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GEOLOGICAL SURVEY CIRCULAR 564

Occurrences of Gold and Other Metals in the Upper Chulitna District, Alaska

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By C. C. Hawley and Allen L. Clark

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Washington 1968

United States Department of the Interior
STEWART L. UDALL, *Secretary*

Geological Survey
William T. Pecora, *Director*

Free on application to the U.S. Geological Survey, Washington, D.C. 20242

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Occurrences of Gold and Other Metals in the Upper Chulitna District, Alaska

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Abstract

Gold and other metals form deposits clustered in three parts of the upper Chulitna district, near Colorado Creek, the Golden Zone in Bryn Mawr Creek, and Long Creek. Trace amounts of gold in thick quartz veins are in the major Blind Creek fault zone, and scattered small vein deposits and anomalous amounts of gold and other metals in stream sediments indicate widespread mineralization in the district.

The mineral occurrences at Colorado Creek and the Golden Zone are associated with small quartz diorite porphyry stocks; they are of vein, disseminated, and breccia-pipe types. Gold accounts for most of their value, but the deposits are complex and contain abundant arsenic and locally abundant antimony, copper, silver, and zinc, and some molybdenum, tin, cadmium, and bismuth. The deposits at Long Creek are apparently clustered around small quartz porphyry plugs. They contain copper, subordinate amounts of gold and silver, and trace amounts of tin and molybdenum.

INTRODUCTION

Gold and other metals occur in breccia pipes, veins, and disseminated deposits at several places in the upper Chulitna district, on the southern flank of the Alaska Range. The main purpose of this report, made as part of the U.S. Geological Survey's Heavy Metals program, is to call attention to four areas that contain deposits of gold or other metals. From north to south these are: Colorado Creek, Golden Zone, Blind Creek, and Long Creek. The main economic features of each area are:

Colorado Creek area.—A stock of biotite quartz diorite porphyry about 1,500 feet wide by 2,000 feet long has associated arsenic-gold-antimony deposits which contain minor amounts of copper, bismuth, and tin. One sulfide-rich body appears to be a breccia pipe similar to that of the Golden Zone.

Golden Zone area.—The main mineralization at the Old Golden Zone mine is in a breccia-pipe deposit that is 200 to 300 feet across and probably extends in depth to more than 1,000 feet. Although the grade of the deposit is uncertain, it is estimated to contain more than $10,000,000 worth of metals, principally gold, silver, and copper, but with anomalous amounts of tin, molybdenum, bismuth, cadmium, and boron.

Blind Creek.—A major fault zone at Blind Creek contains quartz-rich breccia filling as much as 200 feet thick which contains a trace of gold, arsenic, lead, and zinc.

Long Creek.—Gold- and silver-bearing copper occurrences are widely distributed near Long Creek. The main copper concentration is at the old Copper King prospect, but very sparse amounts of chalcopyrite, molybdenite, and pyrite occur in quartz porphyry plugs nearby. An area of strongly hornfelsed rocks, centered around the main quartz porphyry plugs, possibly is underlain by a quartz porphyry stock at shallow depth.

Results of stream-sediment sampling in the district are shown in figure 10 and table 3.

The upper Chulitna district, southeast of Mount McKinley National Park (fig. 1), is only 8 to 10 miles from the Alaska Railroad, but at present is best reached by small fixed-wing aircraft or helicopter, because roads into the district from the railroad have been abandoned.

Acknowledgments

We gratefully acknowledge the aid and encouragement received from J. J. Mulligan and J. H. Herdlick, U.S. Bureau of Mines. Because the only underground mine workings of the area, those of the Golden Zone mine, are now inaccessible, much assay data is taken from maps contained in a report by Mulligan, Warfield, and Wells (1967) or from unpublished maps furnished by H. R. Beckwith, General Manager of Cemco, Inc., or C. H. Herbert.

We would also like to acknowledge the help of Jon Alan Benfer, who served as field assistant, and of Cliff Hudson, bush pilot of Talkeetna, Alaska, who furnished skilled transport to and from the area.

COLORADO CREEK AREA

Arsenic-gold-antimony deposits in the Colorado Creek area (fig. 2) are associated with a small stock of hornblende-biotite quartz diorite porphyry. The stock is bisected by the deep canyon of Colorado Creek. The stock itself is almost inaccessible except at the bottom of the canyon (approximately 200 feet deep), but it appears generally bleached and locally contains disseminated chalcopyrite (as at the locality noted, fig. 3). The northern and southern contacts of the stock, as exposed in the canyon, are both iron stained, and the southern contact is marked by a zone of tactite, approximately 2 feet wide, containing

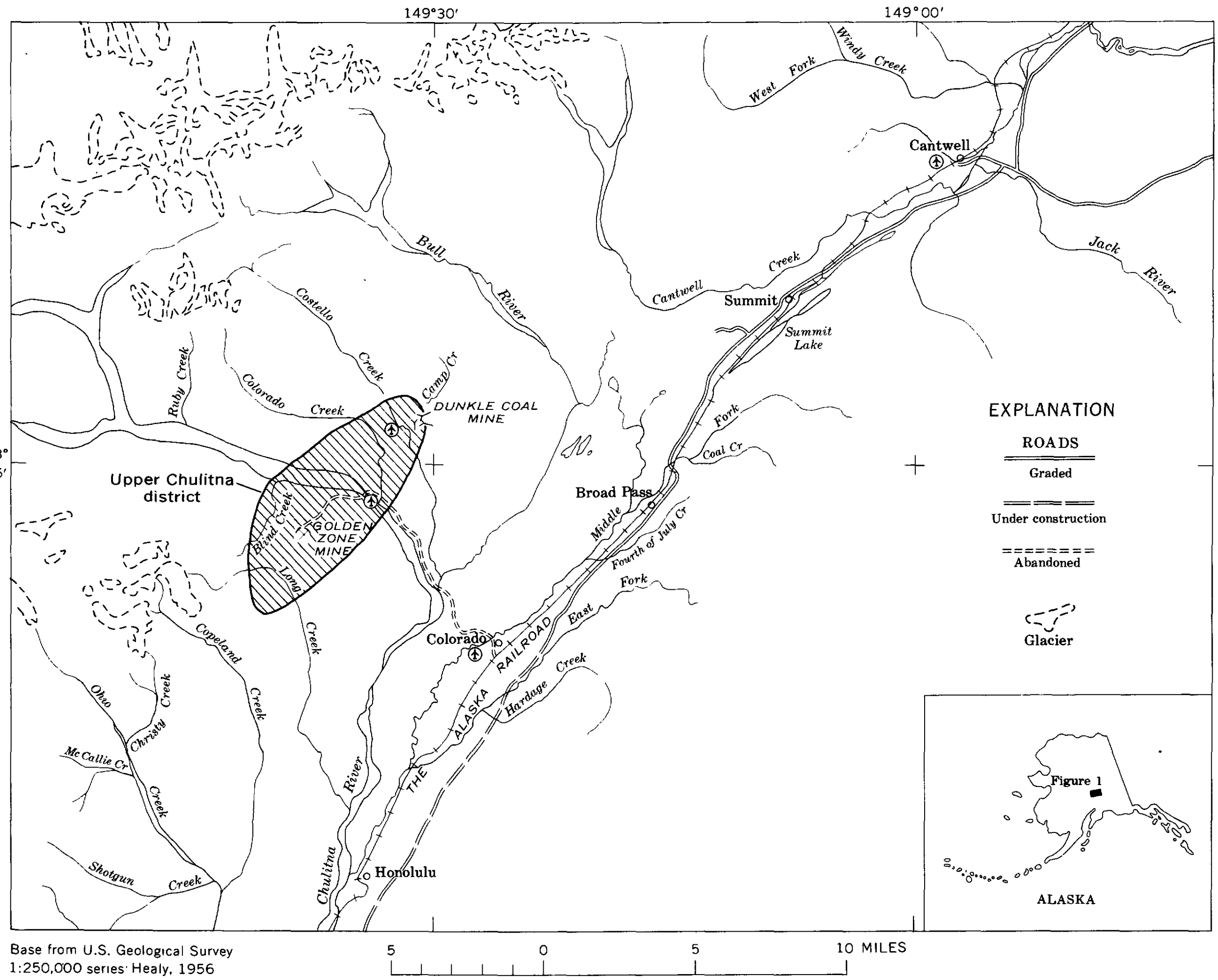


Figure 1.—Location of the upper Chulitna district.

abundant garnet, actinolite, and epidote. The surrounding rocks are hornfelsed and locally are strongly sulfidized.

The main sulfide occurrences are (1) at a previously unprospected knob about 750 feet west-southwest of the Silver King prospect, and (2) at the Silver King prospect itself. The Silver King prospect pits are about 6,000 feet north of the location shown on the Healy A-6 quadrangle map (scale, 1:63,360). Another occurrence is about 750 feet southwest of the main Silver King prospect pits, where an arsenopyrite-stibnite-quartz lode as much as 10 feet wide crops out in Colorado Creek. The new occurrence (locality 1) is a highly sulfidized mass of altered porphyry and hornfels at least 50 feet across that strongly resembles the highly broken and sulfidized rock of the Golden Zone pipe. Arsenopyrite is very abundant, but some chalcopyrite is present, and spectrographic analyses of samples show highly anomalous amounts of bismuth, cobalt, and tin in some samples (table 1). The gold content of samples (table 1) was generally less than 10 ppm (parts per million), but one sample (1A) showed 170 ppm gold by atomic absorption analysis.

The old pits at the Silver King prospect are in moderately to strongly sulfidized hornfels. Stibnite occurs in thin veins in the southernmost main pit and is accompanied locally by gold (sample 7A, table 1). Other samples from the Silver King pits contained from 0.08 to 6.2 ppm gold in addition to markedly anomalous amounts of arsenic and copper; copper ranges from about 150 ppm to 2 percent (20,000 ppm).

The composite vein or lode exposed in Colorado Creek south of the stock consists of distinct hanging and footwall veins in a 10-foot-wide shear zone. The largest vein fissure in the lode, the one sampled, is about 4 feet wide; it contains stibnite and a small amount of gold (sample 9, table 1). A nearby vein (sample 10, table 1) assayed about 20 ppm gold, more than 10 percent antimony, and some lead and zinc.

Except in the canyon of Colorado Creek, exposures are very poor, and therefore it is possible that sulfidized rocks are much more widely distributed than presently known. The contacts of the mineralized rocks at the Silver King prospect and at the knob west of the pits are not exposed, but the mineral deposits at each place appear to be of either disseminated or breccia-pipe type and could be explored by geophysical techniques, trenching, or drilling. Extensive sulfidization at both these places is indicated, particularly by the very high values of arsenic and iron, and at the Silver King by high copper values as well. The amounts of these elements near Colorado Creek are very similar to their abundances at the Golden Zone deposit, as may be seen by comparing the analyses in tables 1 and 2.

Further evidence of mineralization in the Colorado Creek area is given by the anomalous metal values at and near the old Liberty and Lucrata prospects (Nos. 11, 12, and 13, table 1).

