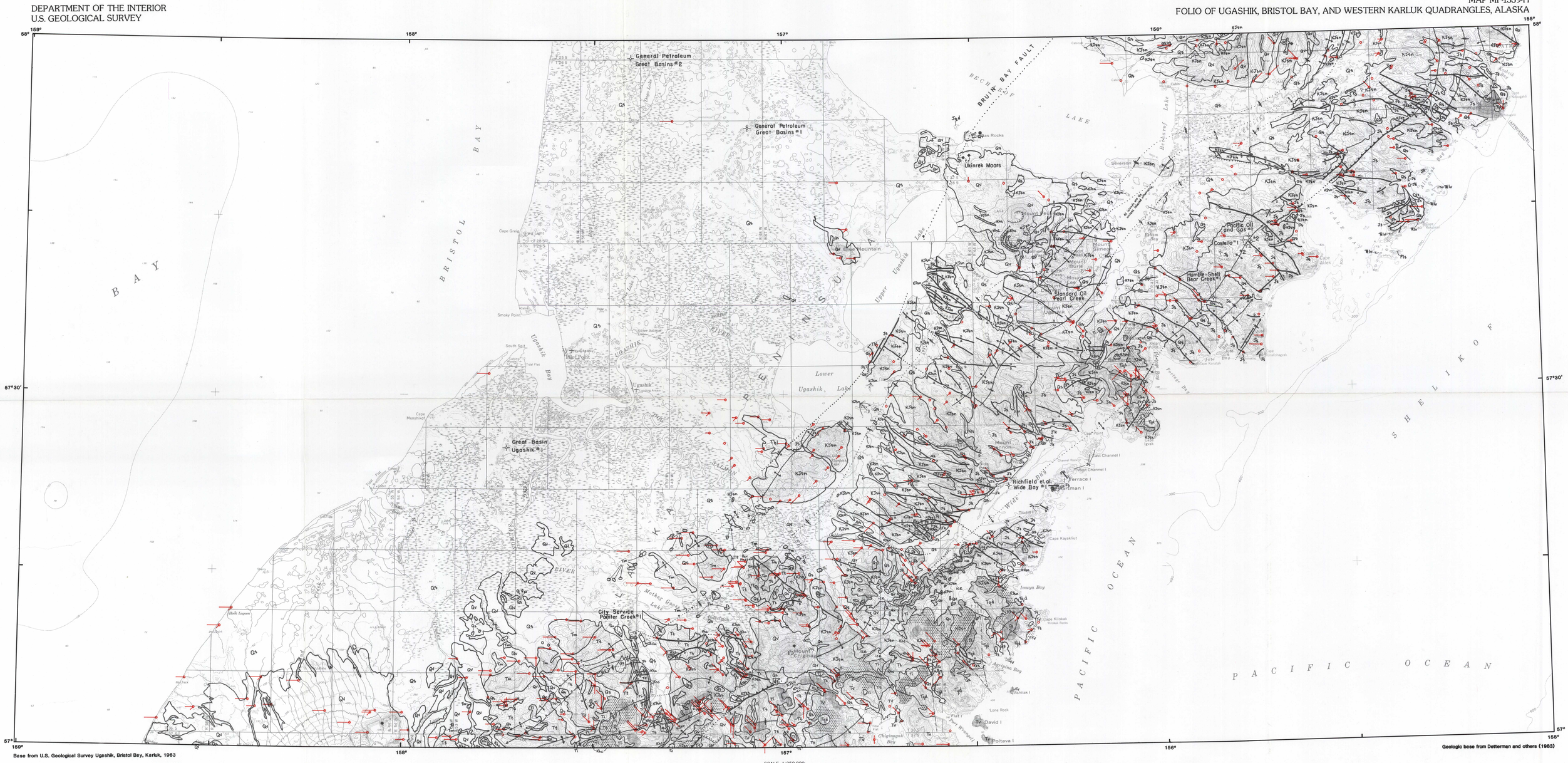
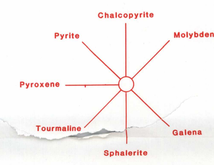
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1539-H
FOLIO OF UGASHIK, BRISTOL BAY, AND WESTERN KARLUK QUADRANGLES, ALASKA



