GEOLOGICAL AND GEOCHEMICAL REPORT
ON THE WEST 1-12 MINERAL CLAIMS
BENNETT LAKE - WEST ARM, YUKON TERRITORY

WHITEHORSE MINING DISTRICT

LATITUDE 60° 04' NORTH LONGITUDE 135° 07' WEST

N.T.S. MAP SHEET 105-D/3E

Based on work completed between the
17th and 20th of July and 20th and 23rd September, 1978

For
E & B Explorations Ltd.

By
R.R. Culbert, PhD., P.Eng.

D.G. Leighton & Associates Ltd.

28 February, 1979

This report has been examined by the Geological Evaluation Unit and is recommended to the Commissioner to be considered as representation work in the amount of

$1200.00

D. B. Craig 12 June/79

Resident Geologist or

~~Resident Mining Engineer~~

Considered as representation work under Section 53 (4) Yukon Quartz Mining Act.

B. R. BAXTER

Supervising Mining Recorder

Commissioner of Yukon Territory

CONTENTS

ILLUSTRATIONS

TELEPHONE: (604) 731-7367

D. G. LEIGHTON & ASSOCIATES LTD.
GEOLOGICAL CONSULTANTS

3155 WEST 12TH AVENUE
VANCOUVER, B.C.
V6K 2R6

WEST PROPERTY
BENNETT LAKE - WEST ARM, YUKON TERRITORY

INTRODUCTION

This report describes the results of geological and geochemical surveys completed on the WEST property during 1978. Work was done between July 17th and 20th and September 20th and 23rd. The first phase involved reconnaissance geochemical sampling and geological-prospecting for uranium; the second, follow-up geochemical sampling with an extendable hand auger. Work was part of a larger program involving the evaluation of a number of properties in the Bennett Lake region of B.C. and the Yukon Territory.

The conclusions and recommendations described here are based on the work cited above.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

1. The WEST property is comprised of 12 unsurveyed claims, and is located on the West Arm of Bennett Lake, 25 kilometres southwest of Carcross, Yukon Territory.

2. The property is underlain mainly by granodiorite and leucocratic quartz monzonite. A fault may separate these units.

3. A zone strongly anomalous in uranium (to 858 ppm) is correlative to an oval shaped swamp and bush area 1400 x 300 m in size. Testing by auger sampling to 11 feet in depth confirmed the presence of high uranium values.

4. Since the source of uranium in the swamp may be a buried fault-controlled uranium deposit or a uranium deposit of the basal type in pre-glacial sediments which could occur here, recommended work includes:

   (a) Grid controlled power auger drilling of the "basin" area on a 50 x 50 m specing;

   (b) Multi-element and LO 1 analyses of all samples from the various horizons encountered;

   (c) Diamond drilling, say two 100 metre holes.

Respectfully submitted,

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
R. R. CULBERT

R.R. Culbert, PhD., P.Eng.

28 February, 1979

GENERAL DESCRIPTIONS

Location and Access

Latitude 60° 04' North; longitude 135° 07' West. Located on the north side of the west arm of Bennett Lake about three kilometres from its western end. Accessible by float plane, helicopter or boat from Carcross, Yukon Territory.

Claims

The WEST property consists of the following claims:

Claims	Grant No.	Record Date	Expiry
WEST 1-12	YA22555-YA22566	25 April 1978	1979

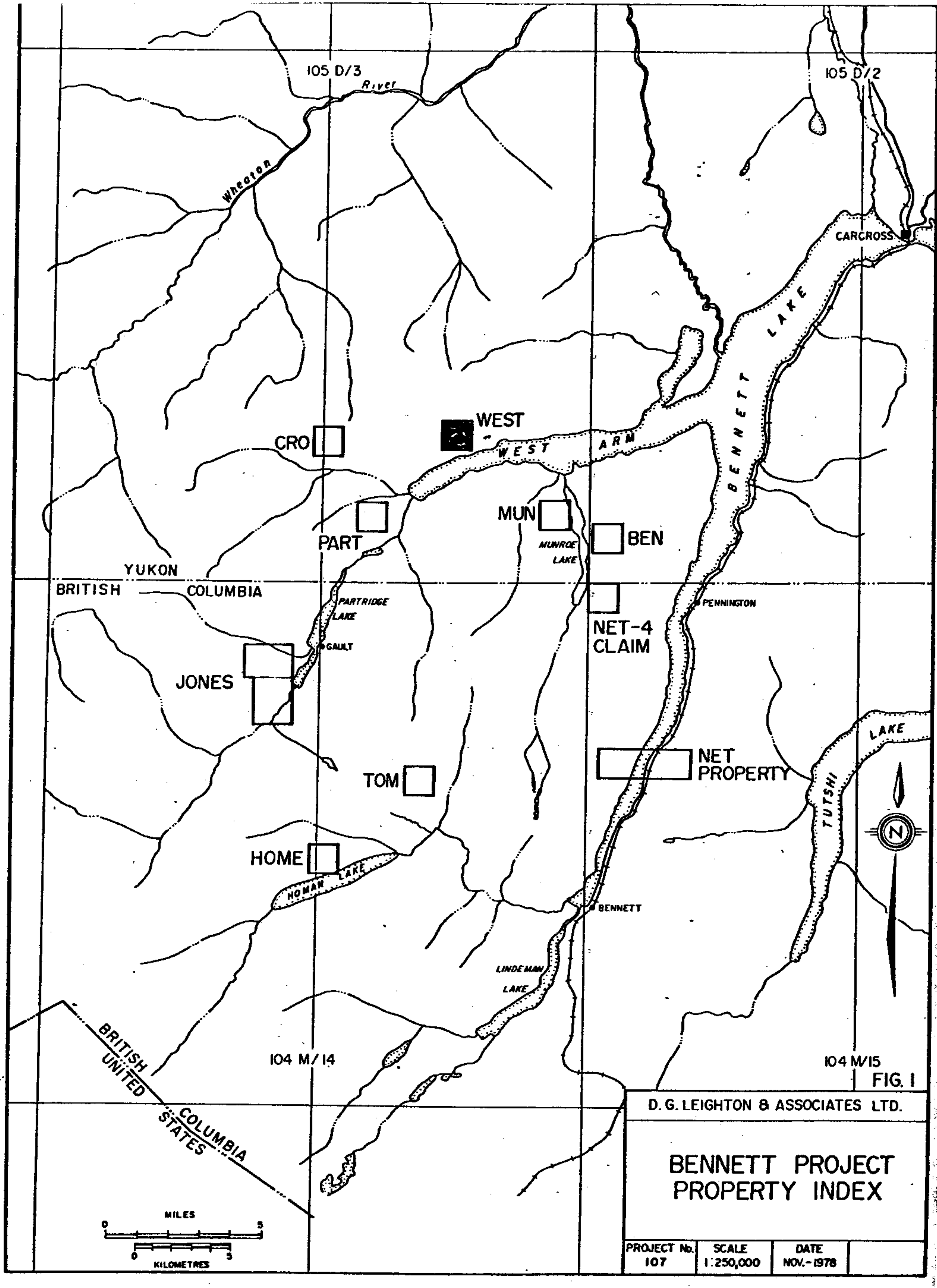

FIG. 1

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BENNETT PROJECT
PROPERTY INDEX

PROJECT No.	SCALE	DATE
107	1:250,000	NOV.-1978

GEOLOGY

Most of the WEST property is covered by glacial drift or colluvium. A glacial lake deposit forms a terrace along the 2,700 foot elevation below which no outcrop occurs. Virtually the only rock cropping out on the property occurs on a knoll extending 1,200 x 400 metres between 2,700 and 3,200 feet asl. Rocks here consist of three varieties of intrusive rock: fine-grained biotite quartz monzonite averaging 80-90 cps (radioactivity), coarse-grained biotite-hornblende granodiorite averaging 90-100 cps, and fine-grained granodiorite averaging 60-70 cps. No clear contacts were observed. All rocks are unaltered and only weakly fractured, and no anomalous radioactivity was encountered on traverses over the knoll. Nearly all rocks on the steep sidehill north of the knoll consists of coarse-grained leucocratic pink to white quartz monzonite containing 25-30% quartz, 30% plagioclase, 40% K-feldspar and 2-5% biotite and hornblende, and varying from 120-180 cps radioactivity.

A suggestion of a fault separating the knoll from the main sidehill to the north is apparent on airphotos.

