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PROGRESS REPORT: GEOLOGY AND MINERAL DEPOSITS OF THE KANTISHNA HILLS, ALASKA

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ABSTRACT

The Kantishna Hills is a geologic terrain of two distinct regionally metamorphosed rock types. The older is the heterogeneous Birch Creek Schist of Precambrian or early Paleozoic age and underlies most of the southern and central protions of the hills. The younger rock, the Totatlanika Schist of Mississippian(?) age, makes up most of the northern Kantishna Hills. The contact between the two rock types is tectonic, possibly a high-angle fault that was modified by later dynamic metamorphism. The Totatlanika Schist contains a thick section of slightly metamorphosed volcanic rocks ranging in composition from basalt to rhyolite. These volcanics are overlain by several thousand feet of carbonates and volcanogenic strata.

The Birch Creek Schist is a complexly deformed metamorphic rock sequence that has undergone at least three periods of dynamic deformation. The last period of deformation generated the broad, northeast-trending antiforms and synforms that are presently the dominant structural features of the Kantishna Hills. High-angle faults cut the bedrock throughout the Kantishna Hills, and thrusting is present in both metamorphic sequences.

The Kantishna Hills are remarkably devoid of fresh intrusive rock. Only small stocks and dikes, mostly cropping out in the southern part, have escaped regional dynamothermal metamorphism. Most of these have been hydrothermally altered.

Kantishna is a well-known antimony-gold-lead-silver-zinc district, noted for course placer gold, high-grade silver ores, and at Stampede, Alaska's largest antimony producer. Known production from this district includes 265,000 ounces of silver, 55,000 ounces of gold, 5,000,000 pounds of antimony, and about 1,000,000 pounds of combined lead and zinc from its lodes and placers.

Mineralization in the southern mining district occurs as quartz-carbonate-sulfide veins structurally controlled along a northeast-trending assymmetrical antiform that is locally slightly overturned to the northwest. A profoundly gossanized metavolcanic zone in the Totatlanika Schist sheds strong zinc and moderate lead-silver anomalies and should be evaluated for potential massive sulfide ore deposits. A small contact metamorphic deposit south of Crooked Creek appears low grade and uneconomic.

The recent upswing in gold prices has stimulated placer mining in the Kantishna; mine operations involving 30 men produced at least 1,000 ounces of gold during 1975. Mineral potential in the district is largely unexplored.

The Kantishna has produced metallic sulfides and gold for many years on a small scale and, barring political land use and boundary changes, will produce more metallics in the future.

INTRODUCTION

The DGGS examined the Kantishna Hills in 1975 to determine the geologic framework and economic mineral potential of D-2 land adjacent to Mount

McKinley National Park. About 140 man-days were spent in June, July, and August of 1975 by three geologists mapping 270 square miles of the bedrock and examining 81 mineral deposits. Most of the work was done on foot. A helicopter-supported stream-sediment sampling program was completed and is included in this report. D.L. Turner of the University of Alaska Geophysical Institute visited the field party on August 1 and collected 14 samples for radiometric age dating.

The authors would like to thank E.R. Pilgrim, owner and operator of the Stampede Mine, for his valuable information about past mining history; Paul Metz, for his information concerning placer gold production in the Kantishna; the numerous placer miners, all of whom gave time and information concerning their operations; Cheri Carver, who assisted the program in August, and Russell Chadwick, Mark Anthony, and Jim Fuksa for their assistance in discussing the mineral deposits. J.T. Kline calculated the cumulative frequency plots for the geochemical part of this report. Special thanks should be given to the Moneta Porcupine Mining Company and to E.R. Pilgrim for the use of previously unpublished production figures. Regards are extended to the National Park Service for their assistance in allowing ease of access and supply of camps in the Kantishna via the Mount McKinley Park road.

This report is preliminary and will be superseded by additional work in the future.

GENERAL AREA

The Kantishna Hills is a northeast-trending range of hills, physiographically separated from the higher terrain of the central Alaska Range (fig. 1). Its 800 square miles of hills range from 1,250 feet on the north flank of the Chitsia massiff to 4,982 feet on Kankone Peak in the southern hills. The lack of recent glaciation has produced a more mature topography than the Alaska Range proper, a difference that shows up distinctly on ERTS satellite imagery. The main streams run northeast-southwest, creating similar trending ridgelines. As streams leave the northeast-southwest-trending structural grain of the Kantishna Hills, they dramatically swing to the north (pls. 1 and 2). Because of the absence of glacial sources, all streams originating in the Kantishna are clear.

A road leaving Mount McKinley Park near Wonder Lake enters the southern limit of the Kantishna Hills. Seven miles of state-maintained road continues to the 800-foot-long Friday Creek airstrip, near Moose Creek. A winter haul road was used during the 1930s and 1940s to haul antimony ores and concentrates from Stampede in the east-central Kantishna Hills to the railroad, 56 miles to the east. Parts of this trail were improved in 1960 by the state to provide a transportation corridor into the district (Stampede Trail), but work was suspended on it and it is unused by miners and overgrown. An airstrip 4,000 feet long was constructed by E.R. Pilgrim in the 1940s and used to haul out antimony ores and concentrates to Nenana from 1947 to 1970. This airport is still used and in good shape. The "180" bush strips at Crooked Creek and the Clearwater Fork need repair. There are no lakes in the Kantishna large enough to land conventional float planes. By and large, the Kantishna Hills are relatively inaccessible.

The field party saw a variety of animals during the summer. Four caribou resided in the flat area north of Crooked Creek area during June and July; several were also observed on the ridgelines between VABM Antim and Spruce Peak. Abundant moose sign is present in the Chitsia Creek-Crooked Creek drainages. Two wolverines were sighted on high ridgelines of the Caribou Creek drainage and several fox were seen in various localities throughout the "Hills."

Three "active" beaver lodges were present on Chitsia Creek in 1975. A number of grizzly bear sightings, many observed in the activing mining district, were reported to Pat Valkenburg, a graduate student of Alaska, who recently completed his studies on the brown bear populations adjacent to the north boundary of McKinley Park. Black bears are common in the Stampede-Crooked Creek area. Dall sheep are not known to inhabit the Kantishna Hills and were not observed.

BEDROCK GEOLOGY

The bedrock geology of the Kantishna Hills has been briefly described by Brooks (1911, 1915), Capps (1940), Wells (1933), White (1942), and Morrison (1964). A reconnaissance map by Wells (1933) supplies a summary of rocks in the mining district and White (1942) supplies an excellent geological study of the Stampede area, which has been slightly modified for this study. Morrison's thesis work (1964) is the best petrographic and structural study done to date on the Birch Creek terrain of the Kantishna Hills. About three-fourths of the Kantishna Hills was geologically poorly known prior to 1975, as almost all the previous work concentrated on the southern mining district. Capps (1940) showed his Totatlanika Schist-Birch Creek contact trending across southern Chitsia Mountain and up Chitsia Creek. This study found the contact to trend down Flume Creek in a northeasterly-southwesterly direction. Our mapping also includes seven mappable units of Totatlanika schist and eight lithologically distinct units of "Birch Creek" terrain. Three compositionally distinct dikes were mapped in 1975. No Tertiary exposures were examined, and they have been added onto the geologic map (pl. 1) from previous sources of information. The reader is referred to the geologic map during the following discussion.

Birch Creek Schist

Amphibolitic greenstone (pCg), marble and graphitic schists (pCm), chloritic and felsic phyllites (pCph), calc magnesium schist (pCcs), graphitic schist (pCgs), felsic schists and gneiss (pCfs), metaconglomerates and quartzites (C-pCg), and undifferentiated quartz mica schists (pCh) were lithologic units mapped in 1975. They are summarized on plate 1 and will only be briefly described here.

Mineralogical criteria in all parts of the terrain examined have suggested that the Birch Creek Schists have undergone at least two distinct periods of thermal metamorphism. A higher grade amphibolite(?) facies of metamorphism has subsequently been retrograded by the greenschist facies (Winkler, 1967). The amphibolitic greenstones commonly show relict oligoclase, biotite and muscovite replaced by pennine chlorite, calcic plagioclase replaced by albite, garnet replaced by magnetite and chlorite, and hornblende replaced by biotite.

Wells (1933) described the Birch Creek Schist in the Kantishna area as a "formation which has two distinct facies--a quartz muscovite schist and a calcareous schist ranging from limestone to chlorite schist." This is in reference to the distinct textural differences from his finer grained "chloritic schists and impure marbles" and the coarser grained strongly schistose-quartz muscovite schist." We mapped his "limestone and chloritic schist" as pCm and pCph. His "quartz muscovite schist" is mapped as pCg, pCh, and pCgs. The apparent metamorphic "facies" difference can be attributed to:

1) Differing premetamorphic compositions of pCm and pCph versus pCh, pCg, and pCgs.

2) The pCm and pCph are commonly found at the crest of the Kantishna antiform and have developed axial-plane cleavage during folding, thus appearing as a finer grained metamorphic texture.

Some of the felsic phyllites (pCph), particularly the porphyroblastic varieties, may have a volcanic origin; however, evidence accumulated thus far is inconclusive.

The Birch Creek Schist in other parts of Alaska is believed to have originally been a thick wedge of Precambrian quartzose sandstones, with occasional limestone and metavolcanic horizons (Capps, 1919; Moffit, 1932). This origin fits the rock compositions in the Kantishna Birch Creek terrain. The amphibolitic greenstones (pCg) are of almost certain igneous origin based on textural, compositional, and structural criteria; however, intercalations of chloritic schists and phyllites in pCh and other pC units may have a metasedimentary parentage.

A heterogeneous unit of sheared pebble conglomerate, chloritized greenstone, massive metacherts(?) and "green-grit" porphyroblastic quartzose schists (C-pCg) has been inferred as being younger than other Birch Creek units. This unit is exposed at the junction of Marten and Crooked Creeks, as small outcrops near Stampede, and on the bluffs overlooking the intersection of Moonlight Creek and the Clearwater Fork. F.R. Weber (personal communication) has mapped units of very similar lithology in the Yukon-Tanana uplands as Cambrian-Precambrian age, because of its apparent stratigraphic position above other Birch Creek units there. Brooks (1908) originally correlated these rocks with the Tatina and Tonzona group of Pre-Ordovician age.

In the Kantishna, C-pCg lies in apparent stratigraphic sequence above most of the other pC units (see cross section C-C', pl. 1). Its unique lithologic character, apparent lower grade of metamorphism (textural) and stratigraphic position has assigned it to an age younger than other pC units.

Totatlanika Schist

This study broke the Totatlanika Schist into seven units: calc-schist (Pcsh), metaquartz-latite (Pgl), graphitic slates (Psl), metavolcanics and chert (Pmv), rhyolite porphyry (Prhy), volcanogenic sediments (Pvs), and limestone (Pls). Unlike the more complexly deformed Birch Creek terrain to the south, these units are remarkably continuous along strike. Texturally, the rocks are lower grade than the Birch Creek Schists.

An apparent stratigraphic section near Chitsia Mountain has been summarized in figure 2. The Totatlanika Schist contains a thick section of slightly metamorphosed volcanic rocks of felsic composition that is overlain by several thousand feet of carbonates and volcanogenic strata. The lower units of graphitic slates and calc schist are folded into small isoclinal folds; they are in tectonic contact with the older Birch Creek terrain. This contact is a low-angle fault in some areas, a high-angle fault in others (pl. 1).

Metaquartz-latite (Pql) has a subfoliated texture and is extensively serecitized. It has been tentatively interpreted as being part of the Pcsh section, that is, premetamorphic. However, Pql appears spatially related to low-angle fault zones and could have been intruded as sill-like bodies along these zones of weakness. Shear action and postemplacement hydrothermal activity along these faults could account for the apparent schistocity and alteration. If this is the case, Pql could be significantly younger than the Paleozoic age that it has been assigned to. Pillow structures in units of Pmv document submarine volcanism in the Totatlanika Schist.

The Totatlanika Schist has undergone at least two periods of dynamic deformation, as illustrated by the presence of tight isoclinal folds cutting the locally developed schistocity. Metavolcanic rocks are essentially nonfoliated. The mineralogical assembledge of quartz-albite-epidote-chlorite (occasional green biotite) suggests that these rocks have undergone lower greenschist facies of metamorphism (Winkler, 1967). Cataclastic textures are common, particularly in volcanogenic rocks (Pvs).

The Totatlanika Schist was first named by Capps (1940) and assigned to the Devonian on the basis of long-range correlation with other formations. Wahrhaftig (1958) suggested that it be assigned to the Mississippian(?) on the basis of the presence of Syringopora, a coral widely distributed throughout the Paleozoic. Gilbert and Redman (1976, in press) have correlated the Totatlanika Schist with low-grade metamorphic rocks of mid-Devonian age in Mount McKinley National Park. No fossils were found during this study and we assigned the Totatlanika Schist in the Kantishna Hills to a mid-Paleozoic age.

Dikes

The Kantishna Hills is remarkably devoid of fresh intrusive rock. Only small stocks and dikes, mostly cropping out in the known mineral belt, have escaped regional dynamothermal metamorphism. Most of these have been hydrothermally altered. Wells (1933) first mapped these small igneous bodies in the mining district. At times, he apparently confused postmetamorphic dikes with premetamorphic amphibolitic greenstones (pCg). Morrison (1964) did some excellent petrographic studies on the dikes he found, although he did map a glacial erratic in Eldorado Creek as one of his Tertiary dikes.

Three compositionally distinct dikes were mapped in 1975: 1) Morrison's (1964) sanidine-bearing augite olivine gabbros (Tgab); 2) quartz porphyry (Tqp), a potassic-rich rock of intermediate composition; and 3) hornblende K-spar dacite (Thd). The best examples of (Tgab) can be found on the ridge east of Twentytwo Gulch. Augite olivine gabbro is found in other localities along the mineral belt and usually shows partially to completely replaced olivine constituting up to 15 percent of the carbonate-rich groundmass. Quartz porphyry (Tqp) outcrops in the southern mining district and at Stampede are believed to be the rock associated with the vein mineralization (discussed in Mineral Deposits section). The Bonnell Prospect, approximately 2-1/2 miles up Eldorado Creek, is an excellent example of quartz porphyry and is the largest exposure of intrusive rock examined in 1975. Hornblende dacite (Thd) is exposed in the ridge east of Last Chance Creek at an elevation of 3,150 feet. It is the freshest exposure of dike material examined in 1975.

All these dikes have visible potassium feldspar in the groundmass and are probably genetically related. Some of the potassium feldspar, particularly in the quartz porphyry, is secondary. Bulk chemical analyses have not yet been attempted. D.L. Turner of the University of Alaska Geophysical Institute is dating some of the dikes using the potassium-argon method of radiometric age dating. The dikes have been tentatively assigned to the early Tertiary on the basis of correlation with igneous activity to the east (Gilbert and others, 1976, in press).

Similar gabbros to those found in the Kantishna (Tgab) are found associated with the Mount Eielson lead-zinc deposits. Reed (1934) suggests that the Mount Eielson intrusives are Mesozoic in age. Kantishna dikes have been hydrothermally altered and suffer extensive shearing locally; they could also be Mesozoic in age.

Tertiary Sedimentary Rocks (Ts)

No exposures of Tertiary sediments were examined in 1975. Moffit (1932) and Reed (1961) show small patches of Tertiary coal-bearing rocks at the mouth of Moonlight Creek, upper Myrtle Creek, and upper Moose Creek on their geologic maps; the approximate extents are shown in plate 1. Churn drilling on Glacier Creek in the 1920s bottomed out into what was thought to be Tertiary sediments (A. Taylor, pers. comm.). Others believe that the entire lower Caribou Creek basin near the Lee Bench may be underlain by Tertiary rocks (Reed, 1961; E. Pilgrim, pers. comm., 1975). The early miners extracted a small quantity of lignite from the headwaters of Moose Creek just outside Mount McKinley National Park in early gold-mining activities (Moffit, 1932; Wells, 1933).

Glacial History

No surficial map units have been included on the geologic map. Pleistocene deposits are found in Eldorado, Moose, Glacier, and Caribou Creeks (Reed, 1961). This study found no evidence of glaciation north of these areas, although it has been speculated that the broad plains north of Crooked Creek has been glaciated (Reed, 1961).

Structure

Both metamorphic terrains in the Kantishna Hills have undergone several periods of dynamic deformation. The last period of folding generated the broad northeast-trending antiforms and synforms, presently the dominant structural feature in the Kantishna Hills.

Structural criteria show evidence of at least three periods of dynamic metamorphism in the Birch Creek Schist. This is illustrated by the presence of:

1) Northwest-trending folds overturned to the northeast, usually seen on the outcrop scale.
2) Northeast-trending folds sometimes slightly overturned to the northwest, seen in both small (outcrop) and larger regional scale (Kantishna antiform near Spruce Creek).
3) Northeast-trending folds within the limbs of larger antiforms and synforms.
4) Small isoclinal folds concordant with regional structure but often cross-cutting schistocity.

Items 3 and 1 may be synchronous, but 2 and 4 apparently signify separate metamorphic events.

Several periods of faulting are summarized below:

1) Northeast fracture patterns associated with regional warping.
2) Northwest fractures at times offsetting the regional northeast fold trends.
3) Low-angle movement in the mining district resulting from a compression to the northwest-southeast.
4) Low-angle movement in the Totatlanika Schist and at the Totatlanika Schist-Birch Creek contact.

A large linear recognized by T.E. Smith has been shown on plate 2 as the "Bearpaw Linament." It is not known if this linament represents a fundamental structural break or is the topographic expression of the structural grain of the area. It may be the source of the placer gold found in Crooked Creek and in the Bearpaw River.

Cataclastic textures are widespread in units of the Totatlanika Schist and may be the result of regional shearing occurring there; they could also be due to differential rock competencies during thrusting.

MINERAL DEPOSITS

Numerous authors have described the mineral deposits of the Kantishna mining district and its subsequent development (Brooks, 1911, 1916; Capps, 1916, 1919, 1940; Davis, 1920, 1922; Wells, 1933; Pilgrim, 1929, unpub.; Seraphim, 1960, 1962, unpub.; White, 1942; Morrison, 1964, unpub.; and Saunders, 1962, unpub.).