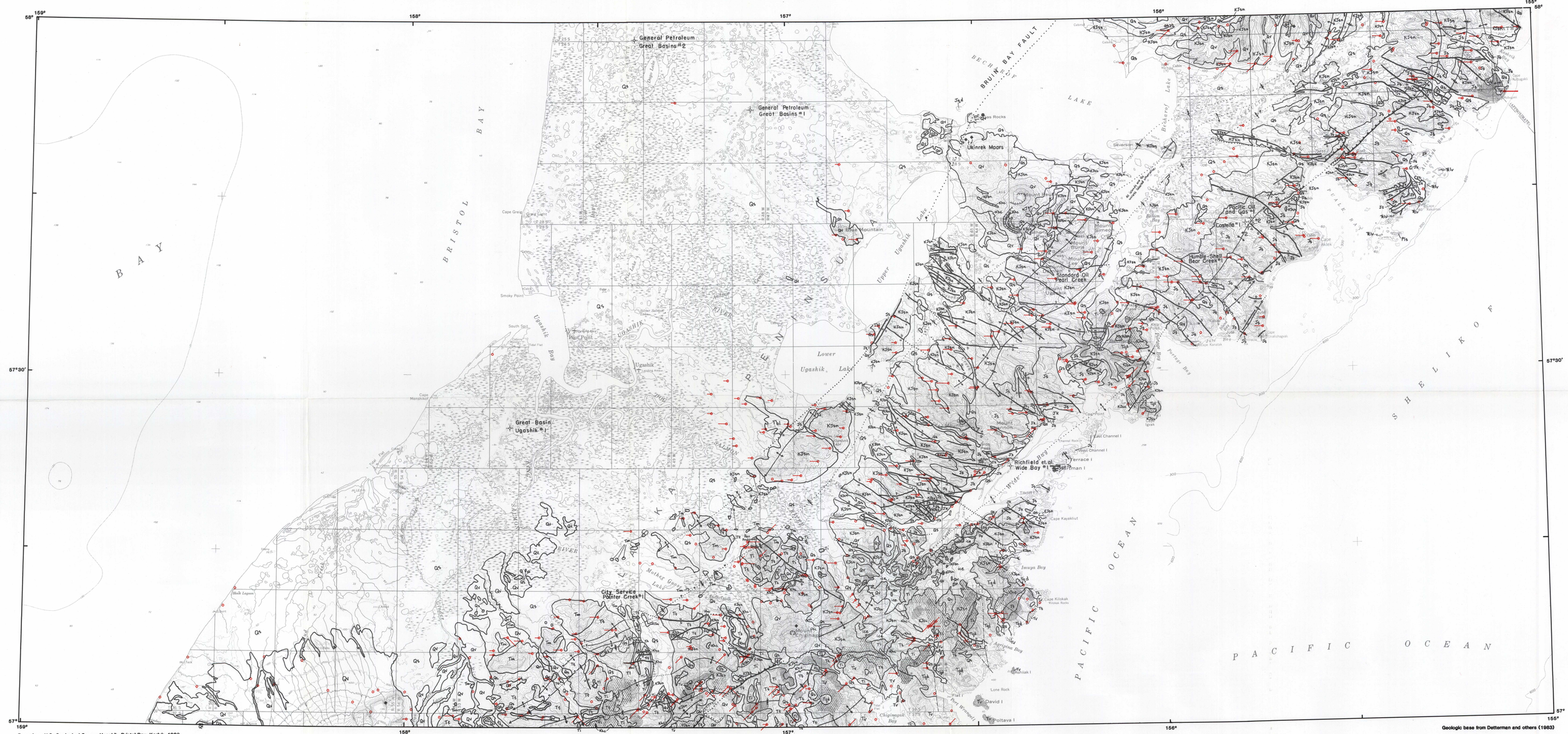
Base from U.S. Geological Survey Ugashik, Bristol Bay, Karluk, 1963

