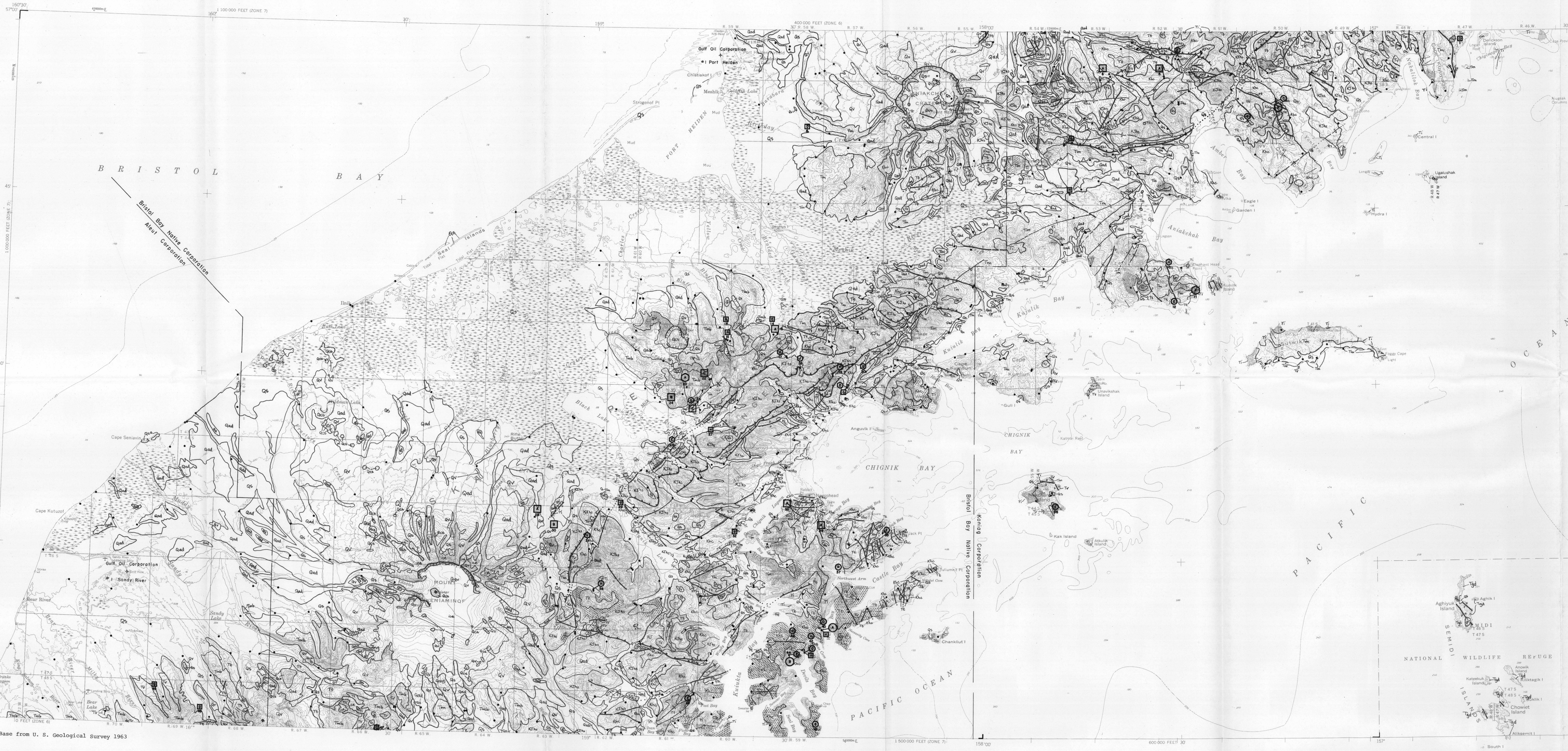
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1053H
FOLIO OF THE CHIGNIK AND SUTWIK ISLAND QUADRANGLES, ALASKA
GEOCHEMICAL MAP, Bi, Sn, W



Base from U. S. Geological Survey 1963

Geology from Detterman and others, 1979

GEOCHEMICAL SYMBOLS

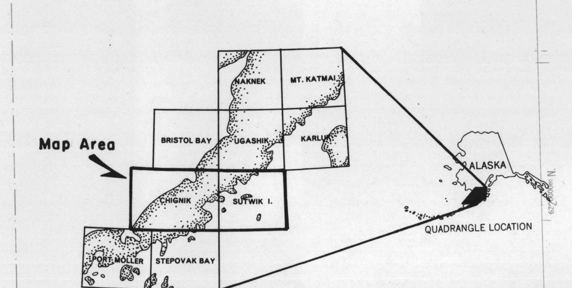
ANOMALOUS BISMUTH VALUE--Number corresponds to analytical results shown in Table 1. Letter defined on fig. 1A.