Wells (1933) gives an excellent account of the southern lode system, and Brooks (1911 and Capps (1916) give detailed accounts of the early placer activity. Seraphim's unpublished work (1961) represents the best detailed work on these particular veins. Examination of Hill's (1933) work suggests remarkable similarities between the Fairbanks and Kantishna mineral belts. The authors briefly examined 61 of the known vein deposits and found 18 new localities. Some time was spent with all but two of the placer operators. Suffice it to say, Kantishna is a well-known and colorful antimony-gold-lead-zinc-silver-tungsten mining district, noted for course placer gold, bonanza-grade silver ores, and a nationally significant antimony producer at Stampede. Most of the mineral lodes crop out in a northeast-trending linear belt extending from Slate Creek to Stampede (and possibly beyond in both directions). The placer deposits are derived from these pre-existing lodes.

A largely unknown potential for massive sulfide lead-zinc deposits, hosted in Totatlanika Schist, exists in the northern Kantishna Hills.

History of Mining

Placer gold was first discovered in the stream gravels of Chitsia Creek (pl. 1) by George Wickersham during his 1903 expedition to Mount McKinley (Wells, 1933; Reed, 1961). In 1904, Joe Quigley and Joe Dalton discovered rich placer ground on Glacier and Eureka Creeks and news of these finds sparked a gold rush into that region during the summer of 1905. The several thousand men that rushed into the district soon found that the rich placer ground was limited, and by fall of 1906, only about 50 men continued to work the rich ground. This scale of placer mining has continued to 1975. Roughly 45,000 ounces (Cobb , 1975) is known to have been produced from small placer operations on Eureka, Eldorado, Friday, Moose, Rainy, Glenn, Yellow, Glacier, Crooked, Little Moose, and Stampede Creeks. A drag-line operation successfully mined on Caribou Creek during the late 1930s.

The immediate discovery of pebble-to-boulder sized galena and stibnite in the sluice boxes of the early miners prompted a successful search for lode sulfide deposits (Brooks, 1916). Likewise, the high price of antimony during the Russo-Japanese war prompted Joe Quigley to ship 12 tons of stibnite ore from the Last Chance antimony mine (E.R. Pilgrim, pers. comm.); thus began the development of lode mining in the Kantishna.

By 1923, a number of small bonanza-grade silver-lead-zinc-gold deposits was successfully developed and mined. Their production is summarized in table 1. Shortly afterwards, the silver mining almost ceased because of excessive shipping costs (ore was not economic if it contained less than about 100 ounces of silver per ton).

Later, during 1939-42, a larger scale gold-quartz mine similar to the operations in the Fairbanks district (Hill, 1933) developed the Banjo lode system (Red Top Mining Company) near Iron Gulch (pl. 1); the production figures are shown in table 2. During 1940, the district produced an all-time high of 7,000 ounces of gold from lodes and placers (Reed, 1961).

Kantishna is a major antimony district in Alaska. Alaska's largest producer, the Stampede Mine, began development in 1937 and has produced high-grade stibnite ores and concentrates on a fairly continuous basis through 1970 (table 3). This mine fulfilled a considerable percentage of United States antimony requirements during the late 1930s (White, 1942). A large antimony deposit on Slate Creek has undergone development during the last 25 years by both government and private groups, and the Last Chance lode on Caribou Creek has produced ore during the last 10 years (Killeen, 1951; Joestings, 1943; A. Taylor, pers. comm.). A stibnite-quartz vein on Eureka Creek produced antimony ore during the early 1900s (Mining & Engineering Journal, 1915). Known production figures are summarized in table 4.

Because gold prices have made a dramatic upswing during the last several years, there has been an increase of activity in Kantishna's placer grounds.

During 1975, nine placer mines involving about 30 men produced at least 1,000 ounces of gold on Caribou, Glacier, Yellow, Eureka, Friday, Eldorado, Spruce, and Glenn Creeks.

Renewed interest in the Quigley Hill galena-silver Gold Dollar lode in 1973 led a lessee to construct a 35-ton/day flotation mill at the Red Top mine, just above the airstrip. About 120 tons of ore were processed and the concentrates shipped to a smelter in British Columbia.

Lode Deposits

Plate 2 shows the locations of sulfide veins in the Kantishna Hills. Because previous workers have made rather thorough descriptions of many of the individual prospects, only the more important ones will be briefly discussed in this report. Pertinent geologic and mineralogic information of each sulfide occurrence has been keyed to table 4.

Most of the old workings were caved and largely inaccessible in 1975, but good exposures of mineralization are present at Stampede (66), the Bunnell prospect (4), the Arkansas claim (46), the Bosart prospect (36) the Weiler prospect (40), and at the Slate Creek deposit (1).

The reopening of the Gold Dollar shaft (23) in 1976 may allow a good view of the galena-silver mineralization there.

Southern Mining District

Mineralogy

Gold, arsenopyrite, pyrite, sphalerite, galena, chalcopyrite, tetrahedrite, freibergite (argentifferous tetrahedrite), scheelite, siderite, stromeyrite, bouronite, stephanite, stibnite, pyargyrite, cassiterite, and their oxidized products scorodite, azurite, malachite, cerussite, stibconite, and kermesite are metallic minerals that have been reported from this district (Wells, 1933; Seraphim, 1961, unpub.; Capps, 1916, 1919; and Brooks, 1911). Gem-quality rhodonite has been found in the placers of Glenn Creek.

Preliminary polished section studies by T.K. Bundtzen and N.C. Veach of DGGS have shown that polybasite, proustite, jamsonite, anglesite, and boulangerite also occur. It is thought that polybasite may have often been mistaken for the more uncommon pyrargarite. In addition, it is likely that several sulfosalts of lead and antimony may have often been mistaken for stibnite.

Gangue minerals include quartz, calcite, and siderite. The most common sulfides recognized in the field are pyrite, arsenopyrite, galena, sphalerite, stibnite, and tetrahedrite.

Wells (1933) recognized three distinct types of mineralization in a complex vein system: 1) quartz-arsenopyrite-pyrite-gold veins containing minor galena and sphalerite, 2) galena-sphalerite-tetrahedrite-pyrite-chalcopyrite "massive sulfide" veins with minor gangue minerals, and 3) massive quartz-stibnite veins.

Polished sections examined during this study suggest transitions between the above vein types. Stibnite is found with galena-sphalerite-tetrahedrite-chalcopyrite-siderite veins at the Bunnell prospect, the Alpha mine, and the McGonnagil prospect on Glacier Peak (table 4). Arsenopyrite-pyrite-quartz mineralogy is found with "massive sulfide" galena-sphalerite-tetrahedrite-siderite veins of the Little Annie, Gold Dollar, and Red Top veins. Wells (1933) suggests that the presence of antimony in other base-metal sulfides may belong to the quartz-stibnite affiliation.

Structure

Almost all the Kantishna veins strike N. 30-70 E. and dip steeply to the southeast; a few dip steeply to the northwest (table 4). Those veins that do dip steeply to the northwest intersect the southeast-dipping veins (Wells, 1933). This crosscutting relationship has localized the bonanza-grade "galena-silver" lodes on Quigley Hill (Seraphim, unpub., 1961) and the large massive stibnite lodes of Stampede (White, 1942; E. Pilgrim, pers. comm.), thus producing the elongated kidney-shaped ore bodies that were mined. Some of the veins in the Glacier Peak-Spruce Peak area and others scattered through the district strike N. 20-40 W. and dip steeply to vertically. They appear to be only weakly mineralized. The mineral veins range in length from less than 200 feet to well over 1,500 feet and vary in width from 3 inches to over 25 feet (Moffit, 1931; Wells, 1933; Seraphim, unpub., 1961; Bundtzen, pers. examination).

These veins are structurally controlled by high-angle fractures that generally parallel a northeast-trending assymetrical antiform that is locally slightly overturned to the northwest (pl. 1). Northwest-trending high-angle faults offset this fold structure, in block-faulted fashion, as much as 3 kilometers (Moose Creek fault, Wells, 1933). There is only minor offset of a few tens of meters along these northwest fractures within each block. Earlier workers noted that the "galena-silver" veins are offset along northwest fractures only a few tens of feet.

The marble and graphitic schists (pCm) and the chloritic and felsic phyllites (pCph) have been mapped for 17 miles of continuous strike length in the southern mineral belt; the rocks are also found at Stampede. Many of the mineral veins are confined to this rock belt, particularly the more brittle types such as the felsic phyllites and siliceous schists. Those rocks that deform more plastically during dynamic metamorphism such as marble and chloritic phyllites are poor hosts of the sulfide veins.

Ore Paragenesis

Several previous workers recognized the likely genetic relationship of the small, hydrothermally altered plugs and dikes of intermediate composition to the mineralized veins (see Bedrock Discussion). These igneous bodies are elongated parallel to northeast fracture patterns and are spatially related to the fold structure that controls the mineral veins. At the Bunnell prospect on Eldorado Creek, galena-sphalerite-stibnite-tetrahedrite-quartz-carbonate veins are found in the quartz porphyry body. On the ridge between Moonlight and Canyon Creeks, copper mineralization is disseminated in a gabbro dike swarm.

Three distinct periods of mineralization are recognized at Stampede (White, 1942; E. Pilgrim, pers. comm., 1975); at least four events are recorded at the Red Top and Little Annie veins (Wells, 1933). Bundtzen believes that although several mineralizing pulses can be recognized, all the veins are related to a single intrusion-fracture episode that does not significantly span geologic time.

Results from this study suggest that the Kantishna veins show telescoping metal zonation away from an intrusive source.

According to Wells (1933):

> "The minerals in order of their deposition from oldest to youngest are arsenopyrite, pyrite, sphalerite, galena, chalcopyrite, tetrahedrite, jamsonite, and marcasite. Quartz came prior to the sulfide minerals, but calcite did not come until after the arsenopyrite and pyrite."

Polished sections examined during this study generally confirm the above paragraph although "siderite" should replace "calcite." The galena-sphalerite-tetrahedrite-siderite silver lodes on Quigley Hill and Eldorado Creek are near altered quartz porphyry (Tqp) bodies. These complex sulfide ore bodies show postpyrite-arsenopyrite-quartz mineralization of galena, sphalerite, tetrahedrite, polybasite, and siderite in all cases studied. The higher temperature arsenopyrite-pyrite-scheelite-gold veins are found spatially farther from igneous sources than the massive sulfide "galena-silver" bodies (pl. 2).

There is also topographic expression of this: the quartz porphyry bodies crop out at lower and intermediate elevations and the "gold-quartz" veins usually are found on the highest slopes. There is about 1,500 feet of relief in the Quigley Hill area. During the mining of the Banjo lode, it was thought that base-metal mineralization increased at depth in the vein system (Morris, 1939).

There are no good spatial relationships with the stibnite-quartz veins and the igneous source, since they appear to be found both far from and near to their apparent hydrothermal sources.

Preliminary X-ray diffraction work by N.C. Veach on samples of the mineral veins suggest a potassic introduction into the ore in the form of secondary orthoclase, kaolinite, and uncommon potassic arsenides (table 5).

Potassic alteration is evident in the altered igneous bodies (see Geology section).

A summary of events in the mineralization is:

1) Longitudinal fracturing caused by warping of terrain into northeast-trending fold structures.
2) Shallow emplacement of porphyry igneous bodies; subsequent hydrothermal alteration and outgassing.
3) Initial higher temperature arsenopyrite-pyrite-scheelite quartz vein deposition along fractures away from their igneous source.
4) Crosscutting of the earlier fractures and deposition of the cutting galena-sphalerite-tetrahedrite-siderite-quartz veins near igneous bodies; subsequent cross fracturing and a weaker phase of arsenopyrite-pyrite mineralization.

5) Low-temperature stibnite-quartz veins deposition along cross cuts, and reintroduction into previous veins.

The following summary may add some insight to the future examination of the Kantishna veins.

1) The "Kantishna antiform" is the regional structure that controls the mineralization and should be explored along strike for more undiscovered sulfide veins. The veins are preferrentially hosted in rocks that have undergone brittle deformation, for example, quartzose, phyllites, and schists.
2) Chlorite phyllites and marble are poor hosts of economic sulfide material.
3) There is no textural evidence for supergene enrichment of the bonanza silver veins, although some enrichment by oxidation may occur at the surface (Wells, 1933; Seraphim, unpub., 1961; this study). This implies that these high-grade "kidney-shaped ore bodies" can exist at depth in the vein systems, most likely in close spatial relationship with porphyry igneous bodies.
4) The bonanza silver veins and the large massive stibnite-quartz veins are located where a northwest-dipping vein intersects a southeast-dipping vein. This fracture relationship could be a structural guide for ore.
5) Polybasite, argentifferous tetrahedrite, and minor pyragarite are the known silver-bearing minerals. Thus copper (in the tetrahedrite) has been found by Seraphim (1961) to be an effective geochemical guide for the exploration of high-grade silver lodes.
6) Siderite is a conspicuous component of the high-grade ore shoots. Its recognition in the field may lead to the discovery of additional material. A resistivity survey and possibly a magnetic survey could detect siderite.
7) Fissure vein systems in districts throughout the world show similar telescopic metal zonation (Parks, 1970; Jerome, 1966). They are often rooted in mineralized porphyry systems. The potassic alteration of the small porphyry igneous bodies, the argillic alteration present in most of the veins and porphyry bodies, the potassic content in the veins, and the abundant disseminated sulfides found in several of the dikes (particularly at the Bunnell prospect) lend evidence toward this type of mineral system.

Totatlanika Mineralization

Galena, chalcopyrite, barite, pyrite, and arsenopyrite are sulfides that are known to be found in mineral deposits of the northern Kantishna Hills. Nine previously unreported deposits containing sulfide mineralization were examined (table 5).

The most extensive mineralization examined is a profoundly gossanized zone of metavolcanic rocks in the Pmv unit that can be traced for 6 miles of strike length. Local areas of this zone contain up to 30 percent visible pyrite when fresh; but more often than not, the rock is extensively leached and weathered. No base-metal sulfides were recognized in the field; however, polished sections examined with an ore microscope found exsolved blebs of sphalerite (Zns) present in some of the pyrite. Geochemical analyses of rock chips and stream sediments show strong zinc anomalies and moderate lead and silver anomalies (table 6, prospects 70, 72, and sample locations 19, 23, 44-50, 52, 53, 58).

This mineralization could represent: 1) high base-metal background in a pyritized metavolcanic sequence, 2) indications of massive-sulfide mineralization related to the premetamorphic volcanism, or 3) mineralization related to low-angle fault zones that are present in Pmv.

Other mineralization related to the northwest-striking fissure system appears to be of low grade and presently uneconomic. Silicified zones of rhyolite porphyry (Prhy) may hold a potential for larger low-grade metal deposits.

Placer Deposits

Placer gold is found in most of the streams that drain the Kantishna Hills and originated from lodes that have intruded the polymetamorphic bedrock terrain. It has been economically extracted from Eldorado, Eureka, Flat, Friday, Moose, Rainy, Yellow, Glenn, Glacier, and Caribou Creeks in the southern hills and Stampede, Little Moose, Crooked, and Bearpaw Creeks in the central hills area (Capps, 1916-1919; Brooks, 1911; Wells, 1933; Reed, 1961). Its extraction constitutes most of the more recent mining activities. Associated with the gold in the heavy concentrates---particularly in the southern mining district---are sulfides of lead, antimony, copper, silver, and zinc, along with the more common garnet, magnetite, and ilmenite. Minor amounts of rhodonite, scheelite, and rarely cassiterite have also been reported (mine operators, pers. comm., 1975). Kantishna's placer production has been about 45,000 ounces, small compared to most other districts in Alaska. Generally, small-scale operations have extracted the metal because the paystreaks are usually restricted in extent. The gold is unusually course, and found in the lower 1-3 feet of gravels that overlie the bedrock. The weathered bedrock itself contains gold to 3 feet in depth, and is often ripped up with the stream gravels during placer mining.

Four of the producing streams have been occupied by glacial ice; placer gravels along Moose, Glacier, Eldorado, and Caribou Creek lie below glacial terraces (Reed, 1961; P. Metz, and Bundtzen, pers. examination, 1975). Either some of the paystreaks formed after an older glaciation or the glaciation did not significantly dilute the gold deposits. Some of the known high-grade pay streaks in the former stream channels have been exhausted, and exploring the large gravel deposits below the glacial terraces may disclose economic-grade placer material. Some of the producing ground in the southern mining district has been worked at least twice and still yields paying quantities of gold.

1975 Activity

Dozers and front-end loaders were used intermittently in placer mines from mid-June to September 25th. Two operations were primitive "pick and shovel" types (pl. 2). All were located within 10 air miles of the old town of Kantishna.

Northwest Mining Company operated a sophistocated sluicing plant at the mouth of Eldorado Creek. A front-end loader and dozer supplied the paydirt. For most of the summer, this operation encountered numerous mechanical problems and undoubtedly will be modified for the 1976 season. Toward the latter part of the season they encountered a rich pay streak on a "false" bedrock silt surface and successfully recovered a good quantity of gold. When fully operational, they processed 400-700 cubic yards daily.

Two operations produced gold from pay streaks on Eureka Creek. D. Stone and partner operated a hydraulic mine about 1/4 mile above the mouth of Eureka Creek. Using a single monitor, they stripped stream channel-bench gravels into a sluice box that used water from the stream bed. Gold recovery, judging by the hints, was encouraging. They processed 100-300 cubic yards a day. Imperial Mining Company successfully operated a gravity sluicing plant at the mouth of Iron Gulch on Eureka Creek by using a dozer and front-end loader. They mined intermittently for about 80 days, producing 4-6 ounces from 500-700 cubic yards of material daily.

Airley Taylor and associates mined stream gravels on Glacier Creek about 1 mile downstream from Fifteen Gulch. This plant was just getting into operation in mid-August, when the DGGS field party was leaving the district, and the results are unknown.

Paul and Eric Wieler operated a placer mine at the junction of the East and West Forks of Glenn Creek. They pushed paydirt through a 2-1/2 by 35-foot sluice box with a dozer, occasionally having problems with large boulders. Two settling ponds were constructed below the mining activities. The Wieler's recovered remarkably coarse gold; several 1-ounce nuggets were found in a single cleanup. (Glenn Creek has produced 7-ounce nuggets in the past.) The Wieler's processed 20-50 cubic yards daily. Their claims constitute some of the richest pay streaks in the district.

W. Copley and associates ran a successful gold placer mine on Spruce Creek, about 2-1/2 miles upstream from its mouth. This was the largest operation in the district; they processed several tens of thousands of cubic yards during the summer. A sluice box, converging at its outlet, was fed water at pressures of 2000 pounds per inch while a front-end loader and dozer supplied the paydirt. There is several hundred thousand cubic yards of reserves left in this claim block. Gold production was considerable.

