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James Doyle Sell Mining Collection

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ASARCO

RECEIVED
OCT 1 1979
S. W. U. S. EXPL. DIV.

Geochemical Office — Exploration Department
L. D. James
Chief Geochemist

September 26, 1979

TO: W. L. Kurtz
Tucson Office

FROM: L. D. James

Limestone Replacement Study - J.D. Sell

I read with interest Mr. Sell's numerous reports on the large quantity of geological and geochemical data relating to limestone replacement mineralization in Colorado he collected last year. He provides persuasive evidence that a combination of specific geological and geochemical data can provide useful leads to areas of high mineral potential in carbonate terrain. Of the geochemical parameters, as in the case of carbonate rocks in a variety of other geological environments (eg. S.E. Missouri, Ireland, etc.), Mn displays particular promise as an exploration guide.

The available geological and geochemical data represent such a wide variety of environments that do not appear to lend themselves to statistical treatment. One particular problem would be assignment of 'weight' to each parameter in each particular type of sample. Empirical evaluation of the data is probably the best that can be achieved at this stage.

As Mr. Sell indicates in his memorandum of July 13, 1979, a major unresolved problem is distinguishing regional from localized mineralization related (?) hydrothermal dolomitization. Cathodoluminescence studies might prove useful in this area. Current ASARCO studies in Mid-Tennessee indicate this approach has considerable potential. Evidence that specific types of dolomite in Colorado might display diagnostic cathodoluminescence patterns was provided by a test I recently made at the University of Tennessee on a sample of unmineralized karst breccia from the Sacramento Mine, west of Fairplay. Apparently Mr. Johansing is considering some cathodoluminescence studies as part of his current MS research program at Colorado State University.

I understand recent studies by others in the Leadville District has supposedly provided evidence that the Belden Shale Unit overlying the Leadville Dolomite is impoverished in a number of elements in the general vicinity of the mineralized district. This type of feature might be worthy of further study in view of its potential value as an exploration guide as well as the light it might throw on deposit genesis.

Although I agree the Skyline semi quantitative emission spectrographic analytical method provides useful data on the first pass over a district, I remain

unconvinced that it is necessarily adequate as a routine tool once potential pathfinder elements have been tentatively delineated in a particular district. This is especially true when exploration decisions might have to be made on the basis of relatively small numbers of samples of specific geological features. The most Skyline claim for the methods is that the "true" value of each element is within ±1 step of the reported range at the 68% confidence level and within ±2 steps at the 95% confidence level. (Note: The stepped series used for reporting purposes are: 1, 1.5, 2, 3, 5, 7, 10, etc.) Thus, 95% of the time a true value of, say, 2ppm Ag will be reported somewhere in the range of 1-5 ppm. Standard geochemical procedures provide much more consistent results. They also provide lower detection limits in the case of several potentially important elements (eg. Ag, As, Mo, Zn, etc.). S and Au are two additional elements which might be worthy of attention in some circumstances.

I strongly advise against analysis of trace elements by the Barringer MRFAPE procedure until more convincing evidence is obtained of its reliability. Our experience with the method has not been good. Skyline has the instrumental ability to carry out trace element analysis by this means but have chosen to confine attention to major elements until the numerous snags related to trace analysis can be overcome.

L. D. James.

Lloyd D. James

LDJ:cej

cc: TCO/RLB
FTG
DMS
JDS

ASARCO

Geochemical Office

F. T. G.

RECEIVED
JUN 18 1979
S. W. U. S. EXPL. DIV.

June 13, 1979

TO: F. T. Graybeal

FROM: L. D. James

Limestone Replacement Study
Check Analysis

As a matter of interest I arranged for a small selection of samples from the Limestone Replacement Study to be analyzed by 'total' geochemical procedures. The results together with those originally obtained by Skyline Lab using emission spectroscopy (ES) are attached.

Assuming the geochemical data to be reasonably accurate the ES procedure appears to often (but not invariably) provide a fair estimate of the general order of element concentrations present. The ES data should usually permit broad categorization of samples but are probably unable to provide consistent definition of more subtle geochemical features.

True, but we're not looking for subtle features of the geochem.

L. D. James.

Lloyd D. James

LDJ:cej

cc: WLKurtz
DMSmith, Jr.
JDSell

ITEM NO.	SAMPLE NO.
17	G-07
18	G-08
19	WP-01
20	WP-01A
21	WP-02
22	WP-03
23	WP-04
24	WP-05

	WP-1	WP-1A	WP-2	WP-3	WP-4	WP-5
ITEM	19	20	21	22	23	24
ELEMENT						
Fe	34.5 20%	1%	4.1 5%	7.2 5%	2.8 2%	1.8 0.07%
Ca	0.14 0.05%	5%	0.60 0.5%	0.09 0.03%	17.0 20%	1.6 1%
Mg	0.04 0.03%	10%	0.30 0.2%	0.06 0.03%	2.15 2%	0.28 0.2%
Ag	28.5 15	10	<.5 <1	1.0 <1	<.5 <1	<.5 <1
As	<500	<500	<500	2000	<500	<500
B	20	<10	15	<10	<10	10
Ba	<10 <10	<10	450 <10	10 <10	1050 <10	1020 50
Be	<2	<2	2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10
Cd	<50	300	<50	<50	<50	<50
Co	<5	<5	<5	5	<5	<5
Cr	10 <10	<10	15 <10	10 <10	20 10	<2 <10
Cu	310 200	100	6 2	53 100	11 5	8 2
Ga	10	<10	<10	<10	<10	<10
Ge	50	<20	<20	<20	<20	<20
La	<20	20	30	20	50	50
Mn	210 100	300	370 200	600 200	750 500	300 150
Mo	62 50	<2	1.2 <2	14.9 2	2.0 <2	1.0 <2
Nb	20	<20	30	20	20	20
Ni	<5	<5	<5	5	5	<5
Pb	6.9% 10000	>10000	150 150	1000 200	30 20	30 10
Sb	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	<10	<10
Sn	20	<10	<10	<10	<10	<10
Sr	<100	<100	100	<100	300	200
Ti	<100 20	<20	400 1000	<100 200	700 700	400 300
V	20	10	50	100	30	10
W	<50	<50	<50	<50	<50	<50
Y	<10	<10	10	<10	10	<10
Zn	1.6% 10000	>10000	230 200	1200 <200	140 <200	67 <200
Zr	<20	<20	300	70	20	50

ITEM NO.	SAMPLE NO.
9	CL-05
10	CL-06
11	G-01
12	G-02
13	G-03
14	G-04
15	G-05
16	G-06

	G-1	G-2	G-3	G-4	G-5	G-6	G-7	G-8
ITEM	11	12	13	14	15	16	17	18
ELEMENT								
Fe	2.5 1%	1.7 0.5%	52.8 20%	19.0 5%	8.1 5%	5.9 2%	5%	0.2%
Ca	0.12 0.1%	20.0 15%	0.16 0.05%	0.35 0.1%	1.8 0.7%	1.1 0.2%	2%	20%
Mg	0.23 0.1%	12.5 15%	0.06 0.03%	0.13 0.03%	1.65 1%	1.57 0.7%	1%	15%
Ag	<.5 <1	<.5 <1	4.7 1	5.8 10	<.5 <1	<.5 <1	<1	<1
As	<500	500	<500	<500	500	500	500	<500
B	10	<10	20	10	100	20	30	<10
Ba	1050 300	160 <10	170 <10	<10 <10	850 10	700 100	20	<10
Be	<2	<2	<2	3	2	2	3	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	70	<50	<50	<50	<50
Co	<5	<5	<5	5	5	<5	<5	<5
Cr	<2 <10	5 <10	55 10	8 <10	47 <10	41 <10	<10	<10
Cu	2 <2	5 <2	890 300	137 50	15 5	21 10	2	<2
Ga	10	<10	10	<10	15	15	10	<10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	20	<20	<20	30.5% 30	50	30	<20	20
Mn	950 500	4500 2000	1700 500	5 10000	600 300	650 200	200	300
Mo	1.2 <2	0.7 <2	3.1 10	1.5 2	3.0 2	1.2 <2	<2	<2
Nb	20	<20	20	20	30	20	20	<20
Ni	<5	<5	<5	20	30	5	5	<5
Pb	30 15	20 20	1.35% 3000	0.88% 1500	20 10	15 10	<10	<10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	20	<10	<10	<10
Sn	<10	<10	20	<10	<10	<10	<10	<10
Sr	100	100	<100	<100	200	200	100	<100
Ti	<100 500	<100 <20	<100 20	<100 50	3000 3000	2000	1000	20
V	20	20	70	30	100	50	30	20
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	15	10	10	<10
Zn	175 <200	0.75% 5000	1.18% 7000	10.2% 10000	120 <200	420 <200	<200	<200
Zr	30	<20	<20	<20	200	100	150	<20

Project 79-55

W. E. C. LABORATORY ANALYTICAL DATA

Page 1

Area

Requested By L. D. James

No. Samples

Date June 11, 1979

SAMPLE NUMBER	Fe %	Mn %	Ti %	Mg %	Ca %	Ba PPM	Cr PPM	Cu PPM	Pb* PPM	Zn PPM	Ag* PPM	Mo PPM
G-1	2.5	.095	<.01	0.23	0.12	1050	<2	2	30	175	<.5	1.2
2	1.7	.450	<.01	12.5	20.0	160	5	5	20	0.75%	<.5	0.7
3	52.8	.170	<.01	0.06	0.16	170	55	890	1.35%	1.10%	4.7	3.1
4	19.0	30.5	<.01	0.13	0.35	<10	8	137	0.80%	10.2%	5.8	1.5
5	8.1	.060	0.30	1.65	1.8	850	47	15	20	120	<.5	3.0
6	5.9	.065	0.20	1.57	1.1	700	41	21	15	420	<.5	1.2
WP-1	34.0	.021	<.01	0.04	0.14	<10	10	310	6.9%	1.6%	28.5	62
2	4.1	.037	<.01	0.30	0.60	450	15	6	150	230	<.5	1.2
3	7.2	.060	<.01	0.06	0.09	10	10	53	1000	1200	1.0	14.9
4	2.8	.075	.07	2.15	17.0	1050	20	11	30	140	<.5	2.0
5	1.8	.030	.04	0.28	1.6	1020	<2	8	30	67	<.5	1.0

ASARCO

Southwestern Exploration Division

May 31, 1979

TO: Geologists

FROM: F. T. Graybeal

Limestone Replacement Textures

Jim Sell has assembled a lovely suite of various alteration textures associated with massive lead-zinc-silver replacements in the Leadville limestone. The individual samples are described in the attached memo by Mr. Sell. The samples are stored in an NC core box presently located on the binocular-microscope table in the microscope room. I suggest you all take the time to review these samples carefully as they are most educational. You never know when you may suddenly find yourselves looking for one of these things or when you might stumble across one while looking for something else.

F. T. Graybeal

F. T. Graybeal

FTG:lb
Att.

cc: WLKurtz - w/att.

ASARCO

Southwestern Exploration Division

May 14, 1979

F.T.G.

TO: F. T. Graybeal

FROM: J. D. Sell

Limestone Replacement Search
Notes for Tucson Hand Specimens
Colorado Samples

For reference purposes, I submit a few representative hand specimens of the Leadville Formation units and their progressive change from limestone to dolomite, to ore-bearing characteristics, to replacement by sulfides. This memo is a revision of the September 21, 1978 report to the Denver Office (DMS,Jr.). Emission-spec reports are contained in individual reports on the areas collected, as well as being compiled in the recently submitted Limestone Replacement Search compendium (May 14, 1979). The numbered LRS- (Limestone Replacement Search -) samples have the following features.

LRS-1. Leadville limestone, Trout Creek Area (TC-1). Very fine crystalline. Note the blocky chocolate conchoidal breakage characteristic of unaltered limestone. Red stain is immediate reaction from Alizarin Red-S.

LRS-2. Leadville dolomite, Hilltop Area (FMH-1). Fine replacement texture has converted the limestone to a dolomitic unit. Note the fine silica ribs and elephant-hide weathering characteristics. The rock contains a trace of manganese (700 ppm), 7 ppm silver, and 1500 ppm lead, indicating metal-bearing solutions have penetrated the area. Alizarin Red-S does not stain this rock.

LRS-3. Leadville dolomite, Leadville district. Extremely well recrystallized; termed "pearly texture" in the literature of Leadville and Gilman areas. Note vug development, with secondary vug filling as well as replacement bands. The stain (a deeper purple red) is from Alizarin Red-S which was allowed to evaporate on the slab. Reaction time is slow. This type of dolomitic recrystallization is pervasive and contains a variable amount of trace elements.

LRS-4. Leadville dolomite, Hilltop area (FMH-2). Coarse recrystallized dolomite, as above, with vug development and secondary dolomite crystal deposition in vugs and interstitial knots. Dusty reddish iron overprint in the secondary dolomite features. As above, may have a variable trace element content, but where found with anomalous values indicates mineral system availability.

LRS-5A. Leadville dolomite, Peerless area (FM-1A). Fine to medium pervasive recrystallization (pearly) with superimposed "zebra" development with coarse white dolomite crystals filling minor vugs and replacing along bands and stripes. In this rock, though only a trace of manganese (700 ppm) was reported, the jump in silver (30 ppm), copper (500 ppm), and lead (5000 ppm) indicates a relationship toward ore. The deep purple stain is again evaporated Alizarin Red-S.

LRS-5B. Leadville dolomite, Peerless area. Well-developed zebra texture of secondary dolomite growths and vug filling. Note control by pre-alteration fractures on size of secondary growths, and the apparent initial limestone depositional feature on control of extent of zebra development.

LRS-6. Leadville dolomite breccia, Mudsill area. Exhibits various recrystallized textures in clast composition, and cemented by secondary dolomite crystal deposition. Often carries anomalous magnesium, manganese, silver, and barium, indicating metal solution pathway.

LRS-7. Leadville dolomite breccia, Mudsill area. As above, with pervasive recrystallization of clasts, with secondary dolomite crystals and quartz crystals. Mineralized with sulfides.

LRS-8. Leadville stratified cave-fill, Hilltop area. Dolomite sand filling karst topography or other solution dissolved pathways. Generally has high metal values suggesting metal pathways following old solution pathways.

LRS-9. Leadville stratified cave-fill, Peerless area. As above, mineralized by sulfides. Note quartz and barite crystal replacement and interstitial filling in the sand.

LRS-10. Leadville karst cave-fill, Hilltop area. Note increased replacement by barite (barite sand). Malachite-azurite generally suggests oxidation from tetrahedrite-ruby silver series of sulfosalts and values in excess of 100 ounces silver per ton are common in this rock.

LRS-11. Leadville dolomite, Peerless area. Replaced by iron-manganese-barite-quartz with variable sulfides of lead-zinc. Now totally oxidized. Base metals may stay behind in oxidized form or may be nearly flushed from system. Silica addition as chert or jasperoid invariably holds amounts of original metal content to indicate favorable zones.

LRS-12. Leadville dolomite, Black Cloud Mine. Zebra texture replaced by sulfides. Note several depositional types and colors of secondary dolomite in vugs and bands. Sulfides apparently replace the grey dolomite bands of the zebra (see LRS-5A and -5B zebra).

LRS-13. Leadville dolomite, Black Cloud Mine. Zebra and birdseye (knot) texture replaced by late dolomite and sulfides. The high percentage of secondary interstitial dolomite (40-50%) may indicate the spent-solution side of fluid flow where the sulfide replaced dolomite (as in LRS-12 above) releases abundant dolomite gangue which moves outward and reprecipitates in the outer zone as in LRS-13.

LRS-14. Leadville limestone, Aspen area. Located within the mineralized trend and is a well-recrystallized limestone with secondary calcite crystal stringers and quartz stringers of cross-cutting nature. The stain is immediate reaction of Alizarin Red-S. The E-S results show 2200 ppm manganese, 2000 ppm lead, 20 ppm moly, with 36% silica. Visually and chemically this is a limestone system equal to that of the dolomite system imposed as of LRS-3 and -4.

LRS-15. Leadville dolomite, Aspen area. This sample is located on the dolomite side of the dolomite-limestone front at Aspen and is in the vicinity of one of the larger producing mines. E-S reports 27,000 ppm manganese, 55,000 ppm lead, 10 ppm moly, plus 40,000 ppm zinc and 106 ppm silver indicating its relationship to ore.

James D. Sell

JDS:lb

Box of hand specimens labeled "LRS"

ASARCO

Geochemical Office
F. G.
RECEIVED
MAY 18 1979
S. W. U. S. EXPL. DIV.

May 15, 1979

TO: W. L. Kurtz

FROM: L. D. James

Limestone Replacement Study (J.D. Sell)
Colorado

This is to acknowledge receipt of your memorandum of May 10 relating to the geochemical data from Jim Sell's limestone replacement study in Colorado last year.

Before attempting any detailed study of the data I am having a little check analysis carried out. When this is complete I will look through the data memoranda together with the final report (not yet received) before deciding what, if any, statistical treatment might be applicable.

L.D. James.

Lloyd D. James

LDJ:cej

cc: TCO
FTG
DMS
JDS

ASARCO

Exploration Department
Western USA

May 10, 1979

F.T.G.

D. M. Smith
Denver Office

Leadville Limestone

Mr. Sell suggests, and I agree, that it would be beneficial for spelling? Johansing to critically review Sell's work and provide us with a written critique.

W. L. Kurtz

WLK:lb

cc: FTGraybeal/JDSell

ASARCO

Exploration Department
Western USA

May 10, 1979

F.T.G.

L. D. James
Denver Office

J. D. Sell's
Limestone Replacement Work
Colorado

This will confirm our phone conversation of yesterday that you will study all of the geochemical data from last summer's limestone replacement studies conducted by Mr. Sell.

You will recall that Mr. Sell gave a brief presentation of his work at the Denver Exploration Meeting last September. At that time he emphasized the megascopic features within and outside of mining districts that an explorationist might use in a limestone replacement search. This suite of samples is available for study in the Denver Office.

Sell's geochem work, complementing his field studies, suggests a number of elements that might be used to augment the megascopic studies.

We would like you to study this data and apply any applicable statistical treatments that might make subtle patterns more obvious. Though the samples in any individual area may be too limited for statistical treatment you will note that samples from different areas (see detailed sample descriptions by Sell) may be grouped.

Please feel free to consult with Mr. Sell -- he is really bullish on the use of both the megascopic criteria and geochemical patterns for limestone replacement ore search.

W. L. Kurtz

W. L. Kurtz

WLK:lb

cc: TCOsborne
FTGraybeal
DMSmith
JDSell

ASARCO

Southwestern Exploration Division

May 7, 1979

F. T. G.

Mr. S. A. Anzalone
Tucson Office

Leadville

Because the Exploration Department believes an understanding of the mineralization (and all its associated features) at Leadville may help in ore search in other limestone replacement districts I request that Mr. Sell spend a few days early in the season with Mr. Cummings so that they may mutually agree on the recordation of certain features which may help in Asarco's exploration efforts. It would probably be beneficial if Sell made another visit in mid-summer. This information would not be made available to Newmont.

W. L. Kurtz

W. L. Kurtz

WLK:lb

cc: JDSell
FTGraybeal
RBCummings
DMSmith

WLK LEADVILLE

FTG - [illegible] but think I will let it [illegible]

Will you somehow request that JDS be invited to review Cummings' work at mid-Summer. Reason is to "see what is being done so our program will benefit" - prob. best way to propose it. If proposed so Expl. Dept. can "advise" we will never get there.

FTG ✓
JDS
FCU

FTG
4/27/79

FTG Copy

ASARCO

Southwestern Exploration Division

March 5, 1979

TO: D. M. Smith, Jr.

FROM: J. D. Sell

F.T.G.

Possible Ore Trend Values
Emission-Spec Values
Black Cloud Unit, Leadville
Sec. 33, T9S, R79W
Lake County, Colorado

On September 25-26, 1978, Mr. Craig Byington, Black Cloud Unit Geologist, and myself collected a series of samples in and near the No. 5 and No. 6 ore bodies. The purpose was to establish, if possible, ore trend values which would indicate the nearness of ore within the favorable units.

The descriptive data on the samples collected on the 1250 Level, and mainly from Leadville Formation units, are recorded in Table One. A plan of the 1250 Level, showing the Black Cloud shaft, the mineral bodies, basic rock types, and sample sites, is recorded in Attachment A. Additional samples were collected from the 1500 Level, mainly in a Manitou Dolomite unit, and are described along with the cross-section (Attach. G, to be discussed later). The 1500 Level plan map is also shown on Attachment A.

The collected data and emission-spec results were separated into several categories: 1) the values in ore; 2) the apparent closeness to ore, i.e., within 20 feet, between 20 and 40 feet, between 40 and 60 feet, and beyond 60 feet from ore. The data were further divided as to the nearness of the sample to porphyry, i.e., in porphyry, up to 5 feet away, between 5 and 10 feet, and beyond 10 feet from porphyry.

As noted by the sample descriptions, the No. 5 ore body is surrounded by pervasive recrystallized dolomite, fine to medium grained, with abundant secondary dolomite replacement features such as vugs, zebra stripes, birds-eye, knots, and vein developments. The recrystallized dolomite carries a variable amount of geochemical values with silver, barium, copper, manganese, molybdenum, lead, and zinc, plus major elements iron, calcium, and magnesium, being of prime importance. Values of other elements may be of overall interpretive interest when evaluated with the above visual and geochemical context.

A synopsis of sample sites in the Leadville Dolomite, from the 1250 Level, and their relationship to ore and porphyry is tabulated in Table Two. The respective analytical data of probable indicative elements are tabulated in Table Three.

Iron, in ore, is generally 10-15% and being 2% or less in the adjacent wall rock. Iron may be slightly higher within 20 feet of ore.

In calcium values the wall rock is mostly between 10% and 15% with some lower values, but is highly depleted in the ore samples (2% or less). (However, it has been noted that within the ore body block, a high percentage

of calcite-dolomite, up to 30% by volume, may be interstitial to the ore minerals. As discussed with Craig Byington, this feature may indicate flow directions for the mineralized solutions which brought in the ore minerals and flushed out the dolomite host unit areas, by replacement, with reprecipitation of calcite-dolomite on the outlet or spent solution side. It was also noted that the high matrix calcite-dolomite was also in the areas where the wall rock was a highly sanded feature.)

Magnesium follows that of calcium in being higher (5 to 10%) in the wall rock versus 0.5% or less in the ore samples. Magnesium may increase adjacent to ore and the ratio of calcium to magnesium often approaches parity as the nearness to ore is approached.

Silver is mostly low in the far wall rock, but often increases significantly as ore is approached.

Barium is low but contains erratic values in the wall rock, as it also is erratic in the ore. It may be that major solution channels are marked by increased barium content.

Copper, lead, and zinc follow that of barium in being highly erratic, but in general they tend to increase in value, especially lead-zinc, as ore boundaries are approached.

Manganese is perhaps the overall indicator for mineralized blocks. Although relatively high values (plus 5000 ppm) may appear far from ore, values tend to increase as ore is approached. In general, the manganese content cannot be visually noted within the sample other than an increase in the dusky coloration. Figure One is a modified histogram plotting the value of contained manganese to the various nearness to ore categories. Thus need lots of samples.

Molybdenum, though of low values, probably also reflects the ore channels or centers of mineral flow. As noted in Table Two, the moly values tend to increase toward the ore boundaries and rise within the ore. This is also shown on the modified histogram of Figure Two. Looks better than Mn.

It should be noted that values may be somewhat higher when in proximity to porphyry masses.

Need a statistical evaluation.

As with all chemical data, the interpretive results should be weighted on the total cumulative effect and not on just the results of one or two elements. Thus the sample values of moly which lie between what is labeled as background value and the lower limit of indicative value may prove to be highly significant when viewed with other element values. For example, sample BC-15, located within 20 feet of ore, contains only 2 ppm moly, but in addition has plus 10,000 ppm manganese and 7% magnesium -- an anomalous sample. Sample BC-31 is another in the same footage bracket which contains only 2 ppm moly, along with 2000 ppm manganese, 10% magnesium, and 2000 ppm barium.

All the analytical data for the Leadville Dolomite samples have been tabulated in a series of attachments: Attachment B (Values in Ore),

Attachment C (Values within 20 feet of ore), Attachment D (Values within 40 feet of ore), Attachment E (Values within 60 feet of ore), Attachment F (Values in Fault Zone Gouge). Also listed in Attachments D and E are Dyer and Manitou formation samples from the 1250 Level.

On the 1500 Level an exploration drift is extending north from the lower edge of the No. 5 ore body. In an earlier study, Craig Byington had collected muck car samples and noted an apparent increase in lead-zinc-silver-gold values as the mineral replacement zones were approached and passed in the drifting. The drift, in the Manitou Dolomite formation, contained an edge of the No. 5 ore body, and two small vein structures which fed small replacement mantos separated from one another by bleached and unbleached zones. The drift was resampled with most of the samples cut from within the Manitou unit which hosted the two manto mineral replacement zones. Underlying the manto unit is a sill of white porphyry.

A plan of the area of sampling of the 1500 Level is shown on Attachment A and indicates that the area underlies part of the No. 5 ore body and extends north of the reported mineralization on the 1250 Level. Attachment G is an expanded scale showing the geology and sample sites along the east wall of the 15-28-300 Drift North, 1500 Level, along with the reported emission-spec results. Table Four is a synopsis tabulation of certain average values taken in the various visual changes along the drift.

In general the variability and variety of trace element distribution indicates that fluid flow has taken place within the bleached and unbleached portions of the bed and left some silver, manganese, and moly as the prime indicators. Of course, the most interesting features are the small, probably uneconomic to mine, mantos in the Manitou which contain ore grade mineralization and which underlie the more favorable Leadville Dolomite formation. These mantos, with their feeder veins, point to areas which should be checked within the more favorable units.

To recap: The study has shown that the Black Cloud No. 5 and No. 6 ore bodies are surrounded by pervasively recrystallized dolomite units with abundant secondary feature development and which contain a variable suite of elements compatible to those found in the ore bodies themselves. Increased values in a number of the elements are suggestive of being near ore and should be used as an additional guide in the establishment of drilling patterns in testing the most favorable stratigraphic and structural traps.

I wish to thank Craig Byington, geologist, and the Black Cloud Unit for their interest and discussion of the problem and access; and to Craig for his help in collecting the base materials and sampling.

James D. Sell

JDS:lb
Atts.

cc: FTGraybeal, Tucson
SAAnzalone, Tucson
CBByington, Black Cloud Unit
DNLewis, Black Cloud Unit

Table One -- Black Cloud Samples (BC Series)

Sample Number	Sample Description* in Leadville Fm.
-1	fine, bd, 2nd knots, few vgs
-2	fine, z, large 2nd knots and vns
-3	(Ore - massive py-sph-gal and carbonate)
-4	fine, z, 2nd stripes, vns, knots, & irreg. structures
-5	fine, z, p, bd, abund 2nd knots & swirls
-6	fine, z, p, bd, abund 2nd knots & swirls
-7	siliceous, fine, abund sheared 2nd vns & irreg. structures
-8	fine, 2nd knots mixed with porph and py-sphal-chert stringers
-9	no recryst., fine sanding, siliceous, cherty
-10	medium, z, 2nd knots & veins
-11	medium, z, 2nd knots & veins
-11A	Ontario Fault zone gouge
-11B	medium, z, 2nd knots & veins
-12	fine, sparse bd, fine 2nd vns
-13	Johnson Gulch porphyry, fragmental, argillized, with weak py, dolomite pods and vugs
-14	same as BC-13, more pyritic
-15	very fine crystalline, fine recrystalline, minor 2nd stringers along bedding and crosscutting
-16	(Ore - massive py-sph-gal with 20% carbonate and silica gangue)
-17	siliceous, fine, abund 2nd knots, clots, and vns
-18	fine, moderate bd, 2nd knots, few vns
-19	very fine, few 2nd knots & vns, but gaudy 1" subhoriz seams
-20	fine, z, bd, spotty 2nd clots & vns
-21	fine, bd, 2nd vug & clots, gaudy 1" vns, white rims around chert (rare)
-22	Johnson Gulch porphyry, argillized, weak FeOx
-23	fine, gaudy 2nd seams & vns, repl rims on blk chert
-24	fine to medium, bd
-25	fine to medium, z, bd
-26	fine to medium, z, bd, coarse 2nd vns
-27	siliceous, fine, minor 2nd vns
-28	fine, minor z, abund bd, few gaudy 1" horiz seams
-29	fine, abund 2nd clots & vugs, fine py-sph outward from massive py-sph-gal repl in floor
-30	shattered (near Hellena flt), fine, partially sanded, w/FeOx
-31	slickensided shear zone, fine, abund bd, few 2nd vugs
-32	fine, minor bd, few 2nd vns & stringers
-33	fine to medium, abund bd, 2nd vns & stringers
-34	fine, minor 2nd streaks
-35	siliceous, fine, notable bd, 2nd streaks
-36	fine to medium, w/stockwork of 2nd veins & streaks
-37	fine to medium, abund bd and 2nd seams, scattered py
-38	Johnson Gulch porphyry, argillic (dirty sample)
-39	Johnson Gulch porphyry, siliceous, weak argillic (dirty sample)
-40	as BC-39 above; (dirty sample)
-41	fine, 2nd streaks & vns
-42	fine, with white rims around blk chert (overlain by JGp)
-43	fine, myriad of 2nd vns along bedding, some silicic bands
-44	fine, some z, more fractures as above (BC-43)
-45	fine to medium, some bd, 2nd stringers, white chert-dolo along bedding

Table One -- Continued

-46	fine to medium, increased bd, abund white chert-dolo along bedding
-47	(basal Leadville?), fine to medium, bd, increased silicic & clear crystalline chert
-48	Dyer dolomite, laminated with fine recrystallized zones
-49	Hellena Fault zone
-50	Manitou dolomite, qtzitic, Fe-Mn stain & films
-51	Manitou dolomite, qtzitic, silicic dolo with py-sph-gal, trace malachite
-52	Ontario Fault zone (1500 Level)
-53 thru -75	Manitou dolomite, Parting quartzite, and White porphyry samples from 1500 Level

*Note: following abbreviations used:
fine = fine recrystallization texture
medium = medium recrystallization texture
z = zebra structures
p = pearly structures
bd = birdseye structures
s = sanded feature
2nd = secondary growths of dolomite crystals
vgs = vugs
vns = veins
gal = galena
sph = sphalerite
py = pyrite
FeOx = iron oxides
Fe-MnOx = iron and manganese oxides

Table Two -- Black Cloud Samples (BC Series), Distance to Ore and Porphyry Tabulation

Distance to known ore*					On 1250 Level Distance to known porphyry			
In Ore	Within 20 Ft.	Within 40 Ft.	Within 60 Ft.	Greater Than 60 Ft.	Within 15 Ft.	Within 10 Ft.	Within 5 Ft.	In Porphyry
Samples from Leadville Dolomite:								
	-1(-)							
	-2(H)							
-3								
	-4(H)					X		
	-5(H)							
		-6(<+)						
		-7(<+)						
		-8(+)						
			-9(<+)					
			-10(<+)					
			-11(<+)			X		
			-11B(<+)					
		-12(<+)					X	
		-13(<+)						X
	-14(H)							X
	-15(H)						X	
-16								
	-17(H)							
		-18(<+)						
	-19(+)					X		
		-20(<+)					X	
		-21(<+)				X		
	-22(+)							X
		-23(<+)			X			
		-24(<+)						
		-25(+)						
		-26(+)						
		-27(+)						
		-28(+)				X		
	-29(-)						X	
		-30(<-)					X	
	-31(+)							
	-32(+)							
			-33±					
		-34(<-)						
		-35(<-)						
		-36(H)				X		
	-37(H)					X		
		-38(H)						X
	-39(H)							X
	-40(H)							X
	-41(H)					X		
	-42(H)							
	-43(H)						X	
	-44(H)							
	-45(H)							
	-46(H)							
		-47(H)						

Table Two -- Continued

<u>Samples in Other Units</u>:	(from 1250 Level unless noted)			
Ontario Fault Zone.				
	-11A(H)			
		-52(H)(1500 Level)		
Hellena Fault Zone.				
-49(+)				
Dyer dolomite.				
-48(+)				
Manitou dolomite.				
-50(+)			X	
	-51(<+)			X

*Notes: H = horizontal
<+ = angle above
<- = angle below
+ = above
- = below

Table Three -- Synopsis of Values, 1250 Level, Leadville Formation

Element	In Ore	Within 20 ft. of Ore	Within 40 ft. of Ore	Within 60 ft. of Ore	In Porphyry
Fe	10-15%	2% or less	less than 2%, few higher	2% or less	2% or less
Ca	2% or less	10%-15%, few low	10%-20%, few low	10%-15%	5% or less
Mg	0.5% or less	around 10%	5%-10%	5%-10%	1% or less
Ag (ppm)	plus 20	1-2, few plus 10	less 1	less 1	less 1
Ba (ppm)	low to hi	mainly low, few hi	mainly less 10	less 10	generally less 50
Cu (ppm)	variable, 5-700	usually below 10, few hi	usually below 5, few hi	usually below 5, few hi	less 10
Mn (ppm)	1500-plus 10,000	1000-plus 10,000	1000-10,000	2000-7000	700-plus 10,000
Mo (ppm)	15-20	2-5, few hi to 15	2-5, few hi to 10	generally below 5	most below 5
Pb (ppm)	variable 50-10,000	variable 10-plus 10,000	most below 100, few hi	most low, few hi	most around 100
Zn (ppm)	plus 10,000	variable 200-plus 10,000	most below 200, few hi	less 200	200-500

Table Four -- Synopsis of Certain Averaged Values in a Manitou Unit of the 15-28-300 Drift North (1500 Level, Black Cloud Unit

Element	North Mineral	Unbleached(?)	Bleached Zone	Central Mineral	Bleached Zone	Unbleached	South Mineral (lower part of #5 ore body)
Fe (%)	18	4	4	16	5	4	15
Ca (%)	4	10	4	3	15	15	2
Mg (%)	1	9	5	0.5 or less	9	10	0.5
Ag (ppm)	48	5	10	74	below 2	3	150
Ba (ppm)	below 10	below 10	below 10	50	100	below 10	below 10
Cd (ppm)	above 200	below 50	below 50	above 200	below 50	below 50	500
Cu (ppm)	above 1000	12	75	2600	45	25	2000
Mn (ppm)	5000-plus 10,000	3000-5000	plus 10,000	3000-7000	5000-plus 10,000	3000	5000
Mo (ppm)	23	5	4	9	4	4	7
Pb (ppm)	5000-plus 10,000	500	250	7000-plus 10,000	32	500	10,000
Zn (ppm)	plus 10,000	below 1000	below 1000	plus 10,000	below 1000	below 2000	plus 10,000

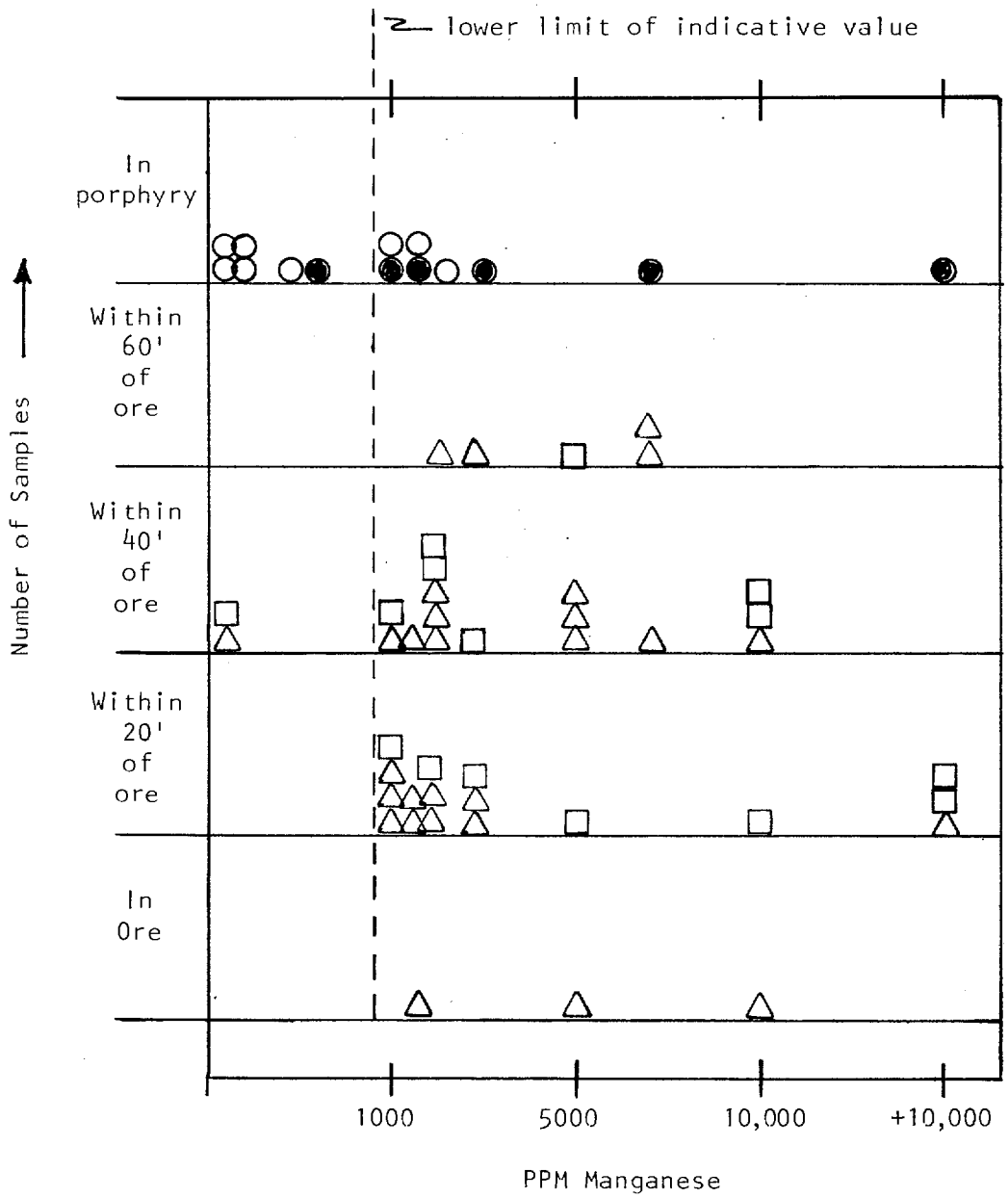
FIGURE ONE

RELATION OF MANGANESE TO NEARNESS TO ORE

Leadville Dolomite, 1250 Level

Sample Site:

- △ Greater than 15 ft. from porphyry
- □ Within 15 ft. of porphyry
- ● In porphyry adjacent to ore (underground)
- ○ In porphyry not known to be near ore (surface)



TO ACCOMPANY Report

DATED March 5, 1979

BY J. D. Lee

Map # 5085

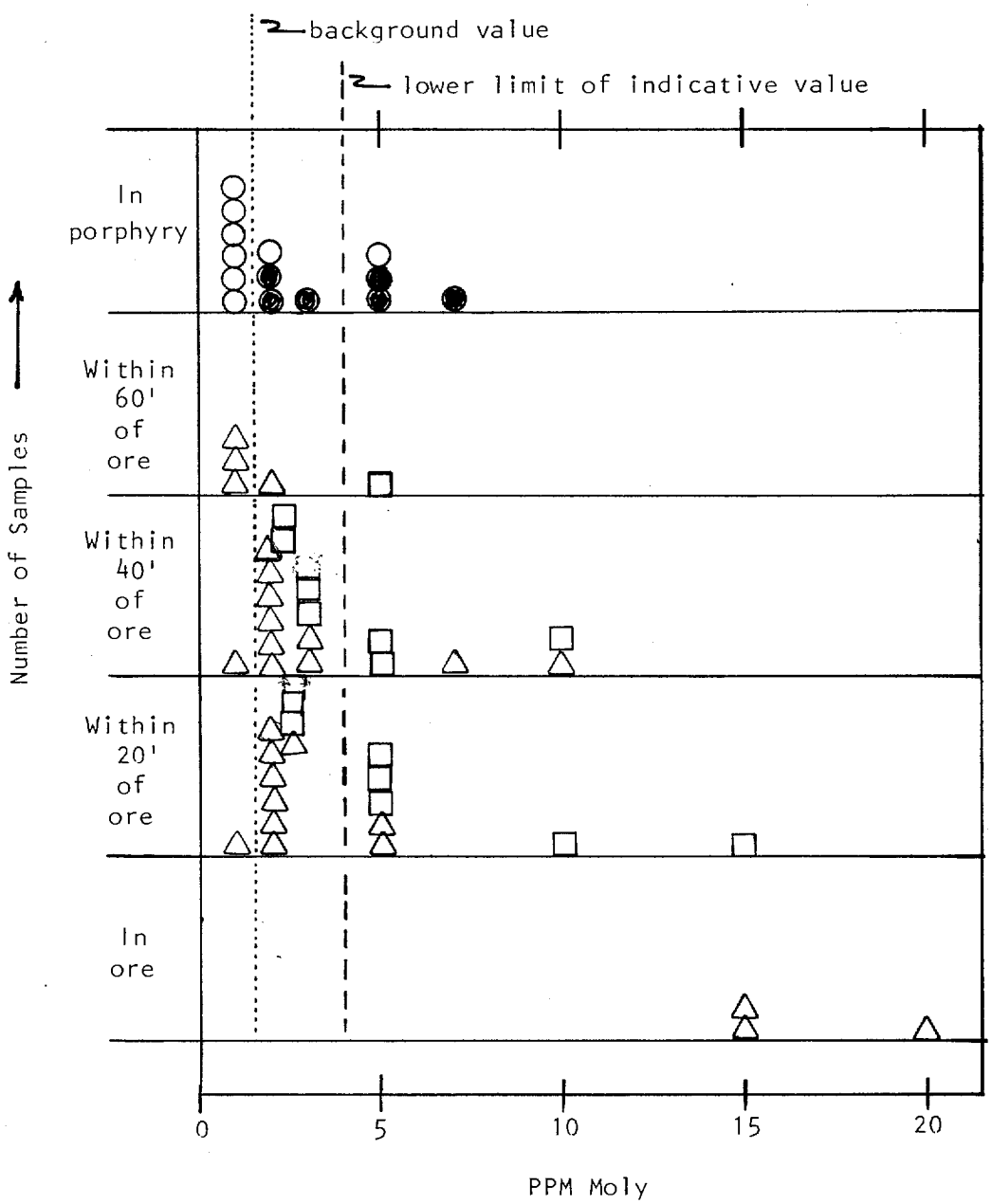
FIGURE TWO

RELATION OF MOLYBDENUM TO NEARNESS TO ORE

Leadville Dolomite, 1250 Level

Sample Site:

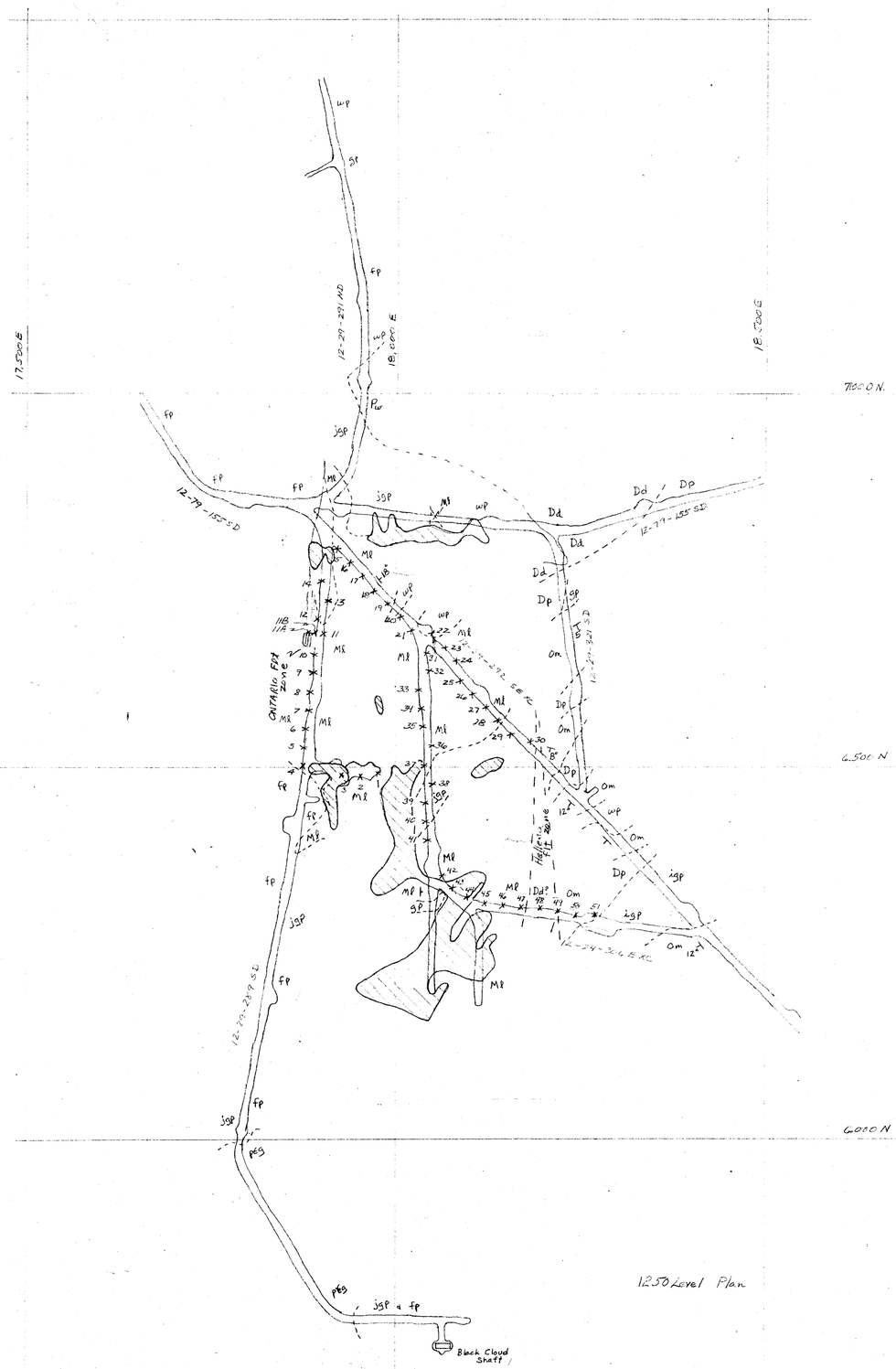
- △ Greater than 15 ft. from porphyry
- □ Within 15 ft. of porphyry
- ● In porphyry adjacent to ore (underground)
- ○ In porphyry not known to be near ore (surface)



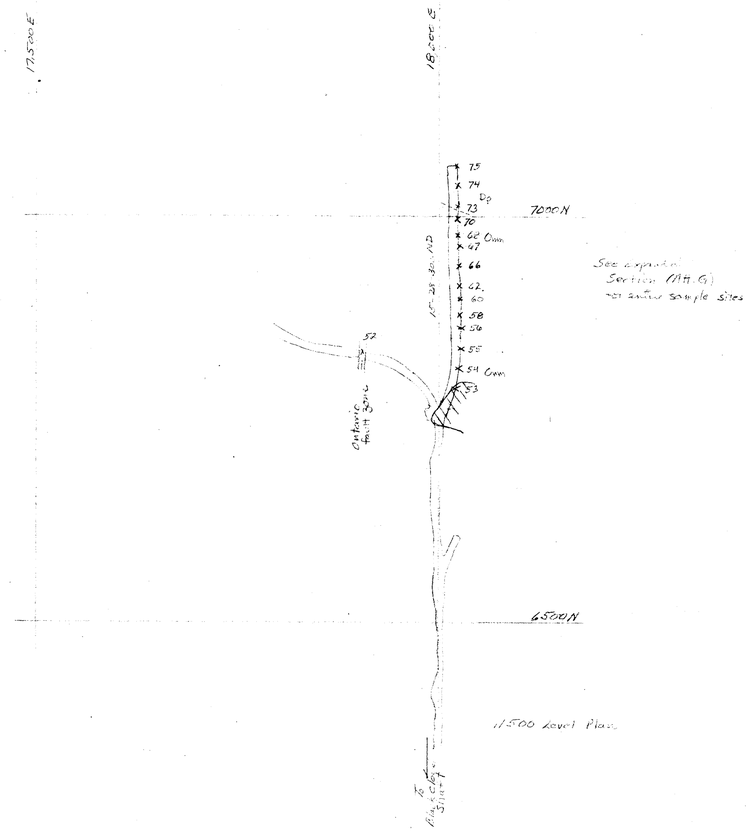
TO ACCOMPANY Report
DATED March 5, 1979
BY J. D. Lee

Map # 5088

ATTACHMENT A



1250 Level Plan



11,500 Level Plan

Explanation

massive sulfides

ROCK UNITS:

- Pw Weber Shale
- Ml Leadville Dolomite
- Dd Dyer Dolomite
- Dp Portuna Quartzite
- Om Manitou Dolomite
- Ep Peerless formation
- peg granite

Porphyries:

- fp fragmental porp.
- igp Iowa Gulch porp.
- wp White porp.
- jgp Jacobson Gulch porp.
- gp grey porp.

X 51 Sample site and number.

BLACK CLOUD UNIT, LEADVILLE, Colorado

The maps of a portion of the 11,500 and 1250 levels showing coordinate lines and general sample locations with surrounding structures, major faults, and rock units.

SCALE 1" = 1000'

TO ACCOMPANY Report
DATED Dec 5, 1979
BY J. W. Lee

Map # 5081

Attachment B

Values in Ore, Leadville Dolomite, Black Cloud Unit

ITEM	1	3	18
SAMPLE	L-3*	BC-3	BC-16
ELEMENT			
Fe	10%	10%	15%
Ca	2%	0.2%	1%
Mg	0.5%	0.1%	0.2%
Ag	50	70	20
As	500	500	500
B	15	10	10
Ba	5000	<10	<10
Be	<2	<2	<2
Bi	<10	<10	<10
Cd	200	300	200
Co	<5	<5	<5
Cr	10	<10	<10
Cu	700	15	5
Ga	10	<10	<10
Ge	<20	<20	<20
La	<20	<20	<20
Mn	5000	>10000	1500
Mo	20	15	15
Nb	20	<20	<20
Ni	10	<5	<5
Pb	10000	50	200
Sb	<100	100	<100
Sc	<10	<10	<10
Sn	10	10	10
Sr	200	<100	<100
Ti	1000	20	20
V	30	<10	<10
W	<50	<50	<50
Y	<10	<10	<10
Zn	>10000	>10000	>10000
Zr	20	<20	<20

TO ACCOMPANY _____

DATED _____

BY _____

* Ore from crusher belt on 7/14/78

Map #5086

Values of Leadville Dolomite within 20 feet of ore, 1,250 Level, Black Cloud Unit.

Attachmeent C

	In Porphyry				Within 5' of Porphyry			Within 10' of Porphyry				Beyond 15' of Porphyry										
ITEM	16	24	41	42	17	31	45	4	21	39	43	1	2	5	19	33	34	44	46	47	48	ITEM
SAMPLE	BC-14	BC-22	BC-39	BC-40	BC-15	BC-29	BC-43	BC-4	BC-19	BC-37	BC-41	BC-1	BC-2	BC-5	BC-17	BC-31	BC-32	BC-42	BC-44	BC-45	BC-46	SAMPLE
ELEMENT																						ELEMENT
Fe	2%	1.5%	2%	0.5%	7%	10%	0.5%	0.5%	2%	7%	1.5%	0.5%	1%	1%	1%	2%	0.5%	0.5%	0.5%	0.2%	0.2%	Fe
Ca	1.5%	0.7%	0.7%	5%	15%	1%	15%	10%	15%	7%	10%	10%	15%	7%	10%	15%	10%	15	10%	15%	15%	Ca
Mg	0.5%	0.2%	0.5%	1%	7%	0.15%	15%	7%	7%	5%	10%	5%	10%	5%	5%	10%	10%	15%	10%	10%	10%	Mg
Ag	1	<1	<1	<1	1	70	<1	2	<1	10	1	<1	1	<1	<1	2	<1	1	<1	<1	<1	Ag
As	<500	<500	<500	<500	<500	<500	<500	<500	<500	700	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	As
B	<10	10	10	10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	B
Ba	<10	<10	500	200	<10	<10	<10	<10	<10	7000	<10	<10	10	<10	<10	2000	<10	<10	200	<10	<10	Ba
Be	<2	2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	Be
Bi	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Bi
Cd	<50	<50	<50	<50	<50	2000	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	Cd
Co	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	Co
Cr	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	20	<10	<10	<10	<10	<10	<10	<10	<10	<10	Cr
Cu	10	<2	<2	3	3	<2	3	15	1000	150	50	5	10	<2	2	5	20	5	3	2	2	Cu
Ga	<10	<10	10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Ga
Ge	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	Ge
La	50	100	20	20	20	<20	20	20	20	<20	20	20	20	20	20	20	20	20	20	20	20	La
Mn	1500	700	3000	7000	>10000	2000	5000	10000	1000	>10000	3000	>10000	1000	1000	1500	2000	3000	1500	3000	2000	1000	Mn
Mo	5	7	2	3	2	5	5	2	5	15	10	<2	5	2	2	2	2	5	2	2	2	Mo
Nb	<20	<20	<20	<20	<20	<20	<20	<20	20	20	<20	<20	<20	<20	<20	20	20	<20	<20	<20	<20	Nb
Ni	<5	<5	<5	<5	<5	<5	<5	<5	<5	7	<5	<5	<5	<5	<5	5	5	<5	<5	<5	<5	Ni
Pb	20	15	70	100	200	20	100	500	>10000	2000	3000	200	70	20	30	100	500	50	200	100	10	Pb
Sb	<100	<100	<100	<100	<100	<100	<100	<100	<100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	Sb
Sc	<10	<10	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Sc
Sn	<10	<10	<10	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Sn
Sr	<100	<100	100	100	<100	<100	<100	<100	<100	200	<100	<100	<100	<100	<100	100	100	<100	<100	<100	<100	Sr
Ti	500	1000	500	300	50	<20	20	<20	<20	30	<20	<20	20	20	500	200	<20	20	<20	<20	<20	Ti
V	10	20	10	10	10	<10	10	<10	10	10	<10	<10	10	<10	20	10	<10	10	<10	10	<10	V
W	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	W
Y	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Y
Zn	500	500	200	300	500	>10000	<200	500	200	10000	1000	<200	<200	<200	200	300	200	<200	<200	<200	<200	Zn
Zr	50	100	30	20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	20	<20	<20	<20	<20	<20	<20	Zr

TO ACCOMPANY Report
DATED March 5, 1979
BY J. D. Lee

Map # 55084

Attachment [D

Values of Leadville Dolomite within 40 feet of ore, 1,250 Level, Black Cloud Unit.

	In Porphyry		Within 5' of Porphyry			Within 10' of Porphyry			Within 15' of Porphyry	Beyond 15' of Porphyry											Dyer Dolomite	Manitou Dolomite Within 15' of Porphyry	
ITEM	15	40	14	22	32	23	30	38	25	6	7	8	20	26	27	28	29	36	37	49	50	52	ITEM
SAMPLE	BC-13	BC-38	BC-12	BC-20	BC-30	BC-21	BC-28	BC-36	BC-23	BC-6	BC-7	BC-8	BC-18	BC-24	BC-25	BC-26	BC-27	BC-34	BC-35	BC-47	BC-48	BC-50	SAMPLE
ELEMENT																							ELEMENT
Fe	1%	0.5%	0.7%	2%	5%	0.2%	0.5%	2%	1%	0.5%	5%	10%	0.7%	0.5%	0.5%	0.3%	1%	0.3%	1%	1%	1.5%	7%	Fe
Ca	1%	0.2%	20%	10%	7%	10%	10%	15%	10%	15%	0.7%	0.2%	15%	15%	15%	10%	7%	10%	10%	10%	10%	1%	Ca
Mg	0.5%	0.3%	15%	5%	0.5%	7%	5%	10%	5%	10%	0.2%	0.15%	7%	7%	7%	7%	5%	10%	10%	10%	10%	0.2%	Mg
Ag	<1	<1	<1	1	5	<1	<1	<1	<1	<1	10	15	<1	<1	<1	<1	1	<1	<1	2	<1	5	Ag
As	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	As
B	<10	10	<10	<10	10	<10	<10	<10	<10	<10	20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	B
Ba	<10	50	10	<10	<10	<10	20	<10	10	2000	<10	<10	<10	<10	50	<10	<10	70	<10	<10	200	200	Ba
Be	<2	2	<2	<2	<2	<2	<2	<2	<2	<2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2	Be
Bi	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Bi
Cd	<50	<50	<50	<50	50	<50	<50	<50	<50	<50	<50	200	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	Cd
Co	<5	<5	<5	<5	20	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	Co
Cr	10	<10	70	<10	<10	<10	50	<10	20	<10	<10	<10	<10	10	70	<10	10	<10	<10	<10	10	20	Cr
Cu	3	2	100	10	3	3	5	3	150	5	2	3	3	500	2	2	2	700	2	5	2	15	Cu
Ga	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	Ga
Ge	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	Ge
La	100	50	20	20	<20	20	20	20	20	20	50	<20	20	20	20	20	20	20	20	20	20	100	La
Mn	>10000	1000	10000	3000	2000	1000	100	10000	2000	2000	10000	2000	2000	1000	10	1500	5000	5000	5000	7000	3000	3000	Mn
Mo	2	5	3	5	10	2	3	5	2	2	10	7	2	2	2	<2	2	3	2	3	5	2	Mo
Nb	20	<20	20	<20	<20	<20	20	<20	20	20	<20	<20	<20	20	20	<20	<20	20	<20	<20	<20	20	Nb
Ni	<5	5	30	<5	<5	<5	20	<5	7	5	<5	<5	<5	5	10	<5	<5	5	<5	<5	5	20	Ni
Pb	500	100	3000	500	20	30	100	100	5000	150	30	150	20	7000	70	20	50	10000	10	100	10	700	Pb
Sb	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	Sb
Sc	<10	<10	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	Sc
Sn	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Sn
Sr	100	100	100	<100	<100	<100	100	100	100	100	<100	<100	<100	100	100	<100	100	<100	<100	100	100	100	Sr
Ti	500	1000	20	50	3000	20	<20	20	<20	50	3000	1000	<20	<20	<20	<20	<20	20	100	<20	50	3000	Ti
V	10	10	<10	15	100	10	10	10	10	<10	50	20	<10	10	10	10	10	10	10	10	10	50	V
W	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	W
Y	<10	<10	<10	<10	10	<10	<10	<10	<10	<10	15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	30	Y
Zn	500	500	<200	300	5000	<200	<200	<200	<200	<200	>10000	>10000	200	<200	<200	<200	500	500	<200	200	<200	1500	Zn
Zr	50	50	20	<20	50	<20	<20	<20	<20	<20	200	100	<20	<20	<20	<20	<20	<20	<20	<20	<20	150	Zr

TO ACCOMPANY Report
DATED March 5, 1979
BY J. D. Lee

Map # 50283

Attachment E

Values of Leadville Dolomite within 60 feet of ore, 1,250 Level, Black Cloud Unit.

	Within 10' of Porphyry	Beyond 15' of Porphyry				Manitou Dolomite Within 5' of Porphyry
ITEM	11	9	10	13	35	53
SAMPLE	BC-11	BC-9	BC-10	BC-11B	BC-33	BC-51
ELEMENT						
Fe	1%	2%	0.7%	1%	1%	10%
Ca	15%	0.03%	10%	15%	10%	0.1%
Mg	10%	0.2%	7%	10%	5%	0.5%
Ag	<1	<1	<1	<1	2	10
As	<500	<500	<500	<500	<500	<500
B	<10	50	<10	<10	<10	10
Ba	<10	<10	<10	<10	70	10
Be	<2	<2	<2	<2	<2	2
Bi	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	100
Co	<5	<5	<5	<5	<5	<5
Cr	<10	<10	<10	<10	<10	10
Cu	10	2	2	1000	7	150
Ga	<10	10	<10	<10	<10	10
Ge	<20	<20	<20	<20	<20	<20
La	20	50	20	20	20	50
Mn	5000	3000	2000	7000	7000	5000
Mo	5	2	2	3	2	15
Nb	<20	<20	<20	20	<20	20
Ni	<5	<5	<5	<5	<5	15
Pb	500	50	100	10000	300	5000
Sb	<100	<100	<100	<100	<100	100
Sc	<10	15	<10	<10	<10	<10
Sn	<10	<10	<10	<10	<10	<10
Sr	<100	<100	<100	100	<100	100
Ti	300	3000	300	20	<20	1500
V	15	150	10	<10	10	30
W	<50	<50	<50	<50	<50	<50
Y	<10	15	<10	<10	<10	10
Zn	<200	200	<200	<200	<200	>10000
Zr	<20	100	20	<20	<20	100

TO ACCOMPANY Report

DATED March 5, 1979

BY J. D. Lee

Map # 5085

Attachment F

Values in Fault Zone Gouge, Black Cloud Unit.

	Ontario flt.		Hellena flt.
	1250 Level	1500 Level	1250 Level
ITEM	12	54	51
SAMPLE	BC-11A	BC-52	BC-49
ELEMENT			
Fe	1.5%	0.7%	1.5%
Ca	0.1%	15%	5%
Mg	0.2%	10%	1%
Ag	<1	<1	<1
As	<500	<500	<500
B	100	<10	20
Ba	<10	<10	100
Be	<2	<2	<2
Bi	<10	<10	<10
Cd	<50	<50	<50
Co	<5	<5	<5
Cr	<10	<10	15
Cu	2	3	3
Ga	10	<10	<10
Ge	<20	<20	<20
La	20	20	30
Mn	7000	5000	2000
Mo	2	3	2
Nb	<20	<20	20
Ni	<5	<5	10
Pb	50	100	50
Sb	<100	<100	<100
Sc	10	<10	<10
Sn	<10	<10	<10
Sr	<100	<100	100
Ti	5000	50	1500
V	100	10	50
W	<50	<50	<50
Y	10	<10	10
Zn	200	500	300
Zr	300	<20	100

TO ACCOMPANY Report

DATED March 5, 1979

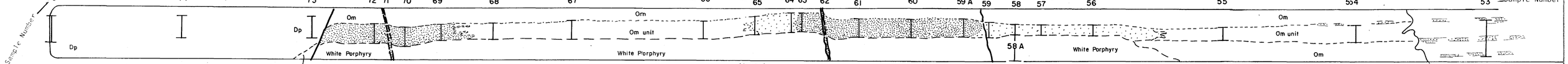
BY J. A. Lee

Map # 5087

Attachment G

ITEM / SAMPLE / ELEMENT	79 BC-75	78 BC-74	77 BC-73	76 BC-72	75 BC-71	74 BC-70	73 BC-69	72 BC-68	71 BC-67	70 BC-66	69 BC-65	68 BC-64	67 BC-63	66 BC-62	65 BC-61	64 BC-60	63 BC-59A	62 BC-59	60 BC-58	59 BC-57	58 BC-56	57 BC-55	556 BCC-54	55 BC-53	ITEM / SAMPLE / ELEMENT
Fe	1%	2%	1%	10%	15%	20%	20%	3%	5%	5%	2%	5%	15%	10%	20%	20%	15%	5%	2%	5%	7%	2%	5%	15%	Fe
Ca	1%	1.5%	2%	5%	3%	1%	7%	10%	10%	10%	3%	10%	5%	7%	1%	1%	1%	10%	10%	15%	5%	15%	115%	2%	Ca
Mg	0.2%	0.2%	0.2%	2%	1%	0.5%	1%	10%	10%	7%	1%	10%	0.5%	0.5%	0.2%	0.2%	0.5%	7%	10%	10%	1%	10%	110%	0.5%	Mg
Ag	<1	<1	<1	10	100	30	50	3	10	1	10	10	20	50	50	150	100	3	1	<1	<1	<1	5	150	Ag
As	<500	<500	<500	<500	<500	1000	500	<500	<500	<500	<500	<500	<500	500	700	1000	500	<500	<500	<500	<500	<500	<500	500	As
B	15	<10	<10	<10	10	10	10	<10	<10	<10	<10	<10	10	10	20	20	10	<10	<10	<10	<10	<10	<10	20	B
Ba	500	50	300	<10	<10	<10	<10	<10	<10	20	<10	<10	10	200	10	20	10	100	20	<10	300	<10	<10	<10	Ba
Be	3	3	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2	<2	<2	<2	<2	<2	<2	<2	Be
Bi	<10	<10	<10	<10	<10	10	<10	<10	10	<10	10	10	<10	<10	<10	20	<10	<10	<10	<10	<10	<10	<10	10	Bi
Cd	<50	<50	<50	50	2000	200	200	<50	<50	<50	<50	<50	100	300	200	1000	300	<50	<50	<50	<50	<50	<50	500	Cd
Co	<5	<5	<5	<5	<5	<5	<5	5	<5	<5	<5	5	10	<5	<5	<5	<5	<5	<5	<5	5	<5	<5	<5	Co
Cr	50	15	10	15	<10	<10	<10	10	10	<10	<10	<10	<10	<10	<10	<10	<10	10	10	15	15	10	<10	<10	Cr
Cu	<2	2	2	300	2000	1000	1500	15	20	10	50	100	1500	2000	1500	5000	3000	100	10	20	50	3	50	2000	Cu
Ga	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	10	10	10	<10	<10	<10	10	<10	<10	10	Ga
Ge	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	Ge
La	200	150	150	20	<20	<20	<20	20	20	20	50	20	<20	<20	<20	<20	<20	<20	20	<20	20	20	<20	<20	La
Mn	200	5000	2000	>10000	10000	5000	>10000	5000	3000	5000	>10000	>10000	5000	5000	3000	7000	5000	>10000	7000	7000	5000	3000	30100	5000	Mn
Mo	20	<2	7	5	30	7	50	5	5	5	2	5	7	10	7	15	7	5	2	2	3	3	5	7	Mo
Nb	20	20	20	20	20	20	20	20	20	20	<20	20	20	20	20	20	20	20	20	20	20	<20	<20	20	Nb
Ni	30	50	20	5	<5	<5	<5	10	5	<5	<5	5	<5	5	<5	5	<5	10	<5	5	10	5	7	5	Ni
Pb	20	100	200	5000	>10000	7000	>10000	1000	300	100	200	300	7000	>10000	7000	7000	10000	500	50	50	30	50	10100	10000	Pb
Sb	<100	<100	<100	<100	200	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	Sb
Sc	10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Sc
Sn	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	10	15	10	10	<10	<10	<10	<10	<10	<10	10	Sn
Sr	100	100	100	100	<100	100	200	<100	<100	<100	100	<100	<100	<100	<100	<100	<100	100	100	<100	100	<100	<100	<100	Sr
Ti	7000	2000	2000	1500	100	200	500	500	500	300	100	500	200	200	300	500	300	500	500	500	2000	1000	5100	500	Ti
V	100	50	50	50	20	20	20	50	30	20	20	30	20	10	20	20	20	50	10	30	50	100	150	30	V
W	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<150	<50	W
Y	50	50	50	<10	<10	<10	<10	10	10	10	<10	10	10	<10	10	20	10	10	10	10	10	10	<10	<10	Y
Zn	<200	<200	<200	>10000	>10000	>10000	>10000	1000	1000	500	500	1000	>10000	>10000	>10000	>10000	>10000	1000	<200	200	500	<200	20100	>10000	Zn
Zr	500	300	500	100	<20	20	50	100	30	50	30	100	30	20	30	100	50	70	50	100	100	50	150	30	Zr

Sample Number



Parting quartzite, vitreous, w/patches of py-sulf in lenses. dolomite lenses and bands

py, sph, gal carb. | vn of py,sph gal w/ carb seams | py, sph, qtz-carb | py,sph, qtz & abund. dolomite bands | increased bleaching & clay-silica slips on bedding | crystalline w/blk-py seams along bedding bleached | fine xln few carbonate seams | bleached & silicic w/py, clay carbonate seams | py,sph qtz w/carb seams veins & blebs | vn py sph gal qtz w/carb selvage | py, sph, gal, qtz carbonate | py, sph, gal, qtz carbonate | py dolo sph | coarse rexly w/py | increased bleaching & FeOx clay | becoming bleached w/fine pyrite, some oxidized to hematite | fine grained recryst. text. clay seams | trrace reccryst. text | stringer ore of lower portion of #5 orebody

ITEM / SAMPLE / ELEMENT	61 BC-58A
Fe	5%
Ca	2%
Mg	1%
Ag	<1
As	<500
B	10
Ba	1000
Be	2
Bi	<10
Cd	<50
Co	<5
Cr	<10
Cu	2
Ga	10
Ge	<20
La	200
Mn	3000
Mo	<2
Nb	20
Ni	<5
Pb	30
Sb	<100
Sc	<10
Sn	<10
Sr	<100
Ti	300
V	10
W	<50
Y	10
Zn	<200
Zr	30

TO ACCOMPANY Report
DATED March 5, 1979
BY J.D. Lee

GEOLOGY & SAMPLES of East Wall of 15-28-300 Drift North 1500 Level — Black Cloud Unit Leadville, Colorado

J.D.S. — Mar. 1979 SCALE: 1" = 10' Map # 5082

FTG
WCKurtz

LMS. REPL.
12/21/78

Brief comment lms. repl. search.
I think in E. New - W Utah I
would want more emphasis
on district - wide, rock type -
control on distribution of favorable
textures as plotted on a map
than done in Colo work. Agree - justify Colo work by "proving the method" but now have summer work to define drill targets in Colo.
Also I would prefer to do it on
a district by district basis than
conceptual for entire region.
Favorable textures or anal. results
would be followed up when received
not next year.
If regional recon. recommended
then maybe you - me - JDS - other(?)
spend 1-2 wks. then settle down to
specifics rather than entire summer
of broad brush. Current method will
not yield drill recommend until 1979,
no drilling until Summer 1980. FTG

WL Kurtz → lms. repl. file.

FTG

ASARCO

Exploration Department

Tucson, Dec. 18, 1978

F.T.G.

TO: D. M. Smith, Jr.

FROM: J. D. Sell

Limestone Replacement Search
Aspen Area (ASP-Series)
T10S, R84&85W
Pitkin County, Colorado

Although the Aspen district is presently a highly commercialized and sports area, the interest in the limestone replacement search was generated because of its past production from replacement orebodies and the observation that the mineral trend transversed from recrystallized Leadville dolomite into Leadville limestone. The samples were run by Barringer (MRFAPE).

Perhaps better if run by Skyline to allow for more internal consistency? Need elements that MRFAPE doesn't provide? See SDS memo.

The general impression is that the mineral forms in both environments are much the same and in regards to alteration (recrystallization) of surrounding wall rock, the dolomite is very similar to the previously discussed districts in showing widespread (in terms of hundreds to thousands of feet) ~~of~~ recrystallization, secondary dolomite filled vugs, manganese addition, etc.; whereas, in the limestones, similar mineral and jasperoid manifestations would be associated with rather narrow and restricted (in terms of tens of feet) marble development, calcite stringers and filled vugs, etc.

She really got around! →

Sample ASP-6 is from the dolomite side of the front, at the dump site of the Mollie Gibson shaft. The replaced unit reported 55,000 ppm lead, 39,700 ppm zinc, 27,417 ppm manganese, 106 ppm silver, and 10 ppm moly as anomalous values. Also noted were 12.3% Fe_2O_3 and 12.2% SiO_2 with 15.9% CaO and 5.19% MgO. Low values of copper (197 ppm), barium (286 ppm), and arsenic (200 ppm) were noted.

The remaining samples were cut from limestone and marble units south of town. Sample ASP-1 was ~~of~~ brecciated, sanded, with manganese and galena additions. High lead (60,000 ppm) and manganese (9681 ppm) were reported along with 29 ppm silver, 1510 ppm zinc, and 10 ppm moly along with 3.6% Fe_2O_3, 8.5% SiO_2, and 29.4% CaO with 7.05% MgO. The ratio of CaO vs. MgO should have revealed a dolomitic reaction but was masked. The sample area was outside the U.S.G.S. mapped mineralized zone.

ASP-2 was collected inside the mapped mineralized area with crystalline limestone, dog-spar crystals, trace pyrite and heavy manganese. Anomalous silica (35.9%), with notable manganese (2285 ppm), lead (2000 ppm), and moly (20 ppm) was present. Also 4.2% Fe_2O_3, 26.2% CaO, and 0.3% MgO. Notable in being absent were ND silver, and low copper, zinc, barium, & arsenic.

Sample ASP-3 was taken of dump material from either upper Leadville limestone or a limestone unit in the lower Belden Shale. Weak textures were associated with the more siliceous appearing unit. The silica content was 37.4% SiO_2 with 18.3% CaO, 6.04% MgO, and 8.01% Fe_2O_3. Anomalous values of manganese (3539 ppm), zinc (3630 ppm), lead (2500 ppm), arsenic (3470 ppm), silver (11 ppm), and moly (40 ppm) indicate excellent promise for the area.

On the far south end around the Silver Bell mine, a sample ASP-4A was taken of the red-black FeOx, siliceous replacement which contained lead (41,000 ppm), zinc (17,300 ppm), arsenic (3420 ppm), manganese (4895 ppm), silver (213 ppm), and 20 ppm moly in 34.4% SiO_2 with 38.4% Fe_2O_3 and only 0.2% CaO with 0.2% MgO. Copper was 526 ppm, the highest of the samples collected.

ASP-4 was collected from a jasperoid bed which traced above the line of pits of which the Silver Bell dump was one. ASP-4 contained 85.2% SiO_2 with 10.6% Fe_2O_3, 0.3% CaO, and 0.3% MgO. Notable values of 5027 ppm manganese, 1200 ppm lead, and 60 ppm moly were also contained.

ASP-5 was of clean Leadville limestone with minor recrystallization (to marble) and a few calcite veins. This is reflected in the high CaO content (52.6%), low MgO (1.6%), Fe_2O_3 (0.13%), and silica (0.61%). All other values were very low to non-detected (ND).

Exploration in limestone districts would necessitate much closer control and attention to subtle differences but similar geochemical patterns are evident to those in the dolomite recrystallized districts. Barite and copper appear to be missing here relative to central zones in other districts.

I recall that MRFADE wasn't in agreement with Sky. spec for Ba.

James D. Sell

James D. Sell

JDS:lb
Atts.

cc: FTGraybeal - w/atts.

TABLE ONE - Description of Aspen Area (ASP-Series) Samples, J.D.Sell, 9/6-7/78.

ASP-1 Leadville limestone, very dense, silicified, brecciated units, dump sample of dark brown, sanded, manganese addition, with some dark brown-black to black FeOx, minor yellow FeOx, with discrete small blocks of ruby silver(?)-galena. (Outside of mapped mineral zone.)

ASP-2 Leadville limestone, high manganese, trace pyrite, calcite dog-spar crystals, quartz crystals; wall rock of fine crystalline limestone with dog-spar vein; from filled dump. Area overlain by T. porphyry with fine FeOx-MnOx films. (Inside of mapped mineral zone.)

ASP-3 Limestone unit in Belden(?) or upper Leadville limestone(?). Filled dump material. Weak FeOx in siderite-ankerite-barite gangue in recrystallized appearing limestone with few vugs, also minor veins of calcite. Unit much darker blue-black, siliceous, with some disseminated pyrite.

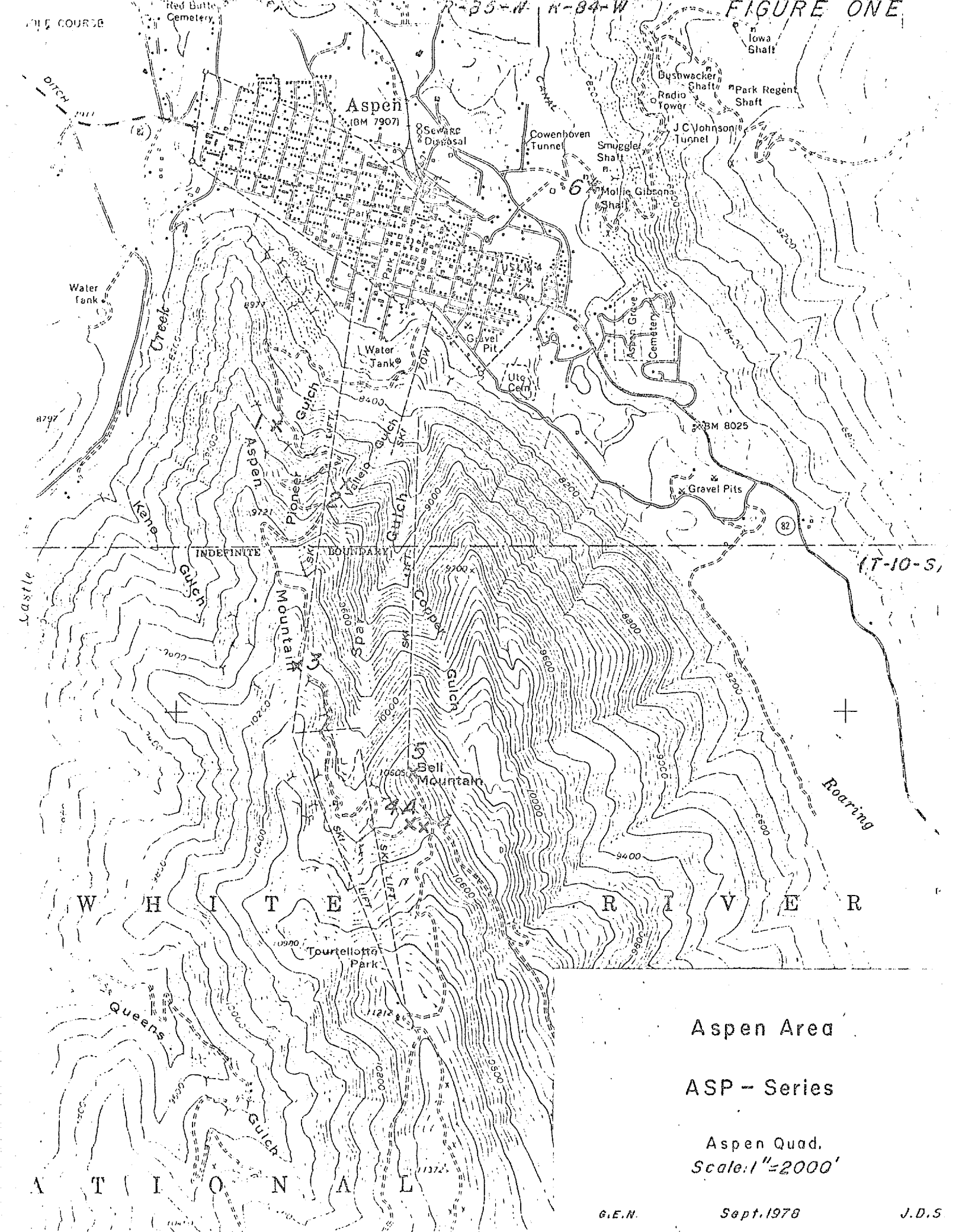
ASP-4 Leadville, dense but somewhat porous, yellow-brown jasperoids with quartz druse. Part of an apparent band of jasper extending northwesterly along "top" of line of dumps (see Sample 4A).

ASP-4A Leadville, Silver Bell dump, moderately strong red-black FeOx, siliceous, porous, replacement. (Not sampled was the associated yellow FeOx; nor the coral-crynoid limestone between samples 4 and 4A.)

ASP-5 Leadville limestone of Bell Mountain. Fresh, slightly recrystallized with minor yellow FeOx on fractures with few calcite seams.

ASP-6 Leadville dolomite from Molly Gibson dump. Manganese replaced, fine crystalline, siliceous dolomite with very fine dolomite crystal-quartz crystal-barite veins.

FIGURE ONE



Aspen Area

ASP – Series

Aspen Quad.

Scale: 1" = 2000'

G.E.N. Sept. 1978 J.D.S

ASARCO (BRI 807 DT) RFWO NO: 8768

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	AL2O3 %	FE2O3 %	CAO %	MGO %	TIO2 %	MNO %	NA2O %	K2O %
ASP-1	.254	3.61	29.4	7.05	.0066	1.25	N.D.	.099
2	1.44	4.20	26.2	.331	.0656	.295	N.D.	.418
3	.273	8.01	18.3	6.04	.0046	.457	N.D.	.094
4	.419	10.6	.323	.298	.0205	.649	N.D.	.116
4A	5.70	38.4	.172	.171	.208	.632	N.D.	1.83
5	.135	.125	52.6	1.60	.0042	.0286	N.D.	.100
6	1.99	12.3	15.9	5.19	.0713	3.54	N.D.	.171

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	NI PPM	CU PPM	ZN PPM	CR PPM	CO PPM	CD PPM
ASP-1	37	75.0	1510	45.2	5	13
2	97	45.2	351	128	10	8
3	91	74.6	3630	46.2	12	26
4	161	51.4	595	212	11	N.D.
4A	103	526	17300	64.8	15	81
5	14	3.6	49	15.5	6	N.D.
6	44	197	39700	38.5	13	59

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	AG PPM	SR PPM	V PPM	BE PPM	BA PPM	P205 %
ASP-1	29	30.2	6.9	0.3	48	N.D.
2	N.D.	76.7	11.7	0.5	99	0.05
3	11	27.9	7.8	0.2	273	N.D.
4	N.D.	9.3	46.9	3.3	405	0.02
4A	213	53.5	110	0.6	208	0.10
5	N.D.	67.4	3.4	0.2	23	N.D.
6	106	147	30.5	0.6	286	0.05

MATRIX: AQUEOUS1 ANALYSIS DATE: 161070 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	PB PPM	AS PPM	ZR PPM	MO PPM	TH PPM	SIO2 %
ASP-1	60000	210	6	10	N.D.	8.52
2	2000	200	13	20	6	35.9
3	2500	3470	N.D.	40	N.D.	37.4
4	1200	430	6	60	N.D.	85.2
4A	41000	3420	33	20	N.D.	34.4
5	55	N.D.	N.D.	N.D.	8	.610
6	55000	200	16	10	N.D.	12.2

WLKurtz → Gla.

FTG

ASARCO

Southwestern Exploration Division

December 19, 1978

F.T.G.

TO: D. M. Smith, Jr.

FROM: J. D. Sell

Limestone Replacement Search
Gold Cup Area (GOC-Series)
Tin Cup District
T.15S., R.82W.,
Gunnison County, Colorado

The Gold Cup area of the Tin Cup district is within the Paleozoic outcrops east and north of Cumberland Pass. The samples were analyzed by Barringer (MRFAPE).

* The area has moderate production, but excellent replacement textures and mineralization associated with replacement deposits.

Three samples were collected from the dump area of the Gold Cup mine. GOC-1 was Leadville dolomite with high iron-garnet jasperoid type replacement. Values included 50.8% Fe_2O_3 and 28.0% SiO_2, with notable manganese (1,193 ppm), copper (1,070 ppm), zinc (3,430 ppm), silver (357 ppm), lead (6,250 ppm), arsenic (1,730 ppm), and moly (20 ppm). Although values of MgO (1.10%) vs CaO (0.20%) are low, the retention of MgO is of interest.

GOC-2 is a pulverulent dark yellow-brown FeOx and black FeOx in structures cutting in GOC-1 type. The silica content increased to 40.8%, with 45.0% Fe_2O_3 and manganese (3,090 ppm), copper (1,020 ppm), zinc (20,400 ppm), silver (178 ppm), lead (10,500 ppm), arsenic (1,300 ppm), and moly (30 ppm), with a slightly higher MgO content (3.22%).

The third sample was from a non-garnet dump having drusy quartz growths and trace of malachite and barite in sooty FeOx-MnOx. Sample GOC-3 returned SiO_2 (42.3%), Fe_2O_3 (2.3%), manganese (56,771 ppm), zinc (48,200 ppm), silver (152 ppm), barium (1,070 ppm), lead (16,500 ppm), and moly (50 ppm). Notably low or missing included copper (804 ppm), and arsenic (ND). The retained CaO (19.5%) and MgO (1.3%) complete the values of interest.

Two samples were collected at the Tin Cup Shaft. The first (GOC-4) is of an iron-manganese-quartz-dolomite replacement of Leadville dolomite. Values include Fe_2O_3 (1.74%), SiO_2 (39.3%), manganese (30,670 ppm), copper (11,200 ppm), zinc (159,000 ppm), silver(678 ppm), lead (32,000 ppm), and moly (80 ppm), with arsenic (ND). The CaO (11.2%) and MgO (3.56%) values indicate ~~excellent lead-zinc carbonate replacement ores.~~ dolomitization?

The sample GOC-5 from the same dump is a Fe-Mn jasperoid with minor garnet and fine quartz crystals in vugs. GOC-5 contained Fe_2O_3 (54.6%), SiO_2 (18.7%), manganese (3,144 ppm), copper (1,560 ppm), zinc (5,480 ppm), silver(131 ppm), lead (62,500 ppm), and moly (80 ppm), with low arsenic (660 ppm) and ND barium. The retained zinc, silver, lead, and moly in the sample point to the jasperoid as being in a main mineralized channelway.

