STATE OF ALASKA

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DIVISION OF MINES AND MINERALS

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GEOCHEMICAL REPORT NO. 2

Geochemical Investigation of the Slana District Southcentral Alaska, 1963 & 1964

By

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GEOCHEMICAL INVESTIGATION OF THE SLANA DISTRICT, SOUTHCENTRAL ALASKA, 1963 & 1964

by D.H. Richter

INTRODUCTION

This report presents the geochemical data and a summary of the pertinent geologic information obtained in the Slana district, in southcentral Alaska, during the course of field investigations by the Division of Mines and Minerals in 1963 and 1964. The report area includes approximately 110 square miles in the eastern part of the Alaska Range north of the Glenn Highway between the Chistochina and Slana Rivers.

GENERAL GEOLOGY

The rocks of the district consist of a series of Permian (?) volcanics and interbedded sediments intruded by igneous stocks, dikes, and sills ranging in composition from quartz monzonite to gabbro. The principal intrusive rock in the report area is a large complex zoned quartz monzonite pluton that trends northerly in an irregular manner across the structural grain of the Alaska Range (see geochemical map). The pluton has a core of coarse-grained porphyritic quartz monzonite, an intermediate zone of medium- to coarse-grained quartz monzonite with minor granodiorite, and a very irregular and heterogeneous border zone of fine-grained quartz monzonite, orthoclase-rich rock, silica-carbonate rock, silica-tourmaline rock, and altered country rock. Biotite is the principal mafic mineral in the core and coarser-grained rocks of the intermediate zone, whereas hornblende is dominant in the finer-grained rocks.

The edge of a large elongate stock of diorite-quartz diorite, trending northwesterly and parallel to the Alaska Range, is exposed in the northeast corner of the map area. The rock, which exhibits pronounced autobrecciation and autointrusion features, ranges from [illegible], fine-grained biotite diorite to light, coarse-grained hornblende-biotite quartz diorite. Smaller stocks and plugs of diorite and [illegible] of horn[illegible] granodiorite gradational to hornblende diorite porphyry, that appear to be genetically related to the larger diorite mass, occur throughout the area.

Less common are dikes of andesite porphyry, diabase, and gabbro. Northeast of Kennedy Lake a differentiated basic sill with offshoots and segregations of mica peridotite is exposed. Neither of these smaller intrusive bodies, nor the granodiorite-diorite porphyry dikes, are shown on the geochemical map.

Hydrothermal alteration has affected much of the rock in the area and sulfide-bearing quartz, quartz-carbonate, and quartz-carbonate-barite veins are relatively common. The principal altered areas and many of the vein deposits occur within, or in close proximity to, the border zone of the quartz monzonite pluton. In the altered areas the rocks have been replaced by quartz, carbonate, pyrite, and locally sericite and clay minerals. The principal ore minerals in the veins are pyrite, chalcopyrite, galena, sphalerite, and silver-bearing tetrahedrite; gold, silver, and native copper are present in the small local placer deposits but only minor gold has been observed in some of the veins. Small poorly defined zones of disseminated chalcopyrite (.02-.05% Cu) occur in the diorite stock, especially along its contact with the volcanic country rock.

GEOCHEMICAL STUDIES

More than 500 stream sediment samples were collected and tested in the field for cold extractable heavy metals by the University of Alaska method 1/. The pH was not adjusted in any of the field tests, and salt (NaCl) was used as a conditioning reagent. Quantitative analyses for copper, zinc, lead, and molybdenum were performed on 265 of these samples by the Division laboratories, using the U.S. Geological Survey pyrosulfate fusion method 2/, and by the Rocky Mountain Geochemical Laboratories, using the acid digestion techniques of Sandell 3/. All of the analytical and field test data for the laboratory analyzed samples are given in Table 1; also listed are field test results for 51 select samples (numbers 266 to 316) that were not quantitatively analyzed. In addition to the stream sediments, 23 rock samples representative of the principal rock types in the area were analyzed for trace amounts of copper, zinc, lead, and molybdenum to determine the background range of these metals. These data are plotted on the stream sediment frequency distribution graphs (Figure 1). Repeat analyses and cross-check samples indicate that the analytical results for copper, zinc, and