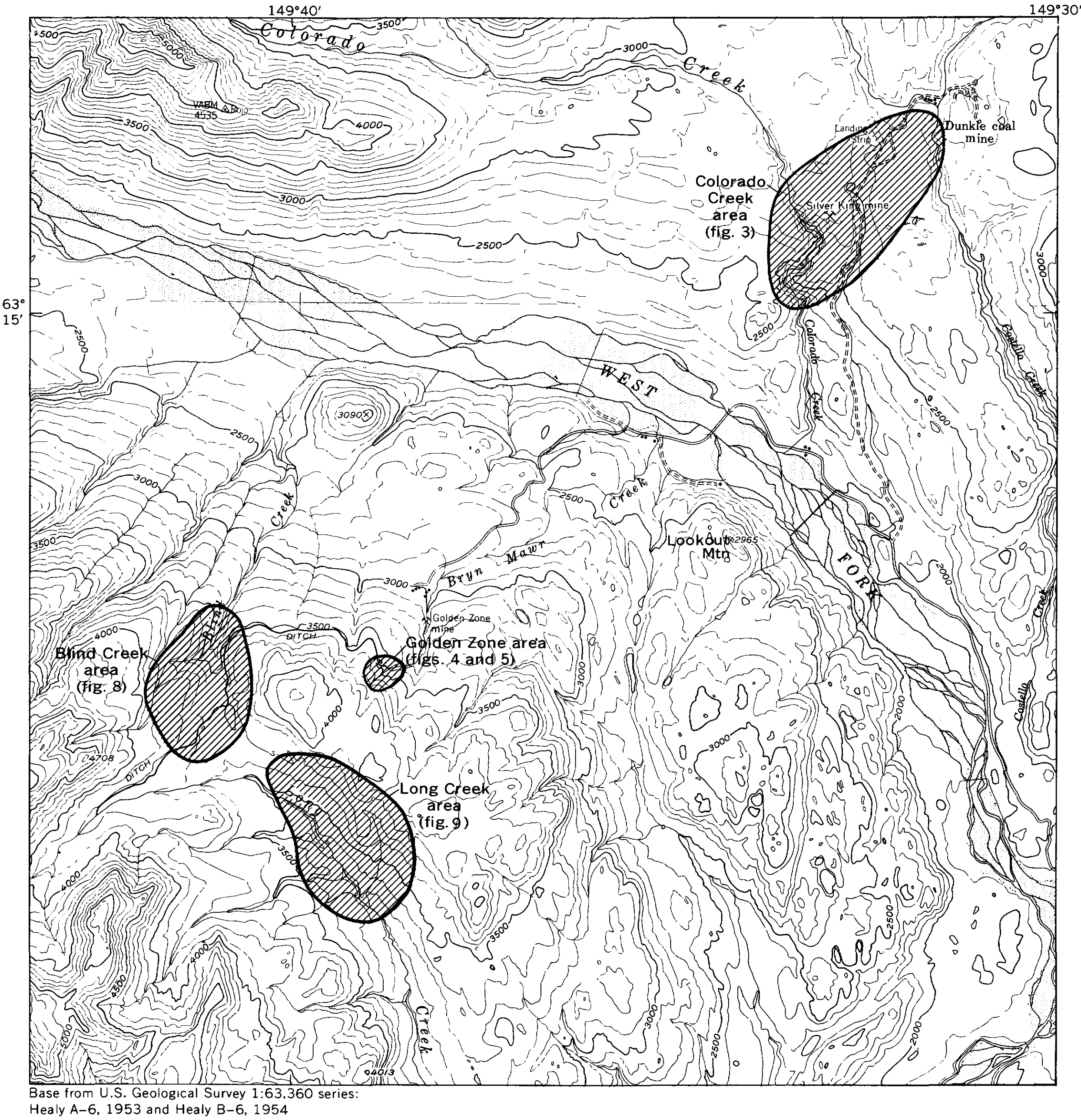


Figure 2.—Location of four mineralized areas in the upper Chulitna district.

GOLDEN ZONE AREA

The Golden Zone mine area was described by Capps (1919, p. 226–227), Ross (1933, p. 321–325), and Hawley, Clark, and Benfer (1968), and the mine was sampled by the U.S. Bureau of Mines in 1950–51 (Mulligan and others, 1967). Claims were staked in the area as early as 1912, but production prior to 1941 is unknown. A little gold and silver were produced in 1941–42, but the mine has been inactive since.

The deposit is in and near a breccia pipe in a quartz diorite porphyry. Vein deposits of the area, not discussed in this report, include the Mayflower, East, Little, and Lindfors. The Golden Zone itself is held by assessment on the BOB group of claims by Cemco, Inc., of Anchorage, Alaska, whose General Manager, H. R. Beckwith, was helpful in furnishing information on ore grade and other data.

The Golden Zone area is largely underlain by volcanic siltstone and conglomerate of Permian or Triassic age (Ross, 1933) that were invaded by biotite quartz diorite porphyry, probably in early Tertiary time. The Golden Zone breccia-pipe deposit is approximately in the center of a small, very steep-walled porphyry stock (figs. 4 and 5). The deposit is in the brecciated and shattered material of the pipe and in adjacent parts of the quartz diorite porphyry. In approximate order of abundance, the metallic minerals of the deposit are arsenopyrite, pyrite, chalcopyrite, sphalerite, and galena. Trace amounts of molybdenum and tin occur in the mineralized rock (table 2), and cassiterite was identified from the deposit by Walter Gnagy of the U.S. Bureau of Mines (written commun., 1967). The strongly mineralized rock is nearly white to very pale brown and has been strongly sericitized,

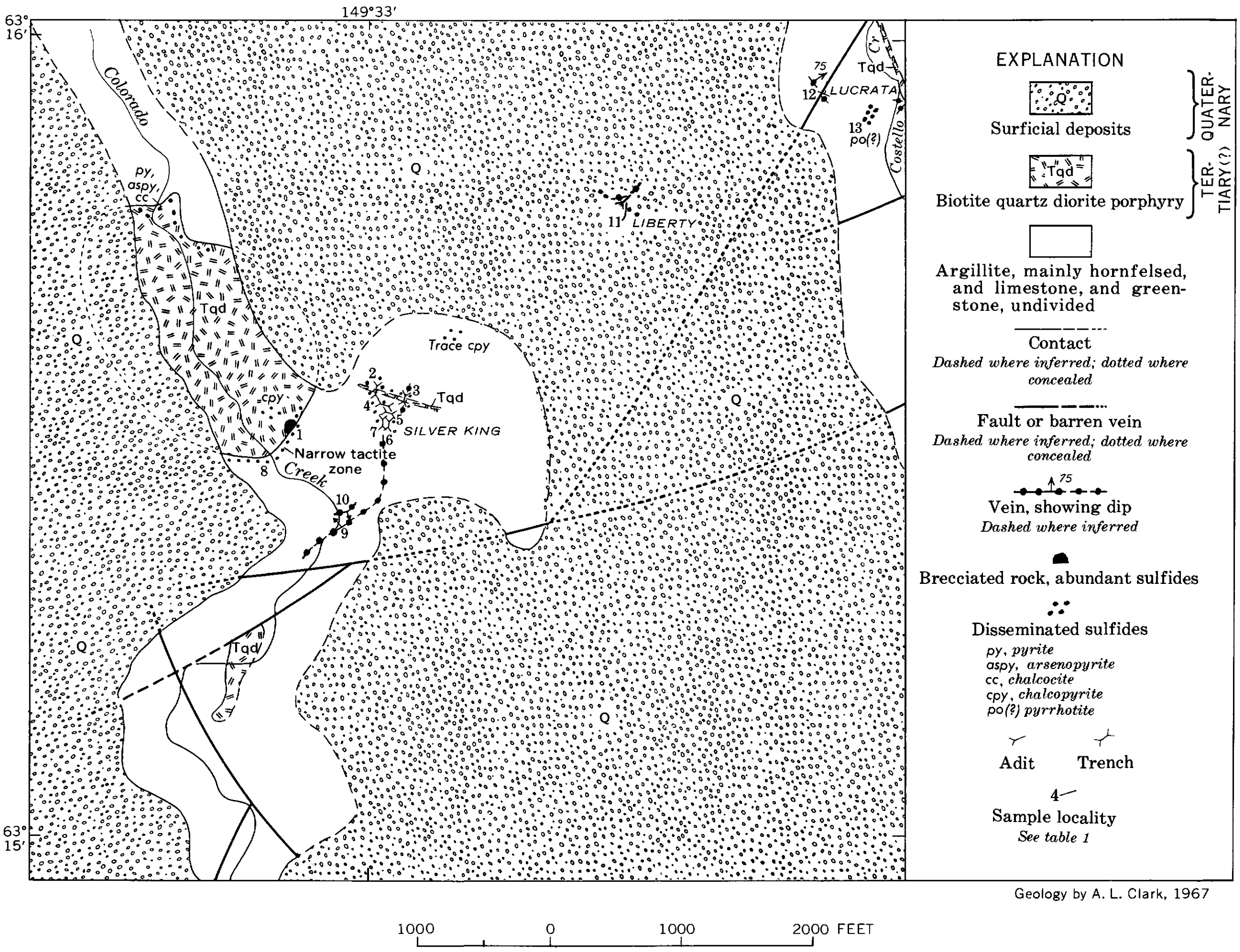
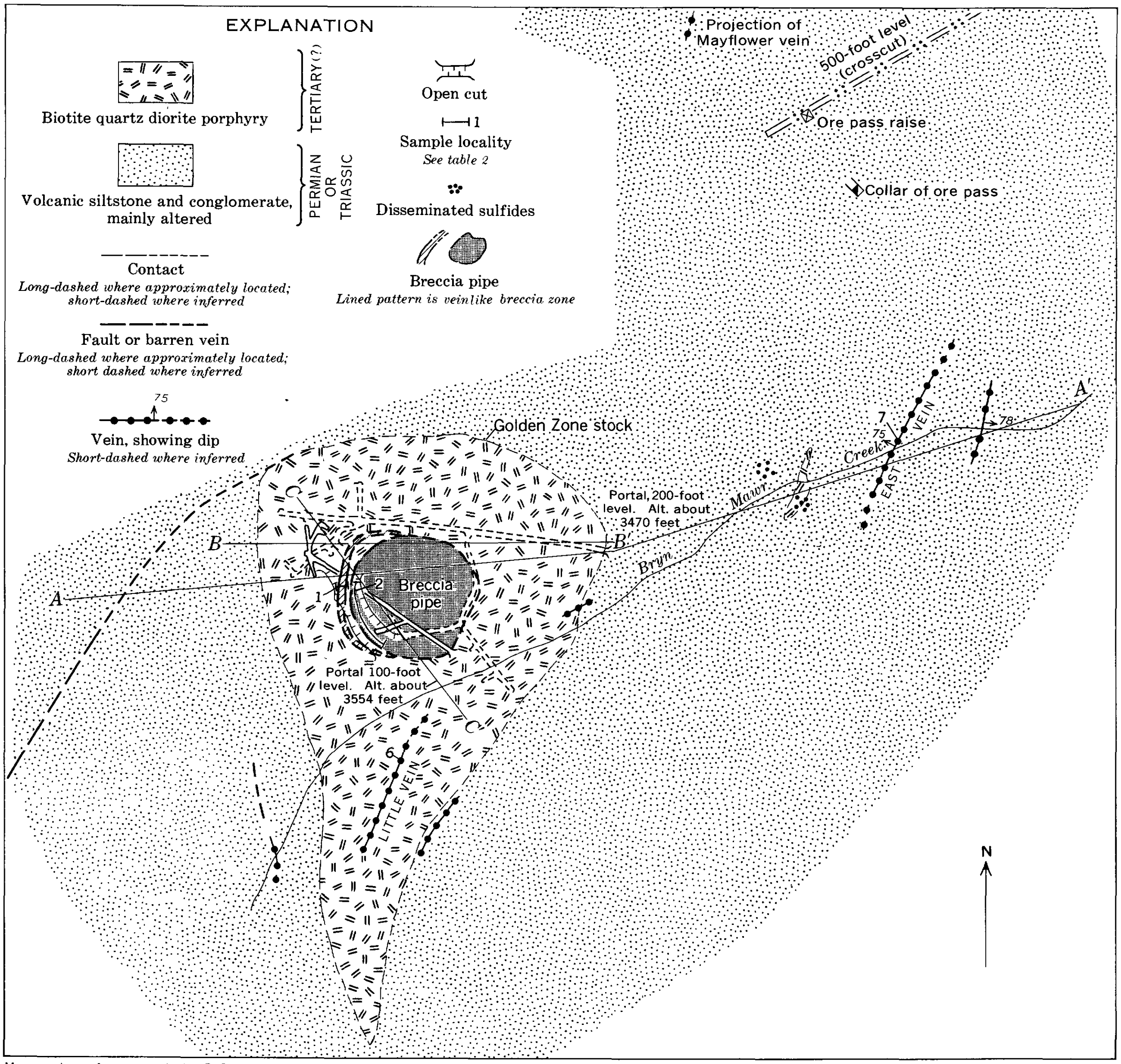


