DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

FOLIO OF THE
GOODNEWS AND HAGEMEISTER ISLAND QUADRANGLES REGION

OPEN FILE REPORT 78-9-R

HESSIN AND OTHERS—GEOCHEMICAL DISTRIBUTION OF ARSENIC, GOLD, SILVER, AND PLATINUM

RECEIVED
JAN 2 1979
Div. of Geological Survey
Anchorage

GEOCHEMICAL AND GENERALIZED GEOLOGICAL MAP SHOWING DISTRIBUTION AND ABUNDANCE OF ARSENIC, GOLD, SILVER, AND PLATINUM IN THE GOODNEWS AND HAGEMEISTER ISLAND QUADRANGLES REGION SOUTHWESTERN ALASKA

BY

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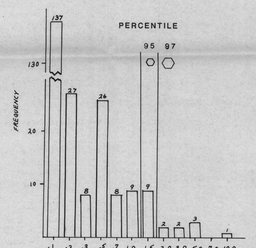
1978

EXPLANATION OF ABUNDANCE SYMBOLS

ARSENIC

- REPRESENTS CONCENTRATIONS OF ARSENIC OF 500-999 PARTS PER MILLION IN PAN-CONCENTRATE SAMPLES
- REPRESENTS CONCENTRATIONS OF ARSENIC OF 1000-1999 PARTS PER MILLION IN PAN-CONCENTRATE SAMPLES
- REPRESENTS CONCENTRATIONS OF ARSENIC OF 2000 PARTS PER MILLION OR GREATER IN PAN-FRACTION SAMPLES
- SED-AS/1000 — NUMBER REPRESENTS PARTS PER MILLION CONCENTRATION OF ARSENIC IN STREAM-SEDIMENT SAMPLES
- REPRESENTS CONCENTRATIONS OF ARSENIC OF 500-999 PARTS PER MILLION IN OXALIC ACID LEACHATE SAMPLES
- REPRESENTS CONCENTRATIONS OF ARSENIC OF 2000 PARTS PER MILLION OR GREATER IN OXALIC ACID LEACHATE SAMPLES
- VEG-AS/200 — NUMBER REPRESENTS PARTS PER MILLION CONCENTRATION OF ARSENIC IN VEGETATION SAMPLES

SILVER



THIS HISTOGRAM GRAPHICALLY ILLUSTRATES THE ABUNDANCE AND FREQUENCY OF SILVER CONCENTRATIONS IN VEGETATION SAMPLES AS REPORTED BY HESSIN AND OTHERS (1978).

- REPRESENTS CONCENTRATIONS OF SILVER FROM 1 TO 5 PARTS PER MILLION IN PAN-FRACTION SAMPLES
- REPRESENTS CONCENTRATIONS OF SILVER FROM 6 TO 20 PARTS PER MILLION IN PAN-FRACTION SAMPLES

GOLD

- REPRESENTS CONCENTRATIONS OF GOLD DETECTED BY ATOMIC ABSORPTION METHODS IN SEDIMENT SAMPLES

PLATINUM

- REPRESENTS CONCENTRATIONS OF PLATINUM DETECTED IN THE THOUSANDTHS PARTS PER MILLION (.00X PPM)
- REPRESENTS CONCENTRATIONS OF PLATINUM DETECTED IN THE HUNDREDTHS PARTS PER MILLION (.0X PPM)

(AREA OF REPORT: Barnes and others, 1978)

(AREA OF REPORT: CLARK, GRYBECK, GREENWOOD and others, 1978 / CLARK, GRYBECK, HESSIN and others, 1978)

EXPLANATION

GEOLOGY GENERALIZED FROM HOARE AND COONRAD (1978)

