Title

Recent Sediments of the Central California Continental Shelf, Pillar Point to Pigeon Point: Part B -- Mineralogical Data

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Publication Date

1971-06-01

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PILLAR POINT TO PIGEON POINT

PART B MINERALOGICAL DATA

by

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BERKELEY
JUNE 1971

University of California
Hydraulic Engineering Laboratory

Technical Report
HEL-2-30

This work was supported by Contract 72-67-C-0015
with the Coastal Engineering Research Center,
Corps of Engineers, U.S. Army

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PART B - MINERALOGICAL DATA

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Berkeley, California
June 1971

ABSTRACT

The heavy mineralogy of the sand fraction for 44 offshore, 9 beach, and 3 stream samples for this region is determined optically. For each sample the percentage of the more abundant or more diagnostic transparent minerals is plotted graphically in order of persistence and additional data on accessory transparent minerals, opaques, and composite grains (rock fragments) are listed.

INTRODUCTION

This section of the study of the sediments of the Central California continental shelf (see Fig. 1) deals with the heavy mineralogy of the sand size fraction. Grain size data for these samples are given in Part A of this study; Yancey and others (1970). Information on samples shown by triangles in Fig. 1 is given in Sayles (1965).

The treated size fractions were divided further by separation in the heavy liquid tetrabrom-ethane (Krumbein and Pettijohn, 1938, p. 325) with a density of 2.95 gms/cc. Particles with a density greater than 2.95 gms/cc were called heavy. Particles with a density equal or less than 2.95 gms/cc were designated light. Grain mounts were made of both the heavy and light particles of each size fraction on glass slides with Cadex mounting media (index of refraction = 1.55).

Slides were made for each $\frac{1}{2}$ Ø interval for the sand fraction. However, to give an idea of the bulk composition of each sample, a slide also was made for the .061 to .351 mm size fraction. For most samples data shown on the following graphs are from this bulk slide. For samples 2104, 2121, 2122, 2124, 2127, 2129, 2132, 2133, 2135, and 2139, there was insufficient sample to make both $\frac{1}{2}$ Ø and bulk slides; thus the slide for the dominant $\frac{1}{2}$ Ø interval was used for the graphs.

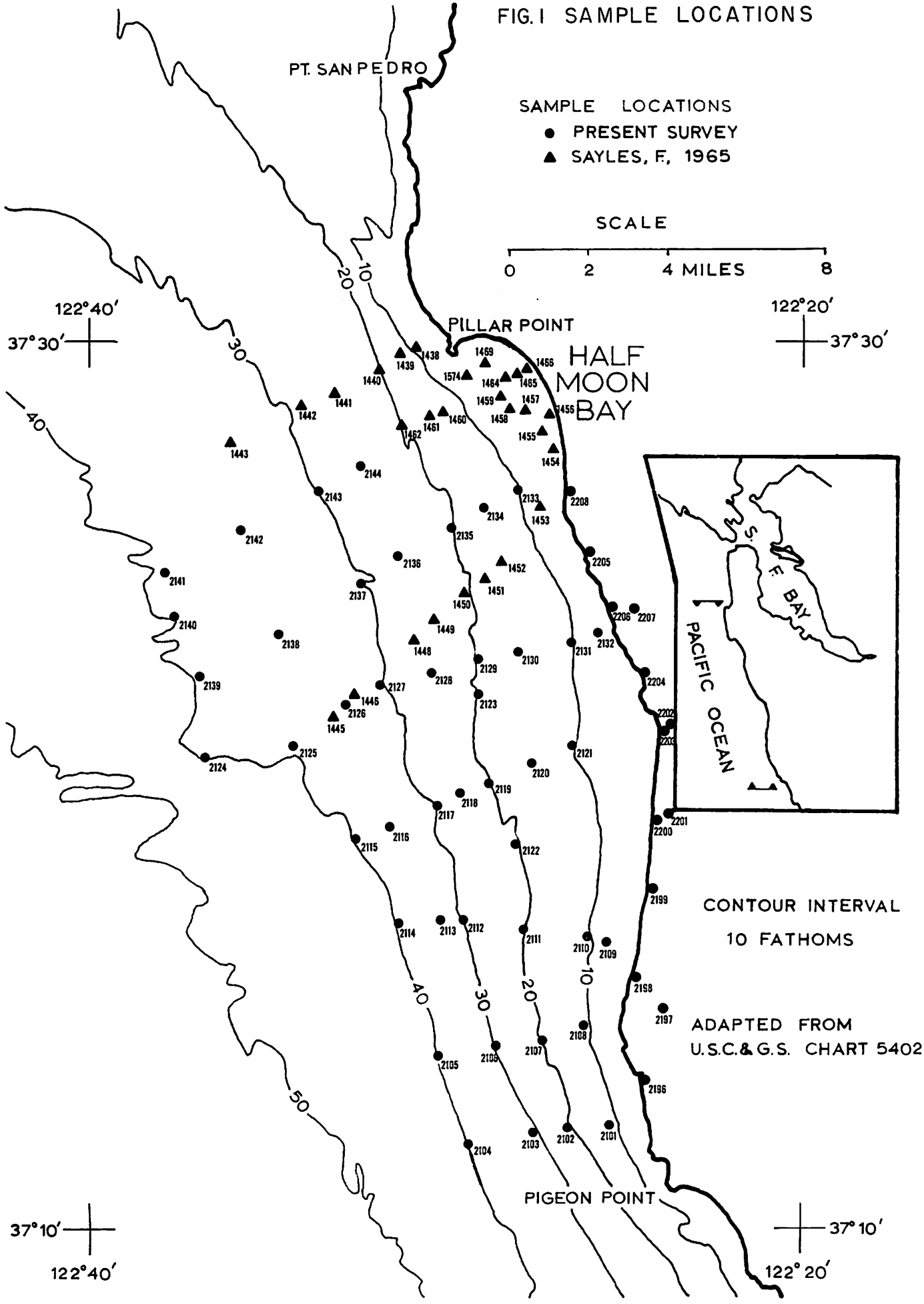


FIG. I SAMPLE LOCATIONS
PT. SAN PEDRO
SAMPLE LOCATIONS
PRESENT SURVEY
SAYLES, F., 1965
SCALE
0 2 4 MILES 8
122°40′
37°30′
122°20′
37°30′
PILLAR POINT
HALF MOON BAY
S. F. BAY
PACIFIC OCEAN
CONTOUR INTERVAL
10 FATHOMS
ADAPTED FROM
U.S.C.&G.S. CHART 5402
PIGEON POINT
37°10′
122°40′
37°10′
122°20′

IDENTIFICATION PROCEDURE

For this report only minerals of the heavy fraction were identified. The grain mounts of the light minerals are available for future study. For each heavy fraction grain mount, individual grains were identified with a Leitz Laborlux polarizing microscope under 28, 80, and 360 power until approximately 100 transparent grains were counted. Opaque grains were identified with oblique reflected light. Alterites (Van Andel, 1958) were considered unidentifiable altered grains. Unknowns were considered unidentifiable unaltered grains. Rock fragments were grains of composite mineral composition. Identifications were checked with reference to diagnostic tables in Krumbein and Pettijohn (1938, p. 412-462); Milner (1962, p. 15-207) and by comparison with standard specimens in the University of California, Berkeley, Geological Museum's reference mineral collection. As an additional check on accuracy, some slides were counted in replicate as noted.

DATA SHEETS

Pertinent grain size and mineralogical data for each grain mount are given below. The most common transparent grains are listed left to right in order of persistence (Pettijohn, 1957, p. 516-517). Under opaque mineral listings hematite = hematite plus limonite; and magnetite = magnetite plus ilmenite. Abbreviations used on the data sheets are:

SF = size fraction

mm = milimeters

% = per cent

wt = weight

HM = heavy mineral

no. = number

For some samples green and brown hornblende were counted separately. On the graphs for such samples the larger % figure in the hornblende position represents total % green plus brown hornblende. The smaller % figure represents just green hornblende. Accordingly, % brown hornblende equals % total hornblende minus % green hornblende.

REFERENCES

Krumbein, W. C., and Pettijohn, F. J., 1938, Manual of Sedimentary Petrography: New York, Appleton-Century Crofts, 549 p.

Milner, H. B., 1962, Sedimentary Petrography, v. 2, Principles and Applications: London, George Allen and Unwin, 715 p.

Pettijohn, F. J., 1957, Sedimentary Rocks: New York, Harpers and Brothers, 718 p.

Sayles, F., 1965, Coastal Sedimentation: Point San Pedro to Miramontes Point, California: University of California, Berkeley, Hyd. Eng. Res. Lab. Rept. HEL-2-15, 105 p.

Van Andel, Tj. H., 1958, A Defense of the Term Alterite: Jour. Sed. Petrology, v. 28, p. 234-235.

Yancey, T., Isselhardt, C., Osuch, L., Lee, J., and Wilde, P., 1970, Recent Sediments of the Central California Continental Shelf - Pillar Point to Pigeon Point, Part A. Introduction and Grain Size Data: University of California, Berkeley, Hyd. Eng. Lab. Rept. HEL-2-26, 64 p.

SAMPLE 2101

Location 37°12.5' 122°25.6'

Depth 18.3 meters 10 fathoms

Size Fraction (SF) _____ mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 94.49

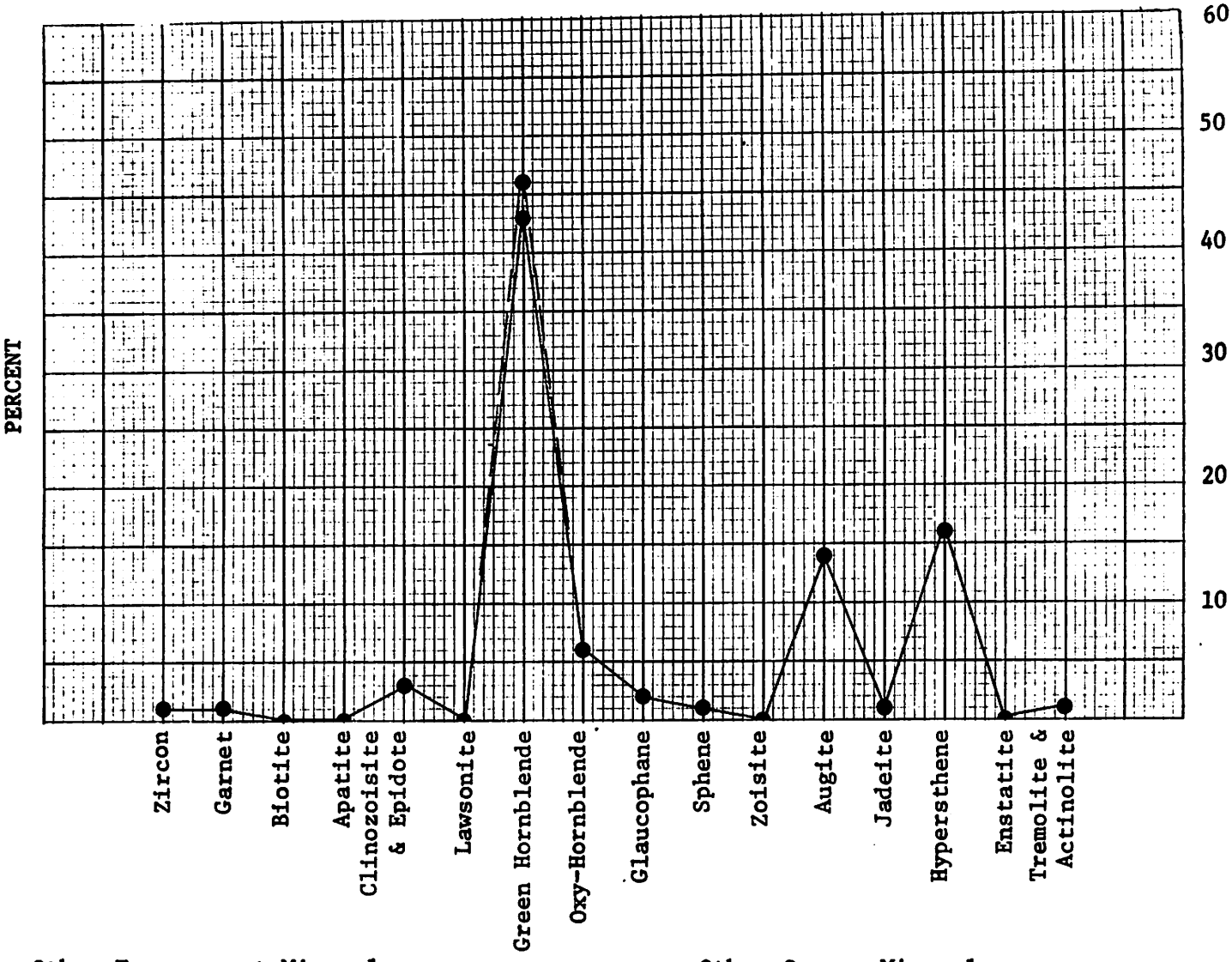
Wt. % of HM/SF 4.43

Total Grains Counted 129

% Transparent Grains 76.75

% Opaques 7.75

% Composite Gr. and Unknowns 15.5



Other Transparent Minerals

Mineral	No. Grains Counted
Zoisite	2
Composites - Alterites	18
Unknowns	2

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	7
Hematite	3

Analyst J. Lee

SAMPLE 2102

Location 37°12.5' 122°26.6'