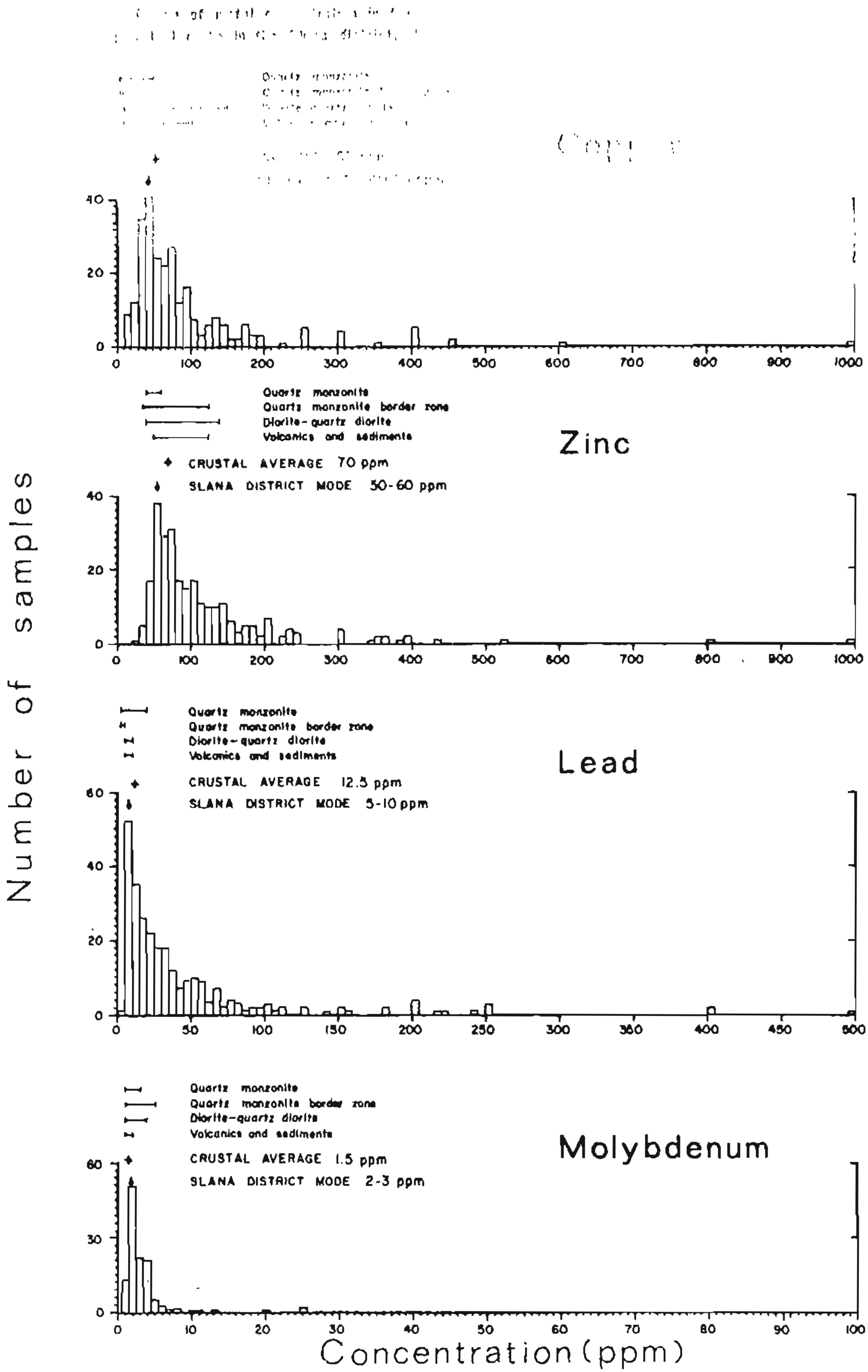

Figure 1. Frequency distribution graphs for copper, zinc, lead and molybdenum in the stream sediments in the Slana district.

