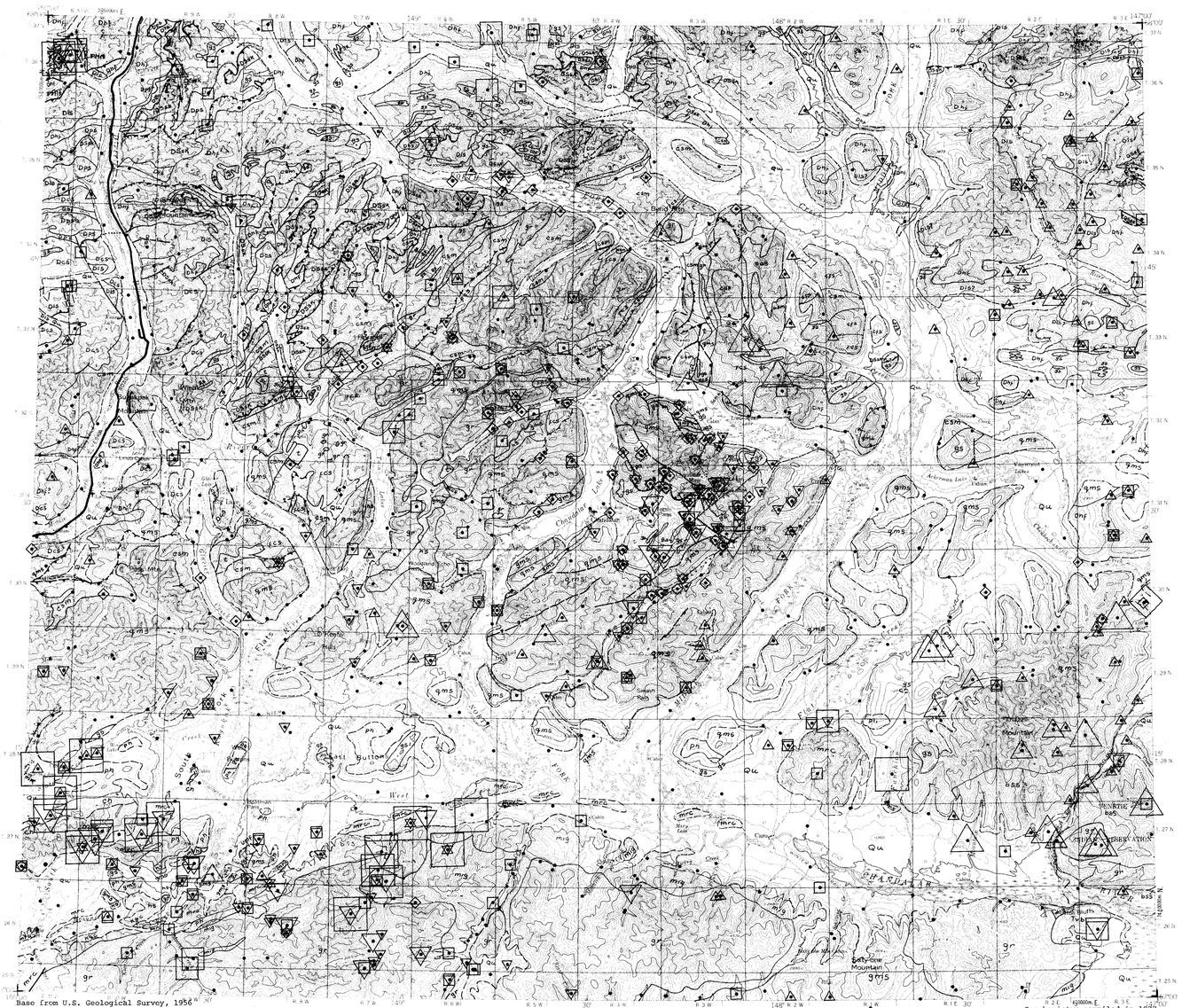
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-878G
FOLIO OF THE CHANDALAR QUAD., AK
BA, AS, B & V, GEOCHEMICAL MAP



EXPLANATION

GEOLOGY GENERALIZED AND REVISED FROM BROSGE AND REISER,1964 , AND CHIPP,1971)