ANOMALOUS TIN VALUE--Number corresponds to analytical results shown in Table 1. Letter defined on fig. 1B.

ANOMALOUS TUNGSTEN VALUE--Number corresponds to analytical results shown in Table 1. Letter defined on fig. 1C.

SAMPLE SITE--Bismuth, tin, and tungsten not detected at lower detection limits of 20, 20, and 100 ppm respectively.

LEADERED SYMBOL--Indicates position of sample site.



BISMUTH, TIN, AND TUNGSTEN IN NONMAGNETIC HEAVY-MINERAL-CONCENTRATE SAMPLES

SCALE 1:250 000

5 0 5 10 MILES

5 0 5 10 KILOMETERS

GEOLOGIC MAP SYMBOLS

- Contact--Dotted where concealed
- Fault--Dashed where approximately located, 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; dashed where approximately located; dotted where concealed. Arrow indicates direction of plunge
  - Anticline
  - Syncline
- Volcanic crater
- Volcanic vent or cinder cone
- Hornfels
- Alteration
- Dikes and sills
- Exploratory drill hole
- Hot spring
- Native Corporation boundary

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS AND SEDIMENTARY ROCKS

Qs SURFICIAL DEPOSITS--Unconsolidated alluvium, colluvium, glacial, marine, swamp and eolian deposits; mainly sand, silt, gravel and pumice

Tmb MILKY RIVER FORMATION OF GALLOWAY (1974) AND BEAR LAKE FORMATION--Milky River Formation (Pliocene); mainly volcanogenic sandstone and conglomerate, non-marine. Bear Lake Formation (Miocene); sandstone, conglomerate, siltstone, shale, and coal; shallow marine to non-marine

Tt TOLSTOI FORMATION OF BURK (1965) (Paleocene and Eocene)--Sandstone, conglomerate, siltstone, dark shale, coal; high percent volcanic debris; mainly non-marine

Khc HOODOO AND CHIGNIK FORMATIONS--Hoodoo Formation (Upper Cretaceous); dark shale and siltstone; deep water deposit. Chignik Formation (Upper Cretaceous); sandstone, shale, conglomerate, siltstone, and coal; shallow water to non-marine

KJhs HERENDEEN LIMESTONE AND STANIUKOVICH, NAKNEK, AND SHELIKOF FORMATIONS--Herendeen Limestone (Lower Cretaceous); thin-bedded calcarenite composed of Inoceramus prisms and thin calcareous sandstone. Staniukovich Formation (Upper Jurassic and Lower Cretaceous); thin-bedded feldspathic and laumontitic sandstone. Naknek Formation (Upper Jurassic); dark siltstone and shale in upper part, light arkosic sandstone and conglomerate in lower part. Shelikof Formation (Middle Jurassic); dark siltstone and shale

VOLCANIC ROCKS

Qad ASH AND DEBRIS FLOW DEPOSITS--Volcanic ash, pumice, tuff, and breccia; includes air-fall, ash flow, and avalanche deposits; unsorted to well-sorted; poorly- to well-stratified; includes some lava flows

Qcs CINDER AND SPATTER CONES, AND DOMES--Cinders, scoria, and associated pyroclastic rock

Qv VOLCANIC ROCKS--Andesite and dacite flows, tuff, volcanic breccia, and lahars

Tv VOLCANIC ROCKS--Rhyolite, andesite, dacite, and basalt flows; tuff, volcanic rubble flows, and lahars; includes hypabyssal plugs and domes

Tm MESHIK FORMATION (Miocene or Oligocene)--Basalt flows, volcanic rubble flows, and lahars; minor volcanogenic sedimentary rock

INTRUSIVE ROCKS

Ti INTRUSIVE ROCKS--Quartz diorite, diorite, and gabbro; medium- to coarse-grained; mainly small plutons