EXPLANATION



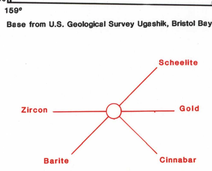
Mineralogical sample site--Vectors centered around the sample locality showing the distribution of pyroxene and six ore-related minerals. Each filled vector of the star diagram represents the relative abundance of a specific mineral recovered from a single 14-in. gold pan of sediment. The length of the vector indicates the relative abundance (estimated visually in percent) of the mineral present in the sample (table 1).

MAP A.– CHALCOPYRITE, MOLYBDENITE, GALENA, SPHALERITE, TOURMALINE, PYROXENE, PYRITE



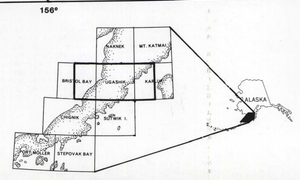
Base from U.S. Geological Survey Ugashik, Bristol Bay, Karluk, 1963

EXPLANATION



Mineralogical sample site--Vectors centered around the sample locality showing the distribution of zircon and four ore-related minerals. Each filled vector of the star diagram represents the relative abundance of a specific mineral recovered from a single 14-in. gold pan of sediment. The length of the vector indicates the relative abundance (estimated visually in percent) of the mineral present in the sample (table 1).

MAP B.– SCHEELITE, GOLD, CINNABAR, PYRITE, BARITE, ZIRCON



Map Area

NOTE: The following correlation, description of map units, and list of symbols is for the geologic base map shown here in gray.

CORRELATION OF MAP UNITS

SURFICIAL DEPOSITS AND SEDIMENTARY ROCKS

VOLCANIC ROCKS

INTRUSIVE ROCKS

Qs	Qv			Holocene and Pleistocene	QUATERNARY
Tbl	Tv	Tqd	Ti	Pliocene to Oligocene	TERTIARY
		Tm		Oligocene and Eocene	
Tt				Eocene and Paleocene	
Khc				Upper Cretaceous	CRETACEOUS
KJsn				Lower Cretaceous and Upper Jurassic	CRETACEOUS AND JURASSIC
Js				Middle Jurassic	JURASSIC
Jk		Jqd		Lower Jurassic	
Jt					
	TRlv			Upper Triassic	TRIASSIC
Pls				Upper Permian	PERMIAN

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS AND SEDIMENTARY ROCKS

Qs — SURFICIAL DEPOSITS (HOLOCENE AND PLEISTOCENE) - Unconsolidated alluvium, alluvial fans, and glacial, marine, lake, swamp, eolian, and landslide deposits; mainly silt, sand, gravel, pumice, and rock fragments

Tbl — BEAR LAKE FORMATION (MIOCENE) - Sandstone, siltstone, shale, minor coal, and conglomerate; nonmarine

Tt — TOLSTOI FORMATION (EOCENE AND PALEOCENE) - Sandstone, conglomerate, siltstone, shale, coal, and tuff; dominantly volcaniclastic and nonmarine

Khc — HOODOO AND CHIGNIK FORMATIONS, UNDIVIDED (UPPER CRETACEOUS) - Hoodoo Formation: dark rhythmically bedded siltstone and shale, minor thin sandstone; deep-water marine. Chignik Formation: sandstone, conglomerate, siltstone, and shale; mainly shallow marine

KJsn — STANIUKOVICH AND NAKNEK FORMATIONS, UNDIVIDED (LOWER CRETACEOUS AND UPPER JURASSIC) - Staniukovich Formation of Late Jurassic and Early Cretaceous age: thin-bedded feldspathic sandstone, commonly laumontitic; minor siltstone and shale. Naknek Formation of Late Jurassic age: thin-bedded sandstone, siltstone, and dark shale with limestone concretions in upper part. Massive arkosic sandstone and conglomerate in lower part; abundant granitic- and metamorphic-rock clasts in conglomerate. Upper part marine; lower part nonmarine fluvial

