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Data on some stratabound Precambrian deposits
containing zinc, copper, lead, silver, and gold
in the Royal Gorge 15-minute quadrangle, Colorado

By

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During 1975 reconnaissance geologic studies were made and samples were taken at several stratabound Precambrian deposits of base-metal sulfides in the central part of the Royal Gorge 15-minute quadrangle, Colorado. These studies are part of a project entitled "Precambrian sulfide deposits in Colorado." The localities sampled and the sample numbers are indicated on the accompanying excerpt from the topographic map of the quadrangle (fig. 1). A geologic map of the area by Taylor and others, 1975, shows the favorable host rock unit in which these deposits are found, designated Xgn.

This report presents descriptions and analyses of the materials sampled and geologic notes concerning the deposits and their host rocks. Analytical data (tables 1, 2, and 3) indicate that most of the samples constitute ores of mineable grade in terms of their zinc and copper contents, supplemented in some by their lead, silver, and gold contents. An earlier report summarized preliminary data concerning Precambrian sulfide deposits and related deposits of zinc spinel (gahnite) throughout Colorado (Sheridan and Raymond, 1977).

Sample No. S-112-75 was obtained from the dump of an adit in W 1/2 sec. 15, T. 19 S., R. 71 W., on the east side of Jennings Gulch, a tributary of Grape Creek (fig. 1). The dump consists principally of sillimanitic mica schist with lesser amounts of calc-silicate gneiss and medium-grained spotted amphibolite. The adit apparently was driven along a layer or layers of calc-silicate gneiss. The sample consists of calc-silicate gneiss containing actinolite, garnet, a pink carbonate mineral (probably calcite), and epidote. The semiquantitative spectrographic analysis (table 1) indicates that the sample contains minor amounts of zinc, copper, lead, chromium, and nickel. Although these metallic constituents are not sufficiently abundant here to constitute an ore of mineable grade, experience elsewhere in Colorado

