MAPS AND PRELIMINARY INTERPRETATION OF ANOMALOUS ROCK GEOCHEMICAL DATA FROM THE PETERSBURG QUADRANGLE, AND PARTS OF THE PORT ALEXANDER, SITKA, AND SUMDUM QUADRANGLES, SOUTHEASTERN ALASKA

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INTRODUCTION

Statistical analyses of minor- and trace-element geochemical data for 6,974 rock samples from the Petersburg quadrangle and minor parts of the Port Alexander, Sitka, and Sumdum quadrangles (hereafter referred to as the Petersburg study area) identified 887 samples with anomalously high concentrations of one or more elements. This report includes a list of the 887 samples (table 1), histograms showing the distribution of chemical values (see fig. 2), a brief description of the geologic context and distribution of the samples, a map of bedrock geochemical groups (sheet 1), and 12 maps showing the locations of samples that have anomalous amounts of precious metals, base metals, and selected rare metals (sheets 2-7). The information presented here is intended to be used in conjunction with the geologic map of the Petersburg study area (Brew and others, 1984), the geochemical data for all of the Petersburg study area rock samples (Karl and others, 1985), the geochemical data for all the Petersburg study area stream-sediment samples (Cathrall and others, 1983a-w), and a description of the known mineral deposits and occurrences in the study area (Grybeck and others, 1984). The rock geochemical data for all samples collected in the study area is also available on a computer tape (Koch and others, 1984).

GENERAL GEOLOGY

The geology of the Petersburg study area was first mapped as part of a larger study of southeastern Alaska by Buddington and Chapin (1929). A more detailed map of the northwestern part of the study area was published by Muffler (1967). Recent work included extensive remapping of most of the study area and resulted in a 1:250,000-scale preliminary reconnaissance geologic map by Brew and others (1984).

The western part of the map area is composed primarily of Paleozoic carbonate rocks and volcaniclastic turbidites and some intercalated intermediate-composition to mafic volcanic rocks (sheet 1). These rocks are part of the Alexander terrane of Berg and others (1978) and the Alexander belt of Brew and others (1984) (fig. 1). East of the Alexander belt is the Gravina belt of Berg and others (1972), locally redefined by Brew and others (1984), which consists of deformed upper Mesozoic flysch, volcanic rocks, and melange that includes fault-bounded blocks of older sedimentary and volcanic rocks.

The eastern part of the study area comprises the Mainland belt of Brew and others (1984), which includes the Taku and Tracy Arm terranes of Berg and others (1978). According to Brew and others (1984), rocks of the Taku and Tracy Arm terranes may include metamorphosed equivalents of the Alexander terrane rocks. The country rocks of the Mainland belt increase in metamorphic grade from west to east, to as high as amphibolite facies, and are intruded by various igneous components of the Coast plutonic-metamorphic complex of Brew and Ford (1984) (sheet 1).

The Coast plutonic-metamorphic complex includes the metamorphosed equivalents of the Paleozoic and Mesozoic stratigraphic sequences of both the Mainland belt and parts of the Gravina belt (Brew and others, 1984) and the Triassic to Miocene plutons that intrude these belts (Brew and Morrell, 1983). In the study area, the oldest plutons of the complex are middle Cretaceous ultramafic rocks that intrude regionally metamorphosed rocks of the Gravina belt on northeastern Kupreanof Island. On the Blashke Islands, ultramafic rocks intrude the rocks along the east margin of the Alexander belt and are consequently not considered part of the Coast plutonic-metamorphic complex. Slightly younger, mid-Cretaceous, intermediate-composition plutons also intrude the Gravina belt. A latest Cretaceous to Paleocene tonalite and granodiorite sill belt, referred to as the tonalite sill belt (Brew and Ford, 1981; Brew and Morrell, 1983), separates the Cretaceous intermediate-composition plutons on the west from the Tertiary intermediate-composition to felsic plutons on the east and is found along the east side of the Coast Range megalineament (fig. 1) in the study area. East of the tonalite sill belt, the proportion of metamorphic rocks diminishes substantially, and migmatites are common.

Middle Tertiary to Quaternary, felsic to mafic, hypabyssal to extrusive igneous rocks intrude and cover the Alexander and Gravina belts in a continuous swath, known as the Kuiu-Etolin belt (Brew and others, 1979; Brew and Morrell, 1983). This belt extends from the head of Keku Strait in the northwest corner of the study area to Etolin Island in the southeast. Rocks of this belt are younger than, and genetically independent of, the Coast plutonic-metamorphic complex (Brew and others,

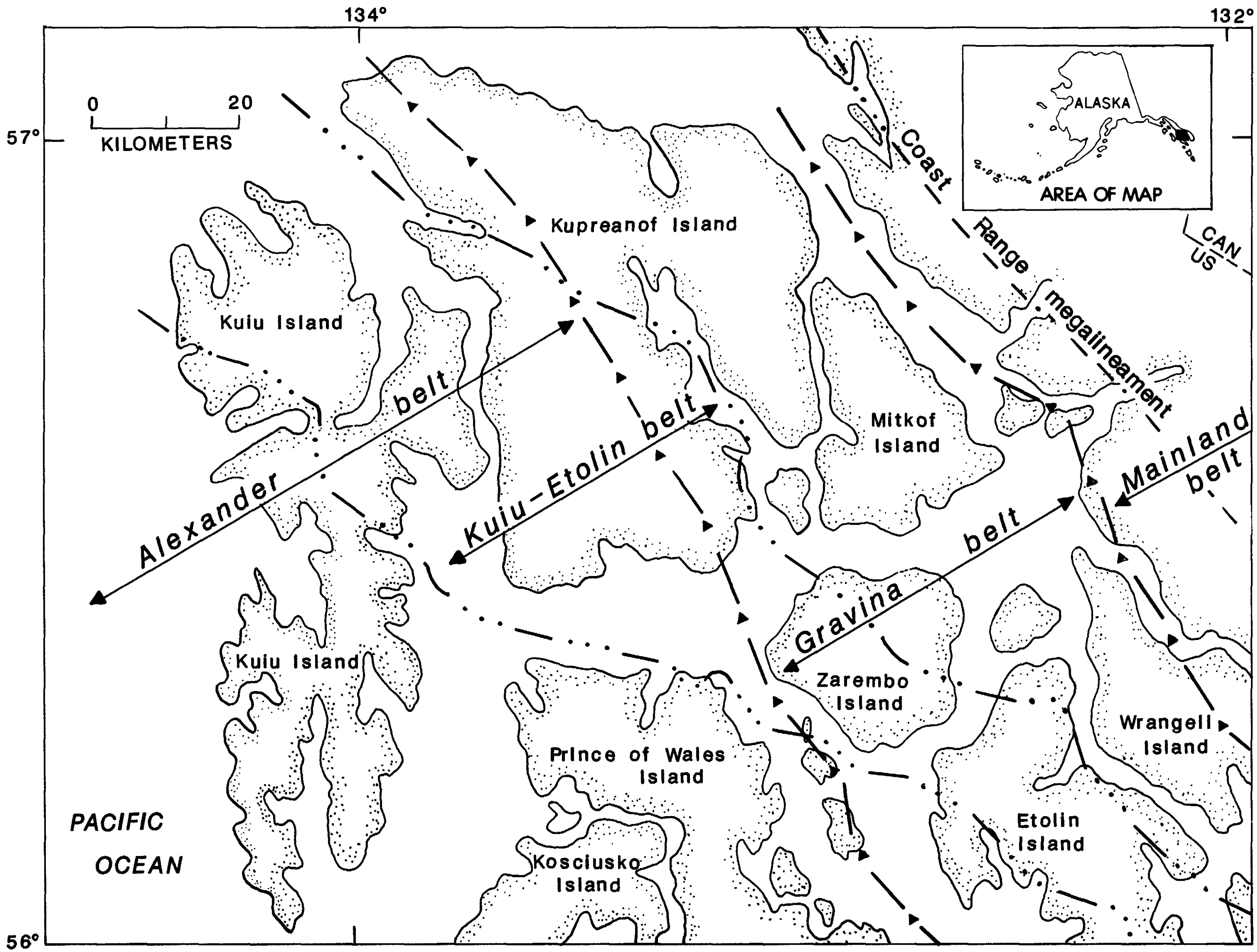

Figure 1. Map showing the distribution of geologic belts in the Petersburg study area (after Brew and others, 1984).

1979; Brew and Morrell, 1983). Middle Tertiary and younger felsic rocks also intrude the Mainland belt in isolated areas, such as Groundhog Basin (sheet 1), and constitute a small part of the Coast plutonic-metamorphic complex. These felsic igneous rocks are not considered to be part of the Kuiu-Etolin belt, but they may be related to the igneous suite of the Kuiu-Etolin belt.

GROUNDHOG BASIN AREA

In discussions below, a number of references are made to the Groundhog Basin area because of the relatively conspicuous geochemical patterns expressed there. For the purposes of this discussion, the Groundhog Basin area is considered to be an area on the west margin of the Mainland belt extending well beyond the confines of Groundhog Basin itself but crudely centered there, between Mount Waters and Marsha Peak (sheet 1). The area referred to here, as indicated by anomalous rock geochemistry, lies just west of the Coast Range megalineament and the tonalite sill belt (fig. 1). The area extends from the east edge of the Petersburg quadrangle at Berg Creek and Glacier Basin, northward to Mount Waters and Horseshoe Basin, and westward to Virginia Lake (sheet 1). Somewhat diminished anomalous patterns for some elements extend as far north as the Stikine River and form a zone near, but west of the west margin of the Coast Range batholith, whose west margin is the tonalite sill belt. For most elements examined here, values are notably diminished north of the Stikine River, even directly along strike from the Groundhog Basin area.

SAMPLE COLLECTION, PREPARATION, AND ANALYSIS

Most samples for rock geochemistry were collected as grab samples chosen to represent the dominant lithologies at the sample site. Sampling was done during the course of geologic mapping. Sample and sample-site selection was based on several factors: (1) the desire to collect samples at evenly distributed sites that are representative of the lithologies present there, (2) the desire to sample areas and materials containing signs of alteration or mineralization, and (3) the accessibility of both the site and sample material. Less than one percent of the samples were collected from known mineralized occurrences.

Samples, which were prepared and analyzed by members of the U.S. Geological Survey (USGS), were crushed and ground to minus 150-mesh size in a grinder with ceramic plates. One split was analyzed for 31 elements by rapid six-step semiquantitative emission spectrography. Two other splits were analyzed by atomic-absorption spectrophotometry--one for gold and another for copper, lead, and zinc. Tungsten analyses were performed on 183 samples by a colorimetric procedure (Welsch, 1983). Equivalent uranium (eU) was calculated for 76 samples from a 400-second count on a 15-gram-ground sample using an Ortec Gamma Counter.

Analytical results are reported as weight percent of the sample for spectrographic analyses of Fe, Mg, Ca, and Ti and as parts per million (ppm) for all other spectrographic analyses and for atomic-absorption and colorimetric analyses. The distribution of values for some of the determinations is truncated at one or both ends by the limits of determinability for that analytical procedure. The limits of determination for each analysis are listed in table 2.

Some of the analytical values in the geochemical data set used for this study are qualified to indicate that (1) the result is outside the limits of analytical determinability, (2) the result was influenced by analytical interference, or (3) that no data are available. The qualification codes used to represent these conditions (fig. 2) are the same single-letter symbols used in USGS Statpac computer data files (Van Trump and Miesch, 1977).

Results from semiquantitative emission spectrographic analyses (Koch and others, 1984; Karl and others, 1985) are reported as the approximate midpoints of class intervals; there are six intervals, or steps, per order of magnitude. The values of successive interval boundaries and the widths of successive class intervals increase geometrically, such that the class intervals have a constant width when the interval-boundary values are plotted on a logarithmic scale (Miesch, 1976, p. 83-84). The spectrographic reporting values and the associated class-interval limits and widths are listed in table 3. The values used to report element concentrations (fig. 2) are integral powers of 10 times one of the listed six-step reporting values. For a more detailed discussion of the analytical methods and reporting procedures, the reader is referred to Karl and others (1985), Miesch (1976), Motooka and Grimes (1976), Johnson and others (1980), and Koch and others (1980).

Locations of 887 rock samples containing anomalous amounts of one or more of the elements listed in table 1 are plotted on sheet 2, map A. All analytical data for these samples are listed in Karl and others (1985, table 12). Histograms showing the distribution of chemical values for selected elements for the full 6,974-sample data set (fig. 2) were used in conjunction with statistical analysis to choose anomalous levels for various elements of interest. Threshold values used to delimit anomalous concentration levels for each element were chosen by inspection of histograms for the entire 6,974-sample data set (Karl and others, 1985; Koch and others, 1984). Histograms for all elements are available in Karl and others (1985). Because all analytical data are reported in steps, or class intervals, it is impossible to select a point in the distributions that corresponds exactly to any particular percentage of the sample population. Threshold values (table 4) were set at the class interval closest to the 98th-percentile level. In cases where a distinct break in the concentration distribution occurred near the 98th-percentile level, the threshold value was set at this break. For elements analyzed by both spectrographic and atomic-absorption methods (gold, copper, lead, and zinc), the atomic-absorption results were used because of the greater sensitivity and precision of this analytical technique. The threshold values listed in table 4 were used to define the data set of 887 samples (table 1) shown on sheets 2 and 3 (maps A-D).

MAPS OF ANOMALOUS GEOCHEMICAL VALUES FOR ELEMENT GROUPS

Locations are shown (sheets 2-7) for samples that have anomalous geochemical values and can be used to (1) identify and characterize rock units that have high background values for specific elements or groups of elements, (2) help interpret stream-sediment data and anomalies, and (3) recognize geochemical patterns or systematic trends across geographic areas, rock units, and geologic terranes. This information, in concert with geologic, geophysical, and mineral-occurrence data, may indicate areas that have potential for undiscovered mineral resources.

Samples from some places in the Petersburg study area have anomalously high concentrations of more than one element. Locations of anomalous values for groups of elements that may be associated with some mineralizing processes were plotted on three multi-element maps (sheet 2, map B and sheet 3, maps A and B). Anomalous-value thresholds used to select the samples plotted on these maps are listed by element in table 4. These maps are intended to facilitate the recognition of geochemical signatures of specific deposit types where the specified groups of elements might be concentrated. The elements in these three groups may not uniquely match the element-concentration signature of a single-mineral deposit type but reflect common element associations of several deposit types that have similar or overlapping geochemical signatures.

