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OCCURRENCES AND POTENTIAL FOR LEAD AND ZINC MINERALIZATION IN THE MT. SCHWATKA REGION

by James C. Barker, Alaska Field Operation Center
Fairbanks, Alaska

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U. S. DEPARTMENT OF THE INTERIOR

Cecil D. Andrus, Secretary

BUREAU OF MINES

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James C. Barker 1/

ABSTRACT

The Mt. Schwatka region, located about 75 miles north of Fairbanks was investigated to provide data on mineral potential for the Bureau of Land Management. The investigations were undertaken in early 1978 as a result of a tentative geological correlation of this area to the Selwyn Basin lead-zinc districts, eastern Alaska, and Yukon Territory. Correlation is based on a reconstruction of approximately 450 km of right-lateral Mesozoic movement along the Tintina Fault System. Prior to the investigation, there was no recorded information concerning mineralization or mining-claim locations.

Occurrences of lead and zinc were found in an area underlain by early to mid-Paleozoic marine sediments and volcanics. There appears to be an affinity between these occurrences and the succession of units known as the Fossil Creek volcanics-Ordovician(Silurian?). In one case volcanogenic zinc was found in a cherty, intermediate, tuffaceous breccia. Lead and zinc values also appear associated with the upper stratigraphic levels of the volcanics and controlled by the unconformity and/or fault contact with the overlying Tolovana Limestone. Manganese mineralization was identified in undifferentiated Paleozoic (Permian?) cherts and mafic volcanics to the west. There also appears to be a potential for asbestos deposits.

1/ Mining Engineer, Fairbanks, Alaska Field Operation Center

INTRODUCTION

This report was prepared for the Dept. of Interior, Bureau of Land Management, Fairbanks District Office, to provide minerals data for land managing.

The study area includes more than 150,000 acres in the vicinity of Mt. Schwatka and the White Mountains of interior Alaska, figure 1. Included are the northern portions of the Livengood D-1 and D-2 Quadrangles and the western half of the Circle D-6 Quadrangle as represented on Plates 1 to 3. In May and June of 1978, a 30-day field project was conducted by the Bureau of Mines with logistical support provided by the Bureau of Land Management. The objective was a reconnaissance of terranes considered favorable for mineralization and a preliminary investigation of the genesis and characteristics of any mineral occurrences found.

This area of Alaska has received little, if any, mineral exploration. There were no reported prospects or mining claims prior to the Bureau of Mines investigation. Only about half of the area had been geologically mapped, and then only in a general manner. Because of the postulated correlation of this region to the lead-zinc districts (15) 2/ of the Yukon Territory, the principal objective was an evaluation of these resources.

The results and conclusions presented in this report are preliminary. They should not be considered to be a thorough assessment of the region's

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2/ Underlined numbers in parentheses refer to references listed in the bibliography

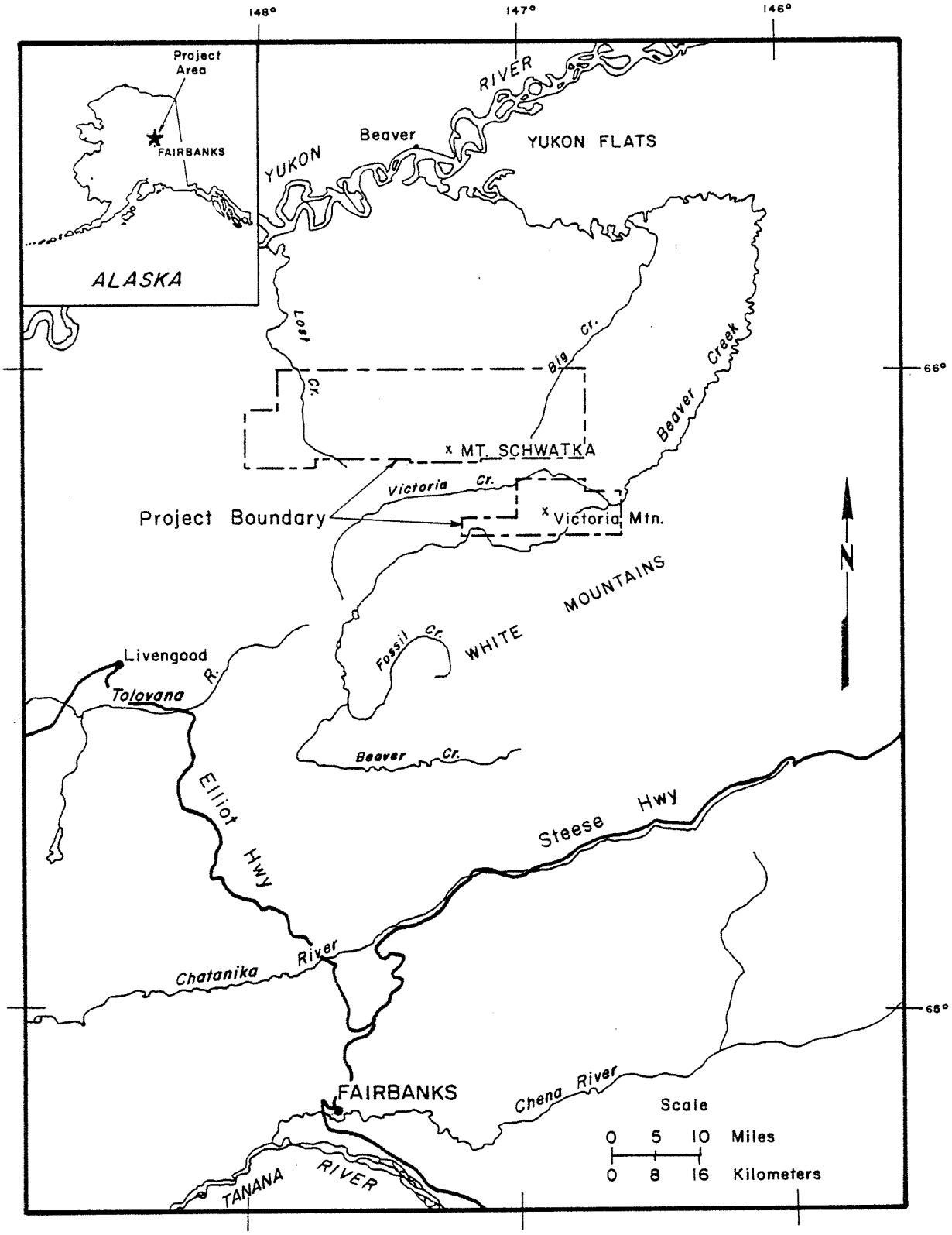


Figure 1 – Mt. Schwatka Project Location Map

mineral endowment, but rather indicative of the types of deposits and commodities that may be present. The data presented here suggest obvious follow up work, but time and funds did not permit detailed prospect evaluations.

ACKNOWLEDGEMENTS

The topographic maps used in this report were adapted from U. S. Geological Survey published maps.

The Bureau of Mines (BOM) was assisted in the preparation of this report by F. Weber who provided indepth advice from previous field work. Petrographic work and technical overview was contributed by T. C. Mowatt and J. Foley of the Bureau of Mines.

Samples were prepared by the University of Alaska through a Bureau of Mines grant. Analyses were performed by the BOM, Reno Metallurgical Research Center, Nevada, under the direction of H. Heady.

A portion of the samples are also being analyzed as part of the Department of Energy (DOE), National Uranium Resource Evaluation program at the Los Alamos Laboratory. Results of these analyses will be made available by DOE at a later date.

HISTORY

The region was first visited by L. M. Prindle (13) in the early 1900's. Geologic reconnaissance of the Mt. Schwatka region was further described by Mertie in 1937 (12). In 1961 a thesis by Church and Durfee (6) on the Fossil Creek area, just south of this project, described in detail some of the bedrock units also found near Mt. Schwatka. Reconnaissance mapping (1:250,000) of the Livengood Quadrangle was open-filed in 1971 by Chapman and others (5). Recent publications by Churkin and Brabb (6, 7, 8) in east-central Alaska and by D. J. Tempelman -

Kluit in the Yukon Territory (16) (17) have also proved useful in the understanding of the Mt. Schwatka geology and origin.

In 1974, the USGS published aeromagnetic mapping (1:250,000 and 1:63,360) of the Livengood and Circle Quadrangles (20) (21). The U. S. Geological Survey is presently conducting a mapping and mineral assessment of the Circle Quadrangle under the direction of H. Foster.

Other references which provide information pertinent to the Mt. Schwatka area are listed in the bibliography.

PHYSIOGRAPHY

Unnamed hills trend east-west of Mt. Schwatka (fig. 1) and front onto the Yukon Flats to form a portion of the northern perimeter of the Tanana Uplands. The terrain is relatively rugged and elevations range from 1000 to 4171 feet at the summit of Mt. Schwatka. Climate is a dry continental type with long, very cold winters and brief warm summers.

Precipitation is about 12-15 inches, largely occurring as snow and occasional summer thunderstorms (11). Snowfall is variable, but rarely accumulates to more than 3 feet; exposed areas will normally be blown free. Snow cover is generally melted May 1, except at higher elevations. This project was conducted between May 10 and June 8 of 1978.

Ground vegetation is nearly continuous below 2000 feet elevation. Timber occurs up to 2500 feet on south-facing slopes. Except for the notable pinnacles and ridge crests of massive white limestone, most rock exposures consist of frost-fractured rubble.