Depth 36.7 meters 20 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 64.16

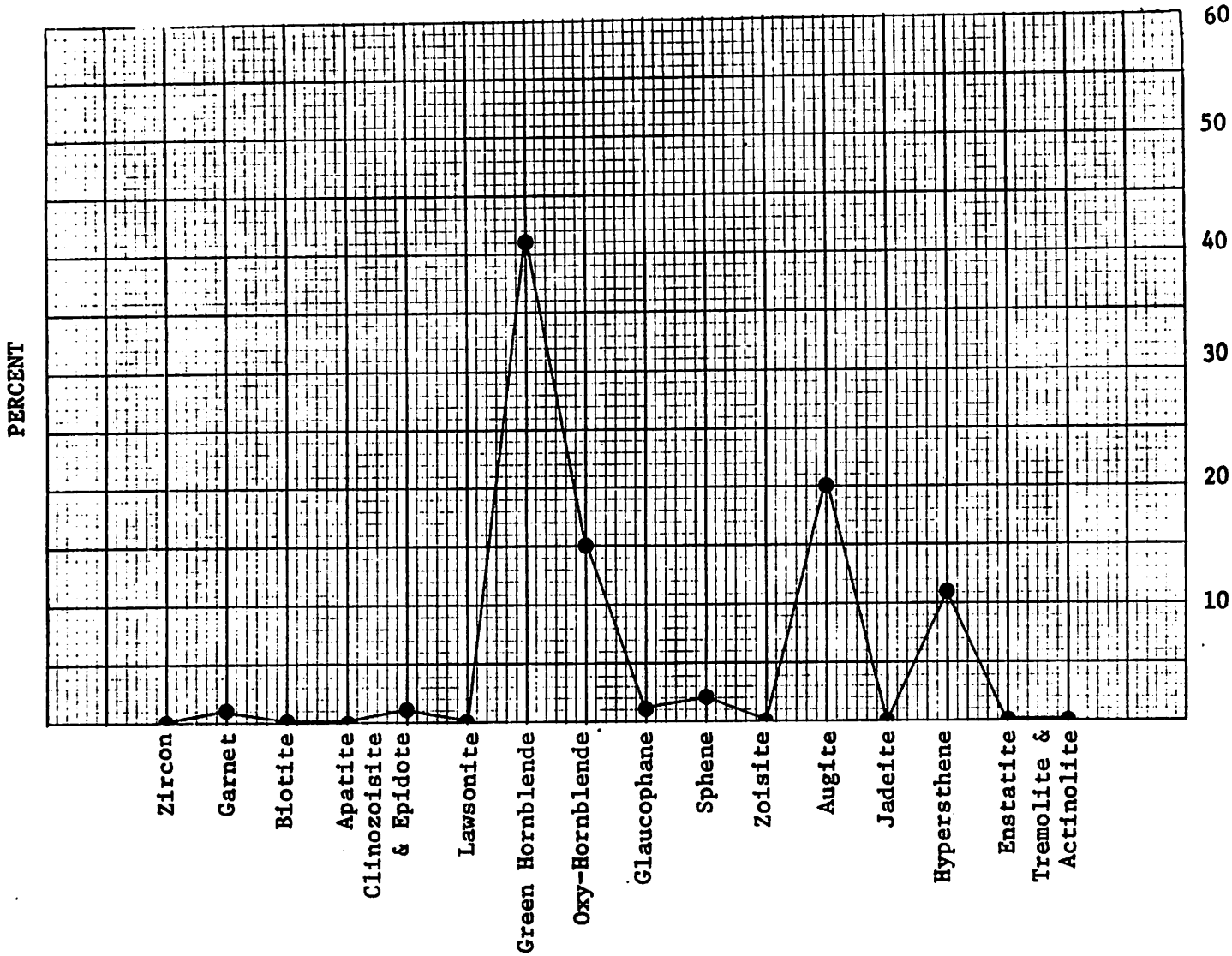
Wt. % of HM/SF 8.18

Total Grains Counted 135

% Transparent Grains 74.83

% Opaques 6.67

% Composite Gr. and Unknowns 18.5



Other Transparent Minerals

Mineral	No. Grains Counted
Unknowns	2
Composite Grains	23

Other Opaque Minerals

Mineral	No Grains Counted
Hematite	1
Magnetite	8

Analyst J. Lee

SAMPLE 2103

Location 37°12.3' 122°27.5'

Depth 54.9 meters 30 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 60.89

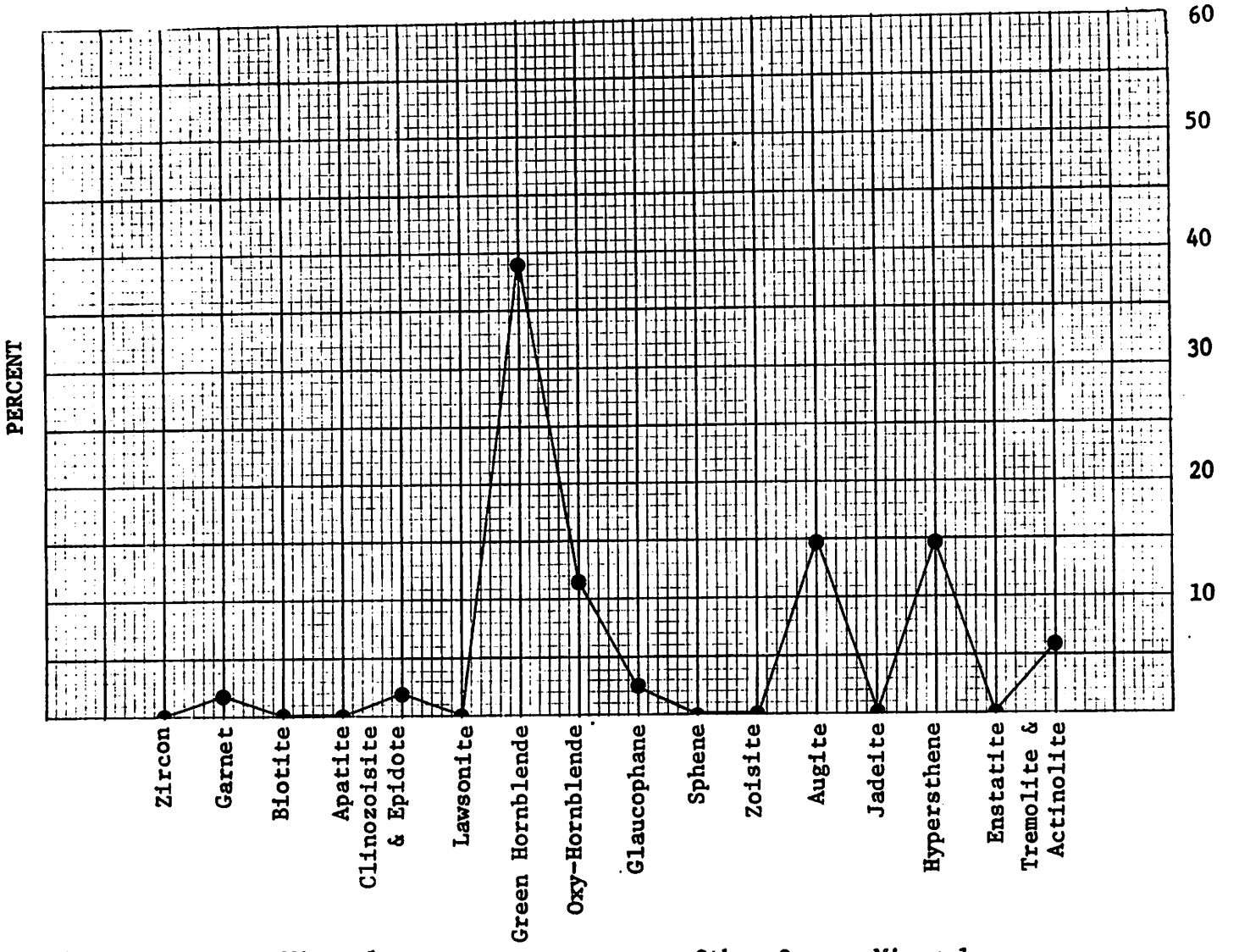
Wt. % of HM/SF 1.54

Total Grains Counted 158

% Transparent Grains 74.7

% Opaques 5.7

% Composite Gr. and Unknowns 19.6



Other Transparent Minerals

Mineral	No. Grains Counted
Unknowns	4
Composite Grains	31

Other Opaque Minerals

Mineral	No Grains Counted
Hematite	1
Magnetite	4

Analyst J. Lee

SAMPLE 2104

Location 37° 12.1' 122° 29.4'

Depth 75.1 meters 41.0 fathoms

Size Fraction (SF) .088 - .124 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 27.40

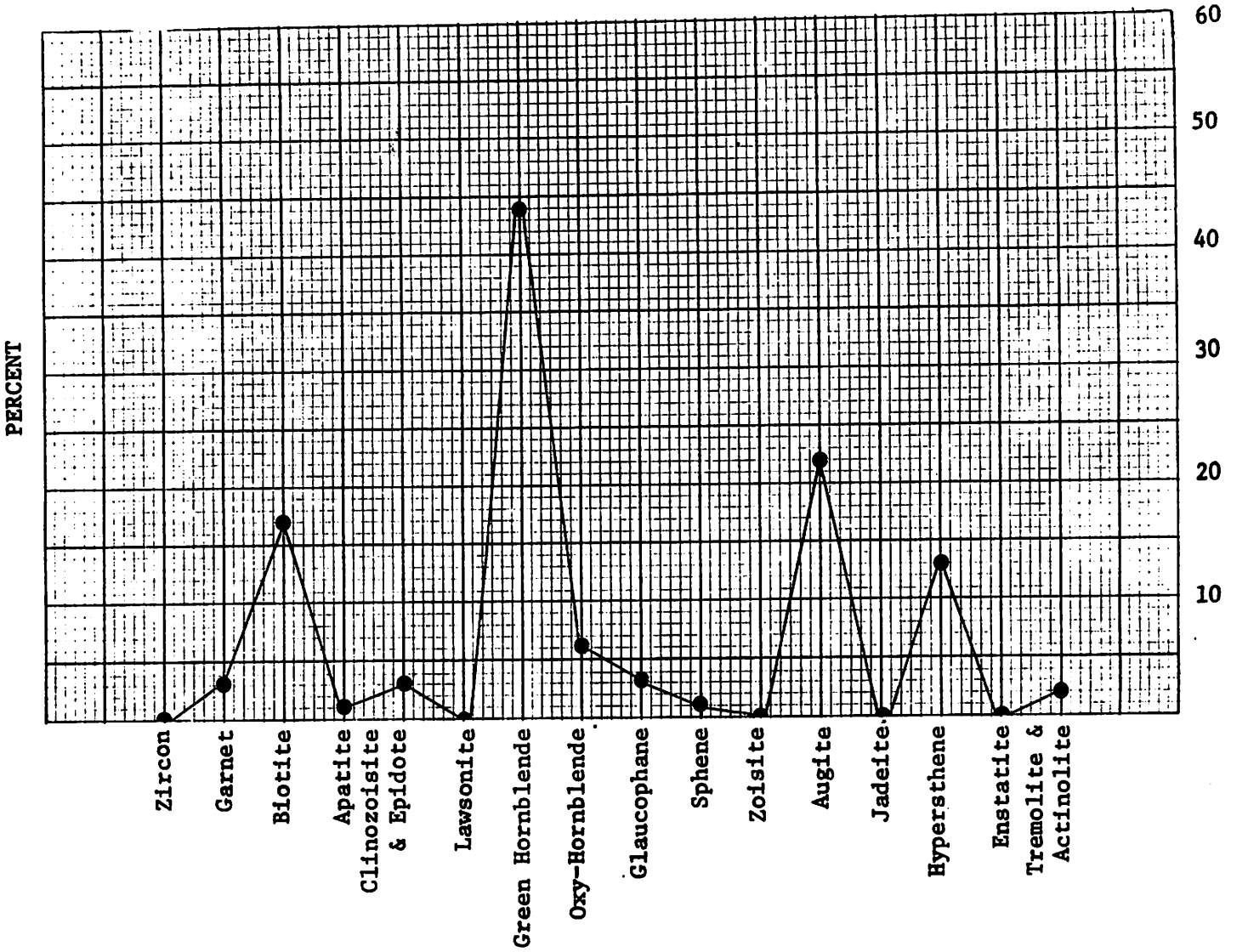
Wt. % of HM/SF 1.01

Total Grains Counted 185

% Transparent Grains 54.05

% Opaques 5.40

% Composite Gr. and Unknowns 31.35



Other Transparent Minerals

Mineral	No. Grains Counted
Allanite	1
Glauconite	1
Composites - Alterites	52

Other Opaque Minerals

Mineral	No. Grains Counted
Hematite	5
Magnetite	4

Analyst J. Lee

SAMPLE 2105

Location 37°14.0' 122°30.2'