Locations are shown for samples that contain anomalously high concentrations of one or more elements, as follows: sheet 2, map B--Ag, As, Au, Ba, Cu, Pb, Sb, Sr, eU or Zn; sheet 3, map A--Co, Cr, or Ni; and sheet 3, map B--Be, Bi, La, Mo, Nb, Sn, eU, W, or Y. The threshold values listed in table 4 were used for selecting samples from the entire 6,974-sample data set to be plotted on these maps. Locations are plotted on these maps for all samples from the entire data set where one or more analytical values for an element of that group is equal to or greater than its corresponding threshold value.

PRECIOUS METALS, BASE METALS, AND SIGNIFICANT ASSOCIATED ELEMENTS

Locations are shown (sheet 2, map B) for rock samples anomalously high in one or more of the following elements: Ag, As, Au, Ba, Cu, Pb, Sb, Sr, eU, and Zn. The associated elements were chosen for base- or precious-metal elemental affinities or as signatures of possible deposit types, such as some epithermal vein deposits, polymetallic vein and replacement deposits, massive-sulfide deposits, and sedimentary-exhalative deposits.

The distribution pattern formed by locations of samples that have anomalous values for this element group reveals several important features. The most striking of these is the pronounced concentration that lies along the Duncan Canal trend, especially near the south end of Duncan Canal, and follows the trend's southward extension across Zarembo and Etolin Islands. This concentration of anomalous samples is located within Mesozoic sedimentary and volcanic rocks of the Gravina belt and near contacts of Cretaceous and Tertiary igneous rocks that have intruded them.

Sample sites along the Duncan Canal trend that extend northward from northern Zarembo Island are characterized mainly by single-element anomalies for gold and copper; there are fewer anomalies for zinc and silver. This area also contains a number of different multi-element anomaly combinations including Au-As, Cu-Ag, Ag-Pb-Zn-Au, Cu-Zn-Ag, Zn-Pb-Ag-As, and two samples that have substantial anomalous Au-Ag-Sb-Cu-Pb-Zn. Anomalous samples from central Zarembo Island southeastward to Etolin Island are mostly single-element arsenic anomalies associated with Kuiu-Etolin belt igneous rocks and with minor gold and Pb-Zn anomalies.

Concentrations of anomalous sample locations for this element group also are found in the western part of the Coast plutonic-metamorphic complex, especially in the area near Groundhog Basin and, to a lesser extent, at the south end of Thomas Bay just west of Patterson Peak at the north margin of the study area. These anomalous samples come mainly from schist and gneiss that were intruded by granitic rocks and, in the Groundhog Basin area, by rhyolite and quartz-porphyry rhyolite dike swarms and by middle Tertiary granite. Single-element anomalies in this mainland area are mostly for gold or silver, but a few anomalies are for zinc or copper. Multi-element anomaly combinations consist of: Au-Ag, Ag-Pb, Cu-Ag, Au-Ag-Pb, Cu-Pb-Zn-Ag, Au-Ag-As-Pb, and Au-Ag-Cu-Pb-Zn.

The area of middle Tertiary felsic volcanic rocks on southwestern Kupreanof Island has a number of anomalous sample locations. Most of these are single-element anomalies for arsenic; a few anomalies are for silver or zinc. Single-element arsenic anomalies are also common in the felsic Cenozoic volcanic rocks on Zarembo Island. Two samples from the south shoreline of southwestern Kupreanof Island were anomalous for Pb-As and Pb-Zn. A smaller number of anomalies are scattered in Paleozoic sedimentary rocks on northern Prince of Wales Island; most of these are single-element anomalies for gold and some are for copper or silver. Paleozoic and Mesozoic carbonate and volcanic rocks near Saginaw Bay and on Cornwallis Peninsula that have bedded, podiform, and vein barite and zinc-lead-barite replacement mineralization yielded samples with Zn, Pb-Zn, Ag-Pb, and As-Ag-Cu-Pb-Zn anomalies.

Scattered sample locations on southern Kuiu Island have anomalous values for gold, lead, copper, and zinc. Samples from Crowley Bight and from the area north of Point St. Albans have multi-element anomalies that have especially high values for gold (as much as 8 ppm by atomic-absorption), silver (as much as 700 ppm), arsenic (as much as 10,000 ppm), antimony (as much as 5,000 ppm), and lead and zinc (as much as to 140,000 ppm). Most of the anomalous samples in this area are from rocks adjacent to small intermediate-composition Cretaceous granitic bodies.

In addition to the correlation with several bedrock geochemical groups, locations of anomalous samples for this group appear to be associated with several major structural features--the Keku Strait and Duncan Canal fault zones and the Coast Range megalineament, which lies along the western side of the tonalite sill belt of the Coast plutonic-metamorphic complex.

COBALT, CHROMIUM, AND NICKEL

Locations are shown (sheet 3, map A) for rock samples that have anomalous values for one or more of the elements cobalt, chromium, and nickel. All samples from the ultramafic body at Kane Peak, along Fredrick Sound on northeastern Kupreanof Island, have high values for both chromium and nickel, containing as much as 5,000 ppm chromium and as much as 1,500 ppm nickel. Two samples from this area also contain 100 and 200 ppm cobalt. Samples from the Blashke Islands in Clarence Strait contain as much as 1,500 ppm chromium and 700 ppm 10 nickel and one sample also has 100 ppm cobalt.

Samples from the ultramafic body at Turn Mountain on northern Kupreanof Island do not contain anomalous amounts of chromium or nickel, although three samples have 100 ppm cobalt. Scattered samples associated with small hornblendite bodies along Zimovia Strait have nickel values above the threshold level; one sample has a chromium value above the threshold level. Scattered anomalous samples from near Washington Bay, on northwestern Kuiu Island, contain 200-300 ppm nickel, and some have 1,000 ppm chromium.

Scattered anomalous samples from along the Duncan Canal trend are mainly from the Gravina belt. About half of these samples have low single-element cobalt anomalies and several have Cu-Ni, Cr-Ni, or Co-Cr-Ni anomalies; these values are lower than those at Kane Peak. Anomalies for Co, Ni, Cr, Cr-Ni, and Co-Cr-Ni are found in a narrow belt parallel to the Coast Range megalineament in the Groundhog Basin area. These samples all come from the margins of intermediate- to felsic-composition igneous bodies. Anomalous values for cobalt, chromium, or nickel are essentially absent in rocks of the Kuiu-Etolin belt and in the Tertiary gabbro near Keku Strait. It should be noted, however, that the highest values for cobalt, chromium, and nickel from samples in this study are within a factor of 2 of the average concentration in ultramafic rocks (Levinson, 1974, p. 43).

SELECTED RARE OR SCARCE ELEMENTS

Locations are shown (sheet 3, map B) for rock samples that have anomalous levels of the selected rare metals Be, Bi, La, Mo, Nb, Sn, eU, W, or Y. This group was chosen because these elements commonly show strong enrichment in highly evolved, felsic igneous rocks and because of their potential for signalling the presence of molybdenum, tin, and tungsten deposits associated with late-magmatic and postmagmatic fluids. Elements of this group are commonly enriched in several types of mineral deposits, including molybdenum porphyry deposits, vein deposits, greisen deposits, tin skarn, and tungsten skarn.

The largest number of anomalous samples for this element group are concentrated in and near the Kuiu-Etolin belt igneous rocks on Etolin, Zarembo, and southwestern Kupreanof Islands. This pattern reflects the highly evolved nature of the magmas that produced many of these rocks. Deer Island, Etolin Island, and the Cenozoic volcanic (bedrock geochemical group 11) part of Zarembo Island are characterized by low-level single-element anomalies, mostly for lanthenum and beryllium, but also for all other elements in this group. In the Cenozoic volcanic rocks on southwestern Kupreanof Island, over half of the anomalous samples have multi-element anomalies for La-Nb-Y, La-Y, Be-La-Nb-Sn-Y, Be-La, and Be-Mo; there are no anomalies for bismuth and tungsten. All anomalous values are at relatively low concentration levels, not far above the selected anomalous threshold levels.

Anomalous-sample sites for this element group are also concentrated in the Coast plutonic-metamorphic complex of the Mainland belt, mostly in the Groundhog Basin area but also in the area extending north to Le Conte Bay. These anomalous values are found in schist, gneiss, and granitic rocks. Of these anomalous samples, two-thirds, including the highest concentrations, are from the general area of Groundhog Basin. This area is cut by swarms of rhyolite and quartz-porphyry rhyolite dikes and by some small granite stocks. Four low-level lanthanum anomalies and one molybdenum anomaly are located within the tonalite sill belt. All other anomalies are west of this belt. North of the Stikine River, there is one tin anomaly from the margin of a small Cretaceous granitic stock and five molybdenum anomalies in schist. In the Groundhog Basin area, most single-element anomalies are for tin or molybdenum and a few are for beryllium or niobium. Multi-element anomalies in this area include Be-Sn, La-Nb, Be-Nb-Sn-Y, Be-Bi-Mo-Sn-Y, and Mo-Bi-Sn (very high levels of Bi and Sn).

Most of the remaining anomalous samples for this element group come from within or near areas of carbonate rocks; a lesser number come from Paleozoic volcanic and clastic sedimentary rocks on northeastern Prince of Wales Island or near Saginaw Bay. Most anomalies on Prince of Wales Island are low-level single-element anomalies for bismuth; a few anomalies are for niobium and molybdenum. The only really high values and the only multi-element anomalies on Prince of Wales Island are along the shore at the northeast corner of the island. Here, there are high concentrations of Be-La-Nb-Y, La-Mo-Nb, and La-Nb in samples from Paleozoic sedimentary rocks. Several small clusters of single-element anomalous values for molybdenum are associated with intermediate-composition granitic plutons on southern Kuiu Island, especially near the contacts. There are a few additional anomalous tungsten values in Davidson Bay. Most of Kuiu, Prince of Wales, and Kupreanof Islands, including the Duncan Canal area, are essentially devoid of locations that have anomalous values for this element group.

The quartz-porphyry rhyolite dikes and granite stocks in the Mainland belt near Groundhog Basin have traces of visible molybdenite and are similar to rocks seen near porphyritic molybdenum deposits at Burroughs Bay and Quartz Hill, 70 and 150 km to the southeast, respectively. This association of lithologic and chemical features in the Groundhog Basin area has attracted commercial interest in the recent past. The areas of anomalous values in silicic rocks of the Kuiu-Etolin belt have appropriate lithologies for buried porphyritic molybdenum or Cu-Mo systems, although the target metals are not present in anomalous amounts. Instead, bismuth and tin are present in anomalous amounts. Part of the heterogeneous intrusive complex on Etolin Island, at the south end of the Kuiu-Etolin belt, is alkaline to peralkaline in composition and is associated with a conspicuous cluster of anomalous samples from this element group, although the target elements, again, are not anomalous here. Some of these rocks resemble a granite 30 km east of the study area, which has elevated tin, uranium, and molybdenum levels and at least minor associated base-metal skarn or epithermal vein-type mineralization.

The association of anomalies of this element group with some pluton contacts and, in several places, with carbonate rocks suggests the possibility of tin- and (or) tungsten-skarn, greisen, replacement, or vein deposits.

BEDROCK GEOCHEMICAL GROUPS

To compensate for background values of certain elements that are higher in some lithologies than in others, each of the 6,974 rock samples collected in the study area was assigned to one of 12 bedrock geochemical groups on the basis of its lithology and (generalized) geologic map unit (sheet 1). In the procedure described below, the level at which an analytical value is considered anomalous depends on the bedrock geochemical group to which that sample has been assigned. This helps to neutralize the effect of different background levels associated with different lithologies and rock units and to enhance detection of greater-than-background-level concentrations of elements in lithologic groups that have lower background levels. Any number of bedrock geochemical groups could be used in this exercise, depending on the diversity of rock units in the map area. In this study, 11 groups effectively represent most of the lithologies in the area that have distinct chemical characters, such as carbonate rocks, mafic igneous rocks, and felsic or silicic igneous rocks. The twelfth group is a heterogeneous collection of lithologies for which there are not sufficient samples to make statistically viable separate groups. Map units were used to determine the areal extent of specific lithologies for the purposes of sheet 1; however, the lithologic designation for each sample in all 12 groups was assigned by the sample collector.

A brief description of the rocks included in each of the 12 bedrock geochemical groups chosen for the Petersburg study area follows:

Group 1--This group is composed of Paleozoic clastic sedimentary and volcanic rocks in the Alexander belt, which are predominantly turbidites of the Descon and Bay of Pillars Formations (Brew and others, 1984). These turbidites consist of massive graywacke and subordinate conglomerate and shale. Volcanic rocks are rare and intermediate to mafic in composition. Group 1 also includes Devonian arkose near Saginaw Bay and sandstone, shale, and chert in the Saginaw Bay and Cannery Formations.

Group 2--Paleozoic carbonates in the Alexander belt comprise this group and include the Kuiu and Heceta Limestones, limestone in the Bay of Pillars Formation, Devonian and Carboniferous unnamed limestone near Keku Straits and Duncan Canal, and limestone and dolomite in the Permian Halleck and Pybus Formations.

Group 3--This group consists of Triassic mafic volcanic rocks in the Alexander belt, chiefly the Hound Island Volcanics, Keku Volcanics, and unnamed volcanic rocks along Duncan Canal. The volcanic rocks include mainly basaltic pillow lava flows and breccias and minor aquagene tuff and andesitic volcanic breccia.

Group 4--Mesozoic felsic volcanic rocks in the Gravina and Kuiu-Etolin belts comprise this group and include felsic volcanic components of the Keku Volcanics and felsic volcanic rocks inferred to be Triassic in age (H.C. Berg, unpub. data, 1979) in the Duncan Canal area and on Zarembo Island. Rare occurrences of felsic volcanic rocks in the Gravina belt may be as young as Cretaceous, but there is no age information available for these rocks.

Group 5--This group consists of Mesozoic carbonate rocks in all belts, including the predominantly Triassic carbonate rocks in the Keku Straits area and in the Hound Island Volcanics, Hamilton Island Limestone, Burnt Island Conglomerate, and Cornwallis Limestone, as well as rocks comprising the Screen Islands (in Clarence Strait) and along Duncan Canal. Marbles of unknown age in the Coast plutonic-metamorphic complex, which are intruded by latest Cretaceous to Late Tertiary plutonic rocks (Brew and others, 1984; Gehrels and others, 1984), are also included in this group.

