STATE OF ALASKA

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James A. Williams - Director

GEOCHEMICAL REPORT NO. 18

Geology and Geochemistry of Part of the Iron Creek Area, Solomon D-6 Quadrangle, Seward Peninsula, Alaska

By

R. R. Asher

College, Alaska

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CONTENTS

C O N T E N T S

Page

ILLUSTRATIONS

GEOLOGY AND GEOCHEMISTRY OF PART OF THE IRON CREEK AREA, SOLOMON D-6 QUADRANGLE, SEWARD PENINSULA, ALASKA

By

R. R. Asher

ABSTRACT

The Iron Creek area in the Kruzgemapa River drainage on the Seward Peninsula was an important placer mining district in the early 1900's. Lode deposits of copper and lead are also in the vicinity. Forty-nine stream sediment geochemical samples were collected during a five-day visit to the area in June, 1968 and a reconnaissance geologic map was prepared. Mica schist, massive limestone, and subordinate black slate are the major rock types.

Copper is localized in the massive limestone near schist contacts. The known copper deposits are too low grade to be of economic interest, but the associated schist may carry economic concentrations of gold. East of Iron Creek geochemical samples indicate an unexposed intrusive near the head of Sherrett Creek with associated beryllium. Known lead deposits are too small to mine.

INTRODUCTION

PURPOSE AND SCOPE

The Iron Creek area was an important placer mining district during the early history of the Seward Peninsula. Within the Iron Creek drainage and the Sherrett Creek drainage to the east, there are also lode deposits. The lode deposits were discovered in the early 1900's; some of these contain lead-silver minerals and others contain copper minerals. This project was planned to study the known lode deposits and to look for similar structural and lithologic settings that might be the sites of other deposits.

Five days were spent in the area between June 20 and June 25, 1968. Snow hampered geologic observations, and ice in many of the streams made geochemical sampling difficult. Approximately 50 stream sediment geochemical samples were taken, and 13 square miles were mapped in reconnaissance fashion.

LOCATION AND ACCESS

Iron Creek is tributary to the Kruzgemapa River from the southeast. The Kruzgemapa flows north and joins the Kuzitrin River. Waters of the Kuzitrin reach the Bering Sea through Imuruk Basin (fig 1).

The area studied is in the northeastern part of the Solomon D-6 quadrangle near 64° 55'N latitude and 164° 40'W longitude. The abandoned Seward Peninsula Railroad crosses the mouth of Iron Creek about 50 miles northeast of Nome, Alaska. A well-graded gravel road that originates at Nome follows the northwest side of the Kruzgemapa River and passes the mouth of Iron Creek on the opposite side of the river.

PREVIOUS WORK

In 1907 Smith reported on the placer deposits of the Iron Creek region. He does not discuss the lode deposits, but the report includes comments on the physiography and the source of placer gold in the region. In 1908 Smith presented a brief discussion of the lode copper deposits with comments on their probable extent and commercial significance.

Mertie (1917) mentions the Wheeler copper prospect at the head of Sherrett Creek (fig 2). The remainder of Mertie's discussion is taken directly from Smith (1908).

Cathcart (1922) presented detailed descriptions of the known prospects in the vicinity. His report contains the most complete discussion of lode deposits in the Iron Creek region. In 1926 Wimmler presented additional information on some of the lode deposits near Iron Creek. His report supplements Cathcart's work.

ACKNOWLEDGEMENTS

John Hedden, field assistant, aided the writer in the field and office. His efforts contributed significantly to the success of this project. Lawrence E. Heiner, Mining Engineer, University of Alaska, programmed geochemical data for processing on the University's IBM 360 computer. Thanks are expressed to the Anchorage field laboratory of the U. S. Geological Survey for providing analytical data on geochemical samples.

G E O L O G Y

ROCK TYPES AND STRATIGRAPHIC RELATIONS

Schist and limestone are the dominant rock types in the Iron Creek area. Greenstone and siliceous black slate that resembles the Hurrah slate in the Solomon C-5 quadrangle are also present. The rocks are thought to be part of the Nome series of Paleozoic age.

The ridge that forms the divide between Iron Creek and Sherrett Creek on the east is composed of massive, crystalline, light blue limestone (fig 2). The limestone belt is a mile to a mile and a half wide; it trends northwest across the area. Chlorite and muscovite schist crop out at lower elevations around the flanks of the ridge and interrupt the continuity of the limestone belt near Bertha Creek on lower Iron Creek (fig 2).

The schist sequence contains interbeds of limestone and black graphitic slate. On upper Iron Creek, near Dome Creek, the interbedded limestone and black slate are well exposed on the limbs of a syncline (fig 2).

Small greenstone masses intrude the schist at places. One greenstone mass is well exposed on a tributary to Rabbit Creek on the west side of Iron Creek (fig 2).

Age relations are not clear because of complex structural and stratigraphic relations that would require detailed mapping to interpret. Chlorite and muscovite schist sequences contain limestone beds that are schistose in character. At contacts the limestone beds are highly contorted and complexly folded. The broad belt of massive limestone on the east side of Iron Creek in turn contains lenses and beds of schist 10 to 50 feet thick. Contacts at such localities are also highly deformed.

Whether the apparent interbedding is related to variations in the depositional environment during accumulation of sedimentary materials or whether thrust faulting and folding have redistributed the rocks is not known. It is likely that both processes have had an effect, but structural adjustments are probably the more important.

