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Geology and Geochemistry of the Sinuk Area Seward Peninsula, Alaska

By

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GEOLOGY AND GEOCHEMISTRY OF THE SINUK AREA

SEWARD PENINSULA, ALASKA

By

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A B S T R A C T

The Sinuk district is 20 miles northwest of Nome. It contains numerous mineralized localities indicated by gossans, showings of sulfide minerals, and geochemical anomalies. Some have been described in Alaska Division of Mines and Geology (ADMG) Geologic Reports 24 and 29. Others are discussed here for the first time. In the area, marble sheets of Paleozoic(?) age have been thrust eastward over a lower plate of Nome Group schist of Paleozoic or Precambrian age. The stronger gossans contain zinc-lead anomalies and are localized near steep faults in upper plate marble. The Monarch gossan, the largest in the district, is in marble along a steep fault about 300 feet above a basal overthrust fault. Three and one-half miles south, the Quarry prospect is along the basal thrust at its intersection with the same steep fault. The steep faults which controlled circulation of mineralizing fluids probably formed near the end of regional metamorphism in Middle Cretaceous(?) time.

Pre-Middle Cretaceous(?) metadiabase (greenstone) is the apparent source of a zinc-lead deposit in lower plate schist on Aurora Creek. A similar deposit near a greenstone body on Oregon Creek is the source of a small gold placer.

It is speculated that remobilization of pre-metamorphic deposits in the lower plate has been the source of late metamorphic deposits in the upper plate.

Geochemical soil sampling shows anomalies for zinc, lead, and other metals at the Monarch, Cub Bear, American, Cleveland Creek, and Iron Creek gossans in the upper plate; at the Quarry and Galena prospects along the thrust; and at the Aurora Creek, and Oregon Creek prospects in the lower plate. The Quarry prospect also contains fluorite and barite; the Last Chance Creek prospect contains antimony and gold.

Strong stream sediment anomalies are present below the Aurora Creek and Last Chance Creek prospects which have sulfides exposed at the surface. Anomalies in stream sediments are weak or lacking below gossans, even though the gossans are strongly anomalous in lead and zinc.

INTRODUCTION

The Sinuk gossans have been known for many years, but surface showings have not been rich enough to mine or to encourage drilling. The district contains numerous mineralized localities indicated by gossans, showings of sulfide ore minerals, and geochemical anomalies. The progress of geologic and geochemical mapping done in the Sinuk district by the author during 1965 and 1966 were reported in Division of Mines and Geology Geologic Reports 24 and 29. The present report includes that work and also additional mapping done in 1968 and 1969. A total of 140 square miles were mapped during 122 days in the field. Geochemical anomalies of possible economic significance found on Aurora Creek and near the Quarry and Galena prospects have been reported (Herreid, 1966 and 1968). A mineralized zone exposed in old prospect cuts at the head of the placer on Oregon Creek is reported here for the first time.

LOCATION AND ACCESS

The map area lies 20 miles northwest of Nome. It is readily accessible along the Nome-Teller highway. The area is one of rolling to steep rubble-covered marble hills. These rise above slopes and lowlands underlain by schist covered, for the most part, by tundra and muskeg. A few willows along creeks at the lower elevations are the only prominent vegetation. Travel in the area was by tracked vehicle and on foot.

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PREVIOUS WORK

The area was studied briefly by Eakin (1915, p. 361-365), Mertie (1918, p. 444-447), and Cathcart (1922, p. 258-261) of the U. S. Geological Survey. The authors described the gossans and concluded that they might overlie sulfide deposits, but no geologic maps were included. During the Second World War, Shallit (1942) of the Territorial Department of Mines mapped the extent of the gossans, estimated tonnage of iron ore and concluded they were not then economic for iron. Mulligan (1965, p. 5) described the gossans again and concluded that they "overlie deposits of lead and zinc sulfides with some copper and silver and little or no gold. The deposits occur in limestone and are roughly aligned along crenulated anticlines that strike N10W. No estimate of the grade and extent of the primary deposits was possible". Berg and Cobb (1967, p. 125-126) have summarized the data recorded by earlier Survey writers and Mulligan. An aeromagnetic map covering a large part of the Seward Peninsula, including the Sinuk area, has been issued by the U. S. Geological Survey (anon., 1969). Flight lines have a one mile spacing and survey altitude was 2500 feet.

GLACIAL FEATURES

Ice of the Nome River glaciation (Coulter and others, 1965) covered the area during Illinoian time. Glacial landforms and deposits have since been largely effaced or carried away. During part of this time, the climate was colder than at present, and the cold climate processes of freeze and thaw and solifluction were more effective than they are now (Hopkins, and others, 1960). The present topography includes rounded, rubble-covered hills, tundra-covered lower slopes with solifluction lobes, and tundra- and muskeg-covered lowlands with few outcrops. No U-shaped valleys and no lateral and end moraines are visible. A small cirque on Last Chance Creek has had its headwall greatly modified. The clearest evidence of glaciation in the area consists of erratic granitic cobbles and boulders in many valleys and low saddles. One such boulder on upper Washington Creek has a deeply weathered upper surface that appears to be older than Wisconsin age. Isolated tors are present on ridges and slopes in schist areas. These are steep-sided bedrock stacks 10-20 feet high and a little larger in horizontal dimensions that jut abruptly out of the tundra. They are resistant schist that by accidents of erosion have been protected from surface water and consequent disruption by freeze and thaw. They have formed since the Illinoian glaciation and give an indication of the amount of interstream downcutting since that time.

The localization of Tertiary conglomerate to the banks of some of the present creeks (Coal, Washington, and Aurora Creeks) indicates that the valleys have not been greatly modified by glaciation and subsequent erosion. Upper Coal Creek is choked with granite boulders and carries little water. It must have carried more water before glaciation than at present. Other misfit creeks present in the Sinuk area suggest that erosion was more vigorous in the past than at present.

G E O L O G Y

SUMMARY

The Sinuk area is in the marble-schist belt that makes up the southern third of the Seward Peninsula. In the Nome area these rocks have been mapped as Paleozoic by Collier and others (1908), Moffit (1913), and Hummel (1962). Similar rocks covering much of the Seward Peninsula have been mapped by C. L. Sainsbury (1969) as lower Paleozoic marble, thrust during Early Cretaceous(?) time, over Precambrian schist which had been intensely metamorphosed in latest Precambrian. In the Sinuk district, the evidence suggests that during the Early Cretaceous(?) Paleozoic(?) marble was thrust at a low angle over rocks of Precambrian or early Paleozoic age. Greenstone dikes of middle Paleozoic to pre-Late Cretaceous(?) age intrude the schist and marble. These rocks were regionally metamorphosed during Late Cretaceous(?) time. The thrust plates are offset by steep faults that form a structural control for zinc-lead-fluorite-barite deposits.

SCHIST (Sch)

The lower plate is schist of varying composition. Areas mapped as schist are largely tundra covered and have only a little schist float. The schist is commonly medium dark gray, fine grained, quartz-muscovite-chlorite-albite schist with well crenulated micaceous foliation surfaces. The chlorite content (5-20%) in many places is sufficient to give the rock a greenish cast. In many areas, the rock is dark gray due to graphite(?). Most of the schist is not limy, but layers of limy schist and dark marble are present in some areas. Limy schist predominates in the northeast part of the area.

The growth of albite metacrysts, late in the period of metamorphism, has resulted in the common occurrence of spotted albite-quartz-muscovite schist or albite-quartz-chlorite-muscovite schist. The albite grains are large (1-2 mm) and inclusion-filled with ragged borders. Other minerals occasionally seen in thin section are epidote, chloritoid (identified by x-ray defraction), and accessory tourmaline.

Crenulated phyllite is present in the schist unit just below the thrust west of the Monarch deposit, and on the east side of the south part of the Cub Bear prospect. Black slate is present near the thrust south of Wheel Creek. In a few areas greenschist and minor greenstone are interlayered with the schist (Coal Creek, Washington Creek). Layers of medium light gray marble up to a few tens of feet thick crop out prominently in an area mainly underlain by schist in the southwest portion of the map area. These probably are complexly faulted slivers of Paleozoic marble.

Schist with Microfolded Quartz Veins (Sqv)

Schist is not conspicuously quartz-rich in most areas, but two quartz-rich linear belts are present near the American Lode and on the ridge south of Hungry Creek. The muscovite-chlorite schist contains up to 60 per cent of boudined, rodded, and microfolded quartz layers up to 1/4 inch thick. The rock forms prominent jagged outcrops. In thin section, it appears that fine granular quartz has invaded folded muscovite-chlorite schist accompanying minor deformation. This is shown by disorientation of muscovite laths in the quartz.

The Hungry Creek placer gold deposit could have resulted from a concentration of material from one of these zones. A sample of this schist, taken northeast of Hungry Creek *(Appendix I, #227)*, showed less than detectable limit for gold and sub-background copper, lead, and zinc. However, much more elaborate sampling would be necessary to properly test the gold content of this unit as a possible source for the placer gold on Hungry Creek. The deformed quartz veinlets in this unit are the equivalent of the older quartz veins described by Smith (1910, p. 90) in the Solomon area.

Geologic Age

The schist in the Sinuk area is correlated with Sainsbury's Nome Group (1969). He describes this as chlorite-epidote-albite-actinolite (or glaucophane)-garnet schist. On his map, he divides this into three units: (1) chlorite-hornblende-epidote schist including intensely deformed, locally graphitic, retrograded blue schist facies rocks; (2) intercalated dark schistose limestone; (3) dark schistose carbonate. He gives the age as probably Precambrian. Just east of the Sinuk area, Hummel (1962, a and b) has mapped graphitic calcareous quartz-chlorite-muscovite-graphite-calcite schist containing an interbedded black marble of lower to middle Paleozoic age. This unit correlates with the high percentage of dark limy units in the schist along the eastern border of the Sinuk map area.

The parallelism of minor structures in the schist and overlying muscovite marble and marble indicate that these rocks were regionally metamorphosed after thrusting. No evidence was recognized in the Sinuk area to indicate that the schist was metamorphosed before the marble was deposited. No glaucophane was found in the Sinuk area. I tentatively consider the schist to be late Precambrian or early Paleozoic age. However, it is possible that both the schist and the marble in the Sinuk district are Precambrian, as Sainsbury suggests (Pers. Communication, June 1970).

MUSCOVITE MARBLE AND SCHIST (Ms)

Brown-weathering tectonized muscovite marble to limy schist underlies the marble thrust sheet and ranges in thickness from zero to more than 200 feet. It is interbedded with the overlying marble in some areas. The rock is commonly muscovite-bearing marble but locally grades into schist with varying proportions of calcite, muscovite, chlorite, and quartz. It has much small scale folding and is sheared in places.

Near the head of Daisy Swift Creek, the unit is mainly brown weathering marble with layers of sericite, but also includes greenish calcite-chlorite-quartz schist with albite spots and silicified marble. A thin section of the latter shows sheared marble with rounded quartz grains (0.1 mm) and unrotated poikilitic albite (1-2 mm).

In the vicinity of the Cub Bear prospect a thrust-faulted gradational contact of limy-schist with marble is suggested by presence of muscovite marble layers above the thrust and marble layers in the limy chlorite schist below the thrust. Near the south end of the prospect, beds of calcite-muscovite-chlorite-dolomite-quartz up to 5 feet thick are interbedded with gray weathering marble 10-20 feet above the thrust. Nearby, slightly brown-weathering marble with minor muscovite in the lower part of the upper thrust plate has been thrust over a thin-bedded folded sequence of gray-weathering marble and greenschist. The gently dipping thrust separates steeply dipping marble from the underlying limy schist unit.

Brown-weathering marble also forms a layer about 20 feet thick on the lower slopes of the hill northeast of the Cub Bear prospect and an area on Snowshoe Gulch well above the base of the marble.

Along the marble contact that extends from Aurora Creek south to the Penny River, the contact of the sericitic marble with the underlying schist is gradational. The thrust must lie within or at the base of the thin layer of limy schist.

Geologic Age

The brown-weathering muscovite marble occupies the same position below a marble thrust sheet that "argillaceous limestone, locally schistose" does in the Lost River area (Sainsbury, 1969a, p. 9). Sainsbury dates the limestone as pre-Early Ordovician, possibly transitional with the overlying Ordovician marble.

MARBLE (M)

The bare, gray, rubble covered hills in the central part of the Sinuk area are underlain by a thrust sheet of Paleozoic marble more than 1000 feet thick. The marble is commonly medium light gray and crystalline with grains 1/4 to 1 mm. Beds are planar, usually 1/8 to 4 inches thick, and break up readily into platy rubble. The marble weathers medium light gray with a hackly surface. Crosscutting calcite veinlets are only locally present. Dolomitization due to small irregular masses of dolomite (up to 4 inches in diameter) in a marble matrix is fairly common.

Both bedding and cleavage (sheeting) are present in the marble thrust sheets and it is important to differentiate between them. Bedding, as mapped, is usually thin with slight composition banding or grain size variations which often show only on weathered surfaces. It has platy surfaces, often with a little sericite, and lineation ranging from fine crenulations ($\pm$ 1 mm) to vague undulations. Minor folds are not too common. Sheeting consists of planar cleavage 1/4 to 2 inches apart without lineation or composition banding. In fold hinge zones sheeting cuts bedding which may be only obscurely visible on weathered surfaces. Bedding attitudes were only taken on surfaces with lineation or banding, often with both.

The role of weathering in emphasizing bedding was seen in a rare exposure of unweathered rock on the upper slopes of Hungry Creek. The surface rubble and scattered outcrops are typical thin platy-bedded marble, but near the base of a scarp at a depth of 10 feet below the general surface, the rock is fresh, rather massive marble with only an obscure cleavage. The cleavage, which does not particularly look like bedding, may be parallel to the original surface of sedimentation, but this would be difficult to prove in this outcrop.

The marble is in thrust contact with non-calcareous schist in parts of the map area, but in other areas where the thrust is lower in the section, the marble is in gradational contact with the underlying brown weathering marble. The contact between marble and the underlying limy schist on the ridge between upper Oregon Creek and Penny River is gradational, but sheared marble and dolomite zones containing deformed marble and dolomite clasts suggest that thrusting is present in the rocks a few tens of feet below the base of the massive marble.

The presence of sericitic marble layers parallel to the bedding near the base of the marble is another indication of a gradational contact with the underlying unit. Such layers, ranging from 5 to 20 feet thick, are present at the Cub Bear prospect and on the mountain just northeast. Near thrusts the marble is often bleached, and has boudined dolomite layers. Thin bedding may be obliterated by recrystallization.

Slightly schistose basic tuff(?) was found in the marble at two localities. On American Creek a greenschist layer 40 feet thick and approximately 20 feet above the base of the marble is made up of chlorite, albite, sphene, calcite, and pyrite. On upper Nugget Gulch a similar looking greenschist layer crops out for 80 feet along the creek. It contains sericite, quartz, chlorite, and albite. The base of the marble is an unknown distance below this layer. It could be just below, as on American Creek.

Geologic Age

The marble is similar to marble in thrust sheets mapped by Sainsbury and others (1969) farther north on the Seward Peninsula. These rocks are dated by them as Ordovician to Mississippian.

Recently Sainsbury (Pers. Comm. June 1970) has suggested that the presence of metagabbro (greenstone) in the marble, its recrystallized state relative to Paleozoic limestone elsewhere on the Seward Peninsula, and the lack of any sign of fossils indicates that the marble is Precambrian in age.

As stated elsewhere (Greenstone) I tentatively consider the greenstone to be of Middle Paleozoic to Pre-Middle Cretaceous in age. This means that the marble of the upper plate in the Sinuk district is considered to be probably Paleozoic, correlative with the thrust sheets of Sainsbury and others (1969).

GREENSTONE (G)

Elongatedgreenstone bodies are present along the Oregon Creek lineament and small bodies occur locally in marble and schist bedrock. Outcrops are prominent in a few places, but are mainly scatterings of greenstone rubble. Greenstone is present near a thrust only on Aurora Creek, and there it extends along below the fault *(fig 1)*. It has not been possible to determine on the basis of field evidence whether intrusion of the greenstone was before or after thrusting.

The greenstone is non-foliated to moderately foliated and fine to medium grained, altered basic intrusive (diabase?) with equant grains of generally untwinned poikilitic albite and chlorite, plus epidote, actinolite, calcite, sphene, and pyrite. The grains have ragged borders, and the inclusion-filled albite and chlorite forms the groundmass for the other grains. The original texture has been completely obliterated. Glaucophane was not seen in thin sections, but is reported by Moffit (1913) in similar rocks in the Nome quadrangle.

The two greenstone plugs at Greenstone Gulch are non-foliated in their central portions, but an offshoot interbedded with non-limy schist on the east side of Greenstone Creek is foliated greenschist.

Mapping shows an apparent post-thrusting age for the greenstone dike on Aurora Creek despite the fact that the dike is probably much older. A cross fault offsets the overthrust, but not the dike. This is probably due to a nearly vertical direction of movement on the fault and a nearly vertical dike. Dike outcrops are rubble and a small offset may be present.

Except for pyrite, there is no sign of mineralization in any of the greenstone bodies *(Appendix I, 244*-2, 244*-4)*. However, a close connection between greenstone and mineralization is suggested by silicification and quartz-sphalerite-galena float near greenstone bodies on Aurora and Greenstone Creeks.

Geologic Age

The greenstone is a metamorphosed basic intrusive rock and must have been emplaced before the most recent period of metamorphism which is probably of Middle Cretaceous age. It intrudes the marble of the upper plate in several places.

Greenstone probably equivalent to that at Sinuk has been mapped in the Nome area. Moffit (1913) shows "Greenstone, altered basic intrusive cutting rocks of Nome group" of "Paleozoic or Mesozoic" age. These are altered diabase or diorite that cut schist and marble and locally contain garnet and glaucophane, according to Moffit. Hummel (1962a, 1962b) shows the same rocks as greenstone, of Mesozoic or Cenozoic age.

Sainsbury and others (1969) on their maps of parts of the Teller and Bendeleben quadrangles, show "Gabbro: includes coarse-grained gabbro, diabase and altered equivalents which locally are garnet-glaucophane rocks". "Age: Pre-Ordovician." This description fits the greenstone in the Nome and Sinuk areas. Sainsbury (Pers. Comm., June 1970) believes that the greenstone in this part of the Seward Peninsula probably belongs to this metagabbro unit and that its presence in marble dates it as Precambrian(?).

In the Southern Brooks Range near Bornite thick thrust plates of Devonian limestone are intruded by Middle Devonian or younger metagabbro (Pers. Comm. C. E. Fritts, June 1970).

In due course regional mapping on the Seward Peninsula will probably resolve this problem. In this report I assume the greenstone at Sinuk falls in the range of middle Paleozoic to pre-Middle Cretaceous.

DOLOMITE

Dolomite is a local replacement of marble related to structural features and ore deposits. It is easily identified in the field by its distinctive color. It is very light gray and weathers medium light gray to grayish orange pink. Rounded, irregular, rather smooth surfaces are common. This rock is distinct from the hackly-surfaced medium-gray-weathering marble. Dolomite replacements of marble take four main forms:

(1) *Dolomite layers a few inches to a few feet thick in marble not far above the thrust.* These are typically boudined, are crackled into smaller than 6-inch blocks by intersecting fractures, and contain cross cutting quartz veins. The marble beds curve around the boudined dolomite. Boudinage of these layers indicates that dolomite replacement took place before or during thrusting. Dolomitization along the thrust is common enough to be, along with bleaching of marble and silicification, a fairly good indicator of thrusting along a contact. Dolomitization was probably syntectonic. Sporli (1968) reports that minor syntectonic dolomitization is associated with thrusts in the Alps. Sainsbury (1969a) believes that dolomitization along and above thrusts on the Seward Peninsula is due to leakage of fluids from the underlying thrust faults.

(2) *Crackled dolomite areas a few feet to 100's of feet across in marble.* A few are associated with mafic rocks, but most are not. An example is the dolomite zone around the greenstone plug, 40 feet in diameter, east of Daisy Swift Creek, just above the placer ditch. Here, the marble is replaced by irregular bodies and tabular veins of much crackled dolomite. Crackled dolomite elsewhere in the map area is similar in appearance, but the origin, as veins, is not so evident. Along some steep faults pods or lenses of crackled dolomite are present.

(3) *Patchy dolomite areas, often hundreds of feet across, composed of much fractured rounded to sub-angular bodies 1/4 to 6 inches across in a matrix of fine-grained marble.* The dolomite patches stand out on weathered surfaces to form a peculiar elephant-hide surface that is common throughout the area.

(4) *Discontinuous envelopes of dolomite similar to 2 and 3 (above) around gossans and sulfide mineral deposits in both marble (Monarch, Quarry, Cub Bear) and schist (Aurora Creek, Greenstone Creek) areas.* At the Quarry and Cub Bear, these envelopes appear to have been deformed during the post-thrust period of minor folding and steep faulting.

Older and Younger Dolomite

Older dolomite -- The boudined dolomite layers in the marble along the thrusts were introduced and deformed before thrusting ceased.

Younger dolomite -- Large bodies of dolomite are present locally along early and late steep faults, around mafic bodies, in granular quartz-dolomite-sphalerite ore, and in halos around mineral deposits. The association of dolomite with greenstone could be genetic or only structural. The presence of dolomite halos around the Monarch and Cub Bear prospects, and of dolomite bodies near the Quarry prospect, and of dolomite as a constituent of the granular ore on Oregon and Aurora Creeks indicates that the origin of the ore deposits in the district is closely related to that of the dolomite.

JASPEROID (Silicified Marble and Schist) (J)

Silicified bedrock (jasperoid) is found sporadically along thrusts, steep faults, and near greenstone intrusives. It commonly is associated with dolomite, but is much less widespread. Patches of totally silicified rock up to 200 feet across and other partially silicified patches are found near greenstones on Greenstone Creek and at the head of the west fork of Nugget Gulch. The textures of the original rocks are well preserved, there is no limonite, and they appear completely barren of sulfides. Analyses of typical silicified marble and schist from both the areas (*Appendix I, samples 239B, 253*, 255*-1, and 255*-2*) show less than the detection limit of gold and sub-background copper, lead, and zinc.

Silification is associated with sulfide minerals at several localities. On Greenstone and Aurora Creeks sulfide float closely associated with greenstone dikes is partially silicified marble containing sphalerite and galena. At the Quarry deposit, the showings are in silicified marble. Association of barite and fluorite here with silicification indicates the possibility that jasperoid zones elsewhere may carry these minerals. Almost completely silicified schist along the north edge of the mineralized area at the American lode carried 0.06 ppm gold.

BASALT (B)

Basalt dikes occur on Coal Creek, near the mouth of Iron Creek, and near the Cub Bear prospect (*fig 6*). The rock on Coal Creek is fine-grained, dark, devitrified glass with amygdules. Near Iron creek a vertical dike two feet wide has serpentinized olivine phenocrysts in a fine-grained, felted, plagioclase-clinopyroxene matrix. These dikes are of post-metamorphic, probably Tertiary age.

TERTIARY CONGLOMERATE (Tc)

Conglomerate is present along the banks of Coal Creek, at two localities along Washington Creek, and above the ore zone on Aurora Creek. On Coal Creek, the conglomerate is a well indurated stream gravel made up of 2-8 inch cobbles in a non-limy matrix of fine grained schist fragments. There are no granite clasts. Coalified plant fragments are associated with beds of fragmental schist. A shaft and adit, both caved, testify to an early attempt to mine the coal. The lack of granite clasts distinguishes this conglomerate from Pleistocene till, which does have granite boulders and is poorly indurated. The limitation of the conglomerate to present creek valleys indicates that it is a younger formation, related in origin to the present drainage. Therefore, it is of Tertiary age.

STRUCTURE

Thrust Faults

A low-angle overthrust fault underlies the large areas of marble bordered by schist between the Sinuk River and Aurora Creek. In general, the marble beds are not parallel to the basal contact of the marble. The clearest large-scale evidence for thrusting is in the hills around the Monarch deposit. Bedding in the marble there dips 15° - 20° W, for a distance of 1-1/2 miles across strike, but the basal contact between marble and underlying schist dips only about 3° west.

This thrust sheet is well exposed on upper Snowshoe Gulch where marble with dips steeper than the contact lies on muscovite marble underlain by schist. Beds at the west margin of the marble dip moderately west, as do those in klippen further west. These klippen in the lowland probably rest on schist, but tundra masks the evidence. The structure in the Snowshoe Gulch area is interpreted as a moderately folded thrust sheet with beds not parallel to the base. Details of an area with beds not parallel to the base of a thrust sheet are shown by the map of the Cub Bear area (*fig 6*). In that area, steep faults offset the thrust sheet and complicate the structure.

In many places a thrust is present at the base of a marble hill that rises abruptly above a gentle tundra-covered slope. Typically, as at the klippen west of Snowshoe Gulch, exposures of bedrock are too poor to determine with certainty whether a marble-schist is actually present. An example of a well exposed thrust at the base of a marble hill is just west of the Quarry prospect where silicified schist float extends for 1/4 mile west of the Quarry prospect.

In the Cub Bear area, many S-shaped drag folds have a sense of shear indicating eastward movement of the upper thrust plate. These folds are common along the top of a muscovite marble layer about 20 feet thick near the base of the hill northeast of the Cub Bear prospect. The layer itself is drag folded near the north end of the hill. Details of two of the S-folds are shown in figure 6. Minor folds suggesting westward thrusting were seen in only three places in the map area. The prevalence of unfolded platy rubble on most hillslopes indicates that drag folds are present only locally in the thrust sheets.

Dolomite layers up to a few feet thick near the base of the thrust sheet are commonly boudined. The presence of these boudins and drag folds near the thrust suggests that the base of the thrust sheet was deep enough to have undergone considerable flowage during thrusting.

Overthrusting is part of the vast Collier thrust belt first recognized and described by Sainsbury (1965) in Western Seward Peninsula, and found by him and his co-workers (Sainsbury 1969) to be present over much of the Seward Peninsula. In his most recent publications, Sainsbury (1969a, p 2595) states:

> Thrusting probably occurred in the Early Cretaceous, for the thrust sheets are intruded by stocks and batholiths of granitic rocks which range in age between 100 and 90 m.y. (Miller and others, 1966). As rocks of Early Cretaceous age are involved in thrusting, the dating of the thrusting is reasonably secure.

