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RESULTS OF STREAM SEDIMENT SAMPLING AND BEDROCK ANALYSES IN THE EASTERN PART OF THE ILIAMNA QUADRANGLE, AND AT KASNA CREEK, LAKE CLARK QUADRANGLE, ALASKA

by

Bruce L. Reed

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OPEN-FILE REPORT

This report is preliminary and has
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conformity with Geological Survey
standards and nomenclature.

Results of Stream Sediment Sampling and Bedrock Analyses in the eastern part of the Iliamna Quadrangle, and at Kasna Creek, Lake Clark Quadrangle, Alaska

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Introduction

Geochemical sampling in the Iliamna quadrangle was focused on comparatively few drainages during the 1966 field season. The selection of drainages was based on previous geochemical results (Reed and Detterman, 1966, and Detterman and Reed, 1965, open-file reports) and included areas which appeared to have undergone alteration. Selected and grab samples of mineralized and altered bedrock were collected from these areas, and the results are reported herein. The Fog Pond area appears to warrant further work. Stream sediment samples from Kasna Creek, Lake Clark quadrangle, which drains an area of copper enrichment, give some basis of reference for interpreting copper values in the Iliamna quadrangle.

Analytical Results

The areas investigated are termed localities (fig. 1); sample stations too close together to show accurately on figure 1 are shown in figures 2-5. Results of the stream sediment and pan concentrate samples are given in Table 1.

Standard methods were used in collecting stream sediment samples. Where possible the sample was collected from the active stream channel. The sample was dried, sieved, and the minus 80 mesh fraction submitted for analyses. Pan concentrate samples were collected from several stream

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OPEN FILE MAP

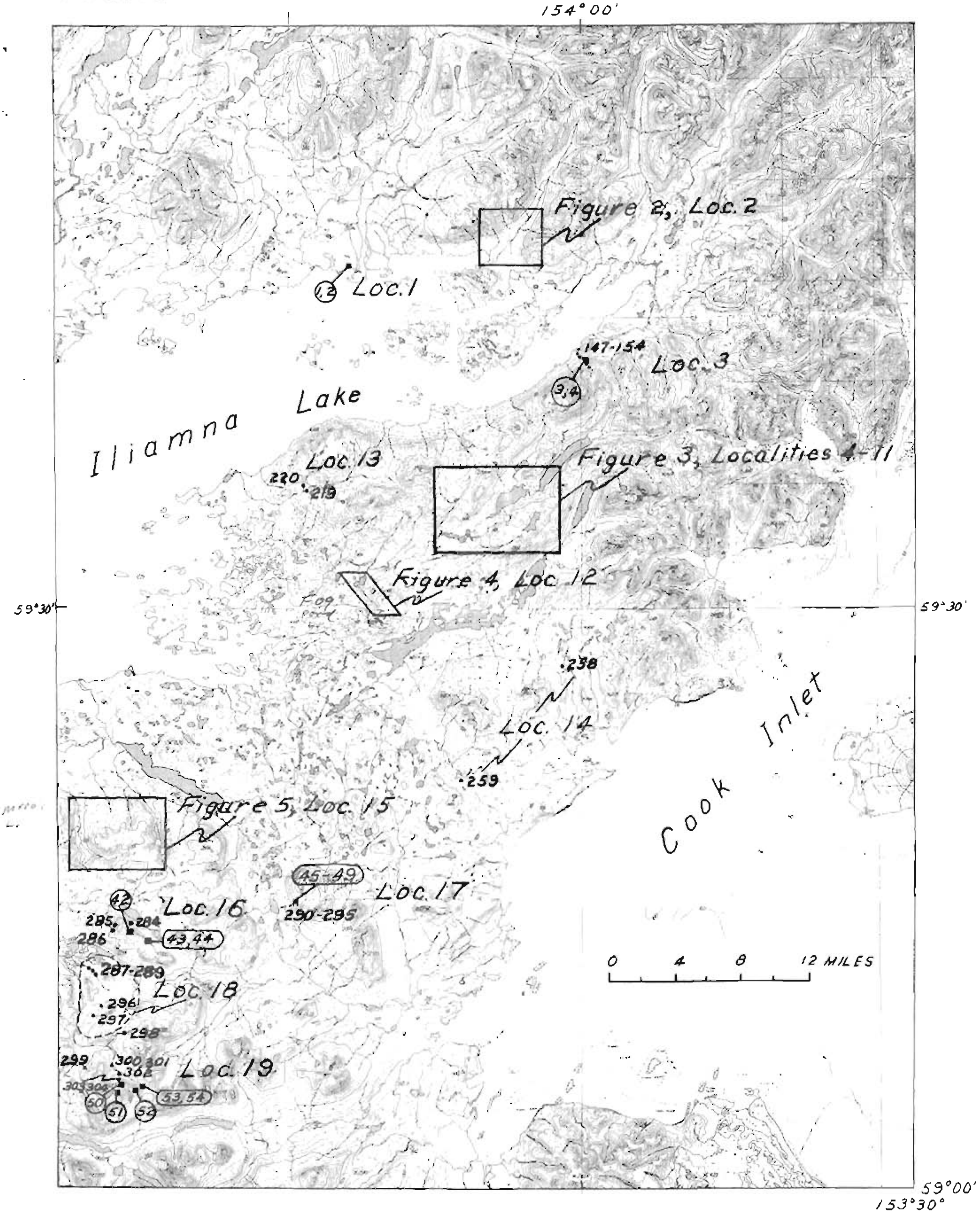

Figure 1.- Eastern part of Iliamna quadrangle showing localities investigated. Stream sediment stations are shown as dots. Bedrock sample locations are shown as squares and sample numbers are circled. Map base from Iliamna quadrangle, scale 1:250,000, 1957.

