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THE GEOLOGY AND GEOCHEMISTRY OF THE INMACHUK RIVER MAP AREA, SEWARD PENINSULA, ALASKA

By

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THE GEOLOGY AND GEOCHEMISTRY OF THE INMACHUK RIVER MAP AREA, SEWARD PENINSULA, ALASKA

by Gordon Herreid

ABSTRACT

The Inmachuk map area covers 110 square miles in northern Seward Peninsula, 10 miles south of Kotzebue Sound and 25 miles southwest of Deering. The known mineral deposits in the area are lead-zinc lodes and gold placers in the vicinity of Hannum Creek, two gossan areas about 8 miles southeast of Hannum Creek and reported placer tin in the creeks 2-5 miles south of the gossans. Placer gold is also present on the Inmachuk River, immediately east of the map area.

Most of the area consists of tundra and muskeg-covered flats and low hills underlain by mica schist, phyllite, and minor marble. A thick section of marble, which underlies these rocks, is exposed on a structural dome about 2 x 8 miles in extent in the southern part of the map area. Doming was probably related to intrusion of Mesozoic(?) granite which is exposed in two small plutons on the dome. Minor fold axes are present, mostly with low to moderate plunges northwest and southeast. A scattering of gently dipping axial planes of folds indicates that large overturned folds may be present.

The Hannum Creek deposit is a pyrite-lead-zinc replacement of marble associated with silicification, probably along a northwest trending fault. The deposit is about a mile long, but exposures are too poor to evaluate the grade and tonnage of ore.

The gossan deposits southeast of Hannum Creek have low gold and base metal contents and appear to be fault controlled pyritic(?) replacements of marble.

At the Hannum Creek deposit high soil trace element anomalies are closely associated with the ore. Stream sediments show anomalous amounts of (total) lead for 7 miles downstream from the deposit. The readily extractable heavy metal anomaly is much more restricted, indicating that the lead in the sediments is detrital.

A weak stream sediment lead anomaly (70 ppm) two miles long is associated with a northwest trending fault zone on the dome. A weak tin anomaly (8-20 ppm) is present in stream sediments along the northeast flank of the dome. These anomalies extend across drainages and evidently represent underlying bedrock mineralization. No ore showings or float were found in these areas.

INTRODUCTION

The map area lies about ten miles south of Kotzebue Sound in the northern part of the Seward Peninsula. It includes low tundra-covered hills, muskeg flats, and a prominent range of limestone hills. It is readily accessible from Nome by bush planes, which can land on one of the two airstrips at Hannum Creek. A road about twenty miles long connects the gold placer mining area on the Inmachuk River with Deering. An area of about 110 square miles was mapped, extending from the vicinity of the Hannum Creek lead-zinc deposit south and east along a reputed mineral belt that contains a prominent gossan on Old Glory Creek and tin in the stream gravels. Travel was by tracked vehicle, and emphasis was on covering a large area with a stream sediment geochemical survey concurrent with mapping as much geology as possible within the available time. The period from July 13 to July 31, 1965 was spent in the field. The author was ably assisted by Kent Smith. Thanks are extended to Mr. and Mrs. Neal W. Foster for their hospitality at Hannum Creek.

GEOLOGY

The low hills and flats in the region are covered with tundra and devoid of outcrops. However, all but the smallest streams in the area are somewhat incised and have gravel float and occasional outcrops along their valley walls or stream banks. The prominent hills and mountains in the southwestern part of the area, to be referred to here as the Old Glory Dome, have good exposures, mostly of rubble, but with occasional bedrock outcrops. Flat-lying basalt rims many of the larger valleys in the area. Little time was spent in examining the areas between the streams.

Rock types

Marble

Light to medium gray marble, usually with grains 1/2 to 1 mm in diameter, makes up the bulk of the Old Glory Dome. The marble has a blocky fracture and forms slopes of frost-heaved rubble with scattered outcrops of bedrock in place. Locally the marble has platy beds 1/2 inch to 2 feet thick, often with rudely crenulated surfaces. When interbedded with schist, contorted folding may be present. Elsewhere bedding is obscure.

Acicular tremolite, often as radiating masses, is present at the north end of the dome (upper Inmachuk River) and in a number of localities at the south end of the dome (figure 1). A few small areas of dolomite were recognized on the upper Inmachuk River and on upper Old Glory Creek. In general, the marble is made up of light gray calcite, is not dolomitic, and contains no recognizable metamorphic minerals. No fossils were seen, nor could they be expected to have survived the deformation and recrystallization.

Schist and marble

The schist varies from a black calcareous phyllite to a dark muscovite schist. Both of these rock types are composed essentially of quartz, muscovite, and calcite, and commonly have strongly crenulated foliation planes. The schist at the junction of Hannum and Cunningham Creeks is typical. It is a silvery medium gray rock composed of quartz, muscovite, calcite, and minor dolomite and chlorite. It has strongly crenulated foliation planes and folded and boudined quartz veins up to a few inches wide. Typical black phyllite at the junction of Hannum Creek and the Inmachuk River has strongly crenulated foliation planes with a micaceous sheen and limy layers folded and boudined on a scale of a few inches or less with folds slightly overturned to the southwest.

In many of the outcrops along the creeks marble and calcareous schist are interbedded with noncalcareous schist. At such places, where lithologic contacts are visible, the rocks can be seen to be folded on both minor and major scales, with axial planes of folds often having moderate dips. Marble evidently underlies a small portion of the tundra-covered areas, but has no expression in the topography or vegetation patterns, and therefore cannot be mapped as a separate unit.

The presence of massive marble in the anticlinal structure of the Old Glory Dome indicates that it underlies and is presumably older than the schist. This is in agreement with other areas on the Seward Peninsula. These rocks are probably of lower Paleozoic age as indicated on the Geologic Map of Alaska (Dutro and Payne, 1957).

Granite

Asses Ears granite - This rock is a medium-grained, subhedral granular biotite granite containing perthitic orthoclase, andesine, quartz, biotite, hornblende, and minor apatite, allanite(?), and pyrite. It is virtually unaltered. A contact metamorphic aureole is extensively developed northeast of this granite, but seems to be lacking in the marble just west of the intrusive. Tremolite (figure 1) is present in the marble on upper Magnet Creek, but not on the marble ridge just west of Asses Ears. The hornfels float on Magnet Creek is a fine-grained bluish-green rock containing diopside, biotite, and minor scapolite, plagioclase, orthoclase, and quartz.

American Creek granite - This is a medium-grained, subhedral granular granite composed of perthitic orthoclase, oligoclase, biotite, and minor sphene. Alteration is limited to minor sericitization of oligoclase and chloritization of biotite. Quartz and feldspar-rich zones, locally containing minor purple fluorite, are present. Copper, lead, zinc, nickel, and tin were sought in these zones but not detected by x-ray fluorescence. This granite is surrounded by a narrow contact metamorphic aureole no more than a few tens of feet wide. Fine-grained hornfels similar in appearance to that on Magnet Creek is present. It contains diopside and minor vesuvianite, calcite, quartz, and feldspar. Less altered marble is also present, with bands of green diopside and brown vesuvianite.

