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REPORT CONCERNING the 1966 SAMPLE PROJECT

JULIENNE LAKE DEPOSIT

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July 5, 1967

CANADIAN JAVELIN LTD.

I N D E X

SCANNED IMAGE

Report Concerning the 1966 Sample Project

Julienne Lake Deposit

Introduction:

The question of the origin of the titania that appears in the control samples and pellets made from the 1960 bulk sample, and other considerations, led to a project in August-September 1966 to collect a comprehensive surface sample of the Julienne Lake Deposit. This report presents the results of this investigation and reviews the evidence regarding the grade of the deposit.

Sample Collection:

The samples collected by W. Blakeman and the writer between August 23 and September 6, 1966, consisted of randomly collected chips of exposed iron formation in the sample areas. The weight of individual samples varied, roughly in proportion to the amount of outcrop, from a few pounds to over 30 pounds from each sample area. The boxed shipping weight of the 36 samples was 760 pounds.

Sample areas were confined to three zones extending across the deposit, namely the western bench, the central stripped area, and the eastern bench zone. The location of individual samples is shown on the map.

All previously collected surface samples were unrelated to the geology of the deposit as it is presently recognized. Individual samples collected during this project were confined to recognized stratigraphic units in an attempt to look for significant variations between the members. Thirty samples were collected with this distribution: five were taken from the 1960 test pits, and one sample is a composite of the preceding 35 samples. The samples were analyzed by Lerch Bros., Hibbing, Minnesota in May 1967.

Assay Results, with predominating mineralogic designations

Group One - Western Bench Zone

Sample	Min.	Fe	Insol	Mn	Phos	Sul	TiO_2
3569	SS, SG	41.43	38.80	.05	.007	.010	.040
3570	SG, G	43.36	36.22	.05	.007	.007	.040
3571	S	47.71	30.53	.05	.007	.010	.032
3572	SG	42.47	38.00	.08	.006	.009	.020
3573	S	39.81	42.88	.02	.006	.006	.030
3574	S, SG	42.07	37.40	.04	.006	.004	.040
3575	S, SS	34.98	46.81	.08	.007	.007	.040
Arithmetic Average		41.69	38.66	.053	.007	.008	.035

Group Two - Central, Stripped Area Zone. Samples do not coincide those collected in 1962.

Sample	Min.	Fe	Insol	Mn	Phos	Sul	TiO_2
3541	S,SS,SG	37.51	44.97	.06	.015	.003	.010
3542	SG, Mn	43.76	32.63	1.68	.033	.005	.010
3543	SS	34.14	50.25	.02	.008	.008	.010
3544	S	32.70	51.70	.02	.007	.025	.031
3545	S, SG	35.43	48.45	.05	.009	.006	.042
3546	SG, Mn	33.18	43.64	3.97	.005	.005	.073
3547	SG	35.27	47.90	.04	.012	.008	.052
3548	G, FeQte	37.51	44.82	.04	.010	.011	.073
3549	SG, S	35.43	47.20	.08	.017	.005	.120
3550	SG	32.86	51.91	.05	.006	.006	.060
3551	SG	33.18	50.57	.06	.011	.011	.052
3552	S, SG	33.37	50.36	.15	.009	.006	.042
Arithmetic Average		35.36	47.03	.52	.012	.008	.043
				.05 excluding 3542, 3546			

Group Three - Eastern Bench Zone

Sample	Min.	Fe	Insol	Mn	Phos	Sul	TiO_2
3558	SS	31.58	53.25	.08	.006	.004	.050
3559	SG, FG	32.54	51.81	.08	.006	.009	.069
3560	FG	36.29	46.44	.15	.009	.011	.084
3563	S	39.43	41.90	.11	.007	.005	.042
3564	S, SG	39.59	43.12	.21	.007	.005	.052
3565	S	32.22	52.51	.10	.011	.008	.021
3566	FeQte, FG, S	40.07	41.70	.10	.010	.008	.061
3568	S, SG, FG	37.40	44.78	.10	.011	.009	.050
3553	S	42.80	38.20	.08	.006	.006	.070
3555	SG	34.30	49.13	.13	.004	.004	.073
3556	SG, S	33.82	49.30	.95	.007	.006	.052
Arithmetic Average		36.37	46.56	.19	.008	.007	.057