Depth 73.2 meters 40.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 28.81

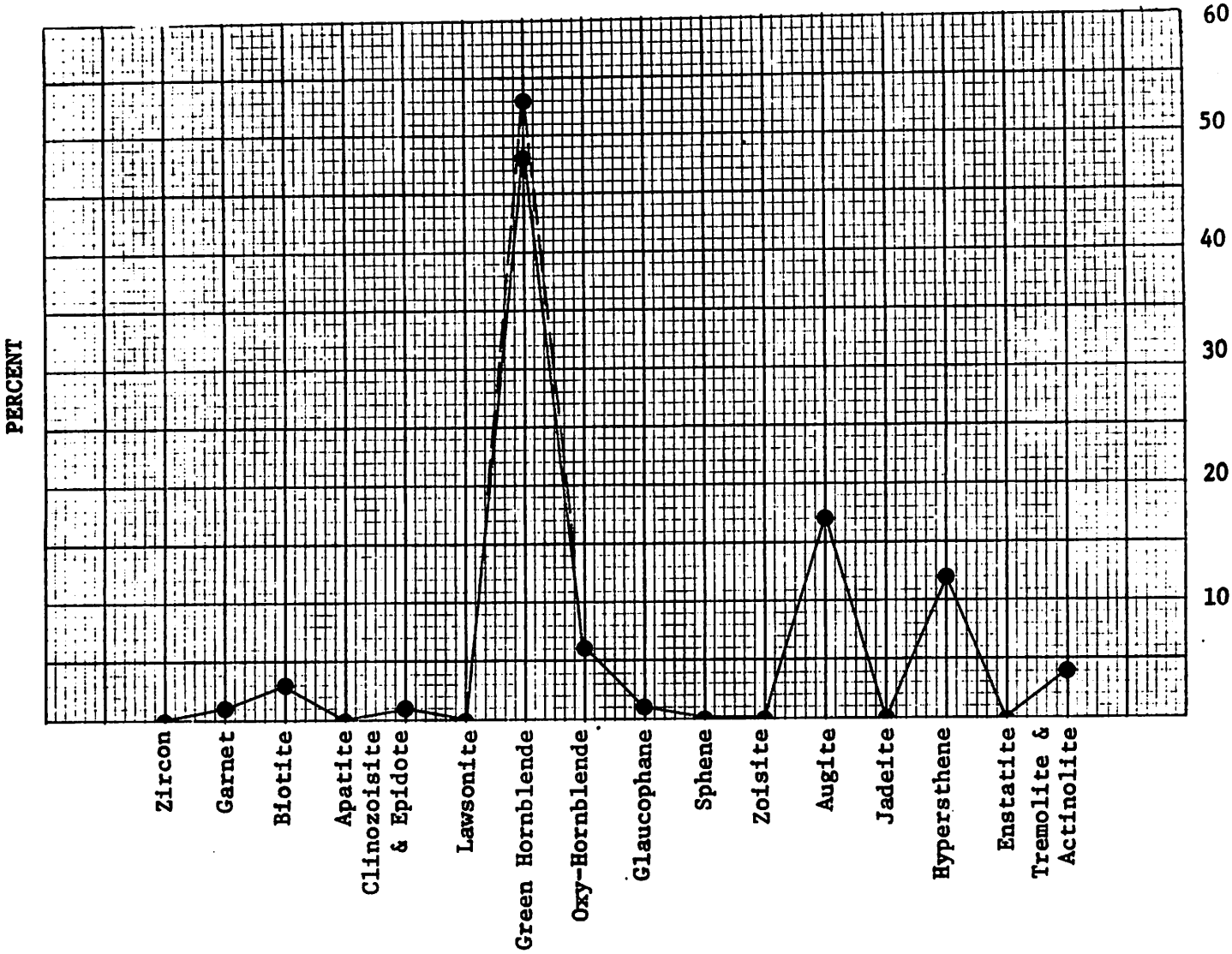
Wt. % of HM/SF 0.49

Total Grains Counted 152

% Transparent Grains 66.35

% Opaques 7.25

% Composite Gr. and Unknowns 26.4



Other Transparent Minerals

Mineral	No. Grains Counted
Composites - Alterites	37
Unknowns	3

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite	4
Hematite	7

Analyst J. Lee

SAMPLE 2106

Location 37°14.3' 122°28.6'

Depth 54.9 meters 30 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 73.78

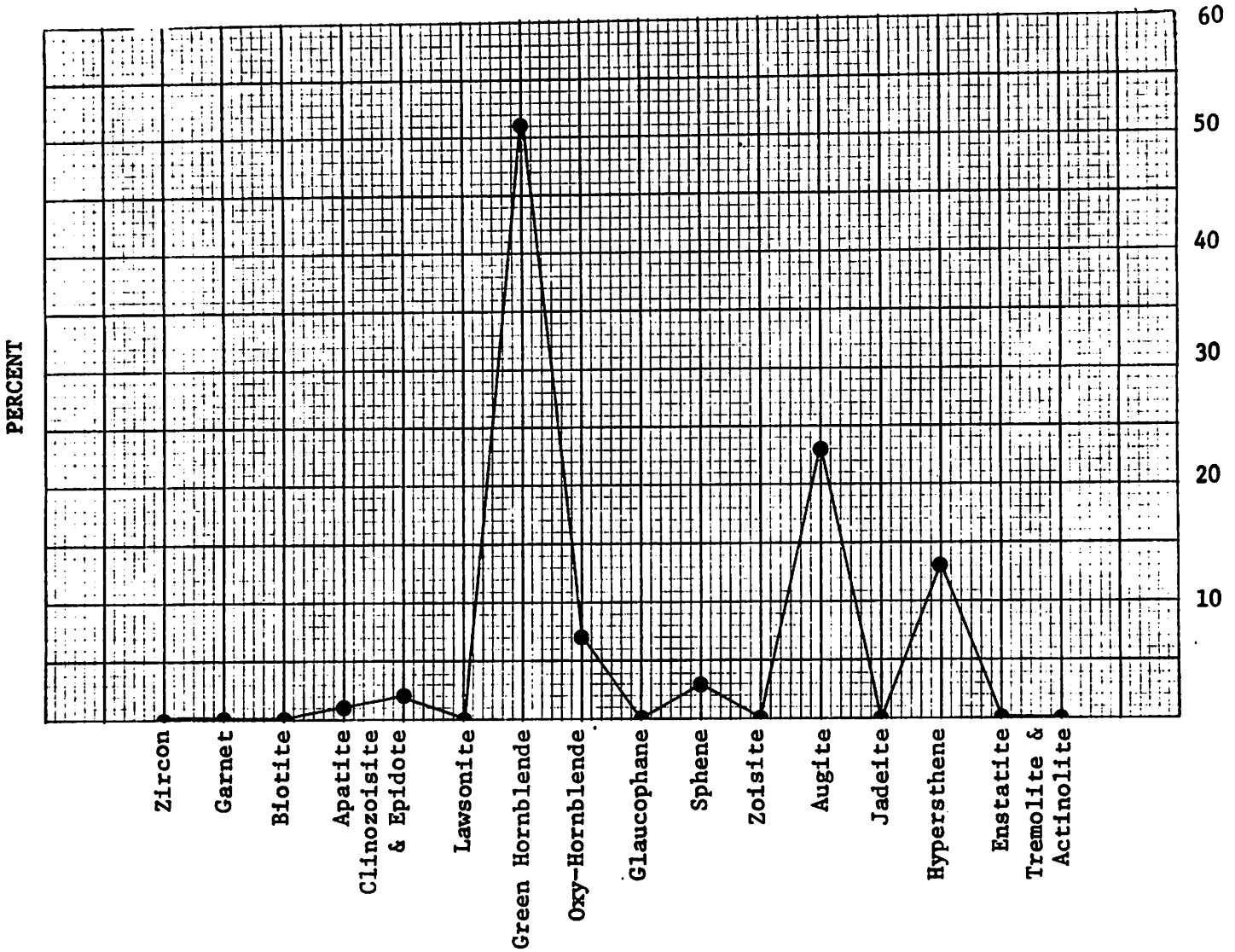
Wt. % of HM/SF 0.91

Total Grains Counted 136

% Transparent Grains 73.52

% Opaques 3.68

% Composite Gr. and Unknowns 22.8



Other Transparent Minerals

Mineral	No. Grains Counted
Alterites	30
Unknowns	1

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	5

Analyst T. Yancey

SAMPLE 2107

Location 37°14.6' 122°27.4'

Depth 36.7 meters 20 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 97.07

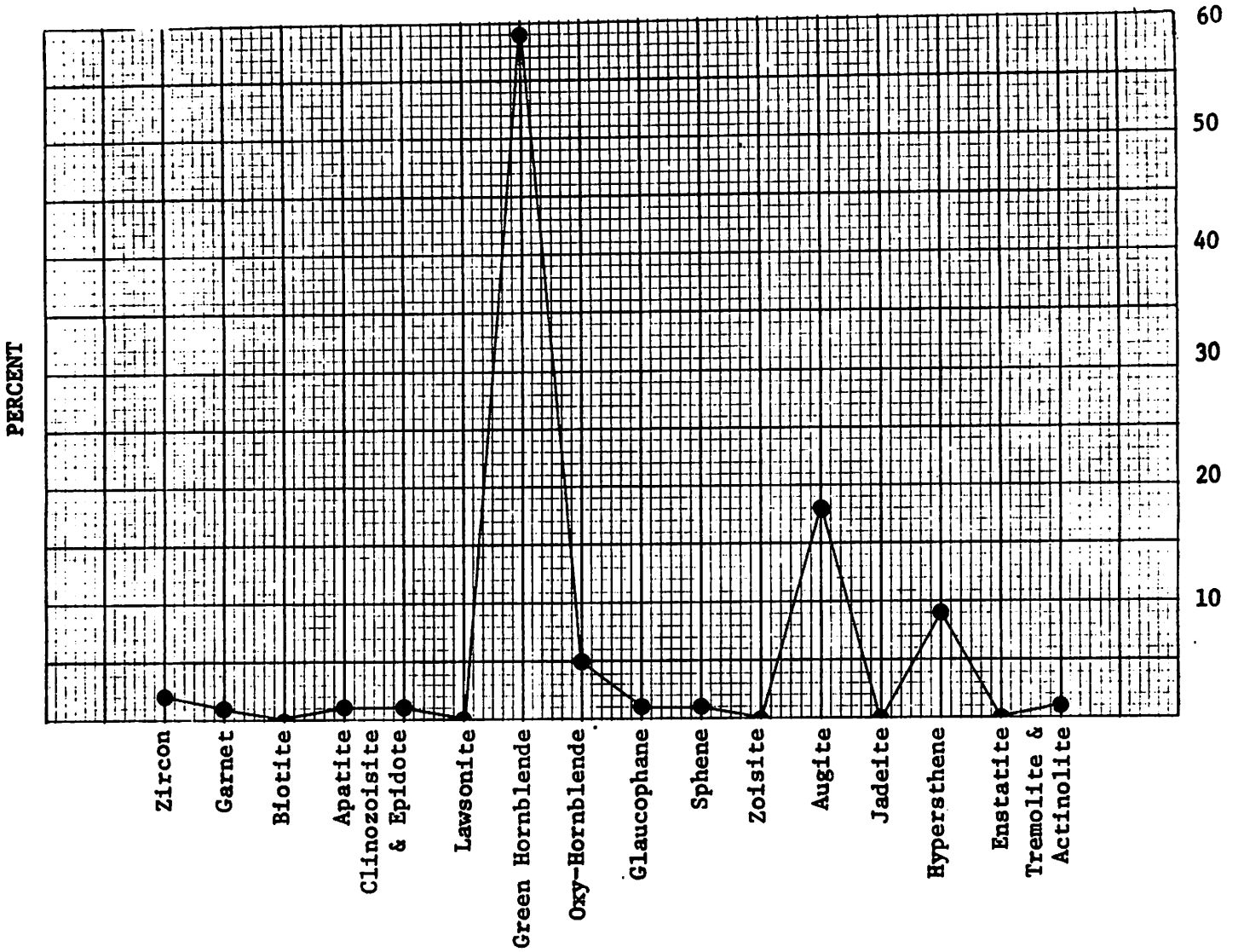
Wt. % of HM/SF 1.31

Total Grains Counted 138

% Transparent Grains 72.0

% Opaques 8.7

% Composite Gr. and Unknowns 18.1



Other Transparent Minerals

Mineral	No. Grains Counted
Alterites	24
Unknowns	1
Calcite	1

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	11
Hematite	1

Analyst J. Lee, T. Yancey

SAMPLE 2108

Location 37°14.8' 122°25.4'

Depth 20.1 meters 11.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 85.81

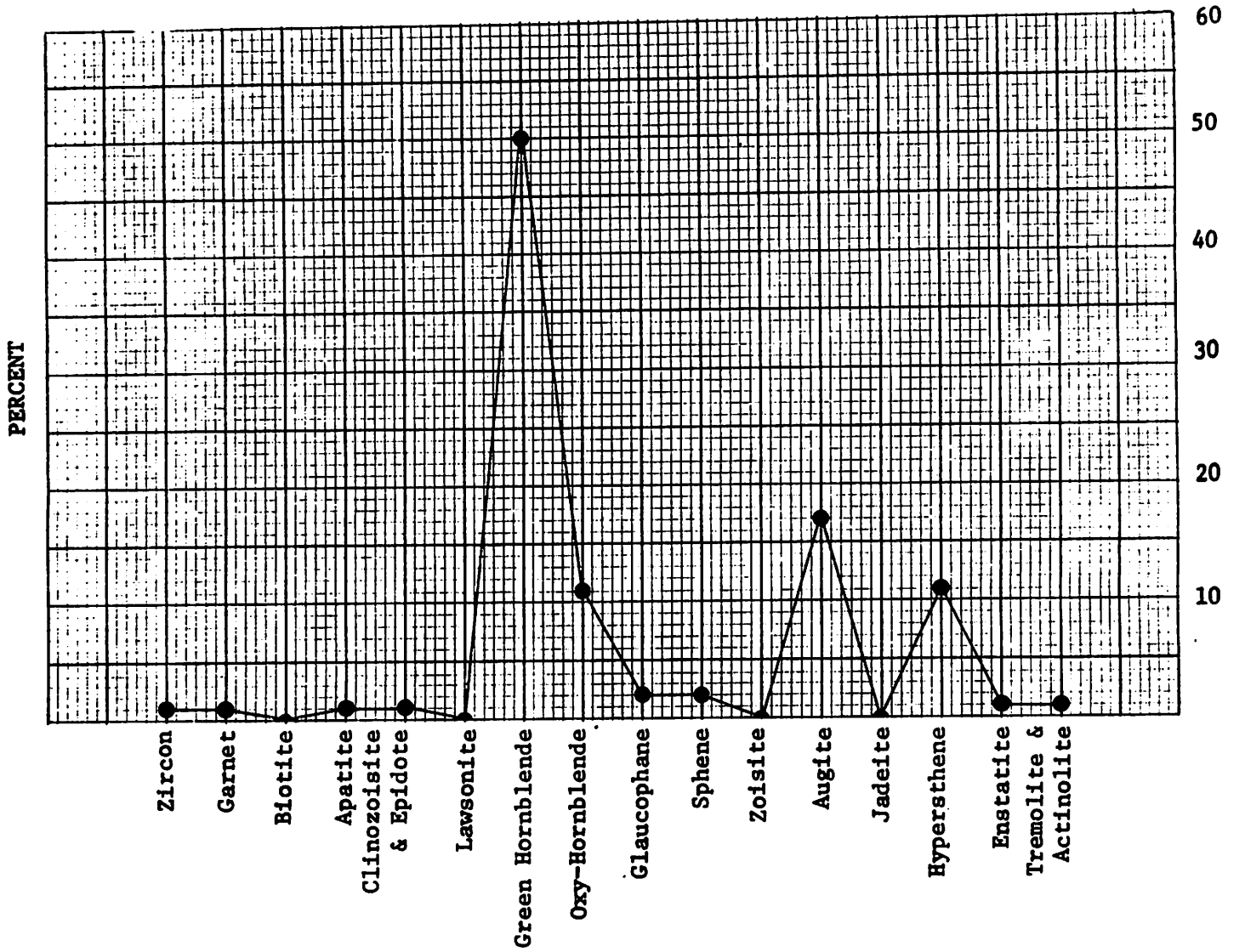
Wt. % of HM/SF 1.55

Total Grains Counted 135

% Transparent Grains 72.6

% Opaques 3.7

% Composite Gr. and Unknowns 23.0



Other Transparent Minerals

Mineral	No. Grains Counted
Unknowns	2
Allanite	1
Composite Grains	29

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite	5

Analyst J. Lee, T. Yancey

SAMPLE 2109

Location 37°16.7' 122°25.5'