Folding of the Thrust Surface

The large scale outcrop pattern of the thrust sheet indicates that the basal thrust is not a plane and must be moderately folded. The folded thrust was only seen in well exposed outcrop at the Quarry prospect. This area of recent bulldozer stripping crosses a typical example of a thrust that would be mapped with confidence on the basis of large scale criteria (Thrust Faults). The thrust has been folded into open folds of as much as 40 feet in amplitude with fold axes plunging gently south (*fig 5*). This exposure is described in the section on the Quarry prospect. The parallelism of these fold axes with crenulations in the underlying schist indicates that the thrust surface was folded at the same time that the schist was folded and crenulated (i.e. while metamorphism was in progress). The early steep faults may have formed at the same time or shortly after folding of the thrust.

Early Steep Faults

The thrust sheet is cut by many steep faults that trend parallel to the regional trend of minor folds and have much minor folding along them in the marble. These faults make conspicuous bifurcating linear traces across the rubble covered hillsides, dip 40° to 65° both to the east and to the west, and are responsible for much of the minor folding in the marble. Marble beds along the hanging walls of the faults tend to have well lineated folds 3-10 feet in radius which make conspicuous mullions. The fault trace itself is often covered by a linear topographic trench, 10 to 50 feet across, covered by small rubble or soil. In the footwall, beds are contorted with low dips. Axes of small folds and crenulations along the steep faults tend to parallel those in marble and schist in the general locality. Vague fault traces across rubble covered areas are commonly marked by conspicuous fluted mullion float blocks up to 5 feet across. Fault lineaments are also marked by scattered rubble patches of bleached marble, dolomite, and greenstone.

Normal and reverse faults offset the marble thrust sheets up to a few hundred feet at the Cub Bear prospect (Cub Bear prospect). Other steep faults with significant displacement bound the west margins of the two major north-northwest trending bands of marble that extend from Tub Mountain to the Penny River.

The parallelism of minor folds and crenulations in the marble near and away from the early steep faults and in nearby schist suggests that steep faulting and development of schistosity in the schist took place during a single period of deformation and metamorphism. The rather intense nature of the folding along the early steep faults suggests that they were formed late in the period of metamorphism while the rocks were still at a relatively high temperature.

Later Steep Faults

Steep faults that offset the thrust sheets, but are not parallel to the minor folds and crenulations of the marble and schist are thought to have formed somewhat later, when the stress field was different. Examples are several faults near the American gossan including the mineralized fault, and three faults that cross Ashland Creek. The most interesting one is the ore controlling fault that extends from the Quarry prospect to the Monarch prospect.

METAMORPHISM

The foliated texture and mineral content of the schist indicates that it belongs to the quartz-albite-chlorite subfacies of the greenschist facies of regional metamorphism. The metamorphism took place after the basic rocks were intruded. Greenstone that intrudes both the schist and the marble has the same mineralogy as the schist (plus actinolite). This metamorphism probably took place at the same time that the thrust surface was deformed by moderate scale open folding. This is shown by the parallelism of the axes of these folds with the crenulations formed in the underlying schist during metamorphism. This open folding of the thrust surface took place after the Early Cretaceous(?) thrusting. The metamorphism is probably of about the same age as the granites that elsewhere on the Seward Peninsula cut the thrust sheets during Middle Cretaceous time. These range in age from 98-102 m.y. (Miller and others, 1966).

Spotted schist with albite porphyroblasts up to 1-2 millimeters in diameter are fairly common in the map area. The albites are inclusion-filled grains with ragged borders. In some parts of the map area, foliation bands of epidote and graphite extend undeflected through albite grains, showing that they grew as a replacement of pre-existing minerals after shearing in the rock had ceased in that area. In other parts of the map area, albite grains containing inclusion bands have been rolled. Some inclusions form S-shaped curves showing rotation up to 90 degrees during growth. These grains were formed before shearing within the rock had stopped, but late enough so that the large crystals were not destroyed. The growth of rotated and nonrotated albite grains in various parts of the map area *(R and UR, fig 1)* is interpreted as having taken place when a wave of soda-bearing solutions passed through the rock late in the period of regional metamorphism when shearing movements were only locally present in the rock.

Strong evidence that soda-metasomatism took place after thrusting is given by the presence of un-rolled albite porphyroblasts in muscovite marble at the base of the thrust. These are present on upper Greenstone Creek and on Aurora Creek.

A possible source of soda would be a buried granite. In the Cosmos Hills near Bornite, albite porphyroblasts are largest and most plentiful close to intrusive granite. The recent areomagnetic data (Anon. 1969) for the southern Seward Peninsula shows a magnetic low that could possibly indicate a buried granite under the Sinuk district.

The Middle Cretaceous(?) metamorphism that has been described above has apparently obliterated, or at least obscured, the late Precambrian blueschist metamorphism reported by Sainsbury and others (1969) from elsewhere on the Seward Peninsula. No relict blueschist minerals were seen in any of the thin sections of schist from the Sinuk area.

G E O C H E M I S T R Y

Analyses of stream sediments in the Sinuk district (*fig 1, Appendix II, III, and IV*) aid in the search for undiscovered mineral deposits. Analyses of soil and rock samples at gossans and other prospects give an idea of the size and metal content of the known deposits.

Soil sampling shows geochemical anomalies at the Monarch and Cub Bear gossans and at the Quarry, Aurora Creek, and Oregon Creek prospects. Stream sediment sampling is ineffective in locating gossans but the Aurora Creek prospect with its surficial sulfide float has a strong sediment anomaly in Aurora Creek. The Last Chance stibnite-gold prospect has a good sediment anomaly for antimony and arsenic in the creek below it. An antimony anomaly in the head waters of Last Chance Creek may indicate an undiscovered antimony deposit. Anomalies for various metals north of the American gossan may indicate an undiscovered deposit north of the mapped area.

Stream sediment samples were taken mainly from mud below water level. Soil samples were taken at a depth of 2 to 6 inches. The threshold (the lowest concentration considered anomalous) for each element has been noted on the histograms for copper, lead, and zinc (*fig 2*) and for other metals on Appendix III and IV. Emphasis on sampling in mineralize areas has skewed the distribution of concentrations towards high values. The thresholds have been determined intuitively rather than by statistical methods.

SOIL AND ROCK GEOCHEMISTRY

Monarch and Aurora Creek Prospects

Monarch-type gossans may reflect a re-mobilization of Aurora Creek-type sulfide deposits at depth. The comparison of trace element compositions of these two deposits, therefore is of special interest. Concentrations of the elements (*table I*) suggest, but do not prove, that these deposits are related in origin. Analyses of mineralized and unmineralized soil samples at and near the Monarch and Aurora Creek deposits are shown in table 1. Both deposits contain twice local background, or more, of zinc, lead, cobalt, and lanthanum, but the soil over the Aurora Creek deposits has several metals with anomalous concentrations that are not abundant in the Monarch gossan. The metals not anomalous in the Monarch gossan may have precipitated when they encountered the marble, may have been removed by surficial leaching, or may not have been present at depth at that locality.

Oregon Creek

A hidden deposit in this vicinity is indicated by the presence of a little ore float in two old open cuts near a greenstone plug. The large open cut on the south side of Oregon Creek, above its junction with Greenstone Gulch, contains a few rounded gossan float bou ders with sphalerite and galena, some rounded white quartz boulders 1-2 feet in diamete and angular dolomite-sericite schist float that probably represents bedrock (*fig 3*). Th walls are glacial till probably about 10 feet deep composed of gray weathering marble co bles and boulders in a fine limy matrix. A grid of geochemical samples taken on the sur face of the till south of the cut shows anomalous concentrations of lead, zinc, and bari arsenic, boron, and beryllium. These values could represent seepage from a buried depos up the hill to the south or syngenetic glacial fines brought in from the north. The lac of an anomaly in the lower part of Greenstone Gulch indicates that no deposit is present

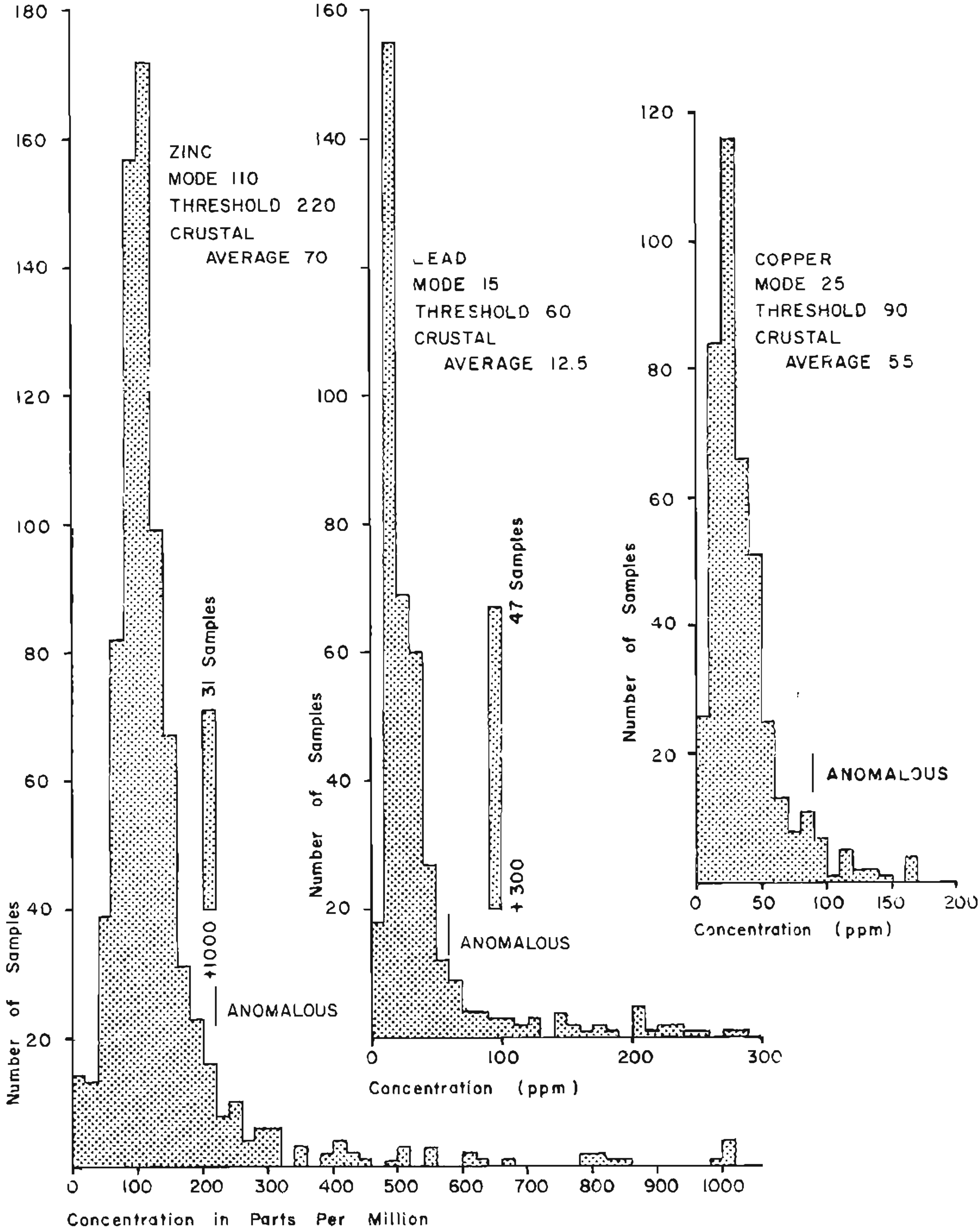


FIGURE 2 HISTOGRAMS FOR COPPER, LEAD, AND ZINC BY ATOMIC ABSORPTION AND COLORIMETRIC ANALYSES, SINUK AREA

Table I

Anomalous Elements in Mineralized Rock at the Aurora Creek and Monarch Prospects

Concentrations of the following elements are at least twice those in nearby unmineralized rock:

Monarch Gossan		Aurora Creek	
Fe	La	Mg	Ni
B	Pb	Ag	Pb
Co	Zn	Ba	Sb
Cu		Co	Y
		La	Zn

Note: Cu and As are high in several samples not considered here.

Data (a)

Samples	Fe%	Mg%	Ca%	Ti%	Mn	Ag	As	B	Ba	Be	Co	Cr	Cu(b)
Monarch Gossan													
Mineralized (c)	10	.7	7	.1	3375	N	L	42	300	L	6	50	20
Unmineralized (d)	3	1.2	4	.8	3000	N	N	20	250	L	3	60	10
Aurora Creek													
Mineralized (e)	5	1	.18	.5	900	.5	N	120	3200	2	30	175	90
Unmineralized (f)	3	.7	.3	.5	300	N	N	100	300	1.5	10	100	50

Samples	La	Nb	Ni	Pb(b)	Sb	Sc	Sr	V	Y	Zn(b)	Zr
Monarch Gossan											
Mineralized (c)	50	L	15	50	N	5	300	40	30	525	70
Unmineralized (d)	25	L	18	25	N	10	750	50	35	50	45
Aurora Creek											
Mineralized (e)	60	10	90	120	40	33	60	140	60	400	150
Unmineralized (f)	20	10	20	15	N	20	100	150	30	50	150

Explanation

(a) Values in parts per million unless indicated otherwise
(b) Value by atomic absorption, others by emission spectograph. Samples analyzed by the U. S. Geological Survey, Anchorage mobile laboratory (table 3, this report).
(c) 4 high zinc samples (123-126)
(d) 2 low zinc samples (112, 113)
(e) 7 high zinc samples (308-314)
(f) 1 low zinc sample (305)
Samples 2X or more the unmineralized values are underlined

Fe	Iron	Ag	Silver	Co	Cobalt	Ni	Nickel	V	Vanadium
Mg	Magnesium	As	Arsenic	Cr	Chromium	Pb	Lead	Y	Yttrium
Ca	Calcium	B	Boron	Cu	Copper	Sb	Antimony	Zn	Zinc
Ti	Titanium	Ba	Barium	La	Lanthanum	Sc	Scandium	Zr	Zirconium
Mn	Manganese	Be	Beryllium	Nb	Niobium	Sr	Strontium		

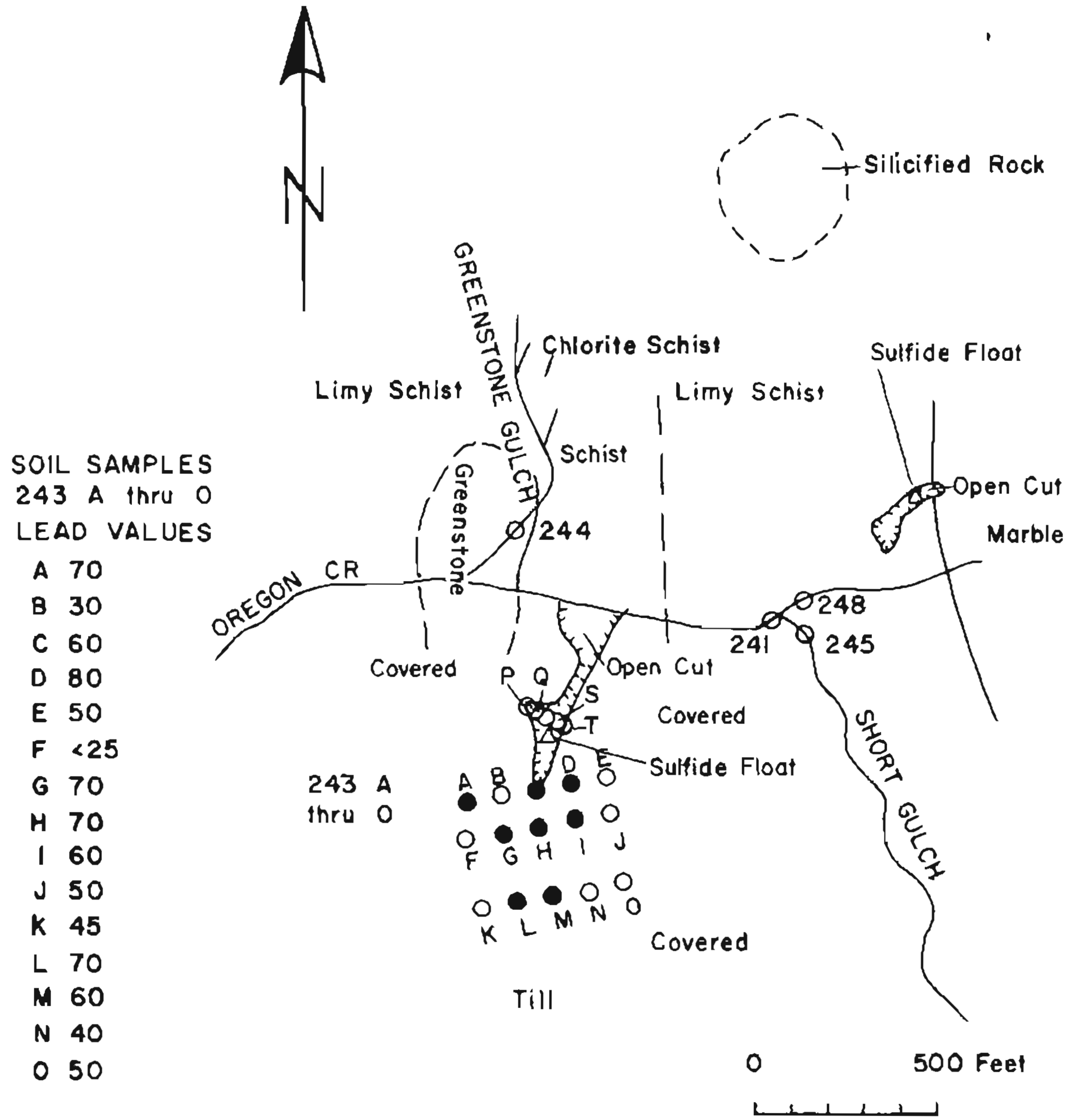


FIGURE 3 SKETCH MAP SHOWING GEOCHEMICAL VALUES NEAR GREENSTONE GULCH

○ ● GEOCHEMICAL SOIL AND STREAM SEDIMENT SAMPLES (BACKGROUND, ANOMALOUS) VALUES IN TABLE I immediately to the north. The lack of an anomaly downstream in Oregon Creek indicates that any deposit to the south is either well masked by till or small.

Quarry Prospect

An extensive soil anomaly for lead, zinc, barium, and beryllium is present around the Quarry showing. The discovery of zinc-lead deposits in schist at Aurora and Oregon Creeks makes this extensive anomaly (9000 X 3000 feet) more interesting. A bedrock deposit must be present in the anomalous area, but its grade may be low. It may represent only disseminated mineralization below the upper plate of the thrust.

Significance of Lead and Zinc Anomalies in the Gossans

Zinc and lead anomalies are present at the Monarch, American, Cub Bear, Upper Iron Creek, and Cleveland Creek gossans. In a weathered calcareous sulfide environment such as these, iron, lead, and copper are relatively immobile, and zinc is moderately mobile (Hawkes and Webb, 1962, p 18). The presence of the moderately mobile zinc in the weathered zone suggests that considerable zinc is present at depth, whereas, where lead and copper are low there are probably only minor amounts of these immobile elements at depth.

STREAM SEDIMENT GEOCHEMISTRY

The data given in detail below shows that stream sediment sampling is not effective in locating gossans, even though the surface rubble is strongly anomalous in zinc and lead. Stream sediment sampling on the larger creeks would have found only the Aurora Creek deposit.

Aurora Creek Prospect

The strongest and most extensive stream sediment anomaly in the map area is in Aurora Creek, which is moderate-sized and has optimum conditions for forming an anomaly. The deposit cuts across the creek and then runs along the hill above it for 1-1/2 miles. At the mouth of the creek, stream sediment contains 340 ppm zinc. This is one mile or less beyond the end of the deposit.

Monarch Gossan

This deposit has no expression in Washington Creek. In Monarch Creek, which cuts the deposit, the anomaly extends for about 1/4 mile from the gossan.

Quarry Prospect

This large soil anomaly has little expression in the creeks below it. It would never be found sampling tributary creek mouths along Cripple River. Sample #183 on Willow Creek just above the highway is strongly anomalous (Pb 200, Zn +1000), but may lie within the deposit or the zone of soil creep below it. The small anomaly down Willow Creek is probably related to a deposit at the placer showing.

Oregon Creek

The float zinc-lead ore found in prospect pits along Oregon Creek is not expressed in Oregon Creek except by arsenic and antimony anomalies. The relation of these to the deposit is not clear. The stream sediment is not anomalous 0.4 miles downstream in Oregon Creek.

American Gossan

Only sample 28 detects this deposit, and 1/2 mile downstream the sediments are not anomalous.

Galena Prospect

This rather small lode deposit shows up in the small creek at sample locality 98. It was not sampled downstream, but probably does not extend to the Sinuk River.

Other Anomalies

Steep faults control the Monarch, Cub Bear, American, Quarry, and probably other deposits in the district. It is likely that the scattering of anomalies in the district are due to other steep faults. This is evident for the barium anomaly on Wheel Creek. It is probably true also for the string of anomalies along the Penny River. The zirconium, barium, and beryllium anomalies on Hungry Creek suggest that its mineralization is fault controlled also.

The clear pattern of anomalous samples along the Penny River and elsewhere would not be present without the multi-element analyses of stream sediments.

O R E   D E P O S I T S

The deposits in the Sinuk area fall into four groups:

1. Quartz-dolomite-sphalerite-galena replacements of calcareous layers in schist of the lower plate near greenstone intrusives on Aurora and Oregon Creeks. Anomalous amounts of zinc, lead, copper, barium, antimony, arsenic, boron, silver, zirconium, chromium, and nickel are present in rocks and soil samples from this deposit.

2. Quartz-dolomite-galena-sphalerite-fluorite-barite replacements of calcareous rocks at or near the base of the marble thrust sheet at the Galena and Quarry deposits. A steep fault offsets the thrust along one side of the Quarry deposit. Anomalous amounts of lead, zinc, barium, fluorine, beryllium, silver, and copper are present in rocks and soil samples.

3. Gossans in upper plate marble along steep faults of late or post metamorphic age at the Monarch, American, and Cub Bear deposits. Probably also the Cleveland Creek gossan. Anomalous amounts of zinc, lead, strontium, beryllium, zirconium, and gold are present in soil samples.

4. Minor leakages in the marble above the thrust not visibly associated with steep faults at the upper and lower Iron Creek gossans and the Mogul gossans.

Monarch-type deposits (3, above) in the upper plate may represent remobilized metals from Aurora-type deposits (1, above) in the lower plate. Aurora-type deposits are in schist of the lower plate near greenstone intrusive. Boudinage of the Aurora-type ore suggests that it is pre-metamorphic, in agreement with the pre-metamorphic age of the greenstone. The Aurora-type deposits are probably related in origin to the greenstone. Monarch-type deposits are localized along steep faults in upper plate marble and are of late- or post-metamorphic age. The similarity of assemblages of elements anomalously abundant in the two types and their proximity suggests that they are related in origin, despite their difference in age. Derivation of the upper plate deposits from these in the lower plate would explain these relations. Steep faults that cut through the marble into the lower plate formed during the waning stages of metamorphism. It is suggested that metals mobilized from the deposits in the lower plate during metamorphism came up along these faults.

The Sinuk deposits may be similar in origin to fluorite-barite-zinc-lead ore deposits in the Illinois-Kentucky fluorite district which are considered to be related to mafic (and ultramafic) dikes and steep faults. (Heyl and others, 1961; Erickson, 1965).

On the other hand, it is possible that a granite pluton underlies the district. This could be indicated by the magnetic low in the area, indicated by the aeromagnetic survey (Anon. 1969), and by the presence of beryllium anomalies and fluorite in some of the deposits. This is not strong evidence and the lack of tin and tungsten anomalies is counter to it.

Placer deposits have been mined on Oregon and Willow Creeks below known mineralized areas that are described in this report. The placer deposits on Hungry Gulch may be related to a possible minor gold content in the schist with quartz veins (Sqv) unit or to a mineral deposit along the fault that offsets the marble at the head of Hungry Gulch. The minor placer workings on Arctic Creek may indicate an unknown mineralized zone in that drainage.

OREGON CREEK LINEAMENT AND THE OREGON CREEK PROSPECT

This lineament extends across the entire marble area from Penny River to Tub Mountain as a belt of reverse faults with associated lenticular greenstone intrusives, scattered patches of silicified marble and schist, vein quartz float, and minor sphalerite-galena-gold mineralization. The country rock is limy schist and quartz-sericite-graphite schist. These grade into one another along Greenstone Creek. A scattering of barren vein quartz boulders up to 4 feet in diameter extends up Oregon Creek to the greenstone (*Appendix I, 241* 1 and 2*). Large barren vein quartz float is present on the hill slopes around the greenstone (*Appendix I, 244*-1*). The greenstone itself contains a little disseminated pyrite, but is not otherwise mineralized (*Appendix I, 244*-2, 244*-4*). Numerous gossan cobbles and boulders of partially silicified marble containing quartz-sphalerite-galena ore are present in an opencut south of Oregon Creek (*fig 3*), within 150 feet of the intrusive (*Appendix I, 243R-1 thru 7*). Farther east minor similar float is present in an opencut along the contact of marble with limy schist (*Appendix I, 248**).

The gold placer on Oregon Creek heads into the greenstone intrusive.

Geochemical stream sediment samples and soil samples taken in the glacial till cover south of the greenstone exposures are discussed under Geochemistry.

In summary, float carrying disseminated zinc-lead-gold ore indicates a deposit of unknown size, but probably small, associated with greenstone. It is possible that this is just the north end of a deposit buried beneath glacial till.

