SURFACE LAKE WATER URANIUM-RADON SURVEY OF THE LINEAMENT LAKE AREA, DISTRICT OF MACKENZIE

Project 720067

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Using the facilities and helicopter support of the field camp at Friday Lake (lat. 65°36'N, long. 107°55'W) (see Cameron, this section), a uranium-radon survey of surface lake waters of the Lineament Lake area was carried out. The survey was prompted by the lake sediment uranium anomaly discovered during the geochemical reconnaissance in 1972 (Allan and Cameron, 1973). The anomaly is situated about 60 miles south-southeast from Friday Lake at lat. 64°50'N, long. 107°00'W.

The area is covered by massive granitic rocks composed mainly of biotite granite and quartz monzonite of Archean age (Wright, 1967).

Follow-up work in the form of ground scintillometry and rock collection in 1973 (Cameron and Durham,

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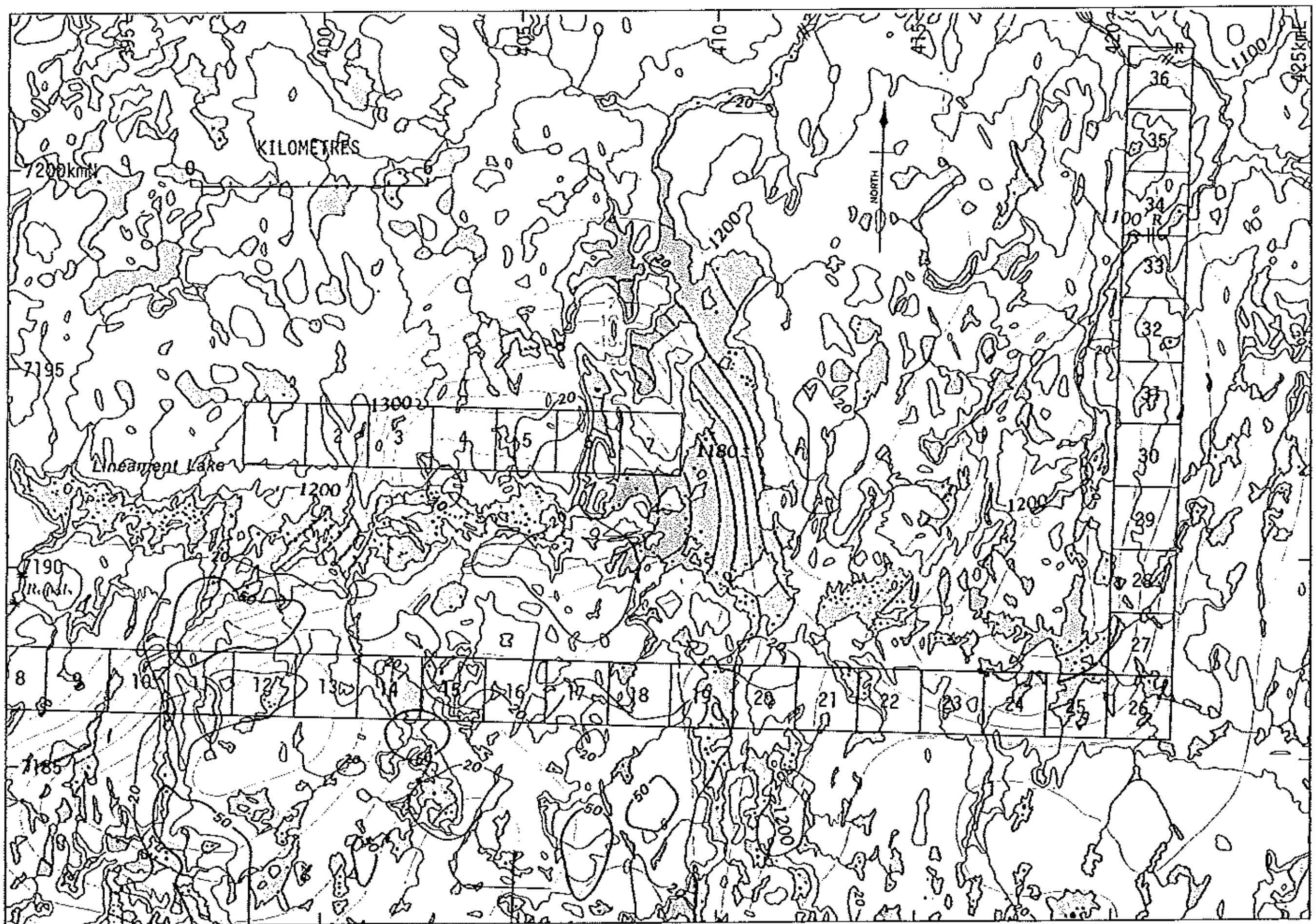