A sluicing plant operated on the Lee Bench of Lower Caribou Creek for most of the season. The mine, operated by Karponek and partners, was an engineering success and few mechanical difficulties were encountered. However, gold production was less than satisfactory. This ground does not yield course gold as other streams in the district do, probably because of its distance from the quartz-sulfide lodes.

A primitive placer operation on Yellow Creek using pick, shovel, and wheel barrel, fed a small sluice box. A few ounces of gold were recovered.

J. Fuksa mined on his claim on Friday Creek, about 3/4 mile above the mouth. Several ounces of course gold were retrieved below an automatic dam, constructed by the operator.

A placer mine operated on lower Moose Creek below the canyon, but DGGS personnel did not visit this operation and know nothing about it.

Geochemistry

Procedure

The geochemical program was aimed at delineating areas of anomalous base-metal concentrations in the Kantishna Hills. This was accomplished by using continuous helicopter support for 8 days to form a reconnaissance stream-sediment sampling net, by collecting rock chips from prominent gossans in the area, and by mapping on foot. In addition, 81 prospects and mines were also sampled and analyzed for potential ore-grade material. Locations of 400 stream-sediment samples and 30 gossan samples are shown on plate 2.

Atomic-absorbtion analysis for all samples was under the supervision of H.S. Potworowski of the DGGS Minerals Lab. A 10.00-gram sample was digested with an appropriate amount of aqua regia. The digestate was diluted to 100 milliliters with distilled H_2O and filtered. The elements copper, lead, zinc, silver, and antimony were aspirated directly into an air-acetylene flame, and gold was determined following a DIBK/Aliquot 336 solvent-solvent extraction. Molybdenum was aspirated into a nitrous oxide flame. We regret that the elements tungsten, tin, mercury, and arsenic were not looked for in this study.

Table 6 summarizes the results. Cumulative frequency plots for four of the elements are shown in figures 3-6. Anomalous values were chosen at the appropriate break in the curve; the anomalous elements were then plotted on plate 2 with the sample localities. Below is a summary of the anomalous areas discovered:

1) Kantishna antiform: Slight to moderate copper, lead, and in particular, zinc anomalies signature the regional antiform that controls the vein mineralization in the Kantishna mining district. In addition, anomalies in the Canyon Creek drainage suggest the possibility of undiscovered deposits in that geologically poorly known area.
2) Chitsia Mountain area: Moderate to strong copper and zinc anomalies are found in creeks that drain the gossanized felsic metavolcanic rocks hold good potential for massive-sulfide mineralization. A profound gossan zone in the Pmv unit 5 miles long and 1 mile wide assays locally up to 0.52 percent zinc. These rocks constitute a high priority in any mineral assessment. This area should be explored. In addition, the rhyolite porphyry in the area (Prhy) is responsible for lead and silver anomalies. Prhy is known to have base-metal vein mineralization (prospects 73, 77, 78, plate 1 and table 5) and should be examined for large low-grade metallic potential and smaller high-grade mineralization.
3) The felsic schists and gneisses (pCfs, pl. 1) north of Crooked Creek are the sources of molybdenum anomalies in the stream sediments. It is not known whether these values point toward economic mineralization or mirror the bedrock elemental background.
4) VA8M Antim in the central hills radially drains strong copper, lead, zinc, and silver anomalies. The possibility of undiscovered mineralization should be explored.
5) Analyses of the numerous gossans in the Kantishna, particularly in the mineral belt, commonly yield anomalous amounts of molybdenum, silver, and zinc (for example, Stampede Fault, sample 253a). These gossans may be the surface expression of sulfide mineralization and should be explored with geochemical and geophysical surveys.

MINERAL POTENTIAL

Because of the nature of the deposits mined and the lack of adequate transportation into the district, the Kantishna has been but a small-scale metal producer. Total past production, in February-1976 gross metal values, would amount to about $15.5 million. The area has been inadequately explored for mineral deposits. Except for the development work at Stampede and the Banjo Mine (Red Top Mining Co.), no diamond-drilling programs have been attempted in the district. The area has been classified as a federal D-2 withdrawal since 1971, and has not received modern systematic exploration, as have other districts in Alaska. On the basis of known geologic criteria, the potential for mineral development lies in 1) continuing smaller scale placer gold production, 2) small- to moderate-sized base- and precious-metal lode producers in the southern mining district, 3) tungsten mining, 4) continued sporadic production of antimony from known and undeveloped vein deposits, and 5) discovery of "massive sulfide" deposits in the northern Kantishna Hills.

Placer Mining

Ignoring future land-use decisions and political boundary changes, Kantishna will probably continue to be a small-scale placer gold producer. Kantishna gold is "jewelery gold," and is worth significantly more per ounce than fine gold. A gold dredge has never operated in the Kantishna Hills. A large-scale hydraulic operation attempted to extract gold on Moose Creek During the 1920s, but it was unsuccessful (Davis, 1922).

A drag-line operation successfully extracted gold for 3 years (1939-41) on Caribou Creek. This remarkable plant produced up to 300 ounces of gold per week. In 1942, its generated capacity was needed for the war effort and the entire plant was removed. A drag line operated on Glacier Creek during the same period, but nothing is known about it. Lower Caribou and parts of upper Moose Creek hold some potential for large-scale production. An unpublished report written in 1925 for the Carrington Company inferred from trench sampling that 40 million cubic yards of gravel averaging $1.80/yard (at $35/ounce) is present on the Lee Bench of Caribou Creek. Several tons of very high grade sulfide concentrates containing Pb, Ag, Zn, and Au are recovered from each of the present sluicing operations and may be shipped to smelters in the future.

This study concludes that small operators will continue to produce several hundred cubic yards daily from their individual sluicing plants for many years.

Lode Mining

Base- and Precious-Metal Vein Deposits

Kantishna has a potential for future primary silver production. The lead-silver lodes mined during the 1920s was on a small scale compared to modern hardrock underground operations. The ores had to be "high-graded" to offset excessive shipping costs. The average silver grade of all deposits mined was 157 oz/ton. Quigley Hill, the heart of the silver mineralization, shows similarities to the mineral deposits of the Coeur d'Alene district in Idaho, currently America's largest primary silver producer (V. Fryklund, 1964). Probably any single mineral vein doe not contain more than a few thousand tons of ore. A successful venture would have to string together a number of known mineral veins, proving continuity and economic grade, while finding new veins.

A modern operation would be risky and costly, with the possibility of exhausting reserves quickly. The ores have flotation problems (Conwell, 1974) and a sophistocated milling process would have to be engineered. This type of mining is not popular with larger mining companies, who prefer to mine larger, lower grade deposits.

Even so, with the constraints described above, there is still a real potential for future production of these ores, particularly on a small scale. Moneta Porcupine Mining Company has successfully accumulated most of the lode claims in the Quigley Hill area, thus eliminating the legal land problems that face other mining districts during predevelopmental exploration. Included in this claim block are 37 patented lode claims. An operator is currently interested in leasing the Gold Dollar deposit from Moneta Porcupine. Average ore grade of several of the known veins may be high, even at depth, and continuity of ore shoots is a geological possibility. Economic extraction would require a mill site (already there), facilities for 30-60 mining personnel, and a transportation corridor, either through the air or along a winter haul road. It is doubtful that existing agencies would allow continuous heavy commercial traffic along the present National Park road system.

Gold-Quartz Mining

Kantishna's largest lode producer mined this type of mineralization and closed down during World War II. It never reopened because of increased labor and machinery costs and the controlled price of gold.

The remarkable comeback of gold may renew interest in this type of mining in Kantishna, as it has done in the Fairbanks district (Bartholemew lode, Ester Dome activities 1975-76). It may never occur on a large scale but could operate on previous levels (about 7000 tons ore milled annually). There remains blocked ore in the Banjo lode and the similar Pennsylvania-Keystone vein system is virtually unexplored. The old Banjo-Red Top mill still exists and could be made operable. Much of the gold would be recovered on an amalgam table; a shipment of sulfide concentrates to a smelter would be required annually. A crew of eight operated the mill and underground workings of the Banjo lode system.

Antimony

The future production of this metal will probably continue as small, sporadic shipments of ore. Antimony production in Alaska is invariably cyclic and fluctuates with rise and fall of demand, particularly in times of war. The price is dependent on how much of the metal is released by the world's major supplier, the People's Republic of China.

The three productive deposits---at Stampede, Slate Creek, and Last Chance Creek---still have economic reserves of ore. The chances of finding additional economic vein systems are good; new deposits could be developed when the price is right.

Tungsten

Tungsten mineralization similar to that found in the Fairbanks district (Hill, 1933) is present in several of the known Kantishna arsenopyrite-gold-scheelite-quartz veins. Up to 0.5 percent scheelite ($CaWO_4$) was present in the ore of the Banjo lode (Red Top Mining Company) but it was never recovered (E.R. Pilgrim and B. Thomas assay reports). Tungsten, like antimony, is a strategic metal that is in demand during times of war. The Fairbanks district has been repeatedly mined for tungsten during World Wars I and II and the Korean War. At the present, there is no interest in this commodity in the Kantishna, but it could become interesting in the future.

Massive Sulfide Deposit, Totatlanika Schist

Geologic mapping, geochemical anomalies, and polished-section work suggest that the metavolcanics of the Totatlanika Schist hold a "massive sulfide" base-metal ore potential.

This potential is inferred in the table 6 mineral listings, prospects 71-73. The Totatlanika Schist to the east has become a focus of hard minerals exploration and it is likely that this same potential holds for these same rocks in the Kantishna Hills.

Coal

A very low probability exists for discovery of economic seams of coal in the poorly exposed Tertiary rocks of the Kantishna Hills, although small amounts of coal from known seams have been used locally in the past.

CONCLUSIONS

The Kantishna Hills a D-2 land withdrawal and slated for possible inclusion into Mount McKinley National Park. If this occurs, mining will probably cease to exist in the Kantishna. Issues including: 1) hunting pressures on animals using McKinley Park, 2) alleged mining abuses of the land, 3) Kantishna's role in the "McKinley Ecosystem," and 4) undesired use of commercial traffic on the Park road have been used to support this D-2 annexation into the Park. Many of the issues are obviously regulatory problems; others involve more fundamental philosphical differences between single and multiple uses of land. The authors firmly believe that more information from different fields of study should be gathered before any final decision is made. Regardless of the outcome, Kantishna's role as an historic metal producer, its current mining activity, and indications of future mineral potential are all factors that must be considered in the forthcoming D-2 land decisions in Washington, DC.

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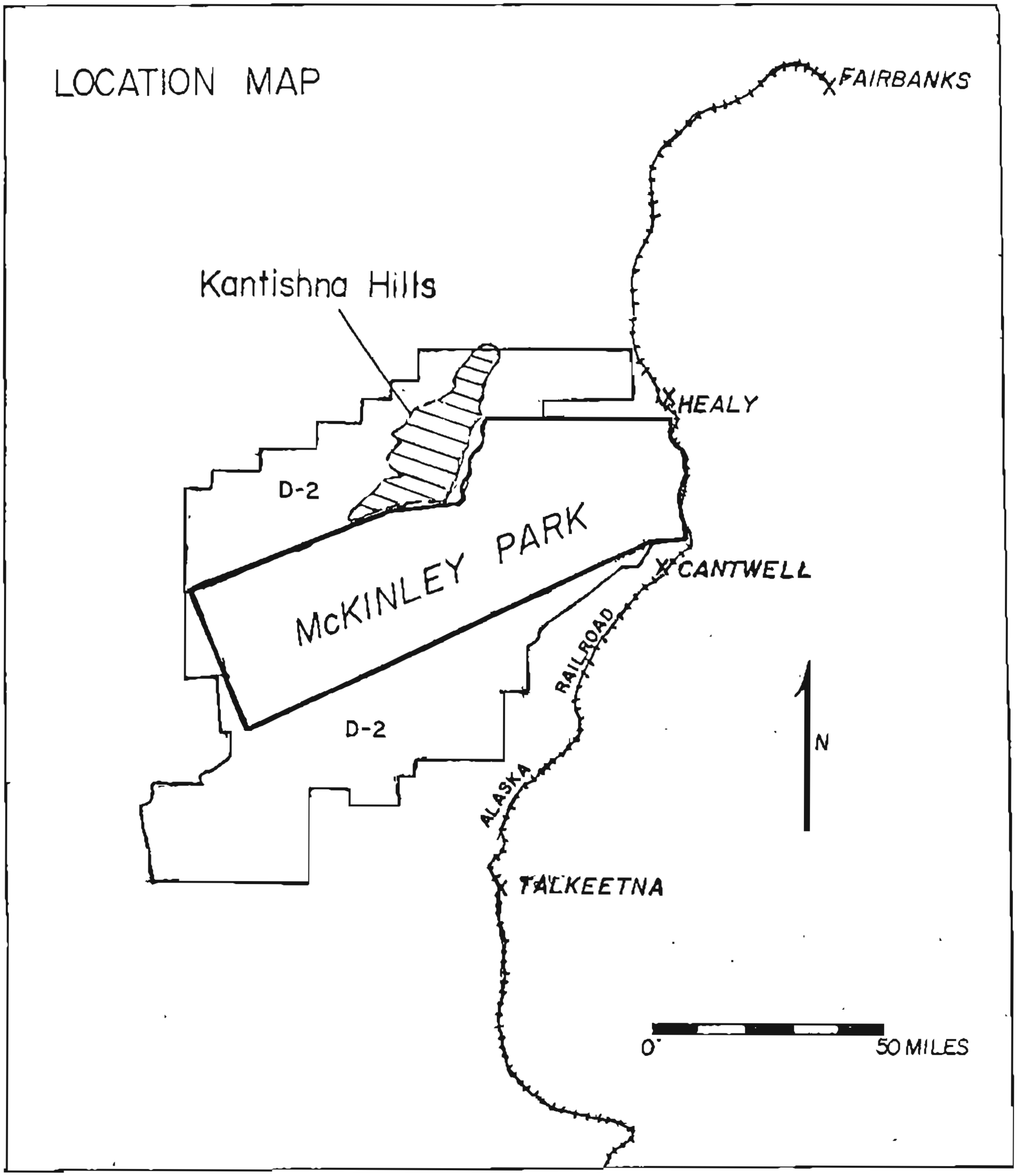


Figure 1. Location map, Kantishna Hills.

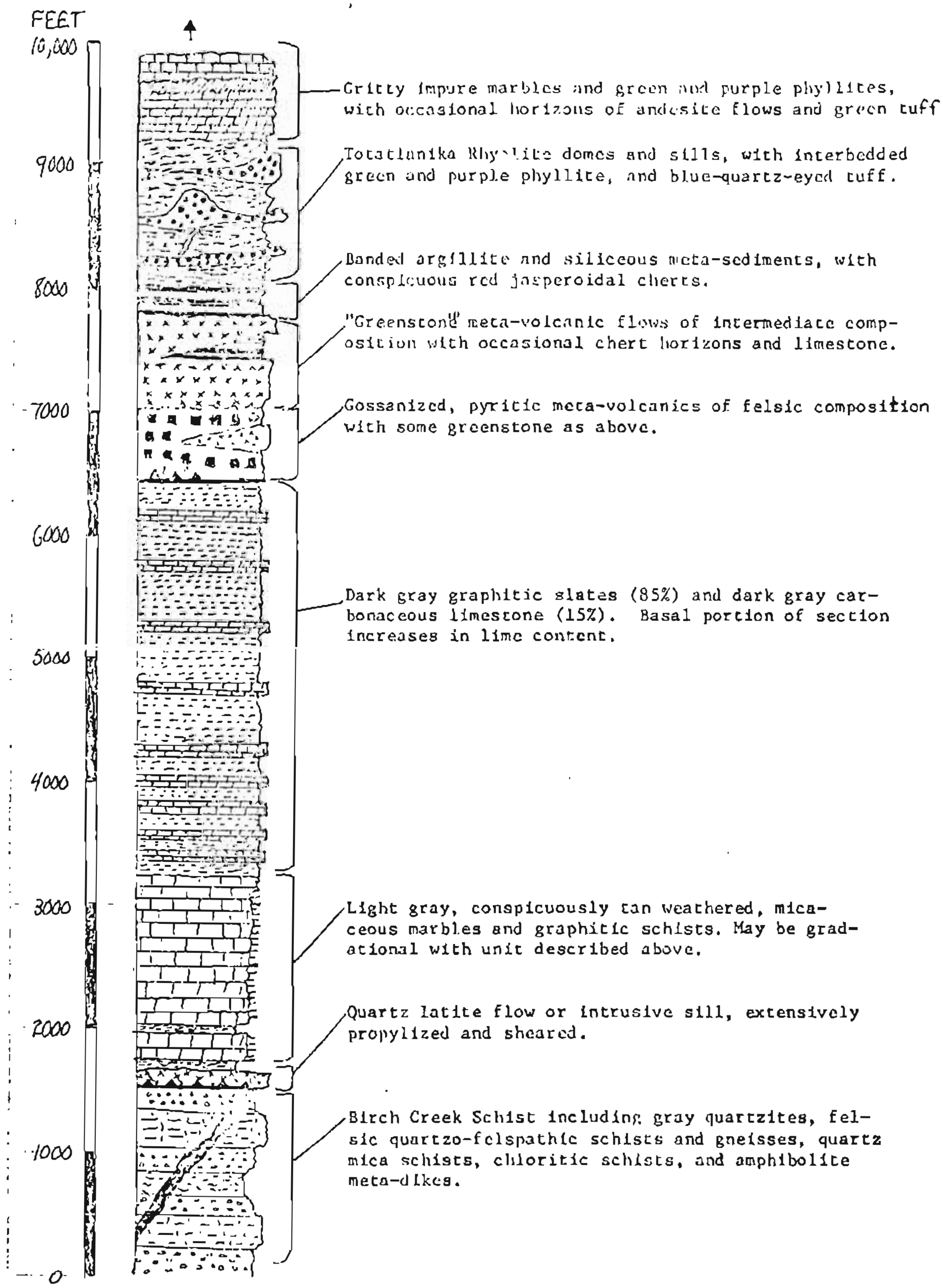
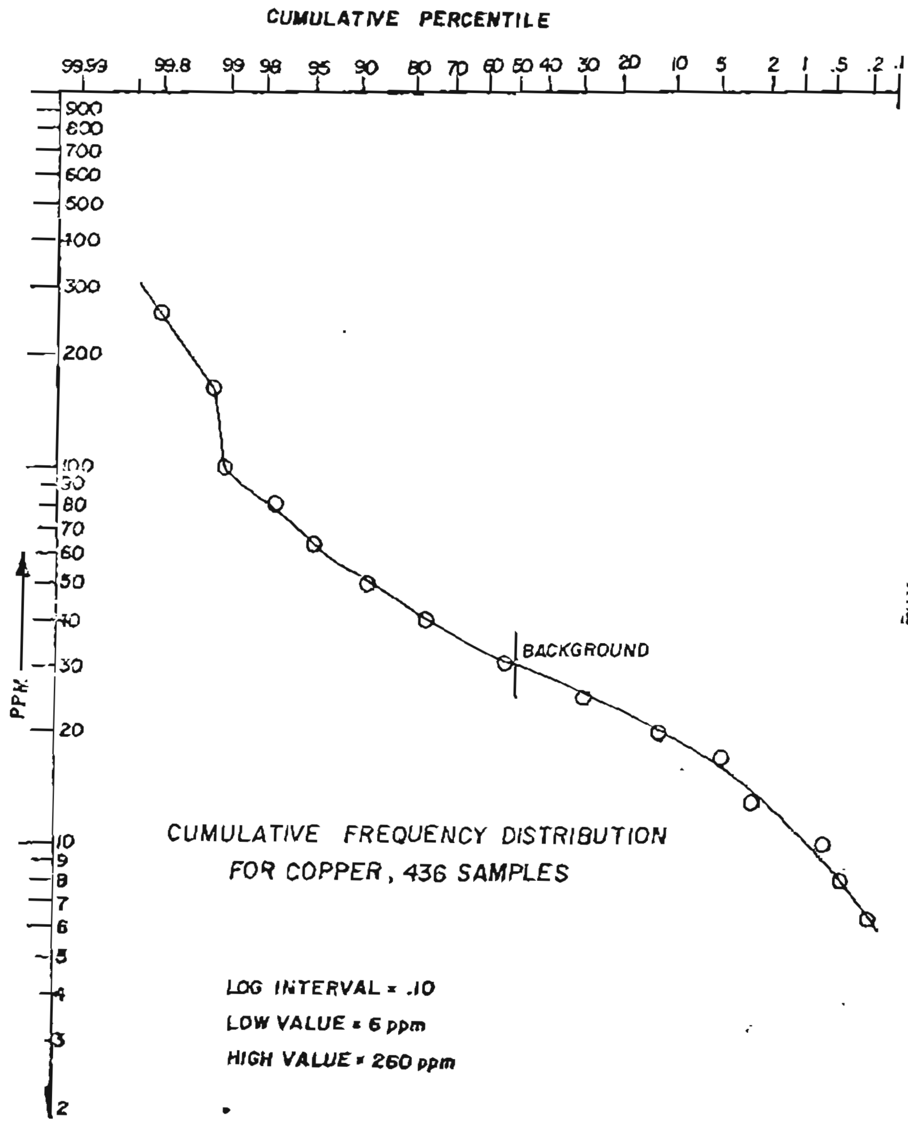


