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SKARN-HOSTED MINERALIZATION IN PALEOZOIC ROCKS BENEATH THE IDARADO MINE, NORTHWEST SAN JUAN MOUNTAINS, COLORADO

by

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ABSTRACT

Three vertical holes were drilled and cored to examine Paleozoic rocks for mineralization beneath the Idarado Mine. The holes are sited along the highly productive Argentine-Black Bear-Cross Vein systems on the northwest side of the Silverton caldera.

With the exception of the Cross Vein-Argentine Vein intersection, economic mineralization at the Idarado mine essentially bottoms at the Tertiary unconformity in the Telluride Conglomerate. The junction between the Cross and Argentine veins apparently served as a major conduit for ore fluids and is well mineralized at an elevation of 9,100 feet (2900 Mill level) in the Permian Cutler Formation.

Calcareous rocks of the Hermosa, Molas, Leadville, Ouray and Elbert formations were metasomatized. Relatively pure carbonates were recrystallized to tremolitic marble while impure siliceous limestones were altered to calc-silicate skarn.

A variety of skarn types are noted. In the Hermosa Formation, this includes rhodonite-epidote, epidote-diopside and epidote-actinolite types. The most extensive skarn is at the top of the Leadville Formation in hole Tb29-H-1. Skarn types there include a combination of: rhodonite, ilvaite, johannsenite, garnet, and magnetite. Calc-silicates are manganiferous.

Base metal mineralization is present with the skarns; Zn and Pb values correlate well with the presence of Mn. Skarn appears to have formed at a relatively high temperature; base metals are later and replace the earlier formed skarn.

GEOLOGICAL SETTING

Structure

A complex of Tertiary-age calderas is the dominant geologic feature in the northwest San Juan Mountains and consists of the Uncompahgre and San Juan calderas (28 m.y.), the Silverton caldera (27 m.y.), and the Lake City caldera (22.5 m.y.) (Lipman et al., 1973). Bounding faults of the Silverton caldera pass through the Idarado property that is situated along its northwest edge (Figure 1).

At the Idarado mine, normal faults radial to the caldera have been filled by both veins and dikes; in plan, these structures form an elongate belt with a long axis that trends N45°W from the edge of the Silverton caldera to the vicinity of the Mt. Sneffels-Stony Mountain intrusion. In general, the dikes and structures dip steeply outward from the central axis.

At the Idarado Mine, base and precious metal ores have been mined from both veins and replacement deposits in Telluride Conglomerate along individual fissures that strike N15-70°W within the system (Mayor and Fisher, 1972).

Stratigraphy

In the mine area, west-dipping Mesozoic and Paleozoic strata rest on quartzite of the Precambrian Uncompahgre Formation; the Paleozoic rocks extend east of the mine area and wedge out along a line that extends southward from Ouray to Silverton. These units are separated by a major angular unconformity from overlying nearly horizontal Tertiary formations that include the basal Telluride Conglomerate and several thousand feet of overlying volcanic rocks (Mayor, 1978). A generalized stratigraphic column is shown in Table 1.

PRODUCTION

The total production of the Idarado property has been given elsewhere (Mayor, 1978); that portion produced by Idarado mining company is shown below:

Year	Tons	Au oz/t	Ag oz/t	Pb%	Cu%	Zn%
1946-1978	10,900,000	0.07	1.91	2.33	0.71	3.63

Approximately 95% of this production was from vein structures and Telluride Conglomerate replacement ores of the Argentine-Black Bear-Cross Vein system.

SOURCE OF DATA

Three diamond drill holes were completed between 1974-1978 to examine the Paleozoic rocks for the presence of mineralization beneath the Idarado Mine. These are shown in Figure 2 and form the database for this report. Placement of the drill holes in relation to the vein conduits and ore shoots, that are hosted in the Tertiary rocks, is summarized below.

Although some vein and dike structures are present in the Paleozoic rocks, economic mineralization essentially bottoms at the Tertiary unconformity within the Telluride Conglomerate at approximately 9,400 feet elevation.

The vicinity of the Cross and Argentine Vein intersection, is the notable exception. On 2900 level, ore-grade vein mineralization is present for 2,600 ft along the Cross Vein system and 900 ft along the Argentine Vein in the Permian Cutler Formation.

Drill hole Tb29-H-1 is situated central to the Argentine vein and replacement ore shoots and positioned to test the Paleozoic rocks at the Argentine-Cross Vein intersection projected to depth. Drill hole Tb29-H-3 is an offset to the mineralized skarn intersected by Tb29-H-1.

The 2400 level (9,500' elevation) is the lowest level along the Black Bear vein. Mine development has exposed a braided system of narrow veins characterized by steep dips. Along the Black Bear, the strike length of vein ore shoots narrows with depth from 4,000 ft at 1200 level to approximately 1,000 ft at the 2400 level.

Drill hole BB24-14-1 is situated central to the Black Bear ore shoots.