Group 6--Upper Mesozoic sedimentary and volcanic rocks in the Gravina belt comprise this group and primarily include intercalated graywacke turbidites, volcaniclastic rocks, and volcanic flows of the Stephens Passage Group, as well as the Cretaceous flysch in the Keku Straits area.

Group 7--This group consists of metamorphic rocks associated with the Coast plutonic-metamorphic complex of the Mainland belt, including biotite and hornblende schist and gneiss and schist and gneissic components of migmatites.

Group 8--This group is comprised of ultramafic rocks, which include the Blashke Islands ultramafic complex of (Kennedy and Walton, 1946) in the Alexander belt and the (informal) Kane Peak ultramafic complex of Taylor (1967) in the Gravina belt, hornblendites in the Zimovia Straits area and at Turn Mountain, and xenoliths and masses of pyroxenite and amphibolite in the Coast plutonic-metamorphic complex of the Mainland belt.

Group 9--Cenozoic mafic igneous rocks in the Kuiu-Etolin belt comprise this group which includes mainly Tertiary and Quaternary basalt and basaltic andesite on Zarembo, Kupreanof, and Kuiu Islands, as well as Tertiary gabbro on Kupreanof Island.

Group 10--This group consists of intermediate-composition intrusive rocks in all belts, including Cretaceous granodiorite, quartz monzonite, monzonite, quartz monzodiorite, monzodiorite, quartz diorite, tonalite, and diorite on Kuiu, Prince of Wales, Kupreanof, Mitkof, Zarembo, Wrangell, Etolin and smaller islands. The group also includes intrusive rocks of the tonalite sill belt (Brew and Ford, 1981) and early to middle Tertiary granite, granodiorite, tonalite, and (quartz) monzonite on the mainland in the Coast plutonic-metamorphic complex.

Group 11--This group is comprised of Cenozoic felsic igneous rocks in the Kuiu-Etolin belt and includes rhyolite and dacite on Kuiu, Kupreanof, Zarembo, and Etolin Islands and rhyolite dike swarms on the mainland, as well as granitic and syenitic plutons on Kuiu, Kupreanof, Zarembo, and Etolin Islands.

Group 12--Various heterogeneous rocks in all belts comprise this group, which includes dikes, as well as some rock units that cover relatively small proportions of the map area; the rocks were not lithologically and geochemically similar enough to one of the existing groups to be included there. The largest map unit included in group 12 is the Tertiary Kootznahoo Formation (Lathram and others, 1965), which consists of sandstone and conglomerate. Rocks in group 12 are so diverse and unclassifiable that they were not included in the single-element anomalous value maps. Samples assigned to group 12 are included in the four multi-element location maps (sheets 2 and 3) and are part of the data set (Karl and others, 1985, table 12) from which samples that had anomalous geochemical values (table 1) were selected.

MAPS OF SINGLE-ELEMENT ANOMALOUS VALUES

Summary statistics were computed and frequency distribution histograms and tables prepared on each of the first 11 bedrock geochemical groups (fig. 2, tables 5-12). Group 12 was not included in the data set used to make these maps because of its extremely diverse composition. This group contains insufficient samples of individual rock types to obtain valid statistical results for geochemically similar subsets of that group. Although samples from quartz veins and certain mineralized and potentially mineralized dikes of this group are not incorporated on sheets 4-7, these samples are represented in the element groups on sheets 2 and 3. Single-element maps were constructed, on the basis of statistical data from the 11 bedrock geochemical groups, for Ba, Cr, Co, Cu, Pb, Mo, Ni, and Zn. These elements were selected because they provide the most useful information for defining areas of economic interest. Precious metals are not sufficiently abundant for statistical analysis.

For the purposes of these single-element maps, analytical values at or above the level of the 95th percentile were considered unusual expressions of a particular element. For each bedrock geochemical group, four separate threshold levels were chosen at approximately the 95th, 97th, 98th, and 99th percentiles for each of the elements. Some of the threshold levels were adjusted slightly on the basis of inspection of distribution histograms. Locations of samples in bedrock geochemical groups (groups 1-11) are plotted on single-element maps and include separate symbols representing the four anomalous threshold levels and numbers representing the lithology of the sample. Because threshold levels were chosen so that each bedrock geochemical group has approximately the same percentage of "anomalous samples", bedrock geochemical groups that have relatively high background levels in a particular element, such as copper in graywackes and mafic volcanic rocks of the Gravina belt, do not obscure anomalous copper values in the rest of the study area by dominating the 95th and higher percentiles.

A disadvantage to this normalizing procedure is that the resulting anomalous-value rock geochemical maps (sheets 4-7) are not directly comparable to the stream-sediment geochemical anomaly maps (Cathrall and others 1983 a-w). However, the normalized rock geochemical maps could be used to distinguish a stream having samples yielding high values for a metal, such as one that drains a rock unit that has high background-level zinc from a stream that drains an area that has low background-level zinc and a significant geochemical anomaly. The distribution and nonweighted character of samples on the nonnormalized maps (sheets 2 and 3) is consistent with that on normal stream-sediment anomaly maps. Sediment samples integrate geochemical abundances of all material in a specific drainage, and high background-level concentrations from one lithologic unit influence the values in stream sediment composed of several lithologies.

This statistical procedure does not discriminate between values that are simply the upper end of a normal distribution of background values and those that represent an unusual concentration of an element resulting from mineralizing processes. It also does not automatically discriminate between high background levels and data from a unit that is pervasively mineralized so that there is no distinct, statistical differentiation between "background" and "mineralized" concentration levels. Thus, values treated here as anomalous may or may not have mineral resource significance.

BARIUM

The most important concentration of anomalous barium values is found along the Duncan Canal fault zone in Duncan Canal and trends south across central Zarembo Island (sheet 4, map A). Duncan Canal contains broken-up, massive-sulfide-bearing blocks of Paleozoic and Mesozoic carbonate and volcanic rocks (for example, the Castle Islands) incorporated into Mesozoic flysch and melange of the Gravina belt (bedrock group 6). Most of the anomalous samples from this area are from metasedimentary or metavolcanic rocks, but a few samples are from carbonate rocks.

A cluster of anomalous values just north of the Stikine River in the Mainland belt is located in an area of middle to late Tertiary intermediate-composition plutonic rocks (bedrock group 10), which also include zones of amphibolite-facies schist and gneiss (bedrock group 7). Another tightly packed cluster of anomalous sample locations is located at Groundhog Basin. In each of these localities, both the intermediate-composition igneous rocks and the metamorphic rocks have high barium values.

A number of samples from the heterogeneous intrusive igneous complex on central and southern Etolin Island, which is part of the Kuiu-Etolin belt (fig. 1), contain anomalous values for barium. Most of these samples are very felsic and alkaline to peralkaline. A lithophilic association of barium with potassium feldspar may account for some or all of these anomalies. Barium is commonly concentrated significantly more in alkaline than in calc-alkaline rocks; this is probably the reason that rocks rich in potassium feldspar are higher in barium than most of the granitic rocks in the study area.

A group of anomalous sample sites on the north side of Keku Strait lies in a section of Paleozoic volcanic and sedimentary rocks (bedrock group 1). Of the few widely scattered anomalies in the rest of the study area, most are found near the margins of plutons or in carbonate rocks.

Barium commonly forms veins and cavity fillings in epithermal deposits, where it may be associated with base-metal (copper, lead, and zinc) sulfides and (or) with precious metals. Any barite deposits in the Mainland belt would likely be of this type. Barite has been mined from the Castle Islands in Duncan Canal, from a deposit (now below sea level) described as a probable replacement of carbonate (Buddington and Chapin, 1929; Grybeck and others, 1984) but more recently classified as bedded barite (Orris, 1986). Bedded or stratiform barite, which may be associated with some (lead and zinc) volcanogenic massive-sulfide deposits, is a possibility in the mafic metavolcanic rocks in the Duncan Canal area and in the vicinity of Keku Strait.

CHROMIUM

The strongest concentration of chromium anomalies lies in the ultramafic body at the east end of the Kane Peak intrusive complex (sheet 4, map B). Several additional anomalies lie in intermediate-composition granitic rocks of the complex near that ultramafic body and in nearby country rocks of the Gravina belt. Three samples from the Blashke Islands ultramafic complex had anomalous chromium concentrations--one high and two threshold level 1 anomalies. None of the chromium analyses (not included in this report--see Karl and others, 1985; Koch and others, 1984) done on ultramafic rocks in the study area in conjunction with major-element analyses had concentrations in excess of average abundances for ultramafic lithologic types (Carmichael, 1982, table 18).

A small cluster of high anomalous values is found in Paleozoic volcanic and clastic sedimantary rocks of the Alexander belt northeast of Keku Strait. Anomalous chromium values are distributed along the upper part of Duncan Canal and around its south end.

Scattered anomalous values are located on Zarembo, Etolin, and Deer Islands, crudely following the trend of the Gravina and Kuiu-Etolin belts. Most of the anomalous samples from this area are from Gravina belt schist or Kuiu-Etolin belt felsic igneous rocks. Scattered anomalies are found in schist and carbonate rocks and in and near granitic rocks. Most of the anomalies are in the Mainland belt between Wrangell Island and the Stikine River (the Groundhog Basin area), some are on Wrangell Island, and a few are scattered elsewhere in the study area.

Significant chromium deposits are unlikely in most of the lithologies represented in the study area. Paleo-placer deposits are possible within some of the sedimentary sequences. There may be some degree of structural control for the high chromium values that line up along the trend of the Port Beauclerc fault or along the axis of Duncan Canal. There are a few small, metamorphosed, tectonically emplaced ultramafic bodies in the Coast Range in the adjoining Bradfield Canal quadrangle east of the study area. Similar small bodies could easily be present within the metavolcanic rocks in this area without being readily apparent. Small ultramafic bodies could contain podiform chromite deposits.

COBALT

The majority of cobalt values at and above the lowest threshold value came from samples scattered along the Duncan Canal trend, extending from northern Kupreanof Island south along Duncan Canal and across Zarembo Island to Etolin Island (sheet 5, map A). Clustering and density of these sites diminishes at the ends of this zone--at the northern part of Kupreanof Island and from about the center of Zarembo Island southeastward. The rocks from this zone, which have high cobalt values, come from several different bedrock geochemical groups--mostly felsic and intermediate-composition igneous rocks on Etolin and Zarembo Islands and these same lithologies plus Gravina belt metavolcanic rocks and some Mesozoic felsic volcanic rocks in Duncan Canal.

Anomalous values are located at both the Blashke Islands ultramafic complex and at the Kane Peak intrusive complex; except for one sample, the Kane Peak values come from granitic, not ultramafic rocks. The Blashke Islands samples yielded only a single value in each of threshold levels 1 (the lowest) and 4 (the highest). A cluster of anomalous values at and near the ultramafic body at Turn Mountain is found in a variety of lithologies, including the ultramafic body itself and intermediate-composition granitic rocks, metasedimentary rocks, and chert.

The second largest concentration of high cobalt values is in samples from schist and gneiss of the west margin of the Coast plutonic-metamorphic complex of the Mainland belt. The highest values and greatest density of anomalous sites there come from the Groundhog Basin area. North of the Stikine River, anomalous values are widely scattered and, with one exception at the south end of Thomas Bay, are all of threshold level 1.

Widely scattered, high threshold values are found on Kuiu Island, mostly from samples of intermediate-composition granitic bodies, but also from a few samples of Paleozoic carbonate rocks and sandstone. High cobalt values in intermediate-composition plutonic rocks do not show a preference for association with the plutons that intrude the Gravina belt or the Alexander belt; however, high cobalt values tend to be lacking in plutons of the Coast plutonic-metamorphic complex.

Cobalt is commonly concentrated in hydrothermal veins and replacement deposits, massive-sulfide deposits, and contact-metamorphic deposits, which are dominated by other metals. The large number of high values in the Groundhog Basin area and along the Duncan Canal trend are probably associated with the enrichment seen in other elements in these areas, particularly in copper, lead, zinc, gold, and silver.

COPPER

The largest concentration of anomalously high copper values, including about half of the samples with copper values at or above threshold level 1, lies along the Duncan Canal trend from north-central Kupreanof Island to central Zarembo Island (sheet 5, map B). The majority of these samples are from sandstone, slate, phyllite, and mafic igneous rocks of the Gravina belt, but they also include samples of bedrock geochemical groups 2 and 5 (Paleozoic and Mesozoic carbonate rocks) and groups 10 and 11 (intermediate-composition and felsic igneous rocks). Numerous small sulfide deposits are found in this area (Grybeck and others, 1984).

Anomalous sample sites are scattered much less densely in intermediate-composition granitic rocks (group 10) on eastern Kupreanof Island (the Lindenberg Peninsula) and on Mitkof Island. On Etolin Island, scattered anomalies are associated mainly with felsic and intermediate-composition igneous rocks of the Kuiu-Etolin belt.

A thin, discontinuous band of sites that has anomalous copper values extends along the west margin of the Coast plutonic-metamorphic complex. The sites are mainly in schist and gneiss, but one site is in skarn and a few are in jasperoid. Several of these sites also have high values for lead, zinc, gold, and silver. Most of the sites that have high copper values are within 2 km of the Coast Range megalineament. Within this zone, the largest concentration of anomalous samples is from an area in and around Groundhog Basin, where some of the anomalies are in Cenozoic felsic igneous rocks, as well as in the schist and gneiss country rock.

Large areas on Kuiu, Kupreanof, and Prince of Wales Islands, including most of the felsic volcanic rocks on southwestern Kupreanof Island, have few or no anomalous sample sites for copper. Scattered isolated anomalies and small clusters are associated with sandstone, siltstone, and carbonate rocks of bedrock geochemical group 1, with the margins of felsic and intermediate-composition granitic bodies (mainly on southern Kuiu and northern Prince of Wales Islands), and with skarns (on Prince of Wales Island).

Potential types of copper deposits for the study area include massive-sulfide and stratiform deposits, especially along the Duncan Canal trend. Vein, skarn, and porphyry-type deposits could be associated with intermediate-composition and felsic igneous intrusive rocks.

