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Geochemical data for Stream-Sediment, Lagoon-sediment, Heavy-Mineral-Concentrate, Water, and Rock Samples Collected in the western part of the Teller 1 x 3 degree Quadrangle, Alaska

By

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INTRODUCTION

Regional geochemical sampling was conducted by the U.S. Geological Survey in the western part of the Teller 1 x 3 degree quadrangle in 1997-98 as part of a study to identify any possible point sources for arsenic, cadmium, and other heavy metals. Stream-sediment, lagoon-sediment, heavy-mineral-concentrate, water, and rock samples were collected and analyzed as part of the regional studies. The purpose of this report is to release these data in a modern, easy-to-use format. A total of 84 streams were sampled for stream-sediment samples, 86 sites were sampled for water, 29 sites were sampled for heavy-mineral concentrate samples, 13 sites were sampled for lagoon sediments, and 11

rock samples were collected. At many sites, a duplicate sample or more than one sample type was collected; for instance, at each of the 86 stream sites for which water samples were collected, three types of waters were collected: filtered and acidified, unfiltered and acidified, and unfiltered and unacidified. Similarly for lagoon sediments, a minus-80 mesh and a minus-80, plus-10 mesh sediment sample was collected. This resulted in the following number of geochemical analyses given in this report: 86 stream-sediments, 25 lagoon sediments, 29 heavy-mineral-concentrate, 259 water, and 11 rock samples. The data files included on this diskette are separated by sample media type. All data files are in wkl(1-2-3) format. The first two letters of the filename (TR) refer to the quadrangle. Letters following refer to sample media: CONC, heavy-mineral concentrates; SEDS, stream and lagoon sediments; WAT, water samples; and ROCK, rock samples.

PHYSIOGRAPHIC AND GEOLOGIC SETTING

The Teller quadrangle is located in the northwestern Seward Peninsula. Topography varies from moderately steep in the southern part of the study area to nearly flat with some low rolling hills and broad open valleys in the northern part. The study area consists mainly of Precambrian(?) And lower Paleozoic argillaceous and dolomitic limestones and slates (Sainsbury, 1972). These rocks were intruded by granites and altered by tin-rich hydrothermal fluids in the Late Cretaceous. Tin deposits occur as lode or placer deposits. Lode deposits consist of cassiterite in greisenized plutonic rocks and in skarn deposits in adjacent marble (Hudson and Reed, 1997).

METHODS OF STUDY

Sample Collection

Stream-sediment samples consist of active alluvium collected from first-order (unbranched) and second-order (below the junction of two first-order) streams as shown on USGS topographic maps (scale = 1:63,360). The sediment was sieved at each site through a 10 mesh (2.0 mm) screen and the sediment was collected from the minus-10 mesh fraction. Heavy-mineral concentrates were collected in conjunction with stream sediment sampling by panning minus-10 mesh sediment at the sample site. Sediments from the bottom of Lopp Lagoon were sampled with a stainless steel scoop attached to a 6-ft extendable pole. Water samples collected for trace element analyses included an unfiltered and a filtered (0.45-micron membrane filter) sample which were acidified using 1 ml of concentrated nitric acid. These samples were stored in acid-rinsed polyethylene bottles and kept cool until analyses. Samples collected for anion analysis were also filtered (0.45-micron membrane filter) but unacidified and kept cool until analysis. At each collection site, the water temperature, pH, specific conductivity, and alkalinity measurements were recorded.

Sample Preparation

All stream- and lagoon-sediment samples were air-dried, then sieved through an 80-mesh (0.17 mm) stainless-steel sieve. The minus-80-mesh fraction was saved for analysis. The coarse fraction of lagoon sediments (minus 10, plus 80-mesh fraction) was also saved for analyses. All samples were mechanically ground before analysis. The heavy-mineral concentrates were sieved to minus-30 mesh. The sample was further separated with the heavy liquid bromoform into two fractions: a light-mineral fraction (specific gravity 2.86 or less) and a heavy-mineral fraction (specific gravity greater than 2.86). Following heavy-liquid separation, magnetite and other strongly magnetic minerals were removed from the heavy-mineral fraction by use of a Frantz isodynamic magnetic separator set at 0.2 ampere and saved for analysis. The remaining fraction was again sent through the Frantz separator at a setting of 0.6 amperes and the non-magnetic fraction was retained for analysis. Water samples were prepared in the field at the stream site (see Sample collection).