Minor scraping on Duncan Hill is mainly in the lower units. GOC-6 is in Dyer dolomite from the El Capitan mine dump. Although the rock was only

weakly stained with manganese, it contained 16,110 ppm manganese, along with lesser values of Fe_2O_3 (1.4%), copper (365 ppm), zinc (1,610 ppm), silver (196 ppm), barium (1,110 ppm), lead (2,980 ppm), along with 3.86% SiO_2, 32.4% CaO, and 11.8% MgO. The high silver value and the ND value for both arsenic and moly are notable.

At the Indiana mine dump, the parting quartzite contained shears coated with an iron-tungsten (?) appearing mineral. The MRFAPE analysis does not analyze for tungsten, but the sample does contain SiO_2 (77.4%), FeO_2 (10.5%), manganese (6,978 ppm), copper (749 ppm), zinc (3,960 ppm), silver (442 ppm), lead (8,500 ppm), and moly(40 ppm), with ND arsenic.

At the same dump, resting on the collapsed shaft house timbers was a partially oxidized, obviously high-grade specimen (probably brought in from another location). The resulting assy of GOC-8 is very surprising, in being 66.3% Fe_2O_3, 4.15% SiO_2, and 7.3% MgO, with essentially no other values.

To the south, on the south side of an outcropping porphyry sill covering the area northward to the Tin Cup mine area, four samples were collected from shallow workings. Sample GOC-9 of a fetid unit with replacement alteration contained 30.6% CaO, 17.5% MgO, with 0.44% Fe_2O_3, and 0.59% SiO_2, and practically no other elements other than a low 1,193 ppm manganese.

Sample GOC-10 is a manganese replacement vein cutting the unit and contained only slightly more manganese (8,132 ppm) in SiO_2 (24.4%), CaO (38.5%), MgO (0.8%), Fe_2O_3 (1.85%) matrix, with very low to non-detected metallic elements.

Sample GOC-11 was from an ore pile with SiO_2 (33.3%), CaO (13.1%), MgO (1.0%), Fe_2O_3 (12.6%), and high zinc (19,200 ppm), lead (67,500 ppm), silver (537 ppm), and moly (810 ppm), and lesser manganese (1,386 ppm), copper (1,040 ppm), and barium (928 ppm).

The final sample was from an oxidized FeOx pit in Belden shale, having 3.74% Al_2O_3 (highest of the group), 64.8% Fe_2O_3, and 12.8% SiO_2. Moly (30 ppm), is of interest, but all other values are present, but in low amounts.

Geographic distrib. of the textures?

The Gold Cup area shows good dolomite replacement textures and potential for large amounts of untested ground.

James D. Sell

James D. Sell

JDS:jlh
attmt
c.c. F.T.Graybeal

Table One - Description of Gold Cup Area (GOC-Series)
Tin Cup District,
J. D. Sell, September 8-9, 1978.

GOC-1	Gold Cup mine dump (#61)*. (*Numbers refer to numbers listed in USGS PP 289, Plate 1). Leadville dolomite, high iron-garnet jasperoid-type replacement.
GOC-2	Same dump area. Pulverulent dark yellow-brown FeOx and black FeOx in structures cutting the sample GOC-1 type; often siliceous.
GOC-3	Same dump area. Silicified unit with quartz crystals, trace malachite, barite and grey-brown-black, often sooty, FeOx-MnOx splotches and blebs along fine drusy structures. (No garnet-jasperoid nor zebra, recrystallized texture on this part of dump.)
GOC-4	Tin Cup shaft dump (#178). Leadville dolomite, Fe-Mn-quartz-dolomite-siliceous replacement with dense, black specks and creamy white blebs with trace azurite-malachite.
GOC-5	Same dump area. Dense, black, Fe-Mn jasperoid, minor garnet with fine quartz crystals in vugs.
GOC-6	El Capitan mine dump (#45). Dyer dolomite with weak manganese stain.
GOC-7	Indiana mine dump (#74). Parting quartzite in quartz shear zone with iron-tungsten(?).
GOC-8	Same dump area. Very high grade lead-copper-silver sulfosalts specimen resting on timbers of collapsed shaft house. No other fragments of this type noted on dumps. May have been brought in.
GOC-9	Dyer or lower fetid unit of Leadville dolomite, recrystallized with scattered, patchy zebra-type texture with clots of dolomite, weak secondary dolomite crystal development in some stripes.
GOC-10	Same area, east-west vein having 3'-5' of manganese replaced recrystallized wall rock (Leadville). Vein is slickensided quartz breccia with calcite on walls.
GOC-11	Same area, ore pile, very broken quartz crystal masses with quartz druse cementing and being brecciated, with various orange to black limonite and FeOx, galena remnants, and zinc carbonate/silicate, trace CuOx.
GOC-12	Belden shale, with red-black, partially oxidized, FeOx nodules and lenses. (Note: porphyry overlying and nearby also has FeOx on shears.)

FIGURE ONE

Gold Cup Area

GOC-Series
(Tin Cup District)

Garfield (15') Quad.
Scale: 1" = 5280'

G.E.N. Sept. 1978 J.D.S.

ASARCO (BRI 807 DT) RFWO NO: 8768

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	AL2O3 %	FE2O3 %	CAO %	MGO %	TIO2 %	MNO %	NA2O %	K2O %
GOC-1	.355	50.8	.196	1.10	.0114	.154	N.D.	.023
2	.345	45.0	.151	3.22	.0246	.399	N.D.	.067
3	.149	2.32	19.5	1.25	.0053	7.33	N.D.	.014
4	.294	1.74	11.2	3.56	.0067	3.96	N.D.	N.D.
5	.066	54.6	.137	.0821	.0020	.406	N.D.	N.D.
6	.356	1.41	32.4	11.8	.0099	2.08	N.D.	.041
7	1.73	10.5	.189	.232	.0712	.901	N.D.	.557
8	2.71	66.3	.458	7.27	.0756	.304	.682	.092
9	.135	.436	30.6	17.5	.0031	.154	N.D.	.020
10	.302	1.85	38.5	.801	.0092	1.05	N.D.	.057
11	.337	12.6	13.1	.992	.0050	.179	N.D.	.041
12	3.74	64.8	.064	.248	.133	.131	.131	.245

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	NI PPM	CU PPM	ZN PPM	CR PPM	CO PPM	CD PPM
GOC-1	93	1070	3430	138	19	N.D.
2	76	1020	20400	39.2	15	N.D.
3	84	804	48200	108	N.D.	44
4	71	11200	159000	86.1	5	N.D.
5	201	1560	5480	259	22	N.D.
6	28	365	1610	35.8	N.D.	24
7	166	749	3960	187	6	N.D.
8	38	N.D.	368	81.3	46	N.D.
9	17	2.7	202	34.9	N.D.	N.D.
10	80	16.2	552	110	3	N.D.
11	83	1040	14200	89.6	N.D.	N.D.
12	69	87.8	955	78.5	35	15

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	AG PPM	SR PPM	V PPM	BE PPM	BA PPM	P205 %
GOC-1	357	4.7	36.0	0.2	43	0.34
2	178	4.7	25.8	0.3	113	0.21
3	152	81.4	14.3	0.7	1070	0.04
4	678	83.7	9.7	0.5	81	N.D.
5	131	69.8	61.9	1.1	N.D.	0.08
6	196	69.8	15.7	0.2	1110	N.D.
7	442	9.3	30.9	0.8	122	N.D.
8	N.D.	51.2	102	N.D.	1940	N.D.
9	N.D.	46.5	3.9	N.D.	60	N.D.
10	N.D.	107	5.7	0.5	699	N.D.
11	537	188	57.9	0.6	928	0.42
12	N.D.	88.9	86.1	2.5	465	0.73

MATRIX: AQUEOUS1 ANALYSIS DATE: 161070 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	PB PPM	AS PPM	ZR PPM	MO PPM	TH PPM	SIO2 %
GOC-1	6250	1730	N.D.	20	N.D.	28.0
2	10500	1300	4	30	N.D.	40.8
3	16500	N.D.	N.D.	50	N.D.	42.3
4	32000	N.D.	N.D.	80	N.D.	29.3
5	62500	660	N.D.	80	N.D.	18.7
6	2980	N.D.	N.D.	N.D.	N.D.	3.86
7	8500	N.D.	11	40	N.D.	77.4
8	N.D.	N.D.	64	N.D.	N.D.	4.15
9	20	N.D.	N.D.	N.D.	N.D.	.590
10	190	N.D.	N.D.	N.D.	N.D.	24.4
11	67500	N.D.	N.D.	810	N.D.	33.3
12	115	100	41	30	N.D.	12.8

WLKurtz → files
Has Lloyd James commented on MRFAPE 2

FTG

ASARCO

Exploration Department

Tucson, Dec. 20, 1978

T.T.G.

TO: D. M. Smith, Jr.

FROM: J. D. Sell

Limestone Replacement Search
Addendum - Fourmile Area (FM-Series)
T.9&10S., R.78&79W.
Park County, Colorado

Why? Spacing far too wide to locate expl. zone?

Six additional samples were collected to supplement the values reported in the September 25, 1978 report on the area. The additional samples were analyzed by Barringer (MRFAPE).

Major sill here I recall

Sample FM-20 is east of the Dauntless mine and is one of a number of workings peeking out from under talus below White Ridge. The dump sample contained excellent replacement textured Leadville dolomite with secondary dolomite crystals, fine quartz crystals with silicification and minor manganese plus noted galena, sphalerite, and trace azurite-malachite. The sample contained anomalous silver (726 ppm), copper (5660 ppm), zinc (18,300 ppm), lead (60,000 ppm), moly (40 ppm), and manganese (4097 ppm). The silica content was 44.7% SiO_2.

Sample FM-21 was taken from the dump of an adit which trends toward the Peerless area. It was mainly black FeOx sinter with yellow-orange limonite. The jasperoid character is exemplified by the 49.9% SiO_2 content with anomalous manganese (79,773 ppm), lead (60,000 ppm), barium (4970 ppm), zinc (2390 ppm), copper (1650 ppm), arsenic (2600 ppm), moly (260 ppm), and silver (14 ppm). Also noted were nickel and cobalt ~~(74,057 ppm each)~~ 74 and 57 ppm respectively; relevance? along with 18.3% Fe_2O_3. The sample is significant in values, as well as being downdip from the Peerless anomalous area (FM-1 & FM-1A) (see previous report).

Samples FM-22 and FM-22A lie north of Peerless and in an area mapped as a possible bedding plane fault zone, with abundant jasperoid. Sample FM-22A is a red-black FeOx cutting the dense yellow-orange jasperoid of FM-22. FM-22 contained 79.1% SiO_2, 6.45% Fe_2O_3, and 2912 ppm manganese with very low values of other elements. FM-22A was relatively more mineralized with 80.4% SiO_2, 14.9% Fe_2O_3, 3361 ppm manganese, 1730 ppm arsenic, and 70 ppm moly, with low but variable copper, lead, and zinc.

Samples FM-23, -24, & -25 were collected on the east flank of Sheep Mountain, with FM-23 being of the Gilman sandstone member and the other two of well-replaced and recrystallized textured Leadville dolomite.

The Gilman sandstone contained minor yellow FeOx and FM-23 contained only 48.4% SiO_2 and 3.43% Fe_2O_3 along with low values in copper, lead, zinc, moly, barium, arsenic, and no silver. Sample FM-24 was collected from a fault zone with good replacement textured material and reported 91.0% SiO_2, 2.7% Fe_2O_3, and 2300 ppm manganese. Again all other values were low. Sample FM-25 is from a dump of strong FeOx replacement with massive to sinter tecture.

Although the sample contained only 6.98% SiO_2, the high values of 67.4% Fe_2O_3, 14,400 ppm zinc, 11,500 ppm lead, 3470 ppm arsenic, 2070 ppm barium, with 11 ppm silver reflect an excellent mineralized zone. Low manganese (352 ppm), copper (157 ppm), and ND moly were also reported.

Any more known than after first pass?

The additional samples show a wide distribution of anomalous and indicative areas for orebodies of the type previously mined in the district with the potential of more extensive mineralization.

James D. Sell

James D. Sell

JDS:lb
Atts.

cc: FTGraybeal - w/atts.

TABLE ONE - Description of Fourmile (FM-Series) Samples -- Addendum
J.D. Sell, 9/1,2,3/78.
See previous report dated September 25, 1978 for previous sample collection and sites. Note that Figure One contains both collections.

FM-20 Leadville dolomite, upper middle, dump sample, high-grade galena, with sphalerite, trace azurite-malachite in replacement textured brownish dolomite having secondary dolomite crystals, fine quartz crystals, and silicification, with minor manganese.

FM-21 Leadville dolomite, dump sample, mainly black FeOx sinter to botryoidal with leached yellow-orange FeOx limonite. Abundant zebra textured and manganese dusted wall rock on dump.

FM-22 Leadville, upper(?), dense yellow-orange jasperoid with blocks of fine recrystallized and silicified clasts and black chert clasts. (May be part of mapped flat fault zone.)

FM-22A Same outcrop, red-black FeOx pseudomorphs, mineralized, quartz crystal, jasperoid, veining and replacing FM-22 type.

FM-23 Gilman member sandstone, leached, with minor yellow FeOx. (On dump, but not sampled, is recrystallized lower Leadville with zebra textures, secondary dolomite crystals and trace of manganese.)

FM-24 Leadville, lower(?), silicified, replacement textured, secondary dolomite crystals, and silica druse, with weak Fe-MnOx in brecciated fault zone (NE trend).

FM-25 Leadville, upper lower, strong FeOx replacement, massive to sinter texture, from dump.

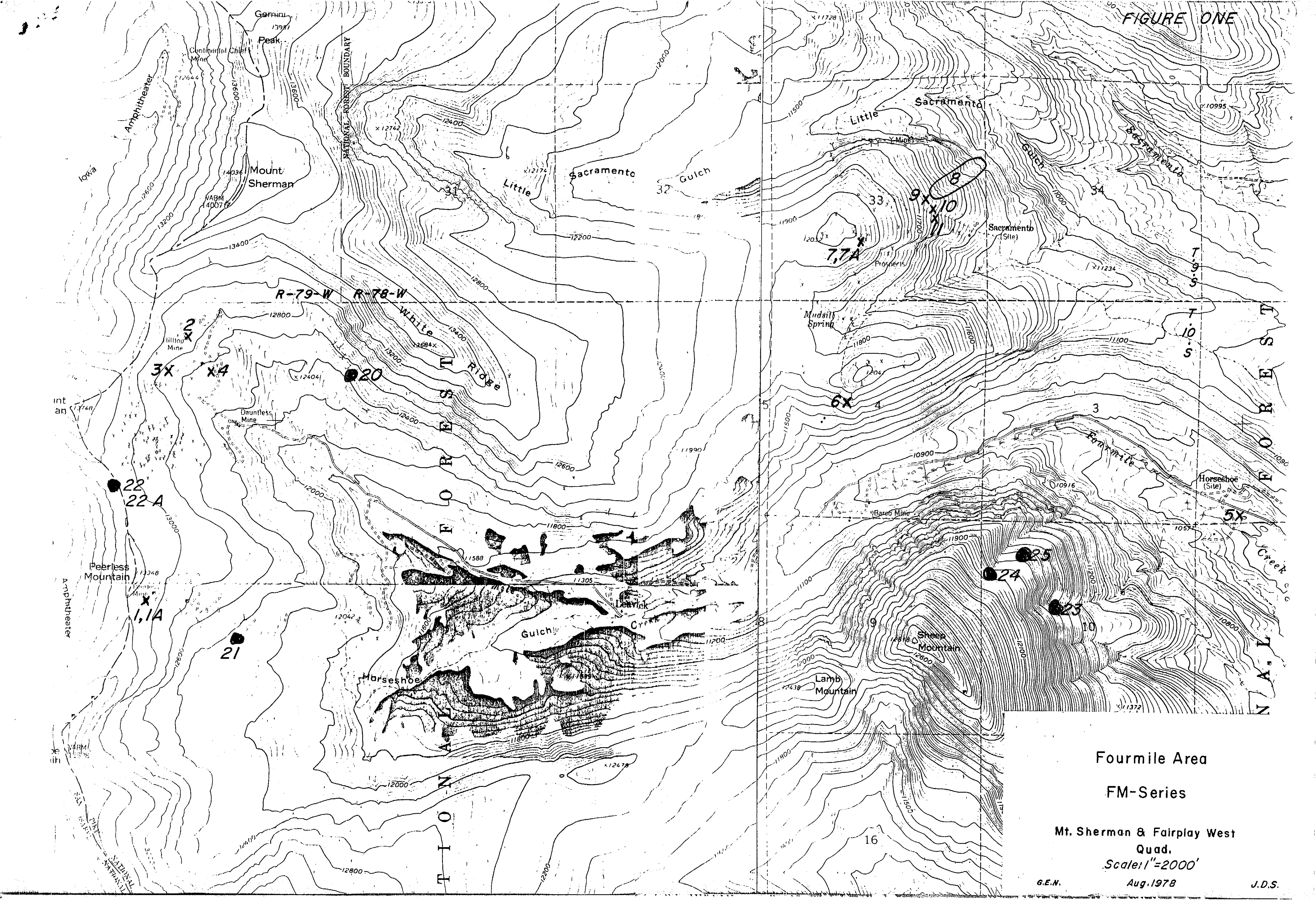


FIGURE ONE
Fourmile Area
FM-Series
Mt. Sherman & Fairplay West Quad.
Scale 1"=2000'
G.E.N.
Aug. 1978
J.D.S.
Gemini Peak
Continental Chief Mine
Mount Sherman
Amphitheater
Iowa
NATIONAL FOREST BOUNDARY
Little Sacramento Gulch
White Ridge
R-79-W
R-78-W
Hilltop Mine
Dauntless Mine
Peerless Mountain
Horseshoe
Gulch
Leavick
Creek
Mudsill Spring
Prospects
Sacramento (Site)
Sacramento Gulch
Fourmile
Horseshoe (Site)
Bares Mine
Sheep Mountain
Lamb Mountain
T. 9 S
T. 10 S
NATIONAL FOREST
1,1A
2
3
4
5
6
7,7A
8
9
10
11
20
21
22
22 A
23
24
25

ASARCO (BRI 807 DT) RFWO NO: 8768

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	AL2O3 %	FE2O3 %	CAO %	MGO %	TIO2 %	MNO %	NA2O %	K2O %
FM-20	2.33	4.29	8.37	4.85	.0485	.529	N.D.	.580
21	.602	18.3	.175	.173	.0080	10.3	N.D.	.104
22	.500	6.45	1.61	.880	.0260	.376	N.D.	N.D.
22A	.364	14.9	.108	.0652	.0062	.434	N.D.	.042
23	1.69	3.43	19.4	4.39	.101	.0989	N.D.	.246
24	.654	2.70	1.64	.738	.0357	.297	N.D.	.049
25	.656	67.4	6.55	.538	.0134	.0454	N.D.	.221

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	NI PPM	CU PPM	ZN PPM	CR PPM	CO PPM	CD PPM
FM-20	215	5660	18300	317	4	75
21	74	1650	2390	28.6	57	N.D.
22	17	5.6	62	22.3	N.D.	N.D.
22A	207	73.4	724	248	10	N.D.
23	67	11.7	194	77.7	N.D.	N.D.
24	151	44.2	35	207	7	N.D.
25	36	157	14400	N.D.	21	N.D.

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	AG PPM	SR PPM	V PPM	BE PPM	BA PPM	P205 %
FM-20	726	86.0	16.6	0.5	429	N.D.
21	14	32.6	100	14.6	4970	0.03
22	N.D.	N.D.	1.2	0.4	17	N.D.
22A	N.D.	14.0	40.4	13.8	330	0.02
23	N.D.	32.6	16.0	0.7	76	N.D.
24	N.D.	32.6	8.5	0.2	48	N.D.
25	11	32.6	22.2	0.2	2070	N.D.

MATRIX: AQUEOUS1 ANALYSIS DATE: 161070 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	PB PPM	AS PPM	ZR PPM	MO PPM	TH PPM	SIO2 %
FM-20	60000	N.D.	7	40	N.D.	44.7
21	60000	2600	13	260	N.D.	49.9
22	65	N.D.	N.D.	N.D.	N.D.	79.1
22A	950	1730	10	70	N.D.	80.4
23	60	420	14	N.D.	N.D.	48.4
24	35	N.D.	7	20	N.D.	91.0
25	11500	3470	8	N.D.	N.D.	6.98

Lms. Replacement File

FTG

JDS

Is there any thing in technique which you think could enhance our ability to locate drill targets or is this something which is still too far down the road, ~~[illegible]~~ which nevertheless still bears watching? FTG.

Cathodoluminescence

An excellent review of the technique and up to date data on the subject has recently appeared in the publication: Minerals Science Engineering (S. Africa), vol. 10, no. 2, 1978, p. 73-100. Attached is a copy of the first page synopsis as found in our library.

James D. Sell

FTG. the review indicates that digenetic and thermal alteration and stages of cement introduction etc can be mapped in limestone terrains. Thus it would appear (down the road) that the technique could be an enforcement for ideas & thoughts generated by our present crude visual & ES values. At present, I believe the targets are such that we can use the present knowledge to excellent use in prospecting and discovery; and as the easy (?) targets are outlined, then more thought & uses, such as Cathodo---, must be brought into play.

F. T. G.

W. Kurtz – GJ Stathis → file

ASARCO

Southwestern Exploration Division

December 14, 1978

F.T.G.

MEMO TO: D. M. Smith, Jr.

FROM: J. D. Sell

Limestone Replacement Search
Comparison of Values from
Pulps Submitted to Skyline
and Barringer Labs
Colorado

Skyline Labs, Inc. of Wheat Ridge, Colorado, ran the Emission Spectrographic Analysis on most of the samples collected during the search. The results are semi-quantitative, and the values are reported to the nearest one of six steps within each order of magnitude. Thirty-one elements were reported with a lower limit of detection noted (see Appendix I).

Barringer Research of Englewood, Colorado, use the Multi-Element Radio Frequency Argon Plasma Emission (MRFAPE) with a recommended hydrofluoric/perchloric acid digestion, for best sensitivity, followed by fusion digestion for the SiO_2 determination (see Appendix II).

Of interest to the limestone search, both labs detect Ca, Fe, Mg, Ag, As, Ba, Cu, Mn, Mo, Pb, and Zn (plus nine other probable non-interest elements such as Be, Cd, Co, Cr, Ni, Sr, Ti, V, and Zr). Skyline only detects Bi, Sb, Sn, W, plus B, Ga, Ge, La, Nb, Sc, and Y, with the first four being of interest. On the other hand, Barringer only detects Al_2O_3, K_2O, and SiO_2, along with Na_2O, P_2O_5, Th, with the first three being of interest.

Seven samples run by Skyline were submitted to Barringer for re-analysis. Table One below, compares the results received for the elements of interest.

Of the seventy-seven reported results, six have differences which would influence interpretation to some extent. Sample L-3, barium values of 5,000 vs 48; LL-3, manganese values of 1,000 vs 29; LL-5A, silver values of 7,000 vs 1,840, and manganese values of 1,000 vs 23; and sample LL-11, barium values of 200 vs 2,190, and manganese values of 10 vs 13,709; (Sky. vs Barr.). From this, it would appear that barium and manganese are most susceptible to differences of value result by the two methods. Visual description of the samples would suggest that Skyline values are possibly in the right direction, though in the low visual values, it is non-diagnostic without petrographic back-up.

Although Barringer has an apparent "true" value compared to Skyline's incremented step value, the lower sensitivity of the elements is about the same. The non-reporting of Bi, Sb, Sn, and W, by Barringer is probably not offset by the gaining of Al, K, and Si values. ∴ Skyline would be better for Carlin environment Search

Overall costs and turn-around times are comparable.

Appendix III contains the Barringer values of the elements while the Skyline values are reported in the September 26, Black Cloud Mine area (L-Series) and September 27, Leadville lead area (LL-Series) reports.

James D. Sell

JDS:jlh
c.c. F.T.Graybeal, w/encls ✓

James D. Sell

TABLE ONE - Comparison of E-S (Skyline) and MRFAPE (Barringer) Results:

Sample No.	L-3 Sky.	L-3 Barr.	L-4 Sky.	L-4 Barr.	L-4A Sky.	L-4A Barr.	LL-1 Sky.	LL-1 Barr.	LL-3 Sky.	LL-3 Barr.	LL-5A Sky.	LL-5A Barr.	LL-11 Sky.	LL-11 Barr.
Element														
Ca	2%	2.9%	15%	21.7%	5%	7.0%	20%	20.4%	>20%	21.2%	1%	2.1%	1%	0.2%
Fe	10%	11.0%	0.2%	0.26%	10%	7.0%	2%	0.11%	5%	0.16%	7%	5.1%	5%	0.6%
Mg	0.5%	1.5%	15%	10.6%	0.03%	0.42%	15%	10.5%	15%	10.7%	2%	1.3%	2%	0.3%
Ag	50	44	<1	ND	200	454	1	ND	<1	ND	7000	1840	<1	6
As	500	240	<500	ND	1000	820	<500	ND	<500	ND	1500	690	<500	780
Ba	5000	48	<10	67	7000	8286	<10	89	<10	385	5000	2320	200	2190
Cu	700	596	<2	ND	200	228	5	6	<2	ND	+10,000	22,000	2	17
Mn	5000	3648	1500	844	+10,000	205,243	500	39	1000	29	1000	23	10	13,709
Mo	20	40	2	ND	20	30	2	ND	3	ND	5	ND	3	ND
Pb	10,000	27,500	10	15	10,000	21,000	20	20	10	5	+10,000	80,000	20	185
Zn	+10,000	63,500	<200	73	2000	3450	<200	83	<200	70	10,000	8710	<200	24

NOTE: Barringer reports Ca as CaO; Fe as Fe_2O_3; Mg as MgO; and Mn as MnO. These have been converted to the element value, as reported by Skyline, using the conversion factors of CaO x 0.7147 = Ca; Fe_2O_3 x 0.6994 = Fe; MgO x 0.6032 = Mg; and, MnO x 0.7745 = %Mn x 10,000 = ppm Mn.

Ca, Fe, Mg reported as "%"; other elements in "ppm" values.

Appendix I

EMISSION SPECTROGRAPHIC ANALYSIS

Emission spectrographic analysis provides a fast, highly sensitive, comparatively low-cost method of determining the content of a large number of elements in earth materials. The spectrographic analyses we perform are considered "semi-quantitative", in that values are reported to the nearest one of six steps within each order of magnitude (see Reports below).

Elements Determined

We use a Jarrell-Ash 1.5 meter D.C. arc instrument set up specifically to provide semi-quantitative analyses of earth materials for 31 elements of maximum interest to the mineral exploration man.

The elements listed at the right of this page are determined down to the approximate lower limit of detection indicated. Maximum values reported are 20 percent for Ca, Fe, and Mg, and 1 percent for other elements.

Reports

Values for each element are reported either in parts per million (ppm) or percent as the nearest number in the series: 1, 1.5, 2, 3, 5, 7, 10, etc. within each order of magnitude (1-10 ppm, 10-100 ppm, etc.). These numbers represent the approximate boundaries and midpoints of arbitrary ranges of concentration differing by the cube root of ten. The "accepted" value for each element is considered to be within ± 1 step of the range reported at the 68 percent confidence level and within ± 2 steps at the 95 percent confidence level.

Materials Analyzed

- Rocks
- Soils
- Stream Sediments
- Plant Ash
- Water Residue

As little as 20 milligrams of sample can be submitted. We prefer to have 50 to 100 grams of representative material.

Sample Preparation

Your pulps will be analyzed as received if we are so instructed, providing they are reduced to <100 mesh and homogeneous. We reserve the right to perform additional preparation on samples we do not consider adequately prepared for satisfactory work. Unprepared samples submitted for spectrographic analysis will be crushed and pulverized in our high-alumina ceramic mill to avoid any metallic contamination.

Charges Per Sample

Up to 18 samples $11.00
More than 18 samples per lot $10.00

Sample preparation charges according to sample preparation price list.

Element	Lower Limit of Detection (ppm)	Reported by both Skyline & Barringer
Ca	200	X
Fe	500	X
Mg	200	X
Ag	1	X
As	500	X
B	10	
Ba	10	X
Be	2	X
Bi	10	
Cd	50	X
Co	5	X
Cr	10	X
Cu	2	X
Ga	10	
Ge	20	
La	20	
Mn	10	X
Mo	2	X
Ni	5	X
Nb	20	
Pb	10	X
Sb	100	
Sc	10	
Sr	100	X
Sn	10	
Ti	20	X
V	10	X
W	50	
Y	10	
Zn	200	X
Zr	20	X

LIST I — February, 1978

Appendix II

	DETECTION LIMIT	PRICE
• BARIUM (partial)	20 ppm	$2.20 per determination
(total including $BaSO_4$)	50 ppm	$3.80 per determination
• ORGANIC CARBON	0.01%	$3.80 per determination
• FLUORINE (rocks, soils, sediments)	4 ppm	$5.00 per determination
(waters)	10 ppb	$3.25 per determination
• GOLD (minimum 10 gms. sample required)	10 ppb	$4.50 per determination
• MERCURY (soils, rocks, sediments)	5 ppb	$4.30 per determination
(waters)	0.02 ppb	$4.10 per determination
• SILVER (cyanide soluble)	20 ppb	$2.15 per determination
• SULPHUR	20 ppm	$4.30 per determination
• THORIUM	10 ppm	$8.00 per determination
• URANIUM (waters)	0.2 ppb	$3.15 per determination
(waters)	0.02 ppb	$3.90 per determination
(waters—Fission track)	0.01 ppb	$3.70 per determination
(soils & sediments—Nitric)	0.2 ppm	$3.20 per determination
(rocks—TOTAL)	0.2 ppm	$3.60 per determination
• SILICON (fusion)		$3.80 per determination

MULTI-ELEMENT RADIO FREQUENCY ARGON PLASMA EMISSION (MRFAPE)

• WATERS	$8.00 per sample
• SINGLE ACID EXTRACTION	$9.20 per sample
• HYDROFLUORIC/PERCHLORIC (Si excluded)	$10.55 per sample
• FUSION (major elements, including Si)	$12.70 per sample

Ag, Al, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, P, Pb, Si, Sr, Ti, V, Zn, Zr, Th

Detection limits similar to atomic absorption.

- ION CHROMATOGRAPHY (IC) F^-, Cl^-, NO_2^-, NO_3^-, Br^-, $PO_4^{\equiv}$, $SO_4^{=}$
- WATER ANALYSIS — $15.00 per sample

Analytical data for several other anions can be provided on special request.

COLORIMETRIC ANALYSES

• ANTIMONY	1 ppm	$3.75 per determination
• ARSENIC	2 ppm	$3.25 per determination
• MOLYBDENUM (total)	2 ppm	$3.25 per determination
(partial)	2 ppm	$2.70 per determination
• TIN	1 ppm	$4.50 per determination
• TUNGSTEN	4 ppm	$4.60 per determination
• SELENIUM	1 ppm	$5.00 per determination

ASARCO (BRI 807 DT) RFWO NO: 8768

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	AL2O3 %	FE2O3 %	CAO %	MGO %	TIO2 %	MNO %	NA2O %	K2O %
L-3	3.79	15.7	4.07	2.55	.133	.471	N.D.	.887
4	.151	.371	30.3	17.6	.0084	.109	N.D.	.026
4A	.804	9.98	9.76	.696	.0303	26.5	N.D.	.442
LL-01	.151	.155	28.5	17.4	.0050	.0368	N.D.	.035
03	.204	.228	29.6	17.8	.0037	.0478	.085	.043
05A	.181	7.35	2.92	2.18	.0030	.0851	N.D.	.021
11	31.9	.899	.311	.548	1.77	.0016	1.65	6.73

Appendix III

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	NI PPM	CU PPM	ZN PPM	CR PPM	CO PPM	CD PPM
L-3	20	596	63500	6.2	8	247
4	15	N.D.	73	38.7	N.D.	N.D.
4A	13	228	3450	0.9	17	29
LL-01	12	5.5	83	36.4	N.D.	N.D.
03	14	N.D.	70	35.5	N.D.	N.D.
05A	19	22000	8710	9.3	N.D.	156
11	8	16.5	24	194	N.D.	N.D.

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	AG PPM	SR PPM	V PPM	BE PPM	BA PPM	P2O5 %
L-3	44	50.8	21.0	0.6	48	0.04
4	N.D.	23.8	4.6	N.D.	67	0.01
4A	454	481	32.1	0.6	8280	0.10
LL-01	N.D.	17.5	8.6	N.D.	89	N.D.
03	N.D.	20.6	4.7	0.2	385	N.D.
05A	1840	175	4.7	0.2	2320	N.D.
[illegible]	6	394	221	1.4	2190	0.02

MATRIX: AQUEOUS1 ANALYSIS DATE: 161070 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	PB PPM	AS PPM	ZR PPM	MO PPM	TH PPM	SIO2 %
L-3	27500	240	17	40	N.D.	42.9
4	15	N.D.	N.D.	N.D.	N.D.	.590
4A	21000	820	N.D.	30	N.D.	30.3
LL-01	20	N.D.	N.D.	N.D.	N.D.	2.97
03	5	N.D.	7	N.D.	N.D.	.290
05A	80000	690	N.D.	N.D.	N.D.	38.7
11	185	780	207	N.D.	24	48.2

Re: JDS 8/11 + 9/26
memos on Limestone
Replacement Search

FROM: F. T. GRAYBEAL

LEADVILLE

TO: SAAnzalone

Attached for your interest -
you can keep these copies.
No recommendations for more
work here - presumably to be
part of a summary report.
I will get all pertinent future
copies to you as I get them.

10/11/78

ASARCO

Southwestern Exploration Division

FTG

December 14, 1978

MEMO TO: D. M. Smith, Jr.

FROM: J. D. Sell

F.T.G.

Limestone Replacement Search
Ouray-Ironton (OI-Series)
Unsurveyed
Ouray County, Colorado

Only one sample was taken in the Ironton Park area in an area of several mine adits (caved) and the remains of an old smelter. The sample was run by MRFAPE (Barringer).

The sample is a manganiferous stained marble of the Leadville formation. Veins cut the marble as well as extending upward into the overlying volcanic sequence. Values include plus 25,000 ppm Mn, 2,860 ppm Zn, 20 ppm moly, trace barium, and silver and arsenic were not detectable.

Bear Creek has been drilling in the Park for a number of years and have found "interesting" mineral in the Leadville formation. The values found in sample OI-1 would suggest that additional work should be conducted.

James D. Sell

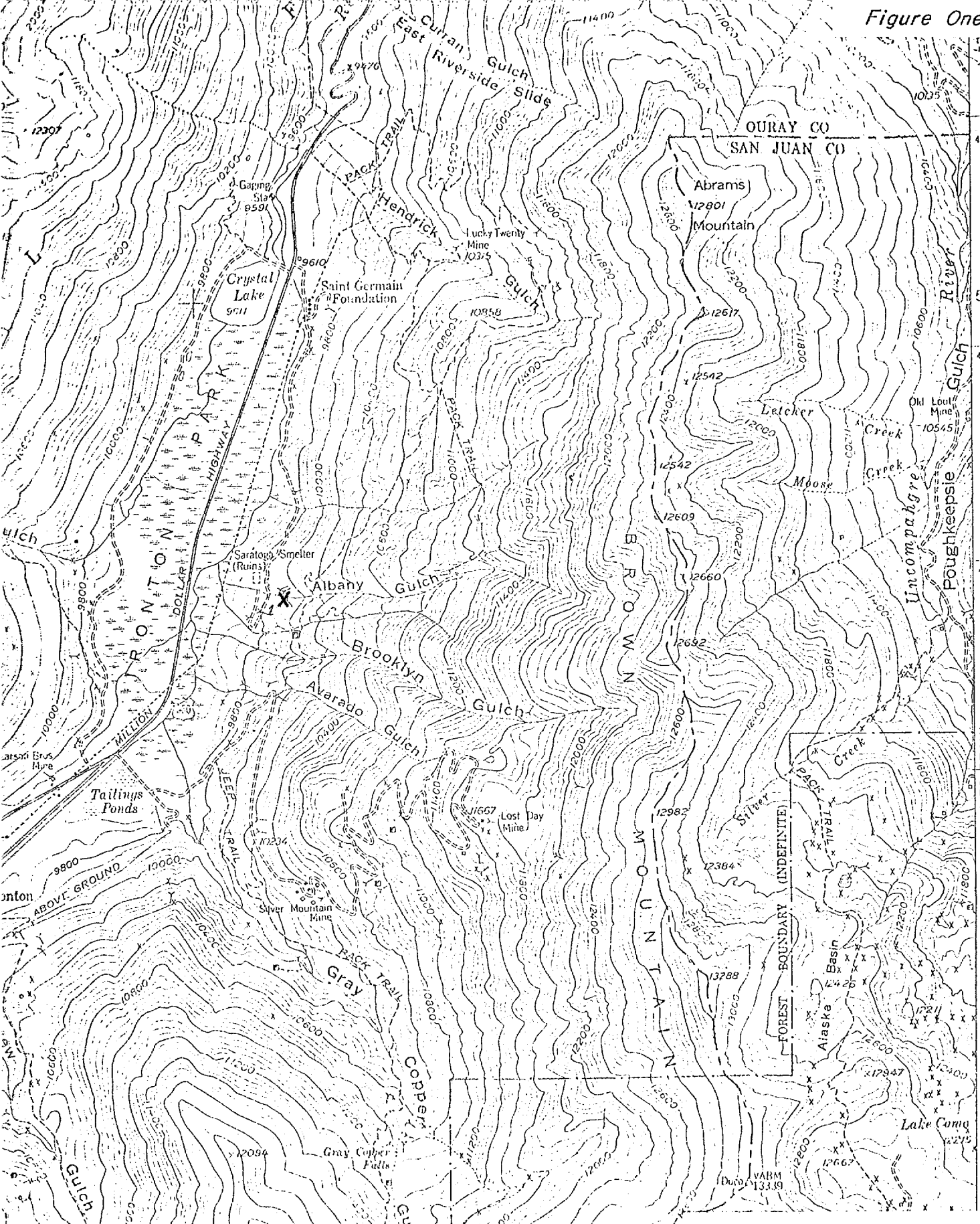
James D. Sell

JDS:jlh
encls

Table One - Description of Ouray-Ironton Sample (OI-Series)
J. D. Sell, August 9, 1978

OI-1	Ironton Park, Albany Gulch. Leadville marble with manganese stain and fracture filling. Note: The associated vein structures (not sampled) continue up into the overlying San Juan volcanics. The marble is very similar to that noted in the deep drill holes (TB-1 and BB-1) of the Idarado Mine.

Figure One



IRONTON AREA
OI-Series

Ironton 7.5 Quad.

SCALE: 1" = 2000'

J.D. Sell Dec. 1978

ASARCO (BRI 807 DT) RFWO NO: 8768

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	AL2O3 %	FE2O3 %	CAO %	MGO %	TIO2 %	MNO %	NA2O %	K2O %
OI-1	.204	.707	49.0	2.31	.0152	3.29	N.D.	.088

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	NI PPM	CU PPM	ZN PPM	CR PPM	CO PPM	CD PPM
OI-1	20	35.9	2860	19.3	9	18

MATRIX: AQUEOUS1 ANALYSIS DATE: 161078 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	AG PPM	SR PPM	V PPM	BE PPM	BA PPM	P2O5 %
QI-1	N.D.	168	5.4	0.5	22	0.02

MATRIX: AQUEOUS1 ANALYSIS DATE: 161070 TAPE NO: 143 FILE NO: 158

CLIENT SAMPLE NO	PB PPM	AS PPM	ZR PPM	MO PPM	TH PPM	SIO2 %
OI-1	310	N.D.	N.D.	20	N.D.	2.98

WK → lms file

ASARCO

RECEIVED OCT 6 1978 S. W. U. S. EXPL. DIV.

Rocky Mountain Exploration Division

September 27, 1978

TO: D. M. Smith, Jr.

FROM: J. D. Sell and D. J. Krasowski

Limestone Replacement Search
Leadville Lead Area (LL-Series)
Unsurveyed T 9 S, R 79 W
Lake County, Colorado

J. D. Sell, D. J. Krasowski, and C. Byington of the Black Cloud Unit were conducted underground by staff geologists of Day Mines, the operators of the Leadville Lead Mine located under Mount Sherman, on July 12, 1978. On July 14, Sell and Krasowski returned and conducted a collection of surface samples at and near drill stations located above and away from the mine area. Sell collected additional samples on the south exposure of Dyer Mountain on the 15th of July.

Table One contains the description of the LL-series samples; Table Two is the Emission-Spec results; and Figure One shows the location of the samples.

Three samples were collected underground near the location P-25-4-7 which is near the most northeastern workings of the Leadville Lead Mine. Sample LL-1 is a sample of Leadville dolomite with zebra development and secondary dolomite crystals replacing the white stripes; the sample was on the same horizon and located some thirty feet from a mining stope. The sample contained pervasive replacement texture, but contained no noteable or anomalous values, except for a possible increase in silica content over normal dolomite.

Approximately fifty feet away from the first sample was an active development face containing excellent galena-tetrahedrite-silver ore overlain by minor oxidized ore which in turn was overlain by stratified cave-fill material and an open cave. No sample was taken of the ore, but it was estimated by the Day Mine geologists to run in excess of 20% lead and contain several hundred ounces of silver per ton. The stratified cave-fill was a friable, tan, recrystallized, sanded dolomite in a karst channel. The fill, sample LL-2, contained anomalous barium (200 ppm) and manganese (2,000 ppm), with noticeable silver (3 ppm). The silica content was approximately that of the previous sample (3.6% versus 3.5%). Within the fill material were fragments of Belden Shale and Leadville dolomite. A sample of the Leadville dolomite fragment showing birdseye recrystallized development is recorded as sample LL-3. No manganese was noticeable, but the sample contained 1,000 ppm manganese with only 0.5% silica.