MONARCH GOSSAN

The largest and most strongly limonitized gossan in the Sinuk district is the Monarch "Lode" (*fig 4*). It lies on a rounded marble ridge overlooking the Sinuk River and consists of one main and one subsidiary gossan lying in two saddles that cross the ridge. Exposures in the gossan areas are almost entirely rubble and cover about 85 acres. The intervening area is dolomitized marble. There has been no drilling or recent trenching, but several old hand dug trenches are present. The deposit has been patented for many years. It has been visited and described by Eakins (1915a) and Mertie (1918a) and mentioned by Cathcart (1922), Mulligan (1965), Berg and Cobb (1967), and Cobb (1968). Shallit (1942) mapped the surface distribution of iron in some detail and estimated that the gossan contains 50,000 long tons of 30-45% iron ore and 500,000 long tons of 15-25% iron ore. An earlier version of this report (Herreid, 1966) is supplemented here by additional geochemical data and further consideration of faults.

The main gossan at the Monarch deposit is localized along the steep Monarch fault. There is a zinc-lead anomaly along this fault ringed by a discontinuous dolomite alteration zone. The Monarch fault can be traced on air photos to the Quarry deposit which it also appears to control. Subsidiary faults parallel to the Monarch Fault are also mineralized to some extent (*fig 4*). The prominent gossan, west of the main Monarch gossan, is the richest of these subsidiary fault gossans.

In the areas of richer gossan, no bedrock is exposed. The gossan is fine ferruginous soil containing angular fragments, up to a few inches across, of limonitic marble, earthy limonite, goethite, crackled dolomite, and in places, unlimonitized marble. The underlying bedrock is exposed in some of the old trenches at the west gossan. Gray weathering marble there is cut by grayish red limonite veinlets, generally less than 1/8-inch thick, which are bounded by limonitized marble with diffuse outer contacts. Evidently the ferruginous marble, which forms the bulk of the gossan rubble, is from alteration halos around limonite or goethite veinlets. This accounts for the ubiquitous mixture of goethite with ferruginous marble in the rubble. The earthy limonite of the veins grades into viterous goethite, often of botryoidal or cellular habit. Cellular goethite box works form from dissolution of the limonitized marble between irregular goethite veinlets. The impression in the field was that the goethite results from surficial reworking of the limonite veins. No thick limonite veins were seen here or elsewhere at the Monarch deposit. Some joint surfaces have a little sooty black, finely branching pyrolusite, and some samples contain up to 10% manganese.

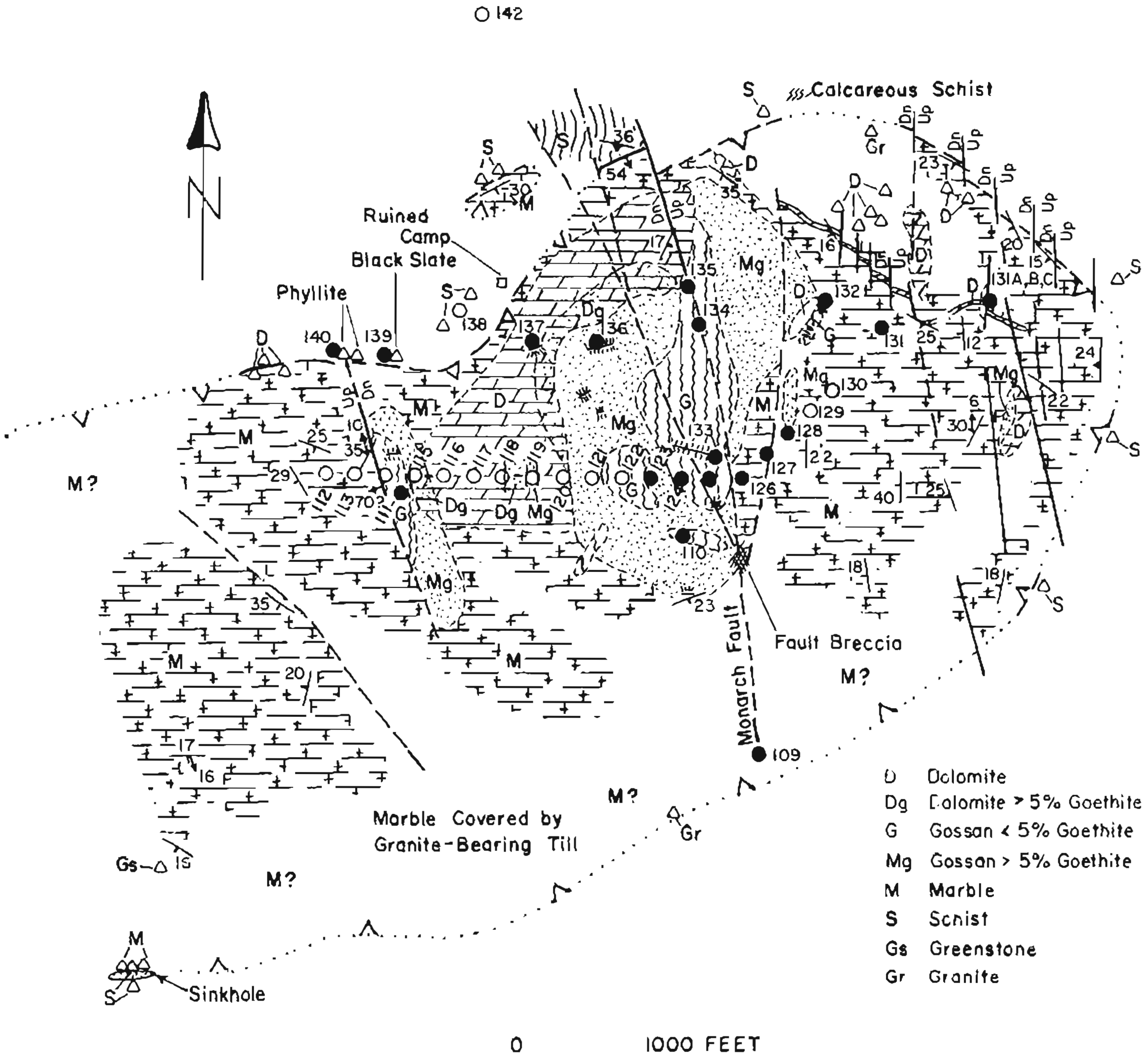


FIGURE 4 GEOLOGIC MAP OF THE MONARCH GOSSAN

D	*Dolomite; fine-grained, light gray, crackled. Weathers moderate orange pink. Where peripheral to gossan, contains scattered 1/8-inch limonite veinlets. At north end of dolomite zone, streaks of calcite in dolomite due to incomplete replacement of original marble*
Dd	*Dolomite; surface rubble contains less than 5% goethite. Transition unit*
G	*Gossan; surface rubble contains greater than 5% goethite, along with limonitized marble. Goethite is dense, non-calcareous, and locally botryoidal*
Mg	*Gossan; surface rubble contains less than 5% goethite, along with limonitized marble, medium-gray-weathering marble, and up to 10% dolomite*
M	*Marble; light to medium light gray, ± 1 mm grains. Weathers medium light gray. Bedding is generally thin, platy to slightly undulating. Map pattern shows area of outcrop*
S	*Schist; sericite-chlorite-quartz; light greenish gray with deformed quartz veinlets. Locally, along thrust southwest of Monarch Creek, silvery gray to black slate and crenulated brown phyllite*
	Attitude of bedding, foliation. Arrow shows crenulations or minor folds
	Contact, approximate
	Steep fault (defined, approximate, assumed)
	Thrust fault (defined, approximate, assumed)
	Geochemical sample (background, anomalous) analyses on tables 1 and 3
	Float
	Trench or pit

Base map is vertical aerial photograph (SEW78-V-124); scale is neither exact nor constant

Goethite was seen in place in one exposure. It replaces altered marble near the fault that bounds the west gossan on the west side. A foot or two from the fault, cellular to fine botryoidal goethite nodules about 8-inches in diameter replace thin bedded bleached marble containing hairline limonite veinlets. The botryoidal surface surrounds the nodules and could not have formed by dripping onto the floor of a cavity.

In the hills around the Monarch Lode (*fig 4*) the discordance between the bedding of the marble and the contact with the underlying schist indicates the presence of a basal thrust. The beds dip roughly 20°-30° west and the underlying thrust fault dips 3° west. Nowhere is the thrust exposed, but in the creek draining the Monarch Lode to the north a covered interval only 40 feet wide separates crenulated schist containing deformed quartz veins from bleached-looking marble with planar beds. The discordance of attitude between the two outcrops is 28°. The schist beneath the main thrust is crenulated brown phyllite and black slate northwest of the Monarch, but changes to light-greenish-gray sericite-chlorite-quartz schist in the creek north of the Monarch and in float further east.

The only thrust fault that was actually seen in the area is in marble near the eastern end of the Monarch hills. It dips 24° west and has drag folding indicating eastward overthrusting. Nearby marble is crackled, with films of red limonitic marble on the surfaces.

The Monarch deposit is localized along steep N10W trending faults that suggest a shallow graben centered under the main gossan. These faults, where mineralized, are marked by saddles, trenches up to 20 feet deep, and escarpments. East of the main gossan movements were west-side down. Offset of the basal thrust at the Monarch fault, and offsets of prominent marble beds further east, show throws of up to about 50 feet. West of the main gossan, the only steep fault recognized in the field is the one bounding the west gossan on the west side. Along this fault, air photos show an offset of the basal thrust a few feet down on the east side. Between this fault and the Monarch fault interpretation of the air photos suggests two other steep faults with east-side-down movement. These three faults drop the basal contact about 50 feet.

Fault control of the two large Monarch gossans is suggested by the small gossan along a steep fault at #131A, 131B, and 131C (*fig 1*). This fault is one of many well exposed steep faults east of the main gossan. It has about 50 feet of movement, down on the west side. Along the fault there is goethite and ferruginous marble, bordered by dolomite. The goethite carries 0.2 ppm gold and 249 ppm zinc, but the adjacent dolomite and marble are not anomalous. This is similar to the deposit along the Monarch Fault, with its high zinc and peripheral dolomite. This minor fault controlled showing is a duplication of the Monarch gossan on a small scale.

QUARRY PROSPECT

The Quarry fluorite-lead-zinc deposit is well exposed in one of the many road metal quarries along the Nome-Teller Highway (*fig 5*). It is located on the rounded divide between Cripple River and Washington Creek at the base of a marble hill. An old shaft, pits, and old claim posts mark early work, which apparently was done before World War I. Several analyses from this area, including two with "abundant" fluorite (Mulligan, 1965) are the only references to this deposit in the literature. The present map was first published in a progress report by Herreid (1966). The nearby large zinc-lead soil anomaly shown on figure 1 (2000 X 6000 feet) was announced at that time.

The mineral deposit consists mainly of pods and masses of fluorite and barite irregularly distributed below the base of a marble (M) thrust sheet in a silicified zone. Minor disseminated galena and sphalerite are also present in the zone.

The deposit is located near a steep fault that offsets the main thrust. The silicified zone is thicker near the steep fault and pinches out westward. The steep fault extends north for three miles to the Monarch Gossan with a braided trace visible on air photos. There it forms the main mineralizing fault. It is also apparently responsible for the Quarry deposit.

The large-scale features of the thrust are typical of such contacts in the district. A silicified zone extends along the schist-marble contact at the base of a marble hill. Patches of dolomite are associated with it in the Quarry. The patch of marble 1500 feet south of the thrust in the pit is a klippe. A gently dipping thrust plane can be inferred that would pass through all of these marble-schist contacts. There is no mineralization in the gray weathering marble above the thrust in the pit or higher up the hill, but a little mineralized gossan (sample 179) with 2.1% zinc is present in an old prospect pit in the klippe. An exception is the limonitized marble seen up the hill from the quarry along the steep fault just to the east.

The thrust, inferred from large-scale relationships, is well exposed in the stripped area of the Quarry prospect. The actual thrust surface is not an obvious shear zone separating marble from the underlying schist. The brown weathering muscovite marble-limy chloritic schist unit of the lower plate is truncated and overlain by gray weathering marble of the upper plate. A flat lying structurally complex silicified transition zone lies between the two. In places this zone is in sharp contact with the overlying marble. This contact dips gently south and is folded on a scale ranging from crenulations up to a few tens of feet. These folds are not overturned, and their axes are parallel to crenulations and fold axes in the schist and marble. The contact appears to be a metamorphosed thrust plane that was folded at the same time as in the marble and schist. It can be identified as a thrust on the basis of large structural relationships and, on a smaller scale by the fact that lineations in the upper and lower plates and transition zone are steeper than the thrust.

In some parts of the Quarry exposure the marble appears to dip under the silicified zone, possibly due to minor interfingering along the contact. Such relationships are numerous enough that the marble-silicified zone contact is only mapped as a probably thrust plane, with the possibility that the actual thrust movement has taken place largely within the transition zone.

The silicified transition zone has a banded texture with irregular layers, rods, and fold hinges of white quartz, mostly narrower than 1/4 inch, separated by quartz-mica schist layers which are locally limonitized. Limonite is most abundant along the marble contacts and around the fluorite-barite masses. Locally in these areas, low-grade disseminated galena occurs in quartz veinlets. Silicification is restricted to a fairly well defined zone a few tens of feet thick below the marble contact and is mainly a replacement of layers in the schist by quartz. There has been no silicification of the marble above the thrust(?) plane. Irregular white patches of marble in the normally light gray marble are apparently due to alteration.

In the silicified transition zone irregular masses of dolomite and dolomite breccia (dolomite fragments up to an inch across in diameter in a calcite and quartz matrix) furnish a link with the Monarch and Cub Bear occurrences, which also have associated dolomite.

Barite and fluorite, apparently of hydrothermal origin is present mainly in the silicified zone below the marble, but also in a few small pods in the lower plate. These minerals form a gently south dipping layer 1-2 feet thick near the collar of the caved shaft. They are intergrown and interbanded and form irregular layers, pods, and disseminations in all of the showings in the pit. In the lower plate, south of the area of figure 5, lenses of bleached muscovite marble a few feet long contain minor barite and fluorite.

Low-grade fluorite a few feet south of sample B (*table II*) is associated with limonite lumps 1/4-inch in diameter in a quartz-fluorite vein. The quartz-fluorite vein and the

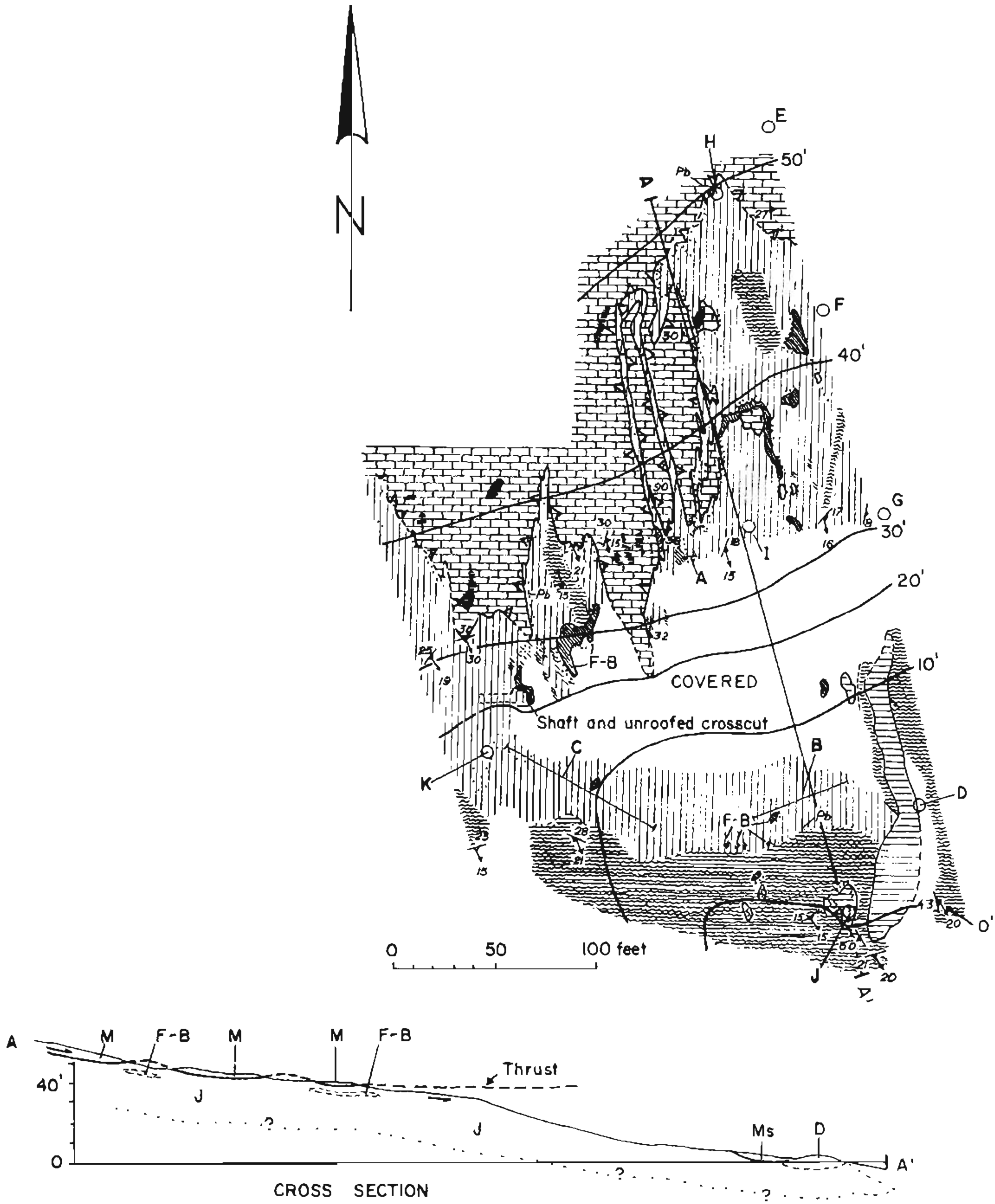


FIGURE 5 GEOLOGIC SKETCH MAP OF THE QUARRY PROSPECT

QUARRY PROSPECT LEGEND


Gossan (dark brown, light brown)


Dolomite, dolomite breccia


Gray weathering marble, bleached marble. Upper plate


Limonitized silicified scnist with muscovite partings, many quartz veins; limonitized granular silicified marble without mica partings, quartz veins; minor unsilicified schist and marble. Transition zone between upper and lower plates


Brown weathering muscovite marble; limy muscovite-chlorite schist; medium gray marble. Strongly crenulated. Lower plate


Fluorite-barite (massive, disseminated)

Contact (defined, assumed, gradational)


Probable thrust, arrows toward upper plate


Foliation, arrow shows crenulations and minor folds

Grab sample of bedrock rubble, table 6


Geochemical soil sample, table 6


Approximate contours, 10 foot interval

adjacent schist layers swirl around the lumps of limonite, which appear to have been rotated. The sulfide(?) mineral which has been replaced by limonite was either present at the time of movement or has replaced an earlier synkinematic mineral. Several pieces of float with these limonite-filled augen were seen in the area, and some are closely associated with quartz-galena veinlets in the vicinity. These augen appear to have been formed during the regional deformation and metamorphism of the country rock. It is possible that the associated ore minerals are later, due to replacement by solutions that came up along the steep fault.

The barite-fluorite deposit exposed in the pit is not of ore grade or size. However, it probably extends west along the contact and north beneath the upper plate, where richer ore could be present.

A strong geochemical soil anomaly for zinc and lead over an area about 2000 X 6000 feet is present in the schist that surrounds the marble (*fig 1*). The three geochemical samples shown on figure 5 are also strongly anomalous in zinc and lead. These samples indicate that low-grade deposits such as are exposed in the quarry can produce strong soil anomalies. A distinct possibility remains, however, that ore grade material underlies parts of the large soil anomaly.

CUB BEAR PROSPECT

The Cub Bear prospect lies just west of a tundra-covered saddle in the divide between Ashland Creek and Cripple River. Exposures consist of limonitic rubble with a few old prospect pits. It has been visited and described by Eakins (1915, p 365), Cathcart (1922, p 261), and Mulligan (1965, p 16-17). Shallit (1942) estimated the iron ore rubble reserves to be 100 tons of 30-45% iron and 10,000 tons of 10-20% iron. Along the margins of the deposit bedrock is exposed in numerous places. The deposit is associated with high angle faults that offset the marble thrust sheet.

The deposit is a ferruginous zone 4000 feet long and up to 200 feet wide (*fig 6*). The surface rubble overlying the deposit consists of: (1) goethite, (2) dark-yellowish-orange cellular ferruginous marble, (3) crackled medium-light-gray dolomite, with a light to heavy coating of limonite, and irregular goethite veinlets, which in places are pseudomorphic after pyrite, (4) medium gray marble, and (5) ferruginous fines. At the north end goethite is most abundant on the east side. On the west side, the deposit grades into unmineralized marble. In the richest sections goethite is estimated to make up 40% of the surface material. An assay of this material taken near sample 4 showed 16% iron, with copper, lead, and zinc less than the limit of detection (0.05%).

Samples of gossan rubble (*fig 6, Appendix III & table III*) show moderate to high zinc anomalies, and moderate lead anomalies. The moderate lead anomaly (sample 94, Herreid, 1966) in unmineralized marble 100 feet west of the gossan was not confirmed by later sampling.

Dolomite breccia is present as rubble in the ferruginous zone and as a discontinuous barren envelope around it. In places, grayish weathering dolomite contains 5-10% of small angular patches of light-gray-weathering, fine-grained marble. This appears to be a fractured marble almost completely replaced by dolomite. Elsewhere, replacement by dolomite has been complete. This relationship of dolomite to ore is similar to that at the Monarch deposit.

Steep faults are common throughout the Sinuk area, but only near the Cub Bear are there good exposures where these offset the marble thrust sheet. The traces of some of these faults across the hills indicate steep east dips. The elevations of the marble-schist contact at the ends of the fault slivers show both normal and reverse movements of up to about 250 feet. Steep dips in the marble are usually near the steep faults, but only some

Table II. Assay and Geochemical Analyses from the Quarry Prospect[a]

Sample No.	Field No.	Type of Sample	Copper	Lead	Zinc	Molybdenum	Gold	Silver
A	5C-293-6	6' grab	ND[b]	1.1%	1.1%		Nil	0.40 oz/T
B	5C-293-14	50' grab	ND	4.0%	0.34		Trace	2.0
C	5C-293-15	83' grab	ND	0.63	0.30		Trace	Tr
D	5C-293-18	2" grab	ND	25.	0.12		0.02	5.30
E	5L-200	geochem soil	50 ppm[c]	1180 ppm	+1000 ppm	2 ppm		
F	5L-201	geochem soil	85 ppm	+1000 ppm	+1000 ppm	2 ppm		
G	5L-202	geochem soil	30 ppm	+1000 ppm	+1000 ppm	2 ppm		
H	5C-293-8	rock	30 element spectroscopic analysis, Table 2					
I	5C-293-5	rock	30 element spectroscopic analysis, Table 2					
J	5C-293-12	rock	30 element spectroscopic analysis, Table 2					
K	5C-293-1	rock	30 element spectroscopic analysis, Table 2					

(a) Sample locations shown on Figure 5. Gold and silver analysis fire assay by Donald Stein, base metals X-ray fluorescence by Michael Mitchell, Jr., Alaska Division of Mines and Geology
(b) ND - Sought but not detected
(c) parts per million

Description of Samples

A - Dark brown surface rubble, some light brown quartz, banded gray schist with moderate limonite stain. Representative of dark brown material at marble-silicified schist contacts. A 6-inch fluorite-barite zone was excluded from the sample.
B - Limonite-quartz rock makes up 20-30% of sample, remainder is banded silicified schist.
C - Brown banded silicified schist without limonite lumps, such as are present in B.
D - Sulfide with yellow-green oxidation stain, 1-2 inches wide along a quartz vein in dolomite, parallel to dolomite schist contact.
H - Silicified schist, moderately limonitized, dolomitic, with galena along quartz layers.
I - Silicified schist, slightly calcareous, deformed quartz layers with diffuse borders.
J - Dolomite-quartz breccia, light brown.
K - Silicified schist, moderately limonitized, porous, non-calcareous, a banded white quartz-light brown limonite rock.

Table III. Analyses of Ferruginous Rubble from the Cub Bear Prospect[a]

Map Number	Field Number	Width of Samples	Gold[b]	Silver[b]	Copper[b]	Lead[b]	Zinc[b]	Description of Samples
1	9C60A	10'	ND[c]	0.6	50	39	9400	Goethite rubble.
1	9C60B	10'	ND	0.4	90	67	9800	Rubble; limonitized marble and dolomite.
2	9C60C	10'	ND	0.6	38	31	24000	Goethite rubble.
2	9C60D	10'	ND	0.8	25	74	6100	Rubble, limonitized marble and dolomite.
3	9C91A	70'	ND	0.6	25	15	450	Goethite rubble.
3	9C91B	70'	ND	1.1	6	37	75	Rubble; limonitized marble and dolomite
4	9C153	80	ND	0.3	6	20	590	Rubble; limonitized marble; crackled dolomite; about 5% goethite partly pseudomorphic after pyrite
5	9C154	100'	ND	1.1	6	23	1650	Rubble, limonitized marble; crackled dolomite; about 1% goethite.
6	9C40G	1	ND	0.4	30	5	120	Goethite rubble.
6	9C40D	1'	ND	0.7	3	28	35	Dolomite rubble
7	9C145	30'	ND	0.7	5	28	28	Medium gray weathering marble rubble.
8	9C144	80'	ND	0.8	4	29	8	Rubble; medium gray weathering marble with dolomite patches.
9	9C143C	29'	ND	0.5	6	20	85	Rubble medium gray weathering marble with ferruginous soil.
10	9C143B	29'	ND	0.3	5	14	190	Rubble medium gray weathering marble with ferruginous soil.
11	9C143A	29'	ND	0.8	5	25	42	Rubble, light gray and dark yellow crackled dolomite, limonitized marble, 3% goethite.
12	9C165	25'	ND	0.3	5	20	80	Rubble in old hand-dug trench; dolomite (limonitized surfaces), ferruginous soil, 2% goethite
13	9C164	75'	ND	1.3	5	40	27	Rubble; medium/light gray weathering marble, ferruginous soil.
14	9C168	35'	ND	0.3	6	67	120	Dump of old trench; limonitized schist, limy schist, marble.
15	9C178	100'	ND	0.5	32	23	38	Limonitized marble zone (15 wide) in contact with schist. Scattered limonite veinlets in marble further west

(a) Location shown on figure 6. All samples are grab samples of surface rubble.
(b) Atomic absorption by Alaska Division of Mines and Geology, Namok Cho, analyst. Reports in parts per million.
(c) ND - below limit of detection.

are in accord with the expected sense of drag folding along the steep faults. Evidently the overthrust faulting at the base of the marble has had more effect on the bedding in the marble than the steep faults (*detail A, cross section A, fig 6*).

