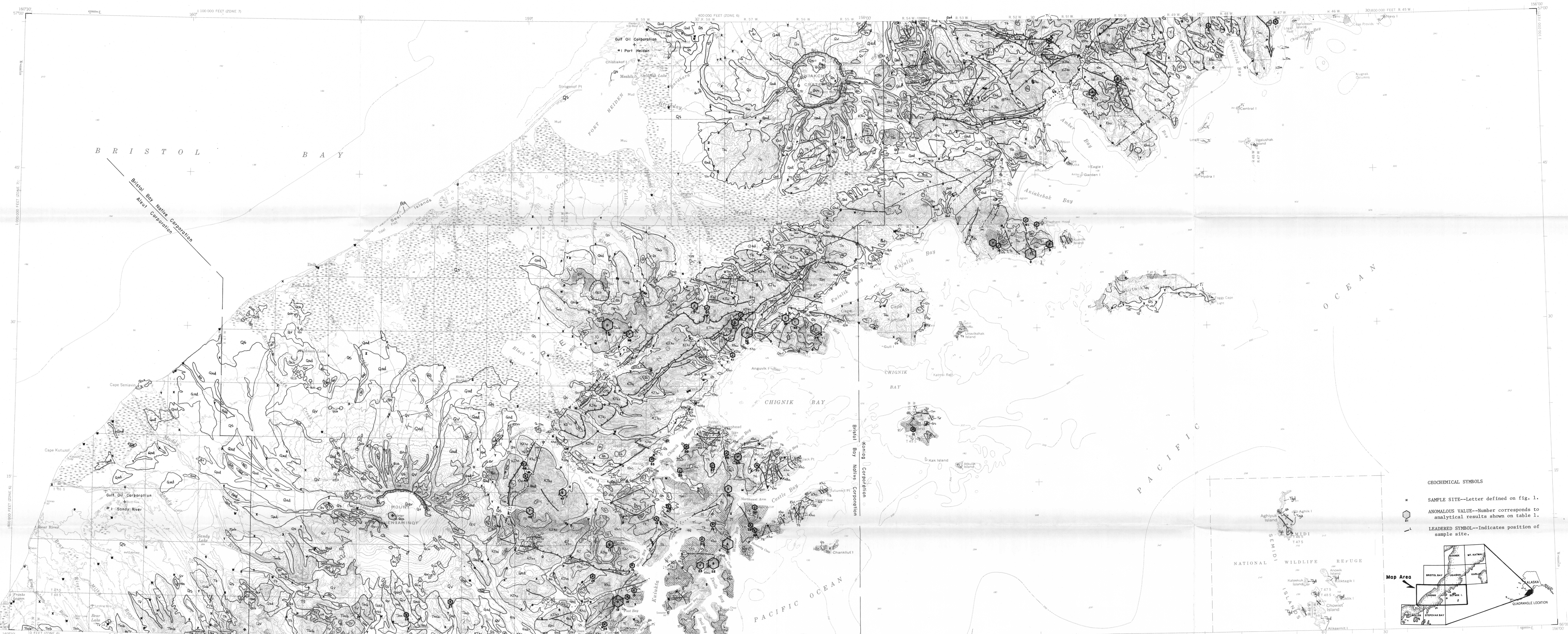

Base from U.S. Geological Survey, 1963

Geology from Detterman and others, 1979.

COPPER IN NONMAGNETIC HEAVY-MINERAL-CONCENTRATE SAMPLES

SCALE 1:250 000

5 0 5 10 MILES

5 0 5 10 KILOMETERS

DISCUSSION

Introduction

These geochemical maps show the distribution and abundance of copper 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 copper in 637 minus-80-mesh stream-sediment samples and 623 nonmagnetic heavy-mineral-concentrate samples collected in 1977 and 1978 are shown on a subdued topographic and generalized geologic base. At each sample site a letter has been plotted on the map; letters represent analytical values of copper expressed in ppm (parts per million) as defined on the histograms (figs. 1 and 2). Hexagons on the nonmagnetic heavy-mineral-concentrate map and circles on the stream-sediment map denote copper concentrations which are considered to be anomalous; increasing symbol size represents increasing ranges of concentrations as defined on histograms (figs. 1 and 2). Anomalous concentrations of copper and associated elements are tabulated by sample site in tables 1 and 2.

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 km^2. 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

Stream-sediment samples were air dried, sieved to minus 80 mesh, and pulverized to minus 250 mesh to produce a homogeneous sample for 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.

Copper in minus-80-mesh stream-sediment samples and 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 copper for the entire sample set for each sample medium is shown on the histograms where frequency is plotted against concentration in ppm (figs. 1 and 2). 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. Below is a listing of correlation coefficients of copper to relevant associated elements. These coefficients (above diagonal) are computed from the number of unqualified pairs within the sample population (below diagonal). A coefficient of 1 indicates a perfect direct correlation and -1 an inverse relation; an asterisk indicates that the correlation coefficient was not computed. Correlation coefficients which are significant with a 5 percent or less chance of error are italicized.

[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.