Figure 2. Stratigraphic section, Chitsia Mountain area.

Figures 3 and 4



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FOR COPPER, 436 SAMPLES

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LOW VALUE = 6 ppm
HIGH VALUE = 260 ppm

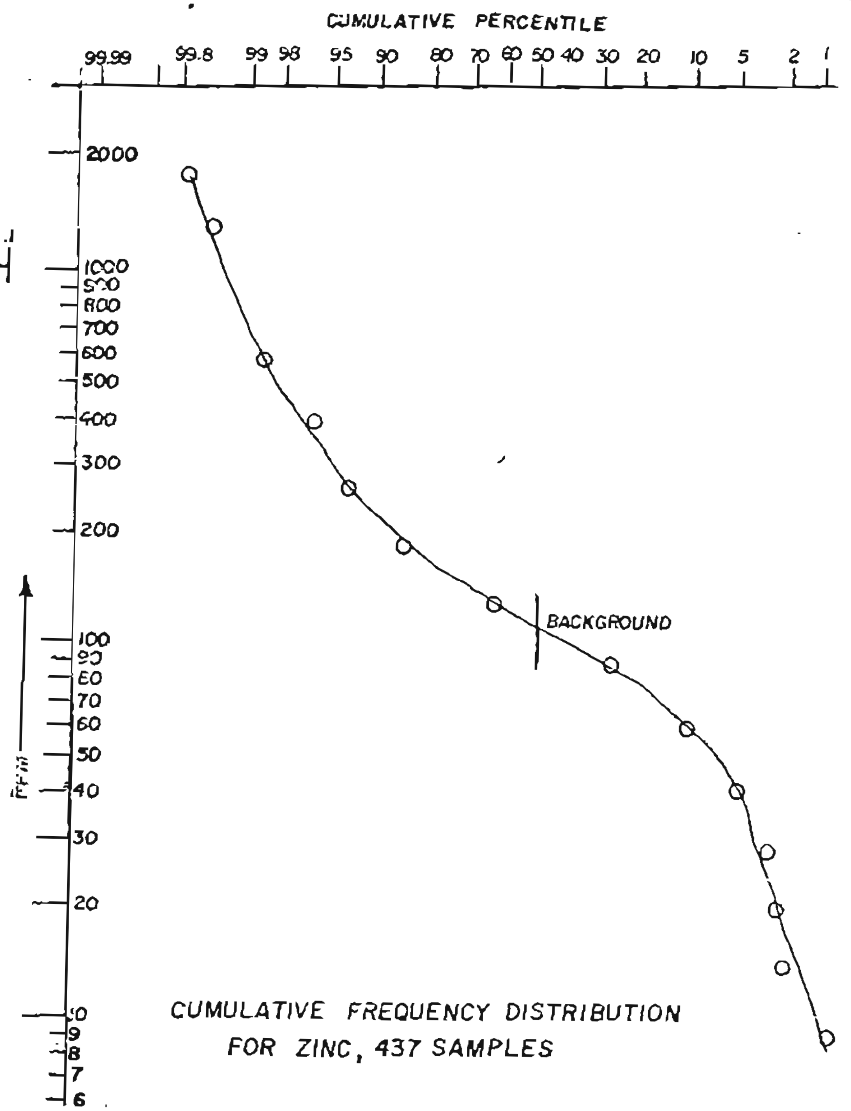

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Figure 5

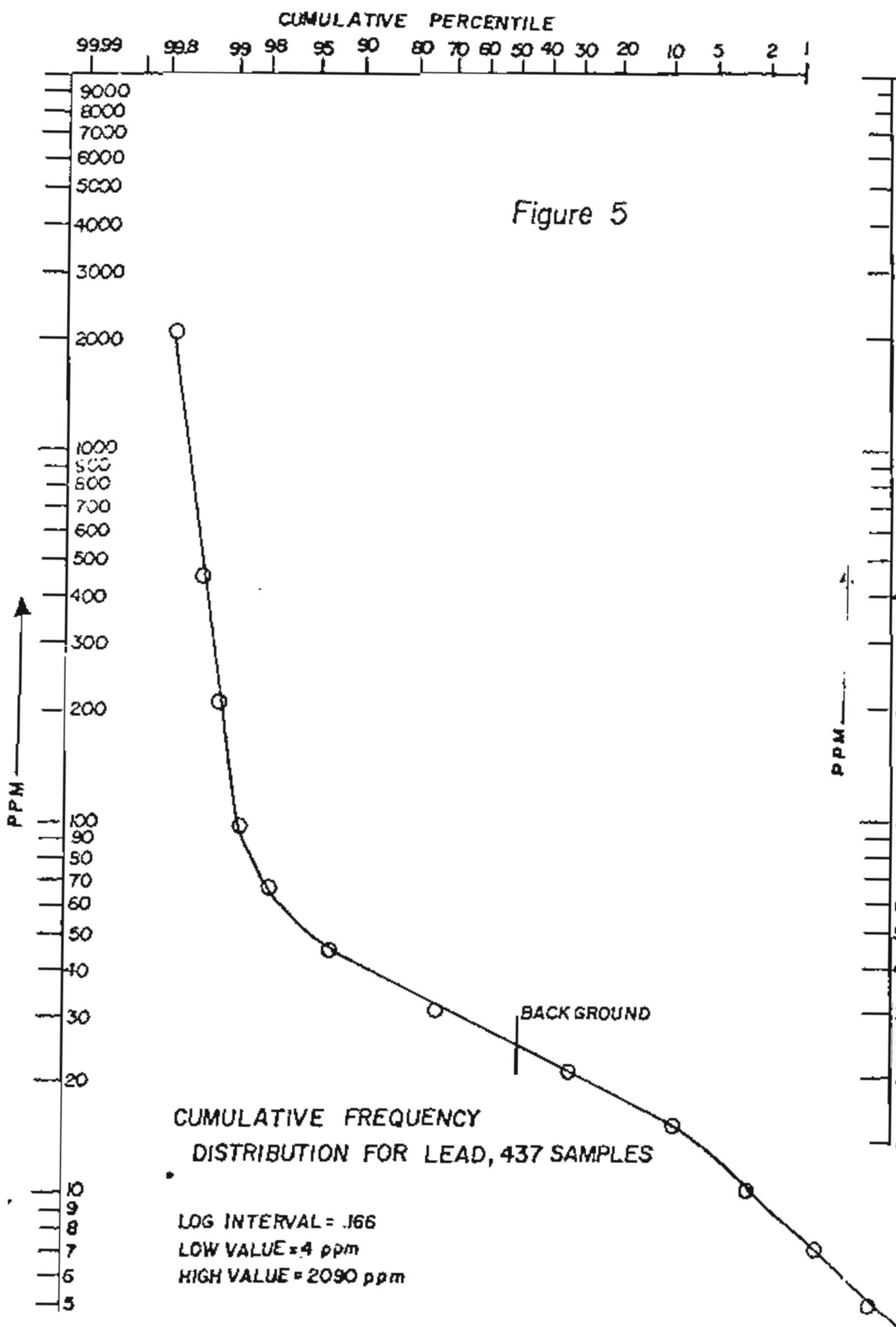

Figure 6

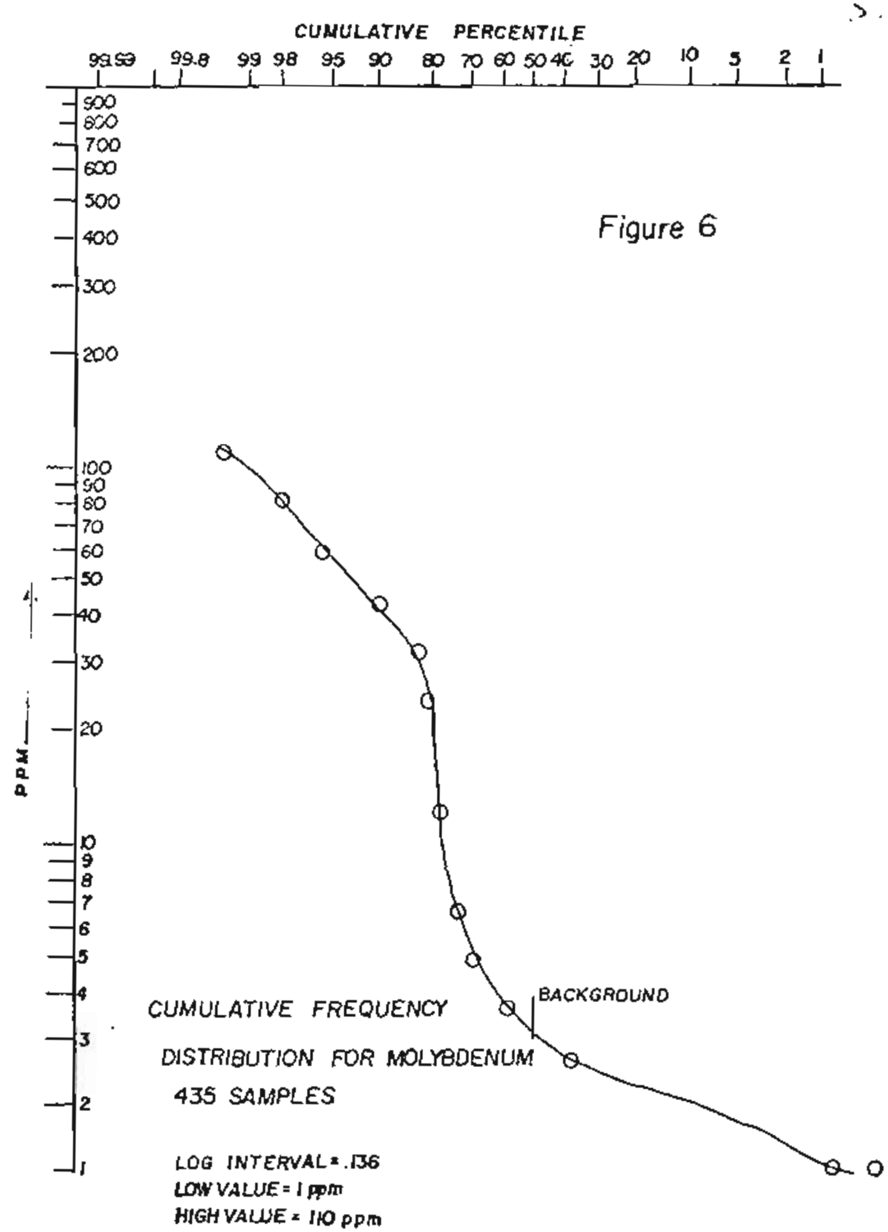

Table 1. Known production of gold, silver, and lead from the Bonanza veins, Quigley Hill and vicinity, Kantishna, Alaska[1]

	Tons of Ore	Silver (oz.)	Gold (oz.)	Lead (lb.)	Years
Gold Dollar	638	76,120	159.5	273,160	1920, 1921, 1973
Little Annie	715	115,945	74.5	144,400	1919, 1920
Little Annie (upper)	10	1,360	NA	4,000	1921
Red Top	184	43,664	187.3	93,200	1922, 1923
Galena	100	17,000	NA	NA	1920, 1921
Gold Eagle	4	680	NA	NA	1920
Martha Q	4	1,136	NA	NA	1920, 1921
Alpha	10	2,000	25.0	NA	1921
Total	1,655	257,965	449.0	504,760	

[1] Includes 120 tons of lower grade ore mined in 1973.

Sources: Davis, 1923; Pilgrim (pers. comm.); Wells, 1933; Morris, 1939; Seraphim, 1960, 1961, unpub.; USBM unpub.).

These figures are probably conservative, as several units of lead-silver ore shipped from Alaska and smelted in Montana during the last 20 years are believed to have come from the Kantishna (C. Conwell, M. Anthony, pers. comm.).

Table 2. Production figures, Banjo Lode (Red Top Mining Company)[1]

Year	Tons of Ore	Gold (oz.)		Silver (oz.)		Duration of Mining
		Amalgam recovery	Sulfide concentrates	Amalgam recovery	Sulfide concentrates	
1939	3225	1073.3	127.7	664.5	341.0	May 1-Oct. 15
1940	4138	1980.6	534.9	1541.5	1385.7	May 24-Nov. 9
1941	6290	1772.4	771.0	1182.1	1999.0	May 10-Oct. 24
Subtotal		4826.3	1433.6	3388.1	3725.7	
Total	13,653	6259.9		7,113.8		

Concentrate Assays

Year	Amount (lb.)	Au (Oz./ton)	Ag (Oz./ton)	Pb (%)	Zn (%)	As (%)	Cu (%)
1939	13,208	19.6	52.3	- - -	- - -	- - -	0.15
1940	32,540	32.9	83.8	13.8	1.6	2.9	0.16
1941	43,214	35.6	92.5	19.7	.9	4.75	0.13

[1]An unknown amount of ore was produced in 1942, before mine closure.

Sources: Morris, 1939, unpub.; E.R. Pilgrim, pers. comm.; Stranberg, 1941, unpub.

Table 3. Production of antimony ores concentrates, Stampede mine

Year[1]	Ore + Concentrates (ton)	Antimony (%)	Antimony (lb.)
Pre-1937	150.0	- - -	- - -
1937	873.67	55.01	962,000
1938	426.73	52.00	444,000
1939	211.51	49.68	210,000
1940	293.83	52.16	306,000
1941	582.90	53.47	624,000
1942	80.0	52.0	83,200
1943	120.0	52.0	124,400
1944	78.5	50.0[2]	78,500
1945	40.0	56.0	46,600
1946	40.0	56.0[2]	44,800
1947	26.0	56.0[2]	29,120
1948	68.5	56.0[2]	69,720
1949	74.0	56.0[2]	82,880
1951	121.0	56.0[2]	135,520
1956	120.0	56.0[2]	134,400
1957	63.5	56.0[2]	71,120
1964	40.0	56.0[2]	46,600
1965	40.0	56.0[2]	46,600
1969	23.0	56.0[2]	29,760
1970	121.35	56.0[2]	126,209
Total	3,594.5		3,695,429

[1]Does not include estimated 150 tons of high-grade ore mined prior to 1937.
[2]Estimated by E.R. Pilgrim.

Sources: White, 1942; E.R. Pilgrim, pers. comm.

Production of antimony from southern part, Kantishna mineral belt[3]

Area	Ore (ton)	Antimony (lb.)	Duration of Mining
Slate Creek	625	800,000	1916, 1942-49, 1970-71
Last Chance	71.5	74,360	1905, 1968-70, 1973-74
Eureka Creek	≈ 50	Unknown	≈ 1915

[3]Most of these figures are approximate and taken from unpublished information; they are conservative.

Sources: Mining and Engineering Journal (1915), v. 99, no. 24; Joesting, 1942, 1943; Mertie, 1951; P. Reese, pers. comm.; and A. Taylor, pers. comm.

