Highway 40, and east of the Blue River, on the west side of the Front Range (fig. 1).

GEOLOGY

A more detailed description of the geology is given in Eppinger, Theobald, and Carlson (1985), a compilation of such reconnaissance and detailed geologic mapping in the study area.

The crystalline rocks in this area form the westernmost part of the Front Range uplift and have been thrust westward over the eastern edge of the generally synclinal basin of Mesozoic sedimentary rocks underlying the Blue River valley. The eastern part of the area has been included in the Front Range mineral belt since the discovery of the Henderson ore body at Red Mountain in 1964. The Ute and Henderson deposits, less than two miles east of the Williams Fork Roadless Area, are recognized as one of the largest accumulations of molybdenum ore in the world (Wallace and others, 1978).

Proterozoic metamorphic and igneous rocks comprise most of the bedrock in the area, although Mesozoic sedimentary rocks are exposed along the west side of the Williams Fork Roadless Area and near Bottle Peak in the northernmost part of the St. Louis Peak Roadless Area. The metamorphic rocks range from sillimanite and biotite gneisses to hornblende and calc-silicate gneisses. The Proterozoic igneous rocks are of two compositions and ages: the Boulder Creek Granodiorite about 1.7 billion years old, and the Silver Plume Granite, a quartz monzonite about 1.4 billion years old. Sparse Tertiary(?) dikes of augite diorite and rhyolite cut the Proterozoic rocks in the central and eastern parts of the area; dikes of this age are generally too small to be shown at this scale.

A complex mesh of faults, fractures, and shear zones ranging in age from Proterozoic to Pleistocene segments the rock units. In the north, northeast-trending faults predominate. To the west, the Williams Range thrust, and parallel faults to the east of it, trend northwesterly. The Berthoud Pass fault zone, on the eastern edge of the study area, trends northwesterly, converging to the southwest with the Williams Range thrust fault system. The triangular area within these three domains, particularly the area bounded by the Middle Fork Williams Fork River on the west, Bobtail Creek on the east, and the Williams Fork River on the north, is a complex maze of faults, fractures, and shear zones.

Cover on bedrock is extensive and ranges from a periglacially deformed, deep regolith on the gentler slopes flanking ridgetops, through a variety of glacial deposits on valley walls and floors, to broad alluvial plains on the lower valley bottoms. In all, seven cover units limit bedrock exposures to 30 percent or less of the area.

SAMPLE MEDIUM, PREPARATION, AND ANALYSIS

This mineralogical map is based on data on the distribution of various minerals in the nonmagnetic fraction of heavy-mineral concentrates from stream sediments (hereafter referred to as concentrates). Many ore and ore-related minerals, transported as detrital grains, are mechanically resistant and of high specific gravity. Separation of the nonmagnetic heavy-mineral fraction greatly reduces dilution of these minerals by ordinary rock-forming minerals.

One hundred sixty-five samples were collected from the mouths of first order drainages and were panned in the field. Panning was terminated upon initial loss of heavy minerals, usually indicated by an abundance of magnetite, epidote, or hornblende (Theobald, 1957). In the absence of these indicator heavy minerals, the panning was terminated at approximately 200 grams. The samples were further concentrated in the laboratory, using bromoform (specific gravity 2.80-2.89) and a magnetic separator. The nonmagnetic heavy-mineral fraction was then split, one part for mineral identification and one part for chemical analysis by emission spectrography. More detailed descriptions of sample media selection, collection methods, preparation, and chemical analysis are found in Barton and Turner (1983). The samples were examined for mineralogical content using a binocular microscope, short-wave ultraviolet light, and X-ray diffractometry.

