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A REPORT ON A SYSTEMATIC QUANTITATIVE ANALYTICAL STUDY OF A GROUP OF UPPER LIARD PLACER HOLDINGS

by

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1. Introduction.

This report follows in sequence the following preliminary reports dated 14th July, 1954; J. Paradis Upper Liard Placer Holdings No. 1, J. Paradis Upper Liard Placer Holdings No. 2, and J. Hradil Upper Liard Placer Holdings. This report represents a more detailed systematic quantitative study of the mineral content of the clastic detritals briefly described in the properties considered in the above-mentioned reports. The method of sampling the deposits, the system of classification of detrital grains and the results of the microscopic examination of the mineralogy of the sediments is included in this report. Calculations on quantities of Titanium, Vanadium and Chromium based on spectrographic analyses are included in this report.

2. Sampling Procedure.

A systematic sampling programme was carried out across the full extent of the following five placer leases on the west bank of the Liard River immediately north of the Liard Bridge at Mile Post 642 Alaska Highway, namely J. Paradis, Theriault, Frame, Anderson and J. Hradil leases (see NES/JP/D1). The total area covered was 5 miles more or less in length and 1,000' more or less in breadth.

Representative sampling was carried out across the full extent of the above-mentioned area to a depth of 6' by Mr. Peter B. Jones, Geologist. Mr. Peter B. Jones, with the assistance of local help, conducted a field sampling programme which took approximately two weeks.

The following procedure was adopted as standard:-

Distances were taped along the river bank between posts 1 and 2 of each claim. In all cases, the number 2 post of a claim coincides with the number 1 post of the adjoining claim. As far as the configuration of the river would permit, taping was carried out in continuous straight lines along compass bearings, but as a check, the bearing of the direction of taping was noted at 200 foot intervals. Along the line of taping, 5 pits were marked out for excavation at regular intervals throughout each claim, including pits marked out at the number 1 or number 2 posts. From each of these points, lines of two further pits at 500 foot intervals were marked out perpendicular to the river bank. Except where these points lie on the gravel flats, all the pits are situated within 5 feet of the points marked.

Deviations from standard procedure of lay out occur in the Paradis claim, where 6 lines of pits were laid out, and in the Frame and Anderson claims, when their common boundary is not marked. In the latter case, pits were marked out at regular intervals between the number 1 post

of the Frame claim and the number 2 post of the Anderson claim. Map NES/JP/M2 included with this report gives the location of points of sampling.

Pits were dug to a depth of 6 feet, except where water and/or caving in of the walls made this impossible. In each pit, a vertical channel sample was cut from one wall, 6 feet in length, 3 inches wide and 3 inches deep. The samples were each mixed thoroughly and quartered three times to reduce the bulk. On completion of the sampling, samples containing gravel were passed through ¼" mesh screening and all samples reduced to a standard volume.

The following system of indexing was followed:-

The claims were each given an index letter, P, T, F and H, representing Paradis, Theriault, Frame and Hradil respectively. It should be noted that the index letter F covers both Frame and Anderson claims. Within each claim, pits were numbered off northwards from the number 1 post, and given letters A, B or C according to whether they were zero, 500 feet, or 1,000 feet from the river bank. The system is illustrated in diagram NES/JP/D2 included with this report.

A complete set of bagged samples is held on file and in the event of any further work, the following information should be noted. The number of times of quartering is indicated by the figure following the "Q" on the sample bag. Similarly, depth of gravel in inches is given by the figure following the letter "G". Presence of water in the pit is denoted by "W". All depths given were measured from the top of the channel sampled, and not from ground level, since in most cases there is a thickness of up to 12 inches of rotting vegetation. All pits were marked by posts or trees suitably blazed, carrying the index figures and flagged with a length of red tape.

During the course of the work, small stakes marked with a strip of yellow tape were placed at 1,000 foot intervals northwards from each number 1 post.

By careful mixing and quartering of the above-described individual samples, five representative compound samples were obtained, namely HC, AC, FC, TC, PC (see Diagram NES/JP/D2) representing leases Hradil, Anderson, Frame, Theriault and Paradis respectively. (Note: the individual samples left from laboratory analysis and kept on file remain representative of the points of sampling). Each compound sample is representative of the full extent of its particular lease to a depth of 6'. To compensate grid distortation on a sharp angular bend of the Liard River in the Frame lease (see Map NES/JP/M2) mean sampling was carried out to ensure accurate representation across this particular lease.

