TIN AND LEAD-SILVER MINERALIZATION IN THE COSNA RIVER REGION

By Roger Burleigh

* *OFR 11-89

UNITED STATES DEPARTMENT OF THE INTERIOR

Manuel Lujan Jr., Secretary

BUREAU OF MINES

T S Ary, Director

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ABBREVIATIONS OF UNITS OF MEASURE USED IN THIS REPORT

ft	feet
g	gram
in	inch
mi	mile
mi^2	square mile
ppb	parts per billion
ppm	parts per million
%	percent
SD	standard deviation
oz/ton	troy ounces per short ton
x	mean

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ABSTRACT

In 1987, as part of an Alaska critical and strategic minerals project, the Bureau of Mines evaluated an occurrence of tin and lead-silver mineralization in the Cosna River drainage near the Bitzshtini Mountains. Tin mineralization is found in dense gossan associated with concentrated quartz veining distributed along linear depressions bearing 140° across a thinly vegetated dome. Gossan grades to 2-3% Sn with anomalous levels of Ag, Pb, Zn, Sb, and As. Lead-silver mineralization (average 71% Pb, 91.3 oz/ton Ag) occurs nearby as pod-like masses of galena associated with <1 ft wide vuggy quartz veins with easterly orientations. Stibnite mineralization is locally present in the lead-silver prospect. Heavy mineral sampling of stream drainages and geologic reconnaissance traverses established a widespread distribution of tourmaline and delineated isolated areas anomalous in Sb, REE, Ag, Te, Th, Sn, W, U, and Pb. Regional geology and available airborne magnetic and radiometric surveys suggest that mineralization reflects hydrothermal activity distal to a buried pluton which possibly cores a portion of the Bitzshtini Mountains several miles to the south of the study area.

INTRODUCTION

This report incorporates the results of two earlier unpublished Bureau of Mines investigations by Berryhill in 1964 and 1966 (1)[2] with the results of the present (1987) investigation of tin and lead-silver mineralization in the Cosna River region (fig. 1). This report is a portion of a Bureau project to evaluate Alaskan reserves and resources of critical and strategic minerals. Tin is considered a critical and strategic element because of its use in defense-related technologies, and because the United States is reliant on foreign sources for the primary metal. The study area is situated 40 miles due south of Tanana and is accessible by fixed wing airplane or by helicopter (fig. 1).

ACKNOWLEDGEMENTS

The author wishes to thank Mr. Charles Woodruff, the claim owner, for permitting the Bureau access to the prospects and for his guidance and hospitality during the investigation.

HISTORY - PREVIOUS WORK

In 1943 the Alaska Territorial Department of Mines (2) reported the discovery of placer cassiterite in the prospect area by Mr. Charles Holky. Additional history is discussed in an unpublished Bureau report (1).

1/Geologist, formerly with the U.S. Bureau of Mines, Alaska Field Operations Center, Fairbanks Section, Fairbanks, Alaska.
2/Underlined numbers in parentheses refer to a list of references at the end of this report.

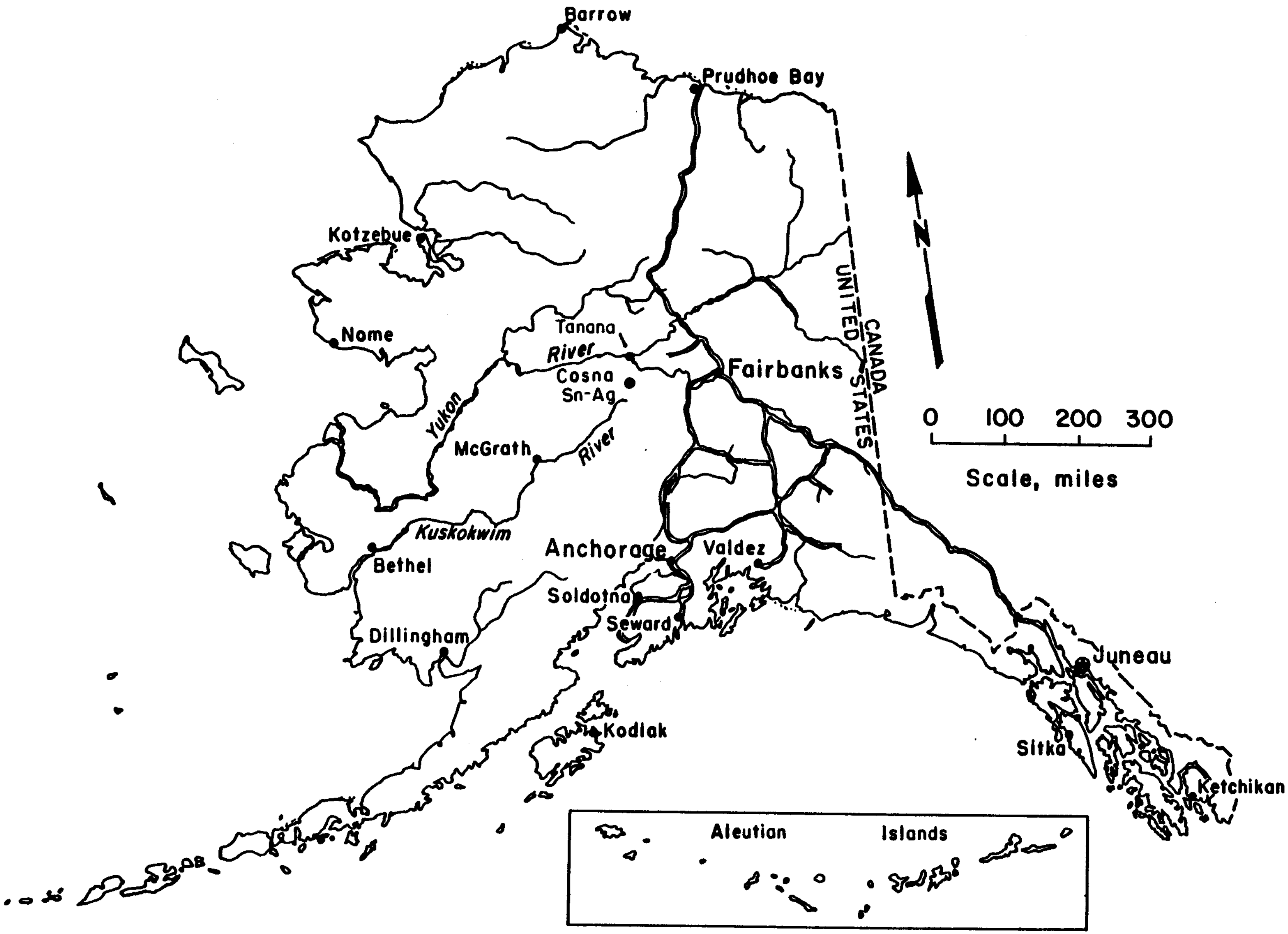


Figure I : Prospect location map.

Mr. Tom Arnstrom discovered lode cassiterite at the head of the gulch which drains to the NW off hill 2,026 ft (Cosna Dome) (fig. 2). Mr. Holky later prospected for tin in that area based upon information supplied by Arnstrom. It appears that Messrs. Holky and Colbert discovered and prospected lead-silver vein mineralization (hereafter referenced as the Pb-Ag Prospect) during their search for tin mineralization. Mr. Holky and Mr. Colbert drove a 100 ft adit and dug three trenches plus several test pits at the Pb-Ag Prospect.

In 1964, the Bureau briefly examined the Pb-Ag and Sn prospects. Rock, soil, and pan concentrate samples (1) were collected as part of a program of mineral deposit investigations in Alaska. A Cu-Pb-Zn soil survey was conducted over the Pb-Ag prospect by the Bureau in 1966 (2) to follow up the earlier investigation.

The Pb-Ag and Sn prospects were staked in 1980 by Mr. Jerry Hook and in 1985, the claims were quit-claimed to Charles Woodruff, the current owner. Mr. Woodruff has trenched tin-bearing gossans and quartz veins on Cosna Dome and the lead-silver veins previously mentioned. Mr. Woodruff has also completed a 1,100 ft long airstrip near the prospects.

