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RECONNAISSANCE GEOCHEMISTRY OF STREAM SEDIMENTS FROM THREE AREAS NEAR JUNEAU, ALASKA

By

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RECONNAISSANCE GEOCHEMISTRY OF STREAM SEDIMENTS

FROM THREE AREAS NEAR JUNEAU, ALASKA

By Henry C. Berg

ABSTRACT

Results of a preliminary inquiry into background metal content of stream sediments near Juneau, Alaska, and whether this background is related to geologic terrane indicate that stream sediments derived chiefly from metamorphic rocks show significantly higher modal nickel, zinc, and arsenic than do sediments derived mainly from sedimentary or igneous rocks. Metal-content data that are closely related to areal geology will be required before systematic geochemical prospecting by stream-sediment sampling in southeast Alaska will be very effective.

Reconnaissance geochemistry of stream sediments

from three areas near Juneau, Alaska

by Henry C. Berg, Menlo Park, California

A reconnaissance study was undertaken near Juneau, Alaska, to determine the relationship between the trace-metal content of stream sediments and the geologic terrane from which the sediments were derived. Previous investigations of trace metals in stream sediments in southeastern Alaska have sought anomalies (unusually high values) in one or more metals (Chapman and Shacklette, 1960; Chapman, 1962) or have been efforts to detect metal anomalies in sediments near specific mineral deposits (Race, 1962) without being able to take into sufficient account the likelihood that the background metal content of stream sediments might vary significantly with varying types of source rocks.

In this study, 46 analyses of the trace-metal content of silt-sized sediments from 43 streams are identified and grouped as nearly as possible by main type of rock--sedimentary, metamorphic, and intrusive igneous (including contact zones)--in the stream drainage (table 1). Figure 1 shows at a glance that the area under consideration is geologically complex, and in some instances the source of the sediment at a sample site might be more than one of these types. Where this is so, the source rock type is queried on table 1. Samples were collected without special reference to known or suspected mineral deposits, but because the area has been sporadically mineralized, some samples show anomalously high values in certain metals. In order to minimize the effect of anomalous values on the calculation of background metal contents, the mode (most commonly occurring value) was selected as the most appropriate and meaningful "average" value for each metal (table 2). For some metals, more than one mode is reported; this happens when two values occur an equal number of times for a given metal, instead of a single value occurring most frequently. Where a bimodal range is small, it is probably of little consequence, but in ranges such as 200 ppm and 700 ppm, and 300 ppm and 700 ppm, it may be very significant. Table 2 also shows ranges in metal content in stream sediments by source-rock type. In some cases, the high end of the range is probably anomalous, such as the maximum of 200 parts per million (ppm) of nickel in stream sediments derived from the metamorphic rocks. However, it should be noted that the modal nickel content of stream sediments derived from the metamorphic rocks is relatively high (70 ppm) compared to that of stream sediments