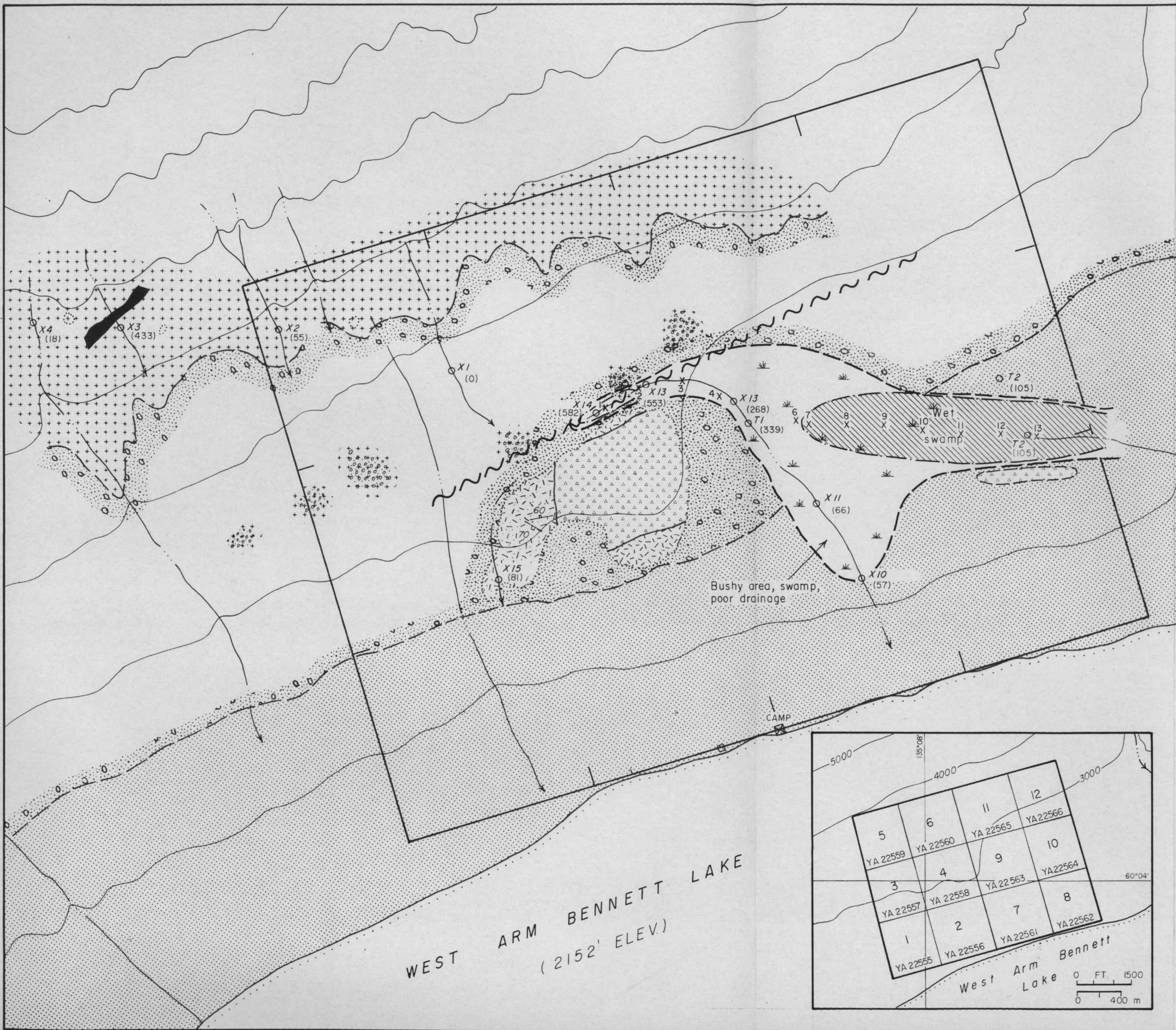
GEOCHEMISTRY

The swamp area on the WEST property is accumulating uranium from through-going waters, the two major questions being:

(a) whether this uranium originated by leaching of granite, or is derived from a deposit;
(b) whether the source is beneath the swamp, or on the adjacent hillside.

Extremely high associated molybdenum values (to 330 ppm), especially near the east end of the swamp, might be explained either by Mo-U mineralization (such as at the Carmi deposit near Beaverdell) or by alkaline water transport. The latter seems unlikely in this environment.

Power-augering and more detailed creek geochemistry is recommended to delineate a drill target. Monitoring less mobile ions should facilitate interpretation and help point more closely to the source area. There is a possibility of pre-glacial basin sediment beneath the present unconsolidated bog material. This possibility should be considered as a potential deposit host also.



LEGEND

- Rhyodacite
- Lencocratic quartz monzonite
- Coarse grained granodiorite
- Fine grained granodiorite
- Fine grained quartz monzonite
- Colluvium
- Glacial till (paleolake terrace)
- Talus
- Geological contact
- Outcrop
- Creek
- Swamp (wet or dry)
- BT7WS13 (268) Silt sample location (ppm uranium in brackets)
- Claim post observed
- X 12 Auger hole location