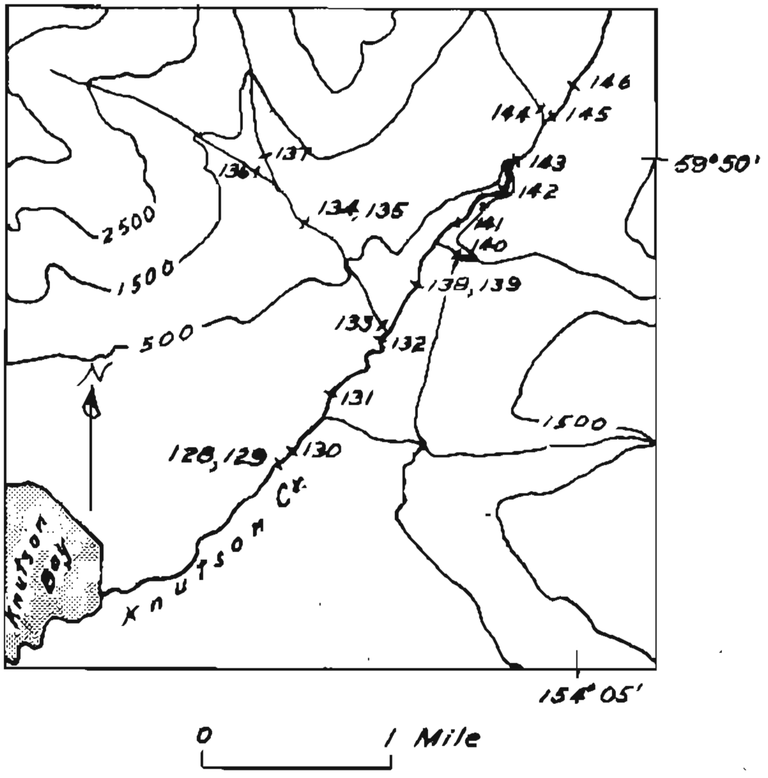

Figure 2.-- Location of stream sediment samples on Knutson Creek (locality 2).
(This map is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards)

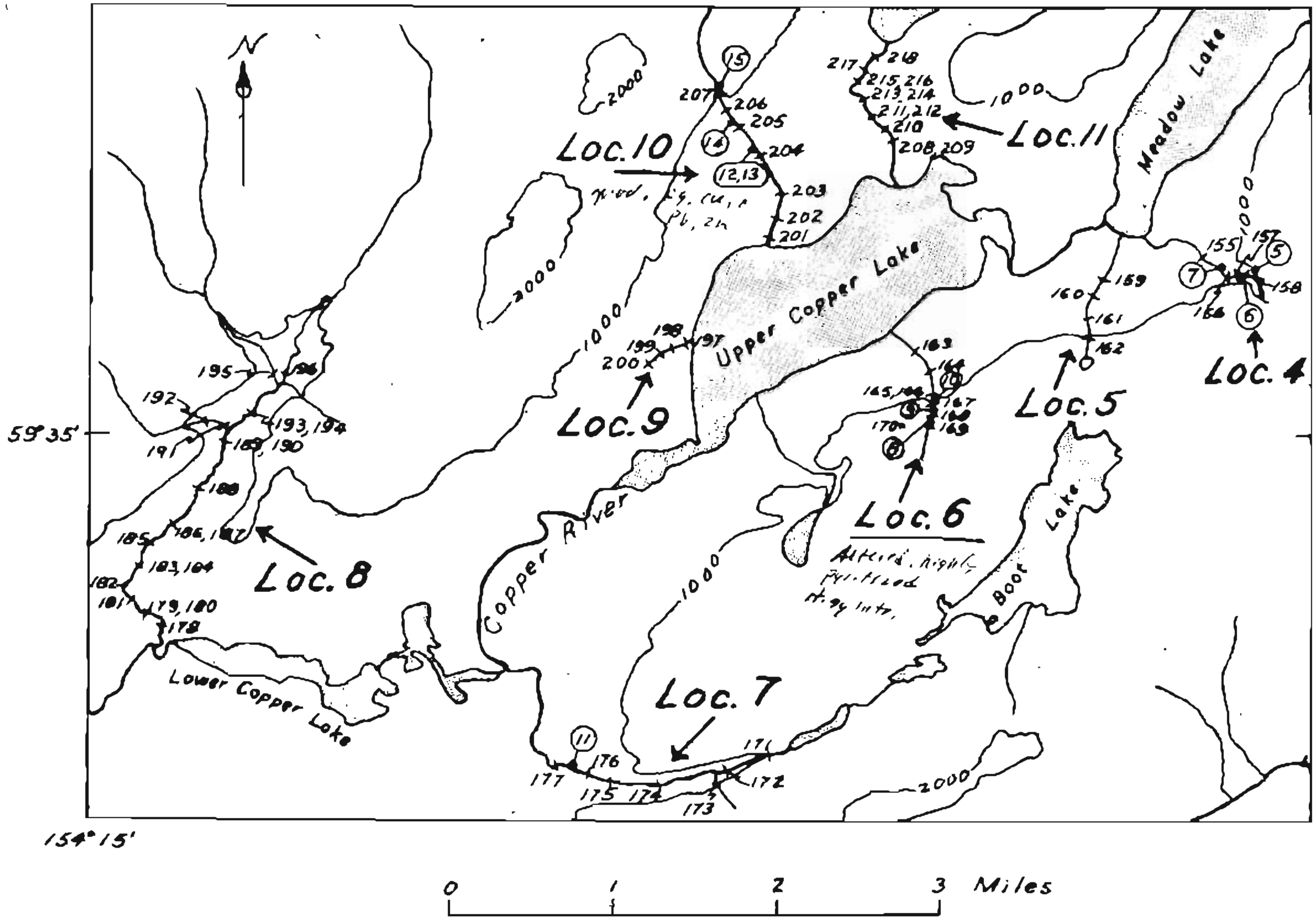

Figure 3.-- Copper Lakes area showing localities, stream sediment stations (lines across streams), and bedrock samples (dots with sample numbers circled).
(This map is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards)