LITHOLOGY OF DRILL CORES, CORRELATION BETWEEN DRILL HOLES AND THE STRATIGRAPHIC POSITION OF SKARNS.

The stratigraphic correlation of altered rocks in drill holes TB29-H-1, Tb 29-H-3 and BB24-14-1 is shown in Figure 3 and Table 5.

Hermosa Formation

The Hermosa Formation is predominantly arenaceous, similar to the overlying Cutler, with relatively thin units of conglomerate and siltstone. Interbedded limestones become increasingly common with depth and range from 1 ft to 22 ft in thickness.

The sandstones are feldspathic with significant amounts of K-feldspar, mostly microcline, in addition to plagioclase. Alteration within the sandstones is generally slight and consists of epidotized plagioclase; minor amounts of calcite, actinolite, chlorite, and sericite occur sporadically throughout the sandstone interstices.

The siltstones are reddish-brown and highly ferruginous (hematitic) near the top of the Hermosa, becoming reduced and carbonaceous near the base. They typically comprise 30%-40% quartz, 3-15% plagioclase, 3-5% microcline, in addition to matrix micas and illitic clays. Carbonaceous siltstones are slightly pyritic with traces of pyrrhotite and chalcopyrite. Siltstones are observed to grade into limestones. The limestones are typically altered to skarn along contacts.

Molas Formation

The most intense skarn is developed at depth in holes Tb29-H-1 and BB24-14-1 (Table 5). Unaltered rock is not present within the skarn, but by correlation both with the regional stratigraphic section and the less altered rocks of drill hole TB29-H-3, these skarns are interpreted to have developed principally at the horizon of the Molas Formation.

The Molas was deposited on a karst surface and thickness can vary over short distances. This feature may explain, in part, the difference in the thickness of skarn between holes Tb29-H-1 and Tb29-H-3. Alternatively, some of the adjacent Hermosa could be included in the skarn.

In BB24-H-1, the 164' of garnet-epidote skarn must include a significant thickness of the lower Hermosa Formation.

TABLE 5

CORRELATION OF LOWER PALEOZOIC AND PRECAMBRIAN ROCKS BETWEEN THE IDARADO DRILL HOLES

Formation	**Tb29-H-3**	**Tb29-H-1**	**BB24-14-1**
Molas	9.2' sedimentary bx	36.0' skarn	164.0' garnet-epidote skarn(1)
Leadville	118.3' marble	113.5' marble	55.0' garnet skarn
Ouray-Elbert	166.0' dol-ls, sh, sst	156.6' dol-ls, sh, ss.	131.5' marble, hornfels
Precambrian	5.0' quartzite	3.0' quartzite	100.0' gneiss 6.0'monzonite

(1) includes lower Hermosa Formation.

Leadville, Ouray and Elbert Formations

The Leadville, Ouray and Elbert Formations are dominated by carbonate rocks and appear to thin to the southeast.

The Leadville, in hole Tb29-H-1, comprises 113.5' of calcitic marble whereas to the southeast in BB24-14-1, the Leadville appears to be represented by 55' of massive garnet skarn.

The Ouray-Elbert Formations comprise alternating beds of limestone, dolomitic limestone, shale and sandstones. The total thickness of these Formations changes from 156.6 feet to 131.5 feet between holes Tb29-H-1 and BB24-14-1, respectively.

Precambrian

Precambrian rocks change in lithology to the southeast. Drill holes Tb29-H-1 and Tb29-H-3 terminate in 3 feet and 5 feet, respectively of "typical" pure quartzite of the Uncompahgre Formation.

The Precambrian rocks of BB24-14-1 comprise 100' of gneiss followed by 6' of weakly foliated monzonite at the end of the hole.

The composition of these metamorphic rocks in BB24-14-1 is variable with quartz (9-27%), K-feldspar (10-42%) and plagioclase (23-41%), the dominant minerals.

The most likely correlation of these rocks is with the Twilight Gneiss or Tenmile Granite that outcrop 17 miles to the south.

ALTERATION-MINERALIZATION IN PALEOZOIC ROCKS

Based on the abundance of garnet, epidote, tremolite-actinolite and the presence of marble, the alteration intensity increases with depth in each hole. In addition, the alteration in BB24-14-1 is more widespread than the other holes and may indicate an increase in the thermal gradient to the southeast.

Skarns in the Hermosa Formation

The thin interbedded limestones within the Hermosa Formation are typically altered to skarn along contacts or throughout (in the case of thinner beds) and result in a range of mineralogic composition.

Moderately pure or slightly dolomitic limestones were recrystallized to tremolitic marble. Impure siliceous limestones were altered to calc-silicate skarn consisting of manganiferous epidotes, pyroxenes, amphiboles and garnets. Skarns are classified into three types: rhodonite-epidote, epidote-diopside, epidote-actinolite.