Chapman (3, 4), of the U.S. Geological Survey (USGS), conducted reconnaissance geologic mapping and sampling in the western half of the Kantishna River quadrangle. Rocks in the Bitzshtini Mountains were found to be anomalous in silver, arsenic, boron, bismuth, and lithium (3, 4). Airborne radiometric and magnetic reconnaissance surveys (1:250,000 scale) have been flown by Western Geophysical Company of America for the U.S. Department of Energy (DOE) in 1980 (5).

PHYSIOGRAPHY AND GENERAL GEOLOGY

The Sn and Pb-Ag prospect area comprises approximately 5 mi^2 just north of the intersection of the Kantishna River C-4, C-5, B-4, and B-5 quadrangles (fig. 2). The area occupies the low rounded hills on the north flank of the Bitzshtini Mountains. Outcrop expression is less than 1% with vegetation of black spruce, birch, and alder forest and unbroken tundra carpet covering most of the region. Discontinuous talus is developed on some steeper north facing slopes and permafrost is present at most lower elevations. Hill 2,026 ft, colloquially called Cosna Dome, lies in the center of the study area and rises above the apparent treeline elevation for the region.

The Sn and Pb-Ag Prospects are found within clastic sedimentary rocks of uncertain age intruded by a NE-trending belt of shallowly exposed Cretaceous-Tertiary-aged, compositionally varied plutonic rocks. These plutonic rocks are emplaced within the Cambrian quartzite, metasiltstone, slate and grit, Ordovician siltstone, limestone, phyllite and chert, Devonian limestone and siltstone, Triassic diabase and basalt, and Jurassic-Cretaceous graywacke and shale (3). Coeval or younger, intermediate to felsic volcanic rocks cap ridges along the NE strike of the plutonic belt (3). Although large exposures of granitic rock do not occur in the immediate vicinity of the prospects, the occurrence of numerous felsic dikes, a small quartz monzonite stock, hornfels, iron-staining, and quartz veining in the higher elevations of the Bitzshtini Mountains, coupled with geophysical evidence, suggest that the Bitzshtini Mountains are cored by a larger pluton.

Sparsely occurring and thin, fine-grained felsic dikes cut the clastic rocks of the immediate prospect area, however their orientation is unknown due to lack of outcrop. The regional structural fabric trends NNE to ENE as mapped by Chapman (3). Within the prospect area, the bedding of the folded sedimentary units has a NNW strike. This divergence from the regional trend may correspond to events that also relate to some of the structurally controlled mineralized zones on Cosna Dome.

Pb-Ag PROSPECT

DESCRIPTION

The veins at the Pb-Ag Prospect were not exposed in any trench or outcrop, so the following prospect description is based upon dump samples, soil geochemistry, and verbal communication with Mr. Woodruff, the claim owner. Structurally, the mineralized system is characterized by several subparallel veins with a reported easterly orientation. Additional trenching (by the owner) exposed at least three veins with an E-W trend. This orientation is corroborated by Pb-soil geochemistry (fig. 3).

At the approximate grid location 2+00E, 5+50N (fig. 3), two small prospect pits contained high grade, silver-bearing (65 to 147 oz/ton silver) galena vein float (samples 41, 42, appendix A) (2). This site was located in 1966 and not re-evaluated in this investigation.

A macroscopic examination of mineralized dump samples indicate that the veins are characterized by vuggy quartz lining open-space fractures in graywacke. The fractures were subsequently filled by very coarse-grained galena.

A small ore dump from a trench is also located on a muck pile above the portal of a caved adit (fig. 3). Chunks of massive galena veining up to 6 inches wide suggest that the vein widths are less than 1 ft maximum thickness, with the majority of the vein material suggesting even thinner widths. Thin veinlets of fractured, massive quartz with very minor pyrite and goethite-filled voids also occur at the prospect. Other veins are composed of anastomosing quartz veinlets crosscutting graywacke. The analyses for 10 high grade samples of galena show an average of 71% Pb, 91.3 oz/ton Ag, and 0.06% Sn (samples 1, 41-49, appendix A).

In polished section, galena exhibits curved cleavage planes that suggest the inclusion of sub-microscopic silver (?) mineralogy which would account for the high silver values in the samples. Samples of massive galena were analyzed by scanning electron microscopy - energy dispersive x-ray microanalysis 3/ and no silver minerals were identified. Micron sized blebs of chalcopyrite and sphalerite were the only other sulfide minerals associated with the galena.

Hydrothermal alteration related to the Pb-Ag mineralization is indicated by the presence of sericite flakes and limonite pseudomorphs of pyrite in the weathered wall rock.

A small cobble of massive stibnite was found in the trench nearest the creek (sample 54, fig. 3) at the Pb-Ag prospect. Additional geochemical analysis of this sample determined 700 ppb Hg, 0.8 ppm Ag, <5 ppb Au, and 68.95% Sb. The relationship of stibnite veining to the Pb-Ag or Sn prospects is not known.

3/Analysis by W. C. O'Conner, BuMines, Albany, Oregon.

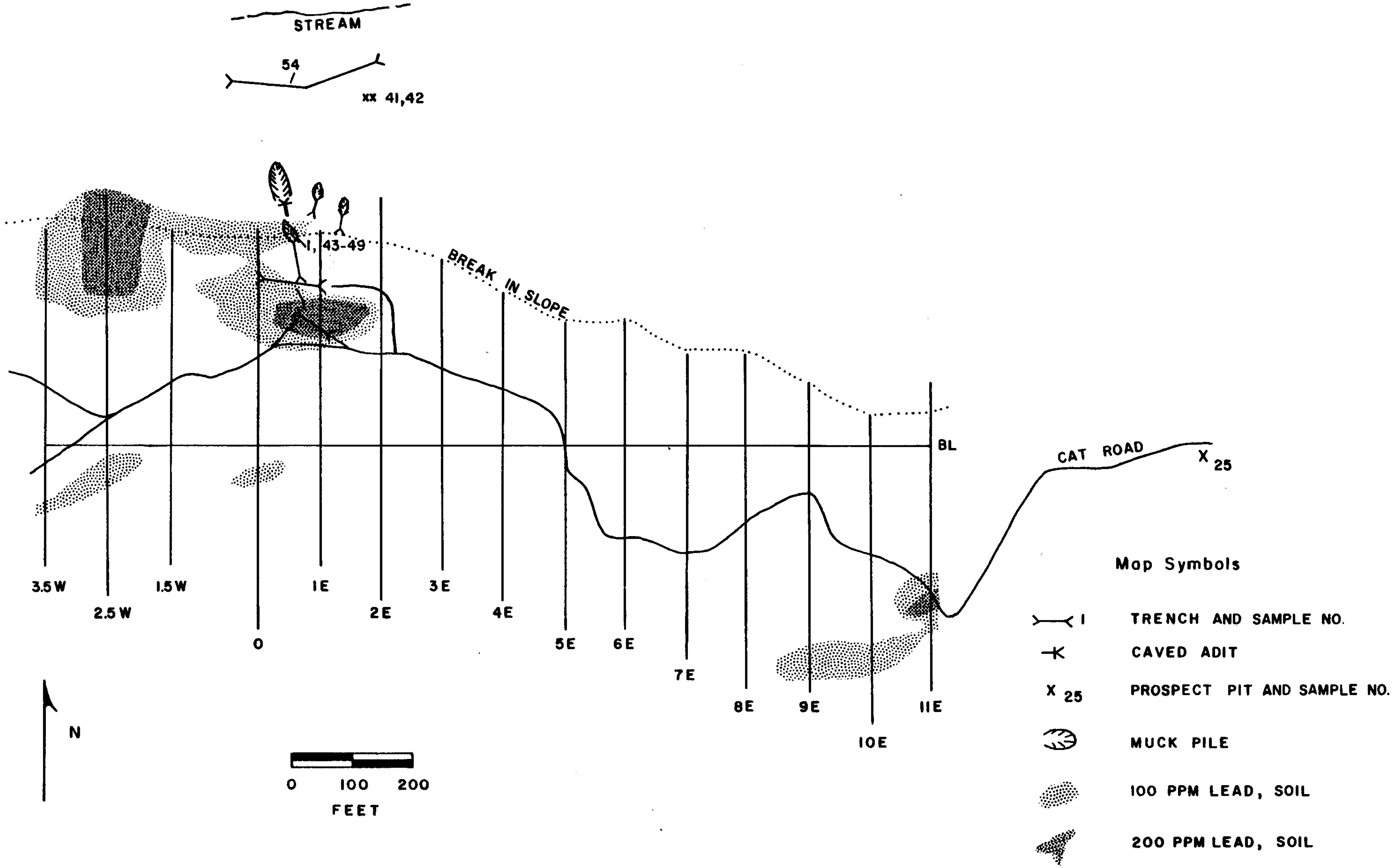


Figure 3 : The Pb-Ag prospect location and soil geochemistry map.