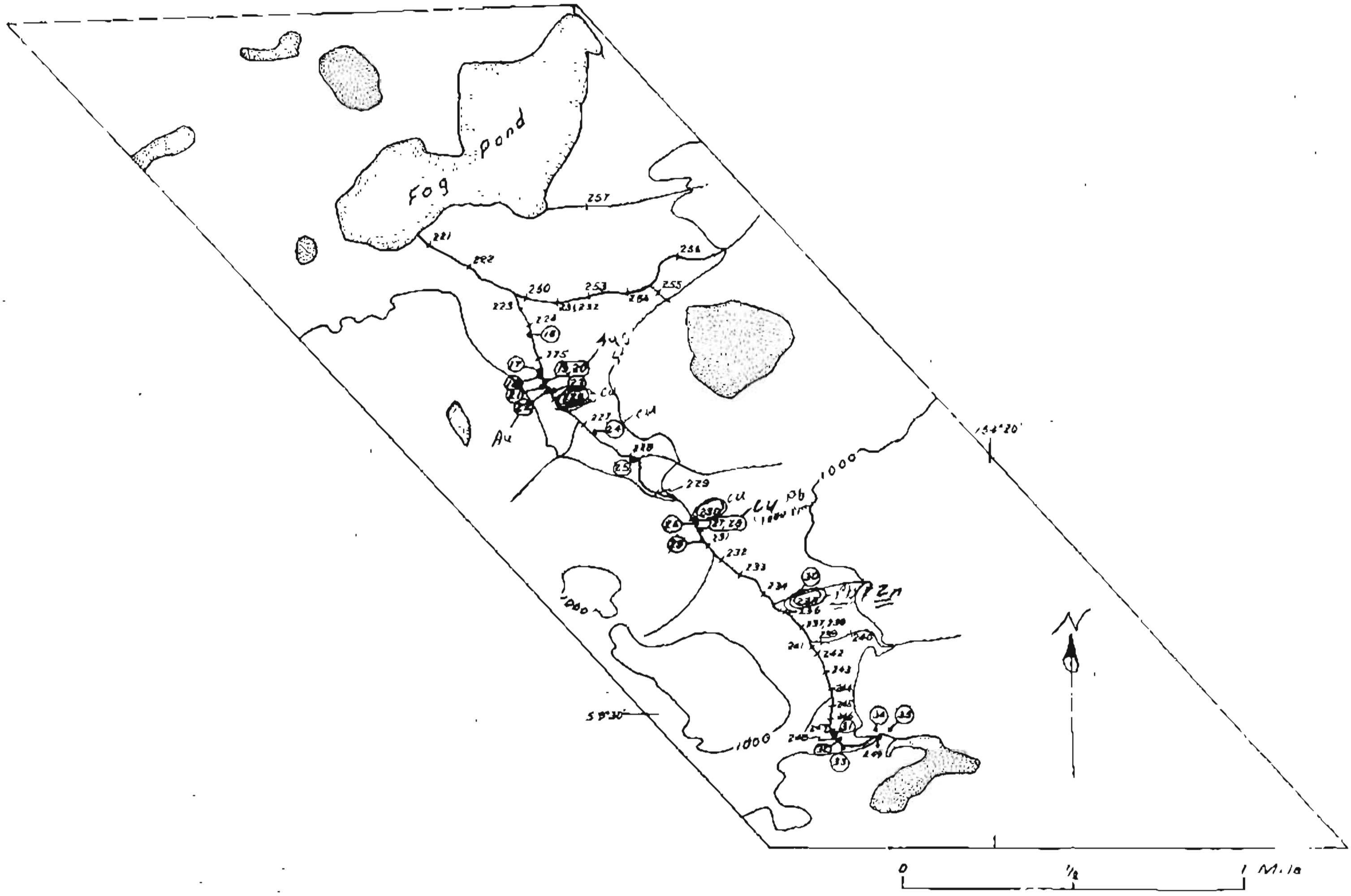

Figure 4.--Location of stream sediment samples (lines across stream) and bedrock samples (dots with sample numbers circled) in Fog Pond area (locality 12). (This map is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards)