Base metal mineralization (Pb and Zn with minor Cu) occurs principally as replacements along the metasomatized skarn horizons. Skarn types are shown on Table 2; rhodonite-epidote is the most favorable skarn type for base metal mineralization.

Skarns in the Molas Formation

Drill Hole Tb29-H-1

Considerable diversity in mineralogic composition is present in skarn of Tb29-H-1 (Table 3I). The Calc-silicate minerals are manganiferous. Base metal values (Zn and Pb) correlate with the Mn content of the skarn and may serve as a guide to mineralization (Table 3II). The assay value for the mineralized skarn is 36 feet, Nil Au, 0.24 oz/t Ag, 1.16% Pb, 0.03% Cu, 2.43% Zn (Table 3III).

The skarn appears to have developed at relatively high temperature prior to base metal mineralization and was subsequently mineralized during stages of declining temperature and surges of hydrothermal activity. In thin section, quartz, calcite, hematite-magnetite and base metals can be seen to replace silicates.

Sphalerite distribution is irregular and ranges from fairly massive replacements to small dispersed grains. Sphalerite replacement is not restricted to a specific rock type and was detected in garnet-magnetite and pyroxene-rhodonite skarn types. It appears that permeability and replaceable silicates are important factors in controlling the distribution of sulphides within the skarn mineral assemblage.

Drill Hole Tb29-H-3

This drill hole is an offset from Tb29-H-1 in a direction toward the Argentine Vein, to test the continuity of the mineralized intercept in Tb-29-H-1.

An 11.7 feet thickness of garnet-epidote skarn with minor base metals was intersected at the contact with the underlying 9.2 feet unaltered sedimentary chert clast breccia that is correlated with the Molas Formation.

Drill Hole BB24-14-1

The skarns of hole BB24-14-1 are of relatively simple mineralogy (Table 4I). Between 2,668-2,832 ft, epidote(0-75%)-andradite(3-88%) skarn dominates with lesser plagioclase, K-feldspar, quartz, sericite, amphibole and specular hematite. Some green grossularite is common locally with the andradite.

From 2,832 ft, the skarn mineralogy changes abruptly to pure garnet skarn; in thin section, anhedral unzoned garnet have euhedral zoned garnet overgrowths.

Base metal mineralization in these skarns is weak (Table 4II) and may indicate unreactive silicates or distance from the source of fluids.

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Illustrations

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TABLE 1. Generalized Stratigraphic Column of Rock Units in the Northwest San Juan Mountains
[Adapted from Burbank (1947) and Fisher, Luedke, Sheridan, and Raabe (1968)]

Era	Period	Rock Formation	Description	Thickness (feet)
	Quaternary		Alluvium, talus, glacial drift, etc.	
		Intrusive rocks	Gabbro to rhyolite stocks, dikes, and plutons.	
		Potosi Volcanic Group	Quartz latitic to rhyolitic welded ash-flow tuffs.	1,000±
Cenozoic	Tertiary	Silverton Volcanic Group	Andesitic to rhyodacitic flows, breccias, and tuffs, and quartz latitic welded ash-flow tuffs.	3,000±
		San Juan Formation	Predominantly rhyodacitic tuff breccia; some flows and tuffs.	3,000±
		Telluride Conglomerate	Red-brown to gray conglomerate; some sandstone, siltstone, and shale.	0–500
		Unconformity		
		Intrusive rocks	Granodioritic stocks, laccoliths, dikes, and sills.	
	Cretaceous	Mancos Shale	Gray fissile shale; a few thin bed of sandstone and limestone.	0–1,000
		Dakota Sandstone	Gray to yellow quartzitic sandstone; some conglomerate and shale.	40–175
		Unconformity		
		Morrison Formation	Lenticular sandstone; some interbedded mudstone and limestone layers.	620–750
		Unconformity		
		Wanakah Formation: Marl member	Mudstone, shale, and siltstone: some limestone.	40–75
Mesozoic	Jurassic	Wanakah Formation: Bilk Creek Sandstone Member	Green sandstone.	14–25
		Wanakah Formation: Pony Express Limestone Member	Gray bituminous limestone with some shale and gypsum.	0–20
		Entrada Sandstone	Light-colored crossbedded sandstone.	45–80
		Unconformity		
	Triassic	Dolores Formation	Brownish-red shale, siltstone, and sandstone; some white limestone and conglomerate near base.	40–300
		Unconformity		
	Permian	Cutler Formation	Reddish-brown shale, siltstone, sandstone, and conglomerate.	0–2,000
Paleozoic	Pennsylvanian	Hermosa Formation	Red arkosic sandstone and fossiliferous green shale, sandstone, and limestone.	1,450±
		Molas Formation	Red limy shale, sandstone, and conglomerate.	40–75
		Unconformity		
	Mississippian	Leadville Limestone	Massive gray dense limestone; a few sandy and chert layers.	70–230
	Devonian	Ouray Limestone	Gray, buff, and white dense dolomite and limestone.	70–120
		Elbert Formation	Buff dolomitic limestone; interbedded shale and sandstone.	30–80
		Unconformity		
Precambrian		Uncompahgre Formation and intrusive dikes and sills	Black and brown argillite, slate, and schist; gray, white, and brown quartzite.	5,000–8,000

