GS-1 GROUND SCINTILLOMETER RECONNAISSANCE OF THE EDEN LAKE AEGIRINE-AUGITE MONZONITE

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BACKGROUND

Routine geological mapping in 1978 and 1979 of the Lynn Lake region identified a 15 km^2 body of aegirine-augite-bearing monzonite and quartz monzonite between Eden and Kwaskwaypichikun lakes (Cameron, 1988) Coincident high levels of potassium, equivalent uranium and equivalent thorium are evident in airborne gamma ray spectrometer surveys of the region (Geological Survey of Canada 1977) and anomalously high uranium and fluoride in lake waters, and uranium in lake sediments were detected in the 1988 MDA geochemical sampling program by the Geological Survey of Canada (Schmitt *et al.*, 1989). The geochemical anomalies encompass a 40 km east-west and 20 km north-south area between Eden Lake and the Churchill River with a smaller tin anomaly (in lake sediment) over the Kwaskwaypichikun Bay region in the west.

Detailed sampling by McRitchie in 1988 confirmed the alkaline miaskitic chemical and mineralogical character of the intrusion and encountered elevated light rare earth elements (Table GS-1-1) in an allanite-bearing cognate zone of pyroxene enrichment on the eastern shoulder of the main ridges south of Kwaskwaypichikun Bay. Follow-up laboratory tests demonstrated elevated levels of radioactivity in the REE-enriched samples (1400 cps) and accordingly it was decided to mount a ground scintillometer reconnaissance over the region in an attempt to locate extensions to the zone discovered in 1988, as well as other possible occurrences.

Additional objectives were to provide a ground-based radiometric signature for the intrusion and to delineate the occurrence and nature of anomalously high radioactive zones that could be correlated with the concurrent airborne gamma ray survey of the intrusion being conducted by the GSC as part of its new EXTECH program. The results of this survey (flown at an altitude of 350 m on 1000 m line spacings) are likely to identify other anomalously high areas that will be targeted for ground spectrometer and scintillometer studies in 1990.

CURRENT WORK

The principal objectives set for 1989 were:

1. To search for extensions to the REE-enriched zone encountered in 1988; and
2. To obtain representative radioactive measurements for the Eden Lake monzonite that could be correlated with the subsequent airborne survey.

The initial plan was to obtain scintillometer readings on a 200 m grid encompassing the eastern ridge of the main Eden Lake outcrop belt and the intervening ill-exposed ground east to Kwaskwaypichikun Lake (Fig. GS-1-1). This approach was soon abandoned once it was found that most anomalies on the ridge were associated with point-sources or narrow zones, and that thick drift cover east of the ridge muted most of the scintillometer responses from this region. Accordingly, efforts were concentrated over the well exposed high ground, and a skeletal network of traverses was conducted with emphasis given to (east-west) profiles that would maximize the likelihood of intersecting the 024° trending REE and "uranium" enriched zones. Additional measurements were also taken over possible extensions to the monzonite east of Kwaskwaypichikun Bay (Fig. GS-1-1).

A Scintrex Broadband gamma-ray scintillometer model BGS-1SL (with a 1.5" x 1.5" thallium activated sodium iodide crystal) was used in conducting the survey. Background readings were taken each day from a boat over water depths exceeding 1 m. Spot measurements were taken on 78 stations in the 20 000 m traverse network both at waist level and on the ground. In most instances these were complemented by sweeps over open outcrop in the immediate vicinity of each station (Fig. GS-1-1) along with notation of spot highs between traverse stations. Sixteen measurements were also taken on shoreline outcrops of neighbouring granitic units for regional comparison.

RESULTS

Scintillometer readings from the alkaline intrusion are organized into four subareas corresponding to the west, central and east ridges of the main outcrop belt south of Kwaskwaypichikun Bay, and the region north of Kwaskwaypichikun Lake. Measurements taken on shoreline outcrops of the outlying granitic rocks are listed separately (Table GS-1-2). Data presented in Tables GS-1-1, and GS-1-2 are to read in conjunction with Figure GS-1-1.

Daily background readings ranged from 25-30 cps. Noticeable drop-off in counts per second were noted over all overburden areas, especially in wet open swamps where source rocks are presumably covered by thick overburden.

