SURFACE LITHOGEOCHEMISTRY, NORTHAIR MINE
(92J/3W)

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INTRODUCTION

A lithogeochemical study in the vicinity of Northair Mines Ltd.'s Callaghan Creek property was undertaken concomittently with a geological mapping program in the area (Miller and Sinclair, 1978 and 1979). Several recent works indicate that readily identifiable geochemical signatures exist in comparable volcanic rock sequences containing polymetallic sulphide deposits (Nicol, *et al.*, 1977; Cagatay, *et al.*, 1977). The apparently layered nature of the Northair deposits and their overall similarity to exhalite deposits suggested that a surface lithogeochemical study of the area was warranted. Consequently, the orientation survey reported here was undertaken to provide some insight into the exploration potential of the method as well as to outline general geochemical characteristics of the mineralized volcanic sequence.

General geology of the Callaghan Creek area is described by Miller and Sinclair (1978) who recognize two principal fragmental volcanic units underlying the Northair property. These rocks are thought to correlate with the Lower Cretaceous Gambier Group to the south (Roddick and Woodsworth, 1975).

SAMPLING PROGRAM

A sampling program was undertaken in the summer of 1978 along two traverse lines confined to lithological units 3 and 5 inclusive as shown on Figure 43. The two traverse lines were selected so that one crossed an ore zone (the Warman zone) approximately at right angles and the second crossed much the same lithological section but in an apparently barren area south of the southernmost extension of known ore in the Manifold zone. Exploration drilling in this latter area confirmed the apparent absence of sulphides of economic interest. Consequently, the two traverses represent a mineralized section and an apparently unmineralized section.

Sample spacing and location depended critically on locations of outcrops. Thus, spacing as indicated on Figure 43 was irregular and samples had to be taken as much as 200 metres off the profile location.

Sampling procedure involved taking three large fist-sized specimens at 1-metre intervals across the regional strike of the units. These samples were submitted to the Analytical Laboratory of the Geological Division, Mineral Resources Branch, Ministry of Energy, Mines and Petroleum Resources where they were crushed, mixed, and reduced in volume for analysis. In this way we hoped to introduce some rigor into the sampling procedure and to reduce an anticipated high local sampling variability.

Samples were analysed for Ag, Pb, Zn, Cu, Mn, Fe, Ba, Ca, Rb, Sr, and K by routine atomic absorption techniques. Samples were taken in a comparable manner from all five rock units of Miller and Sinclair (1979) for whole rock chemical analysis.