The granitic rocks on the Seward Peninsula are considered to be of Mesozoic age by Dutro and Payne (1957) and earlier U.S. Geological Survey writers. The Asses Ears and American Creek plutons are probably no exception.

Olivine Basalt

This rock forms a volcanic cone at Virginia Butte and conspicuous flat-lying rims along many of the large stream valleys (figure 1). At Virginia Butte, a sample thought to represent the base of a flow is porphyritic olivine basalt. The fine-grained rock is composed of calcic andesine laths, tiny magnetite(?) grains and olivine with phenocrysts of olivine up to 1/2 mm in diameter. The volcanic rim just northwest of the mouth of Collins Creek is similar porphyritic olivine basalt except that the groundmass is composed of fine-grained calcic andesine laths and augite with a diabasic texture. This rock has greenish granular inclusions up to an inch in diameter made up of olivine, chrome diopside, enstatite, and chrome spinel.

The basalt originated as flows which followed the stream valleys on a surface of low relief. Later down-cutting by the streams has excavated the valleys to several hundred feet below the base of the flows leaving the basalt as rims along the upper portions of the valleys.

The basalts are of Quaternary age (Hopkins, 1959).

Structure

The presence of crenulations and minor folds throughout the map area indicates that the marble and schist are strongly deformed tectonites, probably with complex minor folding. The gently-dipping axial planes of folds in schist and marble near the mouth of Perry Creek suggest that recumbant folding is present in that area. On Old Glory Dome the outcrop pattern, the attitude of beds, and the plunges of minor folds and crenulations indicate that the gross structure is a doubly plunging (domal) anticline which brings marble to the surface. The outcrop pattern of the dome is complicated by faulting and possibly by some overturned folding.

The American Creek granite pluton crosscuts the structure, and both it and the Asses Ears granite were evidently emplaced after folding had been completed. Probably the doming was superimposed on the earlier structures of the marble and schist and is related to the intrusion of the granite bodies. The presence of cross-cutting tremolite crystals in a number of places on the dome suggests that post-kinematic thermal metamorphism has taken place.

The west trending fault at the south end of the Old Glory gossan (figures 1 and 2) probably was the controlling structure along which ore solutions traveled. At the Hannum Creek deposit, the presence of quartzite breccia on Harrys Creek in conjunction with replacement of marble by quartz suggests fault control also, with the faults probably trending northwesterly parallel to the deposit. At the head of Old Glory Creek an elongated lead anomaly also seems to follow a northwest trending fault. Very likely the ancient grain of the bedrock has to some extent controlled these later faults. A more recent example of this control is the Imuruk Lake graben structure, which dropped down along northwest trending normal faults during Quaternary time (Hopkins, 1959).

MINERAL DEPOSITS

Hannum Creek lead-zinc depost

Mineralized zones of this deposit are exposed on Harrys Creek and in trenches on Harrys and Hannum Creeks. These are northwest trending lead- and zinc-bearing silicified zones 30-150 feet wide, in marble. The area between the two creeks, a distance of a mile along the strike of the deposit, is covered and has not been trenched.

Harrys Creek

The best exposures, with the most promising looking ore, are located on Harrys Creek. Here an irregular zone of quartzite and associated marble gossan trends northwest and is exposed in the banks of the creek and in trenches north and south of the creek. Typically, the quartzite is a course-grained, porous rock often with small cavities lined with quartz crystals. In Harrys Creek north of Sample F (figure 2) coarse-grained planar bedded quartzite crops out for fifteen feet. Immediately east of the quartzite is marble almost identical in appearance with the quartzite and with the same bedding attitude. The quartzite here and elsewhere is probably a replacement of marble. At the contact between the two lies an eighteen-inch band of gossan with a central vein of galena two to three inches wide (AS-2, table 1).

This zone of quartzite and associated ore extends up the hill to the southeast, where it is exposed in several trenches. Massive and disseminated galena is present in quartzite at Z (figure 2) and a small amount of galena float has been stock-piled in the vicinity. The large dump at the north end of this trench contains brown soil and angular fragments of cellular quartzite with a leached appearance. An assay sample (AS-1, table 1) taken from this dump contains 4.0% lead and is an indication of the grade of a wide zone of leached quartzite. This trench is 15 to 20 feet deep but does not reach solid unweathered quartzite bedrock.

The stripped area at F exposes a limy gossan. Ore minerals were only seen at the south end, near T. Here disseminated pyrite and galena are associated with silicified marble. In thin section, the rock contains a scattering of fine (0.01 mm) quartz grains, amounting to 5% of the rock, along boundaries of (0.1 mm) calcite grains, which make up the bulk of the rock. About 2% pyrite is present. This partial replacement of marble by quartz probably represents the incompleted development of quartzite.

The gossan at N and O, in the stripped area north of Harrys Creek, is similar but no sulfides were seen. The anomalous soil sample at Q indicates that ore may lie east of this gossan.

At sample 5, much gossan float is present in the south bank of Harrys Creek. This rock contains disseminated galena and gun-metal-blue felted masses of crystalline boulangerite ($Pb_5Sb_4S_{11}$).

Quartzite breccia float in Harrys Creek at sample 6 contains quartzite clasts cemented by quartzite. This breccia is evidence of fault control of the quartzite replacement in the area.

Hannum Creek

The only ore exposed in this area is in a trench at AT (figure 2). Here a gossan zone thirty feet wide is exposed, with marble on either side. The gossan contains limonite and scattered schist fragments. At its southwestern contact, the marble is silicified for a width of six feet (assay AS-3, table 1). In thin section the rock contains scattered grains of pyrite, brown sphalerite, and minor amounts of an unidentified black acicular mineral in a granular quartz matrix.

Large quartzite boulders are present in several places along Hannum Creek and in trench AO. Quartzite bedrock from the north end of trench AO is a partially silicified marble composed mainly of quartz grains and chert with scattered residual calcite grains. This silicified zone occurs near the marble-schist contact and is associtated with strong zinc anomalies.

Old Glory Creek gossan

This gossan is exposed over an area of 110 feet x 500 feet on lower Old Glory Creek (figures 1 and 3). The country rock in the area is marble interbedded with schist. The gossan marks the replacement for 500 feet along a marble bed by dolomite, quartz, pyrite(?), sericite, chlorite, and spots of green fuchsite (chrome muscovite). This mineralized zone is bounded on the south by a poorly exposed fault. A second parallel(?) fault, 1/4 mile to the north, is bordered along one side by a dolomitized zone. These mineralized zones appear to be the result of wall rock replacement by solution that traveled along the faults.

An analysis of the ferruginous marble from the Old Glory Creek gossan shows 0.04 ounce per ton gold, 500 parts per million zinc, 100 ppm molybdenum, and 100 ppm nickel. (AS-4, table 1). A soil sample taken on the slope twenty feet below the gossan was not anomalous, nor was the stream sediment sample taken from Old Glory Creek downstream from the gossan. This gossan represents a leached pyrite or pyrrhotite-bearing sulfide deposit which could possibly reach ore grade in lead or zinc below the zone of leaching.

