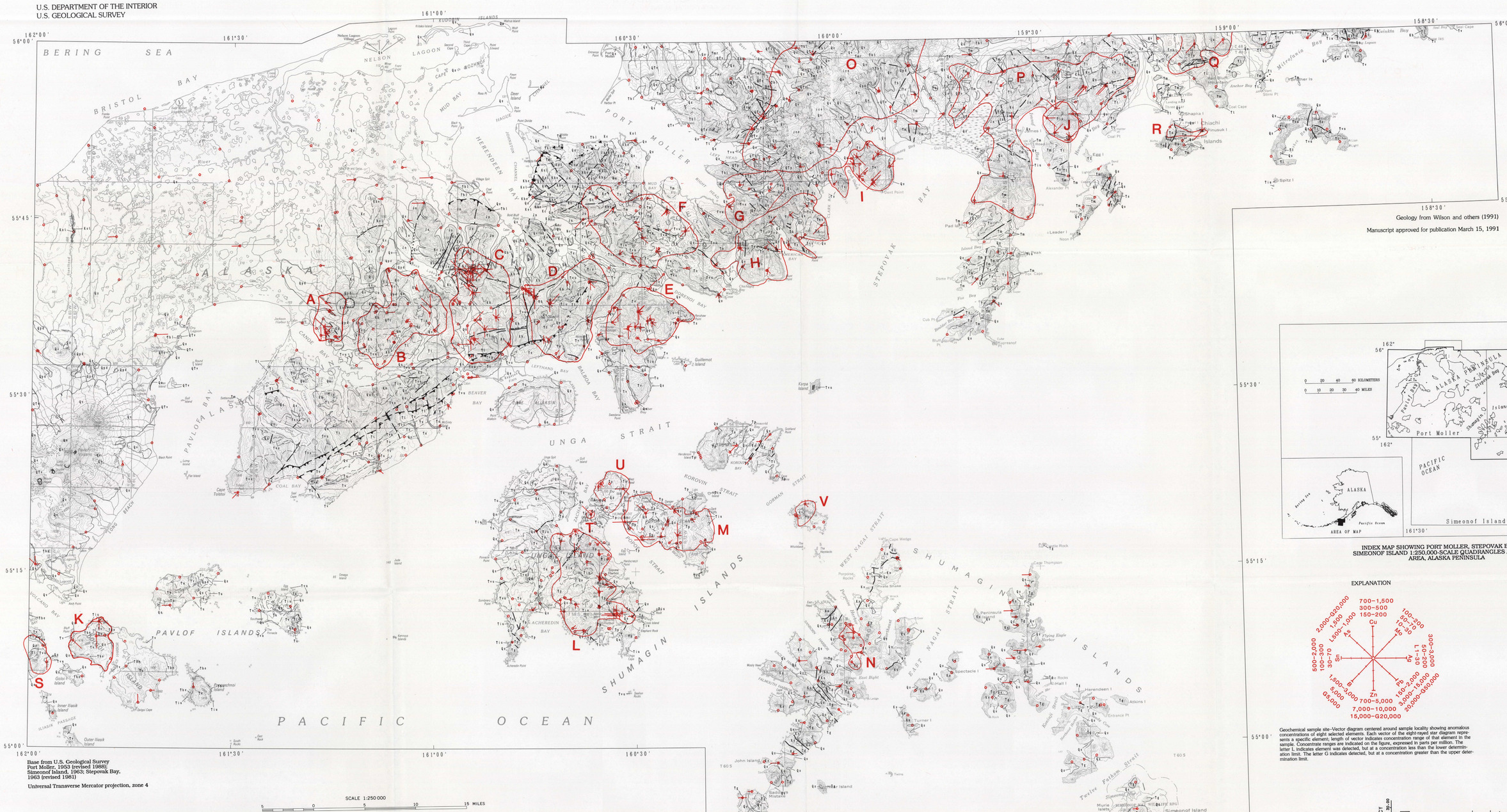


Base from U.S. Geological Survey
Port Moller, 1953 [revised 1988]
Simeonof Island, 1963; Stepovak Bay, 1963 [revised 1981]

