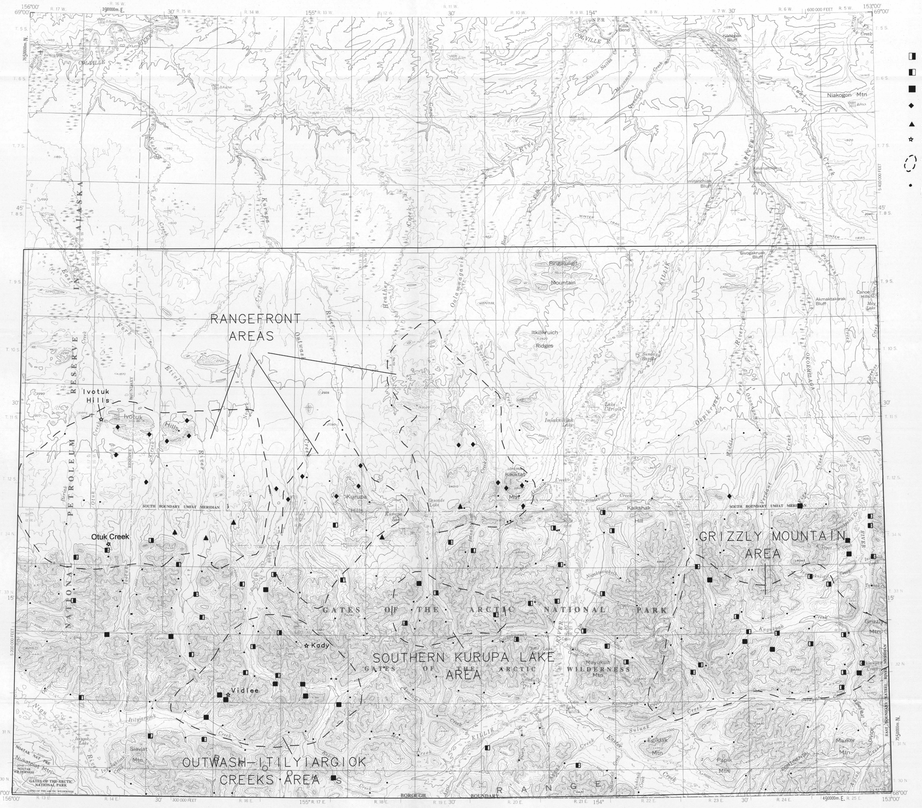


MAP D. DISTRIBUTION OF NONMAGNETIC HEAVY-MINERAL-CONCENTRATE SAMPLES CONTAINING GALENA, SPHALERITE, BARITE, AND SCHEELITE

EXPLANATION
MAP D

- Galena (1 percent or less)
- Sphalerite (1 percent or less)
- Sphalerite and galena
- Barite (greater than 50 percent)
- Scheelite (trace)
- Sulfide mineral occurrence
- Area boundary delineated by nonmagnetic heavy-mineral-concentrate samples containing anomalous concentrations of one or more elements
- Nonmagnetic heavy-mineral-concentrate sample site