Five compound samples representative of each of the five placer leases discussed in this report were analysed mechanically and by microscope in the laboratories of the University of Chicago. The laboratory work was conducted and supervised by Dr. John D. Godfrey and the results of this work are included with this report.

3. Mechanical and Microscopic Analysis.

Laboratory analysis of field compound samples was made at the University of Chicago by Dr. John D. Godfrey. Assistance in mechanical separation and size grading was given by Mr. P. Harrison, Sedimentary Petrologist. Assistance in mineral-microscopic determinations was given by Dr. Y. Baskin and Mr. N. H. Suhr, Economic Petrologist. Assistance in separation of heavy and magnetic fractions was given by Dr. Y. Baskin and G. K. Czamanske, Geologist. Tabular summary of results obtained in this work is included in this Report. Spectrographic analysis for a number of elements and minerals has been carried out on heavy residues from the compound samples by Dr. Oiva Joensuu.

(a) Mechanical Separation and Size Grading.

Compound samples AC, FC, HC, PC and TC were placed separately in a 'Ro-Tap' mechanical shaker (containing six sieves) for ten minutes per sample. The following six size grades were separated for each sample:

Greater than 0.991 ..... Grade 0

0.991 - 0.701 ..... Grade 1

0.701 - 0.417 ..... Grade 2

0.417- 0.246 ..... Grade 3

0.246 - 0.074 ..... Grade 4

Less than 0.074 ..... Grade 5

Thirty to 35 grms. of each of the six samples were weighed and placed in a vial and corked. The corked samples were used for further determinations. (A list of weights of each sample and the weight percentage of each fraction is given in Table No. 9.)

(b) Mineral-Microscopic Determinations.

Grade fractions (one to four inclusive) separated from compound sample HC were examined under a microscope for content of heavy mineral. The results of this determination are shown in Table No. 1. Grains of each mineral present were counted and the figures given represent proportional abundance of minerals present by volume. The figures demonstrate a certain uniformity of mineral content through the four grade fractions. However, grade 4 exhibits the presence of the greatest number of minerals. Following this result, the grade 4 fraction of each compound sample was examined in a similar manner under a microscope. The figures obtained by grain counts are illustrated in Table No. 2. This table illustrates a uniformity of mineral content through the five compound samples (that is across the extent of the five leases under examination; which agrees with the results of qualitative work submitted in the preliminary reports). One marked variable is the opaque (ilmenite ?) content of compound sample PC.

(c) Separation of Heavy and Magnetic Fractions.

The grade 4 fractions of each of the compound samples AC, FC, HC, PC and TC were separated into three groups of different densities by means of heavy liquids. The following was the basis of heavy liquid separation:

Less than 2.9 density - density A ..... Light Minerals

Density 2.9 - 3.9 - density B
Density greater than 3.9 - density C } ..... Heavy Minerals

The weight of "heavies" and weight of "lights" for each compound sample were estimated and from these values the percentage by weight of "heavies" of the grade 4 fraction for each compound sample was calculated (see Table No. 3).

Similar heavy liquid separations were carried out for all four grade sizes and for all five compound samples. The percentage by weight of grade 4 "heavies" contained in the original samples was computed and the results are given in Tables 4 and 5 of this report. Table 4 demonstrates that the greatest percentage weight values for B & C "heavies" are contained in the Grade 4 fraction.

Further differentiation of "heavies" was carried out by magnetic means. Since magnetic minerals appear to be confined to the density C group, the heavy residues from the Grade 4 fractions of each of the compound samples were first separated into density groups B and C. Magnetic minerals were then separated from the density group C fraction by placing a magnet on paper in brushing contact with the mineral grains. From the results, weight percentages of non-magnetic and magnetic "heavies" in the density C group were obtained. (see Tables Nos. 6 and 7).

