82JNW001 (13E) MAG-07

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PROPERTY FILE

Summary Report
Mt. Brussilof Magnesite Deposit
(NTS map 32J/13E, 50° 48', 115° 39')

E. W. Grove Feb. 75

PROPERTY FILE

Summary Report on the Mt. Brussilof Magnesite Deposit

Location

The Mount Brussilof magnesite deposit is located about 20 air miles northeast of Radium Hot Springs, at the junction of Mitchell River and Assiniboine Creek (NTS map 82J/13E, 50° 48', 115° 39').

The claims lie about 8 miles west of the B. C. - Alberta border, about 4 miles south of Mount Assiniboine Provincial Park, and about 5 miles east of the eastern boundary of Kootenay National Park (Fig. 1).

Access

Best access to the mineral claim area is by helicopter. The route from Canal Flats along Settlers Road which involves at least three river fords and is impossible at high water is about 60 miles long. The area can also be reached from Radium via highway 93 and a bush road, a distance of about 30 miles. The claims and the immediate area are shown in Figure 2.

History

The occurrence of magnesite in major quantities was established by G. B. Leech in 1965 during routine field work (Leech, 1966). Thirty-six mineral claims (Mag 1-36) were staked and recorded by Mr. P. Roy Swainson of Calgary, and examined by Baykal Minerals Ltd of Calgary during 1969. The work included geological mapping and sampling. Baymag Mines Co. Ltd. was formed in 1971 to handle the 300 (±) claim property. In January 1972 the prospect was optioned to Canex Placer Ltd. who undertook an extensive program of exploration and development involving detailed geological mapping, diamond drilling and bulk sampling, metallurgical testing and research, production feasibility studies, and market analysis.

Canex Placer Ltd. dropped its option September 17, 1974 and the property has reverted to the vendors who are apparently attempting to reach marketing agreements with U. S. and European interests.

Geology

Magnesite occurs within the Middle Cambrian Cathedral Formation along the west flank of Mount Brussilof at the junction of Cross and Mitchell rivers. The Cathedral Formation is a 1,200 foot thick, cliff-forming unit comprising mainly sandy to argillaceous' fine grained, light to dark grey dolomite.

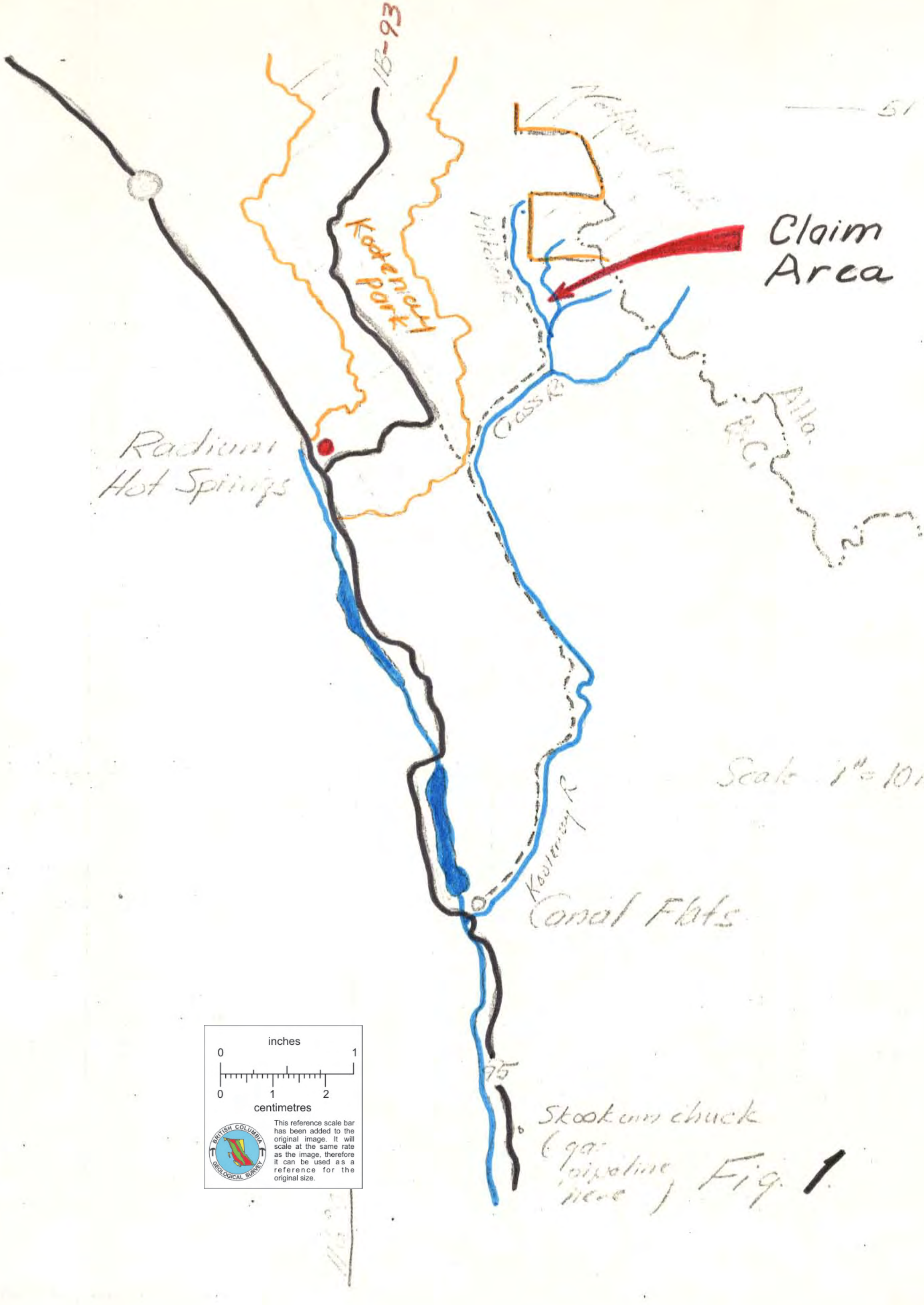

1B-93
Kootenay park
Claim Area
Mitchell R.
Radium Hot Springs
Cross R.
Alta.
B.C.
Scale 1" = 10 mi.
Kootenay R.
Canal Flats
95
Skookumchuck (gas pipeline here)

Fig. 1

The magnesite occurs as massive irregular lenticular bodies 200 to 300 feet thick within the dolomite. Two major magnesite zones (A & B zones) have been outlined within the Cathedral Formation in this area. A-zone has been traced across the upper, steep slope of Mount Brussilof and the upper slope of the ridge between Mitchell River and Assiniboine Creek. B-zone extends along the lower slope of Mount Brussilof and the ridge (Fig 3).

The magnesite is white to greyish in color, and varies from five grained and compact to very coarsely crystalline and friable. In places weathering has produced extensive surficial accumulations of magnesite sand.

The area of most immediate interest is the lower slope between Assiniboine Creek and Mitchell River where a large area of B-zone is exposed and has been explored in some detail by Canex Placer Ltd. (Fig. 4).

Exploration

The bulk of the exploration activity on the B-zone (Mag claims) took place during 1972 when 7,531 feet of BQ core drilling and 1,530 feet of 6 inch core drilling was carried out by Canex. The 6 inch core weighing about 27 tons was used in subsequent metallurgical studies.