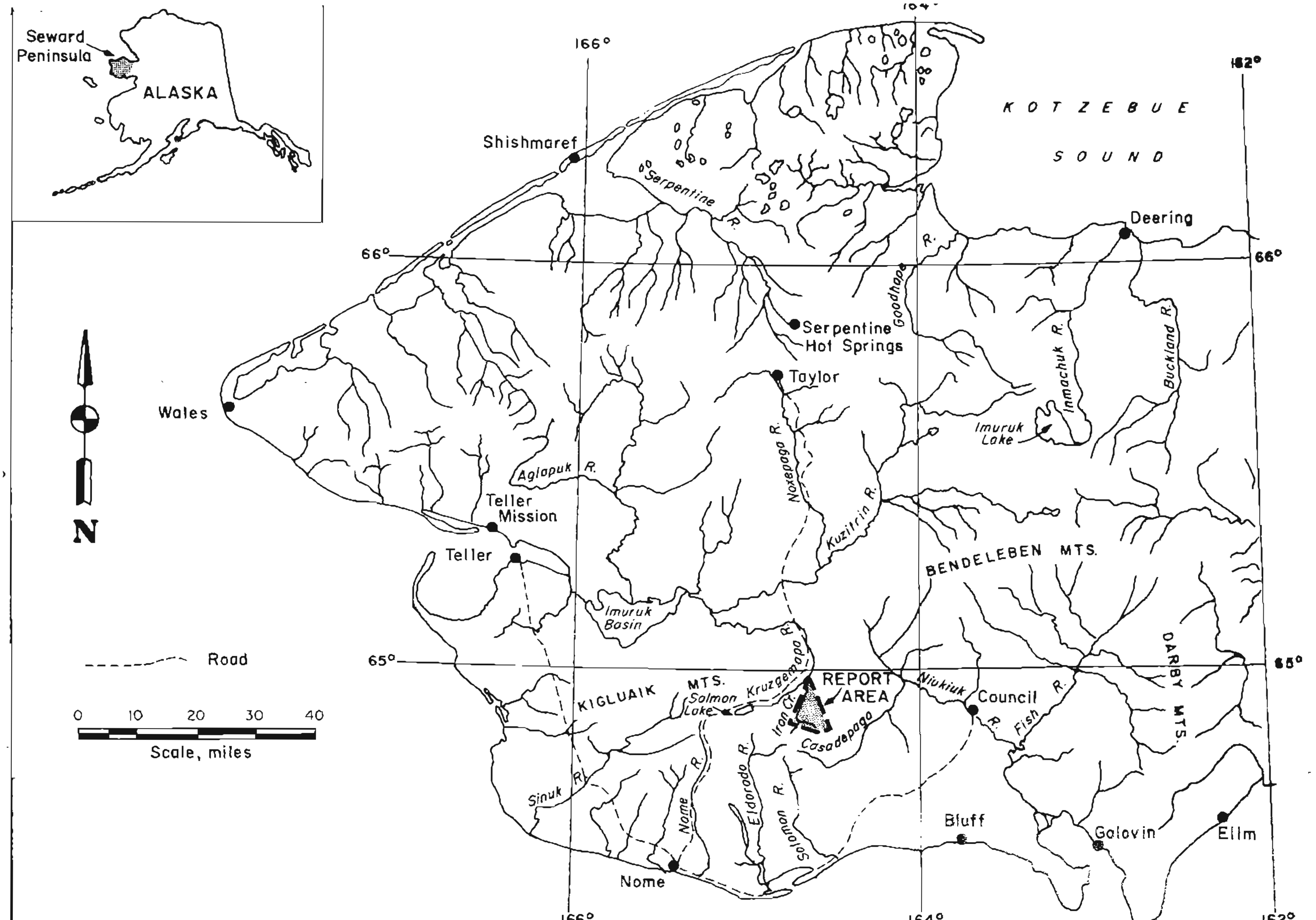

Figure I

LOCATION MAP, IRON CREEK AREA, SOLOMON D-6 QUADRANGLE, SEWARD PENINSULA, ALASKA

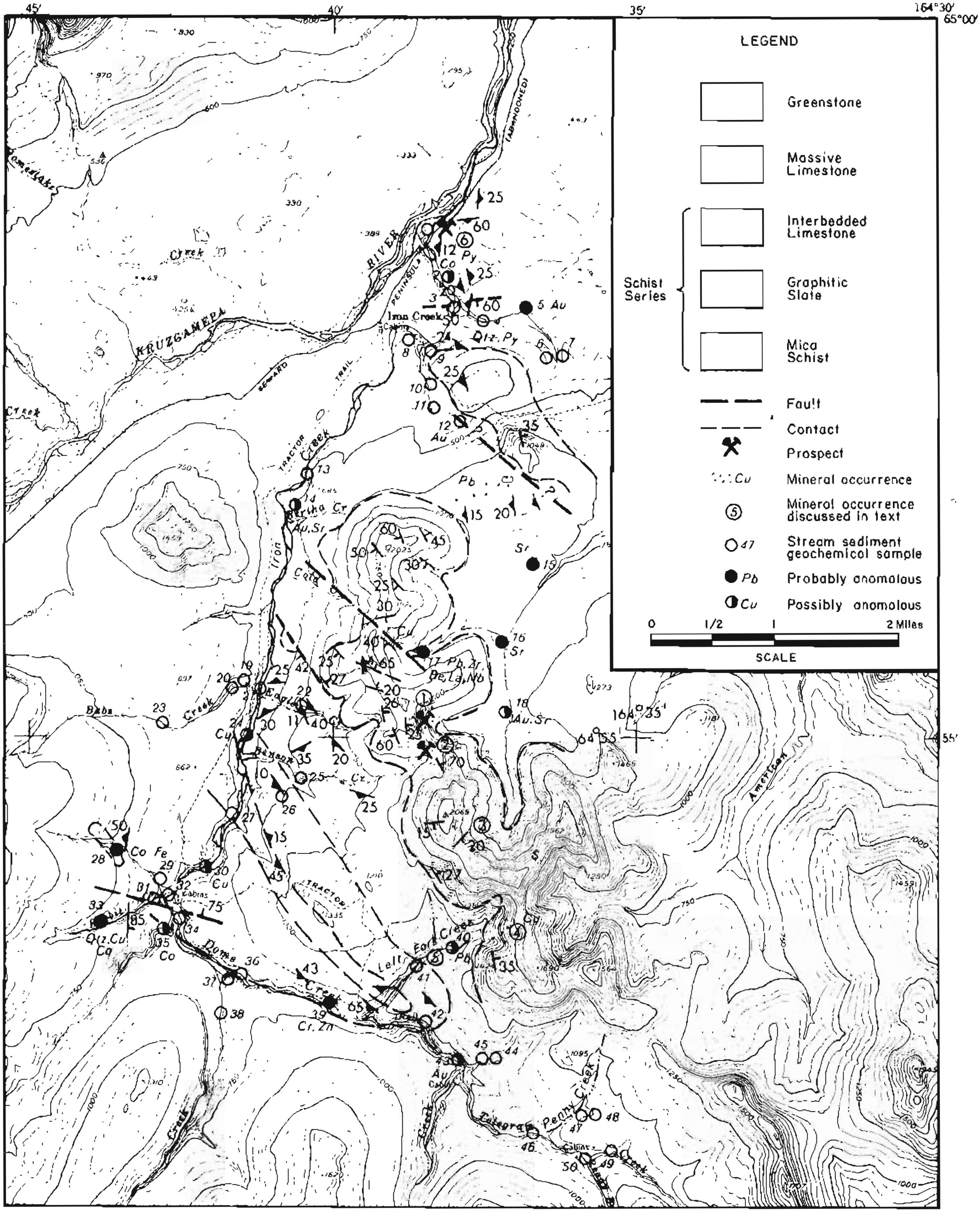

Figure 2

GEOLOGICAL - GEOCHEMICAL MAP, IRON CREEK REGION

SOLOMON D-6 QUADRANGLE, SEWARD PENINSULA, ALASKA

STRUCTURAL GEOLOGY

On the east side of Iron Creek, on the slope leading to the ridge of massive limestone further east, small patches and isolated outcrops of shattered and brecciated blue massive limestone are present. The limestone outcrops are aligned northwesterly. They are probably erosional remnants of a thrust sheet that was more extensive in the past. The thrust fault probably follows the base of the limestone, and the limestone-schist contact marks the surface trace of the fault plane.