TABLE 4. Preliminary listing of mineral occurrences in the Kantishna Hills (keyed to plate 2)

Prospect or sulfide occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
1	"Antimony Mine," Slate Creek deposit (Wells, 1933; Capps, 1915)	At least 625 tons of ore with 45% Sb content	Fissure vein trend. N. 50° E., has 82° SE. dip, 1 20 feet thick, at least 450 feet (taped) of mineralized strike length; heavily serecitized schist country rock (Capps, 1916; Wells, 1933). (This study 1975).	Massive stibnite quartz vein, minor pyrite, boulangerite-cervantite-arsenopyrite.	This deposit has been only minimally developed; has ore remaining in vein, about 150 feet of underground workings are caved. Attempted open cut has exposed dangerous dip-slip schist block in cut wall. Large gossan zone along hillside parallel to strike of vein. Very good potential for future production.
2	________* (75AST 3043)	None recorded	Fissure vein N. 75° E. vertical along fracture, 50 feet of surface exposure chlorite-quartz-muscovite schist country rock (pCh).	Weathered stibnite-quartz, extensive limonitic stain.	Small 15- by 4- by 3-foot pit exposes vein, no publised information.
3	________* (75AST 3040)	None recorded	N. 30° E., 20° NW. dip, possibly barren fissure quartz vein; intrudes siliceous quartz muscovite schist.	Limonitic quartz + minor pyrite.	Small pit; prospectors apparently didn't find much.
4	Bonnell prospect (Saunders, 1962), Neversweet prospect (Wells, 1933).	None recorded	Complexly faulted vein trending E-W to N. 70° E., 50°-70° SE. system intruding quartz porphyry body near its contact with country rock quartz muscovite schist.	Quartz-carbonate-galena-tetrahedrite-stibnite-sphalerite, minor chalcopyrite, boulangerite Jamsonite-K-spar.	Three adits have been driven into 150 vertical feet of vein exposure, up to 4-foot-thick massive sulfide vein material exposed in upper adit; not mined in early days because of low silver values. Has excellent possibilities for mill concentrate materials. Entire quartz porphyry is disseminated with sulfides. Small jamsonite-pyrite vein 150 yards up stream from cabin in quartz porphyry along creek cut.

*No name

TABLE 4 (cont.)

Prospect or sulfide occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
5	Arizona No. 2	None	Gossan zone, general N. 50° to 20° E. trend.	- - - - - - - - - - - - - - -	Unknown potential
6	Eagles Nest	None	N. 30° W.-trending vein with 35° NE. dip, 3-1/2 to 20 feet thick, 75 feet of strike length exposed at surface. Intrudes muscovite-quartzose schist (pCh).	Massive quartz-stibnite vein; about 3 feet of massive stibnite on "hanging wall" of vein.	Thickness of sulfides and exposed veins are very encouraging. Virtually unexplored; may be the most promising antimony prospect in the Kantishna Hills.
7	(75AST 2047)	None recorded	E-W-trending 30°-60° SE. poorly exposed vein 1-3 feet thick, intrudes quartzose schist (pCh)	Stibnite-quartz vein.	Small prospect pit, 3 by 10 by 4 feet, largely caved, appears to be a small showing.
8	Eldorado No. 3	None	N. 75° E. vertical vein 2-6 feet thick intrudes in pure muscovite marble; traceable for 150 feet of strike length.	Stibnite-carbonate-stibconite, with euhedral quartz crystal cavities.	Virtually unexplored vein, unknown potential.
9	Alpha mine	10 tons, high grade silver ore (see table 1)	N. 70° E.? dip vein 1-10 thick; 300 feet of exposed strike length intrudes tan-weathering mica-quartzose schist (pCh).	Galena, jamsonite, stibnite-sphalerite-siderite-pyrite-arsenopyrite minor tetrahedrite, boulangerite.	Ten tons of ore mined in 1920s, averaged 200 oz. Ag/ton. Large gossan several thousand feet long trends SE from Alpha. Should be thoroughly explored. Siderite content in ore may be geophysically detectable.
10	(75AST 3025)	None	N. 55° E.-trending 30° SE. 3-foot vein intrudes pCh.	Quartz-pyrite-limonite.	Small pit, does not appear encouraging.

TABLE 4 (cont.)

Prospect or sulfide occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
11	(75AST 2003)	None	N. 70° E.-trending, 10° SE.-dipping 'vein' of quartz-sulfides parallel to carbonate bedrock (pCm).	Pyrite-sphalerite + euhedral quartz cavities, minor marcasite.	Unusual occurrence or "stratabound" vein in carbonate rock. Completely unexplored. Very similar in form to sulfide occurrence 8 (Eldorado claim).
12	(75AST 2002)	None	N. 35° E. vein with 80° SE. dip, 6 inches to 2 feet thick, intrudes gray quartzite (pCh) and siliceous phyllite (pCph).	Quartz-siderite-pyrite and minor to trace galena.	Seem small but are excellent examples of Kantishna veins. Well exposed. Rock types very similar to those pCh units found at Stampede.
13	Lucky Strike	None recorded	N. 50° E.-trending vein with 84° SE. dip, about 6 feet thick; about 200' of strike length exposed on the surface; intrudes pCph.	Major quartz, galena, and sphalerite; minor siderite, tetrahedrite, free gold.	Open cuts and caved adit exposed 125 feet of strike length of vein; assays show 0.04 oz./ton Au, 6.4 oz./ton Ag, may have produced ore in the 1920s. Would be ideal location to explore Quigley Hill underground.
14	SAST 2950	50 tons in 1915 (Engin. Mining J.)	Caved quartz-sulfide vein apparently 3-6 feet thick,	Quartz-stibnite vein, stibnite forming dentritic intergrowths into quartz gange.	Caved adit and considerable dump of oxidized ore. Produced ore during the early days; unknown potential.
15	White Hawk	None recorded	NE-trending vein 3 feet thick, 500 feet of traced strike length (pCt).	Quartz-siderite-tetrahedrite.	Unknown grade and poorly exposed in 1975. It is one of the larger veins in the lode system. Caved workings.
16	Galena	100 tons high-grade Ag ore.	N. 45° E.-trending, 65° SE.-dipping vein 5-9 feet thick, intrudes (pCph). Francis, Little Mead may be extension of Lucky Strike.	Galena-arsenopyrite-pyrite sphalerite tetrahedrite-siderite-quartz, minor chalcopyrite.	High-grade ore mined in past, very good chance of finding additional tonnage underground. Lower grade ore left in dump. Caved underground workings.

TABLE 4 (cont.)

Prospect or sulfide occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
17	Martha Q	4 tons high-grade Ag ore.	N. 15° W.-trending, 60° E.-dipping vein 5-9 feet thick, intrudes pCph.	Galena-arsenopyrite-tetrahedrite-sphalerite-siderite, minor quartz.	Likely an extension of the Little Annie vein system. Caved workings.
18	Red Top	182 tons high-grade Ag ore.	N. 70° E. vertical vein 8-9 feet thick, crosscutting fracture system localizes high-grade shoots.	Galena-sphalerite-arsenopyrite-siderite-tetrahedrite-polybasite-pyrargyrite-pyrite.	Well known for very high grade ore, 182 tons averaged 237 oz. Ag/ton and 1.1 oz. gold/ton. Caved workings (fig. 3).
19	75AST 1998	None recorded.	Intrudes pCph.	Quartz-siderite, minor pyrite.	Prospect pit, 4 by 4 by 4 feet, caved; "hungry looking."
20	a. Polly Wonder b. Little Maud c. Francis	4-15 tons high grade Ag ore.	a. N. 55° E., 65° SE b. N. 42° E., 70° SE c. N. 75° E. Vertical 1-11 feet thick, 550 feet of combined strike length.	Galena-sphalerite-arsenopyrite-siderite-tetrahedrite-polybasite, minor chalcopyrite quartz.	Has possibilities, along with 16, 17, 18, and 21-26, of being part of same vein system.
21	Silver Pick	None known.	Two veins. N. 88° E., 63° NW. and N. 65° SE., 47° SE., 1200-1400 feet of traceable strike length.	Galena-sphalerite-arsenopyrite-tetrahedrite-siderite quartz pods, also scorodite-quartz vein material.	Seraphim (1961) did a lot of work on this vein. Was impressed with potential tonnage but discouraged by general lack of high-grade ore pockets. Needs more work (underground).
22	Little Annie	715 tons of high-grade Ag ore.	N. 58° E.-trending vein, with steep SE. dip, 600 feet of traceable strike length, up to 27 feet thick	Galena-sphalerite-abundant siderite tetrahedrite-polybasite-arsenopyrite pharmacosiderite, quartz-azurite-malachite.	Ore mined was a very thick lense of massive sulfides at intersection of NE. fractures. Undoubtedly part of Gold Dollar-Gold Eagle vein system (fig. 4).

TABLE 4 (cont.)

Prospect or sulfide occurrence number	Name(s)	Production	Structure geologic description	Mineralogy	Pertinent remarks
23	Gold Dollar	638 tons high-grade Ag ore.	N. 65° E.-trending, 75° SE.-dipping vein, 4-15 feet thick, 400 feet of traceable strike length.	Pyrite-arsenopyrite-galena-sphalerite-siderite-polybasite-tetrahedrite-quartz and oxidized products.	Considerable tonnage of recoverable ore exposed in shaft. Was mined in 1973; may be mined again in 1976.
24	Gold Eagle	4 tons high-grade Ag ore.	N. 65° E.-trending, 75° SE.-dipping vein, 3-4 feet thick, 300 feet of traceable strike length.	Same as Gold Dollar (23).	Almost certainly extension of Gold Dollar claim, holds same potential.
25	75AST 1941	None recorded.	N. 40° E.-trending vein.	Siderite-pyrite-quartz.	Small caved prospect pit, did not yield high-grade sulfide material.
26	75AST 1942	None recorded.	N. 15° E.-trending vein, smaller veins shot through altered dike.	Pyrite and limonitic stain, minor siderite.	"Hungry looking" on surface.
27	Water Level claim (75AST 1982)	None recorded.	N. 70° E.-trending, 65° NW.-dipping vein 4-6 feet thick, much oxidation and shearing, 40 feet of vein trenched.	Galena-tetrahedrite-siderite, minor quartz, extensive oxidation (Cerussite + limonite).	High-grade silver show, should be prospected further.
28	Gold King	None recorded.	N. 80° E. vertical vein intrudes pCph, 4 feet thick.	Quartz-arsenopyrite-galena sphalerite.	Poorly exposed.
29	Pennsylvanian Keystone	None recorded.	Two veins, N. 30° E., steeply dipping, and N. 65° E., 85° SE, over 1400 feet of mineralized strike length.	Quartz-arsenopyrite-pyrite galena, free gold, scheelite.	Impressive strike length may warrant further examination, predominantly a (similar to Banjo Vein) gold-quartz vein
30	Sulphide claim	None recorded.	150 feet of strike length.	Quartz-pyrite-arsenopyrite scorodite-free gold.	Unexplored, poorly exposed.

TABLE 1 (cont.)

Prospect or sulfide occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
31	Banjo + Merry Widow	6,260 oz. gold, 7,113 oz. silver	Northeast-trending vein system cutting pCpn; several thousand feet of vertical extent.	Arsenopyrite-pyrite-scheelite-gold, minor galena-tetrahedrite-sphalerite-scorodite.	Largest lode producer in the Kantishna; several thousand tons of blocked ore left in workings at the time of WW II closure. Several thousand feet of underground workings are caved. Mill is largely intact and could be made operational.
32	Julen prospect	Not known	N. 38° E.-trending, 60° NW.-dipping vein, 4-11 feet wide, 150 feet of strike length traced.	Arsenopyrite-pyrite-scheelite-gold, minor tetrahedrite-galena-malachite, azurite, stibnite.	Poorly exposed; workings caved; needs additional work to redefine vein trace.
33	Flourence lode	Not known	N. 10° E. vertical vein, 1-1/2 to 3 feet thick, 35 feet of strike length exposed.	Galena-tetrahedrite-siderite, minor sphalerite-polybasite-malachite-azurite-anglesite-goethite-cerussite.	High-grade ore shoot with visible polybasite, virtually unexplored, surface showing indicates small vein.
34	(1949)	None recorded.	N. 40° E.-trending (dip unknown) vein trenched for 80 feet.	Major quartz and carbonate, minor fine-grained galena, arsenopyrite, pyrite.	Low-grade mineralized vein is poorly exposed. Hungry looking.
35	(75AST 1952)	Not known	N. 40° to 60° E.-trending, steeply dipping SE vein 1-4 feet thick.	Quartz-carbonate-siderite-galena-tetrahedrite-sphalerite.	Probably upper extension of vein 36, largely unexplored, good mineral shows.
36	Bosart prospect 75AST (1953)	Not known	N. 50° E. vertical vein intrudes pCh, 130 feet of strike length exposed.	Quartz-siderite-galena-tetrahedrite sphalerite, visible polybasite.	High-grade ore on dump, two assays averaged 230 ounces Ag/ton(1 ton of hand-picked ore on dump); one of the most promising galena silver prospects in the district.

TABLE 4 (cont.)

Prospect or sulfide occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
37	75AST 1955	None recorded.	N. 10° W.-trending steeply dipping vein 2 feet thick intrudes felsic phyllite (pCph)	Pyrite-galena-quartz-anglesite carbonate, minor sphalerite and oxidized products.	Small showing; good silver assays.
38	Eureka claim	None recorded.	————————	Reported galena-chalcopyrite-tetrahedrite-malachite azurite.	Did not visit this claim. Reported to have considerable copper.
39a	(75AST 1960)	None recorded.	N. 10° E.-trending (dip unknown) vein 3 10 feet thick.	Pyrite-quartz, minor arsenopyrite.	Three trenches expose large vein system over about 150 feet. Appears only weakly mineralized.
39b	(75AST 1959)	None recorded.	N-S vertical zone 3-8 feet thick (pCph).	Pyrite-quartz.	Silicified-pyritized zone may not be straightforward vein. Appears weakly mineralized.
40	Weiler prospect	Not known.	N. 40° E.-trending, 60°-70° SW.-dipping vein 1-3 feet thick, 50 feet traceable strike length; intrudes pCm.	Galena-tetrahedrite-polybasite-quartz, minor sphalerite.	Very high grade ore shoot appears limited in extent, deserves additional exploration. Assays 3oz. Au/ton.
41	75AST 1964	None recorded.	N. 50° E.-trending, 30° NW.-dipping zone 1-4 feet thick, intrudes pCm.	Pyrite quartz.	Very similar to 39b, appears weakly mineralized.
42	a. 75AST 2960 b. 2964	None recorded.	a. N. 30° W. vertical vein. b. Veins intrudes chloritic felsic schists.	a. Arsenopyrite-pyrite quartz. b. Arsenopyrite-quartz.	Little known about mineralization.
43	75AST 1974	None recorded.	N. 20°-40° W.-trending vertical vein 5 feet thick.	Arsenopyrite-pyrite-quartz.	Small prospect pit discloses only weak mineralization.

TABLE 4 (cont.)

Prospect or sulfide occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
44	McGonogill	2 tons milled yielded several tens of oz. of gold.	N. 58° E.-trending 34° NW.-dipping 8 feet thick, 250+ feet of strike length, cuts pCm. Vein faulted left laterally.	Arsenopyrite-pyrite-quartz, minor galena + sphalerite increasing galena-sphalerite with depth.	Very high gold assays in earlier days. Some ore was milled. Promising prospect; deserves more work.
45	Arkansas(?) claim	Not known.	Poorly exposed vein in distinctly porphyroblastic phyllite (pCph).	Arsenopyrite and quartz + scorodite.	Earlier assays showed strong silver values. Prospect too caved to see anything; has been trenched with dozer.
46	Pension	Not known.	N. 70° E.-trending vertical vein 1-4 feet thick, 150 feet of strike length exposed; intrudes pCph.	Arsenopyrite-boulangerite pyrite-quartz, minor galena.	Excellent exposures of extensively mineralized vein that is offset left laterally for a few feet in three zones; deserves a reopening of caved adit.
47	Glenn	Not known.	N. 80°-85° E.-trending nearly vertical vein up to 10 feet thick, +700 feet of mineralized strike length; intrudes phyllite of pCph.	Arsenopyrite-pyrite-galena sphalerite-jamsonite-K-spar.	Tunnels driven 1906-09 disclosed extensive mineralization with 200 vertical feet of sulfide-bearing vein; warrants more work. Tunnels are caved.
48	Glenn Ridge I	None recorded.	N. 20°-40° W.-trending vein system 4-30 feet thick. Dips 65° SW; 700-1000 feet exposed strike length.	Arsenopyrite-pyrite-scheelite(?) scorodite-quartz.	Entire ridge is covered with large quartz vein shear zone Potential for larger low-grade gold-producing operation; mineralization on the surface is not strong. Should be explored.

TABLE 4 (cont.)

Prospect or mineral occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
49	75AST 2018-19	None recorded.	N. 25°-45° E.-trending; no dip measured on 2-foot-thick vein intruding pCh.	Siderite-boulangerite-pyrite-quartz.	Small weakly mineralized vein, "hungry looking" on the surface; unexplored.
50	Last Chance lode or Caribou lode	75 tons high-grade Sb concentrates.	N. 15°-20° E.-trending, 50° NW.-dipping vein 2-6 feet thick; taped for strike distance of 550 feet.	Stibnite-pyrrhotite jamsonite-pyrite-quartz. Carries some gold.	Mining active today (1975); small concentrator has 60-80 tons of ore on mine sight. Excellent potential for small-scale future mineral production.
51	75AST (1861)	None recorded	Poorly exposed N. 20°-50° E.-trending strike of vein; 100 feet of traceable material intrudes μCn.	Pyrite-quartz extensive limonitic stain.	Unexplored occurrence is weakly mineralized on surface.
51a	Home lode	None recorded.	Vein deposit.	Stibnite-quartz.	Approximate location not visited. Earlier descriptions do not sound encouraging.
52	Lloyd prospect	None recorded.	Quartzite band 3-10 feet thick in chloritic greenstone schist rock, traceable for 150 feet.	Chalcopyrite, sphalerite-magnetite.	Apparently a premetamorphic sulfide occurrence with bands of sulfides folded with country rock. Small adit 40 feet long.
53	(75AST 1971)	None recorded.	Poorly exposed vein deposit.	Arsenopyrite-quartz, minor galena.	Poorly exposed adit driven in 1912 is now caved.
54	75AST 1815a	None recorded.	N. 75°-85° E.-trending (dip unknown) silicified zone 4-15 feet thick. Traced for 2500 feet of discontinuous strike length.	Pyrite-quartz-stibnite, very minor galena.	Impressive strike length of low-grade mineralization. Deserves detailed geochemical-geophysical survey.

TABLE 4 (cont.)