Mineral Reserves

The work carried out by Canex has partially outlined a complexly shaped, cigar-like zone of magnesite aggregating from 15-20 million tons of better than 93% MgO. The deposit has not been delimited, that is, more drilling would increase the present geological reserve significantly

Results of the 1972 Canex assay program published by Baymag Mines Co. Ltd. (1972) is as follows.

Cut-off	Tons	MgO	Fe_2O_3	CaO	SiO_2	Al_2O_3
90%	21,265,000	95.70	0.92	2.19	0.47	2.25
95%	14,748,000	96.68	0.63	1.90	0.39	0.21
96%	10,413,000	97.15	0.53	1.74	0.35	0.18
97%	5,857,000	97.69	0.47	1.53	0.28	0.14
98%	1,807,000	98.28	0.44	1.38	0.23	0.12

Mining

An open pit operation is the only method deemed feasible but is of course subject to the ususal variables that afflict any such operation. The 'Gaps', Nevada magnesite deposit has been studied by Canex because of its comparability. Grade control and grain size control must be considered in the mining operation.

Metallurgy

Canex encountered a number of serious technical difficulties during the metallurgical testing and preparation of a product of the desired density and purity. The market requirement for a higher class of refractory than has been in normal use has come about because of the change over of the steel-making industry from the open-hearth to the basic oxygen furnace process.

As a result of this changing demand the $CaO:SiO_2$ ratio, the Fe_2O_3 content, and even the initial grain size of the magnesite have become controlling parameters. A major problem also encountered by Canex was in the dead-burning of the Baymag magnesite to produce a final product with a specific gravity as close to 3.56 g/cm^3 as possible. The initial technique involved a final double (two stage) burning after briquetting. Canex's most recent advance has been to develope a more economical one-stage burn. The basic flow chart essentially involves:

(1) Grinding - (2) pyrite floatation and separation - (3) briquetting - (4) burning

The metallurgical studies have led to a near solution for the material from the Baymag magnesite but more testing is required.

Marketing

A major problem encountered by Canex was marketing. Magnesite sales etc are apparently exploited by a European cartel with Greece the leading exporter. Also the continually changing economic parameters, including rising energy and labor costs resulted in hazy forecasting.

Conclusions

The geological mineral reserves of the Baymag magnesite deposit are considered (by Canex) of an adequate size and grade to support a world-scale plant. There appears to be no need for further geological inventory but more metallurgical testing, plant location, transportation, production study, market analysis and energy considerations are necessary. These last items include a wide spectrum of problems which have been considered in detail by Canex Placer in their most recent feasibility studies.

E. W. Grove,
Senior Geologist

References

Baykal, Orhan (1969): Preliminary geological report on the Mag 1 to 36 mineral claims (Ass. Rept. 2048).

Baymag Mines Co. Limited (1972): Interim Report

Leech, G. G. (1966): Kananaskis Lakes, W ½, Area, G.S.C. Paper 66-1

McCammon, J. (1973, 1972) Magnesite, in G.E.M., B.C. Dept. of Mines.

Palfreyman, M (1974): Refractory grade magnesia in Canada, C.I.M., March, p. 148-154.

BENEFICIATION POTENTIAL
OF
BAYMAG MINES CO. LIMITED
MAGNESITE RESERVES

Compiled by?

November, 1975

November 5, 1975

Beneficiation Potential of Baymag Magnesite

(1) Placer's drilling and laboratory work indicates drilled reserves of some 21,265,000 short tons with MgO contents in excess of a 90% MgO cutoff.

(2) These reserves can be grouped into three major grade categories having the following average characteristics:

	High Grade 97%+ MgO	Medium Grade 95% to 97% MgO	Low Grade 90% to 95% MgO
Reserves			
MM tons	8	8	5.26
%	37.63	37.63	24.74
Composition Dead Burn Bases			
MgO	97.37	95.92	94.02
CaO	1.648	2.25	2.92
Fe_2O_3	.498	.857	1.630
SiO_2	.315	.495	.658
Al_2O_3	.162	.272	.348
HFI	.010	.204	.415
CaO/SiO_2	5.24	4.55	4.44
Waste/Ore	2.13	.52*	.18*

* These waste to ore ratios are based on cumulative borehole penetrations and in each case refer to the grade in question plus all material of higher quality.

(3) Flotation research by Acres, Placer and Veitscher indicates that two stage flotation can be used to first float pyrite from the raw magnesite followed by a second float which reduces CaO, SiO_2, Al_2O_3, and to a degree hydrofluoric acid insolubles in the final dead burn product. Acres' work indicates that a relatively efficient reduction in Fe_2O_3, as is illustrated by Figure 1, can be achieved with 5% of feed loss as float.

The second stage float should reduce CaO, SiO_2, Al_2O_3, according to the relationships shown by Figures 2, 3 and 4. As can be seen, the relationships for SiO_2 and Al_2O_3 are based on limited data. There is some indication from Placer's work that HFI will follow SiO_2 and reduce to the same extent. The second stage float results can be achieved with a 20% loss of second stage float feed.

(4) Although the average grade of the high grade ore may be acceptable without benefication, some improvement can be made through flotation. In addition, flotation can better assure uniformity of grade and allow greatly simplified and cheaper mining operations.

(5) At this stage, without further guidance from marketing outlets and optimization of selective mining and flotation procedures, the following approximate material balances are only meant to illustrate in a general way the upgrading potential for the project designed to minimize mill reject, and hence tailings disposal and at the same time maximize the amount of marketable product produced.

(6) Applying the measured flotation efficiencies to the three major mine product categories gives the following range of products:

High Grade Ore

Feed Composition On Dead Burn Basis

MgO	97.370 %
CaO	1.648
Fe_2O_3	.498
SiO_2	.315
Al_2O_3	.162
HFI	.010
CaO/SiO_2	5.24

Mass as % of Mill Feed on Dead Burn Basis = 37.63%

95% 5%

Sink HGI

MgO	97.414
CaO	1.649
Fe_2O_3	.450
SiO_2	.315
Al_2O_3	.162
HFI	.010
CaO/SiO_2	5.23
Mass	.3573

Float HGI

MgO	96.487
CaO	1.633
Fe_2O_3	1.397
SiO_2	.312
Al_2O_3	.160
HFI	.010
CaO/SiO_2	5.23
Mass	.01898

80% 20%

Sink HG2

MgO	98.156
CaO	1.209
Fe_2O_3	.453
SiO_2	.111

Float HG2

MgO	94.591
CaO	3.310
Fe_2O_3	.437
SiO_2	1.098

Al_2O_3	.060
HFI	.010
CaO/SiO_2	10.89
Mass	.2837

Al_2O_3	.553
HFI	.010
CaO/SiO_2	3.01
Mass	.07359

Medium Grade Ore

Feed Composition
On Dead Burn Basis

MgO	95.92
CaO	2.25
Fe_2O_3	.857
SiO_2	.495
Al_2O_3	.272
HFI	.204
CaO/SiO_2	4.55
Mass	.3763

95% ↓ 5% ↓

MG Sink 1

MgO	96.314
CaO	2.259
Fe_2O_3	.452
SiO_2	.497
Al_2O_3	.273
HFI	.205
CaO/SiO_2	4.54
Mass	.3560

MG Float 1

MgO	89.068
CaO	2.089
Fe_2O_3	7.941
SiO_2	.459
Al_2O_3	.252
HFI	.189
CaO/SiO_2	4.54
Mass	.02026