Js — SHELIKOF FORMATION (MIDDLE JURASSIC) - Dark siltstone and shale with limestone concretions, sandstone, and conglomerate; nonmarine to near-shore marine, and deep-water turbidite

Jk — KIALAGVIK FORMATION (MIDDLE AND LOWER JURASSIC) - Sandstone, siltstone, mudstone, and shale; mainly shallow water marine

Jt — TALKEETNA FORMATION (LOWER JURASSIC) - Tuffaceous sandstone, siltstone, and limestone; minor bedded tuff

Pls — LIMESTONE (UPPER PERMIAN) - Light-gray massive crystalline limestone

SEDIMENTARY AND VOLCANIC ROCKS

TRlv — LIMESTONE AND VOLCANIC ROCKS (UPPER TRIASSIC) - Light- to dark-gray thin-bedded to massive limestone, limestone conglomerate, and basalt

VOLCANIC ROCKS

Qv — VOLCANIC ROCKS (HOLOCENE AND PLEISTOCENE) - Block and ash flows, debris flows, volcanic mud flows, cinder cones, and andesitic and dacitic lava flows; includes minor hypabyssal rocks

Tv — VOLCANIC ROCKS (PLIOCENE TO OLIGOCENE) - Basalt, andesite, and dacite lava flows, volcanic breccia, and rubble flows; locally includes hypabyssal rocks

Tm — MESHIK FORMATION (OLIGOCENE AND EOCENE) - Basalt flows, volcanic rubble flows, and lahars; locally minor volcanogenic sedimentary rocks

INTRUSIVE ROCKS

Tqd — QUARTZ DIORITE (PLIOCENE TO OLIGOCENE) - Agripina Bay pluton; hornblende-biotite and pyroxene-biotite quartz diorite; medium to coarse grained

Ti — INTRUSIVE ROCKS (PLIOCENE TO OLIGOCENE) - Diorite, quartz diorite, hypabyssal andesite and dacite

Jqd — QUARTZ DIORITE (MIDDLE AND LOWER JURASSIC) - Medium to coarse grained, hornblende and biotite bearing; part of the Alaska-Aleutian Range batholith

GEOLOGIC MAP SYMBOLS

CONTACT--Dotted where concealed

FAULT--Dotted where concealed; queried where probable. U, upthrown side; D, downthrown side. Arrows indicate relative lateral movement

THRUST OR HIGH-ANGLE REVERSE FAULT--Dotted where concealed; sawteeth on upper plate

FOLDS--Showing trace of axial plane; dotted where concealed; queried where probable. Arrow indicates direction of plunge

Anticline

Syncline

LINEAMENT

VOLCANIC CRATER

VOLCANIC VENT OR CINDER CONE (OTHER THAN WITHIN CRATERS)

HORNFELS

ALTERATION--Includes sericitic alteration and silicification

EXPLORATORY DRILL HOLE

OIL SEEPS

HOT SPRING

COLD SPRING

GAS SEEP--Carbon dioxide

INTRODUCTION

The U.S. Geological Survey is required by the Alaska National Interest Lands Conservation Act (ANILCA, Public Law 96-487) to survey certain Federal lands to determine their mineral resource potential. Results from the Alaska Mineral Resource Appraisal Program (AMRAP) must be made available to the public and be submitted to the President and the Congress. This report presents the mineralogical results of a heavy-mineral survey of the Ugashik, Bristol Bay, and western Karluk quadrangles, Alaska.