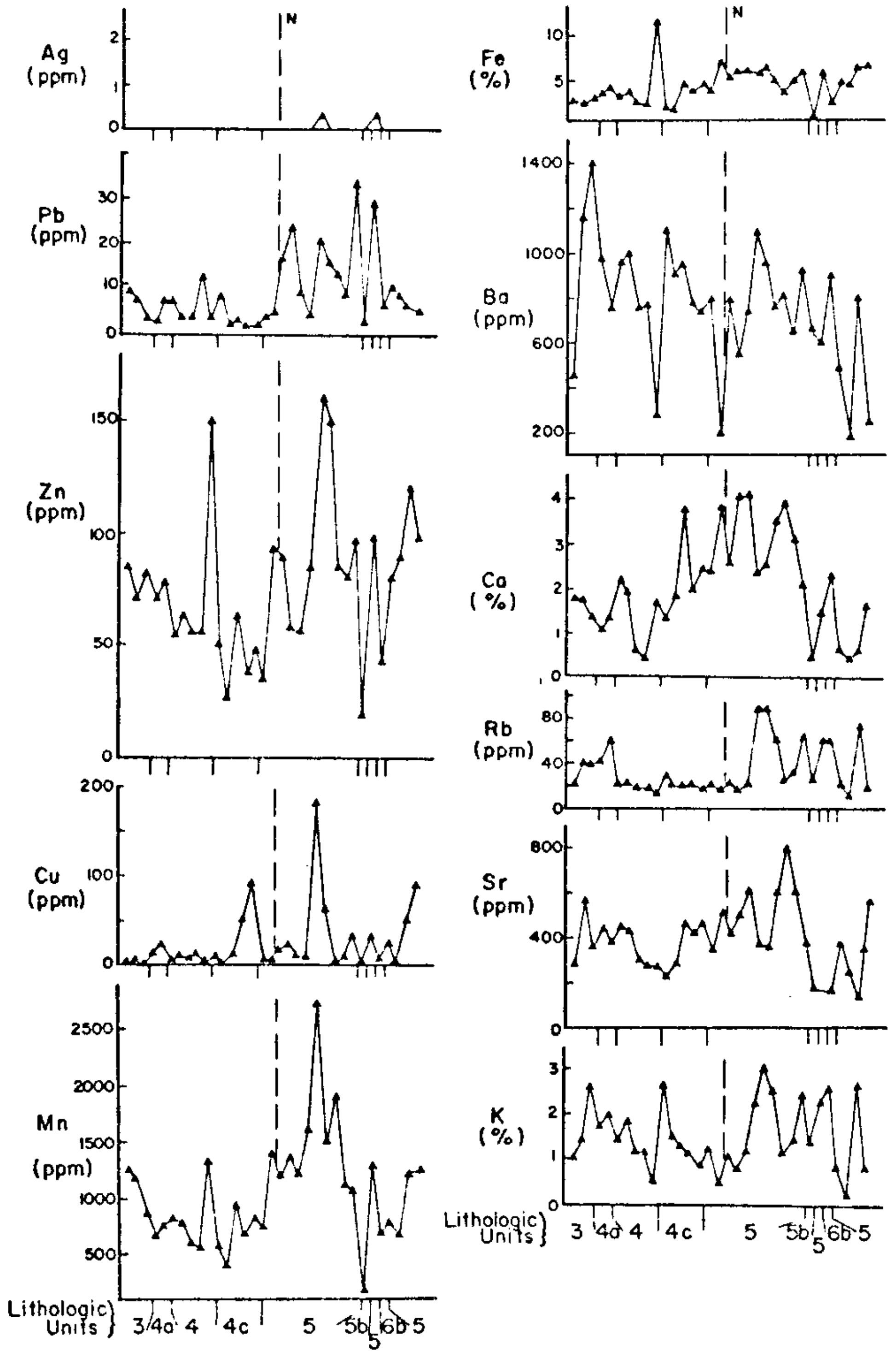

Figure 44. Metal profiles (west on left) for northern traverse through Warman zone whose location is shown by a dashed line marked N. Numbers along the abscissa refer to lithological units of Miller and Sinclair (1978, 1979).