AIRBORNE GAMMA RAY SPECTROMETER COUNTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
346	389	387	383	453	474	465	488	511	484	520	570	516	512	473	637	552	527
38	49	43	64	48	60	50	46	36	59	74	85	97	75	73	73	58	49
75	72	43	52	80	105	174	120	134	120	137	173	246	274	193	182	163	186

19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
712	643	666	665	676	578	408	410	541	447	378	365	435	401	342	382	544	454
49	21	38	24	21	15	28	24	50	39	8	33	30	41	15	51	58	51
127	136	115	114	165	113	53	58	77	80	47	35	32	71	18	72	145	114

Geometric mean + 3S/2 = 50pC/l 50

Geometric mean + S/2 = 20pC/l 20

Uranium in ppm in lake sediments (Map 9-1972 (Sheet 3)) ... 5

Study area 5

Figure 1. Radon in surface lake waters, Lineament Lake geochemical survey, 1974.

1974) confirmed the enrichment of uranium in the rocks in the anomalous area relative to rocks of Archean age outside the anomaly but revealed no uranium-rich minerals in the rocks.

The 1974 follow-up work consisted of (1) surface lake water sampling of about two thirds of the lake sediment anomaly, (2) airborne gamma-ray spectrometry and ground gamma-ray scintillometry of selected portions, and (3) rock collection from sites that gave highest radon and scintillometer readings.

A total of 307 lake water samples were collected, 257 samples for an initial semi-detailed coverage of the anomaly at a sampling density of 1 sample per 2.6 km^2 (1 sample per sq. mile) and 50 samples for more detailed follow-up in the most promising area as outlined by the radon content of the water samples from the semi-detailed survey. The samples were collected in 260 ml glass bottles at inflow or outflow bays of lakes within 5 m to 10 m from shore. Depth, temperature and conductivity of the water was measured at each site. Radon and pH was determined at the field camp using portable instruments. Uranium determinations were carried out in the Geochemical Laboratories of the Geological Survey of Canada, Ottawa (Smith and Lynch, 1969).

The radon and uranium results of the semi-detailed lake water survey are shown in Figures 1 and 2. The 1972 reconnaissance lake sediment uranium survey results are also shown in these figures. The coincidence of radon in water, uranium in water and uranium in sediments is quite striking but the semi-detailed results focus more sharply in an area just south of Lineament Lake. The slight displacement of the uranium in the sediments towards the north is probably due to its relatively greater mobility compared to radium (the immediate parent of radon) in the surface environment and the general direction of flow of the water system.

The highest radon and uranium values encountered were 366 pc/1 and 1.9 ppb with background levels (geometric means) of 7 pc/1 and 0.2 ppb, respectively. By comparison the Beaverlodge lake water survey in 1969 gave highs of 60 pc/1 and 2.7 ppb, and backgrounds of 1 pc/1 and 0.4 ppb respectively (Dyck *et al.*, 1971). Obviously environmental factors such as nature of rock, organic matter, size and depth of lakes, temperature variations etc. affect the mobility of these two elements. Hence an area comparison must take these into account. The lake waters in the area are exceptionally pure. This conclusion is based on the low average conductivity of 8 micromhos compared to 112 for Ottawa tap water and the pH measurements which were erratic and difficult to reproduce indicating poor buffering by ionic species. The negative correlation of lake area, depth, and temperatures with radon observed elsewhere in the Shield (Dyck, 1974) was barely significant in the Lineament Lake area probably as a result of general shallowness of lakes and permafrost in the ground. Incidentally, the mean lake area listed in Table 1 refers to an effective area taking into account the maximum range of approximately 1 km for radium and radon in the surficial environment.

To follow up in more detail on the radon highs, 50

TABLE I

GEOMETRIC MEANS, STANDARD DEVIATIONS, AND RANGES OF VARIABLES OF SAMPLES FROM LINEAMENT LAKE, N.W.T.