TABLE 2

IDARADO MINE DDH TB29-H-1 - CORE SAMPLES
HERMOSA SKARNS, ROCK TYPES AND ASSAYS (XRF)

Depth (ft)	Formation	Rock Type	% Zn	% Pb	% Cu	% Mn
739	Hermosa	Rhodonite-epidote skarn	1.98	1.27	<0.01	14.2
943	"	Feldspathic sandstone	<0.01	<0.01	0.02	<0.1
975	"	Epidotized sandstone	0.02	0.01	<0.01	0.4
980	"	Rhodonite-epidote skarn	5.27	1.59	<0.01	11.5
993	"	Ferruginous siltstone	<0.01	<0.01	<0.01	<0.1
1002	"	Epidotized sandstone	<0.01	<0.01	0.02	0.1
1464	"	Carbonaceous siltstone	<0.1	0.02	0.02	0.1
1468(a)	"	Carbonaceous silt, limestone	<0.01	<0.01	<0.01	0.3
1468(b)	"	Epidote-actinolite skarn	0.02	0.02	<0.01	0.3
1543	"	Epidote-actinolite skarn	0.03	0.02	0.04	0.4
2112	"	Carbonaceous limestone	<0.01	0.01	<0.01	<0.1
2164	"	Carbonaceous siltstone	0.02	<0.01	0.02	<0.1
2165	"	Chloritic sandstone	0.10	0.03	0.39	0.2
2174	"	Feldspathic sandstone	0.03	<0.01	0.01	0.1
2178	"	Feldspathic sandstone	<0.01	<0.01	<0.01	<0.1
2192(a)	"	Tremolitized limestone	<0.01	<0.01	<0.01	0.1
2192(b)	"	Epidote-actinolite skarn	0.02	0.02	<0.01	0.3
2197	"	Epidote-diopside skarn	0.05	<0.01	0.03	0.4
2202	"	Carbonaceous siltstone	0.04	<0.01	<0.01	<0.1
2215	"	Epidote-diopside skarn	0.15	<0.01	0.02	0.4
2245	"	Epidote-diopside skarn	0.10	0.02	0.02	2.0
2257	"	Feldspathic sandstone	<0.01	<0.01	<0.01	<0.1

TABLE 3

IDARADO MINE DDH TB29-H-1 - MOLAS SKARNS.

I. Mineralogic Composition Semi-quantitative X-ray diffraction (Wt. %)

Depth (ft)	Rock Type	Carbonates				Pyroxenes			Amphiboles			Miscellaneous Silicates									
		Quartz	Calcite	Dolomite	Mangano-calcite	Schef-ferite	Johann-senite	Heden-bergite	Tremo-lite	Actin-olite	Epidote	Mica	Chlor-ite	Ilvaite	Garnet	Talc	K-feld-spar	Pyrite	Rhodon-ite	Magne-tite	Hema-tite
2,821	Pyroxene-Actinolite	5	-	-	8	-	-	65	-	10	-	-	2-5	-	tr	-	-	-	-	tr	5
2,835	Rhodonite-Ilvaite	5	-	-	20	-	-	-	-	-	10	-	tr	15	5	-	-	-	40	4	<1
2,840	Garnet-Ilvaite	30	-	-	20	6		-	-	-	5	-	tr	10	15	-	-	-	-	5	5
2,843	Ilvaite-Pyroxene	10	-	-	-	20	5	-	-	5	-	-	-	50	10	-	-	-	tr	<1	<1
2,845	Ilvaite-Pyroxene	5	-	-	<1	4	-	-	-	-	-	-	-	85	<1	-	-	-	4	1	1
2,851	Epidote-Rhodonite	17	-	-	3	6	-	-	-	-	50	-	tr	6	3	-	-	-	10	-	<1
2,854	Garnet-Ilvaite	5	-	-	25	20	10	-	-	-	5	-	tr	4	20	-	-	-	-	3	15
2,855	Garnet-Magnetite	5	-	-	5	-	-	-	-	-	-	-	-	-	25	-	-	-	-	30	5
2,856	Sphalerite-Ilvaite	5	-	-	15	-	-	-	-	-	5	-	-	10	6	-	-	-	5	2	2
2,856.2	Pyroxene-Rhodonite	5	-	-	15	-	55	-	-	-	-	-	-	-	-	-	-	-	15	tr	tr
2,856.4	Pyroxene-Rhodonite	5	-	-	15	-	40	-	-	-	-	-	-	-	-	-	-	-	40	-	tr