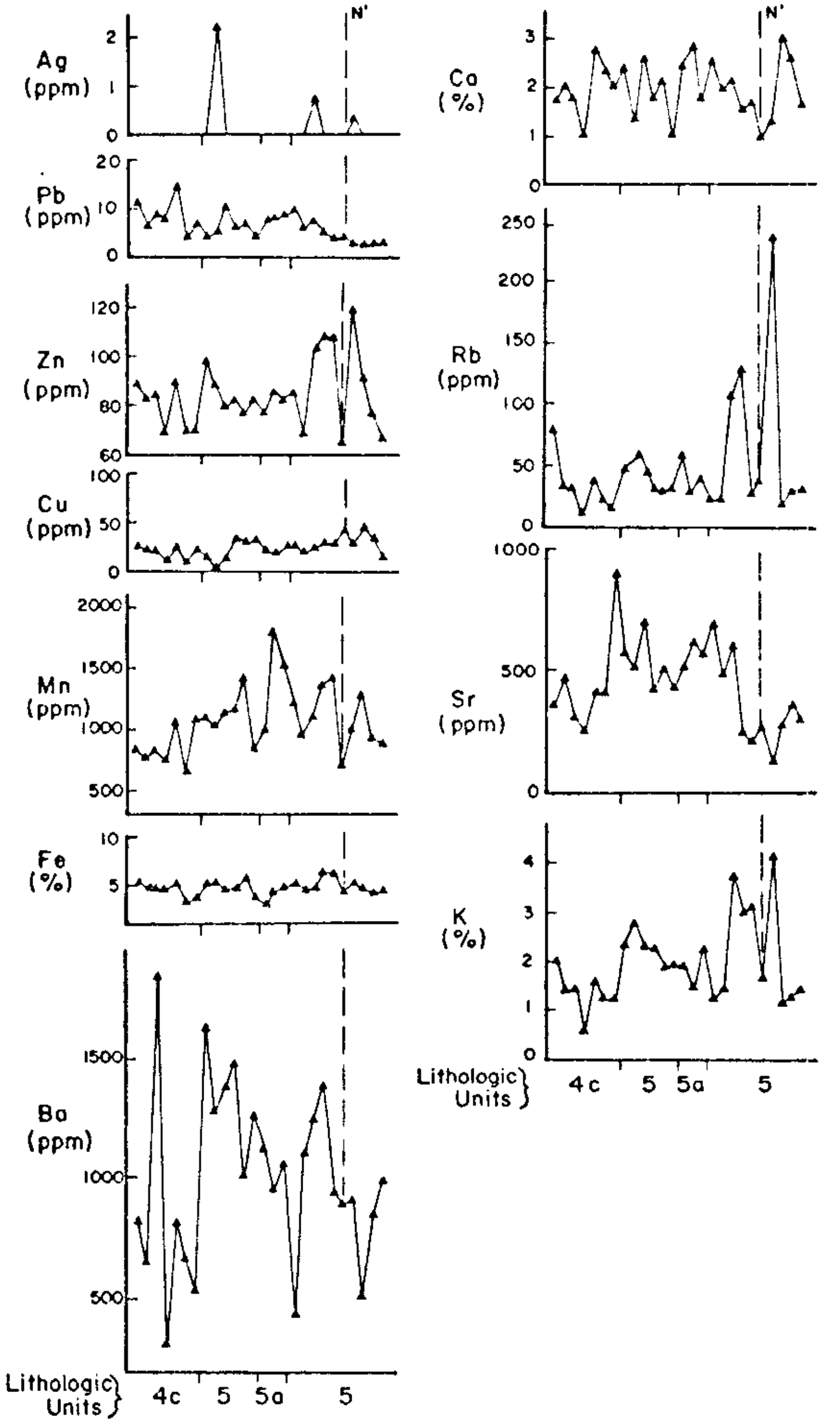

Figure 45. Metal profiles for southern (unmineralized ?) traverse. The projected position of the Manifold zone is shown by a dashed line marked N'.

TABLE 1. WHOLE ROCK GEOCHEMISTRY

Sample No.	SiO_2 *per cent*	Al_2O_3 *per cent*	Fe_2O_3 *per cent*	MgO *per cent*	CaO *per cent*	Na_2O *per cent*	K_2O *per cent*	TiO_2 *per cent*	MnO *per cent*	L.O.I.* *per cent*	Total *per cent*
1	54.04	19.20	7.33	4.18	7.33	3.977	1.983	0.790	0.170	1.38	100.38
2	53.19	18.58	7.61	4.48	5.69	3.779	2.886	0.845	0.168	2.11	99.34
3	58.89	17.58	6.71	2.50	4.28	2.514	2.450	0.643	0.199	2.74	98.50
4	63.76	16.30	4.30	1.92	3.39	5.484	0.842	0.426	0.160	2.51	99.09
5	55.92	17.96	5.81	3.06	5.33	6.018	0.791	0.574	0.137	3.56	99.16
6	52.95	18.07	7.46	3.75	5.55	5.212	1.073	0.754	0.248	3.73	98.80
7	53.23	18.41	7.79	5.20	5.08	4.033	2.159	0.776	0.123	2.18	98.99
8	59.35	16.59	6.04	3.22	2.28	5.533	0.898	0.703	0.149	3.07	97.83
9	63.90	16.74	4.59	2.57	1.47	5.119	1.905	0.504	0.108	2.29	99.20
10	56.67	20.25	5.06	2.75	4.37	4.373	1.336	0.610	0.091	2.68	98.19
11	56.25	20.28	8.53	1.55	6.51	2.631	0.283	0.663	0.215	2.23	99.14
12	55.16	19.07	8.11	2.71	4.45	4.104	1.612	0.792	0.161	2.92	99.10
13	41.54	18.74	10.22	7.26	5.58	0.566	2.889	1.083	1.026	9.06	97.96
14	51.38	21.41	7.46	3.57	5.56	2.951	2.843	0.796	0.137	3.36	99.47
15	63.23	16.42	4.06	2.31	4.44	3.463	1.685	0.457	0.075	3.22	99.36
16	70.64	14.71	1.75	0.56	2.40	0.334	4.225	0.275	0.136	3.82	98.85

*Loss on ignition.