Table 1

COPPER, ZINC, LEAD AND MOLYBDENUM CONTENT OF STREAM SEDIMENTS IN THE SLANA DISTRICT

Sample Number	Concentration (ppm) Cu	Zn	Pb	Mo	Field test (ml of dye)
1	20	30	5	2	1
2	20	50	5	3	1
3	30	60	5	3	1
4	25	70	10	2	1
5	20	65	5	2	1
6	75	60	5	2	1
7	30	50	10	2	1
8	35	65	5	2	3
9	75	175	70	4	3
10	60	85	10		4
11	65	190	60	8	6
12	20	35	5	2	1
13	40	85	10	2	1
14	60	235	20	4	3
15	45	70	15		1
16	30	60	15	2	1
17	30	65	15	2	1
18	85	70	30	2	1
19	100	300	55	6	5
20	100	430	55	4	20
21	65	170	35	2	3
22	50	140	30	2	2
23	300	135	30	4	5
24	75	80	25	2	2
25	190	95	35	4	2
26	40	55	15		2
27	40	65	5		12
28	35	60	5	6	25
29	25	40	5		6
30	40	75	10	2	1
31	30	70	5	2	1
32	30	60	5		2
33	35	75	5		12
34	40	90	5		2
35	45	55	10	2	2
36	55	90	10	2	2
37	30	70	5	1	2
38	35	50	5	2	1
39	20	50	10	1	2
40	55	60	5	2	2

Table 1 - continued

Sample Number	Concentration (ppm) Cu	Zn	Pb	Mo	Field test (ml of dye)
41	70	65	5	2	2
42	90	95	10	3	3
43	105	95	5	3	1
44	135	80	5	2	3
45	30	55	5	2	2
46	45	60	10		4
47	50	110	15	2	3
48	25	80	15	3	2
49	50	125	45	3	2
50	65	75	50	3	2
51	90	140	55	4	4
52	80	145	65	5	2
53	160	205	140	4	2
54	40	65	25	4	2
55	55	210	25	2	4
56	40	60	20	4	2
57	160	70	25	2	2
58	185	175	25	3	2
59	75	350	85	2	4
60	80	120	35	3	2
61	70	210	50	2	18
62	75	235	45	2	2
63	45	160	40	2	2
64	40	110	100	3	2
65	45	100	30	2	2
66	45	130	15	3	2
67	35	65	15	2	2
68	45	110	30	2	2
69	50	75	20	1	2
70	75	150	45	2	2
71	75	110	20	2	2
72	50	95	25	2	2
73	30	60	10	1	2
74	45	340	80	2	2
75	70	135	15	2	2
76	45	105	20		2
77	60	140	80	2	2
78	45	60	20		2
79	35	55	5	5	2
80	45	60	30		2

Sample Number	Concentration (ppm) Cu	Zn	Pb	Mo	Field test (ml of dye)
81	40	55	25	2	2
82	250	105	5		2
83	80	105	45		2
84	60	240	50		12
85	35	60	35		4
86	35	95	40		2
87	50	190	45		6
88	40	155	30		4
89	40	110	45		8
90	35	60	30		4
91	40	140	50		8
92	50	110	25		4
93	45	145	15		4
94	70	150	35		6
95	40	150	25		5
96	40	200	40	3	8
97	100	110	5		2
98	80	100	10		4
99	400	160	55		2
100	125	80	75		2
101	90	80	65		2
102	100	95	100		6
103	90	70	50		2
104	135	140	200		2
105	85	95	150	4	2
106	350	250	250	13	4
107	110	115	70		2
108	100	80	55		2
109	95	90	50	4	2
110	150	60	180	4	6
111	100	185	80	4	6
112	85	300	35	25	6
113	45	110	100		2
114	45	55	20		2
115	50	60	30		2
116	75	85	100	3	2
117	100	120	75	1	2
118	125	150	90	4	2
119	50	65	30		2
120	250	80	500	25	6

Table 1 - continued

Sample Number	Concentration (ppm) Cu	Zn	Pb	Mo	Field test (ml of dye)
121	1000	350	400	20	12
122	125	75	250	6	4
123	45	55	35	1	2
124	50	60	25		2
125	75	80	20	1	2
126	55	75	20	2	2
127	55	60	15		2
128	40	40	10		2
129	100	60	5		2
130	125	50	20		2
131	250	80	15		2
132	175	80	20		2
133	450	100	30		2
134	55	115	65		6
135	40	60	10		2
136	55	190	55		2
137	65	85	30		2
138	70	115	200		2
139	55	140	220	1	2
140	50	250	125		20
141	30	120	35		8
142	55	300	100	1	25
143	75	230	200	3	12
144	40	180	180		2
145	40	90	10		2
146	100	150	125	5	4
147	70	140	150		2
148	80	150	75		2
149	70	120	65		2
150	140	60	40	1	2
151	75	60	30		2
152	140	55	35	2	2
153	185	140	100	10	2
154	125	75	50		2
155	300	140	240		4
156	250	220	400		4
157	135	125	250		2
158	75	105	30	2	4
159	40	135	35	3	4
160	75	160	65	4	2