Permafrost is typically present under any vegetation cover and is particularly thick in poorly drained areas. There is evidence of limited glaciation of the higher valleys and peaks. Several cirque-like features were noted near both Mt. Schwatka and an unnamed peak to the east. A probable terminal-moraine formation was observed on Jefferson Creek, a north flowing tributary onto the Yukon Flats.

The region is located 75 miles north of Fairbanks. There are no roads or suitable fixed-wing aircraft landing sites except on Beaver Creek gravel bars. Access was gained by helicopter based out of Fairbanks and work was conducted from spike camps.

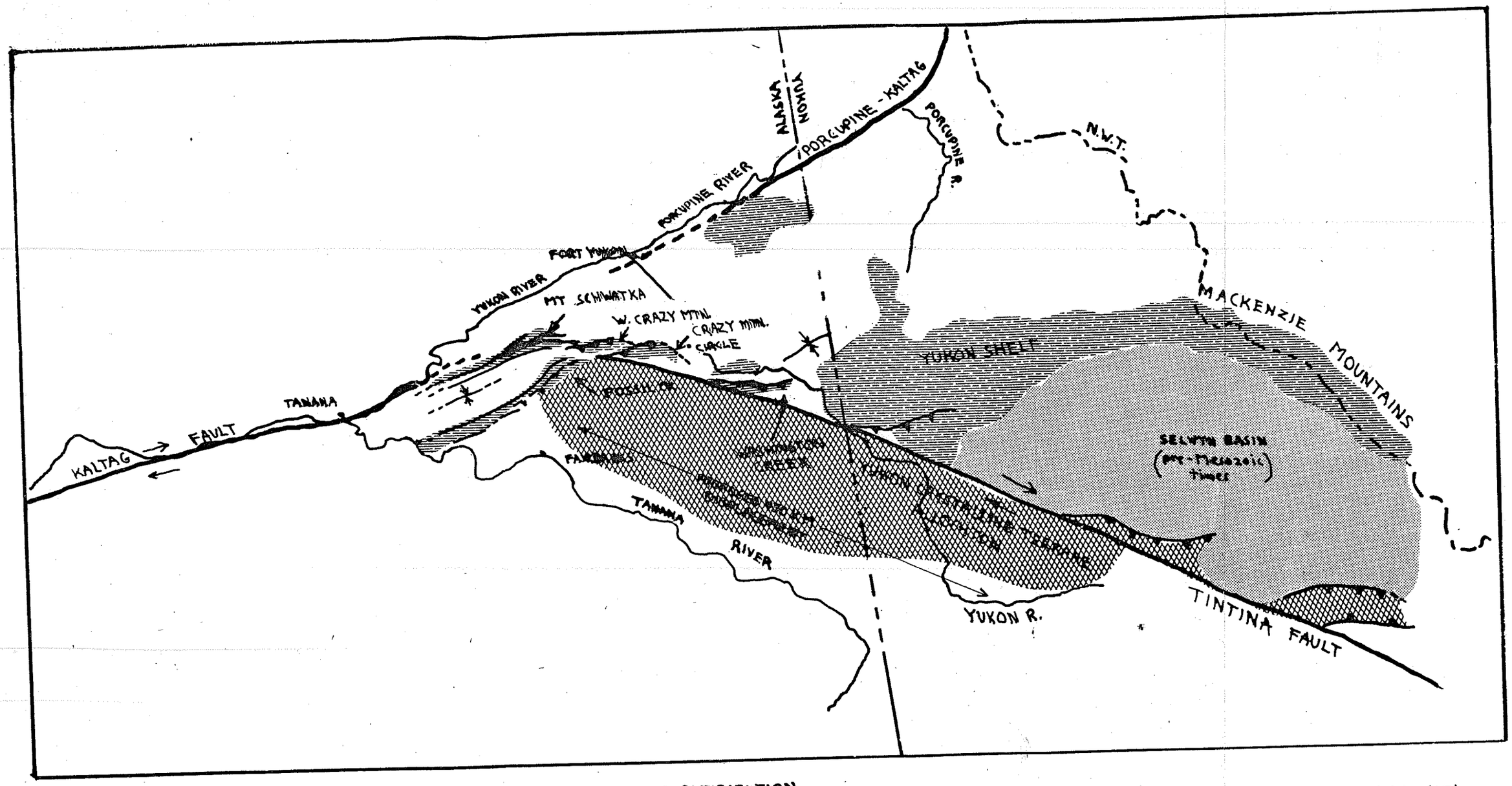
GENERAL GEOLOGY

The Mt. Schwatka region is principally underlain by marine sedimentary and volcanic rocks of Paleozoic age. Geology has been highly complicated by a series of southwesterly trending major faults, which might be continuous with either the Tintina Fault (as westward pulses of thrusting) or as a multiple of offset movements of northeasterly splays from the Kaltag Fault zone. The surface expression of the Tintina Fault trench appears to dissipate into a series of abandoned thrust plates immediately to the southeast. The westerly trending Victoria Creek fault in the study area may be a further extension of the Tintina Fault where it would intersect with the southwesterly (Kaltag?) offsets. Age and extent of local movement along the Kaltag and/or the Tintina Fault zones are unknown, but conspicuous fault-lineated valleys indicate fairly recent (post-Mesozoic) movement. Associated wrench faulting has further juxtaposed bedrock units. Thus, within the study area, bedrock slices of diverse geologic origins have been complexly faulted and folded together.

In a regional sense, the Mt. Schwatka area appears to represent klippen-like features which have been tectonically emplaced between the Tanana crystalline uplands to the south and the Eocene (14) Yukon Flats basin to the north.

The original location of the rocks in this area is conjectural; however, other geologically similiar lithologies exist in eastern Alaska and adjoining portions of the Yukon Territory. Tempelman-Kluit has described a succession of Cambrian through Silurian lithologies peripheral to the Selwyn Basin which have various similarities to the rocks observed in the report area (16). Movement along the Tintina Fault zone (fig. 2), which may have culminated in as much as 450 km following the Late Cretaceous orogeny (17), appears responsible for the tectonic positioning of the Mt. Schwatka rock units.

Fault remnant blocks (alloctons) which include similar stratigraphic intervals can be found at several other points along the Tintina Fault zone extending eastward from Mt. Schwatka. These blocks were shed from the southeast and occur between the active or recently active Tintina Fault zone and older inactive thrust splays from previous movements. Each block probably represents an individual episode of movement. The Crazy Mountains, Little Crazy Mountains, Tacoma Bluff, Washington Creek area, and Nation River region plus the Mt. Schwatka area, which all include at least some of these stratigraphic units, would then have been part of the original early to mid-Paleozoic (Cambrian-Early Devonian) continental margin of the Yukon Shelf as described by Churkin (7). This would be somewhat equivalent to the Selwyn basin and Ogilvie Mountains (2) of the western Yukon Territory as reconstructed from the subsequent 450 km of right-lateral movement.



GENERALIZED TECTONIC DISTRIBUTION OF CAMBRIAN-DEVONIAN SUCCESSIONS

Yukon Portion Adapted in Part From Templeman--Kluit (16) (17)

FIGURE 2

The occurrence of Oldhamia fossils in most of these allocthonous slices (9), along the Tintina zone are further evidence of correlation between the remanent fault blocks and an original assemblage near the Canadian Border. Oldhamia traces in each case occur in an olive-green argillite-silty quartizite.

The Mt. Schwatka block was apparently uplifted beginning about Tertiary time by the extensive orogeny of that period. Subsequent erosion would account for the lack of any sediments younger than Paleozoic.

A portion of the study area extends across the Kaltag(?) Fault zone into a sequence of undifferentiated Paleozoic mafic volcanics, cherts, and shales (see Plate 1). This area is very poorly known but probably is a part of the Permian(?) Rampart Group volcanics as described by Brosge and Rieser (3).

Limited work was also undertaken near the granitic intrusion of Victoria Mountain which lies to the southeast of the Kaltag Fault zone. Age of the intrusive is unknown, however the granitic composition, strong airborne magnetic signature, and hornfels developments of the host rock is very similar to the Sawtooth Mountain intrusion to the southwest. Sawtooth Mountain has been dated at 88.8 $\pm$ 3 million years (4). Partially serpentized mafic and ultramafic rocks occur north and west of Victoria Mountain. These appear to belong to a trend of similar lithology which extends to the Livengood area.

Aerial magnetic surveys (21) indicate the granitic intrusion may extend farther to the northeast across the Beaver Creek valley. Rock types described from field observations in the Mt. Victoria area are depicted on Plate 1. However, there has been no previous geological mapping and no attempt to describe the geology will be made.

STRATIGRAPHY

Previous geological workers in the Mt. Schwatka area have segregated three distinct geological assemblages tentatively based on fossil age control and lithology. It should be stressed that this stratigraphic sucession is very tenuous and, considering the probable allochthonous correlation to the east, it is likely that slices of the thick Ordovician-Devonian and Mississippian sedimentation may also be present in the Mt. Schwatka region.