The geologic setting of the study area, on the Alaska Peninsula, is that of a volcanic arc. At least two-thirds of the study area is covered either by Quaternary alluvial and glacial deposits or by Quaternary volcanic rocks. The Pacific Ocean side of the study area is predominately underlain by Jurassic, Cretaceous, and Tertiary marine and nonmarine clastic sedimentary rocks that are, in places, intruded by, or covered by, Tertiary diorite and quartz diorite and associated extrusive equivalents. The geologic base map is from Detterman and others (1983). The area is favorable for the occurrence of base- and precious-metal deposits, in particular for disseminated sulfide deposits associated with calc-alkaline porphyrys. Contact-metamorphosed rock and hydrothermally altered rock are common near Tertiary volcanic-plutonic centers, most of which are exposed in the southeastern part of the study area (Detterman and others, 1983). MacKevett and Holloway report known mineralization at Puale Bay and Cape Kubugakli in the Karluk quadrangle (MacKevett and Holloway, 1977, p. 16), as well as several copper-molybdenum and molybdenum porphyry systems in the Ugashik quadrangle (MacKevett and Holloway, 1977, p. 35). At the time the field studies were in progress, Bear Creek Mining Company was actively evaluating the mineralized rock at the Mike and Kes prospects.

A reconnaissance exploration geochemical study was undertaken during the 1979 and 1980 field seasons. Two different media were sampled: (1) stream sediments, and (2) heavy-mineral concentrates panned from the stream sediments. The minus-80-mesh stream-sediment medium reflects changes in bedrock geology and geochemistry and may also reveal extensive areas of exposed mineralized rock, whereas the nonmagnetic fraction of the heavy-mineral concentrates will concentrate the ore-related minerals present and may be useful in delineating areas of poorly exposed or buried mineralization. We panned down one 14-in. gold pan full of minus-2-mm stream sediment at 569 sites. This sample was further processed in the laboratory with heavy liquids to remove the light-mineral fraction (sp. gr. <2.8), and through a magnetic separation process to remove magnetite as well as many of the most magnetic mafic minerals.

The nonmagnetic heavy-mineral fraction examined in this study contained some rock-forming minerals having a high specific gravity, such as apatite, zircon, rutile, and sphene; the sulfide, sulfosalt, and some oxide minerals; scheelite; and several of the accessory minerals associated with mineralization and alteration, such as fluorite, barite, epidote, and tourmaline.

A split of the nonmagnetic heavy-mineral fraction was examined under a binocular microscope to determine the mineralogy from optical and physical properties such as luster, crystal form, cleavage, and hardness. Some of these identifications were confirmed by X-ray diffraction analysis. Geochemical anomalies determined from the heavy-mineral concentrates may be compared with and related to the identified suite of minerals representing mineralization and alteration. Anomalies may also be attributed to the presence of contamination from lead shot or copper wire or, in the case of placers, to liquid mercury used to recover gold.

Visual examination of the mineralogy of the nonmagnetic heavy-mineral concentrates can also help to identify geochemical anomalies that result from incomplete separation of mafic silicates. Several important trace elements substitute readily in the crystal lattices of the slightly magnetic rock-forming minerals. In addition, visual examination of the mineral concentrates enhances the probability of finding gold or native metals. Malleable metals, such as gold, are not uniformly dispersed during the grinding process and, therefore, may not be detected by spectrographic analysis.

This report is one of a series of three reports that graphically present selected geochemical and mineralogical data in map format. This report presents mineralogical data from nonmagnetic heavy-mineral concentrates, MF-1539-F (Church and others, 1988) presents the geochemical results from analyses of the minus-80-mesh stream sediments, and MF-1539-G (Frisken and others, 1988) presents geochemical results from analysis of the nonmagnetic heavy-mineral-concentrate samples. An interpretive report (Church, Frisken, and Wilson, in press) delineates selected areas of interest within the study area, interprets the significance of the geochemical and mineralogical signatures of these anomalous areas, and explains how these signatures might relate to mineral systems and ore-deposit models. The interpretive report is based on a study of all of the data available to the authors: the stream-sediment geochemistry (MF-1539-F; Church and others, 1988), the mineralogy (this report) and geochemistry (MF-1539-G; Frisken and others, 1988) of the nonmagnetic heavy-mineral concentrates panned from stream sediments, rock geochemical data (MF-1539-C; Wilson and O'Leary, 1986, 1987), the geologic map of the study area (MF-1539-A; Detterman and others, 1983), the magnetic anomaly map of the study area (MF-1539-D; Case and others, 1988), relevant published mineral occurrence maps and data compiled from references (Cobb, 1978, 1980, 1981), and published mineral assessment studies of the contiguous Chignik and Sutwik Island quadrangles to the south (Cox and others, 1981).