CORRELATION OF MAP UNITS

SURFICIAL DEPOSITS

Q+	QUATERNARY	

VOLCANIC, SEDIMENTARY, AND METAMORPHIC ROCKS

Qb	Pleistocene	QUATERNARY
QTs	Plio-Pleistocene	QUATERNARY or TERTIARY
Tv	Early Tertiary	TERTIARY
Ks	Late Cretaceous or Maastrichian ?	CRETACEOUS
Kk	Upper and Lower Cretaceous	
Kk Kcg Kts Kcg	Lower Cretaceous	
KJvs	Lower Cretaceous to Middle Jurassic	CRETACEOUS AND JURASSIC
Jk Jvs	Middle to Lower Upper Jurassic	JURASSIC
Jtvs	Lower Jurassic	
MzPz	Lower Cretaceous to Lower Ordovician ?	MESOZOIC AND PALEOZOIC
Pzss		PALEOZOIC
pCk		PRE-CAMBRIAN

INTRUSIVE ROCKS

Tit Tib Tx	TERTIARY
TKg	TERTIARY AND CRETACEOUS
Jg Jum Ji	JURASSIC AND JURASSIC ?
Pzmg	PALEOZOIC ?

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

- Qu — UNCONSOLIDATED SEDIMENTARY DEPOSITS

SEDIMENTARY, VOLCANIC, AND METAMORPHIC ROCKS

- Qtb — TOGIAK BASALT
- QTs — SEMICONSOLIDATED MARINE BEACH SEDIMENTS
- Tv — VOLCANIC ROCKS AND VOLCANOGENIC SEDIMENTS - Chiefly andesitic flows and tuffs
- Ks — SUMMIT ISLAND FORMATION - Nonmarine conglomerate, sandstone, shale, and carbonaceous mudstone
- Kk — KUSKOKWIM GROUP - Conglomerate overlain by interbedded greywacke, siltstone, and shale; commonly volcaneous; mostly marine
- Kb — BUSCUS RIDGE GREYWACKE - Chiefly interbedded calcareous greywacke, siltstone, and conglomerate with local coquinas of Aucella shells
- Kcg — LIMY GRIT AND LIMESTONE - Chiefly angular grit cemented by bioclastic limestone
- Kts — TUFFS AND SEDIMENTARY ROCKS - Varied assemblage of andesitic tuffs, greywacke, siltstone, impure limestone, and tuffaceous chert; tuff and tuffaceous sediments commonly transmittized
- Kcg — GREYWACKE AND CONGLOMERATE - Marine greywacke, siltstone, and conglomerate; commonly calcareous
- KJvs — VOLCANIC AND SEDIMENTARY ROCKS - Interbedded intermediate to mafic flows, tuffs, tuffaceous sedimentary rocks, and argillites; intermediate composition tuffaceous rocks commonly transmittized
- Jk — VILIUGA GREYWACKE - Chiefly very hard lithic greywacke and siltstone with local conglomerate
- Jvs — VOLCANIC AND SEDIMENTARY ROCKS - Andesitic, trachytic, and basaltic flows and breccias interbedded with volcanogenic sedimentary rocks
- JTvs — VOLCANIC AND SEDIMENTARY ROCKS - Mafic flows and breccias interbedded with volcanogenic sedimentary rocks; fractures commonly coated with laumontite
- MzPz — MESOZOIC AND PALEOZOIC ROCKS UNDIVIDED - Widespread marine unit including mafic to intermediate volcanic rocks, tuffaceous sedimentary rocks, chert, argillite, siltstone, greywacke, conglomerate, and limestone
- Mrs — VOLCANIC AND SEDIMENTARY ROCKS (Upper Triassic) - Locally differentiated marine unit of chert, tuffaceous chert rocks, argillite, siltstone, wacke, conglomerate, limestone, and mafic flows and breccia
- Pv — VOLCANIC ROCKS (Permian) - Locally differentiated marine unit of pillow basalts, massive mafic flows, breccia, and tuff
- Pl — LIMESTONE (Permian) - Locally differentiated thin unit of marine limestone; generally tuffaceous, commonly has strong fetid odor
- DOl — LIMESTONE - Thin-bedded to massive limestone with minor interbedded tuff and mafic flows; locally recrystallized to marble with interbedded quartzite and quartz-chlorite schist
- Pzcs — CALCAREOUS SCHIST (Permian or older?)
- pCm — KANEVINIK METAMORPHIC COMPLEX - Gneiss, schist, amphibolite, and marble; upper greenschist to lower amphibolite facies
- pCl — MARBLEIZED LIMESTONE - Locally differentiated