Cambrian - The lower part of the sequence includes a thick basal unit of gray quartzite which is very dense, blocky, and resistant to weathering. Deposition is typical of shallow-water fluvial conditions near a stable continental platform. Irregular quartz veins and stockworks are common. Locally the quartzite grades into grit and olive-green slate and argillite. Above the quartzite is an argillite and slate unit which includes several beds of a dense, gray limestone. The upper argillites and slates are generally alternating red and green and frequently very fissile.

The entire sequence has been assigned a Cambrian age largely based on the occurence of *Oldhamia* fossils in the olive-green slates (8). Thick black shale strata are also found to be regionally associated with this sequence, and appear to structurally underlie it; however, its original stratigraphic correlation is unclear at this time. Based on correlations to the Selwyn basin (17), these black shales may be approximatly time equivalent to the overthrusted quartzite, or more likely may correlate to the Ordovician-Devonian Road River Formation of the Yukon. Locally this shale is silicified to black chert and sometimes is pyritic but more typically is thinly bedded and exhibits a silvery

weathering color. The black shale is poorly resistant to weathering and generally consisted of side-hill scree.

Ordovician-Silurian(?) - Overlying the Cambrian sequence is a thick unit of volcanic rocks, more commonly known as the Fossil Creek Volcanics as first referred to by Mertie (12). The unit contains abundant basalt lava beds which are commonly altered to greenstone. The Fossil Creek units appear to have a minimum thickness of 2000 feet (6), although a complete section probably does not exist in the project area because of the extensive faulting.

Limited outcrops of mafic tuff, volcanic breccia, tuffaceous limestone agglomerate, pyroxene andesite, and pyroclastics were frequently observed near Mt. Schwatka. Near here an extensive exposure of chloritic tuffaceous limestone frequently exhibits a schistose fabric. About 3 miles northwest of Mt. Schwatka, an intermediate tuffaceous limestone grading to a tuff with biotite was examined. It weathered to a bright-orange color, apparently because of the leaching of various sulfides. Elsewhere in the Livengood Quadrangle this tuffaceous, sandy limestone has yielded Ordovician fossils from which the Fossil Creek Volcanic sequence has tentatively been dated (5).

Locally the Fossil Creek volcanic sequence also contains beds of gray shale and chert. In the region east of Mt. Schwatka, prominent rusty-weathering outcrops of dolomite and calcarenite also appear to belong to this complex sequence.

Generally speaking, the Fossil Creek sequence appears to be marine, but there are no pillow structures reported and some specific volcanic conglomerate intervals may be of a fluvial orgin (6).

Silurian-Devonian - Disconformably overlying or frequently in fault contact with the volcanic sequence is the Tolovana Limestone. This limestone weathers almost white and forms spectacular outcrops. Chapman and others have reported Silurian to Early Devonian fossils from the unit and suggest that the limestone may be several thousand feet thick (5).

To the southwest, Church and Durfee reported thicknesses of 3200 to 4600 feet near Fossil Creek (6). They described the Tolovana of Fossil Creek to have been deposited as a precipation of calcium carbonate in a stable shallow-water environment. Only minor organic material was found at a few scattered localities, which indicates a lack of reef-building organisms.

West of Mt. Schwatka tuffaceous beds were found near the base of the unit. The Tolovana likely is part of the extensive carbonate platform found in eastern Alaska and the Porcupine River region. Dutro (10) has correlated the Tolovana to the Skajit Limestone of the Brooks Range.

Permian(?) - In the westernmost part of the study area an undifferentiated sequence of varicolored chert, slates, and graywackes with various volcanic members of mafic tuff, volcanic breccia, basalt to andesite, and agglomerate were found. Intrusive mafic dikes were also noted. Aeromagnetic data suggest the sequence underlies much of the vast, thickly vegetated area to the north of the hills (Plate 1). It appears likely that this assemblage of rocks is part of the Rampart Group Volcanics which are best known where they crop out along the Yukon River. Brosge and others (1969) suggested a possible Permian age for these rocks based on fossil evidence in a limestone bed near the base of the Rampart Group. Age dates on hornblende from gabbroic dikes intruding

the volcanics have been determined to be Triassic (205 ± 6 m.y.) Brosge (3).

MINERAL RESOURCES

Lead, Zinc and Copper - These metals appear to be largely confined to the volcanic sequence, although several occurrences were also found in the limestones of both the Cambrian and Tolovana sequences. The carbonate occurrences may well represent remobilization of the metals from volcanic(?) primary sources. However, the black shale unit, with its high intrinsic values of trace metals--notably zinc--may also present a primary source which has evolved mineralizing fluids through an exhalative system. Of particular interest as a loci for mineralization is the unconformity or fault contact of the overlying Tolovana Limestone. Many of the occurrences were found near this stratigraphic position.

(Sec. 25, T. 13N. R.1W.)Refer to Plate 1 - Limestone breccia occurs near the intersection of two north-trending lineaments. The breccia is heavily cemented with ferricretes and goethite and is exposed for several hundred feet along the contact between silificied black-shale and the Cambrian limestone. Additional gossan was visible. The gossan zone appeared to be 50 to 75 feet wide and samples contained up to 0.5% zinc but no significant lead or copper values.

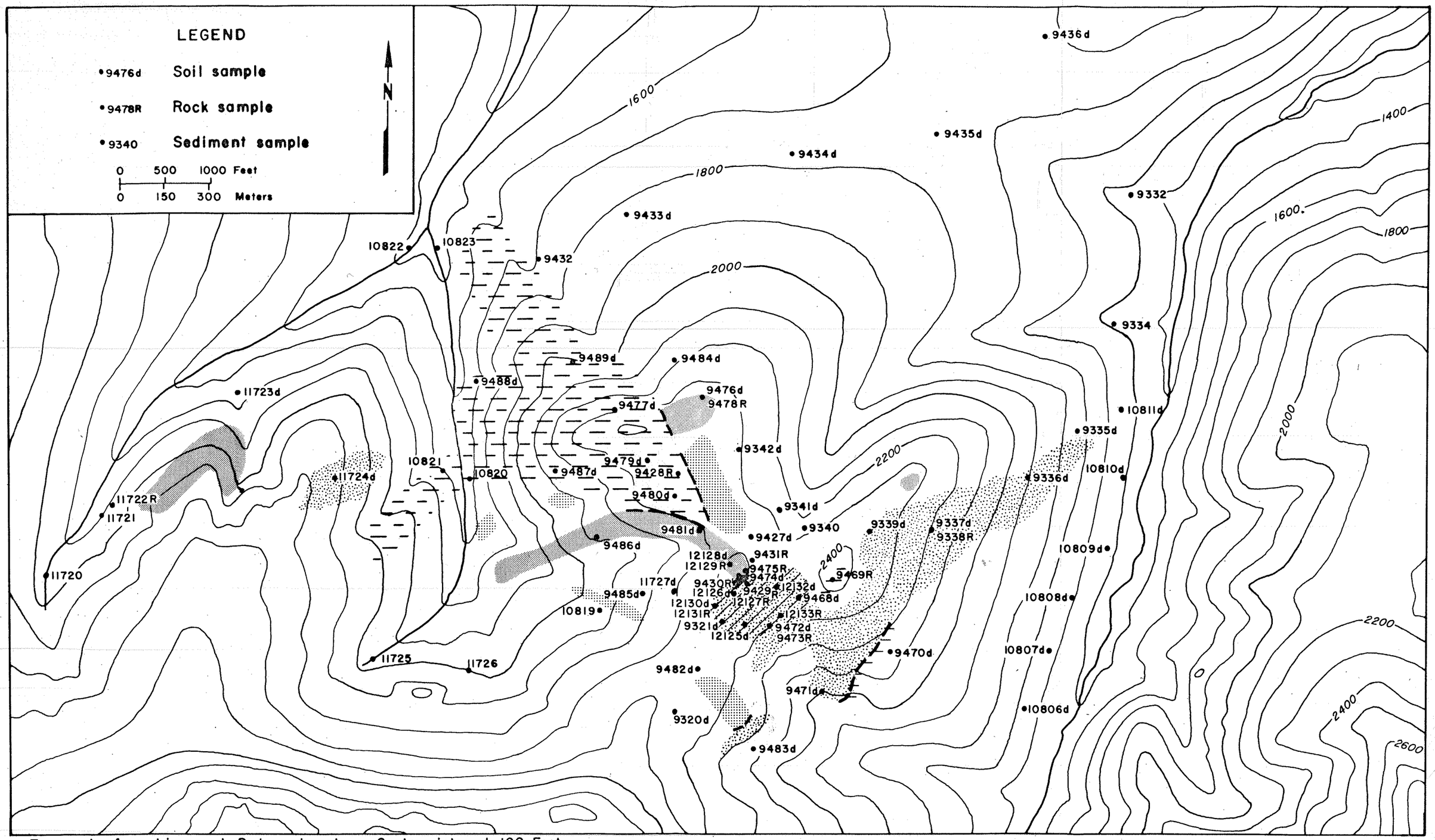
(Sec. 34, T.13N. R.2E.)Plate 1 - Zinc, lead, and barium appear to be associated with volcaniclastic breccia in a cherty quartz matrix. Further examination shows that sericitic, chloritic, and hematitic alteration has taken place and particularly affected the potassium feldspar grains. The volcanic material contains anhedral quartz, pyroxene, potassium feldspar, and possibly amphibole. Overall, composition of this volcanic material could be termed as intermediate

to felsic. Brecciation appears to be tectonic. Various secondary carbonate coatings are also common and on a few selected samples has been identified as smithsonite ($ZnCO_3$).