In order to derive more representative results by weight another analysis was made of the grade 4 fraction using 200 grms. of samples AC, FC, HC, PC and TC. These samples were passed through the 'Ro-Tap' machine and weight percentages of fractions were calculated. By heavy liquid separation weights of B "heavies" and C "heavies" were obtained. Magnetic separation of the C "heavies" was carried out but this time the magnet and paper were not allowed to come into contact with the detrital grains. On this basis less magnetic material (e.g. aggregate grains) was separated from the more magnetic material (e.g. ilmenite, chromite, etc.). Results of this analysis are shown in Table No. 8. (Note in samples TC only sufficient material was available for spectrographic analysis).

4. Spectrographic Analysis

Representative samples were processed from the heavy residues for spectrographic examination. In his estimations for Titanium, Vanadium, and Chromium, Dr. Oiva Joensuu found percentages to be consistent through the compound samples. In estimating lbs/ton, average values have, therefore, been used. (see Table No. 14). Values obtained in analysis for further elements (e.g. Gold, Platinum, Zirconium, Yttrium, Lanthanum) are submitted in a supplement of this report.

5. Discussion of Quantitative Results.

The results of mineral counts would indicate that mineral abundance is fairly consistent through the grades examined and also across the aerial extent of the deposits sampled.

The heavy mineral content of the Grade 4 size is considered to be representative of the compound samples. Using compound sample HC as a type sample, the Grade 4 size was found to contain 37% of the total magnetics (see Table No. 10). This percentage value was used in deriving values for lbs/ton of magnetics in the compound samples.

Since some variation occurs between quantities derived by microscope and spectrograph, results obtained by the latter method are considered more reliable. Initially, smaller amounts of sample (30-35 grms) were separated for microscopic examination and heavy and magnetic separations were made. A second series of experiments was conducted using larger amounts of compound sample (200 grms.). This second series of results is more representative (in view of the larger amounts used) and should receive preference over the 30-35 grm. sample results.

A summary of estimations based on both series of experiments is shown in Tables 11, 12, 13 and 14.

In Table 14, calculations of lbs per ton of Titanium, Vanadium and Chromium are made. In Table 15, figures for conversion to lbs per yard are given.

Note: The significance of the two methods of magnetic separation used (in contact with and out of contact with the mineral grains) must await further spectrographic analysis to ascertain whether or not their is a chemical uniformity through both separated fractions.

A correction has not been made at this stage for any heavy residue which may be contained in aggregate grains of the Grade 0 size and which could be extracted by crushing.

APPENDIX

Table No. 1.

Mineral Analysis of 4 Size Grades of Sample HC.

Greater than 0.991	Grade 0.	
0.991 - 0.701	Grade 1.	
0.701 - 0.417	Grade 2.	
0.417 - 0.246	Grade 3.	
0.246 - 0.074	Grade 4.	Tyler Screens
Less than 0.074	Grade 5.	units - mms.

	Grade 1	Grade 2	Grade 3	Grade 4
Andalusite	-	-	-	-
Sillimanite	-	-	-	?
Kyanite	-	-	-	?
Biotite	20	15	15	15
Hornblende	5	10	15	10
Pyroxene	20	15	20	20
Opaque	30	35	35	25
Magnetite	4	3	4	6
Rutile	-	-	-	2
Garnet	15	10	10	15
Monazite	-	-	-	-
Zircon	?	-	-	?
Spinel	-	-	-	3

Table No. 2

Mineral Analysis of Grade 4 of each Sand Sample.

	AC	FC	HC	PC	TC
Biotite	15	15	15	10	15
Hornblende	15	15	10	10	25
Pyroxene	20	25	20	20	20
Opaque (Ilmenite)	30	30	25	40	25
Magnetite	5	3	6	4	3
Garnet	10	5	15	10	4
Rutile	2	1	2	tr.	?
Sphene	-	-	-	?	-
Monazite	-	-	-	-	-
Zircon	-	-	?	?	-
Spinel	-	5	3	5	6
Topaz		1			
Sillimanite					2

Table No. 3.

Heavy Mineral Analysis of Grade 4 Fractions.