N

METERS
0 100 200 400 600

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
R. R. CULBERT

FIG. 11A

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WEST PROPERTY

GEOLOGICAL & GEOCHEMICAL COMPILATION

PROJECT	PROJECT No.	SCALE	DATE
BENNETT	107	1 : 10,000	NOV. - 1978

URANIUM RESULTS & CORRELATION BETWEEN AUGER HOLES: WEST PROPERTY

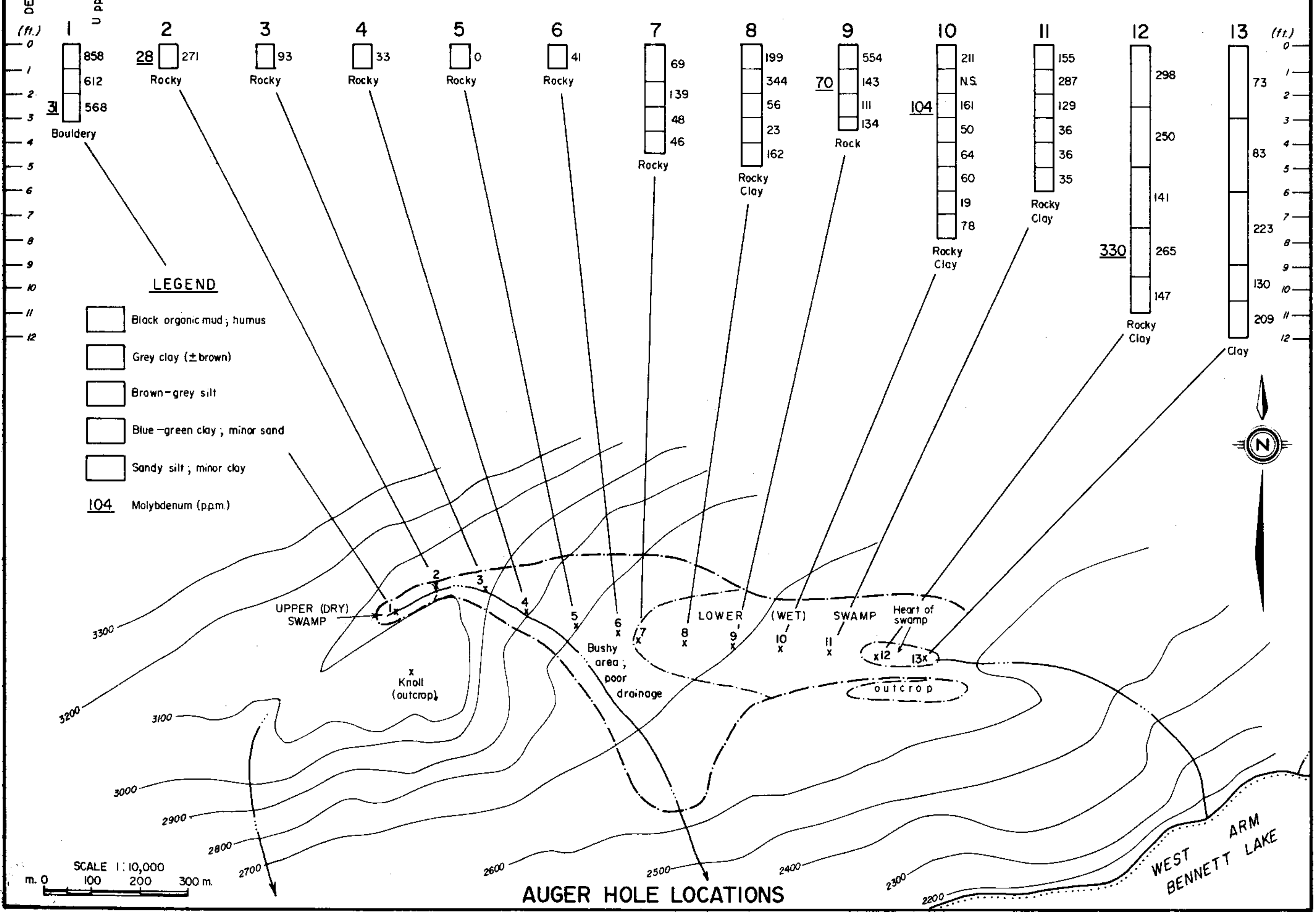


TABLE I

WEST PROPERTY GEOCHEMICAL DATA

EXPLANATION OF HEADINGS
*********** ** ********

SM-- A ONE LETTER CODE DENOTING WHO TOOK THE SAMPLE

SAMP NUMB-- FIELD NUMBER ASSIGNED TO SAMPLE. A '*' FOLLOWING NUMBER INDICATES THAT MULTI-METAL ANALYSIS WAS MADE. SEE APPENDIX I.

TYP-- TYPE OF SAMPLE TAKEN, AS FOLLOWS:

- STRM- STREAM SILT OR WATERCOURSE.
- LAKE- LAKE OR POND SEDIMENT.
- SPRG- SEDIMENT FROM SPRING OR SEEP.
- LINS- LINEAMENT OR GULLY SOIL SAMPLE.
- GRID- SOIL TAKEN BY GRID OR LINE SPACING.
- AUGR- AUGER SAMPLE OF SOIL OR BOG.
- ROCK- ROCK SAMPLE.

SPEC GRAV-- SPECIFIC GRAVITY OF SAMPLE IN GMS/CC. GOOD SILT OR POWDERED ROCKS ARE ROUGHLY 1 GM/CC, WHILE ORGANIC SAMPLES RANGE MUCH LOWER.

URANIUM PPM-- PARTS PER MILLION URANIUM, WITH STANDARD ERROR FOR THE DETERMINATION IN BRACKETS.

PB-214-- LEAD-214, A URANIUM DAUGHTER PRODUCT WHICH FOLLOWS THE RADON ESCAPE POINT IN DECAY SERIES. GIVEN IN EQUIVALENT PPM URANIUM.

RADM 226-- RADIUM 226, A URANIUM DAUGHTER PRODUCT WHICH FOLLOWS THE MAJOR DISEQUILIBRIUM POINT IN THE DECAY SERIES, BUT OCCURS BEFORE RADON. GIVEN IN EQUIVALENT PPM URANIUM.

TH PPM-- PARTS PER MILLION THORIUM.

EQU LIB-- PERCENTAGE EQUILIBRIUM BETWEEN URANIUM AND ITS DAUGHTER RADIUM. VALUES OVER 100 INDICATE DAUGHTER EXCESS AND ARE TYPICAL OF CERTAIN TYPES OF LEACHING. LOW VALUES INDICATE MOBILIZED URANIUM (WATER TRANSPORT ANOMALY) IN SEDIMENTS AND SOILS, OR RELATIVE LEACHING OF RADIUM FROM ROCKS. BLANKS DELETE CASES OF URANIUM WITHIN TWO STANDARD ERRORS OF ZERO-- (IE.-- POOR STATISTICS FOR RATIOS).

RAD ESC-- RADON ESCAPE COEFFICIENT, GIVING DISEQUILIBRIUM DUE TO RADON ESCAPE FROM RADIUM. HIGH VALUES INDICATE LOOSELY HELD RADIUM, TYPICAL OF SPRING OR SEEPAGE ACCUMULATIONS.

FIELD COMMENTS-- ARE NOTES MADE BY SAMPLER TO FACILITATE RECOGNITION OF THE SAMPLE CASE.

D.G. LEIGHTON AND ASSOC. LTD.
NOVEMBER 2, 1978.

**** WEST PROPERTY-- WEST ARM OF BENNETT LK., YUKON

S M	SAMP NUMB	TYP	SPEC GRAV	URANIUM PPM	PB-214 PPM EQV	RADM 226	TH PPM	EQU LIB	RAD ESC	FIELD COMMENTS
B	18-7 2	ROCK	1.20	2 (3)	2 ( )	1	4			WEST-FG QM
B	18-7 3	ROCK	1.17	5 (4)	5 ( )	6	22			WEST-LEUCO QM
B	18-7 4	ROCK		3 (6)	7 (1)	11	24		30	WEST-LEUCO QM
B	19-71	ROCK	1.16	11 (4)	5 ( )	10	21	91		WEST-LEUCO QM
B	19-72	ROCK	1.15	3 (3)	1 ( )	5	17			WEST-BIOT GD
T	WE 1*	STRM	0.40	339 (23)	2 (4)	43	32	12		VRY ORGGRNDSEEP
T	WE 2*	STRM	0.78	105 (10)	3 (2)	18	8	17		VRY ORG
X	WE 1	STRM	0.72	(9)	8 (2)	9	11			DRY CK MOD ORG
X	WE 2	STRM	0.57	55 (14)	8 (3)	12	53	23		DRY CK GRAVEL
X	WE 3*	STRM	0.21	433 (42)	23 (8)	64	30	14		WET MOSS
X	WE 4	STRM		18 (7)	3 (1)	14	16	80		GOOD ACTIVE SILT
X	WE 5	STRM	0.93	24 (8)	7 (1)	6	23	27		DRY CK POOR SILT
X	WE 6	STRM	0.92	1 (7)	7 (1)	12	12		39	DRY CK POOR SILT
X	WE 7	STRM	0.62	27 (12)	9 (2)	18	28	69		HI CK NEAR LAKE
X	WE 8	STRM	0.89	12 (8)	6 (1)	4	22			DRY CK POOR SILT
X	WE 9	STRM	0.80	7 (8)	5 (2)	11	13			WET CK POOR SILT
X	WE 10	STRM	0.60	57 (13)	11 (2)	14	10	25		ONLY CK 2600 ORG
X	WE 13*	LINS	0.37	553 (28)	11 (4)	84	6	15		DRY MUD HI ORG
X	WE 14	LINS	0.48	582 (25)	10 (4)	124	50	21		DRY CRG MUD
X	WE 15	SPRG	0.55	81 (14)	2 (2)	20	19	25		WET SPRING ORG
X	WE 11	STRM	0.78	66 (10)	5 (2)	21	22	32		ONLY CK 2700 ORG
X	WE 12*	STRM	0.60	268 (17)	6 (3)	54	49	20		ONLY CK 2900 ORG
X	WE 1A	AUGR	0.39	858 (33)	22 (5)	160	46	18	86	0-1FT DRY ORG
X	WE 1B	AUGR	0.61	612 (22)	12 (3)	93	38	15		1-2FT GREY CLAY
X	WE1C1*	AUGR	0.64	568 (21)	12 (3)	114	56	20		2-3FT GREY CLAY
X	WE1C2	AUGR	0.64	599 (21)	15 (3)	62	43	10	75	2-3FT GREY CLAY
X	WE 2A*	AUGR	0.51	271 (20)	22 (3)	47	29	17	52	0-1FT DRY SILT
X	WE 3A	AUGR	0.51	93 (15)	10 (3)	14	20	15		0-1FT DRY SILT
X	WE 4A	AUGR	0.63	33 (12)	9 (2)		22			0-1FT DRY SILT
X	WE 5A	AUGR	0.62	(11)	6 (2)		23			0-1FT DRY SILT
X	WE 6A	AUGR	0.58	41 (12)	3 (2)	1	25	3		0-1FT DRY SILT
X	WE 7A	AUGR	0.30	69 (22)	(4)	6	13	9		0-1.5FT WET ORG
X	WE 7B	AUGR	0.48	139 (17)	5 (3)	14	28	10		1.5-2.5FT ORG
X	WE 7C	AUGR	0.95	48 (9)	10 (1)	18	20	37	44	2.5-3.5FT BR CLY
X	WE 7D	AUGR	0.97	46 (8)	12 (1)	27	10	60	55	3.5-4.5FT BR CLY
X	WE 8A	AUGR	0.30	199 (26)	11 (5)	20	25	10		0-1FT WET ORG
X	WE 8B	AUGR		344 (34)	(6)	109	61	31		1-2FT GREY CLAY
X	WE 8C	AUGR	0.89	56 (9)	8 (2)	15	20	27	43	2-3FT BLUE-GR CL
X	WE 8D	AUGR	0.89	23 (8)	11 (2)	8	10	38		3-4FT BL-GR CLAY
X	WE 8E	AUGR	0.70	162 (14)	12 (2)	43	19	26	70	4-5FT BR-GR CLAY
X	WE 9A	AUGR		554 (34)	12 (5)	94		17		0-1FT WET ORG
X	WE 9B*	AUGR	0.72	143 (14)	17 (2)	30	28	21	41	1-2FT GR SLT-SND
X	WE 9C	AUGR	0.83	111 (11)	10 (2)	20	24	18	50	2-3FT GR SLT-SND
X	WE 9D	AUGR	0.80	134 (12)	10 (2)	23	17	17	55	3-3.5FT GR SAND
X	WE10A	AUGR		211 (23)	9 (4)	41		19		0-1FT WET ORG
X	WE10C*	AUGR	0.73	161 (14)	16 (2)	52	29	32	69	2-3FT GR SLT-CLY
X	WE10D	AUGR	0.90	50 (9)	14 (2)	16	3	33	13	3-4FT BL-GR SILT
X	WE10E	AUGR	0.91	64 (9)	3 (1)	11	21	17		4-5FT BL-GR SILT
X	WE10F	AUGR	0.93	60 (9)	8 (1)	12	10	20	34	5-6FT BL-GR SILT
X	WE10G	AUGR	1.05	19 (7)	9 (1)	8	16	43		6-7FT BL-GR SILT
X	WE10H	AUGR	C.77	78 (11)	8 (2)	6	20	8		7-8FT BR-GR SILT
X	WE11A	AUGR	0.31	155 (22)	(4)	12		8		0-1FT WET ORG
X	WE11B	AUGR	0.44	287 (20)	(3)	48	29	17		1-2FT ORG-CLAY