TABLE 3. MEANS AND STANDARD DEVIATIONS LITHOGEOCHEMICAL DATA (n = 59)

Name	Arithmetic $\bar{x}$	Arithmetic s	Logarithmic $\bar{x}$	Logarithmic s
Ba	868.8	346.1	2.897	0.2108
Ca	2.012	0.9250	0.2479	0.2419
Cu	25.29	28.26	1.204	0.4396
Fe	4.836	1.616	0.6601	0.1535
K	1.744	0.8486	0.1836	0.2452
Mn	1 047	407.6	2.986	0.1873
Pb	8.407	6.693	0.8243	0.2876
Rb	40.92	35.76	1.509	0.2821
Sr	413.5	168.0	2.578	0.1923
Zn	81.14	27.13	1.883	0.1606

RESULTS

Analytical data are listed in Table1 for whole rock analyses and in Table 2 for lithogeochemical analyses. The lithogeochemical data are plotted as profiles on Figures 44 and 45. Where sample sites are off the traverse line they have been projected along the regional strike to the line of profile, a procedure that adds to the apparent local variability but which should not cloud any significant trends that exist in the sequence. A few systematic patterns exist which will be discussed with reference to profile I (Fig. 44).

Lead shows a sharp increase in mean value and variability in Unit 5 compared with the underlying Unit 4. Rubidium has a pattern not unlike lead but the division between low and high values is slightly higher in the section than is the case for lead. The pattern for potassium follows those of lead and rubidium but is somewhat more vague. Iron also has a pattern comparable to that of lead. Both manganese and zinc have low values in the upper part of Unit 4 that contrast with higher values in the lower part of Unit 5. Their patterns are both more erratic and more gradational than those of lead, iron, and so on. Despite the local variability shown in all these profiles it is apparent that a significant change in rock chemistry occurs roughly at the contact between Unit 4 (dacitic agglomerate) and Unit 5 (andesitic agglomerate). This result is not so clearly demonstrated in the second profile (Fig. 45).

STATISTICAL ANALYSIS

A correlation matrix of the lithogeochemistry data of Table 2 can be used to classify the elements into groups of correlated variables as follows:

Rb-K-Ba
Sr-Ca-Mn
Zn-Cu-Mn-Fe-(Pb)
Pb-Mn-Fe

These metal associations do not differ greatly for the two principal stratigraphic units underlying the property (Unit 4 and Unit 5 of Miller and Sinclair, 1978) and probably relate to specific minerals such as feldspars and mafic minerals.

Probability graphs (not shown) indicate that all minor elements except calcium and potassium can be considered mixtures of lognormal populations. Calcium and potassium appear to be mixtures of either two normal populations or a combination of normal and lognormal populations. Means and standard deviations for raw data and log transformed data are given in Table 3.

DISCUSSION

Major element analyses indicate the calc-alkaline nature of the mineralized volcaniclastic sequence at Northair Mines Ltd.'s Callaghan Creek property.

The main result of the minor element lithogeochemical study has been to quantify metal abundances in a volcanic rocks sequence that contains polymetallic sulphides in a now disjointed tabular zone parallel to bedding. The rocks do not seem to be abnormal chemically. This orientation survey did not identify particular geochemical signatures near the mineralized zone, perhaps because (1) sample spacing was too wide along traverse lines and (2) there were insufficient sample traverses.

However, the chemical data were successful in pointing to a marked chemical difference between the upper part of Unit 4 and the lower part of Unit 5.