RESULTS

The predominant minerals observed in the concentrates are accessory minerals of the major lithologic units. Zircon and one or more of the titanium minerals (such as rutile, sphene) are ubiquitous. Apatite is present in most concentrates. Monazite is common in the granitic terrane and where pegmatites occur. Sillimanite is usually present in the metamorphic terrane and barite is common in some of the sedimentary terranes. Superimposed on this general, lithologically controlled background are two assemblages of minerals that could reflect the presence of metallic mineral deposits: (1) a scheelite/powellite-gahnite-tourmaline-pyrite assemblage, most commonly observed where the country rocks are calcic metamorphic rocks, and (2) a sulfide-fluorite assemblage occurring predominantly in the southern and southeastern part of the study area, where the dominant host rock, the Silver Plume Granite, commonly exhibits the effects of hydrothermal alteration. Table 1 shows sample locality numbers corresponding only to the samples containing minerals from each assemblage.

Scheelite/powellite-gahnite-tourmaline-pyrite assemblage

The scheelite/powellite-gahnite-tourmaline-pyrite assemblage is best exhibited in samples of stream sediments derived from the calcic metamorphic rocks in the northern part of the St. Louis Peak Roadless Area and in the northwestern part of the Vasquez Peak Wilderness Study Area. However, as described below, occurrences of individual members of the assemblage are not confined only to these areas.

Scheelite, commonly observed in samples taken from streams draining the calcic metamorphic terrane, is most abundant in samples from the northern part of the St. Louis Peak Roadless Area, where sediments are derived from hornblende and calc-silicate gneisses. Anomalous tungsten values occur in several panned concentrates from this area (Barton, 1985). Scheelite occurs in numerous samples in the Williams Fork Roadless Area and throughout the Vasquez Peak Wilderness Study Area. Small bodies of calcic metamorphic rocks, too small to be shown at this scale, occur throughout much of the area of outcrop of Silver Plume Granite, and are the presumed sources of the scheelite in these areas. Sheridan and Raymond (1982) report that some areas of Colorado containing scheelite deposits also contain Precambrian massive-sulfide deposits. Similarly, Mench and Erickson (1980) note a possible spatial relationship between anomalous amounts of tungsten (presumably derived from scheelite) in stream-sediment heavy-mineral concentrates and massive-sulfide deposits in the Sangre de Cristo Range in northern New Mexico.

Powellite and molybdenian scheelite occur along with presumably almost pure scheelite in many of the concentrates from the study areas. This powellite-scheelite relationship in calcic gneisses agrees with the detailed studies of scheelite in gneisses of Colorado by Tweto (1960). Fluorescence of grains from this area under shortwave ultraviolet light ranges from the brilliant blue-white typical of scheelite to the bright pale yellow usually attributed to the powellite end member of the scheelite-powellite series. Diffraction patterns from X-ray analysis indicate, however, that at least some of the yellow-fluorescing grains are nearly pure scheelite. For this reason, the designation presented here is simply scheelite/powellite, and no attempt has been made to distinguish individual members of the solid solution series.

Trace to minor amounts of gahnite, the Zinc-aluminum spinel, were observed in several samples from streams draining the hornblende and calc-silicate gneisses in the northern part of the St. Louis Peak Roadless Area and the northwestern corner of the Vasquez Peak Wilderness Study Area. Trace amounts of suspected gahnite also occur in concentrates from streams draining the southern and eastern parts of the Vasquez Peak Wilderness Study Area, where small inclusions of calcic metamorphic rocks crop out within the Silver Plume Granite. These inclusions are the presumed sources for the gahnite. In most cases, the gahnite occurs in samples containing scheelite. Sheridan and Raymond (1977) report that gahnite is found in most of the metamorphosed Precambrian sulfide deposits in the Front Range of Colorado, and they suggest the use of gahnite as "a prospector's guide to ore, even where sulfide minerals or their oxidation products are not seen in the outcrops" (Sheridan and Raymond, 1977, p. 20). Gahnite has similarly been identified at several localities in the Scandinavian Caledonides, in close association with strata-bound sulfide deposits in Precambrian metasedimentary rocks (Sundblad, 1982).