Group Four - 1960 Test Pits

Sample	Min.	Fe	Insol	Mn	Phos	Sul	TiO_2
60-1 3554	S	45.23	34.62	.06	.005	.009	.031
60-2 3567	S, SG	34.80	49.13	.06	.024	.011	.083
60-3 3562	S	44.35	35.84	.20	.008	.008	.042
60-4 3561	S	45.85	33.11	.13	.007	.003	.073
60-5 3557	SS	33.50	50.59	.08	.005	.006	.070
Arithmetic Average		40.75	40.66	.11	.010	.007	.060

Composite - A small portion of each of the above

Sample	Fe	Insol	Mn	Phos	Sul	TiO_2
3576	36.75	46.20	.110	.007	.008	.022
Average of 35 preceding samples (3541-3575)	37.71	44.30	.26	.009	.007	.050
			.11 excluding 3542,3546.			

Comments

1) One interesting point that appears in the above data is the higher iron content of the group one samples from the western side of the deposit. It is not possible to check this against the 1956 samples, but hole 6 in the same area also averages over 40% iron and also does one of Boyum's 1957 samples. While the evidence suggests an above average grade for this part of the deposit, there is nothing unusual in the appearance of the iron formation and there is no geologic explanation for the apparently anomalous iron content at the present time.

2) One purpose of the sample distribution was to look for differences in grade between the major stratigraphic members. The averages of the samples grouped by stratigraphic units follows.

Lower Iron Formation

North Side	36.16% Fe - 4 samples	Average
South Side	34.98% Fe - 1 sample	35.90-5

Middle Iron Formation		
Lower, north	37.64 - 7	
Lower, south	37.72 - 2	Average
Middle, north	40.16 - 3	37.58 -18
Upper, north	36.65 - 3	
M. & U. south	35.60 - 3	
Upper Iron Formation		
Lower, north	38.33 - 3	Average
Lower, south	32.86 - 1	37.19 -7
Upper, axial	37.51 - 3	

These results suggest that significant differences in grade between the various stratigraphic units do not exist, though there are indications that the Lower Iron Formation may be slightly lower that the other major units. More sampling would be needed to determine whether this indicated difference is real or not, and for the moment it must be assumed that the iron is nearly uniformily distributed in the large scale stratigraphic sense.

3) The 1956 and 1966 sample projects were basically the same in that both were measures of the iron content at the surface of the deposit, collected in the same manner, though mostly from different outcrops. The averages follow.

28 Samples, 1956		35 Samples, 1966
37.15%	iron	37.71%
	insoluble	44.30
.18	manganese	.26
.012	phosphorus	.009
.004	sulphur	.007

The close similarity of these two samples is striking, but as pointed out by Gastil reference the 1956 sample, there is evidence suggesting that surface samples may be one-two percent higher than the subsurface iron formation, probably due to a concentration of secondary iron hydroxides at the surface.

4) The other surface sample which may be compared with part of the 1966 sample is the trench area samples collected in 1962. The two samples are not directly comparable because they did not encompass the same intervals along the stripped area but comparison of the two does disclose one significant factor about the distribution of iron.

