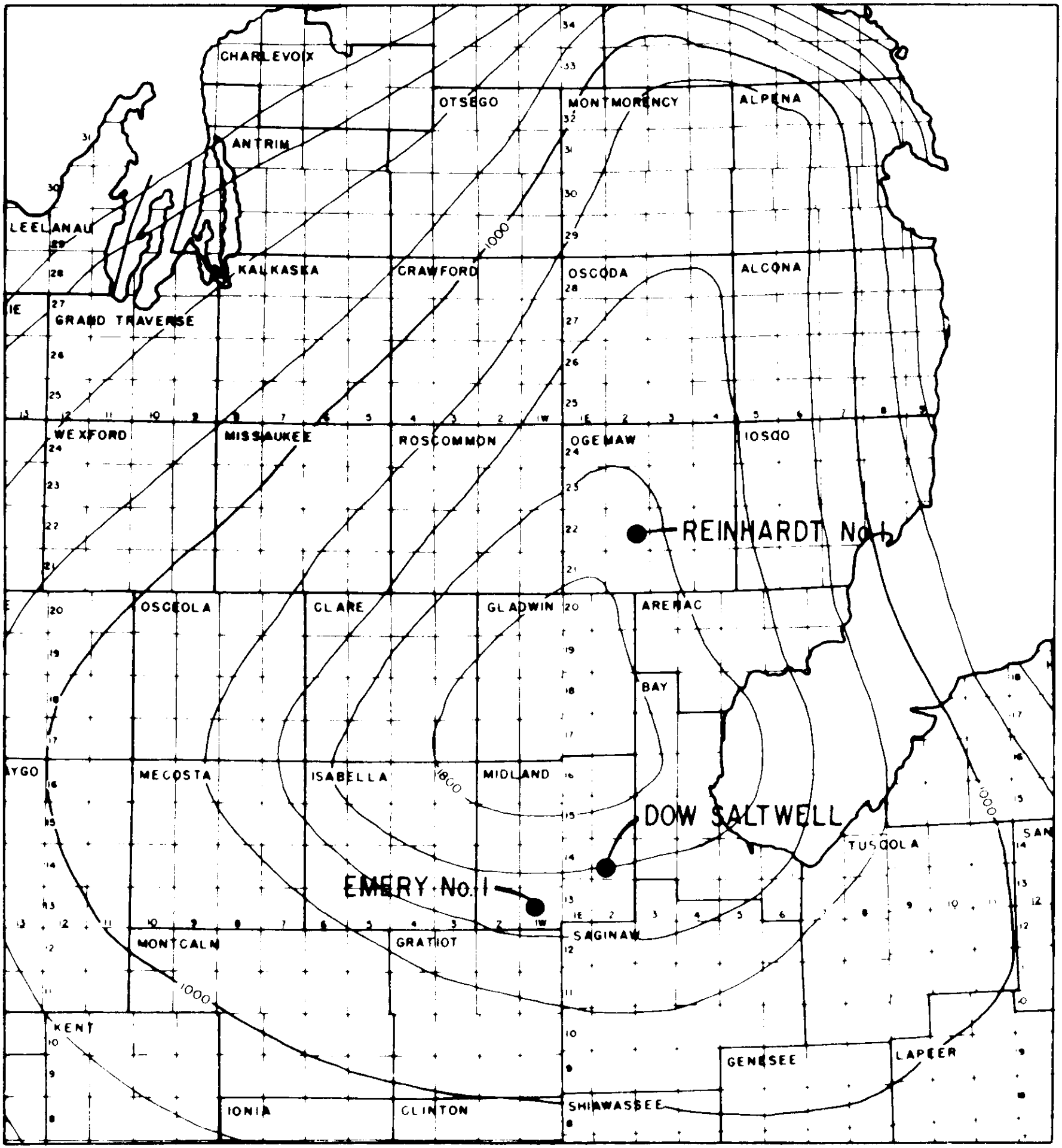
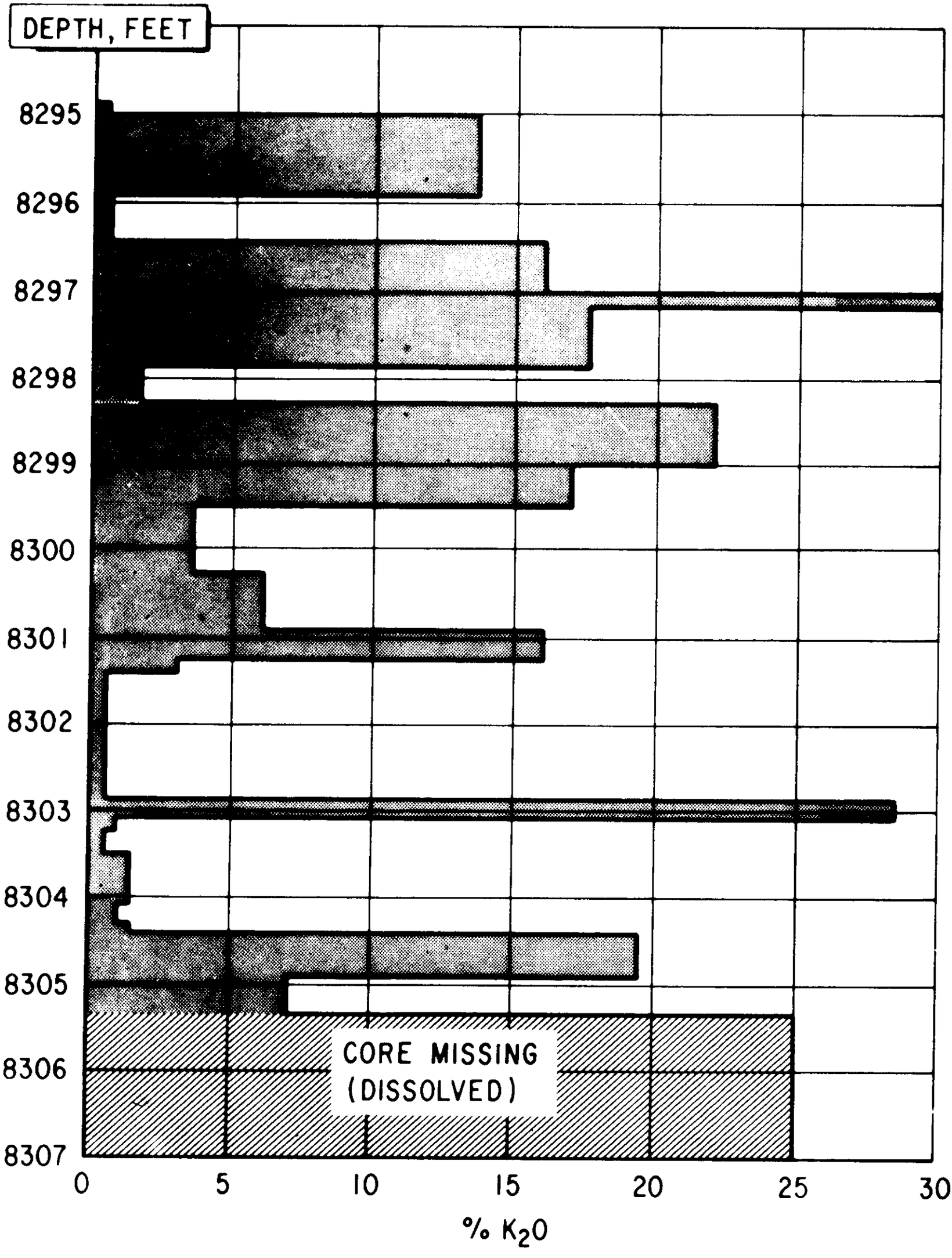
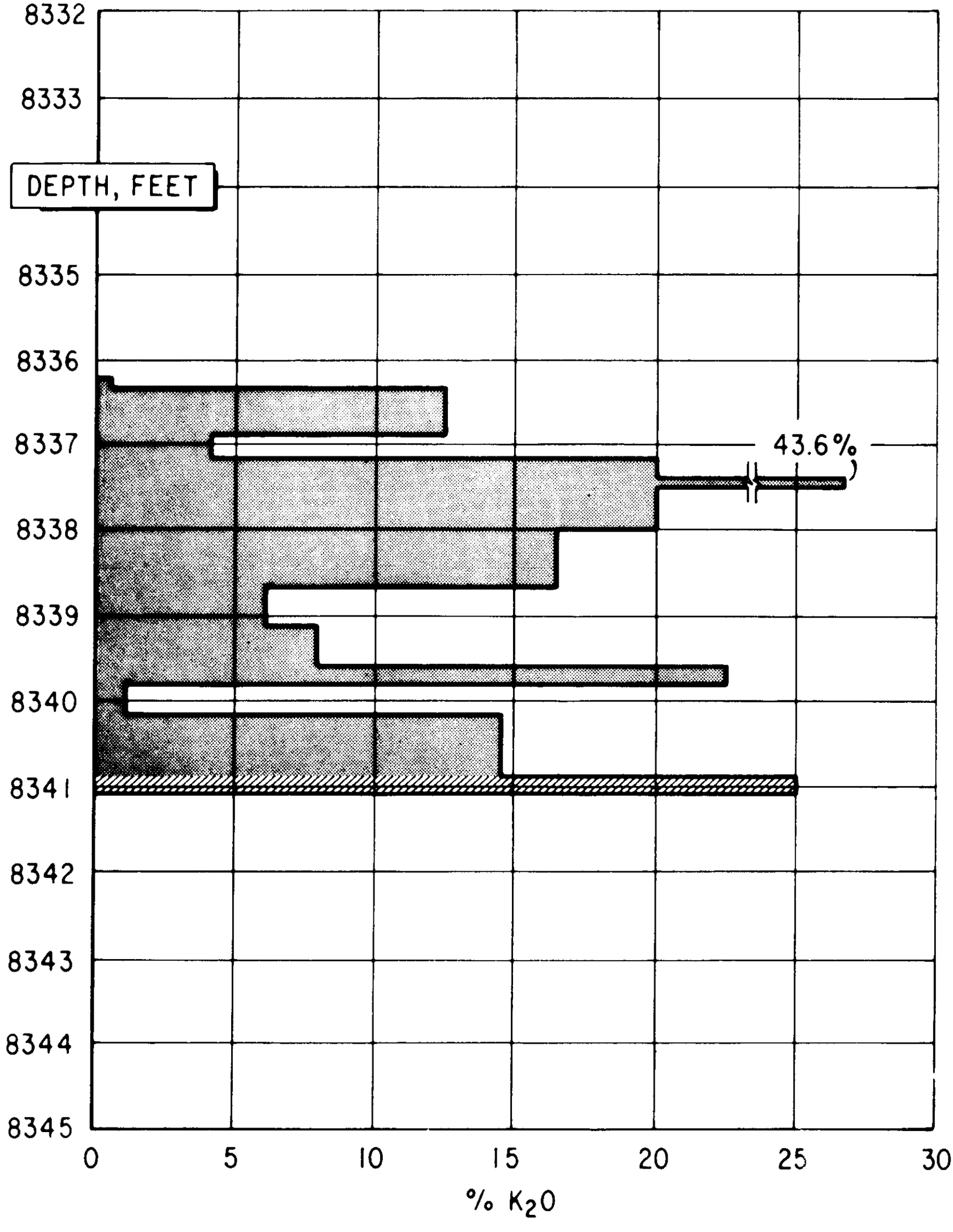
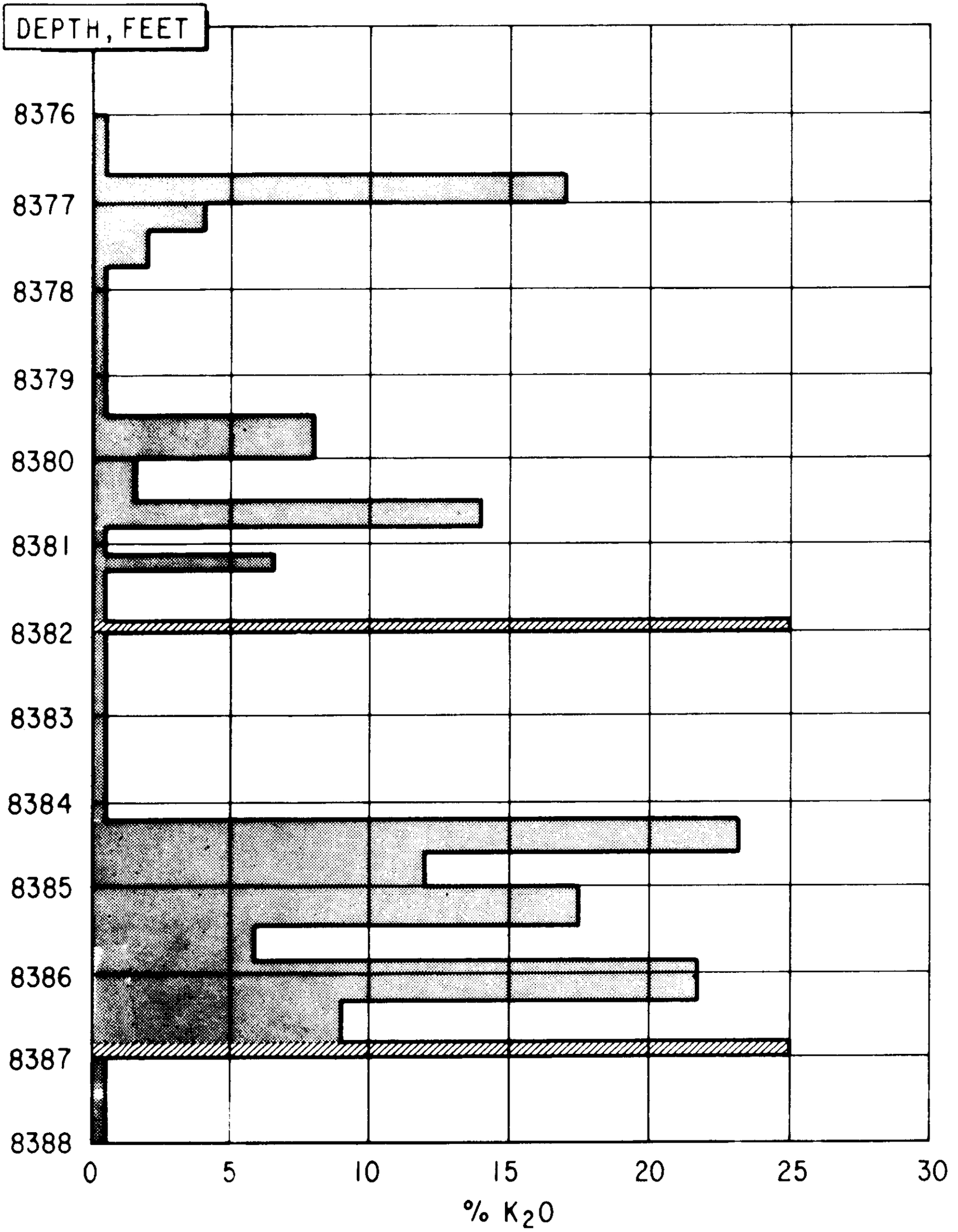
Table 1, Continued

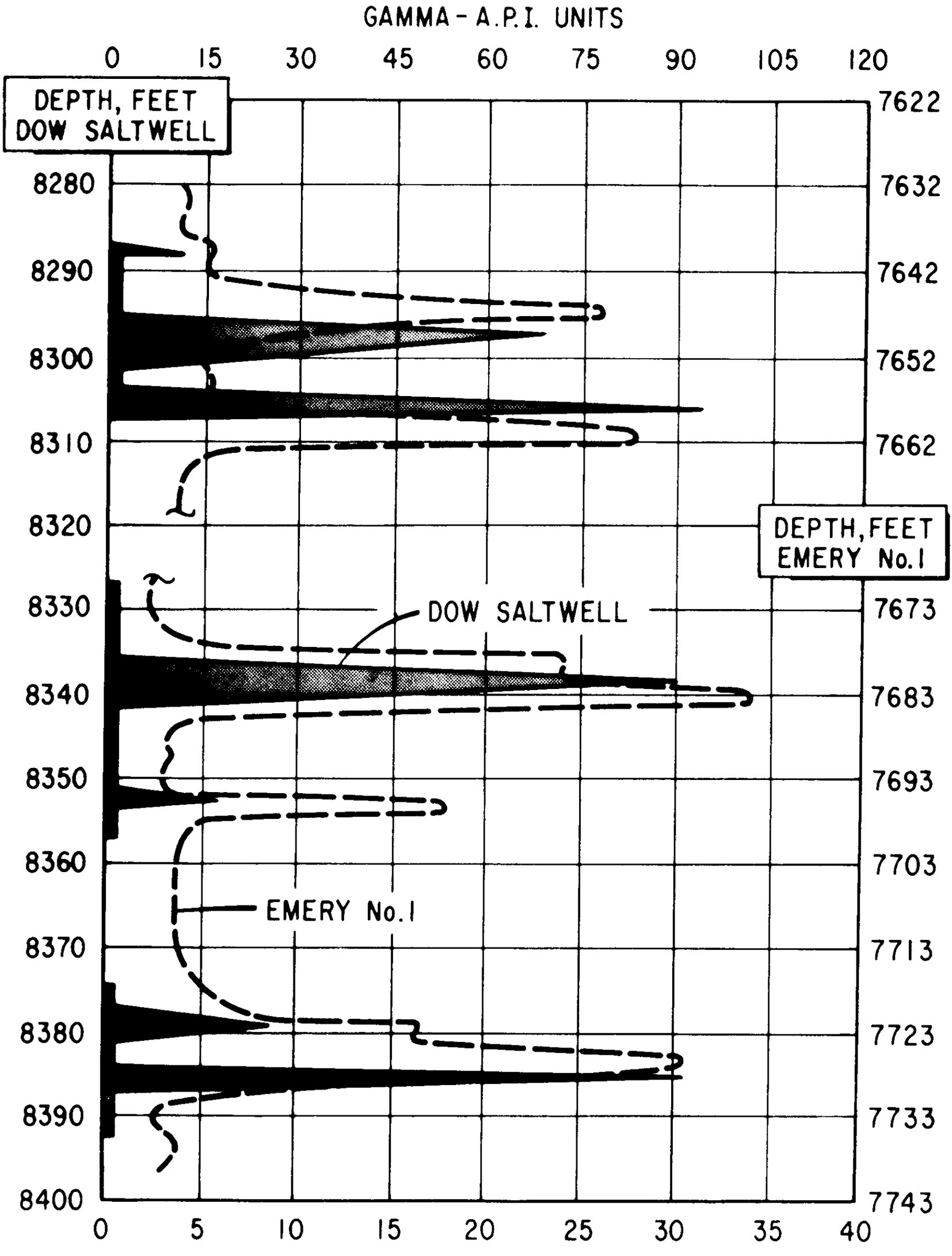
Stratigraphic Position and Sample Number	Quartz	Feldspar	Glauconite	Clay & Silt	Dolomite	Heavy minerals	Iron oxide	Muscovite
Near Colfax, sec. 21, T. 29N., R.11W., Dunn County, Wis.								
Ironton Member								
91-66-35	85.0	0.4	1.0	----	13.6	tr.	----	tr.
91-66-30	91.4	0.2	2.2	6.2	----	----	----	----
91-66-25	96.2	0.2	----	3.6	----	tr.	----	tr.
91-66-20	98.6	1.4	----	----	----	----	----	----
91-66-15	58.4	2.4	----	38.8	----	----	----	0.4
91-66-10	82.0	2.6	----	15.0	----	0.4	----	----
Birkmose Member								
91-66-65	38.2	11.8	9.8	16.0	24.0	tr.	----	0.2
91-66-60	38.2	13.8	11.4	20.6	15.6	tr.	----	0.4
91-66-55	23.4	13.2	16.2	46.6	----	tr.	----	0.6
91-66-50	42.0	14.8	17.0	25.4	----	tr.	----	0.8
91-66-45	52.4	39.2	8.2	----	----	tr.	tr.	0.2
91-66-40	69.2	19.8	10.2	----	----	tr.	----	0.8
Miscellaneous Samples								
Birkmose Member								
91-80-5	59.2	18.0	3.4	17.6	1.8	tr.	----	----
91-2-15	33.0	31.2	14.4	5.4	12.0	----	----	----
Tomah Member								
90-5-15	46.6	46.2	1.2	4.0	0.8	----	----	1.2
90-17-1	27.6	50.0	4.0	4.2	11.4	----	----	1.0
90-50-15	21.2	34.8	1.6	35.4	5.2	----	----	1.8
91-2-26	37.4	46.4	7.0	7.4	1.2	----	----	tr.
90-60-15	35.8	53.8	2.6	7.8	----	tr.	----	tr.
92-30-20	25.8	61.0	6.0	3.0	----	tr.	tr.	4.2
Reno Member								
91-2-36	36.0	16.6	11.0	3.0	32.2	----	tr.	----
91-3-12	44.4	34.2	11.8	9.2	0.2	tr.	tr.	0.2
91-3-13	33.0	23.0	10.0	20.0	6.3	tr.	6.2	1.5
91-3-20	32.4	23.2	19.4	20.0	4.6	tr.	----	0.4


CHARLEVOIX
OTSEGO
MONTMORENCY
ALPENA
ANTRIM
LEELANAU
KALKASKA
CRAWFORD
OSCODA
ALCONA
GRAND TRAVERSE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
REINHARDT No. 1
OSCEOLA
CLARE
GLADWIN
ARENAC
BAY
MECOSTA
ISABELLA
MIDLAND
DOW SALTWELL
TUSCOLA
EMERY No. 1
MONTCALM
GRATIOT
SAGINAW
KENT
GENESEE
LAPEER
IONIA
CLINTON
SHIAWASSEE
1000
1000
1000


DEPTH, FEET
8295
8296
8297
8298
8299
8300
8301
8302
8303
8304
8305
8306
8307
CORE MISSING
(DISSOLVED)
0
5
10
15
20
25
30
% K_2O


DEPTH, FEET
8332
8333
8335
8336
8337
8338
8339
8340
8341
8342
8343
8344
8345
43.6%
0
5
10
15
20
25
30
% K_2O


DEPTH, FEET
8376
8377
8378
8379
8380
8381
8382
8383
8384
8385
8386
8387
8388
0
5
10
15
20
25
30
% K_2O


GAMMA - A.P.I. UNITS
0
15
30
45
60
75
90
105
120
DEPTH, FEET
DOW SALTWELL
8280
8290
8300
8310
8320
8330
8340
8350
8360
8370
8380
8390
8400
DEPTH, FEET
EMERY No.1
7622
7632
7642
7652
7662
7673
7683
7693
7703
7713
7723
7733
7743
DOW SALTWELL
EMERY No.1
0
5
10
15
20
25
30
35
40

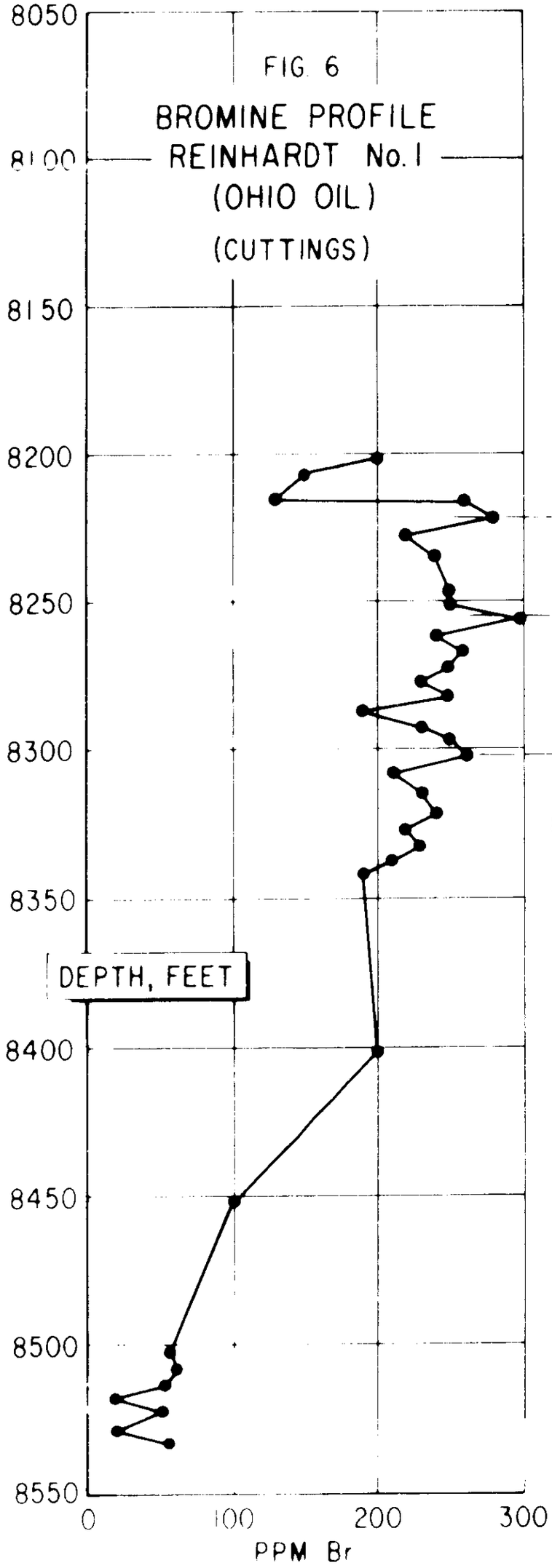


FIG. 6
BROMINE PROFILE
REINHARDT No. 1
(OHIO OIL)
(CUTTINGS)
DEPTH, FEET
8050
8100
8150
8200
8250
8300
8350
8400
8450
8500
8550
0
100
200
300
PPM Br

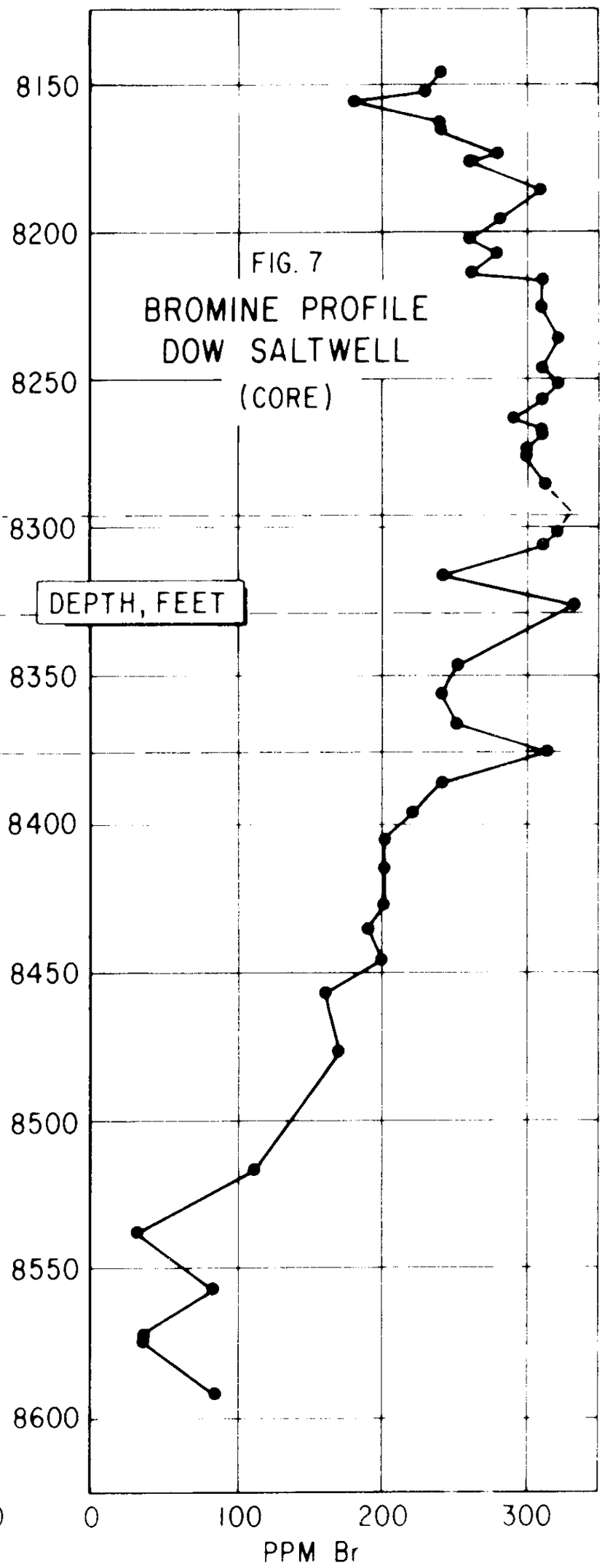
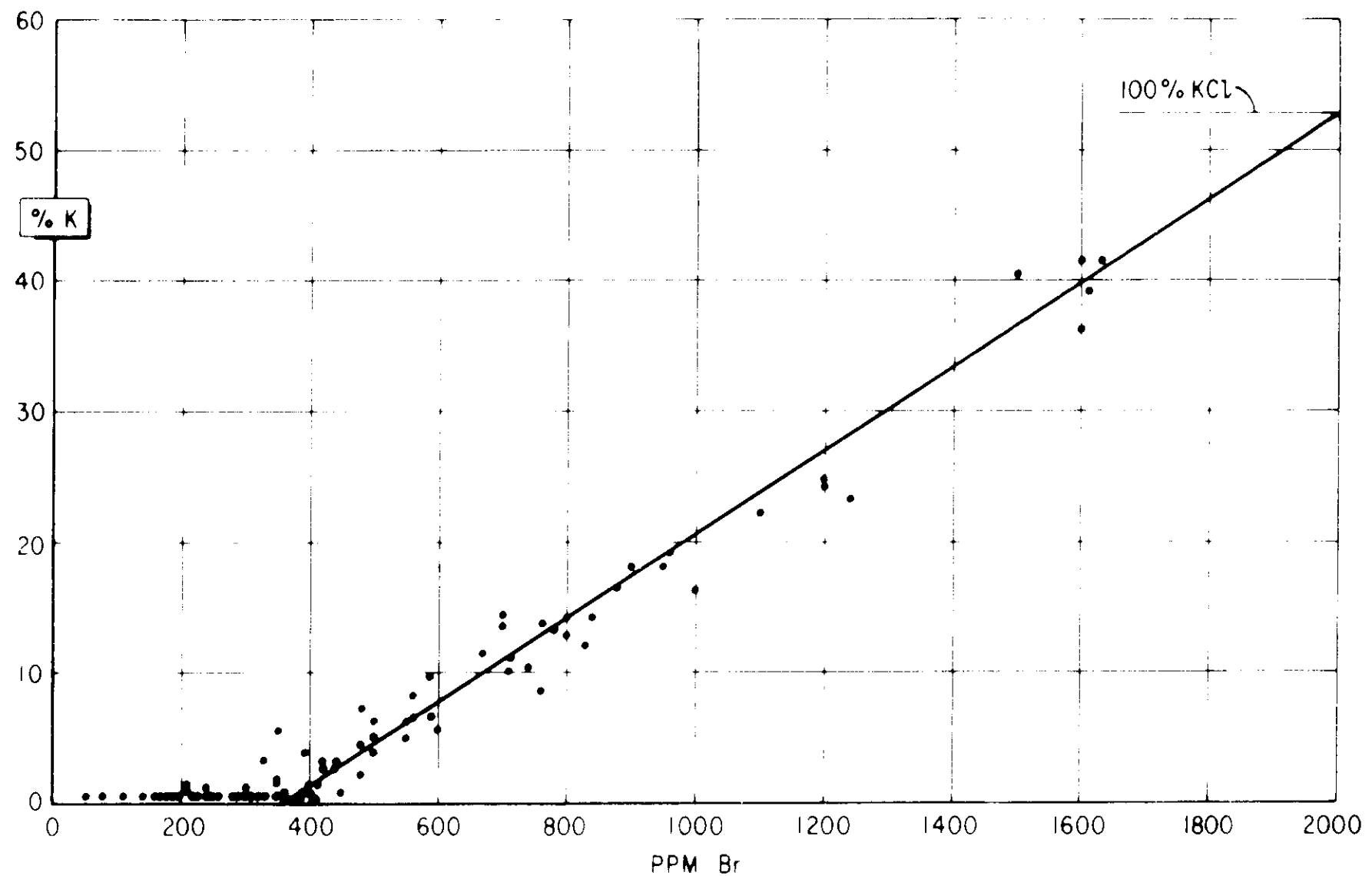


FIG. 7
BROMINE PROFILE
DOW SALTWELL
(CORE)
DEPTH, FEET
8150
8200
8250
8300
8350
8400
8450
8500
8550
8600
0
100
200
300
PPM Br


100% KCl
% K
PPM Br
0
10
20
30
40
50
60
0
200
400
600
800
1000
1200
1400
1600
1800
2000

APPENDIX

Calculations: No. 1 Parmeter.

$$\frac{0.552 \;\overset{\text{average}}{\overline{|\; 0.11\%\ K}}\ \text{(peak of curve)}}{} = 0.0607\%\ K\ \left(\text{over } \frac{8\ \text{min}}{1.29\ \text{min. per ft.}} = \right.$$

6.2 ft.) i.e. 607 ppm K in drilling fluid from 6.2 feet of core.