INTRUSIVE ROCKS

- Tit — FELSIC INTRUSIVE ROCKS - Chiefly rhyolitic to dacitic dikes and sills; locally mapped
- Tib — MAFIC INTRUSIVE ROCKS - Diabase, basalt, diorite, and gabbroic dikes and sills locally mapped
- Tx — WARGRAMM COMPLEX - Quartz-rich porphyritic felsite intrusive-extrusive complex of dikes, sills, tuff, and breccia
- TKg — GRANITIC ROCKS - Chiefly quartz monzonite, granodiorite, and quartz diorite stocks
- Jg — GABBROIC ROCKS - Commonly shows compositional layering and generally associated with ultramafic rocks
- Jum — ULTRAMAFIC ROCKS - Serpentinite, dunite, and websterite
- Ji — TRONDHJEMITE - Associated with serpentinite and gabbro
- Pzmg — METAGABBRO AND GREENSTONE - Probable dismembered ophiolite complex of mafic flows, dikes, volcaniclastic rocks, and gabbro altered by greenschist facies metamorphism and calcium metasomatism

GEOLOGIC SYMBOLS

- Contact. Known, approximately located, gradational, and inferred. Most contacts between bedded rock units are probably faults
- Fault or fault zone. Dashed where approximately located, inferred, or concealed
- Thrust fault. Dashed where approximately located, inferred, or concealed. Sawteeth on upper plate
- Horsfelb

GEOCHEMICAL SYMBOLS

- RED MOUNTAIN ULTRAMAFIC BODY
- RED MOUNTAIN CONTACT ZONE

GEOCHEMICAL SAMPLE SITES

- ROCK (CLARK, GRYBECK, GREENWOOD, AND OTHERS, 1978; COONRAD, AND OTHERS, 1978)
- CONCENTRATE (OVERSTREET, AND OTHERS, 1973)
- OFFSHORE AND ONSHORE SEDIMENTS (BARNES, AND OTHERS, 1978)
- BEACH AND STREAM SEDIMENTS (BERRYHILL, 1963)
- STREAM DRAINAGE SEDIMENT (HESSIN, AND OTHERS, 1978)
- STREAM DRAINAGE SEDIMENT (CLARK, GRYBECK, HESSIN, AND OTHERS, 1978)

ABUNDANCE

- NUMBER WITH SOLID ROCK SAMPLE-SITE SYMBOL REPRESENTS GEOCHEMICAL CONCENTRATION IN PARTS PER MILLION (PPM) (✱ INDICATES ATOMIC-ABSORPTION)
- SOLID STREAM-DRAINAGE SAMPLE-SITE SYMBOL INDICATES GEOCHEMICAL ABUNDANCE OF 90TH PERCENTILE VALUE OR GREATER IN TWO OR MORE GEOCHEMICAL DETERMINATIONS OF ARSENIC
- ABUNDANCE SYMBOLS REPRESENTING 95TH PERCENTILE OR GREATER CONCENTRATIONS DETERMINED IN STREAM-DRAINAGE SITE SAMPLES ARE SHOWN WITH HISTOGRAM

DISCUSSION OF GEOCHEMISTRY

THIS REPORT SHOWS THE GEOCHEMICALLY DETERMINED DISTRIBUTION AND ABUNDANCE OF ARSENIC, GOLD, AND SILVER THROUGHOUT THE GOODNEWS AND HAGEMEISTER ISLAND QUADRANGLES REGION. THE DISTRIBUTION OF GEOCHEMICALLY DETECTED PLATINUM IS RESTRICTED TO THE VICINITY OF PLATINUM AS REPORTED BY COONRAD, HOARE, CLARK, AND OTHERS (1978). DATA PRESENTED HAVE BEEN COMPILED FROM ANALYSES AND LOCATIONS REPORTED BY BARNES AND OTHERS (1978); CLARK, GRYBECK, GREENWOOD, AND OTHERS (1978); CLARK, GRYBECK, HESSIN, AND OTHERS (1978); COONRAD, HOARE, TAUFEN, AND HESSIN (1978); HESSIN AND OTHERS (1978); AND OVERSTREET AND OTHERS (1973).