Pinnell River gossan

A small but clearly visible orange gossan (figure 1) is present above the Fairhaven Ditch, one mile east of the Old Glory gossan. The rock underlying the gossan is marble partly replaced by isolated grains and veinlets of quartz and veinlets of fuchsite. The carbonate is now largely dolomite. A grab sample of the gossan (AS-5, table 1) contains 500 ppm copper, lead, zinc, and 0.5 percent chromium, and 0.02 oz/ton gold. A soil sample (112) taken just below the outcrop was not anomalous. This deposit probably had an origin similar to that of the Old Glory gossan.

Nelson Creek placer cut

On the left limit (northern) bench just above the mouth of Nelson Creek, a tributary of Old Glory Creek, schist bedrock with quartz veins is well exposed in an abandoned placer cut. Minor folds are present in the schist and all quartz veins are boudined or folded. A sample of vein quartz and small amounts of the enclosing schist (AS-6, table 1) assays $0.70 gold per ton. Boundined (pre-or synkinematic) veins such as these often carry small amounts of gold which may provide a source of placer gold under favorable conditions of weathering and erosion. The schist is crosscut by a zone of clay alteration and is locally bleached.

A piece of pyrite-bearing gossan float was found on Old Glory Creek just below the mouth of Nelson Creek.

GEOCHEMISTRY

Geochemical soil and stream sediment samples were taken in the vicinity of the Hannum Creek ore deposit (table 3) to determine the effect of the deposit on the **metal** contents of the soils and stream sediments. With this background information, stream sediment samples were taken along all the major drainages between Cunningham Creek on the north and Magnet Creek on the south, a distance of 13 miles (table 2). Samples were of mud or silt taken from stream beds, (below the water **where** possible). These were analyzed in the field using the cold extractable heavy metals method described by Hawkes (1963) modified for most of the stream sediment samples by using the ammonium citrate extractant full strength. Samples were later analyzed for total copper, lead, zinc, and molybdenum in the minus 80 mesh faction by Rocky Mountain Geochemical Laboratories of Salt Lake City, Utah. Tin was analyzed by the U.S. Geological Survey, Branch of Exploration Research.

Concentration frequency graphs of lead, zinc, and tin (figure 4) indicate the threshold values of stream sediment anomalies to be: Lead, 40 ppm; zinc, 240 ppm; tin, 8 ppm. No copper or molybdenum anomalies were found.

Hannum Creek lead-zinc deposit

The trenches on Hannum and Harrys Creeks have been excavated in the frozen ground at considerable effort over a long period of time. Reconnaissance soil sampling was done in the trenched areas to determine whether the mineralized areas could be outlined by geochemical methods. The sample locations are plotted on figure 2. The pattern of strong lead and zinc anomalies in the vicinity of the quartzite and gossan areas indicates that soil sampling is effective in detecting soil-covered ore deposits in this area.

Most samples were taken at shallow depths (6 to 12 inches) to duplicate the conditions of sampling in tundra-covered frozen ground. In the side of a trench at sample site V (figure 2) samples were taken at depths of one foot and seven feet (near bedrock) to determine the gradient of metals in the soil. The shallow sample contains 60% less zinc than the deep one and both have greater than 1000 ppm lead. It appears that little advantage would be gained by deep soil sampling in this area.

The lead and zinc contents of stream sediment samples shown on figure 2 increase as the deposit is approached from downstream and drop off sharply upstream from it. It is unlikely that other significant lead deposits are present upstream on either Hannum or Harrys Creek. The possibility of zinc mineralization in the headwaters of Hannum Creek is indicated by the moderate anomaly at sample 39 (figure 1).

The strong zinc-lead anomaly at the spring (AV, figure 2) that drains from the marble-schist contact on Hannum Creek indicates continuation of the mineral zone east of the creek. This spring is reported to flow year around.

Stream sediment geochemistry of the Inmachuk region

The Hannum Creek deposit is clearly reflected by the lead content of stream sediments below the deposit (figure 1). Progressively decreasing anomalous lead values continue down Hannum Creek and the Inmachuk River for 7 miles, as far as samples were taken. These values are in sharp contrast to the low lead contents of sediments in the tributaries from the southwest.

Evidently no deposits as large as the Hannum Creek deposit are cut by streams draining the area between Hannum Creek and the Pinnell River. If the Hannum Creek deposit were undiscovered, geochemical sampling would easily detect it. It is noteworthy that low cold extractable heavy metal analyses of most of these samples indicate that the lead in the anomalous stream sediment samples represents detrital lead minerals and not lead adsorbed on the clays. A mineral deposit located between creeks and not cut by a good drainage would produce a smaller anomaly lacking detrital galena and would be more difficult to detect.

Moderate tin anomalies are associated with the Hannum Creek deposit and are present on American and Perry Creeks. All three samples from near the Hannum Creek deposit which have been analyzed for tin are anomalous (2, 22, 31). Two were taken downstream from the deposit and are also anomalous in lead and zinc, but the third was taken upstream from the deposit and is only anomalous in tin. The lack of a direct relationship of tin to lead and zinc is indicated also by the area of moderate tin anomalies on American and Perry Creeks, which contains only background amounts of lead and zinc.

A moderate lead anomaly is indicated by five samples taken near the heads of Old Glory and American Creeks. The presence of a lead anomaly adjacent to the tin anomaly could be an example of mineral zoning.

The weak lead anomaly at 71 (figure 1) is in stream sediments immediately below Inmachuk Springs.

The prominent gossan on Old Glory Creek and the minor gossan above the Fairhaven Ditch, one mile to the east, appear to be fault-controlled replacements of marble with associated silicification and dolomitization - features which are typical of ore deposits. Samples of the ferruginous fines from these gossans were slightly anomalous in gold, silver, and chromium (AS-4 and AS-5, table 1). Soil samples taken at the downhill side of both of these gossans were not anomalous. Moreover there are no stream sediment anomalies associated with either of them. However, the moderate zinc anomaly at 113 (figure 1) is on an eastern tributary to the Pinnell River which cuts the possible eastern extension of the fault at the Old Glory and Fairhaven Ditch gossans. Further prospecting, particularly up the northern branch of this creek, seems warranted.

The weak tin anomaly at 59 and the weak zinc anomaly at 133 were both taken in grassy areas with no outcrops.

Discussion of geochemical results

The geochemical soil and stream sediment sample at and below the Hannum Creek deposit clearly shows the usefulness of this method in finding and defining the boundaries of this type of deposit. If it were not cut by active streams, the stream sediment anomaly would be much less marked.

The anomalous samples elsewhere in the region fall into fairly well-defined groups which suggests that they actually reflect areas containing greater than average concentrations of metals. It is doubtful that these areas contain deposits as rich as the Hannum Creek deposit, and any interest in them will probably wait on developments at Hannum Creek.

The ability to outline areas of anomalous metal content and detect possible zonation of metals is a valuabe tool in relating the areal geology to ore deposits, particularly in areas where extensive cover masks much of the surface.

CONCLUSIONS

Bedrock in the map area is mainly schist, limy schist, and minor marble underlain by light gray marble. The marble has been exposed by doming of a large area centered on the headwaters of Old Glory Creek. Two small cross-cutting granite bodies may be related to the uplift of the dome by a larger granitic body at depth. Pervasive minor folding and crenulation of the marble and schist are probably related to complex large scale folds which formed at considerable depth. These folds are at least in part overturned. This folding is much older than the doming and is unrelated to it.