A northwest-trending fault cuts the massive limestone near the head of Cold Creek and extends to the northeast across the ridge to the head of Sherrett Creek. Rocks on the north side of the fault appear to be displaced westward.

In upper Iron Creek near Dome Creek, there is schistose limestone and black graphitic slate. The slate is in the trough of a syncline that plunges to the northwest (fig 2).

Attitudes of planar elements in the rocks of the area are highly variable. The general trend is northwest; the rocks dip southwest or northeast.

E C O N O M I C   G E O L O G Y

PLACER DEPOSITS

Smith (1907, p 160) states that many placer gold deposits on the Seward Peninsula were derived from mineralization disseminated along limestone-schist contacts. Because limestone is abundantly interbedded in the schist there are numerous contacts, consequently there are numerous sources of placer gold in the Iron Creek region.

LODE DEPOSITS

Lode deposits in the Iron Creek region are of two types: lead-silver and copper. Lead-silver deposits are associated with schist and interbedded limestone. Copper deposits are localized in massive limestone, but in most places the deposits are near a schist contact.

Lead-Silver Deposits

Cathcart (1922, p 210, 211) discusses the Wheeler lead prospect, slightly north of the mouth of Iron Creek (No. 6, fig 2). Mineralization is on both sides of the Kruzgemapa River. Galena and pyrite are localized in schist and an interbedded limestone member.

According to Cathcart (1922, p 210) a section exposed along the river bank shows the following sequence of rocks. At the north end of the exposure there is 50 to 75 feet of blue marbleized limestone that is overlain by 40 feet of quartz-muscovite schist. Galena and pyrite are localized near the contact. The schist is overlain by another bed of limestone about 50 feet thick; at the lower contact of this second limestone there is a greenstone intrusive. The limestone is succeeded to the south by schist. The contacts between the limestone and schist are highly deformed and the limestone is slightly schistose. The beds strike N70W and dip 10 N.

Cathcart (1922, p 211) says that the mineralized zone is typical of a schist-limestone contact along which adjustments have occurred. The limestone underlying the schist is folded and crenulated. It is schistose at the contact, but extreme deformation extends for only 20 feet into the limestone. Beyond 20 feet the limestone is crystalline and slightly schistose in character. The ore zone is in the limestone. Lenticular pods of galena, which probably replaced the limestone, are 30 feet from the contact (Cathcart, 1922, p 211).

Wimmler (1926) gives additional information on the Wheeler galena prospect. On the east bank of the river there are several small pits and a 25 foot adit that was driven to intersect the mineralized contact. A small kidney of ore, 8 to 10 feet long, 6 feet wide and 18 inches thick was removed from the adit. The kidney of ore was made up of heavy limonite, fine granular galena and pyrite in a gangue of siliceous limestone, quartz and calcite. The overlying schist shows some pyrite.

On the west bank of the river about 900 feet northwest of the adit there is a cut about 30 feet long. A kidney of galena ore was removed from it. The ore was in limestone about 30 feet from a schist contact. Wimmler (1926) also describes a kidney of ore exposed in the face of the trench. The ore zone is about three feet wide. Greenstone is exposed nearby in the bank of the cut. About 50 feet beyond the face a 20 foot shaft was sunk on the projection of the orebody but it did not penetrate the overlying schist.

According to Wimmler, pyrite, finely crystalline galena, and minor sphalerite are in the face of the cut. Wimmler took a sample across two feet of what appeared to be the highest grade ore. An assay showed 0.30 ounces of gold per ton, 2.30 ounces of silver per ton, and 2.95 percent lead. The owner of the claims at the time of Wimmler's visit reported that a sample he took assayed 22.87 percent lead and 20.0 ounces of silver per ton. Another sample by the owner gave 14.2 percent lead and 14.5 ounces of silver per ton.

Both Wimmler (1926) and Cathcart (1922) express the opinion that the ore occurs in small disconnected bunches and it is too low grade to be of economic interest. Very little could be seen at the prospect, hence no additional information was learned.

On a low ridge two miles southeast of the mouth of Iron Creek at the base of the north end of the ridge of massive limestone, galena is present (fig 2). Quartz float with disseminated, finely crystalline galena is scattered along the ridge. The source of the float was not found, but further prospecting at this locality might be justified.

Copper Deposits

Copper mineralization, mostly malachite and azurite, is widespread on the east and west sides of the ridge of massive limestone separating Iron Creek and Sherrett Creek. Cathcart (1922) mentions the following localities between Benson and Penny Creeks. Both of these streams are tributary to Iron Creek from the east (fig 2). The localities include the Wheeler copper prospect (No. 1, fig 2), the head of Benson Creek (No. 2, fig 2), the head of Sherrett Creek (No. 3, fig 2), head of Left Fork Creek (No. 4, fig 2), and the forks of Left Fork Creek (No. 5, fig 2).

Snow cover prevented studying and sampling the copper occurrences during the course of this study. Cathcart's descriptions indicate that copper is disseminated along contacts between massive limestone and schist. Malachite, azurite, limonite, and sparse pyrite and chalcopyrite are in silicified limestone. Silicified limestone that does not contain copper is also common. The silicified zones are lenticular and are conformable to the bedding in the limestone.

The only copper occurrence in the area that has been explored by underground workings is the Wheeler prospect. A summary of Cathcart's description follows (1922, p 214).

The prospect is at the head of Sherrett Creek on the east side of the ridge. There are several small pits, a 90-foot vertical shaft, and a 200-foot adit. The adit was driven to connect with the bottom of the shaft, but the connection was never made. The adit is in barren limestone.

The shaft was sunk on an exposure of malachite that is eight feet wide at the surface. At 25 feet, schist was encountered in the shaft, it is stained with malachite. The schist persists for 60 feet; the last five feet of the shaft is in barren limestone.

In an open cut leading to the shaft the limestone is closely folded, marbleized, and schistose at places. The limestone is bleached along certain planes and has a banded appearance. At the contact the schist is folded into the limestone and it is stained by malachite, but most of the copper is in limestone.

Wimmler (1926) reports that the ore in the shaft is high grade for the first 30 feet, where a five foot bed of schist was encountered. Below the schist is barren limestone. Wimmler describes the ore zone as a siliceous replacement of limestone that is underlain by a thin bed of schist. The ore zone conforms with the bedding that strikes N18W and dips 35 SW at the surface. The hanging wall of the ore zone is banded, marblized limestone. Material on the dump consists of silicified limestone with seams of limonite and a little malachite two to three inches wide, quartz and a little chalcopyrite are also present.

According to Wimmler (1926) in 1917 or 1918 a lot of sorted malachite-az urite ore was shipped to the smelter at Tacoma, Washington. The ore was from above 20 feet in the shaft and it assayed as follows: 0.33 ounces of silver per ton, 35.68 percent copper, 7.60 percent iron, and 15.40 percent silica. Another shipment from deeper in the shaft, mostly from the schist, yielded 1.82 ounces of gold per ton, 5.16 ounces of silver per ton, and 17.18 percent copper.