The area of the prospect was situated in a saddle on a low ridge and occurs in a chert unit which was underlain by red and green argillite and quartzite. Intermediate(possibly andesitic) flow rock was found as rubble nearby. Bedrock exposure was limited to weathered rubble and gossan materials, and no systematic sampling could be made. Furthermore, stratigraphic positioning of these occurrences was not possible.

Gossan material was found across an area approximately 1,000 feet in diameter (fig. 3). The surface material, where exposed, was obviously leached and barren of any mineralization which may have once been present. Occasionally, fresher material found in frost boils contained traces of galena and sphalerite. Secondary smithsonite was found in several gulches off the top of the ridge. These samples would contain up to 10% zinc and 15% lead. No anomalous levels of copper or silver were detected, however.

A series of soil samples were taken across the gossan area and its vicinity (fig. 3). Results of this survey were erratic; some samples had highly anomalous values of lead and zinc, whereas many others scarcely had background levels of these metals. Analytical results are listed in the appendix. Radiometric measurements also taken during the soil sampling with a hand-held scintillometer indicated levels two to three times the background values in the vicinity of the occurrence. Radiometric anomalies appeared to correlate to the felsic to intermediate volcanics.



Topography from Livengood D-1 quadrangle. Contour interval 100 Feet.

Figure 3 - Zinc Occurrence - T. 13 N., R. 2 E., Sec. 34

EXPLANATION

Black chert and silicified shale.

Black to green/gray chert frequently brecciated and containing volcanic clasts near gossan area.

Intermediate to felsic tuff and tuffaceous limestone, typically iron stained and leached.

Massive resistant gray quartzite, blocky fracture.

Marron and green argillite.

Intermittent gossan.

No further assessment of this prospect was possible. The southern portion of the occurrence extends into lands which were open to mineral claim location (1978). Several months after the BOM investigation, the occurrence was also found by crews employed by the Anaconda Company. Subsequently, the area was staked with 87 mining claims. Mineralization has reportedly been found, but no further details were released.

(Sec. 36, T.13N. R.2E.)Plate 1 - Brecciated limestone and dolomite of the volcanic sequence, exposed on a north trending spur of a ridge, contained minor traces of galena and sphalerite. The carbonates were underlain by the black-shale unit which graded to gray and black chert.

A soil sampling survey conducted over this occurrence is shown on Plate 2 of the back packet. Results of the survey indicated moderately anomalous zinc values, whereas lead and copper were but a little above background levels. Snow cover and frozen ground prevented further work on the occurrence.

(Sec. 31, T. 13N. R.3E.)Plate 1 - Minor traces of galena and sphalerite were found in calcarenite along a ridge crest. Examination of bedrock textures indicated possible sedimentary breccia prior to final lithification. Because of the small size of the occurrence no follow-up work was performed.

(Sec.5, T.12N. R.3E.)Plate 1 - Traces of zinc oxide were found in brecciated exposures of the Tolovana Limestone. Mineralization did not appear extensive and no follow-up work was performed.

(Sec. 35, T.13N. R.3E.)Plate 1 - Zinc, copper, and lead mineralization occurs as oxides in quartz veins that cut a poorly exposed calcarenite-argillite sequence. This unit is bounded on either side by dolomites.

Very tenuous formation attitudes suggested a tightly folded synclinal feature, but the rubbly nature of the rock exposures made interpretation indefinite.

Occasional pods and fracture coatings of sulfides with malachite and zinc oxide were observed in the sequence, but the principal occurrence consisted of a boulder train of smithsonite from a west-facing ridge slope. No in-place mineralization could be viewed at this site. Samples contained 30% to 46.5% zinc, 0.175% lead and 0.18% copper.

The host sequence is bounded to the north by the Tolovana Limestone, which may be in fault contact. Occasional specks of galena were observed in the limestone. Further work is obviously warranted at this site, but none was logistically possible.

(Sec. 5-10, T.12N. R.3E.)Plate 1 - In August 1978, 170 claims were recorded by agents for the Anaconda Company, reportedly for lead and zinc mineralization. No other details are available.

(Sec. 1, 12, T.11N. R.4E.)Plate 1 - Strongly anomalous zinc values up to 1900 ppm were found in stream sediments of the Squaw and Sand Creek headwaters. Bedrock is hornfels black-shale near the granitic contact with the Mt. Victoria intrusive. Siderite veins are common in the general area, sometimes forming stockworks and breccia fillings. Air-magnetometer data indicate a notable magnetic response over the granite, possibly due to trace amounts of magnetite. Geological settings and the geochemistry suggest possible skarn-type zinc-iron mineralization. No further work was pursued because of logistical limitations.

(Sec. 25, 26, 35, 36, T.13N. R.3E.)Plate 1 - Anomalous values of zinc and lead were found on a ridge saddle apparently underlain by quartzite, shales, and volcanics near a fault(?) contact with the Tolovana Limestone. A soil sample(Be 9362) contained 4700 ppm zinc and 485 ppm lead. Minor copper staining was observed in nearby limestone rubble(Be 9363). Soils were somewhat iron stained.

(Sec. 26, T.13N. R.3E.)Plate 1 - Tolovana Limestone here is in contact with shales and chloritic volcanics. Sample of limestone (Be 9367) gossan contained 0.41% zinc and anomalous copper, lead, and molybdenum. Soils contained up to 1400 ppm zinc (Be 8918, 9363-69).

(Sec. 5, T.12N. R.2E.)Plate 1 - This location is apparently underlain by argillites and phyllites near the contact with the Tolovana Limestone. Rubble included brecciated phyllite and sandstone with calcareous clasts, as well as some volcanic breccia, ash, and basalt. A soil sample (Be 9343) in a ridge saddle contained 3200 ppm zinc and 85 ppm lead. Nearby, a rock sample (Be 9184) of breccia contained 0.61% Zn.

(Sec. 32, T.13N. R.2E.)Plate 1 - Black to green shales and quartzite rubble occur near the contact with iron-stained limestone. Three soil samples (Be 9278, 9279, and 10902) contained 154, 927, and 18400 ppm zinc and 25, 150, and 4600 ppm lead, respectively. Abundant quartz veining was observed north of here.

(Sec. 5, T.12N. R.1W.)Plate 1 - An extensively iron-stained bog area with a ferricrete formation several acres in size was found at the base of limestone bluffs. A sample of sediment (Be 9593) contained 7800 ppm zinc.

Manganese - Manganese occurences have been reported 75 miles west of the study area (18). Thomas described manganese mineralization on a divide between Rock and Granite Creeks as psilomelane in quartz veins with pyrolusite. These veins intersect metalimestone, quartzite, and shcist and contained 0.99% to 5% Mn. Minor trenching was done on what is known as the Avnet Prospect.

In Sec. 9, T.12N. R.2W.,(Plate 1) manganese was found to occur as disseminated manganite in a tough quartz groundmass. The mineralization consisted of chert breccia filling with clasts frequently altered to a claylike material. The breccia contained trace amounts of barium, copper, lithium, and zinc (Be 9155). A black botryiodal mineral (presumably psilomelane) was additionally noted in cross-cutting quartz veins. Mineralization could be observed across several hundred feet of rubble exposure.

Asbestos - A partially serpentinized ultramafic was found as a prominent outcrop in the Big Creek valley (Sec. 21, T. 13N., R.4E.)Plate 1. The outcrop was highly fractured and minor amounts of an amphibole asbestos frequently occurred on fracture surfaces.

On lower Lost Creek (Sec. 7, T.13N., R.1W.)Plate 1 float rock containing chrysotile cross-fiber veinlets was found. The source of this asbestos is unknown. To the south, along Beaver Creek, serpentinite is reported to contain rare thin veinlets of chrysotile as well as segregations of chromium and nickel (5).

Other Mineralization - There have been unverified reports of coal seams on Lost Creek in years past. Investigations during this project,

however, found no coal seams, or coal in the creek gravels. Nevertheless, low bluffs along lower Lost Creek Valley are characteristic of the nonmarine coal-bearing Tertiary sediments known elsewhere in the Yukon Flats area. Fragments of (Tertiary?) mudstone and conglomerate were found in the creek bed along Lost Creek, and the possibility of coal deposits cannot be dismissed.

The Yukon Flats are frequently burned by summer forest fires. Coal seams that would otherwise crop out would probably be burned and covered by colluvium. Drilling would be necessary to prove if coal exists at depth.

The U. S. Geological Survey (USGS) reported an outcrop of yellow to green-coated, crushed and sheared shale which was anomalous with arsenic, molybdenum, and antimony in an outcrop along Lost Creek (5). The shearing was believed associated with east-northeast trending fault, and further sampling was suggested. Adverse weather prevented followup during this project.

SAMPLING

As part of the Bureau of Mines investigation a total of 489 soil samples, 229 stream silt samples, and 105 rock samples were collected. All sample stations are displayed on Plates 2, 3, and 4.

Rock samples consisted of 1 to 2 pounds, generally taken as chips across a particular zone of interest. Specimen splits have been retained and in some cases examined petrographically.

Stream silt sediment samples were collected with a steel shovel from either the finer sandy portion of the active channel or the deepest, most active part of a dry creek bed. Because of the early field season (May), some streams were at flood stage and could not be sampled.