Pump piston area = 0.785×5.5^2 = 23.7 sq. in.

Piston volume = 18 x 23.7 = 427 cu. in.

Capacity = 427 x 60 = 25620 cu. in./min.

$$\frac{25620}{1728} = 14.8\ \text{c.f.m.} = 111\ \text{gpm} = \begin{array}{rl} 1110 & \text{lb. fluid per min.} \\ \underline{\times\ 2} & \text{(double action pump)} \\ 2220 & \text{lbs. fluid/min.} \end{array}$$

For 6.2 ft. interval:

$$\frac{2220\ \text{lb.}\ \overset{\text{fluid}}{\overline{|\; 8\ \text{min.}}}\ \overset{\text{min.}}{\overline{|\; 0.0607\%\ K}}}{} = 10.78\ \text{lbs. K picked up.}$$

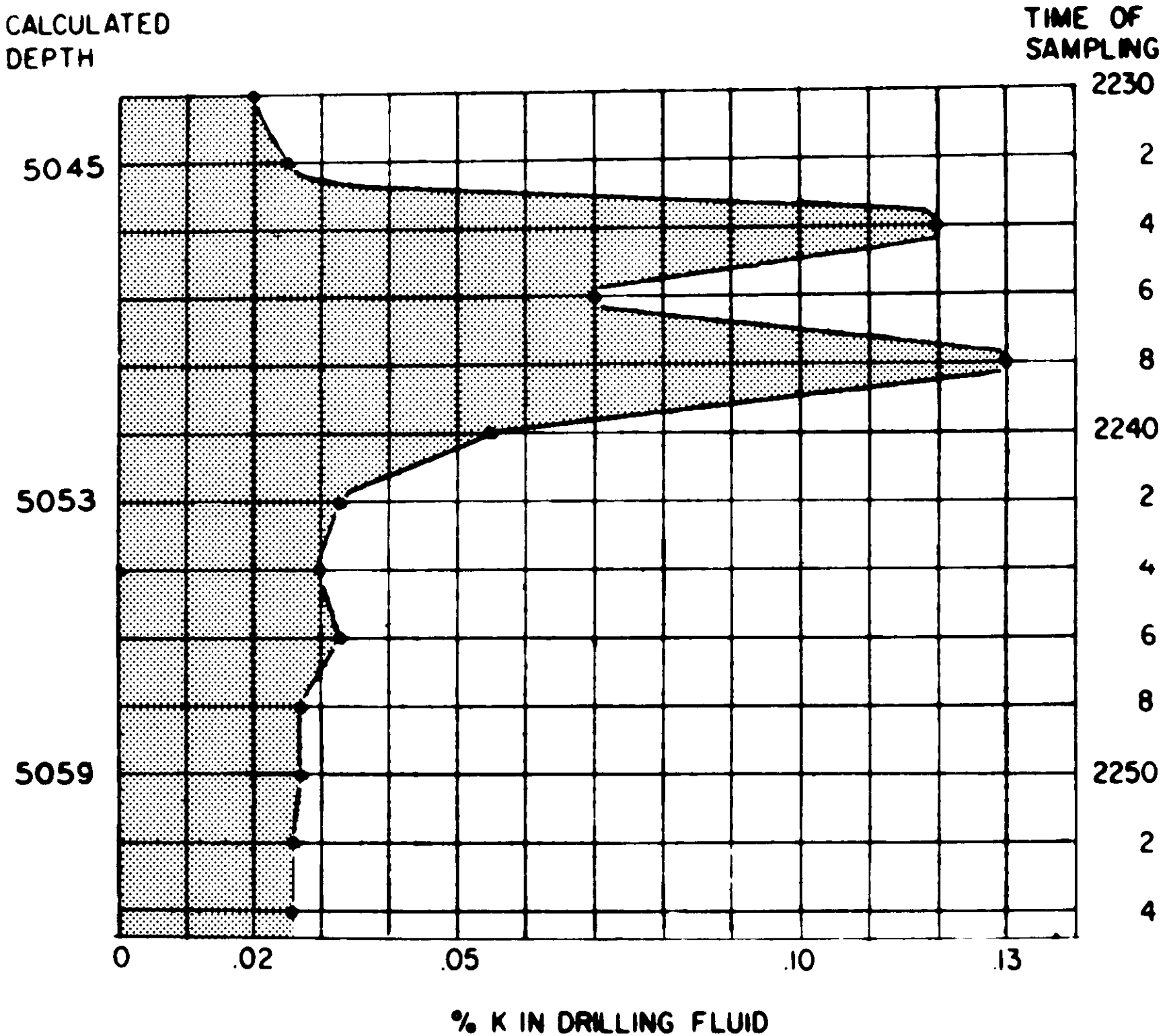
For 7-7/8" diam. cylinder:

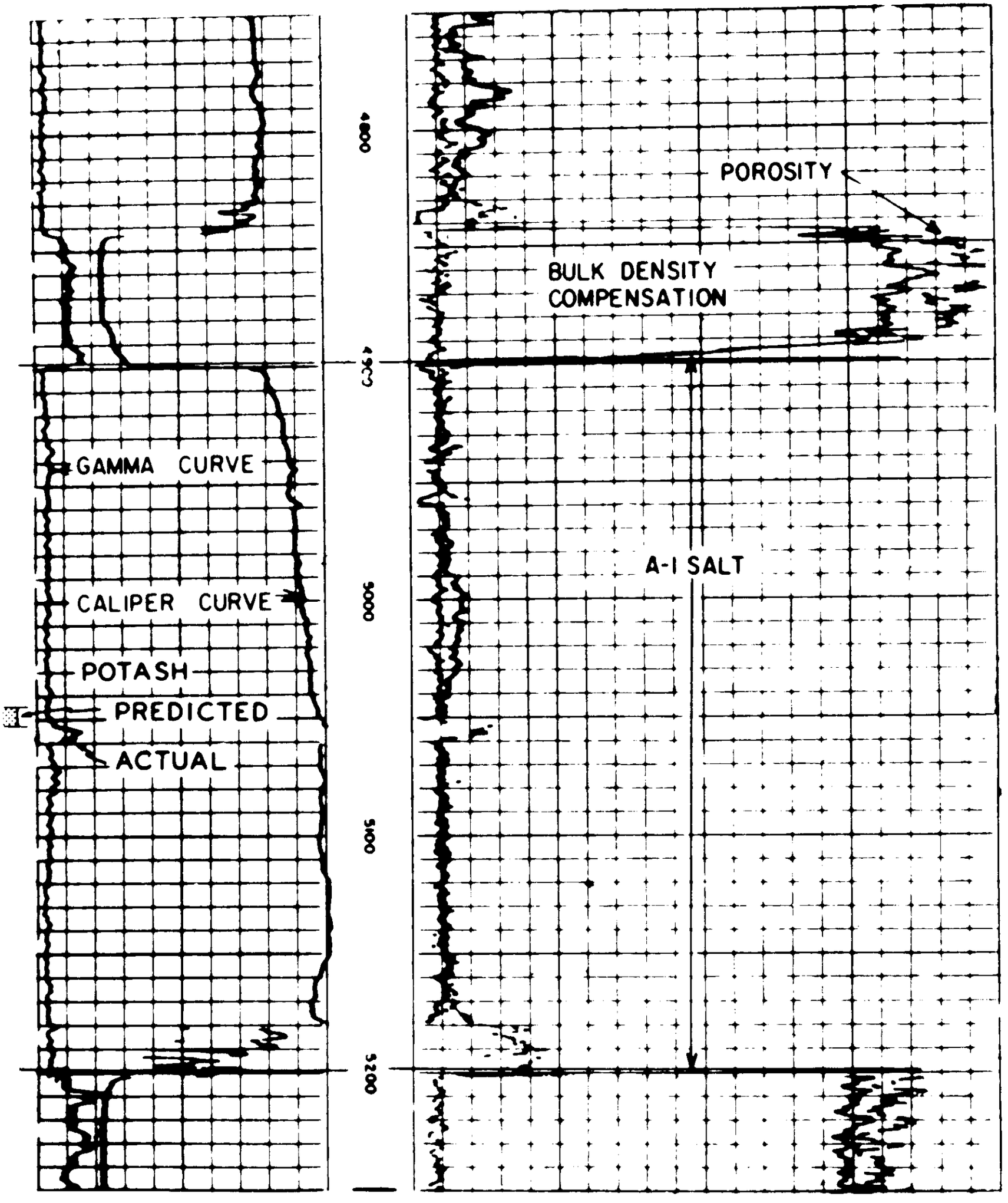
$$\frac{0.785 \;|\; 7.875^2}{} = 48.6\ \text{sq. in.} = 0.348\ \text{sq. ft.}$$

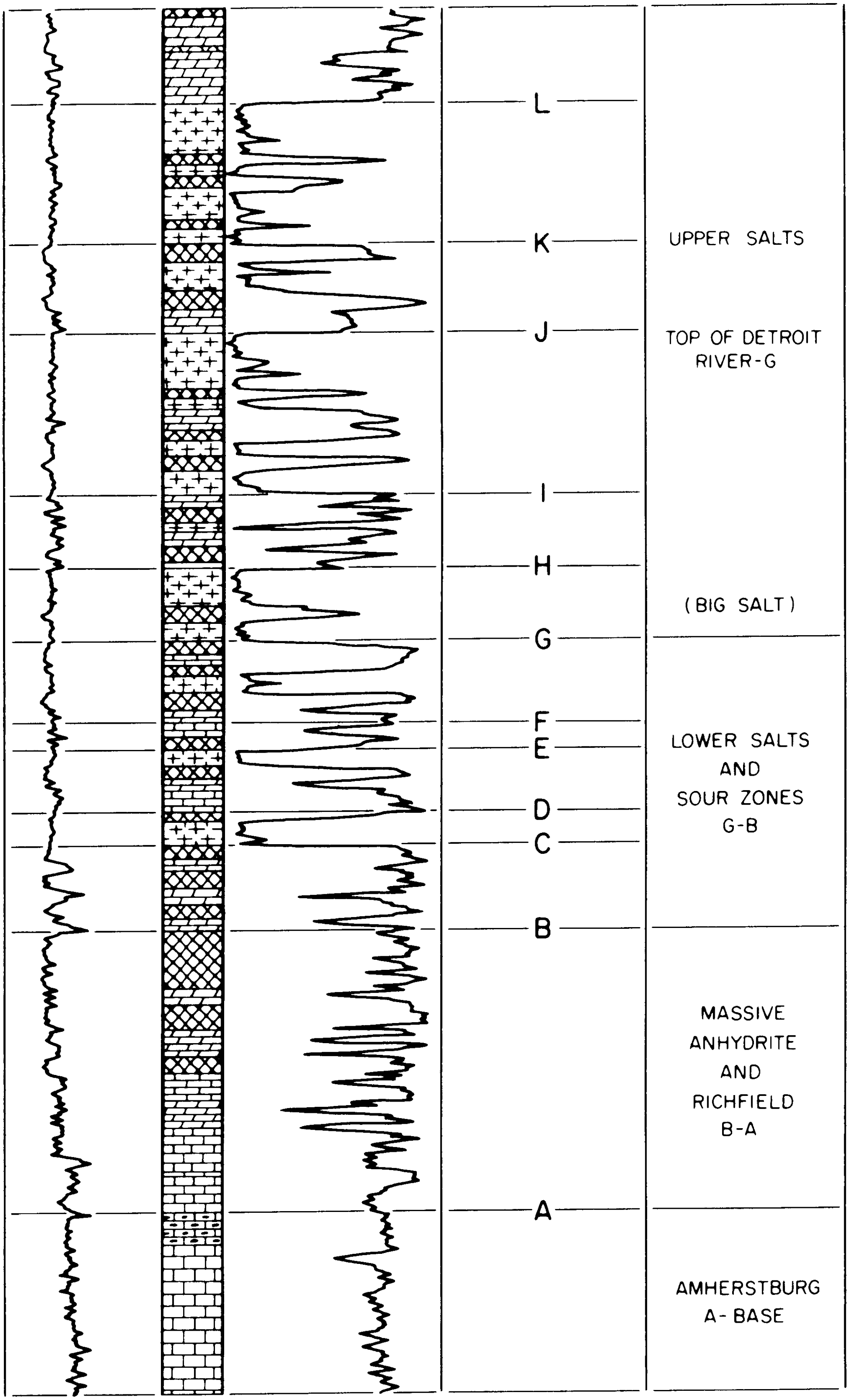
$$\frac{0.348\ \overset{\text{sq. ft.}}{\overline{|\; 6.2\ \text{ft.}}}\ \overset{\text{cu. ft.}}{\overline{|\; 2.1\ \text{S.G.}}}\ |\ 62.4}{} = 283\ \text{lbs. salt.}$$

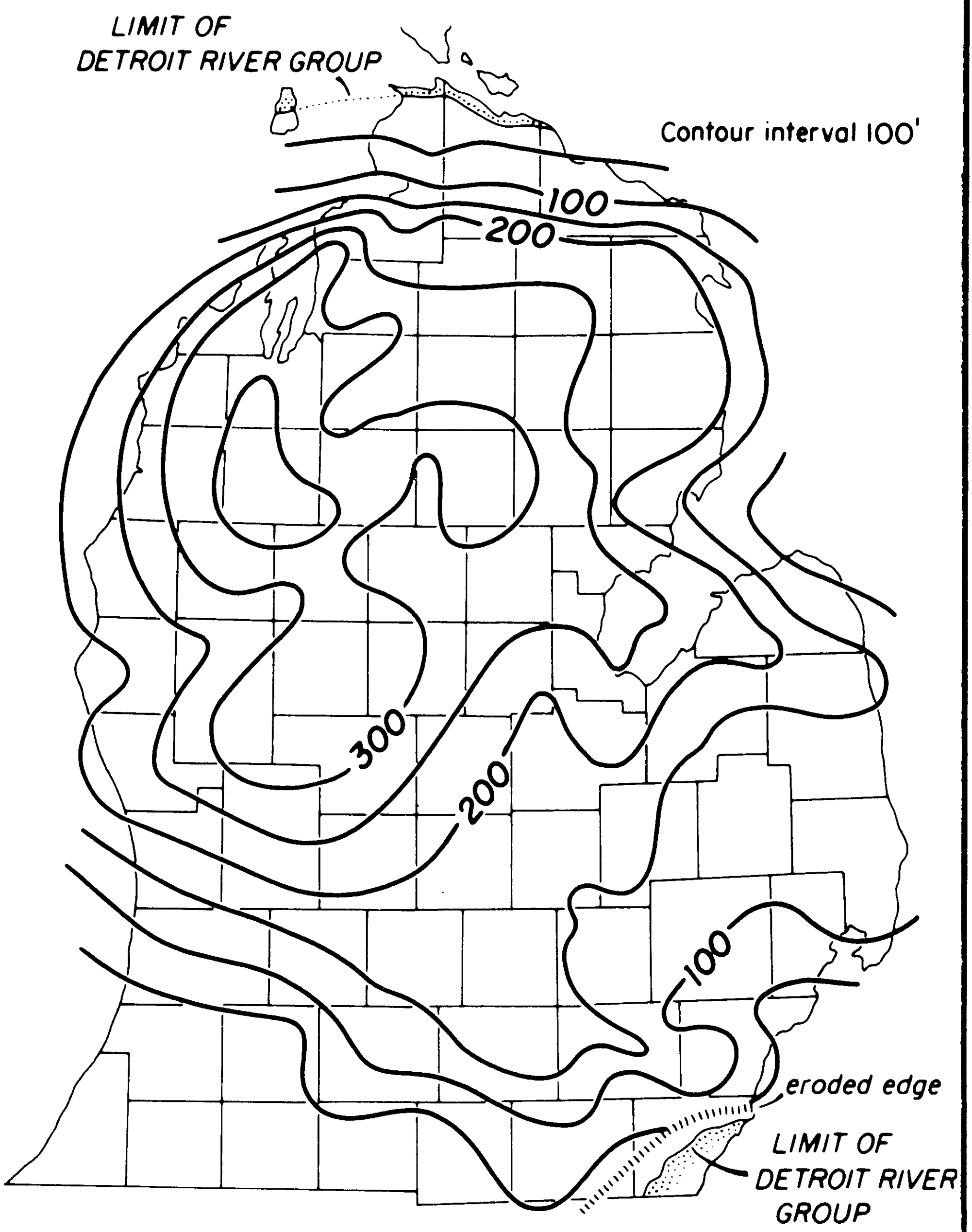
$$\frac{10.78\ \text{lbs. K.}}{283\ \text{lbs. salts}}\ \Big|\ \frac{100}{} = 3.81\%\ K = \frac{3.81}{}\ \Big|\ \frac{94.9}{78.2} = 4.63\%\ K_2O = 7.27\%\ KCl.$$

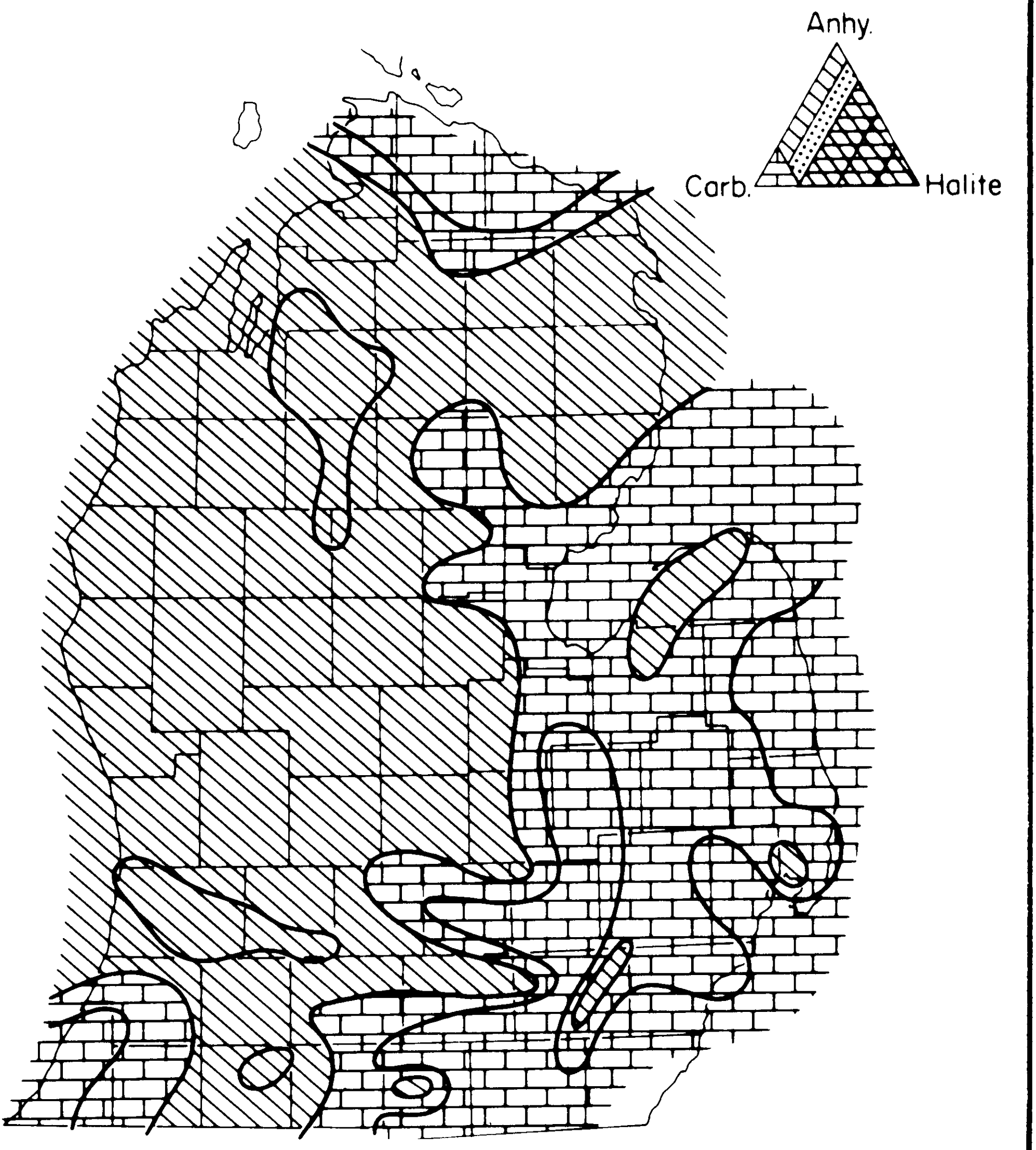
over 6.2 ft.

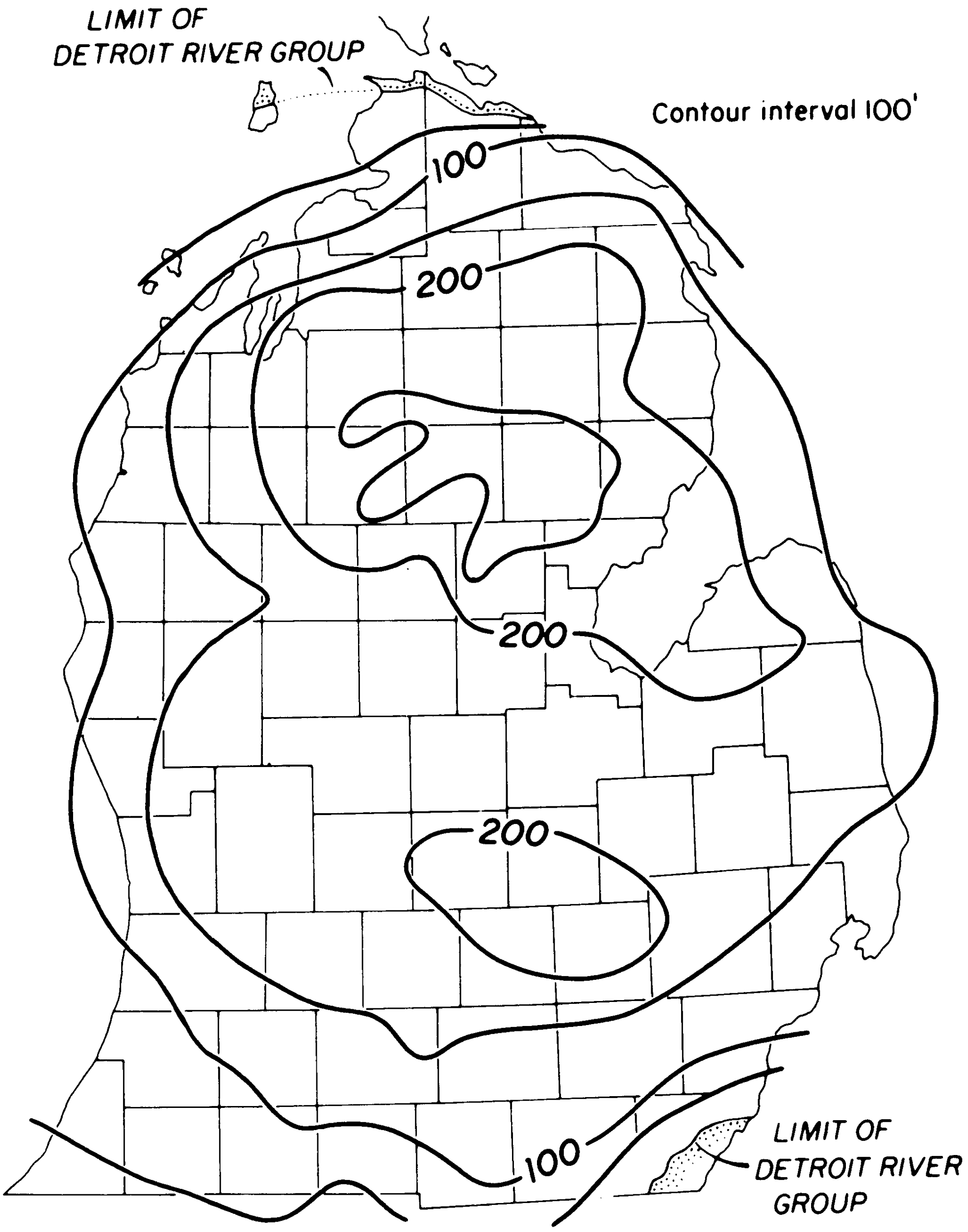

CALCULATED DEPTH
TIME OF SAMPLING
5045
5053
5059
2230
2
4
6
8
2240
2
4
6
8
2250
2
4
0
.02
.05
.10
.13
% K IN DRILLING FLUID

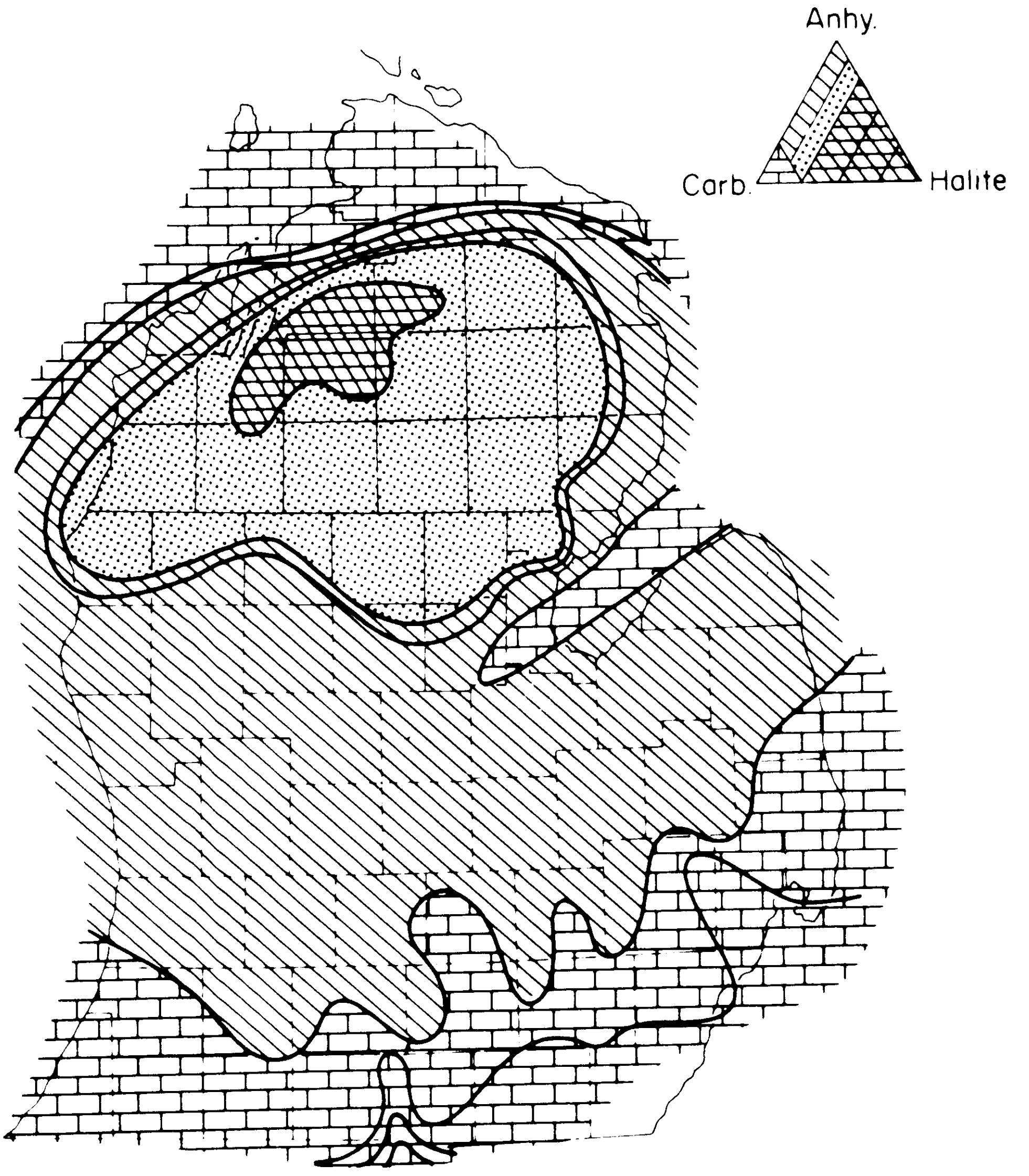

4800
4900
5000
5100
5200
POROSITY
BULK DENSITY
COMPENSATION
A-1 SALT
GAMMA CURVE
CALIPER CURVE
POTASH
PREDICTED
ACTUAL

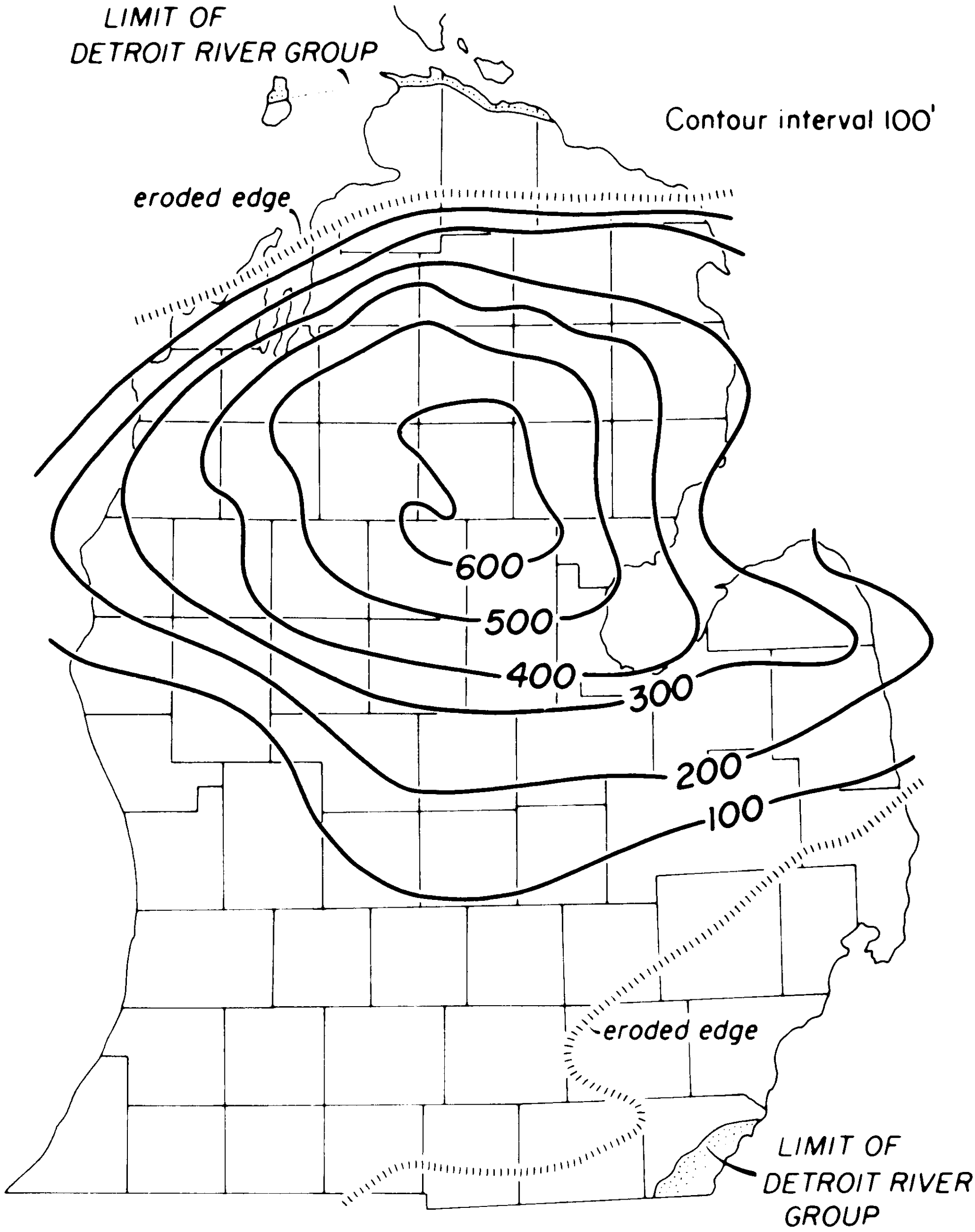

GAMMA RAY
NEUTRON
LOG MARKER
NAME
L
K
J
I
H
G
F
E
D
C
B
A
UPPER SALTS
TOP OF DETROIT RIVER-G
(BIG SALT)
LOWER SALTS AND SOUR ZONES G-B
MASSIVE ANHYDRITE AND RICHFIELD B-A
AMHERSTBURG A- BASE