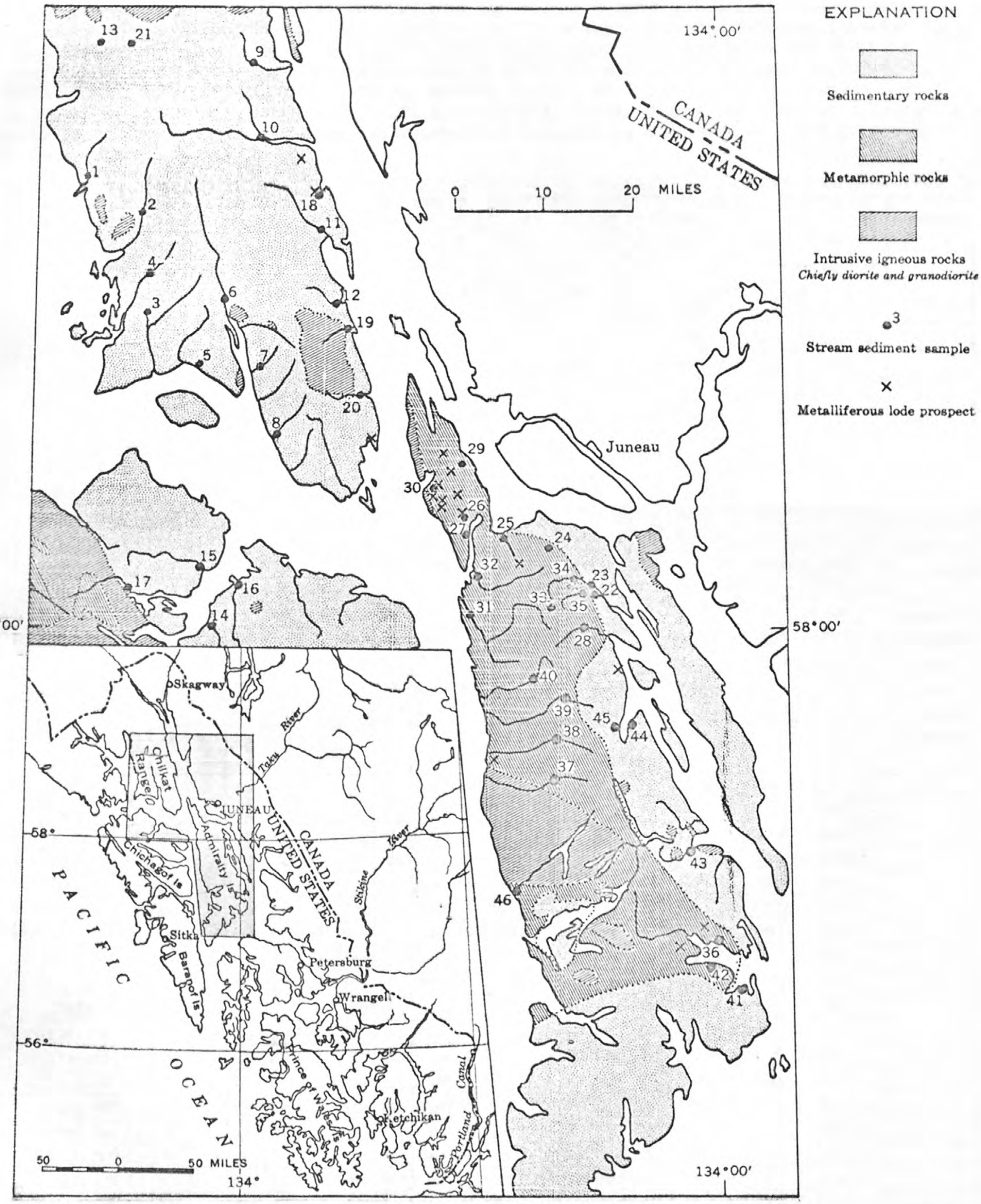

FIGURE 1.-- Generalized geologic map of the Chilkat Range, Admiralty Island, and northeastern Chichagof Island, showing location of stream sediment samples and lode prospects. Inset: Index map of southeastern Alaska showing location of area of this report.

TABLE 1.--Metal content of 46 stream sediment samples from three areas near Juneau, Alaska. (Unless otherwise noted, analyses are by semiquantitative spectrographic methods. Asterisk(*) denotes semiquantitative chemical analysis. The following elements are below the limit of detection of the method used and are reported in parts per million as follows: Sn<10; Ag<1; Ge<20; Ga<20; La<50; Bi<10; In<10; Cd<50; Sb<200; Tl<100; Nb<50; Ta<50; W<50. Samples collected in 1957, 1958, and 1959 by H.C. Berg and R.A. Loney. Semiquantitative spectrographic analyses by E.F. Cooley; semiquantitative chemical analyses by H.H. Mehnert and W.L. Jones, U. S. Geological Survey)