Prospect or sulfide occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
55	75AST 1815b	None recorded.	N. 60°-75° E.-trending near-vertical silicified zone 15 feet wide in saddle.	Arsenopyrite-quartz, minor pyrite, kaolinite.	Impressive show of massive arsenopyrite mineralization in large shear zone. Deserves more work, unexplored.
56 (1)	1) Humbolt Ridge-top claim	None recorded.	1) N. 55° E.-trending vertical quartz vein 6 feet thick.	1) Pyrite-pyrrhotite-quartz, minor arsenopyrite.	Humbolt looks "hungry," but has impressive vein width.
56a(2)	2) Silver Wire	None recorded.	2) N. 60°-70° E.-trending, 80° SE.-dipping vein, 5 feet thick; poorly exposed on surface.	2) Galena-tetrahedrite-pyrite-quartz.	Silver Wire showed good silver values in earlier years. Apparently has discontinuous mineralization along strike.
57	Lucky Jim(?)	None recorded.	N. 40° E. silicified zone, poorly exposed.	Quartz-pyrite, minor galena + chalcopyrite.	Free gold reported from this prospect. Poorly exposed vein.
58	75AST 1882		NE.-trending silicified gossan zone about 6 feet wide; 250 feet long subparallel to schistocity.	Pyrite-quartz-feldspar vanadinite(?)-limonitic gossan.	Extensive limonitic gossan contains iron sulfides.
59	75AST 1884	None recorded.	Same as 58.	Same as 58.	This lines up with 1881. If so, implication of 2500-3000 feet of gossan; should be geochemically explored.
60	75AST 3061	None recorded.	Two-foot vein intrudes pCm unit.	Stibnite-galena-sphalerite-quartz.	New prospect completely unexplored. Surface showings are small.
61	75AST 2922	None recorded.	Sulfide zone 4-6 feet thick in pCg and pCh units; does not appear to be a vein; parallel to foliation.	Pyrite-chalcopyrite-malachite-azurite.	Desseminated sulfide bands in greenstone schists. Deserves close examination and sampling.

TABLE 4 (cont.)

Prospect or sulfide occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
62	75AST 1914	None recorded.	NE.-trending vein swarm 25-30 feet thick intrudes pCh; at least 350 feet of strike length.	Major pyrite-quartz, minor galena.	Low-grade mineralization, previously unreported, should be sampled in detail.
63	2825	None recorded.	Dessemin[a]ted sulfide mineralization in gabbro dike swarm (Tgab); traced for 2,000 feet.	Minor chalcopyrite, malachite.	Low-grade mineralization should be sampled for extent and grade. Suggests primary sulfide source in igneous rock.
64	2832	None recorded.	N. 30° E.-trending, 20° NW.-dipping sulfide mash vein <1 foot thick subparallel to foliation; 6 feet of exposure.	Massive stibnite, minor quartz.	Previously unreported antimony occurrence looks small, area could be explored. Prominent depression 100 feet beyond exposure.
65a	1530	None recorded.	Small 1-foot-thick quartz vein subparallel to schistocity of graph schist.	Disseminated chalcopyrite, pyrite, minor malachite stain.	Unreported copper occurrence in vein SW of Stampede - small showing. Contains copper, zinc, silver.
65b	1541	None recorded.	Quartzite veins with quartz, abundant limonite-trending zone N. 35° E. and dipping 45° SE. for 300 feet.	Pyrite-limonite.	Large silicified zone contains antimony (E. Pilgrim, pers. comm). Deserves detailed sampling.
66	**Stampede mine**	3590 tons high-grade ores + concentrates.	Large cross-cutting northeast-trending veins controlled by Stampede fault. Several thousand feet of mineralized strike length.	Major stibnite-quartz, minor pyrite-pyrrhotite-sphalerite gold.	Stampede vein system still holds economic-grade ore. DMEA project drilled underground and intersected two high-grade shoots, which have never been developed. Potential for mining extensive tonnage of lower grade ore (8-15% Sb).

TABLE 4 (cont.)

Prospect or sulfide occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
66 continued					Natural weathering of "surface ore body" contains 1000+ tons of 12% Sb. Stampede fault 1 mile southwest of mine is anomalous in Mo, Zn, and Ag. Includes five patented claims.
66a	Kobuk lode	170 tons high grade (included in above figure).	Same as above.	Same as above.	Same as above.
67	Upper Ridge	Several tons high grade.	Quartz vein swarm 30-50 feet wide on ridge; extends for several hundred feet.	Major quartz + pyrite, minor stibnite.	Potential low-grade antimony deposit.
68	1600a	None recorded.	Desseminated sulfide in schist.	Minor chalcopyrite malachite.	Weak copper showing.
69	"Little Caribou" prospect	None recorded.	Contact metamorphic deposit in carbonate skarn, 3-5 feet wide on surface, 550 feet long; erratic mineralization. No intrusive exposed.	Pyrite chalcopyrite-magnetite ilmenite(?), epidote-sphalerite(?), massive hematite.	Sporadic sulfide shows on surface doesn't appear extensive; 0.3% zinc content with anomalous lead, silver, copper. Stream sediments below hill show strong zinc anomalies. Needs detailed geochemical-geophysical work.
70	75AST 37 (gossan 1)	None recorded.	Heavily pyritized meta-volcanic gossan zone 1/4 - 1/2 mile wide and up to 6 miles long; primary sulfide occurrence.	Major pyrite with local exsolved blebs of sphalerite in pyrite (polished section).	An important mineral appraisal target in the Kantishna Hills. Some volcanic zones may constitute low-grade zinc deposits. May be strataform or related to low-angle fault zones

TABLE 4 (cont.)

Prospect sulfide occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
71	(gossan 2)	None recorded.	Same as above.	Same as above.	Same as above.
72	(gossan 3)	None recorded.	Same as above.	Same as above.	Same as above.
73	Quartz lode I (75AST 1754)	None recorded.	N. 40° W.-trending, 70° SW.-dipping vein system in massive outcrop of Totatlanika rhyolite (Prhy) vein 2-4 feet thick, trends up cliff face.	Chalcopyrite-galena malachite quartz vein.	Looks low grade. Previously unreported.
74	75AST 1714	None recorded.	N. 20°-40° W.-trending vertical vein system 1-3 feet wide in Totatlanika rhyolite (Prhy); 250 feet of gossan on slope.	Galena-sphalerite-extensive limonitic boxwork structure, minor cerussite.	Appears low grade as above. Previously unreported.
75	75AST 2765	None recorded.	Gossan zone subparallel to strike of unit in Pvs unit, similar to occurrences 70-72. Could be related to low-angle fault zone.	Pyrite-limonite, minor chalcopyrite.	Previously unreported occurrence. Should be looked at in detail.
76	75AST 2771	None recorded.	N. 20°-50° W. vertical vein in Pvs unit in known extent.	Quartz-calcite-pyrite minor chalcopyrite.	Previously unreported occurrence.
77	Chitsia Mtn.	None recorded.	Silicified gossan zone near contact between Pvs and Prhy. Float indicates 15- feet wide. Several hundred feet in strike length.	Barite-quartz-galena-pyrite, minor sphalerite.	This occurrence shows up to 3% Pb, 1% Zn, and 30 ppm Ag; large zone should be examined and sampled. Barite-pyrite vein 100 yards west of gossan.

TABLE 4 (cont.)

Prospect or sulfide occurrence number	Name(s)	Production	Structure, geologic description	Mineralogy	Pertinent remarks
78	Quartz lode 2	None recorded.	N. 55° E.-trending, 55° SE.-dipping complex vein system completely shot through Prhy. Some veins are slightly mineralized.	Galena-limonite-quartz.	Appears low grade, but serves to exemplify mineralized nature of large areas of silicified Prhy (73-74). Rhyolite porphyries in general. May hold large low-grade mineral potential.

Sources of information: Capps, 1916, 1919; Moffit, 1932; Saunders, 1964; Seraphim 1961; Stewart, 1922; Wells, 1933; field work and polished section studies DGGS, 1975; X-ray diffraction studies, DGGS, N. Veach, 1975.

TABLE 5 Compiled Assay Values for Mineral Occurrences in the Kantishna Hills
(See table 4a for descriptions)

Number	Source	Copper (%)	Lead (%)	Zinc (%)	Silver oz/ton	Gold oz/ton	Molybdenum (%)	Antimony (%)	Remarks
1	ADGGS, 1975	tr	.06	.036	tr	tr	tr	40.8	Grab samples from open cut
		.016	.36	tr	tr	tr	tr	25.9	
		tr	.18	.019	tr	tr	tr	23.0	
2		No	assay		information				
3		No	assay		information				
4	ADGGS, 1975	.018	10.3	4.8	19.2	tr	tr	.60	Chips across 26 inches of vein, upper adit.
		.05	20.3	15.2	37.9	tr	tr	1.23	
		.05	10.0	5.1	22.7	tr	tr	1.57	
		.06	.84	34.0	8.2	tr	tr	.40	
	Saunders, 1964	- - -	- - -	- - -	11.9	tr	- -	- - -	Chip sample
	Morrison, 1964	- - -	- - -	- - -	11.1	.04	- -	- - -	Chip samples
		- - -	- - -	- - -	44.96	.04	- -	- - -	
5		No	assay		information				
6	ADGGS, 1975	.01	.06	.02	1.72	tr	tr	28.5	Chip sample across vein
7	ADGGS, 1975	tr	.31	.01	.21	.01	tr	46.5	Chip sample of high grade
8	ADGGS, 1975	tr	tr	tr	.81	tr	tr	14.1	
9	ADGGS, 1975	.57	8.65	2.75	62.7	tr	tr	4.36	Grab samples in caved trenching
		.10	2.02	5.83	17.5	tr	tr	1.22	
		.50	15.4	1.05	20.5	tr	- -	9.3	
	Wells, 1933	- - -	5.46	- - -	374.2	.01	- -	- - -	10 tons averaged 200 oz/ton
10		No	assay		information				
11	ADGGS, 1975	tr	.01	.05	.13	tr	tr	tr	Chip sample
12		No	assay		information				
13	Wells, 1933	- - -	- - -	- - -	6.4	.0[illegible]	- -	- - -	- - -

TABLE 5 (Cont.)

Number	Source	Copper (%)	Lead (%)	Zinc (%)	Silver oz/ton	Gold oz/ton	Molybdenum (%)	Antimony (%)	Remarks
14	ADGGS, 1975	tr	.27	.01	.92	.05	tr	51.5	Grab sample of ore
15	Seraphim, 1961	.08	16.97	- - -	4.88	.02	- -	- - -	
16	Seraphim, 1961	.24	5.49	- - -	51.48	.18	- -	- - -	Grab sample
	Bureau of Mines (1961)	.34	.06	.05	69.51	.01	- -	10.93	Grab sample
17	Wells, 1933	- - -	22.0	- - -	284.20	.08	- -	- - -	Grab sample
18	Wells, 1933	- - -	26.0	- - -	237.0	1.1	- -	- - -	Average of 182 tons, ore
	Seraphim, 1961	.08	40.57		119.06	.4	- -	- - -	Red Top Dump
	Bureau of Mines (1961)	.41	6.0	8.27	87.67	.65	- -	.50	Red Top Dump
19	Bureau of Mines (1961)		1.55	63.7	524.24	.12	- -	1.84	Channel, Little Maud
20	Seraphim, 1961	.08	3.73	- - -	16.44	.30	- -	- - -	Channel Sample
21	Seraphim, 1961 (a)	.24	1.04	- - -	144.14	.56	- -	- - -	20 inch channel sample
	(b)	.48	9.93	- - -	133.92	.12	- -	- - -	Grab sample south extension
	(c)	.24	3.31	- - -	89.28	1.22	- -	- - -	18 inch channel near (a)
22	ADGGS, 1975	.17	2.7	.28	19.0	tr	tr	.16	
		.18	1.86	1.57	18.9	.06	tr	.05	Grab sample
	Bureau of Mines	1.55	36.3	1.56	396.03	.21	- -	1.59	Grab sample
		.26	24.0	.79	80.74	.19	- -	.70	Grab sample
	Seraphim, 1961	tr	tr	- - -	.64	.30	- -	- - -	Channel S.
23	Seraphim, 1961	.32	35.19	- - -	159.58	.20	- -	- - -	Grab sample
	Bureau of Mines	.90	4.6	37.7	140.87	.18	- -	.90	Grab sample
		.41	11.0	5.55	62.09	.11	- -	.47	Grab sample
	ADGGS, 1975	.25	7.2	10.5	39.70	.08	tr	.08	Grab sample
		.25	5.48	5.0	12.70	.15	tr	.06	Grab sample
24	Seraphim, 1961	.10	15.11	- - -	73.04	.32	- -	- - -	Channel cut sample
25	ADGGS, 1975	tr	.03	.02	.22	tr	tr	tr	Grab sample

TABLE 5 (Cont.)

Number	Source	Copper (%)	Lead (%)	Zinc (%)	Silver oz/ton	Gold oz/ton	Molybdenum (%)	Antimony (%)	Remarks
26	ADGGS 1975	tr	.02	.02	tr	tr	tr	tr	Grab sample
27	ADGGS 1975	.23	8.6	7.5	55.47	.02	tr	.18	Channel sample across three feet of vein.
	Seraphim, 1961	.24	1.24	- -	.68	.02	- -	- - -	Float
28	Seraphim, 1961	.88	14.49	- -	152.90	.20	- -	- - -	Grab sample near collar of shaft
29	Davis, 1922	- - -	- - -	- -	1.60	- -	- -	- - -	Channel across 14 inches of vein
		- - -	- - -	- -	.20	.86	- -	- - -	Near old shaft
30	ADGGS, 1975	- - -	- - -	- -	.22	.06	- -	- - -	Float
31	ADGGS, (compiled)	- - -	- - -	- -	.52	.46	- -	- - -	Average tenour of 13,600 tons of ore (see table 3)
32	Bureau of Mines	- - -	- - -	- -	.15	tr	- -	- - -	Grab from ore pile
		- - -	- - -	- -	.01	tr	- -	- - -	Grab from ore pile
		.52	2.22	6.00	43.13	.02	- -	.18	Grab from ore pile
33	ADGGS, 1975	1.4	46.3	1.1	29.1	tr	tr	2.87	Grab sample
	Bureau of Mine (1961)	1.55	70.0	1.49	54.42	tr	- -	3.10	Grab sample
34	ADGGS, 1975	tr	.02	.04	tr	tr	tr	.74	Chip sample across vein
35		No	assay		information				
36	ADGGS, 1975	6.6	24.5	.38	223.35	0.1	tr	15.4	Chip sample in cut high graded
		.34	76.0	1.56	71.2	tr	tr	.94	
37	ADGGS, 1975	.08	52.0	.13	78.5	.04	tr	.38	Grab sample
38	Bureau of Mines (1961)	.03	63.7	1.73	117.54	.08	tr	2.12	Grab sample
39a b		No	assay		information				

TABLE 5 (Cont.)

Number	Source	Copper (%)	Lead (%)	Zinc (%)	Silver oz/ton	Gold oz/ton	Molybdenum (%)	Antimony (%)	Remarks
40	ADGGS, 1975	.03	3.83	.01	13.7	2.99	.01	.05	Chip sample across vein
41		No	assay		information				
42		No	assay		information				
43	ADGGS, 1975	.02	tr	.03	.02	tr	.01	.01	Gossanized chips
44	ADGGS, 1975	tr	2.2	.45	1.41	.10	tr	1.1	Gossan chips in trench
		tr	.68	.52	.86	.03	tr	.58	Gossan chips in trench
	Bureau of Mines	- - -	- - -	- -	.25	.17	- -	- - -	Grab sample
	Seraphim, 1961	- - -	- - -	- -	2.24	.24	- -	- - -	Channel across 1 foot vein
45	Davis, 1922	- - -	- - -	- -	.90	- -	- -	- - -	Also considerable sphalerite-stibnite recognized
46	ADGGS, 1975	tr	.71	.14	1.36	.08	tr	.74	Chips in vein
47	ADGGS, 1975	.05	7.20	.02	5.40	.01	.01	3.36	Grabs of weathered ore
	Seraphim, 1961	- - -	- - -	- -	.76	.04	- -	- - -	Grab from dumps
48	Seraphim, 1961	- - -	- - -	- -	2.14	.08	- -	- - -	Grab of weathered mineralization
	ADGGS	tr	.73	.02	3.30	.03	.01	.02	Chip samples from individual
		tr	.24	.25	6.10	.02	tr	.40	prospelt holes over several hundred
		tr	.35	.31	6.13	.02	tr	.09	feet of strike length
		.02	.78	.07	16.3	.28	tr	.10	
49	ADGGS, 1975	.05	3.5	2.6	9.37	tr	.01	1.2	High graded from float
50	ADGGS, 1975	.01	.03	tr	.03	.01	tr	36.4	High grade ore
51	ADGGS, 1975	tr	tr	tr	tr	tr	tr	tr	Chip sample pyrite rich
52	ADGGS, 1975	2.16	.09	3.98	.97	.01	tr	tr	High graded
53		No	assay		information				
54	ADGGS, 1975	tr	.13	.03	.45	.01	tr	.23	Weathered chip sample
55		No	assay		information				

TABLE 5 (Cont.)

Number	Source		Copper (%)	Lead (%)	Zinc (%)	Silver oz/ton	Gold oz/ton	Molybdenum (%)	Antimony (%)	Remarks
56	ADGGS, 1975	(1)	tr	.01	tr	.23	.01	tr	tr	Chip samples from veins
		(2)	tr	.01	tr	.33	.22	tr	tr	
57			No	assay		information				
58			No	assay		information				
59			No	assay		information				
60	ADGGS, 1975		.30	1.43	.20	.14	.22	tr	.02	Chips
61	ADGGS, 1975		.04	tr	tr	tr	tr	tr	tr	Gossan sample
62	ADGGS, 1975		.01	.18	.08	.05	tr	tr	.03	Chip sample
63	ADGGS, 1975		.02	tr	.04	1.6	.01	tr	.01	
64	ADGGS, 1975		.01	.74	.02	.33	tr	tr	64.0	High grade sample
			tr	.01	.01	tr	.02	tr	1.19	Gossan
65	ADGGS, 1975		.04	.03	.01	1.28	tr	tr	tr	Grab sample
66	ADGGS, 1975		.01	.06	.02	.09	.01	tr	47.5	
			.01	.04	.08	.13	.11	tr	25.3	
66a			tr	.01	tr	.05	.02	tr	26.2	
			tr	tr	tr	.17	.23	tr	30.8	
67	ADGGS, 1975		.01	.03	.03	.20	.06	tr	14.5	Grab of weathered gossan
			.02	.03	1.2	.02	tr	tr	.03	
68			No	assay		information				
69	ADGGS, 1975		.01	tr	.03	.01	.03	tr	tr	
			tr	.10	.37	.17	.01	tr	tr	
			tr	.04	.15	.01	tr	tr	tr	
70	ADGGS, 1975		.01	.02	.16	.02	tr	tr	tr	Grab samples of gossan zones
71	ADGGS, 1975		tr	tr	.52	.01	tr	tr	tr	Grab samples of gossan zones
			tr	.06	.16	.03	tr	tr	.01	Grab samples of gossan zones

TABLE 5 (Cont.)