Correlation coefficients of copper with associated elements

Sample media	Fe	Mn	Ag	Mo	Pb	Sn	W	Zn
Cu in stream sediments	*.52*/628	*.42*/637	*.26*/5	*.65*/21	*.37*/614	*/0	*/1	*.22*/637
Cu in heavy-mineral concentrates	*.42*/569	-*.19*/602	.10/50	-.10/26	*.32*/228	.24/15	-.35/25	.28/33

A statistical summary of background copper values in the major rock units of the Chignik and Sutwik Island quadrangles is presented in table 3. The background summary is based on rock samples which were considered to be compositionally representative of the rock unit from which they were taken. The method of analysis was identical to that used for the minus-80-mesh stream-sediment samples.

Distribution and nature of geochemical anomalies

The most notable anomaly patterns of copper in both minus-80-mesh stream-sediment and nonmagnetic heavy-mineral-concentrate samples occur in the area surrounding Warner Bay (T. 46 S., R. 58 W.), Bee Creek (T. 42 S., R. 58 W.), Weasel Mountain (T. 42 S., R. 57, 56 W.), and Cape Kumlik (T. 41 S., R. 52 W.). These anomalous concentrations are associated with plutons of varying composition shown as unit Ti on the generalized geologic map and at least one occurrence of copper and molybdenum mineralization at Warner Bay. At this occurrence copper in the form of chalcopyrite occurs in veins and fracture fillings. The other high values around the Warner Bay area are probably derived from mineralized zones similar in nature to the Warner Bay occurrence. Many of the sample sites containing anomalous copper concentrations correlate with observed occurrences of chalcopyrite and cuprite (Tripp and Detra, 1980).

Scattered anomalous copper concentrations distributed over the quadrangles are probably related to small intrusive centers ranging in composition from quartz diorite, to diorite, to gabbro. The lack of any significant copper content in some of the stream-sediment samples at some sites suggests that the copper sources are small and that there are strong dilutional effects from the barren source rocks.

Characteristics of the better defined anomaly patterns of copper 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. The poorly patterned copper anomalies in this area may be a response to similar porphyry-type mineralization which is weak or concealed. Scattered anomalous copper values in stream-sediment and heavy-mineral-concentrate samples which are in the lower anomalous concentration ranges probably reflect background values related to source rock (table 3) and are not necessarily an indication of significant mineralization.

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.

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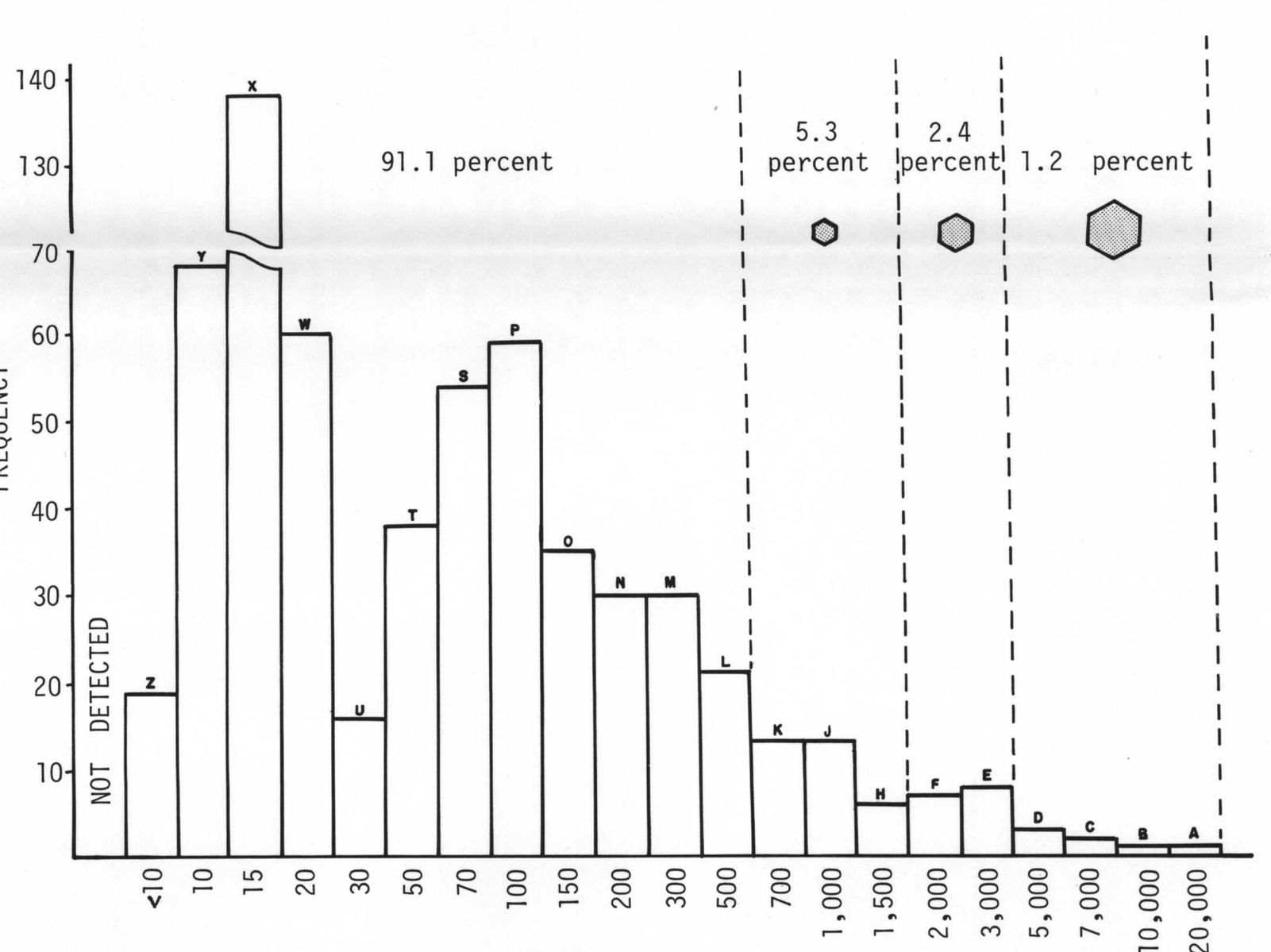