Table 1 - continued

Sample Number	Concentration (ppm) Cu	Zn	Pb	Mo	Field test (ml of dye)
161	45	125	25	2	4
162	75	520	65		8
163	40	130	20	2	4
164	45	205	45	2	4
165	70	365	50	3	8
166	55	365	50	3	8
167	80	380	75	5	8
168	55	150	55	4	2
169	95	195	35	3	4
170	45	190	90	4	2
171	60	300	215	4	4
172	120	+1000	200	5	25
173	40	70	45	3	2
174	400	395	155	8	10
175	75	250	55	4	4
176	70	800	110	4	25
177	35	205	35	2	4
178	15	90	30	2	2
179	60	95	15	2	2
180	50	90	30	2	2
181	20	150	60	3	3
182	70	165	40	3	2
183	105	395	60	7	6
184	50	80	20		6
185	55	75	5		5
186	45	70	5		3
187	55	65	15		2
188	55	95	15		3
189	20	25	5		3
190	40	70	10		2
191	85	110	15		2
192	135	75	10		2
193	35	60	5		2
194	175	85	10		2
195	55	85	20		3
196	65	75	30		3
197	400	75	5		2
198	450	70	10		2
199	70	60	15		3
200	50	90	5		2

Table 1 - continued

Sample Number	Concentration (ppm) Cu	Zn	Pb	Mo	Field test (ml of dye)
201	60	75	10		2
202	70	45	15		4
203	65	50	15		4
204	45	45	10		3
205	45	25	5		4
206	55	60	5		2
207	65	60	5		3
208	75	55	15		3
209	45	60	5		2
210	40	45	10		2
211	50	50	5		3
212	20	50	10		4
213	45	65	10		3
214	225	135	10		2
215	200	240	5		4
216	200	210	30		2
217	90	110	5		2
218	150	145	20	1	2
219	250	125	15		2
220	200	125	5		6
221	400	180	15		2
222	300	210	25		2
223	140	115	15		2
224	150	70	5		4
225	130	120	20		2
226	140	110	5		2
227	150	110	10		2
228	180	120	25		6
229	130	80	10	3	3
230	100	115	5		4
231	140	85	5		2
232	65	50	10		4
233	90	70	10		7
234	180	140			4
235	100	85	5		6
236	80	45	5		2
237	150	50	5		2
238	300	60	15		2
239	600	180	20		2
240	150	95	20		4

Table 1 - continued

Sample Number	Concentration (ppm) Cu	Zn	Pb	Mo	Field test (ml of dye)
241	180	75	20		4
242	100	50	10		2
243	170	90	25		2
244	80	80	15		4
245	170	70	20		2
246	110	75	10		2
247	170	100	45		2
248	250	100	20		2
249	180	105	55		2
250	110	65	20		2
251	100	70	5		4
252	90	70	10		2
253	80	75	5		2
254	80	55	10		2
255	50	60	5	1	2
256	50	65	5		2
257	90	55	10	3	4
258	80	65	5		4
259	70	80	25		2
260	60	90	25		2
261	110	200	65		15
262	110	150	40		6
263	100	165	40		4
264	95	110	20		2
265	50	80	25		2
266					2
267					2
268					2
269					2
270					2
271					2
272					2
273					2
274					2
275					2
276					2
277					2
278					2
279					2
280					4

Table 1 - continued

Sample Number	Concentration (ppm) Cu	Zn	Pb	Mo	Field test (ml of dye)
281					2
282					4
283					4
284					4
285					2
286					2
287					2
288					2
289					2
290					2
291					2
292					2
293					10
294					2
295					10
296					2
297					2
298					2
299					2
300					2
301					2
302					2
303					2
304					2
305					2
306					10
307					4
308					2
309					8
310					2
311					2
312					2
313					2
314					2
315					2
316					2

NOTE: Blank space in Mo column denotes that molybdenum was not detected.

Analytical Laboratories

Alaska Division of Mines and Minerals: Samples 10, 11, 15, 18-23, 26-36, 46, 51, 52, 59, 61, 76-157 (with exception of Mo in 105, 106, 109, 110, 120, and 121), 184-265.