Minor folds developed along steep faults plunge parallel to folds elsewhere in the marble and underlying schist. This relationship can be seen in crenulated dolomite along the west side of the south gossan. The folding here indicates that dolomitization took place during or before deformation along the steep faults.

Drag folding with amplitudes ranging from a few inches to 50 feet show that thrust movement of the marble has been towards the east. Details showing two of these drag folds are shown on figure 6. Axes of these drag folds and of the folds along steep faults are parallel. This suggests that overthrusting was closely followed by steep faulting. The strips of schist along steep faults are due to upward drag of schist along the fault planes. The presence of these schist bands along the side of the gossan indicates the proximity of the underlying thrust.

The muscovite marble is a tectonized unit and not a normal stratigraphic member. It is only sporadically present even in this restricted area and tends to confuse the structural interpretation. It may represent material from the base of the marble squeezed into lower pressure areas. The presence of sericitic bands and slightly brown weathering marble near the base of the marble indicates that in this area the basal thrust is near the stratigraphic base of the marble.

At the Cub Bear there is a strong structure combined with geochemical anomalies in zinc, lead, and silver, some of them quite high. The steep faults extend into the lower plate rocks which, as the Aurora Creek prospect shows, are mineralized in places. This prospect is a worthwhile long shot drilling target.

AMERICAN GOSSAN

The American gossan lies northwest of the Sinuk River on the west side of a bold marble knob, which is one of the more striking features of the local landscape. A patch of gossan rubble up to 300 feet wide extends along a marble-schist contact for 1800 feet (*fig 7*). A few old hand-dug pits and trenches testify to early exploration efforts (Eakins, 1915). The area was mapped in a general way by Shallit (1942), who estimated the ore reserves to be 40,000 long tons of 20-40% iron ore.

Between American Creek and the Sinuk River rolling tundra-covered hills with a few schist outcrops are dominated by ridges of massive marble, which are part of a thrust sheet that overlies the schist. The marble rests on the schist with a basal contact dipping about 5° south, whereas the bedding in the marble dips 10° to 40° south.

The American Lode occurs along the north side of a graben about one mile long and one-quarter mile wide. Numerous steep faults have cut the marble thrust sheet into many fault blocks. Here and there, along these faults, the surface rubble contains concentration of dolomite, limonite, vein quartz, and silicified marble. The richest of these mineralized fault zones by far is the American Lode. The steep dips of these faults are inferred from their straight traces and probably vertical offsets. At the American Lode, the shape of the magnetic profile across the mineralized schist-marble contact (*fig 8*) suggests the presence of a north-dipping tabular magnetic body such as magnetite disseminated along a fault or a mafic dike.

Geochemical traverses across the gossan zone (*Appendix II and IV*) show low lead and moderate zinc anomalies, plus the highest gold analysis from all the gossans in the Sinuk district ($2.10/ton).

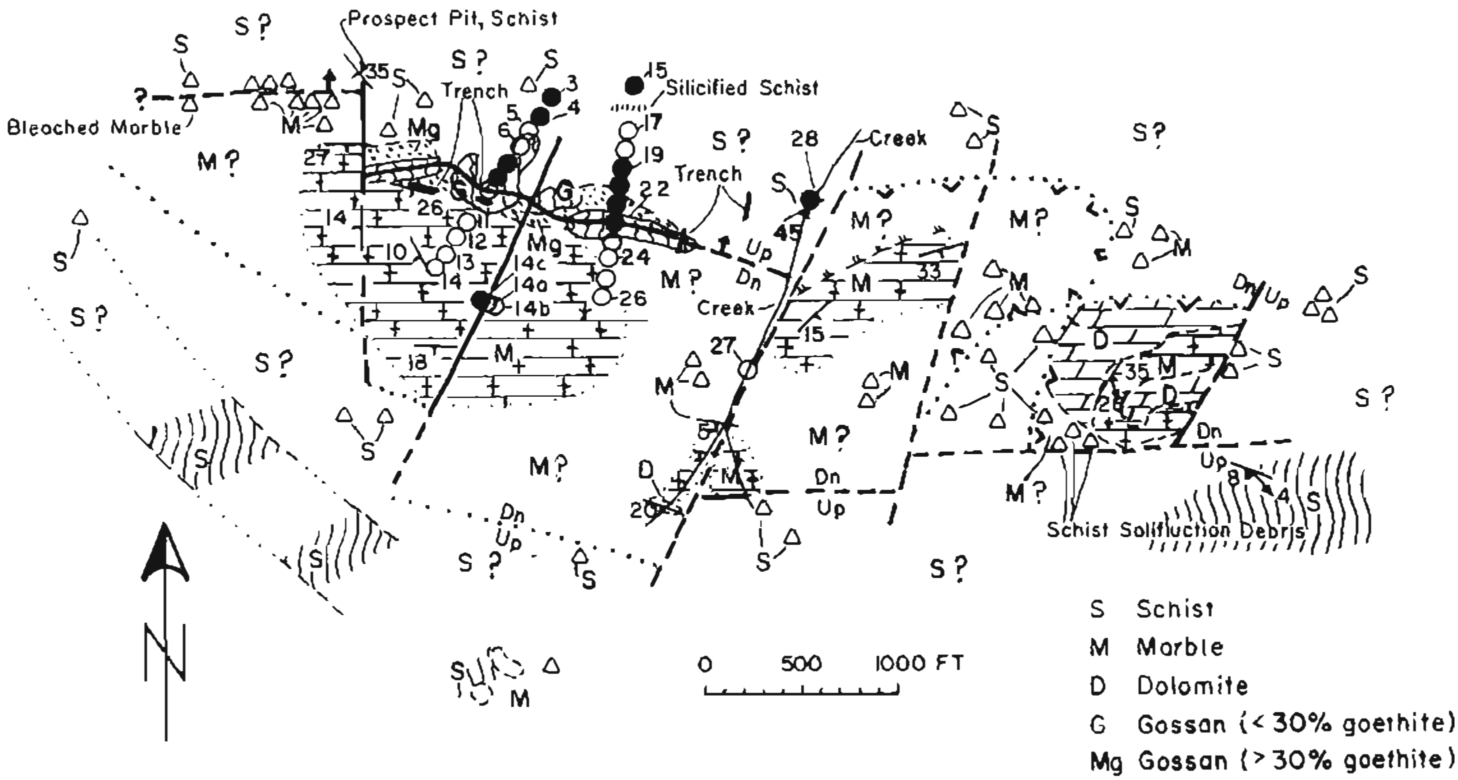


FIGURE 7 GEOLOGIC MAP OF THE AMERICAN GOSSAN

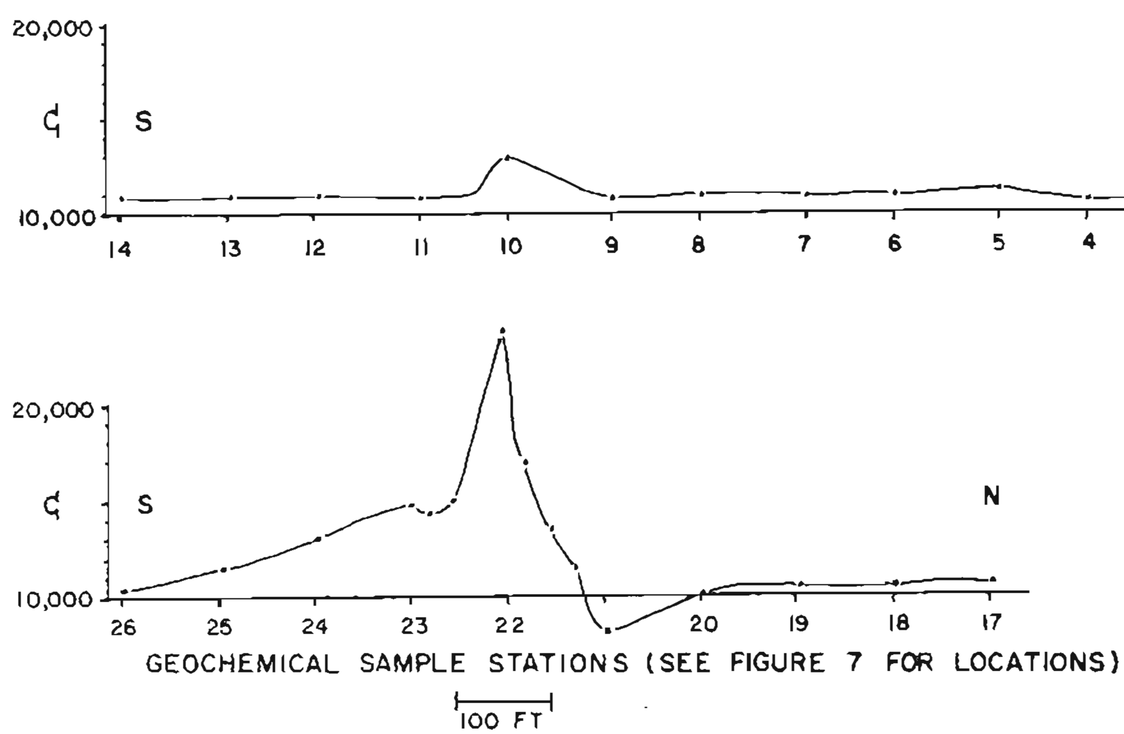
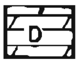


FIGURE 8 VERTICAL MAGNETIC FIELD ACROSS THE AMERICAN GOSSAN (ARVELLA MAGNETOMETER)

Gossan: *surface rubble contains more than 30% goethite, plus limonitized marble, dolomite, limonitized schist and bleached marble. Limonitized marble weathers light brown to dark yellow orange, effervesces strongly with HCl, and often has reticulated goethite veinlets; leaching produces irregular goethite box works. Dolomite is crackled and may contain earthy limonite and goethite veins with disseminated pyrite and green chlorite. Bleached marble is very light gray and weathers light gray to brown; limonitized schist is dark gray sericite-chlorite schist, which is locally calcareous. Contains scattered specks (± 2 mm) of dark green chlorite.*

Gossan: *surface rubble contains less than 30% goethite, plus limonitized marble, dolomite, schist, and bleached marble.*



Dolomite: *very light gray, fine-grained with faint color banding parallel to planar parting. Somewhat fissile, ¼ inch layers weather out. Outcrop is mostly rubble, weathers grayish yellow orange. Contains some remnants of original marble.*

Marble: *light medium gray, thin bedded (¼" - 3").*

Schist: *dark greenish gray sericite-chlorite schist, locally calcareous. Immediately north of marble, unit is locally limy or contains white marble layers interbedded with non-limy schist; farther north schist is non-limy. Schist areas mainly covered by tundra with only sparce float.*

Patterns show areas of outcrop. In gossan areas outcrop is mainly rubble (½" - 3") in a fine limonitic brown soil. Frost rubble runs are present on steeper slopes and on shallower slopes these grade into frost boils and tundra.


Attitude of bedding, foliation. Arrow shows lineation.

Bedrock contact

Steep fault (defined, approximate, assumed)


Thrust fault, assumed

Escarpment

○ ● *Geochemical sample (background, anomalous)*

△ *Float*

Base map is vertical aerial photograph (SEW 78-V-105); scale is neither exact nor constant.

This is a deposit controlled by steep faults, rather similar to the Cub Bear in that it is near the basal thrust. Because of its relatively small size and its moderate geochemical anomalies this deposit is of less interest than some of the other gossans in the district.

AURORA CREEK PROSPECT

On Aurora Creek quartz-dolomite-sulfide float occurs near a crosscutting greenstone dike and extends outward along a favorable horizon in the schist of the lower plate *(fig 1)*. There are no bedrock exposures of the deposit, but scattered sulfide-bearing float and a geochemical soil anomaly extend for at least 7000 feet, mostly along the east side of Aurora Creek. Prominent solifluction lobes cross the deposit and carry float down into the creek. There is a strong stream sediment anomaly 2 miles long in Aurora Creek.

The deposit was discovered by the Alaska Division of Mines and Geology in 1967 (Herreid, 1968). It was first detected in Aurora Creek sediments, using the cold extractable heavy metals field test. The tests required from 10 to over 20 milliliters of dithizone for a distance of 2 miles below the intersection of the deposit with the creek. Total zinc contents of these samples range from 310 to 2600 parts per million, but only background amounts of lead and copper are present in all but one of these samples.

The sulfide-bearing rock occurs along a boudined calcareous zone in the schist. It consists of granular quartz-dolomite-sphalerite-pyrite-(galena)-(chalcopyrite), which in places occurs as dolomite-quartz boudins with bands of differing minerals, including sulfides. Nothing of ore grade and size is exposed, and none is in place. The zone is best exposed on the south bank of Aurora Creek where a zone with sulfide-bearing float nearly in place extends for 200 feet east of #291. It is bleached quartz-sericite schist containing dolomite-quartz-sulfide layers or pods, jasperoid (silicified schistose marble), and silicified zones in the schist. A specimen of highgrade float from this zone, found in Aurora Creek *(table IV, #291-1)*, contains 10% zinc and 0.01 oz. per ton gold. Under the microscope it is a granular aggregate of dolomite with irregular clumps of granular quartz and sphalerite and a scattering of muscovite and chlorite flakes. Float in the creek, below the zone includes gossan boulders (weathering light brown to yellow orange), jasperoid, and several large white vein quartz boulders.

A cross fault offsets the mineralized zone near Aurora Creek. To the west, this same fault offsets the marble-schist thrust contact but does not offset the greenstone dike in Aurora Creek. The dike is of middle Paleozoic to pre-Middle Cretaceous(?) and the overthrust is Early Cretaceous(?). If these ages are correct, the structural relationships of the faults and dike indicate that the movement direction on the fault is about parallel to the dike so that there has been movement but no apparent offset.

The presence of mineralized boudins indicates that the ore was introduced before metamorphism, possibly genetically related to dike emplacement. The large boulders of ore near the dike along Aurora Creek are merely float from the ore zone upstream.

The southern extension of the mineralized zone on Aurora Creek is present on the hillside east of the Aurora Creek-Oregon Creek divide *(fig 1, #340 and #341)*. The zone contains silicified-dolomitized schist blocks mixed with unmineralized schist over a width of 400 feet. Along the uphill side of this zone, large float blocks contain crackled dolomite boudins bordered by granular quartz-dolomite rock with prominent pyrite-leucoxene-sphalerite bands, somewhat similar to ore seen farther north. Fractures in the dolomite are filled with narrow (± 1/8 inch) quartz stringers. Mud from a seepage near the upper side of the zone carries 860 ppm zinc and 370 ppm lead *(341)*. The great width of the zone here may be due to down slope creep from a narrower zone.

Table IV

Assay Data from the Aurora Creek Prospect*

Sample	Gold oz/ton	Silver oz/ton	Copper %	Lead %	Zinc %	Antimony	Arsenic	Other
C	-	-	0.06	0.3	0.7			Trace barium, manganese, chromium.
F	-	-	ND	0.3	2.3	-	Trace	Trace chromium.
G	Trace	Nil	ND	ND	3.7	ND	Trace	
291-1**	0.01	Nil	ND	ND	10	ND	ND	
291-2**	Trace	0.1	.003	0.3	13			
340**	Nil	0.40	ND	0.3	3.4	ND	Trace	

*All samples shown on Figure 1. All have less than 0.0002% molybdenum, except F, which was not run.

**Location keyed to this geochemical sample site

nd - below limit of determination

Sample	Field No.	
C	6C673	Float in tundra, muscovite schist with disseminated pyrite, chalcopyrite, and galena, northernmost ore seen on Aurora Creek.
F	6C675	Float in tundra, silicified muscovite schist with disseminated pyrite and pale yellow sphalerite.
G	6C674	Float in tundra, silicified schist, sphalerite vein bordered by pyrite and sphalerite.
291-1	6C678	Float in Aurora Creek, granular dolomite-quartz-sphalerite rock with disseminated muscovite and chlorite flakes.
291-2	8C625	Large float blocks in Aurora Creek. Light brown to yellow orange weathering silicified rock with sphalerite. Location 200 feet WNW of #291.
340	6C679	Large float blocks, crackled dolomite boudins in a matrix of banded dolomite-quartzite rock with prominent pyrite-leucoxene-sphalerite bands.

The geology between 340 and the old placer ditch on Aurora Creek is obscured by well developed solifluction lobes.

Three thousand feet south of sample locality 340 on the ridge between Oregon Creek and Penny River, slightly mineralized rock is exposed in several old prospect pits for a distance of 500 feet. This is on the old Christophosen claim (Mertie, 1918, p 447). The dump at the northern-most pit contains dolomite boudins (lenses) veined by quartz; and banded porous siliceous rock containing sparse sphalerite, galena, and chalcopyrite. This mineralized rock is an isolated pod in schist. There is no float ore in the rubble exposures surrounding the pit. The mineralized rock is strikingly similar to that in the zone at #340-341.

For 500 feet south along the ridge, most of the exposed rock is unmineralized schist, but in several small pits silicified muscovite schist and some quartz-veined dolomite is present. No ore minerals were seen. The mineralization on the ridge may be related in origin to three west to west-northwest trending faults marked by linear gullies, which cut across the strike of the schist in this area.

LAST CHANCE CREEK PROSPECT

Two caved adits and several prospect pits are present on the upper part of Last Chance Creek. These are on a zone of limonitized sericite-graphite-quartz schist, much sheared over a width of about 400 feet *(fig 9)*. In one pit, a quartz vein at least 1-1/2 feet wide contains stibnite crystals up to 1/4 inch long. These make up less than 1% of the vein. Strongly limonitized gossan from another pit was sampled *(#359*-1, Appendix I)* to determine the possibilities of the gossan for a large low-grade deposit. The results of 0.2% antimony and a trace of gold are not encouraging. About 900 feet northeast, along the shear zone, a sample *(#359-2)* across a 30 foot silicified zone (± 1 mm quartz grains in a black silicified matrix) contains 0.1 oz/ton gold.

According to Cathcart (1922, p 231) who visited this prospect in 1920, "development work consists of two tunnels and several open cuts. The upper tunnel, now caved and unaccessible, is said to be 105 feet long; the lower tunnel is 270 feet long and driven N25W. According to Mertie,

> 'The tunnels are said to intersect a stockwork of iron-stained schist and quartz in which the stibnite occurs as lenticular masses. None of the antimony stringers are over 12 inches in thickness.
>
> In the open cuts it is apparent that a shear zone striking about N20E runs through the property. The attitude of the faults is about vertical. This zone is about 100 feet thick and is heavily iron-stained and mineralized by pyrite, pyrrhotite, stibnite, and gold.'

Little is exposed in the one tunnel which is accessible. About 60 feet from the portal a quartz vein, apparently a lens, is intersected which strikes N50E and dips 80° S. It is followed for 12 feet along its strike and apparently stops. No evidence of mineralization is seen. At 70 feet from the entry a 3-foot quartz vein strikes N70W and dips north. The tunnel is driven in graphitic schist and exposes little quartz, other than that mentioned. On the dump quartz of the later-vein type contains considerable pyrite."

This prospect lies on the Penny River fault. A careful geochemical survey (north and south) along the fault should be made to detect any other deposits or the extension of this one.

LAST CHANCE CREEK SILVER-LEAD PROSPECT

According to Mertie (1918, p 446), "A silver-lead lode owned by G. Christophosen is on the north side of Last Chance Creek, a tributary of Snake River, about half a mile above the mouth of Waterfall Creek. The prospect consists of two lode claims. A tunnel 70 feet long has been driven to prospect the lode. The ore body is said to be 4 feet thick and consists of galena, with some pyrite, in a gangue of quartz. The lead ore carries gold and silver. Stibnite is also reported to be present".

This prospect was not seen during traverses in the area, but was not searched for. Cathcart (1922, p 253) was in the area, but did not mention the prospect.

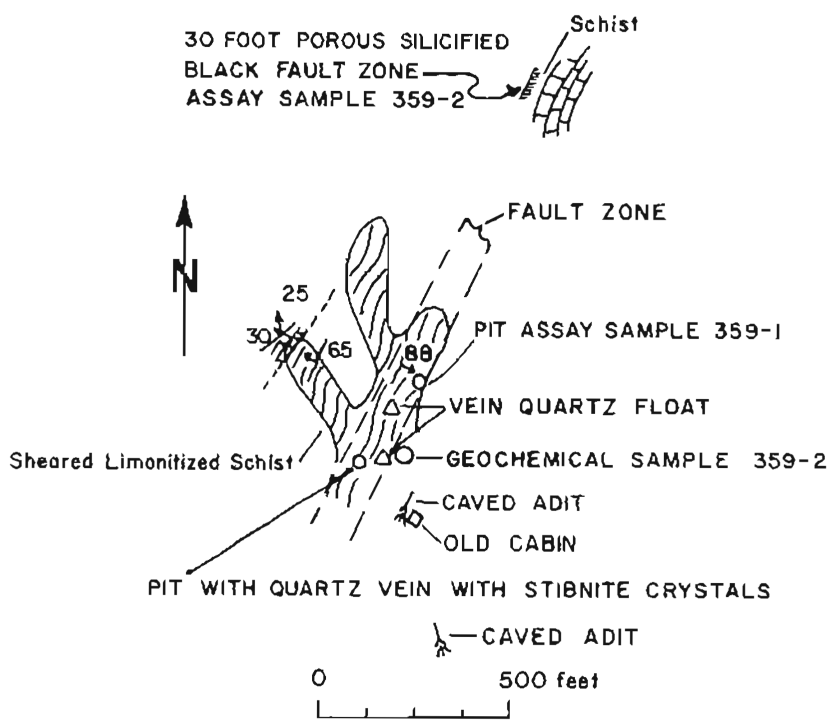


FIGURE 9 SKETCH MAP OF THE LAST CHANCE PROSPECT

Table V

INTERVALS OF ESTIMATION AND DETECTION LIMITS

SEMIQUANTITATIVE SPECTROGRAPHIC ANALYSES

Copper ppm*	Lead ppm	Zinc ppm	Molybdenum ppm	Silver ppm	Cobalt ppm	Chromium ppm	Nickel ppm	Manganese ppm	Titanium ppm	Iron (%)	Magnesium (%)	Calcium (%)	Barium ppm	Strontium ppm
20,000	20,000	10,000	2,000	5,000	2,000	5,000	5,000	5,000	10,000	20	10	20	5,000	5,000
10,000	10,000	5,000	1,000	2,000	1,000	2,000	2,000	2,000	5,000	10	5	10	2,000	2,000
5,000	5,000	2,000	500	1,000	500	1,000	1,000	1,000	2,000	5	2	5	1,000	1,000
2,000	2,000	1,000	200	500	200	500	500	500	1,000	2	1	2	500	500
1,000	1,000	500	100	200	100	200	100	200	500	1	0.5	1	200	200
500	500	200	50	100	50	100	50	100	200	0.5	0.2	0.5	100	100
200	200	100	20	50	20	50	20	50	100	0.2	0.1	0.2	50	50
100	100	L	10	20	10	20	10	20	50	0.1	0.05	0.1	20	L
50	50		5	10	L	10	5	L	L	L	L	0.05	L	
20	20		L	5		5	L					L		
10	10			2		L								
5	L			1										
2				L										
L**														

Boron ppm	Beryllium ppm	Tin ppm	Tungsten ppm	Zirconium ppm	Lanthanum ppm	Niobium ppm	Scandium ppm	Yttrium ppm	Vanadium ppm	Gold ppm	Bismuth ppm	Cadmium ppm	Antimony ppm	Arsenic ppm
2,000	1,000	1,000	10,000	1,000	1,000	2,000	100	200	10,000	500	1,000	500	10,000	10,000
1,000	500	500	5,000	500	500	1,000	50	100	5,000	200	500	200	5,000	5,000
500	200	200	2,000	200	200	500	20	50	1,000	100	200	100	2,000	2,000
200	100	100	1,000	100	100	200	10	20	500	50	100	L	1,000	1,000
100	50	50	500	50	50	100	5	10	200	20	50		500	500
50	20	20	200	20	20	50	L	L	100	10	20		200	L
20	10	10	100	L	L	20			50	L	10		100	
10	5	L	50			10			20		5		50	
L	2		L			L			10		L		L	
	1								L					
	L													

*ppm indicates parts per million
**L = Lowest limit of detection

CONCLUSIONS AND SUGGESTIONS TO PROSPECTORS

In the Sinuk district, Paleozoic(?) marble has been thrust over schist during Early Cretaceous(?) time and both have undergone regional metamorphism, probably in the Middle Cretaceous. Diabase or gabbro dikes and plugs (now greenstone) were intruded before metamorphism, probably before thrusting. Possibly as early as the Devonian. Steep faulting has taken place, perhaps during the waning stages of metamorphism.

The steep faults furnish a control for zinc-lead fluorite-barite deposits in marble (upper plate). These deposits may be a result of remobilization of somewhat similar deposits present near intrusive greenstone in schist of the lower plate.

Soil sampling shows interesting geochemical anomalies at the Monarch and Cub Bear gossans and at the Quarry, Aurora Creek, and Oregon Creek prospects. Stream sediment anomalies are present for at least one mile below the Aurora Creek and Last Chance prospects. An antimony anomaly in the head waters of Last Chance Creek may indicate an undiscovered antimony prospect. Anomalies for several metals on American Creek may indicate an undiscovered deposit north of the mapped area.

Stream sediment sampling is ineffective in detecting gossans, even those strongly anomalous in zinc and lead.