Less than 2.9 density - density A

Density 2.9 - 3.9 - density B

Density greater than 3.9 - density C

Separation of Density (B & C)

	Total Wt. of Sieve Fraction.	Wt. of Heavies.	Wt. of Lights.	% Heavies of Fract.	Fract.Wt. % of Total Sample.
AC	10.4	0.316	10.02	3.03	30.
FC	11.6	0.177	11.38	1.53	39
HC	9.3	0.274	8.92	3.12	27
PC	10.9	0.240	10.62	2.20	38
TC	11.4	0.306	11.09	2.96	32

Table 4.

Heavy Mineral Analysis of 4 Fractions for 5 Sand Samples

% Heavies Density B & C.

Fraction.	AC	FC	MC	PC	TC
Grade 1.	0.94	1.2	1.40	1.32	1.82
Grade 2.	0.76	1.05	1.72	1.18	1.70
Grade 3.	1.91	1.15	2.50	1.78	2.20
Grade 4.	3.03	1.53	3.12	2.20	2.96.

TABLE NO.5.

Heavy Mineral Analysis of 4 Fractions of 5 Sand Samples.

Density B & C.

	Fraction.	Wt.Heavies.	Wt. Lights.	Wt. Retained.	% Heavies in Fraction.
AC	Grade 1.	0.016.	1.68	1.7	0.94
	Grade 2.	0.029.	3.78	3.8	0.76
	Grade 3.	0.118.	6.04	6.2	1.91
	Grade 4.	0.316.	10.02	10.4	3.03
FC	Grade 1.	0.011	0.89	0.9	1.2
	Grade 2.	0.023	2.18	2.2	1.05
	Grade 3.	0.047	4.01	3.9	1.15
	Grade 4.	0.177	11.38	11.6	1.53
HC	Grade 1.	0.026	1.82	1.8	1.40
	Grade 2.	0.073	4.18	4.2	1.72
	Grade 3.	0.166	6.45	6.6	2.50
	Grade 4.	0.274	8.92	9.3	3.12
PC	Grade 1.	0.020	1.65	1.6	1.32
	Grade 2.	0.036	3.02	3.0	1.18
	Grade 3.	0.104	5.68	5.8	1.78
	Grade 4.	0.240	10.62	10.9	2.20
TC	Grade 1.	0.040	2.17	2.2	1.82
	Grade 2.	0.052	3.01	3.0	1.70
	Grade 3.	0.086	3.79	3.9	2.20
	Grade 4.	0.306	11.09	11.4	2.96
		*	*	*	

* Weights recorded checked to within 3.7% - maximum variation.
(0.5 - 1.0% approx. average variation.)

Table No. 6.

Data on Mineral Analysis Density C. Grade 4 Fraction.

	Wt. of Heavies.	% Heavies.	Wt. of Magnetics.	% Magnetics.
AC	0.0075		-	
FC	0.0023		-	
HC	0.0102		0.0390.	
PC	0.0036		0.0387.	
TC	0.0036		-	

Table No. 7.

Weight Percentages of Density B & C Heavies and Weight Percentages of Non-Magnetic and Magnetic Fractions of Density C Heavies for 5 Compound Samples Grade 4 Fraction.

	Wt. of Density B & C Heavies.	%	Weight of Density C Heavies				Remarks.
			Non-Mag.	%	Mag.	%	
AC	0.316	3.03	0.0075	0.072	-	-	Lost.
FC	0.177	1.53	0.0023	0.020	-	-	Very Small.
HC	0.274	3.12	0.0102	0.110	0.0390.	0.42	
PC	0.240	2.20	0.0036	-	0.0387	0.36	
TC	0.306	2.96	0.0036	0.032	-	-	Very Small.

Note: Weight Percentages given with reference to fraction weight.

Table No. 8

Analysis of Grade 4 Fraction of 200 grm. Samples.

	Wt. Fraction	%	Wt. Density B. Heavies	%	Wt. Density C. Heavies	%	Wt. Mag. Fraction	%
AC	53.0	26.5	1.122	-	0.132	0.25	0.071	0.134
FC	85.8	42.9	-	-	0.111	0.13	0.060	0.070
HC	61.5	30.75	1.837	-	0.138	0.22	0.109	0.177
PC	77.7	38.85	2.261	-	0.306	0.38	0.150	0.193
TC	70.0	35.0	-	-	-	-	-	-

Table No. 9

Fraction Weight Percentages for 30-35 grms.

Quantities of Five Compound Samples

for all six size grades.