**** WEST PROPERTY-- WEST ARM OF BENNETT LK., YUKON

S M	SAMP NUMB	TYP	SPEC GRAV	URANIUM PPM		PB-214 PPM EQV		RADM 226	TH PPM	EQU LIB	RAD ESC	FIELD COMMENTS
X	WE11C	AUGR	0.78	129	(12)	10	(2)	24	30	18	59	2-3FT BL-GR CLA
X	WE11D	AUGR	1.C8	36	(7)	7	(1)	20	16	56	64	3-4FT BL-GR SIL
X	WE11E	AUGR	0.93	36	(8)	7	(1)	12	18	34		4-5FT BL-GR SIL
X	WE11F	AUGR	1.01	35	(8)	7	(1)	14	13	40	47	5-6FT BL-GR SIL
X	WE12A	AUGR	0.33	298	(26)	7	(4)	65	17	21		0-2.5FT ORG
X	WE12B	AUGR		250	(24)	17	(5)	69		27		2.5-5FT WET ORG
X	WE12C	AUGR	0.77	141	(12)	7	(2)	16	17	11		5-7.5FT GR OR-CL
X	WE12D*	AUGR	0.64	265	(17)	24	(3)	73	19	27	67	7.5-9.5FT GR SL
X	WE12E	AUGR	0.67	147	(15)	17	(2)	26	36	18	34	9.5-11FT GR SLT
X	WE13A	AUGR		73	(35)	7	(8)		27			0-3FT ORG
X	WE13B	AUGR	0.25	83	(27)	12	(6)	41	15	50		3-6FT WET ORG
X	WE13C	AUGR	0.35	223	(23)	19	(4)	52		23	63	6-9FT BR ORG-CL
X	WE13D	AUGR	C.75	130	(13)	17	(2)	36	22	27	52	
X	WE13E	AUGR	0.74	209	(14)	22	(2)	38	20	18	40	

APPENDIX "A"

ANALYTICAL PROCEDURE

LEGS - LOW ENERGY GAMMA SPECTROMETRY

D.G. LEIGHTON & ASSOCIATES LTD.

TELEPHONE: (604) 731-7367

D. G. LEIGHTON & ASSOCIATES LTD.
GEOLOGICAL CONSULTANTS

3155 WEST 12TH AVENUE
VANCOUVER, B.C.
V6K 2R6

LEGS - LOW ENERGY GAMMA SPECTROMETRY

INTRODUCTION

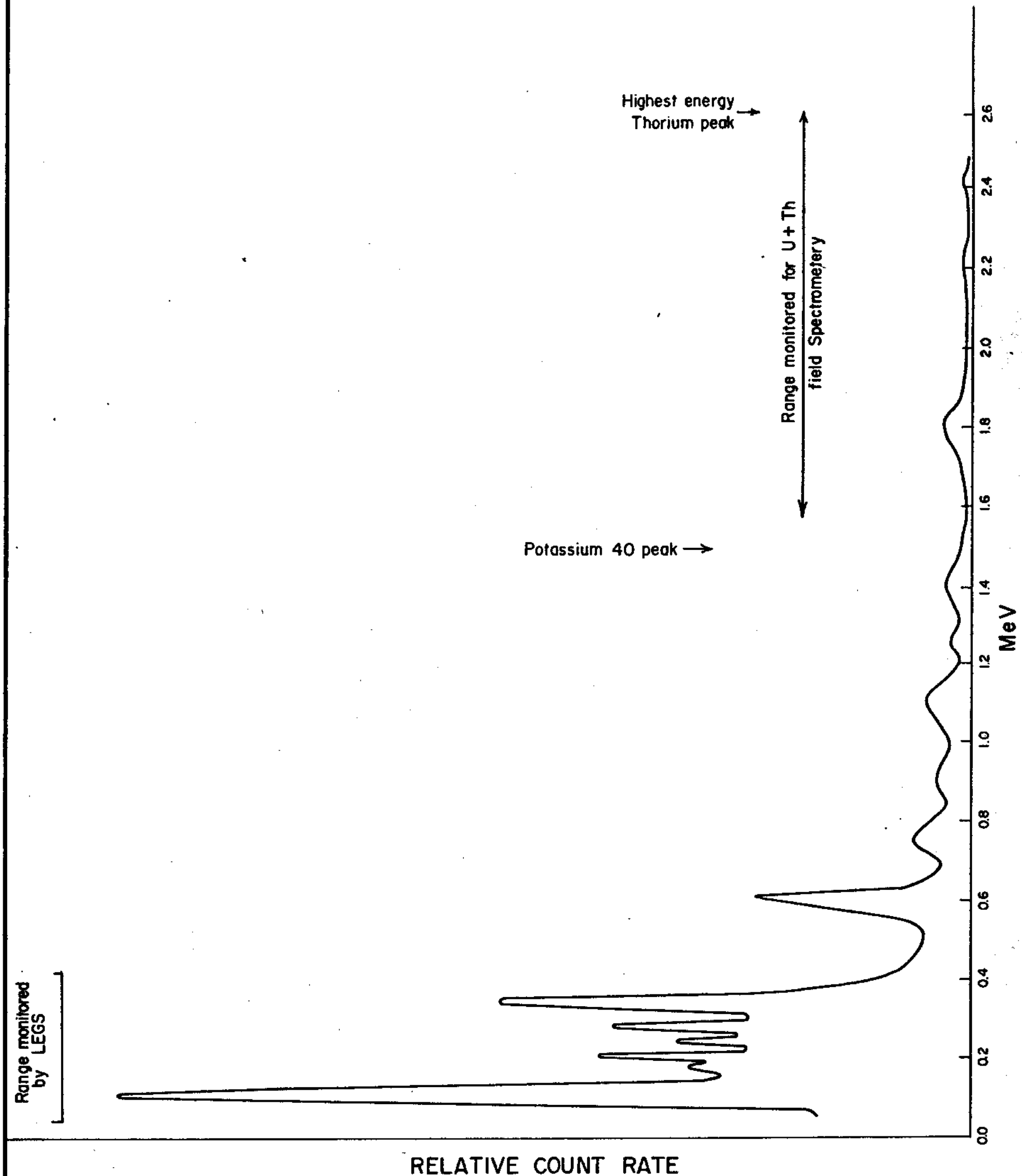
Low energy gamma spectrometry (LEGS) provides a method of determining uranium, thorium and U^{238} daughter products Pb^{214} and radium in geological samples, and has unique advantages when compared with other techniques. The system described here was developed by D.G. Leighton & Associates Ltd. with two objectives in mind. One was to provide an accurate assay facility which could be used in the field, giving field personnel rapid feedback which is particularly valuable on regional type programs. The second objective was to tackle the problem of radioactive disequilibrium. It was felt that routinely monitoring equilibrium would be useful in interpreting mobilizing mechanisms involved in uranium transport and tracking anomalies back to their source. The technique has proven to be reliable and highly cost effective in a variety of exploration programs.