Universal Transverse Mercator projection, zone 4

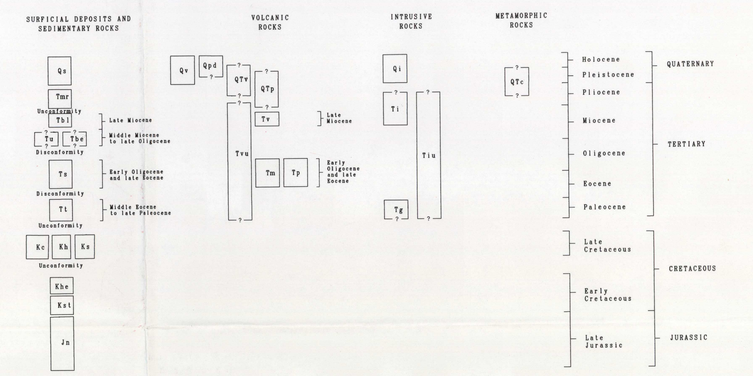
SCALE 1:250 000

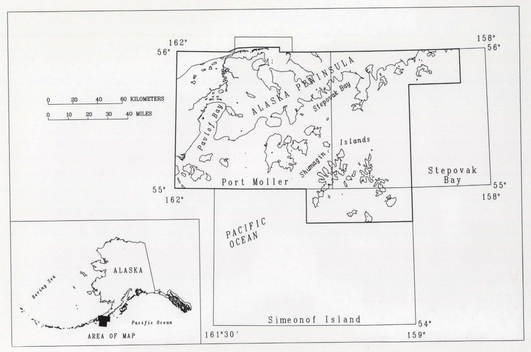
CONTOUR INTERVAL 100 AND 200 FEET
DOTTED LINES REPRESENT 50-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology from Wilson and others (1991)

Manuscript approved for publication March 15, 1991

CORRELATION OF MAP UNITS





INDEX MAP SHOWING PORT MOLLER, STEPOVAK BAY, AND SIMEONOF ISLAND 1:250,000-SCALE QUADRANGLES AND STUDY AREA, ALASKA PENINSULA

LIST OF MAP UNITS

- Qs Surficial deposits (Holocene and Pleistocene)
- Qv Volcanic rocks (Holocene and Pleistocene)
- Qi Younger intrusive rocks, undivided (Holocene and Pleistocene)
- Qpd Pyroclastic and debris-flow deposits (Holocene and late Pleistocene?)
- QTc Contact-metamorphosed rocks (early Quaternary or late Tertiary)
- QTv Volcanic rocks, undivided (Quaternary and Pliocene?)
- QTp Pyroclastic deposits (Pleistocene? and Pliocene)
- Tmr Milky River Formation (Pliocene)
- Ti Older intrusive rocks, undivided (Pliocene and late Miocene)
- Tbl Bear Lake Formation (late Miocene)
- Tv Volcanic rocks (late Miocene)
- Tvu Unga Formation (middle Miocene to late Oligocene)
- Tbd Bellicofski Formation (middle and early Miocene? and late Oligocene?)
- Ts Stepovak Formation (early Oligocene and late Eocene)
- Tm Meshik Volcanics (early Oligocene and late Eocene)
- Tp Popof volcanic rocks (early Oligocene and late Eocene)
- Tl Tolstoi Formation (middle Eocene and late Paleocene)
- Tg Granitic rocks (Paleocene)
- Tvu Volcanic rocks, undivided (Tertiary)
- Tiu Intrusive rocks, undivided (Tertiary)
- Kc Chignik Formation (Late Cretaceous)
- Kh Hoodoo Formation (Late Cretaceous)
- Ks Shumagin Formation (Late Cretaceous)
- Ksv Herendeen Formation (Early Cretaceous)
- Ksl Staniukovich Formation (Early Cretaceous)
- Jn Naknek Formation (Late Jurassic)

Contact– Dashed where approximately located

Fault–Dashed where approximately located; dotted where concealed

Thrust fault–Sawteeth on upper plate; dashed where approximately located

Volcanic crater

INTRODUCTION

A reconnaissance geochemical study of the Port Moller, Stepovak Bay, and Simeonof Island quadrangles was undertaken during the 1983 through 1985 field seasons as part of the Alaska Mineral Resource Assessment Program (AMRAP). For this report, the three quadrangles collectively will be referred to as the "Port Moller study area". Panned-concentrate samples were collected at 778 sites, mostly from active channels of first- and second-order streams (or 1-63.360 map scale) whose drainage basins cover an area of 1 to 10 square kilometers. Sample density is lowest in the swampy lowlands located inland from the Bering Sea coast where outcrops of pre-Tertiary rocks are rare. Sample density is highest in areas containing rocks that display evidence of hydrothermal alteration, which is often characterized by extensive iron-oxide staining.

In the Port Moller study area, most concentrate samples were collected from gravel bars. Some streams, especially those draining the swampy lowland areas, did not have exposed sediments along their banks. At sample sites lacking gravel bars, sediment was collected by scooped from the stream bed with a stainless-steel cup attached to a long pole. The unconsolidated sediment was coarse sand to exclude pebble-size material. A 36-oz (1-kg) pan was filled with sieved sediment, which was then panned at the site.