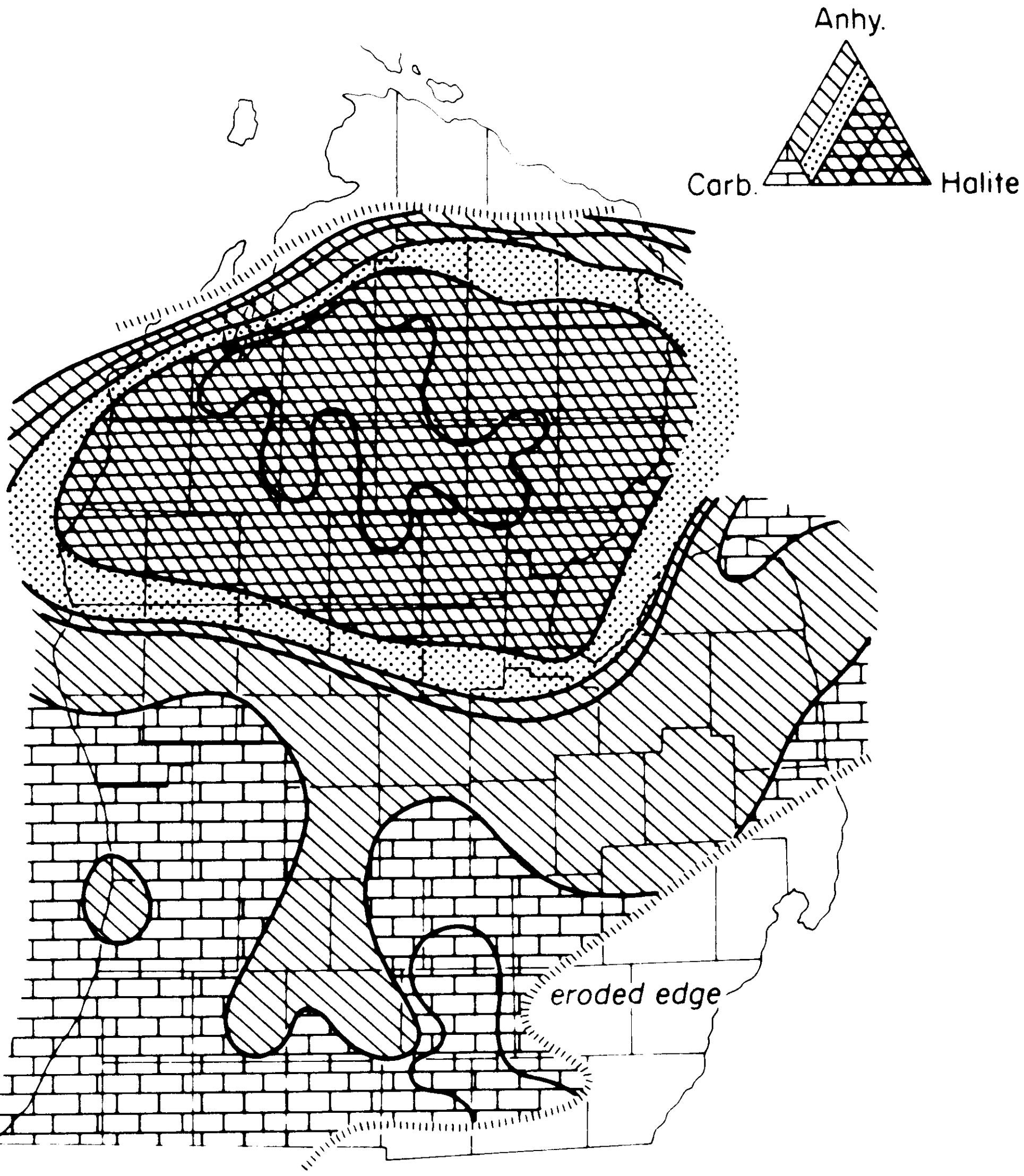

LIMIT OF
DETROIT RIVER GROUP
Contour interval 100'
100
200
300
200
100
eroded edge
LIMIT OF
DETROIT RIVER
GROUP

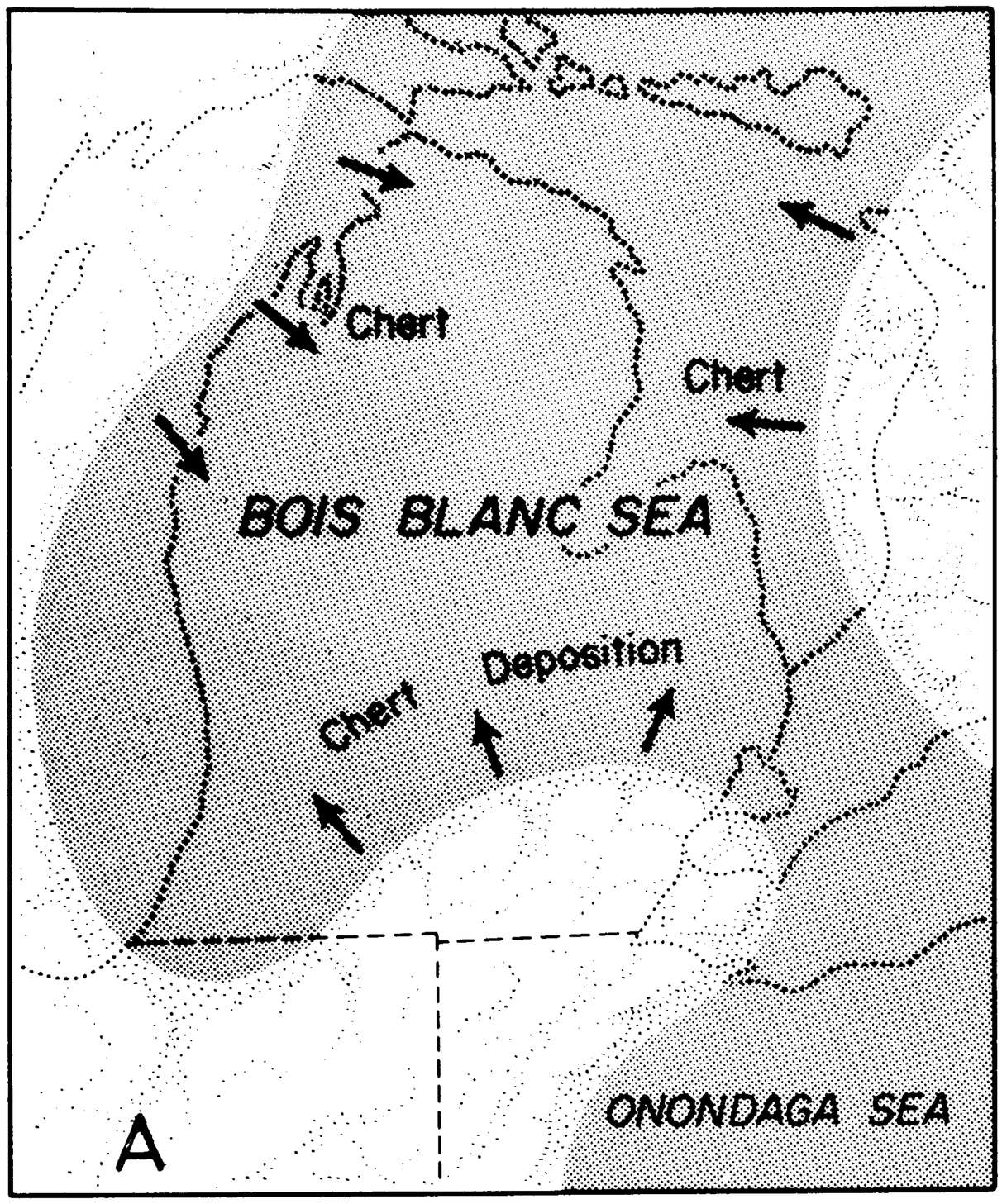

Anhy.
Carb.
Halite

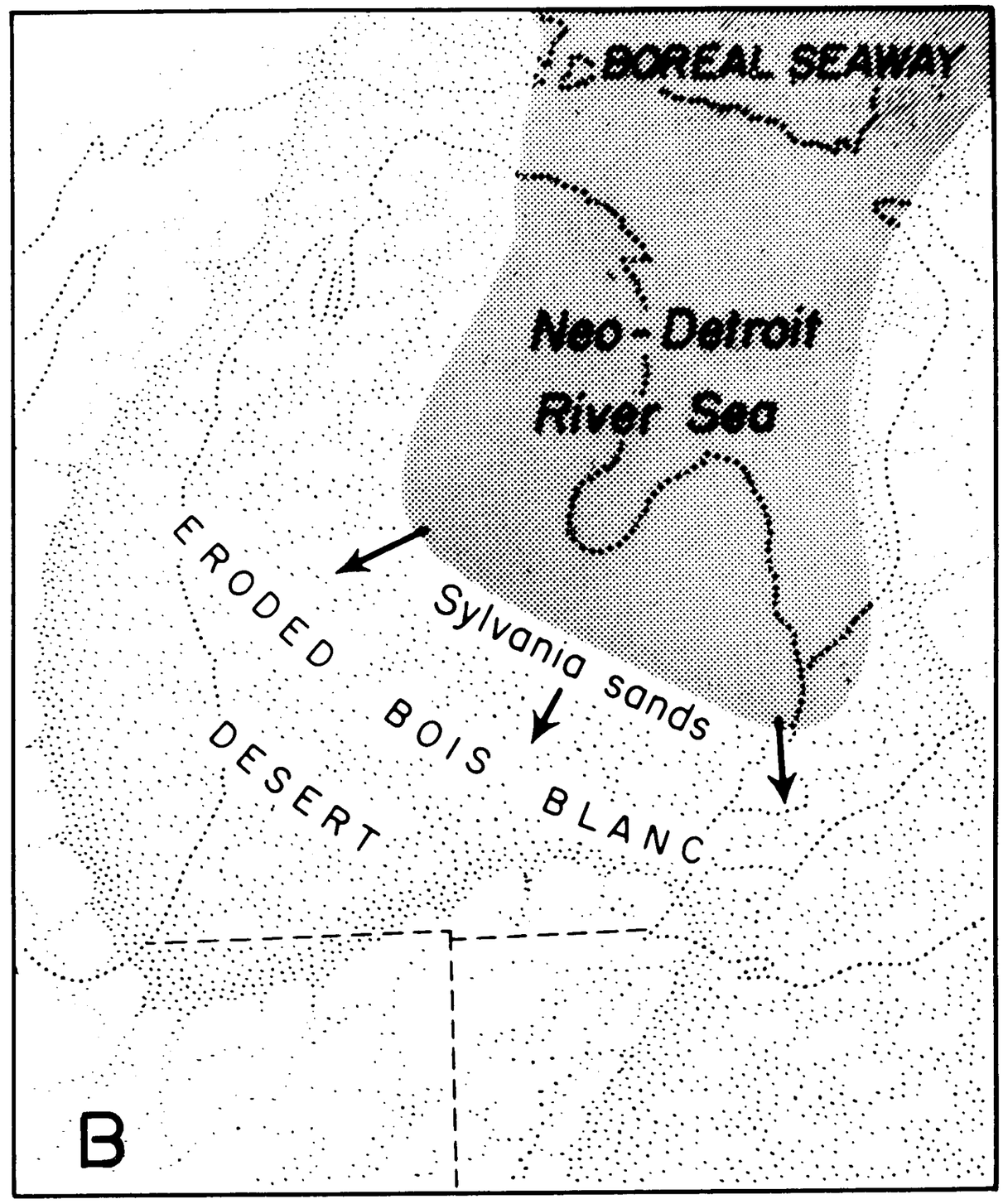

LIMIT OF
DETROIT RIVER GROUP
Contour interval 100'
100
200
200
200
100
LIMIT OF
DETROIT RIVER
GROUP

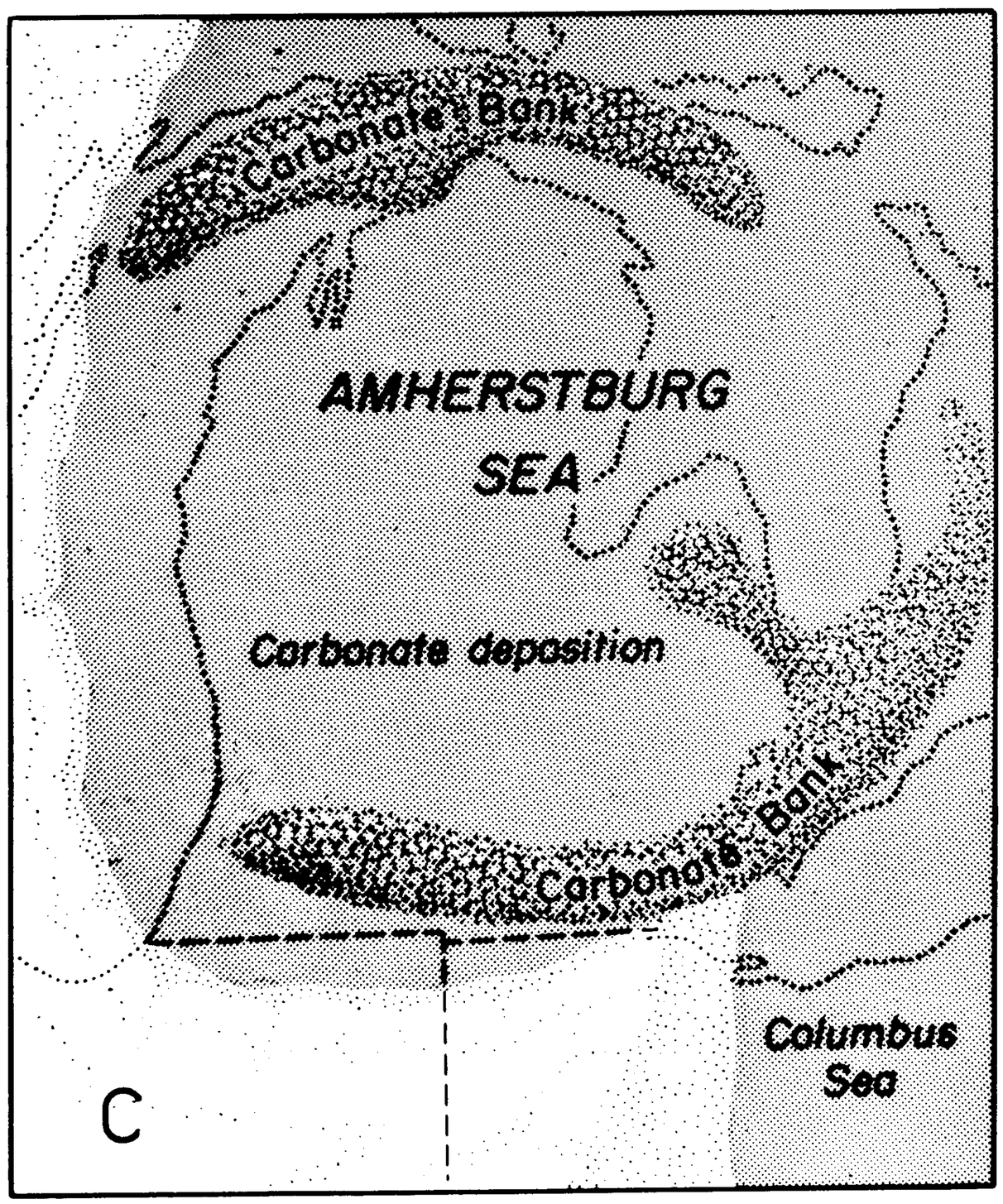

Anhy.
Carb.
Halite

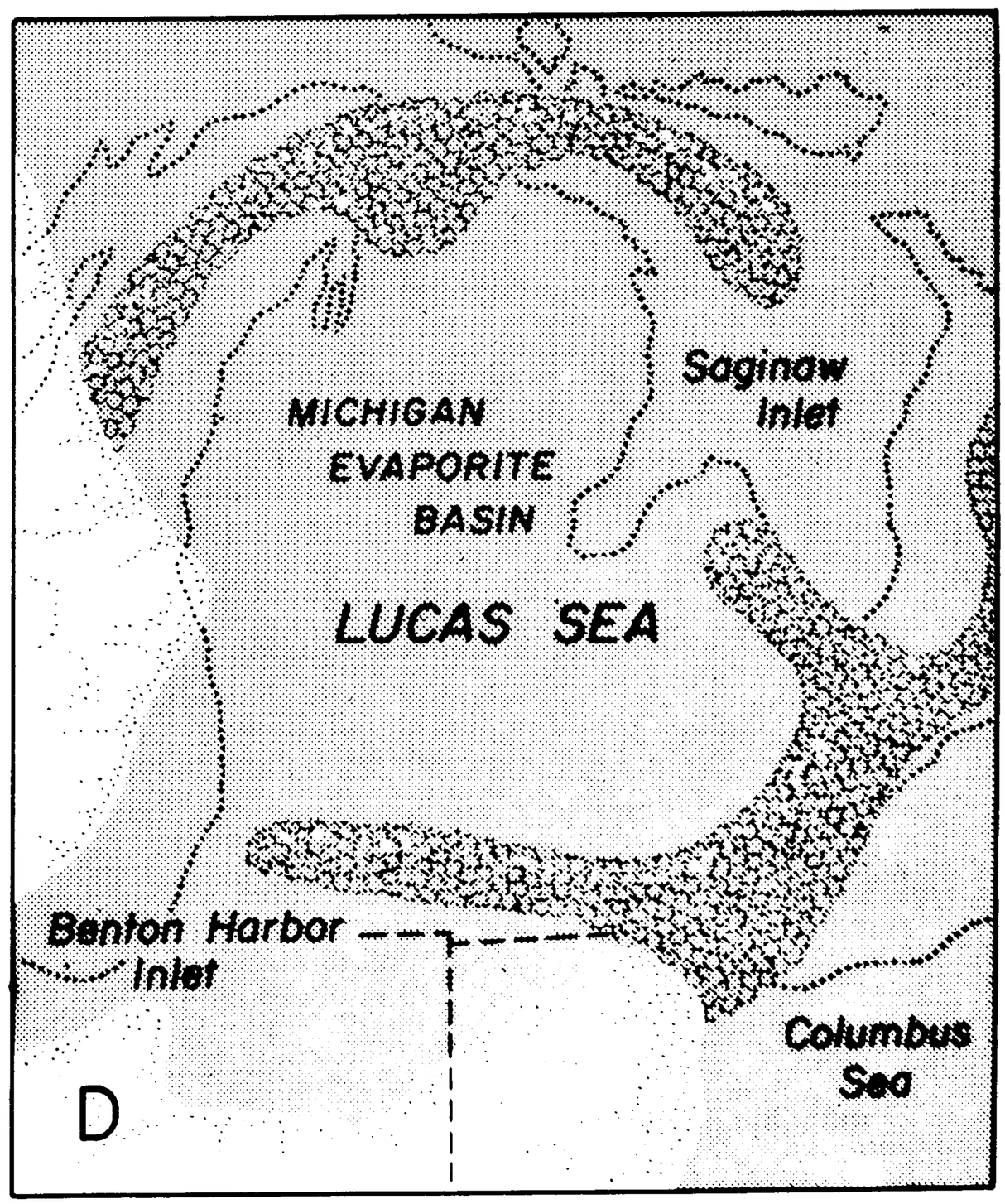

LIMIT OF
DETROIT RIVER GROUP
Contour interval 100'
eroded edge
600
500
400
300
200
100
eroded edge
LIMIT OF
DETROIT RIVER
GROUP

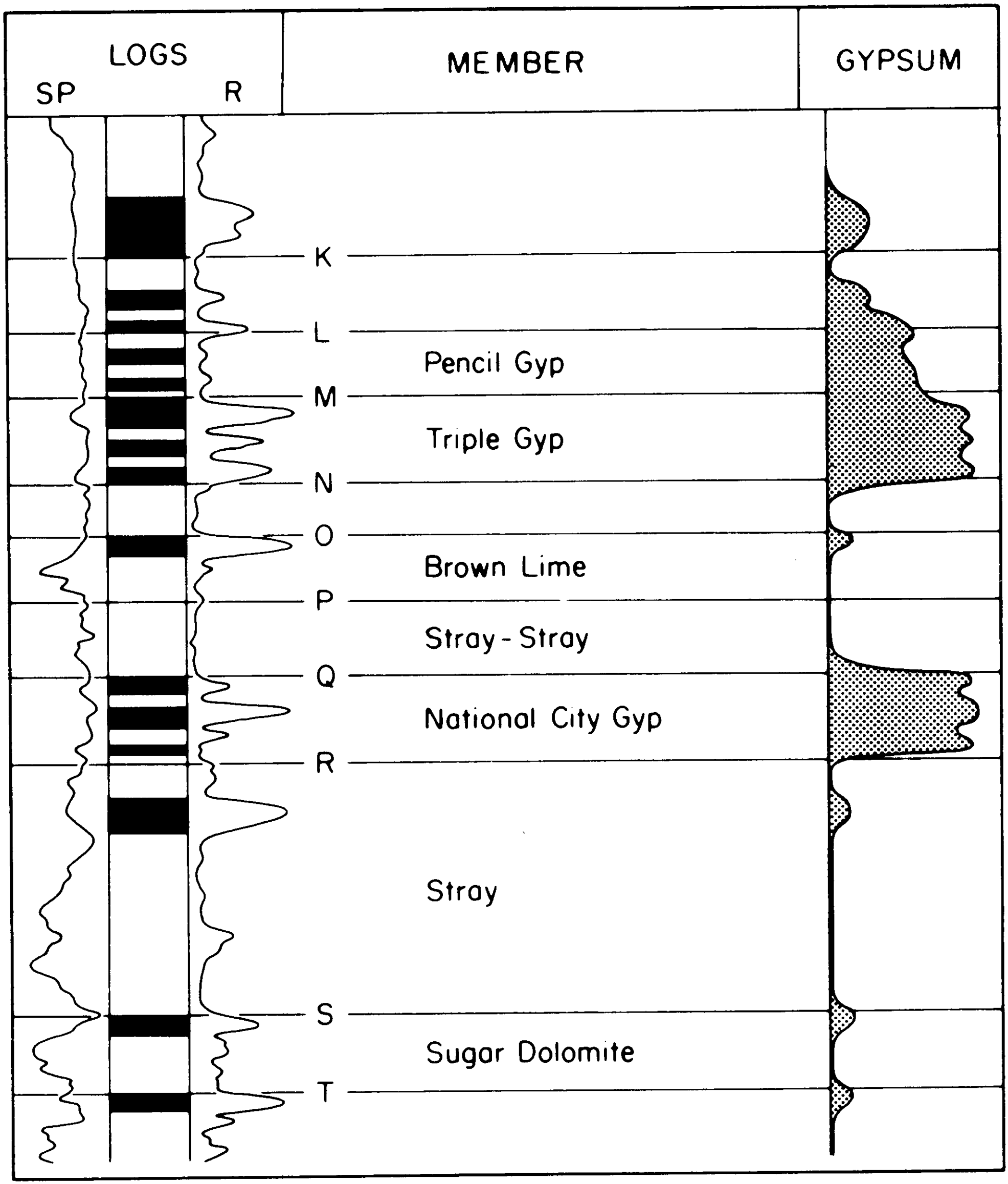

Anhy.
Carb.
Halite
eroded edge

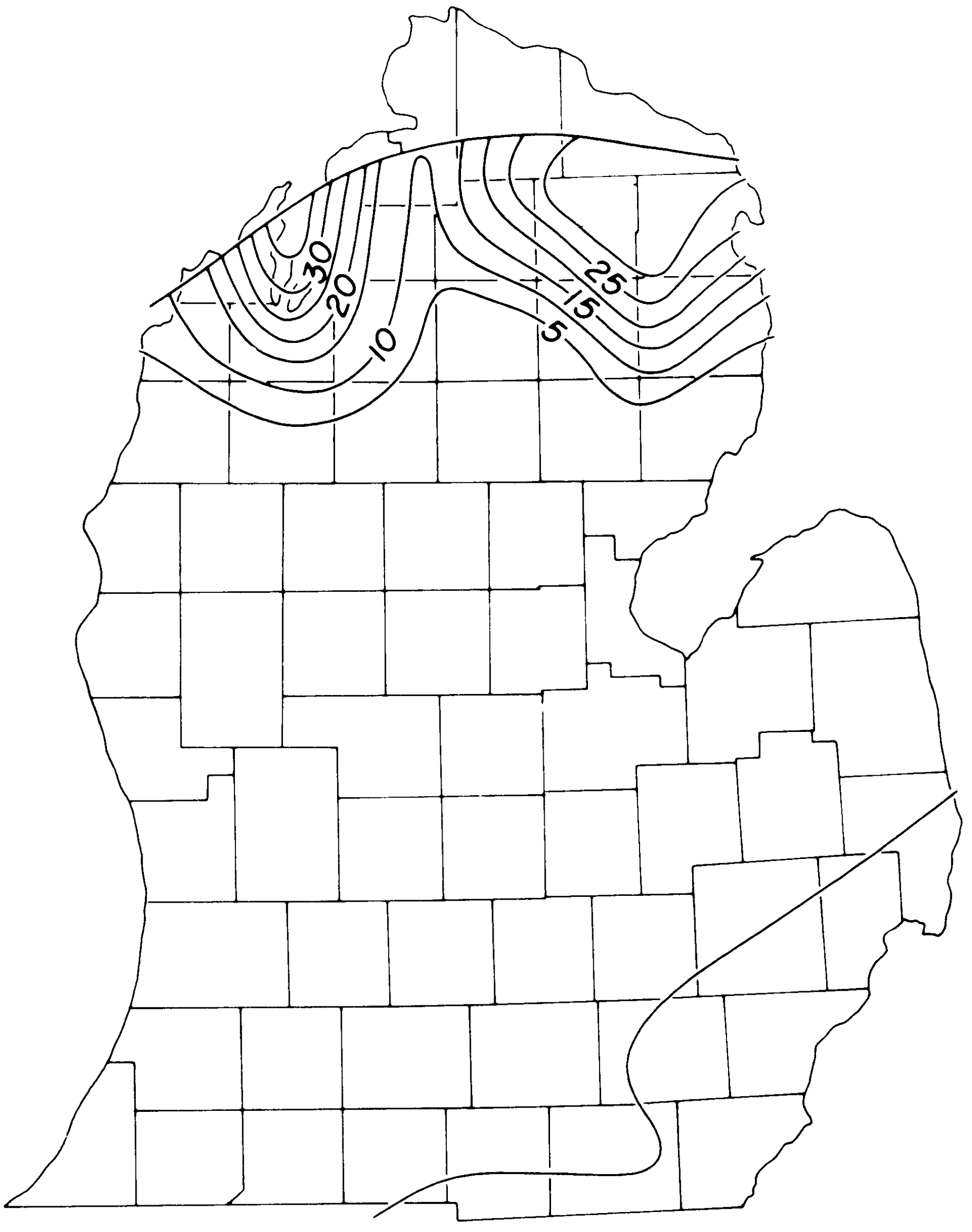

Chert
Chert
BOIS BLANC SEA
Deposition
Chert
ONONDAGA SEA
A


BOREAL SEAWAY
Neo-Detroit
River Sea
ERODED
Sylvania sands
BOIS
BLANC
DESERT
B

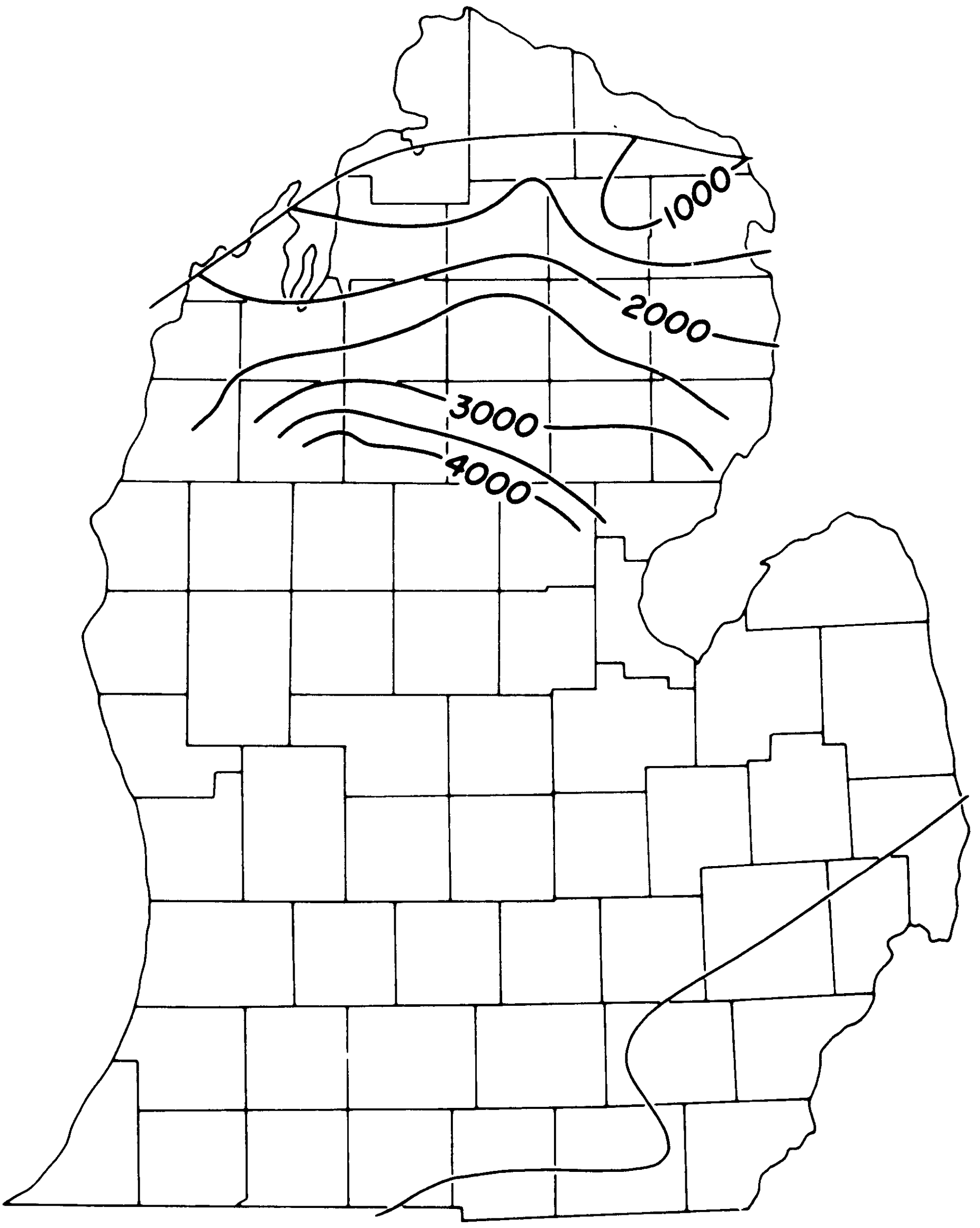

Carbonate Bank
AMHERSTBURG
SEA
Carbonate deposition
Carbonate Bank
Columbus
Sea
C