80% ↓ ↓ 20%

Mg Sink 2

MgO	97.684
CaO	1.521
Fe_2O_3	.458
SiO_2	.172
Al_2O_3	.091
HFI	.071
CaO/SiO_2	8.82
Mass	.2809

Mg Float 2

MgO	91.274
CaO	4.938
Fe_2O_3	.434
SiO_2	1.703
Al_2O_3	.949
HFI	.702
CaO/SiO_2	2.90
Mass	.0751

Low Grade Ore

Feed

MgO	94.020
CaO	2.920
Fe_2O_3	1.630
SiO_2	.658
Al_2O_3	.348
HFI	.415

CaO/SiO_2	4.44
Mass	.2474

95% | 5%

LG Sink 1		LG Float 1	
MgO	95.000	MgO	78.963
CaO	2.950	CaO	2.452
Fe_2O_3	.616	Fe_2O_3	17.390
SiO_2	.665	SiO_2	.553
Al_2O_3	.351	Al_2O_3	.292
HFI	.419	HFI	.348
CaO/SiO_2	4.43	CaO/SiO_2	4.43
Mass	.2326	Mass	.0147

80% | 20%

LG Sink 2		LG Float 2	
MgO	97.012	MgO	87.864
CaO	1.889	CaO	6.654
Fe_2O_3	.629	Fe_2O_3	.582
SiO_2	.235	SiO_2	2.206
Al_2O_3	.112	Al_2O_3	1.209
HFI	.122	HFI	1.486
CaO/SiO_2	8.04	CaO/SiO_2	3.02
Mass	.1823	Mass	.0527

(7) Without further processing or adjustment of constituents, the above flotation process applied to the three main categories of drilled ore would result in 12 different products. Some of this material may be acceptable as kiln feed without further adjustment of composition, some may require blending, and some may be further beneficiated through third and fourth stages of flotation. Again specific input is required from marketing outlets as to the specific desirable compositions required and the relative value of the resulting products such that these values can be compared to the practicality of achieving them and the incremental costs of doing so.

(8) Some possible further steps in product design and production are outlined below:

A. Adjustment of CaO/SiO_2 Ratios

In a paper titled "New Developments in Dead-Burn Magnesite and Dead-Burn Dolomite" by Gilpin and Spencer, their Figure 3 illustrates the optimum CaO/SiO_2 ratios as functions of

SiO_2 content in high grade dead burn magnesites. The attached Figure 5 illustrates a replot of this data both as mole ratios and weight ratios. As shown above, the highest grade flotation product is HG Sink 2 obtained by double floating the highest grade major ore category material. This product has a CaO/SiO_2 weight ratio of 10.89 which is far from optimum according to Gilpin and Spencer's data. However, the addition of a small amount of SiO_2 before fine grinding prior to dead burning would adjust this ratio to the optimum. For example,

Sink HG2		Adjusted Final Sink HG2 Product	
MgO	98.156	MgO	97.832
CaO	1.206	CaO	1.202
Fe_2O_3	.453	Fe_2O_3	.451
SiO_2	.111 + .3330 =	SiO_2	.444
Al_2O_3	.060	Al_2O_3	.059
HFI	.010	HFI	.010
CaO/SiO2	10.89	CaO/SiO2	2.7
Mass	.2837	Mass	.2870

Similarily other flotation products might be adjusted through the addition of SiO_2 to provide optimum CaO/SiO_2 ratios. As illustrated by Figure 6, there do not appear to be many dead burn magnesites on the market with optimum CaO/SiO_2 ratios.

B. Blending and Refloating

To minimize tailings disposal and maximize saleable product income, it is probable that some blending and refloating could be economically used to reduce the number of plant products but still produce a range of output suitable in part for the high grade refractory business (aimed at the steel industry) as well as lessor grades of refractory material aimed at the cement kiln industry (where higher CaO and Fe_2O_3 contents are satisfactory) and similar uses.

For example: We might maintain separately - HG Float 2, MG Float 2, and LG Float 3, blend all remaining material with MgO contents in excess of 90% and refloat the blend and discard as tailings MG Float 1, LG Float 1 and LG Float 2.

Thus, we would proceed with;

(i) Blend HG Float 1, HG Float 2, MG Float 2, to get a blended product with the following specifications:

Blend 1	
MgO	93.320
CaO	3.849
Fe_2O_3	.544
SiO_2	1.280
Al_2O_3	.689
HFI	.319
CaO/SiO_2	3.00
Mass	.17087

(ii) This may be a significant marketable product constituting 17.087% of plant feed or it might be further upgrading with a single float to reduce CaO, SiO_2, Al_2O_3 and HFI. Such a float should yield:

Blend Sink 1 - 80%	
MgO	96.260
CaO	2.370
Fe_2O_3	.561
SiO_2	.453
Al_2O_3	.237
HFI	.113
CaO/SiO_2	5.22
Mass	.1327

Blend Float 1 - 20%	
MgO	83.430
MgO	8.727
Fe_2O_3	.486
SiO_2	4.102
Al_2O_3	2.232
HFI	1.022
CaO/SiO_2	2.12
Mass	.0382

(9) In summary then, we could produce four flotation products as follows:

	Sink HG 2	Sink MG 2	Sink LG 2	Blend Sink 1
MgO	98.156	97.685	97.012	96.260
CaO	1.209	1.521	1.889	2.370
Fe_2O_3	.453	.458	.629	.561
SiO_2	.111	.172	.235	.453
Al_2O_3	.060	.091	.112	.237
HFI	.010	.071	.122	.113
CaO/SiO_2	10.89	8.82	8.04	5.22
Mass	.2837	.2809	.1823	.1327

The total mass of these products would be equivalent to 87.96% of the mill feed on a dead burn basis.

(10) If our market outlets requested optimized CaO/SiO_2 ratio products, the above products could be modified through small silica additions to produce:

	Sink HG 2A	Sink MG 2A	Sink LG 2A	Blend Sink 1A
MgO	97.832	97.238	96.432	95.622
CaO	1.202	1.514	1.877	2.354
Fe_2O_3	.451	.455	.625	.557
SiO_2	.444	.617	.834	1.121
Al_2O_3	.059	.097	.111	.234
HFI	.010	.078	.121	.112
CaO/SiO_2	2.7	2.45	2.25	2.09
Mass	.2870	.2829	.1844	.1351

(11) The tailings under this scheme would consist of a mixture of Float MG 1, Float LG 1, Float LG 2 and Blend Float 1 having a combined composition of:

MgO	85.67
CaO	6.06
Fe_2O_3	3.70
SiO_2	2.31
Al_2O_3	1.26
HFI	1.00
CaO/SiO_2	2.62
Mass	.1204

Since the acid generating potential of the small amount of pyrite contained in these tailings would be more than offset by the acid neutralizing characteristics of the MgO and CaO, tailings disposal in a form environmentally acceptable should be relatively easy to accomplish.

(12) Considering the configuration and distribution of grades in the orebody, it seems probable that it will prove to be more practical to mine and crush various grades in a sequential manner with periods of the sequence probably measured in weeks or even months. Thus, it seems probable that one major ore grade might be processed through the plant at a time rather than several grades simultaneously through parallel circuits. This in turn will require greater than normal raw ore storage and blending facilities at the plant inlet and similar storage and blending facilities for various grades of dead burn product.