Depth 9.1 meters 5.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 94.90

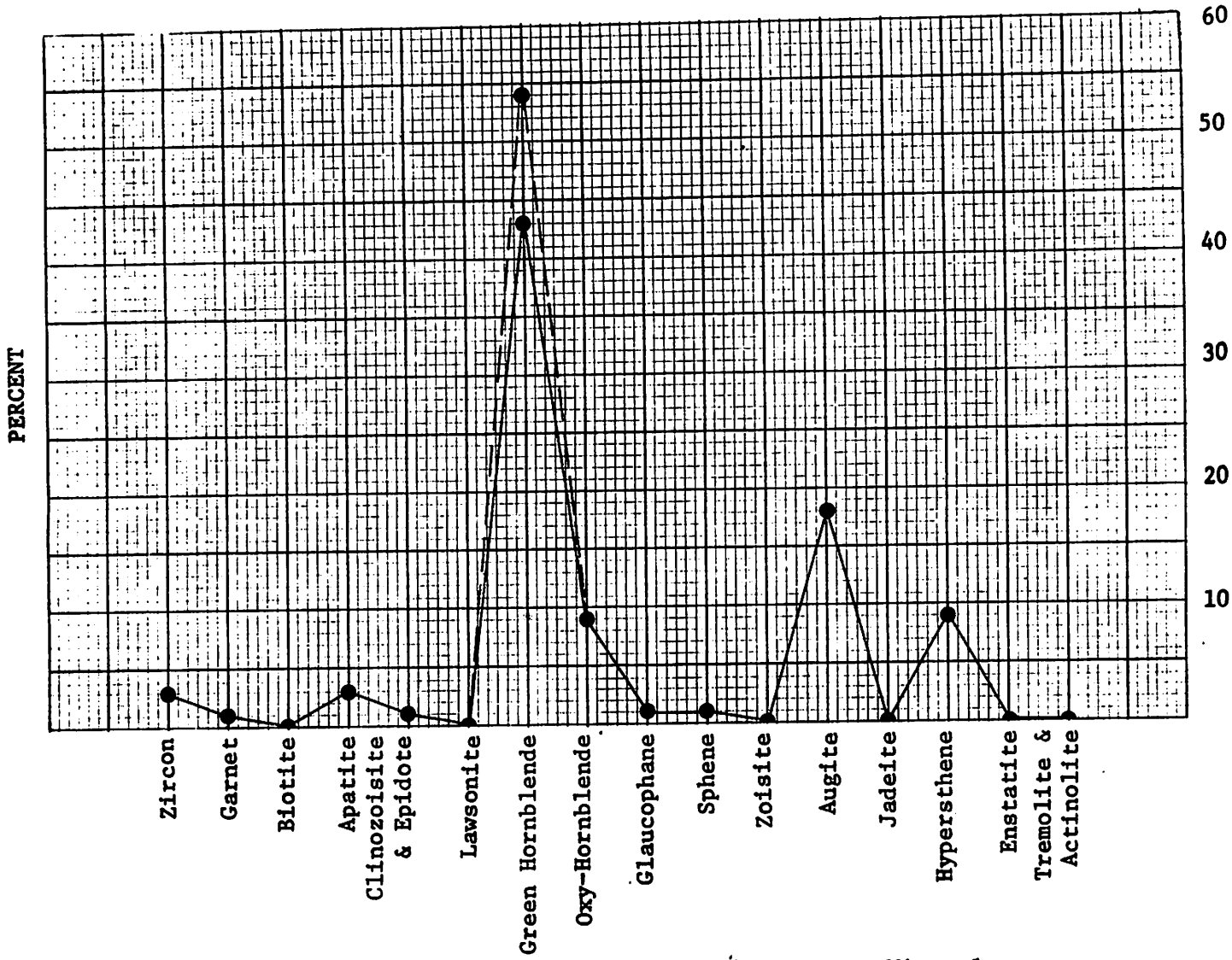
Wt. % of HM/SF 1.33

Total Grains Counted 132

% Transparent Grains 75.77

% Opaques 5.3

% Composite Gr. and Unknowns 18.93



Other Transparent Minerals

Mineral	No. Grains Counted
Pumpellyite	1
Composites - Alterites	24
Unknowns	1

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	6
Hematite	1

Analyst J. Lee

SAMPLE 2110

Location 37°16.8' 122°26.0'

Depth 18.3 meters 10 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 97.16

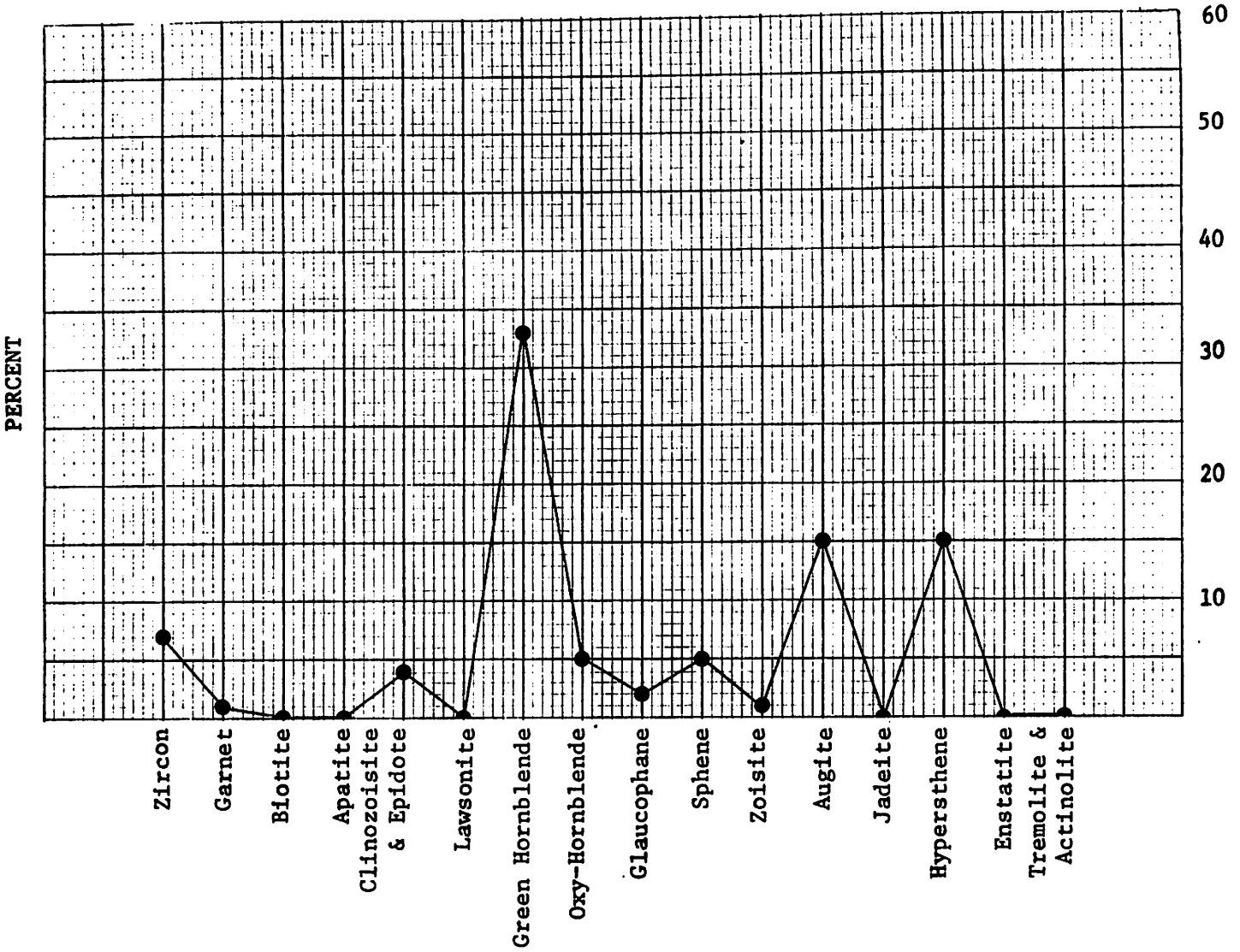
Wt. % of HM/SF 10.92

Total Grains Counted 193

% Transparent Grains 50.75

% Opaques 36.75

% Composite Gr. and Unknowns 12.50



Other Transparent Minerals

Mineral	No. Grains Counted
Unknowns	2
Composite Grains	22

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	68
Leucoxene	3

Analyst J. Lee

SAMPLE 2111

Location 37°16.8' 122°27.9'

Depth 36.7 meters 20.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 90.51

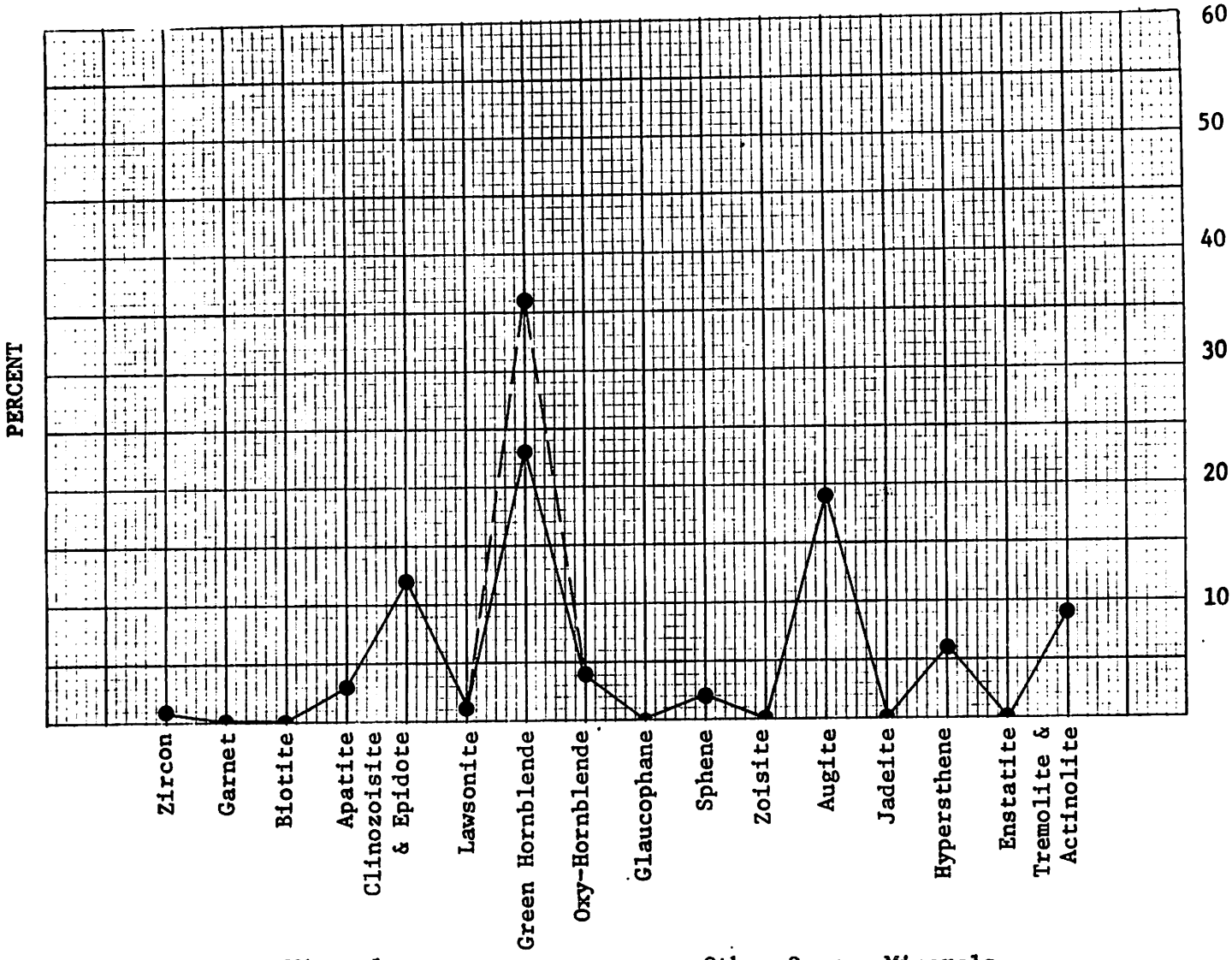
Wt. % of HM/SF 3.53

Total Grains Counted 161

% Transparent Grains 62.7

% Opaques 11.2

% Composite Gr. and Unknowns 26.1



Other Transparent Minerals

Mineral	No. Grains Counted
Allanite	2
Lawsonite	1
Composites - Alterites	39
Unknowns	3