The Hannum Creek lead-zinc deposit is the most promising ore deposit known in the map area. The ore is galena-pyrite-sphalerite which occurs in a quartzite (silicified marble) zone. Introduction of ore minerals was probably related to the silicification of the marble along a northwest trending fault zone. In addition, discontinuous low-grade quartz-pyrite-galena deposits are present along the margins of the quartzite zone.

The Old Glory gossan, 7½ miles southeast of the Hannum Creek deposit, is also a fault-controlled replacement of marble but no ore minerals are exposed. The ferruginous marble is moderately to strongly anomalous in zinc, molybdenum, chromium, gold, and silver. The gossan is evidently underlain by a pyrite or pyrrhotite-bearing sulfide deposit whose size and grade are unknown.

A similar, but smaller gossan is present a mile east of this deposit near the Pinnell River. These deposits, and also an area with anomalous lead content on Old Glory Dome, are probably all closely associated with faults.

Stream sediment sampling in the map area outlined three areas with anomalous metal contents and one drainage anomaly. The strongest anomaly is associated with the Hannum Creek lead-zinc deposit. Near Harrys Creek, samples of soils overlying this deposit are highly anomalous and give a clear indication of the underlying lead-zinc ore. Stream sediment samples show a progressively decreasing lead anomaly for 7 miles downstream. Zinc drops off to background much more rapidly.

The lead anomaly at the head of Old Glory Creek is not associated with known mineral deposits. It is much weaker than the Hannum Creek anomaly and may reflect minor showings associated with a prominent north-northwest trending fault which extends into the vicinity of the American Creek granite body.

The long axis of the weak tin anomaly on American and Perry Creeks extends across the creeks, roughly parallel to the regional structure rather than down the creeks. This pattern indicates that the anomaly represents greater than average concentrations of tin in bedrock in the area of the anomaly, and not a drainage anomaly from the vicinity of the American Creek granite.

In the Old Glory Dome area and on Hannum Creek, tin and lead (with or without zinc) are not coextensive in occurrence and are probably not closely related in origin.

SUGGESTIONS FOR PROSPECTORS

Stream sediment geochemistry is exceptionally effective in locating lead deposits which are cut by creeks. It is probably less effective where detrital lead minerals are not present in the drainage.

All areas on the Seward Peninsula with even small placer showings should be prospected by stream sediment sampling at intervals of one to two miles. Samples should be analyzed for total copper, lead, zinc, and tin as well as cold extractable metal for most effective results.

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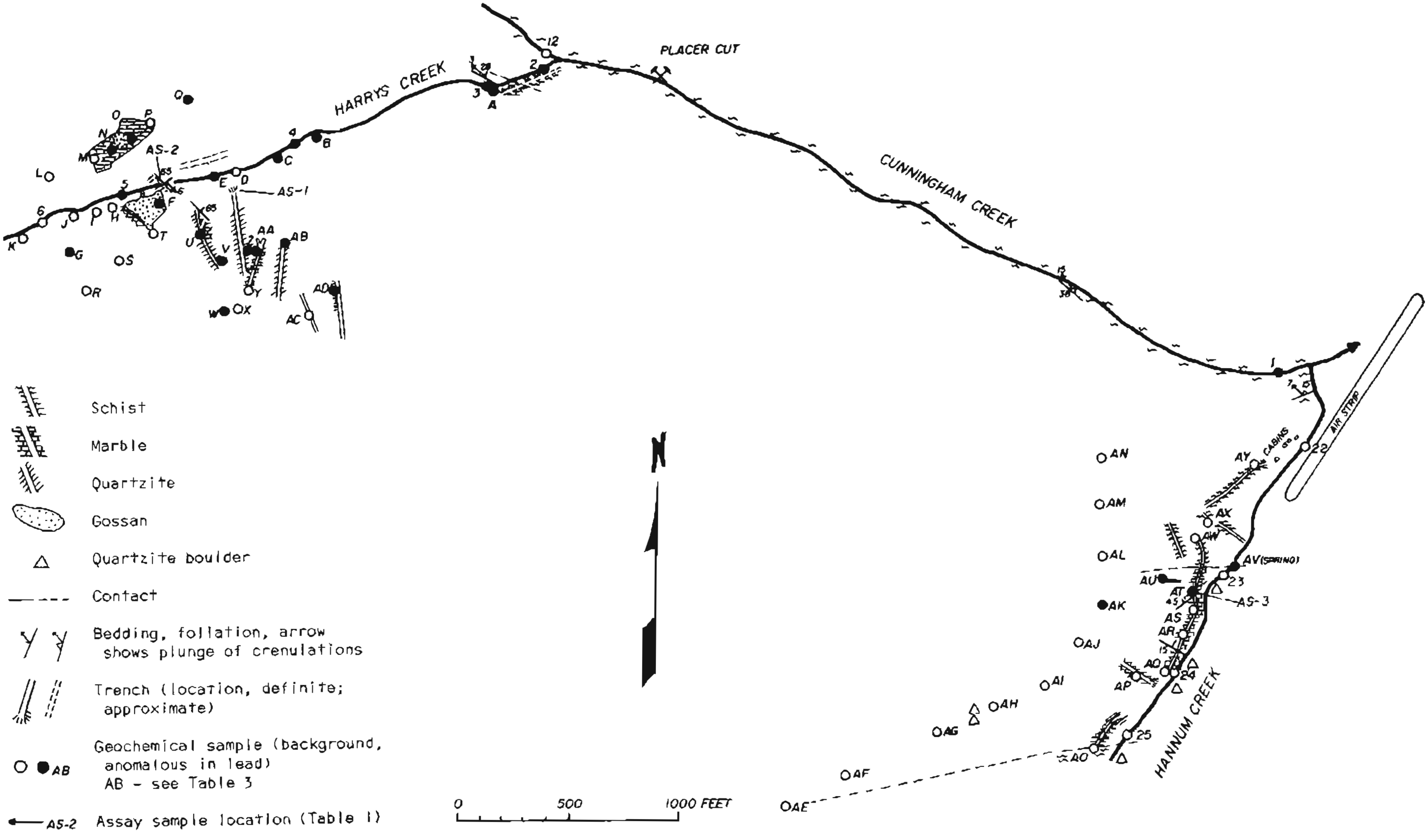