About 2500 feet south of the shaft a different type of mineralization is present according to Wimmler (1926). At this locality there appears to be two parallel mineralized zones in highly-folded limestone. The zones strike N15W to N20W and dip 20 to 30 SE. The ore zone is a replacement of limestone by copper and silica along a shear zone. The replacement conforms to the bedding but it extends irregularly into the walls at places. The zones are three to five feet wide. Sampling done by Wimmler at a place where copper was particularly abundant gave the following results: 0.04 ounces of gold per ton, 0.20 ounces of silver per ton, and 1.75 percent copper.

SUMMARY, ECONOMIC GEOLOGY

1. Silver-bearing galena is associated with limestone near schist contacts. Limestone that is likely to be mineralized with lead-silver ore is probably an interbedded member of the schist and older than the massive limestone.

2. One galena deposit has been explored. The ore occurs as small disconnected lenses.

3. Galena occurs in float at the north end of the Iron Creek-Sherrett Creek divide in schist. The extent of the deposit is not known.

4. The known copper deposits in the massive limestone are lenticular and low grade. Of significance is the fact that a shipment of ore derived from schist in a shaft on the Wheeler copper prospect carried high gold values. Copper mineralization is commonly localized near schist contacts, but known deposits are of little interest for their copper content. The presence of copper, however, may indicate good gold values in the associated schist.

5. Schist-limestone contacts, whether mineralized with copper or not, probably contributed a significant amount of the gold in the Iron Creek placer deposits.

G E O C H E M I S T R Y

A total of 49 stream sediment geochemical samples were taken from Iron Creek and its tributaries. The Dome Creek-Telegram Creek portion of the Iron Creek region marks the south boundary of the area sampled (fig 2). The upper portions of some streams entering Iron Creek from the east could not be sampled because the streams were frozen.

SAMPLING AND ANALYTICAL METHODS

Samples of fine material were taken from the active stream bed where possible. At some places it was necessary to collect material from the bank because of high water. Samples were transported in plastic bags; they were tested in the field by the dithizone method described by Hawkes (1963). The samples were then sent to the laboratory for further analysis. Appendix I shows field data, the results of cold extractable metals tests, and the results of laboratory analyses for copper, lead, and zinc.

The samples were forwarded to the Division of Mines and Geology laboratory in College for drying. The dried samples were then sent to the U. S. Geological Survey field geochemical laboratory in Anchorage for atomic absorption and 30-element semiquantitative emission spectrographic analysis. Data on analytical limits for the spectrograph are shown in Appendix II. The results of all laboratory analyses are shown in Appendices III A and III B. In the appendices sample field numbers and sample map numbers are listed. Each sample was assigned a map number for plotting purposes, but the corresponding field number is indicated in case it should be necessary to trace a sample back to the original field notes. Sample numbers used in the following discussions are the map numbers.

Lawrence E. Heiner, Mining Engineer, University of Alaska, wrote a program for the University's IBM 360 computer to facilitate data processing. The computer tabulated a list of samples and calculated statistical measures of central tendency for each element detected. The mean value and the standard deviation were used to calculate a threshold and anomalous value for each element. Threshold is taken as the mean plus two standard deviations; the anomalous value is taken as the mean plus three standard deviations. Averages and standard deviations are shown in Appendix III C.

The method of calculating an anomaly discussed above is valid for normally distributed data. The further the data depart from normalcy the less reliable is the calculated anomalous or threshold value. Frequency distribution histograms for gold, copper, lead, and zinc are presented in Appendix IV.

DISCUSSION OF ANOMALOUS SAMPLES

The following table shows the anomalous and threshold value calculated for each element detected in the samples.

Anomalous and threshold values of stream sediment samples, Iron Creek area, Solomon D-6 quadrangle, Alaska (all values in parts per million, unless indicated otherwise; (1) indicates atomic absorption data).

Element	Threshold Value	Anomalous Value	Element	Threshold Value	Anomalous Value
Gold (1)	0.07	0.09	Magnesium (%)	3.47	4.16
Copper (1)	34.49	42.24	Calcium (%)	15.10	20.33
Lead (1)	20.99	25.05	Barium	2164.94	2721.13
Zinc (1)	93.48	114.02	Strontium	715.41	978.28
Copper	170.70	219.50	Boron	451.05	583.81
Lead	45.64	60.80	Beryllium	3.22	4.29
Zinc	171.03	201.54	Zirconium	627.72	779.13
Cobalt	47.98	61.82	Lanthanum	82.23	109.51
Chromium	222.91	274.47	Niobium	16.28	20.80
Nickel	193.09	239.05	Scandium	32.90	41.10
Manganese	3935.59	4995.94	Yttrium	45.97	55.88
Titanium (%)	3.24	4.37	Vanadium	587.12	736.53
Iron (%)	19.88	24.71			

When the concentration of an element in a sample is below the threshold value the concentration is in the background range of values. A sample is possibly anomalous if the concentration of an element is between the threshold value and the anomalous value. If the concentration of an element in a sample is above the anomalous value the sample is probably anomalous. All sample locations are shown on figure 2 and samples containing possible and probable concentrations of elements are indicated.

Sample No. 5 contains 120 parts per million gold. All the other samples contain gold in the range of 0.01 to 0.10 parts per million. The value for sample 5 was not included in the calculation to determine the threshold and anomalous values for gold.

Values for copper, lead, and zinc were determined by atomic absorption methods and by spectrographic methods. Atomic absorption zinc is more reliable than spectrographic zinc, but for lead the reverse is true. The spectrograph value for lead is the best one of the two. Samples that show anomalous concentrations of zinc as determined by atomic absorption are indicated on figure 2; spectrographic zinc anomalies are not indicated. Samples anomalous in lead that are indicated on figure 2 reflect spectrograph data, atomic absorption values for lead are not shown.

Copper values determined by atomic absorption and by emission spectrograph are not in close agreement. In general spectrograph values are two to ten times higher than atomic absorption values, but the variation fluctuates over a broad range from less than or equal the atomic absorption value to 150 times greater. Although copper is abundant in the rocks of the area it is not concentrated in stream sediments. Only two possibly anomalous samples are shown, one is from atomic absorption data the other is from spectrographic data.

Sample 17 is probably the most significant sample taken in the Iron Creek area. The sample was collected near the head of a northern branch of Sherrett Creek. The location is just below a fault, the sample is anomalous in lead, beryllium, zirconium, lanthanum, and niobium. This association of elements is indicative of alkaline intrusive rocks. In the draw leading to the sample site, loose float contains fragments of porphyritic rock that looks as if it were derived from an intrusive dike. The local area and particularly the fault zone should be prospected for lode deposits of beryllium and lead.

Samples from near the head of the main fork of Sherrett Creek contain anomalous amounts of gold and strontium. The stream heads at a limestone-schist contact and the samples may point to a lode gold deposit. Strontium is indicative of intrusive rocks, and it is likely that an unexposed dike or other intrusive is in the vicinity.