VARIABLES	SEMI-DETAILED SURVEY				DETAILED SURVEY			
	No. of Analyses	Mean	Log 10 Stand.Dev.	Range	No. of Samples	Mean	Log 10 Stand.Dev.	Range
Rn pc/l	257	7.0	0.585	0.2 - 165.0	50	37.6	0.480	0.2 - 366.0
U, ppb	256	0.2	0.235	0.0 - 1.0	50	0.3	0.336	0.0 - 1.9
pH	257	7.6	0.028	6.9 - 8.8	50	7.4	0.015	7.1 - 8.0
Temp, °C	257	13.8	0.035	11 - 16	50	15.2	0.043	11 - 16
Conductivity µ mhos	257	8.1	0.221	3.0 - 13.0	50	6.8	0.082	4.0 - 9.0
Depth, m	257	1.0	0.302	0.1 - 7.0	50	1.2	0.199	0.5 - 3.6
Area, km^2	257	9,2	0.642	0.01- 4.0	50	0.1	0.784	0.01- 2.50

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GROUND SCINTILLOMETRY STATIONS AND READINGS
(granite - GRNT, pegmatitic - PGMT, general background - BKG)

1	2	3	4	5	6	7	8
GRNT 10-50 μR	GRNT 10-30 μR	GRNT 15-35 μR	GRNT 15-30 μR	GRNT 10-20 μR	GRNT 10-15 μR	GRNT 10-15 μR	GRNT 15-25 μR
PGMT 10-12 μR	PGMT 10-12 μR	PGMT 10-25 μR	PGMT 10-25 μR	PGMT 10 μR	BKG 10-12 μR	BKG 10-12 μR	BKG 5-20 μR
BKG 10 μR	BKG 10 μR	BKG 12-15 μR	BKG 12-15 μR	BKG 12-15 μR			

Geometric mean + 3S/2 = 0.4 ppb 0.4

Geometric mean + S = 0.3 ppb 0.3

Uranium in ppm in lake sediments (Map 9-1972 (Sheet 3)) ...

Detailed water sample site locations ....

Ground stations .... ●

Figure 2. Uranium in surface lake waters, Lineament Lake geochemical survey, 1974.

lake water samples from trenches or faults in the anomalous zone were collected and analyzed. The location of these trenches is shown by the dashed lines in Figure 2. As the means in Table 1 indicate several samples contained more Rn and U than did the semi-detailed samples but no values were high enough to suggest ore nearby.

The numbered squares in Figure 1 are the locations over which integral airborne gamma-ray spectrometry was carried out with the aid of a helicopter and a spectrometer system with a 15 cm by 10 cm crystal leased from Exploranium Corporation of Canada. The counts listed under Figure 1 are the net average of two one minute counts in the K, U and Th channels accumulated while flying in a circle inside a 1.6 km square at an elevation of 91 m, avoiding water as much as possible. Background counts were obtained over the largest part of Lineament Lake near the centre of the map-area.

The U and K counts were corrected for Compton Scattering using the following equations (Grasty and Darnley, 1971):

$$U_c = U_u - \alpha . Th$$

$$K_c = K_u - \beta . Th - \gamma . U_c$$

where the subscripts c and u are corrected and uncorrected respectively and $\alpha = 0.43$, $\beta = 0.62$, and $\gamma = 0.91$ for the 6-inch by 4-inch crystal used.

The counts indicate a rise in K, U and Th in the same area as the water Rn and U highs but fail to support ore grade concentrations of U in the surface rocks. Of interest may be the U/Th ratio counts. These are generally lower where the higher net counts occur. However, quantitative determinations of these ratios are required to confirm these field observations before conclusions may be drawn from them.

Groundstation scintillometry was carried out at 8 stations near sites of high R_n in water. These stations are shown in Figure 2 and the total gamma-ray counts of granites, pegmatites and general backgrounds listed in the legend. Total counts for granites ranged from 10 μR/hr to 50 μR/hr and for pegmatites from 10 μR/hr to 25 μR/hr. Background readings with the scintillometer slung over the shoulder were generally around 10 μR but values of 5 and 25 also were encountered. But as with the other tests, no counts were recorded high enough to suggest U mineralization. It should be noted that the pegmatitic rocks in any one area were always lower in total count activity than the adjacent granitic rocks and pegmatites with large mica flakes were more radioactive than those lacking in mica.

From the tests carried out this summer in the Lineament Lake area, one could conclude that the lake sediment U anomaly has resulted from the weathering of granites with above average U content. However, much more work and more detailed work is required to arrive at any firm conclusions on the uranium potential of the area.

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BEECHEY LAKE AREA: *IN* SEDIMENTOLOGICAL STUDIES OF THE YELLOWKNIFE SUPERGROUP IN THE SLAVE STRUCTURAL PROVINCE

Project 740018

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(*see* report 88 of this publication)