Figure 3.—Generalized geologic map of the Colorado Creek area.

silicified, and carbonatized. The spectrographic analyses show anomalous amounts of boron, probably reflecting tourmaline which was identified in thin sections of the altered rock.

The breccia-pipe deposit is exposed at the surface and has been explored by two adits (fig. 4) and by numerous diamond-drill holes drilled from the 200-foot-level adit. One steep-angle hole (DH–1) 1,025 feet long was drilled by the U.S. Bureau of Mines in 1950–51 (fig. 5, section B–B'). A long crosscut adit, the 500-foot level (fig. 4) was begun in about 1939 but was abandoned about 900 feet from the deposit. None of the workings are presently accessible, but one segment of the contact of the breccia pipe is well exposed at the surface, and the drill core from the deep Bureau of Mines test has been preserved.



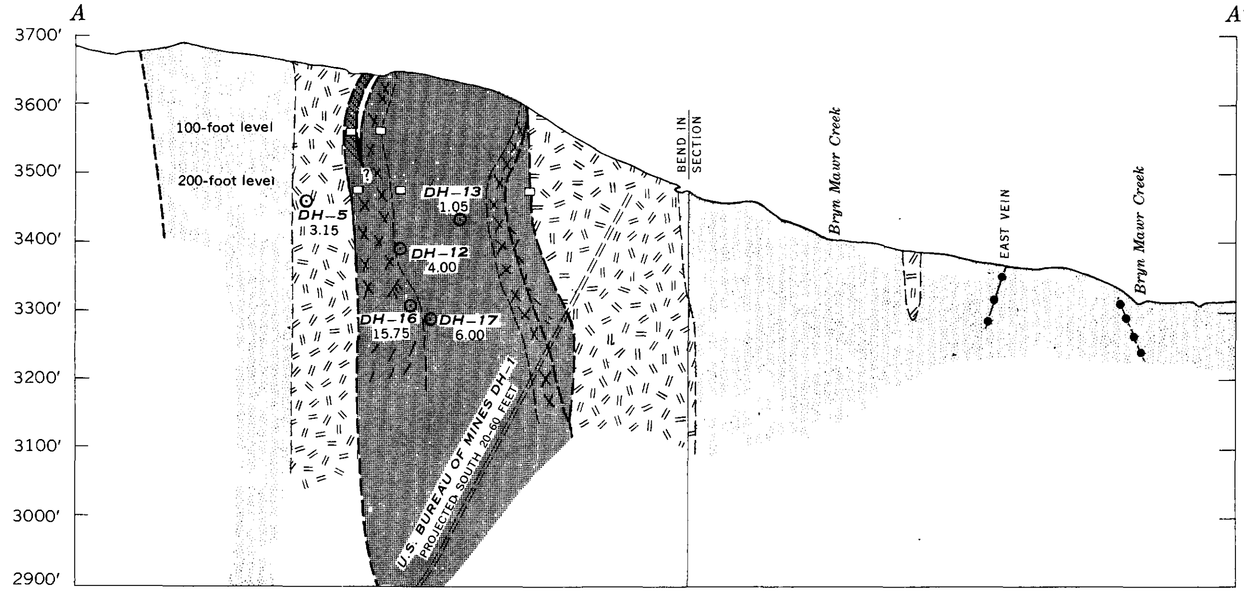
Mine workings from maps by W. E. Dunkle, 1938–41; and Mulligan, Warfield, and Wells, 1967

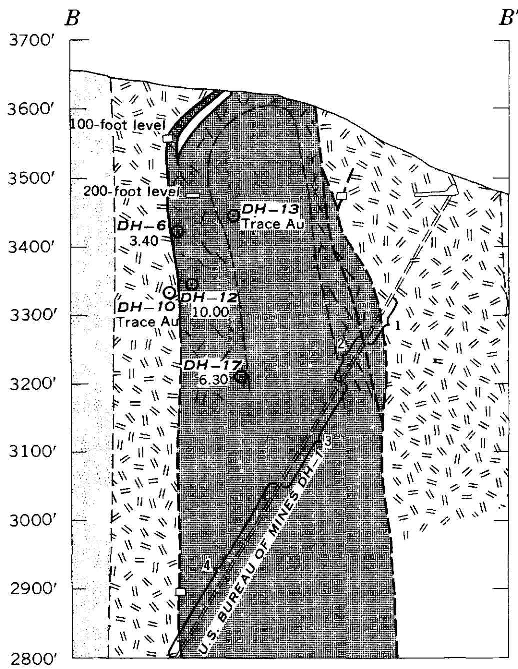
Geology adapted from planetable survey by C. C. Hawley, A. L. Clark, and J. A. Benfer 1967

100 0 100 200 300 FEET

DATUM IS APPROXIMATE MEAN SEA LEVEL

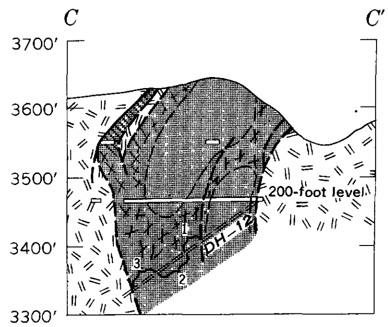
Figure 4.—Generalized geologic map of the Golden Zone mine area.





Assays, gold only		
No.	Value*	Material tested
1.	2.45	Sludge only
2.	6.30	do.
3.	1.40-3.85	do
4.	<1.40	do.

*Value in dollars per ton



Assays, gold only		
No.	Value*	Material tested
1.	10.66	Average sludge plus core
2.	6.00	Sludge only
3.	12.07	Average sludge plus core

*Value in dollars per ton

Geology from surface mapping by C. C. Hawley, J. A. Benfer, and A. L. Clark, 1967; examination of drill core U.S. Bureau of Mines DH-1 by C.C. Hawley, 1967; and by inference from company mine maps. Assay data from Mulligan, Warfield, and Wells (1967) and from Company maps, published with permission

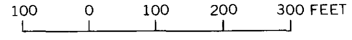


Figure 5.—Sections of the Golden Zone porphyry stock and breccia pipe. See figure 4 for location of lines of section.

EXPLANATION

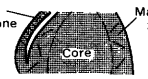
Biotite quartz diorite porphyry — TERTIARY(?)

Volcanic siltstone and conglomerate
Stippled where bleached or hornfelsed
Shown only on section
— PERMIAN OR TRIASSIC

Contact
Dashed where inferred

Fault
Dashed where inferred

Vein
Dashed where inferred



Breccia pipe
Halo shown on figures 6 and 7 indicates results of sampling and is not shown on sections. Dashed line bounding core indicates assay boundary and is shown in section only

Drill hole cut by section
Shows gold value in dollars per ton in sludge at point of section

Drill hole in or near plane of section

Mine openings

Figure 5.—Continued.

Breccia Pipe and Mineralized Rock

The Golden Zone breccia pipe is exposed on a small knob north of Bryn Mawr Creek, particularly in a shallow opencut (fig. 4). At the surface, the pipe is approximately circular in plan and is slightly more than 200 feet across. Drill holes and mine maps indicate that it enlarges slightly with depth. At an altitude of about 3,400 feet (fig. 5), the pipe appears to be about 200 feet long by slightly more than 250 feet across; at an altitude of 3,200 feet, the width, based on one projected and one drilled contact, is as much as 300 feet across. Judged by other breccia pipes described in the geologic literature, it is probably more complex than shown in figure 5. Two distinct zones of concentric fracturing probably are present in the pipe on the 200-foot level—one zone coinciding with the marginal ore zone, discussed later, and a second, outer zone nearly coinciding with the curving drift driven southward from a point about 240 feet from the adit portal (fig. 4). The one deep drill hole in the pipe (section B–B', fig. 5) shows that the pipe continues to a depth of at least 850 feet, and almost certainly to a much greater depth.

Exposures in the opencut and mine maps of the 100-foot level (fig. 6) show a concentric veinlike breccia zone that encircles the western part of the pipe and is locally separated from it by slightly altered rocks. The rocks in this concentric zone are subrounded to angular blocks of porphyry that are strongly silicified and sericitized and are separated from other blocks by arsenopyrite-quartz-chalcopyrite-rich fillings. Some blocks appear to have been slightly rotated. The main part of the pipe, as exposed in the cut, has a sharp boundary, but is less fractured than the concentric breccia zone; its fragments only locally show evidence of rotation. The sulfide minerals in the main body of the pipe form fracture fillings and blobs in shattered, highly altered rocks.

Economic Significance of the Deposit

The ore grade of the Golden Zone breccia pipe varies and has proved to be difficult to determine by drilling (Mulligan and others, 1967). It seems probable, however, that a relatively high-grade part approximately coincides with a strongly fractured zone that bounds the pipe. This zone, called the marginal zone, encloses a core of weakly mineralized rock and in turn is enclosed in a halo of altered and weakly mineralized rock.