LEAD

There are two main concentrations of sites that have anomalous lead values (sheet 6, map A). In the Groundhog Basin area, a narrow belt of anomalous sites, most with values of threshold levels 3 and 4, lies in the belt of metamorphic rocks a short distance west of the tonalite sill belt. The high values here are found in phyllite, schist, and gneiss and in Cretaceous and Tertiary intermediate-composition and felsic igneous rocks of bedrock geochemical groups 10 and 11. There are also high values in samples of jasperoid and silicified schist. Lead anomalies are conspicuously absent from this same structural position north of the Stikine River, except for three sites. One of these sites, on the east shore of Thomas Bay, has multiple anomalies from threshold levels 1 to 4. At this site, the Thomas Bay prospect, pyritized and silicified schist and quartz veinlets reportedly containing gold, argentiferous galena, pyrite, arsenopyrite, chalcopyrite, and pyrrhotite have been prospected.

A second dense clustering of high lead values is found on north-central Zarembo Island in a variety of lithologies, including mafic and felsic Cenozoic volcanic rocks, Cretaceous intermediate-composition granitic rocks, and jasperoid zones. The concentration of lead anomalies along the Duncan Canal trend is weaker than for copper, chromium, barium, or cobalt, but lead anomalies are broadly scattered along a band extending from Etolin Island northwestward across Zarembo Island and up the Duncan Canal trend to the north edge of Kupreanof Island. On Etolin Island, the high values are associated with intermediate-composition and felsic granitic rocks. On Kupreanof Island, they are in Gravina belt metasedimentary rocks and jasperoid. On southern Kuiu Island and northern Prince of Wales Island, small numbers of high lead values are located near the margins of intermediate-composition granitic plutons, both in the Paleozoic country rocks and in the granitic rocks. On northeastern Prince of Wales Island near Salmon Bay, there are a number of sites in jasperoid that have high lead values. Low threshold-level lead anomalies are moderately abundant in Paleozoic siltstone, sandstone, conglomerate, and limestone adjacent to Saginaw Bay on northern Kuiu Island.

Lead can occur in a wide variety of ore deposits, a number of which could exist within the study area. These include stratiform, sedimentary-exhalative, contact-metamorphic, hydrothermal replacement and vein deposits. In the Groundhog Basin area within the Mainland belt, lead is found in solid sulfide bodies containing pyrrhotite, sphalerite, galena, and other sulfides and in disseminated deposits in schist. Elevated lead values, without visible lead mineralization, also are found in silicic intrusive rocks in this area.

MOLYBDENUM

Sites of samples with molybdenum at or above threshold level 1 do not form well-defined patterns but are scattered across much of the study area (sheet 6, map B). The Coast Range area of the Mainland belt, east of the Coast Range megalineament, is conspicuous for its lack of anomalous molybdenum values.

High molybdenum values are found at several single sites and in small tight clusters. A small area on northwestern Zarembo Island contains the largest concentration of anomalies, which are found in Mesozoic and Cretaceous felsic volcanic rocks, intermediate-composition intrusive rocks, and jasperoid zones. A number of these sites are also anomalous for gold, silver, copper, and lead; one site is also anomalous for zinc. A second tight cluster is found just west of the head of Affleck Canal on southern Kuiu Island in a small granitic stock and in the adjacent Alexander belt country rocks and jasperoid zones.

Sites that have anomalous molybdenum values are scattered across much of the mainland belt west of the Coast Range megalineament and across Wrangell and Woronkofski Islands; these samples are mainly from schist, but some are from intermediate-composition granitic rocks.

In general, high molybdenum values in the Petersburg study area are found in sedimentary rocks of the Alexander and Gravina belts and in granitic rocks, mainly of intermediate composition. The conspicuous lack of high molybdenum values in the Coast plutonic-metamorphic complex may exist because these plutons are exposed and eroded to a deeper level than the plutons to the west.

Sparsely disseminated molybdenite and stockwork fracture fillings are found in very felsic granite and rhyolite intrusive rocks in the Groundhog Basin area. Disseminated and stockwork molybdenum deposits in granite and rhyolite dikes also are found in the Coast Range to the southeast of the study area; similar deposits could exist in the Petersburg study area. Molybdenum deposits could also occur as skarns and tactites and in silicified (jasperoid) zones.

NICKEL

Sites that have high values for nickel are not tightly clustered but are broadly distributed in several general areas (sheet 7, map A). The largest of these areas coincides with the Gravina belt from central Kupreanof Island to Etolin, Wrangell, and Deer Islands in the southeast. Most of the anomalous nickel values in this area are from samples of Gravina belt volcanic rocks, Mesozoic granitic rocks (mostly of intermediate composition), or Cenozoic granitic rocks on Etolin Island. A number of anomalous values are found in schist in the Groundhog Basin area and farther north along Le Conte Bay. One sample of intrusive rhyolite from the Groundhog Basin area has very high values for copper, lead, zinc, silver, and nickel. On northern Kuiu Island, relatively high values of nickel are also scattered in Alexander belt rocks and in the granitic rocks that intruded them. A cluster of nickel anomalies in Alexander belt rocks (bedrock group 1) also is found on the northeast side of Keku Strait; this cluster also has high chromium values. High values of nickel are found in several samples of ultramafic rock and one of country rock from the Blashke Islands and in granodiorite and country rocks adjacent to the ultramafic body at Kane Peak. No high nickel values were found in the Turn Mountain ultramafic body.

Many of the high nickel values and clusters of high nickel values are not matched by high cobalt values but are similar to patterns for chromium. A weak trend of lithologically independent high values also is found along Duncan Canal and along the Port Beauclerc fault.

ZINC

Similar to lead, the two most significant concentrations of sites that have anomalous zinc values are found in the Groundhog Basin area and on north-central Zarembo Island (sheet 7, map B). In the Groundhog Basin area, the zone of zinc anomalies is largely coincident with the area of high lead values and is located in schist and gneiss, Cretaceous granitic rocks, and Cenozoic felsic igneous rocks, which form a belt west of the Coast plutonic-metamorphic complex. North of Mount Waters, the high zinc values lie farther west than the lead values, are more numerous, and are located mostly in granitic rocks, not schist. As for lead, the Thomas Bay site has a conspicuous set of anomalous zinc values.

On Zarembo Island the distribution of zinc anomalies is also very similar to that of lead, forming a dense cluster in the northwest corner of the island mainly in Gravina belt rocks, in intermediate-composition and felsic igneous rocks, and in jasperoid. Scattered high values are found in metamorphic rocks along the Duncan Canal trend on central Kupreanof Island and in felsic igneous rocks mainly in, and especially near, the edge of Kuiu-Etolin belt rocks on southwestern Kupreanof Island. About half of these latter anomalous samples have high lead values, too. Several sites that have the highest values of zinc in the Duncan Canal area are found in jasperoid, and these sites also have high values for gold, silver, copper, lead, and antimony.

Scattered high zinc values are found in Alexander belt siltstone, limestone, and marble near Saginaw Bay at the north end of Kuiu Island, adjacent to granitic stocks on southwestern Kuiu Island, and in shale on the eastern side of Prince of Wales Island near Thorne and Stevenson Islands.

Within the study area, zinc is concentrated in massive- and disseminated-sulfide deposits in metamorphic rocks and in veins and silicified zones.

SUMMARY AND CONCLUSIONS

Variation in background element-concentration levels between different lithologic units can, for some elements, influence both geochemical statistics and the distribution pattern of the high-end ("anomalous") values. Utilization of a multiple-threshold procedure, where cutoff levels for identifying anomalous element concentrations are set relative to populations of samples of similar geochemical type, can help to overcome this effect and can aid in the identification of patterns of elemental enrichment. This procedure tends to neutralize the effect on the distribution pattern of high-end values of differing background levels in different lithologic units. This makes the distribution patterns more responsive to postdepositional concentration processes and less sensitive to the distribution of lithologic types and units. Graphical treatment of element-concentration data for groups of geochemically related elements can produce distribution patterns that indicate target or potential areas for specific mineral deposit types and groups of deposit types.

Geochemical patterns are recognizable in the Petersburg study area, and the locations of bedrock geochemical anomalies generally correspond well with locations of stream-sediment and pan-concentrate geochemical anomalous values (Cathral and others, 1983 a-w). The clustering of multi-element anomalous values at localities of known mineralization (Grybeck and others, 1984) gives credibility to the cluster patterns in several new areas (sheets 4-7). The most prominent areas of both known sulfide mineralization and high bedrock geochemical values include the Groundhog Basin area on the mainland, Zarembo Island, Duncan Canal, the area around Saginaw Bay, and the head of Shakan Bay. Two of the more interesting new areas noted in this study are the area underlain by felsic volcanic rocks of the Kuiu-Etolin belt on southwestern Kupreanof Island and northernmost Kuiu Island.

High values for several groups of base and precious metals also are found near the Blashke Islands and Kane Peak ultramafic complexes, the southwestern Kupreanof Island felsic volcanic rocks, near Port Malmesbury, Washington Bay, and Kadake Bay, near intermediate-composition plutons on southern Kuiu island, and in hornfelsed country rocks at Whale Passage.

There are also apparently random instances of anomalous values for metals in the metamorphic rocks and migmatites on the mainland, in the hornfelsed turbidites on southern Kuiu and northern Kosciusko Islands, around the alkalic granitic rocks on Etolin Island, and peripheral to the intermediate-composition plutons on Mitkof and northern Kupreanof Islands. For these localities, stream-sediment data (Cathrall and others, 1983 a-w) do not corroborate the pattern of the rock geochemical anomalies. The significance of these random anomalous values is that they may suggest favorability for resources in a particular lithologic type or a particular rock unit.

Rocks anomalous with respect to precious metals are found predominantly near Duncan Canal, in the Groundhog Basin area, and on Zarembo, Etolin, and southwestern Kupreanof Islands. Rocks anomalous with respect to base metals tend to crop out in the same places as those anomalous in precious metals, as well as in the area northeast of Saginaw Bay and in areas peripheral to the plutons throughout the study area. Rocks anomalous with respect to rare metals generally are found in association with Tertiary igneous rocks in the Coast Range and in the Kuiu-Etolin belt.

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Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area.

EXPLANATION

Histogram bars consist of symbols as follows:

X	Represents a percentage increment (value indicated below each histogram)
I	Top increment of a histogram bar.
+	No values in this class interval

Element concentrations are expressed in parts per million. Because so few values are above the lower limit of analytical determinability for gold and tungsten, histograms and statistics for both of the kinds of analyses performed for these elements are shown. For copper, lead, and zinc, only the results from atomic-absorption analyses, and not the spectrographic results, are shown because these are more precise and are determined on a larger volume of sample material. Data from atomic-absorption and colorimetric analyses and the equivalent uranium values have been reassigned to values on the same six-step scale used to report the spectrographic data. Data and statistical summaries for all of the analytical data collected in the Petersburg study area are available in Karl and others (1985) and Koch and others (1984).

Some of the data values are qualified with single-letter symbols, indicating a special condition for that value as described below. The number and percentage of analytical values qualified with each of these codes and the number of unqualified values are listed below each histogram, both as a raw number and as a percentage. The total number of analyses is also listed.

B	Blank (analysis was not performed)	
	Number	Number of values qualified with "B"
	Percent	As a percentage of all samples
H	Analytical interference influenced value	
	Number	Number of values qualified with "H"
	Percent	As a percentage of all samples
N	Nothing detected. Below limit of analytical determinability	
	Number	Number of values qualified with "N"
	Percent	As a percentage of all values not coded "B" or "H"
L	Detected, but below limit of analytical determinability	
	Number	Number of values qualified with "L"
	Percent	As a percentage of all values not coded "B" or "H"
G	Detected, but above limit of analytical determinability	
	Number	Number of values qualified with "G"
	Percent	As a percentage of all values not coded "B" or "H"

Other abbreviations used in this section are as follows:

UNQUAL	Number	Number of unqualified data values
	Percent	As a percentage of the number of analyses
ANAL	Number	Number of analytical values for this type of analysis
READ	Number	Total number of samples collected

The arithmetic mean, standard deviation, geometric mean, and geometric deviation computed for all unqualified values are listed below each histogram, along with the minimum and maximum unqualified data values. In cases where any of the data values are qualified with codes N, L, or G, estimates of the true values of minimum, maximum, the means, and the deviations were recalculated after setting all values with code N equal to 1/4 the lower determination limit, setting values with code L equal to 1/2 the lower determination limit, and setting values with code G equal to twice the upper determination limit. These estimates are listed on a separate line, immediately below the values calculated using only the unqualified data. The number of data values used in each of these calculations is listed at the right end of these lines.