	Map Location	FIELD NUMBER	Be ppm	B ppm	Mg %	Si %	Sc ppm	Ti %	V ppm	Cr ppm	Mn ppm	Fe %	Co ppm	Ni ppm	Cu ppm	Zn ppm	As ppm	Sr ppm	Y ppm	Zr ppm	Mo ppm	Ba ppm	Pb ppm	Main type of rock in stream drainage
CHILKAT RANGE and NORTHEASTERN CHICHAGOF ISLAND	1	58ABg 22	<1	20	2	20	20	.5	200	100	700	5	15	30	70	50*	40*	300	20	100	<10	300	10	Sedimentary
	2	58ABg 23	<1	50	1.5	20	20	.5	200	100	300	5	15	50	70	50*	20*	200	20	70	<10	300	10	" "
	3	58ABg 24	<1	30	1.5	7	10	.2	150	30	1500	3	10	30	50	75*	30*	10	10	50	<10	200	<10	" "
	4	58ABg 25	<1	20	1	10	10	.3	150	100	200	3	<10	20	50	75*	20*	200	10	30	<10	300	<10	" "
	5	58ABg 26	<1	50	1.5	20	<10	.3	200	100	500	5	15	50	70	<25*	100*	50	20	70	<10	300	10	" "
	6	58ABg 27	<1	20	1.5	15	10	.2	70	70	500	2	<10	20	30	<25*	30*	700	10	20	<10	300	10	" "
	7	58ABg 28	<1	20	3	20	10	.3	100	50	500	5	15	30	20*	50*	20*	700	10	70	<5	300	<25* / 15	" "
	8	58ABg 29	<1	30	3	30	15	.3	150	70	500	5	15	30	30*	<25*	60*	70	10	150	<5	300	<25* / 10	" "
	9	58ABg 95	<1	20	2	20	50	.5	300	150	1500	7	20	50	300	100*	60*	200	30	100	<10	300	<10	" "
	10	58ABg 96	<1	70	1.5	20	20	.3	200	150	500	5	10	50	70	75*	60*	300	20	70	<10	500	10	" "
	11	58ABg 98	<1	10	1.5	10	<10	.2	100	50	300	3	<10	30	30	50*	60*	700	20	50	<10	300	<10	" "
	12	58ABg 99	<1	10	1.5	10	10	.2	70	100	200	2	<10	20	20	<25*	40*	1000	<10	30	<10	300	<10	" "
	13	58ABg 119	<1	<10	1.5	15	10	.3	200	150	500	5	10	30	50	<25*	60*	300	15	50	<10	300	<10	" "
	14	57ALy SC	<1	10	1.5	20	15	.5	150	150	700	5	15	20	70	<25*	50*	200	20	50	<10	300	10	" "
	15	57ALy HC	<1	20	1	20	15	.7	200	150	2000	5	20	50	100	<25*	20*	200	20	100	<10	300	<10	" "
	16	57ALy GC	<1	<10	1.5	15	15	.5	150	150	1500	5	10	30	30	50*	20*	300	20	150	<10	500	<10	" "
	17	57ALy NC	<1	<10	2	15	10	.5	150	70	700	5	15	20	70	25*	100*	200	20	50	<10	300	<10	Igneous
	18	58ABg 97	<1	20	1.5	20	20	.5	200	150	1500	7	15	150	50	75*	10*	200	20	70	<10	700	10	Igneous?
	19	58ABg 100	<1	10	2	30	<10	.3	100	50	700	5	10	20	10*	<25*	30*	1000	10	150	<5	500	<25* / <10	Igneous
	20	58ABg 101	<1	20	3	30	10	.3	100	70	500	5	15	30	15*	<25*	60*	300	10	70	<5	500	<25* / 10	Igneous?
	21	58ABg 120	<1	<10	1	15	<10	.3	150	100	700	5	10	20	30	50*	10*	700	20	150	<10	500	<10	Igneous?
ADMIRALTY ISLAND	22	58ABg 62	<1	10	5	20	20	.5	150	150	1000	7	15	50	40*	25*	80*	300	15	70	<5	300	<25* / 10	Metamorphic