On the west side of Iron Creek in the Rabbit Creek area, copper, cobalt, and iron are concentrated in the stream sediments in anomalous amounts. These anomalies are probably related to the greenstone in the area and are of doubtful significance.

Sample 5 was collected about half way up the first tributary to Iron Creek above its mouth. The sample contains 120 parts per million gold. The significance of this sample in relation to bedrock is unknown.

SUGGESTIONS TO PROSPECTORS

Reconnaissance geology and geochemistry in the Iron Creek area brings out the following points:

1. The head of Sherrett Creek, east of Iron Creek, is the best part of the region for prospecting. Geochemical anomalies indicate the presence of intrusive rocks and possible associated beryllium mineralization. Geologic observations indicate that a fault crosses the head of Sherrett Creek. Lead and other metals may be concentrated in the fault zone.

2. Known copper deposits disseminated in the massive limestone of the area are not of economic significance. However where copper is present a mineralized limestone-schist contact is indicated, and even though the copper is uneconomic there is some evidence that the associated schist may contain gold in economic quantities.

3. One lead-silver deposit has been explored and shown to consist of small disconnected lenses of galena and pyrite. Galena occurs in the float at the north end of the Iron Creek-Sherrett Creek divide. The potential of this occurrence is not known.

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Appendix I

Geochemical field data, results of cold extractable metals test, and comparison to laboratory analyses for gold, copper, lead and zinc.

Map No.	Sample No.	Concentration (ppm) (1) Gold	Copper	Lead	Zinc	Field Test(2)	Stream Width	Bedrock(3)	Float at sample site(3, 4)
1	2	.01	28	10	70	1	2-8'		sh-50, ls-45, qtz-5
2	1	.01	12	5	60	1	-2'		sh-50, qtz-50
3	3	.01	25	15	74	1	20-60'	sh	ls-45, sh-45, qtz-5
4	4			15		1	2-8'		sand
5	5	120*	10	5	64	1	-2'		sand
6	6	.01	5	5	35	1	-2'		sand
7	6a			5		1	-2'		sand
8	11	.01	23	5	72	1	20-60'		sand
9	10	.01	16	30	58	1	2-8'		sh-65, ls-30, qtz-5
10	9	.01	14	15	60	1	2-8'	ls	ls-40, sh-55, qtz-5
11	8	.01	10	20	52	1	2-8'		sh-75, ls-20, qtz-5
12	7	.1	10	5	50	1	-2'		ls-75, sh-20, qtz-5
13	12	.01	20	5	64	1	20-60'	sh-ls	ls-60, sh-35, qtz-5
14	19	.08	12	20	38	1	2-8'		ls-95, sh-qtz-gs-5
15	13	.01	19	5	12	1	8-20'		ls-90, sh-8, qtz-2
16	14	.01	5	20	12	1	2-8'		ls-90, sh-10
17	16	.05	10	100*	50	4	-2'	sh-ls	sh-90, ls-10

(1) Gold, copper, lead, and zinc analyses by U.S.G.S. Field Laboratory, Anchorage; values in parts per million (atomic absorption value for gold, copper, zinc; spectrographic value for lead). 150* - Anomalous value, 135 - Threshold value.

(2) Field test measured in milliliters of dithizone, cold extractable metals test (Hawkes, 1963).

(3) gr-granite, gs-greenstone, ls-limestone, qtz-quartz, sh-schist, sl-slate.

(4) Percent of rock types at each sample site shown in figures after the symbol.

Map No.	Sample No.	Concentration (ppm) (1) Gold	Copper	Lead	Zinc	Field Test(2)	Stream Width	Bedrock(3)	Float at sample site(3, 4)
18	15	.08	5	10	0	1	2-8'		ls-95, sh-5
19	41	.02	16	15		2	2-8'		sh-85, gr-15
20	41a	.02	23	15		2	2-8'		sh-85, gr-15
21	18	.01	19	10	62	2	20-60'	sh	ls-30, sh-60, gs-10
22	17	.02	21	15	46	1	2-8'	ls	ls-90, sh-10
23	40	.02	16	10		1	2-8'		gr-50, sh-40, ls-10
24	31	.01	26	20		1	20-60'	ls-sh	sh-80, ls-20
25	20	.01	14	15	38	1	2-8'	ls-sh	ls-50. sh-40, gr-10
26	21	.01	5	10	25	1	2-8'	sh	sh-90, qtz-10
27	32	.02	19	5		1	2-8'		sh-90, ls-8, qtz-2
28	39	.01	21	15		2	-2'		ls-50, sh-50
29	37	.01	23	10		2	2-8'	sh	sand
30	33	.01	36	10		1	-2'		sh-100
31	36	.01	28	20		3	2-8'	sh	sh-50, ls-50
32	36a	.02		20		3	2-8'	sh	sh-50, ls-50
33	38	.01	33	20		2	2-8'	sh	sh-80, ls-12, qtz-5, gs-3
34	34	.01	27	15		1	20-60'	sh	sh-70, ls-25, qtz-5
35	35	.01	21	15		1	8-20'	sh	sh-90, qtz-5, gr & gs-5
36	42	.01	18	20	74	2	8-20'	ls-sh	sh-50, gs-25, ls-25
37	42a	.02	24	10	64	2	8-20'	ls-sh	sh-50, gs-25, ls-25
38	44	Lost data					-2'		sh-80, ls-20
39	43	.02	28	20	100	2	8-20'	ls	sh-50, ls-50
40	22	.02	15	50	36	3	2-8'	sh	sh-60, ls-39, qtz-1
41	23	.01	22	5	42	1	2-8'	ls-sh	ls-65, sh-35
42	25	.01	20	5		1	8-20'	sh	sh-90, ls-10
43	24	.08	20	5		1	8-20'	sh	sh-50, ls-30, gs-10, gr-10

Map No.	Sample No.	Concentration (ppm) (1) Gold	Copper	Lead	Zinc	Field Test(2)	Stream Width	Bedrock(3)	Float at sample site(3, 4)
44	26	.01	29	5		1	2-8'	sh	sh
45	26a			20		1	2-8'	sh	sh
46	27	.01	26			1	8-20'	sh	sh-90, ls-10
47	28	.06	28	20		1	2-8'	sh	sh-80, ls-20
48	28a			20		1	2-8'	sh	sh-80, ls-20
49	29	.01	15	5		1	2-8'	sh	sh-95, ls-5
50	30					1	2-8'	sh	sh-gs-ls

Appendix II

Intervals of estimation and detection limits; Semiquantitative spectrographic analyses