Saginaw
Inlet
MICHIGAN
EVAPORITE
BASIN
LUCAS SEA
Benton Harbor
Inlet
Columbus
Sea
D


LOGS
SP
R
MEMBER
GYPSUM
K
L
Pencil Gyp
M
Triple Gyp
N
O
Brown Lime
P
Stray - Stray
Q
National City Gyp
R
Stray
S
Sugar Dolomite
T

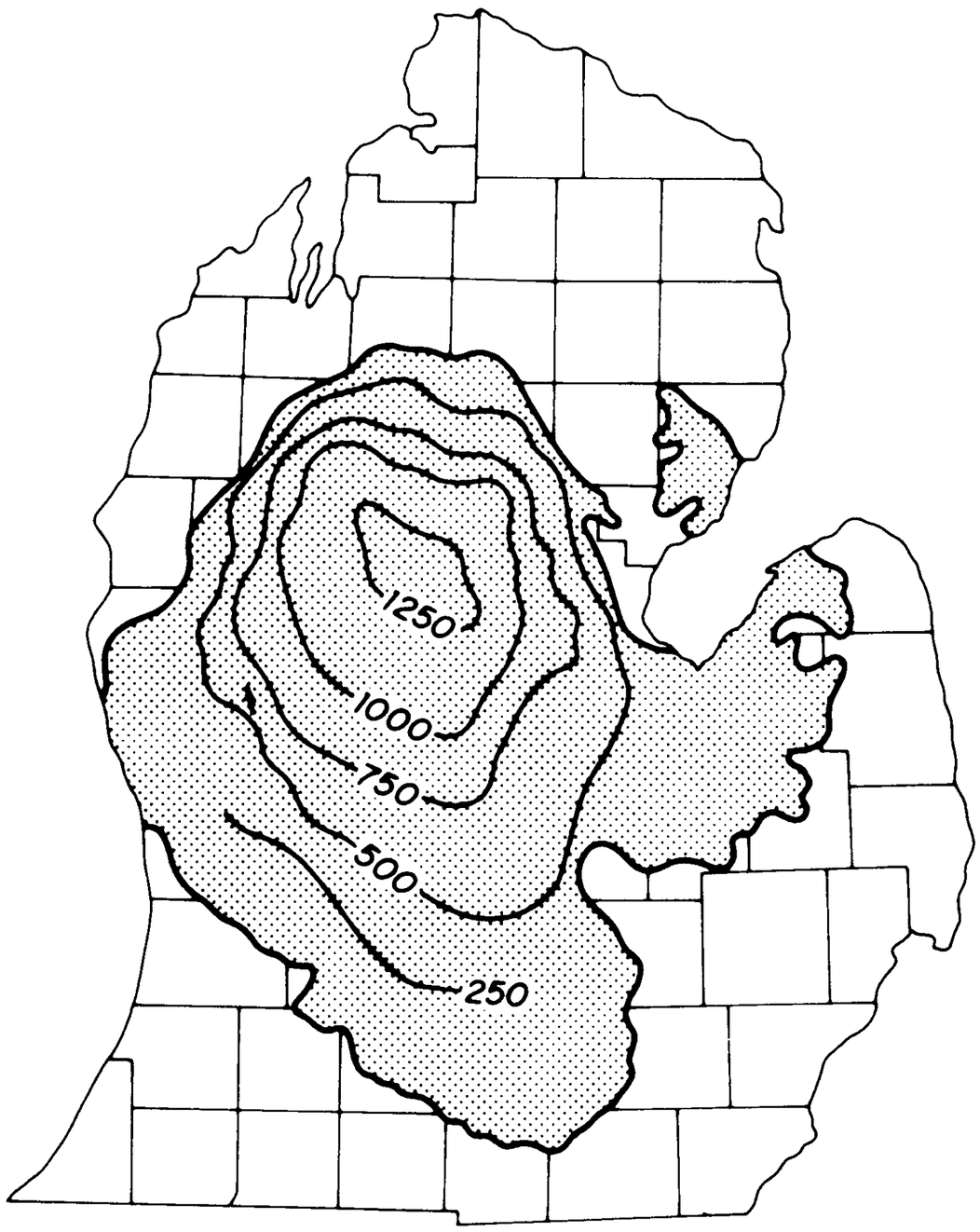


GYPSUM THICKNESS, DETROIT RIVER GROUP UPPER SALTS

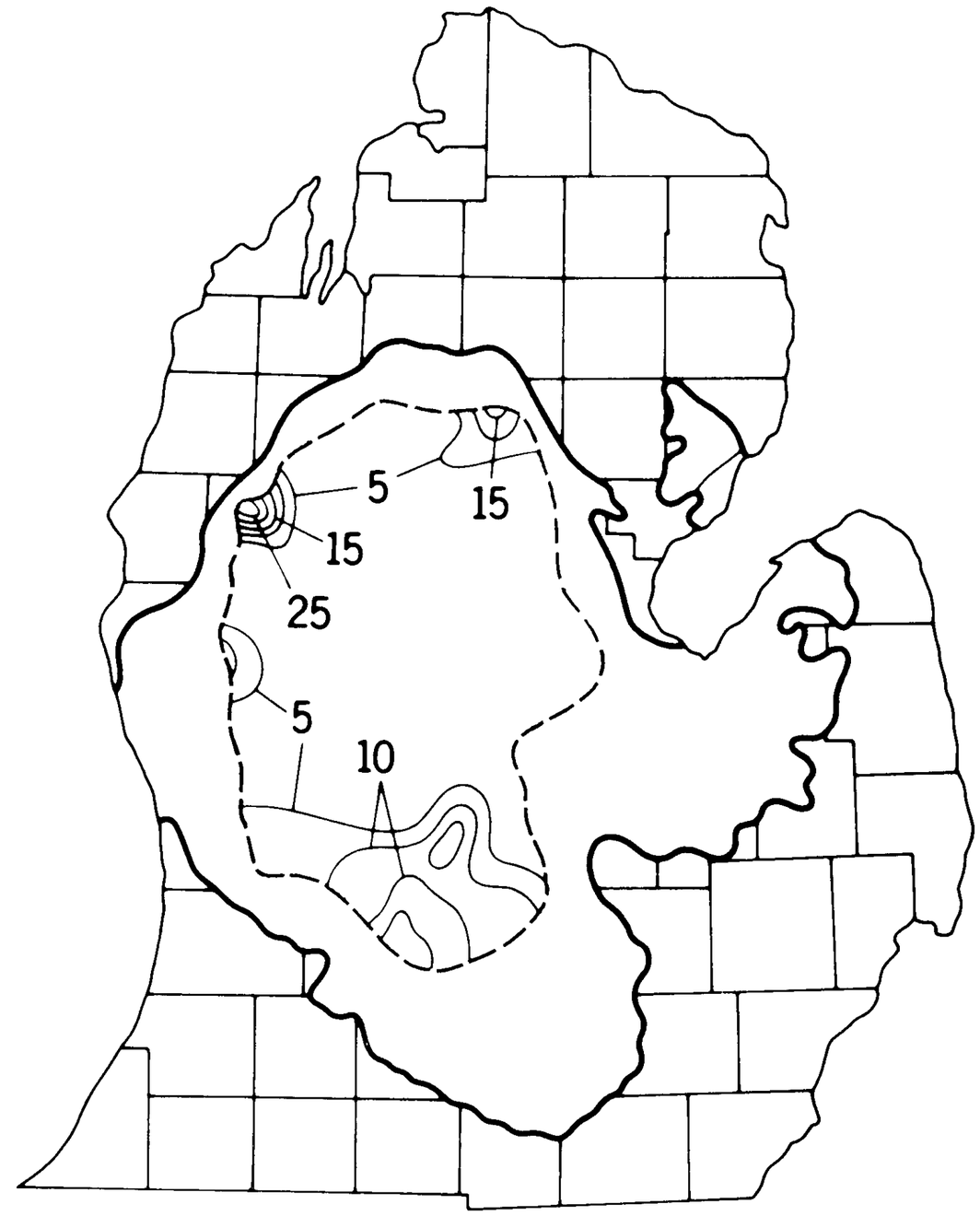


DEPTH TO TOP OF DETROIT RIVER GROUP UPPER SALTS

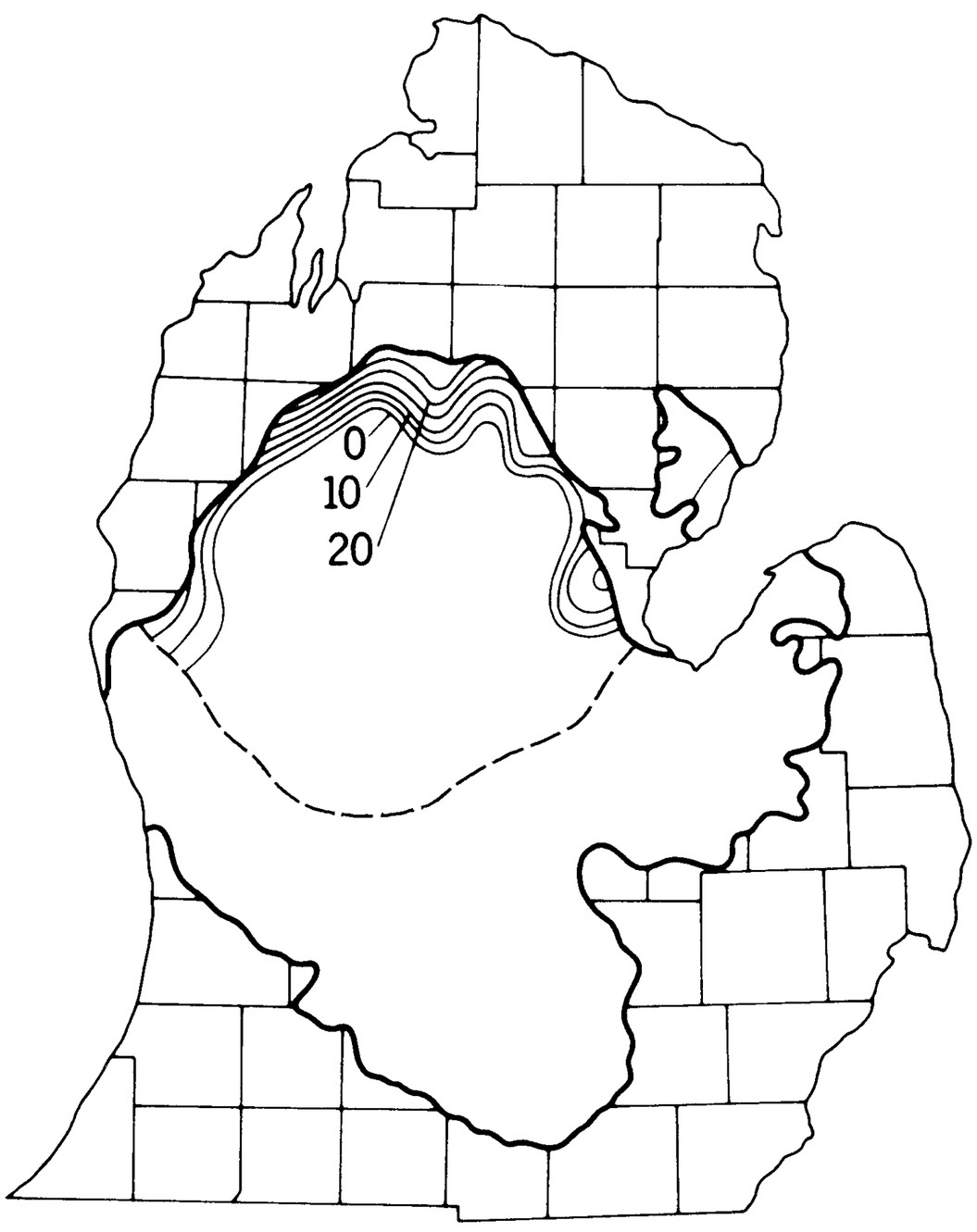
Fig. 7 Depth to top and thickness of gypsum in the Detroit River Group, Michigan Basin.



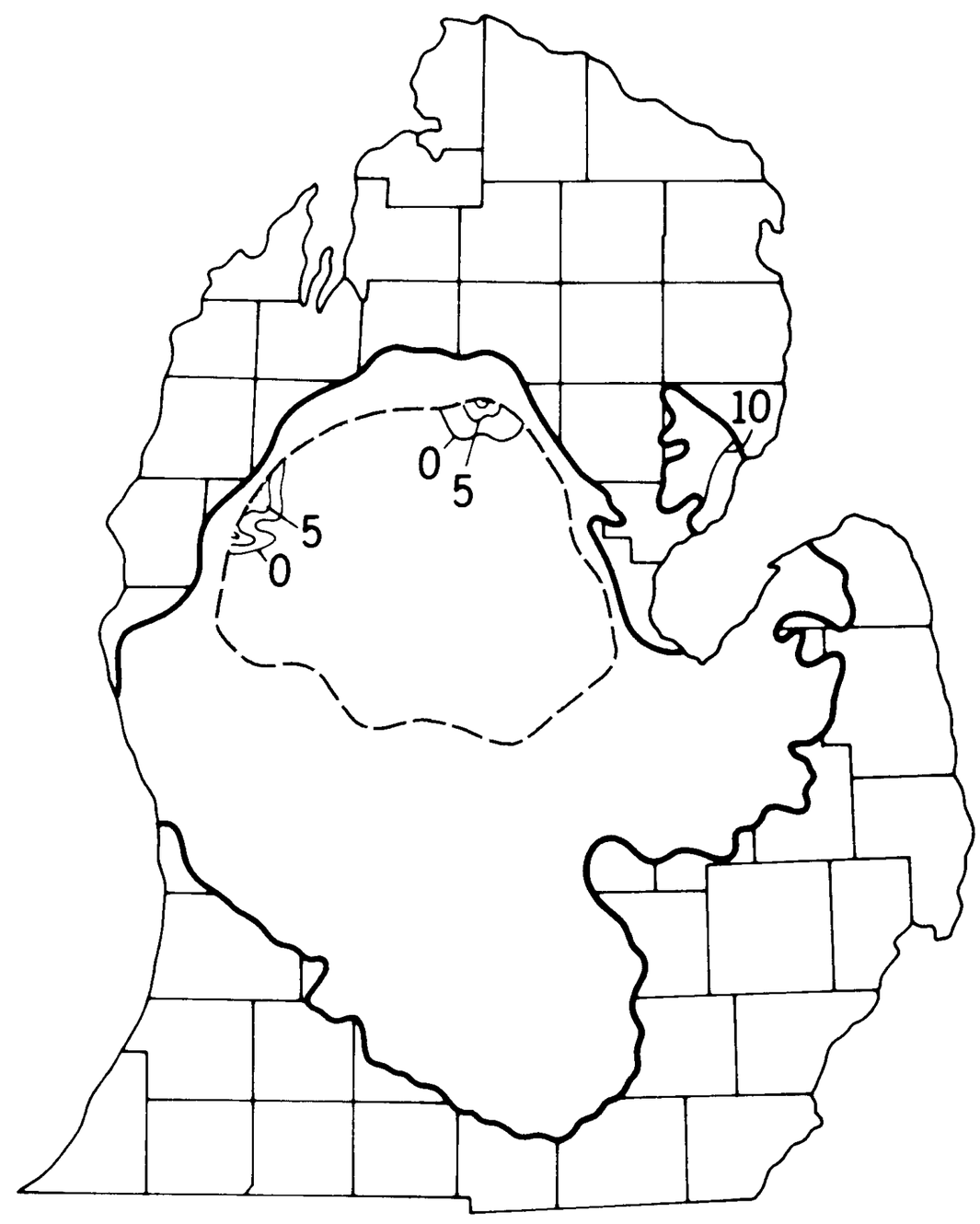
MICHIGAN FORMATION - Depth to top
CONTOUR INTERVAL 250'



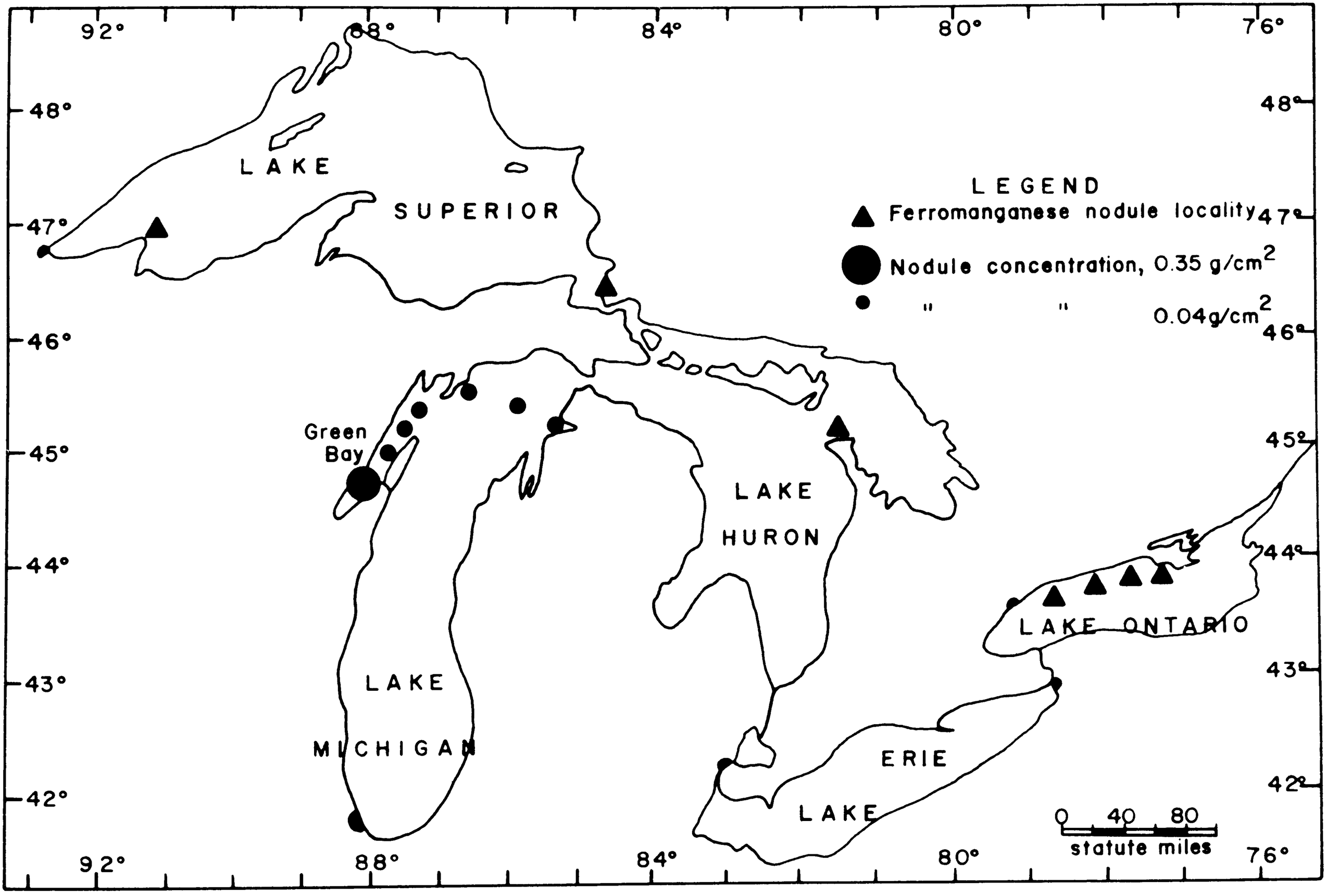
TRIPLE GYP - Gypsum thickness
CONTOUR INTERVAL 5'

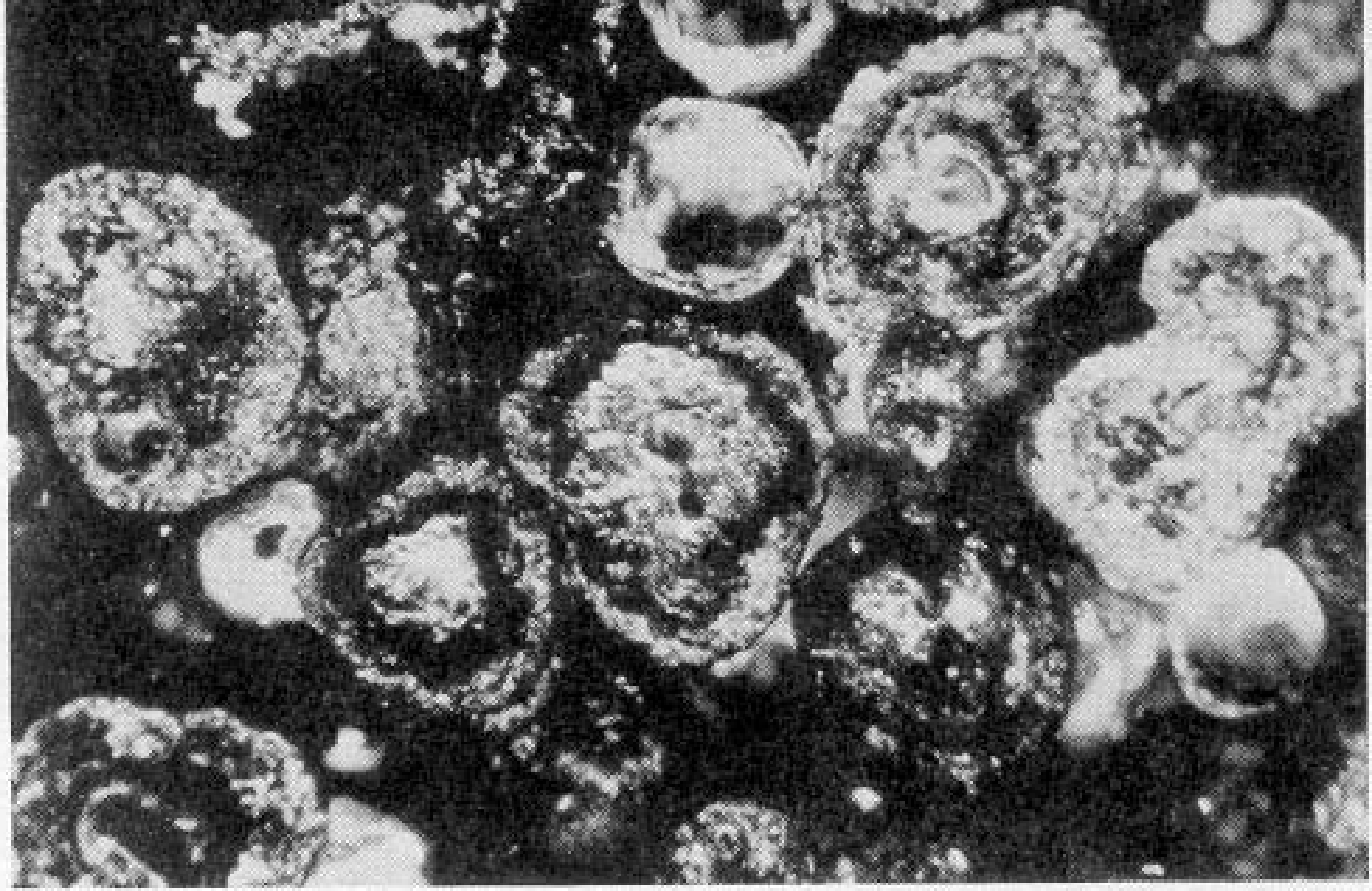


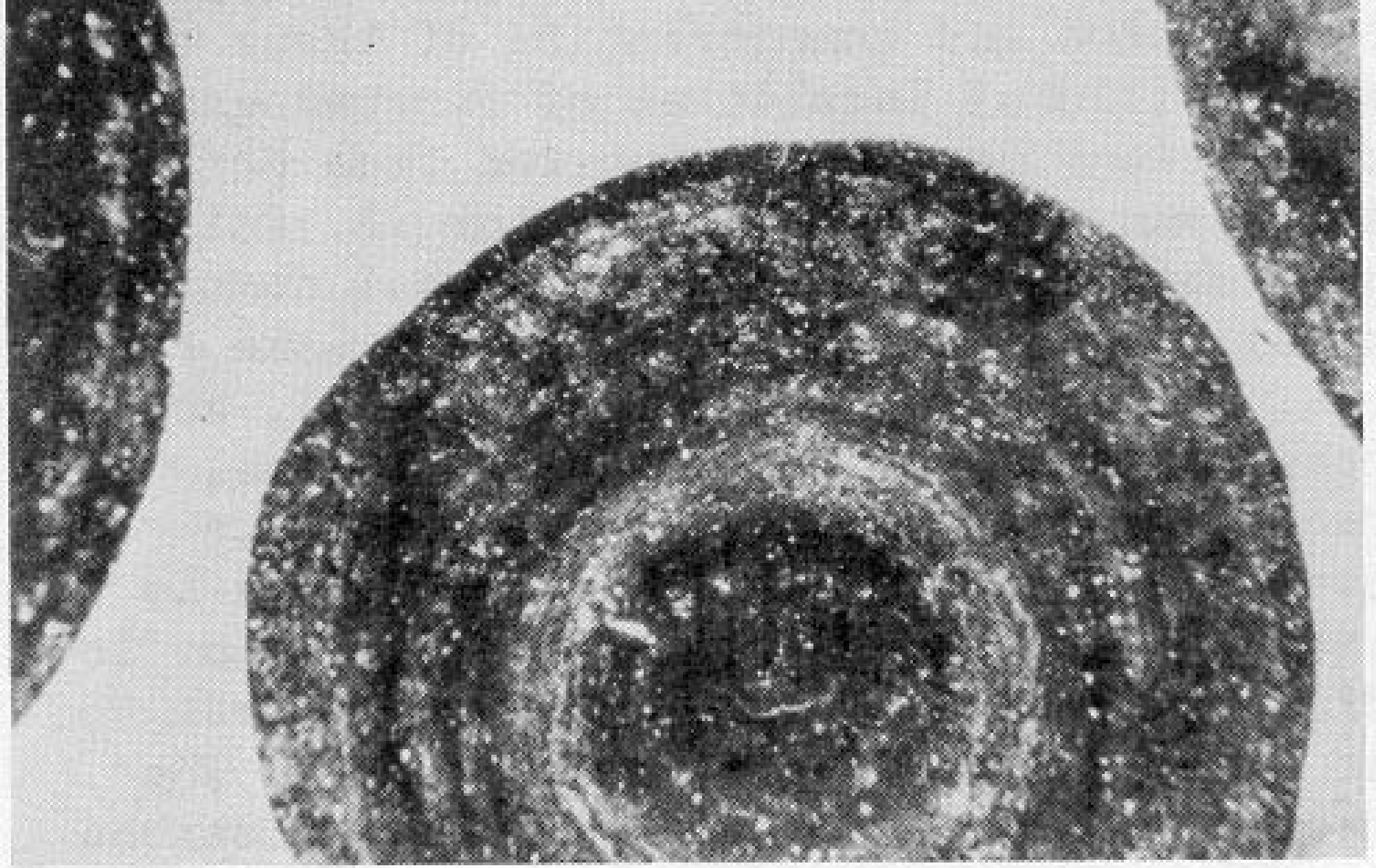
NATIONAL CITY GYP - Gypsum thickness
CONTOUR INTERVAL 5'