Figure 2. Hannum Creek lead-zinc deposit

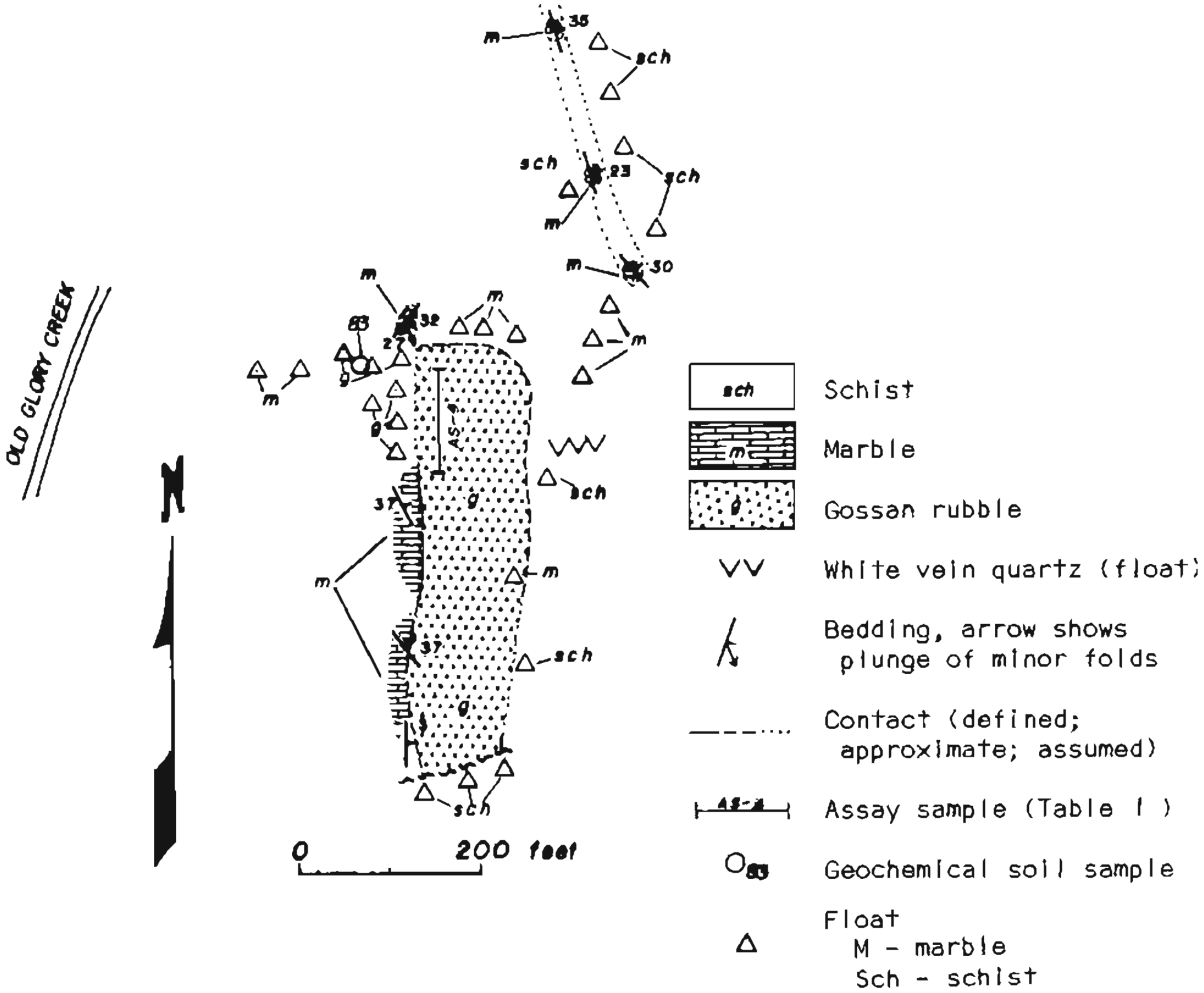

Figure 3. Gossan on Old Glory Creek, 0.8 mile above its confluence with the Pinnell River

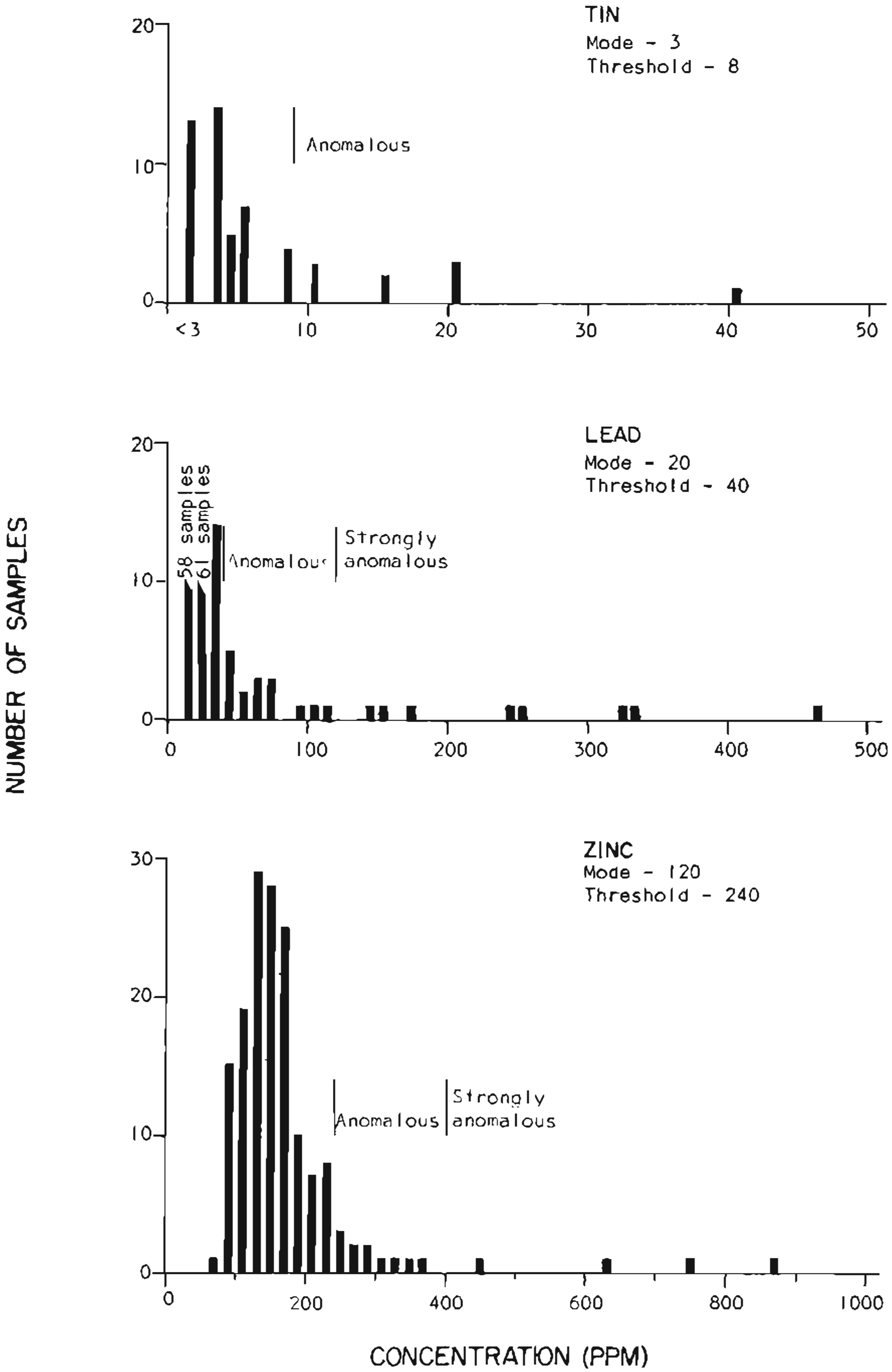

Figure 4. Concentration frequency graphs for metal content of stream sediment samples

Table 1. Assay samples from Inmachuk region*

Map No.	Field No.	Copper	Lead	Zinc	Gold	Silver
AS-1	5C458	0.05%	4.0%	0.62%	0.04 oz/ton	1.00 oz/ton
AS-2	5C468	0.05%	10.0%	2.2%	nil	1.76 oz/ton
AS-3	5C476B	0.05%	0.12%	0.38%	nil	nil
AS-4	5C520	N.D. (Ni -.01%; Mo - .01%; Mn - 1%)	N.D.	0.05%	0.04 oz/ton	0.24 oz/ton
AS-5	5C524	0.05% (Cr - 0.5%)	.05%	0.05%	0.02 oz/ton	0.23 oz/ton
AS-6	5C529	0.05%	.05%	0.05%	0.02 oz/ton	0.10 oz/ton

AS-1. Dump at Harrys Creek north end of long trench. Light brown soil with angular fragments of quartzite, cellular leached quartzite, and massive limonite gossan. Could be representative of the whole leached surface zone.