	1962 Trench Area			1966 Trench Area			
	Iron	Dev.	Len.		Iron	Dev.	Len.
200-300	34.34	1.38	100	200			
300-400	36.71	.99	100	-380	33.37	1.99	180
400-500	35.51	.19	100	380			
500-600	30.54	5.18	100	-625	33.18	2.18	245
600-700	39.51	3.79	100	625			
700-800	33.18	2.54	100	-775	32.86	2.50	150
800-900	33.68	2.04	100	775			
900-1000	39.84	4.12	100	-1000	35.43	.07	225
1000-1100	44.56	8.84	100	1000			
1100-1200	35.11	.61	100	-			
1200-1300	38.31	2.59	100	-1290	37.51	2.15	290
1300-1400	37.35	1.63	100	1290			
1400-1500	33.18	2.54	100	-1475	35.27	.09	185
1500-1600	43.50	7.48	100	1475-1625	33.18	2.18	150
1600-1700	29.82	5.90	100	1625			
1700-1800	36.07	.35	100	-1800	35.43	.07	175
1800-1900	33.50	2.22	100	1800			
1900-2000	30.30	5.42	100	-1970	32.70	2.66	170
2000-2100	31.26	4.46	100	1970-2150	34.14	1.22	180
2100-2200	35.51	.21	100	2150-2285	43.76	8.40	135
2200-2425	38.55	2.82	100	2285-2425	37.51	2.15	140
Average	35.72%	3.09%	100ft.		35.36%	2.14%	185ft.

The significant point here is not that the two averages are nearly the same, but that the average deviation decreases over one full percent with an increase of average sample length from 100 to 185 feet. This is an expression of a characteristic of the deposit whereby large grade deviations from the average occur across wide intervals. For these deviations to approach zero it is necessary to include several hundred feet in the sample.

5) Some of the previous investigations had suggested that there was a systematic relationship between grade and mineralogy. The average of 16 of the present samples which can be classified as consisting of quartz-specular hematite and/or its variants is 37.77% iron. The average of 13 spec-granular, and variants of granular varieties, samples is 36.46% iron. This grade-variety relationship is the reverse of that previously indicated, however the difference between the two averages is probably not significant because the 1966 samples were restricted to stratigraphic units, not unique mineralogic varieties. It is therefore concluded that this grade-mineralogy comparison is of no significance.

The Titania Affair

What is generally called the Titania affair regarding the Julienne deposit has its origins in the Wabush exploration work dating from 1953. Fifteen composite samples were made from the assay pulps of core or sludge samples from 7 holes drilled in 1953. Titania was one of the elements assayed for in these samples. In addition, 5 titania determinations were made on Wabush concentrates by several groups. The average of these 20 determinations is .083% titania, with a range from .005 to .23. These are the only titania assays appearing in

Javelin's literature concerning Wabush, and there are no titania determinations reported in any of the literature submitted to Javelin by Pickands Mather and Co. resulting from their exploration work, though undoubtedly they made enough titania checks to satisfy themselves that titania was not a problem in beneficiating the Wabush deposit.

W. H. Roxburgh's notes reference the titania situation report that he was verbally assured by R. Batchelor of P.M. that they did not see any reason to recommend titania assays during the Julian drilling, based upon a semi quantitative spectrographic analysis of Julienne material. This is not mentioned in their rather terse reports of exploration, however.

From this background titania was considered of little significance and titania determinations were not part of the customary assay procedures at Wabush or Julienne by either Javelin or P.M.

Further support of this policy regarding Julienne is found in a letter report of September 24, 1957 by Walter Numela, metallurgist for Cleveland Cliffs Iron Co. concerning the sink-float test results of three samples of the Julian deposit collected shortly before (in the writer's presence) by Burt Boyum, Chief Geologist of Cleveland Cliffs Iron Co. The returns below are on material crushed to -20+400 mesh.

	Crude	Sink Portion	
West side of deposit	43.65%Fe	62.45%Fe	.026% titania
Top of hill	46.60%Fe	61.85%Fe	.064% titania
Entire east side	42.10%Fe	63.95%Fe	.016% titania

The next samples collected on which titania was requested were the control samples representing the 38½ tons of material collected in Nov-Dec 1960 for metallurgical investigations. Each round was sampled, with the sample accumulated in a burlap bag to form the control sample of each pit. The control sample bags were taken from the stock of bags used to bag the bulk material.

Titania was requested in the assay of these samples as a matter of interest. The returns were received January 5, 1961 long after the project was completed and during the period when the grinding tests were in progress. These returns showed a titania content averaging .21% with a range from .15% to .30%.