Number	Source	Copper (%)	Lead (%)	Zinc (%)	Silver oz/ton	Gold oz/ton	Molybdenum (%)	Antimony (%)	Remarks
72	ADGGS, 1975	.01	.01	.21	.02	tr	tr	tr	Grab sample
73	ADGGS, 1975	.65	.01	tr	.14	tr	tr	tr	Grab sample
74	ADGGS, 1975	.01	10.5	.01	2.72	tr	.01	.02	Weathered chip sample and float
	ADGGS, 1975	tr	.17	.04	.09	tr	tr	tr	
75	ADGGS, 1975	.04	.04	.05	.01	tr	tr	tr	Rock chips and float
76	ADGGS, 1975	.01	.01	.01	.96	.09	.01	.45	Grab sample
77	ADGGS, 1975	.02	3.1	.05	.67	tr	tr	tr	Grab sample
78	ADGGS, 1975	tr	.01	.02	.05	.01	tr	tr	Grab sample

tr = a) < .01
b) < .01 oz/ton
- = No information

TABLE 6.
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
1	75Ast 1769	23	22	68	0.10	ND	1	11	Sed.
2	75Ast 1766	27	19	93	ND	ND	1	ND	Sed.
3	75Ast 1765	20	14	63	ND	ND	1	ND	Sed.
4	75Ast 1767	36	25	123	0.30	0.06	1	ND	Sed.
5	75Ast 1768	37	25	137	0.20	ND	1	ND	Sed.
6	75Ast 1763	24	20	80	ND	ND	ND	4	Sed.
7	75Ast 1762	30	30	108	0.10	ND	1	ND	Sed.
3	75Ast 1332	28	35	86	0.30	ND	ND	14	Sed.
9	75Ast 1333	30	20	160	4.00	ND	ND	3	Sed.
10	75Ast 1335	14	25	58	0.10	ND	11	3	Sed.
11	75Ast 1334	33	23	123	0.20	0.03	25	ND	Sed.
12	75Ast 1336	47	40	140	2.00	ND	ND	ND	Sed.
13	75Ast 1337	31	24	146	0.10	ND	24	ND	Sed.
14	75Ast 1784	27	25	84	ND	ND	ND	1	Sed.

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ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
15	75Ast 1785	34	24	125	1.10	0.03	ND	ND	Sed.
16	75Ast 1770	30	25	114	ND	ND	2	ND	Sed.
17	75Ast 1772	17	8	80	0.20	0.05	ND	ND	Sed.
18	75Ast 1771	33	20	136	0.20	0.07	1	ND	Sed.
19	75Ast 2809	24	12	252	ND	ND	ND	ND	Sed.
20	75Ast 1416	34	26	131	0.30	0.05	3	ND	Sed.
21	75Ast 1405	31	26	82	ND	ND	1	10	Sed.
22	75Ast 1773	40	20	100	0.30	0.07	1	9	Sed.
23	75Ast 2753	36	24	222	0.20	ND	ND	ND	Sed.
24	75Ast 2732	36	30	138	ND	ND	1	ND	Sed.
25	75Ast 2731	24	20	96	ND	0.04	ND	ND	Sed.
26	75Ast 2730	32	26	116	ND	ND	ND	ND	Sed.
27	75Ast 2735	34	22	72	ND	ND	ND	ND	Sed.
28	1706+ 75Ast(2707)	34	22	272	ND	ND	ND	ND	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
29	75Ast 1709	25	11	91	0.40	ND	2	ND	Sed.
29a	75Ast 1707	34	20	224	0.20	ND	5	4	R
29b	75Ast 1703								R
30	75Ast 1726	37	33	140	0.30	ND	4	2	Sed.
31	75Ast 1722	30	32	166	0.20	ND	2	ND	Sed.
32	75Ast 1750	44	23	52	ND	ND	3	2	Sed.
33	75Ast 1755	31	25	133	ND	ND	2	3	Sed.
34									
35									
36									
37	75Ast 1758	27	26	80	ND	ND	1	ND	Sed.
38	75Ast 1757	34	28	144	ND	ND	2	ND	Sed.
39	75Ast 1313	27	22	84	0.10	ND	ND	ND	Sed.
40	75Ast 1314	40	22	100	1.00	ND	ND	ND	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
41	75Ast 1420	22	21	93	ND	ND	1	ND	Sed.
42	75Ast 1312	32	22	184	0.40	ND	2	ND	Sed.
43	75Ast 1311	43	16	188	0.30	.03	11	2	Sed.
44	75Ast 2792	42	18	290	0.10	ND	4	2	Sed.
44a	75Ast 2793a	12	43	65	ND	ND	15	1	Sed.
45	75Ast 1643	30	20	128	0.20	ND	2	2	Sed.
46	75Ast 1644	86	30	810	ND	ND	2	ND	Sed.
47	75Ast 1645	52	56	1042	ND	ND	8	ND	Sed.
48	75Ast 1646	60	22	456	.60	ND	6	ND	Sed.
49	75Ast 2660	25	18	110	ND	0.01	2	3	Sed.
50	75Ast 1647	44	30	634	1.0	ND	6	ND	Sed.
51	75Ast 2662								
52	75Ast 1745	42	36	488	0.60	ND	6	ND	Sed.
53	75Ast 1740	72	40	736	0.20	ND	4	ND	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
54									
55									
56	75Ast 1661	32	24	124	0.20	ND	2	8	Sed.
57	75Ast 1739	37	24	422	ND	ND	1	ND	Sed.
58	75Ast 1746	54	34	414	0.40	ND	4	4	Sed.
59	75Ast 1660	24	17	107	ND	ND	1	ND	Sed.
60	75Ast 1696	35	23	103	0.20	ND	ND	15	Sed.
61	75Ast 2704	36	24	122	ND	ND	2	18	Sed.
62	75Ast 1678	35	23	103	0.20	ND	ND	15	Sed.
63	75Ast 2701	30	30	110	ND	ND	2	ND	Sed.
64	75Ast 2698	40	32	156	ND	.04	ND	12	Sed.
65	75Ast 2699	40	26	128	ND	ND	2	28	Sed.
66	75Ast 1404	34	28	124	ND	ND	2	ND	Sed.
67	75Ast 1397	28	20	266	0.20	0.04	1	ND	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
68	75Ast 1399	27	24	131	18.2	ND	1	40	Sed.
69	75Ast 1398	27	16	119	0.20	0.03	3	ND	Sed.
70	75Ast 1395	26	30	193	0.10	0.01	1	1	Sed.
71	75Ast 1394	29	17	120	0.10	.05	3	ND	Sed.
72	75Ast 1392	29	21	170	ND	ND	ND	ND	Sed.
73	75Ast 1393	38	21	334	.10	.01	1	3	Sed.
74	75Ast 1305	84	44	203	.20	ND	5	ND	Sed.
75	75Ast 1306	39	22	177	ND	ND	3	ND	Sed.
76	75Ast 1307	34	25	115	0.20	.04	4	3	Sed.
77	75Ast 1309	29	21	244	0.30	ND	5	ND	Sed.
78	75Ast 1308	37	24	188	0.20	ND	ND	ND	Sed.
79	75Ast 1304	33	22	130	ND	ND	2	3	Sed.
80	75Ast 1303	25	21	117	0.20	ND	ND	ND	Sed.
81	75Ast 1292	26	20	111	0.10	ND	1	2	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
82	75Ast 1291	34	24	120	0.10	ND	1	ND	Sed.
83	75Ast 1293	20	24	70	0.20	ND	ND	1	Sed.
84	75Ast 1297	26	24	91	0.30	.03	1	3	Sed.
85	75Ast 1296	29	21	90	0.40	.02	1	9	Sed.
66	75Ast 1295	19	23	65	0.10	.03	ND	33	Sed.
87	75Ast 1294	20	17	65	0.30	ND	23	3	Sed.
88	75Ast 1289	29	20	160	0.20	.06	2	1	Sed.
89	75Ast 1285	21	18	91	0.20	ND	26	7	Sed.
90	75Ast 1286	28	16	77	ND	.06	34	6	Sed.
91	75Ast 1284	23	27	155	0.10	.02	26	7	Sed.
92	75Ast 1283	22	19	99	0.20	ND	ND	3	Sed.
93	75Ast 1282	21	19	231	0.10	ND	1	ND	Sed.
94	75Ast 1281	23	19	105	ND	ND	1	2	Sed.
95	75Ast 1428	18	15	65	0.30	.02	ND	ND	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
96	75Ast 1425	36	18	177	1.20	.03	8	ND	Sed.
97	75Ast 1423	43	33	125	.30	ND	2	ND	Sed.
98	75Ast 1422	—	26	83	.30	ND	1	ND	Sed.
99	75Ast 1421	32	24	111	ND	ND	2	ND	Sed.
100	75Ast 1278a	21	30	56	0.50	ND	27	3	Sed.
101	75Ast 1279	19	19	101	0.30	ND	1	ND	Sed.
102	75Ast 1279a	24	26	144	0.80	ND	2	ND	Sed.
103	75Ast 1280	21	21	130	ND	ND	3	ND	Sed.
104	75Ast 1280a	19	15	82	ND	ND	2	ND	Sed.
105	75Ast 1277	23	13	60	ND	ND	20	2	Sed.
106	75Ast 1275	28	15	118	0.30	ND	3	ND	Sed.
107	75Ast 1274	34	22	140	0.60	ND	1	ND	Sed.
108	75Ast 1273	24	17	100	0.20	ND	3	ND	Sed.
109	75Ast 1272	23	21	105	0.10	ND	3	ND	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
110	75Ast 1373	26	23	117	ND	ND	3	ND	Sed.
111	75Ast 1374	30	18	90	ND	ND	ND	1	Sed.
112	75Ast 1375	32	22	117	ND	ND	1	3	Sed.
113	75Ast 1386	23	20	105	0.10	.02	ND	1	Sed.
114	75Ast 1385								
115	75Ast 1382	29	22	102	0.10	ND	1	1	Sed.
116	75Ast 1381	13	14	65	ND	ND	ND	ND	Sed.
117	75Ast 1387	22	13	76	0.30	.03	1	ND	Sed.
118	75Ast 1389	17	15	84	0.10	.02	ND	ND	Sed.
119	75Ast 1390	22	15	82	0.20	ND	1	ND	Sed.
120	75Ast 1388	19	16	72	ND	.07	1	11	Sed.
121	75Ast 1380	21	15	90	0.20	ND	1	ND	Sed.
122	75Ast 1391	22	17	79	ND	ND	1	ND	Sed.
123	75Ast 1379a	32	16	107	0,30	,06	ND	ND	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
124	75Ast 1349	25	11	71	0.10	.03	16	3	Sed.
125	75Ast 1349a	13	16	92	ND	ND	1	ND	Sed.
126	75Ast 1379b	32	22	124	0.20	ND	1	ND	Sed.
127	75Ast 1629	25	22	149	ND	ND	3	5	Sed.
128	75Ast 1377	22	20	119	0.40	.06	2	1	Sed.
129	75Ast 1628	19	10	117	ND	ND	2	ND	Sed.
130	75Ast 1377b	32	22	124	0.20	ND	1	ND	Sed.
131	75Ast 1627	83	13	178	0.90	ND	<u>38</u>	ND	Rock
132	75Ast	30	18	110	0.20	.03	2	ND	Sed.
133	75Ast 1622.2	36	24	96	ND	<u>.24</u>	ND	ND	Sed.
134	75Ast 1623	26	20	161	ND	ND	1	5	Sed.
135	75Ast 1622.1	30	18	110	0.20	.03	1	ND	Sed.
136	75Ast 1620	30	18	110	0.20	.03	2	ND	Sed.
137	75Ast 1619	46	<u>290</u>	14	0.40	ND	14	23	Rock

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
138a	75Ast 2593a	26	20	78	ND	.25	1	5	Rock
138b	75Ast 2593b	52	40	212	1.60	.16	ND	ND	Rock
138c	75Ast 2593c	32	19	26	ND	ND	32	5	Rock
138d	75Ast 2593d	38	30	48	ND	.06	85	5	Rock
139	75Ast 1631	23	18	150	ND	.03	3	ND	Sed.
140	75Ast 1360	19	12	68	ND	ND	37	ND	Sed.
141	75Ast 1359	51	21	333	0.20	.07	2	5	Sed.
142	75Ast 1605	300	108	1804	0.80	0.12	12	ND	Sed.
143	75Ast 1604	9	4	5	ND	0.08	61	0	Rock
144	75Ast 2590	13	9	13	ND	0.04	51	0	Rock
145	75Ast 2584	75	39	120	ND	0.07	32	5	Rock
146	75Ast 2584 3	50	15	220	2.00	ND	ND	100	Rock
147	75Ast 2584 5	18	13	48	ND	ND	20	ND	Rock
148	75Ast 2584 2	30	30	124	ND	ND	4	ND	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
149		31	7	33	ND	.06	21	ND	Rock
150	75Ast 2571	11	12	36	0.25	ND	2	10	Rock
151	75Ast 2567	22	30	125	ND	.08	5	10	Rock
152	75Ast 1632	30	19	186	ND	0.50	1	ND	Sed.
153	75Ast 1570	29	22	151	.30	.02	1	ND	Sed.
154	75Ast 2564	32	24	126	ND	ND	ND	2	Sed.
155	75Ast 20	32	29	170	ND	ND	2	ND	Rock
156a	75Ast 1583	11	5	9	ND	ND	41	ND	Rock
156b	75Ast 1586	23	21	35	0.20	ND	23	5	Rock
156c	75Ast 1588	30	17	10	ND	.150	31	ND	Rock
156d	75Ast 1590	13	9	13	ND	.04	51	ND	Rock
157a	75Ast 16	34	17	62	0.20	.01	1	ND	Rock
157b	75Ast 15	17	17	50	.20	ND	38	ND	Rock
158	75Ast 2576	31	7	33	ND	0.06	21	ND	Rock

TABLE 6
ATOMIC ABSORPTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
159	75Ast 2594	60	40	170	2.00	ND	ND	20	Sed.
160	75Ast 1268	17	8	120	0.30	ND	3	ND	Sed.
161	75Ast 2599	23	17	80	0.15	.09	42	ND	Rock
162	75Ast 1267	24	22	138	0.10	.06	1	ND	Sed.
163	75Ast 1266	22	18	100	ND	ND	3	ND	Sed.
164	75Ast 1264	17	15	103	ND	ND	3	ND	Sed.
165	75Ast 1265	22	19	127	0.20	ND	2	ND	Sed.
166	75Ast 28	15	17	26	0.30	0.16	29	3	Rock
167									
168	75Ast 1263	48	46	120	1.20	ND	4	ND	Sed.
169	75Ast 1263a	30	19	129	0.20	ND	2	ND	Sed.
170	75Ast 1260	15	12	41	0.10	ND	24	ND	Sed.
171	75Ast 1257	22	20	99	0.20	ND	2	ND	Sed.
172	75Ast 1254	32	21	466	0.20	ND	2	ND	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
173	75Ast 1255	25	20	<u>342</u>	0.30	ND	2	ND	Sed.
174	75Ast 1245	20	20	66	0.20	.02	1	5	Sed.
175	75Ast 1246	26	22	184	0.40	.09	ND	9	Sed.
176	75Ast 1218	20	22	158	0.80	ND	ND	ND	Sed.
177	75Ast 1243	12	24	54	ND	.04	2	ND	Sed.
178	75Ast 1241	30	30	198	0.60	.06	ND	ND	Sed.
179	75Ast 1240	18	30	44	0.20	.04	26	4	Sed.
180	75Ast 1239	16	20	69	0.20	.06	4	ND	Sed.
181	75Ast 1203	28	20	82	ND	ND	ND	6	Sed.
182	75Ast 1202	28	30	68	0.40	ND	ND	2	Sed.
183	75Ast 1204	26	23	104	ND	ND	ND	3	Sed.
184	75Ast 1204a	19	17	46	0.10	ND	27	4	Sed.
185	75Ast 1206	<u>88</u>	15	39	ND	.02	37	10	Sed.
186	75Ast 1205	17	11	48	ND	ND	27	5	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
187	75Ast 1207	24	28	88	ND	ND	ND	224	Sed.
188	75Ast 1208a	17	20	58	0.10	ND	ND	1	Sed.
189	75Ast 1208	12	19	75	0.10	0.01	1	13	Sed.
190	75Ast 1209	34	36	146	0.40	ND	ND	ND	Sed.
191	75Ast 1209a	20	16	80	0.10	ND	1	ND	Sed.
192	75Ast 1210	24	22	100	0.20	ND	ND	ND	Sed.
193	75Ast 1211	24	38	92	ND	ND	ND	2	Sed.
194	75Ast 1215	18	20	48	0.10	.02	37	ND	Sed.
195	75Ast 1214	22	20	101	0.10	ND	1	3	Sed.
196	75Ast 1216	21	22	94	0.20	ND	1	2	Sed.
197	75Ast 1217	26	20	138	ND	ND	1	ND	Sed.
198	75Ast 1218	20	22	158	0.80	ND	ND	ND	Sed.
199	75Ast 1219	11	15	75	0.30	ND	2	ND	Sed.
200	75Ast 1220	24	20	120	1.60	ND	ND	ND	Sed.