On the surface, a series of samples were collected along or near the drill road used in the original exploration for the deposit. The first group of samples were collected some 3,000 feet southwesterly from the orebody and updip in the same horizon. Sample LL-4 was upper Leadville dolomite showing excellent recrystallized replacement texture having minor FeOx kernels in dolomite knots as well as minor birdseye, brecciation, and sanding features. No values of note were returned in the Emission-Spec report except for a touch of lead (150 ppm) and zinc (300 ppm). In contrast, a sample taken from karst material overlying the "barren" dolomite is reported in sample LL-5 and contained 100 ppm silver, (= 2.92 troy oz. silver), 2,000 ppm copper, 10 ppm moly, 30 ppm nickel, 5,000 ppm lead, and plus 10,000 ppm zinc, although only 50 ppm barium and 700 ppm manganese were present. Obvious high-grade material had been separated from the karst material and this sample (LL-5A) showing nodules of oxidized tetrahedrite, reported 7,000 ppm silver, 1,500 ppm arsenic, 5,000 ppm barium, 200 ppm cadmium, plus 10,000 ppm copper, 1,000 ppm manganese, 5 ppm moly, plus 10,000 ppm of both lead and antimony, and 10,000 ppm zinc.

Going northward, sample LL-6 was cut in lower middle Leadville dolomite in a shear zone with dark grey dolomite having a recrystallized texture, silica ribs and boxworks and some secondary dolomite crystals in zebra textures. LL-6 returned 100 ppm silver, 200 ppm copper, and 3,000 ppm lead. Nearly absent was barium (10 ppm), manganese (700 ppm) and zinc (less than 200 ppm).

Sample LL-7 is in upper Leadville dolomite containing excellent recrystallized feature with zebra and birdseye development along with pyrite pseudomorphs and FeOx films. LL-7 returned an anomalous 10 ppm silver, along with 15 ppm cobalt, and 50 ppm nickel. Also, the magnesium (15%) versus calcium (15%) was equal. Again, manganese (700 ppm) and zinc (less than 200 ppm) were nearly absent.

The upper middle Leadville dolomite containing excellent replacement textures plus small quartz crystals and silica flooding (in a north-trending sheeted zone) was sampled as LL-8. Anomalous magnesium (15%) versus calcium (10%), manganese (1,500 ppm), and moly (5 ppm) with noticeable silver (5 ppm), and 19.9% silica was contained in LL-8. Although barite was noticed in outcrop, the Emission-Spec reported only 100 ppm barium.

Sample LL-9 taken updip from the south end of the underground orebody contained an anomalous magnesium (15%) versus calcium (10%), 10 ppm silver, 1,000 ppm manganese, and 5 ppm moly in upper middle Leadville having

overall good characteristics of replacement features. Approximately fifty feet stratigraphically below in lower middle Leadville having similar characteristics plus manganese-siderite, sample LL-9A exhibited equal magnesium versus calcium (both 15%), and an anomalous 3,000 ppm manganese.

Sample LL-10, updip and midway of the orebody contained 1,000 ppm manganese and 5 ppm moly in upper middle Leadville with some pyrite pseudomorphs and a trace of secondary dolomite along selvages and slickensides.

A Belden Shale sample with abundant yellow limonite along northeast trending shears, located just above the Leadville contact, sample LL-11, reported 100 ppm boron, 200 ppm barium, 150 ppm chromium, 150 ppm lanthanum, 500 ppm strontium, 10,000 ppm titanium, 200 ppm vandium, and 200 ppm zirconium.

An upper Leadville sample located 2,000 feet northwest of the present extend of the orebody was collected as LL-12. The outcrop of recrystallized texture with minor zebra and birdseye textures with rare secondary dolomite crystals contained no noticeable increase in elements except for a 10% magnesium versus 10% calcium ratio.

At the defunct Continental Chief Mine, excellent examples of oxidized tetrahedrite-galena-sphalerite are found on the dump along with excellent replacement textured wall rock. Three examples of the progressive increase in alteration-mineralization characteristics were taken. LL-13, the wall rock with secondary dolomite crystals in bands and nodules, contained an equal ratio of magnesium (15%) versus calcium (15%), anomalous silver (15 ppm), and noteable manganese (1,000 ppm), with only a trace of the other metals.

Sample LL-13A, of totally oxidized FeOx-quartz-minor barite material with pyrite, pyrite pseudomorph, in late barite, replacing dolomite wall rock, contained almost no calcium and magnesium, 1,000 ppm manganese, and 7 ppm moly, with only 10 ppm barium reported.

The karst cave mineralized material, sample LL-13B, contained anomalous magnesium (15%) versus calcium (5%), 1,000 ppm silver, plus 10,000 ppm barium, 300 ppm chromium, 5,000 ppm copper, plus 10,000 ppm lead, 3,000 ppm antimony, 1,000 ppm strontium and titanium, and plus 10,000 ppm zinc.

Stratigraphically low in the Parting Quartzite is a northeast-trending shear zone containing sanded and leached dolomitic quartzite units with intragranular FeOx. The zone was sampled as LL-14 and contained 5 ppm silver and 1,000 ppm manganese.

West of the Leadville Lead mining area on the south face of Dyer Mountain is extensive porphyry masses underlain by Leadville dolomite. Several shallow pits and short adits have been driven along the upper Leadville. Samples LL-15 and LL-16A represent massive recrystallized Leadville dolomite with secondary dolomite crystals, quartz crystals in zebra textured units and with minor FeOx on fractures. LL-15 contained only 1 ppm silver and 1,500 ppm manganese as indicative of being near mineralized units while LL-16A had 7 ppm silver and only 500 ppm manganese.

Located forty to fifty feet away from these samples were dump and/or cave material. Samples LL-15A contained secondary dolomite crystals, drusy quartz crystals, sanding features, barite, and a trace of galena (no azurite-malachite noted). Values of 100 ppm silver, plus 10,000 ppm barite, 1,000 ppm manganese, 5,000 ppm lead, and 2,000 ppm zinc were noted. The karst material with weak Fe-Mn stain and rubble fill with fine quartz crystals and secondary dolomite crystals (sample LL-16) contained 10 ppm silver, 500 ppm barium, 10,000 ppm manganese, and 5 ppm moly.

The final sample, taken from an oxidized mine dump which was connected to an aerial tram and hence the probable only producer on this portion of the mountain, was completely replaced dolomite with FeOx, pyrite and zinc sulfide pseudomorphs, silica boxworks, some barite and quartz-dolomite crystals. Sample LL-17 returned values of 50 ppm silver, 1,000 ppm arsenic, plus 10,000 ppm barium, 500 ppm copper, 100 ppm moly, 10,000 ppm lead, and 2,000 ppm zinc.

The Leadville Lead Mine area typifies the alteration-mineralization in replacement textured dolomite and in karst cave fill material and associated mineralization.

Although zebra and birdseye textures may only show that alteration solutions and/or heating events have effected the units, the increased amounts of vug development, secondary dolomite crystal growth, the dolomite crystal replacement of previous textures, and quartz crystal growths, are strong indicators of alteration fluids associated with mineralization. The increase in magnesium to calcium ratio is a manifestation of fluid movement. The increase in iron is generally noted visually while the increase in silver,

September 27, 1978

barium, and manganese may not be visually detected at significant values. Copper-lead-and-zinc may or may not be present in oxidized units due to their dispersion, but of course, are highly visible in remnant oxide-sulfides where such remain. The arsenic-antimony-high silver values attest to the presence of tetrahedrite-ruby silver sequences, and is generally visible as secondary azurite-malachite films and crystals growths. Moly is generally present as an anomalous value in and near mineralization.

Not too anomalous. What is Mo background in fresh lms

Erratic, but often anomalous values of boron, cadmium, cobalt, chromium, nickel, vanadium, and zirconium often occur in and near the mineralized zones, but care must be taken not to interpret the intrinsic high values of these elements in shales and igneous rock units. However, when altered shale and igneous units are found, often shown by increased gypsum, vein pyrite, and various FeOx distributions, they are commonly associated with increased alteration within nearby carbonate units.

The strong northeast shearing in the Continental Chief area, the altered porphyry on the western exposures, and values recorded in the sampling, coupled with the apparent strong north-trending control on the presently operating Leadville Lead orebody, all project into the Gemini Peak area. The area has been mapped as being only porphyry (sill) with limestone (dolomite?) down on the far eastern flank. If the Continental Chief samples are indicative of up-dip extensions as recorded in the samples above and adjacent to the Leadville Lead mining area, then additional work should be conducted in the Gemini Peak area.

What was dip at/before time of mineralization

Likewise, the exposed outcrop sampling on the south exposures of Dyer Mountain are very indicative of mineralized systems and further work is needed to determine the extent and direction.

James D. Sell

Dennis J. Krasowski

JDS:DJK:eff

Attachments

CC: F. T. Graybeal

Table One - Description of the Leadville Lead Area Samples (LL-Series). Sampled by D. J. Krasowski and J. D. Sell. July 12, 14, 15, 1978.

LL-1	Leadville Lead underground mining area, location P-25-4-7. Leadville dolomite with zebra and secondary dolomite crystal replacing white zebra stripes, approximately 30 feet from ore, same horizon.
LL-2	Same area, different face (#4-8?), "cave stratified fill" at ± 20° angle to dolomite host bedding, in karst channel with tan recrystallized sanded dolomite containing fragments of Belden Shale and medium grey, well recrystallized dolomite textures. (Underlain by partially oxidized galena and tetrahedrite in quartz crystal boxwork.)
LL-3	Same face as LL-2, clast of birdseye recrystallized texture Leadville dolomite within cave fill material.
LL-4	Surface, south end, angle drill station (#1). Leadville dolomite, excellent recrystallized replacement texture with FeOx kernel and films with dolomite clots, veins, and minor birdseye with minor brecciation and sanding along bedding, medium grey coloration.
LL-5	Same area, above #4, probable karst rubble of FeOx nodules with quartz crystals, secondary dolomite crystals with FeOx pseudos after pyrite on fractures in dolomite clasts.
LL-5A	Same area. Collection of nodules showing tetrahedrite oxidation producing azurite and malachite as in cave deposit underground.
LL-6	Approximately sixty to eighty feet below and sixty to eighty feet north of #4 and #5 samples. Lower middle Leadville dolomite with shear-fault of north-trend and steep west dip, dark grey coloration, recrystallized texture with silica ribs and minor boxwork, some dolomite crystal replacement of zebra and in knots, same jarosite with FeOx on fractures.
LL-7	Approximately one hundred feet uphill and south of angle drill site #2. Upper Leadville dolomite, well recrystallized with secondary zebra, birdseye, clots, films, veins with pyrite pseudomorphs and FeOx mainly as thin film. Very reddish coloration in outcrop.
LL-8	Angle drill station #2, plus/minus forty to fifty feet below road. Upper middle Leadville dolomite with north trending sheeted zone, medium coarse, recrystallized texture with secondary dolomite in zebra, small quartz crystals, silica flooding, and trace of barite.
LL-9	Angle drill station #3, approximately vertically above 4,000 foot drift of adit to mine workings. Upper middle Leadville dolomite, medium grey, recrystallized with breccia zones on bedding and northeast trend with minor FeOx and pyrite pseudomorphs, minor dolomite in few zebra structure, some quartz veining with FeOx, minor jarosite on fractures.

LL-9A Same location, plus/minus fifty feet below in lower middle Leadville dolomite, darker coloration, well recrystallized with secondary dolomite crystal in zebra textures, manganese-limonite as clots and fracture fillings.

LL-10 Approximately fifty feet south of exhaust vent tunnel opening. Leadville dolomite, middle upper, with $1\frac{1}{2}$-2 feet wide N 30°-40° E shear vein, 70°-80° SE dip, with yellow-orange limonite with minor pyrite pseudomorphs and silica with secondary dolomite selvages and slickensides.

LL-11 Belden Shale, six to ten feet above top of Leadville. A compact siliceous dolomitic shale with abundant bright yellow limonite on shears (northeast trend in Ml and Tkp), partings and other planar features.

LL-12 Upper Leadville dolomite plus/minus forty feet below TKp with minor Belden between. Fine to medium recrystallized texture with some zebra, rare secondary dolomite in birdseye and nodules. Sheeted northeast with weak FeOx on sheeting.

LL-13 Continental Chief Mine dump. Leadville dolomite, excellent replacement textures, zebra with secondary dolomite crystals replacing bands, and also in nodules and in minor veins, weak FeOx films.

LL-13A Same dump. Totally oxidized FeOx-quartz-minor barite and pyrite pseudos with pyrite in late barite, replacing Leadville dolomite.

LL-13B Same dump. High grade samples of vuggy, siliceous boxwork, with white barite crystals, and masses of quartz crystal, azurite, malachite, in quartzose dolomite, some quartzite (?), and cellular type as in karst cave type. Contains some partially oxidized sphalerite.

LL-14 Parting quartzite, sanded and leached dolomite units with FeOx intragranular and few FeOx nodules on northeast trending fractures (zone projects to site LL-12).

LL-15 Outcrop of middle Leadville dolomite with fine recrystallized texture, medium dark grey with zebra patches, secondary dolomite crystals, quartz crystals, and minor FeOx on fractures and planes, minor jarosite-silica on northeast fractures. Chert bands and discontinuous quartzite bands in unit.

LL-15A Dump sample adjacent to outcrop, with plus/minus fifty foot drift. Contains Leadville dolomite with excellent replacement texture containing zebra with secondary dolomite crystal stripes, drusy quartz crystal and barite in breccia with sanding, trace oxidized galena, minor FeOx. Probably a bx-vein. No azurite-malachite.

LL-16 Breccia cave filling(?) at top of Leadville dolomite of silicified dolomite with weak Fe-Mn stain and rubble fill with fine quartz crystal in vugs, dolomite in veins and fine secondary dolomite crystals.

LL-16A Upper middle Leadville dolomite, plus/minus forty feet below above sample, massive medium grey, medium-coarse recrystallized textures with abundant zebra containing secondary dolomite crystal, some crosscutting, and minor FeOx on northeast fractures and along bedding.

LL-17 Oxidized mine dump above tramway building. Upper Leadville dolomite completely replaced, oxidized, FeOx, pyrite pseudos and zinc sulfide pseudo, silica boxworks, some barite, quartz crystals and minor dolomite crystals.

LEADVILLE LEAD AREA

TABLE TWO

DCR 011
PAGE 1

ITEM NO.	SAMPLE NO.
1	P-01
2	L-01
3	L-02
4	LL-01
5	LL-02
6	LL-03
7	LL-04
8	LL-05

	LL-1	LL-2	LL-3	LL-4	LL-5
ITEM	4	5	6	7	8
ELEMENT					
Fe	.2%	2%	.5%	.5%	10%
Ca	20%	20%	>20%	15%	7%
Mg	15%	15%	15%	10%	2%
Ag	1	3	<1	1	100 *
As	<500	<500	<500	<500	<500
B	<10	<10	<10	<10	10
Ba	<10	200	<10	<10	50
Be	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50
Co	<5	<5	<5	<5	5
Cr	<10	<10	<10	<10	<10
Cu	5	5	<2	10	2000
Ga	<10	<10	<10	<10	<10
Ge	<20	<20	<20	<20	<20
La	20	<20	<20	<20	<20
Mn	500	2000	1000	700	700
Mo	2	2	3	3	10
Nb	<20	<20	<20	<20	20
Ni	<5	<5	<5	<5	30
Pb	20	150	10	150	5000
Sb	<100	<100	<100	<100	200
Sc	<10	<10	<10	<10	<10
Sn	<10	<10	<10	<10	<10
Sr	<100	<100	<100	<100	100
Ti	20	100	50	<20	150
V	10	10	10	10	10
W	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	<10
Zn	<200	500	<200	300	>10000
Zr	<20	<20	<20	<20	<20
SiO_2	3.5%	3.6%	0.5%		

LINE LABS, INC.
IN EXPLORATION GEOCHEMISTRY

* Note: 100 ppm Ag = 2.92 Troy oz. Ag

ITEM NO.	SAMPLE NO.
9 =	LL-05A
10 =	LL-06
11 =	LL-07
12 =	LL-08
13 =	LL-09
14 =	LL-09A
15 =	LL-10
16 =	LL-11

	LL-5A	LL-6	LL-7	LL-8	LL-9	LL-9A	LL-10	LL-11
ITEM	9	10	11	12	13	14	15	16
ELEMENT								
Fe	7%	.3%	1%	.5%	2%	.7%	1.5%	.5%
Ca	1%	20%	15%	10%	10%	15%	15%	.1%
Mg	.2%	15%	15%	15%	15%	15%	10%	.2%
Ag	7000	100	10	5	10	2	3	<1
As	1500	<500	<500	<500	<500	<500	<500	<500
B	<10	<10	10	<10	<10	<10	<10	100
Ba	5000	10	<10	100	<10	<10	<10	200
Be	<2	<2	2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	200	<50	<50	<50	<50	<50	<50	<50
Co	<5	<5	15	<5	<5	<5	<5	<5
Cr	<10	<10	10	<10	<10	<10	<10	150
Cu	>10000	200	50	20	50	5	20	2
Ga	<10	<10	<10	<10	<10	<10	<10	15
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	50	20	<20	<20	<20	20	<20	150
Mn	1000	700	700	1500	1000	3000	1000	10
Mo	5	3	2	5	5	3	5	3
Nb	20	<20	<20	<20	<20	<20	<20	20
Ni	5	<5	50	<5	<5	<5	5	5
Pb	>10000	3000	500	200	200	100	150	20
Sb	>10000	200	<100	<100	<100	<100	<100	100
Sc	<10	<10	<10	<10	<10	<10	<10	20
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	200	<100	<100	<100	<100	100	100	500
Ti	20	30	300	<20	20	20	20	10000
V	10	10	20	10	20	10	10	200
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	<10	10	<10	<10	<10	<10	20
Zn	10000	<200	<200	<200	200	200	300	<200
Zr	<20	<20	20	<20	<20	<20	<20	200
SiO_2				19.9%				

SKYLINE LABS, INC.
SPECIALISTS IN EXPLORATION GEOCHEMISTRY

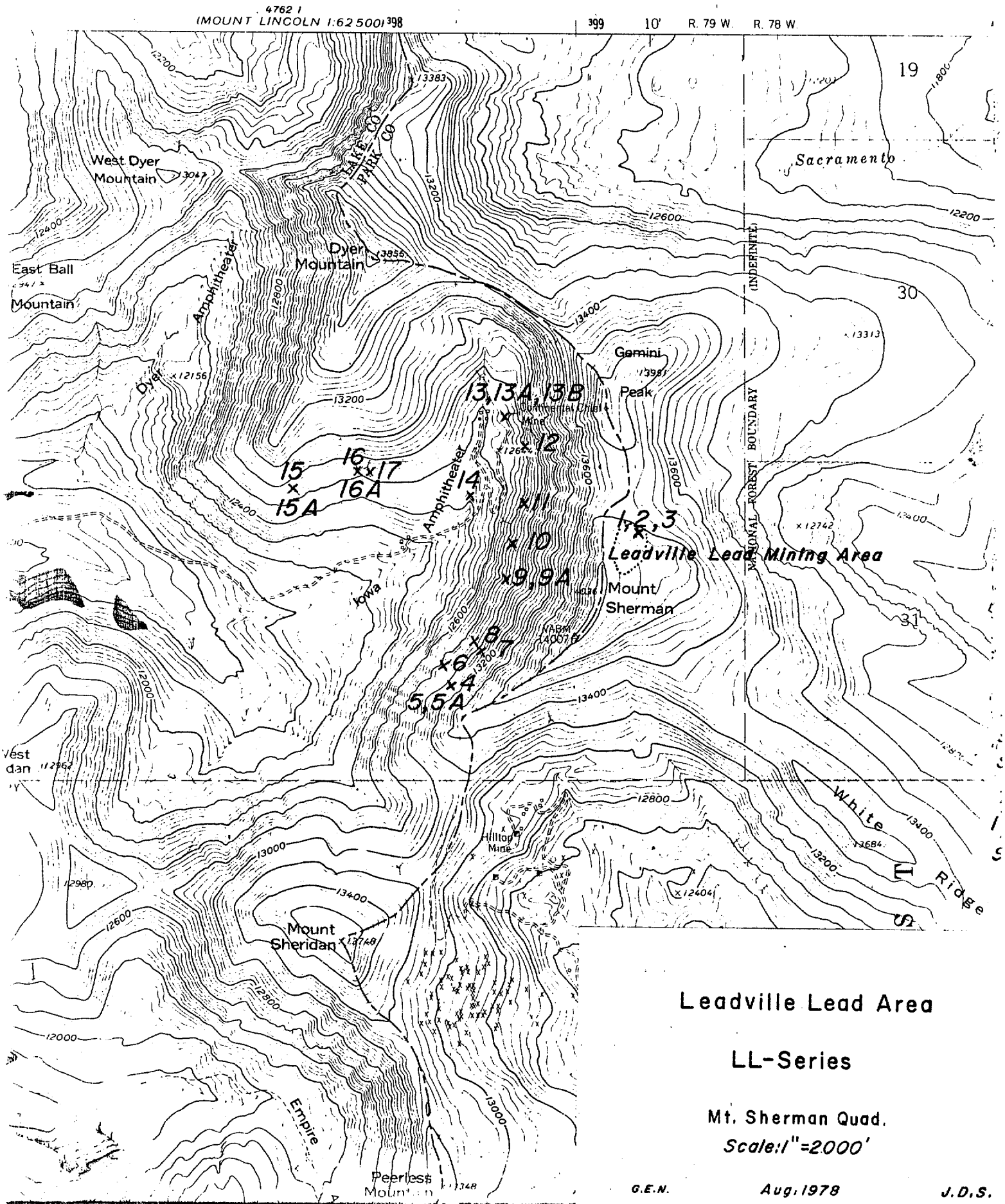
ITEM NO.	SAMPLE NO.
17	= LL-12
18	= LL-13
19	= LL-13A
20	= LL-13B
21	= LL-14

	LL-12	LL-13	LL-13A	LL-13B	LL-14
ITEM	17	18	19	20	21
ELEMENT					
Fe	.2%	.2%	10%	2%	.5%
Ca	10%	15%	.2%	.5%	.7%
Mg	10%	15%	.1%	.15%	.2%
Ag	2	15	2	1000	5
As	<500	<500	<500	<500	<500
B	<10	<10	20	10	10
Ba	<10	20	10	>10000	20
Be	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10
Cd	<50	<50	<50	100	<50
Co	<5	<5	7	<5	<5
Cr	<10	<10	<10	300	<10
Cu	5	10	30	5000	20
Ga	<10	<10	<10	<10	<10
Ge	<20	<20	<20	<20	<20
La	20	20	<20	<20	<20
Mn	300	1000	1000	300	1000
Mo	2	3	7	2	<2
Nb	<20	<20	20	20	<20
Ni	<5	<5	10	5	<5
Pb	30	100	200	>10000	150
Sb	<100	100	<100	3000	<100
Sc	<10	<10	<10	<10	<10
Sn	<10	<10	10	<10	<10
Sr	100	100	<100	1000	<100
Ti	150	30	100	1000	50
V	10	10	10	20	<10
W	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	<10
Zn	<200	<200	500	>10000	200
Zr	<20	<20	<20	30	<20

Charles E. Thompson
Charles E. Thompson
Chief Chemist

SKYLINE LABS, INC.
SPECIALISTS IN EXPLORATION GEOCHEMISTRY

FIGURE ONE



Leadville Lead Area

LL-Series

Mt. Sherman Quad.

Scale: 1" = 2000'

G.E.N. Aug. 1978 J.D.S.

RECEIVED
OCT 6 1978
S. W. U. S. EXPL. DIV.

ASARCO

Rocky Mountain
Exploration Division

September 26, 1978

TO: D. M. Smith, Jr.

FROM: J. D. Sell and D. J. Krasowski

Limestone Replacement Search
Black Cloud Mine Area (L-Series)
Unsurveyed T9S, R79W
Lake County, Colorado

On July 13, 1978, J. D. Sell and D. J. Krasowski toured underground at the Black Cloud Unit, where several samples were collected, as well as the surface sample at the Penn Group workings, (P-1 sample). The following day a sample of mine run ore was collected from the conveyor belt. The underground and surface tour and the conveyor belt collection was with the supervision and guidance of Craig Byington, unit geologist. On the 16th, Sell continued sampling of dumps and units across the Iowa gulch, south of the Black Cloud Shaft.

Table One reports the description of the samples collected; Table Two contains the Emission-Spec results; while Figure One records the location of the collection.

Three samples were collected from near or in the No. 6 Orebody. Sample L-1 was located on the east side of the Ontario fault and about 60 feet west of the edge of the No. 6 Orebody. Here the Leadville dolomite was totally recrystallized, highly fractured, and contained secondary dolomite on fractures and along minor veinlets. Although no manganese was visible, sample L-1 reported 7,000 ppm manganese. No additional anomalous values were reported. Sample L-2 was taken in sanded dolomite wall rock on the north side of the orebody some 2-4 feet from massive pyrite-sphalerite-galena-carbonate ore. The sample (L-2) reported an anomalous ratio of 7% magnesium versus 1% calcium; 2,000 ppm manganese, along with 20 ppm cobalt, 50 ppm chromium, 50 ppm nickel, 200 ppm lead, 3,000 ppm titanium, 100 ppm vanadium, and 300 ppm zirconium. The manganese and magnesium are indicative of the replacement-mineralization process, but the lack of silver (1 ppm) is noteable. The remaining anomalous values have been noted elsewhere in replacement limestone, but are generally associated with porphyry intrusions.

The ore run sample, L-3, contained anomalous silver (50 ppm), barium (5,000 ppm), cadmium (200 ppm), manganese (5,000 ppm), moly (20 ppm), lead (10,000 ppm), titanium (1,000 ppm), and zinc (+10,000 ppm), with

noticeable copper (700 ppm). A short note on this sample compared to a typical trace element assay of the Black Cloud concentrates was submitted on August 11, 1978.

As noted, the anomalous silver, barium, cadmium, manganese, moly and plus/minus base metals are important in checking favorable structures/replacement units. These values have also been recorded for the Gilman district, the western part of the Leadville District, and the Leadville Lead Area of Day Mines, as being indicative of productive units.

Surface samples were collected outside the immediate Black Cloud area. One sample taken at the Penn Group Mine was of the "magnetite skarn", sample P-1, which is often found surrounding part of the ore in the Leadville and Gilman districts. Sample P-1 was anomalous in moly (15 ppm), tin (100 ppm), and zinc (1,000 ppm), with minor copper (200 ppm). Silver (1 ppm), manganese (100 ppm), and lead (less than 10 ppm), are noticeably absent from this high iron-jasper unit.

A series of samples was collected from the dumps and outcrops across Iowa Gulch on the north face of Long and Derry Hill. The high-grade samples, of oxidized FeOx-MnOx-pseudomorphs after sulfides, included samples L-4A, L-5A, and L-6. In order, they reported anomalous silver (200, 150, 150 ppm), arsenic (1,000, 2,000, 5,000 ppm), barium (7,000, 7,000, 5,000 ppm), manganese (all plus 10,000 ppm), moly (20, 10, 10 ppm), lead (10,000, 7,000, 5,000 ppm), and zinc (2,000, 10,000, 3,000 ppm). Copper was also noticeable as 200 ppm (L-4A) and 100 ppm (L-6); along with 500 ppm strontium (L-5A) and 150 ppm vanadium (L-6).

The recrystallized textured Leadville dolimite wall rock samples included L-4 with vugs, secondary dolomite crystals and quartz crystals; L-5 of partially sanded dolomite with minor manganese-siderite replacement; L-7A with zebra development, vugs and secondary dolomite crystals, plus mangano-siderite; and L-7B, a MnOx-FeOx shear zone cutting sanded dolomite with secondary dolomite crystals, quartz crystals, and minor zebra development.

Sample L-4 contained an equal amount of magnesium (15%) versus calcium (15%), and noteable manganese (1,500 ppm). Sample L-5 contained anomalous silver (10 ppm), and manganese (plus 10,000 ppm). Samples L-7A and L-7B reported silver (10 and 7 ppm), and manganese (10,000 and plus 10,000 ppm) with sample L-7B also containing 1,000 ppm zinc.

September 26, 1978

The altered porphyry sill of the area is reported in sample L-7 and contained 2,000 ppm manganese, 20 ppm nickel, 2,000 ppm titanium, and 200 ppm zirconium.

All samples in the Long and Derry Hill area are indicative of mineralized units associated with orebodies as found in the Black Cloud Mine area.

James D. Sell

James D. Sell

Dennis J. Krasowski

Dennis J. Krasowski

JDS:DJK:eff

Attachments

CC: F. T. Graybeal

Table One - Description of the Black Cloud Mine Area (Leadville) Samples. L-Series and P-1 Sample. (Sampled by D. J. Krasowski and J. D. Sell.) July 13, 14, 16, 1978.

L-1	Black Cloud Mine, 1,200 level, Leadville dolomite, totally recrystallized, highly fractured with secondary dolomite on fractures and minor veinlets. Located on east side of Ontario fault and 60 feet west of No. 6 orebody.
L-2	Black Cloud Mine, 1,200 level, panel 3, 15th floor, north end of orebody. Sanded dolomite outside of massive pyrite-sphalerite-galena-cabronate orebody in Leadville dolomite.
L-3	Black Cloud Mine, No. 6 Orebody, crushed ore from conveyor belt from crusher of AM 7/14/78 shift.
L-4	Dump (wall rock sample), Leadville dolomite, fine recrystallized replacement texture, medium-grey, with fine vugs, some with fine quartz crystals, some with secondary dolomite crystals, also minor dolomite crystal veins, weak FeOx on few fractures, some sanding.
L-4A	Same dump (ore pile), Leadville dolomite, FeOx replacing Fe-stained sanded dolomite, totally oxidized, drusy quartz crystal cavities and silica boxworks and veins of quartz and dolomite with weak Fe-siderite type jasper development, pyrite and sphalerite(?) pseudomorphs.
L-5	Largest dump of hillside. Leadville dolomite, medium grained recrystallized textures, partially sanded, with mangano-siderite replacement.
L-5A	Same dump. Leadville dolomite, high-grade, massive Fe hematite, botryoidal, with some manganese oxide, replacement, large vugs with Fe stained quartz crystal with remnant Mn-siderite and pyrite pseudomorphs. (Best looking material.)
L-6	Dump of Leadville dolomite of orange-grey-pale red jasper intramixed with pulverent black FeOx and minor botryidal shapes, fine quartz crystals with some dolomite-calcite veins. Wall rock, not sampled, is weak manganese-dolomite replacement.
L-7	Top of bluff; TK porphyry, weak argillic alteration, sheeted and cut by N 30° W fractures. Sample of FeOx on fractures, partings, and sheeted zones. Underlain by altered and bleached, very cherty Leadville dolomite.
L-7A	Leadville dolomite, ± 20 feet below porphyry sill, medium recrystalline texture, medium grey with weak zebra development, secondary dolomite crystals in zebra and in small vugs and veins with overall mangano-dolomite replacement. Few oxidized FeOx blebs and smears.
L-7B	Leadville dolomite, ± 80 feet below porphyry sill, in shear zone $1\frac{1}{2}$'-3' wide, trending N 30°-40° E toward Black Cloud Shaft, Mn-FeOx replacing partially sanded dolomite along shears and outward along bedding and certain horizons, medium crystalline, large vugs of quartz crystals with dolomite crystals in bands and veins with weak zebra development.

P-1 Penn Group Mine area. Leadville replacement by iron-jasper; dense magnetite-hematite with orange-brown jasper and minor, fluffy, oxidized FeOx. Local brown-black chert-jasper. (Magnetite skarn of T. B. Thompson.)

BLACK CLOUD (L-Series)
&
PENN GROUP (P-1 Sample) AREAS

TABLE TWO

ITEM NO. SAMPLE NO
1 = P-01
2 = L-01
3 = L-02

	P-1	L-1	L-2	L-3
ITEM	1	2	3	1
ELEMENT				
Fe	20%	3%	5%	10%
Ca	.02%	20%	1%	2%
Mg	.03%	15%	.7%	0.5%
Ag	1	<1	1	50
As	<500	<500	<500	500
B	20	<10	30	15
Ba	20	<10	10	5000
Be	2	<2	2	<2
Bi	<10	<10	<10	<10
Cd	<50	<50	<50	200
Co	<5	<5	20	<5
Cr	<10	<10	50	10
Cu	200	15	5	700
Ga	10	<10	10	10
Ge	<20	<20	<20	<20
La	<20	20	50	<20
Mn	100	7000	2000	5000
Mo	15	3	2	20
Nb	20	<20	20	20
Ni	<5	<5	50	10
Pb	<10	30	200	10000
Sb	<100	<100	<100	<100
Sc	<10	<10	15	<10
Sn	100	<10	<10	10
Sr	<100	<100	100	200
Ti	100	30	3000	1000
V	20	10	100	30
W	<50	<50	<50	<50
Y	<10	<10	15	<10
Zn	1000	<200	<200	>10000
Zr	<20	<20	300	20

SKY
SPECIALISTS

ITEM NO.	SAMPLE NO.
1	L-4
2	L-4A
3	L-5
4	L-5A
5	L-6
6	L-7
7	L-7A
8	L-7B

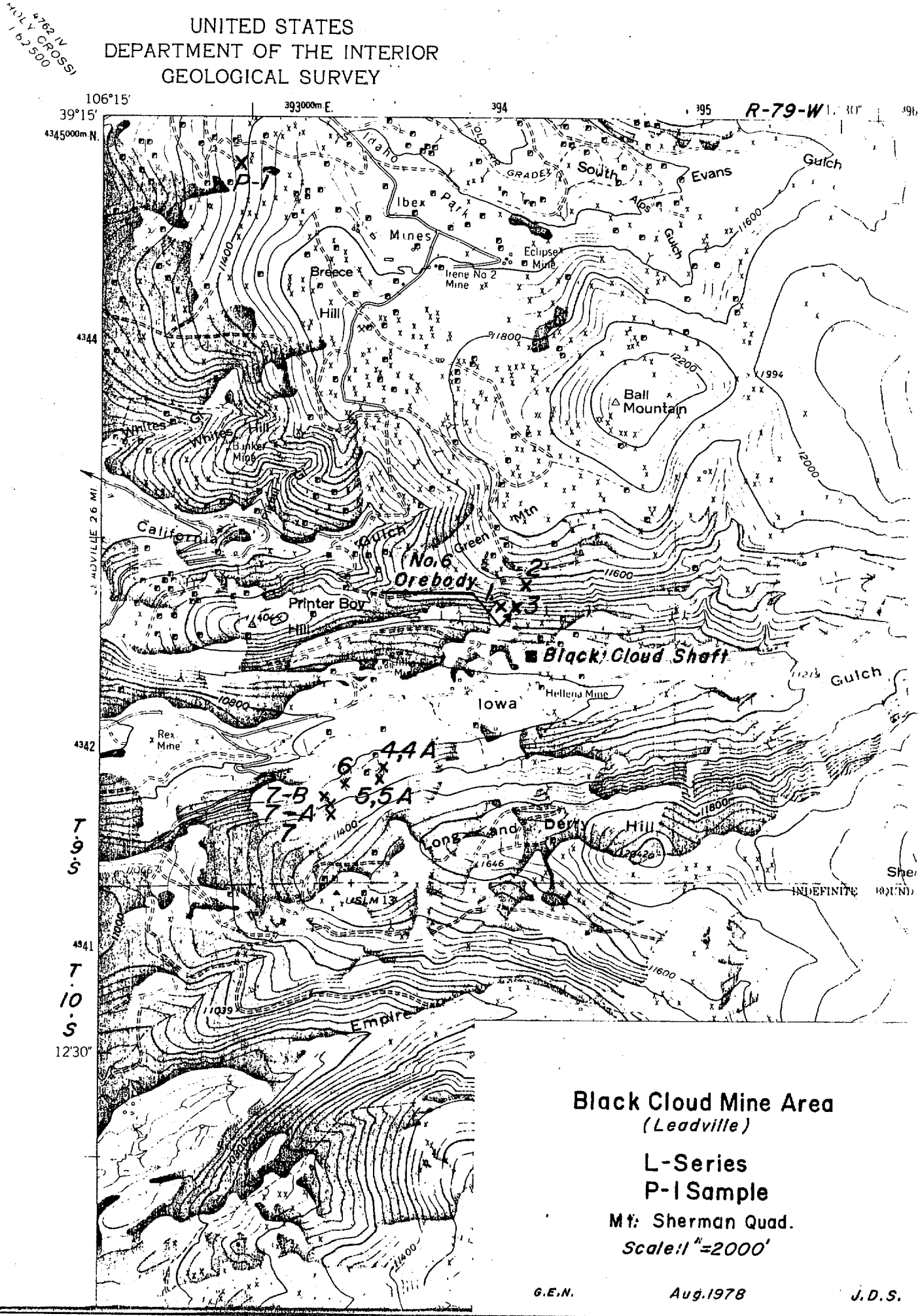
	L-4	*L-4A*	*L-5*	*L-5A*	*L-6*	*L-7*	*L-7A*	*L-7B*
ITEM	1	2	3	4	5	6	7	8
ELEMENT								
Fe	0.2%	10%	1%	7%	10%	10%	0.5%	1%
Ca	15%	5%	20%	0.5%	0.2%	0.07%	15%	7%
Mg	15%	0.03%	15%	0.03%	0.03%	0.05%	10%	1%
Ag	<1	200 *	10	150	150	2	10	7
As	<500	1000	<500	2000	5000	<500	<500	<500
B	<10	10	<10	10	10	30	<10	<10
Ba	<10	7000	10	7000	5000	50	50	<10
Be	<2	<2	<2	<2	<2	2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	<5	<5	<5	<5	5	<5	<5	<5
Cr	<10	20	<10	10	10	20	<10	<10
Cu	<2	200	3	30	100	2	3	5
Ga	<10	<10	<10	<10	<10	<10	<10	<10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	70	20	70	<20	<20	20	20
Mn	1500	>10000	>10000	>10000	>10000	2000	10000	>10000
Mo	2	20	2	10	10	5	2	3
Nb	<20	20	<20	20	20	20	<20	<20
Ni	<5	5	<5	<5	10	20	<5	<5
Pb	10	10000	200	7000	5000	50	100	500
Sb	<100	200	<100	100	100	<100	<100	<100
Sc	<10	<10	<10	<10	<10	10	<10	<10
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	<100	300	<100	500	300	100	<100	<100
Ti	20	100	20	<20	100	2000	100	<20
V	10	70	20	70	150	70	20	20
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	<10	10	<10	<10
Zn	<200	2000	300	10000	3000	<200	500	1000
Zr	<20	<20	<20	<20	<20	200	<20	<20

** NOTE: 100 ppm Ag = 2.92 Troy oz. Ag*

SKYLINE LABS, INC.

SPECIALISTS IN EXPLORATION GEOCHEMISTRY

FIGURE ONE



Black Cloud Mine Area
(Leadville)

L-Series
P-1 Sample

Mt. Sherman Quad.
Scale: 1" = 2000'

G.E.N. Aug. 1978 J.D.S.

ASARCO

RECEIVED
OCT 6 1978
S. W. U. S. EXPL. DIV.

Rocky Mountain
Exploration Division

September 26, 1978

TO: D. M. Smith, Jr.

FROM: J. D. Sell

F.T.G.

Limestone Replacement Search
Pennsylvania-Mosquito Creek (PM-Series)
T 9 S, R 78 W
Park County, Colorado

A one day (7/27/78) traverse was made of the dip-slope of Pennsylvania Mountain. Table One contains the description of the samples, Table Two the results, and Figure One the sample site locations.

Sample PM-1 taken east of the main productive workings (± 1/2 mile) on the mountain was of Sawatch Quartzite containing weak FeOx-MnOx stain. PM-1 returned 1,000 ppm manganese, 1,000 ppm titanium, and 200 ppm zirconium. Further down dip in the west half of Section 16, are a number of open cut-scrapings where the oxidized rubble of Sawatch and Dyer is screened and processed for the gold values.

On the lower slope of the hill, the Dyer and Leadville dolomites outcrop.

Sample PM-2 of Dyer shows minor leaching with manganese additions and the sample contained anomalous silver (100 ppm), barium (5,000 ppm), manganese (± 10,000 ppm), moly (20 ppm), lead (2,000 ppm), and zince (2,000 ppm).

A massive replacement of karst type material, probably developed on Leadville, contained excellent features and had 200 ppm silver, 5,000 ppm barium, 200 ppm cadmium, 1,500 ppm copper, and +10,000 ppm in manganese, lead, and zinc, along with 20 ppm moly.

Although the ownership within the district is complex, it is reasonable that sampling of the available areas in the lesser explored areas away from the London Mine workings will be very indicative of the productive strata and structures.

James D. Sell

James D. Sell

JDS:eff

Attachments

CC: F. T. Graybeal

Table One - Description of the Pennsylvania-Mosquito Creek Area Samples (PM-Series). J. D. Sell, 7/27/78.