In a later investigation of this situation by W.H.R., (here reported from his notes), with the supplier of the bags in Montreal, it was learned that some (number or per cent of the total bags unknown) of the bags which were marked with a distinctive symbol had once contained rutile concentrates. The bags were sold as used but cleaned bags. W.H.R. further reports that, according to a check with Lerch

Bros., Seven Islands, the control samples were contained in bags carrying the same symbol. He therefore concluded that the high titania assays were probably due to titania contamination from the sample bags used, and as nothing could then be done about it the matter was ignored. No titania assays appear in the reports concerning the metallurgical investigations on the bulk material.

The writer did not think to include titania in the assay request concerning the samples of the 1962 trench stripping project.

Dravo conducted a pelletizing test on Julienne concentrates in January 1963. As Julienne and Wabush pellets were being compared, titania was requested, Julienne pellets collected during the test returned .04% titania, Wabush pellets .06% titania.

The 1962 titania oversight was corrected in 1963 when titania was requested in the control samples of the 12 test pits made in the fall. Titania in each of these samples was reported as nil by Lerch, Seven Islands.

The preceding account covers the period when Javelin felt that titania was not a problem and accordingly little effort was made to examine the situation. In the spring of 1965 however, Javelin found itself in the position whereby it could not conclusively demonstrate that there wasn't a titania problem to certain outsiders who were then concerned with the deposit. Time did not permit collection of evidence that year, so as a result the 1966 sample project was devised to collect sufficient evidence which would conclusively show what the titania content of the deposit is.

These samples are reported in the first part of this report where it will be noted that the titania content, based upon 30 composite outcrop samples and 5 samples collected directly from the 1960 test pits, is .05%, the same order of magnitude was found in the Wabush work, Boyum's 1957 samples and the Wabush and Julienne pellets. The importance of these samples was pointed out to Lerch Bros., Hibbing, and they assured the writer that there was no error in their calculations, admitting of course that only the first two figures in the reports are truly significant.

As the 1966 test pits have been sampled twice, the results are compared on the next page.

		Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Arith. Average
Fe	1960	34.56	27.54	45.02	42.86	31.61	36.32
Fe	1966	45.23	34.80	44.35	45.85	33.50	40.75
Silica	1960	50.07	58.97	35.09	36.47	53.33	46.79
Insol	1966	34.62	49.13	35.84	33.11	50.59	40.66
Mn	1960	.02	.08	.16	.14	.02	.084
Mn	1966	.06	.06	.20	.13	.08	.110
Phos	1960	.003	.008	.016	.012	.005	.009
Phos	1966	.005	.024	.008	.007	.005	.010
Sul	1960	trace	trace	trace	trace	trace	trace
Sul	1966	.009	.011	.008	.003	.006	.007
TiO_2	1960	.30	.15	.15	.30	.15	.21
TiO_2	1966	.031	.083	.042	.073	.070	.060

While two of the iron-insol pairs do not compare very well, the rest of the pairs compare reasonably well - except the titania. The 1966 titania returns are consistently lower by ½ or more of the 1960 reports, and the average is less than one third.

In conjunction with this project, nine other samples were assayed. These were taken from samples on hand that were originally collected during the Lakefield test runs. The assays are also by Lerch, Hibbing.

Sample Labels	%Fe	$\%TiO_2$
Ground ore, dry	39.81	.02
Ground ore, wet (now dry)	40.61	.02
Conc. 21, 22, 23, 24, 25, 26, (a composite of each above)	64.76	.05
Conc. 30, 31, 32, 33, (composite)	65.16	.04
Middling 43	64.35	.04
Conc. 40	62.36	.02
Conc. Dravo test	65.16	.06
Pellets, Dravo	65.15	.17

These results on crude and concentrated material are in line with previous evidence, though the increase of the Dravo pellets from .04 to .17 in the batch on hand is not explained. Another unexplained feature is why the report of the 1963 test pits is consistently reported as nil, when all other evidence indicates that the reports should be around .05. The pulps of these samples are no longer available.

In summary, 60 samples in the order of .05 titania average .037% when the 12 nils are included, the average is .046% when these 12 are excluded. Six returns in the higher bracket average .20% of titania, and 5 of these came from the 1960 control sample where there is evidence suggesting the possibility of contamination.