In the laboratory, the samples were sieved to minus-30 mesh. The minerals with a specific gravity of less than 2.85 were removed by heavy-liquid (bromoform) separation; relatively magnetic minerals were removed by electromagnetic separation. The resultant nonmagnetic, heavy-mineral concentrates contain all sulfides and other minerals that possess high specific gravity, such as garnet, zircon, rutile, and sphene. The nonmagnetic concentrates also include other minerals frequently associated with mineralization and alteration processes, such as sulfides, sulfosalts, certain oxides, native gold, scheelite, fluorite, barite, epidote, and tourmaline. Some of the nonmagnetic-concentrate samples contain mafic silicates. This is due to incomplete magnetic separation. Additional magnetic separation of the samples was not attempted due to the typically small sample volume. Some of these mafic silicate minerals (if derived from rocks of the study area) contain concentrations of metals uncorrelated to ore-forming processes.

All samples were analyzed for 31 elements using a semiquantitative, six-step, direct-current arc, emission spectrographic method (Grimes and Marranzino, 1968). Fifty-seven of the 778 panned-concentrate samples also were analyzed by spectrographic data either because of an insufficient volume of sample (35 sites) or because the concentrate was collected for gold analysis only (22 sites). The results of these analyses are not discussed in this report. Details of the analytical procedure are described in Frisken and Foley (1985). Detailed descriptions of the geochemical sampling, sample preparation, and analytical methods used in the reconnaissance study, along with the tabulated geochemical data and sample-locality maps.

Splits of 739 nonmagnetic heavy-mineral concentrates were examined under a binocular microscope to determine the mineral content of the samples. Nineteen samples contained insufficient material for analysis, or no heavy-mineral concentrate was recovered. The samples were also examined under short-wave length ultraviolet light to identify scheelite and powellite. In many cases, the mineral sulfide identified in the concentrates could be used to explain geochemical anomalies. Visual examination of the mineral concentrates also increased the probability of finding gold. Malleable metals, such as gold, are not uniformly dispersed during the sample-grinding process and, therefore, may not be detected by spectrographic analysis, which utilizes only a very small aliquot of the sample.

All of the three maps that make up this report are part of a series of maps that graphically present selected geochemical and mineralogical data. This report presents selected mineralogical observations and selected anomalous spectrographic geochemical results from nonmagnetic heavy-mineral-concentrate samples. Additional maps present data from other media and other sample types collected during reconnaissance studies of selected elements in stream-sediment samples (Frisken and Arbogast, 1992) and present the results of a study of the geochemistry of stream-sediment and rock samples (Frisken and Kelley, 1990). An interpretive report by Frisken (in press) delineates selected areas of interest within the study area and interprets the significance of the geochemical and mineralogical signatures of these anomalous areas.

PHYSIOGRAPHYC AND GEOLOGIC SETTING

The Port Moller study area consists of about 8,800 square kilometers on the Alaska Peninsula and offshore islands. Few roads exist in the study area. Access is by Alaska state ferry or private boat. Small towns located on Popof Island, and to lesser, Pernyville, Port Moller, and Nelson Lagoon by charter boat or air service. The climate is moderated by the effect of the Japanese Current and moist conditions have accaqed the growth of luxuriant vegetation. Trees are stunted and sparse to throughout most of the study area. The vegetation consists primarily of alder thickets, but willow, blueberry and alder thickets are present along some of the drainage.

The study area is part of the Nushagak-Bristol Bay Lowland and Aleutian Range physiographic provinces (Wahrhaftig, 1965). That part of the Aleutian Range province within the study area is characterized by glaciated peaks whose elevations average about 1,000 m. Several Holocene volcanic peaks dominate the landscape. The northwestern part of the study area is characterized by a low (less than 200 m of relief) is the Nushagak-Bristol Bay Lowland province.

The most comprehensive report covering the geology of the study area that was published prior to the AMRAP study is a reconnaissance study by Burk (1965) that emphasizes sedimentary geology. The Pavlof volcanic centers were mapped by Kennedy and Waldron (1955), and part of the outer Shumagin Islands was mapped by Moore (1974). The Port Moller AMRAP geologic map (F.H. Wilson, unpublished data) contains elements of these prior studies with extensive new field mapping.

Mesozoic rocks that crop out in the study area are sedimentary and range in age from Late Jurassic to Late Cretaceous. The oldest rocks in the area are sandstone and siltstone of the Upper Jurassic Naknek Formation. These rocks are conformably overlain by siltstone and shale of the Lower Cretaceous Staniukovich Formation and the stratigraphically higher calcarenite of the Herendeen Formation. Overlying these units are Upper Cretaceous Hoodoo and Chignik Formations (Burk, 1965; Detterman and others, in doc., and Shumagin Formations (Burk, 1965; Detterman and others, in press).