C. F. Agar

Reduction of Fe_2O_3 in Baymag Dead Burn Magnesite Achievable T ough Raw Magnesite Fl ation.

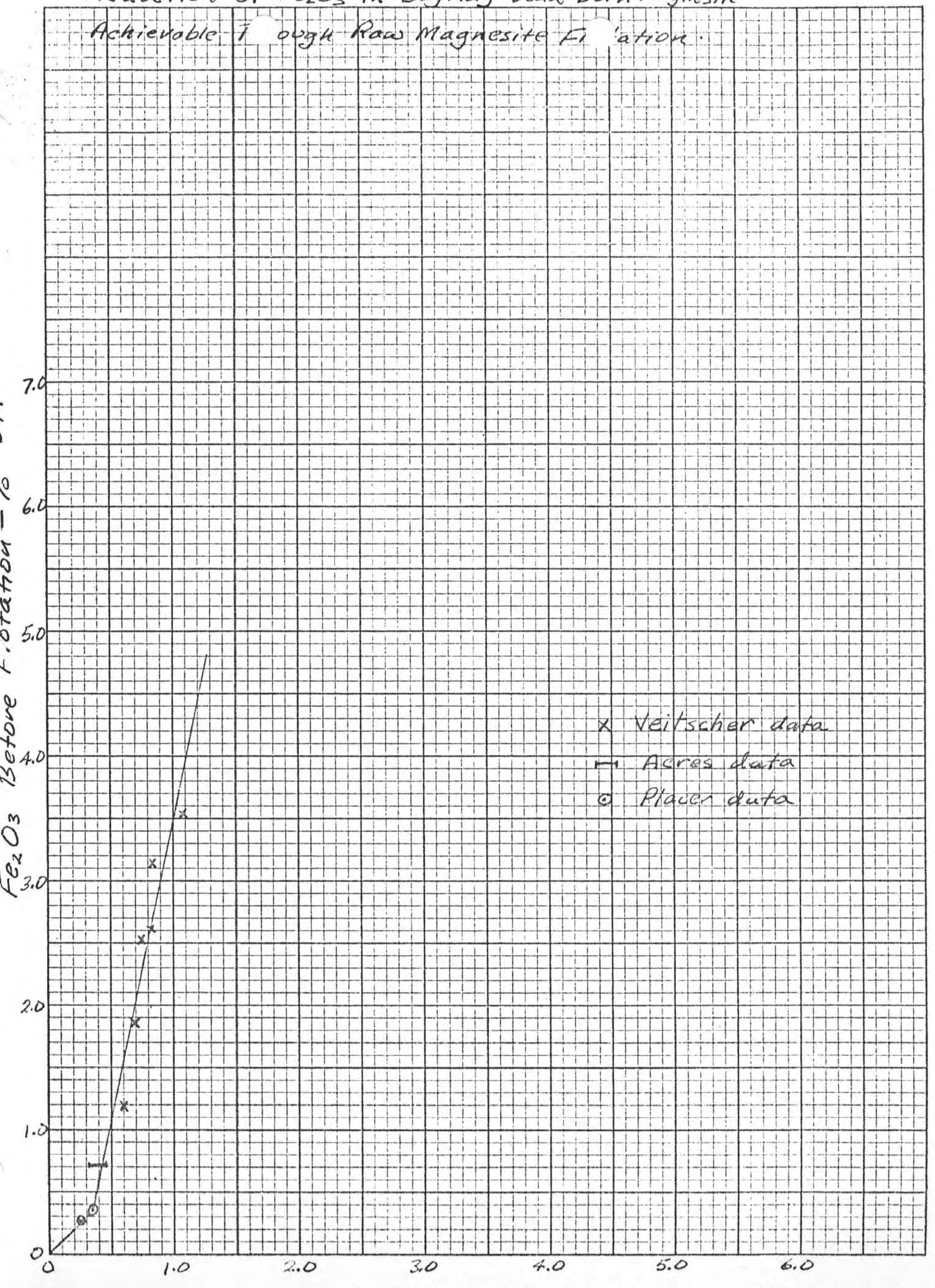


Fig. 1

Reduction in CaO in Baymag Dead Born Magnesite
Achievable Through Raw Magnesite Flotation

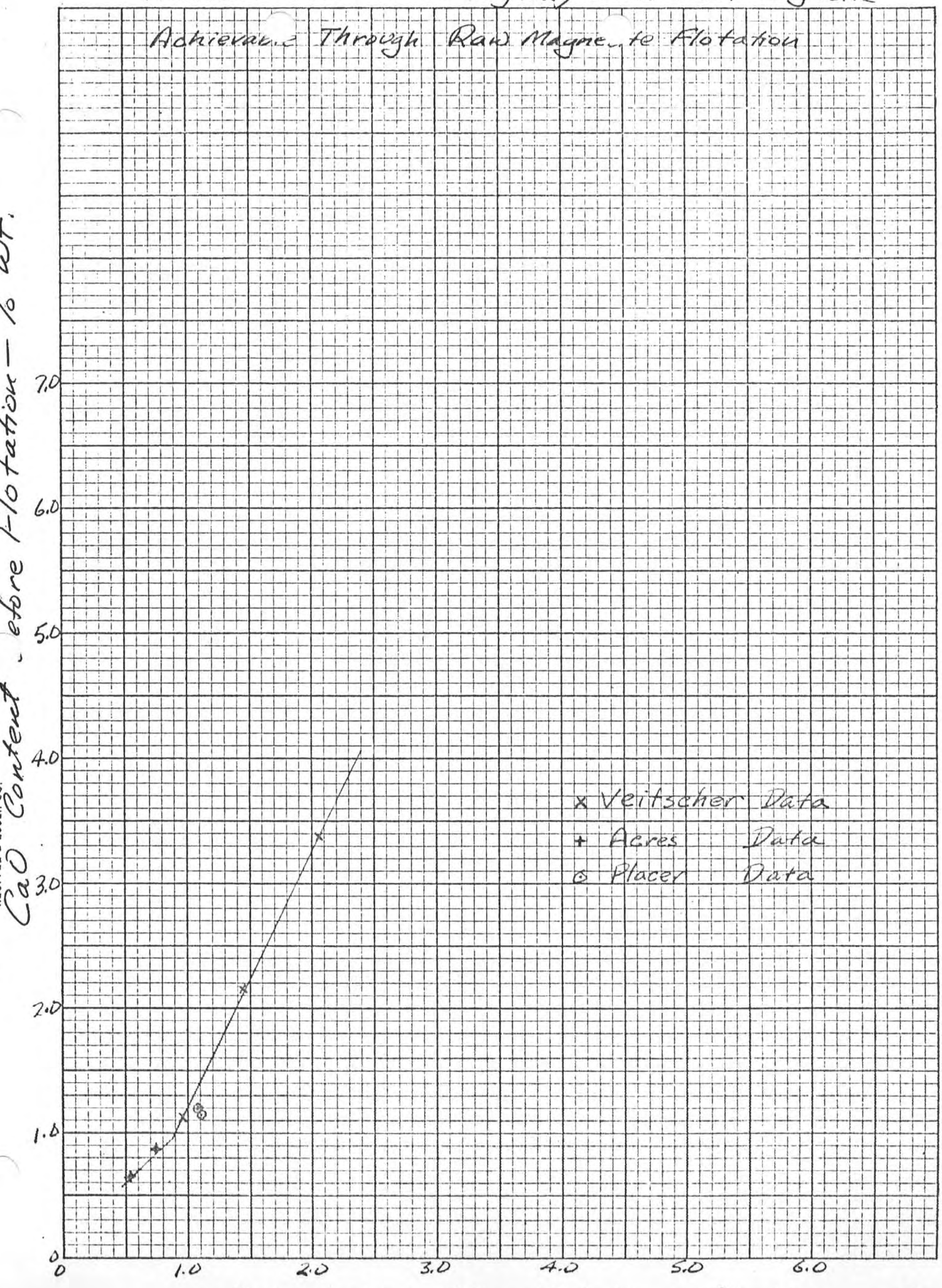


Fig. 2

Reduction in SiO2 in Daymag Dead Burn Magnesite
Achie[illegible]ble Through Raw M[illegible]gnesite Flotation