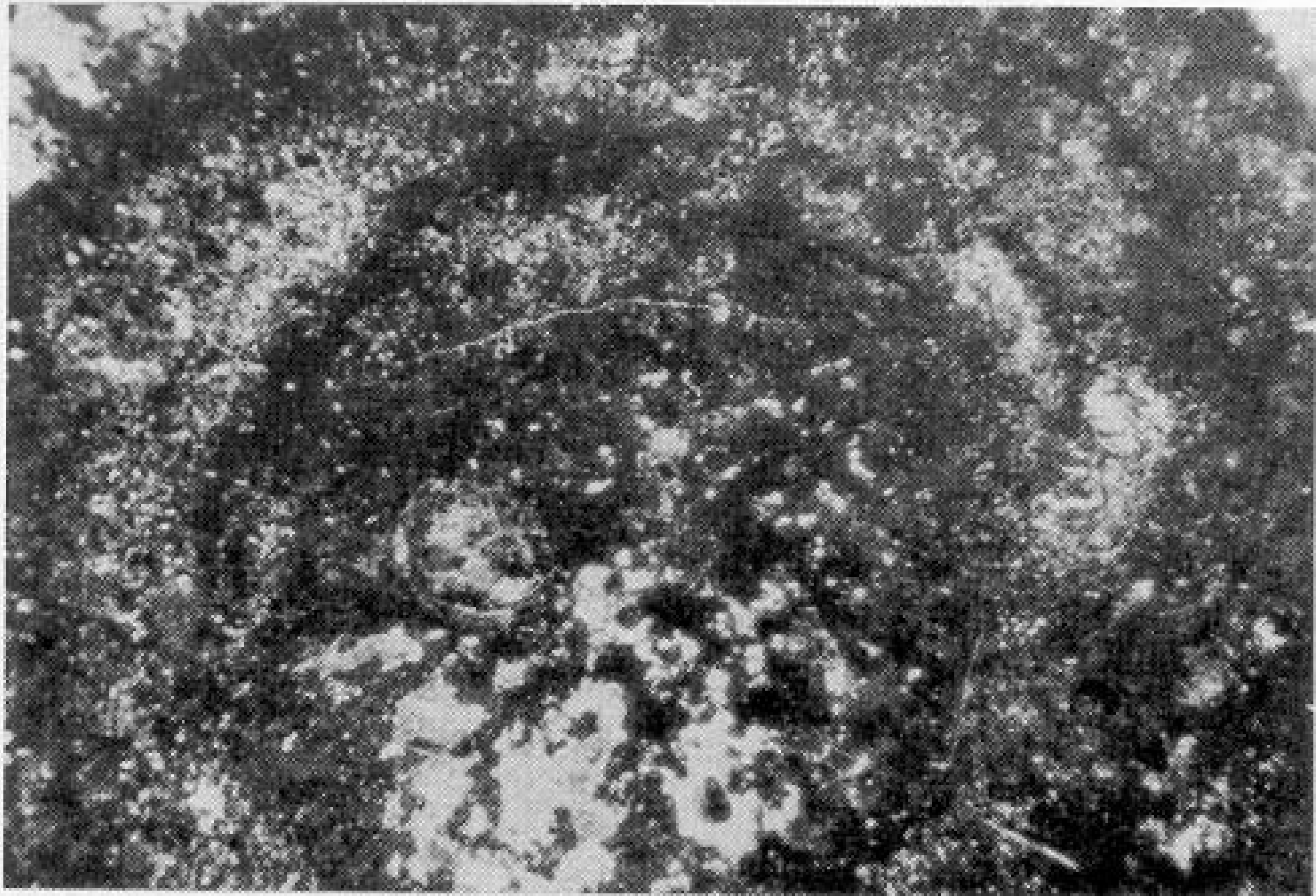


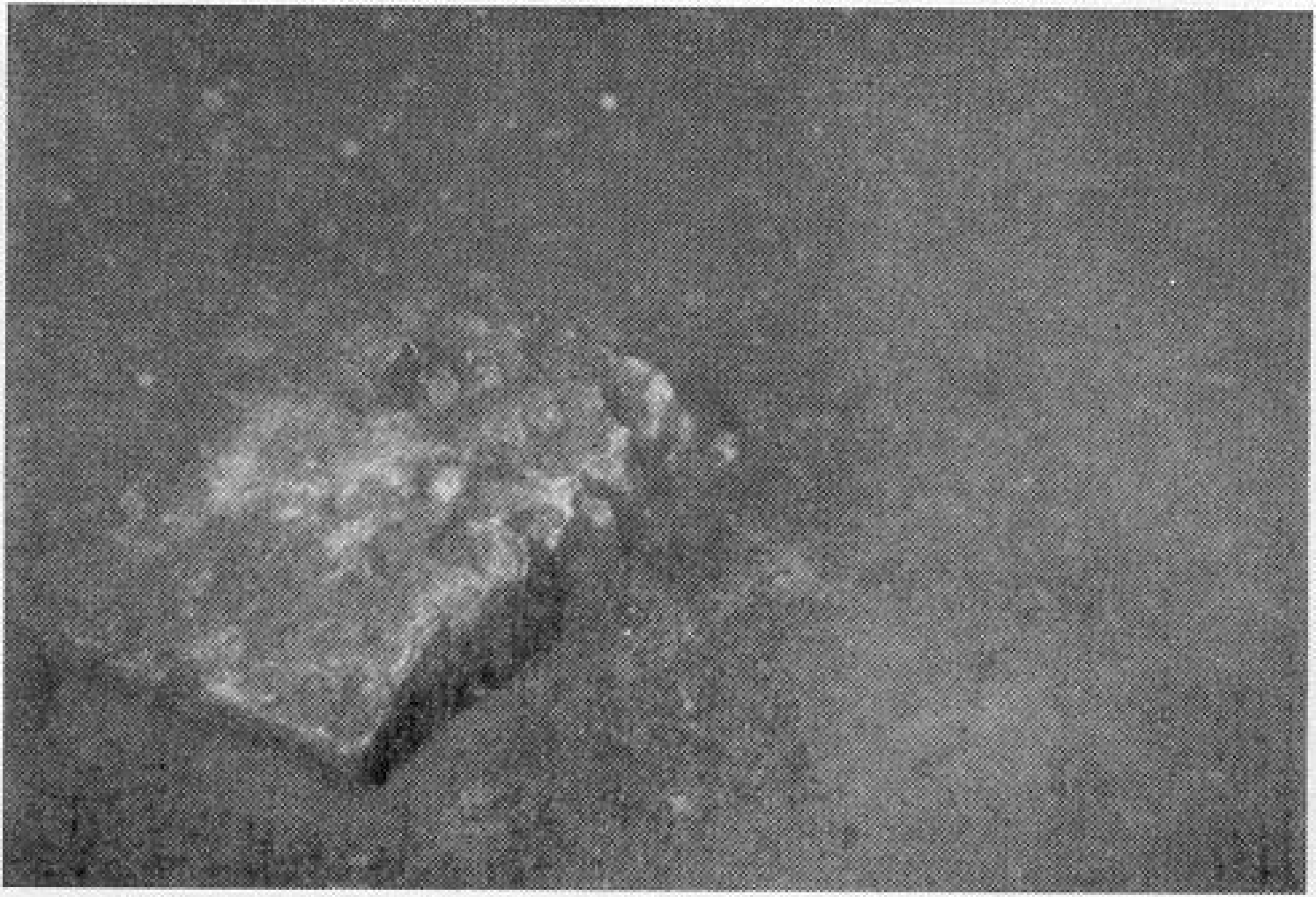
PENCIL GYP - Gypsum thickness
CONTOUR INTERVAL 5'

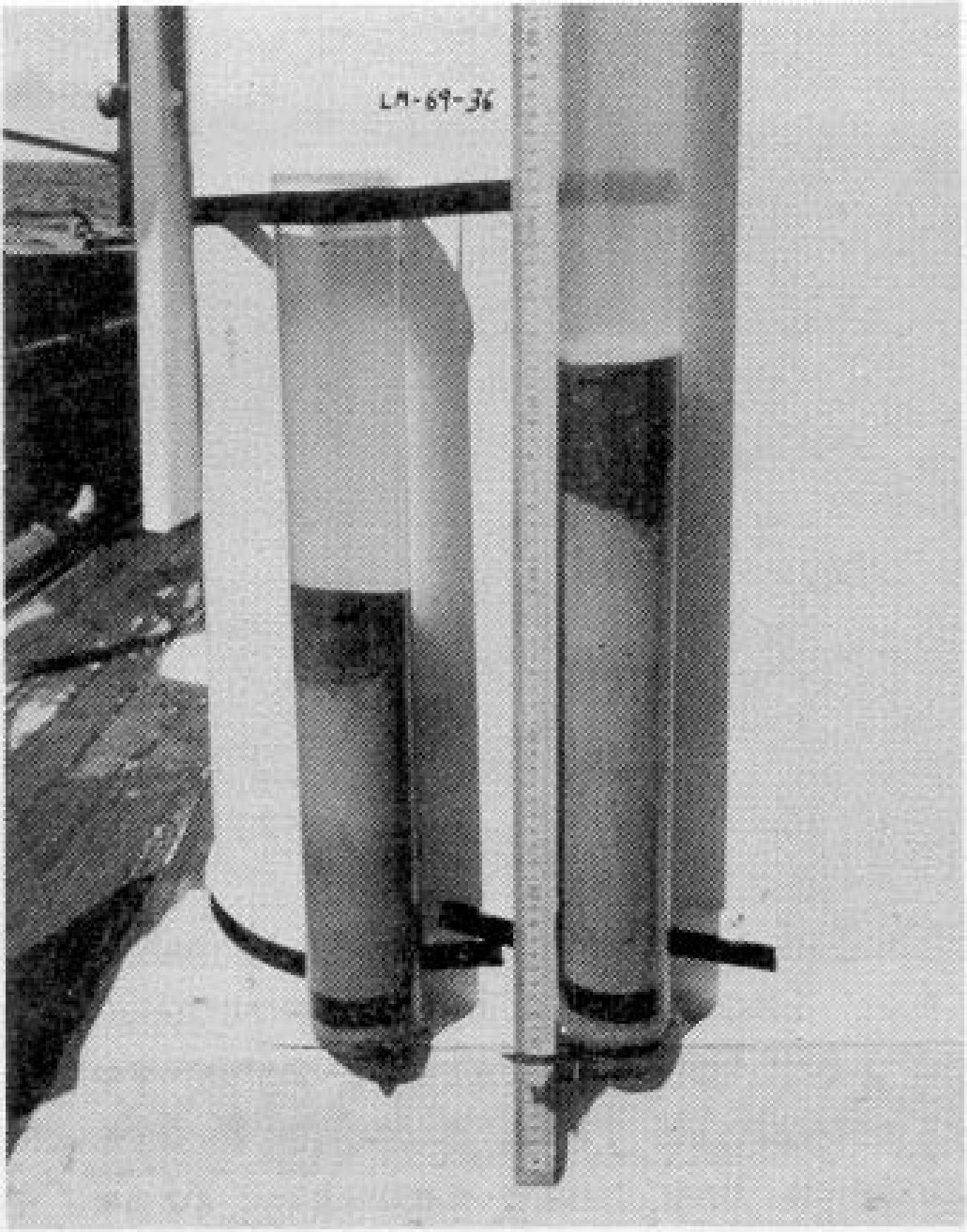

92°
88°
84°
80°
76°
48°
47°
46°
45°
44°
43°
42°
LAKE
SUPERIOR
LEGEND
Ferromanganese nodule locality
Nodule concentration, 0.35 g/cm2
" " 0.04g/cm2
Green
Bay
LAKE
HURON
LAKE ONTARIO
LAKE
MICHIGAN
ERIE
LAKE
0 40 80
statute miles










LR-69-36

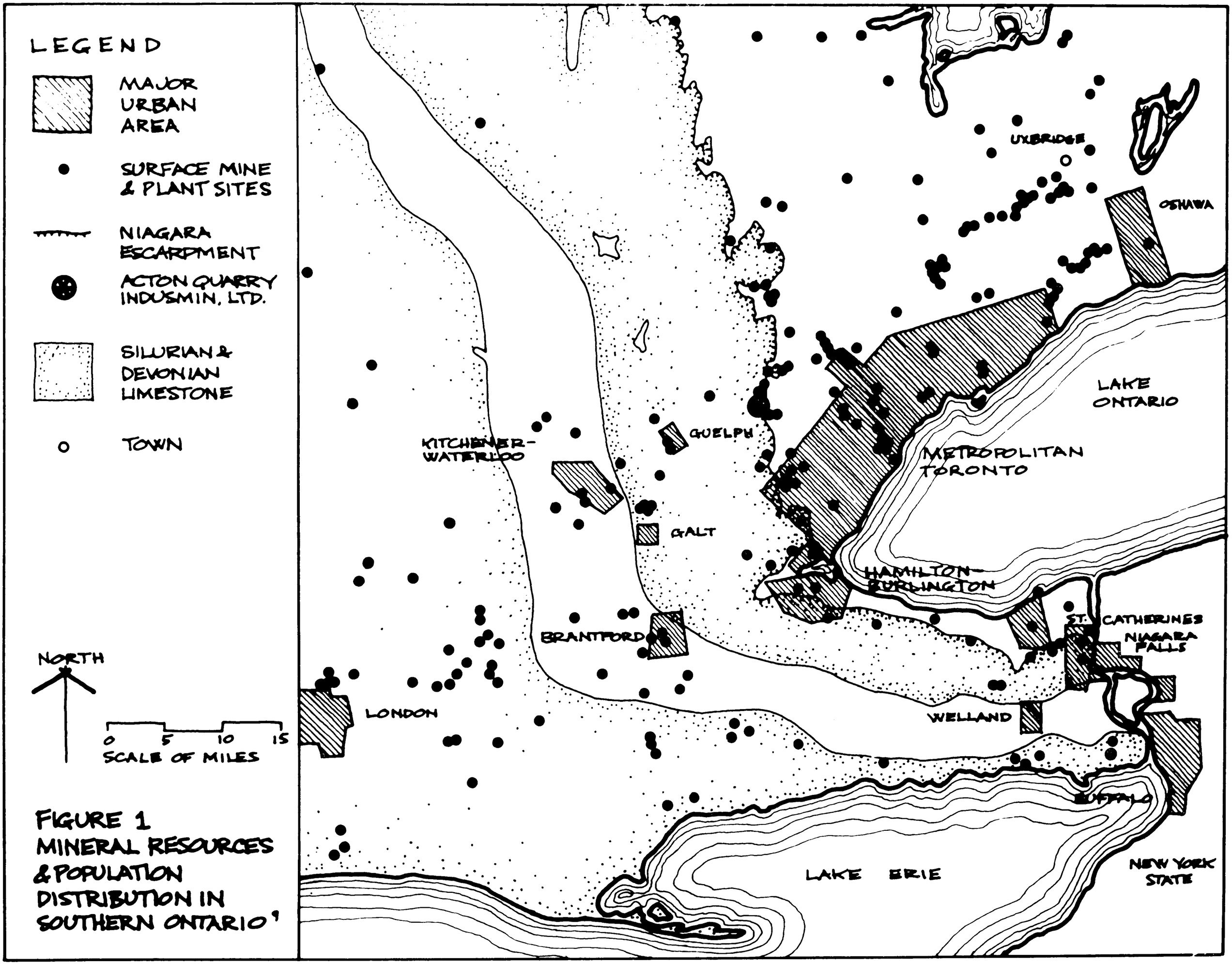


FIGURE 1
MINERAL RESOURCES & POPULATION DISTRIBUTION IN SOUTHERN ONTARIO[9]

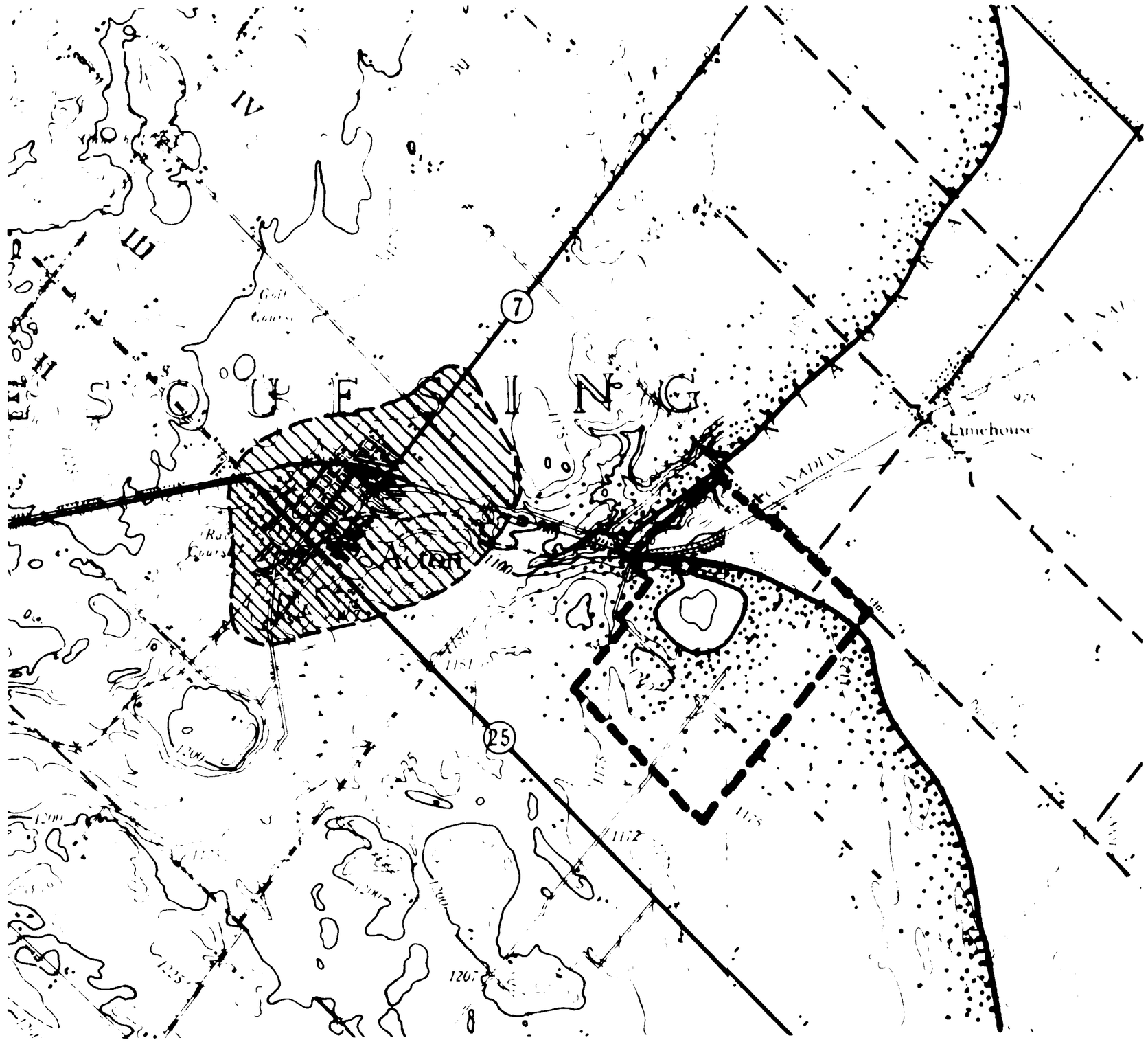
LEGEND

GENERAL LIMITS OF TOWN

SITE LIMITS ACTON QUARRY INDUSMIN, LTD.

NIAGARA ESCARPMENT

SILURIAN & DEVONIAN LIMESTONE



NORTH

SCALE OF MILES

FIGURE 2
ACTON QUARRY REGION[10]