II. Samples of Rock Types with Assays

Depth (ft)	Rock Type	% Cu	% Pb	% Zn	% Mn
2821	Pyroxene-Actinolite Skarn	0.02	0.05	0.10	8.5
2835	Rhodonite-Ilvaite Skarn	.013	.017	1.17	15.00
2840	Garnet-Ilvaite Skarn	<.01	.10	.50	4.1
2843	Ilvaite-Pyroxene Skarn	.016	.021	.05	7.05
2845	Ilvaite-Pyroxene Skarn	.012	.016	.09	8.45
2851	Epidote-Rhodonite Skarn	.014	.021	7.31	5.35
2854	Garnet-Ilvaite Skarn	<.01	<.01	.10	11.8
2855	Garnet-Magnetite Skarn	.02	.01	23.4	.7
2856	Sphalerite-Ilvaite Skarn	.059	.035	21.50	2.46
2856.2	Pyroxene-Rhodonite Skarn	.016	.029	15.00	13.90
2856.4	Pyroxene-Rhodonite Skarn	.015	.016	.04	15.00

III. Assay for Mineralized Skarn

From	To	Length	Assay Data				
			Au oz/t	Ag oz/t	% Pb	% Cu	% Zn
2820	2824	4.0	0.0	0.20	1.50	0.0	1.50
2824	2828	4.0	0.0	0.26	1.40	0.0	1.10
2828	2832	4.0	0.0	0.24	1.20	0.02	1.00
2832	2834	2.0	0.0	0.20	1.30	0.02	1.20
2834	2839	5.0	0.0	0.20	1.10	0.05	2.30
2839	2844	5.0	0.0	0.24	1.00	0.05	1.50
2844	2849	5.0	0.0	0.20	0.90	0.02	1.40
2849	2854	5.0	0.0	0.30	1.00	0.02	3.30
2854	2856	2.0	0.0	0.34	1.40	0.07	14.00

TABLE 4

II. IDARADO MINE DDH BB24-14-1 ASSAY PULPS
SEMI-QUANTITATIVE X-RAY FLUORESCENCE ANALYSES (Wt. Percent)

	Depth (ft)	Fe	MnO	BaO	TiO2	Cu	Pb	Zn	W	Au oz/t	Ag oz/t
Epidote-Garnet Skarn	2668.0-2672.0	12.9	1.20	0.1	0.0	.0005	.0010	.0010		<.0006	<.006
	2672.0-2676.0	11.8	1.05	0.1	0.0	.0005	.0005	.0005		<.0006	<.006
	2676.0-2682.0	11.2	1.25	0.1	0.5	.0005	.0005	.0020		<.0006	<.006
	2682.0-2686.0	13.5	1.05	0.1	0.0	.0005	.0010	.0010		<.0006	<.006
	2686.0-2693.0	5.8	0.66	0.0	0.0	.0215	.0035	.0120		<.0006	.006
	2693.0-2699.0	2.2	0.12	0.1	0.3	.0155	.0005	.0045	.0003		
	2704.5-2707.5	14.1	1.49	0.1	0.0	.0005	.0005	.0035		<.0006	<.006
	2758.7-2767.0	18.2	1.25	0.1	0.5	.0010	.0255	.0325	.0007	<.0006	.006
	2767.0-2779.5	13.5	1.36	0.1	0.5	.0010	.0265	.0460	.0034	<.0006	.012
	2779.5-2804.0	12.9	1.00	0.1	0.8	.0030	.0600	.0510	.0008	<.0006	.024
	2804.0-2810.5	15.4	1.00	0.1	0.4	.0005	.0020	.0070	.0005	<.0006	<.006
	2810.5-2819.5	12.9	0.91	0.1	1.1	.0005	.0085	.0080	.0006	<.0006	.006
	2819.5-2832.0	11.8	1.10	0.1	1.1	.0005	.0065	.0100	.0006	<.0006	.006
Garnet Skarn	2832.0-2842.0	19.6	1.00	0.1	0.0	.0005	.0010	.0030	.0008	<.0006	<.006
	2842.0-2852.0	22.0	0.70	0.0	0.0	.0005	.0050	.0065	.0015	.0035	<.006
	2852.0-2862.0	21.7	0.83	0.1	0.0	.0005	.0050	.0085	.0028	.0109	.006
	2862.0-2872.0	21.7	0.79	0.0	0.0	.0050	.0050	.0080	.0036	<.0006	<.006
	2872.0-2887.0	20.3	1.00	0.1	0.0	.0005	.0050	.0060	.0018	<.0006	.006
Marble	2887.0-2892.5	0.9	0.15	0.1	0.0	.0060	.0010	.0285			
	2892.5-2902.0	0.8	0.28	0.1	0.0	.0005	.0015	.0160			
	2902.0-2912.0	0.7	0.06	0.2	0.0	.0010	.0005	.0050			
	2912.0-2932.0	0.5	0.07	0.1	0.0	.0005	.0020	.0070			
	2932.0-2952.0	0.7	0.13	0.1	0.0	.0005	.0010	.0065			
	2952.0-2970.0	1.0	0.12	0.1	0.0	.0005	.0005	.0155			
	2970.0-2980.0	23.6	0.31	4.0	0.0	.0700	.0250	1.500		.0097	.147
	2980.0-3000.0	4.7	0.17	0.1	0.0	.0115	.0065	.0355			
	3000.0-3008.0	5.1	0.15	0.2	0.0	.0065	.0025	.0650			
	3008.0-3018.5	5.8	0.15	0.1	0.5	.0130	.0005	.0100			