The marginal zone is exposed in an opencut at the surface and is fairly well defined on the 100-foot level by assay values (fig. 6). On the 100-foot level, the outer part of the marginal zone is a breccia of veinlike form that appears to be from 15 to 25 feet wide and to average, on the basis of channel samples cut by other geologists and engineers, 0.30 oz (ounce) gold per ton, 2.94 oz silver per ton, and about 0.9 percent copper. The outer boundary of the marginal zone is defined by a fault contact; the inner boundary is probably gradational. On the basis of unpublished geologic maps of the 100-foot level, which show strongly mineralized rocks close to the veinlike breccia, the entire marginal zone is estimated to be about 60 feet across. In the opencut, the veinlike breccia zone is about 15 feet across and assays about 0.45 oz gold per ton, and 3 oz silver per ton (15 ppm and 100 ppm respectively, sample 2, table 2). The sample shows marked concentrations of bismuth, cadmium, copper, lead, tin, and zinc. The rock in the main body of the pipe in the opencut (sample 1) contains slightly less than 0.1 oz gold per ton, about 6 oz silver per ton, and anomalous amounts of the same elements as sample 2.

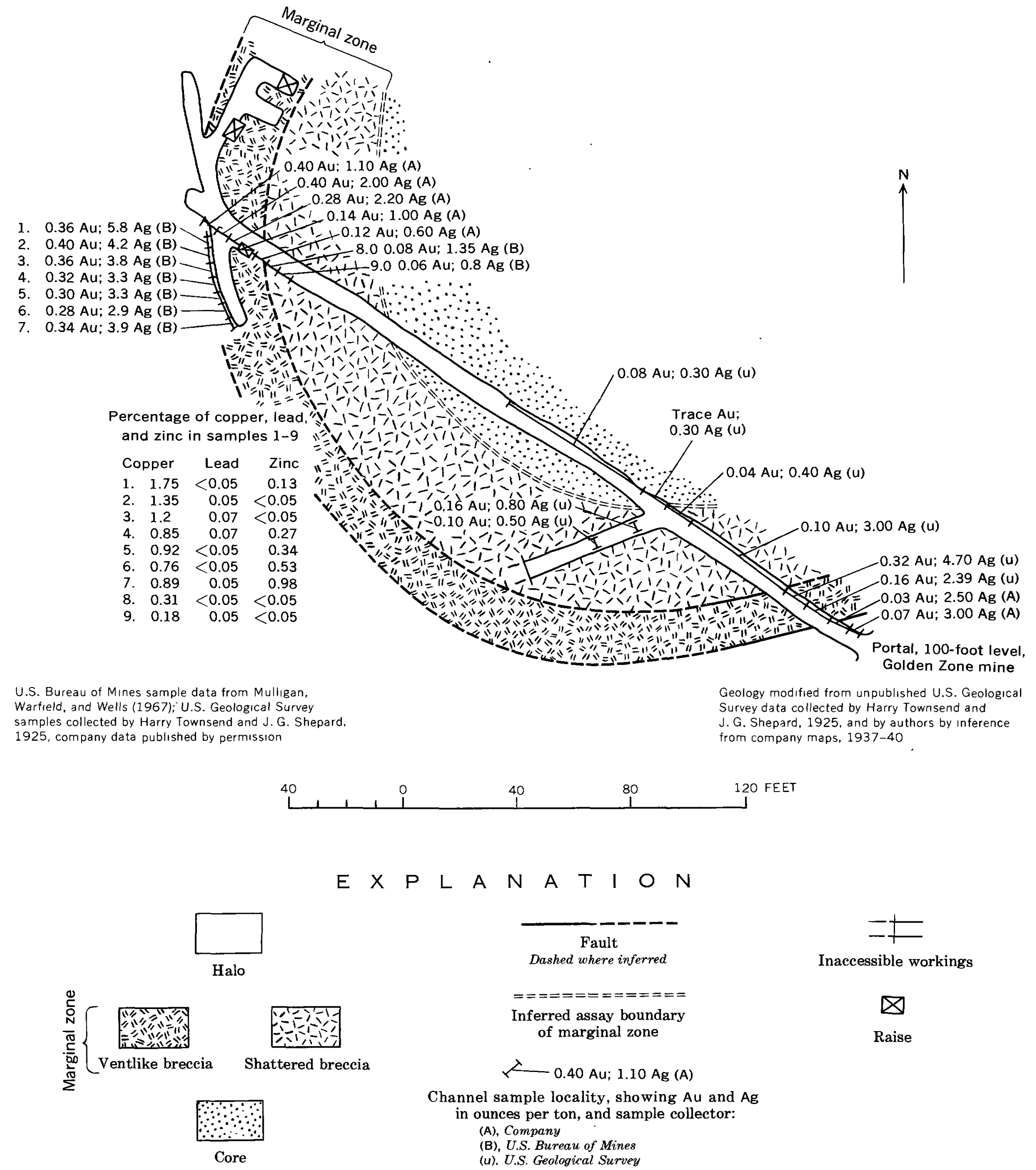


Figure 6.—Generalized geologic map showing assay data, 100-foot-level adit, Golden Zone mine.

On and near the 200-foot level, numerous assays from channel samples or sludge from low-angle drill holes suggest an oval-shaped marginal zone, with maximum dimensions of about 120 by 240 feet, enclosed in a weakly mineralized halo about 370 by 500 feet across (fig. 7). Assays in the marginal zone range from about 0.06 oz gold per ton to more than 0.6 oz per ton and average about 0.21 oz per ton; less abundant assay data suggest a value of from $1 to $3 for other metals, principally silver and copper. The core area, although penetrated by some drill holes, is essentially of unknown value. The average assay value of 228 samples in the halo area is about 0.04 oz gold per ton. Although most samples in this zone contain 0.01 oz gold or less per ton, widely scattered samples or groups of samples contain more, thereby raising the average significantly. As noted above, the oval-shaped marginal ore zone on the 200-foot level is probably surrounded in part by an arcuate zone of strong fracturing, and groups of assays from this zone, particularly in the curving drift south and west 240 feet from the portal (fig. 7), are higher in value than the general average of the halo. This suggests in turn, that more detailed work in the halo may delineate zones distinctly richer than the average.

The only check on the grade of the deposit as estimated from channel samples or drill core and sludge is from mining in 1941–42, when the Golden Zone produced 869 tons of concentrates that contained 1,581 oz gold, 8,617 oz silver, and 42,659 lbs copper (Mulligan and others, 1967). According to H. R. Beckwith of Cemco, Inc. (written commun., 1967), these concentrates came from about 1,730 tons of ore yielding an average grade, from one lot of 1,480 tons, of approximately 0.99 oz gold per ton, 4.5 oz silver per ton, and 1.4 percent copper; a second lot of 250 tons was of lower grade, but both lots were appreciably higher than the grade determined by channel sampling. It seems apparent from the location of the opencut and of raises on the 100- and 200-foot levels (figs. 6, 7) that this ore was mined largely from the marginal zone. The tonnage figure seems reasonable for the short period of mining activity, the size of the mill, and the amount of tailings, and so the grade of the deposit may have been underestimated by conventional sampling.

Although the grade and subsurface dimensions of the deposit are imperfectly known, rough calculations based on assays from the 200-foot level indicate a likelihood of about 260,000 tons of material, containing possibly 0.14 oz gold per ton, per 100 feet of depth. The fairly abundant assay data from surface, underground workings, and drill holes down to about 400 feet also permit a rough calculation of the hypothetical value of metals in the upper part of the deposit. Calculations from these data show about $10,000,000 worth of metals in the upper 400 feet of the deposit, including the marginal zone and the appreciably lower grade core and halo. The single deep U.S. Bureau of Mines drill hole shows that the pipe extends to at least 850 feet in depth and is at least weakly mineralized below 400 feet, so that the $10,000,000 figure is minimal. Furthermore, if the value of metals has been underestimated by conventional sampling, as data on the 1941–42 production suggest, the $10,000,000 value is too small. The deposit appears to warrant further study and exploration.

Particular attention should be given to the possibilities of vertical or horizontal zoning in the pipe. The possibility of vertical zoning is suggested principally by the complex metal assemblage in the Golden Zone and nearby deposits. Horizontal zoning in the deposit itself is apparently indicated by data from U.S. Bureau of Mines drill hole 1, which shows an inverse correlation of copper with gold at the eastern edge of the pipe, with copper enriched relative to gold just outside the pipe.

BLIND CREEK AREA

The Blind Creek area (fig. 8) is about 1 mile west of the Golden Zone and is mainly underlain by volcanic siltstone and conglomerate. It is cut by a major fault zone striking north-northeast which records a late period of strike-slip deformation by nearly horizontal slickensides. Locally the fault zone contains quartz veins and quartz-cemented breccia zones as much as 200 feet across. The quartz ranges from white and massive to a faintly opalescent type with a colloform structure; locally it is limonite stained or contains pyrite.

Assays of the quartz veins and associated pyritic material show very minute amounts of gold, although none was seen. Two samples were collected; sample BC–1 (table 2) was a composite grab sample of quartz and limonitic quartz collected from residual fragments in the soil over a distance of several hundred feet. It contains slightly more gold (0.06 ppm) than the detection limit (0.02 ppm). Sample BC–2 (table 2) was a short (2.0-foot chip) sample collected over a strongly pyritic part of the vein; it contains slightly more gold (0.30 ppm) but still not in amounts approaching commerical value. The samples also contain measurable amounts of silver, trace or greater amounts of arsenic, and one sample shows 150 ppm lead and a trace of zinc (<200 ppm).

Although the Blind Creek occurrence has no apparent economic value, it is reported because of the large size of the quartz veins and because the controlling Blind Creek fault zone apparently is a major premineral throughgoing structure.

LONG CREEK AREA

The Long Creek area (fig. 9) is south of the Golden Zone and appears to have a slightly different type of mineralization. Copper sulfides occur widely in small

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amounts and are concentrated near the Copper King prospect. The copper minerals occur in veins, in massive replacement of favorable strata, and disseminated in bleached areas in predominantly red volcanic siltstone and conglomerate.

The Copper King prospect, once known as the Hector, is on land restaked by Mark Ringstad, Fairbanks, in April 1967. The workings consist of several shallow trenches, all of which expose copper minerals. Massive chalcopyrite and pyrrhotite are exposed as a lensoid mass about 5 feet thick in trench No. 3 (sample location 2 and 3).

The trenches are all in hornfelsed locally calcareous siltstone, which is cut by small dikes and plugs of quartz porphyry. The quartz porphyry and adjacent hornfels are cut by siliceous veinlets on several fracture trends, and the siliceous veinlets contain very sparse amounts of molybdenite, chalcopyrite, and pyrite. The molybdenite is seemingly more abundant in the quartz porphyry than in the hornfels, and the pattern of mineralization suggests a zonal distribution of copper around the quartz porphyry masses.