	23	58ABg 63	<1	30	3	30	20	.5	200	150	700	7	15	50	40*	<25*	60*	100	15	70	7	1500	<25* / 10	" "
	24	58ABg 64	<1	30	3	30	15	.3	150	70	700	5	10	30	20*	<25*	80*	100	10	70	<5	500	<25* / 10	" "
	25	58ABg 65	<1	50	3	30	20	.5	150	100	700	7	15	30	10*	<25*	40*	300	15	100	<5	700	<25* / 10	" "
	26	58ABg 66	<1	20	1	15	10	.7	200	150	1000	7	<10* / 15	100*	40* / 70	75*	60*	50	30	100	<10	3000	<25* / <10	" "
	27	58ABg 67	<1	<10	1.5	15	50	1	500	300	1000	10	30	100	40* / 70	75*	40*	300	50	150	<10	2000	<25* / <10	" "
	28	58ABg 68	<1	30	3	20	30	.7	300	300	1000	10	20	150	75* / 70	75*	<10*	200	30	100	<10	300	<25* / 10	" "
	29	58ABg 69	<1	20	1.5	20	20	.5	200	150	1000	7	<10* / 15	50* / 70	10* / 70	75*	30*	300	20	70	<10	1000	<25* / <10	" "
	30	58ABg 70	<1	20	1.5	20	20	.3	200	100	700	5	<10* / 10	200* / 30	20* / 50	75*	80*	200	20	100	<10	700	<25* / 10	" "
	31	58ABg 71	<1	30	3	30	30	.7	200	150	1000	7	30	70	20*	75*	30*	150	20	70	5	700	<25* / 10	" "
	32	58ABg 72	<1	30	3	30	20	.3	150	150	1000	5	20	70	60*	120*	60*	100	15	50	5	1000	25* / 30	" "
	33	57ALy 29	<1	50	5	30	20	1	200	150	2000	10	30	70	30*	<25*	<10*	100	20	150	10	700	25* / 50	" "
	34	57ALy 130	<1	50	5	30	30	1	200	150	1500	10	30	70	40*	<25*	200*	150	20	150	7	2000	<25* / 15	" "
	35	57ALy 131	<1	15	5	30	20	.7	150	150	1000	7	20	70	30*	25*	40*	200	20	150	5	500	<25* / 10	" "
	36	59ABg 131	1.5	50	1.5	15	15	.7	200	100	2000	5	15	50	40*	125*	40*	200	50	200	7	3000	<25*	" "
	37	59ABg 445	<1	15	3	15	50	.7	300	200	1000	7	30	70	40*	25*	20*	200	30	200	5	300	<25*	" "
	38	59ABg 446	<1	15	3	15	30	.5	150	150	1000	7	20	70	40*	75*	300*	200	30	150	5	300	<25*	" "
	39	59ABg 447	<1	30	1.5	15	20	.3	150	100	1000	5	15	50	60*	100*	150*	100	20	70	5	500	<25*	" "
	40	59ABg 448	<1	50	1.5	20	20	.7	150	150	1000	5	20	70	40*	100*	60*	70	20	70	7	1500	<25*	" "
	41	59ABg 128	<1	50	1.5	20	20	.3	200	200	700	5	15	30	60*	125*	20*	100	15	70	5	1000	<25*	Sedimentary
	42	59ABg 130	1	70	1.5	20	20	.3	150	200	500	5	20	70	40*	100*	10*	150	15	100	5	500	<25*	Sedimentary?
	43	59ABg 132	<1	50	1.5	15	15	.2	150	150	700	3	7	20	40*	100*	60*	200	10	50	<5	1000	<25*	Sedimentary?
	44	59ABg 327	<1	50	1.5	15	20	.5	300	200	1500	7	20	70	75*	75*	20*	150	15	70	7	700	<25*	Sedimentary
	45	59ABg 328	<1	50	1.5	15	30	.7	200	200	1000	7	20	50	60*	50*	10*	200	30	150	5	500	<25*	" "
	46	59ABg 444	<1	10	2	15	15	.3	150	150	1000	5	15	30	30*	25*	<10*	700	20	150	<5	700	<25*	Igneous