Copper ppm*	Lead ppm	Zinc ppm	Cobalt ppm	Chromium ppm	Nickel ppm	Manganese ppm	Titanium (%)	Iron (%)	Magnesium (%)
20,000	20,000	10,000	2,000	5,000	5,000	5,000	1.0	20	10
10,000	10,000	5,000	1,000	2,000	2,000	2,000	0.5	10	5
5,000	5,000	2,000	500	1,000	1,000	1,000	0.2	5	2
2,000	2,000	1,000	200	500	500	500	0.1	2	1
1,000	1,000	500	100	200	100	200	0.05	1	0.5
500	500	200	50	100	50	100	0.02	0.5	0.2
200	200	L	20	50	20	50	0.01	0.2	0.1
100	100		10	20	10	20	0.005	0.1	0.05
50	50		5	10	5	L	0.002	0.05	0.02
20	20		L	5	L		0.001	L	
10	10			L			L		
5	L								
2									
L**									

Calcium (%)	Barium ppm	Strontium ppm	Boron ppm	Beryllium ppm	Zirconium ppm	Lanthanum ppm	Niobium ppm	Scandium ppm	Yttrium ppm	Vanadium ppm
20	5,000	5,000	2,000	1,000	1,000	1,000	2,000	100	200	10,000
10	2,000	2,000	1,000	500	500	500	1,000	50	100	5,000
5	1,000	1,000	500	200	200	200	500	20	50	1,000
2	500	500	200	100	100	100	200	10	20	500
1	200	200	100	50	50	50	100	5	10	200
0.5	100	100	50	20	20	20	50	L	5	100
0.2	50	50	20	10	10	L	20		L	50
0.1	20	L	10	5	L		10			20
0.05	L		L	2			L			10
0.02				1						L
L				L						

** L = Lowest limit of detection
* ppm indicates parts per million

Appendix III A

Atomic Absorption and Semi-quantitative Emission Spectrograph Analytical Data, Stream Sediment Samples, Iron Creek Area, Solomon D-6 Quadrangle, Alaska (All values in parts per million unless indicated otherwise, (1) indicates Atomic Absorption data).

Map Number	Sample Number	Gold (1)	Copper (1)	Lead (1)	Zinc (1)	Copper	Lead	Zinc	Cobalt	Chromium	Nickel	Manganese	Titanium (%)
1	2	0.01	28.00	12.00	70.00	30.00	10.00	0.0	30.00	100.00	100.00	700.00	1.00
2	1	0.01	12.00	12.00	60.00	50.00	5.00	100.00	50.00	100.00	50.00	2000.00	0.70
3	3	0.01	25.00	30.00	74.00	50.00	15.00	100.00	30.00	150.00	100.00	1000.00	1.00
4	4	0.0	0.0	0.0	0.0	20.00	15.00	0.0	15.00	50.00	70.00	700.00	0.70
5	5	120.00	10.00	12.00	64.00	30.00	5.00	0.0	15.00	150.00	70.00	700.00	1.00
[illegible]	6	0.01	5.00	12.00	35.00	50.00	5.00	0.0	2.00	70.00	30.00	700.00	1.00
7	6	0.0	0.0	0.0	0.0	10.00	5.00	100.00	15.00	70.00	30.00	100.00	0.30
8	11	0.01	23.00	12.00	72.00	50.00	5.00	100.00	15.00	150.00	100.00	1000.00	0.70
9	10	0.01	16.00	12.00	58.00	100.00	30.00	0.0	15.00	150.00	100.00	1000.00	0.70
10	9	0.01	14.00	12.00	60.00	50.00	15.00	0.0	15.00	150.00	150.00	1000.00	1.00
11	8	0.01	10.00	12.00	52.00	50.00	20.00	0.0	15.00	70.00	100.00	700.00	1.00
12	7	0.10	10.00	12.00	50.00	50.00	5.00	0.0	10.00	70.00	100.00	1500.00	1.00
13	12	0.01	20.00	12.00	64.00	50.00	5.00	100.00	15.00	100.00	150.00	2000.00	1.00
14	19	0.08	12.00	12.00	38.00	50.00	20.00	0.0	10.00	30.00	70.00	700.00	0.15
15	13	0.01	19.00	12.00	12.00	10.00	5.00	0.0	10.00	50.00	20.00	2000.00	0.20
16	14	0.01	5.00	12.00	12.00	5.00	20.00	0.0	15.00	50.00	30.00	2000.00	0.15
17	16	0.05	10.00	32.00	50.00	30.00	100.00	0.0	15.00	100.00	70.00	1500.00	0.50
18	15	0.08	5.00	12.00	0.0	1.00	10.00	0.0	7.00	30.00	15.00	300.00	0.10
19	41	0.02	16.00	12.00	0.0	70.00	15.00	100.00	15.00	200.00	100.00	3000.00	1.00
20	41	0.02	23.00	12.00	0.0	150.00	15.00	100.00	20.00	150.00	150.00	3000.00	1.00
21	18	0.01	19.00	12.00	62.00	30.00	10.00	100.00	15.00	100.00	70.00	1500.00	7.00
22	17	0.02	21.00	12.00	46.00	50.00	15.00	100.00	15.00	100.00	70.00	2000.00	0.50
23	40	0.02	16.00	12.00	0.0	70.00	10.00	100.00	15.00	150.00	70.00	1500.00	1.00
24	31	0.01	26.00	12.00	0.0	200.00	20.00	100.00	20.00	150.00	150.00	1500.00	1.00
25	20	0.01	14.00	12.00	38.00	150.00	15.00	0.0	15.00	150.00	70.00	2000.00	0.50
26	21	0.01	5.00	12.00	25.00	30.00	10.00	0.0	10.00	20.00	50.00	1000.00	0.50
27	32	0.02	19.00	12.00	0.0	100.00	5.00	100.00	20.00	200.00	150.00	2000.00	0.70
28	39	0.01	21.00	12.00	0.0	70.00	15.00	100.00	70.00	150.00	100.00	2000.00	1.00
29	37	0.01	23.00	12.00	0.0	100.00	10.00	100.00	30.00	150.00	100.00	2000.00	1.00
30	33	0.01	36.00	12.00	0.0	70.00	10.00	100.00	15.00	70.00	150.00	3000.00	0.50
31	36	0.01	28.00	[illegible]	0.0	150.00	20.00	100.00	30.00	150.00	150.00	2000.00	1.00
32	36	0.02	0.0	0.0	0.0	100.00	20.00	100.00	30.00	150.00	150.00	2000.00	1.00
33	38	0.01	33.00	12.00	0.0	150.00	20.00	100.00	70.00	150.00	150.00	3000.00	1.00
34	34	0.01	27.00	12.00	0.0	70.00	15.00	200.00	15.00	100.00	150.00	1500.00	0.70
35	35	0.01	21.00	12.00	0.0	70.00	15.00	200.00	50.00	150.00	150.00	3000.00	1.00
36	42	0.01	18.00	12.00	74.00	70.00	20.00	100.00	15.00	150.00	150.00	2000.00	1.00
37	42	0.02	24.00	12.00	64.00	150.00	10.00	100.00	15.00	150.00	150.00	3000.00	1.00
39	43	0.02	28.00	12.00	100.00	150.00	20.00	100.00	20.00	300.00	150.00	3000.00	1.00
40	22	0.02	15.00	12.00	36.00	20.00	50.00	0.0	15.00	100.00	30.00	700.00	0.20
41	23	0.01	22.00	12.00	42.00	30.00	5.00	0.0	15.00	100.00	50.00	500.00	1.00
42	25	0.01	20.00	12.00	0.0	50.00	5.00	100.00	20.00	150.00	70.00	2000.00	1.00
43	24	0.08	20.00	12.00	0.0	50.00	5.00	100.00	20.00	150.00	70.00	1500.00	0.70
44	26	0.01	29.00	12.00	0.0	150.00	5.00	100.00	20.00	150.00	150.00	3000.00	0.70
45	26	0.0	0.0	0.0	0.0	150.00	20.00	200.00	15.00	100.00	150.00	5000.00	1.00
46	27	0.01	26.00	12.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	28	0.06	28.00	12.00	0.0	100.00	20.00	100.00	15.00	100.00	150.00	5000.00	5.00
48	28	0.0	0.0	0.0	0.0	100.00	20.00	100.00	15.00	150.00	150.00	2000.00	0.70
49	29	0.01	15.00	12.00	0.0	100.00	5.00	100.00	15.00	100.00	150.00	2000.00	0.70