SCALE 1:250 000

5 0 5 10 15 MILES

5 0 5 10 15 KILOMETERS

CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

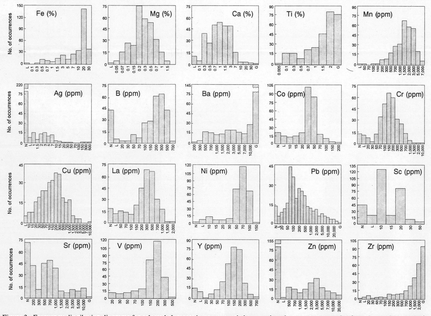
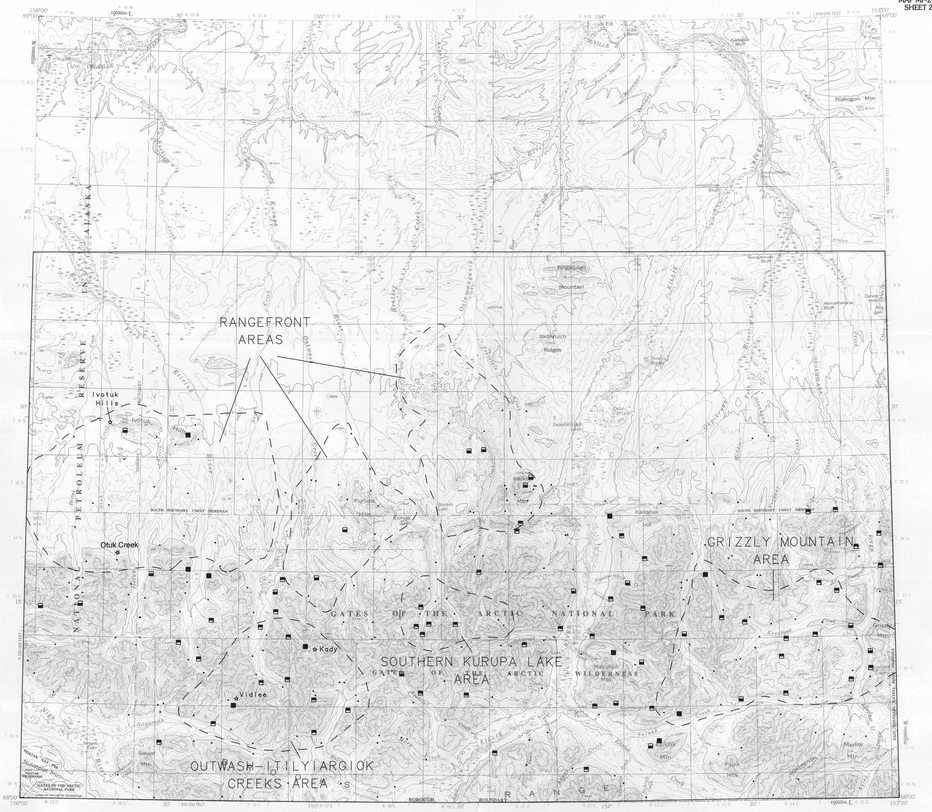


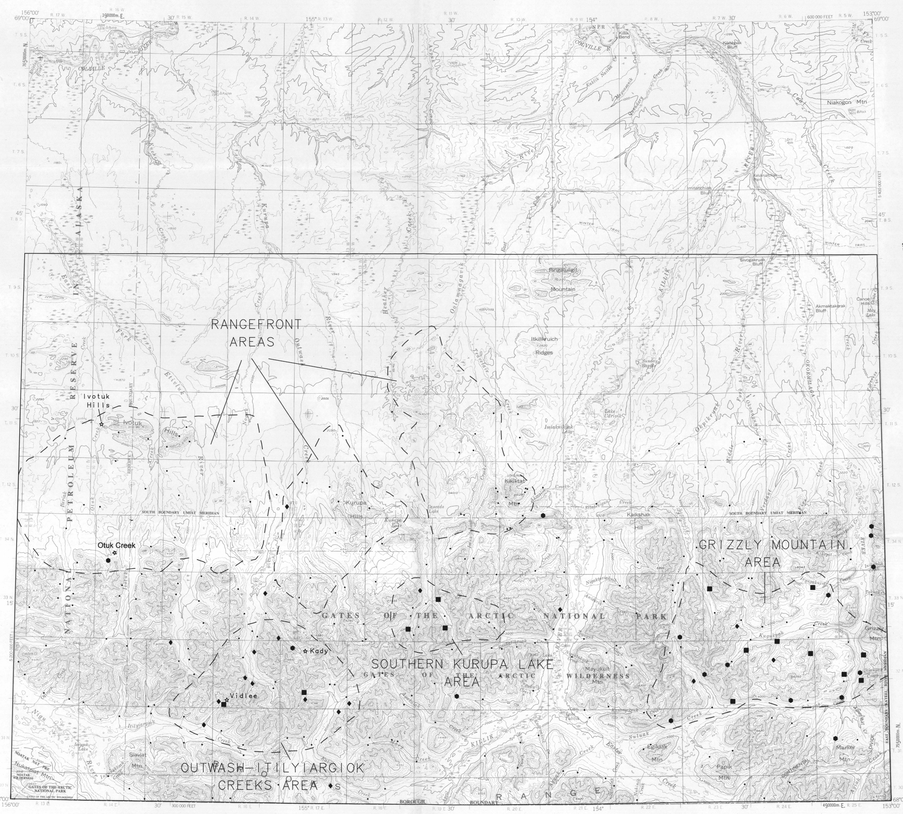
Figure 3. Frequency distribution diagrams for selected elements in nonmagnetic heavy-mineral-concentrate samples from the southern part of the Killik River quadrangle (number of samples, 309; N, not detected at lower detection limit; L, less than lower detection limit; G, greater than upper detection limit).