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APPENDIX I

Atomic Absorption Analyses of Rock Samples from the Sinuk Area[a]

Concentration (ppm)[b]

Map Number	Field Number	Gold	Silver	Copper	Lead	Zinc	Description of Samples
8	8C392	ND	1.0	4	32	32	American lode, earthy limonite.
14A	8C383	ND	0.8	9	34	5	Fault zone (near American lode), siderite and bleached marble.
14B	8C383-1	ND	0.4	5	27	20	Gray marble, 30 feet SW of 14A.
14C	8C383-2	ND	0.5	5	31	20	Gray marble, 30 feet NW of 14A.
22*	8C396-1	0.06	0.2	10	30	64	American lode, silicified schist rubble.
44A	8C593	ND		13	8	38	Schist quartz vein from east side Sinuk River.
51	8C317	ND		14	4	14	Vein quartz boulders in creek north of Coal Creek.
131A	6C568	0.24		54	12	249	Goethite along fault 0.3 miles NE of Monarch deposit.
131B	8C568-1	ND		2	6	ND	Dolomite along fault 0.3 miles NE of Monarch deposit (near _A).
131C	8C568-2	ND		2	3	ND	Marble along fault 0.3 miles NE of Monarch deposit (within 6" of _B).
227*	8C558	ND		20	8	66	Schist quartz vein NE of Hungry Creek (800 feet SSW of 227).
237*	8C545	ND		12	15	11	Bull quartz boulder, five feet diameter, Nugget Gulch, 300 feet west of 237.
239A	8C531	ND		6	4	24	Silicate sericite graphite schist near pyroxenite intrusion near saddle between Penny River and Nugget Gulch.
239B	8C533	ND		8	6	11	Silicified schist, head south fork Nugget Gulch.
241*-1	8L396-1	ND		10	ND	9	White quartz boulders from Oregon Creek, 200 feet upstream from 241.
241*-2	8L396-2	ND		17	ND	47	White quartz boulders from Oregon Creek, 200 feet upstream from 241.
242*	6C606	ND		9	3	230	Limy schist west of greenstone body, Oregon Creek, 500 feet NE of 242.
243R-1	8C538-1	ND		13	320	24000	Silicified gossan float in large cut south of Oregon Creek.
243R-2	8C538-2	ND		4	15	178	Silicified gossan float in large cut south of Oregon Creek.
243R-3	8C538-3	0.64		7	11	61248	Silicified gossan float in large cut south of Oregon Creek.
243R-4	8C538-4	ND		24	1260	9248	Silicified gossan float in large cut south of Oregon Creek.
243R-5	8C538-5	920		21	13	50748	Silicified gossan float in large cut south of Oregon Creek.
243R-6	8C538-6	ND		7	35	102	Silicified gossan float in large cut south of Oregon Creek.
243R-7	8C538-7	ND		1	6	220	Silicified gossan float in large cut south of Oregon Creek.
244*-1	8C421	ND		31	9	22	Vein quartz float between 2 greenstone bodies taken 600 feet south of 244 Oregon River, composite sample.
244*-2	8C537-1	ND		12	8	51	Greenstone with sulfides, Oregon Creek, 500 feet WSW of 244.
244*-3	8C537-3	ND		14	4	42	Pyrite bearing one inch quartz vein, 10 feet from greenstone body, 500 feet SSW of 244.
244*-4	8C542	ND		16	4	6	Greenstone, 450 feet SSW of 244 between Oregon and Greenstone Creeks.
248*	8C424-1	0.09		252	87500	50500	Gossan float in cut across limy schist, marble contact, 200 feet north of Oregon Creek.
250A	8C480	ND		3	28	20	Gossan along steep fault zone, east of Short Gulch.
250A	8C480-1	ND		16	12	16	Vein quartz along steep fault zone.
253*	8C425	ND		3	3	1	Silicified marble along ditch west of Greenstone Creek, 800 feet east of 253.
255*-1	8C543	ND		7	2	2	Silicified limy schist float near Greenstone Creek, intrusive, 400 feet west of 255.
255*-2	8C544	ND		3	6	6	Silicified limy schist float near greenstone intrusive, west of Greenstone Creek.
259	8C419	ND		13	4	16	Vein quartz in frost boils along thrust, Snowshoe Gulch.
359*-1	6C915	Trace	Nil	ND	Trace	Trace	Antimony-0 2%. Antimony prospect on Last Chance Creek drainage. Gossan from prospect pit about 300 feet north of upper adit.
359*-2	6C662	3.5	Nil	ND	Trace	Trace	Antimony-ND. Saddle about 900 feet NE of 359*. Silicified zone 30 feet wide.

ppm - parts per million

(a) Sample locations shown on figure 1.

(b) Total metal contents in parts per million excepting gold which is in parts per billion. Trace element analysis by atomic absorption by the Alaska Division of Mines and Geology laboratory, Namok Cho, analyst. Accuracy ± 5% at 65% confidence level. Major element analysis by X-ray fluorescence, Michael Mitchell, Jr., analyst. Accuracy ± 20% of reported value.

ND Sought but not detected.

* Near geochemical sample site.

APPENDIX II

Atomic Absorption and Colorimetric Analyses of Stream Sediment and Soil Samples from the Sinuk Area[a]

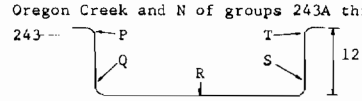
Concentration[b]

Map Number	Spectrographic Table	Field Number	Gold	Copper	Lead	Zinc	Molybdenum	Field Test[c]	Stream Width or Soil Depth[g]	Float, etc.
1	3	8L325	(.1)[d]	(10)[d]	(25)[d]	40	NR	NR	C-1'	S, Gr, L grav
2	3	8L326	(.1)	10	25	60			C 1'	S, Gr. M.
3	3	8L349	(.1)	(10)	50	120			D-2"	Am. Lode S. Q.
4	3	8L348	(.02)	20	40	80			D-2"	Am. Lode S.
5	3	8L347	(.02)	20	25	100			D-2"	Am. Lode
6	3	8L346	(.04)	15	30	50			D-2"	Am. Lode S.
7	3	8L345	(.1)	15	60 (h)	80			D-2"	Am. Lode S.
8	3	8L344	(.04)	15	40	100			D-2"	Am. Lode S.
9	3	8L343	(.02)	10	25	50			D-2"	Am. Lode Goe.
10	3	8L338	(.02)	(10)	(25)	(25)[d]			D-2"	Am. Lode P.P.
11	3	8L339	(.02)	(10)	(25)	(25)			D-2"	Am. Lode
12	3	8L340	(.02)	(10)	(25)	(25)			D-2"	Am. Lode
13	3	8L341	(.02)	(10)	30	(25)			D-2"	Am. Lode
14	3	8L342	(.02)	(10)	30	(25)			D-2"	Am Lode Gr, limy soil
14 A, B, C		Rock analyses, see table 4.								
15	3	8L361	(e)	10	25	220 (h)			D-2"	Am. Lode peat
16	3	8L360	(.04)	(10)	(25)	200			D-5"	Am. Lode Org.
16		8C396-1	.06(h)	10	30	64			Sil. S. float	Am. Lode
17	3	8L359	(.02)	(10)	(25)	(60)			D-2"	Am. Lode S.
18	3	8L358	(.02)	15	(25)	150			D-2"	Am Lode S.
19	3	8L357	(.02)	30	40	160			D-2"	Am. Lode
20	3	8L356	(.04)	(10)	30	600			D-2"	Am, Lode Goe, Org
21	3	8L355	(e)	20	45	800			D-2"	Am. Lode Goe, Org.
22	3	8L350	(.1)	20	40	350			D-2"	Am. Lode LM, Goe.
23	3	8L351	(.1)	20	30	110			D-4"	Am. Lode M, Org
24	3	8L352	(.02)	20	30	110			D-4"	Am. Lode Org.
25	3	8L353	(.02)	25	30	90			D-4"	Am. Lode
26	3	8L354	(.02)	15	25	50			D-4"	Am. Lode M.
27	3	8L362	(e)	20	(25)	60			C-1½'	M, D, Gr. S. Q.
28	3	8L333	(e)	15	30	500			C-4'	S 80, M 10, Gr 5, Goe 4. Q 1, BR, S.
29	3	8L332	(.04)	10	30	75			C-2'	S 50, Gr 40, M 7, Goe 2. Q 1, L grav.
30	3	8L323	(e)	15	(25)	60			C	S.
31	3	8L324	(.2)	10	(25)	180			C	Gr 80, S 20, L grav.
32	3	8L322	(.1)	15	(25)	50			C	M, S, Gr.
33	3	8L321	(e)	(e)	(e)	(e)			C-5' dry cr.	M 60, Sil. S 20, S 10, Gr 10.
34	3	8L320	(.04)	(10)	(25)	55			C-½'	Gr 50, S 50.
35	3	8L318	(.04)	20	25	45			C	M. S.
36	3	8L319	(.04)	15	(25)	50			C	M, S, Gr.
37	3	8L317	(.2)	10	25	45			C	S, M, Gr, Congl.
38	3	8L316	(.2)	(10)	(25)	95			C-½'	S 90, Gr 10, L grav.
39	3	8L315	(.04)	(10)	(25)	50			C-½'	S 100.
40	2	5L160		20	10	60	2	4	C-5'	S 5 D 5, Gr 90.
41	2	5L159		20	5	65	3	4	C-10'	S 10, M 40, Gr 50.
42	3	8L423		10	(25)	50			C-2'	Gr 50, S 45, Q 5, L grav.
43	2	5L158		20	10	90	3	2	C-1'	
44	2	5L157		10	10	85	3	4	C-4'	S 98, Gr 2.
45	3	8L314	(.02)	(10)	(25)	35			C-1½'	Gr 95, Q 5.
46	3	8L313	(.1)	(10)	(25)	50			C-1'	None
47	3	8C308		45	(25)	50			D-4"	Sqv & Yl bn soil
48	3	8C303		30	30	40			D-3"	M, bn soil
49	3	8C311		50	(25)	40			C-6"	M & S, thrust fault
50	3	8C315		45	(25)	80			C-2'	S
51	3	8C317		55	(25)	85			C-4'	S 80, CS 5, Gr 10, Q 5.
52	3	8L310	(.02)	20	(25)	70			C-3'	S 80, Gr 15, M 5.
53	3	8L309	(.1)	40	40	120			C-4'	S 90, M 8, Gr 2
54	3	8C318		40	(25)	60			C-6'	S 80, Sqv 10, Gr 10.
55	3	8C319		30	(25)	50			C-8'	S 65, Gr 30, Q 5.

Map Number	Spectrographic Table	Field Number	Gold	Copper	Lead	Zinc	Molybdenum	Field Test[c]	Stream Width or Soil Depth[g]	Float, etc
56	3	8L311	(.02)[d]	(10)[d]	(25)[d]	30			C-1'	None
57	3	8L312	(.02)	(10)	(25)	40			C-1'	D, L grav
58		5C307		20	10	110	3	6	C-60'	S 2, M 1, G 1, Q 1, Gr 95.
59	3	8L304	(.02)	15	(25)	65			C	M, Gr, Q
60	3	8L305	(.02)	10	(25)	55			C	CS, S, Gr, Sil M, Q.
61	3	8L307	(.02)	(10)	(25)	40			C-3'	CS, S, M, Gr.
62	3	8L306	(.1)	20	30	70			C-6'	CS, S, Gr, Sil M, Q.
63		5L150		10	5	40	2	8	C-50'	S 60, M 5, Gr 35.
64	2	5L151		20	10	65	2		C-6'	
65		5C295		10	5	15	2	5	C-2'-8'	
66		5C294		25	20	85	1	5	C-8'-20'	S 10, Gr 80, Congl 10.
67		5C297		20	10	90	1	12	C-8'-20'	Gr 100.
68		5L183		20	15	100	6	20+	C-2'-8'	S 40, G 10, Q 10, Gr 40.
69		5C306		25	5	100	1	5	D	M, S.
70		5C298		20	10	90	2	5	C	S 95, Q 2, Gr 3.
71	2	5L182		20	20	130	4	7	C-2'-8'	S 30, G 20, Gr 50.
72		5C299		20	10	95	2	7	C-2'-8'	Q 10.
73		5C302		65	15	100	2	7	C	S 30, M 10, Gr 60
74	2	5L184		20	15	115	2	18	C Dry	S 7, G 1, Gr 90
75	2	5L181		20	15	90	7	6	C-2'-8'	S 50, Gr 50.
76	2	5L180		25	25	135	7	8	C-2'-8'	S 20, M 2, Gr 78
77		5L152		30	35	265[h]	2	13	C-8'-20'	S 10, Gr 90
78		5L267		50	35	195	2	2	D	
79	2	5L266		30	20	110	3	6	D	
80	2	5L265		35	20	35	2	5	D-1"	
81		5L264		25	30	80	2	3	D-1"	
82	2	5L263		40	25	135	2		D	
83	2	5L262		40	15	65	3	7	D	
84	2	5L261		10	5	35	3	3	D	
85		5L282		55	30	185	14[h]	13	D	
86	2	5L281		65	55	295	6	13	D	
87		5L280		115[h]	50	120	5	4	D	
88	2	5L271		45	150[h]	+1000	7	+20	D	
89		5L270		30	105	+1000	2	+20	D	
90		5L269		25	275	850	2	11	D	
91		5L274		25	405	+1000	3	+20	D	
92		5L275		20	95	205	2	12	D	
93		5L279		40	125	830	6	10	D	
94		5L278		45	220	+1000	6	+20	D	
95		5L276		20	170	500	1	11	D	M 1.
96		5L277						+20	D	
97		5C399		25	45	260	2	1	D	
98	2	5L155		35	140	980	7	+20	C-1'	S 90, Gr 10.
99	2	5L156		15	5	65	2	6	C-1'	
100	3	8L418		10	(25)	130			C-5'	Gr 95, G 5, large spring
101	3	5L154		25	30	155	2	10	C	
102		5L153		30	15	105	3	5	C-6'	S 2, M 50, Gr 48.
103	2	6L510		20	15	115	2	3	Dry	M 98, Q 1, Gr 1.
104A	2	9C517	ND	15	35	37			D-1"	Silver 1.1 ppm fault trace M.
104	2	9C518	ND	20	45	95			D-4"	Silver 0.7 ppm fault trace M.
105	2	6L511		25	15	85	2	1	Dry	
106	2	6L512		20	15	70	1	1	Dry	
107	2	6L513		20	15	60	1	1	C-4'	
108		6L514		20	20	110	7	1	D-12"	
109	3	8L420		30	60	220			D-2"	Monarch lode, frost boil near lowest M outcrop
110		5C370		25	340[f]	495	1	20+	D	Monarch lode, LM 50, Goe 50.
111		5C382		10	280[f]	105	1	3	D	Monarch lode, M 20, LM 60, Goe 10, earthy lim. 10.
112	3	8L411		10	(25)	(25)[d]			D-2"	Monarch lode, M 99.9, LM 0.1.

Map Number	Spectrographic Table	Field Number	Gold	Copper	Lead	Zinc	Molybdenum	Field Test (c)	Stream Width or Soil Depth (g)	Float, etc.
113	3	8L410		10	35	80			D-2"	Monarch lode, M 99.5, Goe 0.5.
114	3	8L409		10	30	110			D-2"	Monarch lode, M 80, LM 10, Goe 10.
115	3	8L408		10	(25) (d)	80			D-2"	Monarch lode, M 93, LM 2, Goe 5.
116	3	8L407		(10) (d)	(25)	(25) (d)			D-2"	Monarch lode, M 100.
117	3	8L406		(10)	(25)	(25)			D-2"	Monarch lode, M 100.
118	3	8L405		10	30	40			D-2"	Monarch lode, M 95, Goe 0.1 LM 5.
119	3	8L404		10	30	80			D-2"	Monarch lode, M 2, LM 93, Goe 5.
120	3	8L403		10	25	60			D-2"	Monarch lode, D 99.5, Goe 0.5.
121	3	8L402		10	30	50			D-2"	Monarch lode, LM 92, Goe 8.
122	3	8L401		15	30	120			D-2"	Monarch lode, M 20, LM 55, Goe 25.
123	3	8L400		10	30	250 (h)			D-2"	Monarch lode, M 50, LM 49, Goe 1.
124	3	8L399		10	30	220			D-2"	Monarch lode, LM 93, Goe 7.
125	3	8L398		20	35	1200			D-2"	Monarch lode, M 15, LM 78, Goe 7.
126	3	8L397		35	100 (h)	430			D-2"	Monarch lode, M 100, Yl bn soil
127	3	8L412		15	170	100			D-2"	Monarch lode, M 99.5, LM 0.5, Yl bn soil
128	3	8L413		25	40	100			D-2"	Monarch lode, M 100, Yl bn soil
129	3	8L414		25	(25)	85			D-2"	Monarch lode, M 99.5, LM 0.5, Yl bn soil
130	3	8L415		15	25	70			D-2"	Monarch lode, M 100, Yl bn soil
131		6L516		15	25	380	1	6	D 2"	Monarch lode, LM 94, Goe 5, Cc 1.
131 A, B, C		Rock samples, see table 4.								
132		5C387		35	25	175	3	2	D	Monarch lode, LM, Goe, Cc veins
133		6L517		35	25	1000	1	9	D-2'	Monarch lode, LM 70, Goe 30, E and Yr.
134	3	8L421		20	40	210			D-2"	Monarch lode, M 10, LM 50, Goe 40.
135		6L515		20	90	300	1	5	C-2'	Monarch lode, M 35, D 20, Goe 45.
136		5C391		10	140 (f)	45	2	1	D	Monarch lode, LM 95, Goe 5.
137		5C384		15	20	95	1	2	D	Monarch lode, D 99, Goe 1.
138	3	8C581		30	25	50			Dry Creek	Monarch lode, S 100.
139	3	8C580		25	25	180			C-2'	Monarch lode, B 1, S 1, phyllite
140	3	8C579		25	25	1000			D-3"	Monarch lode, Bn phyllite, D.
141	3	8L422		15	(25)	100			C-4'	Monarch lode, M 40, Cr 40, Goe 10, S 10.
142		6L521		20	20	135	2	10	D-2"	Monarch lode, S 50, LM 25, Goe 20, Gr 5.
143	3	8C596		25	(25)	75			C-2'	Monarch lode, S 100.
144	3	8C600		25	45	220			D-4"	
145	3	8C599		30	40	200			D-4"	
146	2	5C337		10	(5)	25	1	8	D	
147		5L199		35	15	100	2	1	C--1'-2'	
148		5C334		35	15	95	2	11	Dry	
149		5C332		25	20	215	2	11	Dry	
150	2	5L231		20	35	150	2	15	D	
151		5C319		30	20	110	2	3	D	
152		5C318		15	20	125	1	5	C-1'	
153		5C317		25	30	250	1	1	D	
154		5L232		30	245	+1000	2	+20	D	
155		5L233		15	5	35	2	1	D-1"	
156		5L230		25	110	230	2	7	D	
157	2	5L228		45	475	+1000	2	+20	D	
158	2	5L220		130 (h)	950	+1000	2	+20	D	
159		5C326		35	370	+1000	1	+20	D	
160		5L218		55	395	+1000	2		D	
161		5L217		45	345	+1000	2	+20	D	
162		5L216		55	525	+1000	2		D	

[illegible]	Spectrographic Table	Field Number	Gold	Copper	Lead	Zinc	Molybdenum	Field Test(c)	Stream Width or Soil Depth(g)	Float, etc.
[illegible]		5L215		80	900(h)	+1000(h)	2		D	
[illegible]		5L214		60	675	+1000	2		D	
[illegible]		5L213		25	40	+1000	2	11	D	
[illegible]		5L212		45	435	+1000	2	+20	D	
[illegible]		No sample								
[illegible]		5L206		55	900	+1000	2	+20	D	
[illegible]	2	5L209		30	950	+1000	2		D	Silver 0.3 ppm, spring below Gos "
[illegible]		5L210		25	900	+1000	2		D	M 99, Gr 1.
[illegible]	2	5L211		80	465	+1000	2	+20	D	M 50 Gos 50.
[illegible]		5L221		40	950	+1000	2		D	M 50. Gos 50.
[illegible]		5L223		30	30	800	2		D	
[illegible]		5L224		20	340(f)	+1000	3		D	
[illegible]		5L225		20	980	130	2	+20	D	M 100.
[illegible]	2	5L229		30	30	155	2	+10	D	
[illegible]	2	5L239		40	405	+1000	3	+20	D	S 50, Gr 50.
[illegible]	2	5L240		15	230(f)	55	6	6	D	
[illegible]	2	9C516	ND	87	1800	21000		+20	Old pit	Silver 1.8 ppm.
[illegible]		5L227		70	900	+1000	2	+20	D	
[illegible]	2	5L226		15	125(f)	95	2	5	D	
182		5L234		20	100	165	2	9	D	
[illegible]		5C308		25	200	+1000	1	+20		S 90, D 5, Gr 5.
[illegible]	3	8C354	(.1)(d)	10	50	190			C-3	S 50, Gr 50.
[illegible]	3	8C349	(e)	(e)	(e)	(e)				
[illegible]	3	8C347	(.02)	(10)(d)	30	20			D-2"	Fault zone in M
186	3	8C352	(.1)	10	(25)(d)	75			Dry creek	Gr 60, S 40, L grav.
187	3	8C350	(.04)	35	80	150			D 5'	S in sandy bn soil, wall of place[illegible]
188	3	8C351	(.2)	20	40	140			C 5'	S 69, Gr 30, Q 1.
189		5L244		10	20	110	2	5	C 2'-8'	S 98, M 2, Q 5, Gr 5.
190	2	5L243		20	10	80	2	8	C-2'-8'	S 75, M 2, Q 23.
191	2	5L246		20	15	90	2	3	C-2'-8'	S 10, M 5, G 2, Gr 78.
192	2	5L245		10	15	70	2	9	C-2'-8'	S 80, M 5, G 1, Q 4 Gr 10.
193	2	5L247		10	5	65	2	5	C 1'-2'	S 45. M 5, Q 50.
194	2	6L457		20	10	90	1	2	C-6'	S 15, M 20, D 27, Q 3, Gr 35.
195	2	6L458		15	15	80	2	2	Intermittent	S 45, G 3, D 1, Q 1, Gr 50.
196	2	6L459		20	5	85	2	1	C-4'	S 95, Q 5.
197	2	6L460		15	10	65	1	1	C-3'	S 10, D 2, Q 2, Gr 86.
198	2	6L461		20	10	80	2	1	C-3'	S 4, G 1, Q 2, Gos 1, Gr 92.
199	2	6L262		20	10	85	2	1	C-10'	S 83, Q 2, Gr 15.
200	2	6L263		25	15	95	2	1	C-10'	S 35, M 52, G 1, Q 2, Gr 10.
201	2	6L464		10	10	65	2	2	C 2'	
202	2	6L466		20	10	80	2	1	C-8'	S 63, M 25, Q 2, Gr 10
203	2	6L467		30	10	80	2	1	C-10'	S 69, M 25, D 1, Gr 5.
204	2	6L469		35	10	95	3	1	C-4'	S 95, Q 5.
205	2	6L470		30	10	75	2	1	C-8'	S 70, M 25, Q 3, Gr 2.
206	2	6L471		15	5	55	2	1	C-3'	S 76, M 20, G 2, Gr 2.
207	2	6L472		30	10	60	3	1	C 5'	S 98, Q 1, Gr 1.
208	2	6L473		35	15	85	2	1	C-7'	S 80, M 10, D 5, Q 3, Gr 2.
209	2	6C730		10	10	25	1		D-2"	D 100.
210	2	6L474		30	10	85	3	1	C-8'	S 92, D 5, Q 2, Gr 1
211	2	6L378		30	20	100	2	1	C-4'	S 86, M 14.
212	2	6L379		30	15	90	1	1	C-6'	S 74, Q 1, Gr 25.
213	2	6C619		25	15	100	2	2	C-4'	S 100.
214	2	6L382		20	15	70	2	3	C-2'	
215	3	8C337		30	(25)	80			C-4'	M 10, S 89, Q 1.
	2	6L506		20	15	90	2	1	C-4'	S 95, Q 5. Same location
216		8C343		10	209	6000				M, Sid, Goe, Gos along fault?
		5L248		10	5	30	1	3	D-2'	Gos.
217	2	6L383		25	20	100	2	1	C-4'	S 95, Q 5.
218	2	6L384		20	15	75	2	1	C-8'	S 99, Q 1.
219	2	6L385		30	15	105	4	1	C-4'	S 99, Q 1.