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	16
Hematite	2

Analyst J. Lee

SAMPLE 2112

Location 37°17.1' 122°29.7'

Depth 54.9 meters 30.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 83.58

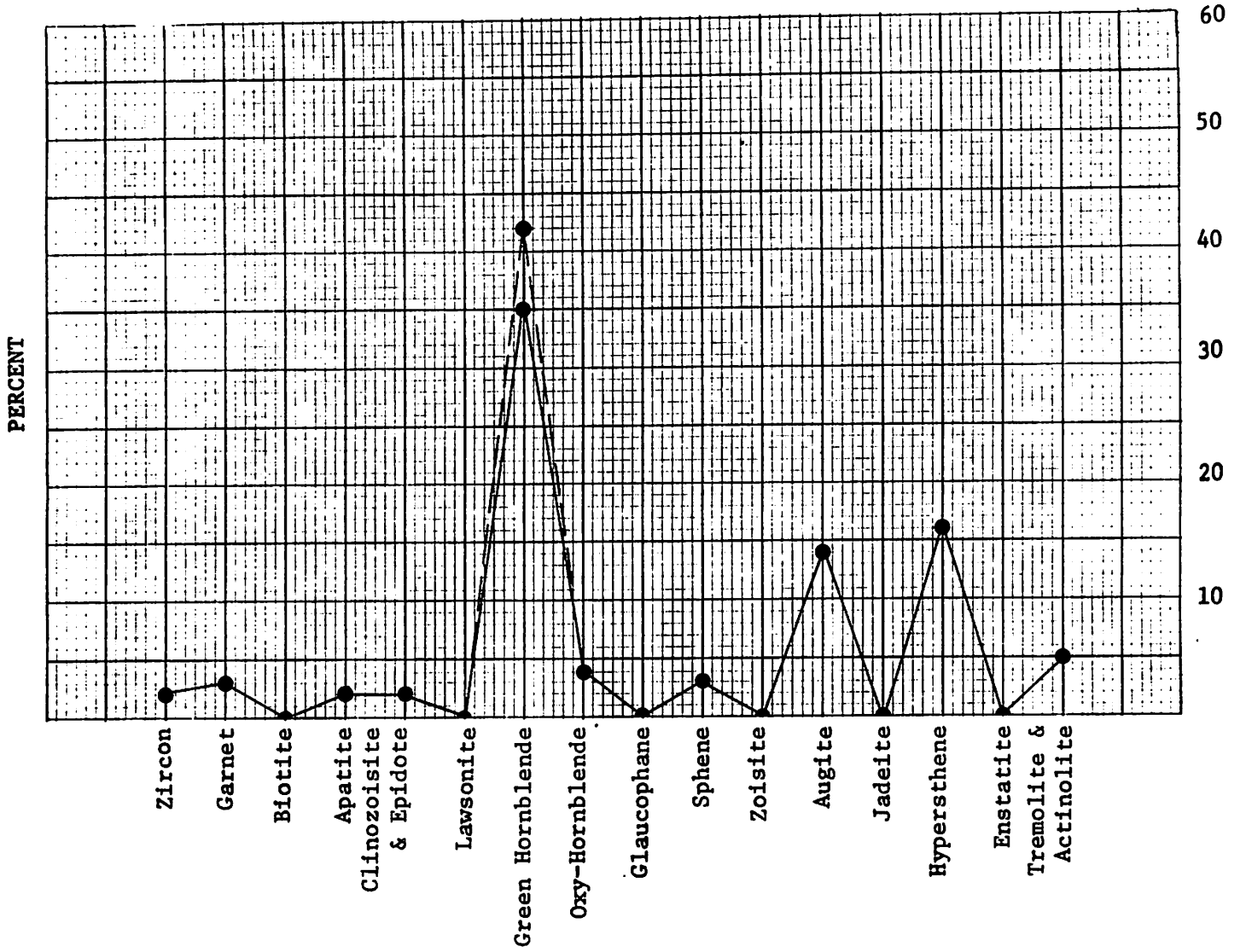
Wt. % of HM/SF 3.38

Total Grains Counted 152

% Transparent Grains 66.63

% Opaques 9.87

% Composite Gr. and Unknowns 24.5



Other Transparent Minerals

Mineral	No. Grains Counted
Rutile	1
Picotite	1
Allanite	1
Composites - Alterites	33
Unknowns	4

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	12
Hematite	1
Leucoxene	1

Analyst J. Lee

SAMPLE 2113

Location 37°17.2' 122°30.1'

Depth 64.0 meters 35.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 73.46

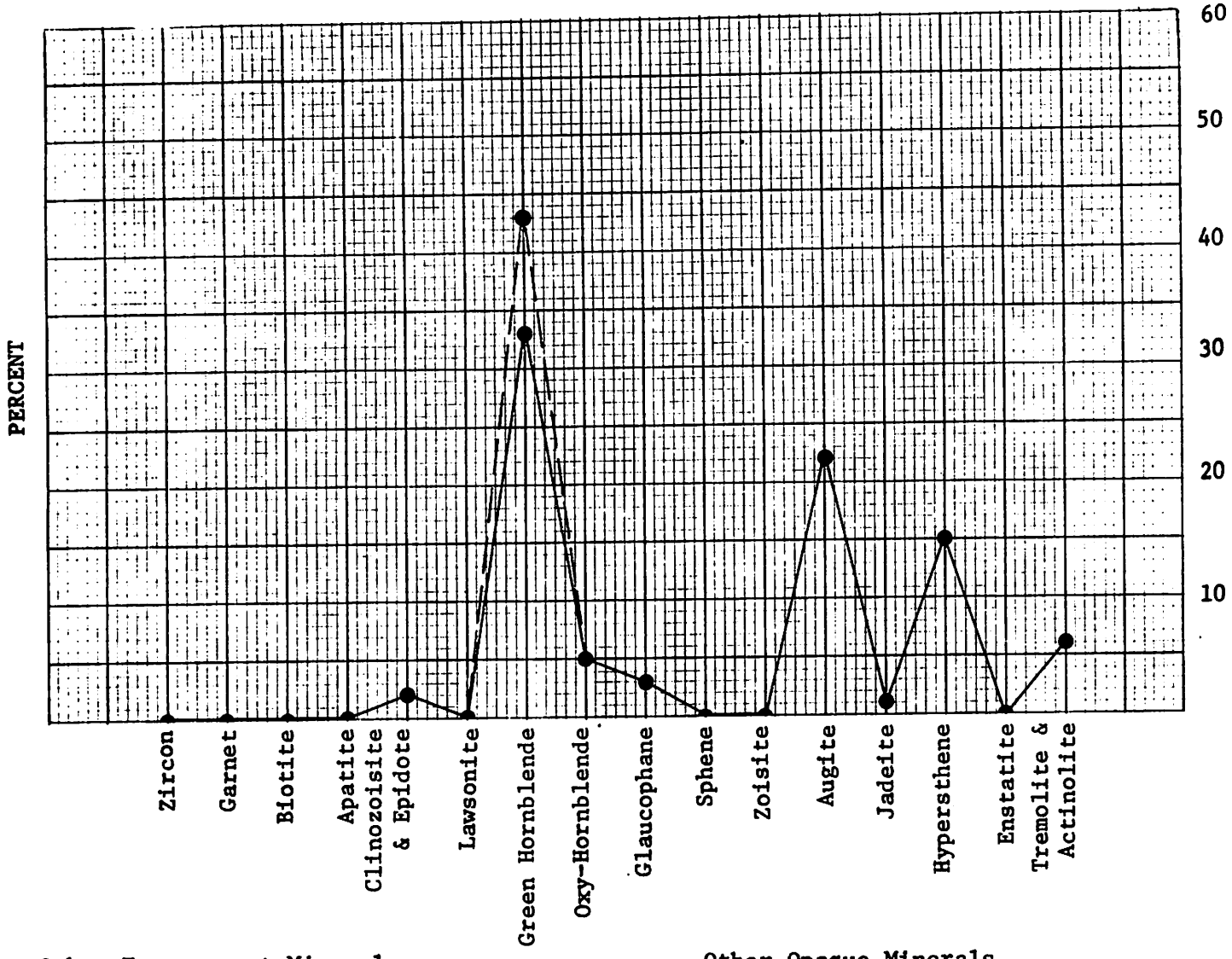
Wt. % of HM/SF 1.92

Total Grains Counted 134

% Transparent Grains 74.77

% Opaques 5.22

% Composite Gr. and Unknowns 20.01



Other Transparent Minerals

Mineral	No. Grains Counted
Rutile	1
Composites - Alterites	26
Unknowns	1

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	4
Hematite	2
Leucoxene	1

Analyst J. Lee

SAMPLE 2114

Location 37°17.0' 122°31.4'

Depth 75.0 meters 41.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 16.02

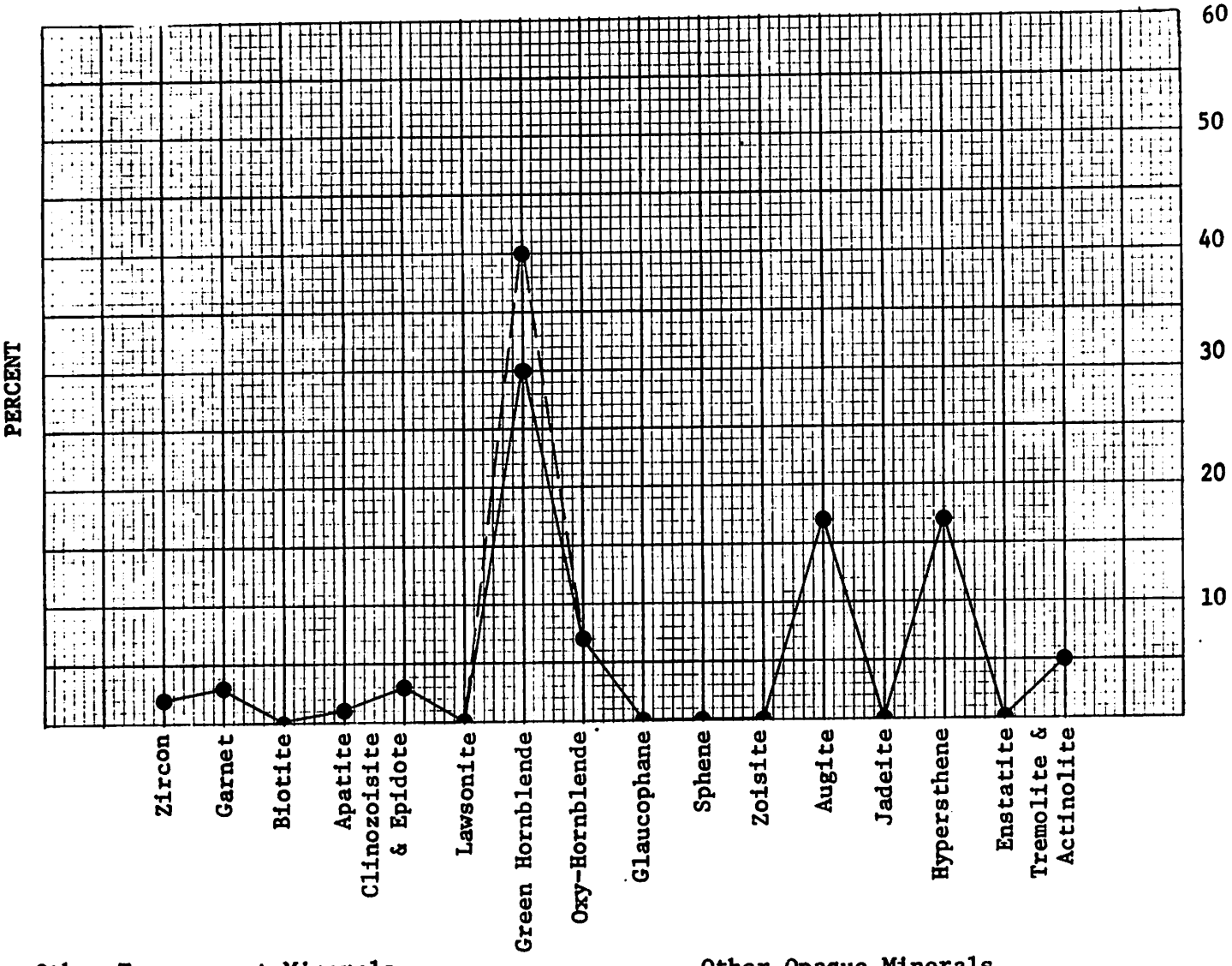
Wt. % of HM/SF 0.67

Total Grains Counted 149

% Transparent Grains 67.2

% Opaques 8.73

% Composite Gr. and Unknowns 24.07



Other Transparent Minerals

Mineral	No. Grains Counted
Monazite	1
Spinel	1
Composites - Alterites	34
Unknowns	2

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	8
Hematite	1
Leucoxene	2
Pyrite	2

Analyst J. Lee

SAMPLE 2115

Location 37°18.8' 122°32.5'