EXPLANATION
MAP E

- Pyrite (greater than 20 percent)
- Chalcopyrite
- Chalcopyrite and pyrite
- Sulfide mineral occurrence
- Area boundary delineated by nonmagnetic heavy-mineral-concentrate samples containing anomalous concentrations of one or more elements
- Nonmagnetic heavy-mineral-concentrate sample site



MAP E. DISTRIBUTION OF NONMAGNETIC HEAVY-MINERAL-CONCENTRATE SAMPLES CONTAINING PYRITE AND CHALCOPYRITE



MAP F. MINERALIZATION FACTORS SUGGESTED BY FACTOR ANALYSIS OF NONMAGNETIC HEAVY-MINERAL-CONCENTRATE SAMPLES

EXPLANATION
MAP F

- Sample yielding anomalously high factor 3 (Ag-Pb-Zn) scores
- Sample yielding anomalously high factor 5 (Co-Cu-Fe-Ni-Zn) scores
- Sample yielding anomalously high factor 3 and factor 5 scores
- Sulfide mineral occurrence
- Area boundary delineated by nonmagnetic heavy-mineral-concentrate samples containing anomalous concentrations of one or more elements
- Nonmagnetic heavy-mineral-concentrate sample site

SCALE 1:250 000

5 0 5 10 15 MILES

5 0 5 10 15 KILOMETERS

CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Table 1. Analytical limits of detection for nonmagnetic heavy-mineral-concentrate samples from the southern part of the Killik River quadrangle using semiquantitative emission spectrography
[All values in parts per million unless otherwise noted]

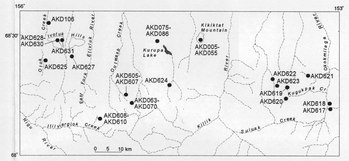
Element	Lower detection limit	Upper detection limit
Ca%	0.1	50
Fe%	0.1	50
Mg%	0.05	20
Ti%	0.005	2
Ag	1	10,000
As	500	20,000
Au	20	1,000
B	20	5,000
Ba	10	5,000
Be	2	2,000
Bi	20	2,000
Cd	50	1,000
Co	10	5,000
Cr	20	10,000
Cu	10	50,000
La	50	2,000
Mn	20	10,000
Mo	10	5,000
Nb	10	10,000
Ni	10	5,000
Pb	20	50,000
Sb	200	20,000
Sc	10	200
Sn	20	2,000
Sr	100	10,000
Th	200	5,000
V	20	20,000
W	100	20,000
Y	20	5,000
Zn	500	20,000
Zr	20	2,000

Table 2. Statistical summary of selected elements from 309 nonmagnetic heavy-mineral concentrate samples from the Killik River quadrangle
[All concentrations in parts per million unless otherwise noted; method of analysis is semiquantitative emission spectrography. UQV, number of samples with unqualified values; N, number of samples qualified with "N" (not detected at lower detection limit); L, number of samples qualified with "L" (less than lower detection limit); G, number of samples qualified with "G" (greater than upper detection limit); DR, detection ratio or the number of samples with unqualified values divided by the total number of samples; Ni ( ), not detected at lower limit of detection shown in parenthesis; ---, not calculated because DR is <0.3; *, geometric mean calculated using all data--values with "N" were set equal to 0.5 the lower detection limit, values with "L" were set equal to 0.7 the lower detection limit, and values with "G" were set equal to twice the upper detection limit; +, threshold value listed only for elements shown graphically on maps B and C]