Organic-rich material was avoided. Samples were put in water-resistant paper sample bags, then air-dired before screening and analysis. Float rock and stream characteristics were noted and recorded at each sample station. Random measurements of pH indicated acidic stream waters ranging from 4.2 to 5.4.

Soil samples were generally collected from the C horizon or from frost boils which provided fresher subsurface colluvium.

Samples were analyzed by standard atomic absorption methods by the Bureau of Mines, Reno Metallurgical Research Laboratory. Analyses for copper, lead, zinc, silver and molybdenum are listed in Tables 1, 2, and 3 of the Appendix.

A representative suite of the Bureau's stream silt sample (62 of the 229 collected) have been analyzed by the Los Alamos Scientific Laboratory for beryllium and lithium by emission spectography, and for silver, bismuth, cadmium, copper, niobium, nickel, lead, tin, and tungsten by X-ray flourescence. Samples will also be analyzed for aluminum, barium, calcium, chlorine, dysprosium, potassium, magnesium, manganese, sodium, strontium, titanium, and vanadium by using neutron activation with a short time delay before analysis; and for gold, cerium, cobalt, chromium, cesium, europium, iron, hafnium, lanthanum, lutetium, rubidium, antimony, scandium, samarium, tantalum, terbium, thorium, ytterbium, and zinc by using neutron activation with a long time delay before analysis. Results will be available in an open-file report from the Department of Energy as well as a more detailed description of the analytical procedures.

To better provide the BLM with data indicating mineral favorability, a computer-generated contour display of the lead and zinc values in

soils and stream silts and copper in stream silts was prepared. However, statistical variation within the copper soils, silver and molybdenum data was felt to be insufficient to be similarly displayed. The computer plottings were done by the University of Alaska (MIRL) under a Bureau of Mines contract. The program is a modified form of one designed by the Alaska Division of Geological and Geophysical Surveys.

MINERAL POTENTIAL

Because of the complex nature of the local geology and the relatively uncertain accuracy of available bedrock mapping, no attempt has been made to map favorable areas for mineralization. Instead, the reader should refer to the local geology of any specific site of interest and use the context of the following comments.

On the basis of the mineral commodities found and the environment in which they occur, geological observations, the available mapping that had been done, and the aeromagnetic survey recently conducted, the following are considered the most favorable zones for specific mineralization:

Zinc-Lead a) There appears to be a high potential for volcaniclastic or sedimentary (from an exhalative source) hosted stratiform deposits associated with the tuffaceous and volcanic rock tentatively included in the Ordovician-Silurian sequence.

b) Favorable tectonic zones (e.g., breccias), particularly in the carbonates, host epigenetic stratabound occurrences. No significant mineralization was found in the overlying Tolovana Limestones; however, there appears to be particular likelihood along the fault or unconformity contact

with the Ordovician-Silurian sequence. Because of the lack of apparent reef formations and paleo-karst structure the Tolovana probably is not favorable for stratabound deposits such as those at Pine Point, Northwest Territories.

c) The contact zone around the Victoria Mountain intrusion is favorable for zinc-iron mineralization of a metasomatic type. Some silver and molybdenum values may also be present.

Maganese Deposits of unknown size and grade occur in the mafic complex presumably of the Rampart Group. Brecciation and shear zones with silicification appear to be controls for the mineralization found to date. Favorability for manganese deposits should be considered high.

Asbestos Several widely spaced occurrences of crysotile and the frequent presence of serpentization is encouraging for asbestos deposits. Particularly favorable are ultramafic units in the Victoria Mountain area and the region immediately north of the east-west trending hills, as suggested by the aeromagnetic survey. However, vegetation cover in this area is continuous and a reasonable estimate of potential cannot be made at this time.

To some extent these estimates of mineral potential can be extrapolated outside of the project area along trends of similar geology. Zinc and lead potential would appear very favorable in any of the lower Paleozoic alloctons along the Tintina system. Zinc mineralization, for instance, was indicated in the western Crazy Mountains to the east (1). The Fossil Creek Volcanic localities near Beaver Creek and Cache Mountain may also be considered favorable.

Manganese and asbestos should be considered favorable in portions of the Rampart Group meta sediments and in the volcanics and ultramafics along the southwesterly trend toward the village of Manley.

CONCLUSIONS

Age and stratigraphic correlations, particularly the occurrence of Cambrian Oldhamia, with the Mt. Schwatka group of rocks suggest similarities with rocks of the western Yukon Territory and eastern Alaska. The present geographic positioning of the Mt. Schwatka area is probably due to a series of right-lateral movements along the Tintina Trench. In the Yukon there are significant lead-zinc deposits in these rocks. Lead and zinc occurrences were found during this study and occur in similar depositional modes, as do some of the Canadian deposits. On the basis of the evidence available, it can be inferred that a high potential for lead and zinc mineralization exists in the Mt. Schwatka region as well as any of the other allochthons along the Tintina system which include this package of rocks.

The undifferentiated mafic volcanics and ultramafics in the western and northern zones of the study area are shown to be tentatively favorable for the occurrence of manganese and asbestos.

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APPENDIX A

ANALYSES OF SOIL SAMPLES

All units are parts per million except as noted.

"-" indicates less than the amount stated.

SOIL SAMPLES

Sample #	Cu	Pb	Zn	Ag	Mo
Be 118	130	0	170	1	5
8801	Not Analyzed				
8802	Not Analyzed				
8804	18	30	85	-3	-5
8806	24	70	190	"	"
8807	95	85	205	"	15
8808	31	30	150	"	-15
8811	25	20	65	"	"
8813	40	15	155	"	"
8816	19	15	65	"	"
8818	22	20	105	"	"
8819	30	20	75	"	"
8820	32	15	70	"	"
8821	27	25	100	"	"
8822	25	20	65	"	"
8823	27	25	95	"	"
8824	24	30	75	"	"
8825	148	210	650	"	20
8826	19	45	110	"	-15
8827	16	20	40	"	"
8828	53	65	75	"	15
8829	32	30	30	"	-15
8832	11	-15	40	"	"
8838	15	15	60	"	"
8840	9	-15	30	"	"
8841	43	25	135	"	"
8843	11	35	50	"	"
8844	14	-69	-69	-12	-69
8845	Not Analyzed				
8846	16	15	90	-3	-15
8847	16	20	75	"	"
8849	18	20	85	"	"
8852	18	-15	85	"	"
8853	18	15	70	"	"
8854	16	-15	80	"	"
8855	16	15	70	"	"
8856	15	15	80	"	"
8857	22	20	100	"	"
8858	13	30	140	"	"
8862	56	30	50	"	"
8864	31	-15	105	"	"
8865	38	40	270	"	"

Sample #		Cu	Pb	Zn	Ag	Mo
Be	8869	38	75	90	-3	-15
	8874	20	50	130	"	"
	8876	13	15	100	"	"
	8877	17	25	130	"	"
	8878	27	20	115	"	"
	8879	28	45	150	"	"
	8880	22	45	115	"	"
	8881	20	70	175	"	"
	8882	23	175	750	"	"
	8883	75	110	365	"	15
	8885	20	-15	80	"	-15
	8886	30	"	70	"	"
	8887	96	25	360	"	"
	8888	24	190	750	"	"
	8890	39	75	360	"	"
	8891	72	40	165	"	"
	8892	85	65	295	"	"
	8893	56	60	220	"	"
	8894	205	85	625	"	15
	8897	Not Analyzed				
	8898	38	30	115	"	-15
	8899	53	50	255	"	"
	8901	26	30	75	"	"
	8902	43	60	.14%	"	35
	8904	161	30	290	"	-15
	8905	64	45	495	"	"
	8906	69	40	120	"	"
	8907	16	230	625	"	"
	8908	36	195	470	"	"
	8909	28	90	.11%	"	"
	8910	93	90	370	"	"
	8913	39	15	90	"	"
	8918	49	165	.14%	"	25
	8926	38	-20	117	-4	-20
	8927	70	15	121	-3	-15
	8928	12	-15	159	"	"
	8929	71	15	111	"	"
	8930	41	55	152	"	"
	8932	54	75	238	"	"
	8933	47	65	426	"	"
	8934	19	20	76	"	"
	8936	13	15	36	"	"
	8941	51	20	100	"	"
	8946	25	30	149	"	"

Sample #		Cu	Pb	Zn	Ag	Mo
Be	8947	31	45	26	-3	-15
	8948	27	40	90	"	"
	8949	24	30	131	"	"
	8951	44	25	163	"	"
	8953	22	30	184	"	"
	8955	19	40	180	"	"
	8957	46	70	367	"	"
	8959	33	20	148	"	"
	8960	25	25	204	"	"
	8961	11	20	200	"	"
	8962	21	55	422	"	"
	8963	16	20	69	"	"
	8964	19	40	.14%	"	"
	8965	23	35	236	"	"
	8967	15	15	81	"	"
	8968	26	25	152	"	"
	8969	25	25	136	"	"
	8971	16	45	168	"	"
	8972	26	60	152	"	"
	8975	41	80	160	"	"
	8979	19	40	89	"	"
	8983	24	35	93	"	"
	8984	10	15	29	"	"
	8985	10	15	37	"	"
	8987	23	20	89	"	"
	8989	14	25	53	"	"
	8990	27	20	85	"	"
	8997	24	-15	81	"	"
	8998	51	100	367	"	20
	9001	18	15	73	"	-15
	9002	14	18	114	"	-18
	9003	22	30	90	"	-15
	9004	28	30	98	"	"
	9006	26	40	94	"	"
	9007	13	30	53	"	"
	9009	15	-15	69	"	"
	9011	15	"	77	7	"
	9013	5	"	17	-3	"
	9014	28	"	114	"	"
	9015	45	35	175	"	"
	9018	18	15	98	"	"
	9019	21	-15	106	"	"
	9021	15	20	90	"	"
	9023	21	-15	77	"	"
	9024	17	25	61	"	"
	9025	11	-15	57	"	"