	Wt. of Compound Sample	GRADE	Fraction Wt. % of Total Sample
AC	34.1 grs.	0	15
		1	5
		2	11
		3	18
		4	30
		5	20
FC	29.5 grs.	0	5
		1	3
		2	7
		3	13
		4	39
		5	32
HC	33.9 grs.	0	19
		1	5
		2	12
		3	19
		4	27
		5	17
PC	28.5 grs.	0	10
		1	6
		2	2
		3	20
		4	38
		5	23
TC	35.5 grs.	0	15
		1	6
		2	8
		3	11
		4	32
		5	27

Table No. 10

Estimation of Magnetics for Compound Sample HC on a Mineralogical Basis

	Wt. % of Total Sample	% Magnetic Fraction	% Magnetic Total Sample	Remarks
Grade 0	19	2	0.38	
Grade 1	5	4	0.20	
Grade 2	12	3	0.36	
Grade 3	19	4	0.76	
Grade 4	27	6	1.62	37% total Magnetic
Grade 5	17	6	1.02	
			4.34% Total	

NOTE: Grades 1 to 4 inclusive based on Microscopic examination. Grades 0 and 5 estimated.

Table No. 11

Estimation of Percentages of Magnetics

In all Compound Samples

In the Grade 4 Size

	Wt. % of Total Sample	% Magnetic In Fraction	% Magnetic in Fraction of Total Sample	% Magnetic in Total Sample
Sample AC	30	5	1.35	3.64
Sample FC	39	3	0.81	2.20
Sample HC	27	6	1.62	4.34
Sample PC	38	4	1.08	2.90
Sample TC	32	3	0.81	2.20
			AVERAGE	3.60

NOTE: Estimations made on the basis of microscopic examination. (30-35 grm. samples).

Table No. 12

Estimation of Magnetics in Compound

Samples HC, PC, TC

(By magnetic separation from 30-35 grm. samples - magnet in contact).

	Total Wt. of Magnetics in Sample	Percentage Magnetics in Sample
HC	1.05 grs.	3.10%
PC	1.04 grs.	3.65%
TC	0.10 grs.	0.28%

Average - 2.34% for Three samples.

TABLE NO.13.

Estimation of Magnetics in Five Compound Samples.

(By Magnetic Separation from 200 gram. Samples - Magnetic in contact)

	Wt. % Sample.	% Mag. in Fraction of Total Sample.	% Mag. in Total Sample.
AC	26.5	0.035	0.10
FC	42.9	0.030	0.08
HC	30.7	0.0545	0.15
PC	38.8	0.0749	0.20
TC	Lack of Data - no calculation.		
		Average.	0.133%

Note - above figures are based on Grade 4 size and the assumption that this grade size in each compound sample contains 37% of the total magnetics.

TABLE No.14.

Calculation of Minerals and Elements in lbs. per ton.

Present in the Magnetic Fraction of the Deposits.

(The term 'ton' means a short ton, namely 2,000 lbs.)

Spectrographic Analyses.

Titanium (TiO_2) - 2% - 5%. (200 grm. sample basis)
Vanadium (V_2O_3) - 0.3%.
Chromium (Cr_2O_3) - 0.3%

Sample	Quantities	% Combined Titanium	% Combined Vanadium	% Combined Chromium
AC	0.1% Magnetics	0.002 - 0.0050	0.0003	0.0003
	lbs./ton	0.04 - 0.100	0.0060	0.0060
FC	0.08% Magnetics	0.0016 - 0.004	0.00024	0.00024
	lbs./ton	0.032 - 0.080	0.0048	0.0048
HC	0.15% Magnetics	0.0030 - 0.0075	0.00045	0.00045
	lbs./ton	0.060 - 0.15	0.0090	0.0090
PC	0.20% Magnetics	0.004 - 0.010	0.0006	0.0006
	lbs./ton	0.08 - 0.200	0.0120	0.0120
TC	0.05% Magnetics	0.001 - 0.0025	0.00015	0.00015
(30-35 gr.basis)	lbs/ton.	0.02 - 0.050	0.0030	0.0030

TABLE NO.15.

Conversion of lbs./ton to lbs./yard.