Element	UQV	N	L	G	DR	Concentration Min	Concentration Max	Concentration Mean*	Percentile 50th	Percentile 80th	Percentile 90th	Threshold value+
Fe	308	0	1	0	0.99	<0.1%	30%	8.7%	5%	15%	30%	
Mg	307	0	2	0	0.99	<0.05%	13.5%	0.28%	0.2%	0.3%	0.7%	
Ca	298	0	10	1	0.96	<0.1%	>50%	0.92%	0.5%	1%	3%	
Ti	233	0	76	0	0.75	<0.005%	1.5%	1.9%	.1%	.2%	>2%	
Mn	306	0	3	0	0.99	151	7,000	1,481	1,000	1,500	3,000	
Ag	37	232	7	0	0.11	Ni(50)	500	51	N	N	N	5
As	1	308	0	0	0.003	Ni(500)	5,000	---	---	---	---	500
B	257	46	7	0	0.85	Ni(20)	700	112	100	200	500	
Ba	161	3	10	0	0.56	>10,000	6,952	2,000	2,000	10,000	>10,000	
Be	2	302	5	0	0.006	Ni(2)	150	---	---	---	---	
Cd	6	303	1	0	0.01	Ni(50)	150	---	---	---	---	
Co	272	31	16	0	0.88	Ni(10)	200	26	20	30	70	70
Cr	303	0	6	0	0.98	Ni(20)	10,000	153	70	150	500	500
Cu	303	0	6	0	0.98	<10	10,000	133	90	150	700	500
La	281	17	11	0	0.91	Ni(50)	2,000	223	150	300	700	
Mo	10	280	9	0	0.03	Ni(10)	50	---	---	---	---	
Nb	81	186	42	0	0.26	Ni(50)	150	---	---	---	---	
Ni	296	3	10	0	0.96	Ni(10)	150	51	50	70	100	100
Pb	286	14	6	3	0.92	Ni(20)	>50,000	228	70	150	4,000	5,000
Sb	6	301	2	0	0.01	Ni(200)	2,000	---	---	---	---	200
Sc	242	46	21	0	0.79	Ni(10)	50	10	10	10	20	20
Sn	14	289	6	0	0.04	Ni(20)	200	---	---	---	---	
Sr	238	69	2	2	0.77	Ni(200)	>10,000	414	200	500	3,000	
V	309	0	0	0	1.0	20	500	150	150	200	300	
W	1	308	0	0	0.002	Ni(100)	100	---	---	---	---	
Y	283	17	9	0	0.92	Ni(20)	700	108	100	150	250	
Zn	151	158	2	0	0.48	Ni(500)	20,000	516	N	<500	5,000	5,000
Zr	208	1	5	95	0.67	Ni(20)	>2,000	1,190	700	2,000	>2,000	

Table 3. Factor loadings for the five-factor model for 309 nonmagnetic heavy-mineral-concentrate samples. Total variance explained by the five factors equals 67 percent
[---, loadings less than 0.30 omitted for simplification]

Element	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Fe	---	---	---	---	0.39
Mg	---	---	---	0.69	---
Ca	0.30	0.60	---	---	---
Ti	0.87	---	---	---	---
Mn	---	---	---	0.60	---
Ag	---	---	0.94	---	---
B	0.51	---	---	---	---
Ba	---	0.72	---	---	---
Co	---	---	---	---	0.64
Cr	---	---	---	0.36	---
Cu	---	---	---	---	0.81
La	0.84	---	---	---	---
Ni	---	---	---	---	0.37
Pb	---	---	0.94	---	---
Sc	---	---	---	0.63	---
Sr	---	0.88	---	---	---
V	0.70	---	---	0.48	---
Y	0.80	---	---	---	---
Zn	---	---	0.32	---	0.73
Zr	0.85	---	---	---	---
Percent of total data variance explained by factor	25.0	16.0	11.0	8.0	7.0



INDEX MAP SHOWING LOCALITIES OF ROCK SAMPLES LISTED IN TABLE 4

Table 4. Concentrations of selected elements in rock samples collected from the Killik River quadrangle
[locations of rock samples on index map; all values in parts per million except Fe, which is in percent *, analyses by atomic absorption method; all other analyses by emission spectrography; N, not detected; NA, not analyzed]