Figure 1.--Histogram for copper in 623 nonmagnetic heavy-mineral-concentrate samples, Chignik and Sutwik Island quadrangles, Alaska, showing: symbols denoting anomalous concentrations, percentage of total number of samples represented by each range, and letters corresponding to concentrations in parts per million. Statistics are based on all unqualified values (603) within the sample population; arithmetic mean, 257.1; standard deviation, 791.4; geometric mean, 57.5; and geometric deviation, 8.2.

Table 1.--*Lead, zinc, molybdenum, and silver associated with anomalous copper values in nonmagnetic heavy-mineral concentrates, Chignik and Sutwik Island quadrangles, Alaska*

[Values reported in parts per million; values shown determined by semi-quantitative emission spectroscopy; N, not detected; L, detected but below value shown; G, detected at a concentration above value shown; lower limits of detection for Pb, Zn, Mo, and Ag are 20, 500, 10, and 1 ppm, respectively; *, anomalous values for Pb, Zn, Mo, and Ag. Map number corresponds to sample site on heavy-mineral-concentrate map]

Map no.	Field no.	Cu	Pb	Zn	Mo	Ag
1	SW001	700	70	7,000*	70*	5*
2	010	1,000	70	N	N	N
3	023	3,000	150*	N	20*	N
4	034	3,000	70	N	N	N
5	046	700	70	N	20*	2*
6	090	1,000	150*	N	N	N
7	091	1,000	50	N	N	N
8	092	3,000	5,000*	1,500*	N	300*
9	093	7,000	300*	N	N	5*
10	094	1,000	1,000*	700*	N	5*
11	097	2,000	1,000*	500*	N	5*
12	125	700	100*	1,500*	N	N
13	CG036	5,000	20	N	200*	7*
14	037	700	N	N	N	N
15	038	700	N	N	N	N
16	040	1,500	100*	3,000*	N	N
17	041	3,000	100*	N	N	N
18	046	700	20	N	N	N
19	049	1,500	50	N	N	2*
20	050	1,500	500*	N	N	N
21	062	G20,000	70	N	1,500*	15*
22	064	10,000	N	N	70*	N
23	065	2,000	50	N	20*	50*
24	073	700	700*	N	N	N
25	076	1,500	1,000*	N	N	N
26	103	1,500	N	N	N	N
27	127	700	N	N	N	N
28	138	1,000	70	7,000*	N	2*
29	139	700	20	G10,000*	N	2*
30	143	3,000	N	N	N	N
31	146					
32	156	3,000	70	N	N	N
33	157	2,000	70	N	N	N
34	159	7,000	20	2,000*	N	N
35	165	2,000	70	N	N	N
36	166	1,000	150*	N	N	N
37	167	1,000	50	N	N	N
38	169	1,500	70	N	N	N
39	170	1,000	70	500*	N	N
40	175	700	70	N	N	N
41	197	1,000	3,000*	N	N	10*
42	201	3,000	N	N	N	2*
43	202	1,000	N	N	200*	N
44	236	5,000	300*	N	N	N
45	242	700	70	N	N	N
46	243	1,000	300*	N	N	15*
47	248	3,000	500*	7,000*	N	150*
48	254	2,000	70	3,000*	N	N
49	265	2,000	100*	1,000*	70*	N
50	358	1,000	70	N	N	2*
51	359	2,000	70	N	N	2*
52	402	5,000	70	N	N	10*
53	407	700	5,000*	N	N	15*
54	141	1,000	70	N	N	2*

DISTRIBUTION AND ABUNDANCE OF COPPER IN MINUS-80-MESH STREAM-SEDIMENT AND NONMAGNETIC HEAVY-MINERAL-CONCENTRATE SAMPLES, CHIGNIK AND SUTWIK ISLAND QUADRANGLES, ALASKA

By
D.E. Detra and E.F. Cooley
1980

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

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