Depth 75.0 meters 41.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 18.57

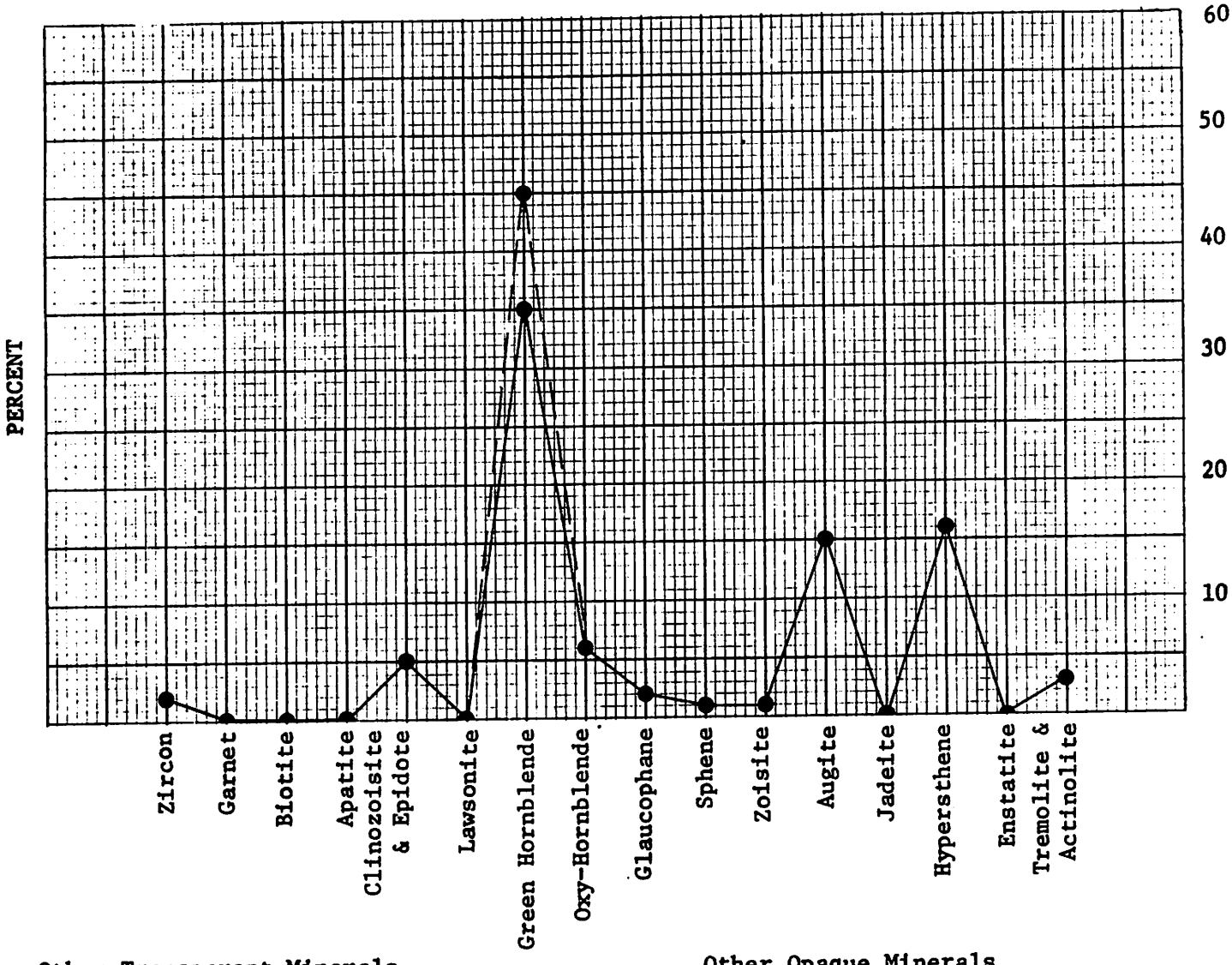
Wt. % of HM/SF 0.47

Total Grains Counted 136

% Transparent Grains 73.0

% Opaques 11.76

% Composite Gr. and Unknowns 14.7



Other Transparent Minerals

Mineral	No. Grains Counted
Zoisite	1
Muscovite	1
Composites - Alterites	18
Unknowns	2

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	9
Hematite	2
Leucoxene	4
Pyrite	1

Analyst J. Lee

SAMPLE 2116

Location 37°19.2' 122°31.6'

Depth 64.0 meters 35.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 48.2

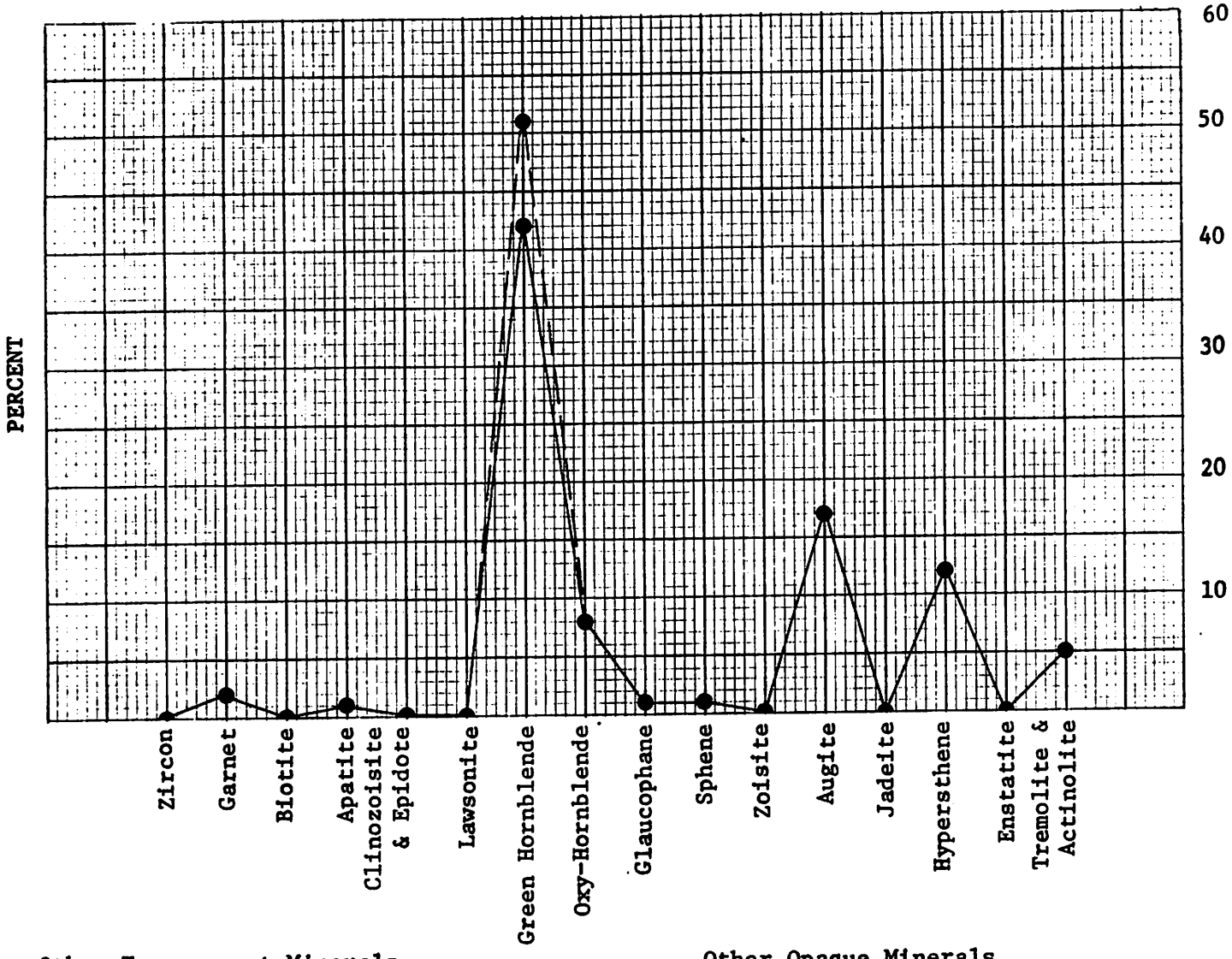
Wt. % of HM/SF 2.68

Total Grains Counted 146

% Transparent Grains 69.2

% Opaques 6.15

% Composite Gr. and Unknowns 24.65



Other Transparent Minerals

Mineral	No. Grains Counted
Picotite	1
Composites - Alterites	32
Unknowns	4

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	6
Leucoxene	3

Analyst J. Lee

SAMPLE 2117

Location 37°19.7' 122°30.3'

Depth 54.9 meters 30.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 90.78

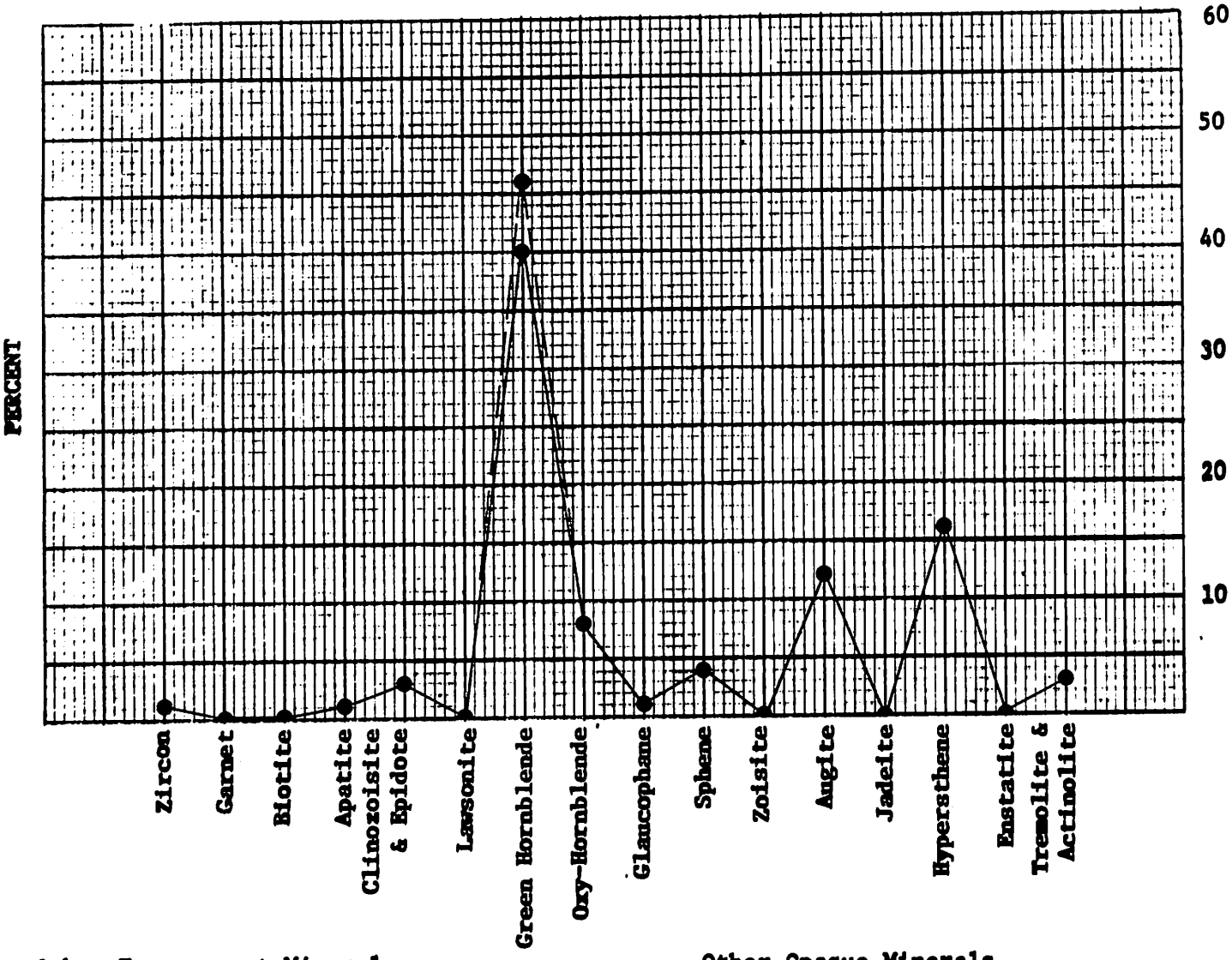
Wt. % of HM/SF 2.33

Total Grains Counted 153

% Transparent Grains 65.4

% Opaques 11.76

% Composite Gr. and Unknowns 22.84



Other Transparent Minerals

Mineral	No. Grains Counted
Rutile	2
Picotite	1
Pumpellyite	1
Composites - Alterites	32
Unknown	3

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite	16
Hematite	1

Analyst J. Lee

SAMPLE 2118

Location 37°19.9' 122°29.6'

Depth 45.7 meters 25 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 94.63

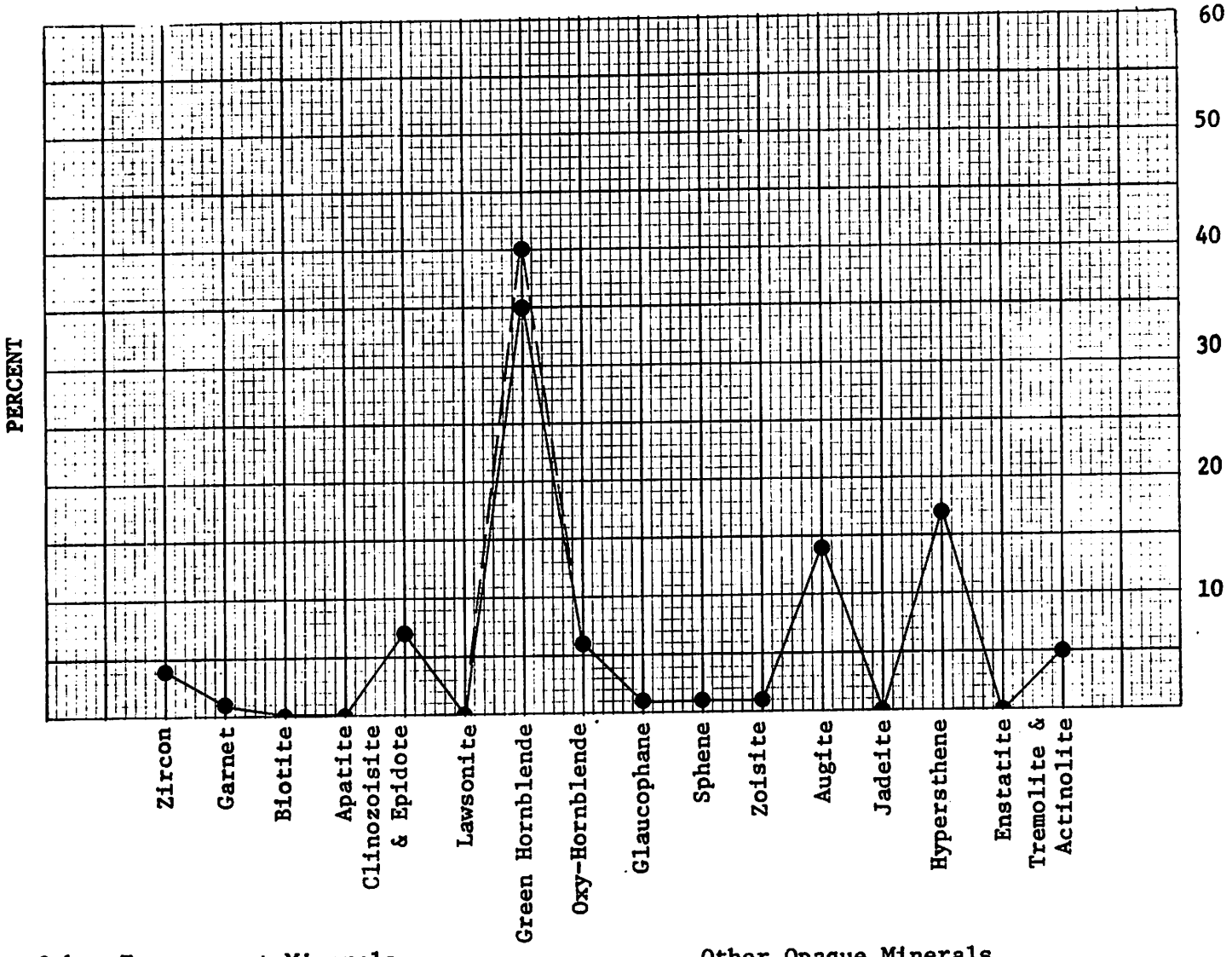
Wt. % of HM/SF 6.53

Total Grains Counted 169

% Transparent Grains 59.2

% Opaques 14.8

% Composite Gr. and Unknowns 26.0



Other Transparent Minerals

Mineral	No. Grains Counted
Picotite	2
Zoisite	1
Composites - Alterites	40
Unknowns	4