SOIL GEOCHEMISTRY AT THE Pb-Ag PROSPECT

In 1964, the Bureau conducted reconnaissance soil sampling for heavy metals peripheral to the Pb-Ag Prospect using an on-site analytical technique (6). One hundred seventy-eight soil samples were collected in 1966 and were analyzed for Cu-Pb-Zn by the Bureau (Juneau) laboratory. The results are tabulated in appendix B with grid references to figure 3. Anomalies were reported "at 1,200 ft E, 900 ft SW, and 1,000 ft NNE of the deposit" (0+75E, 2+60N, fig. 3) (1). Zinc, and particularly copper, do not significantly correlate to lead as suggested by the low linear correlation coefficients presented in table 1. Scatter diagrams for each element pair failed to suggest the existence of any apparent non-linear trends.

TABLE 1. - Correlation matrix and statistics for 1966 soil survey

	Cu	Pb	Zn
Cu.......	1.0		
Pb.......	0.07	1.0	
Zn.......	0.41	0.38	1.0
x........	31.6 ppm	48.4 ppm	51.3 ppm
SD.......	23.9	70.3	39.8
Threshold	100 ppm	240 ppm	110 ppm

Thresholds at the 2.5% confidence interval were estimated by the Lepeltier method (7) and are listed in table 1. The 100 ppm Pb contour of figure 3 possibly defines an easterly trend to potentially pod-like or ore shoot mineralization.

TIN PROSPECTS

Cosna Dome is a relatively flat-topped hill covered by thin tundra. The SW and NE flanks of the dome have linear benches and subtle linear depressions which trend approximately 140-150° and appear to be the loci of the tin-bearing structures. Samples of brecciated graywacke veined by irregular quartz stringers and goethite-limonite box-work veins characterize the tin-bearing outcrops and float on Cosna Dome. Float samples of quartz-tourmaline vein material were also found on top of and on the flanks of Cosna Dome.

The 1964 Bureau survey analyzed a random selection of gossany vein material from Cosna Dome and returned a high value of 3.18% Sn. In 1966, the Bureau resampled vein material on the dome and found up to 0.36% Sn and 2.29 oz/ton Ag (1).

Development work as of 1987 consisted of six shallow trenches distributed in a linear trend bearing 140° (fig. 2). Two of the trenches did not encounter vein material and were therefore not sampled (fig. 2). At sample sites 51-53 (fig.2), a trench is cut beside an old hand dug pit that had encountered Fe-stained, quartz-veined breccia, and associated box-work gossan. An analysis of a sample (sample site 3, fig. 2) composed of random chips of the various types of mineralized vein material from the dump at the hand dug pit indicated 45 ppm Ag, 830 ppm Sn, 2,200 ppm Pb, and 181 ppm As. Three hundred fifty feet to the NW of the pit a trench exposes gossan and quartz-chlorite veinlets crosscutting a massive milky quartz lens within graywacke wallrock. At this site two samples (5, 6, fig. 2) contained up to 54 ppm Ag, 5,800 ppm Pb, 897 ppm As and 320 ppb Au. The Sn concentrations were below detection limits.

A potential new vein system, situated on a prominent bench which trends approximately 145°, was located in rubble during this (1987) investigation. Abundant cobbles (up to 8 in diameter) of dense gossan were exposed by hand trenching (sample 8) at this site, however bedrock could not be exposed. A randomly selected collection of gossan chips (sample 8) was analyzed, and values of 20,000 ppm Sn, 110 ppm Ag, 2,130 ppm As, and 3,950 ppm Pb were reported (appendix A). Gossan was not found in the same relative abundance in vein float collected elsewhere along strike. Instead, quartz veins and brecciated graywacke with some goethite filled voids or fractures appear to be representative of other sections of the structure. These rocks contain up to 2,300 ppm Sn, 33 ppm Ag, 1,100 ppm Pb, and 325 ppm As (samples 32 and 33, appendix A). The depth of the oxidation zone precluded an assessment of the hypogene mineralization at this site.

On strike 2,700 ft to the northwest of the above described tin prospects and in the gulch which drains to the NW off Cosna Dome, a rubble crop of highly fractured, brecciated, and quartz-veined graywacke showed anomalous levels of Sn (390 ppm), Pb (154 ppm), and As (130 ppm)(sample 9, fig. 2, appendix A).

Veined rock samples containing anomalous levels of arsenic were also found in two drainages north of Cosna Dome. Samples 23 and 24 are samples of float in creek gravels and contained 650 ppm and 693 ppm arsenic, respectively (fig. 2, appendix A). Sample No. 36 contained 1,390 arsenic and is from rubble crop exposures composed of densely jointed graywackes and shales. The joints are locally coated with a yellow-green oxide mineral, possibly scorodite.

PAN CONCENTRATE SURVEY

Fifteen pan concentrate samples were taken from alluvial gravels in creeks and gulches draining the prospect area. The concentrate samples were obtained by panning a volume of one level 14-in-gold pan of minus 1/4 in material. Drainage character ranged from dry gulches to muskeg seeps in permafrost areas, and meandering swiftly flowing creeks.

All 15 samples were analyzed for 34 elements by neutron activation and, in addition, for Pb by atomic absorption spectrometry (AAS), table 2. Due to the limited sample set and the generally log normal character of this geochemical data, elementary statistics of mean, standard deviation, and threshold estimation lack significance. Instead, apparent individual elemental anomalies are discussed in relation to known sites of mineralization or lithologies present in the respective drainage.

The most anomalous group of samples (10, 11, 13, and 14, fig. 2, table 2) produced a downstream dispersion pattern in the first drainage south of the Pb-Ag Prospect. Decreasing values of Sb, Ce, Eu, La, Lu, Sm, Ag, Te, Tb, Th, Sn, W, U, and Pb are noted from samples 10 to 14 (fig. 2, table 2).

At the headwaters, in the vicinity of sample 10, angular cobbles of a fine-grained felsic, quartz porphyry dike rock (sample 17, fig. 2) are locally abundant. The erosion of heavy mineral fractions from these rocks may account for the high levels of Ce, Eu, La, Lu, Sm, Tb, Th, and U found in the stream gravels of this drainage. Although petrographic examination of sample 17 revealed an abundance of zircon (and possibly monazite), geochemical analysis (appendix A) did not indicate an anomalous concentration of REE in this sample. An elevated concentration of Sb (113 ppm) is contained within sample 17 (appendix A) and mineralization related to this quartz porphyry dike probably accounts for the anomalous Sb concentrations in the pan concentrate samples from this drainage. Vein quartz cobbles near sample 17 combined with the high metal values in the pan concentrate samples, may be indicative of mineralization similar to that found in the Sn and Pb-Ag prospects.

The presence of the Pb-Ag prospect (fig. 2) is amply reflected by sample 15 in which elevated values of Pb and Ag are present. The occurrence of stibnite at this prospect is weakly expressed by elevated concentrations of Sb (table 2).