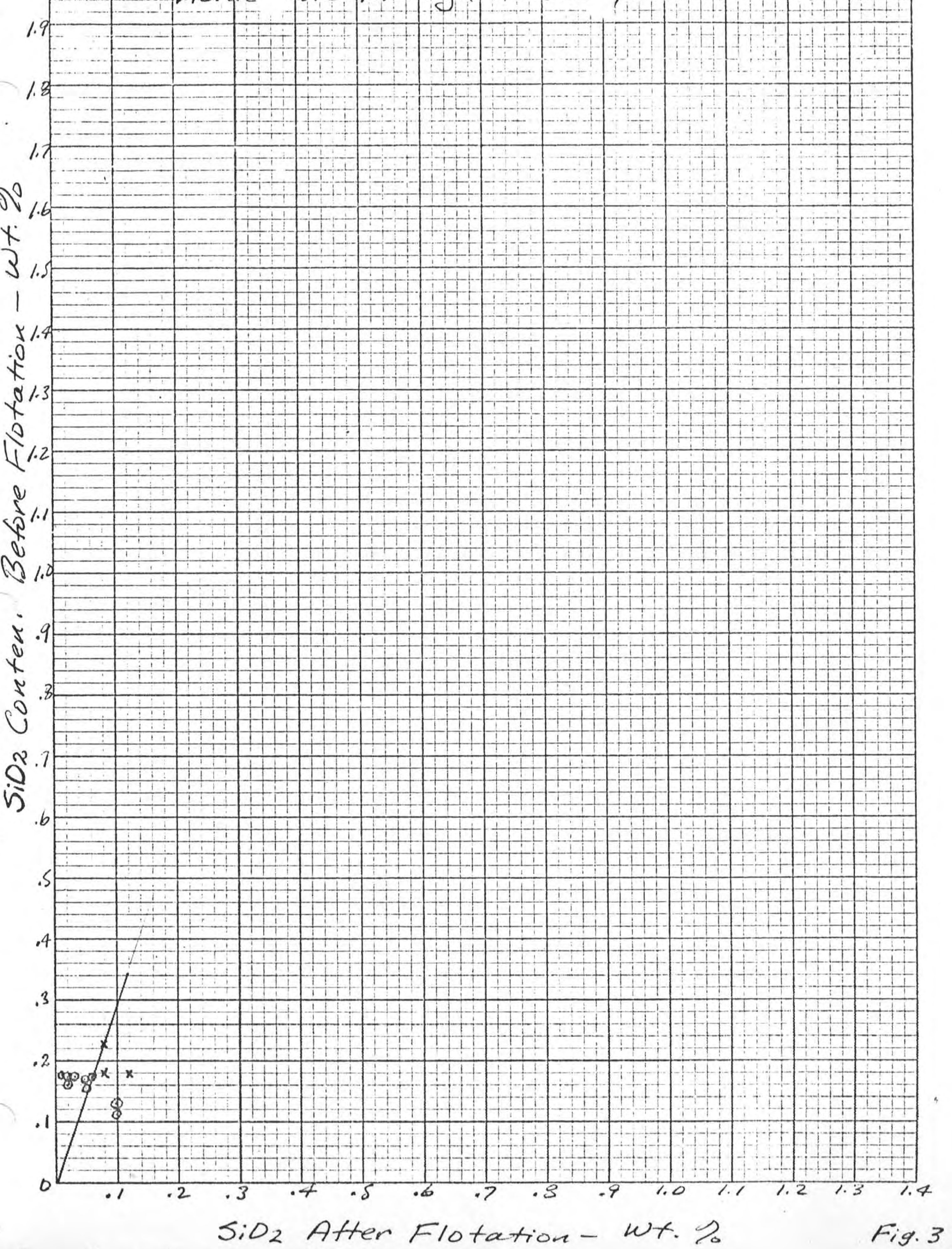


Fig. 3

Reduction of Al_2O_3 in Baymag Dead Burn Magnesite Achievable Through Raw Magnesite Flotation