Appendix III B

Atomic Absorption and Semi-quantitative Emission Spectrograph Analytical Data, Stream Sediment Samples, Iron Creek Area, Solomon D-6 Quadrangle, Alaska (All values in parts per million unless indicated otherwise, (1) indicates atomic absorption data).

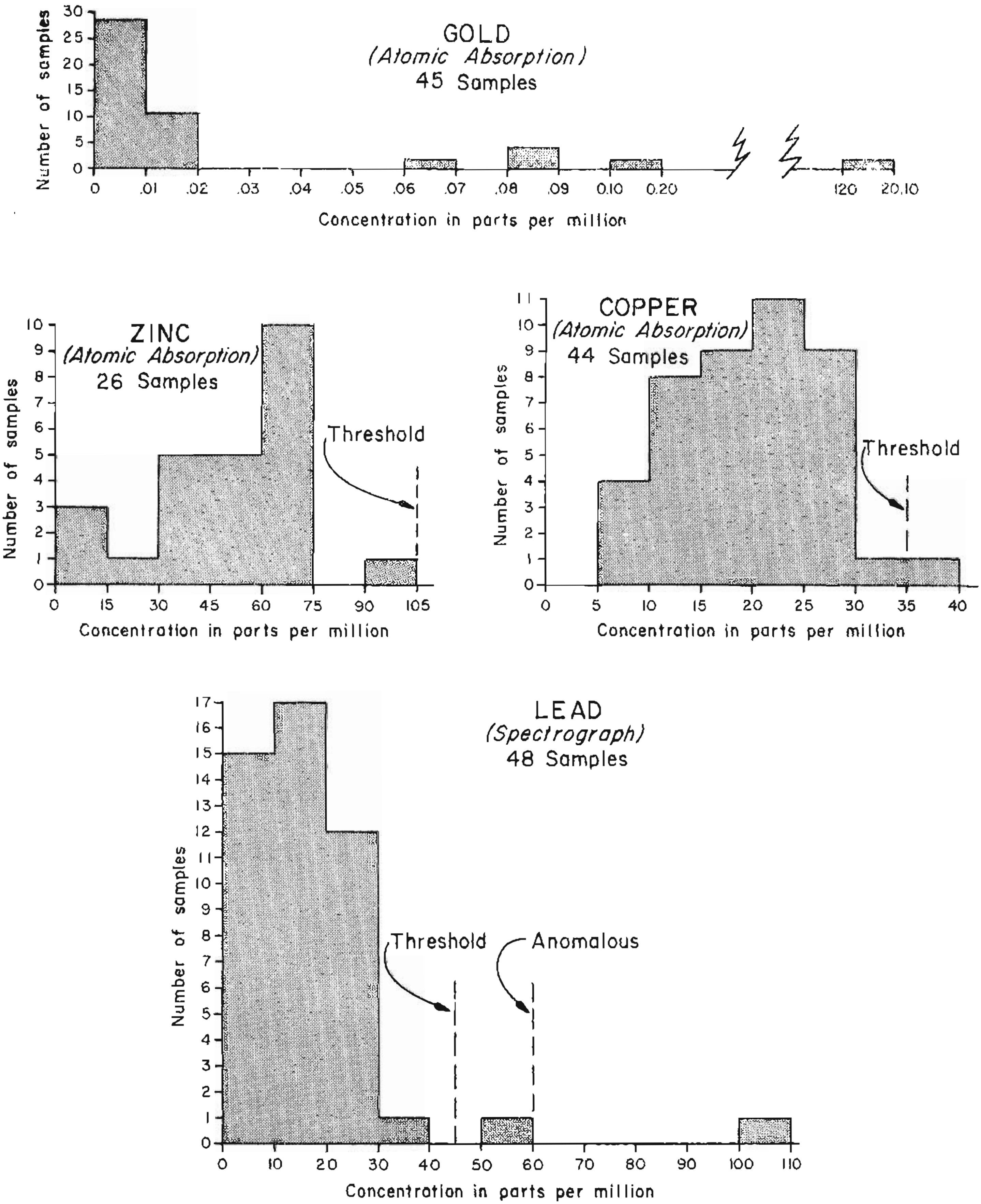
Map Number	Sample Number	Iron (%)	Magnesium (%)	Calcium (%)	Barium	Strontium	Boron	Beryllium	Zirconium	Lanthanum	Niobium	Scandium	Yttrium	Vanadium
1	2	7.00	2.00	3.00	1000.00	150.00	100.00	1.00	300.00	30.00	5.00	15.00	30.00	200.00
2	1	10.00	2.00	2.00	700.00	100.00	50.00	1.00	300.00	30.00	5.00	15.00	15.00	300.00
3	3	15.00	3.00	3.00	1500.00	150.00	100.00	1.00	500.00	30.00	10.00	20.00	50.00	300.00
4	4	7.00	1.50	1.50	700.00	25.00	70.00	0.50	300.00	20.00	5.00	7.00	15.00	200.00
5	5	7.00	1.50	2.00	1000.00	25.00	200.00	0.50	500.00	20.00	5.00	15.00	30.00	300.00
6	6	5.00	1.50	0.70	500.00	25.00	100.00	0.50	300.00	20.00	5.00	5.00	20.00	200.00
7	6	2.00	1.00	0.20	300.00	0.0	50.00	1.50	100.00	30.00	10.00	10.00	15.00	100.00
8	11	10.00	2.00	3.00	1000.00	100.00	200.00	1.50	200.00	30.00	5.00	20.00	30.00	200.00
9	10	7.00	1.50	5.00	500.00	150.00	200.00	2.00	300.00	30.00	15.00	15.00	30.00	200.00
10	9	15.00	3.00	1.50	1000.00	25.00	500.00	0.50	500.00	30.00	5.00	15.00	30.00	300.00
11	8	10.00	2.00	7.00	700.00	25.00	300.00	0.50	500.00	20.00	5.00	15.00	30.00	300.00
12	7	10.00	1.50	3.00	1500.00	25.00	500.00	0.50	500.00	30.00	5.00	7.00	30.00	300.00
13	12	10.00	2.00	5.00	1000.00	300.00	200.00	1.50	300.00	30.00	10.00	20.00	30.00	300.00
14	19	3.00	1.00	20.00	1000.00	1000.00	50.00	1.00	200.00	20.00	5.00	5.00	15.00	150.00
15	13	5.00	1.50	20.00	150.00	1000.00	30.00	0.0	150.00	20.00	5.00	5.00	15.00	70.00
16	14	3.00	1.00	20.00	150.00	1000.00	20.00	0.50	70.00	30.00	5.00	7.00	20.00	50.00
17	16	10.00	3.00	5.00	700.00	200.00	100.00	7.00	700.00	200.00	30.00	15.00	50.00	150.00
18	15	2.00	1.00	20.00	70.00	1000.00	10.00	0.0	30.00	10.00	5.00	2.00	10.00	30.00
19	41	15.00	3.00	5.00	1500.00	200.00	150.00	0.50	500.00	30.00	5.00	20.00	30.00	500.00
20	41	15.00	3.00	1.50	1000.00	100.00	200.00	0.50	700.00	20.00	5.00	20.00	30.00	500.00
21	18	7.00	1.50	3.00	1000.00	100.00	150.00	1.00	300.00	20.00	15.00	15.00	30.00	200.00
22	17	7.00	1.50	5.00	500.00	300.00	100.00	2.00	200.00	30.00	10.00	15.00	20.00	150.00
23	40	10.00	2.00	2.00	700.00	100.00	70.00	0.50	300.00	20.00	5.00	20.00	15.00	300.00
24	31	10.00	2.00	0.50	2000.00	100.00	500.00	0.50	500.00	10.00	5.00	20.00	20.00	500.00
25	20	10.00	2.00	10.00	500.00	300.00	100.00	2.00	300.00	30.00	5.00	15.00	20.00	150.00
26	21	5.00	1.50	10.00	700.00	150.00	50.00	1.00	300.00	30.00	5.00	7.00	20.00	150.00
27	32	10.00	1.50	0.50	1000.00	100.00	500.00	1.00	500.00	20.00	5.00	15.00	20.00	300.00
28	39	20.00	3.00	3.00	700.00	300.00	100.00	0.50	500.00	10.00	5.00	50.00	50.00	500.00
29	37	20.00	3.00	3.00	1500.00	200.00	70.00	0.50	300.00	10.00	5.00	30.00	30.00	500.00
30	33	5.00	1.50	0.20	2000.00	25.00	200.00	0.50	70.00	30.00	5.00	10.00	15.00	300.00
31	36	15.00	3.00	2.00	1500.00	100.00	200.00	1.50	500.00	30.00	10.00	30.00	30.00	300.00
32	36	15.00	3.00	1.50	700.00	100.00	150.00	1.50	300.00	20.00	10.00	20.00	20.00	300.00
33	38	20.00	3.00	3.00	1000.00	100.00	200.00	0.50	500.00	20.00	5.00	30.00	30.00	500.00
34	34	10.00	2.00	2.00	1500.00	25.00	200.00	1.50	200.00	30.00	10.00	15.00	30.00	200.00
35	35	15.00	3.00	3.00	1000.00	100.00	150.00	1.50	300.00	30.00	5.00	30.00	30.00	200.00
36	42	15.00	3.00	1.50	1500.00	100.00	200.00	0.50	300.00	20.00	5.00	20.00	30.00	500.00
37	42	15.00	3.00	3.00	2000.00	200.00	200.00	0.50	300.00	20.00	5.00	15.00	30.00	500.00
39	43	20.00	3.00	3.00	2000.00	100.00	200.00	0.50	300.00	10.00	5.00	20.00	30.00	500.00
40	22	5.00	2.00	5.00	500.00	25.00	100.00	3.00	200.00	50.00	5.00	15.00	30.00	100.00
41	23	10.00	2.00	3.00	700.00	100.00	200.00	1.50	300.00	50.00	10.00	20.00	50.00	150.00
42	25	10.00	3.00	0.70	1500.00	150.00	150.00	0.50	150.00	30.00	5.00	20.00	30.00	200.00
43	24	10.00	2.00	2.00	1000.00	150.00	200.00	0.50	200.00	20.00	10.00	15.00	20.00	200.00
44	26	15.00	2.00	5.00	2000.00	100.00	300.00	1.00	300.00	30.00	15.00	15.00	30.00	500.00
45	26	10.00	2.00	5.00	2000.00	100.00	300.00	1.00	300.00	10.00	10.00	15.00	30.00	500.00
46	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150.00
47	28	7.00	1.50	5.00	1500.00	25.00	300.00	1.00	300.00	10.00	5.00	15.00	20.00	500.00
48	28	10.00	2.00	7.00	500.00	150.00	200.00	0.50	300.00	10.00	5.00	15.00	15.00	200.00
49	29	7.00	1.50	0.50	2000.00	25.00	500.00	0.50	300.00	20.00	5.00	15.00	10.00	500.00