Map Number	Spectrographic Table	Field Number	Gold	Copper	Lead	Zinc	Molybdenum	Field Test (c)	Stream Width or Soil Depth (g)	Float etc.
220		9C550	0.50	25	20	90			C-3'	Silver 0.9 ppm, M 25, S 30, CS 30, D 15.
221	2	6L386		25	15	95	2	1	C-3'	S 98, Q 2.
222	2	6L387		20	15	85	1	1	C-8'	S 99, Q 1
223		5L242		85	10	10	2	2	C 8'-20'	S 85, Q 15.
224		5L241		45	20	120	4	5	C	S 60, M 40.
225		5L185		30	10	90	3	1	C-4'-8'	S 90, Q 5, Gr 5.
226	2	5L187		40	15	90	2	4	C-1' 2'	S 90, Gr 10.
227	3	8C557		20	(25) (d)	60			C-5'	M 20, S 74, Gr 5. Q boulders 1, L grav.
228	2	5L188		30	15	105	2	2	C-1'-2'	S 90, Gr 10.
229		5L190		50	25	125	2	4	C-2' 8'	S 50, M 40, Gr 8.
230	2	5L189		50	15	125	2	2	C	S 45, M 45, Q 2, Gr 8.
231	2	6L362		15	10	65				S 15, M 82, Q 1.
232	2	6L363		20	15	65	2	2	C-4'	S 20, M 19, D 60, Gos 1.
233	2	6L364		25	10	70	2	1	C-15'	M 94, G 2, Q 1, Gos 1, Gr 1.
234	2	6L365		30	15	65	1	1	C-5'	M 94, G 1, D 5.
235	3	8L363		15	(25)	50			C	M 35, S 19, S 45, Q 1.
236	3	8L364		15	(25)	50			C	M 5, S 90, Q 5.
237	3	8C546		20	40	90			Dry creek-2'	Sil S.
238	3	8L365		15	(25)	40			Dry creek	M 40, S 55, Q 5.
239	3	8L366		25	(25)	40			C	M S, along thrust(?), L grav.
240	3	8L367		10	(25)	90			Dry creek	M 100.
241	3	8L375		15	(25)	80			C	M 40, CS 40, Q 20.
242	2	6L366		40	20	75	1	1	C-25'	S 65, M 25, G 2, Q 8.
243A	3	8L376		45	70 (h)	280 (h)			D-2"	Area of glacial till S of G intrusive
243B	3	8L377		25	30	120			D-2"	Area of glacial till S of G intrusive
243C	3	8L378		50	60	230			D-2"	Area of glacial till S of G intrusive
243D	3	8L379		45	80	250			D-2"	Area of glacial till S of G intrusive
243E	3	8L380		40	50	190			D-2"	Area of glacial till S of G intrusive
243F	3	8L381		30	(25)	80			D-2"	Area of glacial till S of G intrusive
243G	3	8L382		55	70	260			D-2"	Area of glacial till S of G intrusive
243H	3	8L383		60	90	400			D-2"	Area of glacial till S of G intrusive
243I	3	8L384		50	60	240			D-2"	Area of glacial till S of G intrusive
243J	3	8L385		40	50	170			D-2"	Area of glacial till S of G intrusive
243K	3	8L386		35	45	190			D-2"	Area of glacial till S of G intrusive
243L	3	8L387		55	70	240			D-2"	Area of glacial till S of G intrusive
243M	3	8L388		45	60	230			D-2"	Area of glacial till S of G intrusive
243N	3	8L389		35	40	400			D-2"	Area of glacial till S of G intrusive
243O	3	8L390		30	50	190			D-2"	Area of glacial till S of G intrusive
243P	3	8L391		45	55	200			D-2" at crest	Samples taken across placer cut about 300' S of
243Q	3	8L392		50	70	230			D-2" 5' above floor	Oregon Creek and N of groups 243A thru 243O.
243R	3	8L393		25	40	120			D-2" floor	
243S	3	8L394		40	50	190			D-2" 6' above floor	
243T	3	8L395		55	60	240			D-2" 2' below crest	
244	2	6L367		20	10	85	2	1	C-6'	S 75, M 15, G 10.
244A	2	6C605		25	15	80	4		C-8'	S 30, M 70.
245	3	8L370		10	(25)	60				M 20, CS 60, S 10, Gr 7, Q 3.
	2	6L368		20	20	65	2	1	C-3'	S 88, M 10, G 2.
246	3	8L369		15	(25)	60			D-2"	M 19, S 30, Gr 50, Q 1.
247	3	8L368		20	(25)	60			C-3'	
248	3	8L371		25	40	100			C-10'	

Map Number	Spectrographic Table	Field Number	Gold	Copper	Lead	Zinc	Molybdenum	Field Test (c)	Stream Width or Soil Depth (g)	Float, etc.
249	3	8C424		25	(25)(d)	50			C-6"	Spring from silicified zone near sulfide ore float showing
250	2	6L369		40	20	130	2	1	C 3'	M 98, D 2.
251	2	6L370		25	15	145	3	2	C-6'	S 25 M 75.
252	3	8C410		20	30	140			C 1'	M 100.
253	3	8L372		15	(25)	70			C-6'	M 15, CS 40, S 40, Q 5.
254	3	8C428		15	(25)	60			C-4'	M, CS, G, (Q to 3' diameter)
255	3	8C543		30	(25)	80			D-2' Sil CS	CS, Sil.
256	3	8L374		15	(25)	60			Dry creek	
257	3	8L373		25	30	100			Dry creek	
258	3	8C431		15	(25)	30			C-2'	M 90, CS 10, D 1, M mullions
259	3	8C418		10	(25)	40			C 6" CS	CS 100
260		5L283		25	15	80	2		C-2'-8'	S 100.
261		5L284		25	45	145	2		D	
262		5L285		35	20	105			D	
263		5L286		35	20	105	2	4	D	
264		5L287		40	30	115	2	3	D	
265		5L288		20	25	115	2	4	D	
266		5L289		35	50	125	2	5	D	
267		5L237		45	35	295(h)	2	5	C-1' 2'	M 98, G 2.
268	2	5L238		25	15	120	2	2	D	
269		5L191		25	10	85	2	3	C-2' 8'	M 90, Gr 10.
270		5L192		20	10	45	1	2	C 2'-8'	S 10, M 88, G 2.
271	2	5L193		45	15	105	2	2	Dry	S 10, M 88, G 2.
272		9C506	ND	19	17	35			C-1'	Silver 1.0, M 60, CS 30, S 2, Q 3.
273	2	5L194		15	10	65	2	2	C 2'-8'	M 100.
274		5C347		15	5	65	2	15	C-2' 8'	
275		5C366		20	300(f)(h)	80	2	5	D	M 80, Gos 20
276		5C365		5	5	30	1	10	D	M 99.9, Gos 0.1.
277		5C358		20	10	70	2	6	C 1'-2'	S 90, M 10.
278		5L171		30	15	80	7	1	D	
279		5C258		5	5	5	1	0	D	M 90, Q 10.
280	2	5L172		15	5	55	12(h)	4	C-1'-2'	
281		5L173		15	250(f)	100	11	3	D	
282	2	5L174		10	5	50	7	6	C-1' 2'	
283	2	5L196		20	10	60	2	2	C-1'-2'	S 50, M 50.
284	2	5L197		30	20	135	2	2	C 2'-8'	S 10, M 80, G 10.
285	2	5L198		35	15	140	2	4	C-20'-60'	S 80, M 10, G 10.
286	2	6C644		15	15	85	1	2	C-6'	S 45, M 50, Q 5.
287	2	6L406		30	20	340	3	+20	C-4'	S 80, M 15, G 5.
288	2	6L408		30	20	310	2	18	C-15'	S 40, M 52, G 5, Q 3.
289	2	6L409		50	45	540	2	10	C-10'	S 49, M 30, G 20, Q 1.
290	2	6L410		20	40	3[illegible]0	2	15	C-2'	S 60, M 30, G 10.
291	2	6L411		75	425	+1000	5	+20	C-5'	S 43, G 50, Q 2, Gos 5.
292	2	6L412		75	15	125	4	4	C-6'	S 23, G 75, Q 2.
293	3	8L436		55	25	110			D-2"	Aurora Creek prospect soil traverse taken in ditch S 100.
294	3	8L437		50	(25)	170			D-3"	Aurora Creek prospect soil traverse S 100.
295	3	8L438		55	(25)	110			D-6"	Aurora Creek prospect soil traverse S 100.
296	3	8L439		45	25	95			C-6"	Aurora Creek prospect soil traverse S 100.
297	3	8L440		75	30	120			C-6"	Aurora Creek prospect soil traverse S 100.
298	3	8L441		50	30	100			C-6"	Aurora Creek prospect soil traverse S 90, Q 10.
299	3	8L442		40	(25)	90			C-6"	Aurora Creek prospect soil traverse S 95, Q 5, peaty
300	3	8L443		100	30	120			C-6"	Aurora Creek prospect soil traverse S 100.
301	3	8L444		90	25	50			C-6"	Aurora Creek prospect soil traverse S 100, peaty

Map Number	Spectrographic Table	Field Number	Gold	Copper	Lead	Zinc	Molybdenum	Field Test (c)	Stream Width or Soil Depth (g)	Float, etc.
302	3	8L445		140(h)	30	80			C-6"	Aurora Creek prospect soil traverse S 100.
303	3	8L446		120	30	75			C-6"	Aurora Creek prospect soil traverse S 100.
304	3	8L447		110	30	70			D-6"	Aurora Creek prospect soil traverse S 100.
305	3	8L448		50	(25)(d)	50			D-6"	Aurora Creek prospect soil traverse S 100 (ridge top)
306	3	8L449		80	40	250(h)			D-6"	Aurora Creek prospect soil traverse S 100.
307	3	8L450		95	60(h)	280			D-6"	Aurora Creek prospect soil traverse S 90, Q 10.
308	3	8L451		85	50	310			D-6"	Aurora Creek prospect soil traverse S 100.
309	3	8L452		60	40	280			D-6"	Aurora Creek prospect soil traverse S 100.
310	3	8L453		110	140	300			D-6"	Aurora Creek prospect soil traverse S 100
311	3	8L454		90	160	400			D-6"	Aurora Creek prospect soil traverse S 100.
312	3	8L455		85	230	500			D-6"	Aurora Creek prospect soil traverse S 100.
313	3	8L456		85	120	450			D-6"	Aurora Creek prospect soil traverse S 100.
314	3	8L457		95	80	550			D-6"	Aurora Creek prospect soil traverse peaty
315	3	8L458		110	60	140			D-6"	Aurora Creek prospect soil traverse S 100 blueberries
316	3	8L459		70	30	80			D-6"	Aurora Creek prospect soil traverse S 50, rusty S 50.
317	3	8L460		95	(25)	80			D-6"	Aurora Creek prospect soil traverse S 40, rusty S 60.
318	3	8L461		75	30	300			D-6"	Aurora Creek prospect soil traverse S 100.
319		6L422		20	25	290	3	20	Seep 3"	
320	2	6L421		55	35	410	3	15	Seep 6"	
321	3	8L462		55	(25)	250			D-4"	S 100 large Q boulders
322	3	8L463		95	30	180			D-4"	S 100, frost boil
323	3	8L464		110	30	75			D-4"	S 100, frost boil
324	3	8L465		65	450	300			D-4"	S 100, swampy
325	3	8L466		130	30	80			D-4"	S 100. peaty
326	3	8L467		160	40	110			D-4"	S 100.
327	3	8L468		80	(25)	75			D-4"	S 100.
328	3	8L469		95	30	60			D-4"	S 100.
329	3	8L470		160	30	50			D-4"	S 100.
330	2	6L435		40	220	600	2	+20	D-10"	
331	2	6L434		40	210	790	2	+20	D-8"	
332	2	6L433		45	200	780	2	20+	D-8"	
333	2	6L432		40	130	1000	1	+5	D-10"	
334	2	6L431		80	200	1900	5	+20	D-10"	
335	2	6L430		130	1000	2300	3	20+	D-10'	
336	2	6L428		65	50	540	3	10	D-8"	
337	2	6L427		70	25	105	2	3	D-2"	
338	2	6C676		35	180	1500	3	+20	D-6"	
339	2	6C677		45	145	1000	4	+20	Seep	
340		6C679			3000	34000			Dolomite-quartzite sulfide float	
341	2	6C680		65	370	860	3	15	Seep 3"	
342	2	6L450		45	60	620	1	10	Dry	S 83, M 5, D 10, Gos 1.
343	2	6L371		25	30	250	2	10	C-4'	S 10, M 90.
344	2	6L451		20	20	95	1	1	Dry	S 68, M 40, Q 1.
345	2	6L452		25	15	60	1	2	Dry	S 20, M 59, G 1, D 20.
346	2	6L404		40	20	150	4	1	C-6'	S 93, G 5, Q 2.
347	2	6C667		45	20	140	5	2	C-6'	S 94, G 5, Q 1.
348	2	6L405		25	15	80	2	1	C-40'	S 89, G 1, Q 10.
349	2	6L403		30	20	80	1	3	C 5'	S 97, Q 2.
350	2	6L402		30	15	75	1	1	C-7'	S 94, M 1, Q 5.
351	2	5L179		20	5	75	4	4	C-1'-2'	Gr 100.
352	2	5L178		15	5	65	3	3	C-2' 8'	Gr 100.

Map Number	Spectrographic Table	Field Number	Gold	Copper	Lead	Zinc	Molybdenum	Field Test (c)	Stream Width or Soil Depth (g)	Float, etc.
353	2	5L177		20	10	105	7	5	C-1'-2'	Gr 100.
354	2	6C649		30	15	85	2	4	C-10'	S 95, M 1, D 1, Q 3.
355	2	6C657		40	20	100	3	2	C-6'	S 98, Q 2.
356	2	6L388		30	15	80	2	3	C-6'	S 99, Q 1.
357	2	6L389		40	35	115	3	1	C-10'	S 98, Q 2.
358	2	6L392		40	45	100	3	1	C-8'	S 99, Q 1.
359	2	6C916		45	25	115	2	1	Dry	
360	2	6C918		75	35	205	6	4	C-4'	
361	2	6L579		30	25	100	5	1	C-4'	S 95, Q 5.
362	2	6L578		40	25	105	5	1	C-4'	S 98, Q 2.
363	2	6L576		55	40	125	6	1	C-5'	S 99, Q 1.
364	2	6L574		40	30	120	4	1	C-7'	S 99, Q 1.
365	2	6L570		40	30	110	5	1	C-5'	S 99, Q 1.
366	2	6L569		40	25	105	3	1	C-6'	S 99, Q 1.
367	2	6L563		35	15	70	1	1	C-5'	S 98, Q 2.
368	2	6L562		60	20	120	1	1	C-6'	S 97, Q 3.
369	2	6L561		40	30	115	2	1	C-6'	S 97, G 2, Q 1.
370	2	6L559		45	25	120	3	2	C-12'	S 99, Q 1.
371	2	6L558		50	80 (h)	430 (h)	5	4	C-4'	S 98, Q 2.
372	2	6L557		45	25	125	4	1	C-4'	S 99, Q 1.
373	2	6L556		60	25	150	6	1	C-2'	S 90, Q 10.
374	2	6L555		40	30	115	3	1	C-8'	S 91, M 5, Q 2.
375		6L548		65	20	140	3	1	C-3'	S 98, Q 2.
376	2	6L553		35	15	100	3	3	C-12'	S 85, M 13, Q 2.
377	2	6C889		60	25	130	3	1	C-2'	S 90, M 10.
378		6L550		85	25	130	5	1	Dry	S 75, M 25.
379	2	5L256		35	115	675	2	3	C-20'-60'	S 89, G 1, Q 5.
380	2	5L255		65	15	135	4	3	C-2'-8'	
381	2	5L257		30	10	115	3	4	Dry 1'-2'	
382	2	6C709		40	20	120	7		C-2'	S 70, M 25, Q 5.
383		5L254		30	15	105	3	0	C-1'-2'	S 90, M 10.
384	2	5L253		15	10	65	2	0	C-2'-8'	S 85, M 10, Q 5.
385	2	6C623		30	10	110	2	2	C-5'	M 100.
386	2	5L251		25	15	120	3	2	C-1'-2'	S 100.
387	2	5L250		35	15	90	2	0	C-2'-8'	S 100.
388	2	5L249		35	20	120	2	2	C-2'-8'	S 100.
389	2	6L373		15	15	90	3	1	C-10'	S 93, M 7.
390	2	6L372		30	20	145	2	2	C-2'	S 94, M 5, Q 1.
391	2	6L375		25	20	85	1	1	C-5'	
392	2	6L374		25	20	100	3	2	C-4'	
393	2	6L376		20	20	70	1	1	C-3'	S 90, M 10.
394	2	6L480		30	15	95	2	1	C-3'	S 99, Q 1.
395	2	6L481		25	15	100	2	1	C-3'	S 95, D 5.
396	2	6L483		20	15	80	1	3	C-1'	

(a) - Sample locations on figure 1.
(b) - Total metal contents in parts per million, analyzed by colorimetric and atomic absorption methods by the Rocky Mountain Geochemical Laboratories, U. S. Geological Survey, and the Alaska Division of Mines and Geology.
(c) - Milliliters of dithizone, cold extractable heavy metals test of Hawkes (1963).
(d) - Metal content less than value in brackets.
(e) - Not analyzed.
(f) - Possible interference, bismuth(?), high iron content.
(g) - C-2' = stream sediment sample taken from a stream two feet wide. D-6" = soil sample taken at a depth of six inches below surface of soil.
(h) - Underlined values are anomalous.

Bl - black
Bn - brown
BR - bedrock
Cc - calcite
Congl - conglomerate
CS - calc-schist, sericitic marble
D - dolomite
G - greenstone
Goe - goethite
Gos - gossan
Gr - granite to diorite
L grav - limonite coated gravel
LM - limonitized marble
M - marble
Org - high organic content in sample
PP, PT - prospect pit, trench
ppm - parts per million
Q - vein quartz
QT - quartzite
S - schist
Sil - silicified
Sqv - schist with thin deformed quartz layers
Tr - trench
Yl - yellow

APPENDIX III

Emission Spectrographic Analyses of Geochemical Stream Sediment, Soil, and Rock Samples from the Sinuk Area (analyzed by MIRL) [a]

Map Number	Sample Number	Copper	Lead	Zinc	Molybdenum	Silver	Cobalt	Chromium	Nickel	Manganese	Titanium	Iron (%)	Magnesium (%)	Calcium (%)	Barium
40	65L160	10	20	100	10	ND	20	200	50	1000	*1.0	2	1	1	500
41	65L159	10	20	100	5	ND	20	100	20	1000	*1.0	2	1	0.5	500
43	65L158	10	20	100	5	ND	20	100	10	5000	5000	2	0.2	1	500
44	65L157	10	10	100	5	ND	10	200	20	1000	2000	5	0.2	0.5	200
64	65L151	20	20	100	10	ND	10	500	200	500	5000	2	0.5	0.5	500
68	5L183	20	20	100	10	ND	20	200	50	1000	*1.0	5	1	2	500
71	65L182	20	20	200	5	ND	20	200	50	1000	*1.0	5	1	2	500
74	65L184	10	10	100	5	ND	20	200	20	1000	5000	5	0.5	0.5	500
75	65L181	10	20	100	ND	ND	20	100	20	1000	5000	2	0.5	5	500
76	65L180	20	50	200	5	ND	20	200	50	1000	*1.0	5	1	5	500
79	65L266	10	ND	100	ND	ND	10	100	20	2000	2000	2	0.2	0.5	200
80	65L265	10	10	200	5	ND	10	10	10	1000	200	5	0.05	0.2	20
82	65L263	50	20	100	10	ND	50	500	50	1000	*1.0	10	1	0.1	500
83	65L262	20	10	100	5	ND	10	100	50	500	5000	5	0.2	0.5	500
84	65L261	2	ND	100	ND	ND	ND	20	10	200	500	0.2	0.05	0.1	50
86	65L281	50	50	200	20	ND	50	500	100	1000	*1.0	10	0.5	0.2	1000
88	65L271	20	50	2000	10	ND	20	200	50	500	5000	5	0.2	0.2	1000
98	65L155	50	100	1000	20	ND	50	200	50	5000	5000	5	0.5	0.2	1000
99	65L156	10	20	100	20	ND	20	500	50	500	*1.0	5	1	1	500
101	65L154	20	20	100	20	ND	20	500	100	2000	5000	5	1	1	1000
103	66L510	20	20	100	5	ND	20	200	20	2000	*1.0	5	0.5	1	500
104	9C518	10	10	100	ND	ND	10	50	10	1000	5000	2	0.5	1	500
104A	9C517	20	50	100	5	ND	20	200	20	2000	5000	5	1	10	500
105	66L511	20	20	100	20	ND	50	500	100	2000	*1.0	5	1	0.5	500
106	66L512	20	20	100	10	ND	20	500	50	2000	*1.0	5	1	0.5	500
107	66L513	20	20	100	10	ND	20	200	50	1000	*1.0	5	1	0.5	500
131	66L516	10	10	500	10	ND	20	100	20	*1.0	1000	20	0.5	5	200
135	66L515	20	10	500	20	ND	20	100	20	*1.0	1000	20	2	5	500
142	66L521	10	10	100	5	ND	20	100	20	1000	5000	5	0.2	1	500
146	66L514	10	10	100	ND	ND	10	100	10	2000	5000	5	0.2	1	500
150	65L231	10	50	100	ND	ND	10	100	20	1000	5000	2	0.5	5	500
157	65L228	50	500	5000	5	ND	20	200	50	1000	5000	5	0.5	0.5	500
158	65L220	100	500	NA	ND	2	10	100	20	1000	5000	2	0.2	2	1000
169	65L209	20	2000	2000	10	2	10	500	20	200	5000	2	1	0.5	1000
171	65L211	50	200	*1.0	ND	ND	10	100	20	200	5000	5	0.1	1	500
176	65L229	20	20	100	10	ND	20	200	50	500	*1.0	5	0.5	0.5	500
177	65L239	20	200	1000	5	ND	20	200	50	2000	5000	5	0.5	1	1000
178	65L240	5	10	200	20	ND	50	20	10	2000	500	20	0.05	0.5	500
181	65L226	5	10	100	10	ND	ND	10	5	200	200	5	ND	0.1	20
190	65L243	20	20	100	10	ND	20	500	50	1000	5000	5	1	1	500
191	65L246	20	20	100	5	ND	20	200	20	1000	*1.0	5	2	2	500
192	65L245	10	20	100	20	ND	20	500	50	500	*1.0	5	2	0.5	200
193	65L247	10	20	100	10	ND	20	500	20	1000	*1.0	5	1	0.5	500
194	66L457	20	20	100	5	ND	20	200	20	1000	*1.0	5	1	1	500
195	66L458	20	20	100	20	ND	50	500	50	2000	*1.0	10	2	2	500
196	66L459	20	20	100	10	ND	50	200	50	1000	*1.0	5	2	0.5	500
197	66L460	10	20	100	20	ND	20	500	50	1000	*1.0	5	1	1	500
198	66L461	10	20	100	10	ND	20	500	50	1000	*1.0	5	2	0.5	500
199	66L462	20	20	100	20	ND	20	500	100	1000	*1.0	5	2	0.5	500
200	66L463	50	20	100	10	ND	20	500	50	2000	*1.0	5	2	2	500
201	66L464	10	10	100	10	ND	20	200	20	500	*1.0	2	1	1	500
202	66L466	20	20	100	10	ND	20	200	50	1000	*1.0	5	1	1	500
203	66L467	20	20	100	20	ND	20	500	50	1000	*1.0	5	1	0.5	500
204	66L469	20	20	100	10	ND	20	200	50	1000	*1.0	5	2	0.5	200
205	66L470	20	10	100	10	ND	20	500	50	1000	5000	5	1	0.5	500
206	66L471	10	10	100	5	ND	20	200	20	1000	5000	5	1	0.5	200
207	66L472	20	20	100	10	ND	20	500	50	1000	5000	5	1	1	500
208	66L473	20	20	100	10	ND	20	200	20	1000	*1.0	5	1	0.5	500
209	66C730	10	10	100	ND	ND	ND	100	10	2000	500	5	10	10	20
210	66L474	20	20	100	10	ND	20	500	50	1000	*1.0	5	2	0.5	500
211	66L378	50	20	200	10	ND	50	500	100	1000	*1.0	5	2	0.2	500
212	66L379	20	20	200	10	ND	50	200	50	1000	*1.0	5	2	0.2	500
213	66C619	20	20	200	10	ND	50	500	100	1000	*1.0	10	2	0.2	500
214	66L382	20	20	100	10	ND	50	500	50	500	*1.0	5	1	0.2	500
215	66L506	20	10	100	5	ND	20	200	50	1000	*1.0	5	1	0.2	500
217	66L383	20	20	100	10	ND	20	500	50	1000	*1.0	5	1	0.5	500

Strontium	Boron	Beryllium	Tin	Tungsten	Zirconium	Lanthanum	Niobium	Scandium	Yttrium	Vanadium	Arsenic	Antimony	Bismuth	Cadmium	Gold	Map Number
100	50	2	ND	ND	500	50	50	20	50	100	ND	50	ND	ND	ND	40
100	50	2	ND	ND	200	50	20	10	20	100	ND	ND	ND	ND	ND	41
100	50	2	ND	ND	200	50	20	20	50	100	ND	ND	ND	ND	ND	43
100	20	1	ND	ND	100	50	20	10	20	50	ND	ND	ND	ND	ND	44
50	50	1	ND	ND	200	50	10	10	50	100	ND	50	ND	ND	ND	64
200	50	2	ND	ND	200	50	20	20	50	100	ND	ND	NA	ND	ND	68
200	50	2	ND	ND	200	50	20	20	20	100	ND	ND	ND	ND	ND	71
50	50	2	ND	ND	200	50	20	10	20	100	ND	ND	ND	ND	ND	74
200	50	1	ND	ND	100	20	20	10	20	100	ND	ND	ND	ND	ND	75
200	50	2	10	ND	200	50	50	20	50	100	ND	50	ND	ND	ND	76
50	50	2	ND	ND	100	50	10	20	20	100	ND	ND	ND	ND	ND	79
50	20	2	10	ND	50	50	10	10	50	50	ND	ND	ND	ND	ND	80
100	100	1	10	ND	200	20	50	50	50	200	ND	50	ND	ND	ND	82
100	20	1	ND	ND	200	50	20	20	50	100	ND	ND	ND	ND	ND	83
50	20	2	ND	ND	50	50	ND	10	10	20	ND	ND	ND	ND	ND	84
50	100	1	10	ND	200	50	20	50	50	200	ND	ND	ND	ND	ND	86
50	100	<u>5</u>	ND	ND	200	50	20	20	20	200	ND	ND	ND	ND	NA	88
50	50	2	ND	ND	200	20	20	20	20	200	ND	50	ND	ND	ND	98
100	20	2	ND	ND	200	50	20	20	50	100	ND	100	ND	ND	ND	99
100	100	2	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	101
100	50	1	ND	ND	200	100	20	20	50	100	ND	ND	ND	ND	ND	103
100	50	1	ND	ND	200	50	10	10	20	100	ND	ND	ND	ND	ND	104
<u>500</u>	50	1	ND	ND	200	50	20	20	50	100	ND	ND	ND	ND	ND	104A
100	50	2	ND	ND	200	100	20	20	50	100	ND	100	ND	ND	ND	105
100	50	1	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	106
100	50	2	ND	ND	200	100	20	20	20	100	ND	50	ND	ND	ND	107
<u>500</u>	20	1	ND	ND	50	20	20	10	20	50	ND	ND	ND	ND	ND	131
200	20	1	ND	ND	50	20	20	10	10	50	ND	ND	ND	ND	ND	135
100	50	2	ND	ND	200	50	20	20	50	100	ND	ND	ND	ND	ND	142
100	20	2	ND	ND	200	50	10	20	20	100	ND	ND	ND	ND	ND	146
<u>500</u>	50	2	ND	ND	200	50	20	10	20	100	ND	ND	ND	ND	ND	150
100	50	2	ND	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	157
100	50	<u>5</u>	ND	ND	200	50	20	10	50	100	ND	ND	ND	ND	ND	158
50	100	<u>5</u>	10	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	169
50	50	<u>5</u>	ND	ND	200	50	20	10	20	100	ND	ND	ND	ND	ND	171
100	50	2	ND	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	176
50	50	<u>2</u>	ND	ND	200	20	20	20	20	100	ND	ND	ND	ND	ND	177
50	50	1	ND	ND	20	20	20	ND	10	50	ND	ND	ND	ND	ND	178
100	20	1	ND	ND	ND	50	20	ND	10	20	ND	ND	ND	ND	ND	181
100	50	1	ND	ND	200	50	20	10	20	100	ND	50	ND	ND	ND	190
100	100	1	ND	ND	200	50	20	20	20	100	ND	ND	ND	ND	ND	191
100	50	ND	ND	ND	200	50	20	10	20	100	ND	50	ND	ND	ND	192
100	100	1	10	ND	<u>500</u>	50	20	20	50	100	ND	50	ND	ND	ND	193
100	50	1	10	ND	200	50	20	20	20	100	ND	ND	ND	ND	ND	194
200	50	1	10	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	195
100	50	2	ND	ND	100	50	20	20	20	100	ND	ND	ND	ND	ND	196
100	50	2	10	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	197
100	50	2	10	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	198
100	50	1	10	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	199
100	50	2	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	200
200	50	2	ND	ND	200	50	20	20	20	100	ND	ND	ND	<u>100</u>	ND	201
100	100	2	10	ND	200	100	50	20	100	100	ND	ND	ND	ND	ND	202
100	50	2	ND	ND	200	50	20	20	20	100	ND	ND	ND	ND	ND	203
100	50	1	10	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	204
100	100	1	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	205
100	50	1	ND	ND	200	50	20	20	20	100	ND	ND	ND	ND	ND	206
100	100	1	ND	ND	200	50	20	20	20	100	ND	ND	ND	ND	ND	207
100	50	1	ND	ND	200	50	20	20	20	100	ND	ND	ND	ND	ND	208
50	ND	1	ND	ND	50	ND	10	ND	10	20	ND	ND	ND	ND	ND	209
100	50	1	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	210
100	50	1	ND	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	211
100	50	2	10	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	212
100	50	1	10	ND	200	50	50	20	20	100	ND	50	ND	ND	ND	213
100	50	2	10	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	214
100	50	2	ND	ND	200	50	20	20	50	100	ND	ND	ND	ND	ND	215
100	50	2	ND	ND	200	50	20	20	50	100	ND	ND	ND	ND	ND	217