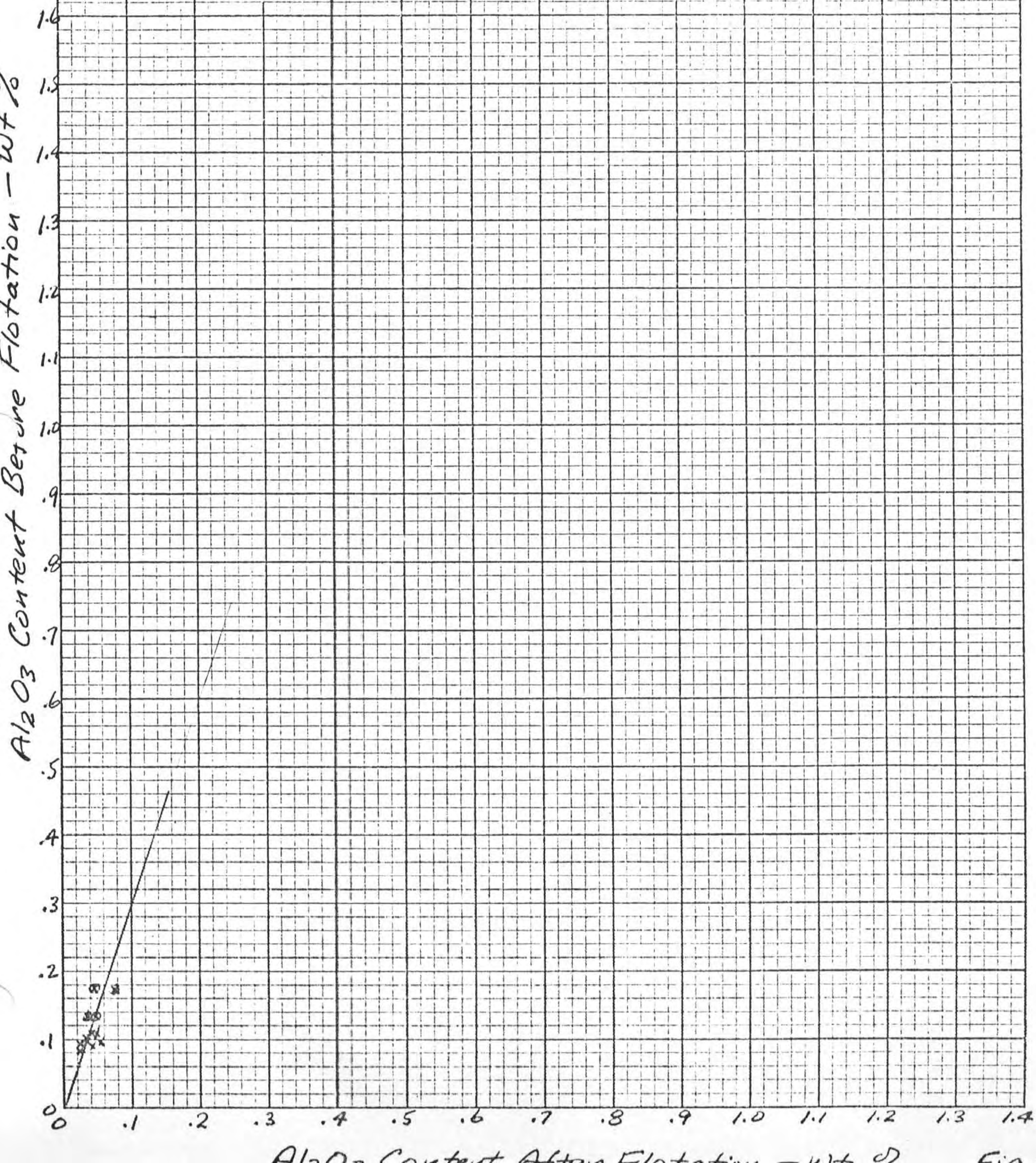
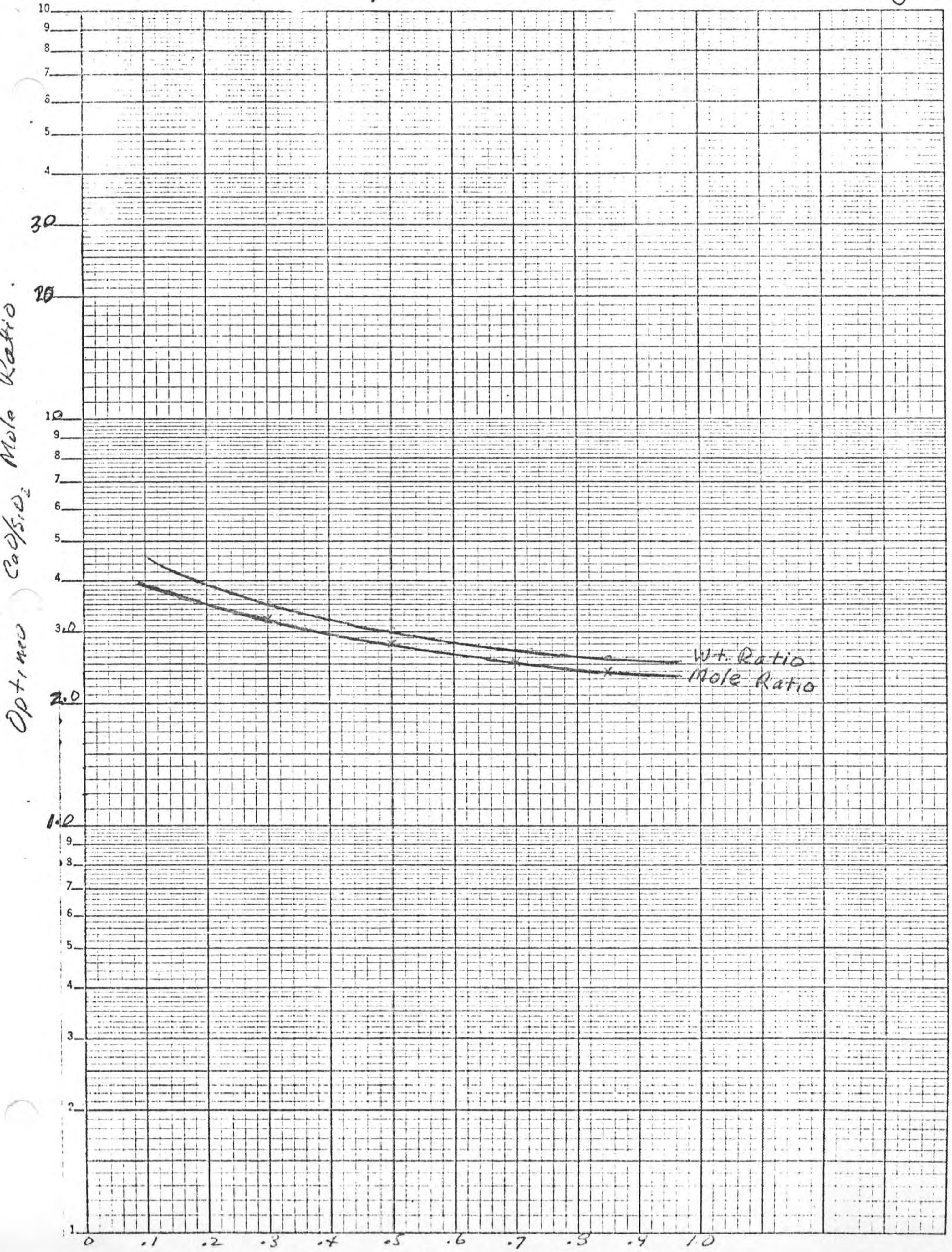
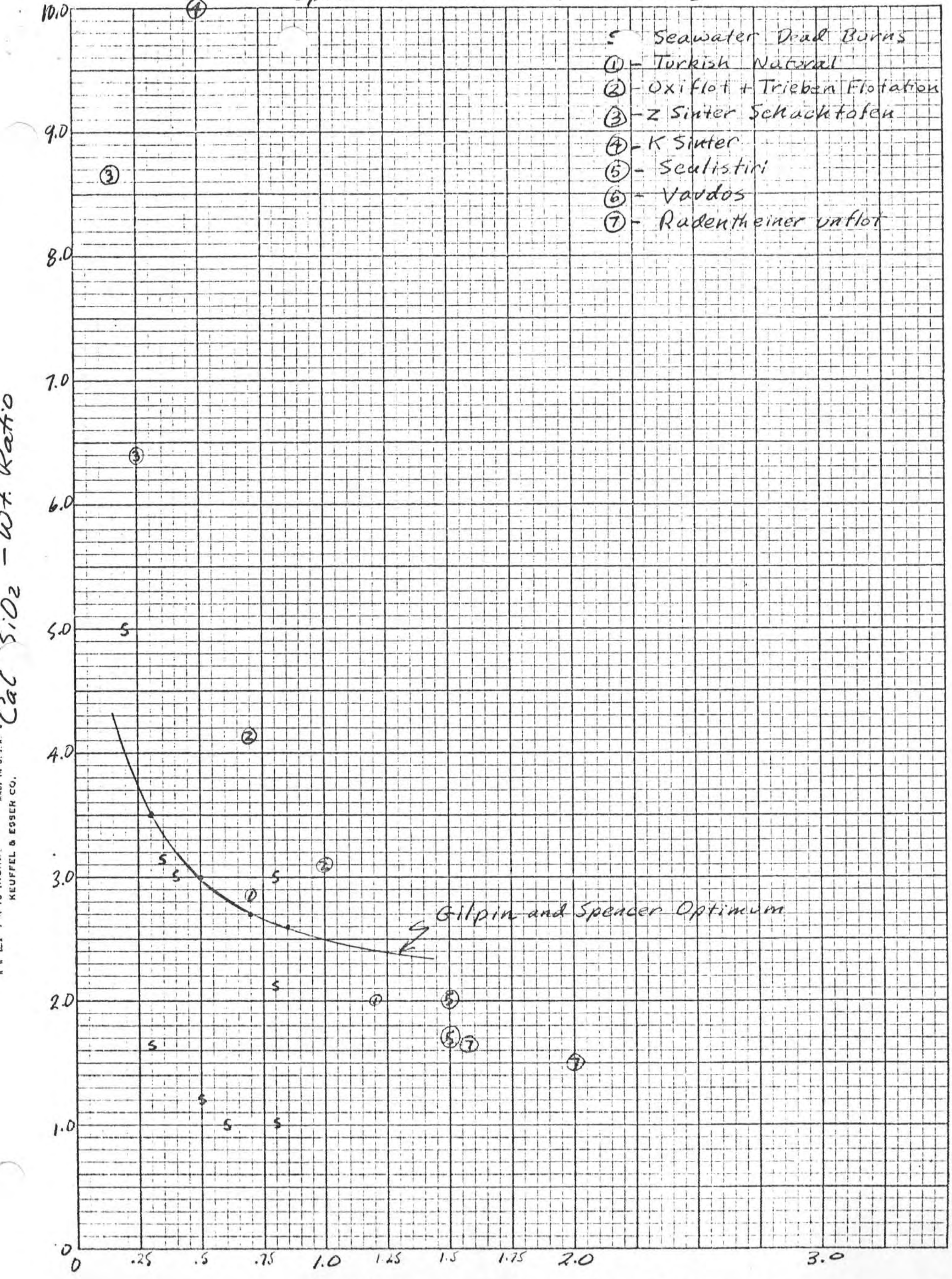