Sample Analysis

The heavy-mineral concentrate samples were analyzed using a semiquantitative, direct-current arc emission spectrographic method (Adrian and others, 1996). Spectrographic results were determined by visually comparing spectra derived from the sample against spectra obtained from laboratory reference standards. Standard concentrations are geometrically spaced over any given order of magnitude of concentration such that values reported for each sample are reported in the geometric sequence 10, 15, 20, 30, 50, 70, 100 etc. The precision of the method is plus or minus one reporting interval at 83 percent, or two intervals at 96 percent confidence (Adrian and others, 1996). The elements analyzed and their nominal limits of determination are listed in table 1. Selected stream- and lagoon-sediment samples were analyzed for 40 elements using inductively coupled plasma-atomic emission spectrometry (ICP-AES). Each sample was dissolved using a low temperature multi-acid digestion with concentrated hydrochloric, hydrofluoric, nitric, and perchloric acids (Briggs, 1996). Lower limits are shown in table 2. The relative standard deviation for replicate determinations of most elements is about 5 percent. An organometallic halide extraction method (Motooka, 1996) was used to determine 10 pathfinder elements in stream- and lagoon-sediment samples by ICP-AES. A hydrochloric acid-hydrogen peroxide digestion followed by extraction with diisobutylketone produces the organometallic halide solution. The relative limits of determination are shown in table 3. The relative standard deviation for most elements is about 5 percent. Samples analyzed for mercury are digested with nitric acid and sodium dichromate and then diluted with water. All samples are then mixed with air and a sodium chloride-hydroxylamine hydrochloride-sulfuric acid solution and Hg (II) is reduced to Hg with stannous chloride. The mercury vapor is separated and measured using continuous-flow cold vapor-atomic absorption spectrometry (O'Leary and others, 1996). Samples analyzed for selenium are also digested with a multi-acid procedure, the oxidation state is reduced, and sodium borohydride is added to the solution to form a gaseous hydride. The hydride is stripped from the analytical stream and transported with inert gas to the atomic absorption spectrophotometer (Hageman and Welsch, 1996). Tungsten is determined in geologic materials by instrumental neutron activation analysis. The water samples were analyzed by inductively coupled plasma-mass spectrometry (ICP-MS). The ICP-MS method is semiquantitative but allows for determination of more than 60 elements directly from the water sample without the need for preconcentration or dilution and with detection limits in the sub-part-per-billion range (Meier and others, 1994). Lower limits of determination are indicated in the analytical data tables. Standard deviation for the method may be as high as 25 percent for some elements (A.L. Meier, oral commun., 1995). Anions were determined on the filtered unacidified stream water samples using ion chromatography (d'Angelo and Ficklin, 1996). The relative standard deviation for this method is approximately 10 percent.

DESCRIPTION OF DATA

Sample description, geologic, and analytical data are presented in each of the sample media files. Sample site locations are given as latitude and longitude both in decimal degree and degree-minute-second formats in the tables. The following list summarizes the description of column headings. Sample description code explanations are listed in Appendix A.