TABLE 4

I. IDARADO MINE DDH BB24-14-1 ANALYTICAL PULPS
SEMI-QUANTITATIVE X-RAY DIFFRACTION ANALYSES (WT. PERCENT)

	DEPTH (FT)	MICA	AMPH	CHL	SER	QTZ	KFEL	PLAG	CALC	DOLO	EPDT	ANDR	OTHER
Epidote-Garnet Skarn	2668.0-2672.0	0.	0.	0.	0.	3.	0.	0.	0.	0.	0.	97.	
	2672.0-2676.0	0.	0.	0.	0.	6.	0.	0.	0.	0.	0.	94.	
	2676.0-2682.0	0.	0.	0.	0.	9.	0.	0.	0.	0.	19.	72.	
	2682.0-2686.0	0.	0.	0.	0.	1.	0.	0.	0.	0.	2.	97.	
	2686.0-2693.0	0.	5.	1.	0.	43.	9.	7.	3.	0.	32.	0.	
	2693.0-2699.0	1.	4.	0.	0.	47.	15.	25.	0.	0.	6.	3.	
	2704.5-2707.5	0.	0.	0.	0.	5.	0.	0.	7.	0.	0.	88.	
	2758.7-2767.0	0.	5.	3.	0.	4.	3.	4.	19.	0.	21.	42.	
	2767.0-2779.5	1.	3.	2.	2.	5.	4.	4.	7.	0.	11.	61.	
	2779.5-2804.0	0.	0.	4.	4.	15.	7.	5.	8.	0.	50.	7.	
	2804.0-2810.5	0.	0.	2.	0.	3.	0.	0.	8.	0.	3.	83.	
	2810.5-2819.5	0.	3.	1.	2.	2.	3.	4.	6.	0.	75.	3.	
	2819.5-2832.0	0.	6.	2.	5.	4.	5.	5.	12.	0.	53.	7.	
Garnet Skarn	2832.0-2842.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	2.	96.	
	2842.0-2852.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	100.	
	2852.0-2862.0	0.	0.	0.	0.	3.	0.	0.	0.	0.	0.	97.	
	2862.0-2872.0	0.	0.	0.	0.	2.	0.	0.	0.	0.	0.	98.	
	2872.0-2887.0	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	99.	
Marble	2887.0-2892.5	0.	3.	2.	0.	0.	0.	0.	34.	61.	0.	0.	
	2892.5-2902.0	0.	8.	3.	0.	0.	0.	0.	44.	46.	0.	0.	
	2902.0-2912.0	4.	8.	1.	2.	1.	0.	0.	31.	53.	0.	0.	
	2912.0-2932.0	4.	0.	0.	0.	0.	0.	0.	55.	40.	0.	0.	
	2932.0-2952.0	5.	10.	0.	1.	1.	0.	0.	56.	27.	0.	0.	
	2952.0-2970.0	2.	6.	3.	0.	0.	0.	0.	45.	45.	0.	0.	
	2970.0-2980.0	12.	0.	3.	0.	0.	0.	0.	18.	0.	0.	0.	*Bal 67.
	2980.0-3000.0	2.	8.	10.	4.	0.	0.	0.	47.	24.	0.	0.	Diop 6.
	3000.0-3008.0	17.	5.	9.	0.	0.	0.	0.	37.	0.	21.	0.	Diop 12.
	3008.0-3018.5	14.	13.	5.	2.	0.	0.	0.	32.	0.	16.	0.	Diop 19.

* Magnetite 50, diopside 5, antigorite 5, Mn-calcite 3, talc 2, ZnS 2

TABLE 5

IDARADO MINE DDH BB24-14-1 CORE SAMPLES INTRUSIVE ROCK
SEMI-QUANTITATIVE X-RAY DIFFRACTION ANALYSES (WT. PERCENT)