CORRELATION OF MAP UNITS

SURFICIAL DEPOSITS

Qu — QUATERNARY

FOSSILIFEROUS,PARTLY METAMORPHOSED SEDIMENTARY ROCKS

METAMORPHIC, INTRUSIVE, AND VOLCANIC ROCKS

Kqc — CRETACEOUS — UNCONFORMITY

PMls — PENNSYLVANIAN AND MISSISSIPPIAN — UNCONFORMITY

Dhf

Dps, Dpsa, Dcs, Dls — DEVONIAN

DSsk — DEVONIAN AND SILURIAN

gs, hs, ph, qms, gms, bss, csm, t, cfs, cas, fcs — MESOZOIC(?) AND PALEOZOIC

mig, gr — PALEOZOIC OR OLDER

Tvb — TERTIARY (?)

mrc, ch, umf — JURASSIC TO MISSISSIPPIAN

MESOZOIC AND OLDER

DESCRIPTION OF MAP UNITS

This map is generalized from Brosgé and Reiser (1964). Many of these map units are combinations of units shown separately on the older map. The Devonian and Devonian(?) age that was assigned to the metamorphic rocks by Brosgé and Reiser (1964) is herein revised to early Paleozoic or older.

SURFICIAL DEPOSITS

Qu — Unconsolidated sedimentary deposits (Quaternary)

FOSSILIFEROUS PARTLY METAMORPHOSED SEDIMENTARY ROCKS

Kqc — Quartz pebble conglomerate (Cretaceous)

PMls — Lisburne Group (Pennsylvanian and Mississippian) and Kayak Shale (Mississippian)—Limestone, dolomite, shale and conglomerate

Dhf — Hunt Fork Shale (Upper Devonian)—Slate and phyllite

Dps — Purple and green slate and phyllite (Devonian)

Dpsa — Purple and green andesitic volcanic sheared conglomerate (Devonian)

Dcs — Chloritic siltstone and grit (Devonian)—Schistose; in part graywacke

Dls — Limestone and siltstone (Upper Devonian)—Schistose; includes some green slate locally

DSsk — Skajit Limestone (Upper and Middle Devonian, Upper Silurian)—Limestone, dolomite, and marble

METAMORPHIC, INTRUSIVE AND VOLCANIC ROCKS

Tvb — Vesicular olivine basalt flows (Tertiary?)

mig — Migmatite—Interslated mica schist and granite; granite with mafic inclusions

gr — Granitic rocks—K/Ar dates of biotite are 101 m.y. and 125 m.y. (Brosgé and Reiser, 1964); of hornblende, 486 m.y. (M. L. Silberman and D. L. Turner, written commun., 1977)

mrc, ch — Mafic rocks and chert—Pillow basalt, andesite, minor chert; diorite; diabase and gabbro. Chert (ch) differentiated where abundant

umf — Ultramafic rocks

gs — Greenstone and greenschist—Includes pillowed flows in Hunt Fork Shale (Dhf) in northeast part of the quadrangle

hs — Hornblende schist—Mostly hornfels facies

ph — Phyllite and schistose wacke

qms — Quartz-muscovite schist

gms — Garnet mica schist—Mostly hornfels facies

bss — Biotite-staurolite schist—Hornfels facies

csm, t — Calcareous schist, marble and tactite (t) locally

cfs — Undifferentiated calcareous schist (csm) and feldspathic chloritic schist (fcs)

fcs — Feldspathic chloritic schist—Includes metaclastic sills and pyritic quartzite

cas — Chlorite and amphibole schist—Local remnant glaucophane

GEOLOGIC SYMBOLS

CONTACT—Dashed where approximate; dotted where concealed

NORMAL FAULT—Dashed where inferred, queried where doubtful; dotted where concealed; U, upthrown side; D, downthrown side

THRUST FAULT—Queried where doubtful; dotted where concealed. Sawteeth on upper plate