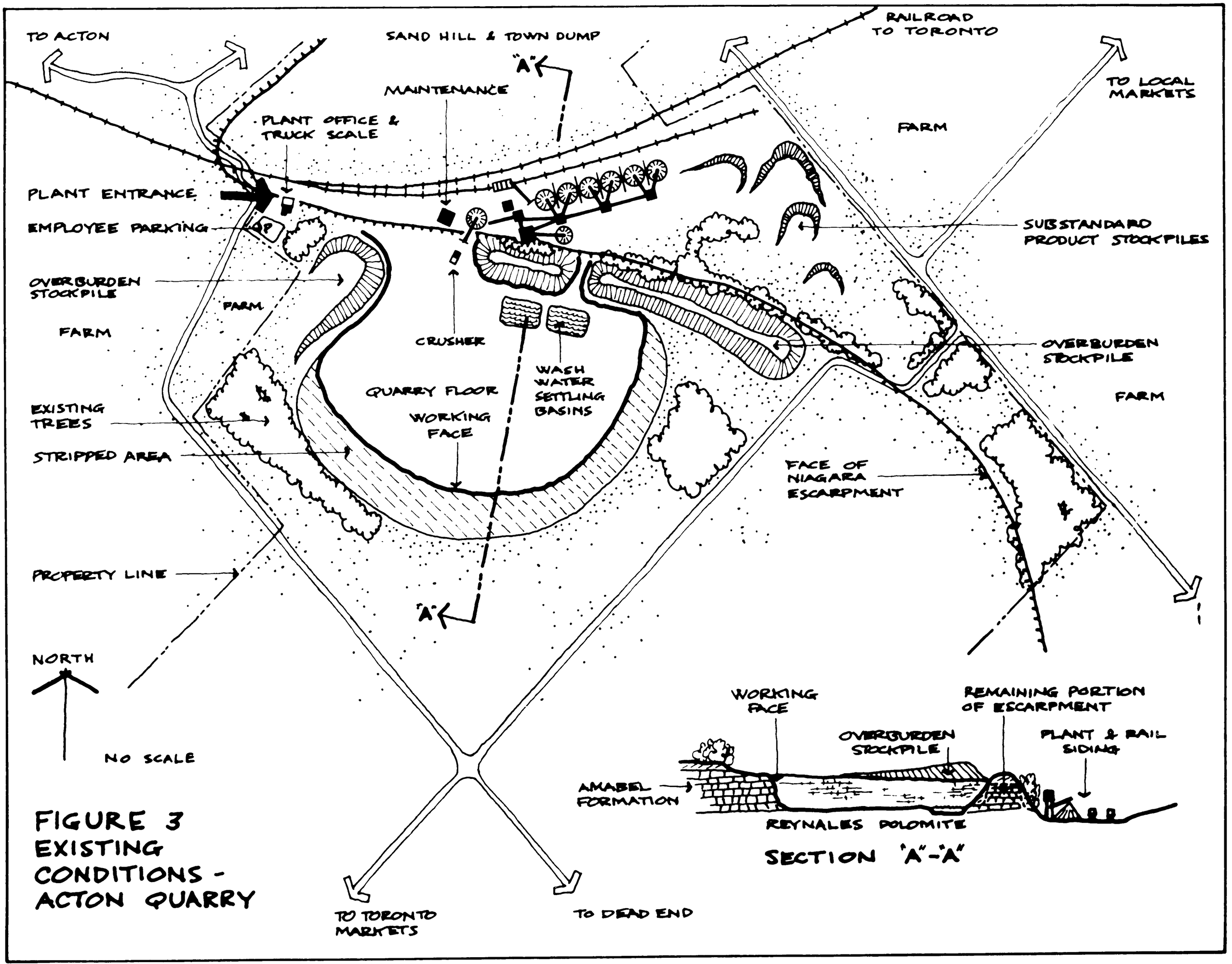


FIGURE 3
EXISTING CONDITIONS - ACTON QUARRY

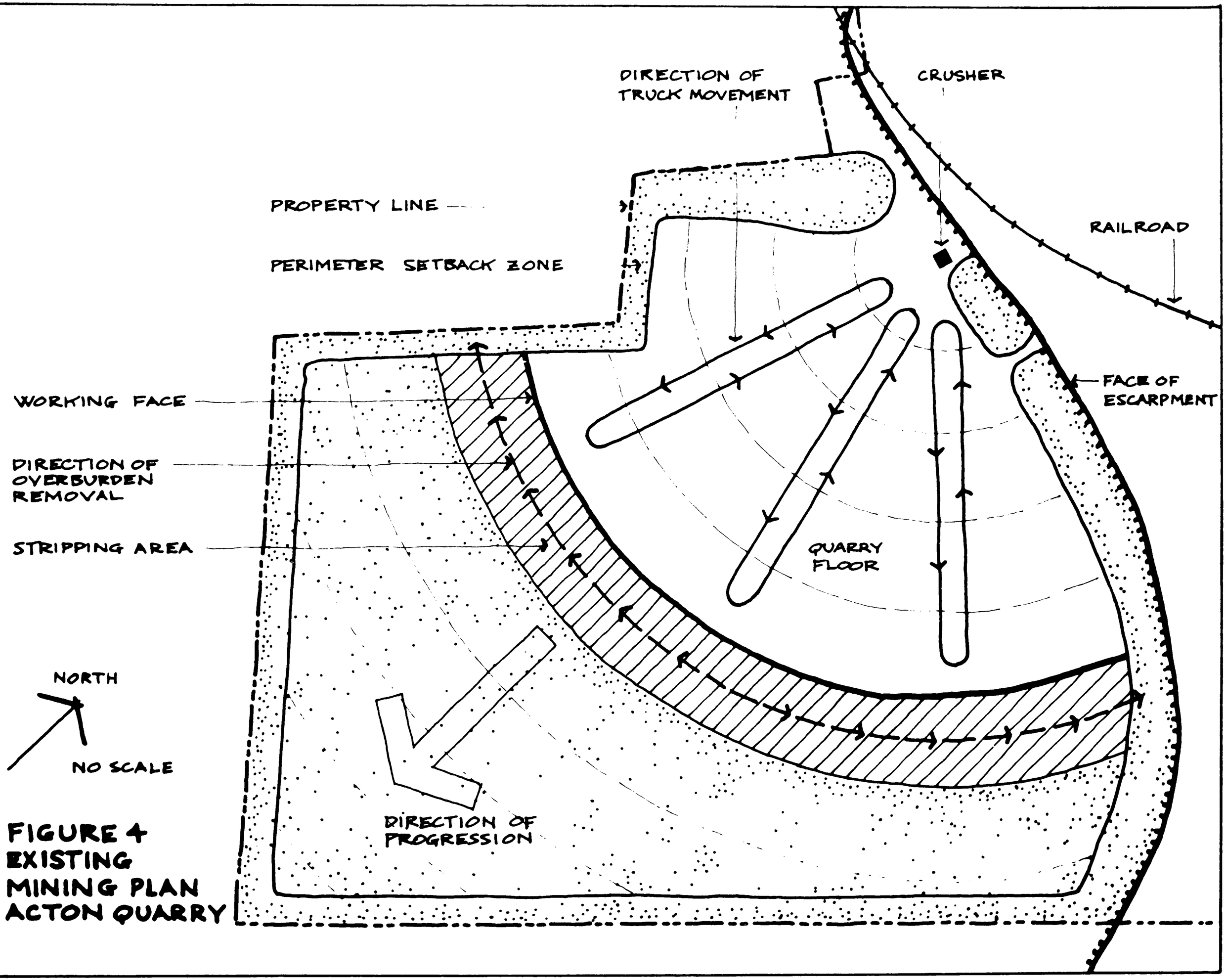


FIGURE 4
EXISTING
MINING PLAN
ACTON QUARRY

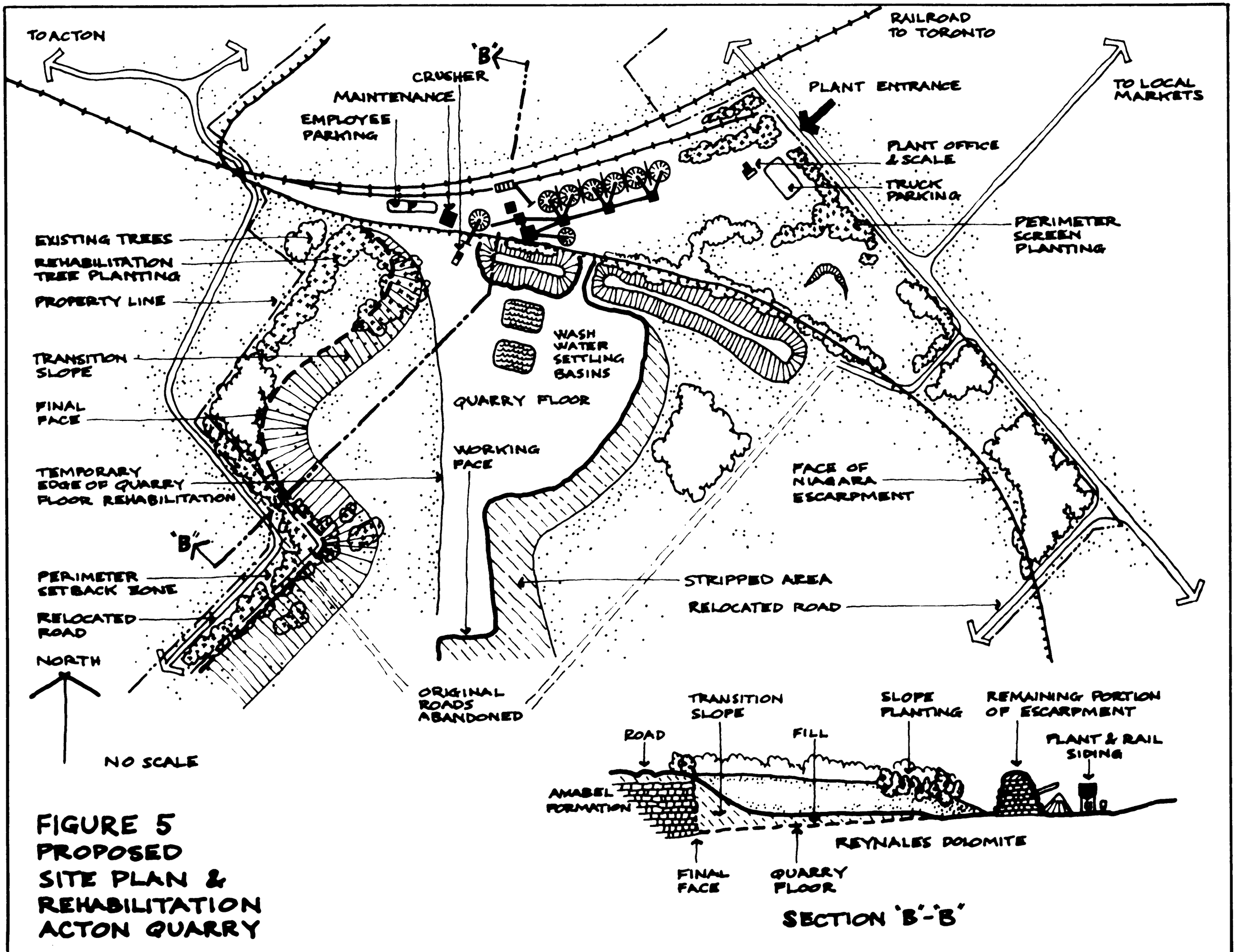


FIGURE 5
PROPOSED
SITE PLAN &
REHABILITATION
ACTON QUARRY

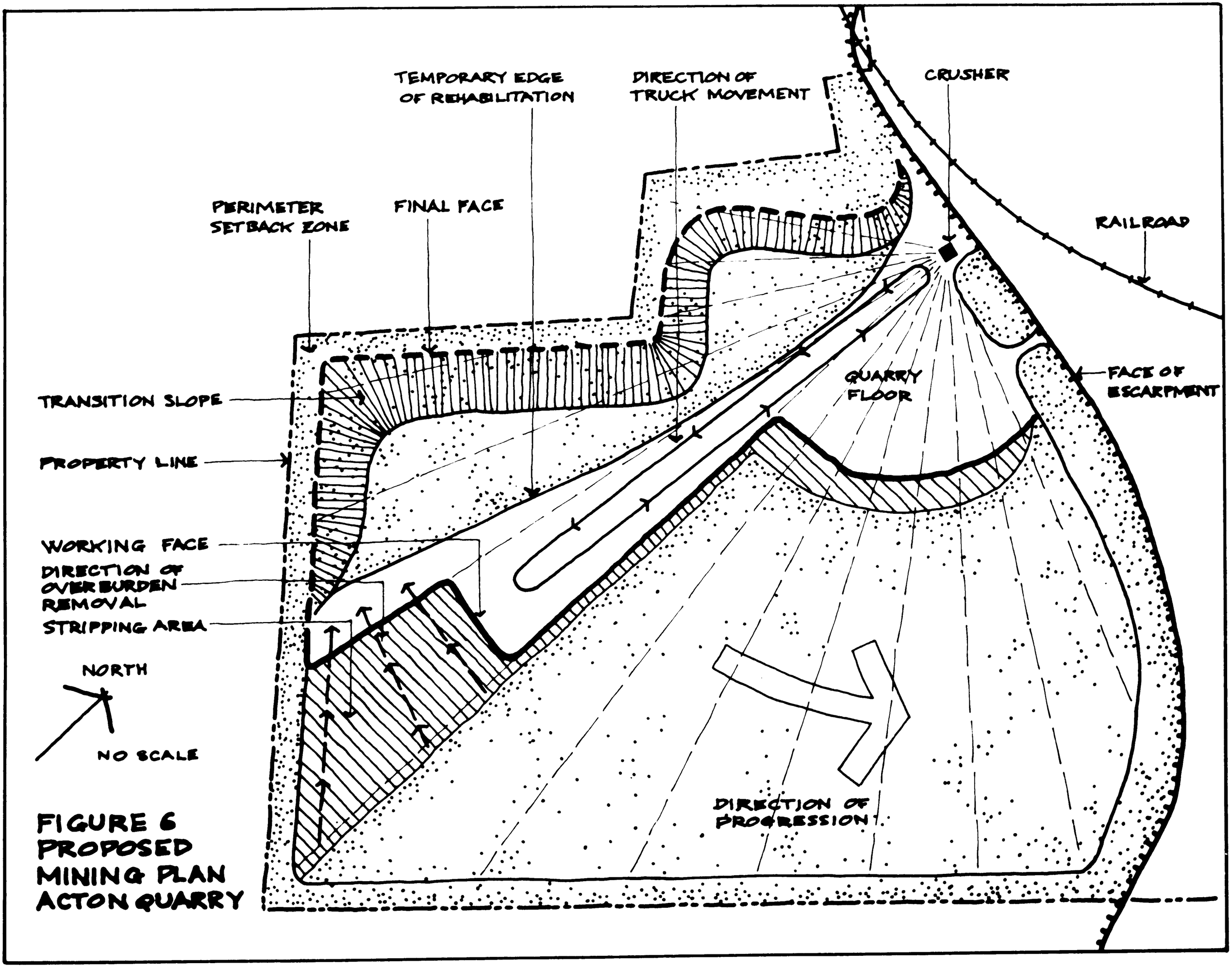
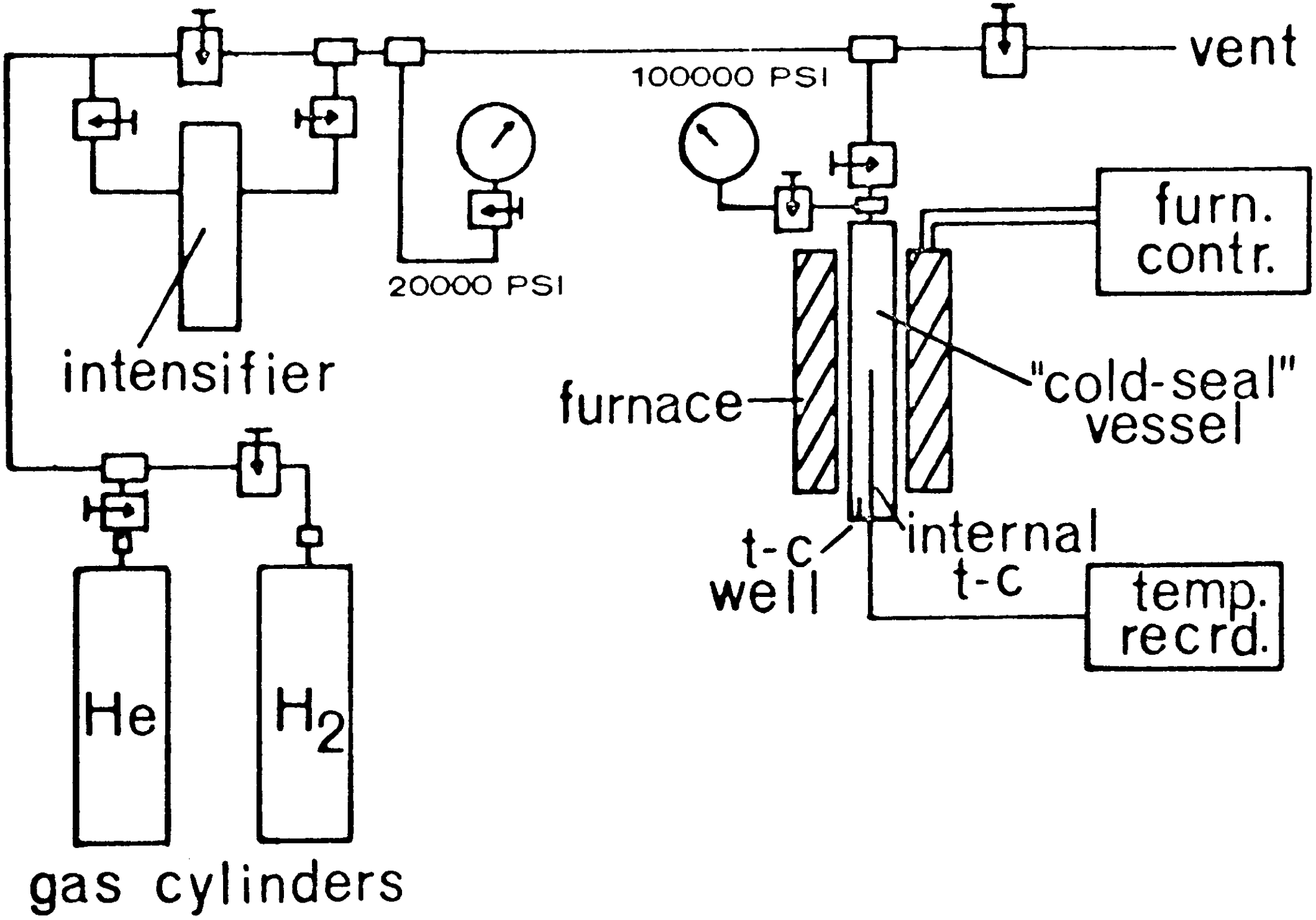
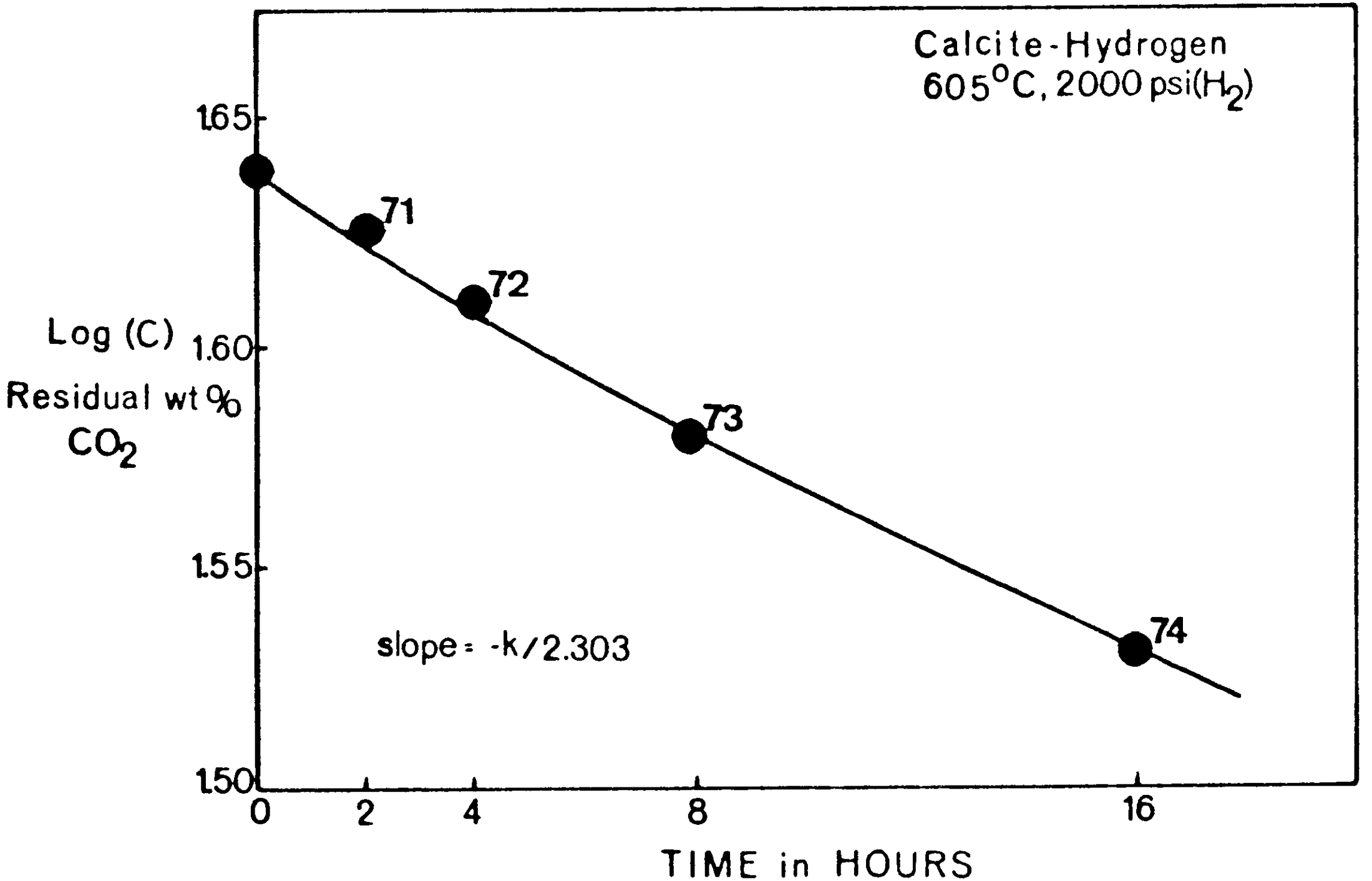
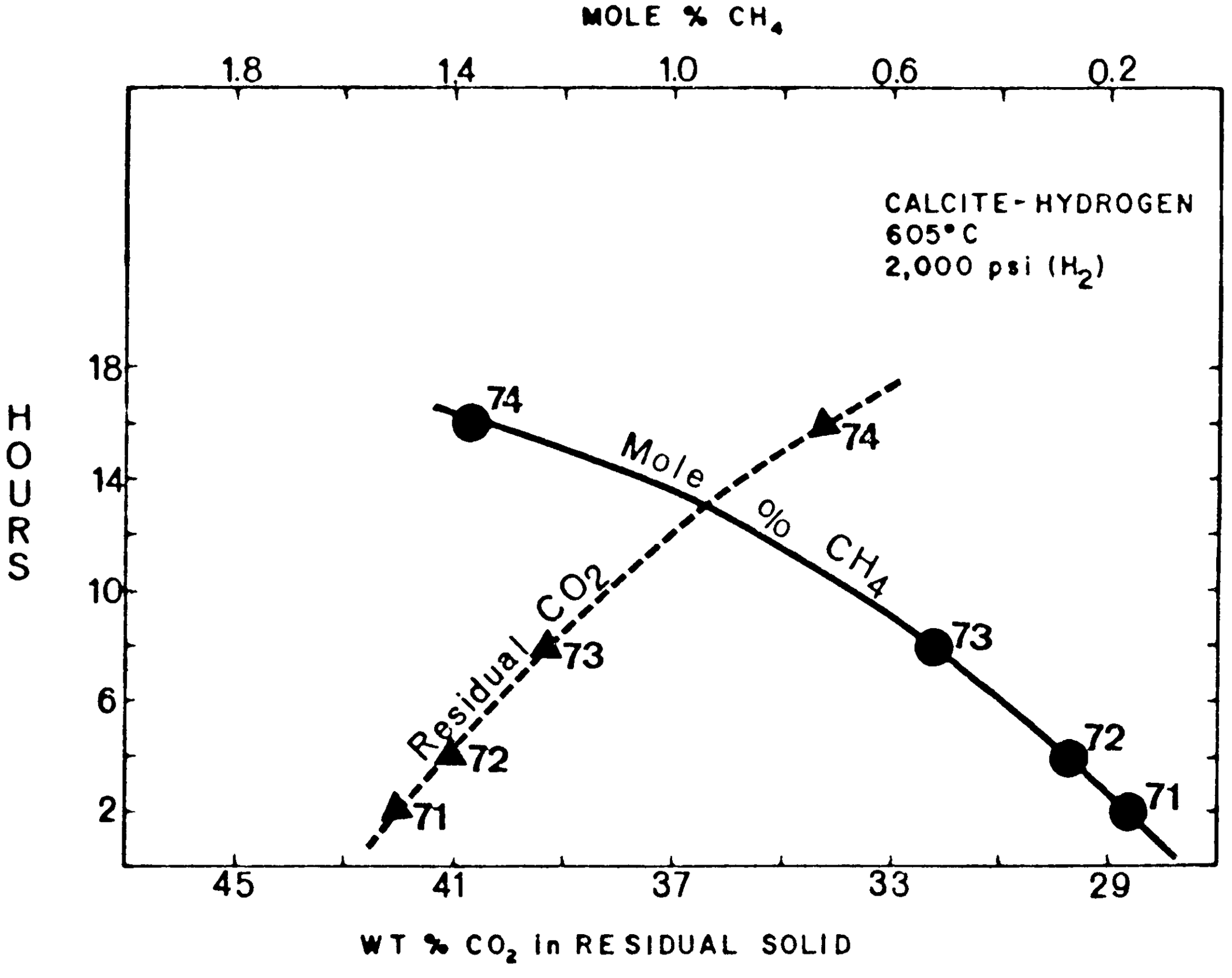
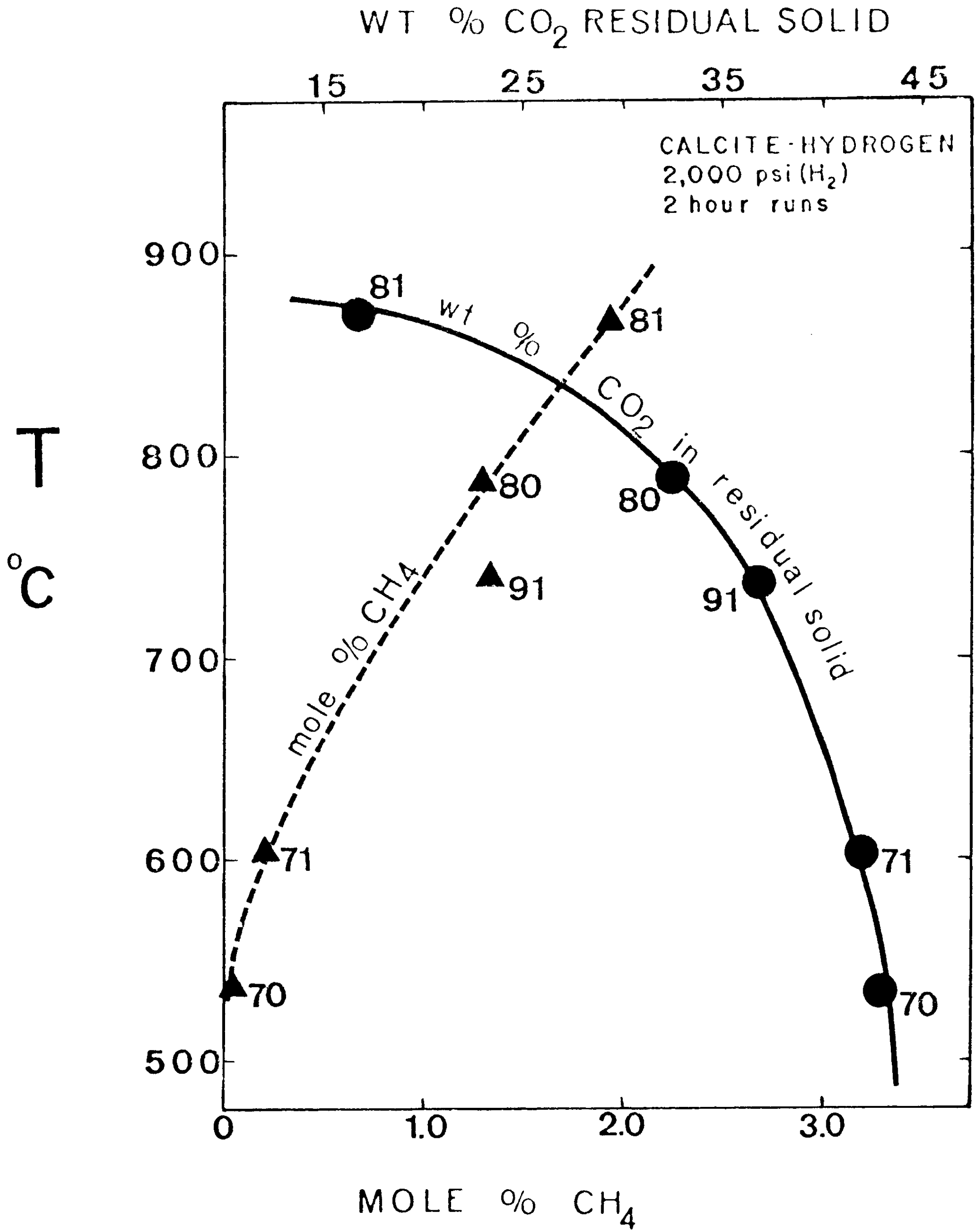


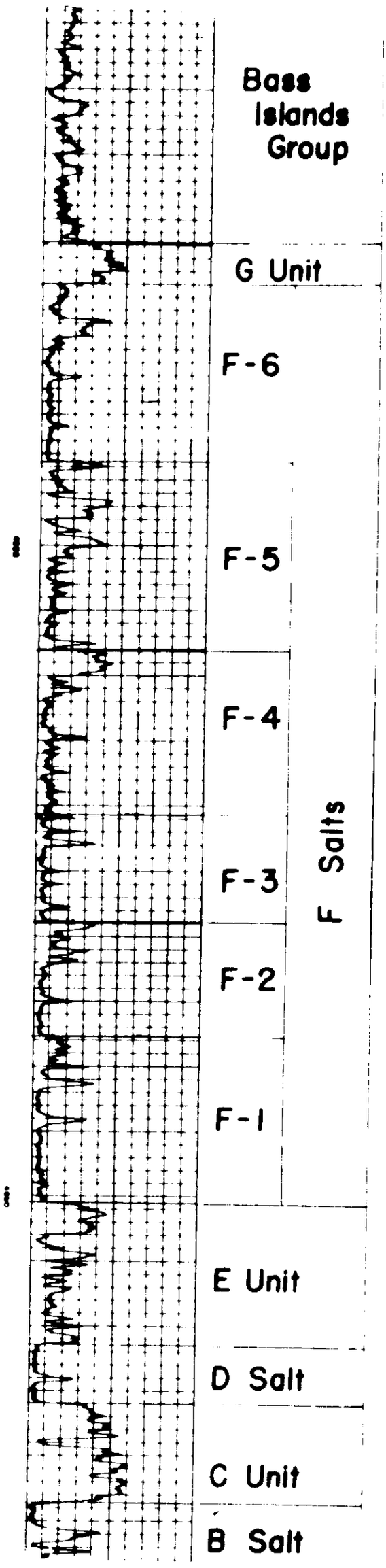
FIGURE 6
PROPOSED MINING PLAN
ACTON QUARRY

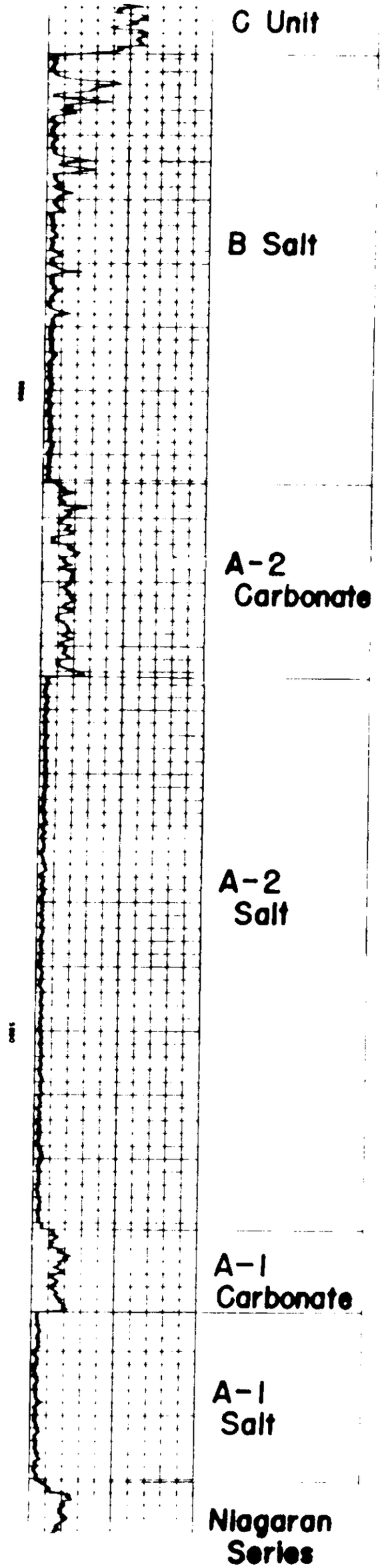

vent
100000 PSI
20000 PSI
furn.
contr.
intensifier
furnace
"cold-seal"
vessel
t-c
well
internal
t-c
temp.
recrd.
He
H_2
gas cylinders

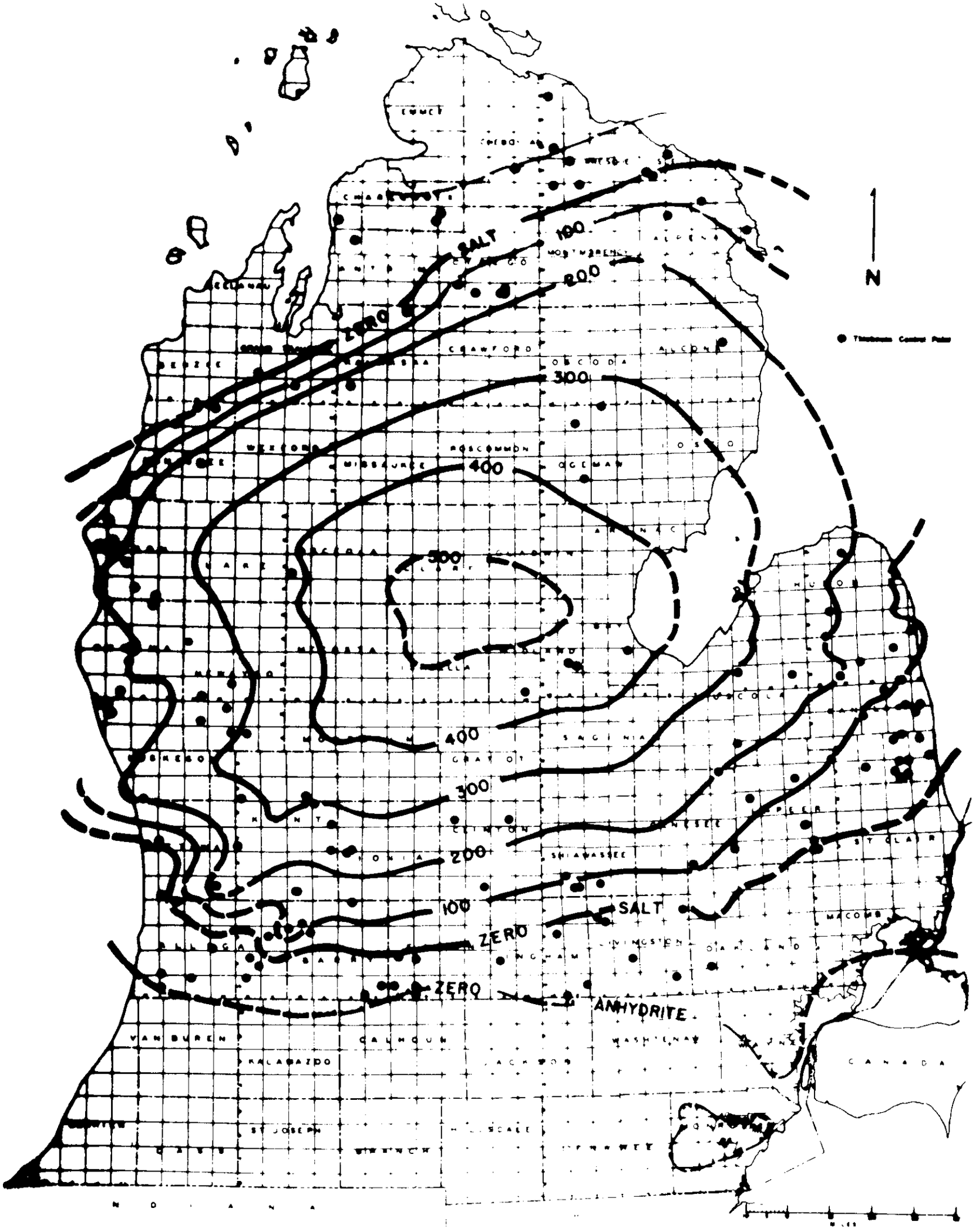

Calcite-Hydrogen
605°C, 2000 psi(H_2)
1.65
1.60
1.55
1.50
Log (C)
Residual wt %
CO_2
71
72
73
74
slope = -k/2.303
0
2
4
8
16
TIME in HOURS


MOLE % CH4
1.8
1.4
1.0
0.6
0.2
CALCITE-HYDROGEN
605°C
2,000 psi (H2)
HOURS
18
14
10
6
2
74
74
Mole % CH4
Residual CO2
73
73
72
72
71
71
45
41
37
33
29
WT % CO2 in RESIDUAL SOLID

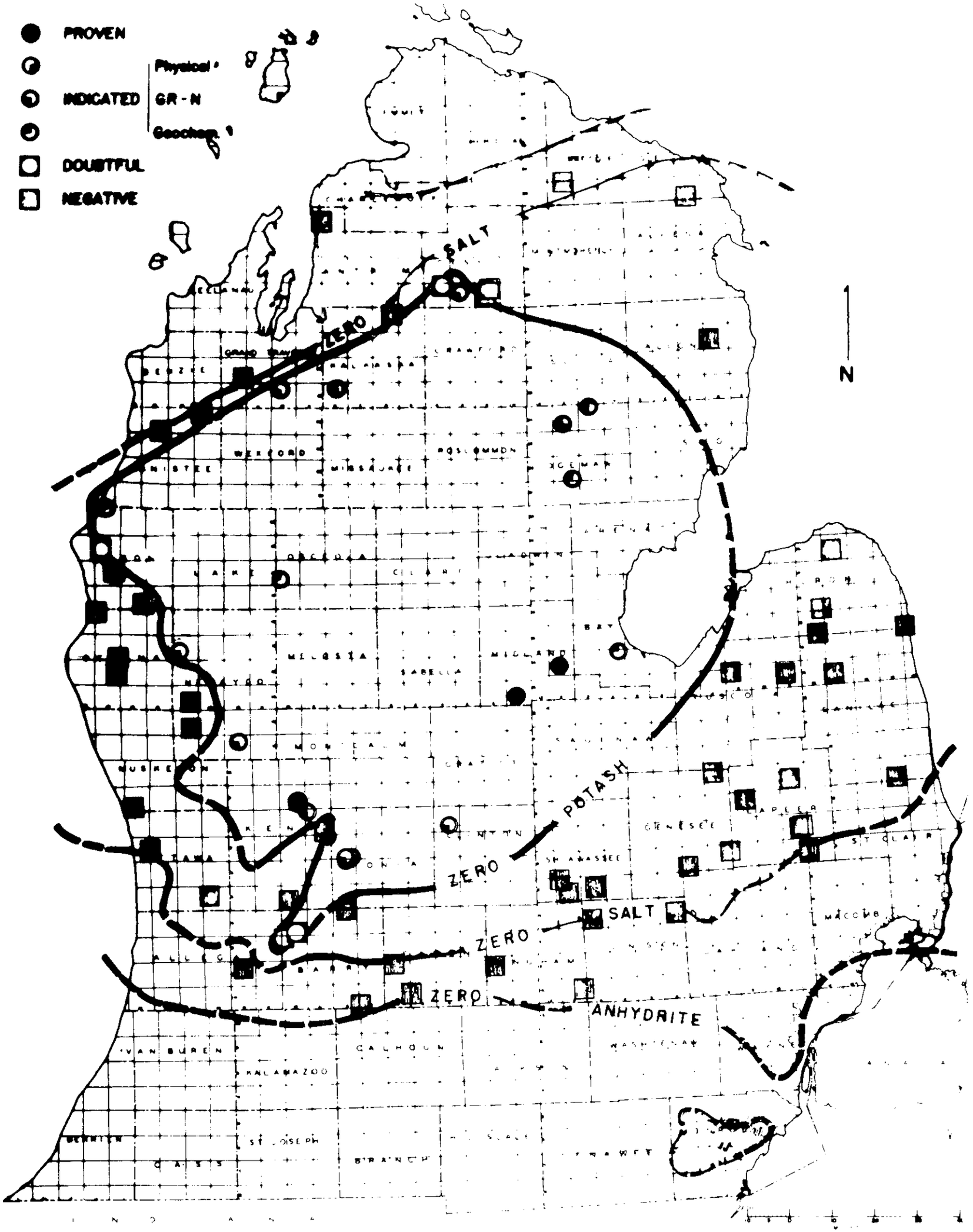

WT % CO_2 RESIDUAL SOLID
15
25
35
45
CALCITE-HYDROGEN
2,000 psi (H_2)
2 hour runs
900
800
700
600
500
T
°C
81
wt
%
CO_2 in residual solid
81
80
80
91
91
mole % CH_4
71
71
70
70
0
1.0
2.0
3.0
MOLE % CH_4