It is concluded that the evidence is overwhelming that .05 represents a fair estimate of the titania content of the Julian deposit.

The Iron Content

As over 250 samples have been collected from the deposit to date, and several grade figures appear in the literature depending upon the evidence available at the time, it would seem appropriate to bring all these sample results together and examine the data again. This review is concerned solely with samples of crude ore representative of iron formation in place. The examination treats these assays arithmetically, that is not weighted for respective sample lengths; to attempt to do so would introduce weighting inconsistencies which could not be evaluated.

1956 Samples, surface

40.63	38.77	29.14	34.48	38.85	27.76	43.70	1060.35
34.32	29.38	35.85	33.34	39.41	40.30	30.59	28
43.70	50.34	44.27	35.04	30.27	30.10	45.81	37.87%
30.27	45.56	42.00	45.16	35.93	46.13	39.25	Average

1957 Samples

B. Boyum's surface samples	43.65	46.60	42.10	132.35
				3
				Average
				44.12%

1957/58 Drill Hole Samples

1) Core / Sludge

Core				Sludge		
38.19	31.75	36.36	40.03	33.94	30.30	36.95
35.45	27.82	31.00	34.75	37.51	38.95	
36.80	30.95	30.16	811.95	(20.55)	33.34	501.79
30.13	46.25	31.05	23	32.54	42.48	14
31.52	41.07	31.81		39.65	31.74	Average
40.23	39.16	43.08	Average	38.37	35.59	35.84%
39.41	35.40	30.21	35.30%	34.68	35.75	

2) Core

42.36	39.40	30.91	
44.21	32.45	32.12	
(14.28)	49.18	37.53	686.81
42.82	36.20	(17.20)	18
(22.77)	34.60	45.33	
(11.94)	42.40	35.63	Average
(14.61)	36.50	39.06	38.16%
34.47	31.64		

Sludge

39.84	38.22	
36.37	46.33	
40.40	34.20	
37.33		356.33
(18.60)		9
42.36		Average
41.28		39.59%

3) Core

38.74	35.43	138.63
31.63	32.79	4
		Average
		34.66%

Sludge

(60.38)	37.98	36.85
36.36	34.90	146.09
		4
		Average
		36.52

4) Core

30.19	29.22	26.74
36.85	27.92	186.63
35.71	(5.52)	6
		Average
		31.10%

Sludge

38.63	30.68	149.98
44.80		4
35.87		Average
		37.49%

5) Core

(62.52)	36.29	32.42	35.17
(64.40)	34.52	32.34	271.21
35.96	31.93	32.58	8
			Average
			33.90%

6) Core

45.30	42.63	39.71	39.63	45.40	747.16
47.71	37.69	41.41	46.11	36.85	18
46.28	39.06	44.90	45.40		Average
40.85	30.63	49.92	27.68		41.51%

7)

38.82	32.37	38.69	32.95	
30.31	30.75	(53.09)	45.12	556.24 / 16
27.80	28.97	39.74		
31.56	32.70	39.85		
31.89	38.12	36.60		Average 34.76%

8)

34.57	29.95	39.12	200.79 / 6
(21.18)	30.19		Average
31.98	34.98		33.46%

9)

34.27	37.50	42.83	254.00 / 7
34.91	34.02		Average
29.98	40.49		36.28%

<u>1960 Test Pits control sample</u>

34.56	27.54	45.02	42.86	31.61	181.59 / 5 Average 36.32%

<u>Grinding Tests</u>

R2	36.68	39.64	466.75	
3	40.73	39.10	12	one reduced figure
4	40.37	39.28	Average	for 38½ tons
5	37.88	39.20	38.89%	
		38.86		
Humphry	34.59			
66 samples		39.81		
		40.61		

'62 Trench Samples

34.34	33.18	38.31	29.82	35.51	
36.71	33.68	37.35	36.07	38.55	783.04
35.51	39.84	33.18	35.50		22
30.54	44.56	27.01	34.30		Average
39.51	35.11	43.20	31.26		35.59%