Tin (Sn) mineralization on Cosna Dome (Hill 2,026 ft) is also reflected in the analyses of pan concentrate samples. Samples 20 and 22 were taken from gulches that drain northwest and roughly on trend with Sn-mineralized linear features on top of the dome. The samples contained anomalous arsenic, tin, lead, and zinc values (table 2). The elevated tin value in sample 39 (fig. 2), which was obtained from a major drainage system north of Cosna Dome, probably reflects the regional presence of tin. A more areally extensive pan concentrate survey by the Bureau in 1966 was conducted for heavy mineral identification and estimation purposes. Tin in the form of detrital cassiterite was noted in several drainages within the region. A compilation of the 1966 and 1987 pan concentrate survey results shows that elevated levels of Sn or the presence of cassiterite is found distributed over a N-S area for at least 5 miles (fig. 4).

The only significant arsenic anomaly is found in sample 37 (362 ppm As) from the NE corner of the project area (fig. 2). In this drainage, joint planes on graywackes are found to be coated with yellow-green oxides suggestive of secondary arsenic minerals.

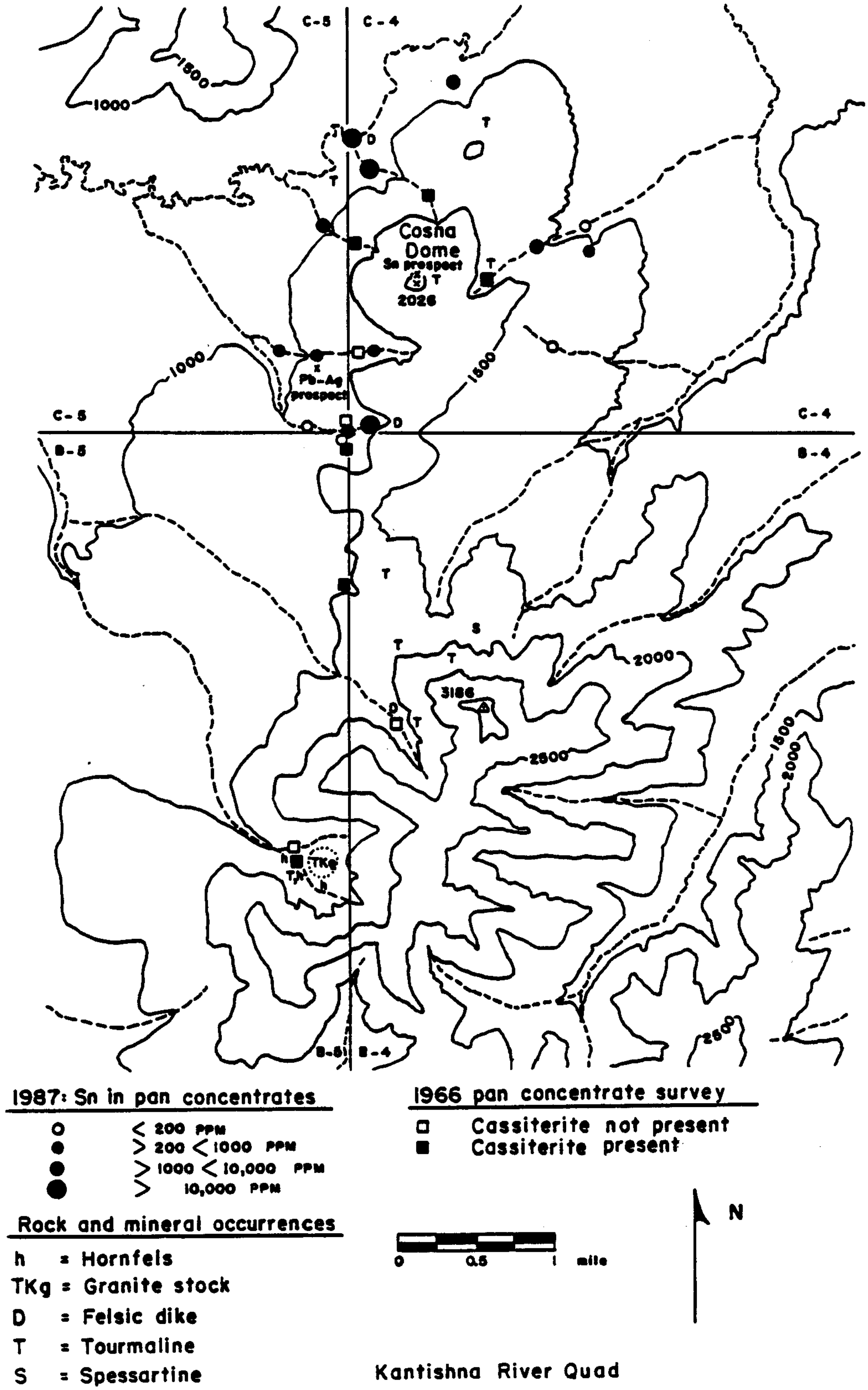


Figure 4 : Compilation of pan concentrate survey results.

DISCUSSION

Approximately 20 miles to the SW of Cosna Dome, Haystack Mountain is cored by a quartz monzonite pluton around which quartzites, siltstones, slates, and grit have been altered to hornfels (3). The plutonic rocks at Haystack Mountain can be distinguished from the enclosing country rock by airborne radiometric and magnetometer surveys (5). The exposed intrusive is marked by a positive radiometric anomaly, whereas the enclosing hornfels is expressed by positive magnetic anomalies on either side of the pluton (5). A similar geophysical expression is evident on an E-W traverse over the Bitzshtini Mountains (profile A-A', figs. 5, 6, and 7). Additionally, geophysical profile B-B' on figure 6 shows that an elevated magnetic signature is coincident with the northeastern flank of the Bitzshtini Mountain massif. Hence from the available data, it appears that the Bitzshtini Mountains are cored by a shallow, unexposed pluton about which an aureole of hornfels developed. Although the immediate prospect area is not covered by geophysical surveys, the occurrence of some felsic dikes and local tourmalinization of the country rock implies the extension of buried plutonic rocks northward of the Bitzshtini Mountains. The Pb-Ag-Sb and Sn mineralization examined in this investigation is possibly a high level expression of intrusive associated tin mineralization at depth. Burns and Newberry (8) compared known tin districts on the basis of the depth and size of granitic exposure and the occurrence of tin deposits to generate a model for tin mineralization found in the Steese-White Mountain region of Alaska. In the Steese-White Mountain region the plutonic rocks are exposed over a small areal extent and are thought to represent the upper portions of a large, unexposed intrusive complex (8). Since tin mineralization is most concentrated near the tops of batholiths (9), Burns and Newberry (8) suggest that the Steese-White Mountain area of Alaska lies at or above the level of significant tin mineralization. Similarly, for the Cosna area, the dispersed and sparsely exposed plutonic rocks implies minor unroofing of a composite intrusive complex in the region. This rationale, coupled with the presence of tin-silver mineralization in the prospect area and the presence of similar intrusions in the region suggests that possibly significant tin-silver mineralization may be found in the NE Kuskokwim Mountains.