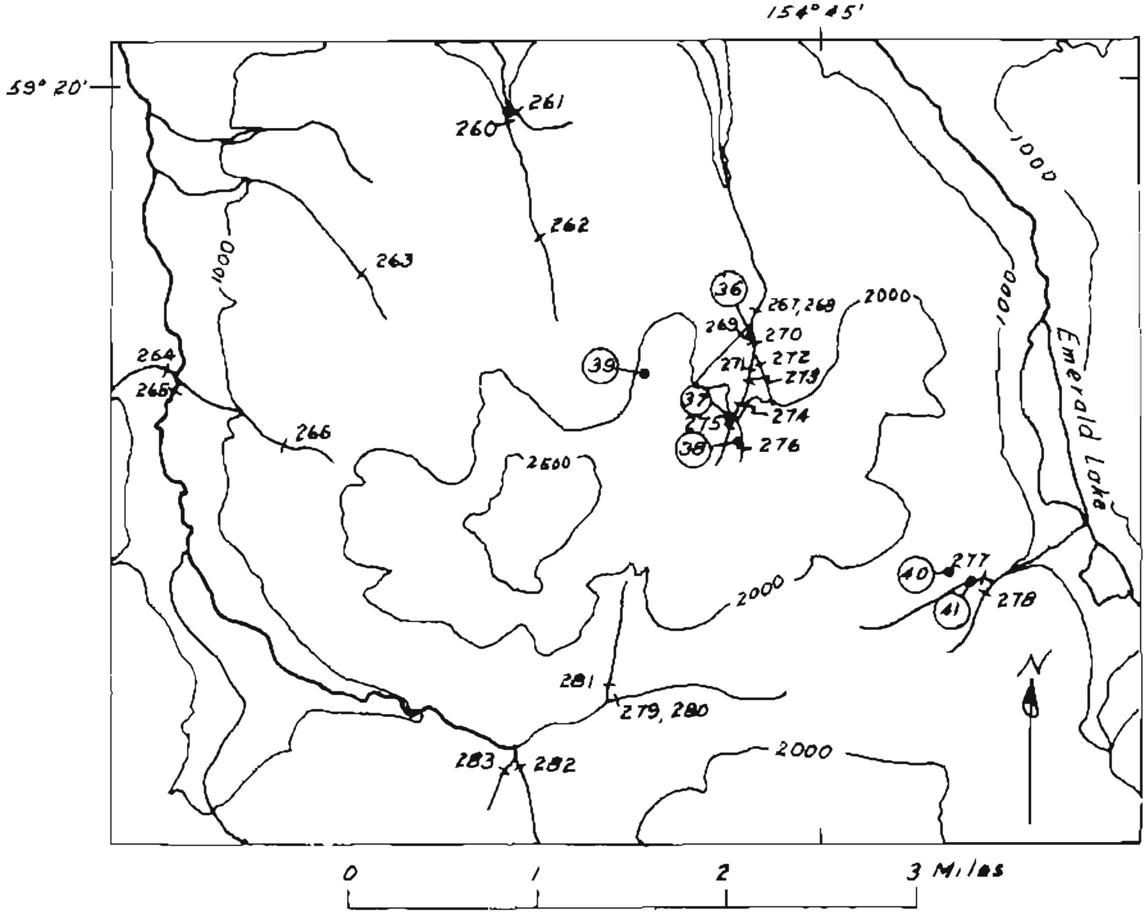

Figure 5.-- Location of stream sediment samples (lines across streams) and bedrock samples (dots with sample numbers circled) in Emerald Lake area (locality 15).

(This map is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards)

sediment localities. A 16-inch gold pan was filled with stream or bank gravels, panned, and the heavy concentrate submitted for analyses.

Bedrock analyses are given in Table 2. The samples were either selected from the richest-appearing parts of the outcrop or they are more representative grab samples. The results in Table 2 should not be considered entirely representative of the outcrops sampled. Time did not permit sufficiently thorough and properly placed sampling of exposures, but it is felt that if the most attractive specimens do not show significant values, then little hope remains for the exposure as a whole.

The geologic setting of the localities and a description of the bedrock samples is given in Table 3. The samples were analyzed by 6-step semiquantitative spectrographic methods. Values for certain elements were determined by different analytical methods. They are: arsenic (colorimetric), gold (atomic absorption), mercury (atomic absorption), stibnite (colorimetric, bedrock analyses only), tellurium (colorimetric, bedrock analyses only), zinc (colorimetric and atomic absorption).

Discussion of Results

One of the most difficult problems in interpreting the results of stream sediment samples is determining truly significant anomalies. In order to do this, a background for the elements in question must be determined. Background, in turn, is dependent on the geologic environment, chemical mobility of the element in question and other factors. Truly anomalous values are indicated only by thorough orientation surveys confined to areas of known geologic and mineralogic environment. Sampling in the Iliamna quadrangle to date has been of a preliminary reconnaissance nature, and carried out in diverse geologic environments. The following values for some of the more important economic elements are therefore tentatively suggested as possible anomalous values for stream sediment samples in the Iliamna quadrangle.[1]

Element	Possible anomalous values for stream sediment samples in the Iliamna quadrangle
Ag	1
As	40
Au	0.2
Co	50
Cu	200
Mo	10
Ni	200
Pb	30
Zn	200

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[1] The values given above are subjective and interpretative on the part of the writer; the geologic setting of any drainage is most important in determining the background for that area; for example, Ni values of 200 ppm for areas draining mafic intrusive rocks or greenstone, of which there are several in the Iliamna quadrangle, would not be considered anomalous. High erratic values are always a possibility.

The quantity of heavy mineral concentrate from panned samples submitted for analyses ranged from 1 to about 6 grams. Thus a very small particle of free gold could give a disproportionately high value. Nonetheless, it is apparent from the Au values in Tables 1 and 2 that the higher Au values in pan concentrate samples are in general from the same localities as the higher Au values reported in stream sediment and bedrock samples. A comparison of pan concentrate samples and stream sediment samples from the same locality shows, in general, an increase in Fe, Au, Co, Cr, Ga, Hg, Ni, Sc, Ti, V, and Zr. Likewise the pan concentrate samples show a decrease in Pb, Sr, and Zn relative to the stream sediment samples. It is concluded from Table 1 that, with the exception of gold, stream sediment values will reflect any anomalous concentration of metalliferous elements in the drainage, and that panned samples are most useful as a field method for determining what heavy minerals are present in the drainage and might serve as a guide to areas of economic mineralization.

Specific Localities

Only occurrences which appear to have possible economic interest are discussed. The geologic setting of these localities is given in Table 3, and bedrock analyses are given in Table 2.

Locality 12.--The creek flowing northwest into Fog Pond (fig. 4) cuts quartz porphyry to the south and mafic Tertiary volcanic rocks to the north. Hills on both sides of the creek are capped by Tertiary flows, tuffs, and volcanic conglomerate. The valley is covered by a dense growth of alders, and poor exposures prevent definite conclusions regarding geologic relations. Altered felsic dikes(?) in the volcanic rocks suggest that the quartz porphyry is intrusive into the volcanics. Altered rocks crop out along the entire length of the stream; in the samples examined much of the quartz porphyry is altered to quartz, sericite, and pyrite, whereas the volcanics are propylitized. Small pink sericitized phenocrysts in the porphyry suggest original K-feldspar. A few relict sericitized twinned grains of plagioclase are visible in thin section. The rock probably originated as a hypabyssal intrusive of rhyolitic composition and later underwent hydrothermal alteration.

Low copper in stream sediment samples 231-249 (fig. 6) suggest low copper values for the porphyry. Pyrite is widespread in the porphyry, iron-oxide staining is locally prominent, and a few small grains of what appears to be chalcopyrite are present. The porphyry is not copper stained, and although the abundant pyrite could have furnished sufficient sulphuric acid to remove the copper from the porphyry, the relatively low Cu values of both oxidized and unoxidized porphyry (samples 30-35, table 2) suggest that little copper ever existed in the rock.

Lead values show an increase upstream from station 231 (fig. 6). Station 235, on an east tributary to the main creek (fig. 4), shows a lead value of 150 ppm. This is the highest value for lead yet found in the Iliamna quadrangle.