DEPTH (FT)	MICA	AMPH	CHL	SER	QTZ	KFEL	PLAG	CALC	DOLO	EPDT	ANDR	MAG*
3029.0	0.	0.	3.	1.	26.	42.	23.	0.	0.	3.	1.	0.
3037.0	1.	41.	6.	3.	9.	10.	26.	0.	0.	1.	0.	1.
3051.0	4.	4.	0.	1.	29.	25.	28.	0.	0.	8.	0.	2.
3062.0	0.	3.	8.	2.	27.	21.	32.	0.	0.	7.	0.	1.
3066.0	3.	3.	6.	2.	27.	18.	32.	2.	0.	6.	0.	1.
3072.0	0.	0.	8.	1.	23.	19.	40.	1.	0.	5.	0.	3.
3078.0	0.	0.	6.	1.	23.	22.	38.	0.	0.	8.	0.	3.
3086.0	0.	0.	5.	0.	26.	18.	38.	0.	0.	10.	0.	2.
3091.0	1.	0.	6.	1.	27.	19.	36.	0.	0.	7.	0.	4.
3097.0	1.	0.	8.	1.	23.	22.	30.	1.	0.	13.	0.	1.
3102.0	11.	16.	1.	3.	15.	11.	37.	2.	0.	0.	0.	5.
3107.0	0.	7.	17.	0.	14.	16.	32.	2.	0.	9.	0.	3.
3108.0	0.	14.	14.	3.	18.	15.	29.	0.	0.	5.	0.	2.
3111.0	6.	11.	9.	3.	17.	12.	31.	1.	0.	5.	0.	4.
3115.0	3.	3.	3.	0.	25.	29.	25.	1.	0.	10.	0.	2.
3122.0	11.	23.	4.	2.	11.	10.	32.	0.	0.	3.	0.	4.
3123.5	0.	3.	4.	0.	22.	21.	41.	0.	0.	8.	0.	1.
3127.0	1.	4.	2.	1.	26.	31.	23.	1.	0.	11.	0.	0.