AS-2 Harrys Creek. 18 inch gossan in creek bank with 2-3 inch galena vein in central part. Located at the contact of planar bedded, sandy marble (1 mm grains) with quartzite (silicified marble?) of similar appearance.

AS-3 Hannum Creek. Wall of trench, medium brown siliceous marble containing sulfides. A grab sample 6 feet wide.

AS-4. Old Glory Creek gossan. A grab sample of ferruginous marble rubble taken over a distance of 115 feet.

Spectroscopic analysis:

Over 10%	1-10%	Trace (less than 1%)
calcium	iron	aluminum
magnesium	sodium	chromium
silicon	titanium	lithium
	barium	copper

Geochemical sample of fines: Cu - 20 ppm; Zn - 100 ppm; Pb - 15 ppm; Mo - 4 ppm.

AS-5. Pinnell River gossan. A quartz vein stockwork in black marble with associated brown gossan zone visible above Fairhaven Ditch. Grab sample of gossan. Soil below the gossan (112, figure 1) Cu ~ 20 ppm; Zn - 85 ppm; Pb - 15 ppm.

AS-6. Left limit (northern) bench at mouth of Nelson Creek boudined quartz veins cutting schist in old placer cut.

*Souce of data: Precious metals - fire assay, Division of Mines and Minerals, Metallurgy Branch, Don Stein, analyst

Base metals - x-ray fluorescence, Division of Mines and Minerals, Metallurgy Branch, Nam Ok Cho, analyst

Geochemical analyses (given in ppm) - Rocky Mountain Geochemical Laboratories

Table 2. Laboratory and field analyses of stream sediment samples from the Inmachuk map area (1)

Map No.	Field No.	Field test ml.dz.(2)	Concentration (ppm)					Stream sediment	Float, etc.
			Copper	Zinc	Lead	Molybdenum	Tin		
1	5L301	15	35	300	330	2		X	Sch with 10% qtz
2	5L302	>20	25	750	500	3	20	X	Sch 50%; M 50%
3	5C451A	8*	25	630	320	3		X	Sch 70%; M 25%; gossan 5%
4	5C452	15*	30	875	460	3		X	Sch; M; gossan 3%
5	5C462	5(8)*+	20	450	170	2		X	Sch; M; gossan in S. bank
6	5C461	8(5)*+	25	200	25	2		X	Sch; M; qtzite breccia
7	5C460	9(8)*+	35	245	30	3		X	>6" M 100%; <2" sch 85%; M 5%; Vein qtz 10%
8	5C459	3(6)*+	25	200	30	3		X	>6" M 100%; <2" sch 85%; M 5%; Vein qtz 10%
9	5L323	2*	30	220	20	3		X	Sch 10%; M 90%
10	5L322	1*	40	235	30	2	4	X	Sch 20%; M 80%
11	5L321	2*	20	145	15	3		X	Sch 95%; M 5%; qtz 5%
12	5L303	4	25	125	100	3		X	Sch 88%; M 2%; qtz 10%
13	5L347	1*	15	105	65	3		X	Sch 80%; Qtz 20%
14	5L348	1*	35	160	15	3		X	Sch 80%; qtz 20%
15	5L350	1*	35	185	20	4		X	Sch 98%; qtz 2%
16	5L351	1*	20	110	15	3		X	Sch 95%; qtz 5%
17	5L352	1*	10	95	15	3		X	Sch
18	5L353	1*	20	150	15	2		X	Sch 97%; qtz 3%
19	5L359	4	30	250	145	4		X	Sch 90%; qtz 10%
20	5L356	6	35	270	155	3		X	Sch 90%; qtz 10%
21	5L355	6	25	165	40	4		X	Sch 80%; qtz 20%; 4' pyrite vein
22	5L300	>20	25	360	110	3	10	X	Sch 90%; qtz 10%
23	5L304	8*	30	350	40	3		X	Sch 20%; M 70%; qtz 5%
24	5L305	3*	30	190	15	3		X	Sch 40%; qtzite 60%
25	5L306	7*	30	225	20	3		X	Sch 70%; qtzite 30%
26	5L307	5*	30	225	15	3		X	Sch; 4' qtzite bed in creek
27	5L308	2*	20	145	10	3		X	Sch 40%; M 20%; qtzite 40%
28	5L309	4*	25	220	10	3		X	Sch 50%; M 20%; qtzite 20%
29	5L310	4*	20	150	15	3		X	Sch 90%; M 8%; qtz 2%
30	5L311	7*	30	210	15	4		X	Sch 85%; M 10%; qtz 5%
31	5L312	4*	35	185	20	3	40	X	Sch
32	5L313	1*	30	250	20	4			Sch 90%; qtzite 2%; bl. slate 2%; basalt 3%
33	5L314	5*	35	270	20	3			Sch
34	5L315	1*	25	160	15	3			Sch
35	5L316	2*	25	170	10	3			Sch; Fe stain

Table 2. (Continued)

Map No.	Field No.	Field test ml.dz.(2)	Concentration (ppm) Copper	Zinc	Lead	Molybdenum	Tin	Stream sediment	Float, etc.
36	5L317	3*	35	205	20	3			Sch 50%; M 50%
37	5L318	1*	30	200	15	4			Sch 10%; M 90%
38	5L319	3*	35	145	15	2			Sch 90%; qtz 3%; basalt 6%; m 1%
39	5L320	2*	45	330	20	4			Sch
40	5L358	3							Sch 95%; qtz 5%
41	5L360	5	20	130	15	3			Sch
42	5L361	6	20	135	15	2			Sch
43	5L362	3	35	150	15	3			Sch 80%; qtz 20%; Fe stain
44	5L363	6	20	130	15	2			Sch
45	5C590	missing							
46	5C502	-	20	130	15	3			Sch 75%; bl. sch 20%; qtz 5%
47	5C494	-	20	140	30	4			Sch
48	5C501	-	25	200	70	3	3		Sand only
49	5C500	-	25	170	15	3	3		Sch
50	5C499	-	60	205	15	5			Sch
51	5C498	6*	40	170	15	3			Sch and basalt
52	5C497	-	15	150	10	3			Sch and basalt
53	5C496	-	20	235	15	4	4		Sch and basalt
54	5C495	-	25	140	25	4			Sch and basalt
55	5L364	-	15	120	15	3			Basalt
56	5L365	-	15	135	20	2	4		
57	5L366	-	15	120	10	2			
58	5L367	-	20	115	15	3			Basalt
59	5L368	-	35	140	15	3	8		
60	5C503	-	35	170	15	3	4		Sch
61	5L371	-	30	225	90	3			Sch 50%; qtz 10%; basalt 40%
62	5L372	-	20	160	55	3			
63	5L373	2	25	140	20	3			Sch 90%; qtz 10%
64	5L374	6	20	190	50	2			Sch 35%; volcanics 60%; qtz 25%
65	5L375	-	25	165	15	4	3		Sch 90%; qtz 10%
66	5L376	3	35	185	20	3			Sch 90%; qtz 10%
67	5C517	-	20	105	10	4	3	X	Sch 85%; M 15%
68	5C516	-	35	150	15	4		X	Sch 60%; M; Dolo; calc-sch; Fe stained creek bed
69	5C515	-	20	95	10	3		X	Sch; Fe stained creek bed
70	5C514	-	35	175	20	4	3	X	Sch 80%; M 20%