Episodes of volcanism occurred during the Tertiary and Quaternary, and continue into the present day. The large pendomorphic batholith in the Shumagin Islands and Paleocene nonvolcanic sandstone of the Tolstoi Formation are the oldest known Tertiary rocks in the area. The upper part (Eocene) of the Tolstoi Formation is rich in volcanic debris and is the earliest evidence for volcanic activity related to the Meshik magmatic arc (Wilson, 1985). Eocene and Oligocene volcanic sandstone and siltstone of the Stepovak Formation, and volcanic rocks of the Meshik Volcanics and correlative units constitute the main part of the Meshik arc. Meshik arc volcanism ceased in middle Miocene time with the deposition of the Unga Formation, which includes lahars associated with volcanic centers on Unga Island. The nonvolcanic rocks of the Miocene Bear Lake Formation were deposited during a time of volcanic quiescence. Late Miocene volcanic and intrusive rocks indicate the time of initiation of Aleutian arc magmatic activity. The Pliocene Milky River Formation is the youngest recognized Tertiary geologic unit in the area and is composed of volcanic flows and sediments. During Quaternary time, additional volcanic-rock units were produced in the Pavlof volcanic field and part of the study area was covered by alluvial, colluvial, lacustrine, glacial, and volcanic deposits.

Hydrothermally altered rocks associated with both the Meshik and Aleutian magmatic arcs are common within the study area and provide a guide to the location of some areas that may host mineral deposits. In the late 1800's, gold prospecting led to the establishment of the Apollo mine on Unga Island, a major producer of mesothermal gold was also recovered from beach deposits near Port Moller and Stepovak Bay (Wilson, 1985). Gold, silver, and copper exploration efforts have located small porphyry copper systems at Pyramid Mountain (Armstrong and others, 1976) and at the Ivanof prospect (Wilson, and others, 1988) located northwest of Humphrey Bay.

DISCUSSION OF GEOCHEMICAL DATA

A statistical summary of the nonmagnetic heavy-mineral-concentrate geochemical data set is given in table 1. The entire data set was used to calculate geometric means, geometric deviations, and percentiles. The G greater (hard values were replaced by values one geographic step higher than the upper determination limits, the L (less (hard) values were replaced by values one step lower than the lower determination limits; and the N (not detected) values were replaced by values three steps lower than the lower determination limits. For this reason, the reliability of the mean and deviation values depends on (1) how close the assumed replacement values approximate the true values, and (2) the qualified parts of the data set that apply to each element, and (3) the detection ratio for that element. Minimum, 50th, 85th, 95th, 97th, and 99th percentile, and maximum values were tabulated to show the distribution of geochemical data.

Anomalous values are those that deviate from the norm or rise above some geochemical background. Commonly, the 95th percentile of a sample data set is chosen for anomaly threshold, with all values equal to or greater than the chosen threshold being considered anomalous. Rocks in the area are strongly iron stained and hornfelsed, and tabulation is common. Pebble or breccia clasts are commonly present in intrusive lapatic dorritid and nearby sedimentary rocks. Hydrothermal alteration of the area's volcanic rocks is widespread and has led to attention of the area's volcanic rocks is widespread and has led to attention of the area's volcanic rocks sedimentary rocks abundant contamination of disseminated sulfides.

Area C is the Beaver River area (Aq, Au, Ag, B, Ba, Bi, Cd, Co, Cu, Fe, Mo, Pb, Sb, Sn, Sr, W, Zn, barite-celestite, cinnabar, galena, native gold, molybdenite, pyrite, scheelite-powellite, and sphalerite). One mineral occurrence in the area is described as consisting of tourmaline-cemented breccia pipes in close proximity to a quartz porphyry stock (porter?) plug and argillized andesite and dacite units. Field observations suggest that the area's rocks are part of the Meshik Volcanics, especially the upper Beaver River valley and the east side of Hoodoo Mountain.

Area D is the Pyramid Mountain area, which includes the Pyramid porphyry copper prospect (Ag, Au, Au, B, Ba, Bi, Cd, Co, Fe, Mo, Pb, Sb, Sr, W, Zn, barite-celestite, galena, molybdenite, pyrite, scheelite-powellite, and sphalerite). The Pyramid prospect was (Wilson and others, 1988) described as containing chalcopyrite (0.413 percent copper and 0.025 percent molybdenum. The late Miocene quartz diorite intrusive rocks and Eocene sedimentary rocks of the prospect contain an extensive altered zone and porphyry-type mineralization; the alteration is zoned outward from a barren potassic core through strong pervasive quartz sericite, to a propylitic zone. Pyrite is obsolete by clastic sedimentary rocks of the Hoodoo and overlying Tolstoi Formation and Quaternary volcanic rocks. Zones of altered andesite and dacite units. Field observations suggest that the area's rocks are part of the Meshik Volcanics, especially the upper Beaver River valley, the latter formation is composed of Eocene and lower Oligocene Stepovak Formation and upper Miocene and Quaternary volcanic rocks are also present in the area.