Abbreviations used in this section are as follows:

MIN	Minimum value
MAX	Maximum value
AMEAN	Arithmetic mean
SD	Standard deviation
GMEAN	Geometric mean
GD	Geometric deviation
VALUES	Number of data values used to determine the above statistics

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

ANTIMONY CONTENT, IN PARTS PER MILLION

```
      +---------+---------+---------+---------+---------+---------+
  100 X|
  150 |
  200 |
  300 +
  500 |
  700 +
 1000 +
 1500 +
 2000 +
 3000 |
 5000 |
      +---------+---------+---------+---------+---------+---------+
      0         1         2         3         4         5         6
                      PERCENT OF ANALYZED SAMPLES
```

Each increment (each "X" or "|" plotted) = 0.1%

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	6957	2	0	15	6974	6974
Percent of values	0.0	0.0	99.8	0.0	0.0	0.2		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	100	5000	1383	1866	437	5.1	15
Recalculated	25	5000	28	105	25	1.2	6974

ANTIMONY (SPECTROGRAPHIC ANALYSIS)

ARSENIC CONTENT, IN PARTS PER MILLION

```
      +---------+---------+---------+---------+---------+---------+
  200 XXXX|
  300 X|
  500 |
  700 X|
 1000 X|
 1500 X|
 2000 |
 3000 |
 5000 |
 7000 +
10000 X|
      +---------+---------+---------+---------+---------+---------+
      0         1         2         3         4         5         6
                      PERCENT OF ANALYZED SAMPLES
```

Each increment (each "X" or "|" plotted) = 0.1%

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	6879	30	4	61	6974	6974
Percent of values	0.0	0.0	98.6	0.4	0.1	0.9		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	200	10000	1436	2705	534	3.6	61
Recalculated	50	20000	74	555	51	1.3	6974

ARSENIC (SPECTROGRAPHIC ANALYSIS)

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

```
                       +---------+---------+---------+---------+---------+---------+
                    20 XX|
                    30 X|
                    50 XXXX|
 BARIUM CONTENT,    70 XXX|
 IN PARTS PER      100 XXXXXXXXXX|
 MILLION           150 XXXXXXXXXX|
                   200 XXXXXXXXXXXXXXXXXXX|
                   300 XXXXXXXXXXXXXXXXXXXXXXXX|
                   500 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
                   700 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
                  1000 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
                  1500 XXXXXXXXXX|
                  2000 XXXXXXX|
                  3000 XX|
                  5000 XX|
                       +---------+---------+---------+---------+---------+---------+
                       0         5        10        15        20        25        30
                                        PERCENT OF ANALYZED SAMPLES

                    Each increment (each "X" or "|" plotted) = 0.5%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	181	59	37	6697	6974	6974
Percent of values	0.0	0.0	2.6	0.8	0.5	96.0		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	20	5000	679	679	447	2.7	6697
Recalculated	5	10000	705	958	391	3.6	6974

BARIUM (SPECTROGRAPHIC ANALYSIS)

```
                       +---------+---------+---------+---------+---------+---------+
                     1 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
                     1 XXXXXXXXX|
                     2 XXXXXXXXXX|
                     3 XXXXX|
 BERYLLIUM           5 XXX|
 CONTENT,            7 X|
 IN PARTS PER       10 X|
 MILLION            15 |
                    20 |
                    30 +
                    50 |
                    70 +
                   100 +
                   150 +
                   200 +
                   300 +
                   500 |
                       +---------+---------+---------+---------+---------+---------+
                       0        10        20        30        40        50        60
                                        PERCENT OF ANALYZED SAMPLES

                    Each increment (each "X" or "|" plotted) = 1%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	1886	853	0	4235	6974	6974
Percent of values	0.0	0.0	27.0	12.2	0.0	60.7		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	1	500	2	7.9	1.5	1.8	4235
Recalculated	0.25	500	1.3	6.2	0.8	2.5	6974

BERYLLIUM (SPECTROGRAPHIC ANALYSIS)

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

```
                 +---------+---------+---------+---------+---------+---------+
               5 XXXXXXXXXXXXXXXXXXXXXXXX|
               7 +
              10 XXXXXXXXXXXXXXXXXXXXXX|
              15 XXXXXXXXXXXXXXXX|
              20 XXXXXXXXXXXXXXXXXXXXXXXXXX|
              30 XXXXXXXXXXXXXXXXXXXXXXX|
              50 XXXXXXXXXXXXXXXXXXXXXXXXXX|
              70 XXXXXXXXXXXXXX|
             100 XXXXXXXXX|
 COPPER      150 XXXXX|
 CONTENT,    200 XXX|
 IN PARTS    300 X|
 PER         500 |
 MILLION     700 |
            1000 |
            1500 |
            2000 |
            3000 |
            5000 |
            7000 |
           10000 |
           15000 +
           20000 |
                 +---------+---------+---------+---------+---------+---------+
                 0         5        10        15        20        25        30
                                 PERCENT OF ANALYZED SAMPLES

                Each increment (each "X" or "|" plotted) = 0.5%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	1	0	283	752	0	5938	6973	6974
Percent of values	0.0	0.0	4.1	10.8	0.0	85.2		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	5	20000	66	497	25	2.9	5938
Recalculated	1.3	20000	56	459	17	3.8	6973

COPPER (ATOMIC-ABSORPTION ANALYSIS)

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

GOLD CONTENT, IN PARTS PER MILLION

```
     +---------+---------+---------+---------+---------+---------+
0.05 XXX|
0.07 +
0.10 XXX|
0.15 X|
0.2  X|
0.3  |
0.5  XX|
0.7  X|
1.0  |
1.5  |
2    +
3    |
5    X|
7    |
10   |
     +---------+---------+---------+---------+---------+---------+
     0         1         2         3         4         5         6
                    PERCENT OF ANALYZED SAMPLES
```

Each increment (each "X" or "|" plotted) = 0.1%

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	15	0	6797	70	0	92	6959	6974
Percent of values	0.2	0.0	97.7	1.0	0.0	1.3		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	0.05	10	0.8	1.7	0.2	4.2	92
Recalculated	0.01	10	0.02	0.2	0.01	1.5	6959

GOLD (ATOMIC-ABSORPTION ANALYSIS)

GOLD CONTENT, IN PARTS PER MILLION

```
   +---------+---------+---------+---------+---------+---------+
10 |
15 +
20 |
30 |
   +---------+---------+---------+---------+---------+---------+
   0         1         2         3         4         5         6
                  PERCENT OF ANALYZED SAMPLES
```

Each increment (each "X" or "|" plotted) = 0.1%

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	6971	0	0	3	6974	6974
Percent of values	0.0	0.0	100.0	0.0	0.0	0.0		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	10	30	20	10	18	1.7	3
Recalculated	2.500	30	2.5	0.4	2.5	1.0	6974

GOLD (SPECTROGRAPHIC ANALYSIS)

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

```
                     +---------+---------+---------+---------+---------+---------+
 BISMUTH CONTENT,  10 XX|
 IN PARTS PER      15 +
 MILLION           20 |
                   30 |
                   50 |
                   70 +
                  100 +
                  150 |
                  200 |
                     +---------+---------+---------+---------+---------+---------+
                     0         1         2         3         4         5         6
                                  PERCENT OF ANALYZED SAMPLES
```

Each increment (each "X" or "|" plotted) = 0.1%

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	6949	5	0	20	6974	6974
Percent of values	0.0	0.0	99.6	0.1	0.0	0.3		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	10	200	32	51	17	2.5	20
Recalculated	2.5	200	2.6	3.1	2.5	1.1	6974

BISMUTH (SPECTROGRAPHIC ANALYSIS)

```
                     +---------+---------+---------+---------+---------+---------+
 COBALT CONTENT,    5 XXXXXXXXXXXXXXX|
 IN PARTS PER       7 XXXXXXXX|
 MILLION           10 XXXXXXXXXXXXXXXXXXXXXXXX|
                   15 XXXXXXXXXXXXXXXXXXXXXXXXXXX|
                   20 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
                   30 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
                   50 XXXXXXXXXXXXXXXXXXX|
                   70 XXX|
                  100 X|
                  150 |
                  200 |
                  300 |
                     +---------+---------+---------+---------+---------+---------+
                     0         5        10        15        20        25        30
                                  PERCENT OF ANALYZED SAMPLES
```

Each increment (each "X" or "|" plotted) = 0.5%

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	1022	159	0	5793	6974	6974
Percent of values	0.0	0.0	14.7	2.3	0.0	83.1		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	5	300	23	17	18	2.0	5793
Recalculated	1.25	300	19	17	12	3.2	6974

COBALT (SPECTROGRAPHIC ANALYSIS)

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

```
                  +---------+---------+---------+---------+---------+---------+
             10   XXXXXXXXXXXXX|
             15   XXXXXX|
             20   XXXXXXXXXXXXXXXXXX|
             30   XXXXXXXXXXXXXXXX|
   CHROMIUM  50   XXXXXXXXXXXXXXXXXXXXX|
   CONTENT,  70   XXXXXXXXXXXXXXXXXXXXXX|
   IN       100   XXXXXXXXXXXXXXXXX|
   PARTS    150   XXXXXXXXXXX|
   PER      200   XXXXXXXXXXX|
   MILLION  300   XXXXXX|
            500   XXXX|
            700   XX|
           1000   X|
           1500   |
           2000   |
           3000   |
           5000   |
                  +---------+---------+---------+---------+---------+---------+
                  0         5         10        15        20        25        30
                                PERCENT OF ANALYZED SAMPLES

                  Each increment (each "X" or "|" plotted) = 0.5%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	2	0	1461	277	0	5234	6972	6974
Percent of values	0.0	0.0	21.0	4.0	0.0	75.1		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	10	5000	114	191	60	3.0	5234
Recalculated	2.5	5000	86	172	28	5.1	6972

CHROMIUM (SPECTROGRAPHIC ANALYSIS)

```
                   +---------+---------+---------+---------+---------+---------+
              20   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
              30   XXXXXXXXXXXXX|
   LANTHANUM  50   XXXXXXXXXXXXXXXXXXXXX|
   CONTENT,   70   XXXXXX|
   IN        100   XXXX|
   PARTS     150   X|
   PER       200   X|
   MILLION   300   |
             500   |
             700   |
            1000   |
                   +---------+---------+---------+---------+---------+---------+
                   0         5         10        15        20        25        30
                                 PERCENT OF ANALYZED SAMPLES

                   Each increment (each "X" or "|" plotted) = 0.5%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	3575	594	2	2803	6974	6974
Percent of values	0.0	0.0	51.3	8.5	0.0	40.2		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	20	1000	43	48	34	1.8	2803
Recalculated	1.25	2000	19	50	5	5.1	6974

LANTHANUM (SPECTROGRAPHIC ANALYSIS)

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

```
                      +---------+---------+---------+---------+---------+---------+
                    5 XXXXXXXXXXXXXXXXXXXXXXX|
                    7 |
                   10 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
                   15 XXXXXXXXXXXXXXXXXXX|
                   20 XXXXXXXXXXXXXX|
                   30 XXX|
                   50 X|
                   70 |
                  100 |
                  150 |
    LEAD CONTENT, 200 |
                  300 |
IN PARTS PER MILLION 500 |
                  700 |
                 1000 |
                 1500 |
                 2000 |
                 3000 |
                 5000 |
                 7000 |
                10000 |
                15000 |
                20000 |
                30000 +
                50000 |
                70000 |
               100000 |
                      +---------+---------+---------+---------+---------+---------+
                      0        10        20        30        40        50        60
                                 PERCENT OF ANALYZED SAMPLES

                   Each increment (each "X" or "|" plotted) = 1%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	709	57	254	0	5954	6265	6974
Percent of values	0.0	10.2	0.9	4.1	0.0	95.0		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	5	100000	89	1841	11	2.2	5954
Recalculated	1.3	100000	85	1795	11	2.3	6265

LEAD (ATOMIC-ABSORPTION ANALYSIS)

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

MOLYBDENUM CONTENT, IN PARTS PER MILLION

```
       +---------+---------+---------+---------+---------+---------+
     5 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
     7 XXXXXXXXXXX|
    10 XXXXXXXXXXXXXXX|
    15 XXXXXX|
    20 XXXXXXX|
    30 XXXX|
    50 XX|
    70 X|
   100 X|
   150 |
   200 X|
   300 +
   500 +
   700 |
  1000 |
       +---------+---------+---------+---------+---------+---------+
       0         1         2         3         4         5         6
                      PERCENT OF ANALYZED SAMPLES
```

Each increment (each "X" or "|" plotted) = 0.1%

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	6246	166	0	562	6974	6974
Percent of values	0.0	0.0	89.6	2.4	0.0	8.1		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	5	1000	21	76	10	2.4	562
Recalculated	1.25	1000	2.9	22	1.5	1.9	6974

MOLYBDENUM (SPECTROGRAPHIC ANALYSIS)

NIOBIUM CONTENT, IN PARTS PER MILLION

```
       +---------+---------+---------+---------+---------+---------+
    20 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
    30 XXXXXXXXXXXXXXXXXXX|
    50 XXXXXXXXX|
    70 XXXXXX|
   100 XXX|
   150 X|
   200 +
   300 +
   500 |
   700 |
  1000 |
  1500 +
  2000 |
       +---------+---------+---------+---------+---------+---------+
       0         1         2         3         4         5         6
                      PERCENT OF ANALYZED SAMPLES
```

Each increment (each "X" or "|" plotted) = 0.1%

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	1	0	5747	552	0	674	6973	6974
Percent of values	0.0	0.0	82.4	7.9	0.0	9.7		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	20	2000	38	94	28	1.7	674
Recalculated	5	2000	8.6	31	6	1.7	6973

NIOBIUM (SPECTROGRAPHIC ANALYSIS)

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

NICKEL CONTENT, IN PARTS PER MILLION

```
      +---------+---------+---------+---------+---------+---------+
    5 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
    7 XXXXXX|
   10 XXXXXXXXXXXXXXXXXXXXX|
   15 XXXXXXXXXXXXXXX|
   20 XXXXXXXXXXXXXXXXXXXXXXXXXXX|
   30 XXXXXXXXXXXXXXXXXXXXXXXX|
   50 XXXXXXXXXXXXXXXXX|
   70 XXXXXXXXXXX|
  100 XXXXXXXXXX|
  150 XX|
  200 X|
  300 |
  500 |
  700 |
 1000 |
 1500 |
      +---------+---------+---------+---------+---------+---------+
      0         5        10        15        20        25        30
                      PERCENT OF ANALYZED SAMPLES

          Each increment (each "X" or "|" plotted) = 0.5%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	486	748	0	5740	6974	6974
Percent of values	0.0	0.0	7.0	10.7	0.0	82.3		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	5	1500	33	50	20	2.7	5740
Recalculated	1.25	1500	27	47	13	3.6	6974

NICKEL (SPECTROGRAPHIC ANALYSIS)

SILVER CONTENT, IN PARTS PER MILLION

```
      +---------+---------+---------+---------+---------+---------+
  0.5 XXXXXXXXXXXXXXXXXXXX|
  0.7 XXXX|
  1   XXXXXXXXX|
  1   X|
  2   XXX|
  3   XXX|
  5   XX|
  7   X|
 10   X|
 15   X|
 20   X|
 30   X|
 50   |
 70   X|
100   |
150   |
200   |
300   |
500   |
700   |
      +---------+---------+---------+---------+---------+---------+
      0         1         2         3         4         5         6
                      PERCENT OF ANALYZED SAMPLES

          Each increment (each "X" or "|" plotted) = 0.1%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	6331	300	0	343	6974	6974
Percent of values	0.0	0.0	90.8	4.3	0.0	4.9		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	0.5	700	13	57	1.5	4.6	343
Recalculated	0.13	700	0.8	13	0.15	1.9	6974

SILVER (SPECTROGRAPHIC ANALYSIS)