TABLE 6
ATOMIC ABSORPTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
201	75Ast 1226	24	14	99	0.20	ND	2	ND	Sed.
202	75Ast 1227	23	12	95	0.20	ND	2	ND	Sed.
203	75Ast 1222	28	16	132	1.20	ND	2	ND	Sed.
204	75Ast 1225	20	27	110	0.60	ND	4	ND	Sed.
205	75Ast 1224	25	15	88	0.60	ND	4	ND	Sed.
206	75Ast 1223	25	16	118	ND	ND	2	ND	Sed.
206a	75Ast 1230	19	14	43	ND	.03	28	ND	Sed.
207	75Ast 1229	23	21	110	ND	ND	3	ND	Sed.
208	75Ast 1232	34	20	124	0.60	ND	2	ND	Sed.
209	75Ast 1233	20	16	102	0.40	ND	2	ND	Sed.
210	75Ast 1234	42	26	120	0.40	ND	4	ND	Sed.
211	75Ast 1615	48	44	160	0.80	.04	ND	ND	Rock
212	75Ast 1612	13	8	23	ND	ND	59	ND	Rock
213	75Ast 1609	30	20	136	0.20	ND	2	ND	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
214	75Ast 8	47	24	35	0.20	ND	14	23	Rock
215	75Ast 15	17	17	50	0.20	ND	38	ND	Rock
216	75Ast 1597	30	19	38	ND	.02	68	ND	Rock
217	75Ast 1598	18	17	80	0.20	ND	1	5	Rock
218	75Ast 1357	52	16	185	0.30	.04	47	2	Sed.
219	75Ast 1356	23	11	56	0.10	ND	36	ND	Sed.
220	75Ast 1355	164	29	225	0.40	ND	3	ND	Sed.
221	75Ast 1354	36	18	146	ND	ND	2	ND	Sed.
222	75Ast 1352	33	15	96	0.30	ND	44	2	Sed.
223	75Ast 1353	31	11	77	ND	ND	30	ND	Sed.
224	75Ast 1351	23	11	75	ND	ND	33	ND	Sed.
225	75Ast 1350	20	11	56	ND	ND	1	ND	Sed.
226	75Ast 2547	19	17	95	ND	.07	ND	20	Sed.
226a	75Ast 2545	50	88	238	3.0	.10	3	5000	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
226b	75Ast 1347	25	18	71	.10	.03	45	3	Sed.
226c	75Ast 1346	40	23	203	.20	.03	ND	5	Sed.
226d	75Ast 1345	27	19	67	ND	.02	30	1	Sed.
226e	75Ast 1343	70	27	370	ND	ND	2	3	Sed.
226f	75Ast 1344	28	22	92	ND	ND	1	6	Sed.
226g	75Ast 2537	8	9	41	ND	.26	ND	ND	Rock
226h	75Ast 2536	46	25	130	.20	.06	2	5	Rock
226i	75Ast 2540	14	7	7	.15	ND	83	ND	Rock
226j	75Ast 2543	17	5	9	ND	.04	75	ND	Rock
227	75Ast 1513	25	33	95	0.50	.025	2	Nil	Sed.
228	75Ast 1512	40	33	140	0.75	ND	2	451	Sed.
229	75Ast 1511	34	26	130	0.85	.02	3	417	Sed.
230	75Ast 2530	33	32	114	ND	.03	4	15	Sed.
231	75Ast 2529	31	36	110	0.35	.03	3	10	Sed.

TABLE 6
ATOMIC ABSORPTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
232	75Ast 1510	35	30	138	1.25	.150	32	1269	Sed.
233	75Ast 2528	33	36	107	ND	ND	3	10	Sed.
234	75Ast 2525	25	37	134	0.35	ND	3	15	Sed.
235	75Ast 2523	29	34	160	0.50	.02	32	49	Sed.
236	75Ast 2522	37	46	142	0.15	.04	5	25	Sed.
237	75Ast 2520	18	26	90	0.20	.07	ND	ND	Sed.
237a	75Ast 2521	35	35	160	0.75	.04	3	ND	Sed.
238	75Ast 2519	20	27	100	0.50	.09	21	26	Sed.
239	75Ast 2518	--	--	--	--	--	--	--	--
240	75Ast 1120	58	27	146	ND	ND	ND	4	Sed.
241	75Ast 2517	10	28	50	0.35	.08	17	ND	Soil
242	75Ast 1119	33	23	85	ND	ND	1	5	Sed.
243	75Ast 1123	33	23	85	ND	ND	1	5	Sed.
244	75Ast 1124	41	32	135	0.10	ND	2	6	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
245	75Ast 1555	35	26	175	0.70	.09	ND	19	Sed.
246	75Ast 1526	41	18	118	0.40	ND	ND	3	Sed.
247	75Ast 1556	20	17	110	0.35	.04	ND	ND	Sed.
248	75Ast 1548	22	26	100	.35	.10	35	ND	Sed.
249	75Ast 1519	15	67	610	.15	ND	48	5	Rock
250	75Ast 1559	24	26	170	0.40	.15	14	12	Sed.
252	—	—	—	—	—	—	—	—	—
253a	75Ast 1527	16	14	90	3.00	.32	26	ND	Rock
253b	75Ast 1529	36	12	80	0.60	.10	3	8	Sed.
253c	75Ast 1530	32	20	95	0.50	.10	4	ND	Sed.
253d	75Ast 1531	37	36	150	0.70	.06	35	ND	Sed.
253e	75Ast 1532	41	16	218	0.60	.02	5	ND	Sed.
253f	75Ast 1533	28	34	180	0.60	.250	2	ND	Sed.
253 g	75Ast 1506	—	—	—	—	—	—	—	—

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
254	75Ast 1541	20	18	60	.50	.15	ND	24	Rock
255	75Ast 1507	36	33	154	12.0	.42	2	1512	
256	75Ast 1508	36	32	140	.70	.22	4	1848	
257	75Ast 1509	33	33	140	.70	.19	25	1380	
258	75Ast 2556								
259	75Ast 2555								
260	75Ast 1190	17	15	62	.10	.05	1	ND	Sed.
261	75Ast 1191	51	29	221	ND	ND	2	2	Sed.
262	75Ast 1194	31	34	131	ND	ND	2	ND	Sed.
263	75Ast 1195	34	2090	410	12.7	.04	45	133	Sed.
264	75Ast 1196	54	26	284	0.20	ND	ND	ND	Sed.
265	75Ast 1197	21	56	78	0.40	.01	34	ND	Sed.
266	75Ast 1198	26	13	120	0.10	.03	1	ND	Sed.
267	75Ast 1189	23	41	67	0,20	ND	28	5	Sed.

TABLE 6
ATOMIC ABSORPTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
268	75Ast 1188	36	14	117	0.10	.01	1	2	Sed.
269	75Ast 1189a	57	29	156	0.10	.01	2	ND	Sed.
270	75Ast 1186	23	17	62	ND	.01	1	3	Sed.
271	75Ast 1185	48	38	164	0.40	.06	2	2	Sed.
272	75Ast 1199	36	23	87	0.10	.05	ND	3	Sed.
273	75Ast 1200	34	18	144	ND	.08	ND	ND	Sed.
274	75Ast 1201	22	17	78	ND	ND	27	3	Sed.
275	75Ast 1300	27	22	119	ND	ND	ND	ND	Sed.
276	75Ast 1299b	75	22	82	.10	ND	1	ND	Sed.
277	75Ast 1299a	27	24	152	ND	ND	ND	ND	Sed.
278	75Ast 1298	30	23	213	.10	.02	1	ND	Sed.
279	75Ast 1172a	12	14	42	ND	.01	ND	ND	Sed.
280	75Ast 1172	25	24	86	ND	.03	ND	2	Sed.
281	75Ast 1173	22	28	144	.20	.06	ND	ND	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
282	75Ast 1173a	12	17	52	.10	.02	1	ND	Sed.
283	75Ast 1175b	22	31	134	.20	ND	ND	ND	Sed.
284	75Ast 1175a	42	548	200	3.8	ND	72	20	Sed.
284a	75Ast 1177	26	21	194	ND	.04	1	3	Sed.
284b	75Ast 1176	27	26	99	0.20	.01	1	112	Sed.
285	75Ast 1178a	24	24	90	0.10	.03	ND	10	Sed.
286	75Ast 1178	26	24	174	ND	ND	1	3	Sed.
287	75Ast 1180	25	21	121	ND	.01	2	2	Sed.
288	75Ast 1181	40	31	212	0.20	ND	1	ND	Sed.
289	75Ast 1182a	42	26	180	0.20	ND	1	2	Sed.
290	75Ast 1182	56	46	165	0.20	ND	2	7	Sed.
291	75Ast 1184	34	26	135	0.20	ND	2	9	Sed.
292	75Ast 1183	36	30	105	0.50	ND	2	39	Sed.
293	75Ast 1169	26	26	82	ND	ND	ND	38	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
294	75Ast 1168	28	27	91	.10	ND	ND	37	Sed.
295	75Ast 1168a	38	27	77	ND	ND	1	7	Sed.
296	75Ast 1170	30	23	133	0.10	ND	1	6	Sed.
297	75Ast 1166	28	46	134	ND	ND	1	16	Sed.
298	75Ast 1164	26	27	143	ND	ND	ND	8	Sed.
299	75Ast 1165	40	24	48	ND	ND	1	ND	Sed.
300	75Ast 1171	28	24	88	ND	.02	ND	6	Sed.
301	75Ast 1162	32	32	84	ND	ND	ND	8	Sed.
302	75Ast 1160	31	41	200	.10	ND	ND	10	Sed.
303	75Ast 1160a	33	27	91	.20	ND	ND	20	Sed.
304	75Ast 1159	34	38	110	.10	ND	ND	10	Sed.
305	75Ast 1158	36	48	105	.10	ND	1	8	Sed.
306	75Ast 1157	32	30	107	ND	ND	1	9	Sed.
307	75Ast 1156	32	28	88	ND	ND	ND	18	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
308	75Ast 1154	30	28	105	ND	ND	ND	8	Sed.
309	75Ast 1152	33	34	101	ND	ND	ND	18	Sed.
310	75Ast 1150	32	33	108	ND	.02	ND	12	Sed.
311	75Ast 1151	40	32	108	ND	ND	ND	10	Sed.
312	75Ast 1149	39	25	168	.10	ND	1	5	Sed.
313	75Ast 1148	38	35	116	ND	ND	1	10	Sed.
314a	75Ast 1135	22	21	78	ND	ND	ND	7	Sed.
314 b	57Ast 1136	—	34	273	.20	.03	3	18	Sed.
314c	75Ast 1134	53	31	257	.10	ND	2	17	Sed.
315	75Ast 1133	26	30	123	ND	ND	1	5	Sed.
316	75Ast 1132	36	34	228	ND	.08	ND	12	Sed.
317	75Ast 1131	102	33	267	.20	ND	1	39	Sed.
318	75Ast 1130	190	40	432	ND	ND	2	6	Sed.
319	75Ast 1129	58	34	70	ND	ND	2	36	Sed.

TABLE 6
ATOMIC ABSORPTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
320	75Ast 1126	40	25	97	.10	ND	1	31	Sed.
321	75Ast 1127	81	27	357	ND	ND	2	18	Sed.
322	75Ast 1128	52	32	140	ND	ND	ND	11	Sed.
323	75Ast 1125	53	28	183	ND	.07	ND	16	Sed.
324	75Ast 1125a	36	21	78	.10	ND	1	17	Sed.
325	75Ast 1138	67	54	380	.60	ND	1	40	Sed.
326	75Ast 1139	51	28	108	ND	ND	ND	16	Sed.
327	75Ast 1137	80	38	512	.10	ND	1	ND	Sed.
328	75Ast 1147	39	30	127	.20	ND	ND	5	Sed.
329	75Ast 1144	48	28	116	.20	ND	3	27	Sed.
330	75Ast 1143	38	20	106	ND	.02	ND	ND	Sed.
331	75Ast 1146								
332	75Ast 1142	40	22	103	.20	ND	ND	5	Sed.
333	75Ast 1141	46	28	103	ND	ND	1	25	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
334	75Ast 1140	43	32	103	ND	ND	1	20	Sed.
335	75Ast 1118	37	37	154	.10	ND	ND	1	Sed.
336	75Ast 1118a	60	48	124	.40	ND	ND	4	Sed.
337	75Ast 1118b	45	29	85	.10	ND	1	5	Sed.
338	75Ast 1117	63	44	438	.40	ND	2	2	Sed.
339	75Ast 1117a	42	27	83	.20	ND	1	38	Sed.
340	75Ast 1116a	38	25	76	.10	ND	ND	12	Sed.
341	75Ast 1116	40	34	126	ND	ND	1	6	Sed.
342	75Ast 1115	30	34	104	ND	ND	ND	3	Sed.
343	75Ast 1114	40	34	75	.20	ND	ND	12	Sed.
344	75Ast 1113	47	35	107	.30	ND	ND	14	Sed.
345	75Ast 1112	40	28	73	.10	ND	ND	12	Sed.
346	75Ast 1111	51	39	52	.30	ND	ND	14	Sed.
347	75Ast 1111a	42	34	60	ND	ND	1	26	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
348	75Ast 1110	53	48	88	.20	ND	ND	<u>103</u>	Sed.
349	75Ast 2823	24	38	96	ND	ND	ND	19	Rock
350	75Ast 2821	13	24	60	ND	ND	ND	ND	Rock
351	75Ast 1109	<u>98</u>	30	108	ND	ND	ND	ND	Sed.
352	75Ast 1108a								
353	75ast 1108	50	32	120	.10	.03	ND	7	Sed.
354	75Ast 1107	30	18	74	ND	ND	ND	8	Sed.
355	75Ast 1106	31	31	96	.20	.02	1	ND	Sed.
356	75Ast 1044a	22	30	102	ND	ND	ND	ND	Sed.
357	75Ast 1104a	56	33	92	.20	ND	ND	21	Sed.
358	75Ast 1045a	28	40	136	.20	ND	2	44	Sed.
359	75Ast 1045	38	47	177	.70	ND	1	<u>65</u>	Sed.
360	75Ast 1103	40	28	78	.30	ND	ND	4	Sed.
361	75Ast 1100	37	32	104	.20	ND	ND	21	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
362	75Ast 1834	30	30	92	.10	ND	ND	20	Sed.
363	75Ast 1833b	38	85	147	.30	ND	2	3	Sed.
364	75Ast 1833a	40	122	193	.80	ND	ND	6	Sed.
365	75Ast 1831	31	26	84	ND	ND	1	14	Sed.
366	75Ast 1829								
367	75Ast 1828								
368	75Ast 1825	18	25	70	ND	ND	ND	7	Sed.
369	75Ast 1823	72	44	206	ND	.04	2	1026	Sed.
370	75Ast 1097	36	30	197	.30	.02	2	18	Sed.
371	75Ast 1097a	36	29	526	ND	ND	1	2	Sed.
372	75Ast 1077	33	26	79	.20	.07	1	66	Sed.
373	75Ast 1076	36	25	108	ND	.04	1	21	Sed.
374	75Ast 1167	38	29	138	.20	ND	ND	8	Sed.
375	75Ast 1075	20	10	46	ND	.04	ND	10	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
376	75Ast 1075a	30	22	116	ND	.01	1	26	Sed.
377	75Ast 1065	42	28	121	.20	ND	1	10	Sed.
378	75Ast 1066	27	26	117	.20	.03	1	14	Sed.
379	75Ast 1068	31	33	169	.60	.02	1	9	Sed.
380	75Ast 1067	38	21	107	ND	.02	1	9	Sed.
381	75Ast 1064	38	28	150	.40	.02	ND	12	Sed.
382	75Ast 1063	30	26	108	.40	ND	ND	ND	Sed.
383	75Ast 1069	55	36	229	.30	.02	ND	11	Sed.
384	75Ast 1070	29	39	177	.70	.09	1	9	Sed.
385	75Ast 1071	43	33	169	.20	.04	5	13	Sed.
386	75Ast 1072	50	28	155	.20	ND	22	7	Sed.
387	75Ast 1073	32	40	206	.60	.05	ND	9	Sed.
388	75Ast 1050	32	36	144	.80	ND	ND	12	Sed.
389	75Ast 1051	45	78	321	.80	ND	1	14	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
390	75Ast 1053	60	48	184	2.8	.12	4	8	Sed.
391	75Ast 1052	44	58	329	1.1	.59	2	8	Sed.
392	75Ast 1032	58	72	153	.60	ND	1	14	Sed.
393	75Ast 1033	50	58	140	.40	.02	1	12	Sed.
394	75Ast 1033a	34	43	97	.40	ND	1	8	Settling Pond
395	75Ast 1033b	69	32	225	.20	ND	1	8	Sed.
396	75Ast 1033d	55	52	128	.60	.02	2	8	Sed.
397	75Ast 1034a	65	49	153	.20	ND	1	9	Sed.
398	75Ast 1034	64	44	123	.40	ND	2	11	Sed.
399	75Ast 1049								
400	75Ast 1048	45	43	177	.60	ND	1	26	Sed.
401	75Ast 1047	76	46	182	2.00	ND	ND	18	Sed.
402	75Ast 1046a	44	32	135	.50	ND	ND	5	Sed.
403	75Ast 1040	16	15	93	ND.	ND	23	ND	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
404	75Ast 1039	16	18	100	ND	ND	2	2	Sed.
405	75Ast 1038	37	20	96	ND	.01	ND	3	Sed.
406	75Ast 1038a	26	12	71	.10	ND	25	1	Sed.
407	75Ast 1036	32	24	94	ND	ND	2	ND	Sed.
408	75Ast 1035	38	26	84	ND	ND	ND	ND	Sed.
409	75Ast 1030	45	44	113	.50	.04	1	17	Sed.
410	75Ast 1031	36	40	102	.20	ND	1	7	Sed.
411	75Ast 1028	36	28	88	.20	ND	1	4	Sed.
412	75Ast 1027	33	34	82	.20	ND	1	9	Sed.
413	75Ast 1025	34	22	103	ND	.02	1	16	Sed.
414	75Ast 1025a	32	29	135	ND	ND	1	6	Sed.
415	75Ast 1026	44	28	156	.20	ND	1	14	Sed.
416	75Ast 1023	39	23	97	.20	ND	1	32	Sed.
417	75Ast 1024	39	41	223	.40	.04	1	15	Sed.

TABLE 6
ATOMIC ABSORBTION SPECTROPHOTOMETRIC
ANALYSES OF STREAM SEDIMENTS
AND GOSSAN ZONES, KANTISHNA HILLS

MAP#	FIELD #	(ppm) Cu	(ppm) Pb	(ppm) Zn	(ppm) Ag	(ppm) Au	(ppm) Mo	(ppm) Sb	Sample Type
418	75Ast 1024a	40	47	207	.40	.02	1	5	Sed.
419	75Ast 1022	26	16	[illegible]	ND	ND	ND	9	Sed.
420	75Ast 1021	26	21	98	ND	ND	ND	6	Sed.
421	75Ast 1020	14	13	50	ND	ND	ND	6	Sed.
422	75Ast 1019	45	44	204	.20	.12	ND	27	Sed.
423	75Ast 1004	35	33	176	.10	.07	ND	ND	Sed.
424	75Ast 1004a	58	25	180	.20	ND	1	ND	Sed.
425	75Ast 1003a	28	26	169	.20	.01	ND	ND	Sed.
426	75Ast 1002	24	22	112	ND	ND	1	5	Sed.
427	75Ast 1003	24	24	92	.10	ND	ND	5	Sed.
428	75Ast 1000	18	14	75	ND	ND	ND	4	Sed.
429	75Ast 1001	26	23	129	.30	ND	ND	9	Sed.
430	75Ast 1006	36	43	128	.20	ND	ND	39	Sed.