Area	Sample no.	Latitude	Longitude	Fe*	Ag	Ag+	As	As+	Au+	Ba	Cd+	Cd	Co	Cr	Cu	Mn	Ni	Pb	Zn+	Zn	Rock description (map-unit symbols from map A)
Otuk Creek	AKD625A	68 19 27	155 41 45	10	N	N	N	N	N	50	0.5	N	10	10	10	5,000	30	<10	120	200	vein in unit Mk
	AKD625B	68 19 27	155 41 45	20	N	2.3	N	N	N	>5,000	0.8	N	10	10	15	3,000	20	10	250	1,500	concretion in unit Mk; contains sphalerite
	AKD625C	68 19 27	155 41 45	20	N	0.8	N	N	N	300	0.8	N	10	<10	10	3,000	20	15	30	300	concretion in unit Mk; contains pyrite, calcite
	AKD625D	68 19 27	155 41 45	30	N	3.3	N	20	N	100	0.6	N	20	30	10	3,000	30	20	65	300	vein in chert; unit IPMK
	AKD625E	68 19 27	155 41 45	>20	N	0.05	N	30	N	500	0.5	N	20	50	10	3,000	30	50	100	500	vein in unit Mk
	AKD625F	68 19 27	155 41 45	1	3	N	N	10	N	700	1.5	N	30	30	10	500	50	N	150	200	chert; unit IPMK
Ivotuk Hills	AKD106	68 32 21	155 43 42	0.5	7	NA	N	NA	NA	>5,000	NA	30	5	200	150	1,500	150	10	NA	1,000	black shale; Otuk Formation?
	AKD627A	68 05 31	150 42 02	2	2	N	N	10	N	>5,000	0.4	N	<5	50	70	700	30	N	30	<200	chert
	AKD627B	68 05 31	150 42 02	2	2	N	N	10	N	>5,000	0.4	N	<5	50	50	50	30	N	20	<200	pyritic chert
	AKD627C	68 05 31	150 42 02	>20	N	N	200	70	N	700	0.3	N	N	<10	15	300	30	10	500	500	coarse pyrite concretion
	AKD627D	68 05 38	150 43 13	7	N	N	N	20	N	>5,000	0.3	N	200	<10	500	>5,000	100	N	150	200	chert
	AKD628A	68 05 38	150 43 13	2	N	NA	N	10	N	>5,000	1.0	N	10	30	100	200	100	15	<200	<200	chert
	AKD628B	68 01 56	151 01 51	3	N	NA	N	N	N	>5,000	0.3	N	30	50	100	150	50	<10	105	<200	chert
	AKD628C	68 03 02	150 53 31	3	0.5	NA	N	10	N	>5,000	0.6	N	30	30	100	200	150	<10	110	<200	chert
	AKD629	68 03 32	150 57 40	2	3	N	N	20	N	>5,000	0.9	N	30	50	200	3,000	100	15	110	200	yellow-weathering shale
	AKD630A	68 03 32	150 57 40	3	2	N	N	N	N	>5,000	N	N	20	30	50	500	70	<10	95	<200	red-green shale; unit JPe
	AKD630B	68 03 32	150 57 40	3	N	NA	N	N	N	>5,000	N	N	20	20	50	500	70	<10	95	<200	red-green shale; unit JPe
	AKD631A	68 03 23	150 57 40	5	20	N	N	30	N	1,000	>100	100	15	1,500	200	1,000	500	20	2,000	2,000	black shale; Lisburne Group?
	AKD631B	68 03 23	150 57 40	0.7	5	N	N	10	N	3,000	46	20	10	500	20	1,000	50	15	400	500	phosphatic carbonate; unit PMi
Kurupa Hills	AKD075	68 08 10	150 03 30	1	0.5	N	N	N	NA	1,000	NA	N	N	50	100	70	15	N	45	N	black chert
	AKD076	68 08 10	150 03 30	1	N	N	N	34	NA	5,000	NA	N	N	30	70	5,000	20	N	27	N	limestone
	AKD077	68 09 55	150 06 10	1	0.5	N	N	N	NA	1,500	NA	N	N	30	70	100	20	<10	52	N	black chert
	AKD078	68 09 55	150 06 10	1	1.5	1.1	N	N	NA	2,000	NA	N	N	30	70	150	100	15	15	<200	pyritic chert
	AKD081	68 09 55	150 06 10	1	1	1.2	N	N	NA	1,500	NA	N	<5	100	70	50	30	<10	51	N	chert
	AKD082	68 09 55	150 06 10	1	1	0.84	N	11	NA	1,500	NA	N	<5	70	50	50	30	5	59	N	chert