The higher gold values reported in Table 2 are from selected hand specimens containing thin (1/8 to 1/2 inch) pyrite stringers. The specimens were collected from shear zones, altered porphyry, and propylitized volcanics. The pyrite stringers are later than the main period of alteration. They have an average strike of N. 50°-60° E. and a near vertical dip. Although of sporadic occurrence, they crop out for two-thirds of a mile along the creek (station 17-26, fig. 4). It is noteworthy that the reported gold values in the stream sediment samples occur in the same area as peak values for the bedrock samples (figs. 4 and 6, tables 1 and 2).

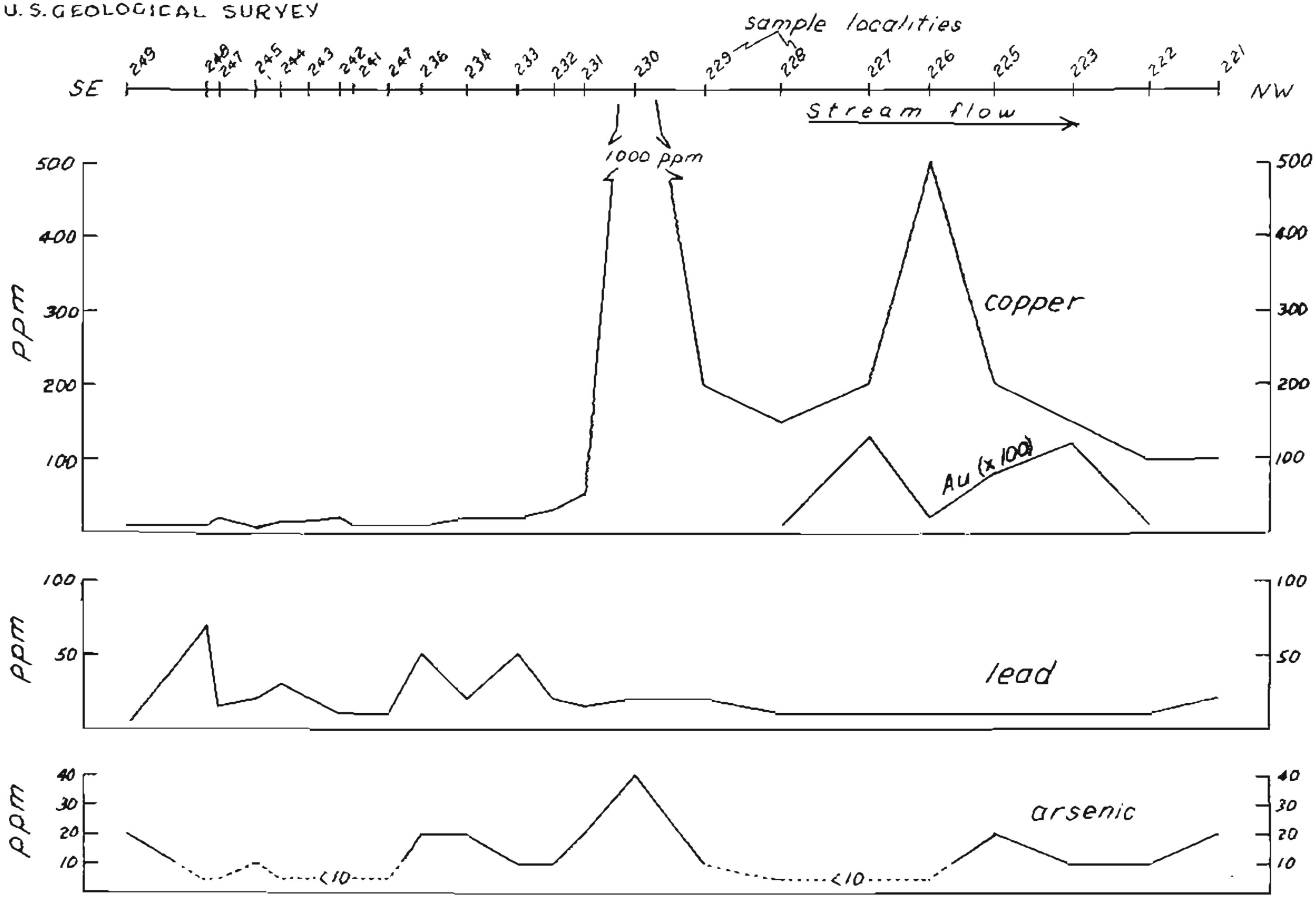

Figure 6.- Sampling profile showing distribution of copper, gold, lead, and arsenic in stream sediment samples from streams flowing into Fog Pond (figure 4, locality 12). Sample locations are shown on figure 4. Gold, in amounts of 0.1 ppm or greater, was detected only in samples 222-228. Data on minus 80 mesh fraction.

This figure is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards.

In conclusion, the gold values from the pyrite stringers are somewhat encouraging, but poor exposures and their irregular distribution present a sampling problem. Systematic sampling and detailed geologic mapping are necessary before evaluation of the occurrence can be made.

Localities 6 and 10.--The small stream draining north into Upper Copper Lake (fig. 3, loc. 6) cuts across about 400 feet of altered and highly pyritized light-gray intrusive. Vertical exposures along the creek are as much as 100 feet. The intrusive is cut by a mafic dike. A shear zone cuts the intrusive and may be related to the shear zone at locality 4 (sample 7, table 3). Both may be part of a major shear zone extending northeastward through the Meadow Lake valley.

X-ray diffraction on several samples of the altered intrusive indicates quartz, kaolinite, andalusite, and pyrite, with minor amounts of molybdenite, barite, rutile and zircon. The original rock has undergone intensive hydrogen metasomatism, as evidenced by the extensive leaching of alkali cations. The andalusite points to relatively high temperatures. It is difficult to ascertain the chemical composition of the original rock. Jurassic quartz diorite lies to the east along the south side of Meadow Lake, but the altered intrusive probably is related to a series of granitic (?) hypabyssal intrusives of probable Tertiary age that underwent hydrothermal alteration (localities 9, 10, 12).