1963 Test Pits

32.00	40.09	31.60	369.42
36.77	30.95	29.50	11
34.11	42.59	(18.35)	Average
30.47	31.68	29.66	33.58%

1966 Samples

41.43	34.98	33.18	33.37	32.23	45.23	
43.36	37.51	35.27	31.58	40.07	34.80	1356.59
47.71	43.76	37.51	32.54	37.40	44.35	36
42.47	34.14	35.43	36.29	42.80	45.85	Average
39.81	32.70	32.86	39.43	34.20	33.50	37.68%
42.07	35.43	33.18	39.59	33.82	36.75	

Average

The averages herein considered deal with normal grade iron formation whose assay values lie in a restricted assay range between 24% and 52% iron. Fourteen samples in the preceding lists are abnormal, these are bracketed and excluded in the calculations. The remaining 243 samples total 8,929.84 for an arithmetic average of 36.75% iron.

Grouped Data

The frequency plot of the data when grouped into 1% classes shows a distribution curve skewed to the right and with a distinct tendency for alternating peaks and valleys. The peak-valley arrangement does not significantly change if the classes are shifted ½%. It would appear, therefore, that the preference for peaks around 28, 31, 35, 39, 42, and 45% iron may be real features. If so, their geologic basis is not understood.

The skewness of the curve to the right immediately suggests a log normal distribution, which is common of most measures of natural phenomena. The midpoint values of the classes were converted to logarithms and plotted. This curve is considerably more symmetrical than the linear plot. Accordingly, the calculations were made on the logarithmetic basis.

The log mean is 36.38% iron, the standard deviation works out to minus 4.8% and plus 5.5%. The median and mode values remain as before, at 35.0% and 34.5% respectively.

A log normal curve was calculated and plotted about the mean. This has been converted to the linear plot for comparison with the actual curve. It will be noted that there is an excess of assays below 36% and above 43%, with a corresponding deficiency in the 36-43% interval. While one might suspect that surficial enrichment might be responsible for the lack of conformity to the normal curve, an analysis of the data shows that surface and subsurface samples are distributed approximately equally relative to each other across the range. At the moment it is not possible to tell whether the nonconformity to a log normal curve is due to the superposition of several geologic events or due to inadequate sampling. If there are geologic reasons for the lack of conformity, further sampling will not change the curve significantly, if it is due to an inadequate number of samples, then additional samples should tend to remove the irregularities of the curve.

Regardless of these considerations, two points are clearly evident.

1) The average grade of the deposit, regardless of whether one cares to use the mean, median, or mode, is clearly in the range of 35.5% $\pm$ 1% iron.

2) The distribution is broad, there being a 10.3% spread between the limits described by one standard deviation, which on a normal curve includes 68.3% of the samples.

<u>Excluded Samples</u>

The 14 samples excluded from the above average 28.96%

iron. When these are included in the calculations, the total is 9335.23, this yields an inclusive average of 36.33%, which corresponds well with the 36.38% derived from the log normal analysis.

Other Elements

This presentation would be incomplete if the data concerning the other elements were not considered. The following arithmetic averages are based upon the 1956 samples, the drill holes, 1960 test pits, 1962 samples, 1963 test pits, and the 1966 samples.

Iron	36.33 %	260 samples
Insoluble	46.85 %	195 samples
Manganese	0.34 %	252 samples
Phosphorus	0.014%	195 samples
Sulphur	0.005%	98 samples
Calcium Oxide	0.026%	17 samples
Magnesium Oxide	0.028%	17 samples
Titanium Oxide	0.046%	48 samples
Aluminum Oxide	0.198%	12 samples