Sample #		Cu	Pb	Zn	Ag	Mo
Be	9026	10	15	77	-3	-15
	9028	28	20	60	"	"
	9030	14	-15	84	"	"
	9031	35	30	55	"	-17
	9033	16	20	47	"	-15
	9034	23	20	214	"	"
	9036	58	40	.39%	"	"
	9037	22	18	184	"	"
	9038	28	30	310	"	"
	9040	13	15	104	"	"
	9041	20	20	92	"	"
	9042	19	20	92	"	"
	9043	19	20	72	"	"
	9045	16	35	76	"	"
	9046	12	20	72	"	"
	9047	20	-15	76	"	"
	9048	57	"	129	"	"
	9049	81	"	43	4	"
	9051	31	"	80	-3	"
	9053	15	"	76	"	"
	9054	24	15	84	"	"
	9055	47	35	231	"	"
	9056	19	25	92	"	"
	9057	19	-15	76	"	"
	9058	13	15	60	"	"
	9059	16	-15	64	"	"
	9061	25	20	84	"	"
	9062	29	155	431	"	"
	9063	22	160	365	"	"
	9064	8	-15	39	"	"
	9065	74	110	193	"	"
	9066	26	55	76	"	"
	9069	24	15	70	"	"
	9072	73	25	158	"	"
	9079	28	20	142	"	"
	9080	11	-15	62	"	"
	9081	27	"	46	"	"
	9082	13	15	60	"	"
	9083	27	-15	66	"	"
	9084	32	20	258	"	"
	9085	29	-15	54	"	"
	9086	31	60	118	"	"
	9087	26	20	74	"	"
	9088	18	20	90	"	"
	9089	18	15	74	"	"
	9090	13	23	62	"	"

Sample #		Cu	Pb	Zn	Ag	Mo
Be	9091	20	30	102	-3	-15
	9092	23	20	98	"	"
	9093	29	35	102	"	"
	9094	19	25	94	"	"
	9095	12	20	50	"	"
	9096	83	70	509	3	"
	9099	18	100	381	-3	"
	9100	19	15	90	"	"
	9101	16	15	66	"	"
	9102	20	20	82	"	"
	9103	21	15	74	"	"
	9104	19	20	80	"	"
	9105	32	45	150	"	"
	9106	37	15	70	"	"
	9109	27	25	95	"	"
	9111	63	33	150	"	"
	9112	14	20	64	"	"
	9113	26	20	73	"	"
	9114	27	15	78	"	"
	9116	74	30	102	"	20
	9118	31	60	431	"	-15
	9119	22	25	124	"	"
	9121	21	25	87	"	"
	9122	20	93	456	"	"
	9126	24	20	97	"	"
	9127	31	120	154	"	"
	9129	200	100	113	"	80
	9130	37	105	154	"	-15
	9133	27	60	401	"	"
	9134	36	20	91	"	"
	9135	29	-15	422	9	"
	9137	24	30	169	-3	"
	9138	16	-30	106	-5	-30
	9139	14	30	77	-3	-15
	9140	41	90	140	"	"
	9141	10	15	55	"	"
	9145	11	-33	105	-5	-33
	9146	31	20	76	-3	-15
	9147	29	15	64	"	"
	9149	15	-15	40	"	"
	9150	38	190	101	"	"
	9151	14	30	56	"	"
	9152	25	30	70	"	"
	9157	27	35	113	"	"
	9158	45	145	68	4	"
	9160	38	20	125	-3	"

Sample #		Cu	Pb	Zn	Ag	Mo
Be	9161	17	15	52	-3	-15
	9162	17	30	48	"	"
	9163	21	-15	80	"	"
	9164	40	25	97	"	20
	9165	42	30	56	"	-15
	9166	37	35	101	"	"
	9168	25	25	105	"	"
	9170	13	-15	113	"	"
	9174	10	55	611	"	"
	9175	30	20	72	"	"
	9176	17	15	48	"	"
	9178	36	35	162	"	"
	9179	12	45	129	"	"
	9187	23	70	164	"	"
	9188	888	20	106	3	"
	9194	21	20	99	-3	"
	9195	22	20	76	"	"
	9196	29	-15	70	"	"
	9200	16	25	186	"	"
	9201	4	-15	200	"	"
	9206	20	640	457	"	"
	9207	42	50	137	"	"
	9208	16	25	80	"	"
	9209	14	30	66	"	"
	9214	25	55	266	"	"
	9215	26	60	157	"	"
	9216	41	35	147	"	"
	9217	22	30	131	"	"
	9219	33	150	483	"	"
	9220	36	210	355	"	"
	9222	27	55	193	"	"
	9223	11	-15	240	"	"
	9226	31	30	183	"	"
	9230	45	25	114	"	"
	9234	20	-31	170	-5	-31
	9235	15	50	176	-3	-15
	9242	40	90	538	"	20
	9247	38	40	99	"	-15
	9258	51	55	172	"	"
	9260	69	90	235	"	"
	9263	42	30	71	"	"
	9265	16	20	78	"	"
	9271	24	35	335	"	"
	9272	23	15	64	"	"
	9273	19	20	61	"	"
	9274	17	20	61	"	"

Sample #	Cu	Pb	Zn	Ag	Mo
Be 9275	15	28	133	-3	-15
9278	23	25	154	"	"
9281	17	25	117	"	"
9282	39	20	41	"	"
9283	18	25	64	"	"
9284	24	50	271	"	"
9286	34	-15	105	"	"
9287	28	55	147	"	"
9288	23	20	84	"	"
9289	24	25	91	"	"
9290	14	40	119	"	"
9294	25	30	129	"	"
9301	39	20	222	"	"
9302	73	140	522	"	"
9309	21	15	92	"	"
9310	34	30	145	"	"
9312	20	25	75	"	"
9313	22	15	78	"	"
9320	22	20	68	"	"
9321	10	705	.29%	"	"
9323	11	40	82	"	"
9325	Not Analyzed				
9328	44	50	138	"	"
9329	20	25	149	"	"
9335	25	55	92	"	"
9336	22	60	149	"	"
9337	8	-15	27	"	"
9339	10	15	66	"	"
9341	13	-15	76	"	"
9342	10	"	60	"	"
9343	28	85	.32%	"	"
9348	40	30	116	"	"
9349	24	20	90	"	"
9352	16	35	56	"	"
9353	24	35	70	"	"
9354	27	15	100	"	"
9355	26	30	80	"	"
9357	38	55	566	"	"
9359	13	20	80	"	"
9360	34	50	113	"	"
9362	48	485	.47%	"	"
9365	26	145	492	"	"
9366	26	140	90	"	50
9368	47	140	110	"	20
9369	24	25	60	"	-15
9370	44	30	188	"	"

Sample #		Cu	Pb	Zn	Ag	Mo
Be	9375	33	125	.13%	-3	-15
	9376	11	60	17	"	"
	9378	22	20	137	"	"
	9384	24	20	56	"	"
	9385	28	110	301	"	"
	9386	76	50	204	"	"
	9387	19	20	69	"	"
	9395	18	-15	56	"	"
	9408	42	180	554	"	"
	9427	14	-21	33	-4	-21
	9433	31	20	60	-3	-15
	9434	22	25	63	"	"
	9435	14	-15	50	"	"
	9436	20	"	66	"	"
	9437	68	35	86	"	"
	9439	23	25	91	"	"
	9440	31	30	106	"	"
	9441	45	20	88	"	"
	9443	24	20	70	"	"
	9444	22	60	15	"	"
	9445	5	45	15	"	"
	9446	15	25	44	"	"
	9448	11	65	15	"	"
	9451	17	35	113	"	"
	9452	23	15	110	"	"
	9455	15	20	70	"	"
	9457	19	30	102	"	40
	9458	19	30	84	"	-15
	9459	26	30	187	"	"
	9467	18	20	95	"	"
	9468	16	30	102	"	"
	9470	21	60	355	"	"
	9471	34	50	274	"	"
	9472	8	550	312	"	"
	9474	16	35	386	"	"
	9476	16	15	187	"	20
	9477	32	80	172	"	-15
	9480	20	15	106	"	"
	9481	17	80	414	"	"
	9482	19	15	84	"	"
	9483	22	15	124	"	"
	9484	8	-15	51	"	"
	9485	5	15	50	"	"
	9486	10	20	221	"	"
	9487	30	55	172	"	"
	9488	16	20	99	"	"