* MAG determined by magnetic susceptibility

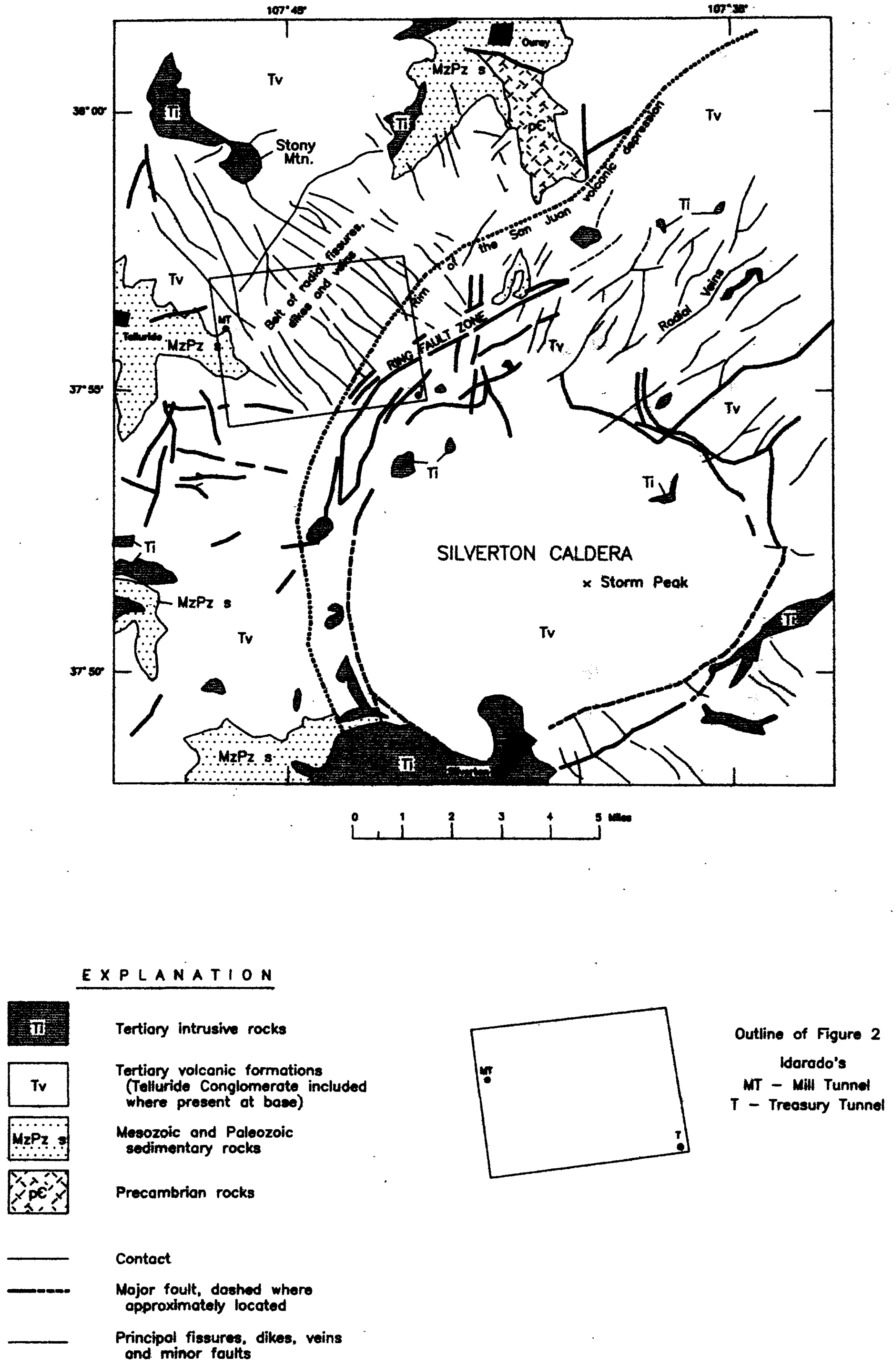

Figure 1

Generalized geologic map showing structural relations of the Silverton caldera, after Burbank (1947)

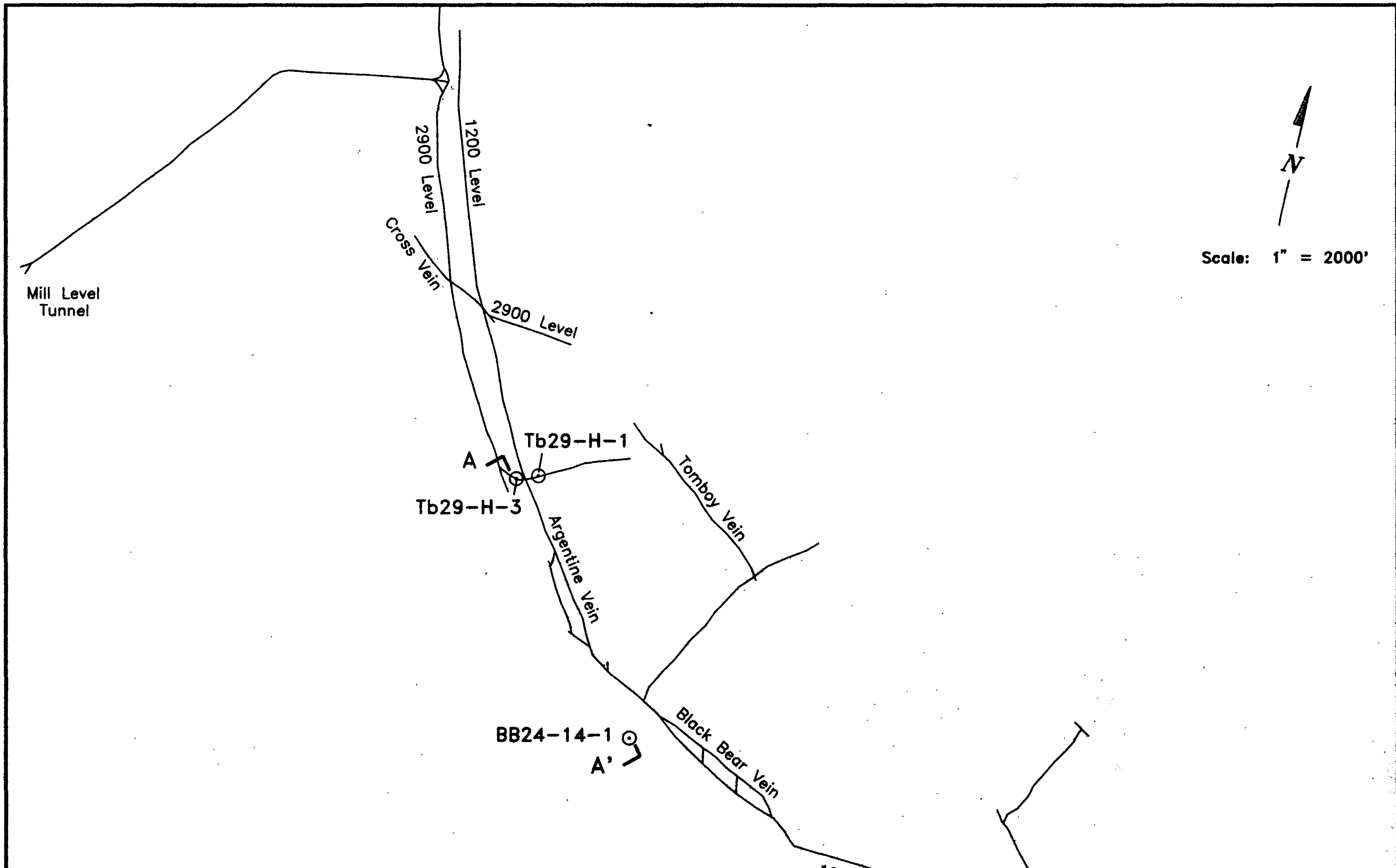

Figure 2

COMPOSITE PLAN – IDARADO MINE

SHOWING SOME MAJOR WORKINGS AND DEEP DRILL HOLES
A–A' LINE OF PROJECTION FOR FIGURE 3