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

```
TIN CONTENT, IN PARTS PER MILLION

      +---------+---------+---------+---------+---------+---------+
   10 XXXXXXXXXX|
   15 XXXXXX|
   20 XX|
   30 XX|
   50 X|
   70 X|
  100 |
  150 X|
  200 |
  300 +
  500 +
  700 +
 1000 |
      +---------+---------+---------+---------+---------+---------+
      0         1         2         3         4         5         6
                     PERCENT OF ANALYZED SAMPLES

          Each increment (each "X" or "|" plotted) = 0.1%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	6754	62	0	158	6974	6974
Percent of values	0.0	0.0	96.8	0.9	0.0	2.3		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	10	1000	33	85	18	2.3	158
Recalculated	2.5	1000	3.2	14	2.6	1.4	6974

TIN (SPECTROGRAPHIC ANALYSIS)

```
TUNGSTEN CONTENT, IN PARTS PER MILLION

      +---------+---------+---------+---------+---------+---------+
  1.0 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
  1.5 +
  2   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
  3   XXXXXXXXXXXX|
  5   XXXX|
  7   XXX|
 10   +
 15   +
 20   X|
 30   X|
 50   X|
      +---------+---------+---------+---------+---------+---------+
      0         1         2         3         4         5         6
                     PERCENT OF ANALYZED SAMPLES

          Each increment (each "X" or "|" plotted) = 0.1%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	5185	0	1426	180	0	183	1789	6974
Percent of values	74.3	0.0	79.7	10.1	0.0	10.2		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	1	50	2.5	4.5	1.8	1.9	183
Recalculated	0.3	50	0.5	1.6	0.3	1.9	1789

TUNGSTEN (COLORIMETRIC ANALYSIS)

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

```
TUNGSTEN CONTENT,
IN PARTS PER MILLION

      +---------+---------+---------+---------+---------+---------+
   50 |
   70 |
      +---------+---------+---------+---------+---------+---------+
      0         1         2         3         4         5         6
                        PERCENT OF ANALYZED SAMPLES

          Each increment (each "X" or "|" plotted) = 0.1%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	6946	24	0	4	6974	6974
Percent of values	0.0	0.0	99.6	0.3	0.0	0.1		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	50	70	55	10	54	1.2	4
Recalculated	12.5	70	13	1.3	13	1.1	6974

TUNGSTEN (SPECTROGRAPHIC ANALYSIS)

```
EQUIVALENT URANIUM CONTENT,
IN IN PARTS PER MILLION

      +---------+---------+---------+---------+---------+---------+
   20 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
   30 XXXXXXXXXXXXXXXXXXXXXXXXXXXX|
   50 XXXXXXXXXXXXXXXXXXXXX|
   70 XXXXXXXXXXXXXXXXXXXXXXXXXXXX|
  100 XXXXXXXXX|
  150 XX|
      +---------+---------+---------+---------+---------+---------+
      0         5        10        15        20        25        30
                        PERCENT OF ANALYZED SAMPLES

          Each increment (each "X" or "|" plotted) = 0.5%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	6842	0	2	54	0	76	132	6974
Percent of values	98.1	0.0	1.5	40.9	0.0	57.6		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	20	150	48	27	41	1.8	76
Recalculated	5	150	32	28	22	2.3	132

EQUIVALENT URANIUM

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

```
                        +---------+---------+---------+---------+---------+---------+
                     10 XXXXXXXXXX|
                     15 XXXXXXXXXXX|
                     20 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
YTTRIUM CONTENT,     30 XXXXXXXXXXXXXXXXXXXXXX|
IN PARTS PER MILLION 50 XXXXXXXXXXX|
                     70 XXXXX|
                    100 X|
                    150 |
                    200 |
                    300 |
                    500 |
                    700 +
                   1000 |
                   1500 +
                   2000 |
                        +---------+---------+---------+---------+---------+---------+
                        0        10        20        30        40        50        60
                                          PERCENT OF ANALYZED SAMPLES

                  Each increment (each "X" or "|" plotted) = 1%
```

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	0	400	232	1	6341	6974	6974
Percent of values	0.0	0.0	5.7	3.3	0.0	90.9		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	10	2000	30	35	25	1.8	6341
Recalculated	2.5	4000	28	59	20	2.2	6974

YTTRIUM (SPECTROGRAPHIC ANALYSIS)

Figure 2. Concentration distribution and summary statistics for all 6,974 rock geochemical samples collected in the Petersburg study area--Continued

```
                +---------+---------+---------+---------+---------+---------+
              5 XXXXX|
              7 +
             10 XXXXXXXX|
             15 XXXXXXXX|
             20 XXXXXXXXXXXXXXX|
             30 XXXXXXXXXXXXXXXXX|
             50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
             70 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
            100 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX|
  Z     I   150 XXXXXXXX|
  I     N   200 XX|
  N         300 X|
  C     P   500 |
        A   700 |
  C     R  1000 |
  O     T  1500 |
  N     S  2000 |
  T        3000 |
  E     P  5000 |
  N     E  7000 |
  T     R 10000 |
  ,       15000 |
        M 20000 |
        I 30000 |
        L 50000 |
        L 70000 |
        I 100000 |
        O 150000 |
        N 200000 |
                +---------+---------+---------+---------+---------+---------+
                0         5        10        15        20        25        30
                                 PERCENT OF ANALYZED SAMPLES
```

ZINC CONTENT, IN PARTS PER MILLION

Each increment (each "X" or "|" plotted) = 0.5%

	B	H	N	L	G	UNQUAL	ANAL	READ
Number of values	0	1	7	53	0	6913	6973	6974
Percent of values	0.0	0.0	0.1	0.8	0.0	99.1		

	MIN	MAX	AMEAN	SD	GMEAN	GD	VALUES
Unqualified only	5	200000	357	5367	53	2.6	6913
Recalculated	1.3	200000	353	5344	51	2.7	6973

ZINC (ATOMIC-ABSORPTION ANALYSIS)

Table 1. List of samples containing anomalous concentrations of one or more elements

[Sample identifiers are listed in ascending alpha-numeric order. Coordinates in degrees, minutes, and seconds]

Sample No.	Lat.	Long.	Sample No.	Lat.	Long.	Sample No.	Lat.	Long.
78AF120A	564818	1331640	78DB117C	562047	1322137	78RM243A	564537	1320917
78AF121B	564608	1331450	78DB117D	562047	1322137	78RM251A	564704	1331610
78AF127C	564421	1330500	78DB119F	562804	1323040	78RM251B	564704	1331610
78AF132C	562603	1320441	78DB123C	563143	1320602	78RM253A	564637	1331512
78AF132D	562603	1320441	78DB123D	563143	1320602	78RM260A	562336	1320105
78AF137A	562703	1320843	78DB126A	563137	1320727	78RM260B	562336	1320105
78AF137B	562703	1320843	78DB126B	563137	1320727	78RM264A	563120	1320324
78AF144B	562307	1322404	78DB131B	563003	1321004	78RM266A	563442	1320553
78AF146B	562312	1322648	78DB131C	563003	1321004	78RM267A	563326	1320142
78AF146D	562312	1322648	78DB131D	563003	1321004	78RM272B	562352	1320157
78AF146E	562312	1322648	78DB132B	563001	1321034	78RM275B	562916	1320227
78AF146F	562312	1322648	78DB132C	563001	1321034	78RM275C	562916	1320227
78AF148A	563353	1320545	78DB132E	563001	1321034	78RM276A	562910	1320236
78AF148B	563353	1320545	78DB133D	562957	1321059	78RM276B	562910	1320236
78AF150A	563258	1320622	78DB135A	563011	1321150	78RM276C	562910	1320236
78AF153B	563250	1320749	78DB135B	563011	1321150	78RM276D	562910	1320236
78AF153C	563250	1320749	78DB143A	562518	1320739	78RM278A	562850	1320320
78AF154A	563252	1320810	78DB143D	562518	1320739	78RM291A	561900	1322320
78AF156B	563226	1320848	78DB169D	561128	1321807	78RM293B	561136	1321908
78AF157A	563238	1320819	78DB185F	562256	1325353	78RM294B	561153	1321945
78AF165A	563013	1320303	78DB185G	562256	1325353	78RM295A	561225	1322032
78AF171C	563408	1321217	78DB186C	562229	1325453	78RM296A	561338	1322200
78BG033B	562439	1323746	78DB187B	562208	1324538	78RM296B	561338	1322200
78CH002A	564750	1331635	78DB207A	561918	1340759	78RM298A	561145	1322848
78CH002B	564750	1331625	78DB219F	563413	1340044	78RM303C	562333	1325825
78CH002C	564750	1331635	78DB220B	563432	1340045	78RM306E	562210	1325812
78CH007A	562303	1322700	78DB232A	562601	1335621	78RM306G	562210	1325812
78CH007B	562303	1322700	78DB241C	563052	1335543	78RM309C	562108	1325700
78CH017H	563510	1321218	78DB254B	563709	1330954	78RM309H	562108	1325700
78CH018A	561919	1322040	78DB255A	563805	1331050	78RM311B	562048	1325836
78CH025B	561140	1322900	78DB258A	564415	1331859	78RM311F	562048	1325836
78CH027C	561200	1322922	78DB263C	563354	1330556	78RM319A	563737	1330714
78CH028H	562540	1325636	78DB264B	563451	1330625	78RM319C	563737	1330714
78CH036B	562655	1325400	78DB265A	563514	1330700	78RM319D	563737	1330714
78CH036D	562655	1325400	78DB265B	563514	1330700	78RM320C	561900	1325957
78CH040A	562135	1324021	78DB266B	563545	1330751	78RM320D	561900	1325957
78CH046D	561253	1340314	78DB266D	563545	1330751	78RM324C	560200	1340655
78CH050B	562410	1334651	78DB266E	563545	1330751	78RM324D	560200	1340655
78CH053A	562608	1335210	78MC009B	560611	1335732	78RM335B	561906	1340700
78CH067A	563930	1331508	78MC009C	560611	1335732	78RM336A	562017	1341530
78DB103A	564842	1332033	78MC009K	560611	1335732	78RM337A	561705	1335607
78DB103C	564842	1332033	78MC009L	560611	1335732	78RM338A	561724	1335727
78DB103D	564842	1332033	78MC009M	560611	1335732	78RM348A	561836	1335928
78DB105B	564745	1331944	78MC009N	560611	1335732	78RM350C	562806	1334817
78DB106A	564521	1331545	78MC010B	561115	1335634	78RM368B	563445	1321113
78DB106B	564521	1331545	78OV016B	560840	1335540	78RM374D	563044	1330730
78DB106D	564521	1331545	78OV016C	560840	1335540	78RM375C	562610	1325040
78DB108A	564408	1331440	78OV021A	561530	1335415	78RM375D	562610	1325040
78DB115C	561926	1322101	78RM242A	564413	1321220	78RM380C	565212	1332004

Table 1. List of samples containing anomalous concentrations of one or more elements--Continued

Sample No.	Lat.	Long.	Sample No.	Lat.	Long.	Sample No.	Lat.	Long.
78RS066A	564927	1321306	78RS148F	562330	1325810	79AF057A	564921	1332349
78RS067A	564846	1322620	78RS149C	562342	1325758	79AF059A	564932	1332512
78RS067B	564846	1322620	78RS150A	564147	1330958	79AF067A	563300	1325805
78RS068B	564734	1322716	78RS151A	564126	1330908	79AF069A	563233	1325805
78RS074A	562233	1325939	78RS152A	564043	1330755	79AF070A	563223	1325820
78RS074B	562233	1325939	78RS152B	564043	1330755	79AF075A	563220	1325910
78RS084B	562618	1320122	78RS152C	564043	1330755	79BG001A	560640	1335715
78RS085B	562345	1320307	78RS153B	563949	1330555	79BG001C	560640	1335715
78RS086F	562452	1320708	78RS154A	563856	1330440	79BG002A	561912	1331005
78RS093A	562538	1320430	78RS154B	563856	1330440	79BG002B	561912	1331005
78RS096A	562557	1320211	78RS211C	563646	1321211	79BG005A	562229	1325453
78RS096B	562557	1320211	78RS211D	563646	1321211	79BG005C	562229	1325453
78RS096E	562557	1320211	78RS213A	563209	1330756	79BG009C	562237	1325307
78RS099C	562701	1320220	78RS213B	563209	1330756	79BG009D	562237	1325307
78RS100B	562701	1320208	78RS214C	563658	1331020	79BG009E	562237	1325307
78RS104A	562720	1320130	78RS214D	563658	1331020	79BG009F	562237	1325307
78RS104D	562720	1320130	78RS215A	563937	1331431	79BG010A	562235	1325835
78RS105A	562723	1320115	78RS216D	564005	1331450	79BG010B	562235	1325835
78RS105B	562723	1320115	78RS218A	564500	1331901	79BG011A	562043	1325125
78RS106A	562720	1320056	78RS220B	565001	1332148	79BG013A	562025	1325138
78RS106C	562720	1320056	78RS221A	562522	1324758	79BG013B	562025	1325138
78RS106D	562720	1320056	78SH001A	563405	1330403	79BG014A	561927	1325219
78RS106E	562720	1320056	78SH013B	561901	1323242	79BG015A	561928	1325312
78RS106F	562720	1320056	78SH014C	561920	1323234	79BG016A	561912	1325340
78RS107A	562742	1320030	78SH015B	561924	1323240	79BG017A	561916	1325403
78RS107C	562742	1320030	78SH015C	561924	1323240	79BG017B	561916	1325403
78RS107D	562742	1320030	78SH016A	561942	1323226	79BG018A	561855	1325504
78RS109A	562802	1320016	78SH016C	561942	1323226	79BG019B	561822	1325528
78RS110B	563532	1321157	78SH024A	561254	1322312	79BG020A	561413	1323959
78RS110C	563532	1321157	78SH029B	564515	1331311	79BG020B	561413	1323959
78RS110D	563532	1321157	78SH032A	564307	1331137	79BG021B	561400	1323936
78RS110I	563532	1321157	78SH032B	564307	1331137	79BG022A	561401	1323842
78RS110K	563532	1321157	78SH033A	564257	1331130	79BG022C	561401	1323842
78RS112B	563630	1321149	78SH034B	564221	1331051	79BG025A	561421	1323559
78RS122C	561605	1322922	78SH048B	564008	1321007	79BG025C	561421	1323559
78RS125B	561506	1322913	78SH052A	563024	1330701	79BG027A	561432	1323548
78RS125C	561506	1322913	78SH056B	563158	1330506	79BG028C	562508	1325707
78RS125D	561506	1322913	79AF008A	560705	1324242	79BG028D	562508	1325707
78RS125F	561506	1322913	79AF017A	560222	1321505	79BG028E	562508	1325707
78RS127D	561519	1322839	79AF024A	560601	1322749	79BG032A	561548	1323512
78RS137C	562340	1325030	79AF033A	562820	1332449	79BG041B	560443	1323545
78RS139A	562355	1325141	79AF037A	562848	1333626	79BG047A	560440	1323245
78RS140A	562408	1325237	79AF039A	563255	1331337	79BG051A	560834	1321211
78RS143C	562422	1325354	79AF041C	563238	1331202	79BG069C	564018	1331527
78RS143D	562422	1325354	79AF041D	563238	1331202	79BG071A	565315	1332219
78RS143E	562422	1325354	79AF043A	563313	1330220	79BG071B	565315	1332219
78RS145A	562404	1325334	79AF046A	563417	1331435	79BG071C	565315	1332219
78RS145B	562404	1325334	79AF047A	563347	1331636	79DB030B	560907	1332719
78RS145C	562404	1325334	79AF049A	563521	1332148	79DB041B	561033	1332351
78RS148C	562330	1325810	79AF050A	563555	1331804	79DB050A	561245	1333142
78RS148D	562330	1325810	79AF053A	563652	1331942	79DB050B	561245	1333142