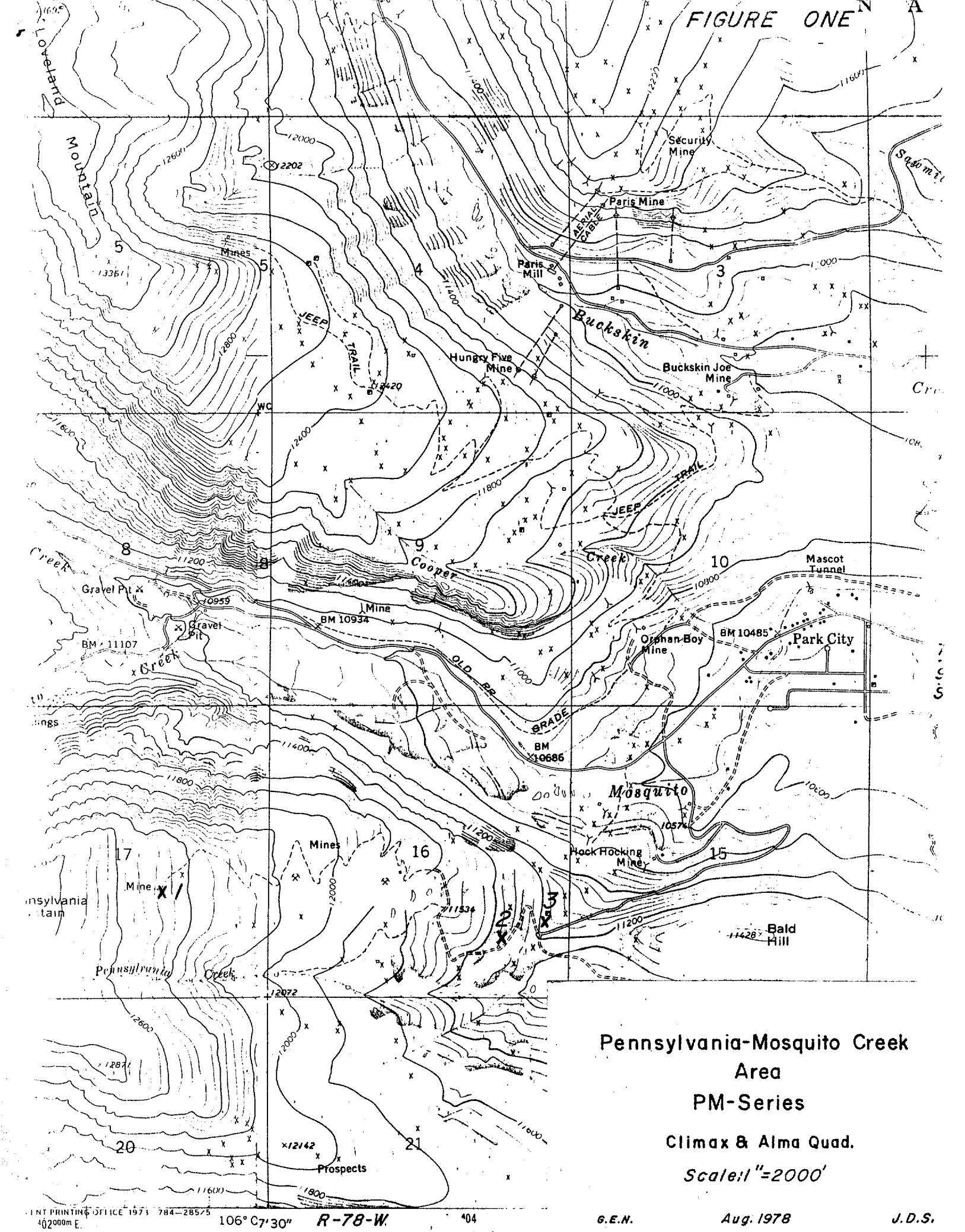
1. Sawatch quartzite, dump sample, sandy with weak FeOx-MnOx stain. (Note: TK porphyry also manganese stained in area.)
2. Dyer dolomite(?), fine crystalline dolomite and sandy units, minor leaching, replaced by minor amounts of black-brown manganese. (Note: Underlying dolomite is uniform fine crystalline, no vugs, and probably not recrystallized to any extent.)
3. Massive replacement of Dyer or Leadville units in karst or hydrothermal solution cavity by manganese, massive sulfides, stained quartz crystals, brecciation, sanding, trace malachite in siliceous fragments, with late dolomite crystals in cavities.

   NOTE: Published mapping shows northeast trending fault from here (PM-3) to Park City area. Verbal from Ernest Vauderhoff, claim owner in area, suggests that the structure and associated carbonate units produced the majority of the ore in this area.

ITEM NO. SAMPLE NO.
33 = PM-1
34 = PM-2
35 = PM-3

	PM-1	PM-2	PM-3
ITEM	33	34	35
ELEMENT			
Fe	2%	3%	7%
Ca	0.5%	7%	0.7%
Mg	0.5%	1%	0.02%
Ag	<1	100	200
As	<500	<500	<500
B	10	10	10
Ba	150	5000	5000
Be	2	<2	<2
Bi	<10	<10	<10
Cd	<50	<50	200
Co	<5	<5	<5
Cr	<10	<10	<10
Cu	5	200	1500
Ga	<10	<10	10
Ge	<20	<20	<20
La	30	20	100
Mn	1000	>10000	>10000
Mo	<2	20	20
Nb	<20	<20	20
Ni	<5	5	<5
Pb	<10	2000	>10000
Sb	<100	100	<100
Sc	<10	<10	<10
Sn	<10	<10	<10
Sr	100	200	200
Ti	1000	300	50
V	20	20	50
W	<50	<50	<50
Y	<10	<10	<10
Zn	<200	2000	>10000
Zr	200	50	<20

for Gordon H. VanSickle
Manager



Pennsylvania-Mosquito Creek Area

PM-Series

Climax & Alma Quad.

Scale: 1" = 2000'

RECEIVED
OCT 6 1978
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ASARCO

Rocky Mountain
Exploration Division

September 25, 1978

TO: D. M. Smith, Jr.

FROM: J. D. Sell

F.T.G.

Limestone Replacement Search
Fourmile Area (FM-Series)
T9 & 10S, R78 & 79W
Park County, Colorado

Samples were collected from three separate areas within the general district on July 23-26 and 27, 1978. Table One is the description of the samples, Table Two the Emission-Spec results, and Figure One the sample locations.

The first two samples were taken in the Peerless Mine area where limited mining has taken place. Sample FM-1, of high-grade dump material returned anomalous silver (200 ppm - a fire assay of the pulp ran 4.53 ounces per ton), barium (+10,000 ppm), copper (1,500 ppm), moly (5 ppm), lead (+10,000 ppm), antimony (500 ppm), strontium (500 ppm), and zinc (2,000 ppm). Noteably absent was manganese with only 100 ppm reported. The fire assay also reported 0.008 ounces/ton of gold.

The other sample at Peerless, FM-1A, of the recrystallized wall rock with zebra development, dolomite clots and veins, manganese dusting, and a few iron pseudomorphs contained anomalous silver (30 ppm), and lead (5,000 ppm), with some copper (500 ppm) and an increase in manganese (700 ppm).

The second group sampled was in the Hilltop Mine area, the only major production of the district of approximately 31,700 tons from 1901-1923. Sample FM-2, of the Hilltop Shaft dump was totally replaced FeOx-MnOx, wall rock and cave-fill (karst) material containing excellent replacement features and noted galena-tetrahedrite, azurite and malachite. In addition to the high iron (10%), anomalous silver (500 ppm), arsenic (1,000 ppm), copper (5,000 ppm), moly (5 ppm), lead (+10,000 ppm), antimony (1,000 ppm), and zinc (+10,000 ppm) were contained in the sample. Other indicative values were barium (500 ppm), cadmium (300 ppm), and manganese (700 ppm). Fire assay of the pulp returned 0.026 ounces/ton gold, and 21.20 ounces/ton silver.

Note that in both silver assays (samples FM-1 and FM-2), the ppm values converted are somewhat higher than the equivalent fire assay value, but recall that the ppm values are incremental steps of value.

Sample FM-3 of the Hilltop area, was a totally oxidized, sinter type FeOx replacement of the Gilman sandstone member of the Leadville with small pseudomorphs of galena-sphalerite. Anomalous silver (150 ppm), and lead (10,000 ppm) with minor copper (500 ppm), antimony (500 ppm), and zinc (1,000 ppm).

Sample FM-4, of manganiferous clots and streaks in Leadville dolomite wall rock, returned a noteable 5 ppm silver, 1,500 ppm manganese, and 1,000 ppm lead, besides the 15% magnesium versus 15% calcium ratio.

A single sample of old smelter slag (pre-1900) was taken as it had been reported as a failure in the treatment of the Mudsill ores; Slag sample FM-5 contained silver (10 ppm), barium (+10,000 ppm), copper (700 ppm), moly (10 ppm), lead (+10,000 ppm), tin (700 ppm), antimony (700 ppm), and zinc (5,000 ppm).

A sample of the Mudsill dump (FM-6) reported 500 ppm silver, 1,000 ppm copper, 7,000 ppm lead, 500 ppm antimony and 10,000 ppm zinc.

Several samples were taken on the hill to the north, Sample FM-7 of high grade dump was very anomalous in values: 1,000 ppm silver (±30 ounces), 1,500 ppm arsenic, 3,000 ppm copper, +10,000 ppm lead, 5,000 ppm antimony, and +10,000 ppm zinc with 300 ppm cadmium, and very minor manganese (300 ppm). The zebra textured wall rock with secondary dolomite crystals contained noteable silver (5 ppm), manganese (1,000 ppm), and lead (1,500 ppm).

Down-dip from the above site are a number of pits and a callapsed area. The collapsed area in Tertiary prophyry (FM-8) contained a noteable barium (1,000 ppm) and manganese (1,000 ppm) content with a probable igneous component of 3,000 ppm titanium and 100 ppm zirconium. No mining is shown to have taken place in this area and perhaps the 200' by 1,000' slump zone is reflection of oxidation-shrinkage of a massive sulfide deposit below. An upper Leadville outcrop (FM-9) was sampled adjacent to the slump area and had an magnesium (15%) versus calcium (15%) ratio, and 1,500 ppm manganese and 2,000 ppm lead. Also nearby was a pit in Belden Shale and sample FM-10 returned little of indicative value (200 ppm copper, 200 ppm lanthanum, 1,000 ppm titanium, and 200 ppm vanadium). Further removed was a pit of Leadville dolomite with zebra texture and other indicative alteration replacement features (no mineralization) and FM-11) contained only the magnesium (15%) versus calcium (15%) ratio suggestive of alteration fluid movement.

September 25, 1978

The Sacremento Mine (site) located further down dip was reported to have a production of $175,000.00 in 1880-1886 from one stope measuring a triangular area of 100 feet per side.

Note that FM-20 thru 25, shown on Figure One, will be contained in a later memo.

James D. Sell

James D. Sell

JDS :eff

Attachments

CC: F. T. Graybeal

Table One - Description of Fourmile Area Samples (FM-Series). J. D. Sell. 7/23-26,28/78.

1. Leadville dolomite, high-grade dump sample, totally oxidized, FeOx pseudomorphs after pyrite, sphalerite, and galena (?), quartz veining and crystals, barite, sanding, and brecciation features. (Note: Although present on dump, no pieces of galena, zinc oxide-carbonate, azurite or malachite were placed in the sample.)

1.A. Leadville dolomite wall rock, recrystallized textures with zebra development, dolomite clots and veins, manganese dusted, and few FeOx pseudormorphs.

2. Leadville dolomite dump sample, mixture of manganese replaced dolomite, sandy cave-fill, and totally replaced FeOx-MnOx units with excellent replacement textures, and galena-tetrahedrite, azurite, and malachite.

3. Leadville dolomite, mainly Gilman sandstone member, dump sample, totally oxidized FeOx sinter type with yellow (PbOx ?), some blebs of FeOx pseudomorphs of galena-sphalerite. (Note: Also on dump and nearby cuts, is excellent replacement textures, brecciation, and karst development. No azurite-malachite noted.)

4. Leadville dolomite, manganiferous with secondary clots and streaks.

5. Smelter slag exhibiting bronze-yellow spots and rosenjack luster. Verbal, Ernest Vanderhoff, smelter built to run Pb-Zn-Ag ores of Mudsill (Sample 6), and probably Sherwood (Sample 7) ores. Apparently very poor recovery and smelter disbanded.

6. Lower Leadville dolomite (and Gilman sandstone), tramway sample, siliceous vein and siliceous breccia replacement of sandy units, possible cave material also, with FeOx, sparce galena, tetrahedrite, and azurite-malachite. (Wall rock exhibits coarse grey to dark grey-black dolomite with secondary dolomite crystals replacing zebra strips, with vugs, and quartz crystals.)

7. Lower Leadville dolomite, high-grade dump sample of dense, siliceous, secondary dolomite crystals in weakly, coarse-grained, dolomite, containing galena, tetrahedrite, azurite, malachite, and FeOx pseudomorphs.

7.A. Leadville dolomite wall rock, zebra textured replacement with secondary dolomite crystals in stripes and crosscutting thin veins.

8. TK porphyry, slump block area, 200'-300' wide by 1,000' long (N 50° E), with yellow-orange FeOx on fractures.

9. Leadville dolomite, black, fine crystalline dolomite cut by white, medium crystalline dolomite with up to 1/8" cross veins of dolomite and few ocherous spots.

10. Belden Shale, with yellow ocherous oxidation spots.
11. Leadville dolomite, with zebra texture, secondary dolomite crystal strips, vugs, and veins with quartz crystals. Only one chunk of FeOx pseudomorphs noted.

FOUR MILE AREA (FM-Series)

TABLE TWO

ITEM NO.	SAMPLE NO.
17	TC-15
18	TC-16
19	TC-17
20	FM-1
21	FM-1A
22	FM-2
23	FM-3
24	FM-4

	FM-1	FM-1A	FM-2	FM-3	FM-4
ITEM	20	21	22	23	24
ELEMENT					
Fe	7%	0.5%	10%	15%	3%
Ca	0.1%	10%	0.15%	0.1%	15%
Mg	0.03%	7%	0.05%	0.05%	15%
Ag	200	30	500	150	5
As	<500	<500	1000	500	<500
B	<10	<10	10	10	<10
Ba	>10000	10	500	100	<10
Be	3	<2	3	<2	<2
Bi	<10	<10	<10	<10	<10
Cd	<50	<50	300	<50	<50
Co	<5	<5	<5	<5	<5
Cr	<10	<10	<10	<10	<10
Cu	1500	500	5000	500	20
Ga	<10	<10	<10	<10	<10
Ge	20	<20	<20	20	<20
La	<20	20	<20	<20	20
Mn	100	700	700	10	1500
Mo	5	<2	5	3	<2
Nb	20	<20	20	20	<20
Ni	5	<5	5	<5	<5
Pb	>10000	5000	>10000	10000	1000
Sb	500	<100	1000	500	<100
Sc	<10	<10	<10	<10	<10
Sn	<10	<10	<10	<10	<10
Sr	500	<100	<100	<100	<100
Ti	100	<20	<20	20	100
V	30	10	<10	30	<10
W	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	<10
Zn	2000	200	>10000	1000	<200
Zr	<20	<20	<20	<20	<20
Au (oz/Ton)	*0.008*	—	*0.026*		
Ag (oz/Ton)	*4.53*	—	*21.20*		

ITEM NO.	SAMPLE NO.
25	FM-5
26	FM-6
27	FM-7
28	FM-7A
29	FM-8
30	FM-9
31	FM-10
32	FM-11

	FM-5	FM-6	FM-7	FM-7A	FM-8	FM-9	FM-10	FM-11
ITEM	25	26	27	28	29	30	31	32
ELEMENT								
Fe	>20%	0.7%	1%	0.5%	5%	2%	2%	0.2%
Ca	1%	1%	2%	15%	0.5%	15%	0.07%	15%
Mg	0.2%	0.5%	1%	10%	0.15%	15%	0.2%	15%
Ag	10	500	1000	5	<1	1	<1	<1
As	<500	<500	1500	<500	<500	<500	<500	<500
B	30	<10	<10	<10	10	<10	500	<10
Ba	>10000	50	50	<10	1000	200	200	<10
Be	<2	<2	<2	<2	<2	<2	3	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	300	<50	<50	<50	<50	<50
Co	<5	<5	<5	<5	<5	<5	<5	<5
Cr	<10	<10	<10	<10	<10	<10	200	<10
Cu	700	1000	3000	100	10	10	3	2
Ga	20	<10	<10	<10	10	<10	20	<10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	20	20	20	20	20	200	20
Mn	500	200	300	1000	1000	1500	<10	500
Mo	10	<2	2	2	2	3	3	2
Nb	50	<20	<20	<20	<20	<20	20	<20
Ni	<5	<5	<5	<5	5	<5	20	<5
Pb	>10000	7000	>10000	1500	100	2000	50	50
Sb	300	500	5000	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	<10	<10	20	<10
Sn	700	<10	<10	<10	<10	<10	<10	<10
Sr	700	100	100	100	300	200	200	<100
Ti	500	200	100	20	3000	50	10000	50
V	30	10	10	10	70	<10	200	10
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	<10	<10	30	<10
Zn	5000	10000	>10000	300	<200	<200	<200	<200
Zr	20	<20	<20	<20	100	<20	200	<20

SKYLINE LABS, INC.
SPECIALISTS IN EXPLORATION GEOCHEMISTRY
12090 WEST 50TH PLACE • WHEAT RIDGE, COLORADO 80033 • TEL.: (303) 424-7718

REPORT OF ANALYSIS

Job No. DCR016
September 15, 1978

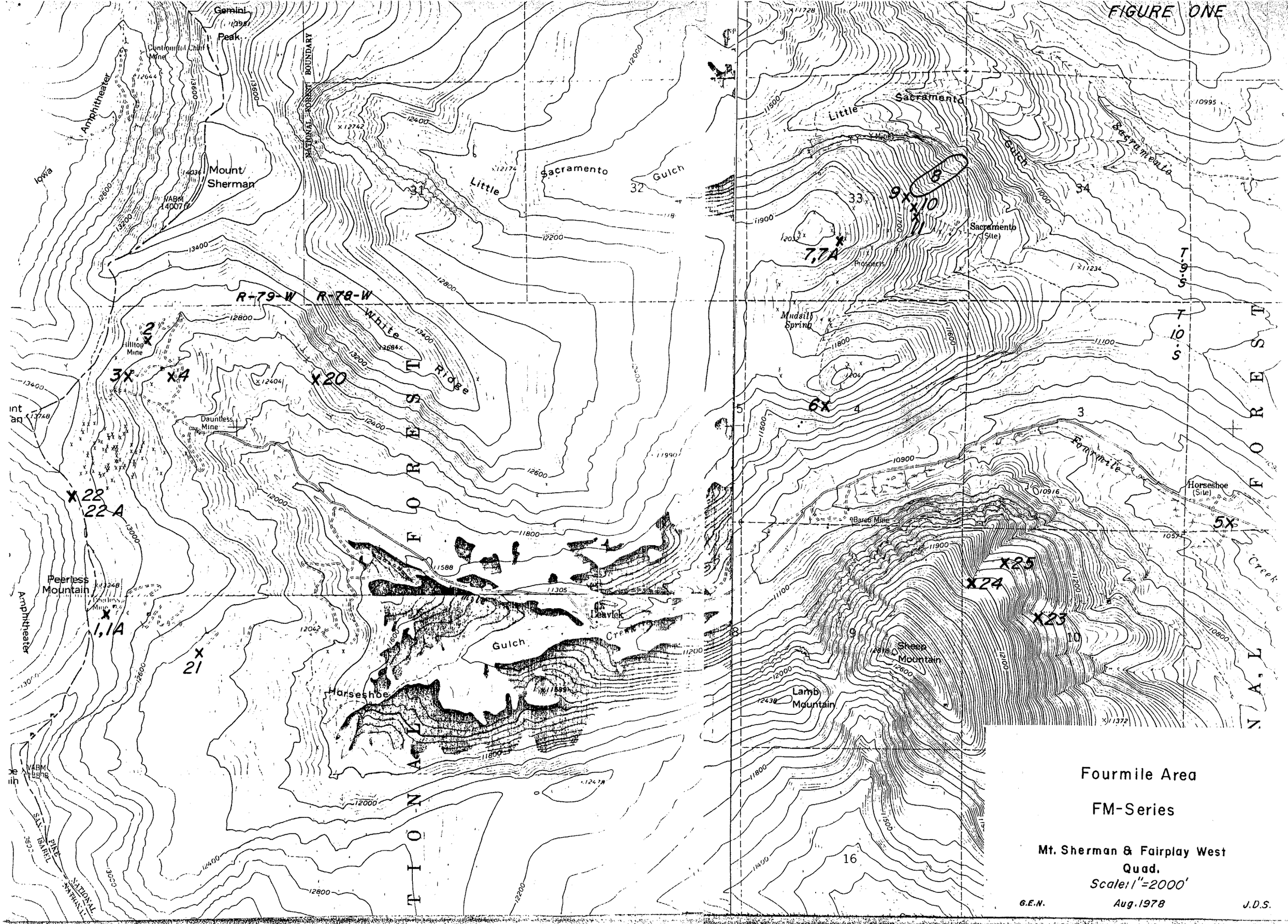
ASARCO, Inc.
Attention: James D. Sell
1805 South Bellaire Street, Suite 301
Denver, Colorado 80222

Analysis of 7 Rock Chip Samples

		Fire Assay	
Item	Sample No.	Au (oz/T)	Ag (oz/T)
6.	FM-01	.008	4.53
7.	FM-02	.026	21.2

Gordon H. VanSickle
Manager

FIGURE ONE



Fourmile Area

FM-Series

Mt. Sherman & Fairplay West Quad.

Scale: 1"=2000'

G.E.N. Aug. 1978 J.D.S.

ASARCO

RECEIVED
OCT 6 1978
S. W. U. S. EXPL. DIV.

Rocky Mountain
Exploration Division

September 22, 1978

F.T.G.

TO: D. M. Smith, Jr.

FROM: J. D. Sell

Limestone Replacement Search
Trout Creek Area (TC-Series)
T13 & 14S, R77 & 78W
Chaffee County, Colorado

Samples in the general Trout Creek area were collect July 18-21, 1978, with one sample of the collection being in the adjacent county and township-range to the north. Table One is the description, Table Two the results, and Figure One the location of the sample sites.

The Trout Creek mine, located along the fault zone, is in brecciated Leadville with coarse crystallization and patchy alteration. Although galena and sphalerite was noted in the area, these minerals were avoided in the sampling. Sample TC-16, wall rock, returned only 500 ppm lead and 500 ppm zinc with a magnesium (15%) versus calcium (15%) ratio. No other values shown to be indicative in other districts, such as silver, barium, arsenic, manganese, moly, and antimony, were noted in the sample. Up dip and to the west, a number of samples were taken in Leadville limestone and associated units.

TC-1, a lower middle limestone unit had only a hint of recrystallization and a few calcite veins. No values were reported. Sample TC-2, of upper middle had a few additional visual characteristics, but the Emission-Spec reported only background values. In the same quarry site, sample TC-2A, of a cold water karst zone having a trace of yellow-red limonites, contained an anomalous 1,000 ppm arsenic, 2,000 ppm manganese, with noteable moly (5 ppm), lead (500 ppm), and vanadium (200 ppm).

An upper limestone unit, slightly dolomitic with silica ribs and weak yellow-orange jasper development was sampled as TC-3 and indicated only background values.

A Belden Shale pit, TC-4, had 1,000 ppm manganese, 5 ppm moly, and 500 ppm zinc. Within the shale and close to the Trout Creek Fault Zone, a sample of an intrusive hornblende diorite sill (TC-5) reported 700 ppm barium, 1,500 ppm manganese, 700 ppm strontium, 5,000 ppm titanium, 200 ppm vanadium, and 100 ppm zirconium.

September 22, 1978

Along strike to the northwest, a pit in upper middle Leadville was completely replaced by FeOx. The sample TC-8 was anomalous in moly (15 ppm) and also contained 50 ppm nickel, and 500 ppm zinc. The area wall rock was weakly recrystallized limestone. A silicified, weakly-jasperized, sandy, brecciated, float material was collected at site TC-7 and returned no values above background. A Belden Shale pit, limestone lense, (TC-6), returned 700 ppm barium, and 7 ppm moly as the only noteable values.

Two samples of Sawatch Quartzite were collected in this area. TC-9 returned anomalous arsenic (2,000 ppm), manganese (3,000 ppm), and moly (5 ppm) with 200 ppm barium and vanadium, and 100 ppm zirconium. Sample TC-10 had weaker addition of iron and had 1,000 ppm barium, 2,000 ppm manganese with 1,000 ppm titanium.

Sample TC-11 and TC-12 were taken in the Sawatch Quartzite to the north and returned no values above background. Stratigraphically above in Dyer dolomite showing a few characteristics, sample TC-13A had no values of interest, nor did samples TC-13 and TC-14 within the Gilman sandstone member of the Leadville where they contained weak jasper and FeOx development.

The Sawatch sample areas appeared to be in an area prospected for gold and so were also fire assayed for gold and silver. All values reported were less than 0.005 oz./ton gold, and less than 0.01 oz./ton silver.

Sample site TC-15 appeared to be a filled leveled site of an old shaft (no symbol on the map) which had started in Belden Shale and penetrated through karst material, Leadville, etc., and into Precambrian basement of biotite gneiss. Only 7 ppm moly was reported from the collection of apparent weakly mineralized rock fragments.

Far to the north, sample TC-17 of a silicified, jasperiodal, yellow to red ocher unit of Leadville, returned only 100 ppm barium and 1,000 ppm manganese.

Overall, the Trout Creek area with minor and weak recrystallization and jasperoid development in limestone has very poor chemical signatures as presently developed.

James D. Sell

James D. Sell

JDS:eff

Attachments

CC: F. T. Graybeal

Table One - Description of the Trout Creek Samples (TC-Series). J. D. Sell. July 18-21, 1978.

1. Leadville limestone, lower middle. Thin-bedded, medium grey with soft conchoidal fracturing; only rare hint of recrystallization along bedding, few calcite veins and trace FeOx; some black and white chert with minor reaction rims.
2. Leadville limestone, upper middle. Light medium grey color with silica beds and chert; upper portion has darker coloration with bleached zones, slightly recrystallized with faint zebra texture.
2.A. Same site in quarry. Karst material of solution breccia with leached cavities containing dripstone, some calcite stringers and light yellow to reddish limonite in siliceous units. Good karst development, but only very weak hydrothermal solution activity.
3. Leadville limestone, upper. "Chocolate bar" conchoidal breakage, dolomite limestone; silica ribs and weak, yellow-orange jasper development in light tan grey, fine crystalline unit.
4. Belden Shale, sandy unit containing nodules with weak-moderate FeOx addition.
5. Hornblende diorite, diabasic textured sill, 3-4 feet thick between thin-bedded dark grey to blackish limey dolomite. (Mapped by DeVoto as intrusive into Belden Shale.) (Good Belden lower on slope.)
6. Belden limestone lense (?), thin-bedded light grey limestone with minor blackjack in coarse, grey white to dark grey, calcite. (Pit area in covered slope.)
7. Leadville limestone, upper. Float or rubble material from pit in covered slope. Silicified, vuggy, Fe-stained, small FeOx kernels of silica-jasper in the thin-bedded, sandy, stained, dolomitic limestone and in breccia matrix, few quartz crystals.
8. Leadville limestone, upper middle, shaft area of rubble blocks completely replaced by FeOx having some pseudomorphs after pyrite and sphalerite, with dolomitic calcite interstitial. (Wall rock is weakly recrystallized limestone.)
9. Sawatch quartzite, sandy, brecciated, upper portion, with yellow and red ochers and pulverulent FeOx.
10. Sawatch quartzite, sandy, limey unit, sample of dump material consisting of chrome green material and medium yellow, pulverulent FeOx.
11. Sawatch quartzite, lower unit; red-brown jasper and yellow FeOx limonite developed along northeast-trending fractures in sandy limey units.

12. Sawatch quartzite, upper unit, breccia material, quartz, and abundant red to yellow FeOx in sanded zones trending N 45° E. (Note: Several additional pits are aligned along trend and show only minor effects in lower Palezoic units, but increasing effects, including minor, weak, zebra textures and spotty, weak, recrystallization in upper Dyer units.

13. Gilman sandstone member of lower Leadville limestone, composed of 15-20 inches of rubble breccia with variable amounts of red-yellow FeOx in boulders and matrix filling, silica and weak jasper replacement of sandstone and limey breccia fragments.

13.A. Dyer, lower unit, medium-coarse, partially recrystallized dolomitic limestone with sandy, vuggy, texture, of tan grey coloration, with myriad of interconnecting silica ribs and breccia zones with minor FeOx coloration and small black specks of unknown composition.

14. Gilman sandstone member of sandstone-limestone breccia weakly replaced by pale yellow-pink FeOx and silica-jasper; minor drusy quartz.

15. This site is a leveled area which may have contained a shaft which started in Belden Shale, penetrated cave fill material, recrystallized limestone, sanded Gilman, Sawatch quartzite, and into barren Precambrian biotite gneiss. No symbol on map. Sampled FeOx, yellow to red, in dirty grey to grey brown, vuggy, calcite crystals (dog-toothed spar), dolomitic limestone; red FeOx in sandstone; silica cave breccia; and pyrite in Belden Shale material.

16. Trout Creek Mine. Complex fault zone in lower to middle Leadville units with blackjack in replacement textured, zebra features, secondary dolomite crystals in stripes, vugs, and open spaced cavities, minor staining, some small quartz crystals in cavities; abundant yellow FeOx in fractures and breccia zones. Zebra in wall rock is as medium-coarse patches and not pervasive replacement texture.

17. Leadville limestone, silicified with yellow to red ocher, and silica-jasper with quartz crystal cavities.

TROUT CREEK AREA
(TC-Series)

ITEM NO.	SAMPLE NO.
1	TC-1
2	TC-2
3	TC-2A
4	TC-3
5	TC-4
6	TC-5
7	TC-6
8	TC-7

	TC-1	TC-2	TC-2A	TC-3	TC-4	TC-5	TC-6	TC-7
ITEM	1	2	3	4	5	6	7	8
ELEMENT								
Fe	0.1%	0.1%	5%	1%	15%	10%	2%	2%
Ca	>20%	>20%	20%	10%	0.2%	3%	20%	0.2%
Mg	0.1%	2%	5%	5%	0.05%	1%	0.2%	0.05%
Ag	<1	<1	<1	<1	<1	<1	<1	<1
As	<500	<500	1000	<500	<500	<500	<500	<500
B	<10	<10	<10	10	20	10	<10	10
Ba	<10	<10	50	<10	<10	700	700	<10
Be	<2	<2	2	2	2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	<5	<5	5	<5	<5	10	<5	<5
Cr	<10	<10	<10	<10	<10	<10	<10	<10
Cu	2	<2	100	5	20	30	3	2
Ga	<10	<10	<10	<10	<10	10	<10	<10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	20	20	<20	<20	<20	<20	20	20
Mn	200	200	2000	200	1000	1500	500	100
Mo	3	3	5	2	5	<2	7	2
Nb	<20	<20	<20	<20	20	20	<20	<20
Ni	<5	<5	10	<5	20	<5	20	<5
Pb	10	10	500	30	20	<10	10	<10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	<10	<10	<10	<10
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	100	100	<100	<100	<100	700	200	<100
Ti	150	150	50	150	100	5000	200	100
V	<10	10	200	30	50	200	20	50
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	10	<10	<10	<10
Zn	<200	<200	200	<200	500	<200	<200	<200
Zr	<20	20	<20	<20	<20	100	<20	20

ITEM NO.	SAMPLE NO.
9 =	TC-8
10 =	TC-9
11 =	TC-10
12 =	TC-11
13 =	TC-12
14 =	TC-13
15 =	TC-13A
16 =	TC-14

	TC-8	*TC-9*	*TC-10*	*TC-11*	*TC-12*	*TC-13*	*TC-13A*	*TC-14*
ITEM	9	10	11	12	13	14	15	16
ELEMENT								
Fe	20%	10%	3%	7%	7%	0.5%	0.1%	0.5%
Ca	0.2%	0.05%	0.05%	0.15%	1%	0.5%	15%	5%
Mg	0.05%	0.05%	0.1%	0.05%	1%	0.3%	10%	1.5%
Ag	<1	<1	2	<1	<1	<1	<1	<1
As	<500	2000	<500	<500	<500	<500	<500	<500
B	20	10	20	10	20	10	<10	10
Ba	10	200	1000	<10	<10	<10	<10	<10
Be	5	30	2	3	5	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	15	<5	<5	<5	<5	<5	<5	<5
Cr	<10	<10	<10	<10	<10	<10	<10	<10
Cu	100	20	3	10	10	<2	2	2
Ga	10	<10	<10	<10	<10	<10	<10	<10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	<20	20	20	<20	20	20	20
Mn	500	3000	2000	50	100	200	300	100
Mo	15	5	2	<2	2	<2	2	<2
Nb	20	20	<20	20	<20	<20	<20	<20
Ni	50	7	5	5	7	5	<5	5
Pb	<10	<10	15	15	30	10	30	15
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	<10	10	<10	<10	<10	<10	<10	<10
Sn	20	<10	<10	<10	<10	<10	<10	<10
Sr	<100	<100	100	<100	100	100	<100	100
Ti	50	200	1000	200	500	100	20	100
V	50	200	70	100	50	20	10	10
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	50	10	<10	<10	<10	<10	<10
Zn	500	200	<200	<200	<200	<200	<200	<200
Zr	<20	100	70	70	20	<20	<20	<20
Au (oz/Ton)		*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*		
Ag (oz/Ton)		*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*		

ITEM NO.	SAMPLE NO.
17	= TC-15
18	= TC-16
19	= TC-17
20	= FM-1
21	= FM-1A
22	= FM-2
23	= FM-3
24	= FM-4

	TC-15	*TC-16*	*TC-17*
ITEM	17	18	19
ELEMENT			
Fe	1.5%	0.5%	0.7%
Ca	10%	15%	1%
Mg	2%	15%	0.1%
Ag	<1	<1	<1
As	700	<500	<500
B	10	<10	<10
Ba	50	<10	100
Be	<2	<2	<2
Bi	<10	<10	<10
Cd	<50	<50	<50
Co	<5	<5	<5
Cr	<10	<10	<10
Cu	3	10	<2
Ga	<10	<10	<10
Ge	<20	<20	<20
La	20	20	20
Mn	100	700	1000
Mo	7	<2	2
Nb	<20	<20	<20
Ni	<5	<5	<5
Pb	<10	500	20
Sb	<100	<100	<100
Sc	<10	<10	<10
Sn	<10	<10	<10
Sr	100	100	100
Ti	150	<20	50
V	10	20	50
W	<50	<50	<50
Y	<10	<10	<10
Zn	<200	500	<200
Zr	20	<20	<20

SKYLINE LABS, INC.
SPECIALISTS IN EXPLORATION GEOCHEMISTRY
12090 WEST 50TH PLACE • WHEAT RIDGE, COLORADO 80033 • TEL: (303) 424-7718

REPORT OF ANALYSIS

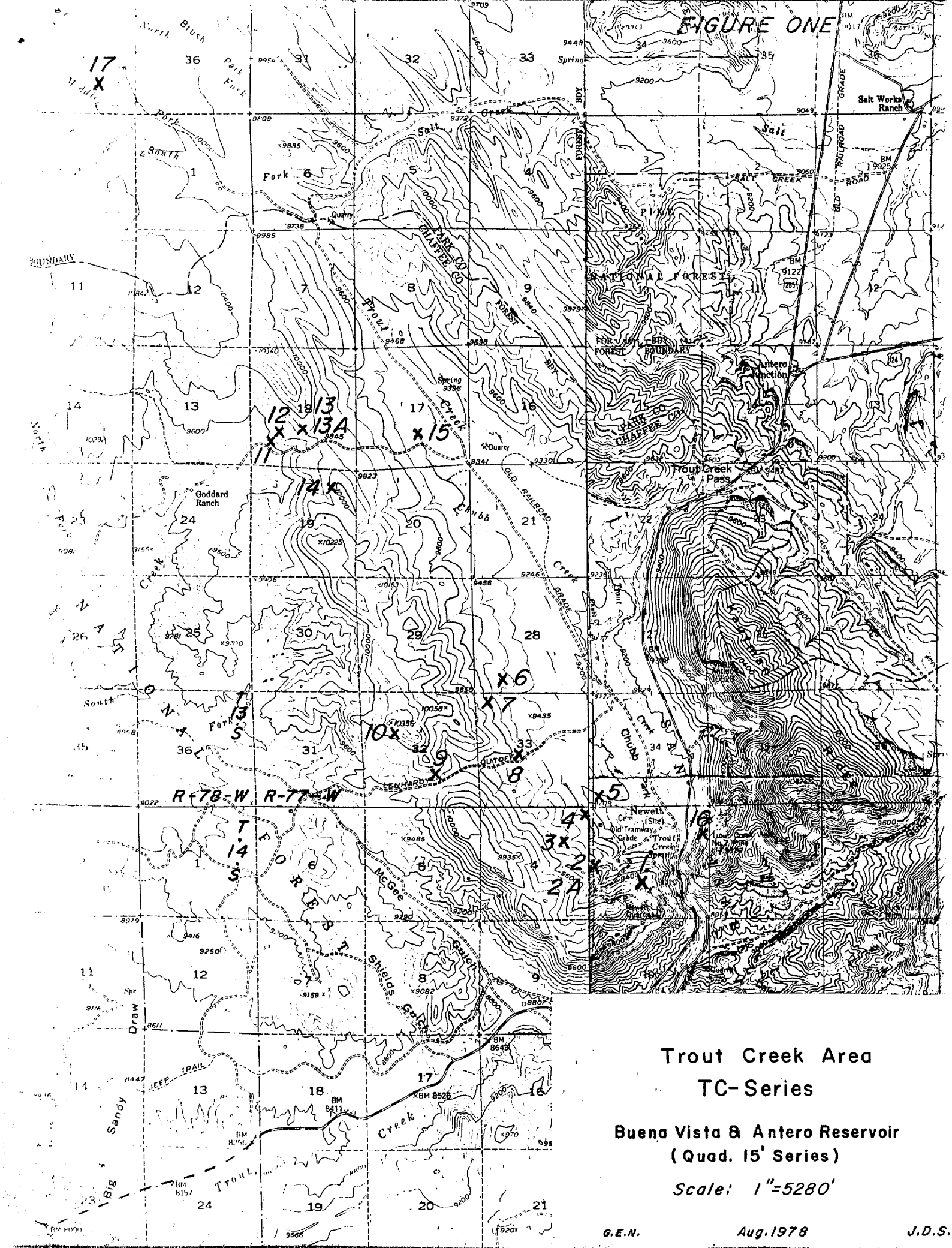
Job No. DCR016
September 15, 1978

ASARCO, Inc.
Attention: James D. Sell
1805 South Bellaire Street, Suite 301
Denver, Colorado 80222

Analysis of 7 Rock Chip Samples

		Fire Assay	
Item	Sample No.	Au (oz/T)	Ag (oz/T)
1.	TC-09	<.005	<.01
2.	TC-10	<.005	<.01
3.	TC-11	<.005	<.01
4.	TC-12	<.005	<.01
5.	TC-13	<.005	<.01

for Edwin V. Post
Gordon H. VanSickle
Manager



Trout Creek Area

TC-Series

Buena Vista & Antero Reservoir

(Quad. 15' Series)

Scale: 1"=5280'

G.E.N. Aug. 1978 J.D.S.

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ASARCO

Rocky Mountain
Exploration Division

F.T.G.

September 21, 1978

TO: D. M. Smith, Jr.

FROM: J. D. Sell

Limestone Replacement Search
Hand Specimen Collection Notes
Colorado

A collection of representative samples ranging from unreplaced Leadville limestone to recrystallized Leadville dolomite through various stages of alteration and mineralization to oxidized ore has been assembled. Also attached is the respective emission-spec results of the samples and/or similar samples taken from the same areas.

1. Leadville limestone, Trout Creek Area (TC-1). Lower middle unit, very fine crystalline, dark, dusty grey coloration, minor cold water solution with deposition of calcite drip stone and blunt calcite crystals, not conchoidal fracturing. No hydrothermal alteration. 3 ppm moly would be interesting if other values were present.

2. Leadville dolomite, Hilltop Area (FMH-1). Lower middle unit, fine pervasive replacement texture cut by fine quartz-silica ribs. Elephant hide weathering texture. District wide dolomite alteration by passage of solutions. Trace manganese (700 ppm), with 7 ppm silver and 1,500 ppm lead, indicates metal bearing solutions penetrated area.

3. Leadville dolomite, Hilltop Area (FMH-2). Lower middle unit, coarse pervasive replacement texture with secondary vug development and secondary dolomite crystal deposition in vugs and interstital knots. Dusty reddish iron overprint in secondary carbonate features. Increased intensity of hydrothermal-mineralization processes. Trace manganese (700 ppm) and loss of magnesium (5%), suggests movement of alteration solutions carrying minor elements.

4. Leadville dolomite, Peerless Area (FM-1A). Fine to medium coarse replacement texture with superimposed secondary zebra development with secondary dolomite crystals replacing zebra stripes, filling minor vugs, and in veins. Note discordant dolomite crystal development along strike of stripe and across structures. One pyrite pseudomorph as circled. Though only trace manganese (700 ppm), the jump in silver (30 ppm), copper (500 ppm), and lead (5,000 ppm), indicates a relationship to mineralization.

5. Leadville dolomite, Trout Creek Fault Area (TC-16). Irregular coarse replacement texture, tectonically broken with secondary dolomite crystal development in crushed zones and vugs. Note discrete block of galena, and sphalerite in coarse groundmass (not placed in ES sample). This coarse replacement texture may be more common to dry heat sources rather than pervasive movement of hydrothermal solutions. Increased magnesium, but low manganese (700 ppm) and lead (500 ppm).

6. Leadville dolomite, Peerless Area. Medium-coarse pervasive replacement texture with sanded zone (more porous unit and high fluid movement) replaced by silica-quartz crystals-late ankerite and other carbonates, and nodules of iron pseudomorphs and clots of tetrahedrite-ruby silver; note azurite-malachite oxidation products. (No ES analysis of this type sample, probably similar to values given in #7 below.)

7. Leadville dolomite (Gilman sandstone member), Peerless Area (FMP-1). Sanded and replaced by silica, quartz crystals, carbonate, and mineralized by galena-sphalerite-tetrahedrite (partially converted to iron oxide pseudomorphs). Very high values of barium, silver, copper, lead, and antimony.

8. Leadville dolomite breccia, Mudsill Area. Exhibiting various recrystallized textures and cemented by secondary dolomite crystal deposition. (No ES analysis of this type sample, but often carried anomalous magnesium, manganese, barium and silver.

9. Leadville stratified cave-fill, Hilltop Area. Fine crystalline dolomite with dusty grey overprint, trace of mineral debris and replacement by sulfide (oxidized). (See report of Leadville Lead sample LL-2 as similar type and ES value.) Noteable manganese (2,000 ppm).

10. Leadville cave-fill breccia, Hilltop Area. Sanded and weakly mineralized features. (No ES analysis of this type sample; undoubtably increase manganese and variable amounts of other values, especially, barium, silver.)

11. Leadville dolomite, Peerless Area. A strongly replaced unit by secondary dolomite, quartz crystals, and barite followed by iron-manganese and sulfides (now totally oxidized showing pseudomorph forms). (See report on Fourmile sample FM-2, and Leadville sample L-4A for similar types and ES values.) High iron and high silver, arsenic, barium, copper, manganese, moly, lead, antimony and zinc suggest well mineralized units.

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12. Leadville dolomite, Hilltop (H), Peerless (P), and Mudsill (M) areas. Various examples of orebearing features, brecciation, and karst filling. Note replacement by secondary dolomite, quartz, barite, and sulfides (and pseudomorph oxidation forms) with azurite-malachite generally indicating oxidation of tetrahedrite-ruby silver series. (Values in excess of 100 ounces silver indicated by azurite-malachite plus sulfide remnants at the Leadville Lead operations.) (See report on Fourmile samples FM-1, and also Leadville Lead samples LL-5A and LL-13B as representative of ES values.) Increased ratio of magnesium versus calcium plus high mineral values show exploration potential.