Rocky Mountain Geochemical Laboratories: Samples 1-9, 12-14, 16, 17, 24, 25, 37-45, 47-50, 53-58, 60, 62-75, and 158-183.

lead from the three laboratories are in good agreement. Molybdenum, however, was consistently low from the Division laboratories and as a rule went undetected where present in concentrations of less than 2 to 3 ppm. Fair correspondence was generally obtained between the field test and quantitative laboratory data especially if zinc was among the enriched elements. Copper and/or lead enrichment was often missed by the field test, evidently in part due to the optimum extractibility of these metals at pH values significantly different from the near neutral to weakly acid field test solutions. In the other extreme, a strong field anomaly, near Kennedy Lake (samples 27, 28, 29, and 33) could not be substantiated by the laboratory analyses.

Histogram frequency distribution graphs have been prepared for each of the four metal elements in the 265 analyzed samples (Figure 1). Although these plots have not been smoothed, a single population, lognormal in distribution, is apparent for each element. Moreover, the mode, i.e., the concentration that occurs oftenest, for each metal element in the stream sediments of the Slana district is within a few percent of the crustal average estimate 4/. Approximate upper background limits (threshold values) for the four metal elements were estimated on the basis of the known metal concentration range in the principal rock types of the area and visual inspection of the histogram distribution plots. These threshold values are: copper, 150 ppm; zinc, 150 ppm; lead, 50 ppm; and molybdenum, 6 ppm. On the accompanying geochemical map the red half circle denotes stream sediments with at least one metal element whose concentration is greater than the threshold and the red full circle at least one metal element whose concentration is greater than twice the threshold.

DISCUSSION OF RESULTS

Anomalous concentrations of heavy metals are present in many stream sediments in the report area. Most of the anomalies are on streams draining the border zone of the quartz monzonite pluton and the diorite-quartz diorite intrusives; a few are on streams draining the intermediate zone of the pluton and bedded country rock, but none were found draining only the core of the pluton. Zinc and lead are the principal enriched metals in anomalies related to border zone rocks and altered areas, whereas copper is the principal metal in the diorite-quartz diorite anomalies. Although the data are insufficient to determine which, if any, of the anomalies may be significant, at least two areas of high metal concentration - one near Long Lake and the other southeast of Flat Lake - warrant further investigation.

The Long Lake anomaly includes an area of roughly six square miles underlain by quartz monzonite, quartz monzonite border zone rock, and bedded volcanic rocks. The anomaly appears to be centered around a conspicuous altered area that has been recently explored for molybdenum. However, other than the stream sediments derived from the exposed altered area, which are high in molybdenum, lead, copper, and zinc, the anomaly is characterized by high lead values. Within the anomalous area at least 34 streams contain sediments with lead concentrations above 50 ppm, including 20 with concentrations of 100 ppm to 500 ppm (sample 120). The rocks in the altered area have been replaced by an intimate mixture of sericite, clay minerals, and quartz and locally contain disseminated pyrite and sparse, fine-grained molybdenite. Two quartz veins, one containing minor chalcopyrite, were observed in the altered area. Outside of the altered area there is only meager evidence to suggest a source for the high metal concentrations. Northwest of the west end of Long Lake a number of galena-bearing quartz veins may be responsible for the high lead values in samples 104, 155, 156, and 157, but elsewhere no mineralization was observed in association with the anomalies.

The anomaly southeast of Flat Lake is restricted to streams draining quartz monzonite border zone rock. Unlike the Long Lake anomaly, zinc is the principal enriched element, with one sample (172) containing in excess of 1000 ppm. High lead values (maximum 215 ppm, sample 171) are present in a number of streams, but copper does not occur in amounts above threshold values (150ppm). No source of the anomaly is apparent from the geologic investigations conducted in the area. A number of barren quartz veins and one pyrite-bearing quartz vein in quartz-tourmaline border zone rock are exposed between sample sites 62 and 163 in the main stream flowing into Flat Lake. To the east a small limonite-stained area and quartz-carbonate vein with pyrite is exposed below sample site 172 and minor disseminated chalcopyrite and a few quartz-carbonate veins are present in quartz-rich border zone rock below sample site 51.

Elsewhere in the report area most of the high metal sediments are enriched chiefly in copper and are from streams draining the diorite-quartz diorite intrusives. Many of these apparent copper anomalies, however, probably only reflect the relatively high background copper content (as much as 150 ppm) of the dioritic rocks. A possible significant exception is near the headwaters of Porcupine Creek north of Indian Pass Lake where disseminated chalcopyrite has been observed in the diorite between sample sites 229 and 239. The four tributaries of the West Fork of Ahtell Creek which show higher than threshold copper values may also drain dioritic rocks beyond the map area.

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