Samples from the main trenches at the Copper King (Nos. 1–4, Long Creek area, table 2) contain from about 0.5 to 2 percent copper, 1 to 3 oz silver per ton, gold worth about \$1 to \$8 per ton, and detectable amounts of bismuth, zinc, and tin. Mineralized rock from the prospect is also represented by sample 6, a grab sample of sacked ore that is probably from the same trench as samples 2 and 3. Molybdenum, visibly

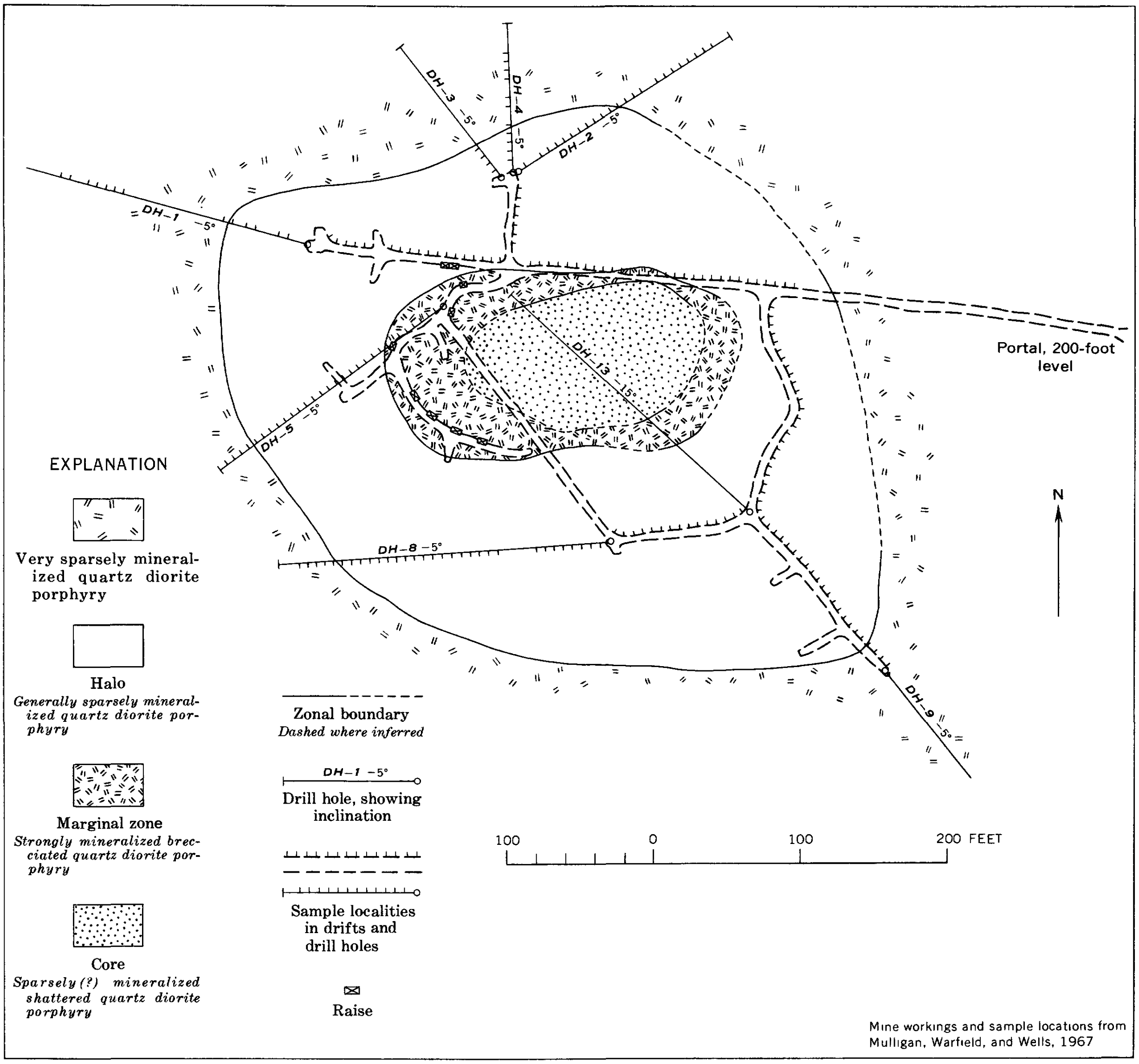


Figure 7.—Distribution of mineralized rock, 200-foot-level adit, Golden Zone mine.

present as molybdenite in veinlets in quartz porphyry near the prospects, was not detected at the prospect, but was found in a trace amount (15 ppm) in weakly veined porphyry (sample 5).

Conclusions and Recommendations

The known copper mineral occurrences of the Long Creek area are small but are locally rich in copper; the molybdenite deposits are small and of very low grade. Nevertheless, the sulfide mineral occurrences are numerous and widespread. Because of this and the apparent association of deposits with quartz porphyry, more exploration of the area is justified. Geophysical exploration, particularly by induced polarization, would be desirable, as well as additional trenches and shallow drill holes.

STREAM-SEDIMENT SAMPLES

Anomalous amounts of gold and other elements are found in some stream-sediment samples from the district (fig. 10 and table 3). The largest anomalous values in gold are in Bryn Mawr and Colorado Creeks. Sample 24 from Bryn Mawr Creek was taken just below the Golden Zone mine, where any naturally occuring gold may have been augmented by gold from the mine debris. However, two uncontaminated right-limit tributaries to Bryn Mawr Creek, represented by samples 17 and 27, are also anomalous, indicating bedrock mineralization in their headwaters. Sample 12, from near the mouth of Bryn Mawr, while not anomalous in gold, is highly anomalous in arsenic and copper (table 3), as is sample 11 from an adjacent stream. Since mining activity in and near the Silver King prospect has probably not been extensive enough to contaminate Colorado Creek, sample 8 is believed to approximately represent the natural gold value of the stream. The drainage nearest the Copper King prospect, sample 43, has detectable amounts of silver and arsenic, but little else to indicate mineralization.

With the exception of sample 9, most anomalous gold values are in a linear belt that extends northeast from near the head of Long Creek to Colorado Creek, or subparallel to the major direction of faulting recognized in the district by Ross (1933).

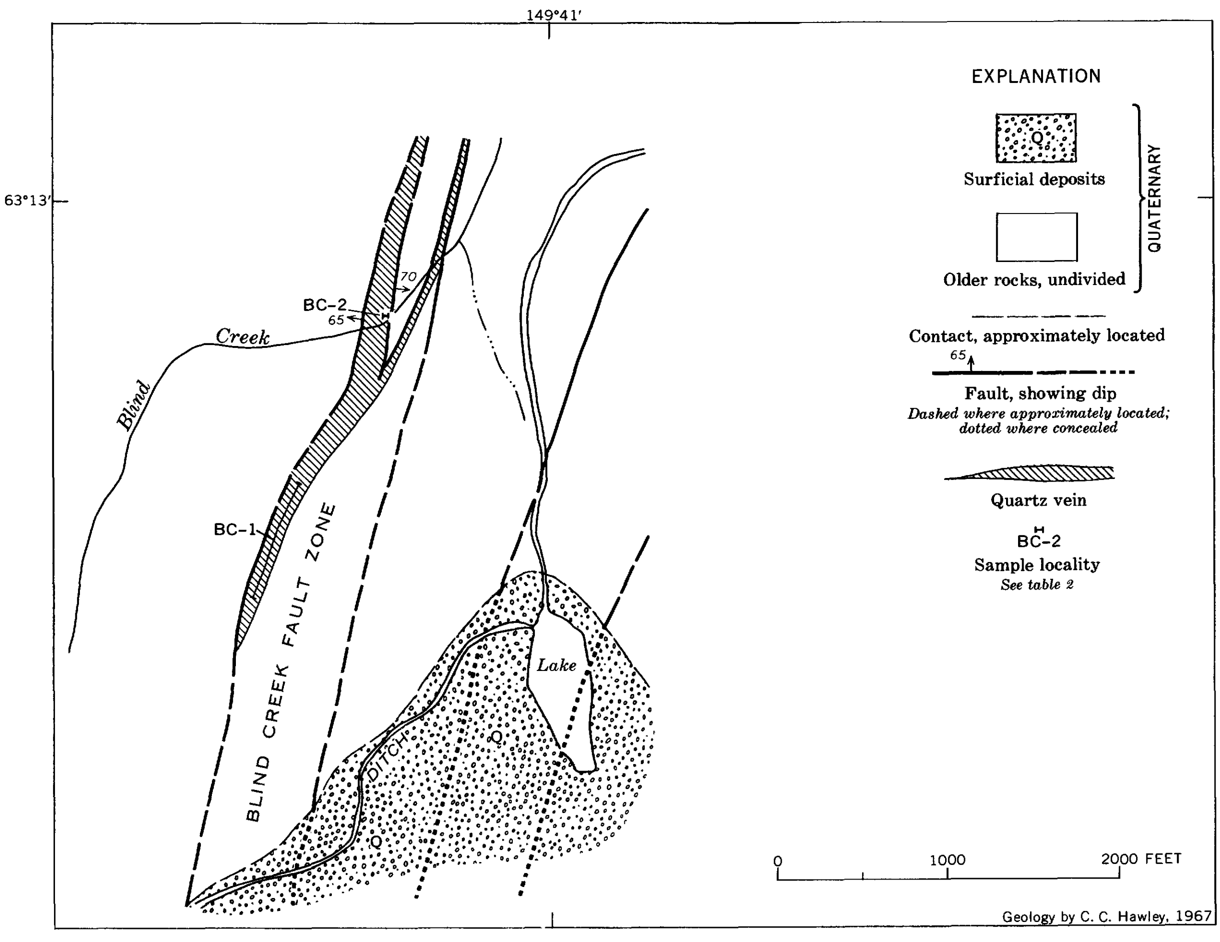
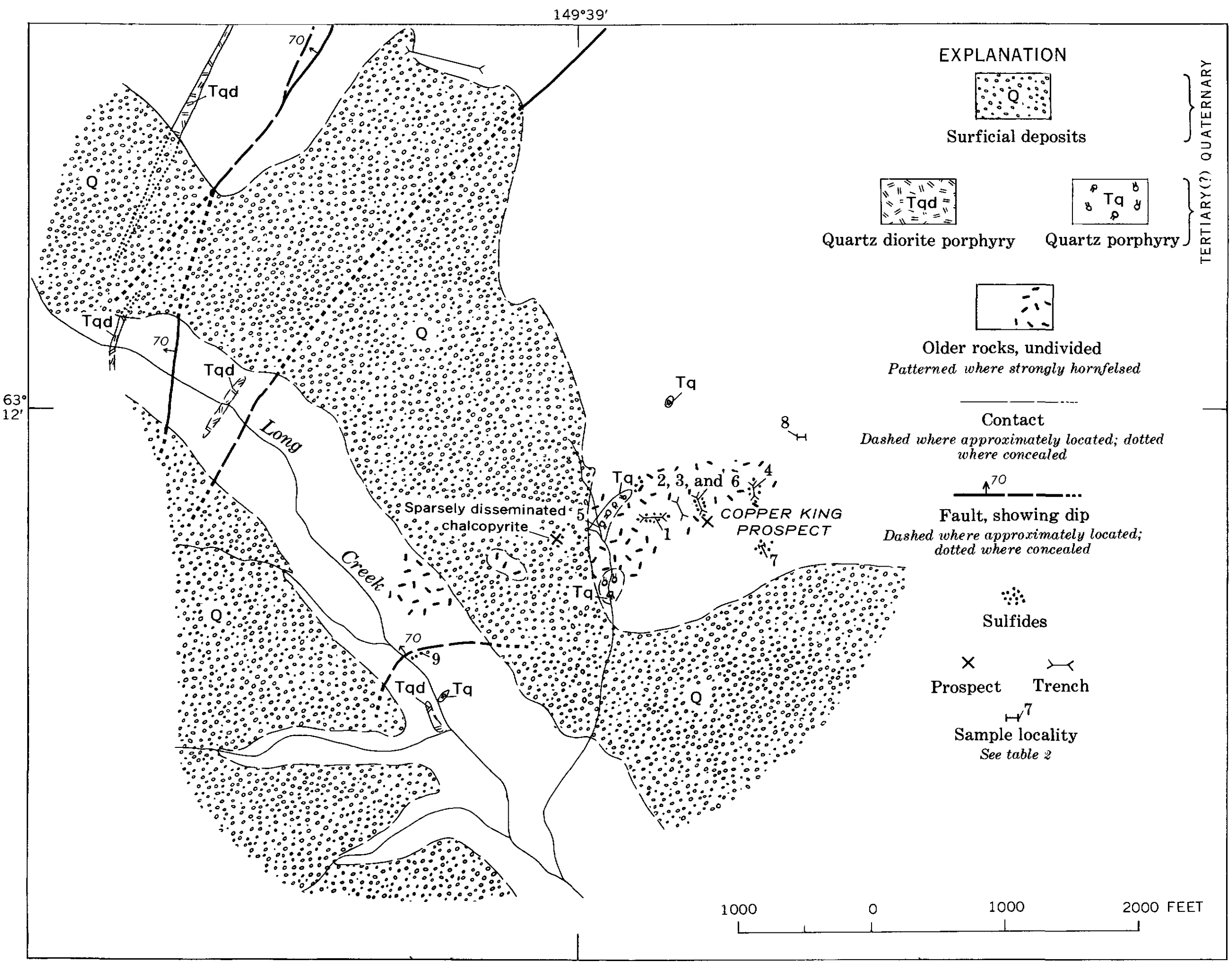


Figure 8.—Generalized geologic map of the Blind Creek area.