James D. Sell

James D. Sell

JDS:eff

Attachments

CC: F. T. Greybeal

TABLE ONE: Representative Emission Spec. Analysis Values of Hand Specimen Collection

Hand Specimen Number	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)		(12)		
SAMPLE NO.	TC-1	FMH-1	FMH-2	FM-1A	TC-16		FMP-1		LL-2		FM-2	L-4A	FM-1	LL-5A	LL-13B
ITEM	1	1	2	21	18		3		5		22	2	20	9	20
ELEMENT						No		No		No					
Fe	0.1%	0.5%	0.3%	0.5%	0.5%	ES	3%	ES	2%	ES	10%	10%	7%	7%	2%
Ca	>20%	20%	15%	10%	15%		0.07%		20%		0.15%	5%	0.1%	1%	.5%
Mg	0.1%	10%	5%	7%	15%	Analysis	0.03%	Analysis	15%	Analysis	0.05%	0.03%	0.03%	2%	15%
Ag	<1	7	<1	30	<1		700		3		500	200	200	7000	1000
As	<500	<500	<500	<500	<500		<500		<500		1000	1000	<500	1500	<500
B	<10	<10	<10	<10	<10		<10		<10		10	10	<10	<10	10
Ba	<10	<10	<10	10	<10		>10000		200		500	7000	>10000	5000	>10000
Be	<2	<2	<2	<2	<2		<2		<2		3	<2	3	<2	<2
Bi	<10	<10	<10	<10	<10		<10		<10		<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50		<50		<50		300	<50	<50	200	100
Co	<5	<5	<5	<5	<5		<5		<5		<5	<5	<5	<5	<5
Cr	<10	<10	<10	<10	<10		<10		<10		<10	20	<10	<10	300
Cu	2	300	50	500	10		1500		5		5000	200	1500	>10000	5000
Ga	<10	<10	<10	<10	<10		<10		<10		<10	<10	<10	<10	<10
Ge	<20	<20	<20	<20	<20		<20		<20		<20	<20	20	<20	<20
La	20	<20	<20	20	20		<20		<20		<20	70	<20	50	<20
Mn	200	700	700	700	700		500		2000		700	>10000	100	1000	300
Mo	3	2	<2	<2	<2		2		2		5	20	5	5	2
Nb	<20	<20	<20	<20	<20		<20		<20		20	20	20	20	20
Ni	<5	<5	<5	<5	<5		5		<5		5	5	5	5	5
Pb	10	1500	150	5000	500		>10000		150		>10000	10000	>10000	>10000	>10000
Sb	<100	<100	<100	<100	<100		2000		<100		1000	200	500	>10000	3000
Sc	<10	<10	<10	<10	<10		<10		<10		<10	<10	<10	<10	<10
Sn	<10	<10	<10	<10	<10		<10		<10		<10	<10	<10	<10	<10
Sr	100	100	150	<100	100		200		<100		<100	300	500	200	1000
Ti	150	100	<20	<20	<20		<20		100		<20	100	100	20	1000
V	<10	<10	<10	10	20		<10		10		<10	70	30	10	20
W	<50	<50	<50	<50	<50		<50		<50		<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	<10		<10		<10		<10	<10	<10	<10	<10
Zn	<200	<200	<200	200	500		300		500		>10000	2000	2000	10000	>10000
Zr	<20	<20	<20	<20	<20		<20		<20		<20	<20	<20	<20	30

* Note: 100 ppm Ag = 2.92 troy oz. Ag.

JDSeff

and maybe that chart to the "geochemist" would be much clearer

yes it would

ONLY REPL.

It would be useful to have a chart showing calculated averages for every emmission spec. element for each rock type. Could you prepare one. It might show 1.) average, 2.) range, 3.) number of analyses for each rock type.

I would suggests averages for each of Tables 1A - 4A, 6A, 7A, 8A, 9A, 10A. Table 5A includes several rocks which could also be separated and listed. A chart of average values would make it far easier to see geochem. changes.

FTG 10/11/78

yes, excellent points — were started but not completed because of 1) getting this initial report out & 2) the members of the team are with Hughes

~~ETG~~ ~~copy~~
WDK → Ins file.

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ASARCO

Rocky Mountain
Exploration Division

September 20, 1978

F.T.G.

TO: D. M. Smith, Jr.

FROM: J. D. Sell

Limestone Replacement Search
Compilation of Emission-Spec Values
Colorado

To clarify the visual and chemical parameters found in the various units encountered in the Limestone Replacement Search, the following compilation is presented.

Table One. Leadville limestone description, generally original depositional features with rare secondary features such as silica, calcite, vugs, or iron oxides-jasper development.

Table One A. Emission-Spec Values of Leadville Limestone. Note lack of metal values and high calcium values.

Table Two. Leadville dolomite, exhibiting recrystallized replacement textures in various degrees, but with only minor secondary features (such as zebra and birdseye development, secondary dolomite and quartz crystal growth), and weak iron and manganese additions.

Table Two A. Emission-Spec Values of Leadville dolomite with only minor secondary features. Note abnormal magnesium versus calcium values, variable but often abnormal silver, barium, manganese, molybdenum, lead, and zinc values. Note also that limestone samples generally show lower values even though they have some otherwise favorable secondary characteristics.

Table Three. Leadville dolomite, pervasive recrystallized replacement texture with abundant secondary features such as zebra and birdseye development, secondary dolomite crystals replacing zebra stripes, knots, and filling vugs, also quartz crystal growths which are often iron stained, vug development, sanding development, silica development, and brecciation, with variable, but generally low to non-observable iron-manganese addition and replacement.

Table Three A. Emission-Spec Values of Leadville dolomite with pervasive replacement texture and abundant secondary features.

Note the often de-dolomitization values in magnesium as well as the increase in magnesium values versus calcium. Also the silver and especially manganese increase with variable lead-zinc.

Table Four. Leadville dolomite, originally pervasive recrystallized replacement type replaced to a high degree by iron-manganese, various sulfides, and various silica-jasper types; now totally oxidized and forming various iron-manganese pseudomorphs.

Table Four A. Emission-Spec Values of iron-manganese oxide jasperoids. Note the general jump in silver values as well as barium plus the increased manganese and retention of copper, lead, and zinc values. The multiplicity of elements and variability reflect the mineralized versus barren jasperoids.

Table Five. Karst and cave-fill type material ranging from normal weathering (terra rosa), to cold water solution, to hydrothermal cave-fill and mineralized karst replacement.

Table Five A. Emission-Spec Values of Karst and Cave-fill Material. Note blah values in terra rosa and cold water (drip-stone) deposits versus the very high silver, arsenic, barium, copper, manganese, moly, lead, antimony, and zinc values which reflect the original mineral species found in the mineralized (no oxidized) karst and cave-fill material.

Table Six. Cambrian Sawatch Quartzite descriptions.

Table Six A. Emission-Spec Values in Sawatch Quartzite. Any increase in values should be carefully evaluated in terms of the total system as trends to solution and metal transport.

Table Seven. Devonian Dyer Dolomite descriptions.

Table Seven A. Emission-Spec Values of Dyer Dolomite samples. The Dyer is also a favorable host unit and reacts similar to the Leadville dolomite. Textured and chemical parameters of interest are equal to those of the Leadville; i.e., increased magnesium values, silver, manganese, moly, lead, and zinc are favorable characteristics as well as the visual zebra, dolomite crystals, quartz crystals, vugs, sanding, etc.

Table Eight. Pennsylvanian Belden Shale description. Generally, the Belden is dirty black, shiny, thin-bedded, platy shale; but when in areas of hydrothermal-mineralization activity the shale often becomes dirty brown-black, manganese-soot appearance, with gypsum flakes and white efflorescent material along partings and disentegration mud debris, and with variable yellow iron oxides as films, small knots and nodules, and often fine pyrite in crosscutting seams.

Table Eight A. Emission-Spec Values of Belden Shale. The Belden is often the capping shale to the ore zones and hence any hint of leaking up into and through the shale should be carefully evaluated in overall context. Erratic values of boron, chromium, strontium, vanadium, and possibly zirconium may reflect original basin depositional values.

Table Nine. Tertiary Porphyry, generally the Pando or Gilman sill type. In areas of mineralization the porphyry generally exhibits increased fracturing, alteration features, and increase iron and manganese limonites.

Table Nine A. Emission-Spec Values of porphyry units. Titanium is undoubtably part of the rock-forming elements, but increases in barium, manganese, and moly should be treated as possible leakage features and evaluated in total context.

Table Ten. Other rock unit descriptions: includes Precambrian granite, Cambrian Peerless Shale, Devonian Parting Quartzite, Pennsylvanian-Permian Maroon formation, and recent smelter slag.

Table Ten A. Emission-Spec Values of various units and material. These units and values should be evaluated as passage and leakage trends in relatively unreactive units.

Additional evaluation of the samples have been submitted in individual reports covering the area groups sampled.

James D. Sell

James D. Sell

JDS:eff

Attachments

CC: F. T. Graybeal

Table One - Leadville limestone descriptions.

DC-4	Fine vugs with brecciation.
TC-1	Conchoidal fracturing, trace calcite, FeOx.
TC-2	Silica bands and chert, trace zebra texture.
TC-3	Conchoidal fracturing, weak silica and yellow-orange jasper.

TABLE ONE A- ES Values of Leadville Limestone

SAMPLE NO.	DC-4	TC-1	TC-2	TC-3
ITEM	4	1	2	4
ELEMENT				
Fe	<0.05%	0.1%	0.1%	1%
Ca	>20%	>20%	>20%	10%
Mg	5%	0.1%	2%	5%
Ag	<1	<1	<1	<1
As	<500	<500	<500	<500
B	<10	<10	<10	10
Ba	20	<10	<10	<10
Be	<2	<2	<2	2
Bi	<10	<10	<10	<10
Cd	<50	<50	<50	<50
Co	<5	<5	<5	<5
Cr	<10	<10	<10	<10
Cu	<2	2	<2	5
Ga	<10	<10	<10	<10
Ge	<20	<20	<20	<20
La	20	20	20	<20
Mn	50	200	200	200
Mo	3	3	3	2
Nb	<20	<20	<20	<20
Ni	<5	<5	<5	<5
Pb	<10	10	10	30
Sb	<100	<100	<100	<100
Sc	<10	<10	<10	<10
Sn	<10	<10	<10	<10
Sr	<100	100	100	<100
Ti	100	150	150	150
V	15	<10	10	30
W	<50	<50	<50	<50
Y	<10	<10	<10	<10
Zn	<200	<200	<200	<200
Zr	<10	<20	20	<20

Table Two - Leadville dolomite, recrystallized, but with minor secondary features (Z, zebra; B, birdseye; D, dolomite crystals; Q, quartz crystals).

Section Minus - relatively less and weaker characteristics.

CL-6 Trace Z and minor Fe-Mn.

FM-9 Fine crystalline black cut by medium white.

G-5 Upper shaley unit with calcite veins.

GC-3 (limestone). Lower fetid unit, calcite, FeOx limonite.

LL-12 Trace Z, B, and D.

WP-6 Minor D, Q, iron pseudomorphs.

Section Plus - relatively more and varied characteristics.

FM-4 Manganiferous.
FM-7A Crosscutting Z and D.
FM-11 Z, D, Q.

G-2 Upper unit, D vugs and veins.

GC-4 (limestone). Ocher, dog spar, FeOx nodules.

L-4 D, rare Q, weak FeOx.

LL-6 Minor silica, trace D, trace FeOx.
LL-9 Minor Z, D, Q, weak FeOx-jarosite.
LL-10 Minor pyrite, yellow-orange limonite, silica, trace D.
LL-15 Trace Z, D, Q, and minor FeOx.

TABLE TWO A - ES Values of Leadville Dolomite, recrystallized, with minor secondary features.

	Section Minus					
SAMPLE NO.	CL-6	FM-9	G-5	GC-3	LL-12	WP-6
ITEM	10	30	15	7	17	25
ELEMENT						
Fe	0.5%	2%	5%	2%	.2%	0.01%
Ca	10%	15%	0.7%	15%	10%	15%
Mg	15%	15%	1%	0.3%	10%	15%
Ag	1	1	<1	<1	2	<1
As	<500	<500	500	<500	<500	<500
B	<10	<10	100	20	<10	<10
Ba	<10	200	10	20	<10	<10
Be	<2	<2	2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50
Co	<5	<5	5	<5	<5	<5
Cr	<10	<10	<10	10	<10	<10
Cu	2	10	5	3	5	<2
Ga	<10	<10	15	<10	<10	10
Ge	<20	<20	<20	<20	<20	<20
La	20	20	50	20	20	20
Mn	500	1500	300	1000	300	200
Mo	<2	3	2	3	2	<2
Nb	<20	<20	30	20	<20	<20
Ni	<5	<5	30	5	<5	<5
Pb	100	2000	10	20	30	10
Sb	<100	<100	<100	<100	<100	<100
Sc	<10	<10	20	<10	<10	<10
Sn	<10	<10	<10	<10	<10	10
Sr	100	200	200	200	100	100
Ti	150	50	3000	700	150	<20
V	30	<10	100	30	10	20
W	<50	<50	<50	<50	<50	<50
Y	<10	<10	15	<10	<10	<10
Zn	300	<200	<200	<200	<200	700
Zr	<20	<20	200	30	<20	<20

	Section Plus									
SAMPLE NO.	FM-4	FM-7A	FM-11	G-2	GC-4	L-4	LL-6	LL-9	LL-10	LL-15
ITEM	24	28	32	12	8	1	10	13	15	9
ELEMENT										
Fe	3%	0.5%	0.2%	0.5%	7%	0.2%	.3%	2%	1.5%	0.2%
Ca	15%	15%	15%	15%	0.7%	15%	20%	10%	15%	10%
Mg	15%	10%	15%	15%	0.1%	15%	15%	15%	10%	7%
Ag	5	5	<1	<1	<1	<1	100	10	3	1
As	<500	<500	<500	500	500	<500	<500	<500	<500	<500
B	<10	<10	<10	<10	50	<10	<10	<10	<10	<10
Ba	<10	<10	<10	<10	2000	<10	10	<10	<10	10
Be	<2	<2	<2	<2	10	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Co	<5	<5	<5	<5	5	<5	<5	<5	<5	<5
Cr	<10	<10	<10	<10	20	<10	<10	<10	<10	<10
Cu	20	100	2	<2	15	<2	200	50	20	2
Ga	<10	<10	<10	<10	10	<10	<10	<10	<10	<10
Ge	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
La	20	20	20	<20	<20	<20	20	<20	<20	20
Mn	1500	1000	500	2000	700	1500	700	1000	1000	1500
Mo	<2	2	2	<2	5	2	3	5	5	<2
Nb	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Ni	<5	<5	<5	<5	20	<5	<5	<5	5	<5
Pb	1000	1500	50	20	50	10	3000	200	150	100
Sb	<100	<100	<100	<100	<100	<100	200	<100	<100	<100
Sc	<10	<10	<10	<10	10	<10	<10	<10	<10	<10
Sn	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sr	<100	100	<100	100	200	<100	<100	<100	100	<100
Ti	100	20	50	<20	2000	20	30	20	20	<20
V	<10	10	10	20	150	10	10	20	10	20
W	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	10	<10	<10	<10	<10	<10
Zn	<200	300	<200	5000	200	<200	<200	200	300	<200
Zr	<20	<20	<20	<20	100	<20	<20	<20	<20	<20

Table Three - Leadville dolomite, recrystallized with abundant secondary features and variable iron-manganese oxides. (Z, zebra; B, birdseye; D, dolomite crystals; Q, quartz crystals; V, vugs; S, sanding.)

CL-3	Z, B, D, V, minor Fe-MnOx.
DC-2	D, Q, V, S, ocher.
FM-1A	Z, D, Mn dusting.
G-8	Z, D, V.
GC-2 (Gilman ss).	S, dog spar, limonite.
GC-5 (limestone).	FeOx ocher, silica, jasper, dog spar.
GC-6 (limestone).	FeOx ocher, S, brecciation, dog spar.
GC-7 (limestone).	FeOx ocher, silica, dog spar.
L-1	D.
L-2	S.
L-5	S, mangano-siderite.
L-7A	Weak Z, D, and mangano-siderite.
L-7B	S, iron-manganese replacement.
LL-1	Z, D.
LL-3	B.
LL-4	B, D, S, brecciation, weak FeOx knots.
LL-7	Z, B, FeOx films.
LL-8	Z, D, minor Q, silica, barite.
LL-9A	Z, D, manganese limonite.
LL-13	Z, D, weak FeOx.
LL-15A	Z, D, Q, S, barite, breccia, trace galena.
LL-16A	Z, D, crosscutting FeOx.
TC-16	Z, D, Q, V, abundant yellow FeOx.

Note the absence of any values in the limestone units which have some secondary features.

TABLE THREE A- ES Values of Leadville Dolomite, recrystallized, with abundant secondary features.

SAMPLE NO.	CL-3	DC-2	FM-1A	G-8	GC-2	GC-5	GC-6	GC-7	L-1	L-2	L-5	L-7A	L-7B	LL-1	LL-3	LL-4	LL-7	LL-8	LL-9A	LL-13	LL-15A	LL-16A	TC-16
ITEM	7	2	21	18	6	9	10	11	2	3	3	7	8	4	6	7	11	12	14	18	10	12	18
ELEMENT																							
Fe	0.5%	1%	0.5%	0.2%	2%	1.5%	1%	0.5%	3%	5%	1%	0.5%	1%	.2%	.5%	.5%	1%	.5%	.7%	.2%	0.2%	0.5%	0.5%
Ca	20%	15%	10%	20%	7%	1%	20%	15%	20%	1%	20%	15%	7%	20%	>20%	15%	15%	10%	15%	15%	7%	15%	15%
Mg	15%	0.2%	7%	15%	0.3%	1%	0.3%	0.5%	15%	.7%	15%	10%	1%	15%	15%	10%	15%	15%	15%	15%	3%	10%	15%
Ag	2	<1	30	<1	<1	<1	<1	<1	<1	1	10	10	7	1	<1	1	10	5	2	15	100	7	<1
As	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
B	<10	10	<10	<10	10	10	10	<10	<10	30	<10	<10	<10	<10	<10	<10	10	<10	<10	<10	<10	<10	<10
Ba	10	<10	10	<10	20	20	500	100	<10	10	10	50	<10	<10	<10	<10	<10	100	<10	20	>10000	20	<10
Be	<2	<2	<2	<2	<2	2	<2	2	<2	2	<2	<2	<2	<2	<2	<2	2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cd	50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Co	<5	<5	<5	<5	<5	<5	<5	<5	<5	20	<5	<5	<5	<5	<5	<5	15	<5	<5	<5	<5	<5	<5
Cr	<10	10	<10	<10	<10	10	10	<10	<10	50	<10	<10	<10	<10	<10	<10	10	<10	<10	<10	<10	<10	<10
Cu	<2	3	500	<2	2	3	2	2	15	5	3	3	5	5	<2	10	50	20	5	10	50	3	10
Ga	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Ge	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
La	20	20	20	20	<20	<20	20	20	20	50	20	20	20	20	<20	<20	<20	<20	20	20	<20	20	20
Mn	2000	700	700	300	200	500	700	700	7000	2000	>10000	10000	>10000	500	1000	700	700	1500	3000	1000	1000	500	700
Mo	<2	5	<2	<2	2	3	2	3	3	2	2	2	3	2	3	3	2	5	3	3	2	2	<2
Nb	<20	<20	<20	<20	20	<20	<20	20	<20	20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Ni	<5	5	<5	<5	7	7	5	5	<5	50	<5	<5	<5	<5	<5	<5	50	<5	<5	<5	<5	5	<5
Pb	500	10	5000	<10	30	20	30	<10	30	200	200	100	500	20	10	150	500	200	100	100	5000	50	500
Sb	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	200	<100	<100
Sc	<10	<10	<10	<10	<10	<10	<10	<10	<10	15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sn	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sr	100	100	<100	<100	100	200	100	<100	<100	100	<100	<100	<100	<100	<100	<100	<100	<100	100	100	500	<100	100
Ti	<20	500	<20	20	200	300	200	200	30	3000	20	100	<20	20	50	<20	300	<20	20	30	150	50	<20
V	20	20	10	20	20	50	20	20	10	100	20	20	20	10	10	10	20	10	10	10	10	15	20
W	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	<10	<10	<10	<10	<10	15	<10	<10	<10	<10	<10	<10	10	<10	<10	<10	<10	<10	<10
Zn	500	<200	200	<200	<200	<200	<200	<200	<200	<200	300	500	1000	<200	<200	300	<200	<200	200	<200	2000	<200	500
Zr	<20	20	<20	<20	20	20	20	<10	<20	300	<20	<20	<20	<20	<20	<20	20	<20	<20	<20	<20	<20	<20

Table Four - Leadville dolomite, with high degree of replacement by iron-manganese, and various sulfides; now totally oxidized, often with various silica-jasper types.

L-3 SULFIDE Ore from Black Cloud No. 6 Orebody.

CL-2 Black jasper and silica with zinc carbonate.
CL-4 Fe-Mn-Silica jasper.
CL-5 Orange-brown to red-black Fe-Mn jasper.

DC-1 (limestone). FeOx-silica jasper.

FM-1 Q, S, bx, barite, FePbZn pseudomorphs.
FM-3 (Gilman ss). FeOx sinter, PbOx?
FM-6 (Gilman ss). Siliceous bx, sparce galena, tetrahedrite.
FM-7 D, siliceous, with galena, tetrahedrite.

G-3 Red-black hematite, minor jasper.
G-4 Manganese-specularite.

L-4A Fe-MnOx, weak jasper.
L-5A Fe-Mn replacement.
L-6 Orange jasper with black FeOx.

LL-13A Q, barite, FeOx, pyrite pseudomorphs.
LL-13B Q, barite, silica bx, azurite, malachite, sphalerite.
LL-17 D, Q, silica, FeZn pseudomorphs.

M-1 Fe jasper.
M-2 Fe jasper with Z, D, Q.

P-1 Orange-brown jasper with magnetite-hematite.

TC-7 V, silicified, FeOx, and silica-jasper.
TC-8 Complete replacement by FeOx and py-sphal pseudomorphs.
TC-13 (Gilman ss). Silica, red-yellow FeOx, weak jasper.
TC-14 (Gilman ss). Weak replacement by yellow-pink FeOx and silica-jasper.
TC-17 Silicified yellow-red ocher and silica-jasper with Q.

WP-2 FeOx-jasper-quartz grains in sanded unit.
WP-6A FeOx sinter.
WP-8 Fe sinter and pyrite pseudomorphs, weak jasper.

TABLE FOUR A-ES Values of Leadville Dolomite with high degree of replacement by Iron-Manganese Jasperoids.

SAMPLE NO.	L-3	CL-2	CL-4	CL-5	DC-1	FM-1	FM-3	FM-6	FM-7	G-3	G-4	L-4A	L-5A	L-6	LL-13A	LL-13B	LL-17	M-1	M-2	P-1	TC-7	TC-8	TC-13	TC-14	TC-17	WP-2	WP-6A	WP-8
ITEM	1	6	8	9	1	20	23	26	27	13	14	2	4	5	19	20	13	2	3	1	8	9	14	16	19	21	26	28
ELEMENT																												
Fe	10%	10%	1%	10%	15%	7%	15%	0.7%	1%	20%	5%	10%	7%	10%	10%	2%	15%	15%	15%	20%	2%	20%	0.5%	0.5%	0.7%	5%	20%	20%
Ca	2%	0.7%	0.5%	0.1%	10%	0.1%	0.1%	1%	2%	0.05%	0.1%	5%	0.5%	0.2%	.2%	.5%	0.2%	5%	0.05%	.02%	0.2%	0.2%	0.5%	5%	1%	0.5%	1.5%	0.1%
Mg	0.5%	0.1%	0.2%	0.1%	0.3%	0.03%	0.05%	0.5%	1%	0.03%	0.03%	0.03%	0.03%	0.03%	.1%	.15%	0.05%	0.1%	0.1%	.03%	0.05%	0.05%	0.3%	1.5%	0.1%	0.2%	0.2%	0.05%
Ag	50	100	15	10	<1	200	150	500	1000	1	10	200	150	150	2	1000	50	1	<1	1	<1	<1	<1	<1	<1	<1	<1	<1
As	500	<500	<500	<500	<500	<500	500	<500	1500	<500	<500	1000	2000	5000	<500	<500	1000	<500	<500	<500	<500	<500	<500	<500	<500	<500	5000	5000
B	15	10	<10	10	30	<10	10	<10	<10	20	10	10	10	10	20	10	15	10	20	20	10	20	10	10	<10	15	20	30
Ba	5000	5000	50	500	20	>10000	100	50	50	<10	<10	7000	7000	5000	10	>10000	>10000	10	<10	20	<10	10	<10	<10	100	<10	<10	10
Be	<2	<2	<2	<2	<2	3	<2	<2	<2	<2	3	<2	<2	<2	<2	<2	<2	<2	2	2	<2	5	<2	<2	<2	2	<2	2
Bi	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cd	200	200	100	<50	<50	<50	<50	<50	300	<50	70	<50	<50	<50	<50	100	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Co	<5	<5	<5	<5	10	<5	<5	<5	<5	<5	5	<5	<5	5	7	<5	<5	<5	10	<5	<5	15	<5	<5	<5	<5	5	7
Cr	10	<10	<10	<10	10	<10	<10	<10	<10	10	<10	20	10	10	<10	300	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
Cu	700	5	150	20	2	1500	500	1000	3000	300	50	200	30	100	30	5000	500	150	700	200	2	100	<2	2	<2	2	5	10
Ga	10	<10	<10	<10	10	<10	<10	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	10	<10	<10	<10	<10	<10	10
Ge	<20	<20	<20	<20	<20	20	20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	<20	20	<20	<20	<20	<20	20	20	<20	30	70	70	<20	<20	<20	<20	<20	<20	<20	20	<20	20	20	20	30	<20	<20
Mn	5000	>10000	>10000	>10000	700	100	10	200	300	500	>10000	>10000	>10000	>10000	1000	300	200	2000	500	100	100	500	200	100	1000	200	50	50
Mo	20	10	<2	5	7	5	3	<2	2	10	2	20	10	10	7	2	100	10	20	15	2	15	<2	<2	2	<2	10	10
Nb	20	20	<20	20	20	20	20	<20	<20	20	20	20	20	20	20	20	20	20	20	20	<20	20	<20	<20	<20	[illegible]	20	20
Ni	10	<5	<5	<5	20	5	<5	<5	<5	<5	20	5	<5	10	10	5	7	5	15	<5	<5	50	5	5	<5	<5	50	100
Pb	10000	5000	200	500	20	>10000	10000	7000	>10000	3000	1500	10000	7000	5000	200	>10000	10000	10	10	<10	<10	<10	10	15	20	150	50	70
Sb	<100	<100	<100	<100	<100	500	500	500	5000	<100	<100	200	100	100	<100	3000	150	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sn	10	<10	<10	<10	<10	<10	<10	<10	<10	20	<10	<10	<10	<10	10	<10	<10	10	15	100	<10	20	<10	<10	<10	<10	15	20
Sr	200	100	100	200	<100	500	<100	100	100	<100	<100	300	500	300	<100	1000	200	100	100	<100	<100	<100	100	100	100	100	<100	<100
Ti	1000	<20	20	<20	700	100	20	200	100	20	50	100	<20	100	100	1000	[illegible]	<20	200	100	100	50	100	100	50	1000	100	200
V	30	50	30	30	50	30	30	10	10	70	30	70	70	150	10	20	20	30	70	20	50	50	20	10	50	50	200	200
W	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	50	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	<10
Zn	>10000	>10000	>10000	7000	<200	2000	1000	10000	>10000	7000	>10000	2000	10000	3000	500	>10000	2000	<200	200	1000	<200	500	<200	<200	<200	200	<200	200
Zr	20	<20	<20	<20	50	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	30	<20	<20	<20	<20	20	<20	<20	<20	<20	300	<20	<20

Table Five - Karst and Cave-fill Type Material ranging from cold water solution, to sanded cave-fill, to mineralized cave-fill-karst deposits.

DC-3	Terra rosa karst.
TC-2A	Karst of cold water solution bx, calcite, dripstone, wk terra rosa.
FM-2	Karst with FeMnOx replacement, galena, tetrahedrite.
LL-2	Cave-fill, tan, sanded dolomite.
LL-5	Karst with D, Q, FeOx.
LL-5A	Karst with azurite-malachite.
LL-16	Karst, fine D, Q, silic dolomite with weak FeMn.
PM-3	Karst, late D, Q, S, bx, Mn-massive sulfide, trace malachite.
TC-15	Karst and other material, V, silic bx, py, dog spar, FeOx.

TABLE FIVE A – ES Values of Karst & Cave-Fill Type material.

SAMPLE NO.	DC-3	TC-2A	FM-2	LL-2	LL-5	LL-5A	LL-16	PM-3	TC-15
ITEM	3	3	22	5	8	9	11	35	17
ELEMENT									
Fe	1%	5%	10%	2%	10%	7%	2%	7%	1.5%
Ca	20%	20%	0.15%	20%	7%	1%	10%	0.7%	10%
Mg	0.2%	5%	0.05%	15%	2%	.2%	7%	0.02%	2%
Ag	<1	<1	500	3	100	7000	10	200	<1
As	<500	1000	1000	<500	<500	1500	<500	<500	700
B	<10	<10	10	<10	10	<10	10	10	10
Ba	<10	50	500	200	50	5000	500	5000	50
Be	<2	2	3	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	300	<50	<50	200	<50	200	<50
Co	<5	5	<5	<5	5	<5	<5	<5	<5
Cr	10	<10	<10	<10	<10	<10	10	<10	<10
Cu	2	100	5000	5	2000	>10000	15	1500	3
Ga	<10	<10	<10	<10	<10	<10	<10	10	<10
Ge	<20	<20	<20	<20	<20	<20	<20	<20	<20
La	20	<20	<20	<20	<20	50	<20	100	20
Mn	700	2000	700	2000	700	1000	10000	10000	100
Mo	2	5	5	2	10	5	5	20	7
Nb	<20	<20	20	<20	20	20	20	20	<20
Ni	<5	10	5	<5	30	5	5	<5	<5
Pb	<10	500	>10000	150	5000	>10000	100	10000	<10
Sb	<100	<100	1000	<100	200	>10000	<100	<100	<100
Sc	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sn	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sr	<100	<100	<100	<100	100	200	<100	200	100
Ti	100	50	<20	100	150	20	200	50	150
V	20	200	<10	10	10	10	30	50	10
W	<50	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	<10	<10	<10	<10	<10
Zn	<200	200	>10000	500	>10000	10000	300	10000	<200
Zr	<10	<20	<20	<20	<20	<20	<20	<20	20

Table Six - Cambrian Sawatch Quartzite description.

PM-1	Sandy with weak FeOx.
TC-9	Sandy, yellow-red ocher.
TC-10	Sandy, chrome green with yellow FeOx.
TC-11	Sandy, yellow FeOx and red-brown jasper.
TC-12	Sandy, bx, quartz, abundant yellow-red FeOx.
WP-3	Fault breccia with FeOx.
WP-9	Chrome green grains (may be lower Peerless).
WP-10	Sanded, FeOx seams.

TABLE SIX A – ES Values of Sawatch Quartzite

SAMPLE NO.	PM-1	TC-9	TC-10	TC-11	TC-12	WP-3	WP-9	WP-10
ITEM	33	10	11	12	13	22	29	30
ELEMENT								
Fe	2%	10%	3%	7%	7%	5%	10%	5%
Ca	0.5%	0.05%	0.05%	0.15%	1%	0.03%	0.1%	0.02%
Mg	0.5%	0.05%	0.1%	0.05%	1%	0.03%	0.1%	0.03%
Ag	<1	<1	2	<1	<1	<1	<1	<1
As	<500	2000	<500	<500	<500	2000	<500	500
B	10	10	20	10	20	<10	20	<10
Ba	150	200	1000	<10	<10	<10	<10	<10
Be	2	30	2	3	5	<2	7	10
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	<5	<5	<5	<5	<5	5	<5	<5
Cr	<10	<10	<10	<10	<10	<10	<10	<10
Cu	5	20	3	10	10	100	100	50
Ga	<10	<10	<10	<10	<10	<10	10	<10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	30	<20	20	20	<20	20	<20	<20
Mn	1000	3000	2000	50	100	200	100	50
Mo	<2	5	2	<2	2	2	2	2
Nb	<20	20	<20	20	<20	20	20	20
Ni	<5	7	5	5	7	5	5	5
Pb	<10	<10	15	15	30	200	10	20
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	<10	10	<10	<10	<10	<10	10	<10
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	100	<100	100	<100	100	<100	<100	<100
Ti	1000	200	1000	200	500	200	500	150
V	20	200	70	100	50	100	50	30
W	<50	<50	<50	<50	<50	<50	<50	50
Y	<10	50	10	<10	<10	<10	10	<10
Zn	<200	200	<200	<200	<200	<200	<200	<200
Zr	200	100	70	70	20	70	200	30

Table Seven - Devonian Dyer Dolomite descriptions.

GC-1	Weak FeOx and sanding.
GC-8	Yellow ocher, minor silica, and red FeOx.
PM-2	Sandy, minor black-brown manganese.
TC-13A	Partly recrystallized, sandy, vuggy, minor FeOx.
WP-1	Q, iron, red-brown jasper.
WP-1A	Recrystallized with galena.

TABLE SEVEN A-ES Values of Dyer Dolomite

SAMPLE NO.	GC-1	GC-8	PM-2	TC-13A	WP-1	WP-1A
ITEM	5	12	34	15	19	20
ELEMENT						
Fe	5%	7%	3%	0.1%	20%	1%
Ca	7%	0.7%	7%	15%	0.05%	5%
Mg	0.1%	0.05%	1%	10%	0.03%	10%
Ag	<1	<1	100	<1	15	10
As	<500	<500	<500	<500	<500	<500
B	50	50	10	<10	20	<10
Ba	<10	100	5000	<10	<10	<10
Be	<2	5	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	300
Co	<5	10	<5	<5	<5	<5
Cr	10	15	<10	<10	<10	<10
Cu	3	20	200	2	200	100
Ga	<10	10	<10	<10	10	<10
Ge	<20	<20	<20	<20	50	<20
La	<20	20	20	20	<20	20
Mn	700	2000	>10000	300	100	300
Mo	2	5	20	2	50	<2
Nb	20	<20	<20	<20	20	<20
Ni	10	30	5	<5	<5	<5
Pb	10	20	2000	30	10000	>10000
Sb	<100	<100	100	<100	<100	<100
Sc	<10	10	<10	<10	<10	<10
Sn	<10	<10	<10	<10	20	<10
Sr	200	100	200	<100	<100	<100
Ti	1000	1500	300	20	20	<20
V	30	100	20	10	20	10
W	<50	<50	<50	<50	<50	<50
Y	10	10	<10	<10	<10	<10
Zn	<200	200	2000	<200	10000	>10000
Zr	50	100	50	<20	<20	<20

Table Eight - Pennsylvanian Belden Shale descriptions.

FM-10	Yellow ocherous spots.
LL-11	Bright yellow FeOx.
TC-4	Nodules of weak FeOx.
TC-6	Limestone lense with blackjack (zinc).
WP-4	Gypsiferous, fine pyrite.
WP-11	FeOx knots and pyrite pseudomorphs.

TABLE EIGHT A-ES Values of Belden Shale

SAMPLE NO.	FM-10	LL-11	TC-4	TC-6	WP-4	WP-11
ITEM	31	16	5	7	23	31
ELEMENT						
Fe	2%	.5%	15%	2%	2%	10%
Ca	0.07%	.1%	0.2%	20%	20%	0.1%
Mg	0.2%	.2%	0.05%	0.2%	2%	0.15%
Ag	<1	<1	<1	<1	<1	<1
As	<500	<500	<500	<500	<500	<500
B	500	100	20	<10	<10	20
Ba	200	200	<10	700	<10	10
Be	3	<2	2	<2	<2	2
Bi	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50
Co	<5	<5	<5	<5	<5	5
Cr	200	150	<10	<10	10	20
Cu	3	2	20	3	5	30
Ga	20	15	<10	<10	<10	<10
Ge	<20	<20	<20	<20	<20	<20
La	200	150	<20	20	50	<20
Mn	<10	10	1000	500	500	70
Mo	3	3	5	7	<2	3
Nb	20	20	20	<20	20	20
Ni	20	5	20	20	5	10
Pb	50	20	20	10	20	<10
Sb	<100	100	<100	<100	<100	<100
Sc	20	20	<10	<10	<10	10
Sn	<10	<10	<10	<10	<10	<10
Sr	200	500	<100	200	300	100
Ti	10000	10000	100	200	700	1000
V	200	200	50	20	30	50
W	<50	<50	<50	<50	<50	<50
Y	30	20	10	<10	10	20
Zn	<200	<200	500	<200	<200	<200
Zr	200	200	<20	<20	20	30

Table Nine - Tertiary Porphyry (Gilman sill type), except where noted otherwise.

C-1	Lincoln porphyry, weak clay.
CL-1	Argillic with Fe-MnOx.
FM-8	Orange-yellow FeOx.
G-1	Argillic with fine manganese and limonites.
L-7	Argillic with FeOx.
M-3	Weak clay.
TC-5	Hornblende diorite, fresh.
WP-5	Sulfidized ferromags with trace pyrite.

TABLE NINE A – ES Values of Porphyry Types.

SAMPLE NO.	C-1	CL-1	FM-8	G-1	L-7	M-3	TC-5	WP-5
ITEM	1	5	29	11	6	4	6	24
ELEMENT								
Fe	2%	0.5%	5%	1%	10%	3%	10%	0.07%
Ca	0.07%	0.02%	0.5%	0.1%	0.07%	0.07%	3%	1%
Mg	0.05%	0.1%	0.15%	0.1%	0.05%	0.2%	1%	0.2%
Ag	<1	<1	<1	<1	2	<1	<1	<1
As	<500	<500	<500	<500	<500	<500	<500	<500
B	<10	<10	10	10	30	10	10	10
Ba	<10	100	1000	300	50	200	700	50
Be	<2	2	<2	<2	2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	<5	<5	<5	<5	<5	<5	10	<5
Cr	<10	<10	<10	<10	20	<10	<10	<10
Cu	2	2	10	<2	2	5	30	2
Ga	10	10	10	10	<10	10	10	<10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	50	50	20	20	<20	20	<20	50
Mn	100	200	1000	500	2000	150	1500	150
Mo	<2	<2	2	<2	5	<2	<2	<2
Nb	20	20	<20	20	20	20	20	20
Ni	<5	<5	5	<5	20	5	<5	<5
Pb	10	30	100	15	50	20	<10	10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	10	<10	<10	<10
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	100	200	300	100	100	200	700	200
Ti	1000	300	3000	500	2000	1000	5000	300
V	50	20	70	20	70	20	200	10
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	10	<10	<10	<10
Zn	<200	<200	<200	<200	<200	<200	<200	<200
Zr	100	30	100	30	200	50	100	50

Table Ten - Other Rock Unit descriptions.

G-6	Precambrian biotite granite gneiss with Fe-MnOx films.
WP-7	Precambrian granite with quartz-sericite and pyrite pseudomorphs.
G-7	Peerless Shale, sandy dolomite with orange-brown limonite.
LL-14	Parting Quartzite with FeOx intragranular and along sheeting.
OCC-1	Maroon Sandstone, burnt yellow.
OCC-2	Maroon Sandstone, white.
OCC-3	Maroon Sandstone, black residuals.
OCC-4	Maroon Sandstone, limestone lense with replacement texture and dog spar.
SMS-1	Maroon Sandstone with quartz crystals, pyrite, magnetite, and ocher.
SMS-2	Maroon Sandstone, total ocher, sanded.
SMS-3	Maroon Sandstone, sanded breccia, minor yellow ocher.
FM-5	Smelter (1890) slag.

TABLE TEN A - ES Values of Miscellaneous Units & Slag.

	PЄ Granite		Peerless Shale	Parting Quartzite	Maroon Sandstone							Smelter Slag
SAMPLE NO.	G-6	WP-7	G-7	LL-14	OCC-1	OCC-2	OCC-3	OCC-4	SMS-1	SMS-2	SMS-3	FM-5
ITEM	16	27	17	21	13	14	15	16	17	18	19	25
ELEMENT												
Fe	2%	1%	5%	.5%	1%	0.7%	0.5%	0.7%	10%	10%	0.7%	>20%
Ca	0.2%	0.05%	2%	.7%	15%	2%	20%	15%	10%	0.1%	0.05%	1%
Mg	0.7%	0.1%	1%	.2%	0.7%	0.2%	0.3%	0.15%	0.05%	1%	1%	0.2%
Ag	<1	5	<1	5	<1	<1	<1	<1	<1	3	<1	10
As	500	<500	500	<500	<500	<500	<500	<500	<500	<500	<500	<500
B	20	<10	30	10	10	20	10	10	10	10	50	30
Ba	100	20	20	20	100	50	200	70	<10	<10	50	>10000
Be	2	<2	3	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Co	<5	<5	<5	<5	<5	<5	<5	<5	20	<5	<5	<5
Cr	<10	<10	<10	<10	<10	15	10	10	10	10	10	<10
Cu	10	150	2	20	<2	<2	5	3	7	100	3	700
Ga	15	<10	10	<10	<10	<10	<10	<10	<10	10	<10	20
Ge	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
La	30	50	<20	<20	20	<20	30	30	<20	<20	30	<20
Mn	200	50	200	1000	700	100	500	700	2000	30	150	500
Mo	<2	<2	<2	<2	3	2	3	5	3	5	2	10
Nb	20	20	20	<20	<20	<20	<20	20	20	<20	<20	50
Ni	5	<5	5	<5	5	10	5	5	10	5	5	<5
Pb	10	200	<10	150	20	<10	10	10	100	500	10	>10000
Sb	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	300
Sc	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sn	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	700
Sr	200	100	100	<100	200	200	500	300	100	100	500	700
Ti	2000	2000	1000	50	500	2000	200	200	200	1000	1000	500
V	50	20	30	<10	30	50	30	30	200	100	50	30
W	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Y	10	<10	10	<10	<10	<10	<10	<10	10	<10	<10	<10
Zn	<200	1000	<200	200	<200	<200	<200	<200	700	500	<200	5000
Zr	100	70	150	<20	100	500	20	20	20	100	100	20

ASARCO

F. T. G.

Rocky Mountain
Exploration Division

August 29, 1978

RECEIVED
AUG 31 1978
EXPLORATION DEPARTMENT

TO: W. L. Kurtz

FROM: D. M. Smith, Jr.