Area E is located between Albatross Anchorage, San Diego Bay, and Deerend Bay, it includes the San Diego porphyry copper and gold prospect (Ag, Au, Ba, Bi, Cd, Cu, Fe, Mo, Pb, Sb, Sr, Zn, barite-celestite, cinnabar, native gold, molybdenite, pyrite, and sphalerite). Gold was (Wilson and others, 1988) reported to be as high as 5.5 ounces per ton (opt) and gold prospect (Ag, Au, Ba, Bi, Cd, Cu, Fe, Mo, Pb, Sb, Sr, Zn, barite-celestite, cinnabar, native gold, molybdenite, pyrite, and sphalerite). Gold was (Wilson and others, 1988) reported to be as high as 5.5 ounces per ton (opt) and were drilled for porphyry evaluation in 1975 and was later extensively worked primarily for gold. The area is a 50-square-kilometer color anomaly in Miocene volcanic rocks. Small stocks and northwest trending dikes of diorite and quartz diorite are present, but they are difficult to distinguish textually from the intruded andesite country rock. Sericitically altered rocks are common and the area contains widely scattered zones of intense argillic alteration associated with well-developed stockwork vein systems. Gold concentrations rarely exceed 2 parts per million (ppm). The highest values were detected in quartz-barite-carbonate veins.

Area F is located between Mud Bay and Grass Valley (Ag, Au, Au, B, Ba, Bi, Cd, Co, Fe, Mo, Pb, Sb, Sn, Sr, W, Zn, barite-celestite, cinnabar, native gold, molybdenite, pyrite, and scheelite-powellite). The geologic map shows area is underlain by Tertiary intrusive rocks and surrounding Tertiary volcanic rocks, and in clastic rocks of the Stepovak Formation. In the northern part of the area are rocks of the Tolstoi Formation, the upper Eocene and lower Oligocene Meshik Volcanics, the Oligocene and Miocene Unga Formation, the Miocene Bellicofski Formation, and the Upper Jurassic Naknek Formation. Three mineral occurrences have been described within area F. These include (1) a silicified(?) granodiorite pluton intruding rocks of the Tolstoi Formation along the ridge northeast of Grass Valley, (2) a mineralized coarse-grained granodiorite pluton containing many quartz-pyrite veins located at the upper end of the next valley to the northeast of Grass Valley, and (3) siltstone and sandstone of the Stepovak Formation are. The last andesite(?) dikes and by veins containing masses of galena. This last occurrence is located on a ridge 7 km southwest of Mud Bay.

More than 40 anomalous areas can be delineated on the nonmagnetic heavy-mineral-concentrate maps, each area represented by 3 to 40 concentrate samples, and each sample represented by 2 to 23 plotted elements and minerals that are present in anomalous concentrations. The number of plotted elements and minerals representing each anomalous area is, to some extent, influenced by sample density. The major geochemical anomalies in the study area appear to be related, at least in part, to the intrusive and extrusive rocks and associated hydrothermal activity. The larger anomalous areas may represent several overlapping magmatic and hydrothermal events.

Although any or all the heavy-mineral-concentrate anomalies may indicate areas of mineralized rock, those areas represented by several samples that contain multiple base and precious-metal anomalies values are most likely to indicate extensive areas of exposed or near-surface mineralized rock. The 21 areas that may host mineral deposits are circled on the maps and assigned letters. Those areas that overlap significant entire-80-mesh stream-sediment anomalies (Frisken and Arbogast, 1992) are designated on the map and in the text by the letters A through N. The following paragraphs briefly describe the 22 most significant anomalous areas and list, alphabetically in parentheses, the plotted anomalous elements and minerals within each circled area. Some apparently less significant anomalous areas are also given. Information and references on many of the anomalous areas are contained in the Port Moller AMRAP geologic map and mineral-exploration data in the following descriptions are from Wilson and others (1988) and the AMRAP geological map (F.H. Wilson, unpublished data). Some field observations made during the reconnaissance geochemical sampling program are also included. A more detailed description of gold distribution in the study area is covered in Frisken and Kelley (1990).

Area A is the Canoe Bay gold prospect (Ag, Au, Au, Ba, Bi, Cd, Cu, Fe, Mo, Pb, Sb, Sr, W, Zn, barite-celestite, native gold, molybdenite, pyrite, and sphalerite). It is located on a rhyolitic(?) dome intruding siltstone of the Upper Cretaceous Hoodoo Formation. Field observations include physical characteristics noted in several of the 20 anomalous areas, including (1) a localized red color anomaly caused by altered, disseminated pyrite (phyllic alteration), (2) cobbles of blanched (bleached or deeply weathered), sometimes brecciated intrusive(?) rock characterized by disseminated to veinlet quartz crystals, (3) argillically altered rocks, and (4) numerous small quartz veinlets.

Area B is the Mud Bay area, which includes Mount Dana and Hoodoo Mountain (Ag, Au, Au, B, Ba, Bi, Cd, Co, Fe, Mo, Pb, Sb, Sr, Zn, barite-celestite, native gold, pyrite, and scheelite-powellite). It includes a small, poorly exposed Tertiary intrusive(?) stock intruding rocks of the Stepovak Formation. Rocks in the area are strongly iron stained and hornfelsed, and silicification is common. Pebble or breccia clasts are commonly present in intrusive lapatic dorritid and nearby sedimentary rocks. Hydrothermal alteration of the area's volcanic rocks is widespread and has led to attention of the area's volcanic rocks sedimentary rocks abundant contamination of disseminated sulfides.