Sample #		Cu	Pb	Zn	Ag	Mo
Be	9489	13	-15	41	-3	-15
	9490	28	30	95	"	"
	9491	24	23	66	"	"
	9495	22	20	87	"	"
	9496	30	50	108	"	"
	9497	26	30	82	"	"
	9498	35	-88	90	-15	-88
	9500	32	100	207	-3	-15
	9502	13	15	95	"	"
	9503	30	20	78	"	"
	9504	10	30	58	"	"
	9505	22	15	54	"	"
	9506	26	35	247	"	"
	9507	35	30	91	"	"
	9510	24	120	436	"	"
	9511	75	-15	54	"	"
	9514	29	25	78	"	"
	9515	25	140	.15%	"	"
	9516	19	15	74	"	"
	9517	41	25	116	"	"
	9519	46	20	137	"	"
	9520	27	25	99	"	"
	9521	13	-15	74	"	"
	9522	14	"	58	"	"
	9523	23	"	103	"	"
	9526	16	15	70	"	"
	9527	13	15	62	"	"
	9530	57	85	93	"	"
	9531	15	20	58	"	"
	9532	18	15	66	"	"
	9536	20	20	64	"	"
	9538	21	30	66	"	"
	9539	27	35	119	"	"
	9541	19	30	173	"	"
	9542	22	25	97	"	"
	9543	26	25	115	"	"
	9544	22	25	62	"	"
	9545	20	35	226	"	"
	9546	25	-15	66	"	"
	9548	20	15	53	"	"
	9553	19	30	177	"	"
	9555	24	20	213	"	"
	9556	21	15	71	"	"
	9557	35	35	119	"	"
	9559	25	60	424	"	"
	9560	42	100	271	"	"

Sample #	Cu	Pb	Zn	Ag	Mo
Be 9561	11	25	66	-3	-15
9563	17	15	58	"	"
9564	32	55	88	"	"
9565	16	20	80	"	"
9566	23	20	59	"	"
9568	23	50	100	"	"
9569	22	40	40	"	"
9573	16	45	53	"	15
9574	22	90	63	6	-15
9575	13	25	94	-3	"
9577	33	25	70	3	"
9579	87	225	70	5	"
9581	16	35	43	-3	"
9584	18	20	70	"	"
9585	30	25	87	"	"
9586	28	65	66	3	"
9588	18	15	59	-3	"
9590	13	35	63	"	"
9591	17	25	76	"	"
9594	15	20	93	"	"
9595	18	-15	53	"	"
9596	10	115	90	-17	-100
9597	9	25	36	-3	-15
9598	15	25	59	"	"
9599	10	-15	83	"	"
10806	28	50	286	"	"
10807	20	20	231	"	"
10808	51	20	99	"	"
10809	21	25	95	"	"
10810	21	15	59	"	"
10811	17	23	81	"	"
10824	17	25	70	"	"
10827	23	90	347	"	"
10828	24	20	88	"	"
10830	19	30	98	"	"
10831	13	-15	73	"	"
10832	17	"	77	"	"
10833	13	15	84	"	"
10834	24	33	151	"	"
10835	111	85	748	"	"
10836	27	25	117	"	"
10875	27	55	140	"	"
10877	7	-15	39	"	"
10881	25	35	164	"	"
10882	23	30	320	"	"
10883	21	25	84	"	"

Sample #	Cu	Pb	Zn	Ag	Mo
Be 10884	13	-21	78	-4	-21
10885	39	15	101	-3	-15
10886	10	-15	98	"	"
10887	14	-29	108	-5	-29
10888	21	-15	67	-3	-15
10894	15	-15	84	"	"
10895	34	-15	126	"	"
10897	54	125	566	"	"
10902	15	.46%	1.84%	"	"
10905	32	-15	154	"	"
10910	30	20	182	"	"
10912	23	35	225	"	"
10913	22	23	77	"	"
11705	15	16	90	0	4
11713	19	12	31	0	4
11719	27	13	72	0	4
11721	38	52	350	0	18
11723	52	20	340	0	18
11724	24	19	59	0	9
11727	23	7	100	0	5
12101	96	4	84	1	5
12102	26	0	58	0	5
12103	75	39	160	1	7
12105	65	20	160	1	6
12110	53	40	420	0	20
12114	24	23	97	0	6
12115	16	19	59	0	6
12116	24	8	62	0	6
12118	37	20	110	0	6
12125	18	150	410	0	11
12126	40	1400	6900	0	12
12128	24	26	8600	0	9
12130	11	16	69	0	11
12132	33	23	110	1	8

APPENDIX B

ANALYSES OF STREAM SEDIMENT SAMPLES

All units are parts per million except as noted.

"-" indicates less than the amount stated.

STREAM SEDIMENT SAMPLES

Sample #		Cu	Pb	Zn	Ag	Mo
Be	101	35	16	120	1	5
	103	46	29	180	2	7
	105	23	13	84	1	7
	106	65	25	180	1	8
	108	77	24	290	2	8
	111	62	28	200	1	7
	112	46	20	180	1	7
	115	61	12	130	1	8
	117	61	12	120	1	8
	125	27	9	260	0	5
	127	37	18	64	3	7
	129	35	13	98	0	5
	163	63	35	490	1	8
	165	36	9	210	0	3
	180	23	9	81	0	3
	423	50	30	360	1	5
	426	49	32	230	1	6
	429	33	21	440	0	6
	430	200	100	1200	1	10
	431	84	170	360	1	7
	432	92	260	760	1	11
	433	130	92	1600	2	11
	434	44	41	1000	1	5
	435	130	160	1900	2	16
	436	62	23	360	1	6
	437	29	15	99	0	4
	856	39	20	130	0	5
	860	47	23	170	0	5
	862	24	23	240	0	5
	864	39	21	220	0	6
	866	65	54	680	2	10
	870	41	21	160	2	7
	872	22	18	85	1	5
	2280	28	16	110	1	7
	2282	31	16	110	1	7
	2305	70	24	1200	1	19
	2306	31	16	480	1	16
	2308	-80	0	610	0	0
	2309	70	29	1500	0	19
	8810	20	30	100	-3	-15
	8812	23	20	85	"	"
	8815	Not Analyzed				
	8817	23	-15	70	"	"

Sample #		Cu	Pb	Zn	Ag	Mo
Be	8830	23	20	100	-3	-15
	8831	15	15	115	"	"
	8833	14	15	90	"	"
	8834	18	15	90	"	"
	8835	21	15	125	"	"
	8836	17	15	100	"	"
	8837	22	20	150	"	"
	8839	23	50	120	"	"
	8842	25	30	160	"	"
	8848	15	20	90	"	"
	8850	17	20	85	"	"
	8851	17	15	85	"	"
	8859	27	25	95	"	"
	8860	28	33	125	"	"
	8861	18	20	100	"	"
	8867	46	30	500	"	"
	8868	27	40	155	"	"
	8870	22	40	205	"	"
	8871	26	35	145	"	"
	8872	23	40	175	"	"
	8873	22	35	185	"	"
	8875	27	75	245	"	"
	8915	38	155	625	"	25
	8916	18	-15	140	"	-15
	8917	27	35	185	"	"
	8919	24	110	380	"	"
	8920	20	55	213	"	"
	8921	41	65	283	"	"
	8922	18	25	100	"	"
	8923	30	60	209	"	"
	8924	27	30	131	"	"
	8925	17	15	170	"	"
	8935	24	35	166	"	"
	8937	39	45	234	"	"
	8944	44	75	223	"	"
	8945	34	40	184	"	"
	8950	42	50	461	-8	-50
	8952	21	45	328	-3	-15
	8954	23	35	298	"	"
	8956	29	35	321	"	"
	8966	21	25	144	"	"
	8970	35	35	148	"	"
	8973	31	35	363	"	"
	8974	37	50	164	"	"
	8976	35	15	109	"	"
	8977	34	33	164	"	"

Sample #		Cu	Pb	Zn	Ag	Mo
Be	8978	37	40	439	-3	-15
	8980	27	60	144	"	"
	8981	37	45	236	"	"
	8982	35	30	305	"	"
	8986	34	50	727	"	"
	8988	32	50	140	"	"
	8991	21	45	110	"	"
	8992	26	35	98	"	"
	8993	33	175	834	"	"
	8994	31	80	477	"	"
	8995	37	45	415	"	"
	9000	25	40	287	"	"
	9005	20	25	110	"	"
	9012	21	-15	81	"	"
	9016	21	15	101	"	"
	9017	15	15	73	"	"
	9020	25	20	232	"	"
	9022	20	15	122	"	"
	9060	23	15	88	"	"
	9067	35	65	146	"	"
	9068	22	33	90	"	"
	9070	21	60	86	"	"
	9073	33	20	94	"	"
	9077	21	18	90	"	"
	9078	26	25	94	"	"
	9108	71	45	180	"	"
	9110	42	75	117	"	"
	9115	28	25	98	"	"
	9123	20	30	97	"	"
	9124	19	25	73	"	"
	9125	21	40	143	"	"
	9132	41	25	131	"	"
	9142	18	20	161	"	"
	9143	18	15	84	"	"
	9144	26	-15	88	"	"
	9148	12	"	88	"	"
	9167	41	60	179	"	"
	9197	25	25	118	"	"
	9198	38	15	113	"	"
	9199	25	15	120	"	"
	9203	20	55	287	"	"
	9204	29	70	453	"	"
	9205	31	63	548	"	"
	9211	30	45	504	"	"
	9212	13	20	99	"	"