METHOD

General

Conventional gamma spectrometry in geological exploration is severely limited for two reasons. First, because very high background gamma flux occurs at low energy levels (below 1 MeV), conventional systems are constrained to measure only the highest portion of the natural gamma energy range (above 1 MeV) and so cannot measure uranium directly (requiring measurements below 0.1 MeV) determining instead potassium, thorium and Bi^{214}. Unfortunately, if the geological system is in disequilibrium, considerable error will result in the value for uranium (from reliance on these measures as an indicator of uranium). In natural systems, especially in sediments and weathered rock, disequilibrium is the rule rather than the exception, due to the varying half lives and chemistries of uranium daughter products. The second limit in conventional systems is that, because only measurements at high energy levels are made, large statistical errors are introduced since at these energy levels, very low count rates occur (see Figure 1).

The LEGS system avoids both of these limitations. Measurement of the gamma spectrum at low energy levels (between 0.05 and 0.4 MeV) is achieved by ringing a 7 cm radius lead shield around both the sample and a "center-well" scintillating crystal to screen out background radiation. Since high count rates are measured at these low energy levels, a much lower statistical error exists. Moreover, uranium can be measured directly, together with two of its daughter products, so that the degree of disequilibrium in the system can be determined.



AN ORDINARY ROCK GAMMA SPECTRUM

FIGURE 1

The LEGS system, then, is a laboratory or field base method, involving a lead shielded scintillating crystal and a pulse height analyzer capable of integrating counts across preset segments of the gamma spectrum. A weighted 8.7 cc sample of the material to be analyzed is placed in a plastic vial and inserted into the scintillating crystal. Pulse counts are monitored by the pulse height analyzer and the .05 - .4 MeV gamma spectrum is broken into four segments and measured. Resultant numbers are entered into a programable desk calculator to obtain uranium and thorium content in ppm and, Ra^{226} and Pb^{214} content in percent equilibrium or ppm uranium equivalents. Background radiation corrections are involved for samples of low radioactivity and self absorption corrections for those rich in uranium or thorium.

The technique is calibrated using Geological Survey of Canada Radioactive Rock Standards, and chemical standards from Min-En Laboratories and the B.C. Department of Mines. Figure 2 shows the standardization results for uranium. These samples were counted for at least 4,000 seconds each, however, and in the usual 400 - 1,000 second geochemical analysis runs it is the counting statistic uncertainty which almost entirely controls the accuracy.

Components Measured

Although the decay sequence of uranium is very complex it may spectrographically be broken into three components (Table 1), within which the half-lives of the daughters are sufficiently short that there is unlikely to be noticeable separation of the members by natural chemical processes. The first component includes the uranium isotopes and their short lived daughter Th^{234}.

CALIBRATION STANDARDS FOR URANIUM BY L.E.G.S.

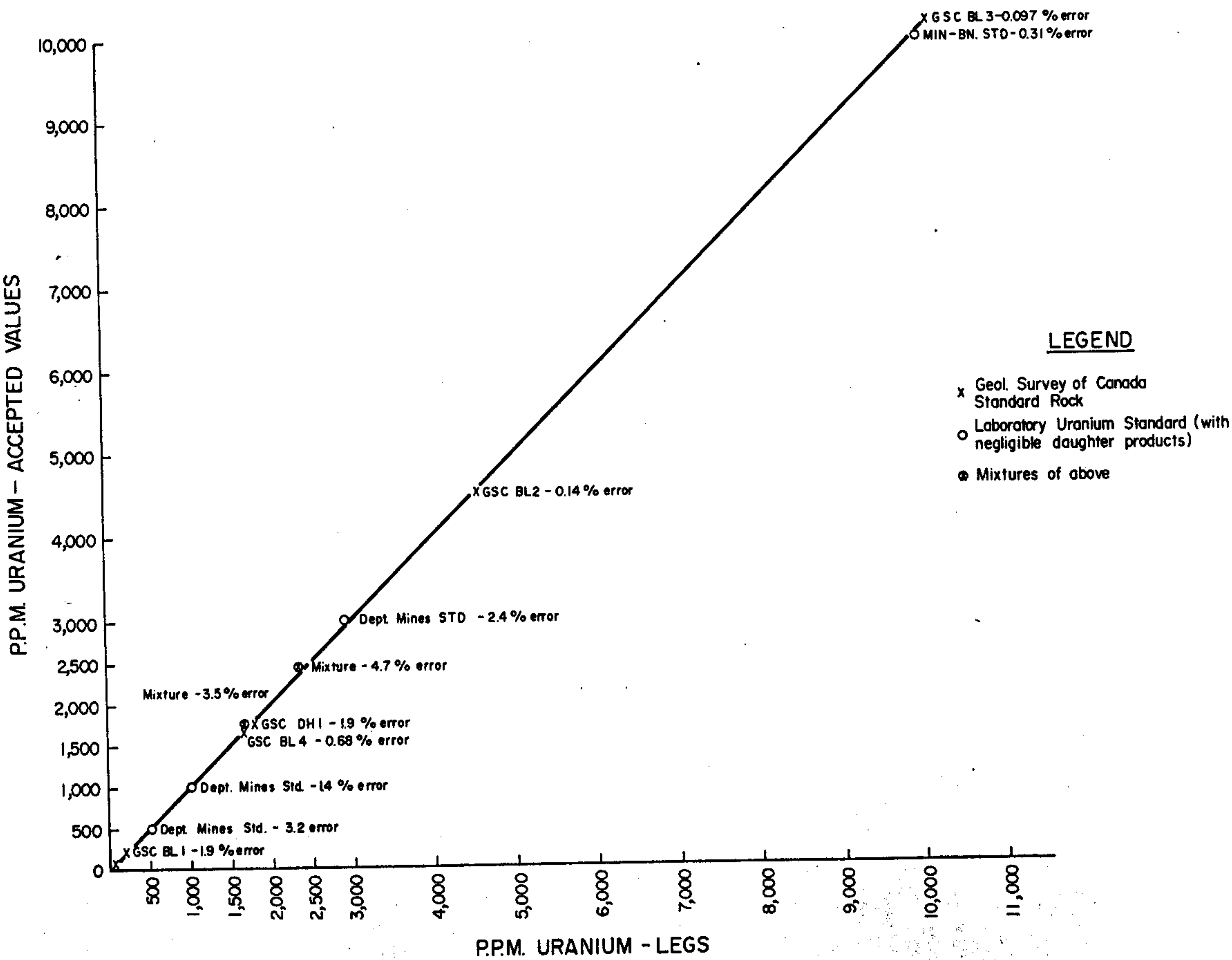


FIG. 2

TABLE 1

DISEQUILIBRIUM COMPONENTS IN U^{238} DECAY SEQUENCE (SIMPLIFIED)

	Isotope	Half Life	Importance In LEGS	Channel (Fig. 3)	Remarks
1st Component	U^{238}	4.51 x 109 yr.			
	Th^{234}	24.1 days	Major	A	Peaks at 93 and 64 KEV
	P_q^{234}	6.75 hr.			
	U^{234}	2.47 x 105 yr.	U-Minor	A	
2nd Component	Th^{230}	8.0 x 104 yr.	U-Minor	A	Major disequilibrium point
	Ra^{226}	1602 yr.	Major	B	Peak at 186 KEV
3rd Component	Rn^{222}	3.82 days			Disequilibrium due to mobility of radon gas
	Po^{218}	3.05 min.			
	Pb^{214}	26.8 min.	Major	C & D	Peaks at 242, 295 and 352 KEV
				A	Conversion x-rays at 80 KEV
	B_i^{214}	19.7 min.			Higher energy gamma emission
	Po^{214}	1.6 x 10.4 sec.			
	Pb^{210}	22.0 yr.			
	B_i^{210}	5.0 days			
	Po^{210}	138.4 days			
	Pb^{206}	Stable			

Most radiation from the U^{235} decay series may be included in this component. The 80,000 year half-life of Th^{230} provides the first break in the uranium decay series and in view of the differing chemistry of U and Th, this is a major point of disequilibrium. Th^{230} itself produces negligible gamma radiation, and so may be grouped with its daughter product, radium. Ra^{226} has a 1,602 year half-life and a chemistry similar to the alkaline earths. Its immediate daughter Radon forms the second disequilibrium break in the decay chain, for although it has a short half-life, its gaseous state gives it mobility (especially during grinding or preparation of geochemical samples). Radon itself is not a gamma emmitter, but its daughter Pb^{214} has three important low energy wave lengths, and the subsequent Bi^{214} has a variety of high energy emmissions.