Column Identifier

Description

Jobnum	assigned laboratory job number
Labnum	assigned sample laboratory number
Fieldnum	sample field identification number
Date_sub	date sample submitted to laboratory
Date_col	date sample was collected
Submitter	submitter name

Lat_deg	latitude in degree
Lat_min	latitude in minutes
Lat_sec	latitude in seconds
Lon_deg	longitude in degrees
Lon_min	longitude in minutes
Lon_sec	longitude in seconds
D_lat	latitude in decimal degrees
D_lon	longitude in decimal degrees
LL_precis	latitude/longitude precision
St	type of sample media
Mc	method sample collected
Sc	sample source
Rt	rock type
Ga	geologic age
Ms	mesh/sieve code
Sd	additional sample description information
Sd3	additional sample description information
Sd4	additional sample description information
Sd5	additional sample description information
Sp1	sample lab preparation information
Sp2	sample lab preparation information
Sp3	sample lab preparation information
Cm	lab/submitter comments

Chemical data follows the above sample description information in the data files. The chemical data are accurate to two significant digits. Trailing zeros are non-significant. Columns in which the element headings contain the prefix "S" represent emission-spectrographic data. The prefix "ICPA" indicates inductively coupled plasma-atomic emission spectrometry; "ICPM" indicates inductively coupled plasma-mass spectrometry; "IC" indicates ion chromatography; "CDT" indicates conductivity. The suffix "P" indicates a partial digestion, and "T" indicates a total digestion. The results for the elements are reported either in parts per billion (PPB), parts per million (PPM), or percent (PCT). The results for conductivity are reported in S/cm. Definitions of the qualifier codes used in the tables are as follows: B, sample not analyzed for this element; N, not detected at the specified level of detection; "<", detected, but below the specified limit of determination; and ">", greater than the specified upper limit of determination.

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Table 1. Limits of determination for emission spectrographic analysis of heavy-mineral-concentrate samples

Element	Lower limit	Upper limit
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Percent

Iron (Fe)	.1	50
Magnesium (Mg)	.05	20
Calcium (Ca)	.1	50
Sodium (Na)	.5	10
Titanium (Ti)	.005	2
Phosphorus (P)	.5	2

Parts per million

Silver (Ag)	1.0	10,000
Arsenic (As)	500	20,000
Gold (Au)	20	1,000
Boron (B)	20	5,000
Barium (Ba)	50	10,000
Beryllium (Be)	2	2,000

Bismuth (Bi)	20	2,000
Cadmium (Cd)	50	1,000
Cobalt (Co)	20	5,000
Chromium (Cr)	20	10,000
Copper (Cu)	10	50,000
Gallium (Ga)	10	1,000
Germanium (Ge)	20	200
Lanthanum (La)	100	2,000
Manganese (Mn)	20	10,000
Molybdenum (Mo)	10	5,000
Niobium (Nb)	50	5,000
Nickel (Ni)	10	10,000
Lead (Pb)	20	50,000
Palladium (Pd)	5	1,000
Platinum (Pt)	20	1,000
Antimony (Sb)	200	20,000
Scandium (Sc)	10	200
Tin (Sn)	20	2,000
Strontium (Sr)	200	10,000
Thorium (Th)	200	5,000
Vanadium (V)	20	20,000
Tungsten (W)	50	20,000
Yttrium (Y)	20	5,000
Zinc (Zn)	500	20,000
Zirconium (Zr)	20	2,000

Table 2. Lower limits of determination for 40-element inductively coupled plasma-atomic emission spectrometry (ICP-AES) analyses of stream- and lagoon-sediment and rock samples

Elements	Lower limit
Al	0.005%
Ca	0.005%
Fe	0.005%
K	0.05%
Mg	0.005%
Na	0.005%
P	0.005%
Si	---
Ti	0.005%
Ag	2 ppm
As	10 ppm
Au	8 ppm
B	---
Ba	1 ppm
Be	1 ppm
Bi	10 ppm
Cd	2 ppm
Ce	5 ppm
Co	2 ppm
Cr	2 ppm
Cu	2 ppm
Eu	2 ppm
Ga	4 ppm
Ho	4 ppm
La	2 ppm
Li	2 ppm

Mn	4 ppm
Mo	2 ppm
Nb	4 ppm
Nd	9 ppm
Ni	3 ppm
Pb	4 ppm
Sc	2 ppm
Sn	5 ppm
Sr	2 ppm
Ta	40 ppm
Th	6 ppm
U	100 ppm
V	2 ppm
Y	2 ppm
Yb	1 ppm
Zn	2 ppm
Zr	---