Exposures at locality 6 are of interest because they contain small disseminated flakes of molybdenite. Stream sediment samples (Table 1) show higher than average values for Mo, but selected specimens (Table 2) are low for both Mo and Au.

Locality 10 on the north side of the lake (fig. 3) also drains an area of altered granitic intrusive. Although the few selected bedrock analyses show low metal values (Table 2), stream sediment samples show moderately high values for Ag, As, Cu, Mo, Pb and Zn.

Locality 17.--Selected sulphide-rich specimens from a shear zone in quartz diorite yield gold and silver values in excess of $\frac{1}{2}$ oz. per ton. The shear zone is exposed on the valley wall for about 150 feet. The quartz diorite intrudes gabbro and a breccia zone, exposed for about 150 x 50-100 feet along the contact, is sporadically replaced by sulphides, chlorite and biotite. A partially caved adit driven 15 feet into the breccia in an area of intense iron-oxide staining shows meager sulphide mineralization. The extent of the breccia zone is not known. This area was staked in 1964 during a flurry of iron exploration on the Alaska Peninsula.

Kasna Creek.--Kasna Creek, in the Lake Clark A-3 quadrangle, drains a copper deposit presently under exploration by the St. Eugene Mining Corporation. The deposit was described by Warfield and Rutledge (1951) as a contact metamorhpic replacement in limestone. Skarn mineralization consists chiefly of specular hematite, chalcopyrite, magnetite, pyrite, amphibole, calcite, garnet and quartz. The limestone is covered to the north by glacial deposits and terminated to the south (south of the area shown in figure 7) by hornblende-biotite granodiorite.

As Kasna Creek drains an area of known copper enrichment, a comparison of values from this stream should give some basis of reference in interpreting copper values from samples in the Iliamna quadrangle. The location of samples and areas of mineralization at Kasna Creek are shown in figure 7. Data on the minus 80 mesh fraction of these samples are given in Table 4. Copper

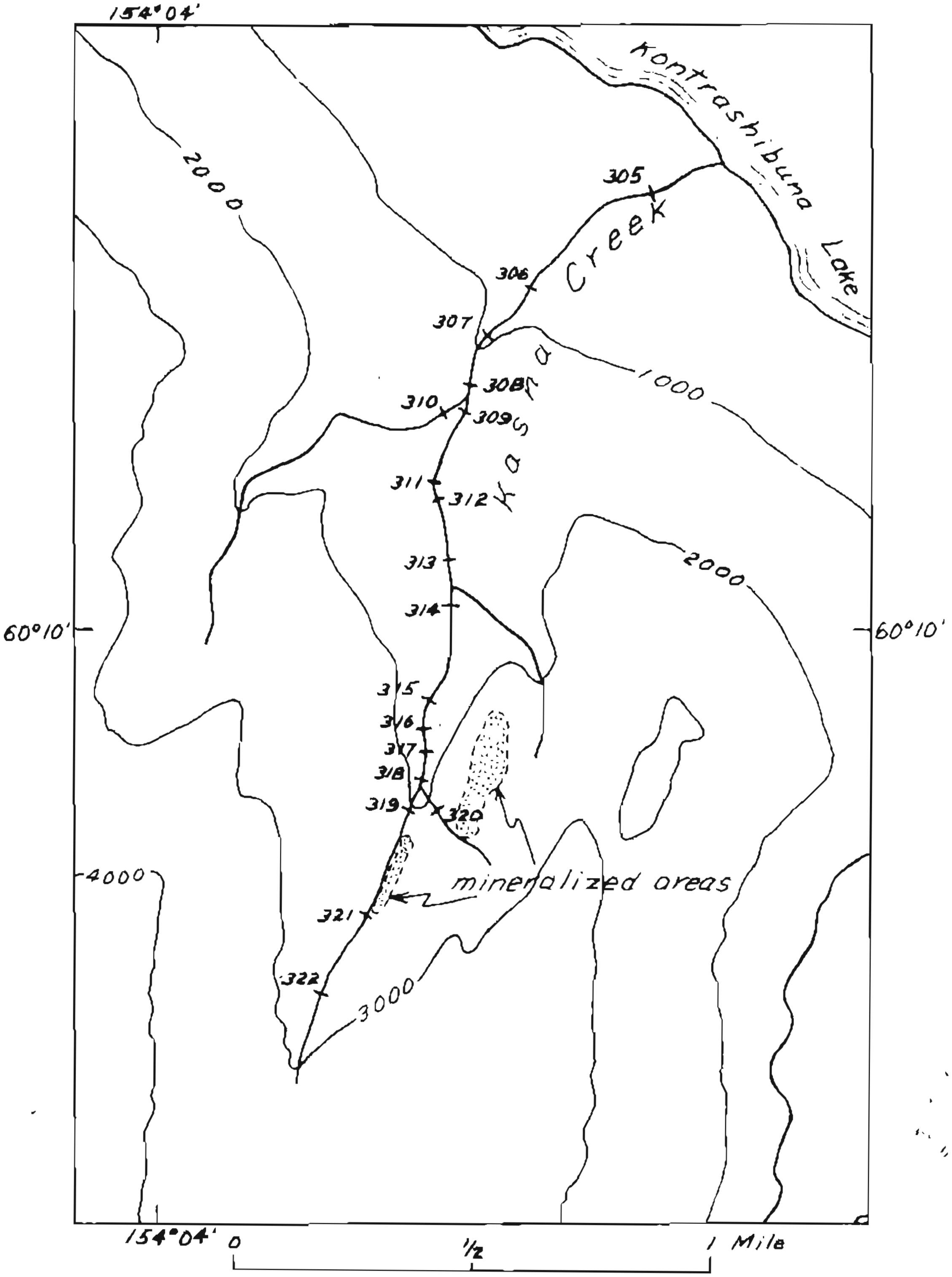

Figure 7.-- Map of Kasna Creek showing location of stream sediment samples and mineralized areas. Data on samples given in table 4.
(This map is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards)

values from samples downstream from the deposit greatly exceed copper values from stream sediment samples in the Iliamna quadrangle. In addition, Kasna Creek values for molybdenum, lead, mercury, zinc and arsenic are, in general, also higher than those of the Iliamna quadrangle. Figure 8 is a sampling profile along Kasna Creek which shows a general increase in Cu, Pb, Zn, As and Co as the deposit is approached. Peak values are found at the deposit or just downstream. There is a notable absence of metal content from sample 310 located on the west tributary to Kasna Creek, which does not drain any of the known ore bodies.