TABLE 2. SURFACE LITHOGEOCHEMICAL DATA, NORTHAIR MINES

		Ag	Ba	Ca	Cu	Fe	K	Mn	Pb	Rb	Sr	Zn
1	+5	<0.3	425	2.62	27	5.07	1.11	1 200	10	24	700	86
2	–5	<0.3	1 500	1.73	35	4.94	2.27	1 144	6	32	415	82
3	–5	<0.3	1 000	2.18	31	5.93	1.92	1 434	7	33	520	59
4	5A	<0.3	1 125	2.41	21	3.29	1.93	1 000	8	60	520	76
5	5A	<0.3	940	2.75	19	4.31	1.43	1 840	8	35	615	86
6	4C	<0.3	660	2.03	23	4.84	1.34	767	7	32	470	83
7	4C	<0.3	825	1.71	26	5.46	2.02	806	12	80	350	88
8	4C	<0.3	1 840	1.80	21	4.69	1.46	800	9	30	300	84
9	4C	<0.3	825	2.79	24	5.32	1.66	1 080	15	40	415	90
10	4C	<0.3	300	0.92	10	4.20	0.55	720	8	10	250	68
11	4C	<0.3	670	2.31	8	3.24	1.25	680	4	20	400	68
12	4C	<0.3	525	1.94	24	3.62	1.20	1 090	7	15	920	70
13	–5	<0.3	1 650	2.40	16	5.04	2.36	1 086	4	46	570	98
14	–5	2.2	1 250	1.26	2	5.28	2.81	1 046	5	52	500	88
15	–5	<0.3	1 365	2.63	16	4.64	2.30	1 128	11	58	700	78
16	–5	<0.3	1 275	0.96	34	3.62	1.90	776	4	36	410	82
17	5A	<0.3	1 075	1.72	25	4.75	2.31	1 514	9	42	560	82
18	+5	<0.3	1 100	1.94	20	4.57	1.46	915	6	26	470	67
19	+5	0.8	1 250	2.19	26	4.90	3.80	1 100	8	108	615	104
20	+5	<0.3	1 100	2.38	9	6.11	2.45	1 616	4	92	365	88
21	+5	0.3	950	2.66	187	6.36	3.13	2 726	22	88	350	164
22	+5	<0.3	770	3.43	60	5.24	2.60	1 452	17	60	590	150
23	+5	<0.3	815	3.97	2	3.97	1.13	1 924	14	22	800	89
24	4A	<0.3	975	1.02	15	4.01	1.71	682	3	40	440	74
25	4A	<0.3	750	1.33	23	4.51	2.03	768	8	64	380	82
26	3	<0.3	460	1.80	2	3.32	1.01	1 268	10	19	275	88
27	3	<0.3	1 150	1.73	5	3.10	1.42	1 172	8	42	570	74
28	3	<0.3	1 400	1.35	3	3.43	2.74	872	4	38	350	86
29	4	<0.3	950	2.22	3	3.65	1.42	814	8	20	450	56
30	4	<0.3	1 000	1.84	11	4.12	1.93	770	4	23	420	68
31	4	<0.3	750	0.57	9	3.26	1.26	620	4	17	300	58
32	4	<0.3	765	0.49	12	2.79	1.18	546	14	18	270	58
33	4	<0.3	280	1.71	41	2.02	0.53	1 362	4	13	270	154
34	4C	<0.3	1 200	1.36	10	2.41	2.75	560	10	31	220	52
35	4C	<0.3	900	1.82	2	2.22	1.49	392	2	20	280	28
37	+5	<0.3	650	3.11	9	5.64	1.38	1 100	9	32	590	83
38	+5	<0.3	925	2.03	35	6.64	2.49	1 040	35	67	380	100
39	–5	<0.3	725	4.11	10	6.36	1.24	1 184	10	23	615	58
40	–5	<0.3	550	4.09	25	6.22	0.72	1 360	25	14	500	60
41	–5	<0.3	790	2.53	19	5.89	1.13	1 140	19	24	405	92
42	–5	<0.3	200	3.94	8	7.93	0.41	1 423	5	17	520	97
43	–5	<0.3	800	2.38	7	4.10	1.32	746	4	21	335	36
44	4C	<0.3	950	3.82	15	5.10	1.29	1 004	4	19	460	68
45	4C	<0.3	775	1.94	55	4.23	1.11	674	2	22	420	40
46	4C	<0.3	740	2.46	94	5.03	0.81	836	2	16	570	52
47	5B	<0.3	650	0.36	5	1.06	1.40	138	2	22	170	20
48	+5	0.3	600	1.47	38	6.55	2.33	1 314	31	62	164	102
49	*5	<0.3	250	1.70	90	6.82	0.82	1 240	5	16	560	98
50	*5	<0.3	800	0.57	52	6.99	3.06	1 214	6	80	125	122
51	*5	<0.3	175	0.47	4	4.91	0.18	670	8	12	230	92
52	*5	<0.3	475	0.60	28	5.12	0.80	780	11	18	380	84
53	6B	<0.3	900	2.44	8	2.96	2.71	680	6	60	160	44
54	+5	<0.3	1 400	1.54	29	6.33	2.93	1 360	5	133	240	108
55	+5	<0.3	950	1.71	29	6.38	3.11	1 430	4	24	205	108
56	+5	<0.3	890	0.96	45	4.56	1.60	684	4	43	275	63
57	+5	0.4	900	1.29	29	5.24	4.31	1 006	3	230	125	120
58	*5	<0.3	500	3.05	46	4.51	1.14	1 310	4	18	275	90
60	*5	<0.3	1 000	1.68	13	4.20	1.47	874	4	27	290	66
61	*5	<0.3	850	2.51	34	4.33	1.28	920	4	28	370	76