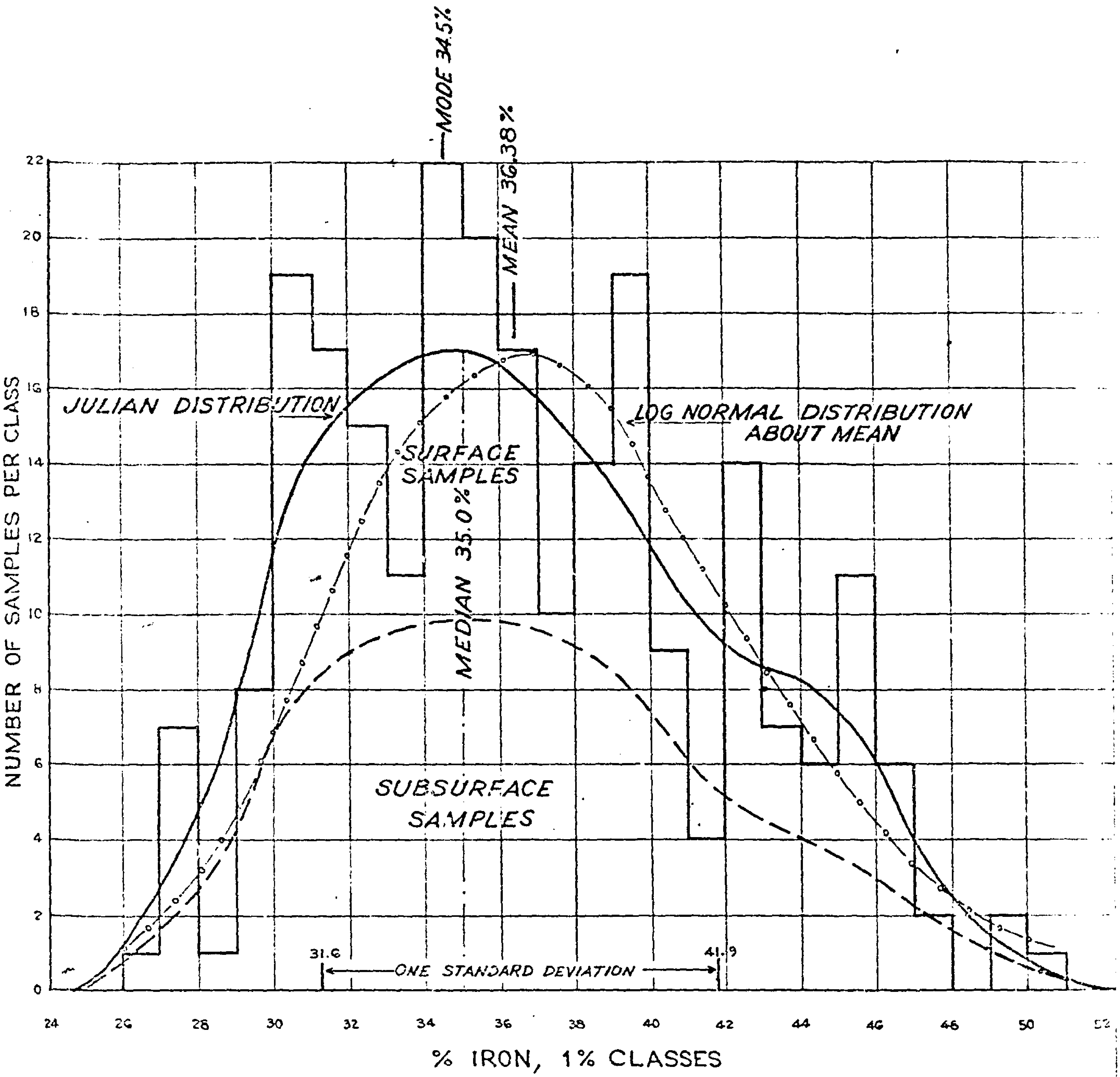
Conclusion

It is concluded that 35-36% iron represents a good working average for the most probable value for the average grade of the Julian deposit according to the presently available evidence.

SCANNED IMAGE

JULIAN DEPOSIT

IRON ASSAY FREQUENCY DISTRIBUTION



243 SAMPLES, INCLUDES ALL SAMPLES OF CRUDE ORE TO DATE
WORKING AVERAGE: 35.5±1%, S.D. +5.5, -4.8.

NOTE: *Based upon analysis of log normal distribution, here illustraded on a linear plot*

June 1967