Tourmaline was identified in 29 of the 165 concentrates. More than 75 percent of the tourmaline-bearing samples occur in stream sediments derived from calcic metamorphic rocks in the northern part of the St. Louis Peak Roadless Area. Other tourmaline-bearing samples occur in the southwestern part of the St. Louis Peak Roadless Area near the mouths of Kinney and Darling Creeks; in the northwestern part of the Williams Fork Roadless Area near Ute Pass and near Leal; west of the Williams Fork Roadless Area near Quaking Aspen Creek; and in the southeastern part of the Williams Fork Roadless Area near the headwaters of the South Fork Williams Fork River. The tourmaline generally occurs as small, dark-brown to black, subhedral to anhedral grains in trace to minor amounts; however, in sample 74 tourmaline is the most abundant of the nonmagnetic heavy minerals.

Ettlinger and Campbell (1977) summarize several tourmaline occurrences reported in the literature. While the majority of these occurrences are attributed to intrusive igneous processes, they note that many of the tourmaline occurrences are strata-bound, and some are associated with strata-bound sulfide ores. Precambrian strata-bound sulfide deposits occur in the Front Range of Colorado in rocks metamorphosed to the upper amphibolite facies. In rocks characterized by (1) feldspar-rich gneisses, (2) amphibolites and hornblende gneisses, (3) gray schists and gneisses containing variable amounts of quartz, biotite, muscovite, plagioclase, and sillimanite, and locally (4) impure marbles and calc-magnesian-silicate gneisses (Sheridan and Raymond, 1982). Tourmaline-bearing concentrates in the northern part of the St. Louis Peak Roadless Area are derived from calcium-rich gneisses characterized by hornblende and calc-silicate gneisses with interbedded plagioclase-quartz-biotite gneiss containing disseminated sillimanite. Marble occurs locally.

The magnesian tourmaline, dravite, has been suggested by Slack (1982, 1982) to be a potential prospecting guide for strata-bound mineral deposits, especially massive base-metal sulfides. Detailed X-ray studies were performed on 15 of the tourmaline samples selected from throughout the area. A plot of the a versus c unit-cell dimensions reveals that these tourmalines are part of the dravite-schorl (Mg-Fe) series (fig. 2). Generally, two populations exist: a large one centered close to the dravite end member, and a smaller one occurring closer to schorl. Most of the samples in the dravite field occur in and around the northern part of the St. Louis Peak Roadless Area, where hornblende and calc-silicate gneisses are predominant. The two samples nearest the schorl end member occur in the northern and western parts of the Williams Fork Roadless Area. One of these occurs south of Quaking Aspen Creek in stream sediments draining Cretaceous sedimentary and undifferentiated metamorphic rocks. The other occurs near Leal in stream sediments draining undifferentiated metamorphic rocks and Boulder Creek Granodiorite. The third sample which plots near the schorl end member occurs in the northern part of the St. Louis Peak Roadless Area.

Three significant aspects of the tourmaline distribution suggest association with possible massive-sulfide mineralization: (1) more than 75 percent of the tourmaline-bearing samples cluster in and around the northern part of the St. Louis Peak Roadless Area in an area of favorable lithology, (2) magnesium-rich dravites tend to characterize the tourmalines, and (3) the dravite-rich samples associated with the calcium-rich gneisses are generally those rich in scheelite/powellite, gahnite, and pyrite.

Concentrates containing pyrite occur in clusters in two general areas: (1) in the northern part of the St. Louis Peak Roadless Area, and (2) in a large area extending northeastward from the heads of Straight Creek and South Fork Williams Fork, in the Williams Fork Roadless Area, through the Red Mountain area, to the head of the Fraser River just east of the Vasquez Peak Wilderness Study Area. Both fresh pyrite and iron-oxide pseudomorphs after pyrite were observed in the samples. Pyrite in the northern part of the St. Louis Peak Roadless Area occurs in concentrates derived from the calcic metamorphic terrane, where in nearly all cases scheelite/powellite occurred with the pyrite. Pyrite is nearly ubiquitous in samples from drainages in the second, larger area where it is commonly accompanied by minerals of the sulfide-fluorite assemblage. Sheridan and Raymond (1982, p. 94) report that in a favorable lithologic terrane, even trace amounts of pyrite may be indicative of strata-bound massive sulfides. In the more general case, pyrite almost invariably occurs as a gangue or ore-bearing mineral in metallic mineral deposits (Ford, 1932, p. 434-435) and is common in moderate- to high-temperature hydrothermal deposits (Palache and others, 1944, p. 285).