Table 1. List of samples containing anomalous concentrations of one or more elements--Continued

Sample No.	Lat.	Long.	Sample No.	Lat.	Long.	Sample No.	Lat.	Long.
79DB064A	561128	1330944	79DG073D	562230	1325455	79RS109B	562155	1325838
79DB065A	560833	1331042	79DG073E	562230	1325455	79RS109C	562155	1325838
79DB066A	560802	1330942	79DG073F	562230	1325455	79RS152A	563105	1333450
79DB067A	560448	1331448	79DG077A	562420	1325332	79RS161B	563958	1332238
79DB068A	561049	1331832	79DG077B	562420	1325332	79RS163A	563707	1333459
79DB069A	561134	1330649	79DG077C	562420	1325332	79RS183B	563653	1325610
79DB071A	561136	1330634	79DG078A	562404	1325333	79RS201B	565750	1322905
79DB071B	561136	1330634	79DG079A	562515	1323147	79SH024B	561026	1331402
79DB072A	561124	1330550	79DG089A	560948	1322443	79SH028C	562002	1331147
79DB073A	561053	1330618	79DG102A	562507	1325713	79SH029A	561951	1331122
79DB074A	560144	1330955	79DG102B	562507	1325713	79SH031C	561947	1331054
79DB076A	555953	1325356	79DG102C	562507	1325713	79SH032A	560000	1324700
79DB078A	560739	1330647	79DG102D	562507	1325713	79SH051B	560636	1325921
79DB081A	561943	1331025	79DG102E	562507	1325713	79SH068A	561226	1323940
79DB081C	561943	1331025	79DG103A	560407	1322845	79SH074A	561322	1322636
79DB081D	561943	1331025	79DG109B	560455	1323220	79SH083A	561854	1324608
79DB083B	561928	1330904	79DG128A	563156	1330304	79SH085A	561727	1324150
79DB087C	560244	1325246	79DG129A	563415	1330407	79SH090A	561531	1324812
79DB089A	560453	1325123	79DG130A	563409	1330410	79SH093A	560552	1323937
79DB112A	560634	1325227	79DG131A	563412	1330409	79SH098B	561011	1324330
79DB112B	560634	1325227	79DG132A	563411	1330403	79SH107A	562930	1332158
79DB119A	562058	1324822	79DG133A	564002	1331525	79SH110A	563150	1330258
79DB120D	562020	1324810	79DG133B	564002	1331525	79SH110E	563150	1330258
79DB124A	562055	1324453	79DG135A	564018	1331525	79SH113A	563325	1330426
79DB132A	561821	1325726	79DG135B	564018	1331525	79SH115A	563434	1330414
79DB139A	560746	1323501	79DG136A	564738	1332145	79SH120B	563542	1325913
79DB152A	562928	1333323	79DG140A	565313	1332215	79SH134A	563859	1330948
79DB159D	563116	1330229	79DG140B	565313	1332215	79SK022B	561030	1332252
79DB163D	563729	1330317	79DG140C	565313	1332215	79SK032A	561757	1333142
79DG051A	560634	1335725	79DG140D	565313	1332215	79SK062A	561234	1330708
79DG051B	560634	1335725	79DG141A	563354	1330157	79SK062B	561234	1330708
79DG051C	560634	1335725	79DG141B	563354	1330157	79SK063A	561253	1330710
79DG053A	560652	1341400	79DG141C	563354	1330157	79SK064B	561307	1330723
79DG059A	561642	1331647	79DG142A	563355	1330346	79SK065A	560603	1325043
79DG060A	561929	1331808	79MC003A	561840	1333257	79SK075A	561424	1333114
79DG066A	561812	1332024	79MC014B	561955	1331452	79SK084A	560503	1322645
79DG070A	561912	1331006	79MC016B	561929	1331342	79SK088A	560901	1322235
79DG070B	561912	1331006	79MC023A	561111	1331501	79SK089A	561035	1322405
79DG070C	561912	1331006	79OV026B	561938	1331258	79SK090A	561039	1322016
79DG070D	561912	1331006	79OV027A	561947	1331230	79SK124A	560321	1324056
79DG070E	561912	1331006	79OV027B	561947	1331230	79SK134B	561823	1324948
79DG071A	561547	1330643	79OV029B	562013	1331145	79SK153A	560801	1322831
79DG071B	561547	1330643	79RS002A	562711	1322754	79SK174A	562708	1322901
79DG072B	562255	1325355	79RS006A	563816	1335401	79SK183A	563413	1330703
79DG072C	562255	1325355	79RS016A	560928	1332057	79SK183C	563413	1330703
79DG072D	562255	1325355	79RS016B	560928	1332057	79SK196C	563520	1325834
79DG072E	562255	1325355	79RS026B	560903	1331226	79SK199A	563358	1325819
79DG072F	562255	1325355	79RS031A	561230	1330420	80BG002B	563144	1320336
79DG073A	562230	1325455	79RS082A	561820	1324251	80BG002C	563144	1320336
79DG073B	562230	1325455	79RS090A	561343	1322825	80BG002Y	563144	1320336
79DG073C	562230	1325455	79RS109A	562155	1325838	80BG002Z	563144	1320336

Table 1. List of samples containing anomalous concentrations of one or more elements--Continued

Sample No.	Lat.	Long.	Sample No.	Lat.	Long.	Sample No.	Lat.	Long.
80BG003A	564007	1331536	80DB240B	564757	1322733	80SK580A	565940	1330457
80BG003B	564007	1331536	80EK004A	561537	1341425	80SK581A	565920	1330425
80BG004A	561651	1324207	80EK006B	561547	1341341	80SK588A	565405	1330335
80BG005A	561803	1324242	80EK009C	562533	1341432	80SK589A	565415	1330359
80BG005B	561803	1324242	80EK090B	570142	1335314	80SK590A	565427	1330357
80BG005C	561803	1324242	80EK142A	565700	1331630	80SK591A	565132	1330230
80BG006B	565601	1324718	80EK152A	570338	1334600	80SK592A	565155	1330208
80BG007A	565927	1324718	80EK152B	570338	1334600	80SK603B	565358	1334924
80BG007B	565927	1324718	80RS022C	561723	1341232	80SK607A	564715	1322853
80BG007C	565927	1324718	80RS029G	561911	1340650	80SK614A	565850	1330657
80BG007D	565927	1324718	80RS029H	561911	1340650	80SK615A	565848	1330642
80BG007E	565927	1324718	80RS029I	561911	1340650	81DB102A	563808	1322107
80BG007F	565927	1324718	80RS030A	561857	1340715	81DB105A	565841	1321439
80BG008B	561848	1340718	80RS030D	561857	1340715	81DB108B	565237	1321408
80BG010W	562842	1320132	80RS030E	561857	1340715	81DB108C	565237	1321408
80BG010X	562842	1320132	80RS033C	561912	1340747	81DB109B	565333	1321438
80BG010Y	562842	1320132	80RS054C	564338	1341752	81DB113C	565125	1321536
80BG010Z	562842	1320132	80RS077B	565443	1341149	81DB117A	563711	1323209
80BG011X	563013	1320230	80RS086A	565801	1334507	81DB125B	564401	1321621
80BG011Y	563013	1320230	80RS088C	565718	1334534	81DB125C	564401	1321621
80BG011Z	563013	1320230	80RS090A	565750	1334638	81DB127A	564454	1321015
80BG012A	563039	1320225	80RS116A	564308	1334303	81DB143A	570126	1324821
80BG012Z	563039	1320225	80RS142A	565352	1330227	81DB143C	570126	1324821
80BG013A	563118	1320400	80RS144A	565417	1330150	81DB163B	560517	1321553
80BG013B	563118	1320400	80SH001A	561019	1341405	81DB165A	560717	1321731
80DB032A	570400	1335008	80SH007B	561447	1341618	81DB167A	560614	1322037
80DB032C	570400	1335008	80SH013C	561917	1341202	81DB171B	563546	1330140
80DB035A	570335	1335117	80SH026A	563248	1340420	81DB174A	563616	1325958
80DB038B	564843	1340217	80SH051A	564701	1341338	81DB178A	563734	1325648
80DB039A	564636	1340231	80SH054B	565250	1340858	81DB200A	564858	1322910
80DB048A	562806	1332504	80SH055A	565531	1341226	81DB206A	564525	1321200
80DB048B	562806	1332504	80SH058A	564649	1341525	81DB221B	564632	1324803
80DB048C	562806	1332504	80SH059B	564733	1341533	81DB222D	564708	1324839
80DB088B	560748	1341534	80SH060B	564857	1341538	81DB241B	565355	1325614
80DB092A	562202	1341456	80SH068A	570450	1335136	81DB249A	563755	1320052
80DB093A	561953	1341721	80SH072B	565811	1334837	81PB002A	564003	1323709
80DB108B	564127	1341750	80SK145A	564745	1340138	81PB035A	560651	1323758
80DB109A	564152	1341736	80SK150C	564133	1330101	81PB037A	560834	1323837
80DB123C	564253	1340721	80SK166A	560911	1322018	81PB069B	564536	1323109
80DB138C	565422	1341906	80SK170A	560841	1321955	81PB072A	564738	1324918
80DB157A	570331	1335211	80SK456A	561153	1341456	81PB077A	565221	1330807
80DB185B	562947	1333954	80SK492A	564918	1341830	81RK223B	564421	1321412
80DB227C	565700	1334500	80SK498A	565240	1341205	81RK228B	564051	1320624
80DB228C	565253	1334938	80SK500A	565537	1341205	81RK234A	563409	1324740
80DB232A	565358	1335236	80SK500C	565537	1341205	81RK244A	565902	1324719
80DB233A	565338	1335357	80SK510A	565533	1340935	81RK257C	560711	1330427
80DB236A	570519	1335529	80SK512C	565509	1340910	81RK259A	560739	1325338
80DB236B	570519	1335529	80SK544A	564724	1334337	81RK260A	560719	1325341
80DB237G	570432	1335915	80SK544B	564724	1334337	81RK262A	560634	1325228
80DB238A	570243	1340106	80SK557A	564730	1334448	81RK262B	560634	1325228
80DB238B	570243	1340106	80SK559A	564642	1334307	81RK262C	560634	1325228

Table 1. List of samples containing anomalous concentrations of one or more elements--Continued

Sample No.	Lat.	Long.	Sample No.	Lat.	Long.	Sample No.	Lat.	Long.
81RK285A	563816	1320916	82DB113A	565234	1331410	82PB136E	562617	1333404
81RK287A	563420	1320633	82DB120A	565037	1330019	82PB138A	562611	1333542
81RK289C	564212	1322448	82DB125A	565734	1332934	82PB138C	562611	1333542
81RK294A	564212	1322301	82DB135B	565716	1332318	82RK704A	561226	1323432
81RK297B	565900	1325200	82DB136A	565618	1332114	82RK708A	562439	1323749
81RK298A	565934	1325443	82DB178C	562806	1333137	82RK711A	563537	1324040
81RK308B	564824	1322928	82DB194A	563050	1320342	82RK727A	565834	1331541
81RK311A	564804	1323005	82DB194B	563050	1320342	82RK742A	565547	1334322
81SH018A	564142	1321303	82DB194C	563050	1320342	82RK742B	565547	1334322
81SH022A	564125	1325128	82DB197B	563051	1321111	82RK747A	565130	1332400
81SH031A	561122	1321912	82DB199A	563126	1320431	82RK753A	564532	1341811
81SH033C	561140	1321759	82DB213A	563551	1320618	82RK755B	564811	1333644
81SH036B	560158	1321730	82DB213E	563551	1320618	82RK769A	562446	1335321
81SH040A	561521	1320822	82DB216C	563628	1320728	82RK770A	562657	1333127
81SH047C	561121	1322040	82DB244B	561307	1320135	82RK771A	562904	1332857
81SH054C	564457	1324948	82DB252B	560234	1320318	82RK771B	562904	1332857
81SH060A	564610	1322310	82DB254A	560151	1320401	82RK789D	562204	1320231
81SH064A	564716	1321513	82DB260A	560316	1320704	82RK824A	560303	1320002
81SH098A	565611	1330207	82DB274A	564943	1340436	82RK853A	562708	1333922
81SH108A	564150	1322147	82DB274B	564943	1340436	82RK853C	562708	1333922
81SK036A	565800	1330600	82DG102A	563129	1333012	82SH008A	562725	1325542
81SK042A	565800	1330600	82DG112A	562831	1332500	82SH014A	563825	1330054
81SK051A	565800	1330600	82DG113A	562821	1332457	82SH025B	565612	1330736
81SK145A	563037	1325245	82DG114A	562808	1332504	82SH036D	565125	1333400
81SK148A	563014	1325009	82DG115A	562823	1332529	82SH038B	564552	1332126
81SK150A	563018	1324752	82DG116A	565517	1341158	82SH074A	562118	1321926
81SK158A	565943	1324953	82DG116B	565517	1341158	82SH101A	560230	1321325
81SK161A	570106	1325012	82KR049A	562956	1333700	82SH119B	560514	1321342
81SK220A	564600	1322925	82KR059A	564415	1320206	82SH127A	562822	1333955
81SK223A	564727	1322307	82KR083A	562200	1320432	82SK010A	564020	1331529
81SK263A	565911	1330633	82KR109D	562617	1333045	82SK044A	564956	1335810
81SK264A	565929	1330635	82KR110A	562649	1332949	82SK047A	565000	1335945
81SK291A	563648	1324028	82PB008A	563053	1331633	82SK049A	565110	1340001
81SK298A	564313	1321555	82PB008B	563053	1331633	82SK076A	562758	1333442
81TM002A	563507	1324438	82PB009A	563117	1331959	82SK092A	563036	1320310
81TM036B	561036	1330217	82PB022A	564308	1330142	82SK092B	563036	1320310
81TM049C	561313	1322420	82PB039A	565225	1333512	82SK093B	563016	1320328
81TM051A	561241	1322454	82PB041A	564846	1330027	82SK115A	564010	1321013
81TM068A	564222	1322239	82PB049A	565413	1340701	82SK134D	562131	1320720
81TM095B	564756	1320941	82PB051A	565513	1341108	82SK172D	563218	1334017
81TM115C	565712	1331431	82PB077A	563214	1320548	82SK173C	563201	1334021
81TM125A	565614	1325930	82PB120A	560323	1320330	82SK174E	563129	1334020
81TM125D	565614	1325930	82PB130B	562937	1332208	82SK177A	563211	1333133
82DB098A	561649	1323056	82PB134A	563556	1333718	82SK179B	563214	1333149
82DB105A	563054	1322710	82PB135A	562616	1333315			