GEOCHEMICAL SYMBOLS

SAMPLE LOCALITY

ANOMALOUS VALUES OF BARIUM--Histograms show numerical values for symbols

ANOMALOUS VALUES OF ARSENIC-- Histograms show numerical values for symbols

ANOMALOUS VALUES OF BORON--Histograms show numerical values for symbols

ANOMALOUS VALUES OF VANADIUM--Histograms show numerical values of symbols

DISCUSSION

This geochemical map shows the distribution and abundance of barium (Ba), arsenic (As), boron (B), and vanadium (V) in ~80 mesh (177 micrometers) stream-sediment samples in the Chandalar quadrangle, Alaska. The map is part of a series of geochemical maps that together with the background information circular comprise the folio on the Chandalar quadrangle, Alaska (Reiser and others, 1978). The data are plotted on a subdued base map showing the generalized geology, topography, and sample localities. Map symbols showing the ranges of metal values are indicated on the accompanying histograms and all values shown are considered anomalous. An explanation of sampling, preparation, analytical procedures, and and geochemical raw data for all samples are discussed by O'Leary and others (1976). The ~80 mesh (177 micrometers) stream-sediment modium was used in this study because of the regional setting in the north-central Brooks Range. Given the rather restrictive time and manpower constraints the ~80 mesh (177 micrometers) stream sediment combined with panned concentrates was determined to be the most economical and adequate medium in this case where clastic sediments are being derived from local bedrock.

The study area is one of generally high relief with short fast-moving streams and broad glacial valleys. All samples were taken from active streams, as close to the center channel as possible. All sediments were considered to be locally derived. When sampling an obviously glaciated terrane, care was taken to sample above or upstream from morainal material, wherever possible. Most samples were taken in areas where bedrock was within 30 m of the sample site.

Due to the poor sensitivity by spectrographic analysis for arsenic, 200 ppm (parts per million), all arsenic analyses were done by colorimetry.

GEOCHEMISTRY OF BARIUM, ARSENIC, BORON, AND VANADIUM

Barium is a strongly lithophile element and in igneous rocks is contained in feldspars and micas. Barium tends to become concentrated in the late stages of magmatic crystallization and forms independent minerals in hydrothermal rocks (Rankama and Sahama, 1955). It is a common constituent in metalliferous veins as barite ($BaSO_4$).

Arsenic is a chalcophile element that separates in magmas at the highest temperatures after main stage crystallization (Rankama and Sahama, 1955). Arsenic is not often used to find arsenic deposits, but, it is very useful as a pathfinder element for other types of deposits, particularly gold, copper, lead, and zinc (Boyle, 1974).

Boron is a lithophile element and it concentrates in the late stages of magmatic crystallization, usually in the pegmatitic or hydrothermal stages (Rankama and Sahama, 1955). The primary boron mineral is tourmaline, a common constituent in granites. Boron is associated with skarns, greisenized, sericitized, and albitized granites, and porphyry copper and molybdenum deposits (Boyle, 1974).

Vanadium is a lithophile element and in igneous rocks tends to concentrate in basic rocks formed in the initial steps of main stage crystallization (Rankama and Sahama, 1955). Vanadium often combines with lead, copper, zinc, and uranium to form vanadates.

STATISTICAL DATA

There are four sections of statistical data included with this map: 1) Four histograms show frequency (number of samples) plotted against concentration in ppm (parts per million). Analytical values qualified by an N indicate that an element was not detected at an established lower limit of detection (20 ppm for Ba, 10 ppm for As, 10 ppm for B, and 10 ppm for V). Analytical values qualified by an L indicate that the element was detected, but at a concentration below the lower limit of determination. A short table of statistical information is included with each histogram. 2) A correlation diagram shows correlation coefficients (in decimal fractions of 1) in the upper part and the number of sample pairs used in the correlation in the lower part. The correlation coefficients and number of sample pairs for barium, arsenic, boron, and vanadium are shaded on the diagram. A coefficient of 1 indicates a perfect direct proportional relation, -1 an inverse relation. 3) A cumulative frequency plot shows cumulative frequency plotted against concentration of barium, arsenic, boron, and vanadium in ppm. 4) Four perspective plots, show a three-dimensional representation of occurrences of anomalous Ba, As, B, and V in the Chandalar quadrangle. A grid was arbitrarily applied to the quadrangle to give the best representation of Ba, As, B, and V values. The metal values of samples in each grid were averaged and the peaks shown reflect this average. The plateaus in the perspective plots represent an arbitrary anomalous level (usually the 90th percentile), above which all samples were considered anomalous. Because N and L values were used only in the histograms and cumulative plots and not in the computation of other statistical information, the results may be somewhat biased.