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	19
Hematite	4

Analyst J. Lee

SAMPLE 2119

Location 37°20.3' 122°28.9'

Depth 36.7 meters 20.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 94.41

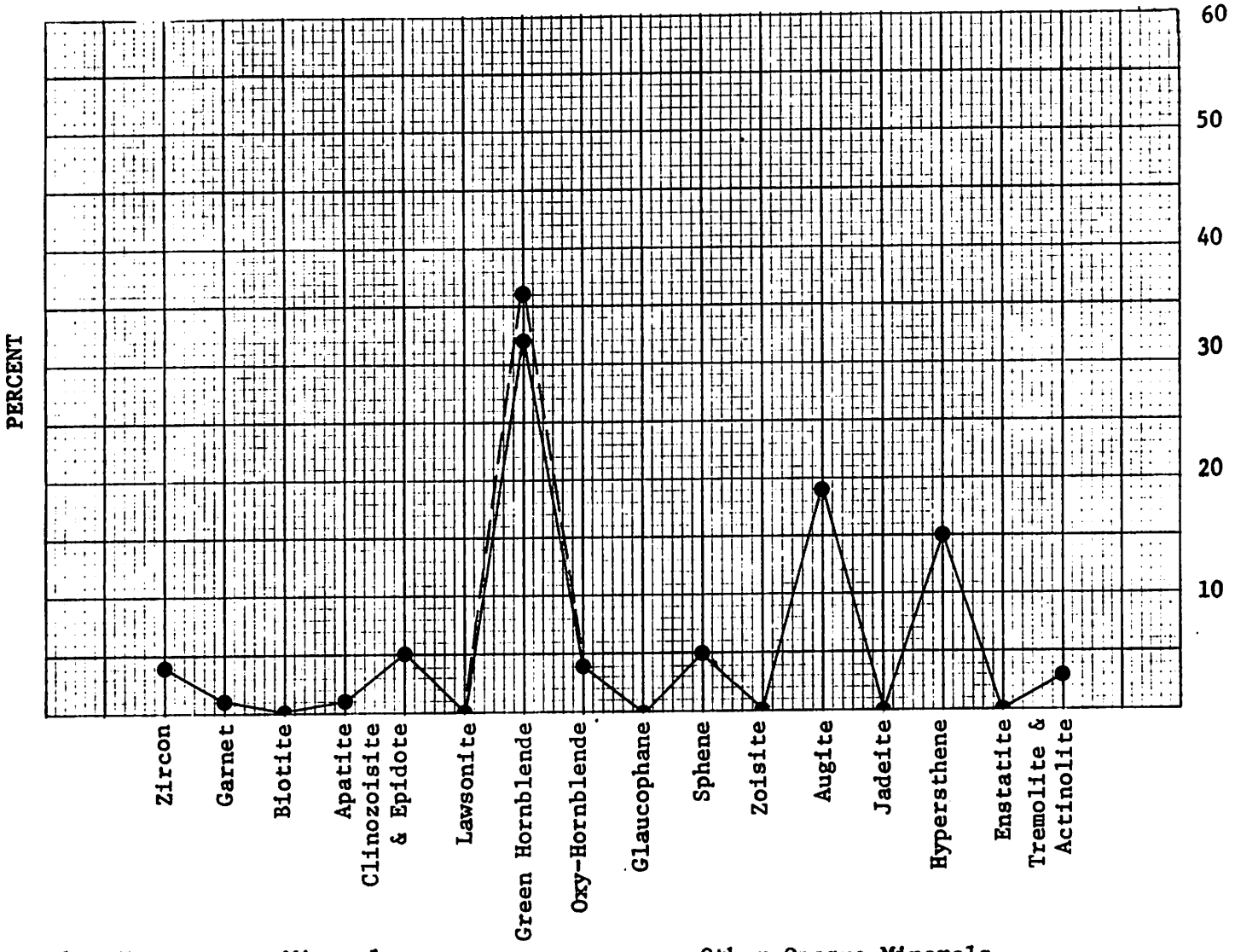
Wt. % of HM/SF 14.67

Total Grains Counted 155

% Transparent Grains 64.53

% Opaques 16.12

% Composite Gr. and Unknowns 19.35



Other Transparent Minerals

Mineral	No. Grains Counted
Picotite	2
Zoisite	2
Pumpellyite	1
Composites - Alterites	28
Unknowns	2

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite	23

Analyst J. Lee

SAMPLE 2120

Location 37°20.7' 122°27.6'

Depth 27.4 meters 15.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 98.13

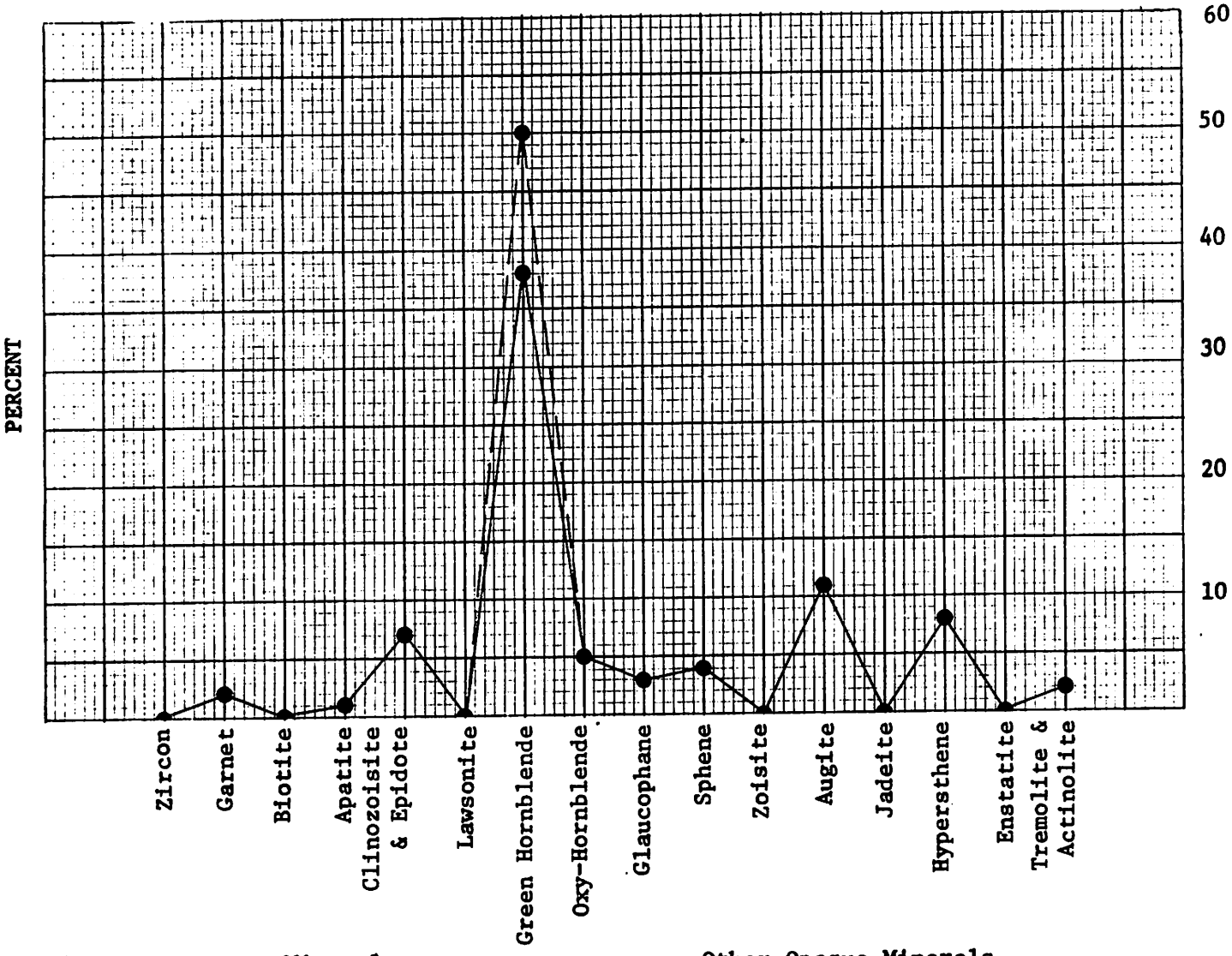
Wt. % of HM/SF 12.28

Total Grains Counted 196

% Transparent Grains 51.0

% Opaques 24.5

% Composite Gr. and Unknowns 24.5



Other Transparent Minerals

Mineral	No. Grains Counted
Rutile	1
Picotite	2
Zoisite	1
Composites - Alterites	45
Unknowns	3

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	42
Hematite	2
Leucoxene	2

Analyst J. Lee

SAMPLE 2121

Location 37° 21.0' 122° 26.4°

Depth 18.3 meters 10.0 fathoms

Size Fraction (SF) .124 - .175 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 99.55

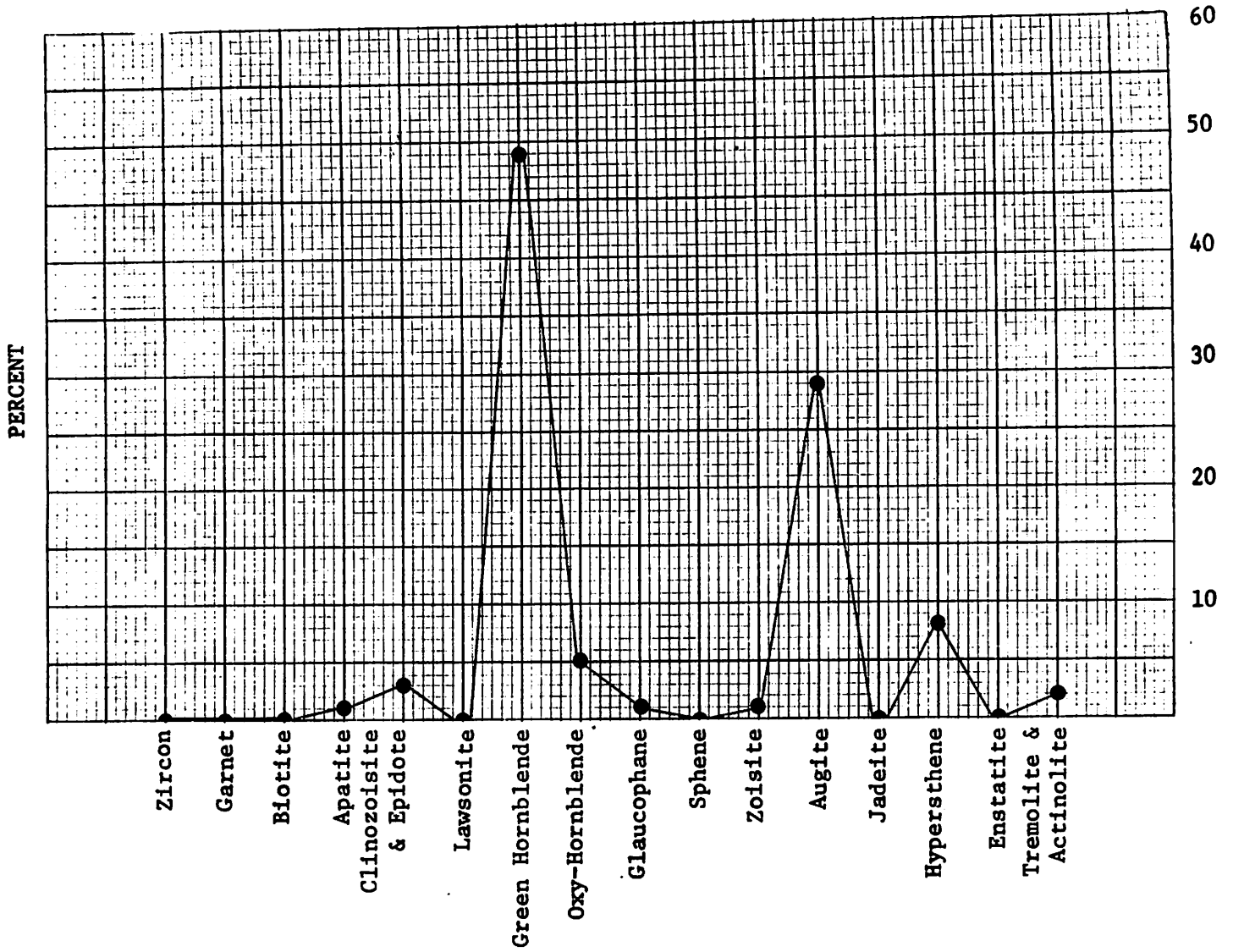
Wt. % of HM/SF 19.17

Total Grains Counted 140

% Transparent Grains 71.43

% Opaques 3.57

% Composite Gr. and Unknowns 25.00



Other Transparent Minerals

Mineral	No. Grains Counted
Allanite	1
Composites - Alterites	32

Other Opaque Minerals

Mineral	No Grains Counted
Hematite	1
Leucoxene	2
Magnetite	2

Analyst J. Lee

SAMPLE 2122

Location 37° 18.8' 122° 28.1'