DISTRICTWIDE SUMMARY AND RECOMMENDATIONS

Gold and other metals are concentrated at several places in the upper Chulitna district, in particular, the Colorado Creek, Golden Zone, and Long Creek areas. Trace amounts of gold occur in strong quartz veins of the area, as at Blind Creek. Many more mineral occurrences, particularly of vein type, are known, and, because surficial deposits cover much of the district, probably many deposits are buried. The dominant structural grain of the region is northeasterly, and scattered mineral occurrences known both northeast and southwest of the district indicate that the full extent of the district is not known. We believe that more prospecting is justified in the area, particularly in Colorado Creek and near the Golden Zone deposit. Our experience indicates that there are outcropping mineral occurrences to be found, but because of the cover by surficial deposits, geophysical prospecting seems particularly appropriate in a search for new disseminated and breccia-pipe mineral deposits.



Geology by C. C. Hawley, 1967

Figure 9.—Generalized geologic map of the Long Creek area.

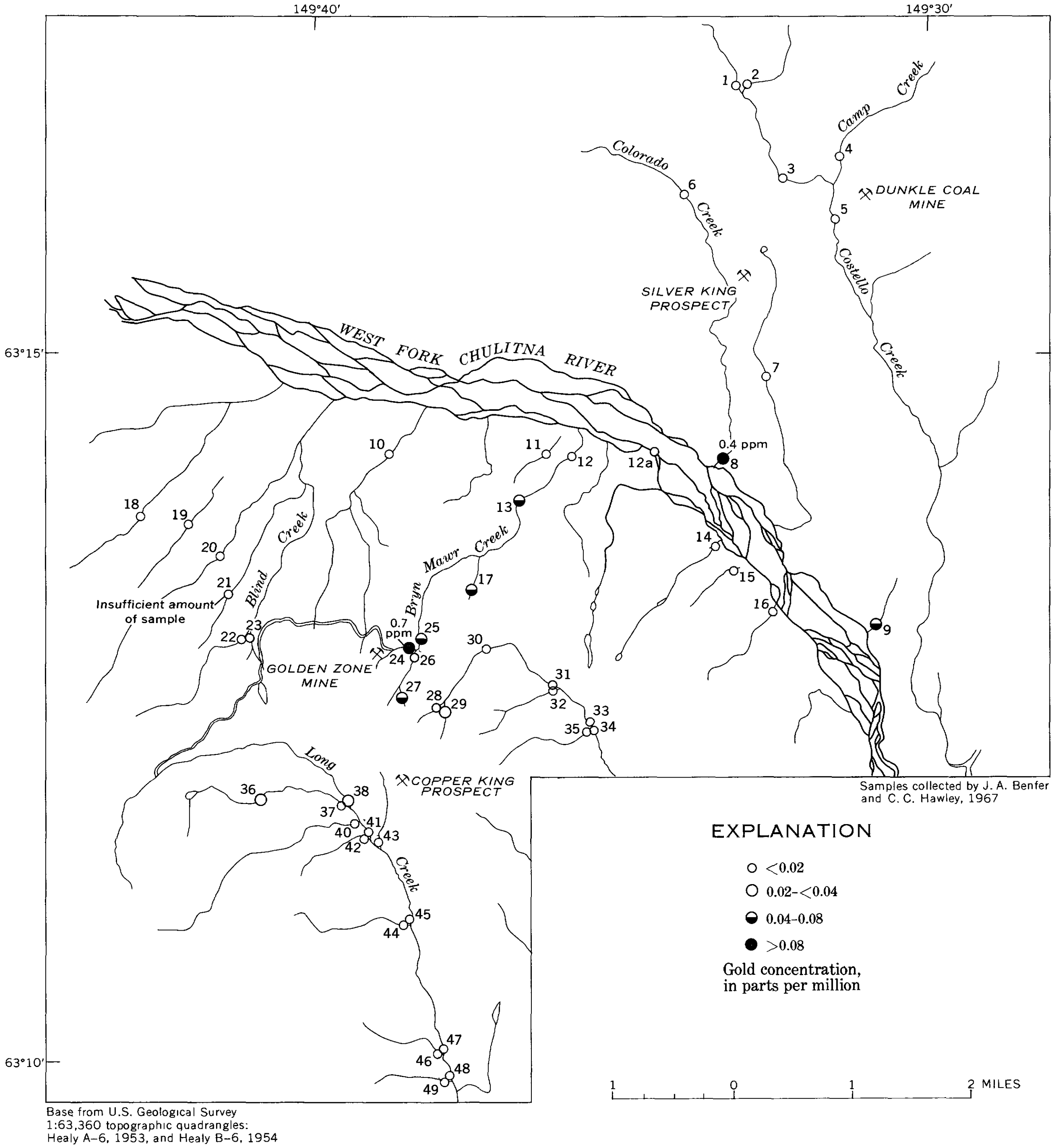


Figure 10.—Location and gold concentration of stream-sediment samples, upper Chulitna district.

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Ross, C. P., 1933, Mineral deposits near the West Fork of the Chulitna River, Alaska: U.S. Geol. Survey Bull. 849–E, p. 289–333.

Table 1.—Analyses of samples from

[Analyses, except of gold, are semiquantitative spectrographic by D. J. series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following ---, not looked for. Results are given in parts per million except for sorption are by W. L. Campbell and A. L. Meier. Gold analyses by fire Samples: Localities are shown in figure 3; all are chip samples; lengths

Sample No.	Lab. No.	Field No.	Ag	As	Au	Au 1/	Au 2/	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo
1A	ACK 018	67ACx 162	50	10,000	200	170	282	N	300	N	>1000	N	150	20	300	N	N
B	ACL 010	296A	L	N	N	N	---	100	2000	N	N	N	N	300	100	200	5
C	011	B	L	200	N	N	N	N	300	N	N	N	N	70	200	N	5
D	012	C	N	N	N	0.02	N	N	2000	1	N	N	5	150	20	30	N
E	013	D	L	200	N	N	N	10	1000	1	N	N	10	70	50	N	5
F	014	E	3	>10,000	L	10	7.3	N	300	N	300	N	700	20	500	N	N
2	ACK 013	152V	7	>10,000	15	6.2	---	10	300	L	700	N	1000	5	500	N	30
3	012	151	5	1000	N	.2	0.1	L	150	L	N	N	10	100	1500	N	N
4	014	153	L	300	N	.1	---	L	70	L	N	N	15	20	500	70	N
5A	015	154	1.5	7000	N	.08	---	L	200	L	10	N	150	50	1000	N	N
5B	ACL 107	67ACx 154E	1.5	>10,000	N	.4	---	N	300	1	20	N	150	50	1000	N	N
C	108	154W	0.5	10,000	N	.1	---	N	300	1	N	N	15	30	300	N	N
6	ACK 016	155	50	>10,000	N	.2	---	15	70	N	70	N	700	10	20,000	N	N
7A	017	156	70	10,000	30	15	---	150	100	L	10	N	5	30	500	L	N
B	ACF 200	156V	3	300	N	1	---	15	30	N	N	N	N	N	150	70	N
8A	ACL 015	297	L	200	N	N	N	10	300	1	N	N	5	100	50	N	N
B	016	297A	10	500	N	.04	.07	10	1500	1	N	N	15	70	1500	N	10
C	017	297B	7	700	N	.2	.1	10	700	1	15	N	70	150	1000	N	5
D	018	297C	N	500	N	.02	N	N	1500	1	10	N	10	150	150	30	N
9	020	299	7	10,000	N	.5	---	10	700	1	10	N	300	70	2000	50	50
10	019	67ACx 298	10	7000	15	23	19.0	100	100	1	10	20	7	30	200	N	N
11	ACK 019	166	3	N	N	.08	---	100	1500	L	N	N	20	150	700	N	N
12	010	136	100	>10,000	50	24	50	10	150	N	1000	N	300	30	700	N	N
13	011	137	.5	500	N	.3	.6	15	300	N	15	N	30	300	200	N	N
Limits of determination			.5	200	10	.02	.05	10	5	1	10	20	5	5	5	20	5

1/ Atomic absorption.
2/ Fire assay or fire assay-atomic absorption.
3/ Specific instrumental or chemical method.