OCCURRENCES

Barium

Barium is not a widely distributed element in the Chandalar quadrangle in amounts considered to be anomalous, above 700 ppm. Two major areas of anomalous barium occur on the map. In the southwest corner of the map strong barium anomalies are associated with strong vanadium anomalies in the mafic rocks (mrc) and chert (ch) including volcanic rocks. These apparent anomalies along the related copper anomalies (Marsh and others, 1978a) may reflect normal background values for these rocks. Anomalies in chrome and nickel in panned concentrates from this area (Detra and others, 1977) also appear to be a normal consequence of the presence of these rocks. A much more significant area of barium anomalies occurs in the central area of the quadrangle, in streams draining the gold mining district around the Chandalar and Little Squaw Mines. Here barium is associated with arsenic and probably is in the quartz-gold veins in the area.

Several other areas contain anomalous barium. In the southwest corner of the map in granitic rocks (gr) barium occurs sometimes, but not always, with other base metal anomalies (Marsh and others, 1978a, b). A few barium anomalies occur in streams draining the altered zone in granite at the head of Geroce Creek (T. 33 N., R. 5 W.) (Marsh and others, 1978a) in the north-central area of the quadrangle and are associated with other metal anomalies (Marsh and others, 1978a, b, c, d, Marsh and Wiltse, 1978). Barium occurs in the anomalous lead area (Marsh and others, 1978a) along the North Fork Chandalar River in the north part of the map. Barium also occurs in the northwest corner of the map in two highly anomalous samples that are probably related to the Hunt Fork Shale (Dhf) or older black phyllites and are derived updrainage, off the map to the west.

Arsenic

Arsenic is not an abundant element in the Chandalar quadrangle and was either not detected or detected in amounts less than the limits of determination in over 80 percent of the samples. The remaining arsenic values are primarily related to specific mineralized areas. The most significant occurrence of arsenic in the stream sediments is in association with barium in the area of gold-quartz veins in the central part of the quadrangle. A field trip to the area in 1976 provided hand specimens of the gold-quartz veins containing scorodite ($FeAsO_4.2H_2O$) and possible arsenopyrite. Two large arsenic anomalies occur south of Chekhechunnjik Creek on the east edge of the quadrangle and are associated with base metals (Marsh and others, 1978a, b) and arsenic, molybdenum, silver, and antimony in the nonmagnetic fraction of panned concentrates (Detra and others, 1977). These may represent mineralization along a fault in quartz-muscovite schist (qms) (W. P. Brosgé, oral commun., 1976). Arsenic also occurs peripheral to the Geroe Creek altered zone and in some streams draining the skarn-type deposits in Skajit Limestone (DSsk), tactite (t), and calcareous schist and marble (csm) that outcrop in a belt from the southern end of Big Spruce Creek on the south to the north side of the North Fork of the Chandalar River (Marsh and others, 1978a, and Marsh and Wiltse, 1978). An arsenic anomaly on the south side of Horace Mountain in an altered shear zone is associated with boron, copper, and zinc in the magnetic fraction of panned concentrates and with silver, antimony, tin, and tungsten in the nonmagnetic fraction of panned concentrates (Detra and others, 1977).

Boron

Boron anomalies are confined almost exclusively to the eastern half of the Chandalar quadrangle with highest concentrations and most intense anomalies along the eastern border. The largest boron anomalies occur in drainages around Thazzik Mountain in the southeast, north of the Chandalar River, in quartz-muscovite schist (qms) and biotite-staurolite schist (bss). These anomalies are associated with the rare earth elements yttrium (Y), and lanthanum (La), niobium (Nb), and zinc (Zn) (Marsh and others, 1978b, c). Boron anomalies are also associated with strong anomalies of these elements (Y, La, Nb, and Zn) along with tungsten and some tin in the nonmagnetic fraction of panned concentrates (Detra and others, 1977). These anomalies would indicate the potential for rare-earth pegmatites in the area although none are known to exist. Further north along the eastern border of the quadrangle large areas of weakly anomalous boron oxists in predominately Hunt Fork Shale (Dhf) and limestone and siltstone (Dls). This area is also anomalous in molybdenum and zinc (Marsh and others, 1978a, b). A broad, subdued aeromagnetic high is also exhibited in this area and the anomalies may reflect mineralization from a deeply buried pluton (Cady, 1978).