Waist-level and on-the-ground measurements differ markedly over hot-spots and along zones of strong radioactivity however little or no contrast was noted for background readings taken in areas of open outcrop. A thin veneer of soil or clay (10-20 cm) was found to cause a moderate fall-off in readings taken at waist level.

Monzonite outcrops in all three ridges consistently give readings of 150-300 cps with the greater proportion being near the upper level of this range. This is consistently higher than readings obtained from the outlying granitic phases which range from 100-150 cps.

No systematic regional differences between one ridge and another were noted in the course of the present skeletal coverage, hot-spots tending to be clustered locally in all three outcrop areas. The northern end of the western ridge gives slightly lower readings (150-250 cps).

Anomalously high responses were obtained in association with the following features:

1. Extremely localized (1200-6000 cps) hot-spots (10-20 cm) corresponding to individual or clustered radioactive minerals.
2. Local hot-spots (1000-4000 cps) corresponding with (30 cm- 1.5 m) fractures exhibiting splayed terminations.

TABLE GS-1-1 EDEN LAKE MONZONITE
(Zones of elevated REE from region between Eden and Kwaskwaypichikun lakes)

Sample description	SC PPM	TH PPM	U PPM	LA PPM	CE PPM	ND PPM	SM PPM	EU PPM	TB PPM	YB PPM	LU PPM
04-89-31-1	2.9	3500	1180	13700	36500	20700	3060	600	180	54	21
04-89-08-1	2.9	1800	880	17700	45900	22900	3300	680	180	68	16
04-89-084C	1.9	2100	1400	13800	39600	24300	3150	670	180	27	14
04-88-06-5	2.47	775	690	12100	15000	6140	1840	247	65.9	55.5	5.13
04-88-00-5(2)*	-	-	369	7180	12700	5530	1070	161	97.8	40.0	4.77