TABLE 2.--Metal content of stream sediments grouped by main type of rock in stream drainage. (Compiled from data in Table 1. Range shows minimum and maximum metal content of samples by main drainage rock type. "Average" or background metal content of each metal is expressed as mode(s))

Main type of rock in stream drainage		METAL	Be ppm	B ppm	Mg %	Si %	Sc ppm	Ti %	V ppm	Cr ppm	Mn ppm	Fe %	Co ppm	Ni ppm	Cu ppm	Zn ppm	As ppm	Sr ppm	Y ppm	Zr ppm	Mo ppm	Ba ppm	Pb ppm
	Metamorphic (19 samples)	RANGE	<1-1.5	<10-50	1-5	15-30	10-50	.3-1.0	150-500	70-300	700-2000	5-10	<10-30	30-200	10-70	<25-125	<10-300	50-300	10-50	50-200	<5-10	300-3000	<10-50
		MODE(S)	<1	30	3	30	20	.7	150 and 200	150	1000	7	15	70	40	75	40 and 60	200	20	70	5	300 and 700	10
	Sedimentary (21 samples)	RANGE	<1-1	<10-70	1-3	7-30	<10-50	.2-.7	70-300	30-200	200-2000	2-7	7-20	20-70	20-300	<25-125	10-100	10-1000	<10-30	20-150	none	200-1000	~10-15
		MODE(S)	<1	20 and 50	1.5	20	10 and 20	.3	200	150	500	5	15	30	70	<25	20	200	20	70	<10	300	<10
	Igneous (6 samples)	RANGE	none	<10-20	1-3	15-30	<10-20	.3-.5	100-200	50-150	500-1500	5-7	10-15	20-150	10-70	<25-75	<10-100	200-1000	10-20	50-150	none	300-700	none
		MODE(S)	<1	none	2	15	<10 and 10	.3	150	70 and 150	700	5	15	20	30	<25 and 25	10	200 and 700	20	150	<10	500	<10

derived from the intrusive igneous rocks (20 ppm). Thus, the 150 ppm of nickel at the upper end of the nickel range for sediment derived from the intrusive rocks and their contact aureoles may be of greater prospecting significance. Similarly, from table 2, the maximum zinc content of stream sediments derived chiefly from the metamorphic rocks is 125 ppm, and this value may be anomalous (Chapman and Shacklette, 1960, p. B107; Chapman, 1962). The zinc mode in this case is 75 ppm. The maximum zinc content reported in stream sediments derived mainly from the sedimentary rocks is also 125 ppm, but the zinc mode is less than 25 ppm, suggesting (1) that 125 ppm of zinc in stream sediments derived from the sedimentary rocks is of greater prospecting significance than 125 ppm of zinc in stream sediments derived from the metamorphic rocks, and (2) that anomalous zinc values in the sedimentary rocks may start at lower levels than those in the metamorphic rocks in the Juneau district. A similar, but less extreme, case may be made for arsenic.

The results of this investigation show that, in the area under consideration, and perhaps throughout southeastern Alaska, there is a relationship between background content of at least certain metals in stream sediments and the rocks from which the sediments were derived. The results also show that prospecting for mineral deposits by stream-sediment sampling in southeastern Alaska is likely to be more meaningful, and that subtle, difficult-to-detect anomalies in metal content are less likely to be overlooked if analytical data are arranged so as to reflect the influence of the geologic terrane. A program of detailed, random, stream-sediment sampling throughout southeastern Alaska is indicated in order to compute background metal-content data that are closely related to areal geology. These data are necessary before effective systematic geochemical prospecting by stream-sediment sampling in this region can be undertaken.

References cited

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