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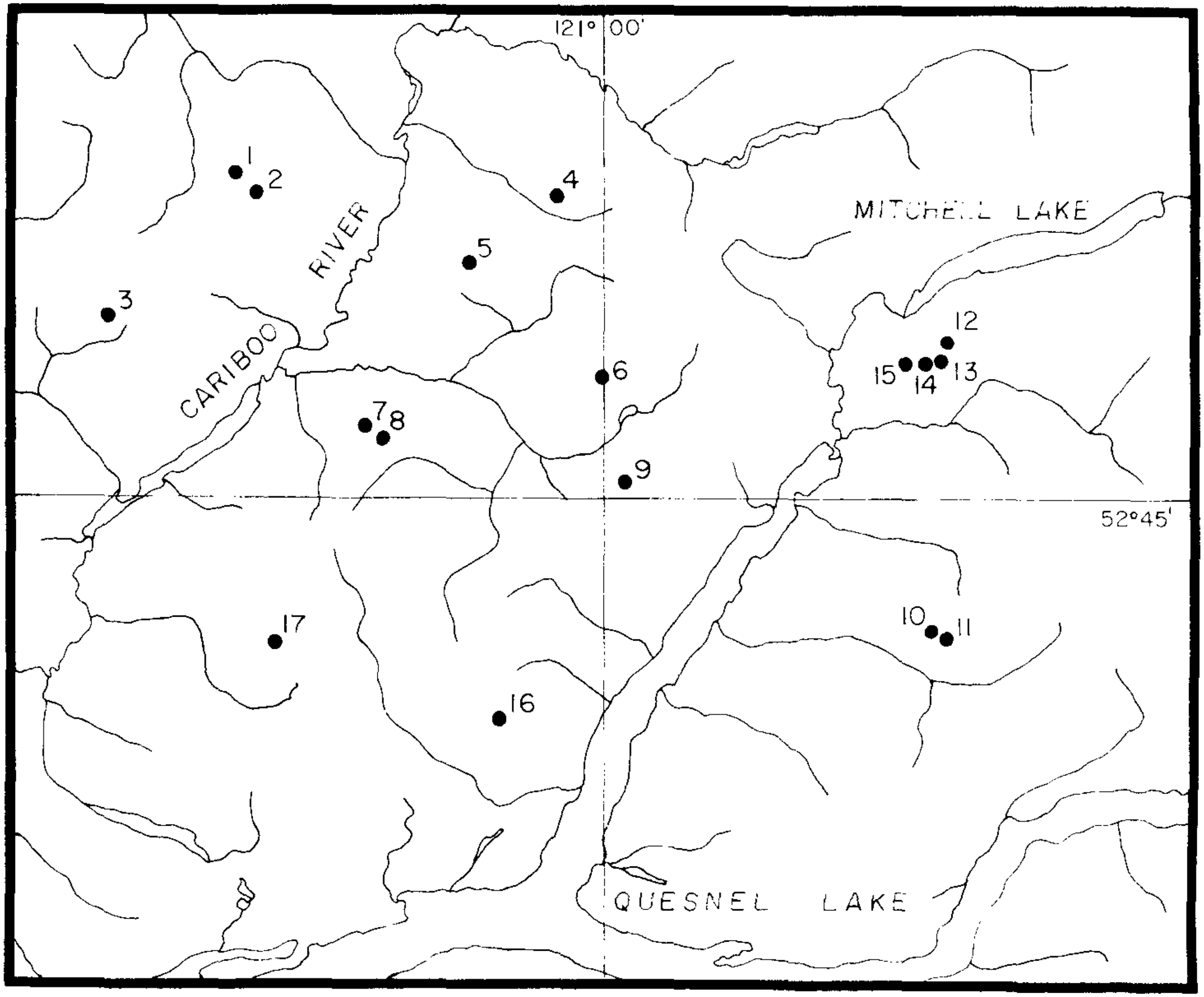

Figure 46. Geographic distribution of specimen locations for the study of fluid inclusions, Cariboo Mountains.