Tgd GRANODIORITE--Semidi Islands pluton; medium- to coarse-grained; hornblende- and biotite-bearing

CORRELATION OF MAP UNITS

SURFICIAL DEPOSITS AND SEDIMENTARY ROCKS	VOLCANIC ROCKS	INTRUSIVE ROCKS	Age	
Qs	Qad, Qcs, Qv		Holocene and Pleistocene	QUATERNARY
Tmb Unconformity	Tv	Ti	Pliocene and Miocene	TERTIARY
	Tm		Miocene or Oligocene	TERTIARY
Tt Unconformity			Eocene and Paleocene	TERTIARY
		Tgd	Paleocene	TERTIARY
Khc Unconformity			Upper Cretaceous	CRETACEOUS
KJhs			Lower Cretaceous to Middle Jurassic	CRETACEOUS AND JURASSIC

DISCUSSION

Introduction

These geochemical maps show the distribution and abundance of bismuth, tin, and tungsten in the Chignik and Sutwik Island quadrangles, Alaska and are part of a folio of maps which were compiled under the auspices of the Alaska Mineral Resource Assessment Program. Background information pertaining to this folio is available in U.S. Geological Survey Circular 802 (Detterman and others, 1980).

The distribution and abundance of bismuth, tin, and tungsten in 623 nonmagnetic heavy-mineral-concentrate samples collected in 1977 and 1978 are shown on a subdued topographic and generalized geologic base. Letters within symbols have been plotted at sample sites where concentrations of detectable, bismuth, tin, or tungsten where determined in the nonmagnetic heavy-mineral concentrates; the letters represent the analytical values expressed in ppm (parts per million) as defined on the histograms (fig. 1). Hexagons, squares, and circles represent anomalous values of bismuth, tin, and tungsten respectively; increasing symbol size represents increasing ranges of concentrations as defined on fig. 1. Anomalous concentrations of bismuth, tin, and tungsten and associated elements are tabulated by sample site in table 1.

Sample media

The topography of the Chignik and Sutwik Island quadrangles is characteristically rugged with short, rapidly flowing mountain streams on the east and west flanks of the Aleutian Range. Where the west flank grades into tidal flats toward Bristol Bay the streams become slow and meandering. Because of earlier work, minus-80-mesh stream-sediment and nonmagnetic heavy-mineral-concentrate samples were considered to be the best sample media for the reconnaissance resource assessment of the area. In all cases the sediment samples were taken from the beds of active stream channels which were draining areas ranging from 6 to 12 km². The detrital material and clays composing the sediment are considered to be representative of the composition of the bedrock and colluvium within the confines of the drainage basin upstream from the sample site; analysis of this sediment may reflect the presence of mineralization. The heavy minerals were concentrated by panning the sediment to remove the dilutional effects produced by common rock-forming minerals and rock fragments, and minerals of economic importance were isolated. The concentration of heavy minerals enhances the contrast between background and anomalous values, thus making heavy-mineral-concentrate samples excellent indicators of mineral occurrences within the environment.

Sample preparation and analysis

The heavy-mineral-concentrate samples were panned to remove a percentage of the light minerals and were then air dried. The samples were sieved to minus 20 mesh and separated using bromoform (specific gravity, 2.86) into light- and heavy-mineral fractions. The heavy-mineral fraction was passed through a Frantz Isodynamic Separator[1] to obtain a nonmagnetic fraction at a 0.6 ampere setting. The nonmagnetic fraction was then split; one fraction was used for mineralogical study and the other was pulverized with a mortar and pestle for spectrographic analysis.

Bismuth, tin, and tungsten in nonmagnetic heavy-mineral-concentrate samples was determined by semiquantitative emission spectroscopy (Grimes and Marranzino, 1968). Detailed descriptions of sample preparation, analytical techniques, and tabulated results for the elements analyzed appear in Detra and others (1978).

Statistical data

The statistics presented on this map were compiled using U.S. Geological Survey STATPAC program (VanTrump and Miesch, 1977). The distribution of bismuth, tin, and tungsten for the entire sample set of nonmagnetic heavy-mineral concentrates are shown on the histograms where frequency is plotted against concentration in ppm (fig. 1). Summary statistics listed beneath each histogram were calculated using unqualified values. An unqualified value is a reported value which has not been coded with an N, L, or G, where: N indicates not detected; L indicates detected at a concentration below the lower limit of determination; G indicates detected concentration is above the upper limit of determination.