Area C is the Beaver River area (Ag, Au, Au, B, Ba, Bi, Cd, Co, Fe, Mo, Pb, Sb, Sn, Sr, W, Zn, barite-celestite, cinnabar, galena, native gold, molybdenite, pyrite, scheelite-powellite, and sphalerite). One mineral occurrence in the area is described as consisting of tourmaline-cemented breccia pipes in close proximity to a quartz porphyry stock(porter?) plug and argillized andesite and dacite units. Field observations suggest that the area's rocks are part of the Meshik Volcanics, especially the upper Beaver River valley and the east side of Hoodoo Mountain.

Area D is the Pyramid Mountain area, which includes the Pyramid porphyry copper prospect (Ag, Au, Au, B, Ba, Bi, Cd, Co, Fe, Mo, Pb, Sb, Sr, W, Zn, barite-celestite, galena, molybdenite, pyrite, scheelite-powellite, and sphalerite). The Pyramid prospect was (Wilson and others, 1988) described as containing chalcopyrite (0.413 percent copper and 0.025 percent molybdenum. The late Miocene quartz diorite intrusive rocks and Eocene sedimentary rocks of the prospect contain an extensive altered zone and porphyry-type mineralization; the alteration is zoned outward from a barren potassic core through strong pervasive quartz sericite, to a propylitic zone. Pyrite is obsolete by clastic sedimentary rocks of the Hoodoo and overlying Tolstoi Formation and Quaternary volcanic rocks. Zones of altered andesite and dacite units. Field observations suggest that the area's rocks are part of the Meshik Volcanics, especially the upper Beaver River valley, the latter formation is composed of Eocene and lower Oligocene Stepovak Formation and upper Miocene and Quaternary volcanic rocks are also present in the area.

Area E is located between Albatross Anchorage, San Diego Bay, and Deerend Bay, it includes the San Diego porphyry copper and gold prospect (Ag, Au, Ba, Bi, Cd, Cu, Fe, Mo, Pb, Sb, Sr, Zn, barite-celestite, cinnabar, native gold, molybdenite, pyrite, and sphalerite). Gold was (Wilson and others, 1988) reported to be as high as 5.5 ounces per ton (opt) and gold prospect (Ag, Au, Ba, Bi, Cd, Cu, Fe, Mo, Pb, Sb, Sr, Zn, barite-celestite, cinnabar, native gold, molybdenite, pyrite, and sphalerite). Gold was (Wilson and others, 1988) reported to be as high as 5.5 ounces per ton (opt) and were drilled for porphyry evaluation in 1975 and was later extensively worked primarily for gold. The area is a 50-square-kilometer color anomaly in Miocene volcanic rocks. Small stocks and northwest trending dikes of diorite and quartz diorite are present, but they are difficult to distinguish textually from the intruded andesite country rock. Sericitically altered rocks are common and the area contains widely scattered zones of intense argillic alteration associated with well-developed stockwork vein systems. Gold concentrations rarely exceed 2 parts per million (ppm). The highest values were detected in quartz-barite-carbonate veins.

Area F is located between Mud Bay and Grass Valley (Ag, Au, Au, B, Ba, Bi, Cd, Co, Fe, Mo, Pb, Sb, Sn, Sr, W, Zn, barite-celestite, cinnabar, native gold, molybdenite, pyrite, and scheelite-powellite). The geologic map shows area is underlain by Tertiary intrusive rocks and surrounding Tertiary volcanic rocks, and in clastic rocks of the Stepovak Formation. In the northern part of the area are rocks of the Tolstoi Formation, the upper Eocene and lower Oligocene Meshik Volcanics, the Oligocene and Miocene Unga Formation, the Miocene Bellicofski Formation, and the Upper Jurassic Naknek Formation. Three mineral occurrences have been described within area F. These include (1) a silicified(?) granodiorite pluton intruding rocks of the Tolstoi Formation along the ridge northeast of Grass Valley, (2) a mineralized coarse-grained granodiorite pluton containing many quartz-pyrite veins located at the upper end of the next valley to the northeast of Grass Valley, and (3) siltstone and sandstone of the Stepovak Formation are. The last andesite(?) dikes and by veins containing masses of galena. This last occurrence is located on a ridge 7 km southwest of Mud Bay.

Field observations revealed scattered red color anomalies in the rocks of the area.

Area G is the Right Hand area (Ag, Au, Ba, Bi, Cd, Co, Mo, Pb, barite-celestite, and pyrite). The area's rocks are Tertiary and Quaternary volcanic rocks, up to a lesser extent, upper Miocene clastic sedimentary rocks of the Bear Lake Formation. One mineral occurrence in the area is basaltic lava altered to a brilliant yellow color. Field observations revealed scattered color anomalies and quartz- and pyrite-rich rocks.