*Check analysis

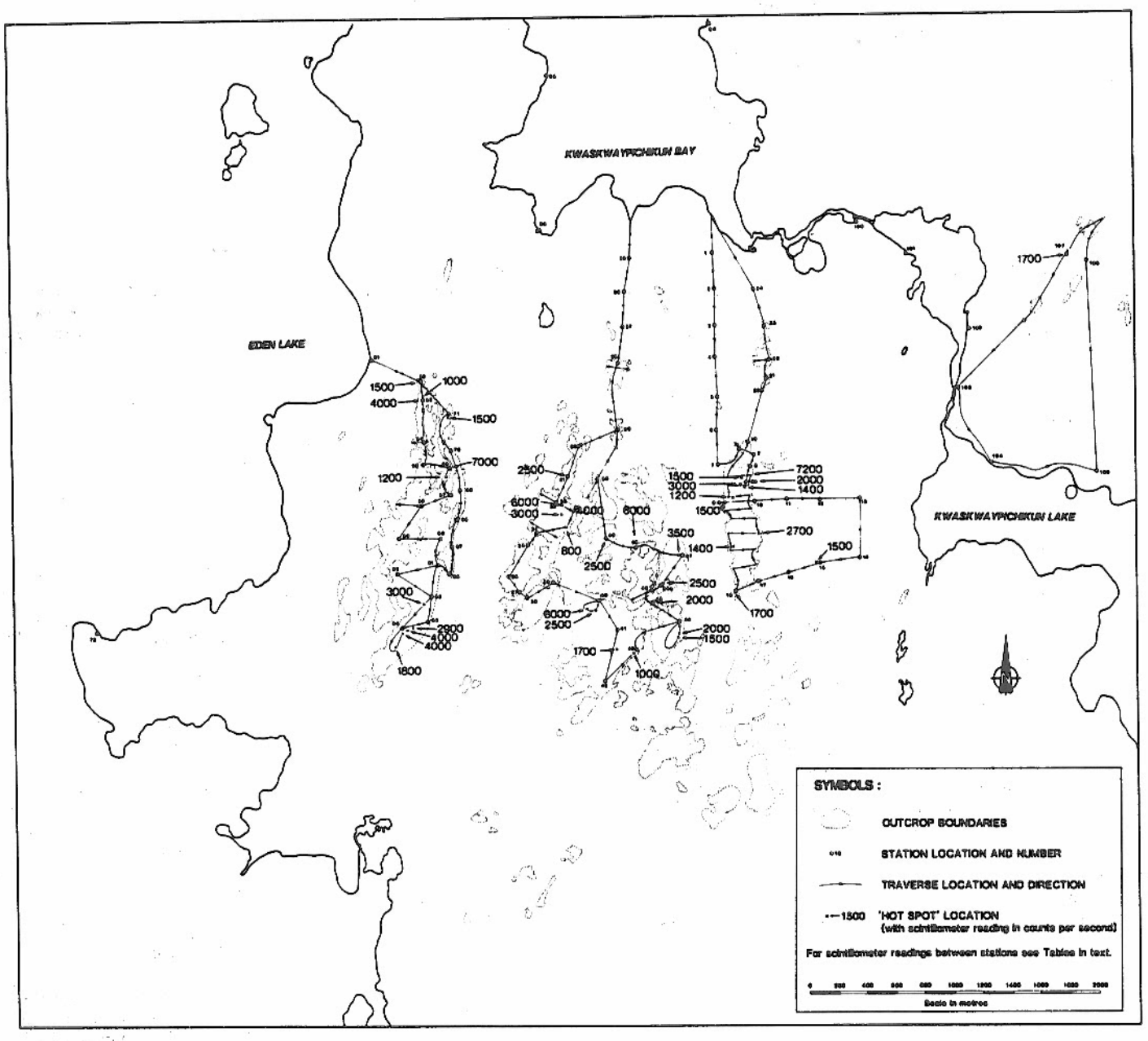

Figure GS-1-1: Ground scintillometer reconnaissance of Eden Lake monzonite

3. 300-024° azimuth zones, (1200-7000 cps varying along strike but consistently high) 6-40 m long and 5-20 cm thick containing elevated levels of brown, glassy allanite and possible uranophane, as well as prominent concentrations of coarse grained (up to 1.5 cm) pyroxene segregations in layers and lenses - these may also have an associated overprinting foliation.
4. Discordant fine grained, buff coloured layers (2-6 cm thick, and up to 5 m long); no observed offset in associated host phases.
5. 11-20 m zone of elevated readings (400-1500 cps) in association with shallow dipping complex of aplite, pegmatite, syenite.
6. 024° azimuth, 5 m wide, 150 m + long zone of finer grained syenite with prominent rusty weathering (readings from 400- 1600 cps).

Most occurrences with elevated readings exhibit a prominent rusty weathering, that is associated with oxidized pyrite mineralization. Forty of the features were "hot spots" of limited lateral extent, four constituted pyroxene and allanite-enriched zones ranging in length from 1.5 to 40 m with cps 2500-7000, and three were 3 m, 5 x 150 m and 11 x 25 m zones of moderately elevated readings ranging from 400-500, 400-800, and 400-1500 cps, respectively.

Analytical and microscope studies are currently in progress to determine the mineralogy and chemistry of the anomalous zones.

Although the current work has confirmed the unique chemistry and mineralogy of the Eden Lake intrusion (Fig. GS-1-2) as well as the existence of elevated levels of high REE (Table GS-1-1) and uranium, none of the observed anomalies appear of economic significance. Subsequent follow-up work will be limited to an evaluation of new targets resulting from the more regional airborne gamma ray surveys conducted by the GSC.