Location	Sample No. and description
1	1A, 2-foot. Hornfels with abundant arsenopyrite, pyrite, and limonite.
	1B, 1-foot. Hornfelsed argillite, weakly mineralized with disseminated arsenopyrite.
	1C, 3-foot. Hornfels, pervasively stained by limonite.
	1D. Biotite quartz diorite, altered to clay and sericite.
	1E. Hornfels marginal to 1D.
	1F, 6-inch. Massive sulfide veinlet. Primarily arsenopyrite, pyrite, and quartz. Weak copper (azurite) stain.
2	2, 2-foot. Vein material, primarily arsenopyrite. Strongly limonite-stained.
3	3, 1-foot. Sericitized quartz diorite with strong limonite gossan.
4	4. Hornfels near limonite-stained fault zone. Strongly sheared.
5	5A, 8-foot. Altered hornfels near face of small prospect pit. Contains minor arsenopyrite; pervasive limonite stain.
	5B, 10-foot. Same as 5A on east side of pit.
	5C, 10-foot. Same as 5A on west side of pit.

the Colorado Creek area

Grimes, E. E. Martinez, and R. T. Hopkins, Jr., and are reported in the symbols: N, not detected; L, detected but below limit of determination; Fe, Mg, Ca, Ti, which are given in percent. Gold analyses by atomic ab- assay-atomic absorption are by W. D. Goss and Claude Huffman, Jr. shown with description where known]

Mn	Nb	Ni	Pb	Pd 3/	Pt 3/	Rh 3/	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
1500	L	5	200	0.012	<0.01	<0.005	200	7	70	N	50	N	30	N	20	15	0.1	7	0.07
3000	10	20	20			---	N	50	20	500	200	N	20	N	30	10	2	5	.5
2000	10	5	10	---	---	---	N	15	100	N	100	N	N	200	30	15	.1	10	.15
700	10	30	10	---	---	---	N	10	N	1000	70	N	15	N	150	2	2	2	.5
1500	N	50	10	---	---	---	N	20	N	700	150	N	20	N	100	5	2	3	.5
1500	N	30	20	---	---	---	200	L	N	100	20	N	20	N	20	15	.05	5	.07
30	L	300	L	---	---	---	200	N	N	N	N	N	N	N	150	15	<.02	L	.07
500	L	15	L	<.004	<.01	<.005	N	20	N	150	70	N	15	N	50	10	1.5	1.5	.15
1000	L	30	L	---	---	---	N	7	N	50	50	N	20	N	30	10	.7	3	.1
700	L	150	L	---	---	---	100	15	N	L	70	N	N	N	L	15	.2	3	.15
700	10	50	10	---	---	---	100	15	N	70	100	50	15	N	50	15	1.5	2	.2
700	10	20	10	---	---	---	N	10	N	70	70	N	15	N	70	10	.7	1.5	.2
200	N	200	10	---	---	---	500	N	N	N	10	N	15	N	30	20	.3	1.5	.15
150	N	5	100	---	---	---	>10,000	10	N	N	70	N	15	N	70	7	.3	0.05	.3
20	N	L	500	---	---	---	>10,000	N	N	N	L	N	N	N	N	0.2	L	L	.01
500	10	50	10	---	---	---	N	15	20	700	100	N	10	N	150	2	2	2	.07
2000	10	30	10	---	---	---	N	10	50	100	100	N	20	200	50	10	.5	20	.5
1500	10	50	15	---	---	---	N	15	15	700	150	N	15	N	50	7	2	3	.2
300	10	30	10	---	---	---	N	10	N	700	70	N	15	N	150	3	1.5	3	.5
150	10	30	20	---	---	---	200	15	N	50	100	N	15	N	100	1.5	.15	.7	.3
1000	10	30	300	---	---	---	>10,000	10	N	70	70	N	15	1500	70	7	.7	3	.7
200	L	50	15	---	---	---	150	N	N	L	500	N	20	N	70	10	.3	.2	.15
30	L	30	700	<.04	<.1	<.05	700	7	N	50	50	N	15	L	50	20	.5	.15	.07
700	L	150	L	<.004	<.01	<.005	L	20	10	700	150	N	15	N	50	10	3	2	.5
10	10	5	10	.01-.004	.004	.005	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

Location	Sample No. and description
6	6. Contact zone between altered quartz diorite and hornfels that contains disseminated arsenopyrite.
7	7A, 6-inch. Hornfels containing disseminated arsenopyrite and stibnite.
	7B, 1-foot. Arsenopyrite vein containing minor stibnite.
8	8A, 14-inch. Tactite at margin of quartz diorite plug. Tactite is mainly composed of magnetite, epidote, garnet, and actinolite.
	8B, 14-inch. Same zone as 8A.
	8C, 1-foot. Hornfels peripheral to tactite zone.
8	8D. Chip of altered quartz diorite associated with tactite and hornfels of 8B and 8C.
9	9, 4-foot. Arsenopyrite vein, sparse stibnite. Vein is on footwall of 10-foot shear zone, 1- to 2-foot hanging-wall vein inaccessible.
10	10, 1-foot. Stibnite-pyrite vein material.
11	11. Gossan developed from arsenopyrite-pyrite veinlets in altered hornfels.
12	12. Arsenopyrite-pyrite vein with minor quartz.
13	13, 2-foot. Hornfels containing disseminated pyrrhotite(?).

Table 2.—Analyses of samples from the Golden

[Analyses, except of gold, are semiquantitative spectographic by Arnold series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following not looked for. Results are given in parts per million except for Fe, are by A. L. Meier, R. L. Miller, and T. A. Roemer. Gold analyses by

Sample No.	Lab. No.	Field No.	Ag	As	Au	Au 1/	Au 2/	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo
Golden Zone area (sample localities shown in fig. 4)																	
1	ACF 117	67AHx 43	200	7000	N	4.2	1.9	150	700	1	30	200	L	100	>5000	30	N
2	116	42	100	10,000	10	15	14.8	150	700	N	50	50	L	30	>5000	30	N
3	119	46	20	>10,000	N	5	5.3	100	500	1	70	20	20	70	1500	20	N
4	ACE 627	46D	10	3000	N	.4	---	200	300	1	N	30	10	50	500	<50	L
5	9-255 to 9-272	D128680 - 128697	2	3000	N	.8	---	-	500	1	L	<50	10	150	200	<30	23 3/
6	ACF 118	67AHx 45	30	>10,000	20	25	25.0	70	150	N	200	20	N	10	300	20	N
7A	011	128A	150	>10,000	10	9.4	---	15	N	L	30	300	15	L	1000	N	N
7B	012	128B	100	>10,000	L	4.2	---	50	200	L	L	500	10	100	500	N	N
Blind Creek area (sample localities shown in fig. 8)																	
BC-1	ACF 068	67AHx 196	0.5	L	N	0.06	---	L	200	1	N	N	L	7	20	N	N
2	091	197	1.5	1000	N	.30	---	10	300	1	N	N	N	20	30	N	N
Long Creek area (sample localities shown in fig. 9)																	
		67AHx															
1	ACF 096	218-1	100	N	L	6.8	---	10	300	N	100	N	20	7	15,000	N	N
2	097	-2	50	N	N	1.2	---	L	1500	N	100	N	70	15	20,000	50	N
3	098	-3	50	N	L	8.0	---	L	2000	N	100	N	20	20	10,000	20	N
4	099	-4	30	200	N	1.3	---	L	150	N	100	N	150	20	5000	N	N
5	061	169	0.7	N	N	N	---	L	1000	1	N	N	5	L	50	N	15
6	060	168	150	L	N	0.2	---	10	2000	L	50	30	100	10	>20,000	30	N
7	062	170	1.5	N	N	.1	---	L	200	N	N	N	30	1000	100	N	N
8	ACE 613	219	.5	N	N	N	---	15	300	L	N	N	70	1000	20	<50	N
9	ACF 095	216	2	N	N	.06	---	L	150	N	N	N	15	10	2000	N	N
Limits of determination			.5	200	10	.02	.05	10	5	1	10	20	5	5	5	20	5

1/ Atomic absorption.
2/ Fire assay or fire assay-atomic absorption.
3/ Specific instrumental or chemical method.

Location	Sample No. and description
Golden Zone area:	
1	Composite of random chips collected at about 3.0-foot intervals over 150 feet in Golden Zone opencut.
2	15.0-foot chip sample of veinlike breccia zone, abundant arsenopyrite and quartz, locally abundant scorodite and copper stain.
3 (Golden Zone mine)	Mill feed; crushed ore from 1942 operations in mill hopper, Golden Zone mill.
4 (Golden Zone mine)	Coarse tailings, Golden Zone mill.
5 (U.S. Bureau of Mines DH-1)	Average (approximate geometric mean) of 18 composite sludge samples from DH-1. Maximum gold content in any sample, 6.3 ppm. Molybdenum, detected in all samples, was determined quantitatively to range from 6 to 43 ppm. Samples furnished by U.S. Bureau of Mines.
Golden Zone area—Continued	
6	Grab sample of arsenopyrite-quartz ore, Little vein. Abundant scorodite.
7	7A. East vein: Grab sample of arsenopyrite-rich vein material. 7B. East vein: Grab sample of galena-sphalerite-arsenopyrite vein material. (See Mulligan and others (1967) for analyses of channel samples of East vein.)
Blind Creek area:	
BC-1	Composite sample of quartz and limonitic quartz. Sample consists of random chips picked up on traverse of several hundred feet along course of vein.
BC-2	2.0-foot chip sample of pyritic-quartz vein on wall of main quartz vein.

Zone, Blind Creek, and Long Creek areas

Farley, Jr., R. H. Heidel, and E. E. Martinez, and are reported in the symbols: N, not detected; L, detected but below limit of determination; ---, Mg, Ca, Ti, which are given in percent. Gold analyses by atomic absorption fire assay-atomic absorption are by J. E. Troxel and Claude Huffman, Jr]

Mn	Nb	Ni	Pb	Pd[3/]	Pt[3/]	Rh[3/]	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
Golden Zone area (sample localities shown in fig. 4)--Continued																			
300	20	5	300	<0.04	<0.1	<0.05	200	15	30	150	70	N	10	7000	150	10	0.7	1.5	0.3
150	20	L	700	<.02	<.05	<.025	500	15	50	150	150	N	15	2000	150	15	.3	1.0	.3
300	L	15	300	<.008	<.02	<.01	500	15	N	200	70	N	N	1000	100	15	.7	2	.3
700	10	7	500	----	---	---	N	5	N	0	100	N	10	2000	70	5	1.5	3	.3
500	L	70	20	---	---	---	L	---	10	150	100	N	15	L	50	---	---	---	---
20	<20	N	5000	<.04	<.1	<.05	700	N	N	100	L	N	N	N	30	15	.3	<.05	.03
500	N	30	10,000	---	---	---	1500	L	N	N	10	N	N	10,000	N	10	.5	1	.03
500	N	50	15,000	---	---	---	1000	20	100	N	50	N	L	>10,000	L	10	.7	.3	.15
Blind Creek area (sample localities shown in fig. 8)--Continued																			
150	N	7	N	---	---	---	N	L	N	N	100	---	N	N	L	2	0.2	0.1	0.1
300	N	10	150	---	---	---	N	10	N	L	30	---	L	L	20	2	.7	.7	.1
Long Creek area (sample localities shown in fig. 9)--Continued																			
2000	N	50	N	---	---	---	N	10	30	L	70	N	30	L	15	7	1	5	0.1
700	N	70	L	---	---	---	N	10	30	N	100	L	20	300	10	7	1.5	1.5	.1
700	N	50	L	---	---	---	N	15	30	N	100	N	30	200	20	7	1.5	1.5	.2
2000	N	50	10	---	---	---	N	15	50	N	200	N	30	200	50	7	2	1	.2
200	L	7	10	---	---	---	N	N	N	200	15	N	L	N	70	1.5	0.5	0.5	.1
1000	N	100	N	---	---	---	N	10	70	N	50	N	20	1500	L	10	1	2	.1
700	N	200	L	---	---	---	N	30	N	200	100	N	20	N	30	5	5	2	.3
1500	30	500	30	---	---	---	40[3/]	N	N	200	70	N	15	N	15	7	10	7	.3
300	N	30	N	---	---	---	N	5	N	N	100	N	30	N	10	3	.2	.7	.05
10	10	5	10	.01-.008	.004	.005	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

Location	Sample No. and description
Long Creek area:	
1	2.0-foot chip across strongly mineralized layer in hornfelsed argillite. Layer strikes N. 82° W., dips 52° NE., and can be traced for about 100 feet.
2	10.0-foot chip across massive chalcopyrite and pyrrhotite. Sulfide-rich zone trends N. 10° W., and probably dips to the east. Material from this same pit reported by Ross (1933) assayed 0.22 oz per ton Au, 4.9 oz per ton Ag and 7.34 percent Cu.
3	Random pieces of sulfide-rich material, same trend as sample 2.
4	Composite of sulfide-bearing chips; main sulfide-bearing zone trends about N. 80° E.
5	Grab sample of quartz porphyry cut by 1/4-inch quartz veinlets on 2-inch to 2-foot spacing. Veinlets on several fracture sets including: N. 30° W., dipping 65° NE.; N. 25° E., dipping 52° NW.; and N. 85° E., dipping 44° NW. Sparse molybdenite, chalcopyrite, and pyrite in quartz veinlets.
Long Creek area—Continued	
6	Grab sample of sacked ore.
7	Composite grab sample of chips collected at four corners of outcrop area in fine-grained tuff and volcanic breccia which has very fine disseminated chalcopyrite in altered breccia fragments.
8	Composite grab sample of chips collected on outcrop of green volcanic conglomerate. Green stain probably caused by chromium or nickel (see spectrographic analyses).
9	Grab sample of copper-stained gossan, sheared limestone host rock.