Table 2 (Continued)

Map No.	Field No.	Field Test ml.dz.(2)	Concentration (ppm)					Stream sediment	Float,etc.
			Copper	Zinc	Lead	Molybdenum	Tin		
71	5C513	-	25	225	40	2		X	Inmachuk Springs bedrock lt. gray f. gr. marble
72	5C510	-	35	185	20	3		X	Sch 70%; lt. gray M 30%
73	5C508	-	35	185	20	4	3	X	Sch (with 1% v. qtz) 70%; M 30%
74	5C505	-	20	150	20	3		X	Sch 95%; M 14%; v. qtz 1%
75	5C504	-	35	170	15	6		X	6" M; 6" sch
76	5L382	6	20	160	45	3		X	Sch 30%; qtz 10%; basalt 60%
77	5L383	8	30	185	35	4		X	High water; no float visible
78	5L384	4	20	130	30	3	3	X	High water; no float visible
79	5L381	8	35	165	25	3		X	High water; no float visible
80	5L379	6	25	130	10	4			Sch 10%; M 80%; basalt 10%; qtz 2%
81	5L378	-	25	120	10	3	3		Sch 10%; M 80%; qtz 5%; basalt 5%
82	5C520	-	20	100	15	3		Soil	Old Glory gossan - fines - depths 3"
83	5C519	-	35	125	15	4		Soil	Brown soil 20' below red gossan - depth 3"
84	5L377	5	25	140	20	3		X	Sch 25%; M 60%; greenstone 10%
85	5L385	2	35	125	15	3	3	X	Sch 78%; M 20%; v qtz (to 18" dia) 2%
86	5L386	8	35	140	15	2		X	Sch 80%; M 20%; qtz 1%
87	5L388	-	35	135	15	3	8	X	Sch 70%; M 30%; v. qtz boulders
88	5L389	11	35	165	15	4		X	Sch 80%; v qtz 20%
89	5L390	5	35	120	15	3			
90	5L391	12	35	150	20	3			
91	5C531	-	15	110	15	2	3	X	Sch 50%; M 50%
92	5C534	-	35	140	25	3		Dry	Sch 60%; M 40%; v. qtz 1%
93	5C535	-	25	170	60	3		Dry	Sch 5%; M 95%
94	5C537	-	30	170	60	3		X	Sch 30%; M 70%
95	5C538	-	20	160	70	2	3	X	M
96	5C540	-	35	175	45	2		X	M
97	5L387	-	20	120	15	2	5	X	Sch 80%; M 10%; basalt 10%
98	5L392	-	15	80	15	2		X	Sch 50%; M 50%
99	5L394	-	20	125	15	3	8	X	Grass
100	5L393	-	20	115	20	2	8	X	Sch 25%; M 70%; granite 5%
101	5L395	-	20	105	15	2		X	Sch 20%; M 80%
102	5L396	-	35	115	20	3	20	X	Sch 25%; M 75%
103	5L397	-	25	120	25	4		X	M
104	5L398	-	35	170	20	4		X	M
105	5L399	-	35	125	25	3	15	X	Sch 10%; M 90%

Table 2. (Continued)

Map No.	Field No.	Field test ml.dz.(2)	Concentration (ppm) Copper	Zinc	Lead	Molybdenum	Tin	Stream sediment	Float, etc.
106	5L400	-	30	135	10	3		X	M
107	5L401	-	35	145	30	2	10	X	Sch 10%; M 70%; basalt 20%
108	5C550	-	20	100	25	3	3	X	Sch 50%; M 50%
109	5C548	-	25	105	25	3	3	Dry	Sch 30%; M 50%; granite (up to 2' dia.) 10%
110	5C547	-	40	190	70	3	5	X	M
111	5C522	-	20	140	15	3	3	X	Sch 80%; M 10%; qtz 5%; basalt 5%
112	5C524	-	20	85	15	3		Soil	Soil at bottom side of orange weathered zone in black marble
113	5C559	-	35	280	15	4		X	Sch 98%; M 1%; v. qtz 1% (in sch)
114	5L414	-	20	135	25	3		X	Sch 90%; M 2%; v. qtz 3%; basalt 5%
115	5L413	-	30	170	25	3	3	X	Sch 75%; M 5%; v. qtz 10%; basalt 10%
116	5L412	-	20	130	20	3		X	Sch 90%; M 5%; basalt 5%
117	5L410	-	20	105	20	2		X	Sch 70%; M 20%; basalt 10%
118	5L409	-	25	120	20	3	3	X	Sch 80%; M 10%; basalt 10%
119	5L408	-	35	130	25	3	5	X	Sch 80%; M 20%
120	5L407	-	25	125	25	2		X	Sch 20%; M 80%
121	5L406	-	20	95	20	2	5	X	Sch 70%; M 30%
122	5L404	-	20	90	20	2	15	X	Sch 95%; qtz 5%
123	5L402	-	25	110	25	3	5	X	Fine sediment
124	5L405	-	20	90	30	2	5	X	Sch 10%; M 80%
125	5L403	-	20	105	30	2	10	X	Sch 10%; M 90%
126	5L411	-	20	145	25	3	3	X	Sch 75%; M 20%; basalt 5%
127	5L430	-	45	175	30	3		X	Sch 85%; M 10%; v. qtz 5%
128	5L431	-	20	95	15	4		X	Sch 88%; M 5%; v. qtz 2%; basalt 5%
129	5L433	-	20	145	20	3		X	Sch 85%; M 2%; qtz 3%; basalt 10%
130	5L434	-	25	160	20	4	3	X	Sch 30%; basalt 70%
131	5L436	-	20	170	20	3		X	Basalt
132	5L437	-	15	95	20	3		X	Grass
133	5L438	-	5	280	15	4		X	Grass
134	5L435	-	25	140	25	2	3	X	Sch 80%; M 5%; basalt 5%
135	5L445	4	20	140	20	3		X	Fine sediment
136	5L440	-	20	85	20	3		X	Moss
137	5L444	-	20	160	20	3		X	Sch 15%; M 5%; basalt 80%
138	5L443	-	20	105	20	3	4	X	Moss
139	5L441	-	15	115	250(3)	7		X	Moss
140	5L442	-	15	120	240(3)	9		X	Moss