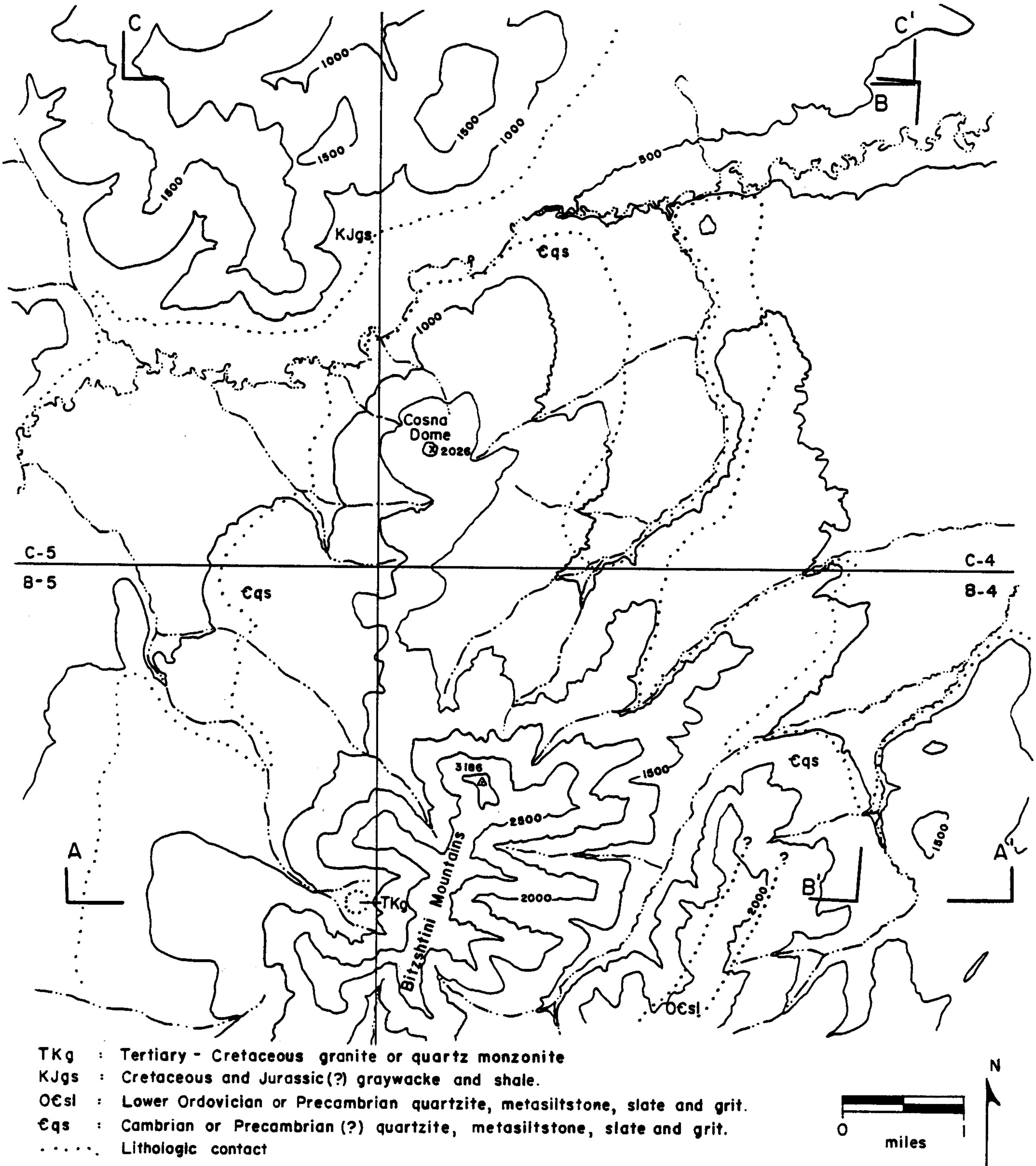
The mineralization discussed in this report is too poorly exposed to suggest the continuity of the veins. However, the apparent abundance of vein-type occurrences given this degree of vegetative cover is encouraging and worthy of additional exploration.

TABLE 2. - PAN CONCENTRATE ANALYTICAL RESULTS

Map Sample Number	Archive Sample Number	Elements, units																	
		Au ppb	Sb ppm	As ppm	Ba ppm	Br ppm	Cd ppm	Ce ppm	Cs ppm	Cr ppm	Co ppm	Eu ppm	Hf ppm	Ir ppb	Fe pct	La ppm	Lu ppm	Mo ppm	Ni ppm
10....	CI-26702.	<40	668.0	74	740	25	<54	7550	3	650	<10	66	<5	<100	2.8	3600	1.2	<12	<50
11....	CI-26703.	49	106.0	44	880	<5	<23	1710	6	330	<10	18	<2	<100	4.2	659	0.9	<7	97
13....	CI-26705.	<5	39.2	19	780	<5	<10	960	6	370	<10	6	6	<100	4.3	350	0.6	<2	55
14....	CI-26706.	<5	56.3	28	840	<5	<10	460	6	250	20	2	6	<100	5.7	170	<0.5	<2	78
15....	CI-26707.	<5	18.0	28	850	<5	<10	88	9	300	22	<2	3	<100	4.8	34	<0.5	<2	68
16....	CI-26708.	21	12.0	36	720	<5	<10	71	16	260	31	<2	5	<100	5.0	28	<0.5	2	<50
18....	CI-26710.	<5	11.0	40	760	<5	<10	57	7	250	15	<2	5	<100	5.4	23	<0.5	<2	<50
20....	CI-26712.	90	6.2	78	890	<5	<10	85	8	270	13	<2	9	<100	6.3	28	<0.5	2	60
22....	CI-26714.	<5	8.8	70	890	<5	<10	71	15	330	20	<2	5	<100	5.6	32	<0.5	<2	70
26....	CI-26718.	120	5.4	26	810	<5	<10	180	8	300	23	3	8	<100	4.7	72	0.6	<2	<50
27....	CI-26719.	<5	3.2	20	1000	<5	<10	240	9	240	16	<2	4	<100	3.9	82	<0.5	<2	<50
29....	CI-26721.	<5	8.0	34	870	<5	<10	150	11	200	26	<2	6	<100	6.2	59	<0.5	<2	82
31....	CI-26723.	72	8.1	31	980	<5	<10	130	10	250	24	<2	8	<100	5.4	52	0.5	<2	75
37....	CI-26729.	<5	10.0	362	890	<5	<10	49	50	170	20	<2	<2	<100	6.8	32	<0.5	<2	120
39....	CI-26731.	240	9.5	33	870	<5	<10	430	11	310	16	6	<2	<100	4.0	160	0.8	<2	97

Map Sample Number	Archive Sample Number	Element, units																
		Rb ppm	Sm ppm	Sc ppm	Se ppm	Ag ppm	Na pct	Ta ppm	Te ppm	Tb ppm	Th ppm	Sn ppm	W ppm	U ppm	Yb ppm	Zn ppm	Zr ppm	Pb ppm
10....	CI-26702.	66	636.0	10.0	<22	23	<3.80	2	<100	33	367.0	21900	92	4.4	20	<200	1800	455
11....	CI-26703.	89	158.0	11.0	<10	12	0.51	2	<64	7	81.4	4100	9	2.9	9	<200	<1100	119
13....	CI-26705.	66	61.8	13.0	<10	<5	0.47	<1	<20	3	40.0	320	<5	1.9	5	<200	<500	50
14....	CI-26706.	86	33.0	14.0	<10	<5	0.52	<1	<20	2	21.0	<200	<4	1.6	<5	450	<500	62
15....	CI-26707.	64	6.4	14.0	<10	7	0.66	<1	<20	<1	6.9	260	5	1.5	<5	590	920	1150
16....	CI-26708.	69	5.4	15.0	<10	<5	0.52	<1	<20	<1	5.6	770	7	2.1	<5	750	<500	230
18....	CI-26710.	63	4.5	16.0	<10	<5	0.51	<1	<20	<1	6.0	290	4	1.3	<5	450	<500	285
20....	CI-26712.	69	5.6	17.0	<10	<5	0.42	1	<20	<1	6.4	2100	8	2.3	<5	770	890	195
22....	CI-26714.	69	6.1	15.0	<10	<5	0.57	<1	<20	<1	6.8	12000	39	1.8	<5	520	<500	158
26....	CI-26718.	49	12.0	17.0	<10	<5	0.72	<1	<20	<1	12.0	<200	<2	2.6	<5	220	<500	58
27....	CI-26719.	84	15.0	15.0	<10	<5	0.55	<1	<20	2	14.0	760	6	3.9	<5	280	<500	76
29....	CI-26721.	80	10.0	16.0	<10	<5	0.59	<1	<20	1	11.0	<200	8	2.8	<5	300	<500	156
31....	CI-26723.	72	10.0	15.0	<10	<5	0.63	<1	<20	<1	11.0	1300	8	2.5	<5	330	<500	176
37....	CI-26729.	150	6.7	15.0	<10	<5	0.52	<1	<20	1	6.1	1000	420	1.9	<5	230	840	260
39....	CI-26731.	60	30.0	14.0	<10	<5	0.55	1	<20	2	19.0	14000	77	2.1	<5	480	<500	63

1. Analytical methods are presented in Appendix A.



TKg : Tertiary - Cretaceous granite or quartz monzonite
KJgs : Cretaceous and Jurassic(?) graywacke and shale.
OЄsl : Lower Ordovician or Precambrian quartzite, metasiltstone, slate and grit.
Єqs : Cambrian or Precambrian (?) quartzite, metasiltstone, slate and grit.
. . . . . Lithologic contact

Base map adapted from USGS quadrangles Kantishna River B-4, B-5, C-4, and C-5.
Geology adapted from USGS Open File Map 75-351.