Analysis by semiquantitative emission spectroscopy (Grimes and Marranzino, 1968) of representative rock samples collected from the major rock units of the Chignik and Sutwik Island quadrangles showed no detectable bismuth, tin, or tungsten at lower detection limits of 10, 10, and 50 ppm, respectively.

[1]The use of commercial trade names is for descriptive purposes only and does not constitute endorsement of those products by the U.S. Geological Survey.

Distribution and nature of geochemical anomalies

The most striking anomaly pattern of tungsten in nonmagnetic heavy-mineral-concentrate samples occurs in the Warner Bay area (T. 46 S., R. 58 W.). These anomalous concentrations are associated with plutons of varying composition shown as unit Ti on the generalized geologic map. There is a correlation between the presence of tungsten by spectroscopic analysis in heavy-mineral concentrates and the occurrence of scheelite in the area (Tripp and Detra, 1980).

Anomalous bismuth, tin, and tungsten show poorly developed anomaly patterns occurring around Cathedral Creek (T. 43 S., R. 52 W.), Dry Creek (T. 42 S., R. 58 W.), and Cape Kumlik (T. 41 S., R. 52 W.). These weak patterns are probably associated with intrusive centers of diorite or quartz-diorite composition.

Characteristics of the bismuth, tin, and tungsten anomaly patterns and the better defined pattern at Warner Bay suggest the possibility of porphyry-type mineralization where hydrothermal zoning has produced (1) a core enriched in copper, molybdenum, and locally, tungsten centered on the intrusive; (2) an adjacent halo of copper, lead, zinc, silver, arsenic, and (or) gold; and (3) a peripheral halo produced by tin and bismuth anomalies.

Generally scattered anomalous bismuth, tin, and tungsten values in this area are probably related to intrusive centers ranging in composition from quartz diorite, to diorite, to gabbro shown as unit Ti on the generalized geologic map and may be a response to similar porphyry-type mineralization which is weak or concealed. The lack of any significant bismuth, tin, or tungsten content in the stream-sediment samples suggests that the sources are small and that there are strong dilutional effects from the barren source rocks.

Many of the geochemical patterns have a close spatial correlation with conspicuous aeromagnetic anomalies (U.S. Geological Survey, 1978); of special interest are correlations near Devil's Bay, Cathedral Creek area, and near Cape Kumlik.

References

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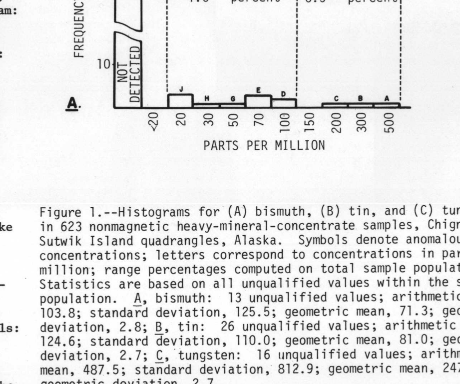

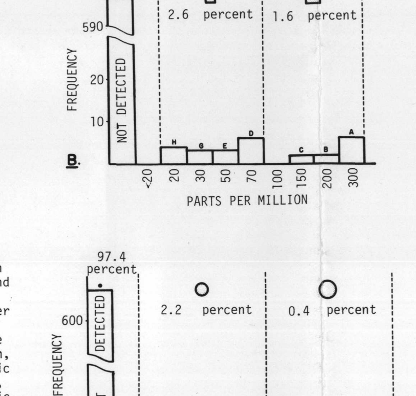

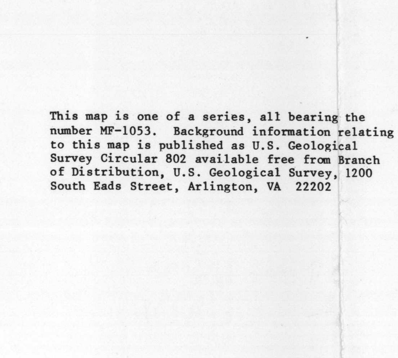

Figure 1.--Histograms for (A) bismuth, (B) tin, and (C) tungsten in 623 nonmagnetic heavy-mineral-concentrate samples, Chignik and Sutwik Island quadrangles, Alaska. Symbols denote anomalous concentrations; letters correspond to concentrations in parts per million; range percentages computed on total sample population. Statistics are based on all unqualified values within the sample population. A, bismuth: 13 unqualified values; arithmetic mean, 103.8; standard deviation, 125.5; geometric mean, 71.3; geometric deviation, 2.8; B, tin: 26 unqualified values; arithmetic mean, 124.6; standard deviation, 110.0; geometric mean, 81.0; geometric deviation, 2.7; C, tungsten: 16 unqualified values; arithmetic mean, 487.5; standard deviation, 812.9; geometric mean, 247.1; geometric deviation, 2.7.