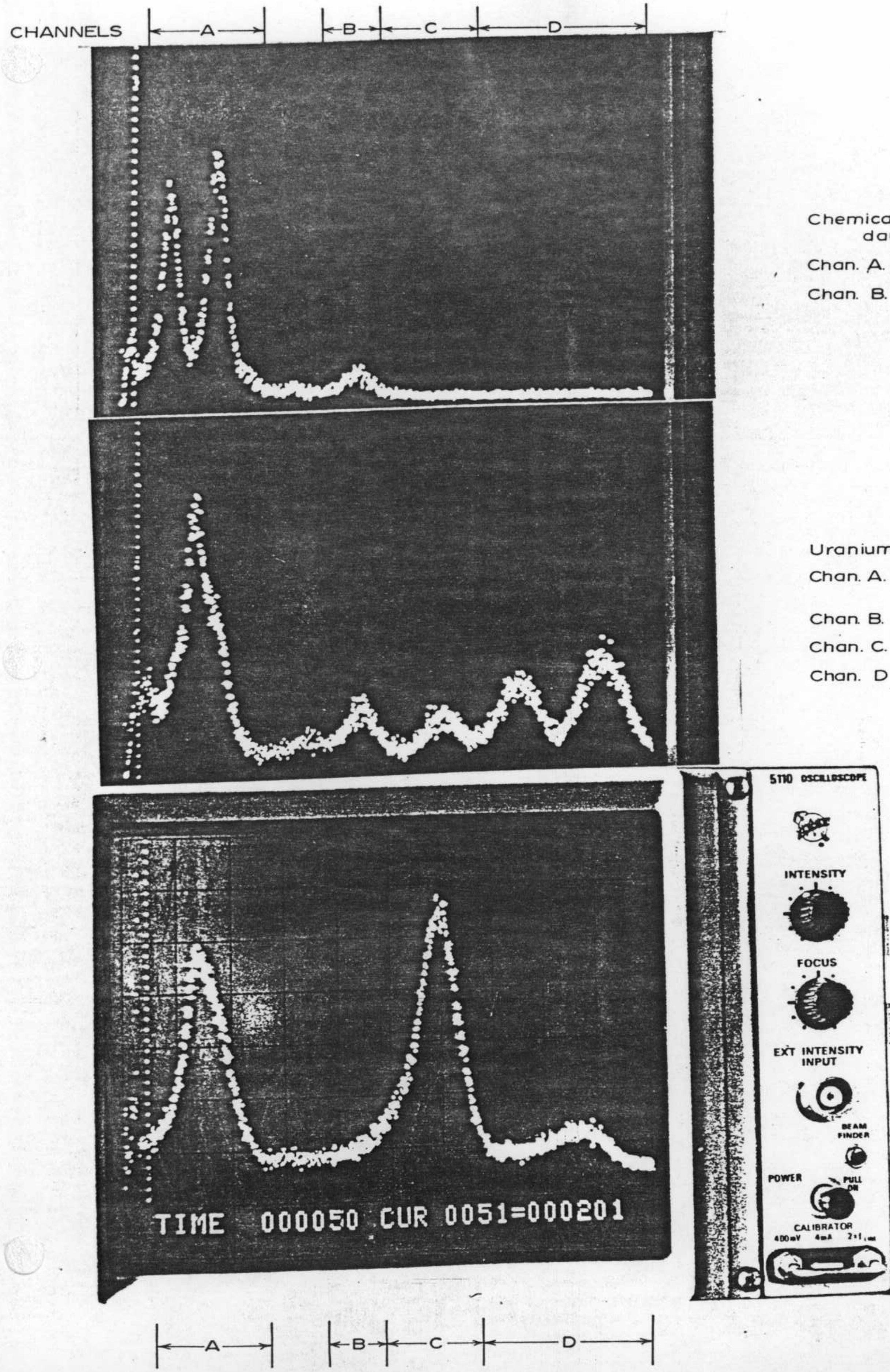
Two other radioactive components must be considered. The first of these is thorium, which is generally considered to have a fixed radiation signature in view of the short half-lives of its daughters and the especially close grouping of its major gamma emmitters. The second additional component is due to the one step decay of potassium, which does not significantly effect the technique.

Figure 3 shows the spectra of the three components of uranium radiation and thorium as viewed on the pulse height analyser. It also demonstrates how the spectrum is broken into four channels across which the counts are automatically integrated.

Precision

Both uranium and thorium are difficult elements in quantitative analysis, and the level of precision in geochemical determinations tends to be low. Figure 4 shows the results from splits

COMPARISON OF GAMMA ENERGY DISTRIBUTIONS IN THE 50-400 KEV RANGE



Chemical uranium, separated from daughter products

Chan. A. U^{238} (Via $Th.^{234}$)

Chan. B. U^{235} (Via $Th.^{231}$)