A statistical summary of the mineralogical observations from 486 nonmagnetic heavy-mineral concentrates is given in table 1 (mineralogical data are available for only those samples large enough to split). The areal distribution of zircon, pyroxene, and ten ore-related minerals that may reflect mineralization or alteration is shown by vectors on star diagrams on maps A and B. The mineral suites shown on maps A and B reflect the primary sulfide or silicate phase of elements of interest and are plotted on the same vector as are the corresponding elements on the geochemistry maps of the nonmagnetic heavy-mineral concentrates (MF-1539-G; Frisken and others, 1988). Not all of the vectors have been used in the star diagrams. Only those ore-related minerals that have a particular element as a primary part of their chemical makeup and that could be readily identified in the nonmagnetic heavy-mineral concentrates are shown. For example, galena, PbS, is shown on map A on the vector corresponding to lead on map A of MF-1539-G (Frisken and others, 1988). No separate silver-bearing mineral was identified, so this vector was used for cinnabar on map B. When sufficient data were available (table 1), the vectors were subdivided into three lengths corresponding to selected ranges of abundance expressed as visually estimated volume percentages of the mineral in each nonmagnetic heavy-mineral sample. The distribution of pyroxene, shown on map B, is useful in identifying sample sites where the presence of mafic minerals may explain anomalies that are not related to mineralization processes.

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TABLE 1.--Statistical summary of the mineralogical data for nonmagnetic heavy-mineral-concentrate samples, Ugashik, Bristol Bay, and western Karluk quadrangles, Alaska

[Qualified population is one in which mineral concentrations are coded with an N or I, where N = not detected; and I = insufficient sample to estimate concentrations. Unqualified population is one in which mineral concentrations can be estimated. Leaders (--) denote no data or insufficient data; < = less than; > = greater than; ≥ = greater than or equal to. Ranges for silicate minerals, barite, and pyrite are given in percent, others are given as numbers of grains observed in nonmagnetic heavy-mineral concentrate.]

Mineral	Data based on the qualified population N	Data based on the qualified population I	Data based on the unqualified population Number of values (n)	Data based on the unqualified population Range of values	Distribution (by percent based on visual estimate) Selected ranges plotted Short vector	Medium vector	Long vector
Pyroxene/amphibole	72	82	415	<1–90	5–15	20–50	>50
Zircon	45	82	442	<1–75	5–15	20–50	>50
Tourmaline	370	82	117	<1–20	<1	1–4	≥5
Pyrite	141	82	346	<1–90	5–15	20–50	>50
Barite	368	82	119	<1–35	1–4	5–15	>15
Chalcopyrite	466	82	21	1	1	2–4	≥5
Molybdenite	480	82	7	1–20	1	2–4	≥5
Galena	482	82	5	1–2	--	1	>1
Sphalerite	471	82	16	1–5	1	2–4	≥5
Scheelite-powellite	467	82	20	1–20	1	2–4	≥5
Gold	481	82	6	1	--	--	>1
Cinnabar	481	82	6	1	--	--	>1

MINERALOGICAL MAP SHOWING THE DISTRIBUTION OF SELECTED ORE-RELATED MINERALS IDENTIFIED IN NONMAGNETIC HEAVY-MINERAL CONCENTRATES FROM THE UGASHIK, BRISTOL BAY, AND WESTERN KARLUK QUADRANGLES, ALASKA

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