Sample #		Cu	Pb	Zn	Ag	Mo
Be	9213	28	50	339	-3	-15
	9218	32	35	233	"	"
	9224	39	30	147	"	"
	9231	25	90	747	"	"
	9232	22	70	273	"	"
	9233	21	25	132	"	"
	9237	32	40	202	"	"
	9238	33	45	198	"	"
	9239	27	40	154	"	"
	9240	31	25	36	"	"
	9241	22	25	107	"	"
	9243	34	50	139	"	"
	9244	28	40	135	"	"
	9245	28	45	128	"	"
	9246	31	30	135	"	"
	9248	36	40	168	"	"
	9249	32	25	154	"	"
	9250	30	30	128	"	"
	9251	26	40	187	"	"
	9252	70	30	190	"	"
	9254	17	15	89	"	"
	9255	20	25	110	"	"
	9256	21	20	92	"	"
	9257	23	15	96	"	"
	9261	17	15	78	"	"
	9262	27	25	99	"	"
	9264	16	15	95	"	"
	9266	24	35	301	10	"
	9267	20	30	324	-3	"
	9268	23	30	328	"	"
	9269	21	20	102	"	"
	9270	25	30	320	"	"
	9279	34	150	927	"	"
	9280	96	250	.18%	"	"
	9285	30	30	213	"	"
	9292	32	15	129	"	"
	9295	26	-15	108	"	"
	9296	37	25	256	"	"
	9297	13	-15	278	"	50
	9298	53	65	650	"	15
	9308	30	25	134	"	-15
	9311	32	30	149	"	"
	9317	121	30	283	"	"
	9322	25	55	167	"	"
	9324	22	40	134	"	"
	9325	Not Analyzed				

Sample #		Cu	Pb	Zn	Ag	Mo
Be	9326	27	30	606	-3	-15
	9327	24	25	85	"	"
	9332	17	20	89	"	"
	9333	25	45	229	"	"
	9334	21	25	145	"	"
	9340	10	25	191	"	"
	9346	19	20	83	"	"
	9372	12	30	278	"	"
	9373	36	55	261	"	"
	9374	32	65	289	"	"
	9379	34	50	143	"	"
	9380	19	40	80	"	"
	9382	39	40	174	"	"
	9391	27	35	156	"	"
	9392	19	-15	124	"	"
	9393	18	"	90	"	"
	9396	21	35	131	"	"
	9397	32	25	114	"	"
	9398	36	30	107	"	20
	9399	34	15	110	"	-15
	9400	49	40	160	"	"
	9401	29	40	171	"	"
	9402	20	35	156	"	"
	9403	32	35	131	"	"
	9404	38	45	257	"	"
	9405	22	30	253	"	"
	9406	35	35	208	"	"
	9407	44	50	182	"	"
	9409	37	55	230	"	"
	9410	43	-36	205	-6	-36
	9432	34	30	189	-3	-15
	9492	17	25	142	"	"
	9493	19	30	159	"	"
	9512	22	50	82	"	"
	9524	16	15	87	"	"
	9525	18	-15	78	"	"
	9528	8	-15	37	"	"
	9529	19	15	88	"	"
	9533	13	-15	58	"	"
	9534	23	20	93	"	"
	9535	24	25	119	"	"
	9537	33	25	97	"	"
	9540	20	25	115	"	"
	9550	30	70	363	"	"
	9551	24	50	299	"	"
	9552	26	30	258	"	"

Sample #	Cu	Pb	Zn	Ag	Mo
Be 9954	30	25	102	-3	-15
9558	21	35	137	"	"
9562	18	25	115	"	"
9578	26	45	139	"	"
9582	81	65	150	"	"
9587	40	115	158	"	"
9589	18	30	93	"	"
9592	31	35	97	"	"
9593	11	25	.78%	"	"
9600	17	20	107	"	"
10801	31	50	425	"	"
10802	25	40	300	"	"
10803	24	60	509	"	"
10804	26	25	151	"	"
10805	25	30	204	"	"
10812	25	35	223	"	"
10814	16	40	200	"	"
10815	20	150	558	"	"
10816	28	30	204	"	"
10817	31	15	173	"	"
10818	27	30	200	"	"
10819	20	25	87	"	"
10820	17	25	166	"	"
10821	28	30	204	"	"
10822	24	20	102	"	"
10823	19	40	208	"	"
10826	22	30	143	"	"
10867	40	35	240	"	"
10868	35	20	266	"	"
10869	37	35	239	"	"
10870	26	25	363	"	"
10871	28	45	246	"	"
10872	33	25	223	"	"
10873	26	40	278	"	"
10889	28	35	221	"	"
10898	26	-15	143	"	"
10899	18	15	136	"	"
10900	19	20	133	"	"
10901	33	65	291	"	"
10903	25	15	168	"	"
10904	35	20	171	"	"
10906	34	50	207	"	"
10908	36	40	218	"	"
10911	22	15	105	"	"
11706	62	47	260	0	17
11707	39	27	900	0	5

Sample #	Cu	Pb	Zn	Ag	Mo
Be 11708	39	62	180	0	4
11709	51	200	550	0	23
11710	35	37	690	0	6
11711	37	27	130	0	5
11712	28	21	120	0	5
11720	25	10	140	0	5
11725	26	23	420	1	7
11726	30	11	100	0	5
11256	41	17	80	1	7
12107	74	50	110	0	10

APPENDIX C

ANALYSES OF ROCK SAMPLES

all units are parts per million except as noted.

"-" indicates less than the amount states.

ROCK SAMPLES

Sample #	Cu	Pb	Zn	Ag	Mo
Be 874	26	9	71	1	4
8863	22	25	-15	-3	-15
8866	165	175	.78%	10	85
8884	43	340	170	-3	-15
8889	257	215	1.8%	"	"
8896	99	80	450	"	15
8911	66	40	163	"	-15
8931	55	15	191	"	"
8938	14	150	.13%	"	"
8939	13	170	305	"	"
8940	131	30	145	"	"
8942	20	15	264	"	"
8943	162	.18%	45.2%	3	"
8958	103	140	260	-3	"
8999	123	180	814	10	20
9008	126	60	236	-3	-15
9010	56	-15	69	"	"
9029	30	"	47	4	"
9032	67	15	306	-3	"
9035	79	25	.28%	"	"
9039	22	55	19	"	"
9071	36	35	50	"	"
9074	67	20	293	"	"
9075	10	15	30	"	"
9076	21	35	267	"	"
9097	49	30	233	"	"
9117	33	20	70	"	"
9120	34	35	106	"	"
9136	23	28	173	"	"
9155	91	-15	914	"	"
9169	11	"	695	"	"
9172	7	"	-15	"	"
9177	41	"	164	"	"
9181	48	"	101	"	"
9184	15	108	.61%	"	"
9185	318	-15	25	"	"
9186	12	755	.27%	"	"
9189	5.85%	20	60	20	"
9190	34	145	304	-3	"
9191	58	40	103	"	"
9192	69	35	109	"	"
9193	50	15	81	"	"
9202	38	-15	89	"	"
9225	63	15	265	"	"
9228	55	740	446	6	195
9229	35	-15	53	-3	-15

Sample #		Cu	Pb	Zn	Ag	Mo
Be	9236	39	25	57	-3	-15
	9277	25	35	136	"	"
	9291	49	-15	98	"	"
	9293	7	-15	54	"	"
	9300	61	20	260	"	20
	9303	69	35	535	"	30
	9304	24	15	156	"	-15
	9305	50	-15	127	"	"
	9306	58	15	85	"	"
	9307	15	15	85	"	"
	9314	51	245	211	"	"
	9316	23	20	124	"	"
	9319	17	-15	41	"	"
	9330	23	15	75	"	"
	9338	55	25	134	"	"
	9358	34	-15	123	"	"
	9361	35	35	137	"	"
	9363	8	25	.20%	"	"
	9364	21	15	113	"	"
	9367	207	95	.41%	"	20
	9371	46	15	116	"	-15
	9377	16	-15	56	"	"
	9388	51	35	80	"	"
	9389	63	-15	80	"	"
	9390	11	"	40	"	"
	9394	53	"	76	"	"
	9438	42	35	53	"	"
	9442	17	-15	22	"	"
	9449	15	"	44	"	"
	9479	125	30	232	"	"
	9494	88	15	146	"	"
	9499	11	-15	50	"	"
	9508	24	"	29	"	"
	9513	9	"	62	"	"
	9518	14	"	33	"	"
	9549	23	15	240	"	"
	9567	98	20	125	4	40
	9571	16	55	83	-3	-15
	9572	106	45	.15%	"	"
	9576	10	-15	36	"	"
	9580	650	45	.17%	4	"
	9583	61	-15	93	-3	"
	10907	18	15	63	"	"
	11252	14	8	110	0	4
	11258	22	0	74	1	4
	11259	930	0	25	3	3

Sample #	Cu	Pb	Zn	Ag	Mo
Be 11722	20	26	110	1	20
12104	33	9	26	1	10
12106	13	28	13	1	9
12108	37	7	84	0	9
12111	15	47	73	0	9
12112A	50	9	130	0	11
12112B	23	24	120	0	11
12113	62	69	210	1	7
12127A	33	1500	58000	1	9
12127B	15	40	230	0	10
12129A	7	14	190	1	5
12129B	15	23	240	0	7
12133	130	1200	17000	4	13