Uranium ore – approx. equilibrium

Chan. A. U^{238} and X–Rays from Pb^{214} decay

Chan. B. U^{235} and Ra^{226}

Chan. C. $Pb.^{214}$

Chan. D Pb^{214}

Thorium sample showing full cathode ray screen for pulse height analyser

FIG. 3

Comparison of duplicate analyses for uranium between two Laboratories

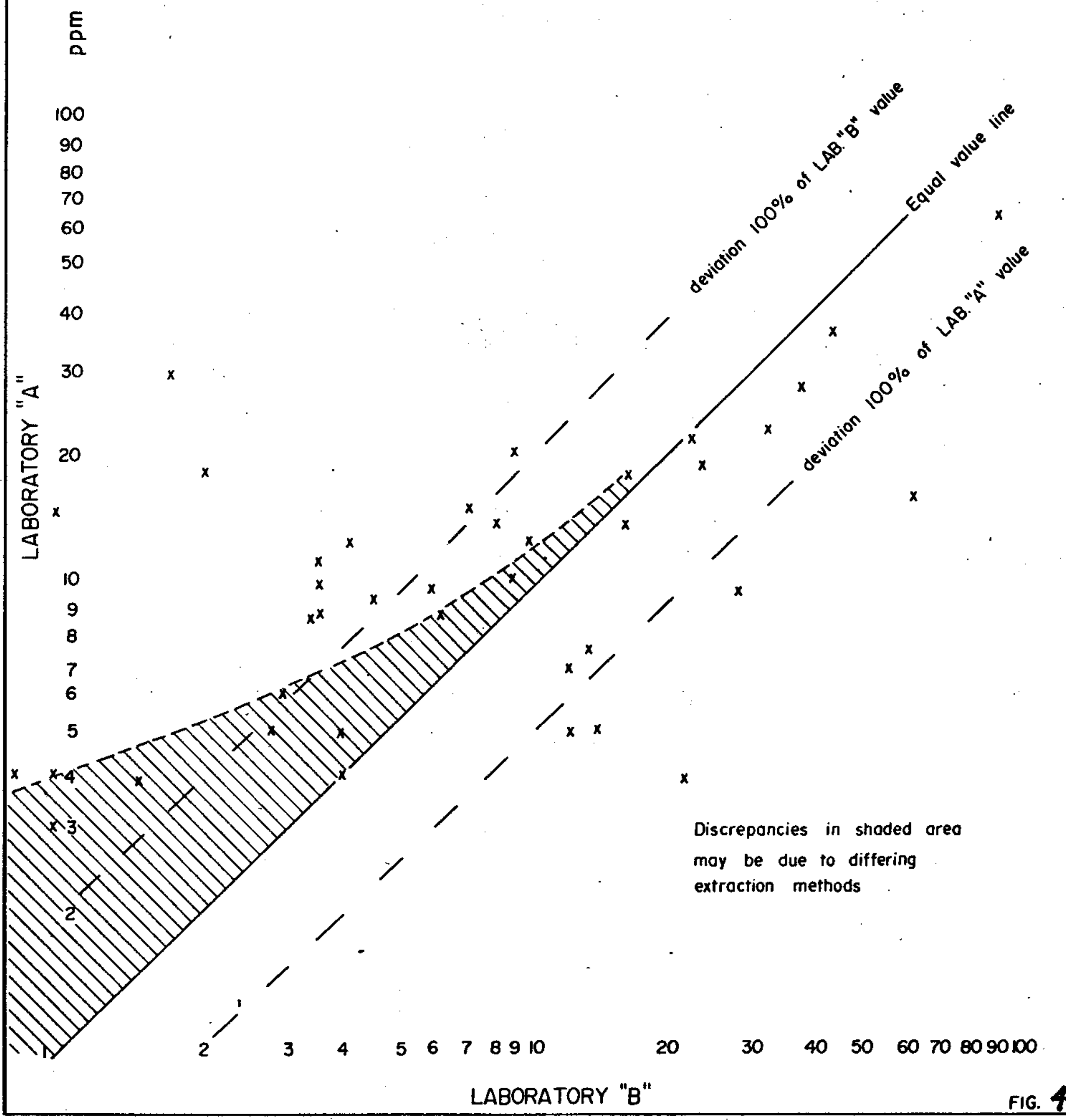


FIG. 4

of a group of -80 mesh silt samples sent to two different laboratories, and Figure 5 gives a similar example of a laboratory fluorimetric analysis (with unusually strong acid extraction) compared to neutron activation. The results show clearly that ordinary uranium geochemical determinations are really only semi-quantitative. "Assay-mode" delayed activation neutron analysis is as good as is rountinely available, in our opinion.

In statistical theory, the standard error (expected standard deviation) of a number produced by counting events is very close to the square root of that number. In practice, this is the controlling factor in precision for routine analysis by the LEGS technique, with other factors such as sample reloading differences and long term drift having little additional influence. This has the practical result of allowing quite accurate calculation of a standard error for each analysis, given the count on each of the spectrum channels monitored. Standard error curves for uranium and Pb^{214} in a variety of circumstances are shown in Figures 6 and 7 assuming a typical background radiation level and a sample density of 1 gm/cc.

Limitations

1. The main limitation of the LEGS technique in exploration geochemistry (at least with the present small crystal size) depends on the definition of "anomaly". If a few ppm is considered significant and Pb^{214} cannot substitute for uranium, then the lengthy counting times involved make another approach more applicable. Figure 6 shows the relationship of counting time to precision.