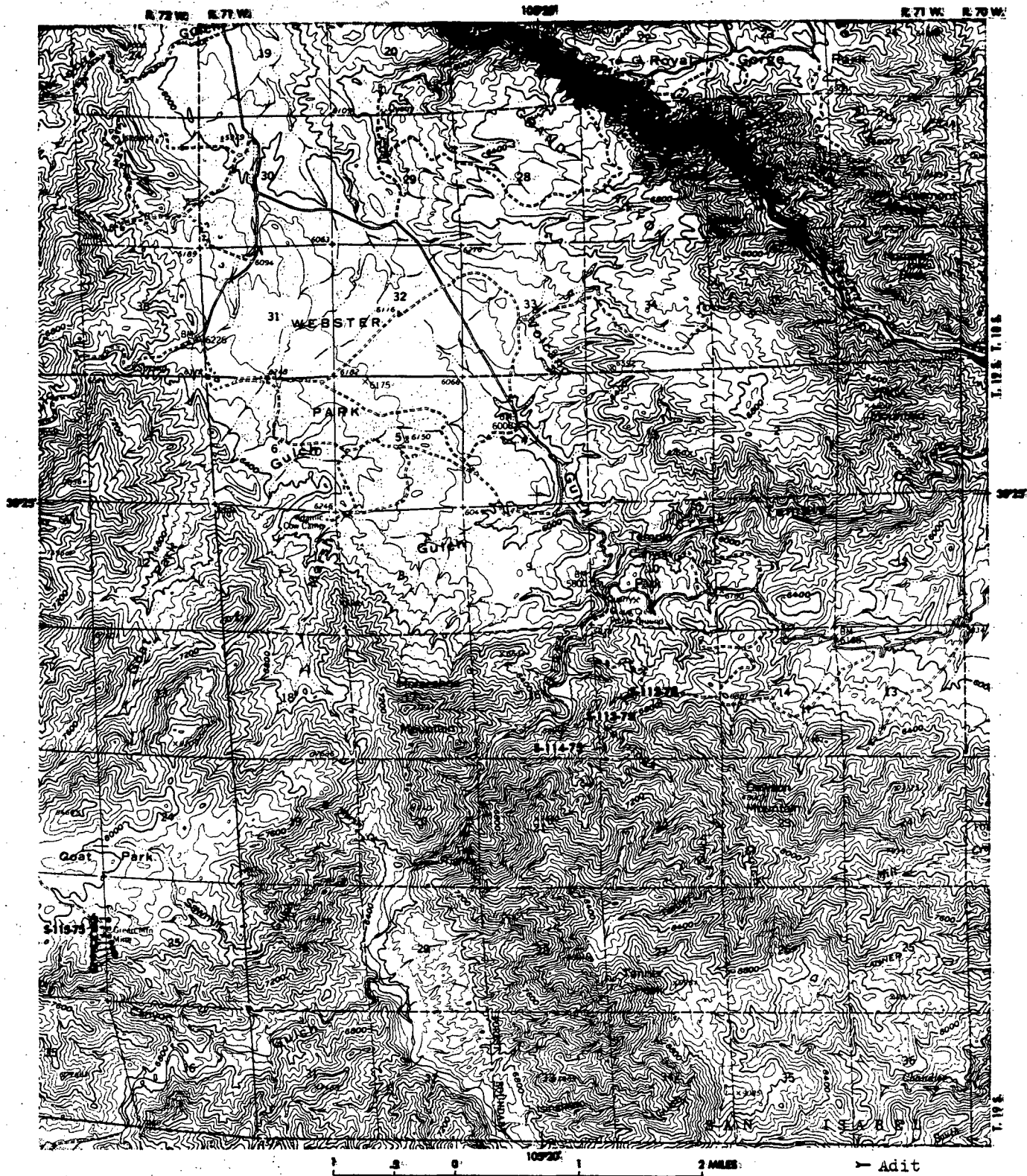


Figure 1.—Excerpt from central part of Royal Gorge 15-minute quadrangle,

Colorado showing localities sampled and sample numbers.

- Adit
- Shaft
- Other sample site

Table 1.--Semi-quantitative 6-step spectrographic analyses¹ of ten samples from Precambrian sulfide deposits, Royal Gorge 15-minute quadrangle, Colorado

(Analyses by Marilyn W. Solt, U.S. Geological Survey. Si, Al, Fe, Mg, Ca, Na, K, and Ti are reported in percent; all other elements are in parts per million (1 percent = 10,000 ppm). The 6-step reporting is based on geometric number brackets reported as the approximate mid-points of these brackets as follows: 120-83 bracket as 100, 83-56 as 70, 56-38 as 30, 26-18 as 20, 18-12 as 15, 12-8.3 as 10, etc. Thus 0.07 is the value reported for the bracket 0.083-0.056, and 0.07 percent is 700 ppm. Symbols used are: G, greater than 10 percent; --, not looked for; N, not detected, at limit of detection or at value shown; L, detected but too little in amount to be given a reportable value. (See table 2 immediately following))

Sample No.	Si	Al	Fe	Mg	Ca	Na	K	Ti	Mn	Ag	Ba	Be	Bi	Cd	Co	Cr	Cu
S-112-75	G	G	10.0	1.5	G	0.05	N	0.5	1,500	N	150	L	N	N	20	70	100
S-113-75	7.0	1.5	G	3.0	3.0	--	N	.03	2,000	20	50	N	30	500	200	3	5,000
S-114-75	G	2.0	G	5.0	10.0	.3	N1.0	.02	2,000	15	70	N	15	150	150	7	20,000
S-115A-75	G	10.0	G	3.0	.7	.5	5.0	1.0	1,500	7	700	1.5	L	L	70	20	15,000
S-115B-75	G	G	G	G	1.0	--	N	.3	3,000	30	150	2	700	L	20	7	15,000
S-115C-75	G	10.0	G	10.0	3.0	.7	1.0	.15	2,000	3	50	N	100	N	30	5	20,000
S-115D-75	G	3.0	7.0	1.5	.2	.7	2.0	.2	1,000	1.5	300	N	L	N	20	10	15,000
S-115E-75	G	1.5	G	10.0	7.0	.15	N	.03	700	30	10	N	150	N	70	5	70,000
S-115F-75	G	G	G	7.0	.2	.2	N	.2	1,500	1.5	150	10	N	N	15	3	2,000
S-115G-75	G	5.0	G	5.0	.15	.2	.7	.15	1,500	3	150	N	30	N	20	5	20,000