Samples 313 and 314 show relatively high copper and zinc values and might reflect ground water enrichment of these metals leached from a northern extension of the deposit that is covered by glacial deposits.

Conclusions and suggestions for prospecting

Results of stream sediment sampling and bedrock analyses of the areas investigated do not appear to indicate areas of significant metallization. Systematic sampling of the auriferous pyrite veins at Fog Pond (locality 6) is necessary before evaluation of the occurrence can be made.

Geologic mapping has provided some guides relative to the genetic and temporal relations of mineralization and alteration. With the exception of iron occurrences there are few indications of mineral deposits related to Jurassic plutonism. Jurassic intrusives form the backbone of the Chigmit Mountains and are largely diorite and quartz diorite with subordinant hornblende gabbro and hornblendite (Martin and Katz, 1912; Detterman, Reed, and Lanphere, 1965).

Most of the hydrothermal alteration and mineralized areas are associated with quartz porphyry, granodiorite or quartz monzonite. Many of these

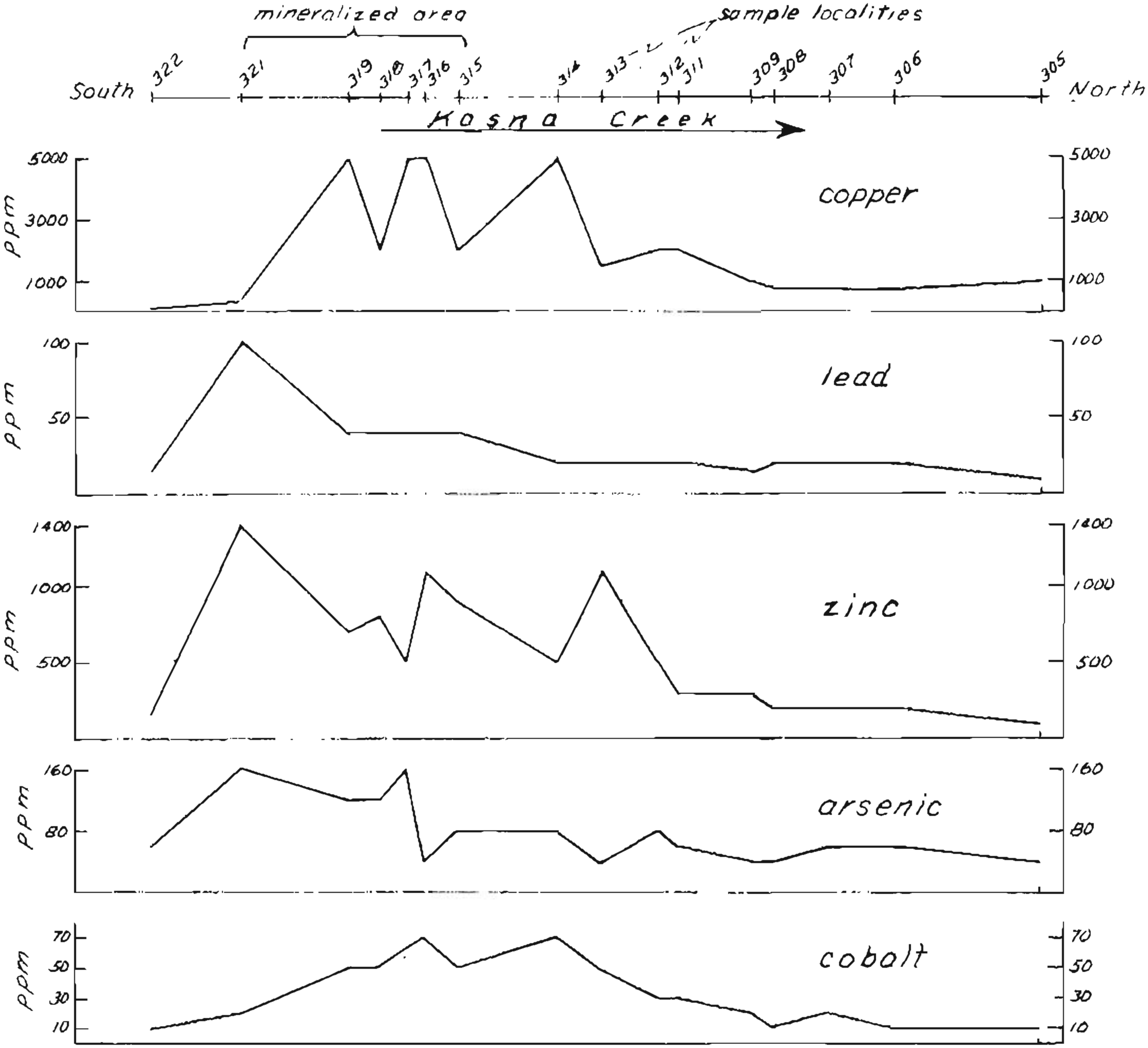

Figure 8.-- Sample profile showing distribution of copper, lead, zinc, arsenic, and cobalt in stream sediment samples from Kasna Creek. Sample localities and mineralized area shown in figure 7. Stream flows to right (north). Data on minus 80 mesh fraction (see table 4).

(This map is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards)

intrusives are of probable Tertiary age. Mineralization at Paint River (Richter and Herreid, 1965), Dutton prospect (Martin and Katz, 1912), Millit claims (Martin and Katz, 1912) and Kasna Creek (Warfield and Rutledge, 1951)--all contact metamorphic deposits in Triassic limestone, is associated with nearby granodiorite and quartz monzonite. This limestone also extends north of the Lake Clark quadrangle on the west side of the Alaska Range. Where dioritic rocks intrude limestone in the Iliamna quadrangle, skarn minerals may be developed, but significant sulphide mineralization is lacking. Although many of the previously mentioned localities are small, exploration concentrated along the limestone, and near areas of granitic contacts that show the effects of alteration, seems promising.