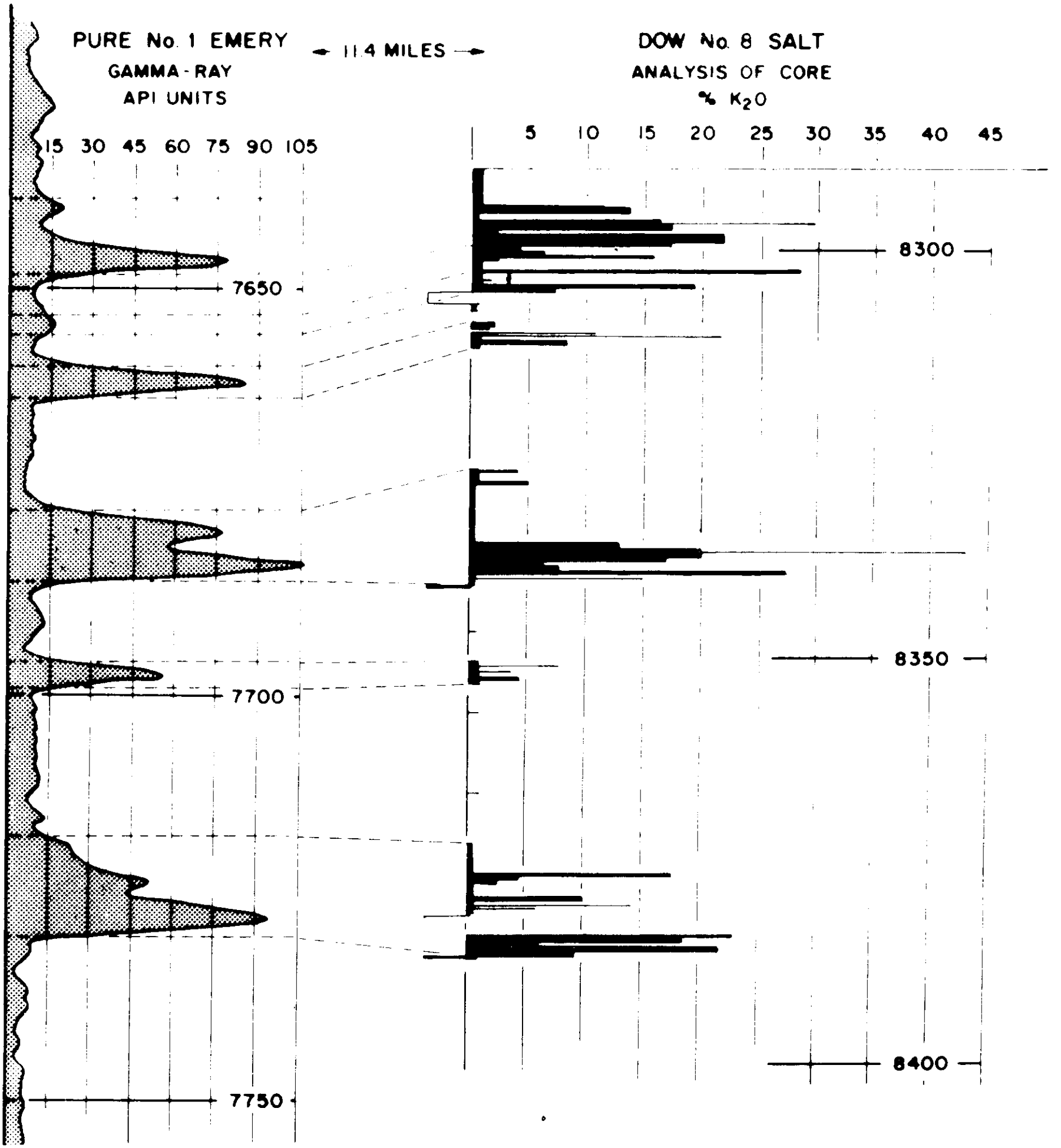

Bass Islands Group
G Unit
F-6
F-5
F-4
F-3
F-2
F-1
F Salts
E Unit
D Salt
C Unit
B Salt

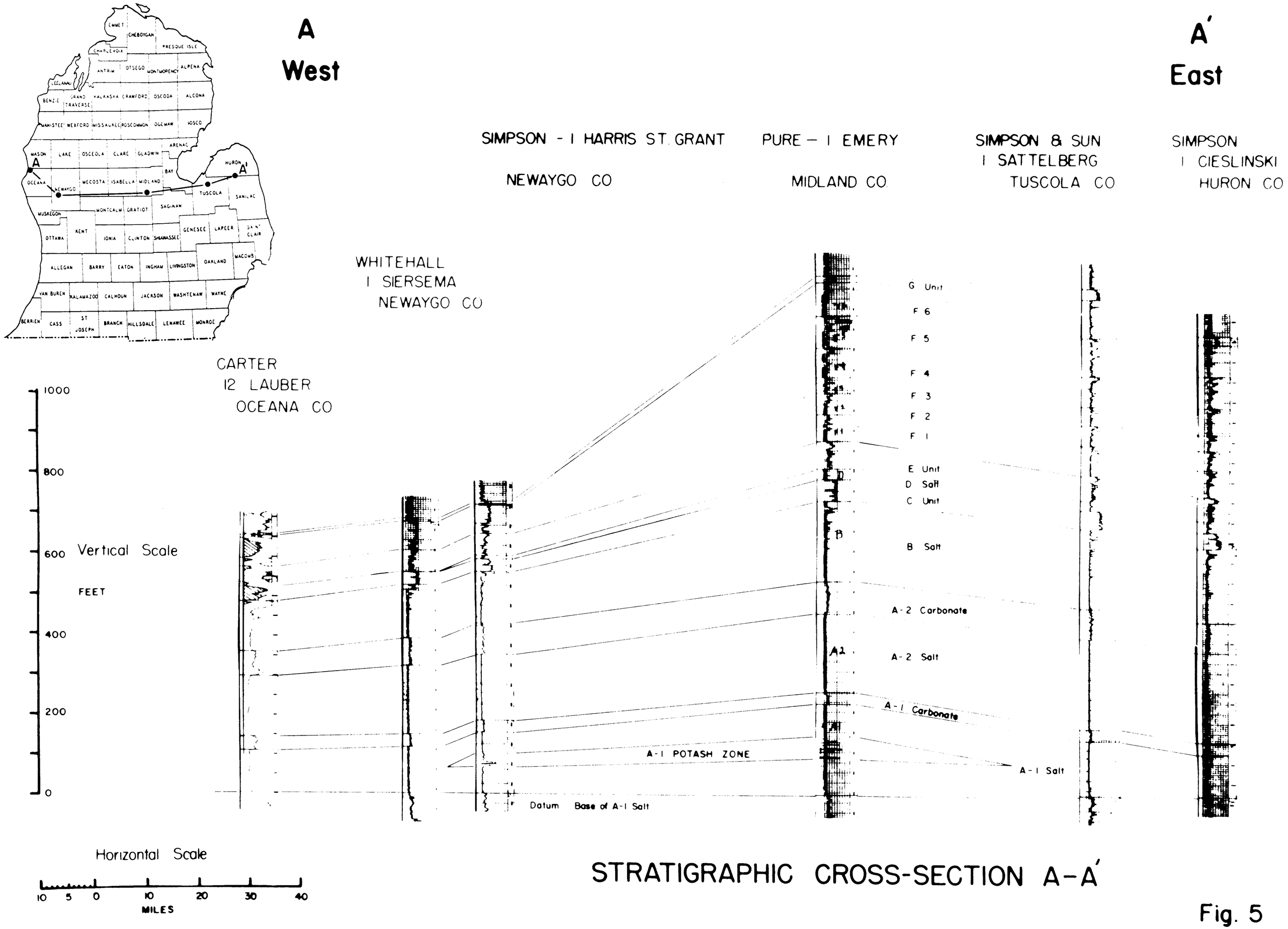

C Unit
B Salt
A-2 Carbonate
A-2 Salt
A-1 Carbonate
A-1 Salt
Niagaran Series



N
Thiobacco Control Point
SALT
ZERO
100
200
300
400
500
400
300
200
100
SALT
ZERO
ZERO
ANHYDRITE
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
ANTRIM
OTSEGO
MONTMORENCY
ALPENA
LEELANAU
GRAND TRAVERSE
BENZIE
KALKASKA
CRAWFORD
OSCODA
ALCONA
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
ARENAC
LAKE
OSCEOLA
CLARE
GLADWIN
HURON
MECOSTA
ISABELLA
MIDLAND
NEWAYGO
MONTCALM
GRATIOT
SAGINAW
TUSCOLA
MUSKEGON
KENT
CLINTON
GENESEE
LAPEER
ST CLAIR
IONIA
SHIAWASSEE
MACOMB
ALLEGAN
BARRY
INGHAM
LIVINGSTON
OAKLAND
VAN BUREN
CALHOUN
WASHTENAW
WAYNE
KALAMAZOO
JACKSON
CANADA
ST JOSEPH
HILLSDALE
MONROE
CASS
BRANCH
LENAWEE
INDIANA

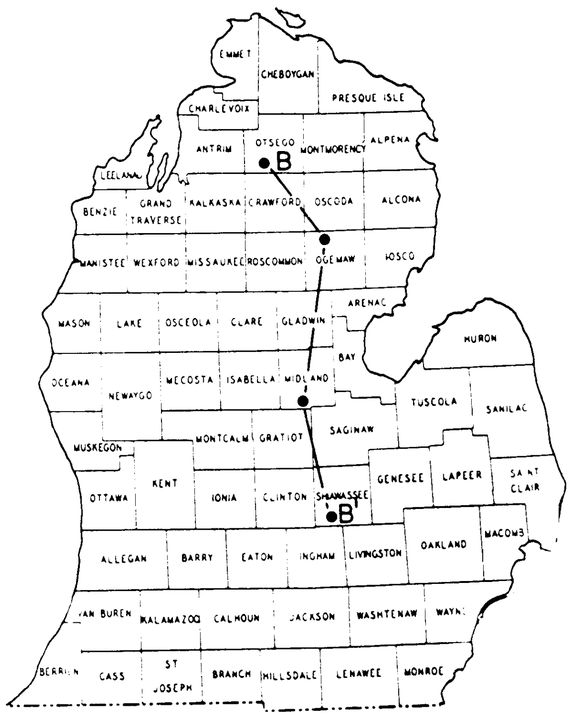

PROVEN
INDICATED
Physical
GR - N
Geochem.
DOUBTFUL
NEGATIVE
N
ZERO SALT
ZERO POTASH
ZERO SALT
ZERO ANHYDRITE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
OSCEOLA
CLARE
MELOSIA
SABELLA
MIDLAND
BAY
MONTCALM
NUSKEGON
GENESEE
SHIAWASSEE
ST CLAIR
MACOMB
VAN BUREN
KALAMAZOO
CALHOUN
WASHTENAW
ST JOSEPH
BRANCH
CASS
BERRIEN


PURE No. 1 EMERY
GAMMA-RAY
API UNITS
11.4 MILES
DOW No. 8 SALT
ANALYSIS OF CORE
% K_2O
15 30 45 60 75 90 105
5 10 15 20 25 30 35 40 45
7650
7700
7750
8300
8350
8400



STRATIGRAPHIC CROSS-SECTION A-A'

Fig. 5



B

North

B'

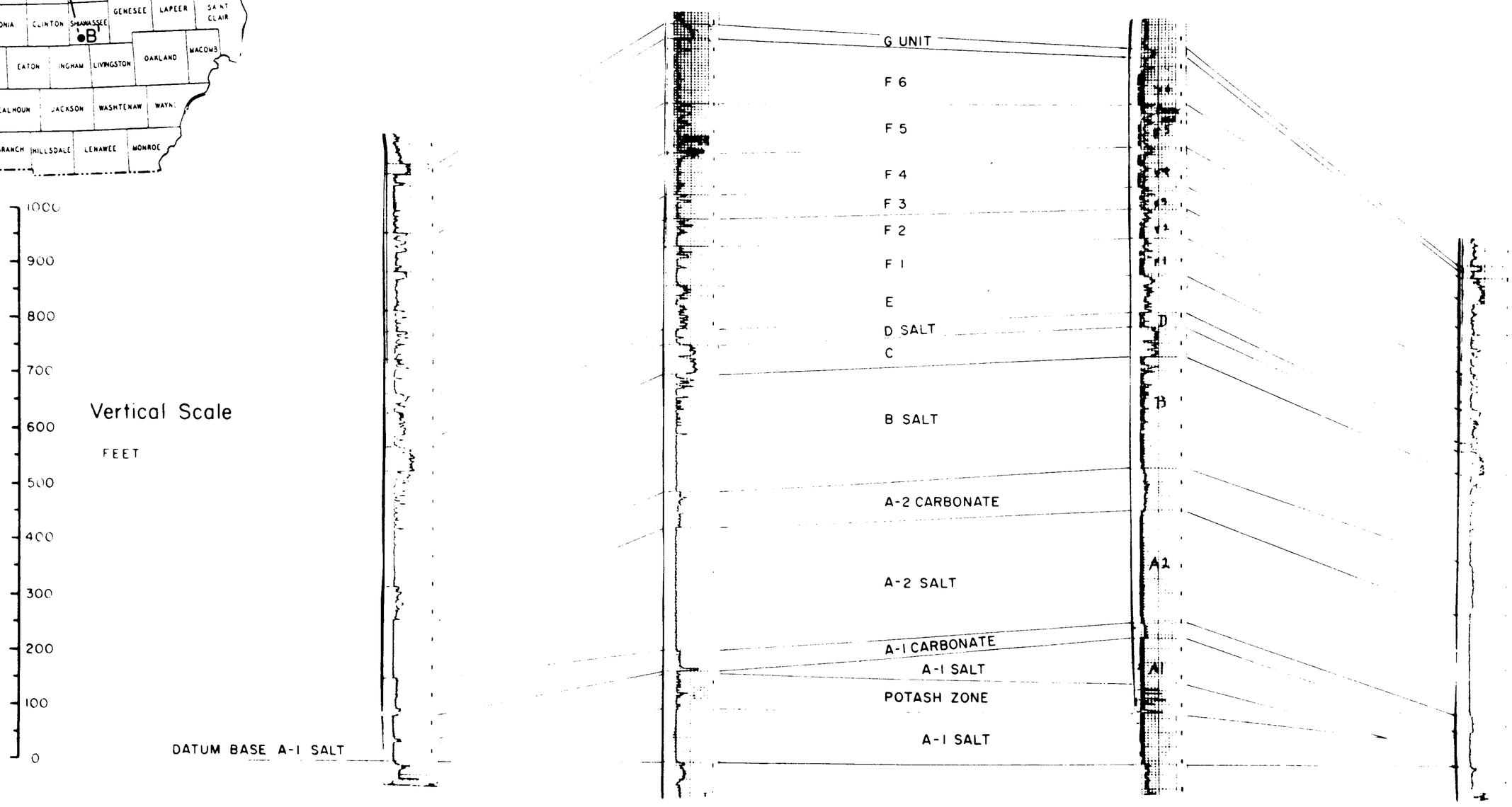
South

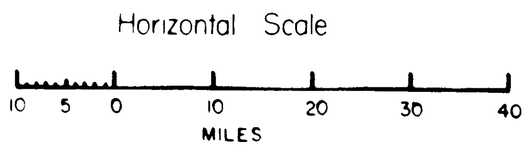
SIMPSON
ST.-OTSEGO No. 1
OTSEGO CO

BRAZOS-SUN-SUPERIOR
ST.-FOSTER No. 1
OGEMAW CO.

PURE
EMERY No. 1
MIDLAND CO.

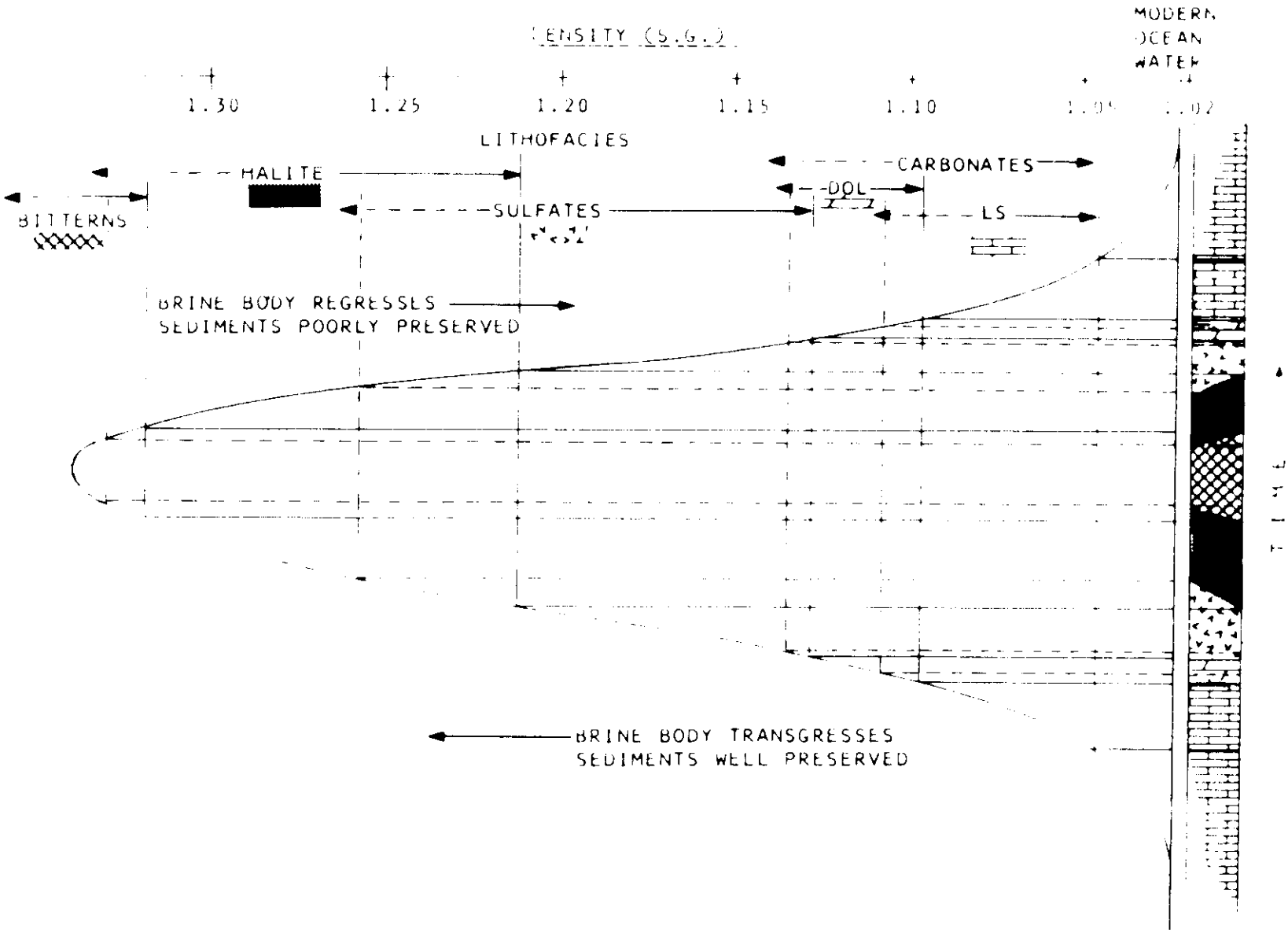
LEE
FERRIS No. 1
SHIAWASSEE CO.





STRATIGRAPHIC CROSS-SECTION B-B'

Fig. 6


DENSITY (S.G.)
MODERN OCEAN WATER
1.30
1.25
1.20
1.15
1.10
1.05
1.02
LITHOFACIES
HALITE
CARBONATES
DOL
SULFATES
LS
BITTERNS
BRINE BODY REGRESSES
SEDIMENTS POORLY PRESERVED
BRINE BODY TRANSGRESSES
SEDIMENTS WELL PRESERVED
TIME

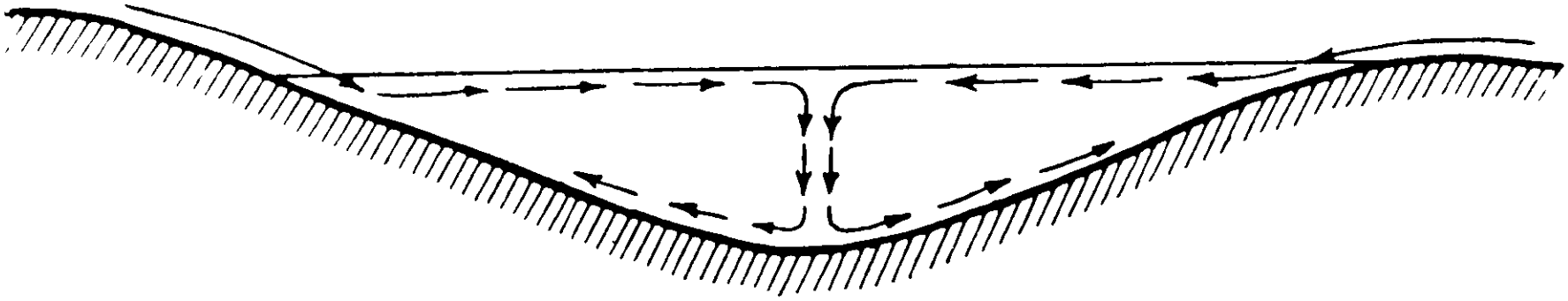
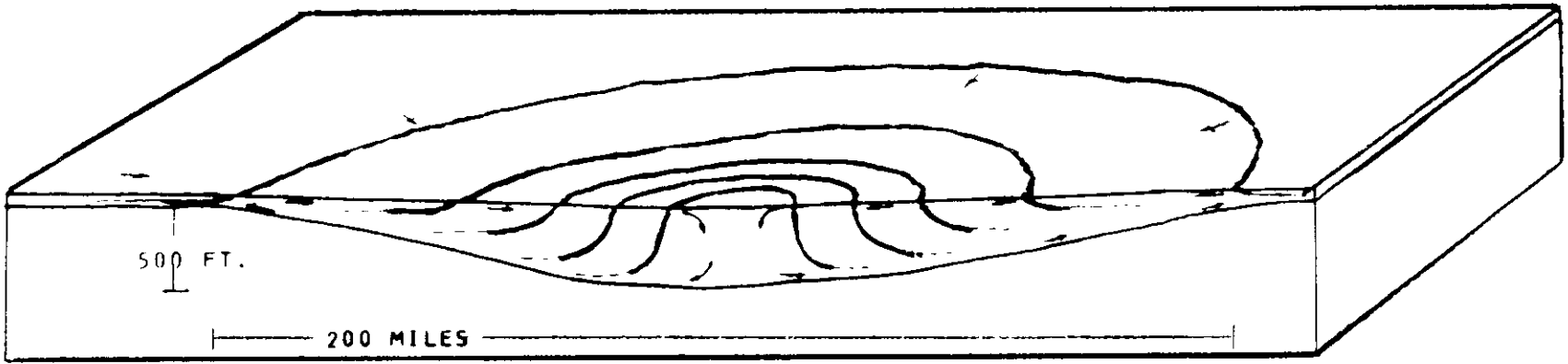
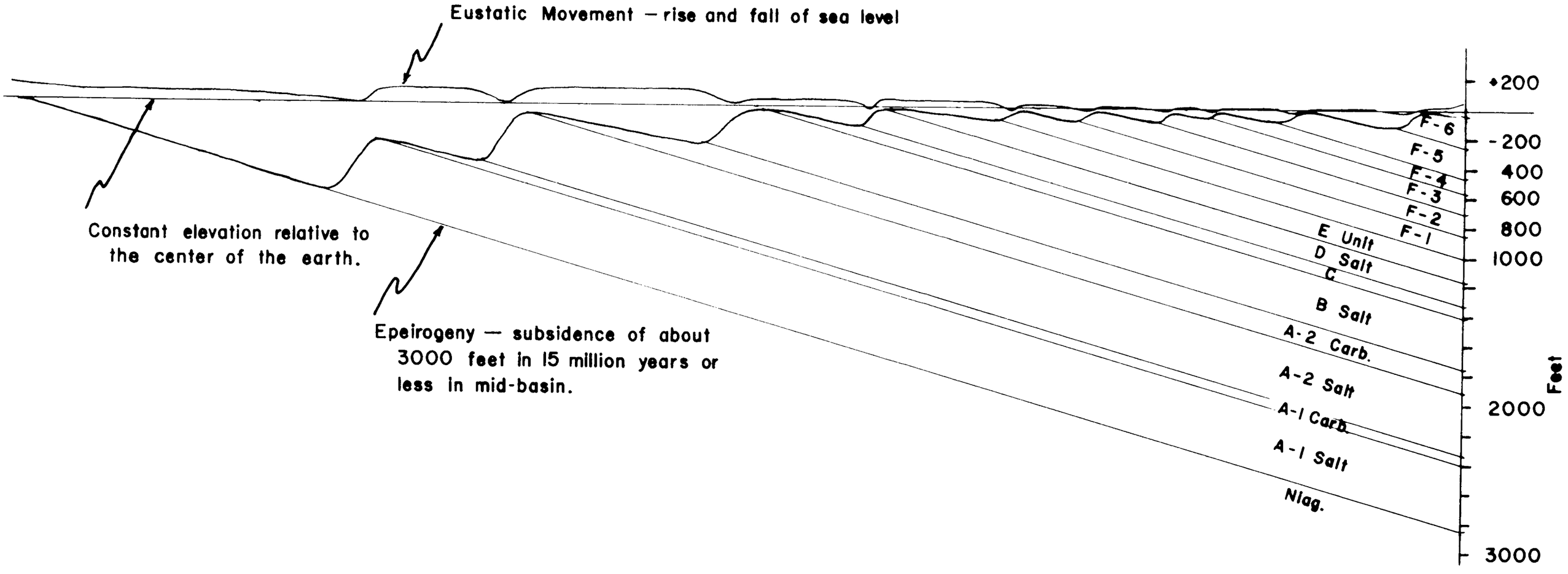
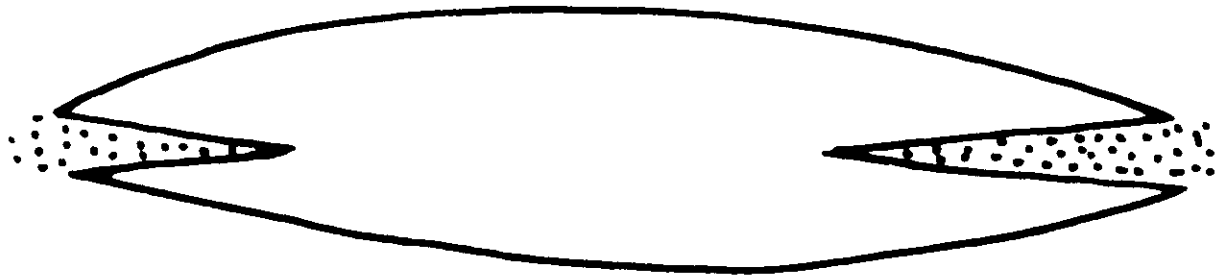


Abb. 48. Ideales Strömungsbild in einem gleichförmig gestalteten Salzsee bei gleichmäßigem Zustrom und Windstille.


500 FT.
200 MILES

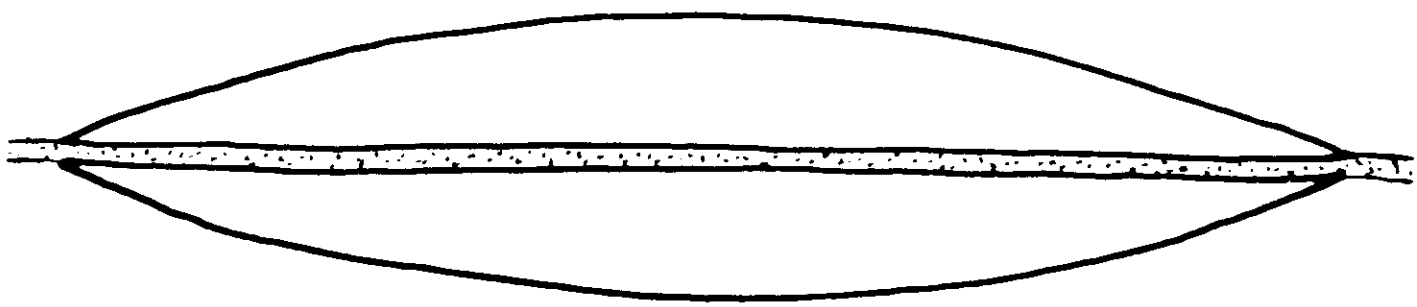

Eustatic Movement — rise and fall of sea level
Constant elevation relative to the center of the earth.
Epeirogeny — subsidence of about 3000 feet in 15 million years or less in mid-basin.
F-6
F-5
F-4
F-3
F-2
F-1
E Unit
D Salt
C
B Salt
A-2 Carb.
A-2 Salt
A-1 Carb.
A-1 Salt
Niag.
+200
-200
400
600
800
1000
2000
3000
Feet

A.



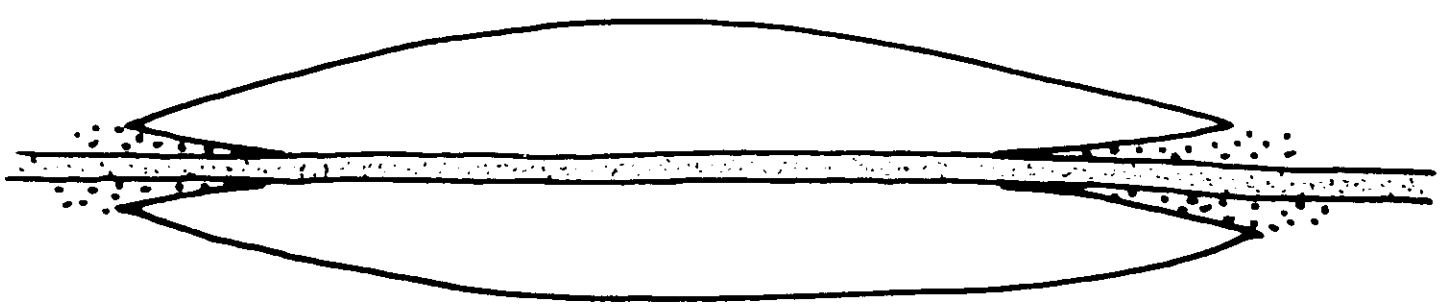
Water-borne. Basin margin partially exposed at mid-cycle. Reef tops erode.

B.



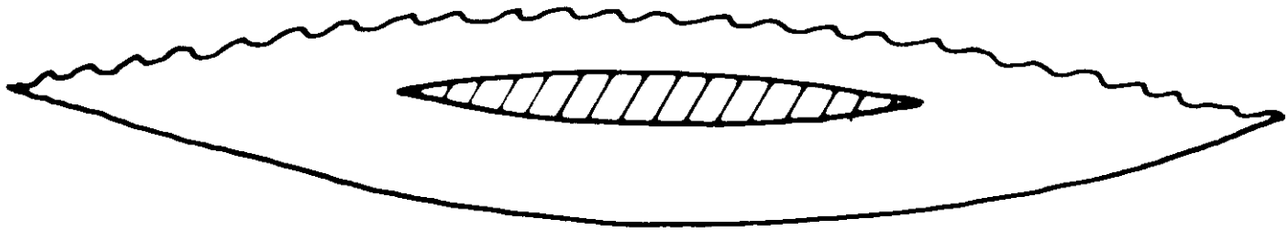
Wind-blown. Basin margin widely exposed at mid-cycle. Epeiric sea bottoms exposed to subaerial erosion.

C.



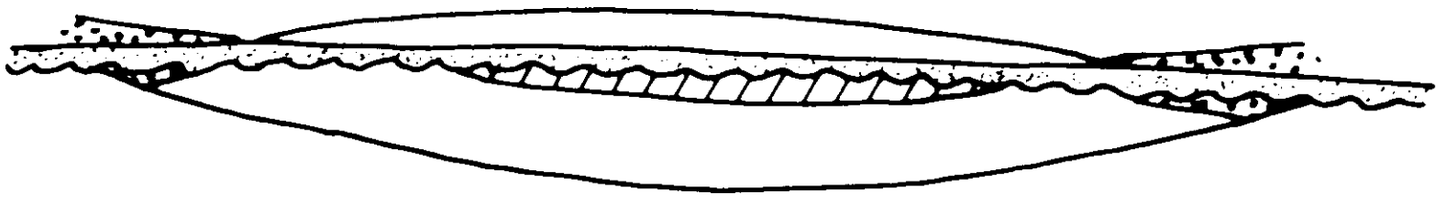
Wind-blown sheet is always associated with water-borne wedges.