Area H is the Clark Bay to Chichagof Peak (Moon Steps) area (Ag, Au, B, Ba, Cu, Mo, Pb, Sb, Sr, W, Zn, barite-celestite, pyrite, scheelite-powellite, and sphalerite). It is underlain by a complex granitoid Tertiary intrusion and surrounding Tertiary volcanic rocks. The intrusion is in contact with rocks of the Stepovak Formation. Some quartz- and pyrite-rich rocks are present. Field observations revealed some sample sites located in area H.

Area I is the Red Hill-Grub Gulch (Bent Point) area (Ag, Au, Au, B, Ba, Bi, Cd, Co, Fe, Mo, Pb, Sb, Sn, Sr, W, Zn, barite-celestite, galena, pyrite, and sphalerite), which is represented by Tertiary volcanic rocks. Rocks of the Stepovak and Tolstoi Formations underlie the northern part of the area. The Stepovak Formation is composed of a lower sandstone and a Tertiary quartz diorite intrusive(?) unit. Rocks in the area are red and display phyllic and propylitic alteration. Field observations revealed red color anomalies, quartz-pyrite veins, and rocks showing pyrite-phyllic and argillic alteration.

Area J is the Ivanof porphyry-copper prospect (Ag, Au, Au, B, Bi, Cu, Fe, Mo, Pb, Sn, and Zn, as well as chalcopyrite, galena, molybdenite, and pyrite). This prospect is located in a 7-square-kilometer color anomaly zone porphyry-type mineralization related to a small quartz diorite intrusion. The area is underlain by rocks of the Tolstoi Formation. Veinlet and replacement mineralization is present in the intrusive and tolstoi rocks. Rocks in the area have been subjected to minor potassic and sericitic alteration, and widespread propylitic alteration. Field observations revealed red color anomalies and quartz-pyrite-rich altered rocks; many molybdenite flakes were noted in panned concentrates.

Area K is the northwest part of Dolgoi Island (Ag, Au, Ba, Bi, Cd, Co, Fe, Mo, Pb, Sb, Sn, Sr, Zn, barite-celestite, and pyrite). Rocks in the area are Tertiary intrusive rocks, and in clastic rocks of the Stepovak Formation. Field observations revealed a red color anomaly and quartz-rich altered rocks.

Area L is the Cape Kekurnoi area (Ag, Au, Ba, Bi, Cd, Co, Fe, Mo, Pb, Sb, Sn, Sr, W, Zn, barite-celestite, cinnabar, galena, native gold, pyrite, and scheelite-powellite). Rocks in the area are strongly iron stained and hornfelsed, and silicification is common. Pebble or breccia clasts are commonly present in intrusive lapatic dorritid and nearby sedimentary rocks. Hydrothermal alteration of the area's volcanic rocks is widespread and has led to attention of the area's volcanic rocks sedimentary rocks abundant contamination of disseminated sulfides.

Area M is located northwest of Coal Harbor on Unga Island (Ag, Au, Ba, Bi, Co, Fe, Mo, Pb, Sb, Sn, Sr, Zn, cinnabar, molybdenite, and pyrite). The area is underlain by the Popof volcanic rocks, rocks of the Stepovak Formation, and a small Tertiary intrusion. Field observations revealed a color anomaly in the Popof volcanic rocks along the beach on the west side of the area, and abundant cinnabar in a panned-concentrate sample collected just inland from the beach. Pyrite is common.

Area N covers the Cinnabar Creek area (Ag, Ba, Bi, Cd, Co, Fe, Mo, Pb, Sb, Sr, W, Zn, barite-celestite, cinnabar, and pyrite), which is underlain by the Popof volcanic rocks. It is composed of a complex of rocks that are described as an altered zone in Tertiary volcanic rocks. Field observations revealed disseminated pyrite in andesite.

The 22 areas described above and delineated on the maps represent some of the most significant anomalies in the study area. Many heavy-mineral-concentrate data generated during this study. These data are presented on the maps as symbols representing selected and associated alphabetic sets and mineral occurrences on Popof Island. Many additional heavy-mineral-concentrate anomalies are present in the study area, but supplemental data are required to delineate mineralization within the study area boundaries is, for the most part, lacking. Some anomalies located in the northwest part of the Port Moller boundaries of the study area probably are derived from mineralized rocks located in adjacent areas to the west (Frisken, in press).