The widespread and varied sequence of dominantly andesitic and dacitic Tertiary volcanics show local effects of alteration and minor mineralization. The recent discovery at Battle Lake of an epithermal gold-, silver- and copper-bearing quartz vein in propylitized Tertiary volcanic rocks (also near a quartz monzonite intrusive) suggest that alteration zones in the Tertiary volcanic rocks are potential targets for exploration.

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Warfield, R. S., and Rutledge, F. A., 1951, Investigation of Kasna Creek copper prospect, Lake Kontrashibuna, Lake Clark region, Alaska: U.S. Bur. Mines Rept. Inv. 4828, 10 p.

Table 4.--Semiquantitative spectrographic analyses and gold, arsenic, mercury and zinc analyses on minus 80 mesh fraction of stream sediment samples from Kasna Creek, Lake Clark A-3 quadrangle, Alaska.

(Spectrographic results are reported in parts per million to the nearest number in the series 0.5, 1, 3, 5, 7, 10, 15, 20, 30, 50, 70, 100, and 150, etc. which represent approximate midpoints of interval data on a geometric scale. The assigned interval for 6 step results will include more accurately determined values about 30 percent of the time; Ca, Fe, Mg reported in percent and converted to parts per million.)

Symbols used: < = less than
The following elements were looked for but not found (limit of detectability in ppm for each element in parenthesis): Bi(10), Cd(20), Sb(100), Sn(10), W(50)
Spectrographic analyses by K. C. Watts
Gold analyzed by atomic absorption; analyses by Elizabeth Martinez, R. L. Miller, T. A. Roemer, J. G. Frisken
Arsenic analyzed by colorimetric methods; analyses by T. G. Ging, Jr. and R. F. Hansen
Mercury analyzed by ultraviolet mercury detector; analyses by V. M. James and J. G. Frisken
Zinc values of less than 200 ppm determined by colorimetric methods: G. W. Dounay analyst. Zinc values 200 ppm or greater determined by semiquantitative spectrographic analysis, with the exception of samples 313, 315, 316, 318, 319, and 321 which were determined by atomic absorption

Sample No	Field No 66A-	Ca	Fe	Mg	Ag	As	Au	B	Ba	Be	Co	Cr	Cu	Ga	Hg	La	Mn	Mo	Ni	Pb		Sc	Sr		Ti	V	Y	Zn	Zr
305	R1364a	30,000	200,000	10,000	<0.5	40	<0.1	50	500	<1	10	70	1000	20	0.2	<20	2000	10	20	10		20	100		5000	200	20	100	300
306	R1367a	20,000	150,000	10,000	<0.5	60	<0.1	70	500	<1	10	70	700	50	0.1	<20	3000	5	20	20		20	150		5000	200	20	200	200
307	R1368a	20,000	150,000	20,000	<0.5	60	<0.1	100	300	<1	20	70	700	30	0.1	<20	3000	10	20	20		20	150		5000	200	30	200	200
308	R1369a	20,000	100,000	20,000	<0.5	40	<0.1	70	500	<1	10	100	700	20	0.1	<20	2000	5	30	20		20	200		3000	200	30	200	300
309	R1371a	20,000	70,000	20,000	<0.5	40	<0.1	50	300	<1	20	100	1000	20	0.1	<20	1500	10	20	15		20	150		5000	200	20	300	150
310	R1370a	20,000	70,000	20,000	<0.5	40	<0.1	70	300	<1	20	150	100	20	0.1	<20	1000	5	70	10		50	100		5000	500	20	50	150
311	R1373a	50,000	100,000	20,000	1	60	<0.1	50	300	<1	30	100	2000	30	0.2	<10	2000	10	10	20		20	150		5000	200	30	300	150
312	R1375a	30,000	100,000	10,000	<0.5	80	<0.1	50	300	<1	30	300	2000	30	0.2	<20	1500	15	20	20		30	200		5000	200	50	500	200
313	R1376a	50,000	100,000	10,000	1	40	<0.1	50	500	<1	50	70	1500	20	0.3	<20	2000	20	20	20		30	150		5000	200	50	1100	150
314	R1377a	30,000	100,000	20,000	2	80	<0.1	50	200	<1	70	100	5000	20	0.2	<20	2000	15	30	20		20	150		3000	200	30	500	100
315	R1378a	20,000	100,000	20,000	2	80	<0.1	100	500	<1	50	70	2000	30	0.3	<20	2000	20	30	50		30	150		3000	200	50	900	200
316	R1379a	30,000	70,000	10,000	5	40	<0.1	30	300	<1	70	100	5000	20	0.3	<20	2000	20	30	50		20	150		3000	200	30	1100	150
317	R1380a	30,000	100,000	30,000	1	160	<0.1	70	500	<1	50	150	5000	20	0.2	<20	2000	15	30	50		30	150		5000	200	30	500	150
318	R1381a	30,000	70,000	30,000	1	120	<0.1	70	500	<1	50	100	2000	30	0.1	<20	2000	10	20	50		15	150		3000	100	30	800	150
319	R1362a	20,000	70,000	30,000	1	120	<0.1	70	500	<1	50	100	5000	10	0.2	<20	2000	10	20	50		20	150		3000	100	50	700	150
320	R1383a	50,000	70,000	10,000	<0.5	40	<0.1	<10	500	<1	30	200	500	15	0.2	<20	1000	15	50	20		30	300		5000	200	30	200	100
321	R1397a	20,000	70,000	30,000	<0.5	160	<0.1	70	500	1	20	100	300	20	0.13	<20	2000	2	20	100		15	150		7000	100	50	1400	200
322	R1398a	30,000	50,000	30,000	<0.5	60	<0.1	20	500	1	10	100	100	15	0.12	20	1500	<2	20	15		15	200		3000	100	30	150	200