Sample No.	La	Mo	Nb	Ni	Pb	Sc	Sa	Sr	V	Y	Zn	Zr	Ce	Ga	In	Yb	Nd
S-112-75	L	N	10	50	70	30	N	700	150	50	300	150	N	50	N	5	N150
S-113-75	L	15	L	7	10,000	N	30	10	50	L	G	N	N	--	N	--	N
S-114-75	N	N	L	7	7,000	N	N	15	20	L	50,000	N	N	--	N	--	--
S-115A-75	200	20	20	20	500	30	50	50	200	150	30,000	200	300	50	N	15	200
S-115B-75	N	N	L	L	7,000	20	30	10	20	30	70,000	300	N	70	N	5	--
S-115C-75	300	N	15	5	20	15	50	15	20	50	10,000	150	300	70	N	--	150
S-115D-75	N	5	L	7	50	10	N	15	70	20	3,000	50	N	15	N20	2	--
S-115E-75	N	N	L	5	10	N	15	N	30	L	1,000	N	N	--	N	--	--
S-115F-75	N	N	L	L	20	15	N	10	20	30	10,000	200	N	70	N	5	--
S-115G-75	N	N	10	N	30	10	15	5	15	30	20,000	150	N	30	N	5	--

¹The following elements are not tabulated because all entries are N, L, or --: P, As, Au (see table 2), B, Pd, Pt, Sb, Te, U, W, Ge, Hf, Li, Re, Ta, Th, Tl, Pr, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Lu.

Table 2.--Approximate visual lower limits of determination for the elements
analyzed by the 6-step spectrographic method at the
Denver U.S. Geological Survey Laboratory

[Revised February 1972. Some combinations of elements affect the limits of determination. In favorable materials, values lower than these may be detected. In unfavorable materials these limits of determination may not be attained. (*) Values for Al below 0.1 percent may result from grinding with high alumina ceramic plates]

Percent		Percent	
Fe	0.001	Si	0.002
Mg	0.002	Al	0.01*
Ca	0.002	Na	0.05
Ti	0.0002	K	0.7
		P	0.2
Parts per million		Parts per million	
Mn	1	Ce	200
Ag	0.5	Ga	5
As	1000	Ge	10
Au	20	Hf	100
B	20	In	10
Ba	2	Li	100
Be	1.5	Re	50
Bi	10	Ta	500
Cd	50	Th	200
Co	5	Tl	50
Cr	1	Yb	1
Cu	1	Pr	100
La	50	Nd	70
Mo	3	Sm	100
Nb	10	Eu	100
Ni	5		
		Gd	50
Pb	10	Tb	300
Pd	2	Dy	50
Pt	50	Ho	20
Sb	200	Er	50
Sc	5	Tm	20
		Lu	30
Sn	10		
Sr	5	Ir	50
Te	2000	Os	50
U	500	Rh	2
V	7	Ru	10
W	100		
Y	10		
Zn	300		
Zr	10		

Table 3.—Gold content of eight samples from Precambrian sulfide deposits, Royal Gorge 15-minute quadrangle, Colorado

[Au determined by fire assay and atomic absorption by J. G. Crock, Joseph Haffty, and A. W. Haubert, all U.S. Geological Survey. < = less than]

Sample No.	Au (parts per million)
S-113-75	0.15
S-114-75	.25
S-115A-75	.32
S-115B-75	9.24
S-115C-75	1.62
S-115D-75	<0.05
S-115E-75	2.64
S-115G-75	.42

has shown that calc-silicate gneiss is one of several rock types commonly found near and along strike from Precambrian sulfide deposits.

Sample No. S-113-75 was obtained from the dumps of two closely associated shafts in SE 1/4 sec. 16, T. 19 S., R. 71 W. on the southeast side of Grape Creek; only one of the two shafts is shown on the map (fig. 1). The principal rock in this area is a feldspar-rich gneiss. The shafts were sunk on an ore-bearing layer, about 15 ft (5 m) thick, consisting of amphibolite, calc-silicate gneiss, and dark-colored biotitic gneiss, some of which is garnetiferous. The layer strikes N. 60° E. and dips 70° SE. The sample is a composite sample of sulfide ore collected from the dumps of the two shafts. The ore contains sphalerite, galena, chalcopyrite, magnetite, and gahnite in a metamorphically intergrown matrix of silicate minerals. The semiquantitative spectrographic analysis (table 1) indicates that sample S-113-75 contains over 10 percent Zn, supplemented by 0.5 percent Cu, 1.0 percent Pb, and 20 ppm Ag (corresponding to about 0.6 troy oz of Ag per ton). The gold content is 0.15 ppm (table 3).