Limestone Seminar
September 18-19, 1978

James D. Sell has prepared a two-day program in which he will present his parameters for the recognition of physical and geochemical features in carbonate rocks which indicate the presence or absence of nearby replacement ore deposits. An office orientation and discussion session during the late morning and early afternoon on Monday will be followed by the $2\frac{1}{2}$-hour drive to Fairplay. Tuesday will be spent on the outcrop with a probable late evening return to Denver.

Motel arrangements will be made for T. C. Osborne and F. T. Graybeal in addition to yourself. Please advise us of your arrival times and dates.

I assume that you, F. T. Graybeal and I will proceed to Reno on Wednesday the 20th. Correct?

D. M. Smith, Jr.

D. M. Smith, Jr.

DMS:eff

CC: T. C. Osborne
✓F. T. Graybeal
J. D. Sell

ASARCO

F.T.G. Rocky Mountain Exploration Division

RECEIVED AUG 28 1978 U. S. EXPL. DIV.

August 16, 1978

TO: D. M. Smith

FROM: J. D. Sell

Replacement Limestone Search
Glenwood Canyon Area (GC-Series)
T5S, R87W
Garfield County, Colorado

On the east end of Glenwood Canyon, where the Leadville limestone and Paleozoic section is first encountered along U.S. Highway 6-24, a number of limonitic zones are found cutting the units.

Table One is a description of the Dyer Dolomite, and Leadville Limestone units sampled; Table Two is their Emission-Spec results; and Figure One is the location of the samples.

Two samples were collected in the Dyer Dolomite: sample GC-1 on the east and GC-8 located on a separate structure a mile and one-half to the southwest. Sample GC-8 contained anomalous manganese (2,000 ppm), and moly (5 ppm) with interesting boron (50 ppm), barium (100 ppm), nickel (30 ppm), titanium (1,500 ppm), vanadium (100 ppm), and zirconium (100 ppm); while GC-1 contained only 50 ppm boron, 700 ppm manganese, and 1,000 ppm titanium. The values of boron, nickel, titanium, vanadium, and zirconium may in part be depositional.

The Gilman sandstone member of the Leadville (GC-2) contained no significant values although minor FeOx and calcite crystal growths were present.

The lower Leadville (GC-3) reported 1,000 ppm manganese.

Forget Ti, Zr, Ni, V, Be, B?

In the middle Leadville, an oxidized FeOx-limonite fracture zone (sample GC-4) contained anomalous barium (2,000 ppm) and possibly titanium (2,000 ppm) with interesting boron (50 ppm), beryllium (10 ppm), manganese (700 ppm), moly (5 ppm), nickel (20 ppm), vanadium (150 ppm), and zirconium (100 ppm).

Recommend more work?

The remaining three samples were taken in upper middle (GC-5 and GC-6) and lower upper (GC-7) Leadville limestone. Minor, but interesting barium values of 500 ppm (GC-6) and 100 ppm (GC-7), and low manganese values of 500 ppm (GC-5), and 700 ppm for both GC-6 and GC-7. GC-5 also contained 50 ppm of vanadium.

The Leadville limestone values on the east end of Glenwood Canyon are overall low with no reflection of silver, cadmium, lead, or zinc values.

James D. Sell
J. D. Sell

JDS:eff
Attachments
CC: G. T. Graybeal

Table One - Description of Glenwood Canyon (GC-Series) Samples, East End.
J. D. Sell. July 5, 1978.

GC-1 Dyer dolomite, shaley, quartzose, green glassy to light-medium grey to thin-bedded, dark, fine grained, cut by weak FeOx veins and along bedding, with sanded wall rock.

GC-2 Gilman sandstone of Leadville limestone, with discrete blebs of FeOx on fractures with limonite, calcite crystals (dog spar), and sanded borders.

GC-3 Leadville limestone, fetid lower member, modular, fossiliferous, cut by calcite filled fractures with variable FeOx-limonite.

GC-4 Leadville limestone, (middle), 1'-3' vertical fracture zones filled with oxidized FeOx-limonite of red-orange-yellow ocher in fine-grained replacement textured wall rock containing Fe-Ox nodules and dog-spar calcite filled fractures. (Also, rare, very fine pyrite in center of some nodules.)

GC-5 Leadville limestone, upper middle, cut by 2'-8' zones of ocher, FeOx orange-red-yellow, with silica, jasperiod, leached, replacement textured limestone containing calcite nodules of dog tooth-spar. All zones strike N ± 5° with vertical dip, and replace wall rock as well as along bedding and some total favorable beds.

NOTE: GC-1 starts at Garfield County boundary and thru GC-5 progresses eastward to last altered outcrop as one enter the Canyon.

GC-6 Leadville limestone, upper middle, at zone of two faults which brecciated rock; replacement of breccia-faults and along bedding by various FeOx, red-orange-yellow ocher (red next to dolomite limestone wall rock or breccia rinds with bright yellow in highly oxidized, pulverent centers, abundant dog spar with fine crystals, some breccia filling by spar, sanded borders. Located on BLM road 500 feet north of main highway (U.S. 6) and probably continuation of zone, not sampled, located just west of GC-1 site.

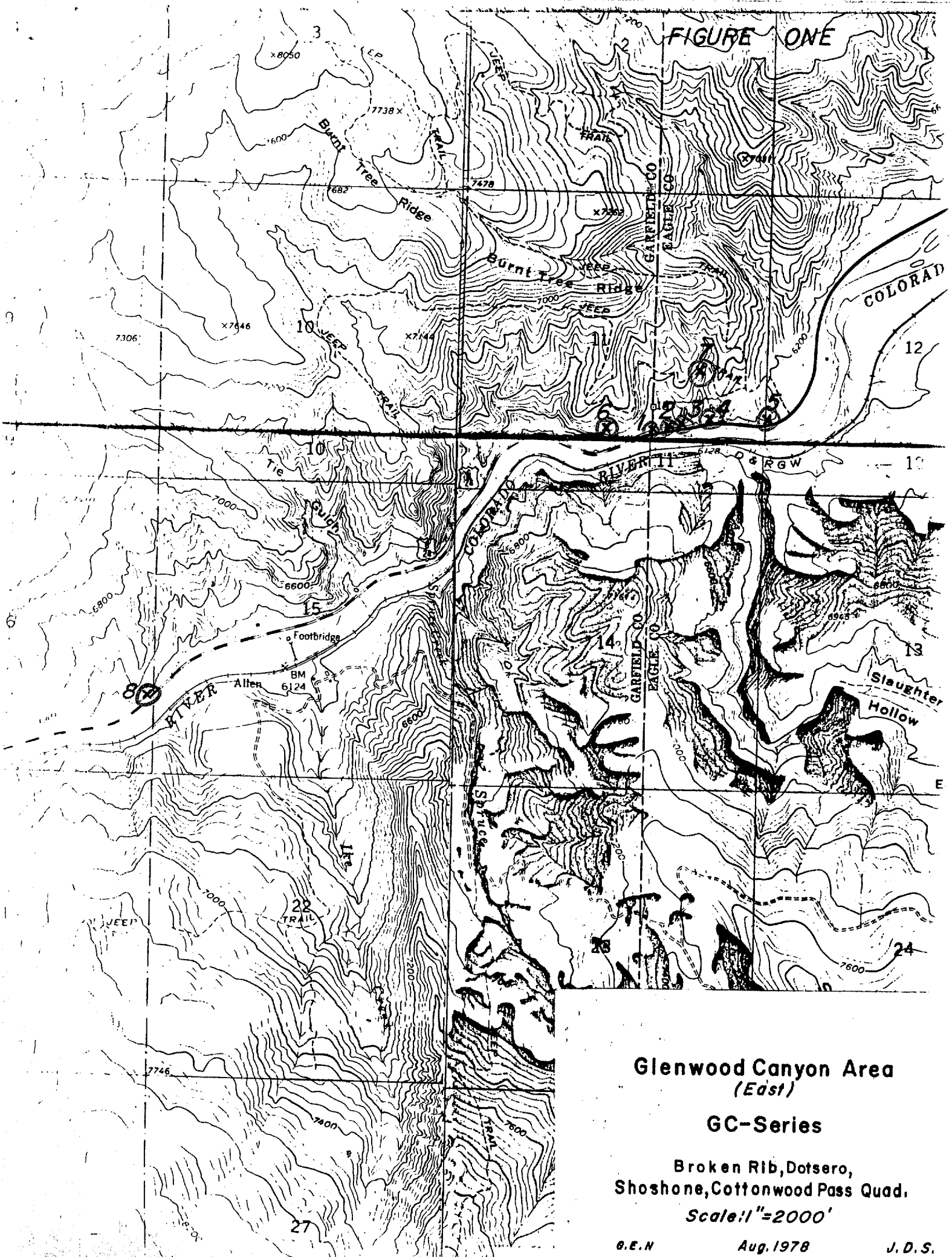
GC-7 Leadville limestone, upper unit, thin bedded black with fine replacement texture and abundant vugs 1" to 3" to 6" lined with 1/4" dog toothed spar with some coating of FeOx, excess silica as ribs in yellow-orange ocher replacing along fractures and bedding. Located on BLM road ± 800 north of U.S. 6 and along projection of sample GC-4 structure.

GC-8 Dyer dolomite, yellow ocher sanding and replacing along joints, fractures, and bedding with minor silica and red FeOx of northeast trend. Located on U.S. 6 at east sign of White River N.F.

NOTE: Zone undoubtably connects with Deep Creek area.

which zone

→ Aug 16, 1978 report.



Glenwood Canyon Area
(East)

GC-Series

Broken Rib, Dotsero,
Shoshone, Cottonwood Pass Quad.

Scale: 1" = 2000'

G.E.N Aug. 1978 J.D.S.

GLENWOOD CANYON AREA (GC-)

TABLE TWO

DCR 010
PAGE 1

ITEM NO.	SAMPLE NO.
1	DC-01
2	DC-02
3	DC-03
4	DC-04
5	GC-01
6	GC-02
7	GC-03
8	GC-04

	GC-1	GC-2	GC-3	GC-4	GC-5	GC-6	GC-7	GC-8
ITEM	5	6	7	8	9	10	11	12
ELEMENT								
Fe	5%	2%	2%	7%	1.5%	1%	0.5%	7%
Ca	7%	7%	15%	0.7%	1%	20%	15%	0.7%
Mg	0.1%	0.3%	0.3%	0.1%	1%	0.3%	0.5%	0.05%
Ag	<1	<1	<1	<1	<1	<1	<1	<1
As	<500	<500	<500	500	<500	<500	<500	<500
B	50	10	20	50	10	10	<10	50
Ba	<10	20	20	2000	20	500	100	100
Be	<2	<2	<2	10	2	<2	<2	5
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	<5	<5	<5	5	<5	<5	<5	10
Cr	10	<10	10	20	10	10	<10	15
Cu	3	2	3	15	3	2	2	20
Ga	<10	<10	<10	10	<10	<10	<10	10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	<20	20	<20	<20	20	20	20
Mn	700	200	1000	700	500	700	700	2000
Mo	2	2	3	5	3	2	3	5
Nb	20	20	20	<20	<20	<20	20	<20
Ni	10	7	5	20	7	5	5	30
Pb	10	30	20	50	20	30	<10	20
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	10	<10	<10	<10	10
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	200	100	200	200	200	100	<100	100
Ti	1000	200	700	2000	300	200	200	1500
V	30	20	30	150	50	20	20	100
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	10	<10	<10	10	<10	<10	<10	10
Zn	<200	<200	<200	200	<200	<200	<200	200
Zr	50	20	30	100	20	20	<10	100

ASARCO

F.T.G.

Rocky Mountain
Exploration Division

RECEIVED
AUG 28 1978
S. W. U. S. EXPL. DIV.

August 16, 1978

TO: D. M. Smith, Jr.

FROM: J. D. Sell

Replacement Limestone Search
Deep Creek Area (DC-Series)
T4S, R87W
Garfield County, Colorado

– North of Glenwood Canyon area

In the Deep Creek area, three samples were taken on trends which seem to trend into the Glenwood Canyon area. Table One is a description of the samples; Table Two the Emission-Spec results; and Figure One is the locations.

Sample DC-1 was taken a half mile northwesterly from Deep Creek Overlock, from two locations along the same northeast-trending FeOx-silica-jasper-filled shear structure. The wall rock is Leadville limestone. The spec results report low manganese (700 ppm) and vanadium (50 ppm) with anomalous moly (7 ppm) and nickel (20 ppm).

Approximately four miles to the southeast is sample DC-2, a zone of yellow-white-orange ocher, kaolinite, silica, and sanded dolomite in Leadville dolomite with recrystallized texture, large blebs of secondary dolomite crystals, weak vug and some quartz crystal development. Again, the low manganese (700 ppm) and less moly (5 ppm) was reported.

To the northeast, and possibly along the same general structural zone as DC-2, two samples were collected. The altered terra rossa, breccia replacement sample (DC-3) had the same 700 ppm manganese value and minor (2 ppm) moly values. The adjacent wall rock sample of DC-4 reported only 50 ppm manganese with 3 ppm moly.

Lms-dolo. front is important?

Although the dolomite of the texture found, and perhaps the limestone-dolomite front, are indicative in the search, it is apparent that these samples with a lack of any silver values and the low manganese and other indicators show low priority values. The values are similar, though generally lower, than comparable samples on the east end of Glenwood Canyon.

James D. Sell
J. D. Sell

JDS:eff

Attachments

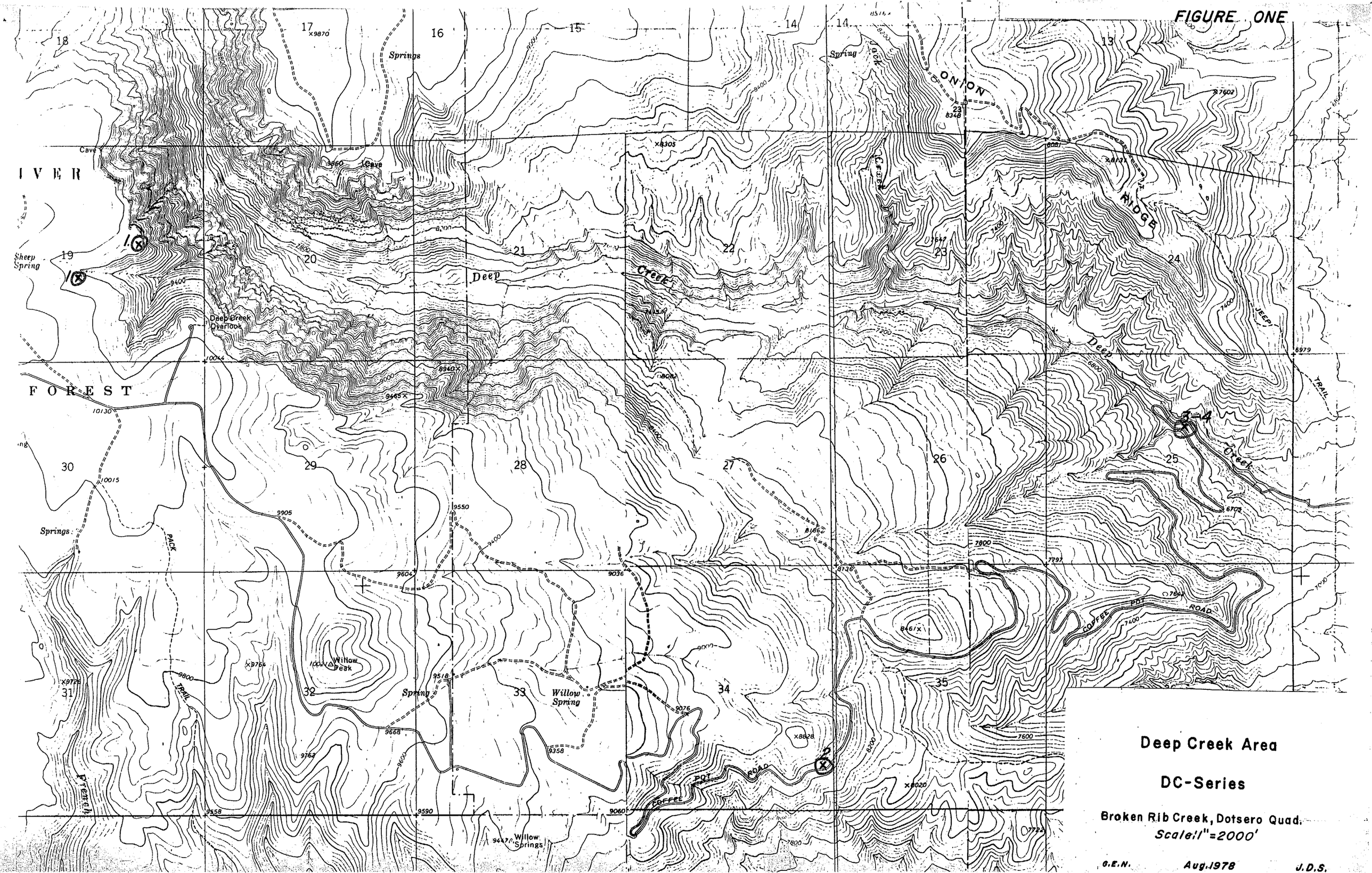
CC: F. T. Graybeal

Table One - Description of Deep Creek (DC-Series) Samples. J. D. Sell July 4, 1978.

1. Leadville limestone, good FeOx-silica-jasper in northeast-trending shear zones (from two locations).
2. Leadville dolomite, yellow-white-orange ocher, kaolinite, and silica, and sanded dolomite, recrystallized, with large blebs of secondary dolomite, weakly vuggy, some quartz linings in fractures and joints in structures trending N 10° E; some bedding replacement.
3. Leadville limestone, terra rossa and pink-orange limestone nodules as replacement in breccia with some breccia filling.
4. Leadville limestone, fine-grained, medium grey, slightly vuggy limestone breccia wall rock to sample DC-3. Dominant fracture-faults trend N 10°-20° E and N 50°-60° W.

NOTE: Samples DC-2 and DC-3 are part of a zone (?) which trends northeasterly from the east end of Glenwood Canyon. See GC-series samples.

FIGURE ONE


Springs
Cave
Sheep Spring
Deep Creek Overlook
Deep Creek
Onion Ridge
Jeep Trail
Pack Trail
Willow Peak
Spring
Willow Spring
Willow Springs
Coffee Pot Road
FOREST
Deep Creek Area
DC-Series
Broken Rib Creek, Dotsero Quad.
Scale: 1" = 2000'
G.E.N.
Aug. 1978
J.D.S.

DEEP CREEK AREA (DC-)

TABLE TWO

ITEM NO.	SAMPLE NO
1	= DC-01
2	= DC-02
3	= DC-03
4	= DC-04
5	= GC-01
6	= GC-02
7	= GC-03
8	= GC-04

	DC-1	DC-2	DC-3	DC-4
ITEM	1	2	3	4
ELEMENT				
Fe	15%	1%	1%	<0.05%
Ca	10%	15%	20%	>20%
Mg	0.3%	0.2%	0.2%	5%
Ag	<1	<1	<1	<1
As	<500	<500	<500	<500
B	30	10	<10	<10
Ba	20	<10	<10	20
Be	<2	<2	<2	<2
Bi	<10	<10	<10	<10
Cd	<50	<50	<50	<50
Co	10	<5	<5	<5
Cr	10	10	10	<10
Cu	2	3	2	<2
Ga	10	<10	<10	<10
Ge	<20	<20	<20	<20
La	<20	20	20	20
Mn	700	700	700	50
Mo	7	5	2	3
Nb	20	<20	<20	<20
Ni	20	5	<5	<5
Pb	20	10	<10	<10
Sb	<100	<100	<100	<100
Sc	<10	<10	<10	<10
Sn	<10	<10	<10	<10
Sr	<100	100	<100	<100
Ti	700	500	100	100
V	50	20	20	15
W	<50	<50	<50	<50
Y	50	<10	<10	<10
Zn	<200	<200	<200	<200
Zr	50	20	<10	<10

SKYLINE LAB
SPECIALISTS IN EXPLORATIC

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ASARCO

Rocky Mountain Exploration Division

RECEIVED
AUG 28 1978
S. W. U. S. EXPL. DIV.

August 15, 1978

TO: D. M. Smith, Jr.

FROM: J. D. Sell

Replacement Limestone Search
South Mount Sopris (SMS-Series)
T9S, R88W
Pitkin County, Colorado

A large area of altered, bleached, broken, brecciated, and milled sandstone of the Maroon Formation is found on the outside edge of the Mt. Sopris intrusive. The bleached beds and the inter-fingering of bleached units and red beds continue east of the sample area up Bulldog Creek and along Avalanche Creek as well as north along the Eagle River.

The samples were taken as an indication of the possible discharge from a Mt. Sopris type intrusive as well as a possible confirmation of the cause of the similar type bleaching-brecciation in the Opposite Cattle Creek area.

As in previous reports, Table One is the description of the samples; Table Two the Emission-Spec results; and Figure One the sample locations.

Sample SMS-1 was cut on a vein having pyrite and specularite in a quartz gangue in altered sandstone. The spec reported 2,000 ppm manganese along with 700 ppm zinc, 200 ppm vanadium, and 20 ppm cobalt. The ocherous, sanded unit nearby (SMS-2) contained 100 ppm copper, 5 ppm moly, 500 ppm lead, 1,000 ppm titanium, 100 ppm vanadium, 500 ppm zinc, and 100 ppm zirconium. This sample appeared similar to OCC-1, but has a higher base metal value including 3 ppm silver. The outer brecciated, sanded sandstone with no vein structure nearby returned values more similar to the samples of Opposite Cattle Creek with a variable interesting sequence of boron, barium, strontium, titanium, vanadium, and zirconium.

No Mn in SMS-2

The sampling suggests that a variable boron-barium and possibly strontium population may be reflective of the intrusive with the strong quartz veins carrying variable manganese with copper-lead-zinc values. The titanium-vanadium-zirconium population may in part be detrital from the sandstone environment.

It would appear that this type of intrusive cutting; favorable limestone-dolomites and/or in strong structural vein zones would host mineral deposits.

Does sampling bear this out?

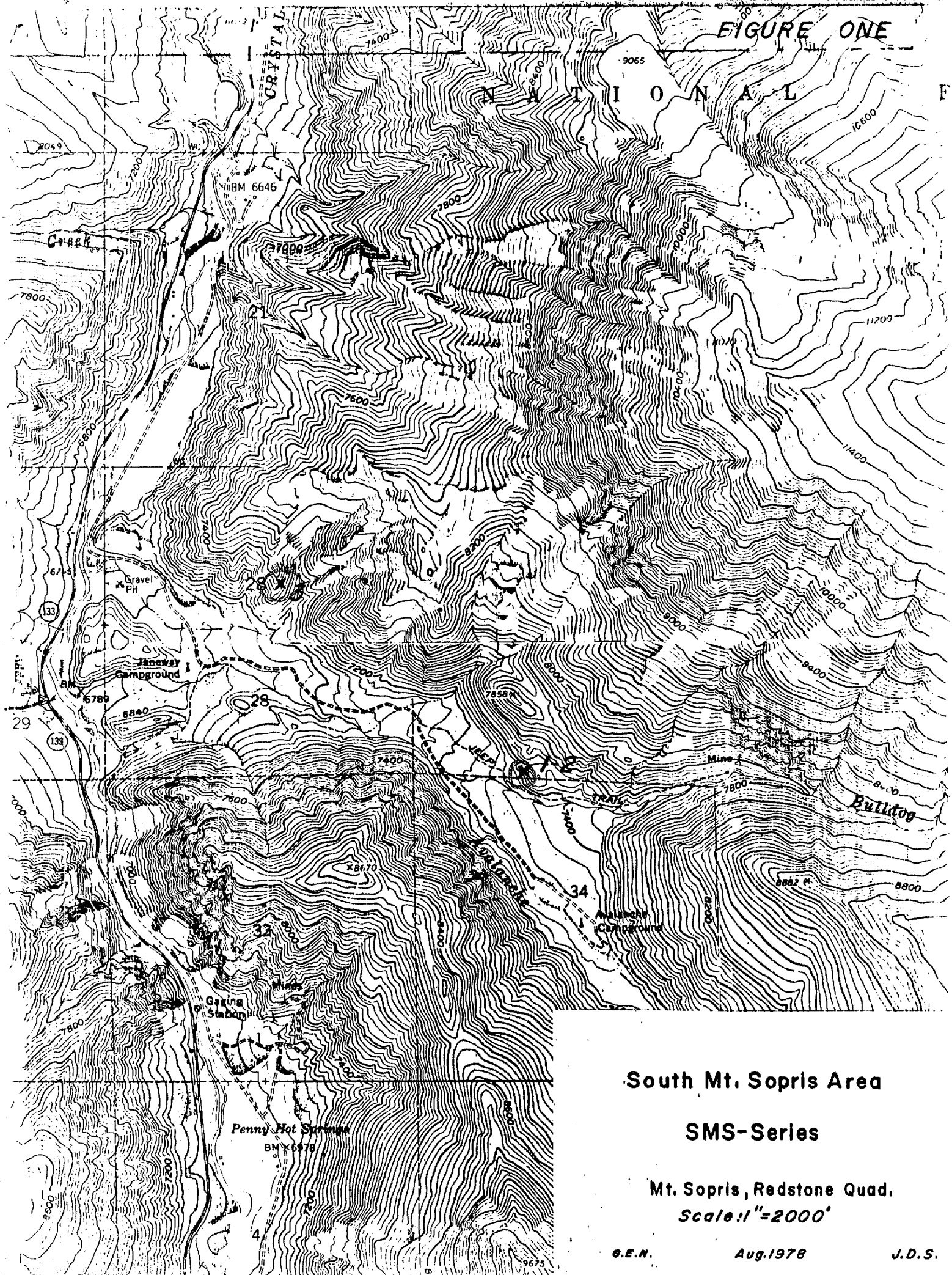
James D. Sell
J. D. Sell

JDS:eff
Attachments
CC: ✓ F. T. Graybeal

Table One - Description of South Mount Sopris (SMS-Series) Area Samples.
J. D. Sell. July 6, 1978.

1. Maroon formation, altered sandstone with pyrite, magnetite, pseudomorphs after both, yellow-orange ocher, abundant quartz crystals (some corroded) containing magnetite-specularite inclusions.
2. Total ocherous yellow, sanded unit (very similar to OCC-1 sample).
3. Yellow ocher in sanded, sandstone breccia with some calcite veinlets, minor black films. (Maroon Formation.)

FIGURE ONE



South Mt. Sopris Area

SMS-Series

Mt. Sopris, Redstone Quad.

Scale: 1" = 2000'

G.E.N. Aug. 1978 J.D.S.

SOUTH MOUNT SOPRIS AREA (SMS-)

TABLE TWO

DCR 010
PAGE 3

ITEM NO. SAMPLE NO.
17 = SMS-01
18 = SMS-02
19 = SMS-03

	SMS-1	SMS-2	SMS-3
ITEM	17	18	19
ELEMENT			
Fe	10%	10%	0.7%
Ca	10%	0.1%	0.05%
Mg	0.05%	1%	1%
Ag	<1	3	<1
As	<500	<500	<500
B	10	10	50
Ba	<10	<10	50
Be	<2	<2	<2
Bi	<10	<10	<10
Cd	<50	<50	<50
Co	20	<5	<5
Cr	10	10	10
Cu	7	100	3
Ga	<10	10	<10
Ge	<20	<20	<20
La	<20	<20	30
Mn	2000	30	150
Mo	3	5	2
Nb	20	<20	<20
Ni	10	5	5
Pb	100	500	10
Sb	<100	<100	<100
Sc	<10	<10	<10
Sn	<10	<10	<10
Sr	100	100	500
Ti	200	1000	1000
V	200	100	50
W	<50	<50	<50
Y	10	<10	<10
Zn	700	500	<200
Zr	20	100	100

Charles E. Thom
Chief Chemist

SKYLINE LABS, INC.
SPECIALISTS IN EXPLORATION GEOCHEMISTRY

ASARCO

F. T. G.

Rocky Mountain
Exploration Division

RECEIVED
AUG 28 1978
S. W. U. S. EXPL. DIV.

August 15, 1978

TO: D. M. Smith, Jr.

FROM: J. D. Sell

Replacement Limestone Search
Opposite Cattle Creek (OCC-Series)
T 7 S, R 89 W
Garfield County, Colorado

Opposite, the small town of Cattle Creek on Highway Colorado 82, is a dike-plug appearing feature on the west side of the Roaring Fork River. At this area, the Maroon formation sandstone is completely brecciated and broken apart, mixed, milled, and bleached. Within the chaos, some blocks strike N 65° W, dip 60° SW, while the main breccia dike strikes N 35° W and dips vertical. Other breccia dikes show a variation as a radial pattern from the main area. Some breccia dike material is found across the river at the exit to Cattle Creek. The overall zone of bleached and altered sandstone is over a mile wide and two-three miles long parallel to the river. Normal bright red Maroon Formation is found at both ends along the valley.

The colors within the central complex range from pure white to off-white, pale yellow, burnt yellow, pale pink-red, to dirty red-brown.

The area is similar to the South Mount Sopris area (see report) in being a high gas discharge event and is probably located on the edge and above a Mt. Sopris type intrusive.

The samples of altered sandstone and limestone of the Maroon Formation are described in Table One; the Emission-Spec results tabulated in Table Two; and the location of the area recorded on Figure One.

Minor values in barium and manganese appear in the samples along with variable strontium, titanium, vanadium, and zirconium in various samples. A high of 5 ppm moly was also found in the replacement textured limestone sample (OCC-4). The values are similar to the bleached wall rock of Maroon sandstone found on the south side of Mount Sopris (see sample SMS-3).

James D. Sell
J. D. Sell

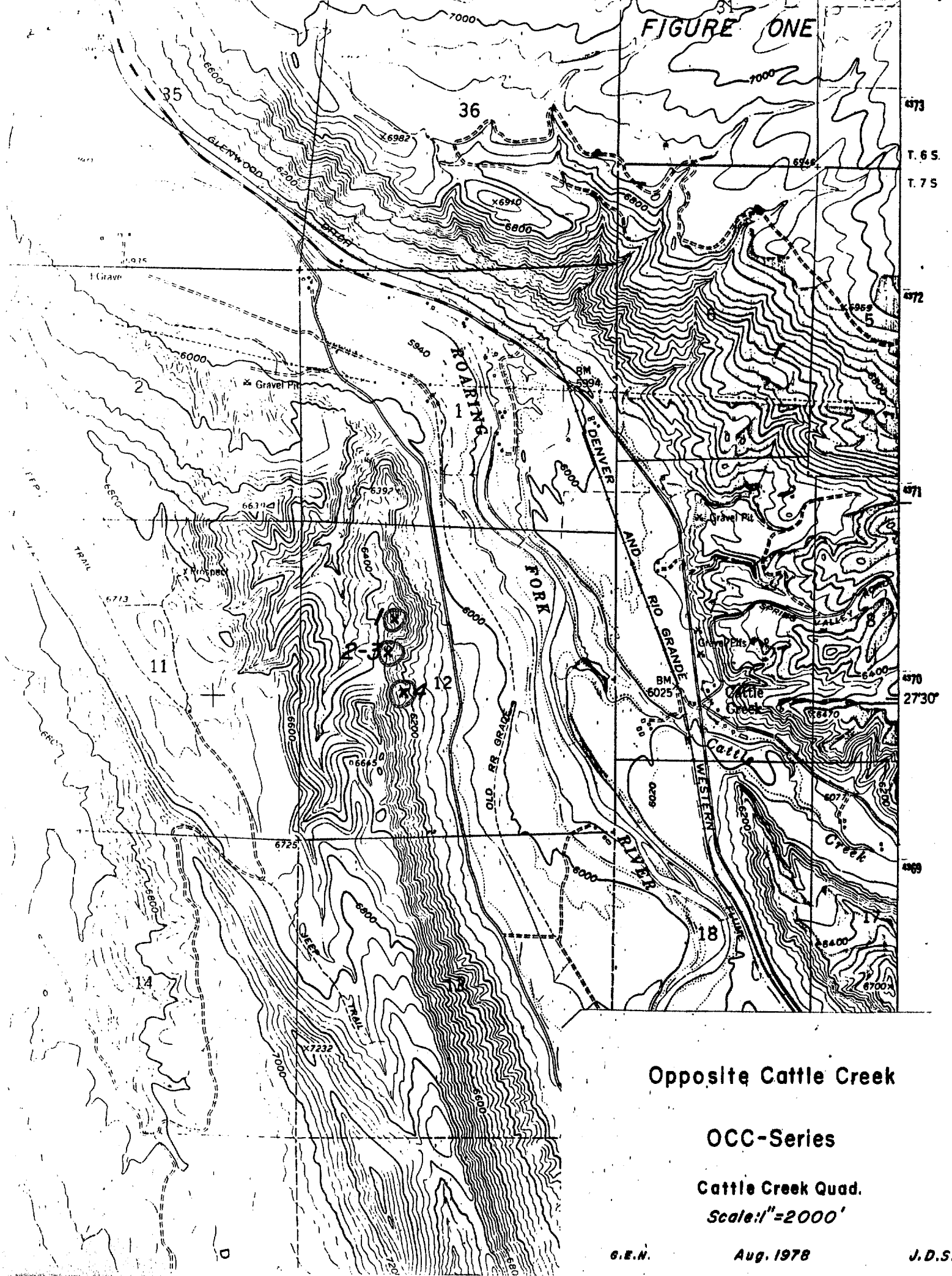
JDS:eff

Attachments

CC: √F. T. Graybeal

Table One - Description of Samples from Opposite Cattle Creek (OCC-Series).
J. D. Sell. July 5, 1978.

1. Light tan-brown-yellow, "burnt" yellow, limonite impregnated and along fractures and in matrix cement of sanded sandstone.
2. Pure white sanded sandstone.
3. Thin, 1/8" surface slabs of black porous sandstone residuals from near site OCC-2.
4. Replacement textured limestone and limestone breccia, very fine crystalline, dark grey to black, with minor calcite dog spar crystals in lower side of one of the sandstone breccia dikes.



Opposite Cattle Creek

OCC-Series

Cattle Creek Quad.

Scale: 1" = 2000'

G.E.N. Aug. 1978 J.D.S.

OPPOSITE CATTLE CREEK AREA (OCC-)

TABLE TWO

ITEM NO.	SAMPLE NO.
9	= GC-05
10	= GC-06
11	= GC-07
12	= GC-08
13	= OCC-01
14	= OCC-02
15	= OCC-03
16	= OCC-04

	OCC-1	OCC-2	OCC-3	OCC-4
ITEM	13	14	15	16
ELEMENT				
Fe	1%	0.7%	0.5%	0.7%
Ca	15%	2%	20%	15%
Mg	0.7%	0.2%	0.3%	0.15%
Ag	<1	<1	<1	<1
As	<500	<500	<500	<500
B	10	20	10	10
Ba	100	50	200	70
Be	<2	<2	<2	<2
Bi	<10	<10	<10	<10
Cd	<50	<50	<50	<50
Co	<5	<5	<5	<5
Cr	<10	15	10	10
Cu	<2	<2	5	3
Ga	<10	<10	<10	<10
Ge	<20	<20	<20	<20
La	20	<20	30	30
Mn	700	100	500	700
Mo	3	2	3	5
Nb	<20	<20	<20	20
Ni	5	10	5	5
Pb	20	<10	10	10
Sb	<100	<100	<100	<100
Sc	<10	<10	<10	<10
Sn	<10	<10	<10	<10
Sr	200	200	500	300
Ti	500	2000	200	200
V	30	50	30	30
W	<50	<50	<50	<50
Y	<10	<10	<10	<10
Zn	<200	<200	<200	<200
Zr	100	500	20	20

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ASARCO

Rocky Mountain
Exploration Division

F. T. G.

August 11, 1978

TO: D. M. Smith, Jr.

File.

FROM: J. D. Sell

Replacement Limestone Search
Black Cloud Ore
#6 Ore Body, Leadville
Park County, Colorado

On the morning of July 14, 1978, Black Cloud geologist, Craig Byington, D. J. Krasowski, and myself, collected a sample of ore from the #6 ore body which was on the conveyor belt from the first crusher at the mill. The sample was mainly fines and ± one inch material.

The Emission-Spec results are on Table One while Table Two is a letter from C. Byington showing a typical assay of the ore at Black Cloud unit.

Of particular interest in the limestone replacement search is the anomalous or significant values of silver (50 ppm), barium (5,000 ppm), cadmium (200 ppm), manganese (5,000 ppm), moly (20 ppm), and of course, lead and zinc. Other values include copper (700 ppm), niobium (20 ppm), and titanium (1,000 ppm). It is unknown if the titanium values are totally from the ore or partially from the crusher steel and other metal partially consumed in the mining operation.

Note that the lead concentrate (Table Two) value for arsenic of 0.162% vs. 50 ppm in the ore; also antimony of 0.084% vs. less than 100 ppm, and bismuth 0.02% vs. less than 10 ppm. In the zinc concentrates, the cadmium values of 0.30% vs. 200 ppm in ore and 0.30% manganese vs. 5,000 ppm in ore.

Certainly, samples with anomalous values in silver, barium, cadmium, manganese, moly, and plus or minus lead-zinc are indicative in the search for additional ore bodies of this type.

James D. Sell
J. D. Sell

JDS:eff

Attachments

CC: ✓F. T. Graybeal

 TABLE ONE

ITEM NO. SAMPLE NO.
1 = L-3

ITEM	1
ELEMENT	
Fe	10%
Ca	2%
Mg	0.5%
Ag	50
As	500
B	15
Ba	5000
Be	<2
Bi	<10
Cd	200
Co	<5
Cr	10
Cu	700
Ga	10
Ge	<20
La	<20
Mn	5000
Mo	20
Nb	20
Ni	10
Pb	10000
Sb	<100
Sc	<10
Sn	10
Sr	200
Ti	1000
V	30
W	<50
Y	<10
Zn	>10000
Zr	20

Leadville, Black Cloud, ore from conveyor belt, AM shift of 7/14/78.

Charles E. Thompson
Chief Chemist

TABLE TWO

ASARCO

Leadville Unit

John R. Hoyer
Unit Superintendent

July 17, 1978

Dennis Krasowski
Denver Exploration
ASARCO Incorporated
1805 South Bellaire Street
Denver, CO 80222

Dear Dennis:

Here are the assays you asked for. I have included the trace metals assays that are determined here or at the smelter. Although there isn't a great number of trace metals which are assayed for, I hope that these may be of some value to you. You may want to send a copy to Jim Sells also.

Lead Concentrates

Fe%	Ni%	As%	Sb%	Bi%
3.5	0.01	0.162	0.084	0.02

Zinc Concentrates

Fe%	Cd%	Mn%
10.0	0.30	0.30

Sincerely yours,

Craig B. Byington

CBB:ib

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ASARCO

Rocky Mountain
Exploration Division

F. T. G.

August 9, 1978

TO: D. M. Smith, Jr.

FROM: J. D. Sell and D. J. Krasowski

Replacement Limestone Search
Carbonate Hill Area (CL-Series)
T9S, R80W, Leadville District
Lake County, Colorado

On June 29, 1978, we, along with K. Von Fay, examined the Carbonate Hill Area on the southeastern outskirts of Leadville. The dump samples were taken as examples of the type of discarded mineralization and wall rock of the productive mines of the area.

Table One is a description of the samples; Table Two is the Emisson-Spec results of the samples; and Figure One records the locations.

If no Mn in spec then black in rock prob not Mn mineral

The porphyry sill sample (CL-1) had a minor amount of FeOx and MnOx stain, but this is not recorded in any anomalous value in the spec results. The minor titanium (300 ppm) is undoubtably tied up within the ferromags within the porphyry. In the field exposures it often appears that altered and stained porphyry are associated with mineral zones, but the spec results do not report any unusual relations.

Sample CL-2 is a sample of the black iron jasper of complete replacement of the Leadville dolomite which often partially or completely surrounds the ore bodies. The companion sample CL-3, from the same dump, is the wall rock Leadville dolomite with weak, but pervasive recrystallization texture, contains vugs, secondary dolomite crystal patches, zebra development, minor rod development, and contains a minor amount of FeOx-MnOx.

As expected, the iron jasper (CL-2) contained 10% iron with anomalous values of silver (100 ppm), barium (5,000 ppm), cadmium (200 ppm), manganese (+10,000 ppm), lead (5,000 ppm), and zinc (+10,000 ppm), with some molybdenum (10 ppm). Within the wall rock dolomite (CL-3) the anomalous manganese (2,000 ppm) and minor lead (500 ppm) are the only indicative values.

Sample CL-4 appeared in the field to be a more intensely mineralized example of CL-2, being a totally replaced Fe-Mn-silica-jasper with high-grade pods and seams of zinc carbonate and/or silicate. The CL-4 spec results show only 1% iron, but noticeable silver (15 ppm), cadmium (100 ppm), copper (50 ppm), and anomalous manganese (+10,000 ppm) and zinc (+10,000 ppm) values.

Samples CL-5 and CL-6 were taken at the same dump site, with CL-5 being the totally replaced jasperiod ranging in color from the shinny, dense, orange-brown type to the red-black type of Fe-Mn and containing very small vugs. CL-6 is the moderately recrystallized dolomite wall rock containing minor zebra features, and having noticeable Fe-Mn along fractures and soaked throughout the mass of sample.

In the jasperiod (CL-5) the anomalous values are again, silver (10 ppm), barium (500 ppm), manganese (+10,000 ppm), zinc (7,000 ppm), and minor lead (500 ppm). The recrystallized wall rock (CL-6) had a trace of manganese (500 ppm) and an increase in titanium (150 ppm), with an anomalous ratio of magnesium (15%) to calcium (10%).

From these samples, it would appear that the recrystallized textures alone (CL-3 and CL-6), without abundant secondary dolomite filled vugs, quartz crystal growth, and coloration, show little addition of values suggesting their nearness to jasper and/or ore.

* The jasperiods (CL-2, CL-4, and CL-5) invariably show noticeable silver and high manganese-zinc values with variable, but often anomalous values in barium, cadmium, and lead.

James D. Sell
J. D. Sell

Donald J. Krasowski
D. J. Krasowski

JDS:DJK:eff

Attachments

CC: √ F. T. Graybeal

Table One - Description of the samples from the Carbonate Hill Area (CL-Series). J. D. Sell, D. J. Krasowski, and K. Von Fay. 6/29/78.