Table 2. (Continued)

Map No.	Field No.	Field test ml.dz.(2)	Concentration (ppm) Copper	Zinc	Lead	Molybdenum	Tin	Stream sediment	Float, etc.
141	5L446	3	30	170	25	3		X	Sch
142	5C562	-	20	145	20	3	3	X	Sch 40%; v.qtz 10%; olivine basalt 50%
143	5L447	4	10	80	15	2	3	X	
144	5L448	3	20	150	25	3	5	X	Basalt
145	5C563	-	10	110	20	3		X	Basalt boulders
146	5L449	2	15	140	10	2		X	Basalt
147	5L450	2	15	130	15	2	3	X	Basalt
148	5L451	2	15	125	25	3	3	X	Sch 80%; M 1%; basalt 20%
149	5L452	-	10	90	15	2		X	Sch 10%; granite 1%; hornfels 90%
150	5L454	1	20	120	25	2		X	Moss
151	5L455	1	5	65	15	3		X	M 20%; hornfels 70%; basalt 10%
152	5L456	-	20	100	20	3		X	Slate 10%; M 10%; hornfels 90%
153	5L458	2	15	85	20	2	3	X	Hornfels; Fe stain in creek
154	5L460	2	15	80	20	3		X	M 50%; granite 10%; hornfels 40%
155	5L461	-	15	110	20	2	3	X	M 50%; granite 10%; hornfels 40%
156	5L470	-	40	190	35	2		X	Sch
157	5L468	-	30	130	25	3		X	Sch 80%; M 20%
158	5L467	-	30	145	30	2	3	X	Sch 30%; M 70%
159	5L466	-	45	145	30	2		X	Sch 70%; M 30%
160	5L465	-	30	115	30	2	3	X	M 95%; granite 5%
161	5L464	-	15	90	25	3		X	M 95%; granite 5%

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(1)	Sample locations shown on figure 1. Soil samples from Hannum Creek deposit shown on table 3.
(2)	Milliliters dithizone, cold extractable heavy metals field test
(3)	Interference in lead determination.
+	Sample run twice (field test)
*	Dilution of extractant with water 1:4; unmarked samples run with 1:1 dilution
-	Not run
>	Greater than
40	Underline indicates anomalous value

Sch - Schist
Qtz - Quartz
M - Marble
Qtzite-Quartzite

Table 3. Laboratory and field analyses of geochemical samples from the Hannum Creek deposit(1)

Map No.	Field No.	Field Test ml dz(2)	Concentration (ppm) Copper	Zinc	Lead	Molybdenum	Stream Sediment Sample	Soil Depth	Float, remarks
A	5C451B	20*	20	+1000	900	5		X	Light brown soil in bank with Sch. frags.
B	5L327	3*	20	660	400	3		X	
C	5L326	20*	35	850	950	3		X	
D	5L324	-	20	680	475	2	Dry		3" - 90% M, 10% Sch. 3" - 70% Sch., 20% m, 10% gossan
E	5L325	>20*	80	700	+1000	3		X	
F	5L338	>20*	25	+1000	950	3		X	
G	5L339	>20*	65	+1000	+ 1000	3		X	
H	5L328	11*	25	950	70	3		X	
I	5L329	17*	25	+1000	150	4		X	
J	5L330	10*	35	530	45	3		X	
K	5L331	3*	35	560	40	4		X	
L	5L337	4*	35	225	40	3		X	
M	5L332	2*	20	320	170	3		X	
N	5L333	10*	40	+1000	385	4		X	
O	5L334	9*	30	+1000	800	4		X	
P	5L335	2*	20	140	175	4		X	
Q	5L336	20*	35	+1000	490	3		X	
R	5C472	6*	10	165	25	4		6"	Sch. frags.
S	5C471	13*	20	560	40	2		6"	
T	5L341	10*	20	365	35	4		X	
U	5L342	>20*	35	+1000	490	3		X	
V	5C464	14*	20	310	+1000	2		X	1 ft. deep, taken in side of trench
	5C465	23*	20	505	+1000	2		X	7 ft. deep, taken in side of trench
W	5C454	20,14*	20	320	725	3	Dry		Sch., qtzite
X	5C453	10,15*	15	165	110	3		X	Brown siliceous frags. in soil
Y	5C456	6*	15	250	225	3		6"	Sch., Qtzite
Z	5C457	12,>25*	20	310	750	3		X	Qtzite and schist frags.
AA	5L343	9*	20	380	+1000	3		X	
AB	5L345	9*	120	330	450	3		X	
AC	5C455	12*	15	160	35	2			Sch., Qtzite
AD	5L344	15*	50	505	+1000	3		X	
AE	5C492	12*	20	950	45	3		X	Brown mud
AF	5C491	12*	25	630	25	2		X	Fines only

Table 3. (Continued)

Map No.	Field No.	Field Test (2) ml dz	Concentration (ppm)				Stream Sediment Sample	Soil, Depth	Float, remarks
			Copper	Zinc	Lead	Molybdenum			
AG	5C490	16*	30	485	40	3			Fines only
AH	5C489	16*	30	550	40	3			Basalt cobble
AI	5C488	16*	35	485	35	3			Fines only
AJ	5C487	18*	20	425	70	2			Fines
AK	5C486	>20*	35	1050	+1000	3		X	2x2 Ft. prospect pit Sch, Qtzite, basalt
AL	5C483	-	30	+1000	75	3			
AM	5C484	12*	25	320	55	3		X	
AN	5C485	7*	25	185	40	3			
AO	5C481	11*	50	+1000	60	5		X	Qtzite float, Sch. bedrock
AP	5C592	-	25	385	40	1			
AQ	5C479	11*	20	550	55	3			
AR	5C478	6*	20	410	105	3			
AS	5C477	18*	20	550	185	3			
AT	5C476	14*	20	750	395	3			Sample from 1 ft. dark gray soil over gossan
AU	5C591	-	25	750	+1000	1			
AV	5C593	-	20	+1000	600	1			Perennial spring, limonite stain on rock, about 50 gal/minute
AW	5C474	>20*	20	660	160	2			Sch. vein qtz., basalt
AX	5C473	-	20	395	65	3			Sch. with qtz. veins
AY	5C494	-	20	140	30	4			
1	5L301	15	35	300	330	2	X		See Table 2
2	5L302	>20*	25	750	500	3			" " "
3	5C451A	8*	25	630	320	3	Dry		" " "
4	5C452	15*	30	875	460	3	Dry		" " "
5	5C462	5,8*	20	450	170	2	X		" " "
6	5C461	8,5	25	200	25	2	X		" " "
12	5L303	4	25	125	100	3	X		" " "
22	5L300	>20	25	360	110	3	X		" " "
23	5L304	8*	30	350	40	3	X		" " "
24	5L305	3*	30	190	15	3	X		" " "
25	5L306	7*	30	225	20	3	X		" " "

(1)	Location of samples shown on figure 2
(2)	Millileters dithizone for cold extractable heavy metals field test
*	1:4 dilution of extractant with water. Unmarked samples run with 1:1 dilution
>	Greater than
-	Not run
Sch.	Schist
M	Marble
Qtzite.	Quartzite