Figure 5 : Bedrock geology and geophysical profile location map.

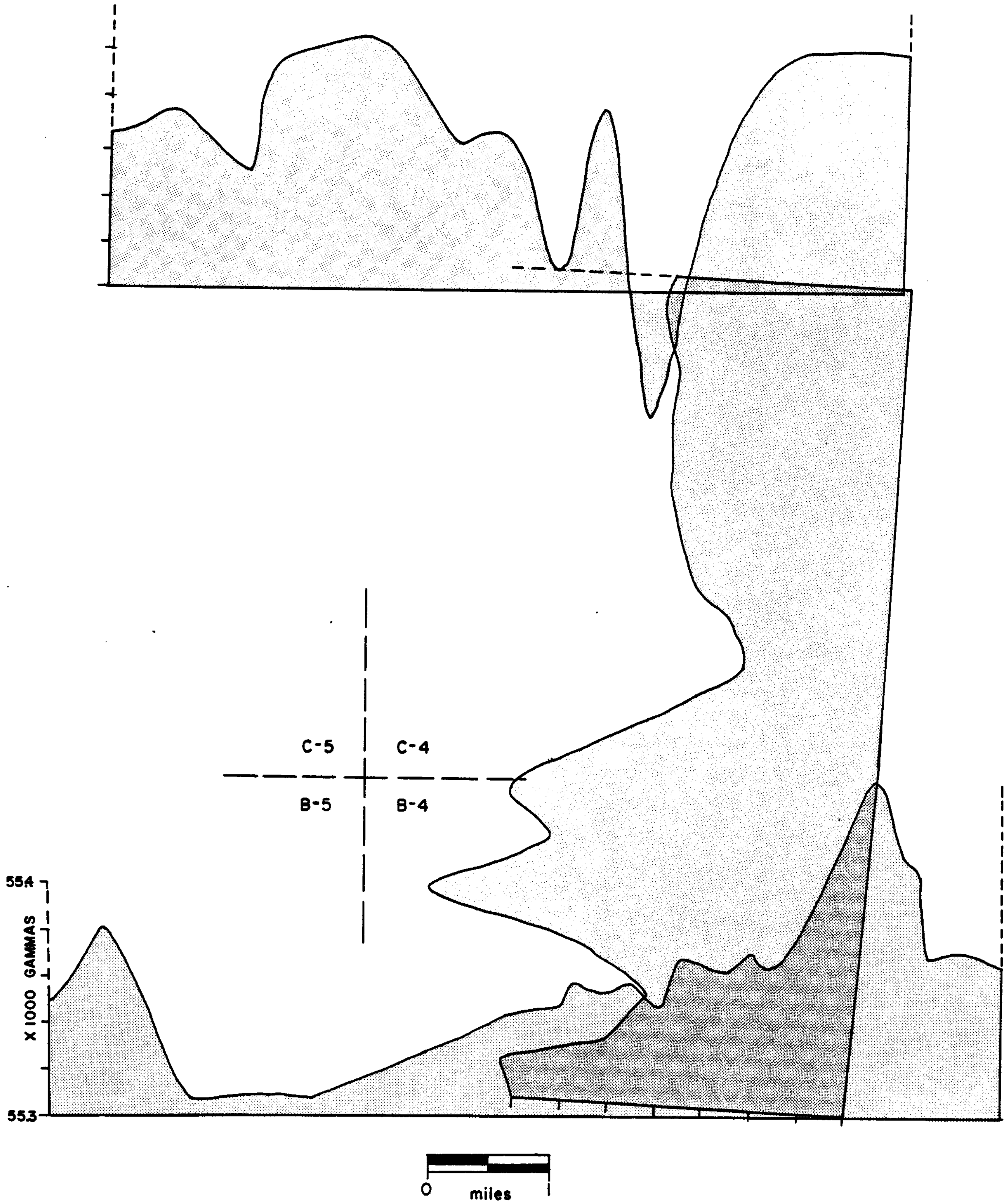


Figure 6 : Total field airborne magnetic profiles - overlay to figure 5 .

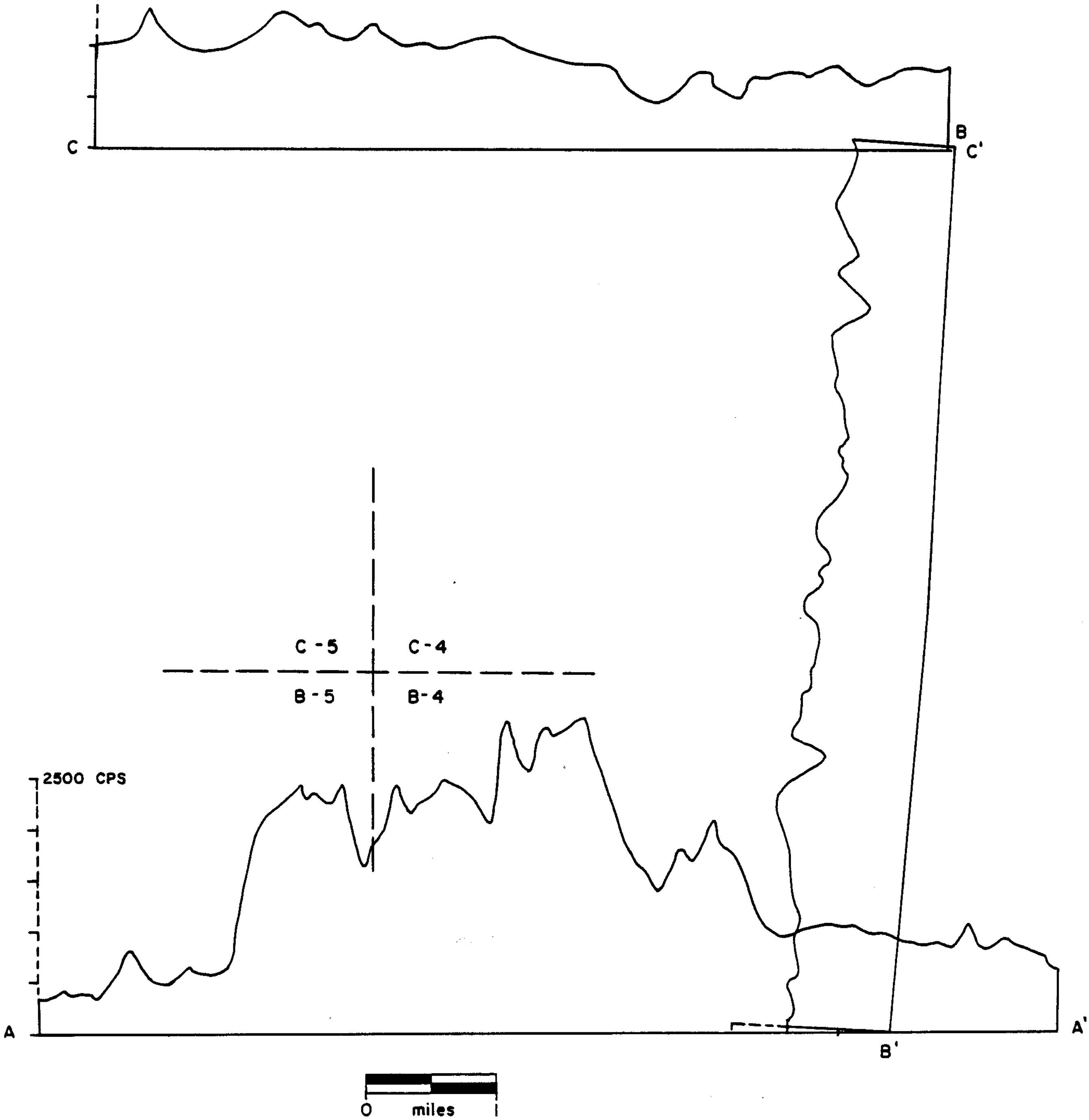


Figure 7 : Total counts per second airborne radiometric profiles - overlay to figure 5.