1. Porphyry, white, overall argillic alteration with sericite in the biotite sites, minor FeOx in vugs, on fractures, and with minor MnOx.
2. Leadville dolomite, complete replacement by black iron jasper with minor secondary silica with some zinc carbonate-silicate veining.
3. Leadville dolomite, wall rock, weak, but pervasive recrystallization texture with vugs, secondary dolomite crystals patches, zebra and minor rod development, with faint MnOx throughout as patches and linear streaks as well as minor Fe-MnOx on fractures and bedding planes.
4. Leadville dolomite, total replacement by Fe-Mn-silica-jasper with high-grade pods and seams of lead-zinc carbonate-silicate, minor replacement textured fragments remain.
5. Leadville dolomite, total replacement by shinny, dense orange-brown to red-black Fe-Mn jasper, few small vugs.
6. Leadville dolomite, wall rock, minor zebra, excellant medium recrystallized replacement texture with moderate Fe-Mn soaking and along fracture with trace of ankerite films and manganese dendrites.

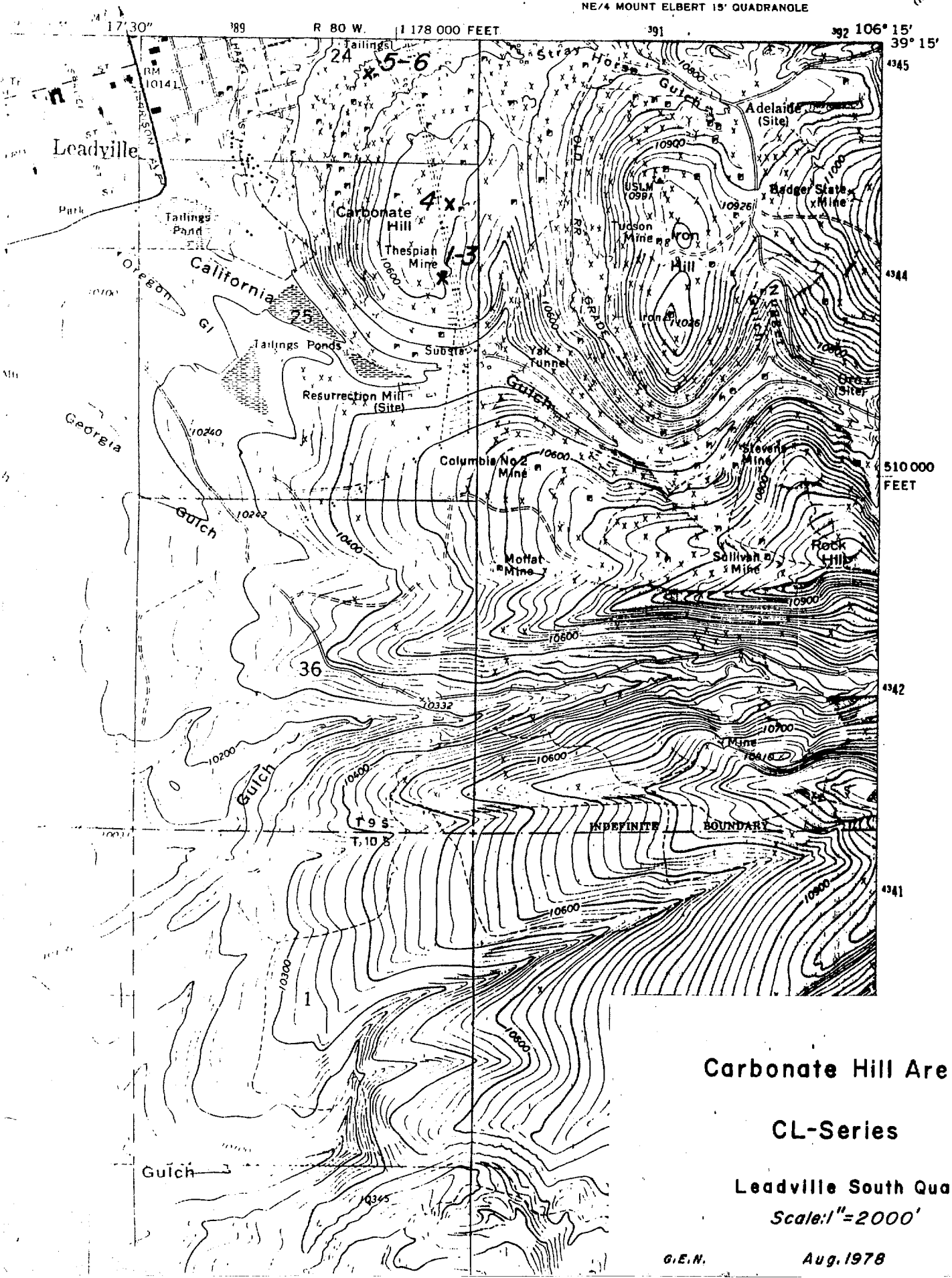
ITEM NO.	SAMPLE NO.
1	C-01
2	M-01
3	M-02
4	M-03
5	CL-01
6	CL-02
7	CL-03
8	CL-04

	CL-1	CL-2	CL-3	CL-4	CL-5	CL-6
ITEM	5	6	7	8	9	10
ELEMENT					NT	
Fe	0.5%	10%	0.5%	1%	10%	0.5%
Ca	0.02%	0.7%	20%	0.5%	0.1%	10%
Mg	0.1%	0.1%	15%	0.2%	0.1%	15%
Ag	<1	100	2	15	10	1
As	<500	<500	<500	<500	<500	<500
B	<10	10	<10	<10	10	<10
Ba	100	5000	10	50	500	<10
Be	2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10
Cd	<50	200	50	100	<50	<50
Co	<5	<5	<5	<5	<5	<5
Cr	<10	<10	<10	<10	<10	<10
Cu	2	5	<2	150	20	2
Ga	10	<10	<10	<10	<10	<10
Ge	<20	<20	<20	<20	<20	<20
La	50	<20	20	20	<20	20
Mn	200	>10000	2000	>10000	>10000	500
Mo	<2	10	<2	<2	5	<2
Nb	20	20	<20	<20	20	<20
Ni	<5	<5	<5	<5	<5	<5
Pb	30	5000	500	200	500	100
Sb	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	<10	<10
Sn	<10	<10	<10	<10	<10	<10
Sr	200	100	100	100	200	100
Ti	300	<20	<20	20	<20	150
V	20	50	20	30	30	30
W	<50	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	<10	<10
Zn	<200	>10000	500	>10000	7000	300
Zr	30	<20	<20	<20	<20	<20

FIGURE ONE

LEADVILLE SOUTH QUADRANGLE
COLORADO—LAKE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 MOUNT ELBERT 15' QUADRANGLE

4762 I
(MOUNT LINCOLN)
1:62 500



Carbonate Hill Area

CL-Series

Leadville South Quad

Scale: 1" = 2000'

G.E.N. Aug. 1978 J.D.S.

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ASARCO

Rocky Mountain
Exploration Division

F. T. G.

August 8, 1978

TO: D. M. Smith, Jr.

FROM: J. D. Sell and D. J. Krasowski

Limestone Replacement Search
Missouri Hill (M-) and
Cooper Mtn. (C-Series) Areas
T8S, R80W
Lake County, Colorado

The areas were visited on June 28, 1978, by J. D. Sell, D. J. Krasowski, and K. Von Fay. The area is a portion of a belt of Leadville dolomite containing numerous pits, with heavy forest cover, continuing north from the Leadville district. In 1971, C. E. Beverly collected a sample from the north shaft of the Jennie June Mine which ran 0.18 oz. gold, 0.76 oz. silver, and 0.08% zinc. (See report dated October 12, 1971, Tennessee Pass Area.)

Our group collected two samples from the area: M-1 at the location of the Jennie June Mine, and M-2 on a similar structure to the south. Both samples were massive Fe-jasper replacement of Leadville dolomite along east-west structures, with replacement texture, zebra features, secondary dolomite crystals and minor quartz crystals throughout the wall rock found on the dumps. The spec results indicated minor copper values of 150 ppm (M-1) and 700 ppm (M-2) with high manganese in M-1 (3,000 ppm) and a trace (500 ppm) in M-2. Moly was noticeable; M-1 having 10 ppm, while M-2 had 20 ppm. No anomalous silver, lead, or zinc values were associated with these jasperiods.

Would anomalous Ti - Zr be significant? Even if highly anomalous?

The remaining two samples were of porphyry. M-3, the Pando-type near the Jennie June Mine shows only titanium (1,000 ppm) and zirconium (100 ppm) while the large mass of Lincoln porphyry (C-1) returned values of titanium (1,000 ppm) and minor zirconium (50 ppm) with increased barium (200 ppm). The porphyry values are similar to other porphyry results in the district.

Table One is a description of the samples; Table Two a copy of the Emission-Spec results; and the location of the samples recorded on Figure One.

Tentative interpretation is that the values are not as indicative as other areas which have been sampled, but the widespread replacement textures noted here suggest that the entire belt of Leadville dolomite should be examined for additional and more conclusive clues from here south to the main Leadville District.

Elements of interest:

ORE	ASSOC W. ORE MINERALS	ASSOC METALS POSSIBLY OF MAJOR SIGNIFICANCE	POSSIBLY SIGNIFICANT
Pb	Cd	Mn	Cu Bi
Zn	Ag	Ba	Sb
		Au(?) - can't be picked off spec.	As
			Mo
			Mg or Mg/Ca

Not significant:
B, Be, Co, Cr, Ga, Ge, La, Nb, Ni, Sc, Sn, Sr, Ti, V, W, Y, Zr

James D. Sell
J. D. Sell

Dennis J. Krasowski
D. J. Krasowski

JDS:DJK:eff

Attachments

CC: F. T. Graybeal

Table One - Description of the samples from the Missouri Hill (M-Series) and Cooper Mountain (C-Series) areas. J. D. Sell, D. J. Krasowski, and K. Von Fay. 6/28/78.

M-1 Leadville dolomite, FeOx, Fe-jasper, pyrite pseudomorphs, massive replacement along east-west quartz-bearing structures (middle vein).

M-2 Leadville dolomite, same as above on south vein. Abundant zebra features, secondary dolomite crystals, minor quartz crystals throughout the area.

M-3 Porphyry, Pando-type, weak clay, some sericite, biotite altered, clay in feldspars, minor FeOx on seams and joints.

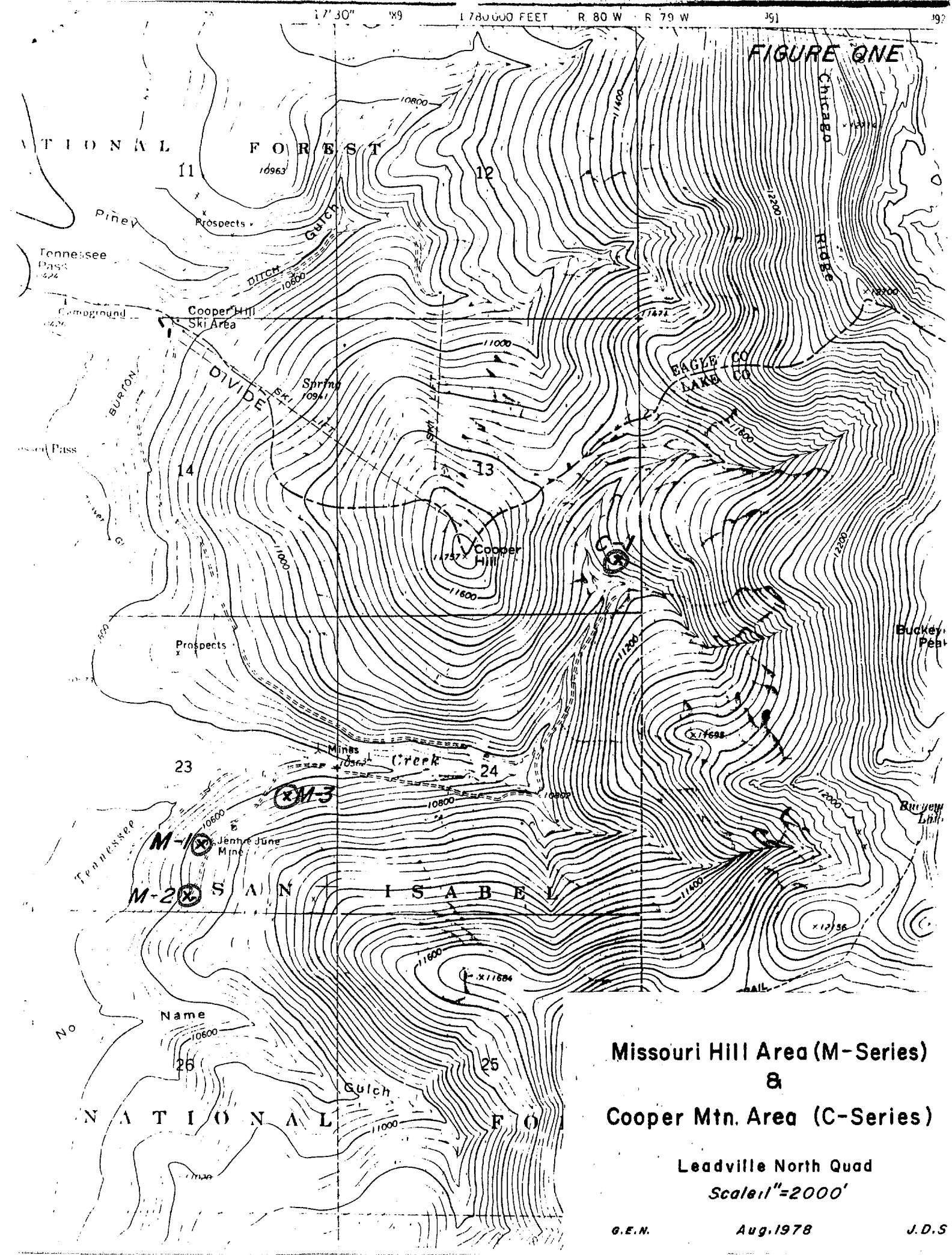
C-1 Lincoln Porphyry, weak clay on feldspars with patches of pyritic to hematitic FeOx replacing former feldspar sites. Nil quartz veining.

MISSOURI HILL
&
COOPER MOUNTAIN AREAS

TABLE TWO

	C-1	M-1	M-2	M-3
ITEM	1	2	3	4
ELEMENT				
Fe	2%	15%	15%	3%
Ca	0.07%	5%	0.05%	0.07%
Mg	0.05%	0.1%	0.1%	0.2%
Ag	<1	1	<1	<1
As	<500	<500	<500	<500
B	<10	10	20	10
Ba	<10	10	<10	200
Be	<2	<2	2	<2
Bi	<10	<10	<10	<10
Cd	<50	<50	<50	<50
Co	<5	<5	10	<5
Cr	<10	<10	<10	<10
Cu	2	150	700	5
Ga	10	<10	<10	10
Ge	<20	<20	<20	<20
La	50	<20	<20	20
Mn	100	3000	500	150
Mo	<2	10	20	<2
Nb	20	20	20	20
Ni	<5	5	15	5
Pb	10	10	10	20
Sb	<100	<100	<100	<100
Sc	<10	<10	<10	<10
Sn	<10	10	15	<10
Sr	100	100	100	200
Ti	1000	<20	200	1000
V	50	30	70	20
W	<50	<50	<50	<50
Y	<10	<10	<10	<10
Zn	<200	<200	200	<200
Zr	100	<20	<20	50

SKYLINE LABS
SPECIALISTS IN EXPLORATION



Missouri Hill Area (M-Series) & Cooper Mtn. Area (C-Series)

Leadville North Quad

Scale 1"=2000'

G.E.N. Aug. 1978 J.D.S

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AUG 24 1978
S. W. U. S. EXPL. DIV.

ASARCO

F. T. G.

Rocky Mountain
Exploration Division

August 7, 1978

TO: D. M. Smith, Jr.

FROM: J. D. Sell

Limestone Replacement Search
Western Pass Area (WP-Series)
Unsurveyed T10S, R79W
Lake County, Colorado

The exploration potential of the Weston Pass area has long been considered by the Denver Office (see files) and small ore trends undoubtably exist in the area. During June 22-25, 1978, I examined the area and collected a number of samples to compare with those from the Gilman-Leadville area. Table One is the description of the samples with the Emission-Spec results in Table Two. The sample locations are recorded on Figure One.

Samples WP-3 and WP-7 were collected from the Weston Pass fault as a check of possible mineral leakage through the structure. WP-3 being Cambrian Sawatch quartzite breccia with films and one-quarter inch FeOx layers. The arsenic value of 2,000 ppm is anomalous along with minor copper (100 ppm) and titanium (100 ppm). The latter value is probably detrital. WP-7 is from crushed Precambrian granite containing what appears to be melaconite-pyrite pseudomorphs. Values of 5 ppm silver, 1,000 ppm zinc, 150 ppm copper, and 2,000 ppm titanium was reported. The latter two not being indicative in the granite terrain.

To the west, well away from the Weston Fault zone, a northeast-trending sanded zone cutting Sawatch quartzite (WP-10) reported only a slight enrichment in beryllium (10 ppm), with all other values at or near the detection limit. This northeast zone trends toward sample site WP-9 which is a sandy unit of either the Peerless formation or the upper part of the Sawatch. A green coloration was present among the sand grain matrix and with the 10% iron content of the sample and no other comparable values, it is suggestive of being an iron sulfate. Minor copper (100 ppm) and zirconium (200 ppm) was reported.

The apparent most productive area within the district sampled came from sample site of WP-1 and WP-1A. Both samples were from the same dump of Dyer dolomite, with WP-1 being totally oxidized, high-iron, dense red-orange jasperiod with silica overgrowths. The sample contained anomalous silver (15 ppm), lead (10,000 ppm), and zinc (10,000) with minor copper (100 ppm) and moly (50 ppm).

Are single samples enough.

The sample WP-1A was recrystallized, coarse-grained dolomite with blebs and stringers of galena. The magnesium content of 10% vs. 5% calcium is anomalous along with silver (10 ppm), lead (+10,000 ppm) and zinc (+10,000 ppm). Also 100 ppm copper was reported.

The Leadville dolomite was sampled from south to north. Sample WP-2, from the lower portion, was collected from FeOx-sanded-jasper zones cutting non-recrystallized sand units. Only 1,000 ppm titanium and 300 ppm zirconium were reported, probably reflective of the detrital material brought in with the sand during original deposition.

Two samples were collected from an area showing a thick sequence of recrystallized texture, zebra structure, vugs, secondary dolomite crystals in vugs and seams, and quartz crystal growth. Sample WP-6 was the wall rock showing a few iron pseudomorphs after pyrite and only minor zinc (700 ppm) was reported. The sample WP-6A was the totally replaced FeOx sinter replacement and contained high iron (20%), 5,000 ppm arsenic, and minor values in moly (10 ppm), nickel (50 ppm), and vanadium (200 ppm).

The last Leadville dolomite sample is WP-8, being a massively replaced zebra bed of FeOx-sinter, weak jasperiod development, with minor pyrite pseduomorphs. Again, high iron (20%), arsenic (5,000 ppm), with moly (10 ppm), nickel (100 ppm), and vanadium (200 ppm) were reported.

Overlying the Leadville unit is a consistent sill of porphyry and one sample was taken (WP-5) in what appeared to have sulfidized ferromags. The spec results show no values, not even in barium and titanium which other samples of porphyry had often revealed.

Two samples of Belden Shale were collected. WP-4, from the main part of the old district contained pyrite seams and gypsum flakes. Only 2% iron was reported along with 20% calcium, plus minor manganese (500 ppm). The other Belden sample, WP-11, was taken on the far north side of the area showing FeOx knots and pyrite pseudomorphs. Here the iron was reported at 10%, with 1,000 ppm titanium the only other value of note.

length of zone

what is replacement texture? Is this silicification as seen at Magma?

Tentative conclusions suggest that a half mile wide zone of increased replacement texture, zebra structure, vugs, secondary dolomite crystals and quartz crystal growth is centered around sample site 6-6A. The anomalous arsenic of the area and the variable vanadium is unusual based on sampling in other areas, but may be indicative of a silver-poor, lead-enriched system.

The galena in the Dyer occupies relatively unaltered units. Manganese-braium was absent although silver values were present. If major bodies of sulfide are present down dip toward the Weston fault, they show little expression based on the present sample coverage.

James D. Sell

James D. Sell

JDS:eff

Attachments

CC: ✓F. T. Graybeal

Table One - Description of Samples from the Weston Pass Area (WP-Series). J. D. Sell, 6/20-25/78.

1. Dyer dolomite, totally oxidized, high FeOx, silica overgrowths, with dense red-orange-brown jasper.
1A. Dyer dolomite, recrystallized, coarse grained dolomite with galena (± 5%) as curved blebs and stringers.
2. Leadville dolomite, lower unit, narrow FeOx-jasper-quartz grains, purple coating, cutting fine sanded, yellowish white to light grey, medium crystalline dolomite.
3. Sawatch quartzite, films to 1/4 inch layers of FeOx cementing breccia in Weston Pass fault zone.
4. Belden Shale, gypsiferous, with thin, fine pyrite seams.
5. Rhyolite porphyry, with sulfidized ferromags, and minor pyrite with melaconite and tourmaline.
6. Leadville dolomite, minor iron pseudomorphs in secondary recrystallized dolomite with secondary dolomite crystals in vugs and veins, quartz crystal growths.
6A. Leadville dolomite, complete replacement by FeOx sinter.
7. Precambrian granite, crushed in Weston fault zone, with quartz-sericite and melaconite-pyrite pseudomorphs.
8. Leadville dolomite, massive replaced zebra bed with iron sinter, pyrite pseudomorphs, weak jasper development.
9. Peerless formation (may be upper Sawatch), iron added to quartz grains in sandstone and quartzite with emerald green specks and grains.
10. Sawatch quartzite, iron seams in sanded zones along N30°E shears. (Zone projects to sample WP-9 area, but iron content is less.)
11. Belden Shale, sandy-limy unit with FeOx knots and masses with pyrite pseudomorphs. Complex structure. Sill of porphyry may overlie sample site.

ITEM NO.	SAMPLE NO.
17	G-07
18	G-08
19	WP-01
20	WP-01A
21	WP-02
22	WP-03
23	WP-04
24	WP-05

	WP-1	WP-1A	WP-2	WP-3	WP-4	WP-5
ITEM	19	20	21	22	23	24
ELEMENT						
Fe	20%	1%	5%	5%	2%	0.07%
Ca	0.05%	5%	0.5%	0.03%	20%	1%
Mg	0.03%	10%	0.2%	0.03%	2%	0.2%
Ag	15	10	<1	<1	<1	<1
As	<500	<500	<500	2000	<500	<500
B	20	<10	15	<10	<10	10
Ba	<10	<10	<10	<10	<10	50
Be	<2	<2	2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10
Cd	<50	300	<50	<50	<50	<50
Co	<5	<5	<5	5	<5	<5
Cr	<10	<10	<10	<10	10	<10
Cu	200	100	2	100	5	2
Ga	10	<10	<10	<10	<10	<10
Ge	50	<20	<20	<20	<20	<20
La	<20	20	30	20	50	50
Mn	100	300	200	200	500	150
Mo	50	<2	<2	2	<2	<2
Nb	20	<20	30	20	20	20
Ni	<5	<5	<5	5	5	<5
Pb	10000	>10000	150	200	20	10
Sb	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	<10	<10
Sn	20	<10	<10	<10	<10	<10
Sr	<100	<100	100	<100	300	200
Ti	20	<20	1000	200	700	300
V	20	10	50	100	30	10
W	<50	<50	<50	<50	<50	<50
Y	<10	<10	10	<10	10	<10
Zn	10000	>10000	200	<200	<200	<200
Zr	<20	<20	300	70	20	50

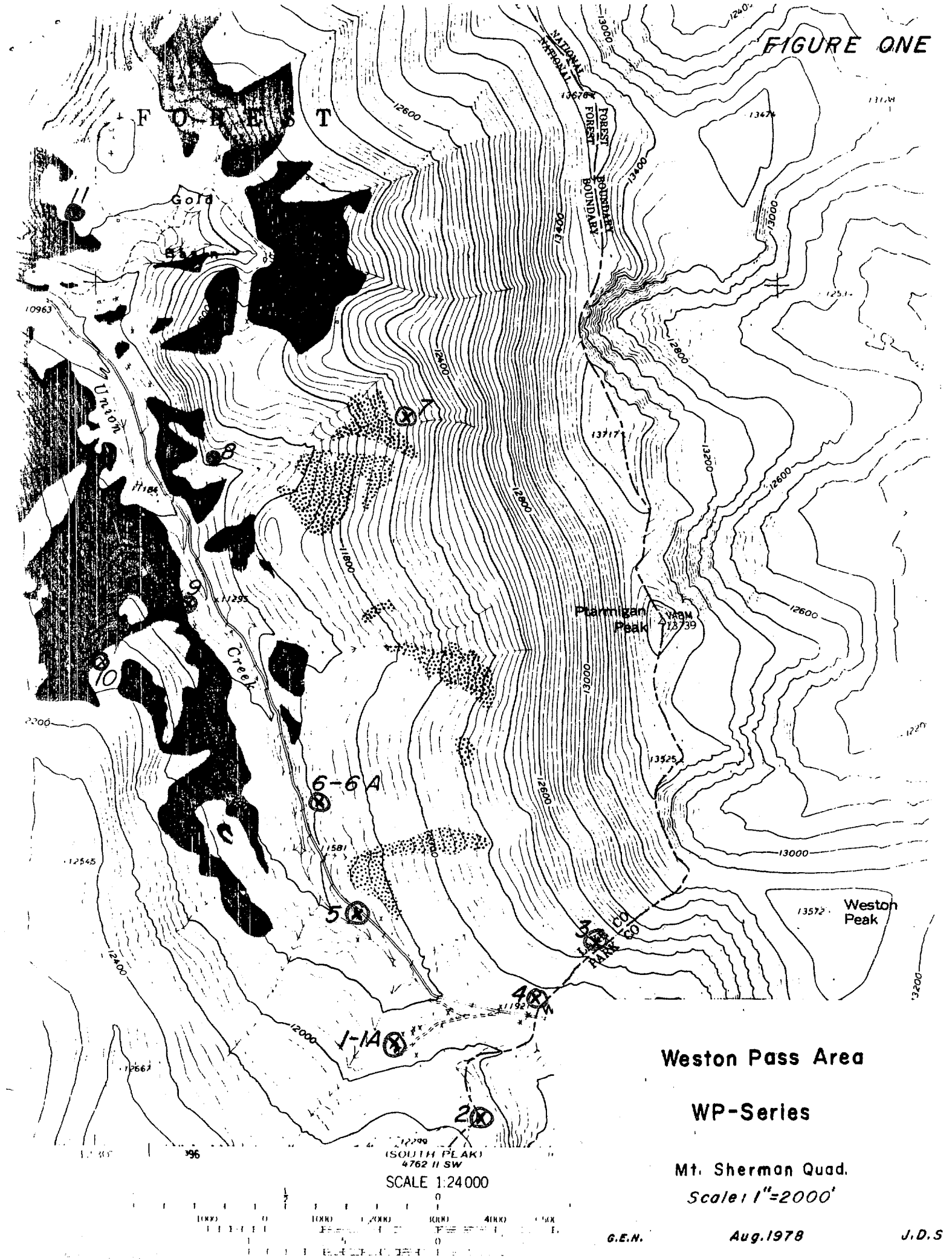
ITEM NO.	SAMPLE NO.
25	= WP-06
26	= WP-06A
27	= WP-07
28	= WP-08
29	= WP-09
30	= WP-10
31	= WP-11

	WP-6	WP-6A	WP-7	WP-8	WP-9	WP-10	WP-11
ITEM	25	26	27	28	29	30	31
ELEMENT							
Fe	0.01%	20%	1%	20%	10%	5%	10%
Ca	15%	1.5%	0.05%	0.1%	0.1%	0.02%	0.1%
Mg	15%	0.2%	0.1%	0.05%	0.1%	0.03%	0.15%
Ag	<1	<1	5	<1	<1	<1	<1
As	<500	5000	<500	5000	<500	500	<500
B	<10	20	<10	30	20	<10	20
Ba	<10	<10	20	10	<10	<10	10
Be	<2	<2	<2	2	7	10	2
Bi	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50
Co	<5	5	<5	7	<5	<5	5
Cr	<10	<10	<10	10	<10	<10	20
Cu	<2	5	150	10	100	50	30
Ga	10	<10	<10	10	10	<10	<10
Ge	<20	<20	<20	<20	<20	<20	<20
La	20	<20	50	<20	<20	<20	<20
Mn	200	50	50	50	100	50	70
Mo	<2	10	<2	10	2	2	3
Nb	<20	20	20	20	20	20	20
Ni	<5	50	<5	100	5	5	10
Pb	10	50	200	70	10	20	<10
Sb	<100	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	10	<10	10
Sn	10	15	<10	20	<10	<10	<10
Sr	100	<100	100	<100	<100	<100	100
Ti	<20	100	2000	200	500	150	1000
V	20	200	20	200	50	30	50
W	<50	<50	<50	<50	<50	50	<50
Y	<10	<10	<10	<10	10	<10	20
Zn	700	<200	1000	200	<200	<200	<200
Zr	<20	<20	70	<20	200	30	30

Edwin V. Pot
for Charles E. Thompson
Chief Chemist

SKYLINE LABS, INC.
SPECIALISTS IN EXPLORATION GEOCHEMISTRY

FIGURE ONE



Weston Pass Area

WP-Series

Mt. Sherman Quad.

Scale: 1"=2000'

G.E.N. Aug. 1978 J.D.S

RECEIVED
AUG 24 1978
S. W. U. S. EXPL. DIV.

ASARCO

F. T. G.

Rocky Mountain
Exploration Division

August 7, 1978

TO: D. M. Smith, Jr.

FROM: J. D. Sell and D. J. Krasowski

Limestone Replacement Search
Gilman Area (G-Series)
Unsurveyed T6S, R81W
Eagle County, Colorado

On June 27, 1978, J. D. Sell, D. J. Krasowski, and K. Von Fay, collected a series of samples in the Gilman area.

Table One is the description of the samples and Table Two contains the Emission-Spec results; with the sample locations shown on Figure One.

The first four samples were collected in and around the oxidized outcrop of the upper part of the South Ore Run of the Gilman mine workings. Sample G-1 is the Gilman porphyry sill while G-2 through G-4 are successive samples from the wall rock (G-2) of recrystallized Leadville dolomite containing coarse secondary dolomite crystal in vugs and connecting seams; grading to G-3 of total replacement by dense red-black hematite, some jasper, siliceous, and having vuggy texture (partially oxidized to orange-red limonite); to G-4 the core of mineral replacement of crystalline and pulverulent black manganese and hematite.

The porphyry sill (G-1) contained noticeable barium (300 ppm) and titanium (500 ppm) only.

The "unmineralized" wall rock (G-2) dolomite shows it is enriched in magnesium (15%) and anomalous in manganese (2,000 ppm) and zinc (5,000 ppm), even though no manganese was noticeable in the unit site sampled some thirty feet away from the core. The mineralized jasperiod shell (G-3) contained iron (20%), copper (300 ppm), and anomalous lead (3,000 ppm) and zinc (7,000 ppm); but, only low manganese (500 ppm). The inner core mineralization (G-4) contained only minor iron (5%), but anomalous silver (10 ppm), manganese (+10,000 ppm), nickel (20 ppm), lead (1,500 ppm) and zinc (+10,000 ppm). The increased nickel content is four times the detection limit and some seven times the average limestone content, but no association or relationship of nickel to limestone replacement ore is known.

Sample G-5 was taken in upper Leadville dolomite (shaley) between two ore runs. It has a fine replacement texture with minor FeOx along fractures, joints,

and bedding, and contained coarse calcite along these surfaces. The spec results show an odd assortment of boron (100 ppm), nickel (30 ppm), vanadium (100 ppm), and zirconium (200 ppm), along with anomalous titanium (3,000 ppm); perhaps in keeping with the dark shale environment.

In the Precambrian basement of biotite granite gneiss, located below the main ore run, sample G-6 was taken with FeOx-MnOx films on joint faces and minor jarosite present. The spec results indicate a trace of barium (100 ppm) and high zerconium (100 ppm) and titanium (2,000 ppm); these latter two, and possibly all three values, undoubtably reflecting the igneous parentage.

Sample G-7 was taken north of the ore runs in dirty brown, limonite, sandy dolomite just above the Sawatch-Peerless contact. Field observations suggested that fluid movement had taken place along the contact zone, but the spec results show only titanium (1,000 ppm), and zirconium (150 ppm) as the only misbehaving elements, and these may reflect detritus influx from an eroding basement during original sedimentation.

The final sample (G-8) was taken in the middle unit of the Leadville dolomite which exhibited moderate recrystallization textures, weak zebra features, large vugs, and secondary dolomite crystal pods, far north of the known mineralization. Although similar in appearance to sample G-2, the spec results show no pathfinders suggesting movement of mineralized solutions through the section.

Tentative conclusions from the sampling indicates that the mineralized zones and the surrounding "unmineralized" dolomites show anomalous, but variable amounts of silver, manganese, lead, and zinc additions.

Perhaps also that geochemical expression is more important than textural expression

James D. Sell

J. D. Sell

Dennis J. Krasowski

D. J. Krasowski

JDS:DJK:eff

Attachments

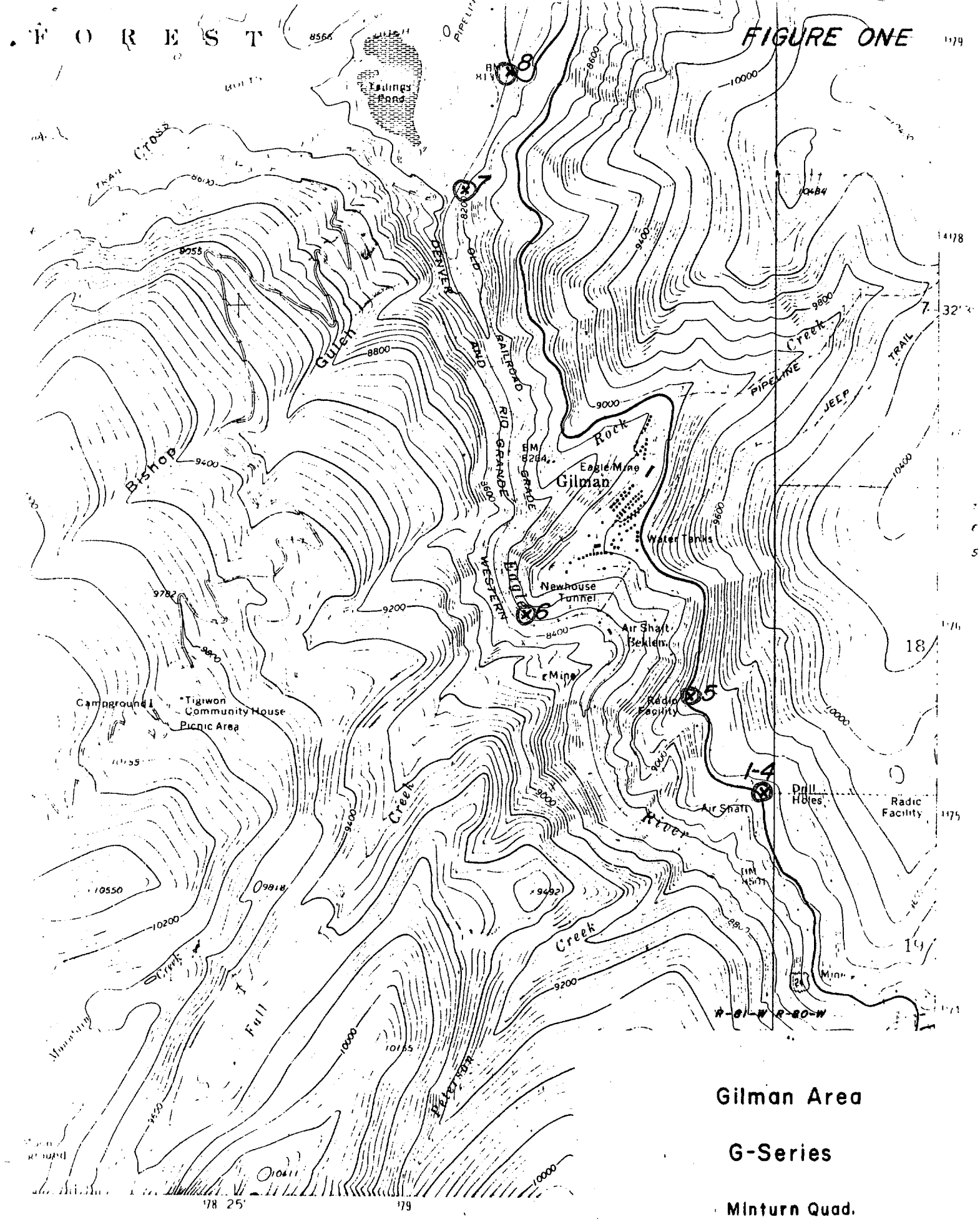
CC: ✓F. T. Graybeal

Table One - Description of the Gilman Area Samples (G-Series).
J. D. Sell, D. J. Krasowski and K. Von Fay. 6/27/78.

1. Gilman sill, porphyry, sericite-argillic alteration with fine manganese films with fine orange-brown limonite stain and incrustations.
2. Leadville dolomite, medium-coarse recrystallization, coarse secondary dolomite crystals in vugs and rare connecting seams. Located thirty feet from mineralized core of G-3 and G-4.
3. Leadville dolomite, complete replacement by dense red-black hematite, siliceous, vuggy, minor jasper; oxidized portions going to orange-red limonite.
4. Leadville dolomite, totally replaced by crystalline and pulverulent powder of black manganese and fine specularite.
   (Note: Sample G-4 core zone is surrounded by G-3 shell which is surrounded by G-2 wall rock.)
5. Leadville dolomite, upper shaley portion, very fine grained, weak fine replacement texture with minor FeOx on fractures, joints, and bedding, with coarse calcite seams along these surfaces.
   (Note: Taken approximately half way between two ore runs.)
6. Precambrian biotite granite gneiss, manganese and iron oxide films and minor thin fillings on joint faces, minor jarosite.
7. Peerless shale, sandy, gritty, dolomite with dirty brown to orange brown limonite. Fractures trend to northeast.
8. Leadville dolomite, middle unit, moderate recrystallized texture, weak zebra features, large vugs, secondary dolomite crystal pods.

ITEM NO.	SAMPLE NO.
9	CL-05
10	CL-06
11	G-01
12	G-02
13	G-03
14	G-04
15	G-05
16	G-06

	G-1	G-2	G-3	G-4	G-5	G-6	G-7	G-8
ITEM	11	12	13	14	15	16	17	18
ELEMENT								
Fe	1%	0.5%	20%	5%	5%	2%	5%	0.2%
Ca	0.1%	15%	0.05%	0.1%	0.7%	0.2%	2%	20%
Mg	0.1%	15%	0.03%	0.03%	1%	0.7%	1%	15%
As	<1	<1	1	10	<1	<1	<1	<1
As	<500	500	<500	<500	500	500	500	<500
B	10	<10	20	10	100	20	30	<10
Ba	300	<10	<10	<10	10	100	20	<10
Be	<2	<2	<2	3	2	2	3	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	70	<50	<50	<50	<50
Co	<5	<5	<5	5	5	<5	<5	<5
Cr	<10	<10	10	<10	<10	<10	<10	<10
Cu	<2	<2	300	50	5	10	2	<2
Ga	10	<10	10	<10	15	15	10	<10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	20	<20	<20	30	50	30	<20	20
Mn	500	2000	500	>10000	300	200	200	300
Mo	<2	<2	10	2	2	<2	<2	<2
Nb	20	<20	20	20	30	20	20	<20
Ni	<5	<5	<5	20	30	5	5	<5
Pb	15	20	3000	1500	10	10	<10	<10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	20	<10	<10	<10
Sn	<10	<10	20	<10	<10	<10	<10	<10
Sr	100	100	<100	<100	200	200	100	<100
Ti	500	<20	20	50	3000	2000	1000	20
V	20	20	70	30	100	50	30	20
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	<10	<10	<10	15	10	10	<10
Zn	<200	5000	7000	>10000	<200	<200	<200	<200
Zr	30	<20	<20	<20	200	100	150	<20



Gilman Area

G-Series

Minturn Quad.

Scale: 1" = 2000'

G.E.N. Aug. 1978 J.D.S

WLK - I pass this on to you re any future plans TCO may have for an exploration meeting.
FTG 3/20/78

ASARCO Southwestern Exploration Division

March 14, 1978

use file Limestone Replacement 11/14/78

F.T.G.

TO: F. T. Graybeal

FROM: J. D. Sell

Prospecting for Ores in Carbonates
In-House Seminar Proposal

I attach the following article by Callahan to renew the interest in prospecting for ores in carbonates. The article is entitled: "Some Thoughts Regarding Premises and Procedures for Prospecting for Base Metal Ores in Carbonate Rocks in the North American Cordillerans," by W. H. Callahan: Economic Geology, V. 72, No. 1, p. 71-81, 1977.

Callahan clearly and strongly endorses the main locations of ore deposits in carbonate rocks. However, he leaves it up to the reader to devise the means and ways of determining how to find additional members of the Appalachian—Mid-Continent—Rocky Mountain—Cordilleran suite of deposits.

I believe there are a number of ways to help zero in on the general environment and habitat of these deposits and I am encouraged that additional clues might be available to the outcrop geologists for a tighter control prior to prospecting by drill hole.

I propose an in-house seminar on the guides to mineralized districts and ore deposits, in specific, through the collection and interchange of ideas, thoughts, concepts, and specific details by interested people from the various offices. Mr. Vance Greene, Knoxville, has extensive knowledge in this area and initiated a study in central Colorado several years ago and undoubtedly could add considerable thought to the specific problem.

Some topics of discussion should include:

1) What are the visual characteristics of favorable limestones-dolomites?
2) What are the chemical characteristics?
3) Do certain ores have a preference? If so, how?
4) How far away are the characteristics observed?
5) Change in type or pattern of characteristic as district or deposit is approached?
6) Do structures enhance the environment? If so, how?
7) Do intrusives enhance the environment? If so, how?
8) Other thoughts, biostratigraphic recognition, etc.?

Perhaps outside speakers could be brought in to chat for a session, such as Dr. Tommy Thompson, who did some Leadville studies for Asarco.

Denver would be a good meeting place from the standpoint of underground studies and relationships at Leadville. Arizona has a number of areas and mines of interest but access underground might be limited.

The interested participants should have some of the data available for discussion and perhaps reproduction, but it would be productive if the sessions could be taped and ultimately condensed into a workbook of knowledgeable facts and thoughts for distribution.

James D. Sell

James D. Sell

JDS:lb
Att.

Economic Geology
Vol. 72, 1977, pp. 71–81