Fig. 4

Gilpin and Spe -er Optimum CaO/SiO_2 Ratios – Dead Burn Magnesite



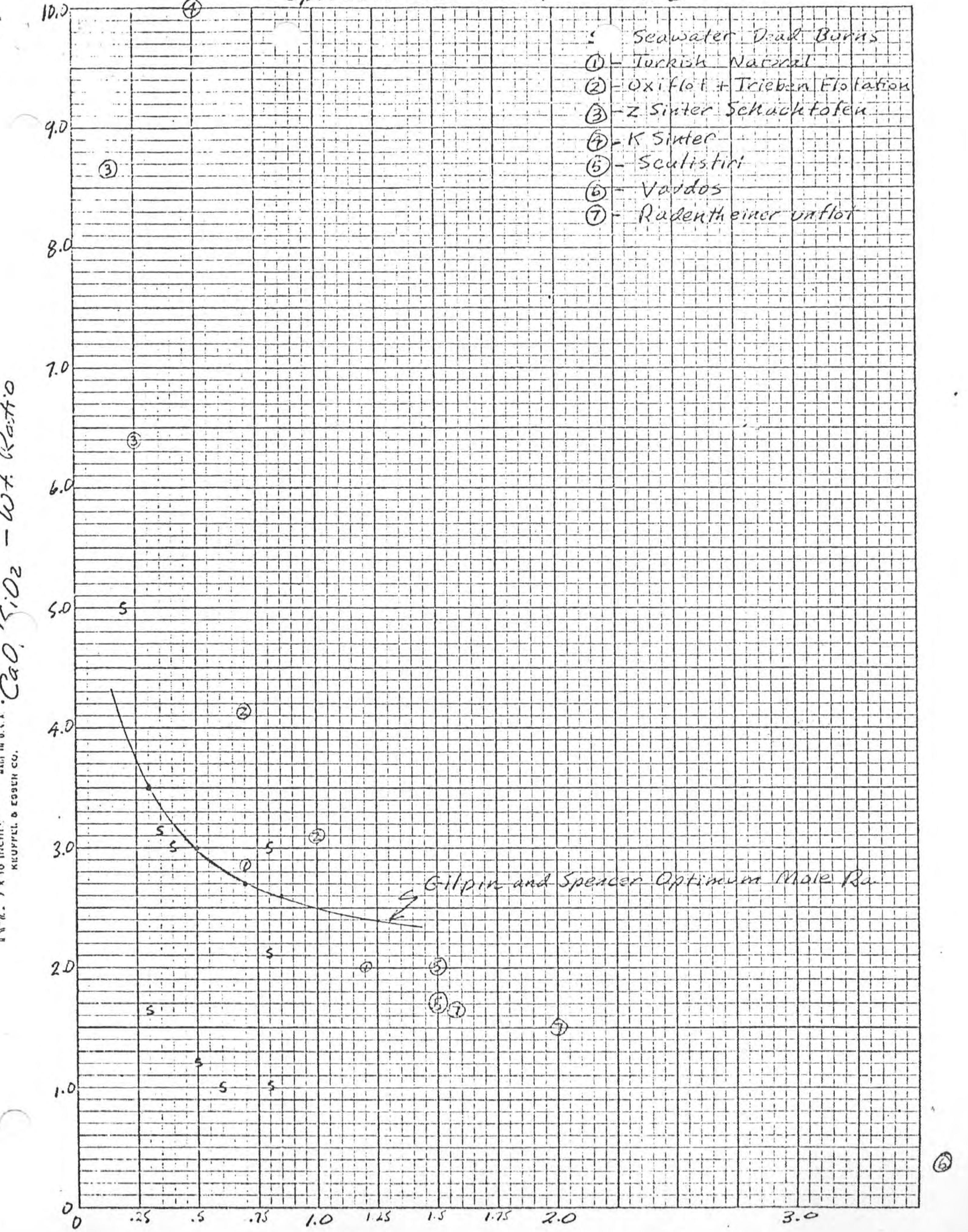
Optimum and Actual /SiO$_2$ Ratios



% SiO$_2$ by Wt. in Dead Burn Magnesite

Fig. 6

Optimum and Actual CaO/SiO2 Ratios



% SiO2 by Wt. in Dead Burn Magnesite Fig. 6

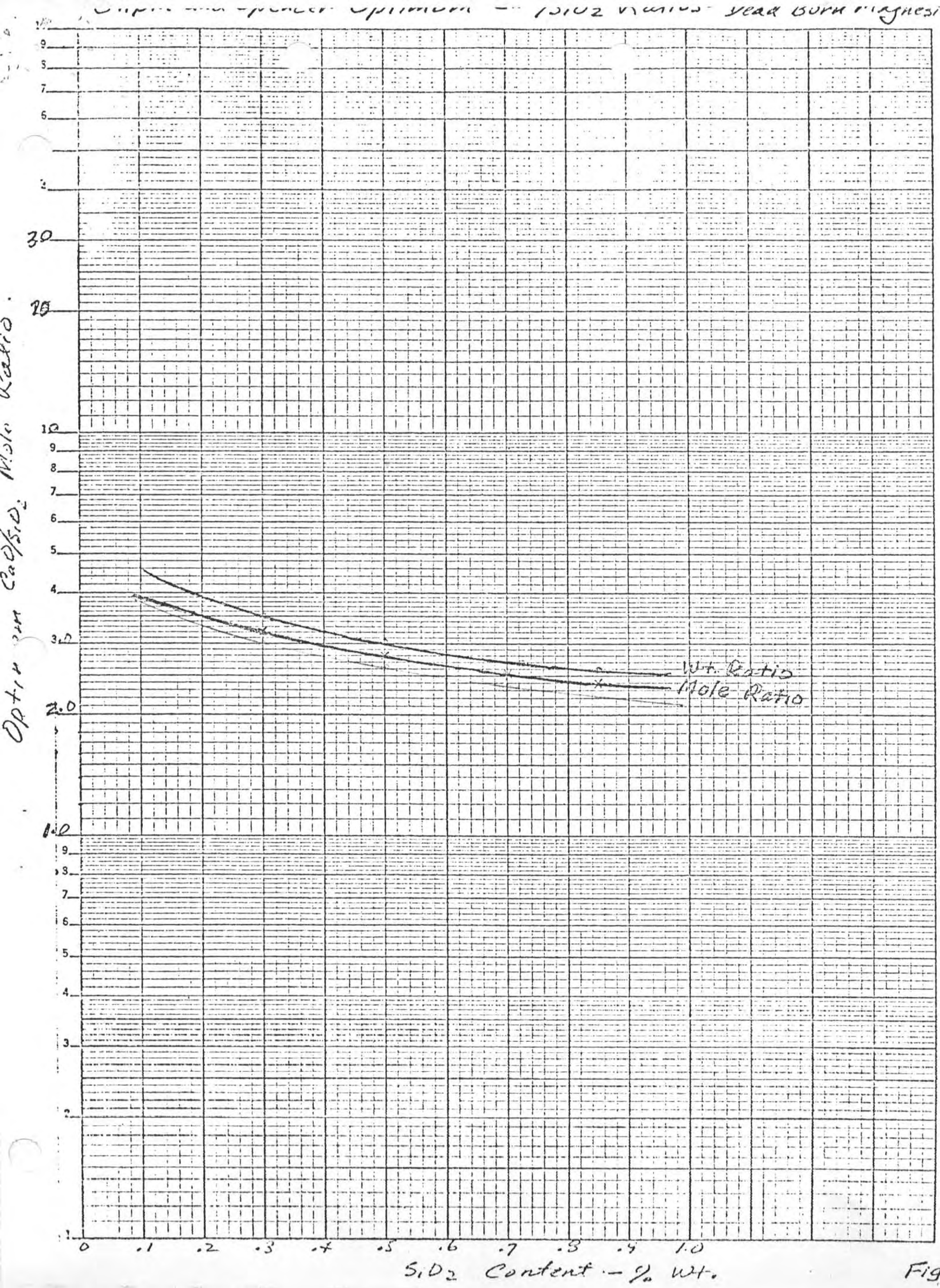
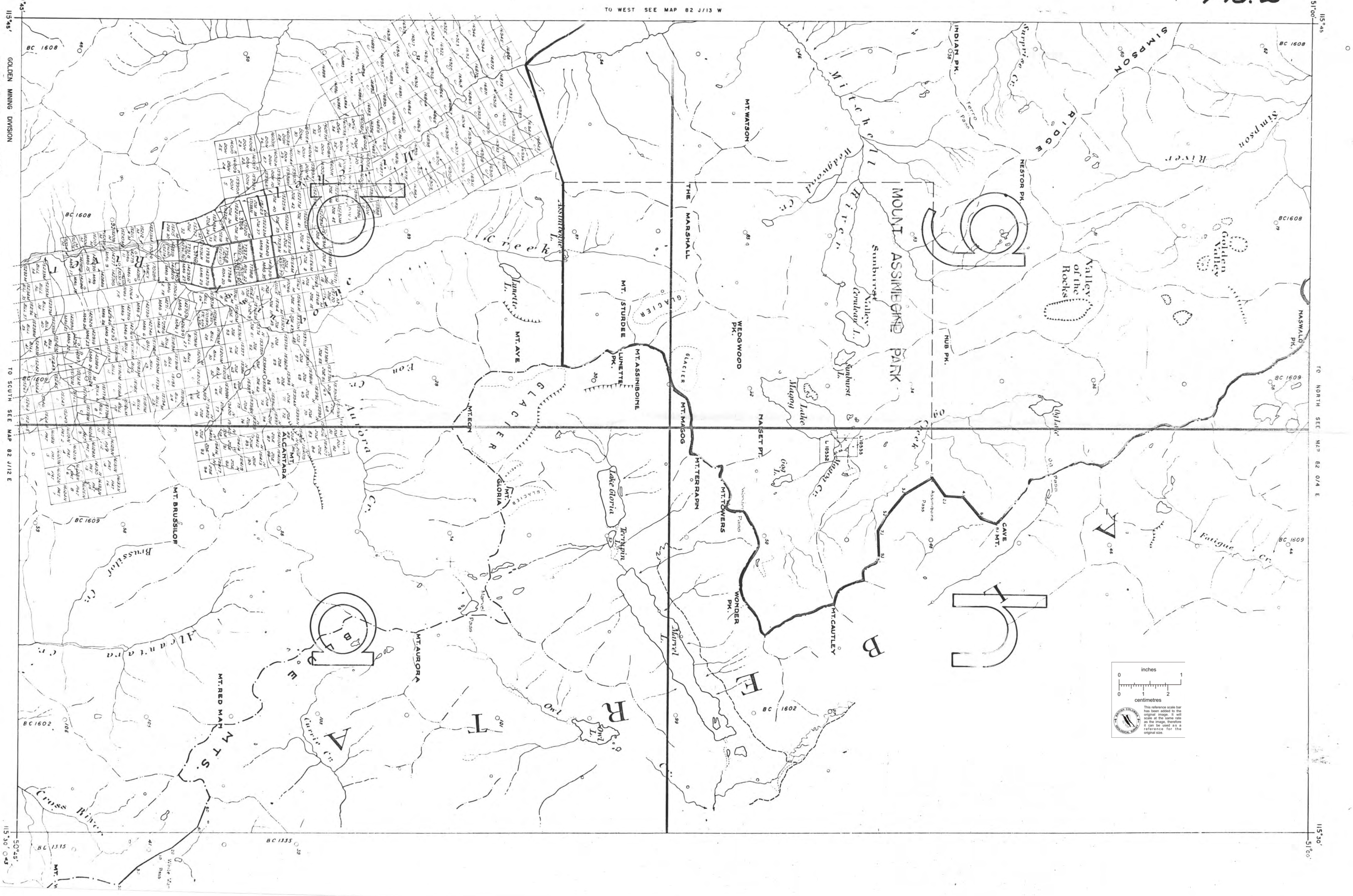

Optimum — /SiO2 Ratios- Dead Burn Magnesite
Optimum CaO/SiO2 Mole Ratio
30
20
10
9
8
7
6
5
4
3.0
2.0
1.0
Wt. Ratio
Mole Ratio
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
SiO2 Content - % wt.

Fig. 5

M 82J/13E

FIG. 2



GOLDEN MINING DIVISION

DEPARTMENT OF MINES AND PETROLEUM RESOURCES

MINERAL TITLES REFERENCE MAP 82J/13E

This map is prepared only as a guide to the location of mineral claims and Placer Mining Leases as shown on the locator's sketches. For current or more specific information, application should be made to the Mining Division concerned.

Map prepared by d l fox
from Air Interim 82J/13E
drawn from aerial photograghs dated 1952