Pyrite occurs in samples containing the scheelite/powellite-gahnite-tourmaline-pyrite assemblage, in samples containing the sulfide-fluorite assemblage, in samples containing minerals from both assemblages, and in samples in which pyrite is the only mineral present from either assemblage. Thus, where pyrite occurs alone, it cannot be used to differentiate the two assemblages. Perhaps geochemical/morphological studies of the pyrite would reveal trace-element patterns unique to each of the mineral assemblages observed, but this type of study was beyond the scope of our work. Pyrite is shown on the map as a separate symbol to emphasize its distribution, common to both mineral assemblages.

Sulfide-fluorite assemblage

The sulfide-fluorite assemblage occurs in the eastern parts of the Williams Fork Roadless Area and Vasquez Peak Wilderness Study Area, generally trending parallel to the northeast trend of the Berthoud Pass fault zone. Bedrock in the area is predominantly Silver Plume Granite, although inclusions of the metamorphic rocks are locally common. Hydrothermal alteration is present throughout much of the area (Eppinger and Theobald, 1985). Pyrite is nearly ubiquitous in concentrates, and other common sulfide minerals in the areas include galena, sphalerite, molybdenite, and to a lesser degree, chalcopyrite. Concentrates commonly contain fluorite and, locally, trace amounts of secondary copper minerals.

The sulfide minerals generally are found in concentrates from stream sediments draining areas of past or present mining activity. The majority of these sites occur in the vicinity of Jones Pass and the Continental Divide, in the Dailey (Atlantic) and La Plata mining districts (Bieiski and others, 1983). Mineralization occurring at mines and prospects on the southern slopes of Stanley Mountain, Vasquez Pass, and Vasquez Peak lies within and probably is related to the lead-zinc geochemical halo around the Henderson deposit at Red Mountain (Bieiski and others, 1983). Sulfides and fluorite in concentrates from drainages in these areas are likely related to mines and prospects within the Henderson lead-zinc halo.

Sulfides and fluorite occur in concentrates taken north of Vasquez Pass, in the Vasquez Peak Wilderness Study Area. The drainages overlie an isolated gravity low (Moss, 1985). The drainages overlie an area exhibits intense hydrothermal alteration (Eppinger and Theobald, 1985). A small local alteration (Eppinger and Theobald, 1985) similar to the large system at Red Mountain, may occur beneath the surficial cover.

Trace amounts of galena, sphalerite, and pyrite were observed in three concentrates taken along U.S. Highway 40 between Berthoud Pass and First Creek to the north. Silver Plume Granite in the area is extensively faulted and sheared by strands of the Berthoud Pass fault zone (Theobald, 1965), but no known mineralization exists.

Galena, fluorite, and abundant pyrite occur in samples taken from drainages near the heads of the South Fork Williams Fork and Straight Creek. This assemblage, together with altered bedrock (Eppinger and Theobald, 1985) and a few small prospects in the area, may indicate a local center of mineralization, similar to that at Red Mountain.

Molybdenite, chalcopyrite, and fluorite occur in a concentrate from East St. Louis Creek. These sediments are derived, in part, from the Vasquez Peak Wilderness Study Area. To know mineralization or prospects occur in the drainage basin, although faulted and sheared rocks are common near the head of the basin.

SUMMARY

Minerals identified in nonmagnetic fractions of heavy-mineral concentrates from stream sediments collected in the three areas of study reveal two mineral assemblages which could reflect the presence of metallic mineral deposits: a scheelite/powellite-gahnite-tourmaline-pyrite assemblage and a sulfide-fluorite assemblage.

The scheelite/powellite-gahnite-tourmaline-pyrite assemblage occurs generally in the calcic metamorphic terrane in the northern part of the St. Louis Peak Roadless Area and along the northwestern fringe of the Vasquez Peak Wilderness Study Area. Minerals common to this assemblage also occur in other parts of the study areas. This assemblage could reflect the presence of undiscovered Precambrian tungsten or massive-sulfide deposits, as described by Tweto (1960) and by Sheridan and Raymond (1977).