100 grs. Sample.	Uncompacted. (CCS)	Compacted. (CCS)
AC	67	62
FC	77	72
HC	67	61
PC	71	65
TC	71	64

Average volume of five compacted samples (100 grm. sample) = 65 ccs.

On this basis, 1 cu. yard = 1.3 tons.

CERTIFICATE

I, Claud N. Rands of Calgary, Alberta, author of this report, hereby certify that:

1: I am a registered geologist of the University of London, a fellow of the Geological Society, a member of the Engineering Institute of Canada and a Professional Engineer of Alberta.

2: I have no interest, direct or indirect, nor do I expect to receive any interest, direct or indirect, in the properties described in this report.

3: This report is based on two weeks of field investigation followed by intensive laboratory examination.

Claud N. Rands, P. Eng.

24 January, 1955

LIARD RIVER PROSPECT

DIAGRAM TO SHOW PLAN OF SAMPLING AND COMPOUNDING OF SAMPLES

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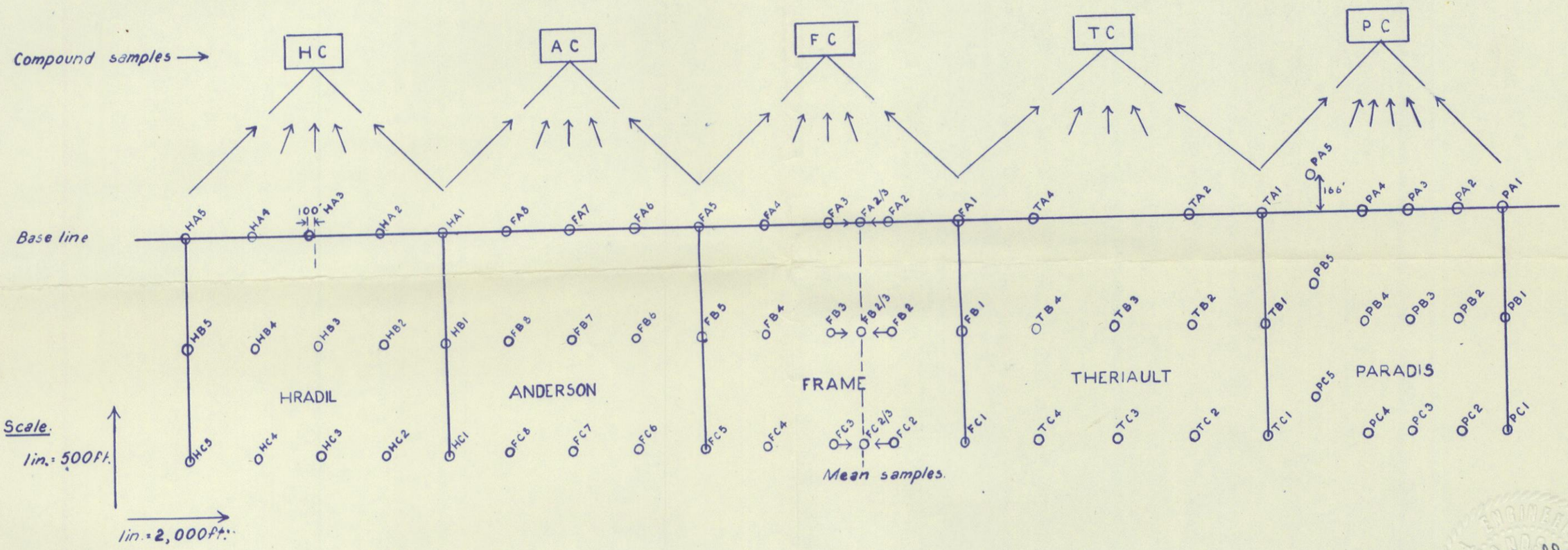

Claudius Quelle
24 Jan. 55

NORTHERN EXPLORATION SERVICE.
NES/JP/D2.
RANDS EXPLORATION CO. 718 - 8th. AVE. W., CALGARY, ALTA.

PBO.