Table 2. Determination limits for analyses performed from 1978 through 1982

[Analyses: S, spectrographic; AA, atomic absorption; CM, colorimetric; eU, radioactivity determination expressed as equivalent uranium. Elements: Fe, iron; Mg, magnesium; Ca, calcium; Ti, titanium; Mn, manganese; Ag, silver; As, arsenic; Au, gold; B, boron; Ba, barium; Be, beryllium; Bi, bismuth; Cd, cadmium; Co, cobalt; Cr, chromium; Cu, copper; La, lanthanum; Mo, molybdenum; Nb, niobium; Ni, nickel; Pb, lead; Sb, antimony; Sc, scandium; Sn, tin; Sr, strontium; Th, thorium; V, vanadium; W, tungsten; Y, yttrium; Zn, zinc; Zr, zirconium. Units: %, weight percent; ppm, parts per million; --, no value]

Analysis and Element	Limits		Analysis and Element	Limits		Analysis and Element	Limits	
	Lower	Upper		Lower	Upper		Lower	Upper
S-Fe	0.05	20%	S-Cd	20	500 ppm	S-Sr	100	5000 ppm
S-Mg	.02	10%	S-Co	5	2000 ppm	S-Th	100	2000 ppm
S-Ca	.05	20%	S-Cr	10	5000 ppm	S-V	10	10,000 ppm
S-Ti	.002	1%	S-Cu	5	20,000 ppm	S-W	50	10,000 ppm
S-Mn	10	5000 ppm	S-La	20	1000 ppm	S-Y	10	2000 ppm
S-Ag	.5	5000 ppm	S-Mo	5	2000 ppm	S-Zn	200	10,000 ppm
S-As	200	10,000 ppm	S-Nb	20	2000 ppm	S-Zr	10	1000 ppm
S-Au	10	500 ppm	S-Ni	5	5000 ppm	AA-Au	0.05	-- ppm
S-B	10	2000 ppm	S-Pb	10	20,000 ppm	AA-Cu	5	-- ppm
S-Ba	20	5000 ppm	S-Sb	100	10,000 ppm	AA-Pb	5	-- ppm
S-Be	1	1000 ppm	S-Sc[1]	5	100 ppm	AA-Zn	5	-- ppm
S-Bi	10	1000 ppm	S-Sn	10	1000 ppm	CM-W	1	-- ppm
						eU	20	-- ppm

[1] Limits 5-1000 ppm for samples analyzed in U.S. Geological Survey Anchorage laboratory instead of Denver laboratory

Table 3. Class intervals of the six-step spectrographic scale

[Class intervals are roughly log-normally distributed; there are six intervals per order of magnitude]

Six-step reporting value (approximate class-interval midpoint)	Approximate class-interval limits		Approximate class-interval width
.	.	.	.
.	.	.	.
.	.	.	.
1.0	0.825	1.21	0.385
1.5	1.21	1.78	0.57
2.0	1.78	2.61	0.83
3.0	2.61	3.83	1.22
5.0	3.83	5.62	1.79
7.0	5.62	8.25	2.63
10.0	8.25	12.1	3.85
15.0	12.1	17.8	5.70
.	.	.	.
.	.	.	.
.	.	.	.

Table 4. Threshold values considered anomalously high for all rock samples

[+, analysis used to select samples shown on sheets 2 and 3. See table 1 for analysis and element symbols. adc, any determinable concentration; ppm, parts per million]

Analysis and element	Cutoff concentration	% of analyses	analysis and element	Cutoff concentration	% of analyses
+ S-Ag	≥1.5 ppm	1.7	+ S-Ni	≥200 ppm	0.8
+ S-As	adc (≥200 ppm)	0.9	+ AA-Pb	≥100 ppm	1.2
+ AA-Au	adc (≥0.05 ppm)	1.3	S-Pb	≥150 ppm	1.1
+ S-Au	adc (≥10 ppm)	0.04	+ S-Sb	adc (≥100 ppm)	0.2
S-B	≥150 ppm	0.9	S-Sc	>70 ppm	0.9
+ S-Ba	≥5000 ppm	1.4	+ S-Sn	≥20 ppm	0.7
+ S-Be	≥10 ppm	0.8	+ S-Sr	≥2000 ppm	1.0
+ S-Bi	adc (≥10 ppm)	0.3	S-Th	adc (≥100 ppm)	<0.1
+ S-Cd	adc (≥20 ppm)	0.75	+ eU	≥150 ppm	0.8
+ S-Co	≥100 ppm	0.7	S-V	≥700 ppm	0.8
+ S-Cr	≥1000 ppm	0.8	+ CM-W	≥5 ppm	0.9
+ AA-Cu	≥300 ppm	1.0	+ S-W	adc (≥50 ppm)	0.1
S-Cu	≥500 ppm	0.9	+ S-Y	≥150 ppm	0.6
+ S-La	≥150 ppm	1.0	+ AA-Zn	≥500 ppm	1.1
+ S-Mn	≥5000 ppm[1]	0.6	S-Zn	≥1000 ppm	1.0
+ S-Mo	≥30 ppm	1.0	S-Zr	≥700 ppm	1.2
+ S-Nb	≥70 ppm	1.0			

[1] Only samples qualified by "G" (upper determination limit = 5000 ppm; see fig. 2)

Table 5. Threshold values in parts per million for barium (sheet 4, map A) for bedrock geochemical groups

[Barium determined by semiquantitative emission spectrographic analyses. Dash indicates no samples]

Bedrock geochemical group	Threshold level			
	1	2	3	4
Paleozoic volcanic and clastic sedimentary rocks	1500	2000	3000	5000
Paleozoic carbonate rocks	1000	2000	3000	5000
Triassic mafic volcanic rocks	3000	5000	5000	5000
Mesozoic felsic volcanic rocks	5000	--	--	5000
Mesozoic carbonate rocks	2000	3000	--	5000
Upper Mesozoic sedimentary and volcanic rocks	2000	3000	5000	5000
Schist and gneiss of the Coast plutonic-metamorphic complex	3000	5000	--	5000
Ultramafic rocks	1500	2000	3000	5000
Cenozoic mafic volcanic rocks	1000	1500	2000	5000
Intermediate-composition intrusive rocks	2000	3000	--	5000
Cenozoic felsic igneous rocks	1500	2000	--	3000

Table 6. Threshold values in parts per million for chromium (sheet 4, map B) for bedrock geochemical groups

[Chromium determined by semiquantitative emission spectrographic analyses. Dash indicates no samples]

Bedrock geochemical group	Threshold level			
	1	2	3	4
Paleozoic volcanic and clastic sedimentary rocks	200	300	500	700
Paleozoic carbonate rocks	100	150	200	300
Triassic mafic volcanic rocks	1000	--	--	--
Mesozoic felsic volcanic rocks	500	--	700	--
Mesozoic carbonate rocks	500	700	--	--
Upper Mesozoic sedimentary and volcanic rocks	500	--	700	1000
Schist and gneiss of the Coast plutonic-metamorphic complex	500	--	700	1000
Ultramafic rocks	1500	2000	--	3000
Cenozoic mafic volcanic rocks	500	--	700	1500
Intermediate-composition intrusive rocks	150	200	300	500
Cenozoic felsic igneous rocks	150	200	--	300

Table 7. Threshold vaules in parts per million for cobalt (sheet 5, map A) for bedrock geochemical groups

[Cobalt determined by semiquantitative emission spectrographic analyses. Dash indicates no samples]

Bedrock geochemical group	Threshold level			
	1	2	3	4
Paleozoic volcanic and clastic sedimentary rocks	50	--	--	70
Paleozoic carbonate rocks	30	--	50	--
Triassic mafic volcanic rocks	70	100	--	--
Mesozoic felsic volcanic rocks	70	150	200	--
Mesozoic carbonate rocks	50	--	--	--
Upper Mesozoic sedimentary and volcanic rocks	50	70	100	150
Schist and gneiss of the Coast plutonic-metamorphic complex	50	--	70	100
Ultramafic rocks	100	--	150	200
Cenozoic mafic volcanic rocks	70	--	--	100
Intermediate-composition intrusive rocks	30	50	--	70
Cenozoic felsic igneous rocks	30	50	--	70

Table 8. Threshold values in parts per million for copper (sheet 5, map B) for bedrock geochemical groups

[Copper determined by atomic-absorption analyses. Dash indicates no samples]

Bedrock geochemical group	Threshold level			
	1	2	3	4
Paleozoic volcanic and clastic sedimentary rocks	110	130	140	220
Paleozoic carbonate rocks	55	70	90	120
Triassic mafic volcanic rocks	210	230	--	--
Mesozoic felsic volcanic rocks	260	700	2000	7000
Mesozoic carbonate rocks	70	100	150	180
Upper Mesozoic sedimentary and volcanic rocks	170	200	240	400
Schist and gneiss of the Coast plutonic-metamorphic complex	120	150	210	300
Ultramafic rocks	250	340	450	600
Cenozoic mafic volcanic rocks	55	70	110	750
Intermediate-composition intrusive rocks	65	85	110	200
Cenozoic felsic igneous rocks	45	65	80	140

Table 9. Threshold values in parts per million for lead (sheet 6, map A) for bedrock geochemical groups

[Lead determined by atomic-absorption analyses. Dash indicates no samples]

Bedrock geochemical group	Threshold level			
	1	2	3	4
Paleozoic volcanic and clastic sedimentary rocks	35	45	65	400
Paleozoic carbonate rocks	65	90	--	--
Triassic mafic volcanic rocks	350	500	--	--
Mesozoic felsic volcanic rocks	300	1000	5000	10,000
Mesozoic carbonate rocks	500	1000	2500	5000
Upper Mesozoic sedimentary and volcanic rocks	30	35	40	55
Schist and gneiss of the Coast plutonic-metamorphic complex	25	30	50	470
Ultramafic rocks	25	--	30	55
Cenozoic mafic volcanic rocks	30	35	40	500
Intermediate-composition intrusive rocks	20	--	25	30
Cenozoic felsic igneous rocks	35	55	65	250

Table 10. Threshold values in parts per million for molybdenum (sheet 6, map B) for bedrock geochemical groups

[Molybdenum determined by semiquantitative emission spectrographic analyses. Dash indicates no samples]

Bedrock geochemical group	Threshold level			
	1	2	3	4
Paleozoic volcanic and clastic sedimentary rocks	10	15	20	30
Paleozoic carbonate rocks	--	7	10	15
Triassic mafic volcanic rocks	--	10	--	--
Mesozoic felsic volcanic rocks	30	--	50	--
Mesozoic carbonate rocks	--	--	15	--
Upper Mesozoic sedimentary and volcanic rocks	7	15	20	30
Schist and gneiss of the Coast plutonic-metamorphic complex	10	20	30	50
Ultramafic rocks	7	10	15	30
Cenozoic mafic volcanic rocks	7	10	15	30
Intermediate-composition intrusive rocks	--	5	7	15
Cenozoic felsic igneous rocks	10	15	20	50

Table 11. Threshold values in parts per million for nickel (sheet 7, map A) for bedrock geochemical groups

[Nickel determined by semiquantitative emission spectrographic analyses. Dash indicates no samples]

Bedrock geochemical group	Threshold level			
	1	2	3	4
Paleozoic volcanic and clastic sedimentary rocks	70	100	--	150
Paleozoic carbonate rocks	50	70	--	100
Triassic mafic volcanic rocks	150	200	--	--
Mesozoic felsic volcanic rocks	150	--	200	--
Mesozoic carbonate rocks	100	--	150	--
Upper Mesozoic sedimentary and volcanic rocks	100	150	--	200
Schist and gneiss of the Coast plutonic-metamorphic complex	100	--	150	200
Ultramafic rocks	300	500	700	1000
Cenozoic mafic volcanic rocks	100	--	150	300
Intermediate-composition intrusive rocks	50	--	70	100
Cenozoic felsic igneous rocks	50	--	70	100

Table 12. Threshold values in parts per million for zinc (sheet 7, map B) for bedrock geochemical groups

[Zinc determined by atomic-absorption analyses. Dash indicates no samples]

Bedrock geochemical group	Threshold level			
	1	2	3	4
Paleozoic volcanic and clastic sedimentary rocks	150	190	280	1500
Paleozoic carbonate rocks	90	100	130	180
Triassic mafic volcanic rocks	700	1500	2000	3000
Mesozoic felsic volcanic rocks	1000	--	5000	20,000
Mesozoic carbonate rocks	400	1000	5000	20,000
Upper Mesozoic sedimentary and volcanic rocks	145	160	190	500
Schist and gneiss of the Coast plutonic-metamorphic complex	150	200	380	910
Ultramafic rocks	90	100	110	145
Cenozoic mafic volcanic rocks	140	180	330	790
Intermediate-composition intrusive rocks	110	120	130	150
Cenozoic felsic igneous rocks	200	270	310	600