Appendix III-C

Averages and standard deviations of results of analyses stream sediment samples, Iron Creek area, Solomon D-6 quadrangle, Alaska (Values in parts per million unless indicated otherwise; (1) indicates atomic absorption data).

Element	Average	Standard Deviation	Element	Average	Standard Deviation
Gold (1)	2.75	18.09*	Magnesium (%)	2.10	0.69
Copper (1)	19.00	7.75	Calcium (%)	4.63	5.23
Lead (1)	12.88	4.05	Barium	1052.55	556.19
Zinc (1)	52.42	20.53	Strontium	189.67	262.87
Copper	73.11	48.80	Boron	185.53	132.76
Lead	15.32	15.16	Beryllium	1.09	1.07
Zinc	110.00	30.51	Zirconium	324.89	151.41
Cobalt	20.30	13.84	Lanthanum	27.66	27.28
Chromium	119.79	51.56	Niobium	7.23	4.52
Nickel	101.17	45.96	Scandium	16.49	8.20
Manganese	1814.89	1060.35	Yttrium	26.17	9.90
Titanium (%)	0.99	1.12	Vanadium	288.30	149.41
Iron (%)	10.23	4.82			

* Sample 5, that contains 120 parts per million gold, was included when the average and standard deviation were calculated. Thus the values are much higher than would normally be expected.



Appendix IV
FREQUENCY DISTRIBUTION HISTOGRAMS
FOR GOLD, COPPER, LEAD & ZINC STREAM SEDIMENT SAMPLES
IRON CREEK AREA, SOLOMON D-6 QUADRANGLE, ALASKA