N. A. Vs. LAB. URANIUM P.P.M.

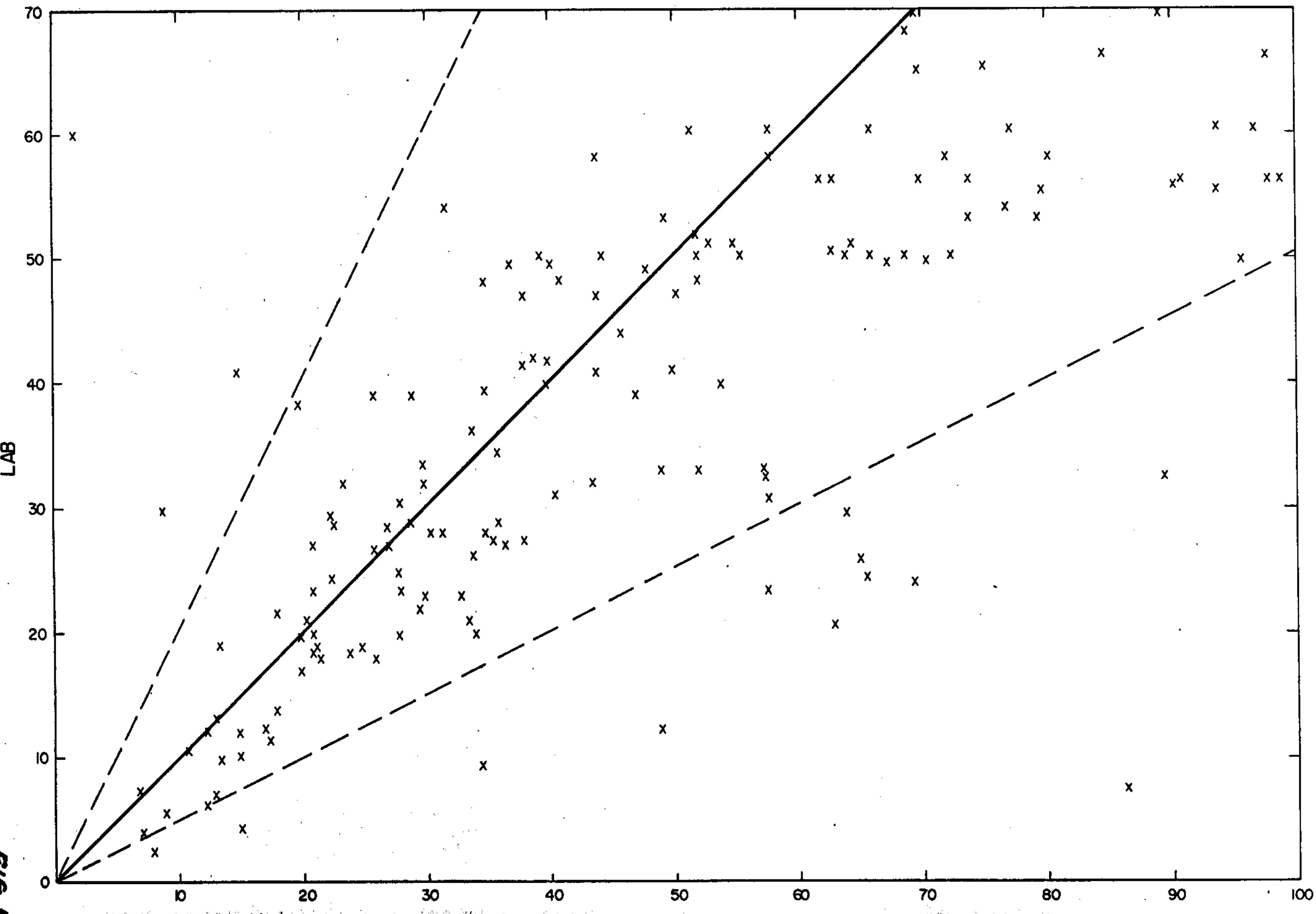


FIG. 5

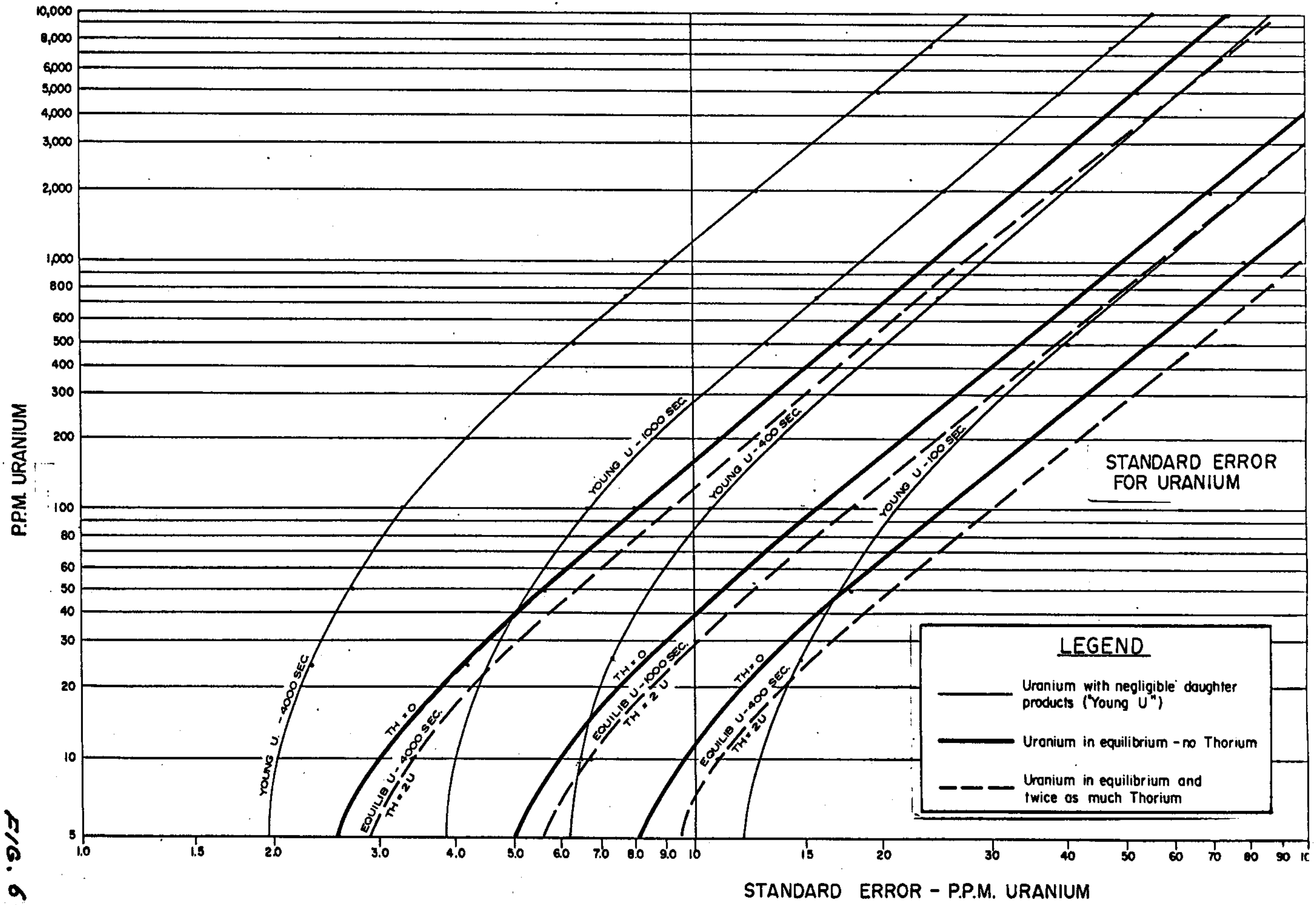

STANDARD ERROR
FOR URANIUM
LEGEND
Uranium with negligible daughter products ("Young U")
Uranium in equilibrium - no Thorium
Uranium in equilibrium and twice as much Thorium
YOUNG U. - 4000 SEC.
YOUNG U - 1000 SEC.
YOUNG U - 400 SEC.
YOUNG U - 100 SEC.
TH = 0
EQUILIB U - 4000 SEC.
TH = 2 U
EQUILIB U - 1000 SEC.
EQUILIB U - 400 SEC.
P.P.M. URANIUM
STANDARD ERROR - P.P.M. URANIUM
10,000
8,000
6,000
5,000
4,000
3,000
2,000
1,000
800
600
500
400
300
200
100
80
60
50
40
30
20
10
5
1.0
1.5
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10
15
20
30
40
50
60
70
80
90

FIG. 6

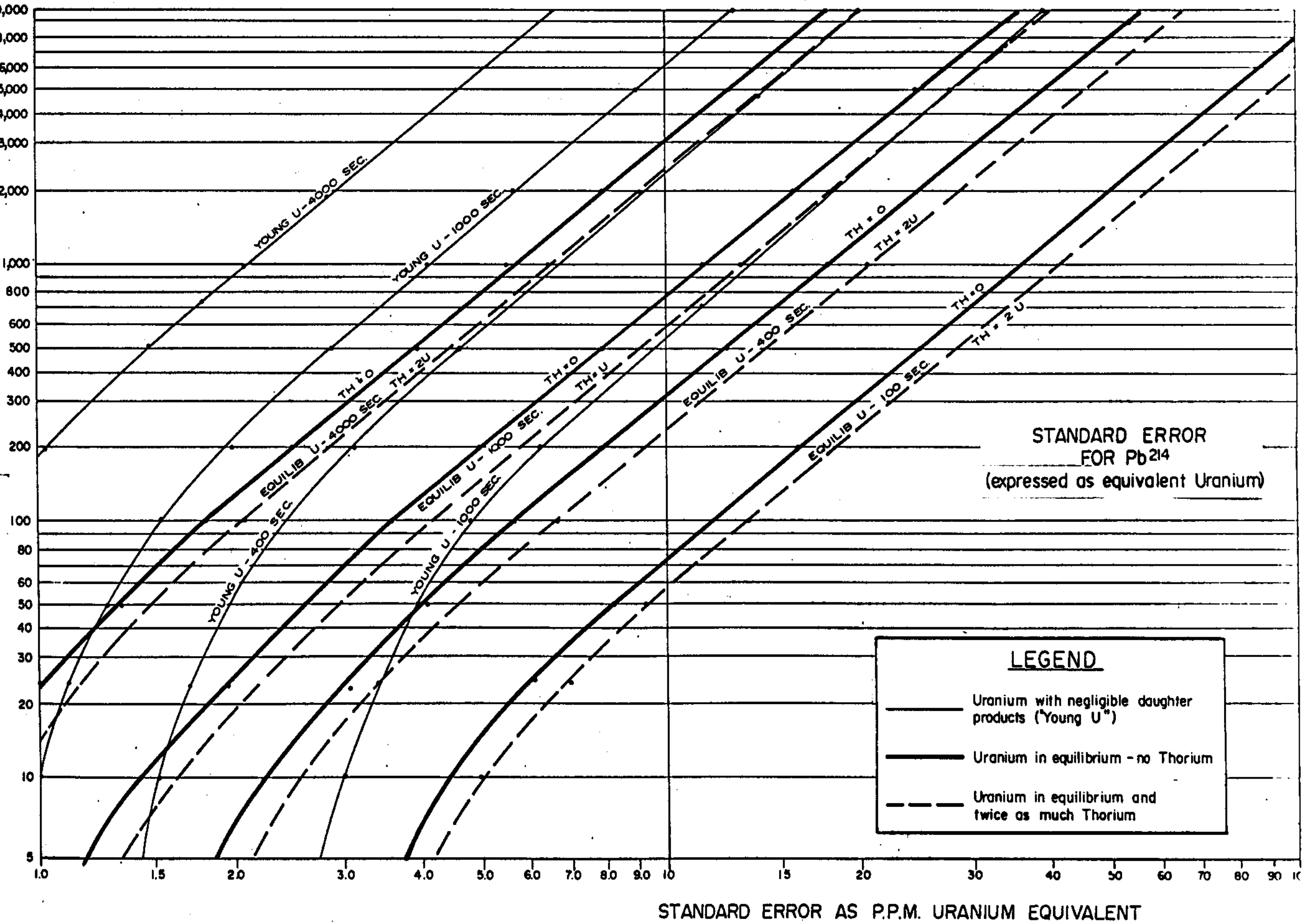

STANDARD ERROR
FOR Pb214
(expressed as equivalent Uranium)
P.P.M. URANIUM
STANDARD ERROR AS P.P.M. URANIUM EQUIVALENT
YOUNG U - 4000 SEC.
YOUNG U - 1000 SEC.
YOUNG U - 400 SEC.
YOUNG U - 1000 SEC.
EQUILIB U - 4000 SEC.
EQUILIB U - 1000 SEC.
EQUILIB U - 400 SEC.
EQUILIB U - 100 SEC.
TH = O
TH = 2U
TH = U
TH = 2 U
LEGEND
Uranium with negligible daughter products ("Young U")
Uranium in equilibrium - no Thorium
Uranium in equilibrium and twice as much Thorium
10,000
8,000
6000
5,000
4,000
3,000
2,000
1,000
800
600
500
400
300
200
100
80
60
50
40
30
20
10
5
1.0
1.5
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10
15
20
30
40
50
60
70
80
90

FIG. 7

2. The very heavy elements tend to absorb radiation in the lowest energy channel. Where high uranium or thorium contents are involved, an interval correction for this effect is easily made. The only element likely to be a problem, therefore, is lead, with which 1,000 ppm gives roughly a 0.5% reduction in counts for that channel. This is likely to be a limitation only in working with certain ores.

3. Although thorium should, in theory, remain fairly close to equilibrium throughout its short decay sequence, cases of apparent thorium disequilibrium have been observed. This may cause problems in weathered, thorium-rich rocks, and is under investigation.