APPENDIX III - continued

Map Number	Sample Number	Copper	Lead	Zinc	Molybdenum	Silver	Cobalt	Chromium	Nickel	Manganese	Titanium	Iron (%)	Magnesium (%)	Calcium (%)	Barium
218	66L384	20	20	100	10	ND	20	500	100	1000	*1.0	5	1	0.5	500
219	66L385	50	20	100	10	ND	50	200	50	1000	*1.0	5	2	0.5	500
221	66L386	20	10	100	10	ND	20	500	50	1000	5000	5	1	0.2	500
222	66L387	20	20	100	10	ND	20	200	50	1000	5000	5	1	0.2	500
226	65L187	10	10	100	5	ND	10	200	50	1000	5000	2	0.5	0.5	200
228	65L188	10	ND	100	5	ND	10	200	20	1000	2000	2	1	1	200
230	65L189	50	20	100	10	ND	50	500	50	1000	*1.0	10	2	1	1000
231	66L362	20	20	100	5	ND	20	200	20	2000	*1.0	5	2	5	500
232	66L363	20	20	100	10	ND	20	500	20	2000	5000	5	2	2	500
233	66L364	20	10	100	5	ND	20	200	20	1000	*1.0	5	1	5	200
234	66L365	20	20	100	20	ND	50	500	20	1000	*1.0	10	1	10	500
242	66L366	50	20	200	10	ND	50	100	50	1000	*1.0	10	2	5	500
244	66L367	20	20	200	10	ND	50	100	20	1000	*1.0	10	2	2	500
244A	66C603	20	20	100	10	ND	50	200	100	1000	*1.0	10	2	0.5	500
245	66L368	20	20	100	20	ND	20	500	100	1000	*1.0	5	2	10	500
250	66L369	50	10	200	10	ND	50	200	20	2000	*1.0	10	2	5	500
251	66L370	20	20	200	10	ND	20	200	20	1000	*1.0	5	5	10	500
268	65L238	20	10	100	ND	ND	10	100	20	500	5000	2	0.2	1	500
269	5L191	20	20	100	10	ND	20	500	50	1000	*1.0	5	0.5	1	500
270	5L192	10	20	100	20	ND	20	1000	50	1000	*1.0	5	1	5	500
271	65L193	20	10	100	10	ND	20	500	50	2000	5000	2	1	2	500
273	65L194	10	20	100	20	ND	20	500	50	2000	*1.0	5	1	5	500
280	65L172	10	20	100	5	ND	10	500	20	1000	*1.0	2	0.5	1	500
282	65L174	20	20	100	20	ND	20	500	100	500	*1.0	2	0.5	1	500
283	65L196	10	20	100	10	ND	20	500	50	1000	5000	5	2	2	500
284	65L197	50	20	100	10	ND	50	500	50	1000	*1.0	5	5	10	500
285	65L198	50	20	100	20	ND	50	1000	100	1000	*1.0	5	2	0.2	500
286	66L644	20	20	100	5	ND	20	200	50	2000	5000	5	2	5	500
287	66L406	50	20	500	10	ND	20	500	50	2000	*1.0	5	2	5	500
288	66L408	20	20	1000	5	ND	20	200	50	2000	*1.0	5	2	5	1000
289	66L409	20	50	1000	10	ND	50	500	100	2000	*1.0	5	2	2	1000
290	66L410	20	50	500	10	ND	20	500	50	1000	*1.0	5	1	1	500
291	66L411	100	500	2000	20	1	50	500	100	2000	*1.0	5	2	0.5	1000
292	66L412	100	20	100	20	ND	50	500	100	5000	*1.0	10	5	0.5	500
320	66L421	50	20	500	20	ND	50	500	100	5000	*1.0	10	2	0.1	500
330	66L435	50	200	1000	10	ND	20	500	50	200	*1.0	5	1	0.1	2000
331	66L434	50	500	1000	10	ND	20	1000	100	500	*1.0	10	1	0.2	2000
332	66L433	50	500	1000	10	ND	20	500	50	200	*1.0	5	1	0.1	1000
333	66L432	50	200	1000	10	ND	20	500	50	500	*1.0	10	1	0.1	2000
334	66L431	50	100	2000	5	ND	20	200	50	500	5000	5	0.5	0.2	1000
335	66L430	200	2000	2000	20	5	50	500	50	500	*1.0	10	1	0.1	*1.0
336	66L428	50	50	1000	10	ND	20	200	50	2000	*1.0	5	1	0.2	1000
337	66L427	100	20	100	20	ND	50	500	100	2000	*1.0	10	2	0.1	1000
338	66C676	50	200	1000	10	1	20	500	50	500	*1.0	10	1	0.1	5000
339	66C677	50	200	1000	10	ND	20	500	50	500	*1.0	5	2	0.1	2000
341	66C680	100	500	1000	10	1	50	1000	100	1000	*1.0	10	2	0.05	5000
342	66L450	20	50	1000	10	ND	20	200	50	1000	*1.0	5	1	0.2	1000
343	66L371	20	50	200	20	ND	20	500	50	1000	5000	5	5	10	500
344	66L451	20	20	100	10	ND	20	200	20	500	*1.0	5	1	0.2	500
345	66L452	20	20	100	10	ND	20	200	50	1000	*1.0	5	1	5	500
346	66L404	50	20	200	20	ND	50	500	100	2000	*1.0	5	2	0.1	500
347	66C667	50	20	200	20	ND	50	500	100	1000	*1.0	10	2	0.2	500
348	66L405	20	20	100	10	ND	20	500	50	1000	*1.0	5	2	0.1	500
349	66L403	20	20	100	10	ND	20	500	50	1000	*1.0	5	2	0.1	500
350	66L402	20	20	100	20	ND	20	500	100	500	*1.0	5	2	0.1	500
351	65L179	20	20	100	10	ND	20	500	100	500	*1.0	5	1	0.5	500
352	65L178	10	20	100	20	ND	20	500	100	1000	*1.0	5	1	0.5	500
353	65L177	20	50	100	10	ND	20	200	50	1000	*1.0	5	1	1	500
354	66C649	20	20	100	10	ND	20	500	100	500	*1.0	5	2	0.2	500
355	66C657	50	20	200	20	ND	50	500	100	1000	*1.0	10	2	0.2	500
356	66L388	20	20	100	5	ND	20	200	50	500	*1.0	5	2	0.1	500
357	66L389	20	50	200	10	ND	20	500	50	1000	*1.0	5	2	0.1	500
358	66L392	50	50	100	20	ND	20	500	100	1000	*1.0	5	2	0.1	500
359	66C916	50	20	100	10	ND	50	200	50	1000	5000	5	0.5	0.1	1000
360	66C918	50	20	100	5	ND	50	200	50	1000	2000	5	0.2	0.2	500
361	66L579	20	20	200	20	ND	50	500	50	1000	*1.0	10	2	0.2	500

Strontium	Boron	Beryllium	Tin	Tungsten	Zirconium	Lanthanum	Niobium	Scandium	Yttrium	Vanadium	Arsenic	Antimony	Bismuth	Cadmium	Gold	Map Number
100	50	2	ND	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	218
100	50	2	ND	ND	200	20	20	20	20	200	ND	50	ND	ND	ND	219
100	50	1	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	221
100	50	1	ND	ND	200	20	20	20	20	100	ND	ND	ND	ND	ND	222
50	50	1	ND	ND	100	50	20	10	50	100	ND	50	ND	ND	ND	226
50	50	2	ND	ND	200	50	20	10	20	100	ND	ND	ND	ND	ND	228
100	50	5	10	ND	500	20	50	20	50	200	ND	50	ND	ND	ND	230
100	100	2	ND	ND	500	50	20	20	50	100	ND	ND	ND	ND	ND	231
50	100	1	ND	ND	200	50	20	20	50	100	ND	ND	ND	ND	ND	232
200	100	1	ND	ND	200	50	20	20	20	100	ND	ND	ND	ND	ND	233
200	100	1	10	ND	200	50	50	20	50	100	ND	100	ND	ND	ND	234
200	50	1	10	ND	200	50	50	20	50	100	ND	50	ND	ND	ND	242
200	50	1	10	ND	200	50	50	20	50	100	500	ND	ND	ND	ND	244
100	50	2	10	ND	500	50	50	20	50	100	ND	200	ND	ND	ND	244A
200	50	1	10	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	245
200	ND	2	10	ND	500	20	50	50	100	200	ND	ND	ND	ND	ND	250
200	50	1	10	ND	200	20	20	20	50	100	ND	50	ND	ND	ND	251
100	50	2	ND	ND	200	50	20	20	20	100	ND	ND	ND	ND	ND	268
100	50	1	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	269
100	50	1	ND	ND	200	50	50	20	50	100	ND	100	ND	ND	ND	270
100	20	1	ND	ND	200	50	20	10	20	100	ND	50	ND	ND	ND	271
200	50	1	ND	ND	200	50	20	20	20	100	ND	100	ND	ND	ND	273
100	50	2	ND	ND	200	50	20	10	50	100	ND	ND	ND	ND	ND	280
100	50	2	ND	ND	200	50	50	10	50	100	ND	100	ND	ND	ND	282
200	50	2	ND	ND	500	50	20	20	20	100	ND	ND	ND	ND	ND	283
500	50	2	10	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	284
100	50	2	ND	ND	200	20	20	20	50	200	ND	100	ND	ND	ND	285
100	50	2	ND	ND	100	50	20	10	20	100	ND	ND	ND	ND	ND	286
200	50	2	ND	ND	200	100	20	20	50	100	ND	50	ND	ND	ND	287
200	100	1	10	ND	200	100	20	20	50	100	ND	50	ND	ND	ND	288
200	50	1	10	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	289
100	50	2	ND	ND	200	50	20	20	50	100	ND	100	ND	ND	ND	290
100	100	2	10	ND	200	50	20	20	50	100	ND	100	ND	ND	ND	291
100	50	1	10	ND	200	100	20	50	50	200	ND	100	ND	ND	ND	292
100	100	2	10	ND	200	50	20	50	50	200	ND	50	ND	ND	ND	320
100	50	2	10	ND	200	100	20	20	50	100	ND	100	ND	ND	ND	330
100	100	2	ND	ND	500	50	20	20	50	200	ND	50	ND	ND	ND	331
50	50	2	10	ND	200	100	20	20	50	100	ND	100	ND	ND	ND	332
50	100	2	10	ND	200	100	20	20	50	100	ND	100	ND	ND	ND	333
50	50	1	ND	ND	200	50	10	20	20	100	ND	ND	ND	ND	ND	334
100	100	5	10	ND	500	100	20	20	50	100	ND	100	ND	ND	ND	335
100	50	2	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	336
100	100	2	10	ND	200	50	20	50	50	200	ND	50	ND	ND	ND	337
100	100	2	10	ND	500	50	50	50	50	200	ND	50	NA	ND	ND	338
100	100	2	10	ND	200	50	50	20	50	200	ND	50	ND	ND	ND	339
100	100	2	10	ND	200	50	50	50	50	200	ND	50	ND	ND	ND	341
50	50	2	ND	ND	200	50	20	20	50	100	ND	ND	ND	ND	ND	342
200	50	1	10	ND	100	20	20	10	20	100	ND	50	ND	ND	ND	343
100	100	2	10	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	344
200	50	2	10	ND	200	100	20	20	50	100	ND	ND	ND	ND	ND	345
100	50	2	10	ND	200	50	20	20	50	100	ND	100	ND	ND	ND	346
100	50	2	10	ND	200	50	50	20	50	200	ND	100	ND	ND	ND	347
100	50	2	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	348
100	50	2	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	349
100	50	2	ND	ND	200	50	20	20	20	100	ND	100	ND	ND	ND	350
100	50	2	ND	ND	200	50	50	20	20	100	ND	100	ND	ND	ND	351
100	100	2	ND	ND	200	100	50	20	50	100	ND	100	ND	ND	ND	352
100	100	2	10	ND	200	50	50	20	50	100	ND	50	ND	ND	ND	353
100	50	1	10	ND	200	50	50	20	20	100	ND	50	ND	ND	ND	354
100	50	2	10	ND	200	50	50	20	50	100	ND	50	ND	ND	ND	355
100	50	2	ND	ND	200	50	20	20	50	100	ND	ND	ND	ND	ND	356
100	50	2	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	357
100	100	2	ND	ND	200	50	20	20	50	100	500	100	ND	ND	ND	358
100	200	2	ND	ND	200	50	20	20	20	100	2000	500	ND	ND	ND	359
100	200	2	ND	ND	100	50	20	20	20	100	1000	200	ND	ND	ND	360
100	50	2	10	ND	200	50	20	20	50	100	500	200	ND	ND	ND	361

Map Number	Sample Number	Copper	Lead	Zinc	Molybdenum	Silver	Cobalt	Chromium	Nickel	Manganese	Titanium	Iron (%)	Magnesium (%)	Calcium (%)	Barium
362	66L578	50	20	200	10	ND	50	500	50	1000	*1.0	10	2	0.1	500
363	66L576	50	20	200	10	ND	50	500	100	2000	*1.0	10	2	0.1	500
364	66L574	50	20	200	20	ND	50	500	100	1000	*1.0	10	2	0.2	500
365	66L570	20	20	200	10	ND	50	500	50	1000	*1.0	10	2	0.2	500
366	66L569	50	20	200	10	ND	50	500	100	1000	*1.0	10	2	0.2	500
367	66L563	20	20	100	10	ND	20	500	50	1000	*1.0	5	2	0.2	500
368	66L562	50	20	100	20	ND	50	500	100	1000	*1.0	10	2	0.2	500
369	66L561	20	20	100	20	ND	50	500	50	1000	*1.0	10	2	0.1	500
370	66L559	20	20	100	20	ND	50	500	100	1000	*1.0	10	2	0.2	500
371	66L558	100	100	500	20	ND	50	500	100	2000	*1.0	10	2	0.2	1000
372	66L557	50	20	100	10	ND	50	500	100	1000	*1.0	5	2	0.2	500
373	66L556	100	20	200	20	ND	50	500	100	2000	*1.0	10	2	0.2	1000
374	66L555	50	20	100	10	ND	50	500	50	1000	5000	5	2	0.2	1000
375	66L548	100	20	200	20	ND	50	500	100	1000	*1.0	10	2	0.1	500
376	66L553	50	10	100	5	ND	20	500	100	1000	5000	10	2	0.2	500
377	66C889	100	20	200	20	ND	100	1000	200	2000	*1.0	10	5	1	500
378	66L550	50	20	100	10	ND	50	500	100	2000	*1.0	5	2	0.5	500
379	65L256	50	100	1000	10	ND	50	200	50	2000	*1.0	5	1	1	1000
380	65L255	100	20	100	20	ND	50	500	100	2000	*1.0	5	2	0.2	500
381	65L257	50	20	100	20	ND	50	500	100	100	*1.0	5	2	1	1000
382	66C709	50	50	100	20	ND	20	500	100	500	*1.0	5	2	0.5	1000
384	65L253	10	10	100	10	ND	20	200	20	500	*1.0	2	1	1	500
385	66C623	50	20	200	10	ND	50	500	100	1000	*1.0	10	2	0.2	500
386	65L251	20	20	100	10	ND	50	200	50	2000	*1.0	5	2	0.2	500
387	65L250	50	20	100	20	ND	20	500	50	1000	*1.0	5	2	0.1	500
388	65L249	50	20	100	20	ND	50	500	50	1000	*1.0	5	2	0.2	500
389	66L373	20	20	100	10	ND	20	500	50	1000	*1.0	5	2	0.5	500
390	66L372	20	20	100	10	ND	20	200	50	1000	*1.0	5	1	0.5	500
391	66L375	20	20	100	5	ND	20	200	50	1000	*1.0	2	1	0.5	500
392	66L374	20	20	100	10	ND	20	200	50	500	*1.0	5	1	0.5	500
393	66L376	20	20	100	10	ND	50	200	50	2000	*1.0	5	2	0.2	500
394	66L480	20	20	100	20	ND	20	500	100	1000	*1.0	5	1	0.2	500
395	66L481	20	20	100	10	ND	20	500	50	2000	*1.0	10	1	0.2	500
396	66L483	20	10	100	10	ND	20	500	50	500	*1.0	5	1	0.5	500
179 *2*	9C516	100	-	9100	20	2	10	50	10	ND	0.02	20	0.2	10	ND
243R *4*	8C538-7	2	50	1000	10	-	ND	50	10	5000	0.01	5	5	20	20
244 *4*	8C537-1	20	20	-	10	-	50	200	50	500	0.9	5	2	2	200
244-4 *4*	8C542	50	10	500	10	-	100	200	20	2000	0.9	10	5	5	50
H *6*	5C293-8	20	5000	2000	10	10	10	200	20	1000	0.01	2	0.05	2	200
I *6*	5C293-5	5	10	1000	5	-	10	100	20	200	0.01	1	1.0	5	500
J *6*	5C293-12	5	500	500	-	-	10	50	10	500	0.005	2	10	10	500
K *6*	5C293-1	100	9100	5000	5	20	10	100	20	1000	0.01	2	0.05	0.5	2000
1 *7*	9C5-60A	50	20	9000	50	2	-	20	10	9000	0.02	20	0.2	1	100
1 *7*	9C5-60B	100	50	9000	10	-	10	100	10	5000	0.02	10	2	10	20
2 *7*	9C5-60C	50	50	9100	50	2	10	20	10	9000	0.01	20	0.1	0.2	200
2 *7*	9C5-60D	20	100	5000	10	-	10	100	10	2000	0.02	10	5	20	20
10 *7*	9C5-143B	5	100	500	10	-	-	50	10	5000	0.01	10	5	10	20
291-2 *5*	8C625	50	2000	9100	10	5	20	100	10	5000	0.02	10	2	10	500
Threshold		100	50	500	50	1	100	1000	200	5000	-	-	-	-	1000

(a) Sample locations on figure 1. Values in parts per million, unless indicated otherwise. Intervals of estimation shown on table V. Emission spectrography under direction of Lawrence Heiner, Mineral Industries Research Laboratory, University of Alaska.

NA - indicates not analyzed

ND - indicates sought but not detected

* - percent

Underlined values are anomalous.

Italicized numbers following map numbers refer to table.

Strontium	Boron	Beryllium	Tin	Tungsten	Zirconium	Lanthanum	Niobium	Scandium	Yttrium	Vanadium	Arsenic	Antimony	Bismuth	Cadmium	Gold	Map Number
100	50	2	10	ND	200	50	20	20	50	100	500	50	ND	ND	ND	362
100	50	2	10	ND	200	100	20	20	100	100	1000	50	ND	ND	ND	363
100	100	2	10	ND	200	100	20	20	50	100	2000	100	ND	ND	ND	364
100	50	2	10	ND	200	100	20	20	50	100	ND	50	ND	ND	ND	365
100	500	2	10	ND	200	50	20	20	50	100	ND	200	ND	ND	ND	366
100	50	2	10	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	367
100	100	2	10	ND	200	50	20	20	50	100	ND	100	ND	ND	ND	368
100	50	2	10	ND	200	100	20	20	20	100	ND	50	ND	ND	ND	369
100	100	2	10	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	370
100	50	2	10	ND	200	100	20	20	100	100	ND	100	ND	ND	ND	371
100	50	2	ND	ND	200	100	20	20	50	100	ND	50	ND	ND	ND	372
100	100	1	10	ND	200	50	20	20	50	200	ND	100	ND	ND	ND	373
100	50	2	ND	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	374
100	100	2	10	ND	200	50	50	20	50	200	ND	50	ND	ND	ND	375
100	100	1	ND	ND	200	50	10	10	50	100	ND	ND	ND	ND	ND	376
100	100	1	ND	ND	200	50	50	50	100	200	ND	100	ND	ND	ND	377
100	50	2	ND	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	378
100	50	2	ND	ND	200	50	20	20	50	100	ND	ND	ND	ND	ND	379
100	100	2	10	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	380
100	100	1	10	ND	200	20	20	20	20	200	ND	100	ND	ND	ND	381
100	100	1	10	ND	200	50	50	20	20	200	ND	50	ND	ND	ND	382
100	50	1	ND	ND	200	50	20	10	20	100	ND	100	ND	ND	ND	384
100	50	1	10	ND	200	50	50	20	20	100	ND	ND	ND	ND	ND	385
100	100	2	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	386
100	100	2	10	ND	200	50	20	20	20	100	ND	100	ND	ND	ND	387
100	100	1	ND	ND	200	50	20	20	20	100	ND	100	ND	ND	ND	388
100	50	1	10	ND	200	20	20	20	20	100	ND	50	ND	ND	ND	389
50	50	2	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	390
100	50	2	ND	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	391
100	50	2	ND	ND	200	50	20	20	50	100	ND	50	ND	ND	ND	392
100	50	2	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	393
100	100	1	10	ND	200	50	20	20	50	100	ND	100	ND	ND	ND	394
100	50	1	ND	ND	200	20	20	20	20	100	ND	ND	ND	ND	ND	395
100	50	1	ND	ND	200	50	20	20	20	100	ND	50	ND	ND	ND	396
100	ND	1	ND	ND	ND	20	50	ND	ND	ND	ND	ND	ND	ND	-	179
200	-	1	-	-	-	10	-	5	10	20	2000	-	-	ND	-	243R
100	20	2	-	-	200	20	-	20	50	100	1000	500	-	-	-	244
200	20	5	-	-	200	-	50	50	50	500	-	-	-	-	-	244-4
50	-	1	-	-	-	20	10	-	-	10	-	100	-	-	-	H
50	-	1	-	-	-	-	10	-	-	10	-	50	-	-	-	I
100	-	1	-	-	-	-	10	10	-	20	-	50	-	-	-	J
100	10	2	-	-	-	20	10	-	-	10	-	200	-	-	-	K
50	100	1	-	-	50	20	50	10	50	100	-	100	-	10	-	1
50	10	1	-	-	20	20	20	5	20	100	-	-	-	-	-	1
50	50	1	-	-	20	50	50	10	50	200	-	100	-	10	-	2
200	-	1	-	-	-	-	20	5	20	50	-	-	-	-	-	2
200	20	1	-	-	-	-	50	-	10	20	-	-	-	-	-	10
500	10	1	-	-	-	-	20	5	20	10	-	-	-	-	-	291-2
500	200	5	-	-	500	-	-	-	-	-	500	200	-	100	-	Threshold

APPENDIX IV

Emission Spectrographic Analyses of Geochemical Stream Sediment and Soil Samples from the Sinuk Area[a]