TABLE GS-1-2
MONZONITE - EAST RIDGE

STATION #	OUTCROP/NON-OUTCROP/ BOULDERS	SCINTILLOMETER READINGS cps WAIST	GROUND	RANGE	SPOT HIGH(S)	ZONES L/READING
1	N	75	90	-	-	-
1-2	N	-	-	90	-	-
2	B	80	90	-	-	-
2-4	N	-	-	80	-	-
	B	100	110	-	-	-
3-4	N	-	-	90	-	-
4	B	120	120	-	-	-
4-5	N	-	-	-	-	-
5	B	100	120	-	-	-
5-6	N			-	-	-
6	B	110	120	-	-	-
6-7	N	-	-	-	-	-
7	B	120	120	-	-	-
7-8	O	-	-	200-220	-	-
8	O	180	220	200-260	-	40 m/7000
8-9	O	-	-	200-400	1400	30 m/3000
9	B	150	150	-	1500	-
9-10	O	-	-	230-250	1200	-
10	N	160	160	-	-	-
10-11	N	-	-	120-130	-	-
11	O	150	200	-	-	-
11-12	N	-	-	70-100	-	-
12	O	250	250	-	-	-
12-13	N	-	-	80	-	-
13	N	50	50	-	-	-
13-14	N	-	-	70	-	-
14	N	80	80	-	-	-
14-15	N	-	-	-	-	-
15	O	250	400	-	800-1500	-
15-16	N	-	-	-	-	-
16	N	60	60	-	-	-
16-17	N	-	-	-	-	-
17	O	170	250	-	-	-
17-18	O	-	-	150-220	-	-
18	O	220	220	-	1400-1700	-
18-19	O	-	-	200-250	-	-
19	O	250	280	-	-	-
19-20	N	-	-	-	-	-
20	O	200	220	-	-	-
20-21	O	-	-	-	-	-
21	O	200	220	-	-	-
21-22	O/N	-	-	-	-	-
22	O	160	220	-	-	-
22-23	O	-	-	-	-	-
23	O	150	150	-	-	-
23-24	N/B	-	-	-	-	-
24	N	100	100	-	-	-

*Background 25 cps

MONZONITE - CENTRAL RIDGE

STATION #	OUTCROP/NON-OUTCROP/ BOULDERS	SCINTILLOMETER READINGS cps WAIST	GROUND	RANGE	SPOT HIGH(S)	ZONES L/READING
Shore	N	70	-	-	-	-
25	N	100	-	-	-	-
25-26	N	-	-	-	-	-
26	B	140	140	-	-	-
26-27	B	-	-	-	-	-
27	B	120	120	-	-	-
27-28		-	-	-	-	-
28	O	150	150	-	-	-
28-29	O	-	-	150-170	-	-
30	O	150	150	-	250	-
30-31	N	-	-	-	-	-
31	O	150	150	-	2500	1.5 m/2500
31-32	O	-	-	200-220	-	-
32	O	250	400	-	-	-
32-33	O	-	-	200-300	-	-
33	O	250	280	-	6000/3000/4000	150 m/400-800
33-34	O	-	-	170-250	1000/1000/3000	-
34	O	160	220	-	-	-
34-35	N	-	-	-	-	-
35	O	150	250	-	-	-
35-36	O	-	-	150-200	-	-
36	O	150	200	-	-	-
36-37	O	-	-	150-200	-	-
37	O	200	200	-	-	-
37-38	N	-	-	-	-	-
38	O	170	170	-	-	-
38-39	O	-	-	150-200	-	-
39	O	200	200	-	-	-
39-40	O	-	-	150-200	6000/2500	-
40	O	200	230	-	-	-
40-41	O	-	-	170-220	-	-
41	O	190	220	-	-	-
41-42	O	-	-	-	1700	-
42	O	150	200	-	-	-
42-43	O	-	-	200-250	1000	-
43	O	250	250	-	-	-
43-44	O	-	-	200	-	-
44	O	280	310	200/-	1500	-
44-45	O	-	-	250-300	-	-
45	O	200	200	200-400	600/2000	-
45-46	O	-	-	-	-	-
46	O	230	230	200-300	-	-
46-47	O	-	-	250-300	2500	-
47	O	300	350	300-500	3500/2000	-
47-48	O	-	-	250-300	-	-
48	O	230	230	-	600/6000	-
48-49	O/N	-	-	350	-	-
9	O	400	400	400-600	2500	11x35m/400-1500
49-50	O	-	-	250-300	-	-
50	O	250	270	400-500	-	-