A.



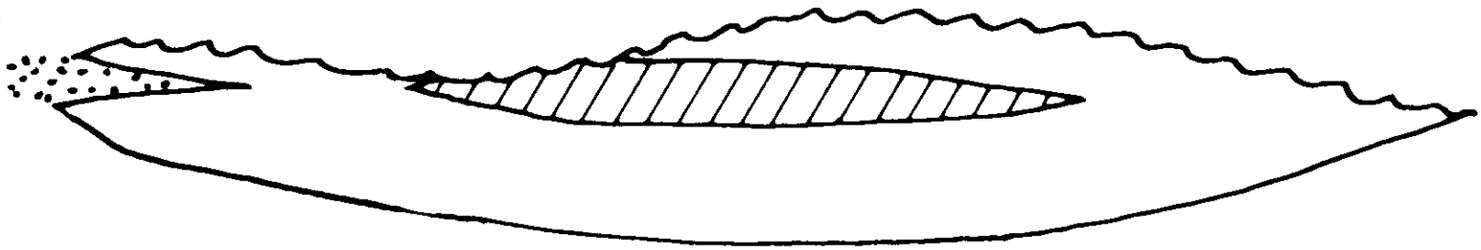
Deep basin potash. Basin margins water covered throughout the cycle. Some sub-aqueous re-solution of "recessive" salt.

B.

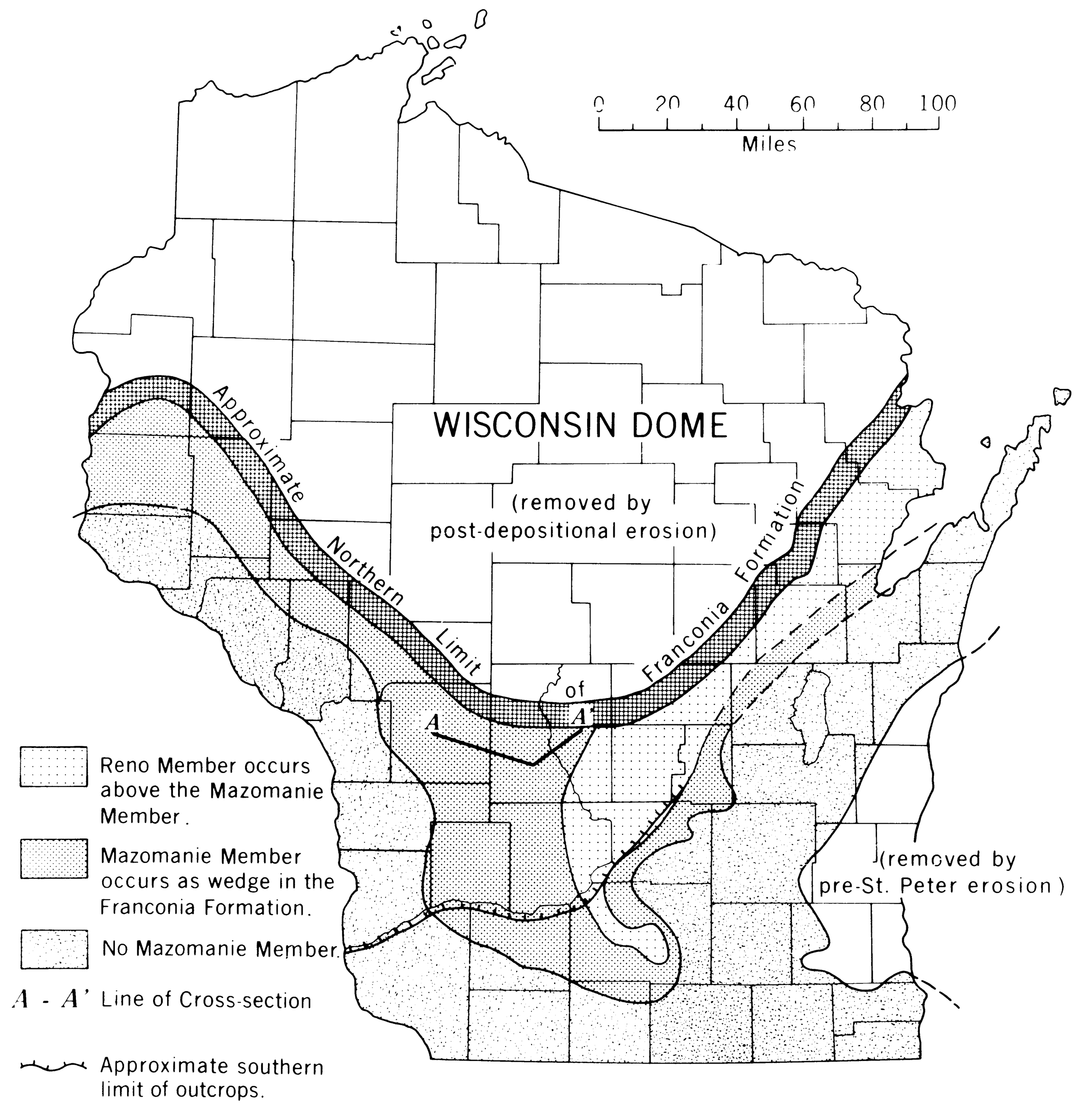


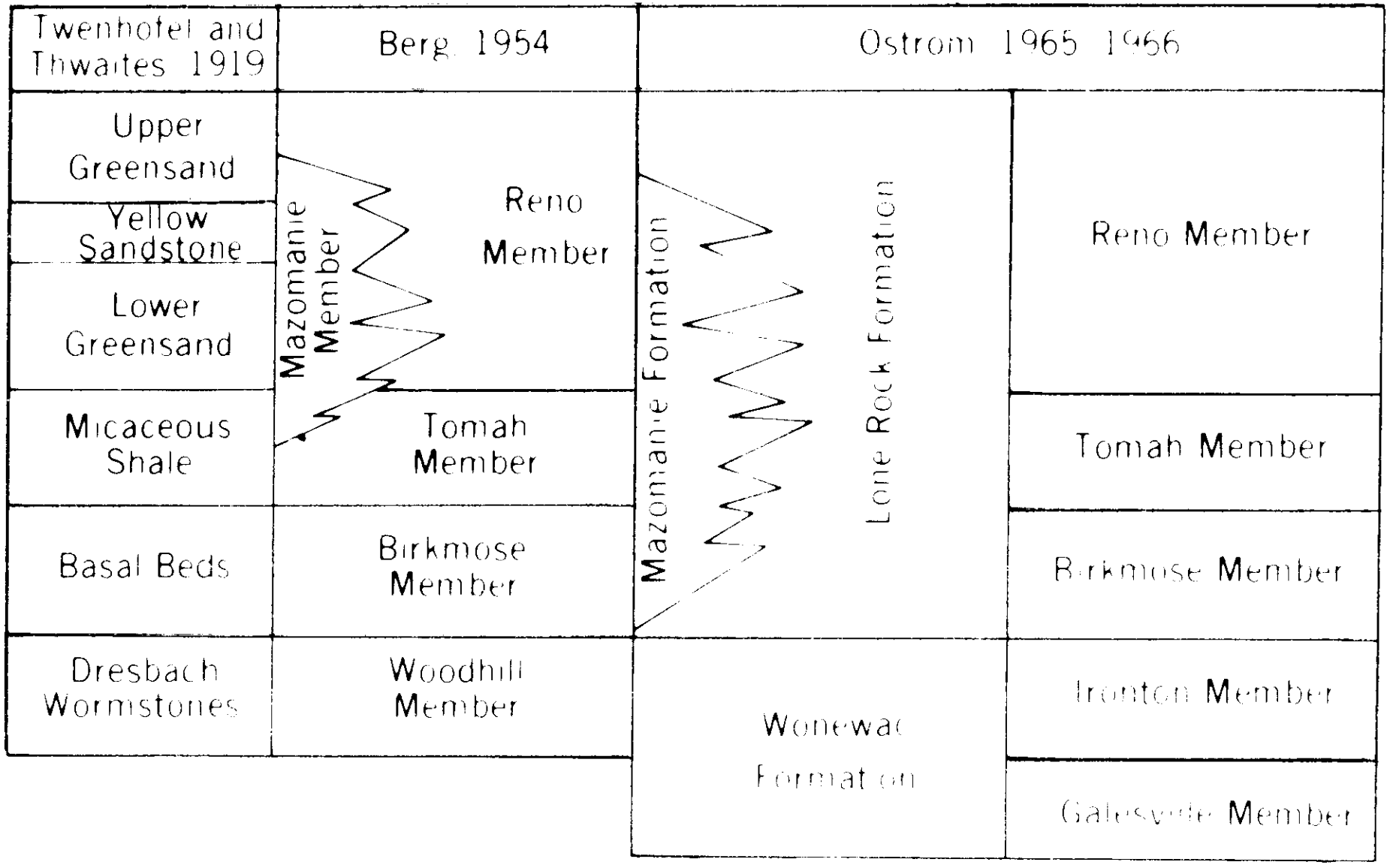
Shallow water potash armored by wind-blown and other clastics and covered by redeposited salt. Margins and most of basin exposed at mid-cycle.

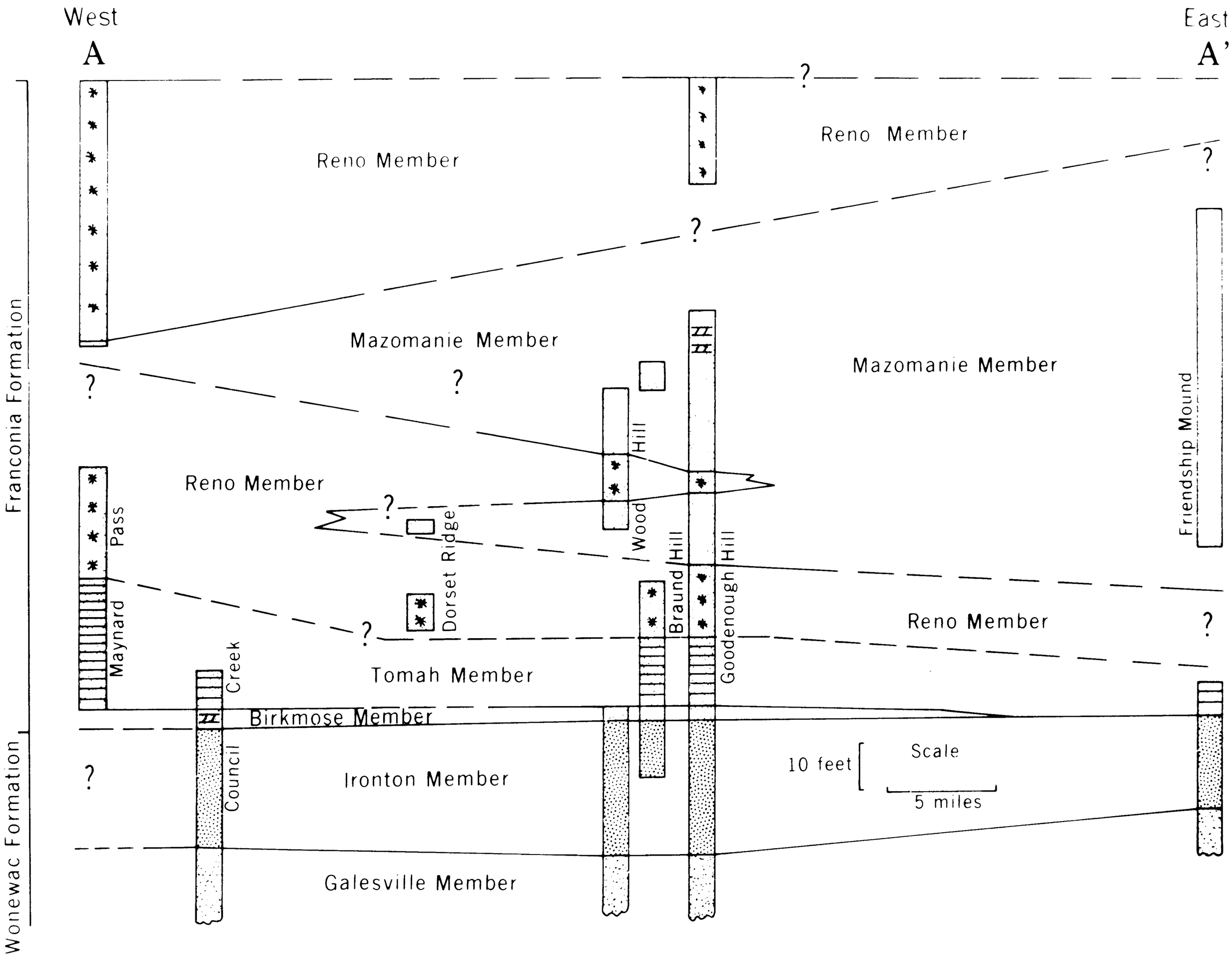
C.

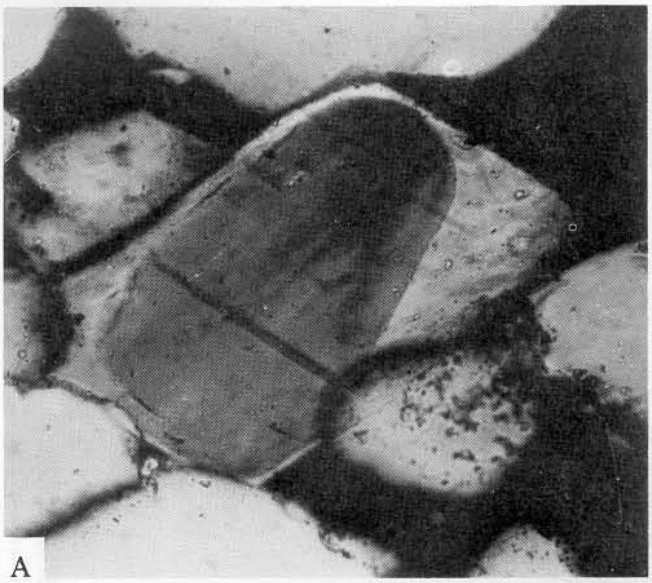


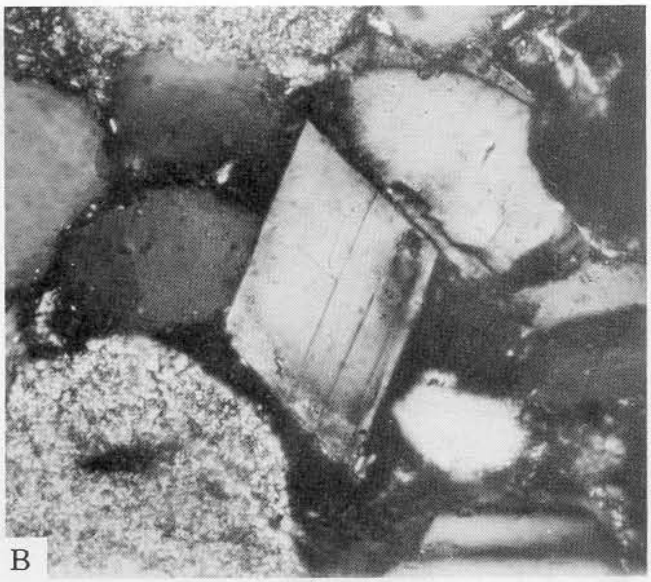
Deep basin A-1 Potash in Michigan. Synchronous deposition of northern clastic wedge and mid-basin potash facies. Major re-solution in the north.

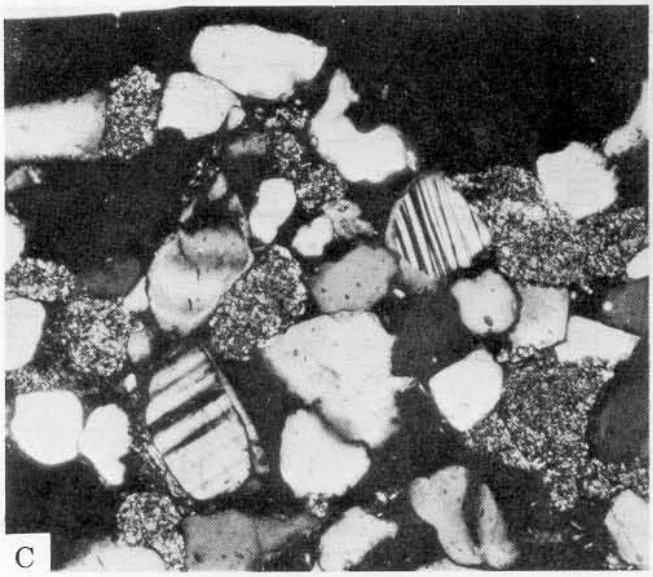

0 20 40 60 80 100
Miles
WISCONSIN DOME
(removed by post-depositional erosion)
Approximate Northern Limit of Franconia Formation
A
A'
(removed by pre-St. Peter erosion)
Reno Member occurs above the Mazomanie Member.
Mazomanie Member occurs as wedge in the Franconia Formation.
No Mazomanie Member.
A - A' Line of Cross-section
Approximate southern limit of outcrops.

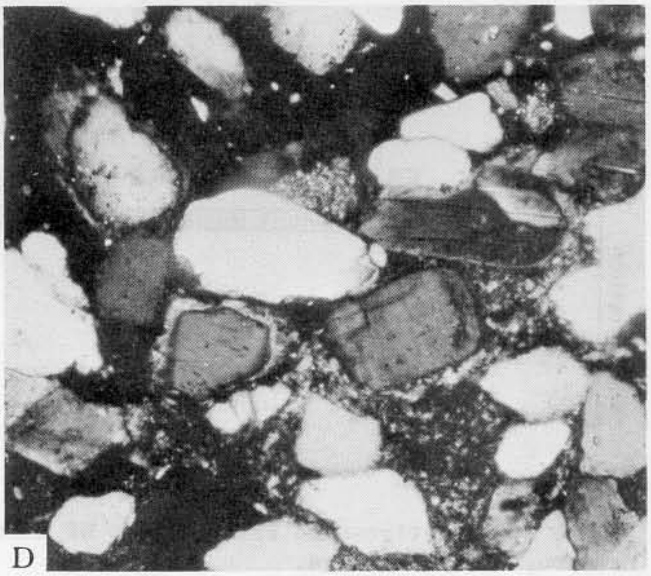

Twenhofel and Thwaites 1919
Berg 1954
Ostrom 1965 1966
Upper Greensand
Yellow Sandstone
Lower Greensand
Micaceous Shale
Basal Beds
Dresbach Wormstones
Mazomanie Member
Reno Member
Tomah Member
Birkmose Member
Woodhill Member
Mazomanie Formation
Lone Rock Formation
Wonewoc Formation
Reno Member
Tomah Member
Birkmose Member
Ironton Member
Galesville Member

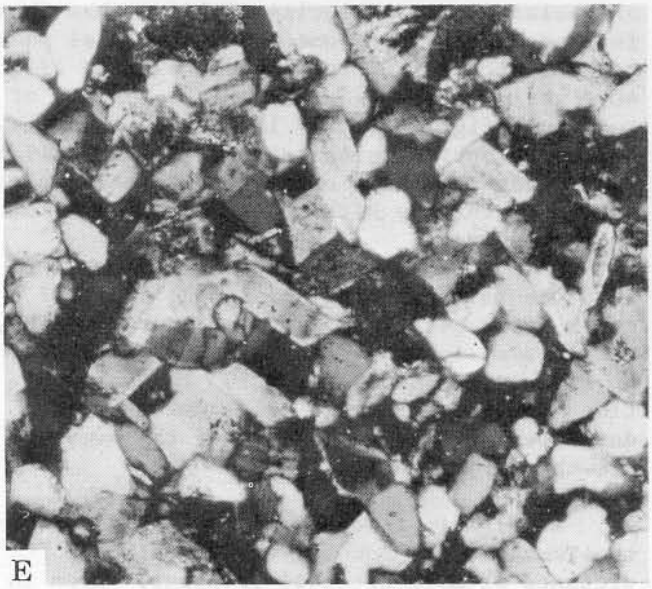

West
A
East
A'
Reno Member
Reno Member
Reno Member
Mazomanie Member
Mazomanie Member
Reno Member
Reno Member
Tomah Member
Birkmose Member
Ironton Member
Galesville Member
Franconia Formation
Wonewac Formation
Maynard Pass
Creek
Council
Dorset Ridge
Wood Hill
Braund Hill
Goodenough Hill
Friendship Mound
10 feet
Scale
5 miles

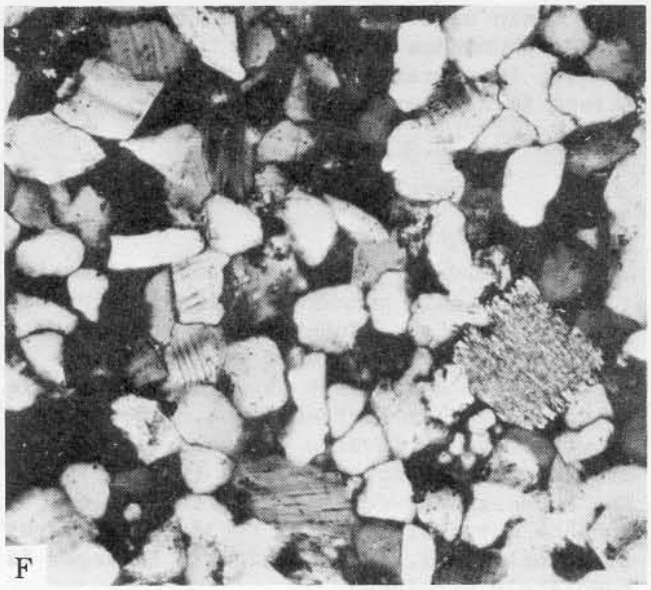

A


B


C


D


E


F

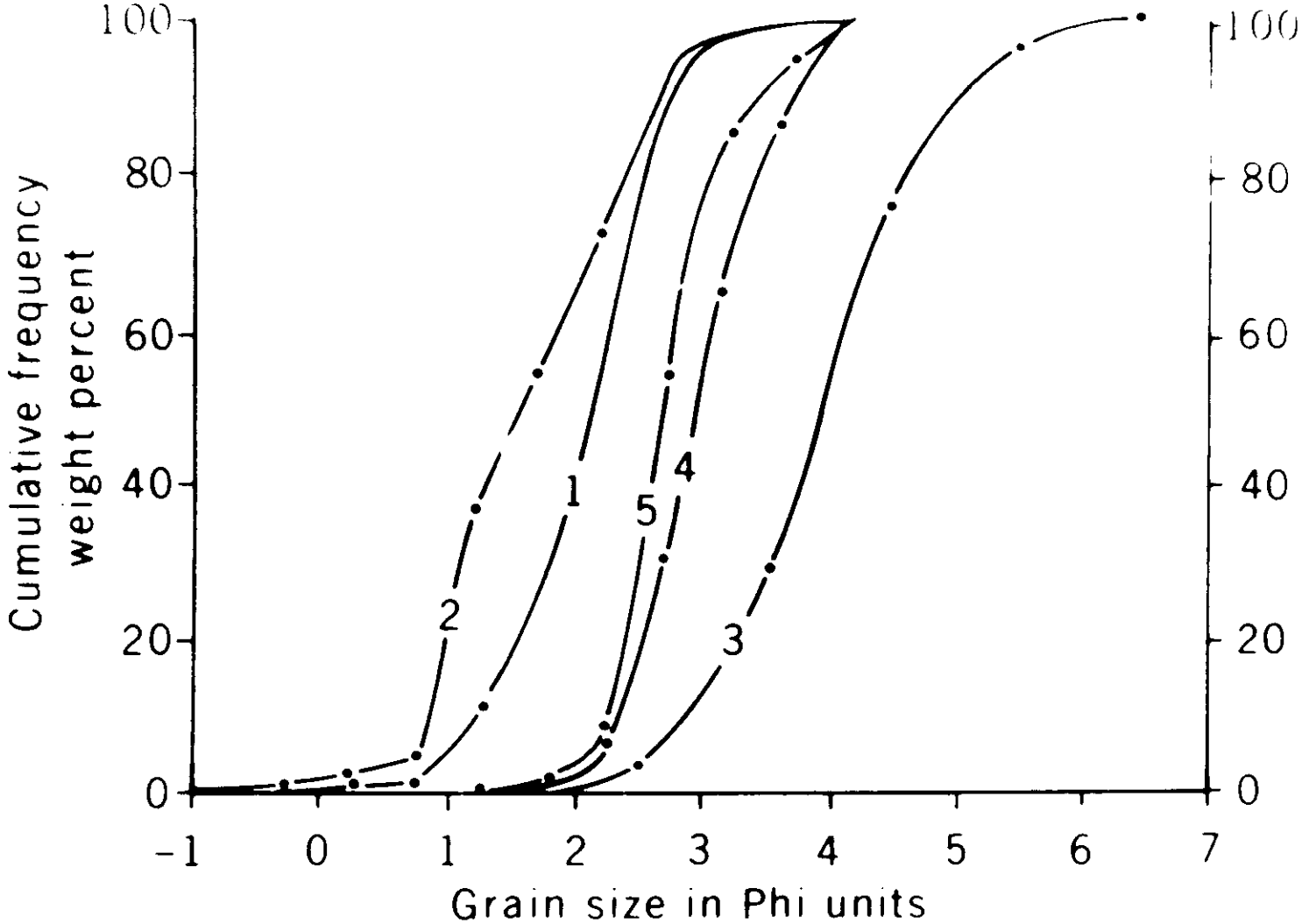

Cumulative frequency
weight percent
100
80
60
40
20
0
-1
0
1
2
3
4
5
6
7
Grain size in Phi units
1
2
3
4
5

Table 1. Modal analysis of sandstones from the Franconia and Wonewac Formations.

Stratigraphic Position and Sample Number	Quartz	Feldspar	Glauconite	Clay & Silt	Dolomite	Heavy minerals	Iron oxide	Muscovite
Friendship Mound, NW 1/4, sec. 5, T, 17N., R.6E., Adams County, Wis.								
Galesville Member								
89-30-14	99.3	----	----	tr.	----	tr.	tr.	----
Woodhill Member								
89-30-9	99.8	0.2	----	tr.	----	tr.	tr.	----
Mazomanie Member								
89-30-5	98.6	1.4	----	----	----	tr.	tr.	----
89-30-2	99.0	1.0	----	----	----	tr.	tr.	----
Goodenough Hill near Mauston, SE 1/4, sec. 13, T. 15N., R. 2E., Juneau County, Wis.								
Galesville Member								
1-1	99.5	0.3	----	0.2	----	tr.	----	----
Ironton Member								
1-6	100.0	----	----	tr.	----	tr.	----	----
1-10	99.6	0.4	----	----	----	tr.	tr.	----
Birkmose Member								
1-13	57.8	----	4.0	----	38.2	----	tr.	----
Tomah Member								
1-14	29.4	43.0	1.0	4.8	19.0	tr.	2.0	0.8
1-14a	64.8	26.2	2.8	3.0	----	tr.	tr.	3.2
Reno Member								
1-16	58.2	22.8	17.4	1.6	----	tr.	tr.	----
1-19	60.0	30.8	8.4	0.8	----	tr.	tr.	----
Mazomanie Member								
1-17	84.2	11.2	0.4	----	4.2	tr.	----	----
1-18	80.4	18.0	0.4	0.2	1.0	tr.	----	----
1-20	76.2	22.4	0.8	0.6	----	tr.	----	----
1-23	92.8	6.8	----	----	0.4	tr.	----	----
1-26	24.2	1.4	----	----	74.4	----	tr.	----
Maynard Pass, NW 1/4, sec. 22, T. 17N., R.2W., Monroe County, Wis.								
Tomah Member								
8-1	33.0	53.4	5.2	3.8	----	tr.	tr.	2.6
8-1	50.2	41.2	3.4	4.0	4.0	tr.	tr.	1.2
Reno Member								
8-7	63.8	26.4	9.2	0.6	----	tr.	----	----
8-10	69.8	24.8	5.2	0.2	----	tr.	----	tr.
8-11	72.4	3.4	23.8	----	----	tr.	0.4	----
8-13	71.6	15.0	8.8	----	4.6	tr.	----	tr.
8-14	57.7	12.7	29.4	0.2	----	tr.	----	----
8-16	82.0	9.0	9.0	----	----	tr.	----	tr.

Table 1, Continued

Stratigraphic Position and Sample Number	Quartz	Feldspar	Glauconite	Clay & Silt	Dolomite	Heavy minerals	Iron oxide	Muscovite
8-18	66.0	15.1	12.6	1.8	2.3	tr.	1.7	----
90-45-17	40.4	44.0	5.2	9.6	----	tr.	----	0.8
90-45-13	47.6	23.2	7.0	6.8	15.0	tr.	----	0.4
Mazomanie Member								
8-12	92.8	6.8	tr.	0.4	----	tr.	----	----
Near Lake Deltona, NE 1/4, sec. 24, T.1 3N., R.5E., Sauk County, Wis.								
Ironton Member								
89-16-5	75.8	0.8	----	23.4	----	----	----	----
Birkmose Member								
89-16-15	60.0	0.4	31.6	----	----	----	8.0	----
Near Lone Rock, SE 1/4, sec. 13, T. 8N., R. 2E, Iowa County, Wis.								
Birkmose Member								
90-5-5	4.6	----	8.2	----	87.2	----	----	----
90-5-10	55.0	22.4	19.8	2.6	----	tr.	----	0.2
Tomah Member								
90-5-15	46.7	46.3	1.2	5.0	0.8	----	----	tr.
Near La Crecent, sec. 33, T. 105N., R.4W., Winona Co., Minn.								
Ironton Member								
91-20-0-2	97.2	2.4	0.4	----	----	tr.	----	----
91-20-0-4	99.2	0.8	----	----	----	tr.	----	----
91-20-0-9	69.6	0.8	----	29.6	----	tr.	----	----
91-20-0-15	93.7	5.8	----	0.5	----	tr.	----	----
Birkmose Member								
91-20-1	39.6	11.4	30.8	----	18.2	tr.	----	----
Tomah Member								
91-20-2	21.1	23.5	3.6	21.6	29.2	tr.	----	1.0
91-20-3	26.8	59.8	4.0	7.0	0.4	tr.	----	2.0
Reno Member								
91-20-5	20.8	10.2	27.4	23.4	16.4	tr.	1.4	0.4
91-20-6	26.2	23.6	10.6	39.0	----	----	0.4	0.2
91-20-7	41.5	26.2	16.5	15.1	----	tr.	tr.	0.7
91-20-8	36.2	10.4	22.6	7.6	7.4	tr.	12.8	3.0
91-20-20	9.5	10.3	23.5	53.9	2.3	----	0.5	----
91-20-21	28.8	24.8	23.6	16.6	3.2	tr.	1.8	1.0
91-20-22	47.0	20.0	21.6	6.2	0.2	tr.	3.8	1.2
91-20-23	24.4	17.0	8.0	46.6	2.2	tr.	0.6	1.2
91-20-24	54.7	9.8	30.1	1.0	----	tr.	1.9	2.5
91-20-28	46.4	23.3	26.9	1.2	----	tr.	2.0	0.2