	AKD084	68 09 55	150 06 10	1	0.7	0.73	N	14	NA	1,500	NA	N	<5	50	30	200	20	<10	52	N	chert
	AKD085	68 09 55	150 06 10	0.7	0.5	N	N	N	NA	1,500	NA	N	7	30	30	70	30	<10	98	N	chert
Kiliktat Mountain	AKD005	68 02 00	151 40 55	5	N	N	N	N	NA	200	NA	N	20	500	100	1,000	70	N	53	N	unit mi
	AKD009	68 05 00	151 39 20	3	N	N	N	N	NA	3,000	NA	N	50	70	50	1,500	70	15	160	200	shale
	AKD014	68 05 00	151 39 20	3	<0.5	N	N	N	NA	200	NA	N	10	20	10	1,500	30	20	3	N	chert
	AKD018	68 05 00	151 39 20	5	<0.5	N	N	N	NA	200	NA	N	10	20	10	1,500	30	20	3	N	chert
	AKD023	68 05 00	151 39 20	1	7	N	N	N	NA	300	NA	N	15	10	100	500	100	15	140	N	unit mi; contains disseminated pyrite
	AKD029	68 04 31	151 39 20	1	N	N	N	N	NA	200	NA	N	10	<10	30	500	70	N	15	N	chert; contains disseminated pyrite
	AKD030	68 04 00	152 45 00	5	N	N	N	N	NA	500	NA	N	50	150	150	1,000	50	N	76	N	unit mi; contains pyrite
	AKD033	68 04 00	152 45 00	1	N	N	N	5.4	NA	500	NA	N	7	20	7	1,000	30	30	45	N	chert nodules
	AKD037	68 04 00	152 45 00	1.5	0.7	N	N	N	NA	700	NA	N	N	70	70	300	50	20	81	N	clastic rock
	AKD046	68 04 00	152 45 00	5	N	N	N	N	NA	200	NA	N	20	50	20	2,000	30	<10	84	N	unit mi
	AKD055	68 04 00	152 45 00	0.5	1	N	N	23	NA	1,000	NA	N	10	20	10	200	20	N	22	N	chert
Grizzly Mountain	AKD617	68 12 48	155 04 00	3	N	N	N	N	N	100	0.2	N	10	10	10	2,000	20	<10	35	<200	quartz vein
	AKD618	68 10 46	153 04 30	5	N	N	N	N	N	70	0.4	N	15	30	15	1,000	30	50	130	<200	quartz vein
	AKD618A	68 13 15	153 28 45	10	N	N	N	N	N	<20	0.3	N	10	<10	5	2,000	10	N	10	200	quartz vein; contains pyrite and sphalerite
	AKD619B	68 13 15	153 28 45	2	N	0.1	N	N	N	300	0.2	N	<5	20	5	50	10	<10	10	<200	unit MDk with disseminated oxidized pyrite
	AKD619C	68 13 15	153 28 45	5	N	N	N	N	N	50	0.3	N	10	10	15	1,000	30	20	40	<200	quartz vein; iron oxides
	AKD620	68 11 55	153 30 00	10	N	N	N	N	N	70	0.3	N	50	30	5	300	50	N	30	200	quartz vein; contains pyrite
	AKD621	68 16 45	153 17 00	10	N	0.5	N	N	N	100	0.5	N	20	50	20	1,500	50	<10	200	200	quartz vein
	AKD622	68 16 30	153 37 58	3	N	1.9	N	20	N	100	0.3	N	<5	10	5	50	10	10	<5	<200	unit MDk; contains disseminated pyrite
	AKD623	68 16 30	153 39 00	3	N	0.3	N	20	N	200	0.3	N	<5	20	10	100	10	<10	<5	<200	unit MDk; contains disseminated pyrite
Southern Kurupa Lake	AKD624A	68 13 28	154 38 58	10	N	1.7	200	230	N	70	0.2	N	50	15	200	200	50	N	N	<200	quartz vein
	AKD624B	68 13 28	154 38 58	10	N	0.15	N	N	N	100	0.8	N	50	100	50	2,000	50	<10	N	<200	iron oxides
Outwash Creek (Kady occurrence)	AKD605C	68 12 00	155 02 00	0.5	3	6.0	N	80	<0.05	50	480	100	50	<10	1,000	30	20	30	28,000	>10,000	breccia; contains pyrite, galena
	AKD605D	68 12 00	155 01 25	0.2	0.7	1.9	N	30	N	50	0.3	N	10	<10	500	N	15	500	35	<200	quartz vein; contains pyrite, galena
	AKD605E	68 12 00	155 01 25	5	7.2	700	240	0.15	<20	1,900	200	<10	200	<10	2,000	15	150	50	270,000	>10,000	vein-breccia; contains sphalerite, pyrite