MONZONITE - WEST RIDGE

STATION #	OUTCROP/NON-OUTCROP/ BOULDERS	SCINTILLOMETER READINGS cps WAIST	GROUND	RANGE	SPOT HIGH(S)	ZONES L/READING
51	N	120	120	-	-	-
51-52	N	120	-	-	-	-
52	O	150	150	-	1500	-
52-53	O	170	-	-	-	-
53	O	170	200	-	-	6 m/4000
53-54	O	-		150-200	-	-
54	O	150	180	-		3M/400-500
54-55	O	-	-	150-200	-	-
55	O	150	200	150-200	-	-
55-56	O	-	-	150-200	-	-
56	O	160	250	-	1600/7000	-
56-57	O	-	-	200-250	1200	-
57	O	200	250	400	-	-
57-58	O	-	-	150-200	-	-
58	O	150	200	250-300	1200	-
58-59	O	-	-	200-250	-	-
59	O	200	250	180-230	-	-
59-60	O	-	-	200-250	-	-
60	O	200	250-	-	-	-
60-61	O	-	-	200+	-	-
61	O	200	200	180-250	-	-
61-62	O	-	-	170-250	-	-
62	O	200	200	200-250	-	-
62-63	O	-	-	-	-	-
3	O	200	200	200-250	-	-
63-64	O	240	240	240-250	3000	-
64	O	240	240	150-200	1800/4000/4000	-
64-65	O	-	-	200-250	2900	-
65	O	200	200	-	-	-
65-66	O	-	-	200-250	-	-
66	O	200	200	-	-	-
66-67	O	-	-	-	-	-
67	O	150	150	-	-	-
67-68	O	-	-	200	-	-
68	O	200	200	-	-	-
68-69	O	-	-	-	-	-
69	O	150	180	150-200	-	-
69-70	O	-	-	150-200	-	-
70	O	180	180	-	-	-
70-71	O	-	-	-	-	-
71	O	150	150	150-200	1400	-
71-52	O	-	-	100-150	-	-
72	O	-	160-200	-	-	-
86	O	-	140-200		-	-

OTHER GRANITIC ROCKS

STATION #	OUTCROP/NON-OUTCROP/ BOULDERS	SCINTILLOMETER READINGS cps WAIST	GROUND	RANGE	SPOT HIGH(S)	ZONES L/READING
73	O	-	100-200	-	-	-
74	O	-	100-150	-	-	-
75	O	-	100-140	-	-	-
76	O	-	140-160	-	-	-
77	O	-	120-140	-	-	-
78	O	-	100-120	-	-	-
79	O	-	90-110	-	-	-
80	O	-	120-160	200	-	-
81	O	-	100-130	160-170	-	-
82	O	-	110-140	170	-	-
83	O	-	80-110	150	-	-
84	O	-	120-140	-	-	-
85	O	-	120-160	200	-	

100	O	100	170	-	-	-
101	O	150	250	250-300	-	-
102	O	100	200	300	-	-
103	O	100	150	-	-	-
103-104	N	-	-	110	-	-
104	N	90	90	-	-	-
104-105	N	-	-	90-120	-	-
105	N	80	80	-	-	-
105-106	N	-	-	120-180	-	-
106	N	-	-	-	-	-
106-107	N	-	-	170-190	-	-
107	O	150	150	150-250	1700	-
107-102	N	-	-	140-150	-	-

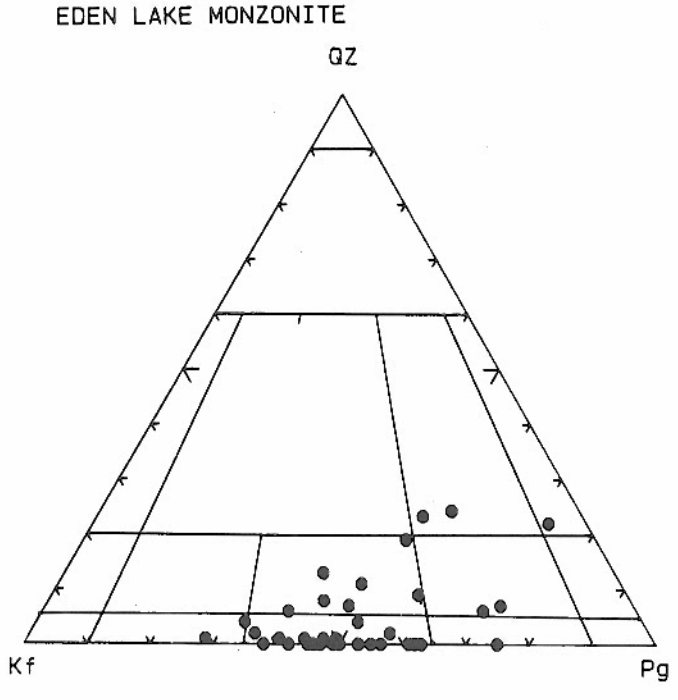

Figure GS-1-2: Modal analyses (plagioclase/quartz/potassium feldspar) from Eden Lake monzonite

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