Table 3. Limits of determination for 10-element inductively coupled plasma-atomic emission spectrometry (ICP-AES) analyses of stream- and lagoon-sediment samples

Elements	Lower limit
Ag	0.08 ppm
As	1.0 ppm
Au	0.10 ppm
Bi	1.0 ppm
Cd	0.05 ppm
Cu	0.05 ppm
Mo	0.06 ppm
Pb	1.0 ppm
Sb	1.0 ppm
Zn	0.05 ppm

APPENDIX A

Explanation of sample description codes
 Lat/lon precision (LL_precis)
 A apparently accurate to nearest second
 B apparently accurate to nearest minute
 C apparently accurate to nearest degree
 D digitized; accurate to nearest second

Sample Type (St)
 A rock
 B unconsolidated sediment
 C organic material
 D soil
 E water
 F other
 G gas

Method collected (Mc)

- A single (grab)
- B composite
- C channel
- D other

Sample source (Sc)

- A outcrop
- B mine
- C dump or prospect pit
- D float
- E drill hole, well
- F marine
- G other
- H stream
- I spring
- J lake
- K aqueduct, canal, irrigation ditch
- L atmosphere

Rock type (Rt)

- A unidentified rock
- B sedimentary rock
- C metamorphic rock
- D igneous rock
- E unconsolidated sediment
- F conglomerate
- G sandstone
- H siltstone
- I claystone
- J shale
- K limestone or dolomite
- L carbonate
- M gneiss
- N schist
- quartzite
- P marble
- Q skarn
- R phyllite or slate
- S felsic igneous
- T intermediate igneous
- U mafic igneous
- V ultramafic igneous
- W feldspathoidal
- X chert or jasperoid
- Y other

Geologic age of sample (Ga)

- A Precambrian undifferentiated
- B Early Precambrian
- C Middle Precambrian
- D Late Precambrian
- E Paleozoic undifferentiated

F Cambrian
G Ordovician
H Silurian
I Devonian
J Mississippian
K Pennsylvanian
L Permian
M Mesozoic undifferentiated
N Triassic
P Jurassic
Q Cretaceous
R Tertiary undifferentiated
S Paleocene
T Eocene
U Oligocene
V Miocene
W Pliocene
X Quaternary undifferentiated
Y Pleistocene
Z Holocene

Mesh/sieve fraction (Ms)

A unknown, assumed to be -80 mesh
B identified as -80 mesh
C identified as -100 mesh
D identified as -120 mesh
E identified as -150 mesh
F identified as -200 mesh
G identified as -60 mesh
H identified as -40 mesh
I identified as -35 mesh
J identified as -30 mesh
K identified as -24 mesh
L identified as -20 mesh
M identified as -30+80 mesh
N Other; see Lab/submitter comments (Cm)

Sample description (Sd)

AL alluvium
AS ash
CL clay
CV colluvium
C pan or artificial concentrate
C1 concentrate, high magnetic fraction
C2 concentrate, moderately magnetic fraction
C3 concentrate, low or non-magnetic fraction
GV gravel
GT grit
HS heavy sand
LO loess
MD mud
OZ ooze
SN sand
SD stream sediment
SI silt
TI till

Sample description (Sd3)

AN animal parts
CS combined splits of heavy-mineral-concentrate
DM detrital magnetites
MS splits of magnetites
NS non-magnetic splits from heavy-mineral-concentrate
OA oxalic acid leachate
VG vegetation

Sample description (Sd4)

GD glacial debris
MT moss-trap-sediment sample
PT peat material
SP spruce

Sample description (Sd5)

MI mill tailings
MT moose pellets
WL willow leaves

Sample preparation (Sp1)

AD ashed
BR bromoform
GR ground

Sample preparation (Sp2)

FR Frantz isodynamic separator
PV pulverized

Sample preparation (Sp3)

FS fire assay PGE
HG hand ground
HM separated by hand magnet
RT split

Lab/submitter comments (Cm)