	AKD606	68 12 00	155 01 25	0.5	2	3.7	N	N	N	100	150	30	N	<10	15	<10	15	15	120,000	>10,000	vein; contains sphalerite
	AKD606A	68 12 00	155 01 25	1	5	3.7	N	N	N	700	150	30	20	<10	70	50	15	15	120,000	>10,000	quartz vein; contains sphalerite
	AKD606B	68 11 57	155 00 30	5	N	N	N	N	N	<20	0.5	N	<5	<10	<5	<10	<5	N	105	<200	quartz vein; barren
	AKD606C	68 11 57	155 00 30	1.5	1.5	2.6	N	400	<0.05	<20	1,200	>500	50	N	1,000	10	20	20	150,000	>10,000	vein-breccia; contains sphalerite
	AKD606D	68 11 57	155 00 30	7	12	N	N	N	0.20	<20	1,300	N	70	15	200	10	<5	50	170,000	<200	quartz vein
	AKD607A	68 11 30	155 00 00	0.5	3	10	N	10	0.05	<20	1.8	N	<5	<10	1,500	15	<5	N	130	1,000	vein; contains pyrite, chalcopyrite
	AKD607C	68 11 30	155 00 00	15	150	72	500	110	0.10	50	1.1	N	30	<10	>20,000	10	100	100	40	<200	vein; contains pyrite, chalcopyrite
	AKD607D	68 11 30	155 00 00	2	10	>100	N	10	0.05	50	0.5	N	15	<10	7,000	30	20	10	35	<200	disseminated pyrite, chalcopyrite
	AKD608	68 09 14	155 00 43	0.7	0.5	N	N	N	NA	200	NA	N	20	50	7	500	20	N	95	N	shale
	AKD064	68 09 14	155 00 43	0.7	0.5	N	N	41	NA	700	NA	N	30	150	30	150	70	30	87	N	limestone
	AKD065	68 09 14	155 00 43	3	N	NA	N	NA	NA	200	NA	N	20	70	7	1,000	20	30	NA	N	siltstone
	AKD070A	68 07 08	155 00 00	2	N	NA	N	NA	NA	200	NA	N	10	70	7	500	20	N	NA	N	sandstone
	AKD070C	68 07 08	155 00 00	20	10	NA	1,000	NA	NA	150	NA	N	1,000	20	200	20	1,000	700	NA	300	pyrite nodule in sandstone
Itilyiargiok Creek (Vidlee occurrence)	AKD608	68 07 45	155 18 00	0.7	20	32	1,000	6,400	0.75	50	120	150	500	<10	1,500	50	50	20,000	140,000	>10,000	disseminated pyrite, arsenopyrite
	AKD609A	68 07 30	155 17 00	7	7	14	200	240	0.05	50	3.6	N	50	50	10,000	200	20	150	120	500	vein; contains pyrite
	AKD609B	68 07 30	155 17 00	5	2	2.4	200	120	0.15	50	98	<20	50	20	50	20	10	70	1,600	2,000	disseminated pyrite
	AKD609C	68 07 30	155 17 00	7	15	7.2	N	20	0.05	20	1,300	>500	50	<10	500	70	15	1,000	250,000	>10,000	quartz vein; contains sphalerite
	AKD609D	68 07 30	155 17 00	10	50	39	N	20	0.10	20	2,500	>500	50	<10	500	70	7	1,000	250,000	>10,000	quartz vein; contains sphalerite
	AKD610A	68 07 35	155 16 45	7	20	28	<200	140	0.05	50	8	20	70	<10	1,000	20	20	2,000	1,200	3,000	quartz vein; contains pyrite
	AKD610B	68 07 35	155 16 45	5	300	21	500	110	0.05	50	1,100	>500	70	50	7,000	50	20	>20,000	4,000	10,000	quartz vein; contains galena
	AKD610C	68 07 35	155 16 45	10	150	100	N	N	0.05	<20	2,800	>500	50	<10	300	150	5	15,000	27,000	10,000	massive sphalerite

GEOCHEMISTRY AND MINERALOGY OF HEAVY-MINERAL CONCENTRATES FROM THE SOUTHERN PART OF THE KILLIK RIVER 1° × 3° QUADRANGLE, ALASKA

By

Karen D. Kelley, Charles G. Mull, and Harlan N. Barton

1995