REFERENCES

1. Berryhill, R. V. Summary Report of Minerals Examination, Unpublished Report Form 6-803, 1966, Report available from the Bureau of Mines, Fairbanks, Ak.

2. Joesting, Henry R. Supplement to Pamphlet No. 1 - Strategic Mineral Occurrences in Interior Alaska. Terr. of Alaska, Dept. of Mines, Pamphlet No. 2, March 1943, pp. 18-19.

3. Chapman, R. M., W. E. Yeend, and W. W. Patton, Jr. Preliminary Reconnaissance Geologic Map of the Western Half of Kantishna River Quadrangle, Alaska. U.S. Geol. Surv. Open File Map 75-351.

4. Chapman, R. M. Geochemical Anomalies in Bedrock, West Half of Kantishna River Quadrangle in Accomplishments of the U. S. Geological Survey during 1976. IC 751-B, pp. B35-36.

5. Areo Service. U.S. Energy Research and Development Administration, Aerial Gamma Ray and Magnetic Survey of the Kantishna River Area, Alaska. Prepared for U.S. ERDA, Grand Junction Office, Grand Junction, CO, 1980.

6. Mukherjee, N. R. and L. Mark-Anthony. Geochemical Prospecting. School of Mines, Univ. of AK, Bull. No. 3, Fairbanks, AK, 1957.

7. Lepeltier, C. A simplified statistical treatment of geochemical data by graphical representation. Econ. Geol., vol. 64, pp. 538-550, 1969.

8. Burns, L. E. and R. J. Newberry. Intrusive Rocks of the Lime Peak - Mt. Prindle Area, in Mineral Assessment of the Lime Peak-Mt. Prindle Area, Alaska. T. E. Smith, G. H. Pessel, and M. A. Wiltse eds. Div. of Geol. and Geophys. Surv., Fairbanks, AK, 1987.

9. Taylor, R. G. Geology of Tin Deposits: New York, Elsevier Scientific Publishing Co., 543 pp., 1979.

APPENDIX A. - RESULTS OF GEOCHEMICAL ANALYSIS OF ROCK SAMPLES

Map Sample Number	Archive Sample Number	Elements, units															Descriptions
		Au ppb	Sb ppm	As ppm	Ce ppm	Co ppm	Fe pct	La ppm	Mo ppm	Ag ppm	Th ppm	Sn ppm	W ppm	U ppb	Zn ppm	Pb ppm	
1**...	CI-26552...	10	150							92.94 oz/ton		0.08%			0.03%	78.46%	High grade massive coarse grained galena vein from prospect trench dump; Pb-Ag Prospect.
2.....	CI-26553...	No analysis															Vuggy quartz plus galena in veinlet crosscutting medium-coarse grained arkose from trench dump; Pb-Ag Prospect.
3.....	CI-26554...	<10	17	181	24	<10	11.0	14	<2	45	4.0	830	16	1.9	2800	2200	Random selected quartz vein and gossan vein material from hand dug pit.
4.....	CI-26555...	<5	12	51	28	16	5.4	12	<2	11	3.6	330	10	1.6	1500	770	High graded grab samples of quartz vein material from small trench.
5.....	CI-26556...	9	38.1	14	29	<10	2.3	7	<2	44	<.05	<200	4	1.0	280	5800	Chip sample (1.5 ft) across quartz vein in arkose; wallrock and vein is crosscut by gossan and quartz-chlorite veinlets.
6.....	CI-26557...	320	12.0	897	41	22	28.0	13	<2	54	3.6	<200	11	<.5	2100	1200	Grab samples of cinder-like gossan vein material at sample site 5.
7.....	CI-26558...	10	3.3	11	27	<10	5.3	10	<2	6	3.6	<200	11	1.7	280	225	Chip sample across quartz veins zone in trench; width = 6 in.
8.....	CI-26559...	33	135.0	2130	<28	<10	43.0	5	<2	110	2.6	20000	58	<.5	5700	3950	Massive dense gossan; abundant in hand dug pit; microscopic cassiterite and minor unidentified sulfides.
9.....	CI-26560...	<5	7.6	130	21	<10	9.2	14	<2	<5	2.2	390	17	1.8	920	154	18 x 30 in boulders of sheared and veined pebble conglomerate. Gossany shears with molds of pyrite.
17....	CI-26709...	10	113	51	85	<10	<0.5	49	2	<5	21.0	<200	2	5.0	<200	---	Altered aplite dike float with quartz phenocrysts and disseminated sphene or zircon.
19....	CI-26711...	<5	3.9	102	15	<10	3.2	<5	<2	<5	1.0	<200	<2	<.5	650	75	Grab sample of massive milky quartz with limonite-filled cavities.
21....	CI-26713...	<5	15.0	66	21	25	7.3	13	<2	5	4.9	<200	<2	1.7	370	83	Shale-siltstone crosscut by vuggy quartz, tourmaline, and pyrite or arsenopyrite veinlets.
23....	CI-26715...	<5	30.7	650	<25	<10	4.9	<5	<2	<5	2.4	<200	120	0.7	250	46	50% vuggy, irregularly oriented quartz veining through arkose.
24....	CI-26716...	<11	39.7	693	<28	13	29.0	7	9	<5	3.1	<200	19	1.3	4400	111	Porous black-red gossan float, blocks to 8 x 8 in.

APPENDIX A. - RESULTS OF GEOCHEMICAL ANALYSIS OF ROCK SAMPLES - CONTINUED

Map Sample Number	Archive Sample Number	Elements, units															Descriptions
		Au ppb	Sb ppm	As ppm	Ce ppm	Co ppm	Fe pct	La ppm	Mo ppm	Ag ppm	Th ppm	Sn ppm	W ppm	U ppb	Zn ppm	Pb ppm	
25....	CI-26717...	7	11.0	31	21	25	2.6	8	<2	7	3.5	<200	<2	1.5	310	310	Arkose cross-cut by vuggy quartz veinlets, <1/4 in. thick gossan veinlets and deep chocolate brown oxide coating.
30....	CI-26722...	<5	5.8	13	13	12	1.7	5	2	<5	1.5	<200	<2	0.7	300	56	Six in block of slickensided, silicified siltstone breccia cemented by vuggy quartz.
32....	CI-26424...	<5	31.7	278	24	<10	8.8	26	<2	17	5.8	2300	11	2.4	840	1100	Bleached and altered arkose with an adjacent 1/4-1/2 in. gossan veinlet, deeply weathered.
33....	CI-26725...	20	15.0	325	<20	<10	14.0	13	<2	33	2.9	<200	14	1.5	1700	690	Quartz and gossan veined brecciated arkose; 60-70% vein quartz and 10-15% gossan.
36....	CI-26728...	<5	19.0	1390	30	<10	4.9	11	3	<5	3.3	<200	51	1.7	<200	75	Veined arkose, veins 5% by volume; <1/4 in wide and oriented along joints; yellow oxide coatings.
38....	CI-26730...	<5	7.6	106	44	<10	0.6	11	<2	<5	37.0	<200	3	8.4	<200	25	Float, believed close to source. Altered felsic dike rock; leucocratic aplite with sparse quartz phenocrysts; radiating tourmaline rosettes in fractures and miarolitic cavities.
40....	CI-26732...	<5	6.3	141	<10	15	3.2	<5	3	<5	1.4	240	<2	0.8	510	16	One ft chip sample across sheared and broken massive milky quartz vein. Abundant Fe and Mn-oxide stain; = 10% gouge.
41*...	66-1455-10.	.02 oz/ton								147.92 oz/ton		0.06%				69.26%	Galena vein float in prospect pit; Pb-Ag Prospect.
42*...	66-1456-11.	.02 oz/ton								65.16 oz/ton		0.08%				72.56%	Galena vein float in prospect pit; Pb-Ag Prospect.
43*...	64-1301-RB.	.02 oz/ton								97.44 oz/ton		<.01%				76.94%	Massive galena vein from trench dump; Pb-Ag Prospect
44*...	64-1302-RB.	Tr								8.58 oz/ton		0.02%				5.0%	Vein-bearing galena from trench dump; Pb-Ag Prospect
45*...	64-1303-RB.	Nil								65.26 oz/ton		0.03%				54.84%	Massive galena vein from trench dump; Pb-Ag Prospect