Geochemical anomalies may not usually considered reliable indicators of the presence of mineralized rocks, although all Au and Ag anomalies were evaluated. Two single-element anomalies were discovered in heavy-mineral concentrates collected along the west side of a ridge extending north-northeast from Mount Dana, perhaps indicating that anomalous area A extends north of Mount Dana. However, the presence of a single-element anomaly in the area indicates that the gold may have been transported northward by glacial ice from a source farther to the south. The Canoe Bay prospect is located about 2 km west of Jackson Lagoon. Numerous sand and debris-flow deposits surrounding Mount Dana are another possible source, although panned-concentrate samples collected from the area of these deposits did not contain detectable concentrations of Au. A single-element anomaly located about 2 km southwest of Ivanof Bay is also located in an area mapped as monzite. Pyrite and arsenopyrite are present in the monzite, and the area is a 50-square-kilometer color anomaly in Miocene volcanic rocks. Small stocks and northwest trending dikes of diorite and quartz diorite are present, but they are difficult to distinguish textually from the intruded andesite country rock. Sericitically altered rocks are common and the area contains widely scattered zones of intense argillic alteration associated with well-developed stockwork vein systems. Gold concentrations rarely exceed 2 parts per million (ppm). The highest values were detected in quartz-barite-carbonate veins.

Area P is located between Humphrey Harbor on Nagai Island (Ag, Au, Au, Cu, Pb, Sn, W, zinc, pyrite, and scheelite-powellite) and underlain by Tertiary intrusive rocks and rocks of the Shumagin Formation. Field observations include granitic dikes that intrude the Shumagin Formation and disseminated sulfides in sandstone. A sample collected from one of the dikes was shown to be the same age as the Shumagin formation. Field observations include granitic dikes that intrude the Shumagin Formation and disseminated sulfides in sandstone. A sample collected from one of the dikes was shown to be the same age as the Shumagin formation. Field observations include granitic dikes that intrude the Shumagin Formation and disseminated sulfides in sandstone. A sample collected from one of the dikes was shown to be the same age as the Shumagin formation. Small stocks and northwest trending dikes of diorite and quartz diorite are present, but they are difficult to distinguish textually from the intruded andesite country rock. Sericitically altered rocks are common and the area contains widely scattered zones of intense argillic alteration associated with well-developed stockwork vein systems. Gold concentrations rarely exceed 2 parts per million (ppm). The highest values were detected in quartz-barite-carbonate veins.

Area Q is the high, partly ice-covered, mountainous area that extends northeast from Left Head to the northern boundary of the study area (Ag, Au, Au, B, Ba, Bi, Cd, Co, Fe, Mo, Pb, Sb, Sn, Sr, W, Zn, barite-celestite, pyrite, and sphalerite). The area is underlain by Tertiary intrusive rocks and rocks of the Stepovak Formation. Field observations include a red color anomaly and quartz-rich altered rocks.

Area R is the Kozhemyaka area (Ag, Au, Ba, Bi, Co, Fe, Mo, Pb, Sb, Sn, Sr, W, Zn, barite-celestite, cinnabar, native gold, molybdenite, pyrite, and scheelite-powellite). The area is underlain by rocks of the Stepovak Formation, and a small Tertiary intrusion. Field observations revealed a red color anomaly in the rocks of the area, and abundant cinnabar in a panned-concentrate sample collected just inland from the beach. Pyrite is common.

Area S is a single sample site at Quartz Point on Unga Island (Au, Cu, Mo, Zn, and pyrite). The area is underlain by the Popof volcanic rocks and Quaternary volcanic rocks. Field observations revealed a red color anomaly in volcanic rocks at the site and the presence of large quartz veins in the area.

Area T is located northwest of Coal Harbor on Unga Island (Ag, Au, Ba, Bi, Co, Fe, Mo, Pb, Sb, Sn, Sr, Zn, cinnabar, molybdenite, and pyrite). The area is underlain by the Popof volcanic rocks, rocks of the Stepovak Formation, and a small Tertiary intrusion. Field observations revealed a color anomaly in the Popof volcanic rocks along the beach on the west side of the area, and abundant cinnabar in a panned-concentrate sample collected just inland from the beach. Pyrite is common.

Area U covers the Coal Harbor area (Ag, Ba, Bi, Co, Cu, Fe, Mo, Pb, Sb, Sn, Sr, Zn, cinnabar, and pyrite), which is underlain by the Popof volcanic rocks. It is composed of a complex of rocks that are described as an altered zone in Tertiary volcanic rocks. Field observations revealed disseminated pyrite in andesite.

Area V is located on Popof Island (Ag, Au, Au, Ba, Bi, Cd, Co, Cu, Fe, Mo, Pb, Sb, Sn, Sr, W, Zn, barite-celestite, cinnabar, native gold, molybdenite, pyrite, and sphalerite). A small inactive placer gold mine and several prospects and mineral occurrences on Popof Island lie along the general northwest trend of faults mapped on both Unga and Popof Islands. The Mary Lou Eocene Porphyry Copper Prospect was drilled in 1904 and 1965. An estimated 50 to 125 million tons of low-grade copper mineralization (0.3 percent copper) and gold (0.03 opt) and silver (0.3 opt) are contained in the area's rocks. The gold-bearing, chalcopyrite, and sphalerite are present in the cliffs above. Native gold, galena