Sample No. S-114-75 was obtained from the dumps of two closely associated adits in SE 1/4 sec. 16, T. 19 S., R. 71 W. on the southeast side of Grape Creek (fig. 1). Feldspar-rich gneiss, the principal rock in this vicinity, contains ore-bearing layers, about 3 ft (1 m) thick, of amphibolite, calc-silicate gneiss, and impure marble. Some garnetiferous quartz-mica gneiss is present between the adits and Grape Creek. The adits were driven S. 25° E. across the layering, which strikes N. 75° E. and dips 75° SE. A shaft from the surface connects with the upper of the two adits. The sample is a composite sample of sulfide ores collected from the dumps of the two adits. The ores contain sphalerite, chalcopyrite, galena, and pyrrhotite in a metamorphically intergrown matrix of silicate minerals and carbonate (impure

marble). The semiquantitative spectrographic analysis of sample S-114-75 (table 1) indicates that it contains 5.0 percent Zn, 2.0 percent Cu, 0.7 Pb, and 15 ppm Ag (corresponding to about 0.4 troy oz Ag per ton). The gold content is 0.25 ppm (table 3).

Sample numbers S-115A-75 through S-115G-75 were obtained from the Green Mountain mine area south of Goat Park in T. 19 S., R. 72 W. (fig. 1). Although only two shafts are shown on the small scale map, seven shafts are located at intervals over a distance of at least 1,000 ft (300 m) along an alignment trending north-northeast. This is approximately parallel to the lithologic layering, which strikes N. 25°-40° E. and dips 75°-85° SE. The samples were collected from the dumps of the mine workings along this alignment, starting with S-115A-75 at the north end and proceeding successively to S-115G-75 at the south end. The principal Precambrian rocks cropping out in the vicinity of the mine workings are sillimanite-biotite-quartz gneiss, garnetiferous sillimanite-biotite-quartz gneiss, garnetiferous feldspathic gneiss, and granitic gneiss. Materials observed on the mine dumps indicate that these rocks contain interlayers of dark-colored amphibolite, biotite-quartz gneiss, cordierite gneiss, and a gneiss rich in light-colored amphiboles. These interlayers are important to the economic geology because they are the favorable host rocks containing significant amounts of chalcopyrite and the zinc spinel, gahnite. Magnetite and sphalerite were also noted in some of the samples. Secondary copper minerals are abundant on the dumps of the shallower workings. Samples S-115B-75, S-115C-75, S-115E-75, and S-115F-75 are from the principal workings and consist of varying amounts of chalcopyrite and gahnite metamorphically intergrown with silicate minerals of the favorable host rocks. The other samples are from shallower workings and consist of varying amounts of gahnite and secondary copper minerals in the

favorable host rocks. The semiquantitative spectrographic analyses (table 1) indicate the following ranges: 0.2 to 7.0 percent Cu, 0.1 to 7.0 percent Zn, and 1.5 to 30 ppm Ag (corresponding to as much as 0.9 troy oz Ag per ton). The gold contents (table 3) of five of these samples range from less than 0.05 to 9.24 ppm (corresponding to as much as 0.27 troy oz Au per ton).

REFERENCES CITED

- Sheridan, D. M., and Raymond, W. H., 1977, Preliminary data on some Precambrian deposits of zinc-copper-lead sulfides and zinc spinel (gahnite) in Colorado: U.S. Geological Survey Open-File Report 77-607, 27 p.
- Taylor, R. B., Scott, G. R., Wobus, R. A., and Epis, R. C., 1975, Reconnaissance geologic map of the Royal Gorge [15-minute] quadrangle, Fremont and Custer Counties, Colorado: U.S. Geological Survey