Map Number	Field Number	Copper	Lead	Zinc	Molybdenum	Silver	Cobalt	Chromium	Nickel	Manganese	Titanium	Iron	Magnesium
1	8L325	10	L	N	N	N	10	70	50	2000	1	7	1.5
2	8L326	10	10	200	N	N	10	100	50	700	.5	5	2
3	8L349	L	N	H(500)	N	N	10	N	L	300	.007	G(20)	.05
4	8L348	10	15	L	5	N	15	100	50	700	.2	10	1
5	8L347	10	20	L	L	N	15	100	30	1000	.2	10	1
6	8L346	10	20	L	L	N	15	70	30	2000	.3	7	.7
7	8L345	L	15	L	L	N	10	50	30	700	.15	5	.5
8	8L344	5	15	L	L	N	10	30	30	1000	.15	5	.7
9	8L343	15	20	L	L	N	10	30	20	700	.2	5	1
10	8L338	5	15	N	N	N	7	70	30	2000	.15	10	3
11	8L339	10	15	N	N	N	7	70	30	1000	.2	5	5
12	8L340	L	L	N	N	N	5	50	15	700	.15	5	5
13	8L341	10	L	N	N	N	5	50	15	500	.1	5	5
14	8L342	L	10	N	N	N	5	30	7	150	.03	1	2
15	8L361	L	L	L	L	N	5	70	L	5000	.02	7	.1
16	8L360	L	15	N	N	N	L	20	L	300	.15	1	.2
17	8L359	10	20	200	L	N	15	70	50	700	.3	10	1
18	8L358	10	L	N	N	N	7	30	30	700	.7	5	.7
19	8L357	30	20	H(200)	N	N	15	100	70	1000	.7	15	1
20	8L356	20	10	N	N	N	5	20	20	700	7	5	.7
21	8L355	10	L	H(700)	N	N	7	20	30	3000	.3	10	.7
22	8L350	30	20	1500	N	N	15	100	50	5000	.5	15	1.5
23	8L351	10	20	L	N	N	10	70	30	700	.2	7	2
24	8L352	10	20	L	L	N	15	100	50	700	2	5	1.5
25	8L353	30	30	N	N	N	15	150	70	700	.5	5	2
26	8L354	20	L	N	N	N	10	100	70	1000	.5	5	3
27	8L362	15	15	N	N	N	10	30	30	700	.2	5	2
28	8L333	15	L	2000	N	N	10	150	50	3000	.7	15	2
29	8L332	15	10	L	N	N	10	70	50	2000	1	10	2
30	8L323	10	15	N	N	N	15	100	50	1000	.2	5	2
31	8L324	15	10	L	N	N	10	70	50	1000	.5	5	2
32	8L322	30	20	L	L	N	15	70	50	1500	.5	5	2
33	8L321	L	10	L	N	N	15	50	30	700	.7	5	1.5
34	8L320	7	20	L	L	N	20	70	30	500	.1	5	1.5
35	8L318	20	20	N	L	N	10	100	50	500	.2	5	2
36	8L319	5	30	N	L	N	15	70	50	500	.15	3	1
37	8L317	5	15	L	L	N	15	100	30	1000	.5	5	1.5
38	8L316	20	20	L	L	N	20	70	50	2000	.5	7	1.5
39	8L315	5	15	L	L	N	15	70	30	700	.3	5	1
42	8L423	10	10	N	N	N	15	70	20	1000	.3	3	1
45	8L314	L	10	L	N	N	10	50	20	700	.15	3	1
46	8L313	20	10	N	L	N	10	50	20	500	5	5	3
47	8L308	20	15	N	N	N	50	500	70	1000	.7	7	2
48	8L303	15	20	N	N	N	15	100	20	500	.5	3	7
49	8L311	30	20	N	N	N	30	200	100	1500	.5	5	1
50	8L315	50	30	N	N	N	30	200	100	1500	.5	5	1
51	8L317	20	20	N	N	N	30	200	70	500	5	5	1
52	8L310	10	20	N	N	N	20	150	70	700	.2	5	2
53	8L309	20	L	L	N	N	15	300	100	500	.7	10	3
54	8L318	30	20	N	N	N	30	100	70	700	.7	5	1.5
55	8L319	30	20	N	N	N	30	100	50	700	.7	7	1
56	8L311	10	15	L	N	N	15	70	30	300	2	3	1.5
57	8L312	5	15	N	N	N	15	70	30	500	.3	3	1.5
59	8L304	10	L	N	N	N	10	70	50	500	.5	5	1
60	8L305	15	L	N	N	N	7	30	50	500	.7	5	1
61	8L307	20	L	N	N	N	7	30	30	500	.7	5	1
62	8L306	20	10	L	N	N	10	70	50	700	.7	7	1.5
100	8L418	10	15	200	N	N	7	30	15	500	.5	2	.5
109	8L420	30	50	200	N	N	10	50	20	3000	.2	10	.5
112	8L411	15	20	N	N	N	5	70	20	3000	.1	3	1
113	8L410	10	20	N	N	N	L	50	15	3000	.07	3	1.5
114	8L409	10	15	L	N	N	N	30	10	5000	.05	10	.7
115	8L408	15	10	N	N	N	N	20	10	3000	03	7	10
116	8L407	10	10	N	N	N	N	50	10	2000	.05	5	10
117	8L406	10	10	N	N	N	N	30	15	3000	.07	5	10
118	8L405	10	15	N	N	N	N	30	15	2000	.07	5	10
119	8L404	10	30	N	N	N	5	50	20	3000	.1	5	10
120	8L403	15	20	N	N	N	7	70	20	3000	2	5	3
121	8L402	10	20	N	N	N	L	20	10	5000	.03	7	2
122	8L401	15	30	N	N	N	10	30	15	5000	.1	10	.7
123	8L400	5	30	300	N	N	10	50	15	5000	.05	10	.7
124	8L399	L	20	N	N	N	N	20	5	5000	.05	20	1

(Analyzed by U. S. Geological Survey)

Calcium	Barium	Strontium	Boron	Beryllium	Zirconium	Lanthanum	Niobium	Scandium	Yttrium	Vanadium	Arsenic	Antimony	Map Number
1.5	700	L	500	1	500	100	L	20	50	200	N	N	1
2	700	L	50	1.5	1000	30	L	15	50	150	N	N	2
3	L	N	50	N	N	N	L	N	L	10	N	N	3
.3	700	150	70	3	200	70	15	20	70	150	N	N	4
1	500	100	50	1.5	200	50	15	20	50	150	N	N	5
1	500	100	50	5	300	30	10	20	30	150	N	N	6
5	300	100	20	3	70	30	10	15	30	100	N	N	7
1	300	100	15	1.5	70	30	L	15	30	100	N	N	8
2	700	300	15	3	150	50	10	15	30	100	N	N	9
20	150	700	15	N	70	20	L	7	20	70	N	N	10
20	200	700	L	N	70	L	L	7	15	100	N	N	11
20	150	700	L	N	50	L	L	7	10	50	N	N	12
20	100	700	L	N	30	L	L	5	10	30	N	N	13
15	70	700	N	N	20	N	L	5	L	20	N	N	14
1	150	L	10	N	20	N	L	L	L	10	L	N	15
.3	200	L	15	2	100	30	L	7	20	50	L	N	16
.3	500	100	50	3	300	50	10	20	30	150	N	N	17
2	500	150	30	N	300	L	L	15	15	150	N	N	18
3	700	L	200	N	500	30	L	15	30	200	N	N	19
1	500	100	50	N	300	30	L	7	15	150	N	N	20
3	300	100	150	1	300	50	L	10	15	150	N	N	21
1.5	700	150	20	1	300	70	L	20	30	150	N	N	22
3	500	150	30	3	300	L	L	15	50	150	N	N	23
1	500	200	30	1	150	50	10	20	30	100	N	N	24
2	700	L	30	N	300	30	L	20	30	150	N	N	25
10	500	300	50	N	200	L	L	10	15	150	N	N	26
2	5	L	50	3	1000	50	L	7	30	100	N	N	27
2	700	L	200	L	300	N	L	20	15	150	N	N	28
2	1000	L	200	1.5	500	50	10	20	30	200	N	N	29
2	700	150	100	2	150	150	10	20	30	100	N	N	30
2	1000	100	200	2	300	30	L	15	30	150	N	N	31
3	700	200	200	2	150	20	15	20	30	100	N	N	32
3	500	L	100	1	100	20	L	15	15	100	N	N	33
.5	500	L	50	1	200	20	15	20	20	100	N	N	34
3	1000	200	30	3	100	50	10	15	20	150	N	N	35
1	700	200	20	2	100	50	10	10	20	100	N	N	36
3	500	200	30	5	200	50	15	20	30	150	N	N	37
1.5	700	100	15	3	100	200	20	20	50	150	N	N	38
3	500	L	50	2	300	L	20	15	30	100	N	N	39
.3	500	100	100	1.5	100	150	L	15	30	150	N	N	42
7	300	L	15	3	100	20	10	10	20	70	N	N	45
2	300	L	20	L	70	30	10	10	50	150	N	N	46
2	700	500	10	L	150	50	L	30	70	100	N	L	47
10	500	200	50	1	100	30	L	10	20	70	N	N	48
.5	500	L	70	1.5	150	30	20	20	50	100	N	N	49
1	500	100	100	1.5	150	30	20	30	50	150	N	N	50
.2	200	L	100	1	150	30	10	20	30	70	N	N	51
.3	300	L	15	L	100	30	L	15	15	150	N	N	52
.3	300	L	50	N	300	L	L	30	20	200	N	N	53
1	300	150	150	1	150	30	15	30	30	150	N	N	54
1	300	200	50	1	150	20	20	30	50	150	N	N	55
1	300	200	30	1.5	100	20	L	15	15	100	N	N	56
1.5	300	200	20	1.5	200	30	10	20	30	100	N	N	57
.7	300	L	20	N	200	L	L	10	15	150	N	N	59
.5	300	L	50	L	300	L	L	7	10	150	N	N	60
.7	300	L	20	N	70	N	L	7	10	100	N	N	61
.7	500	L	100	1.5	500	50	10	20	70	200	N	N	62
1	700	100	150	1.5	150	50	10	7	150	70	L	N	100
1	700	100	100	1	100	30	L	15	50	100	N	N	109
G(20)	300	700	20	L	70	30	L	15	50	70	N	N	112
20	200	1000	20	L	30	20	L	5	20	30	N	N	113
G(20)	200	300	15	L	30	20	L	L	30	20	N	N	114
20	100	100	L	L	15	N	L	L	15	15	N	N	115
20	100	L	L	L	20	N	L	5	15	15	N	N	116
G(20)	100	L	L	L	30	N	L	L	15	20	N	N	117
G(20)	100	100	10	L	30	N	L	L	10	30	N	N	118
20	200	100	20	L	50	N	L	L	15	30	N	N	119
5	500	L	30	1	70	20	L	7	20	70	L	N	120
7	150	100	10	L	50	L	L	L	10	20	N	N	121
10	500	100	50	1	70	20	L	5	20	50	L	N	122
10	300	200	20	L	50	20	L	L	15	20	L	N	123
.1	200	N	30	L	50	L	L	5	15	30	N	N	124

APPENDIX IV · continued

Map Number	Field Number	Copper	Lead	Zinc	Molybdenum	Silver	Cobalt	Chromium	Nickel	Manganese	Titanium	Iron	Magnesium
125	8L398	15	50	1000	N	N	15	70	20	2000	.1	7	1.5
126	8L397	15	70	200	N	N	N	70	15	1500	.3	5	.5
127	8L412	20	500	N	N	N	15	70	20	3000	.2	7	.7
128	8L413	15	30	N	N	N	10	70	30	1500	.5	3	.7
129	8L414	10	15	N	N	N	N	70	15	1500	.15	2	.3
130	8L415	15	20	N	N	N	5	50	15	1500	.1	3	1
134	8L421	10	30	300	N	N	15	30	15	G(5000)	.05	20	.7
138	8C581	15	20	N	N	N	15	50	20	2000	.15	5	2
139	8C580	10	15	N	N	N	10	50	15	2000	.5	5	.5
140	8C579	15	20	2000	N	N	20	70	30	3000	.5	7	.7
141	8L422	15	20	L	N	N	15	50	15	5000	.2	7	.7
143	8C596	15	20	N	N	N	20	70	50	1000	.5	5	.7
144	8C600	10	20	200	N	N	15	20	15	3000	.1	G(20)	.5
145	8C599	15	20	N	N	N	5	20	15	3000	.1	20	.5
184	8C354	5	20	L	N	N	10	70	70	700	.7	5	.7
184A	8C349	L	30	200	N	N	10	50	30	300	.2	3	5
185	8C347	L	L	N	N	N	7	30	20	200	.03	3	2
187	8C350	30	70	L	L	N	15	100	50	700	.2	5	1
188	8C351	15	30	L	N	N	15	100	70	700	.5	5	1.5
215	8C337	20	20	N	N	N	20	100	50	700	.5	5	1
227	8C557	10	15	N	N	N	20	70	30	1500	.5	3	.7
235	8L363	10	20	N	N	N	20	70	20	1000	.5	3	1
236	8L364	50	10	N	N	N	20	70	20	700	.7	3	.7
237	8C546	10	20	N	N	N	15	50	50	500	.5	3	.7
238	8L365	30	15	N	N	N	20	70	20	500	.7	3	.7
239	8L366	30	10	N	N	N	20	50	20	300	.7	3	.5
240	8L367	5	20	N	N	N	15	30	15	500	2	2	1.5
241	8L375	30	20	N	N	N	50	70	20	1000	1	5	.7
243A	8L376	50	150	300	N	N	30	150	70	1000	.5	3	.7
243B	8L377	20	100	N	N	N	20	100	30	1000	.5	2	.7
243C	8L378	50	100	300	N	N	30	200	70	700	.7	5	1
243D	8L379	30	150	300	N	N	20	100	50	300	.5	3	1
243E	8L380	30	100	L	N	N	20	100	50	1000	.5	5	1.5
243F	8L381	L	15	N	N	N	N	10	L	150	.05	.2	.15
243G	8L382	70	100	300	N	N	30	150	70	1000	.7	5	1
243H	8L383	70	200	200	N	N	30	150	70	1000	.5	5	1.5
243I	8L384	50	100	200	N	N	30	150	100	1000	.7	5	1
243J	8L385	70	70	L	N	N	20	100	50	700	.3	3	1
243K	8L386	30	100	200	N	N	20	100	50	1500	.5	5	1.5
243L	8L387	70	150	500	N	N	30	150	100	1500	.7	7	1.5
243M	8L388	50	150	300	N	N	20	100	70	1000	.5	5	1.5
243N	8L389	20	100	L	N	N	30	150	50	700	.3	5	1.5
243O	8L390	20	70	L	N	N	20	100	30	500	.3	5	1.5
243P	8L391	30	50	300	N	N	30	150	70	700	.5	5	1
243Q	8L392	50	100	300	N	N	30	150	70	1500	.5	5	1
243R	8L393	20	50	N	N	N	20	70	30	2000	.7	5	.7
243S	8L394	50	100	500	N	N	50	150	70	1000	.5	7	1.5
243T	8L395	50	100	500	N	N	50	200	100	2000	.7	7	1
245	8L370	20	20	N	N	N	20	70	20	700	1	2	.7
246	8L369	20	15	N	N	N	30	70	20	1000	1	3	.7
247	8L368	30	15	N	N	N	20	100	20	700	.2	2	1
248	8L371	30	50	N	N	N	20	70	20	1000	.5	3	1
249	8C424	15	20	N	N	N	20	70	20	700	7	3	.7
252	8C410	20	20	N	N	N	50	20	15	2000	1	10	1.5
253	8L372	20	10	N	N	N	50	50	20	1000	G(1)	5	1
254	8C428	15	10	N	N	N	50	50	20	1500	1	10	1.5
255	8C543	20	20	N	N	N	30	50	20	1500	1	7	1
256	8L374	20	15	N	N	N	20	70	20	500	7	3	.5
257	8L373	15	30	N	N	N	20	100	20	700	.5	3	.7
258	8C431	10	15	N	N	N	15	50	15	1000	.3	3	1
259	8C418	10	20	N	N	N	15	70	15	300	.3	3	1
293	8L436	70	50	L	N	N	30	150	100	1500	5	5	1
294	8L437	15	20	N	N	N	15	100	30	1000	.3	3	.7
295	8L438	30	50	L	N	N	20	150	70	1000	3	5	1
296	8L439	30	30	N	N	N	20	200	70	700	.5	5	1
297	8L440	50	70	200	N	N	30	200	100	700	.3	5	1
298	8L441	20	20	N	N	N	15	100	70	500	.3	3	.5
299	8L442	10	15	N	N	N	N	50	20	700	.3	2	.5

Calcium	Barium	Strontium	Boron	Beryllium	Zirconium	Lanthanum	Niobium	Scandium	Yttrium	Vanadium	Arsenic	Antimony	Map Number
G(20)	300	1000	50	L	70	20	L	7	30	50	L	N	125
1	500	L	70	1	100	50	L	10	50	70	N	N	126
5	700	200	10	1.5	150	30	10	10	50	100	200	L	127
1	700	150	100	1.5	150	50	10	20	50	150	N	N	128
1	500	100	70	1.5	70	20	L	10	30	100	N	N	129
10	300	700	50	L	50	20	L	7	30	50	N	N	130
2	500	150	100	L	30	N	L	5	15	30	N	100	134
5	500	L	200	1	70	20	L	10	150	50	N	N	136
.7	500	L	100	2	100	20	L	15	30	100	N	N	139
1	1000	100	150	1.5	200	100	10	20	50	70	N	N	140
1	700	100	150	1.5	150	20	L	10	100	100	200	N	141
2	300	100	100	1.5	150	30	10	15	20	100	N	N	143
3	500	200	30	L	50	N	L	5	20	50	2000	500	144
2	500	100	30	1	70	N	L	5	30	50	1000	500	145
.7	700	L	700	L	500	100	L	7	10	200	N	N	184
.2	500	L	50	L	70	50	L	7	100	100	N	N	184A
10	N	500	L	N	20	N	L	5	L	30	N	N	185
.15	500	L	100	L	150	50	L	15	20	100	N	N	187
1	500	L	50	N	200	30	L	15	30	150	N	N	188
.2	200	100	100	1.5	150	L	20	20	50	100	N	N	215
1	200	100	70	1	100	30	15	20	30	100	N	N	227
1.5	300	150	100	1.5	100	20	L	10	20	70	L	N	235
.7	150	200	100	1	150	100	10	15	30	100	L	N	236
.2	500	L	200	1	300	30	10	10	200	70	N	N	237
1	300	100	100	1	100	20	L	10	20	100	N	N	238
3	150	100	70	1	100	20	10	10	20	100	N	N	239
15	100	1000	50	L	30	20	L	5	20	70	L	N	240
5	200	200	100	L	100	30	10	20	50	150	L	N	241
1	1500	100	100	2	200	50	10	20	50	100	N	N	243A
7	500	300	70	1.5	150	50	10	10	50	70	300	N	243B
5	1500	200	100	2	200	50	15	30	50	100	N	N	243C
2	1000	150	100	2	150	50	10	20	30	100	N	N	243D
7	1000	500	100	2	150	50	L	20	50	100	N	N	243E
1	150	100	10	L	30	20	N	5	L	30	N	N	243F
5	1500	200	150	1.5	200	50	10	20	50	150	N	N	243G
2	1500	150	100	1.5	150	50	L	20	50	100	N	N	243H
3	1500	150	100	1.5	200	50	10	20	50	150	N	N	243I
10	1000	500	70	1.5	100	30	L	20	30	70	N	N	243J
7	3000	300	200	2	300	50	10	20	50	150	N	N	243K
2	5000	200	200	3	200	50	10	20	50	150	L	N	243L
5	2000	300	150	2	150	50	10	20	50	100	N	N	243M
7	1500	500	200	2	150	50	L	15	50	150	N	N	243N
10	1000	700	200	1	150	50	L	10	50	100	N	N	243O
2	2000	300	150	1.5	200	50	10	30	50	150	L	N	243P
1.5	2000	200	200	2	300	50	20	20	50	150	N	N	243Q
2	1000	200	200	1	200	70	10	15	70	100	N	N	243R
3	2000	300	150	2	200	50	10	20	50	150	200	N	243S
1	3000	150	200	3	300	70	15	30	70	150	N	N	243T
3	200	200	150	L	150	20	L	20	30	100	N	N	245
2	200	300	100	L	100	20	L	20	30	150	N	N	246
20	100	1500	50	L	30	20	L	20	20	70	L	N	247
10	200	700	100	1	50	30	L	10	20	100	N	N	248
.5	700	100	300	1.5	200	70	20	20	70	100	N	L	249
2	200	200	30	N	100	20	20	50	100	150	300	L	252
5	150	500	100	L	100	30	L	50	50	200	200	N	253
2	150	500	70	N	150	30	10	50	70	300	N	N	254
1.5	300	300	150	1	200	50	10	20	70	200	700	N	255
1	200	100	150	1	200	50	15	15	70	70	N	N	256
10	300	700	100	1	70	50	L	15	30	70	L	N	257
20	200	1000	50	L	50	20	L	7	15	70	N	N	258
5	300	500	150	1.5	70	30	L	10	20	50	N	N	259
.15	1000	100	200	2	300	50	10	30	70	200	N	L	293
.2	500	100	100	1.5	150	30	L	20	30	150	N	N	294
.15	1000	100	200	1.5	200	50	L	20	50	200	N	L	295
.2	1000	L	150	1.5	200	70	L	30	50	200	N	N	296
.2	1000	150	200	2	200	70	L	50	50	200	N	N	297
.2	700	100	100	1.5	150	50	L	20	50	150	L	N	298
.3	500	100	50	1	100	20	L	15	20	100	N	N	299

APPENDIX IV - continued

Map Number	Field Number	Copper	Lead	Zinc	Molybdenum	Silver	Cobalt	Chromium	Nickel	Manganese	Titanium	Iron	Magnesium
300	8L443	70	30	N	N	N	50	200	150	2000	.7	7	1
301	8L444	20	15	N	N	N	N	70	30	300	.2	2	.5
302	8L445	70	50	N	N	N	70	200	100	2000	5	7	1
303	8L446	50	50	N	N	N	30	150	70	700	3	5	1
304	8L447	20	15	N	N	N	5	70	20	200	.2	2	.7
305	8L448	20	20	N	N	N	10	100	20	300	5	3	.7
306	8L449	30	50	300	N	L	20	200	70	500	.5	5	1
307	8L450	30	50	200	N	N	20	200	70	700	.7	5	1
308	8L451	70	70	500	N	.5	30	300	100	1000	.7	7	1
309	8L452	50	100	300	N	L	20	150	70	700	.5	5	1
310	8L453	100	500	700	N	.7	30	200	100	700	.5	5	1
311	8L454	70	200	500	N	.5	50	150	100	700	.5	5	1
312	8L455	50	300	1000	N	1	15	100	70	500	.5	3	7
313	8L456	70	200	500	N	7	50	200	100	1000	.7	5	1
314	8L457	50	100	700	N	L	20	150	70	1500	.5	3	1
315	8L458	70	100	200	N	L	50	200	100	1500	.5	5	1
316	8L459	70	30	L	N	N	30	200	100	1500	.7	7	1
317	8L460	70	30	N	N	N	30	200	100	1000	.5	5	1
318	8L461	20	20	N	N	L	15	100	70	500	.5	3	.7
321	8L462	70	20	300	N	L	20	150	100	1500	.7	5	1
322	8L463	50	50	200	N	.5	30	200	100	1000	.7	7	1
323	8L464	70	50	L	N	.5	50	200	100	2000	.7	7	1
324	8L465	20	1000	500	N	1	20	100	50	1000	.5	5	.7
325	8L466	15	15	N	N	.5	L	70	20	500	.2	1.5	.3
326	8L467	100	30	N	N	L	70	200	100	2000	.5	7	1
327	8L468	15	10	N	N	N	5	70	30	200	.3	1.5	.5
328	8L469	50	20	N	N	N	15	100	50	500	.5	2	7
329	8L470	70	50	N	N	N	50	150	100	1500	.5	5	1
356	8L352	7	L	L	N	N	15	70	50	700	.7	5	1.5
Threshold		100	70	300		.5	70	300	150	5000			

(a) Sample locations on figure 1.
Values in parts per million, unless indicated otherwise.
Intervals of estimations shown on table V.
All samples were below detection limit for tin, bismuth, and cadmium.
Analyses were done in the Anchorage mobile laboratory of the U. S. Geological Survey in 1968.
Underlined values are anomalous.

L - lowest limit of detection
N - below detection limit
G - greater than value shown
H - interference

(500) - Less than value shown

Calcium	Barium	Strontium	Boron	Beryllium	Zirconium	Lanthanum	Niobium	Scandium	Yttrium	Vanadium	Arsenic	Antimony	Map Number
2	700	100	100	1	200	50	L	30	70	200	L	N	300
.1	200	L	70	1	100	20	L	15	30	100	N	N	301
.1	700	150	200	1.5	150	100	L	50	100	200	N	L	302
.07	500	100	150	1.5	150	50	10	30	50	200	N	L	303
05	200	L	100	1	100	20	L	20	20	100	N	N	304
.3	300	100	100	1.5	150	20	10	20	30	150	N	N	305
2	1000	L	100	2	150	30	15	30	50	150	N	L	306
.15	1500	100	100	2	150	50	15	50	100	150	N	L	307
.15	2000	100	150	2	150	100	10	50	70	200	N	100	308
15	1500	L	100	2	200	30	10	30	50	150	L	L	309
.15	5000	100	150	2	150	70	10	30	50	150	N	L	310
1	3000	100	100	2	150	50	10	30	70	150	N	100	311
2	5000	L	100	2	150	50	10	20	50	100	L	L	312
3	5000	100	150	2	200	100	15	50	70	150	N	100	313
2	1000	L	100	2	100	50	10	20	50	100	L	L	314
05	1500	L	100	2	150	100	20	50	50	200	N	L	315
.1	1000	L	100	2	150	70	20	50	100	200	N	L	316
.07	500	L	100	1.5	150	30	20	30	50	200	L	L	317
2	300	L	50	1	150	50	10	20	30	100	L	L	318
1	1000	L	150	2	150	50	20	20	70	150	200	100	321
15	1500	100	150	2	150	70	20	50	70	150	300	100	322
.07	700	L	100	1.5	100	50	L	50	70	200	500	100	323
.2	5000	100	100	2	200	50	L	20	50	100	200	L	324
.5	300	N	20	1	50	30	L	7	20	70	N	N	325
.07	700	100	70	2	150	70	10	50	70	150	N	100	326
.1	300	L	50	1.5	100	20	10	15	20	100	N	N	327
.2	500	L	70	1.5	150	30	L	20	50	100	N	N	328
.2	700	100	70	2	150	50	10	30	70	100	N	L	329
.7	300	L	70	2	300	L	L	10	10	150	N	N	356
	1000	700	200	3	500	150			150		200	100	Threshold