Table 3.--Analyses of stream-sediment

[Analyses, except of gold, are semiquantitative spectrographic by D. J. Grimes,
0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols:
looked for. Results are given in parts per million, except for Fe, Mg, Ca,
A. L. Meier, R. L. Miller, and T. A. Roemer. Sample localities are shown in

Sample No.	Lab. No.	Field No.	Ag	As	Au	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La
1	ACK 006	67ACx 257	N	N	N	70	1500	1	N	N	15	300	70	N
2	005	256	N	N	N	70	1000	1	N	N	15	200	70	N
3	007	258	0.5	N	N	100	1500	1	N	N	15	200	70	N
4	004	254	N	N	N	50	1000	L	N	N	10	70	50	L
5	003	253	N	N	N	70	1500	1	N	N	15	300	70	N
6	008	259	N	N	N	70	1000	1	N	N	20	200	70	L
7	002	176	N	N	N	50	700	L	N	N	15	150	70	N
8	ACE 649	169	N	N	0.4	30	700	1	N	N	20	200	70	N
9	650	173	N	N	.04	50	1000	L	N	N	15	150	50	20
10	651	88	N	N	N	70	1000	1	N	N	20	150	70	N
11	ACF 104	67AHx 31	2	1500	N	70	700	N	N	N	20	300	100	30
12	103	30	1.5	5000	N	70	500	N	N	N	30	1500	300	N
12a	ACE 646	239 a	N	N	N	100	1000	L	N	N	15	200	30	N
12a	647	239 b	N	N	.02	100	1000	1	N	N	15	150	50	N
12a	648	239 p	L	N	N	70	1000	L	N	N	20	2000	30	N
13	ACF 069	67ACx 64	3	3000	.04	100	300	1	N	N	20	300	200	N
14	ACE 609	Hx 98	N	N	N	70	1000	1	N	N	20	150	100	20
15	610	99	.7	200	N	70	1000	1.5	N	N	20	100	150	50
16	611	100	N	N	N	50	700	1	N	N	15	150	70	20
17	ACF 032	101	N	N	.04	50	500	1	N	N	7	150	30	20
18	ACE 607	67AHx 96	N	N	N	100	2000	1	N	N	30	150	100	N
19	606	95	N	N	N	100	1000	1	N	N	20	150	100	30
20	605	94	N	N	N	100	3000	1.5	N	N	20	150	100	20
21	604	93	N	N	---	100	1000	1	N	N	20	150	70	20
22	603	92	N	N	N	50	700	1	N	N	20	150	70	N
23	602	91	N	N	N	50	700	1	N	N	20	150	100	N
24	ACF 028	70	3	5000	.7	100	700	1	10	N	20	100	300	30
25	026	68	N	N	.06	150	300	1	N	N	20	200	100	N
26	027	69	N	N	N	100	300	1	N	N	20	300	150	20
27	029	71	N	N	.04	50	2000	1	N	N	20	700	100	N
28	031	73	N	N	N	150	700	1	N	N	20	70	100	20
29	030	72	N	N	.02	100	500	1	N	N	20	100	100	30
30	033	103	N	N	N	100	500	L	N	N	20	70	70	N
31	082	87	N	N	N	70	500	L	N	N	20	70	70	L
32	081	86	N	N	N	50	700	N	N	N	20	300	70	N

samples, upper Chulitna district

E. E. Martinez, and Arnold Farley, Jr., and are reported in the series 0.1,
N, not detected; L, detected but below limit of determination; ---, not
Ti, which are given in percent. Gold analyses are by atomic absorption by
figure 10]

Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
N	700	L	70	15	N	20	N	100	150	N	20	L	150	5	1.5	0.7	0.5
N	500	L	100	15	N	15	N	150	150	N	15	L	100	5	1	.3	.5
N	700	L	70	20	N	15	N	150	100	N	20	L	150	7	1.5	.5	.5
N	700	L	30	15	N	15	N	70	70	N	15	L	150	3	.7	1.5	.5
N	500	L	70	15	N	20	N	100	150	N	20	L	150	5	1.5	.7	.5
N	700	L	100	15	N	15	N	100	100	N	15	L	150	5	1.5	.5	.5
N	700	L	50	15	N	10	N	70	70	N	15	N	100	3	.7	.2	.3
N	700	L	70	10	N	15	N	100	150	N	15	L	150	5	1.5	.5	.3
N	700	L	50	15	N	15	N	100	100	N	20	L	150	3	1	.3	.5
N	700	L	30	20	N	15	N	100	150	N	20	N	100	5	1	.5	.5
N	5000	L	70	30	N	20	N	150	100	N	10	L	150	15	.7	.7	.2
N	1000	L	70	30	N	20	N	150	150	N	10	L	100	15	1.5	.7	.5
N	1000	L	100	10	N	10	N	150	70	N	15	L	50	3	1.5	3	.3
N	1000	L	70	10	N	10	N	150	100	N	15	L	50	5	1.5	2	.3
15	2000	L	200	20	N	10	N	150	100	N	15	L	70	5	1.5	3	.3
N	700	L	100	200	N	20	N	70	100	N	15	N	150	7	1.5	1.5	.5
N	700	L	70	30	N	15	N	70	100	N	15	L	100	5	.7	.2	.3
N	1000	L	70	70	N	15	N	100	150	N	20	500	150	5	.7	.3	.3
N	700	L	50	20	N	15	N	70	100	N	15	L	150	3	1	.7	.5
N	700	L	30	15	N	15	N	50	70	N	15	N	150	1.5	.7	.2	.3
N	1000	L	70	15	N	15	N	100	150	N	15	200	150	5	1	.5	.5
N	1000	L	70	30	N	15	N	50	150	N	20	L	150	3	.7	.15	.7
7	700	L	100	15	N	15	N	150	150	N	30	200	150	7	.7	.7	.5
N	700	L	70	20	N	15	N	50	100	N	20	L	100	5	.7	.2	.3
N	700	L	50	20	N	15	N	70	150	N	15	N	100	7	1	.3	.5
N	700	L	70	20	N	20	N	150	150	N	20	N	100	7	1.5	.5	.3
N	700	L	50	70	N	15	N	70	100	N	15	200	70	5	1	1	.5
N	700	L	100	10	N	20	N	100	200	N	15	N	70	5	3	2	.5
N	700	L	100	20	N	20	N	150	150	N	15	N	70	5	2	1.5	.5
N	1000	L	70	15	N	30	N	150	150	N	15	L	70	7	2	.7	.5
N	1000	L	30	20	N	20	N	150	150	N	15	N	100	7	1.5	.5	.5
N	1000	L	30	20	N	20	N	100	150	N	200	N	100	7	1.5	.3	.7
N	700	L	30	20	N	20	N	150	150	N	15	N	70	7	1.5	.7	.5
N	700	L	30	30	N	15	N	150	150	N	15	N	100	7	1.5	.7	.5
N	700	L	150	20	N	15	N	100	100	N	15	L	70	5	1.5	.3	.3

Table 3.--Analyses of stream-sediment

Sample No.	Lab. No.	Field No.	Ag	As	Au	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La
33	ACF 084	67AHx 89	N	N	N	70	700	L	N	N	20	150	70	N
34	085	90	L	N	N	50	500	L	N	N	15	150	50	N
35	083	88	N	N	N	30	500	L	N	N	20	300	50	N
36	055	115	N	N	.02	70	300	L	N	N	15	150	70	N
37	035	114	N	N	N	50	500	L	N	N	20	150	70	N
38	034	113	N	N	.02	50	700	L	N	N	15	100	70	L
40	070	75	N	N	N	70	700	L	N	N	20	100	70	N
41	072	77	N	N	N	30	500	L	N	N	15	150	100	N
42	071	76	N	N	N	70	700	L	N	N	20	300	100	N
								L						
43	073	78	L	L	N	30	500	L	N	N	15	150	100	N
44	074	79	7	N	N	70	300	L	N	N	30	2000	70	N
45	075	80	N	N	N	70	700	L	N	N	20	200	70	N
46	077	82	N	N	N	70	700	L	N	N	20	200	70	N
47	076	81	N	N	N	70	700	L	N	N	20	500	100	N
48	078	83	N	N	N	70	700	L	N	N	20	1000	100	N
49	079	84	N	N	N	70	700	L	N	N	20	150	70	N
Limits of determination			.5	200	.02	10	5	1	10	20	5	5	5	20

samples, upper Chulitna district--Continued

Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
N	1500	L	50	20	N	15	N	100	100	N	15	L	100	5	2	.3	.7
N	700	L	50	70	N	10	N	50	100	N	15	L	70	5	1	.15	.3
N	700	L	100	15	N	15	N	70	100	N	15	L	70	5	1.5	.2	.3
N	700	L	50	15	N	15	N	100	100	N	15	N	100	3	1	.5	.5
N	700	L	50	15	N	15	N	100	100	N	15	N	70	3	1	2	.5
N	700	L	30	15	N	30	N	300	100	N	15	N	70	5	1	.5	.5
N	700	L	50	10	N	15	N	150	100	N	15	N	100	5	1.5	1	.5
N	700	L	70	15	N	15	N	200	150	N	15	N	150	5	1.5	1.5	.5
N	700	L	100	20	N	15	N	70	150	N	20	N	150	7	1.5	.5	.7
N	700	L	70	20	N	15	N	50	100	N	15	N	70	3	1	.5	.3
N	1000	L	300	70	N	15	N	L	100	N	15	L	70	7	3	.2	.3
N	700	L	100	20	N	15	N	150	100	N	15	N	100	5	1.5	1.5	.3
N	700	L	150	30	N	15	N	200	100	N	15	N	100	5	2	1.5	.5
N	700	L	150	20	N	15	N	200	150	N	15	N	100	7	2	1.5	.5
N	700	L	150	15	N	15	N	300	150	N	15	N	100	7	2	2	.7
N	1000	L	150	20	N	20	N	150	150	N	15	N	100	5	.15	.3	.3
5	10	10	2	10	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

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