This map is one of a series, all bearing the number MF-1053. Background information relating to this map is published as U.S. Geological Survey Circular 802 available free from Branch of Distribution, U.S. Geological Survey, 1200 South Eads Street, Arlington, VA 22202

Table 1.--*Copper, molybdenum, lead, and zinc associated with anomalous bismuth, tin, and tungsten values in nonmagnetic heavy-mineral-concentrate samples, Chignik and Sutwik Island quadrangles, Alaska*

[Values reported in parts per million; values shown determined by semiquantitative emission spectroscopy; N, not detected; L, detected but below value shown; G, detected at a concentration above value shown; lower limits of detection for Bi, Sn, W, Mo, Pb, and Zn are 20, 20, 100, 10, 20, and 500 ppm, respectively; *, anomalous values for Cu, Mo, Pb, and Zn. Map number corresponds to sample site on heavy-mineral-concentrate map]

Map no.	Field no.	Bi	Sn	W	Cu	Mo	Pb	Zn
1	SW001	N	70	N	700*	70*	70	7,000*
2	023	300	N	500	3,000*	20*	150*	N
3	034	N	N	200	3,000*	N	70	N
4	049	70	N	N	150	N	50	N
5	052	N	300	N	15	N	N	N
6	062	N	300	N	20	N	N	N
7	140	N	50	N	70	N	N	N
8	CG336	N	70	N	15	N	N	N
9	SW135	N	20	N	15	N	N	N
10	090	30	N	N	1,000*	N	150*	N
11	092	200	N	N	3,000*	N	5,000*	1,500*
12	093	N	N	200	7,000*	N	300*	N
13	CG375	N	70	N	10	N	N	N
14	365	N	50	N	200	N	N	N
15	373	N	20	N	100	N	100	N
16	364	N	300	N	500	N	70	N
17	359	20	N	N	2,000*	N	70	N
18	358	20	N	N	1,000*	N	70	N
19	202	N	N	100	1,000*	200*	N	N
20	162	100	N	N	15	N	N	N
21	402	100	30	N	5,000*	N	70	N
22	239	N	150	N	50	N	N	N
23	236	500	N	N	5,000*	N	300*	N
24	417	N	200	N	300	N	100	N
25	415	50	150	N	300	N	150*	5,000*
26	223	70	N	N	200	N	N	N
27	412	N	20	N	100	N	30	N
28	273	N	300	N	10	N	N	N
29	424	N	30	N	200	N	70	N
30	274	N	200	N	15	N	N	N
31	243	20	N	N	1,000*	N	300*	N
32	407	N	30	N	700*	N	5,000*	N
33	405	N	300	N	70	N	70	N
34	166	N	300	N	1,000*	N	150*	N
35	150	N	N	200	300	N	20	N
36	SW131	N	N	200	150	N	70	500*
37	CG144	N	N	100	300	150*	200*	N
38	265	N	N	100	2,000*	70*	100	1,000*
39	051	N	N	150	150	N	1,000*	N
40	061	N	N	300	70	700*	500*	N
41	062	N	20	3,000	G20,000*	1,500*	70	N
42	063	N	N	100	500	N	N	N
43	064	N	20	300	10,000*	70*	N	N
44	065	70	N	2,000	2,000*	20*	50	N
45	067	N	N	150	500	N	500*	N
46	036	N	N	200	5,000*	200*	20	N
47	096	N	70	N	500	N	N	N
48	134	N	70	N	70	N	30	N
49	437	N	70	N	20	N	L(20)	N

DISTRIBUTION AND ABUNDANCE OF BISMUTH, TIN AND TUNGSTEN IN NONMAGNETIC HEAVY-MINERAL-CONCENTRATE SAMPLES, CHIGNIK AND SUTWIK ISLAND QUADRANGLES, ALASKA

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