APPENDIX A. - RESULTS OF GEOCHEMICAL ANALYSIS OF ROCK SAMPLES - CONTINUED

Map Sample Number	Archive Sample Number	Elements, units: Au ppb	Sb ppm	As ppm	Ce ppm	Co ppm	Fe pct	La ppm	Mo ppm	Ag ppm	Th ppm	Sn ppm	W ppm	U ppb	Zn ppm	Pb ppm	Descriptions
46*...	64-1304-RB.	Nil								76.84 oz/ton		<0.01%				79.64%	Massive galena vein from trench dump; Pb-Ag Prospect
47*...	66-1462-19	.04 oz/ton								96.64 oz/ton		0.06%				69.72%	Massive galena from adit muck pile; Pg-Ag Prospect.
48*...	66-1463-20.	Nil								105.84 oz/ton		0.06%				67.33%	Massive galena vein from trench dump; Pb-Ag Prospect
49*...	66-1466-23.	Nil								62.48 oz/ton		0.03%				71.29%	Massive galena vein from trench dump; Pb-Ag Prospect
50*...	66-1467-24									103.06 oz/ton		0.05%				74.83%	Massive galena vein from trench dump; Pb-Ag Prospect
51*...	66-1446-2..									2.29 oz/ton		0.04%				<0.03%	Dark brown gossan in breccia zone within graywacke; grab sample; Cosna Dome Tin Prospect.
52*...	66-1447-3..									1.26 oz/ton		0.36%				<0.03%	Fe-stained breccia from pit at Cosna Dome.
53*...	66-1448-4..									1.82 oz/ton		0.05%				<0.03%	Random pieces of gossan with drusy quartz and breccia from pit at Cosna Dome.
54....	CI-25751...	<5								0.8 ppm							Small cobble of massive stibnite (68.95% Sb, 700 ppb Hg).

Analytical Methods

1. Analysis for Au, Sb, As, Ce, Co, Fe, La, Mo, Ag, Th, Sn, W, U, Zn by Bondar Clegg, Inc.[4/] Neutron activation except where noted by *.

2. Analysis for Pb by Bondar Clegg, Inc.[4/] Atomic absorption spectrometry except where noted by *.

3. * means analysis for Au and Ag by Fire Assay; Pb and Sn by wet method at BuMines Laboratory - Juneau, Alaska.

4. ** means analysis for Ag, Pb, Zn by fire assay analysis, Sn by x-ray fluorescence by Bondar Clegg, Inc.[4/]

Note: Additional analysis for Ba, Br, Cd, Cs, Cr, Eu, Hf, Ir, Lu, Ni, Sm, Sc, Se, Zr in samples 1-40 indicated no anomalous values.

4/ Reference to specific commercial services does not imply endorsement by the Bureau of Mines.

APPENDIX B. - RESULTS OF THE 1966 SOIL GEOCHEMISTRY SURVEY FOR COPPER, VALUES IN PPM

	3.5W	2.5W	1.5W	0	1E	2E	3E	4E	5E	6E	7E	8E	9E	10E	11E
400N		120				10									
350N	32	105	15	20	20	45									
300N	35	55	15	20	20	50	20								
250N	32	35	15	25	20	60	40	20							
200N	30	25	5	25	25	45	30	65	0	0					
150N	35	35	10	20	15	80	35	5	25	50	5	15			
100N	35	35	20	25	20	120	35	35	35	65	40	10	10		5
50N	30	30	10	25	20	65	60	85	45	50	10	15	0	20	10
BL	32	27	40	25	125	65	40	35	2	5	15	10	5	10	10
50S	35	30	47	25	115	90	55	30	35	35	45	5	10	15	5
100S	35	35	15	20	20	95	65	60	25	30	105	20	0	5	25
150S	37	35	52	20	120	60	40	70	25	20	55	20	5	10	25
200S	35	95	57	20	100	45	60	25	35	45	45	20	0	30	37
250S		30		20		10		20	30	30	20	10	20	30	35
300S				20					15	55	20	10	10	20	35
350S											15	15	20	20	27
400S												20	5	15	30
450S														15	

RESULTS OF THE 1966 SOIL GEOCHEMISTRY SURVEY FOR LEAD, VALUES IN PPM

	3.5W	2.5W	1.5W	0	1E	2E	3E	4E	5E	6E	7E	8E	9E	10E	11E
400N		207				60									
350N	115	295	105	400	60	85									
300N	112	290	82	100	12	75	12								
250N	115	250	87	165	100	80	10	15							
200N	70	57	32	140	600	2	5	20	10	15					
150N	70	62	30	50	15	7	5	10	10	20	55	20			
100N	50	40	32	20	5	35	2	2	20	10	50	0	0		40
50N	35	35	25	15	15	100	10	2	15	10	10	25	35	30	25
BL	25	42	40	15	20	55	5	2	15	5	15	20	5	35	45
50S	55	160	15	150	20	12	10	20	10	15	25	20	30	25	20
100S	112	35	32	20	15	15	2	20	15	20	130	30	10	35	20
150S	25	55	25	35	15	12	2	20	15	20	30	30	20	35	25
200S	32	10	30	35	20	10	0	20	25	30	5	30	20	40	40
250S		42		20		10		20	20	30	30	0	35	55	250
300S				35					20	30	45	45	45	55	105
350S											65	65	145	160	30
400S												70	80	65	95
450S														65	

RESULTS OF THE 1966 SOIL GEOCHEMISTRY SURVEY FOR ZINC, VALUES IN PPM

	3.5W	2.5W	1.5W	0	1E	2E	3E	4E	5E	6E	7E	8E	9E	10E	11E
400N		245				95									
350N	92	145	30	102	80	117									
300N	90	130	27	90	65	95	100								
250N	85	135	30	112	110	60	110	45							
200N	50	47	20	95	150	57	100	35	30	35					
150N	75	50	35	55	55	57	110	35	25	0	0	0			
100N	50	75	40	55	52	85	95	95	30	30	10	0	0		35
50N	0	32	32	55	50	90	110	100	45	50	0	5	20	95	125
BL	0	20	42	55	60	75	100	100	60	30	0	25	0	60	80
50S	40	82	32	60	60	100	112	35	55	50	5	0	0	15	27
100S	82	25	17	55	70	122	110	40	50	40	10	10	0	25	30
150S	95	20	30	45	55	115	105	45	45	30	5	20	10	30	32
200S	40	25	25	52	70	110	100	50	50	5	15	15	20	25	130
250S		0		55		105		45	45	5	15	5	30	25	45
300S				67					45	5	20	5	20	20	80
350S											10	5	30	20	45
400S												0	0	20	40
450S														85	