Vanadium

Vanadium is a fairly abundant element in the Chandalar quadrangle and most occurrences are located along the northern and northeastern border of the map, in areas of Hunt Fork Shale (Dhf). A large vanadium anomaly in the northwestern corner of the map is associated with barium, copper, molybdenum, zinc, and antimony anomalies (Marsh and others, 1978a, b, d) and is probably related to the Hunt Fork Shale (Dhf) or older black phyllites. A cluster of large vanadium anomalies occurs in the southwest corner of the quadrangle. One group occurs in mafic rocks (mrc) and chert (ch) which include some basalts and andesites. These anomalies correlate with copper and barium anomalies and probably represent background values for these rocks. Another group occurs in granitic rocks (gr) and migmatite (mig); these anomalies probably represent vanadates from mineralized quartz veins. Vanadium also occurs in stream drainages around the Geroe Creek altered zone (Marsh and others, 1978a). Small vanadium anomalies continue southwestward from the altered zone and may represent a continuation of mineralization along strike.

Another area of anomalous vanadium occurs in quartz-muscovite schist (qms) in the south-central part of the quadrangle along Big Creek and its tributaries. This area is associated with molybdenum, cobalt, and rare earth (La and Y) anomalies (Marsh and others, 1978a, c) and with barium, beryllium, tin, arsenic, and rare-earth (La and Y) anomalies in the nonmagnetic panned concentrates (Detra and others, 1977). These anomalies along with the presence of an aeromagnetic high (Cady, 1978) may represent buried, mineralized intrusive rocks.

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_____1978c, Geochemical and generalized geologic map showing distribution and abundance of nickel, cobalt, yttrium, and lanthanum in stream sediments in the Chandalar quadrangle, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-878F.

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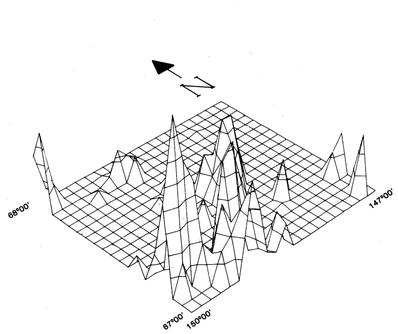
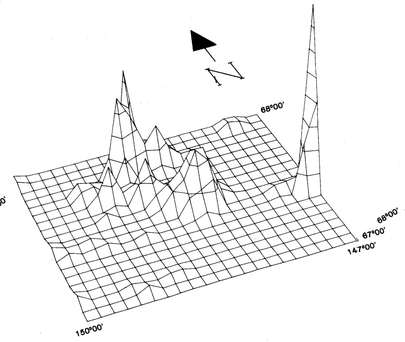
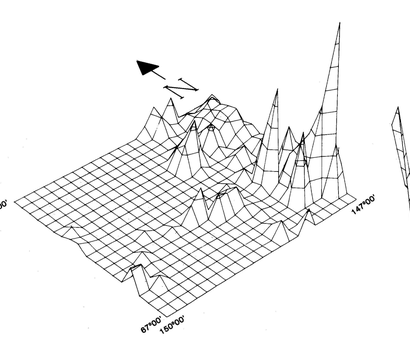