THE LIMITS OF THE SYMBOLIZED CONCENTRATION VALUES WERE ARBITRARILY SELECTED. HISTOGRAMS HAVE NOT BEEN CONSTRUCTED BECAUSE OF THE SMALL NUMBER OF SAMPLES CONTAINING DETECTABLE AMOUNTS OF THESE ELEMENTS. ROCK SAMPLES IN WHICH ARSENIC, GOLD, SILVER, OR PLATINUM WERE DETECTED HAVE CONCENTRATION VALUES SHOWN IN PARTS PER MILLION (PPM).

THE GENERALIZED GEOLOGIC MAP DATA INCLUDED IN THIS REPORT AND THE MORE DETAILED GEOLOGIC MAP OF THE REGION (HOARE AND COONRAD, 1978) SHOULD BE UTILIZED IN CONSIDERING POSSIBLE METALLOGENIC SIGNIFICANCE OF THE ARSENIC, GOLD, SILVER, AND PLATINUM THAT HAS BEEN GEOCHEMICALLY DETECTED IN VARIOUS SAMPLES.

NOTE ON POSSIBLE HAZARDOUS ARSENIC CONCENTRATIONS

AS FAR AS IS KNOWN, THERE ARE NO ANALYSES OF WATER FROM OR NEAR THE SITES WHERE ARSENIC HAS BEEN DETECTED BY THE GEOCHEMICAL SAMPLING PROGRAM IN THE GOODNEWS-HAGEMEISTER ISLAND QUADRANGLES REGION. HOWEVER, THE OCCURRENCE IN GEOLOGIC MATERIALS OF CONCENTRATIONS OF ARSENIC DETECTABLE BY SEMIQUANTITATIVE EMISSION SPECTROGRAPHIC ANALYSES (LOW LIMIT 200 PPM) SUGGESTS THAT HAZARDOUS CONCENTRATIONS OF ARSENIC (GREATER THAN OR EQUAL TO 0.050 PPM)[1] COULD BE PRESENT IN WATER FLOWING THROUGH THESE MATERIALS.

QUANTITATIVE ANALYSES OF ARSENIC-BEARING WATERS AND ASSOCIATED STREAM SEDIMENTS IN THE PEDRO DOME-CLEARY SUMMIT AREA NEAR FAIRBANKS SHOW A GENERALLY HIGH CORRELATION OF ARSENIC CONCENTRATION, ACCORDING TO F. H. WILSON,[2] IN THAT AREA OF KNOWN HAZARDOUS ARSENIC CONCENTRATION WHERE STREAM-BOTTOM SEDIMENTS SHOW ARSENIC VALUES OF 200 PPM OR GREATER, THE WATER ANALYSES COMMONLY HAVE ARSENIC VALUES IN EXCESS OF THE 0.050 PPM HAZARD LEVEL.

[1]U.S. PUBLIC HEALTH SERVICE, 1962, DRINKING WATER STANDARDS: U.S. PUBLIC HEALTH SERVICE PUBLICATION 956.

[2]WILSON, F. H., 1975, ARSENIC AND WATER, PEDRO DOME-CLEARY SUMMIT AREA, ALASKA: FAIRBANKS, ALASKA, UNIVERSITY OF ALASKA, UNPUBLISHED THESIS, 91 P.

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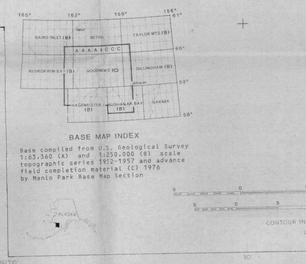

BACKGROUND INFORMATION RELATING TO THIS REPORT IS PUBLISHED AS U.S. GEOLOGICAL SURVEY OPEN-FILE REPORT 78-9 (AVAILABLE FROM THE SAME SOURCES AS THIS MAP)

This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards and nomenclature.