LIARD RIVER PROSPECT

LOCATION PLAN OF SAMPLING PITS

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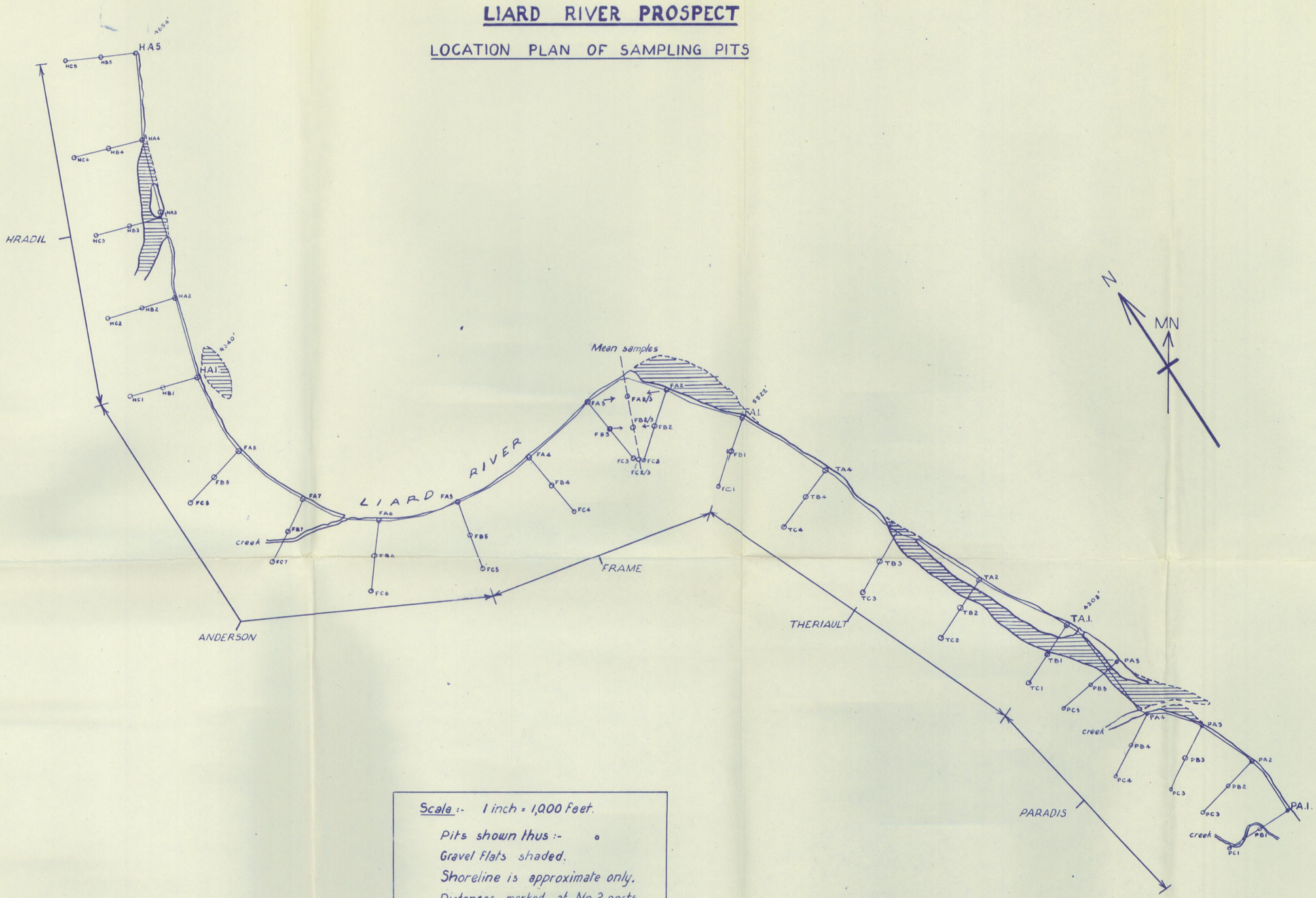

Scale :- 1 inch = 1,000 feet.

Pits shown thus :- o

Gravel flats shaded.

Shoreline is approximate only.

Distances marked at No.2 posts indicate length of claims.

Claude McArdle
27 Jan. 55.

NORTHERN EXPLORATION SERVICE
NES/JP/M2
RANDS EXPLORATION COMPANY, 718-8th. AVE. W., CALGARY, ALBERTA.

PBJ.