The sulfide-fluorite assemblage generally occurs along the eastern edge of the study area, in the Williams Fork and Vasquez Peak Wilderness Study Area. This assemblage occurs predominantly in Silver Plume Granite locally containing inclusions of the metamorphic rocks, and generally trends parallel to the northeast-trending Berthoud Pass fault zone. Sphalerite, galena, molybdenite, pyrite, and fluorite occur in the area, along with lesser amounts of chalcopyrite. The sulfide-fluorite assemblage observed in samples from drainages in the vicinity of Red Mountain probably reflects the lead-zinc geochemical halo and fluorine enrichment surrounding the Henderson molybdenum deposits. Other sulfide-fluorite occurrences in concentrates in the study areas may reflect mineralization similar to that at Red Mountain.

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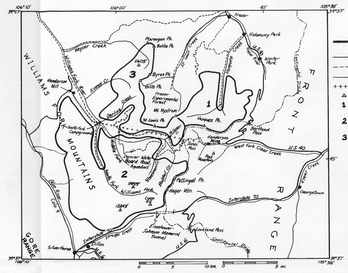

Figure 1.--Map showing locations of the Vasquez Peak Wilderness Study Area and the Williams Fork and St. Louis Peak Roadless Areas, Colorado.

TABLE 1.--Distribution of minerals in samples containing the scheelite/powellite-gahnite-tourmaline-pyrite assemblage or the sulfide-fluorite assemblage

Sample locality number	galena	molybdenite	chalcopyrite	sphalerite	fluorite	pyrite	scheelite/powellite	gahnite	tourmaline
1						X			
2						X	X		
3							X		
4						X			
5						X	X		
6						X		X	
7						X			
8						X			
9						X		X	X
10						X			
11						X			
12							X		
13						X			
14						X			
15						X			
16						X			
17						X			
18						X			
19						X			
20						X	X		
21						X	X		
22						X			
23						X			
24						X			
25						X			
26						X			
27						X	X		
28	X					X	X		
29						X			
30						X	X		
31							X		
32						X			
33						X			
34						X			
35						X			
36						X			
37						X			
38						X			
39						X			
40						X			

Sample locality number	galena	molybdenite	chalcopyrite	sphalerite	fluorite	pyrite	scheelite/powellite	gahnite	tourmaline
41						X			
42						X			
43						X	X		
44						X			
45						X			
46						X	X		
47						X	X		
48						X			
49						X	X	X	
50						X	X	X	
51						X	X		
52						X	X		
53						X	X		
54						X	X	X	
55						X	X	X	
56						X	X	X	X
57						X	X	X	
58						X	X		
59						X	X	X	X
60						X	X		
61						X		X	
62						X	X	X	
63						X	X	X	
64						X	X	X	
65						X	X	X	
66						X	X		
67						X	X		
68						X	X		
69						X	X		
70						X		X	
71							X		
72						X	X		
73						X	X	X	
74						X	X		
75						X	X		
76						X			
77	X	X	X	X	X	X			
78						X			
79						X			
80						X			

Sample locality number	galena	molybdenite	chalcopyrite	sphalerite	fluorite	pyrite	scheelite/powellite	gahnite	tourmaline
81						X	X		
82						X	X		
83						X			
84						X			
85						X			
86						X			
87						X			
88			X						
89						X			
90						X			
91						X	X	X	
92						X			
93				X		X			
94						X	X	X	
95						X			
96		X	X	X					
97						X			
98						X		X	X?
99	X			X					
100						X			
101	X			X	X	X			
102			X		X	X	X?		
103	X	X	X	X		X	X		
104	X			X		X	X		
105			X	X	X	X	X?		
106		X				X	X		
107						X	X?		
108						X	X		
109					X		X		
110	X								
111						X			
112						X	X		
113						X			
114						X			
115						X			
116						X	X		
117						X			