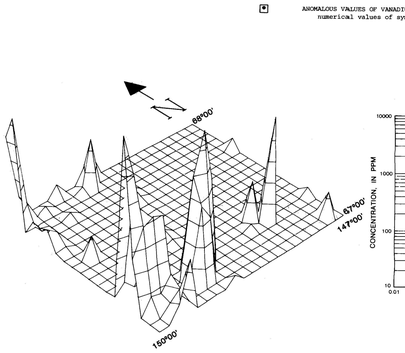
PERSPECTIVE PLOT OF BARIUM, CHANDALAR QUADRANGLE, ALASKA



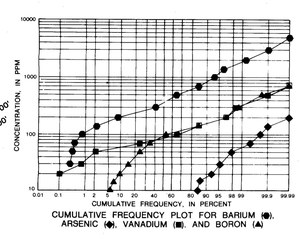
PERSPECTIVE PLOT OF ARSENIC, CHANDALAR QUADRANGLE, ALASKA



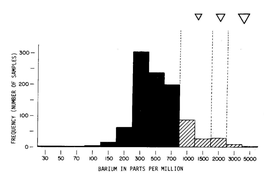
PERSPECTIVE PLOT OF BORON, CHANDALAR QUADRANGLE, ALASKA



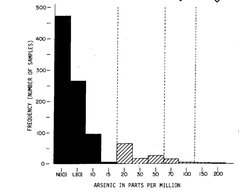
PERSPECTIVE PLOT OF VANADIUM, CHANDALAR QUADRANGLE, ALASKA



CUMULATIVE FREQUENCY PLOT FOR BARIUM (◆), ARSENIC (◆), VANADIUM (■), AND BORON (▲)



HISTOGRAM SHOWING STATISTICAL DATA FOR BARIUM



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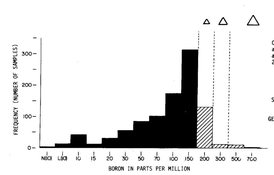

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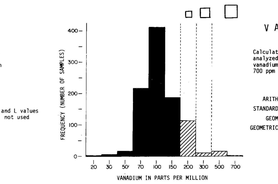

HISTOGRAM SHOWING STATISTICAL DATA FOR VANADIUM

CORRELATION COEFFICIENT

		Semi-quantitative spectrographic analysis										Atomic absorption analysis		Colorimetric analysis
		B	BA	CO	CU	LA	MO	NB	NI	PB	V	Y	ZN	SB	AS
Semi-quantitative spectrographic analysis	B		.0958	.24	.21	.04	.07	-.11	.26	-.02	.512	.09	.40	-.17	.1561
	BA	978		.29	.12	.11	-.30	.17	.06	-.27	.533	.14	.25	.06	.59
	CO	887	906		.27	.08	.07	.07	.51	.22	.385	.22	.42	.09	-.17
	CU	962	975	909		.12	.29	.01	.47	.21	.277	.14	.35	.20	-.26
	LA	750	769	716	759		.20	.16	.13	.22	.174	.40	.05	-.04	-.02
	MO	64	45	37	59	39		-.38	.43	.003	.285	.34	.25	.22	.04
	NB	411	417	416	414	14	51		.13	.19	.36	-.19	-.01		.28
	NI	962	978	909	977	760	61	418		.23	.490	.29	.43	.20	-.03
	PB	888	900	872	902	707	41	412	902		.198	.27	.24	.13	.20
	V	978	978	909	977	760	66	417	978	902		.32	.24	.11	.1561
	Y	901	902	881	932	731	41	413	933	873	933		.002	-.03	-.10
Atomic absorption analysis	ZN	950	963	897	964	752	46	413	965	890	965	929		.38	.01
	SB	787	808	805	807	631	29	389	808	802	808	792	801		.14
Colorimetric analysis	AS	1561	1561	171	239	104	21	27	231	163	1561	186	228	113	

NUMBER OF SAMPLE PAIRS

CORRELATION DIAGRAM FOR BARIUM, ARSENIC, VANADIUM, AND BORON IN STREAM SEDIMENTS, CHANDALAR QUADRANGLE, ALASKA

[Upper half of table contains correlation coefficients; lower half is the number of pairs of values used to compute coefficients. Where number of pairs is less than the total number of samples analyzed the bivariate frequency distribution was censored owing to the limitations of the method of analysis (L, N, and G values were not used in the correlation)]

GEOCHEMICAL AND GENERALIZED GEOLOGIC MAP SHOWING DISTRIBUTION AND ABUNDANCE OF BARIUM, ARSENIC, BORON, AND VANADIUM IN STREAM SEDIMENTS IN THE CHANDALAR QUADRANGLE, ALASKA

By
S. P. Marsh, D. E. Detra, and S. C. Smith

1978

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1979

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