Depth 36.7 meters 20.0 fathoms

Size Fraction (SF) .124 - .175mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 67.07

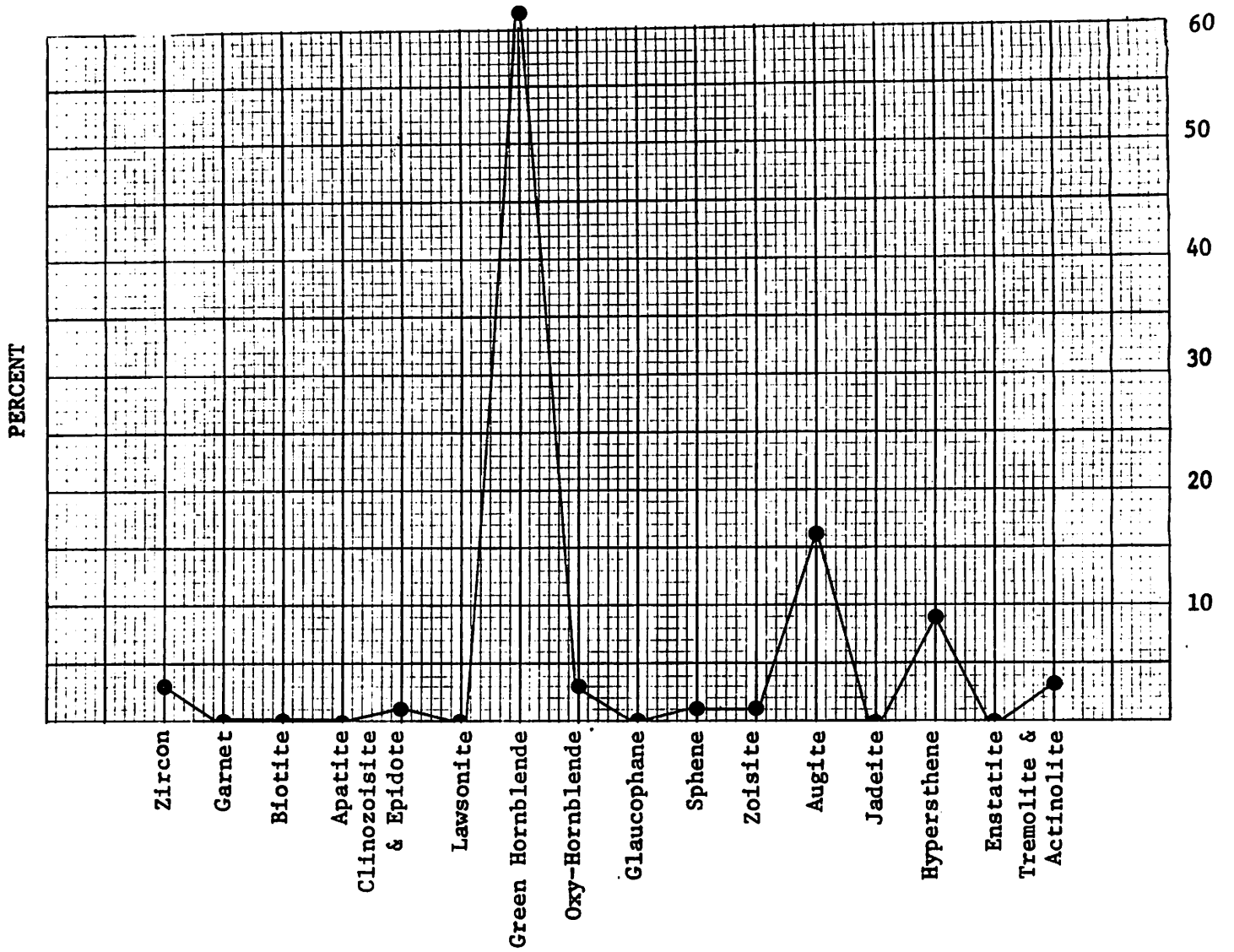
Wt. % of HM/SF 7.83

Total Grains Counted 146

% Transparent Grains 68.48

% Opaques 4.11

% Composite Gr. and Unknowns 27.40



Other Transparent Minerals

Mineral	No. Grains Counted
Allanite	1
Composites - Alterites	37

Other Opaque Minerals

Mineral	No. Grains Counted
Hematite	3
Leucoxene	1
Magnetite	2

Analyst J. Lee

SAMPLE 2123

Location 37°22.3' 122°29.0'

Depth 36.7 meters 20 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 95.54

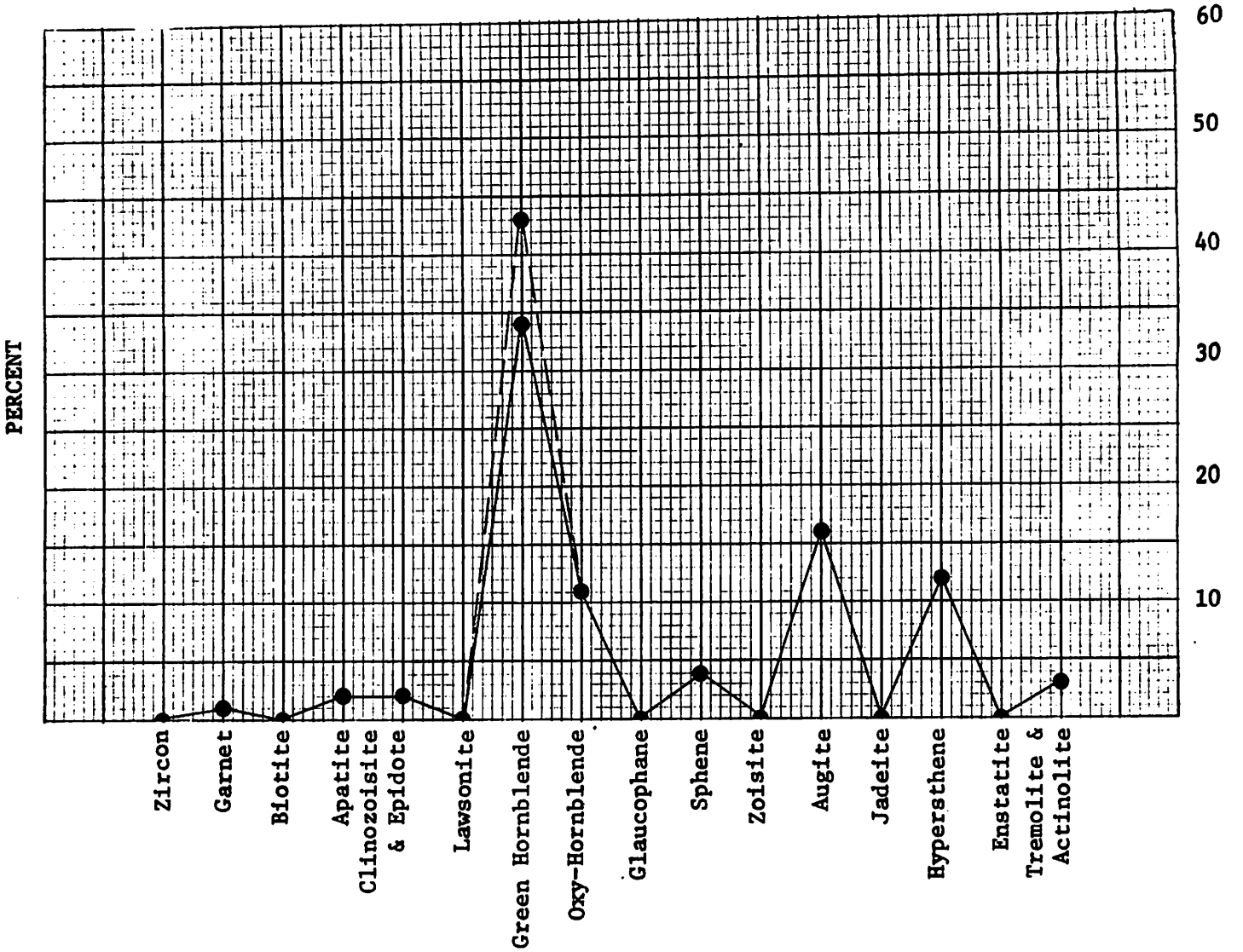
Wt. % of HM/SF 3.56

Total Grains Counted 140

% Transparent Grains 71.4

% Opaques 5.72

% Composite Gr. and Unknowns 22.88



Other Transparent Minerals

Mineral	No. Grains Counted
Allanite	2
Glauconite	1
Composites - Alterites	29
Unknowns	3

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite	8

Analyst J. Lee

SAMPLE 2124

Location 37° 20.7' 122° 36.7'

Depth 73.2 meters 40.0 fathoms

Size Fraction (SF) _____ mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample N.A.

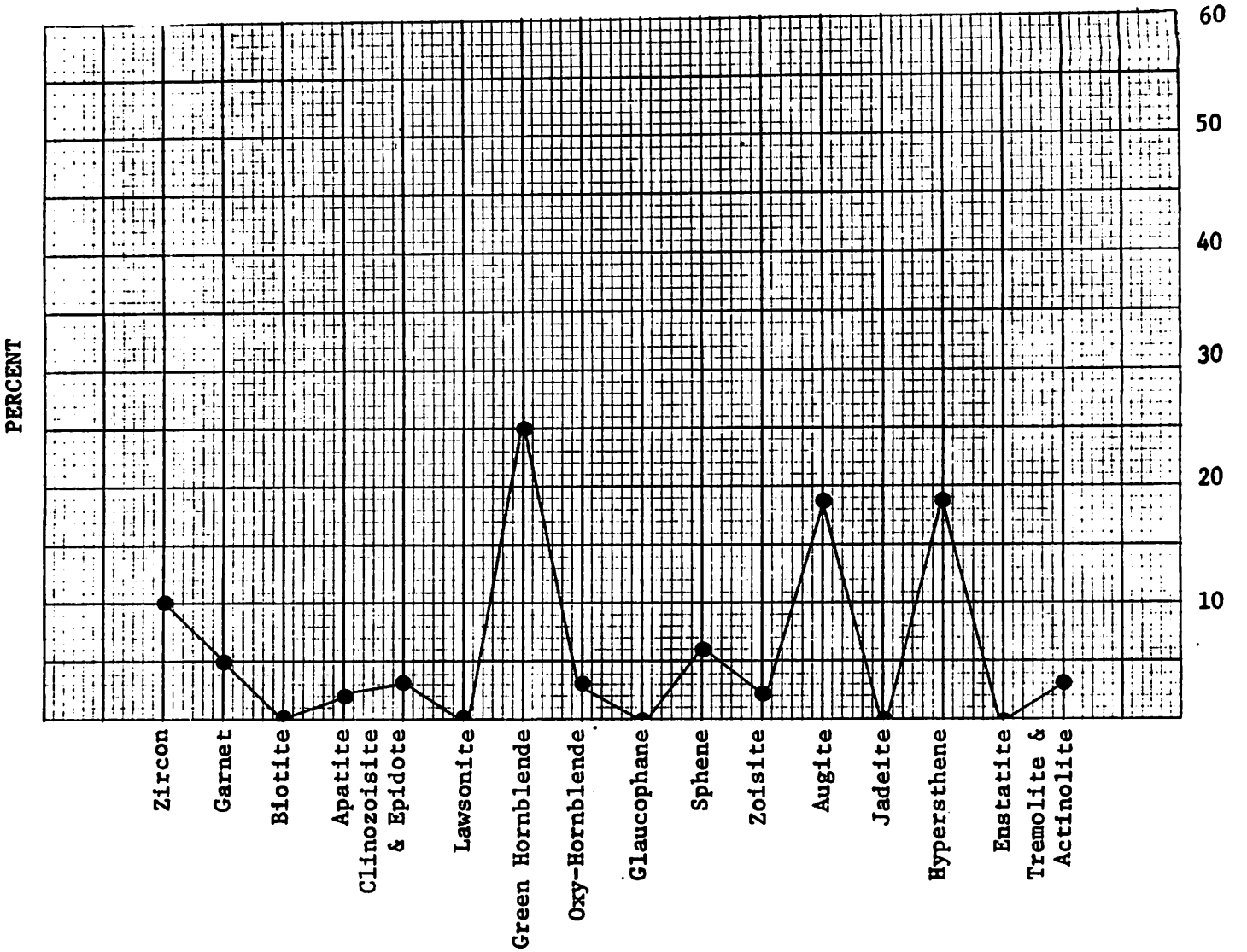
Wt. % of HM/SF 1.03

Total Grains Counted 142

% Transparent Grains 70.44

% Opaques 12.68

% Composite Gr. and Unknowns 16.90



Other Transparent Minerals

Mineral	No. Grains Counted
Allanite	1
Pumpellyite	2

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	2
Hematite	15
Pyrite	1

Analyst J. Lee

SAMPLE 2125

Location 37°20.9' 122°34.3'

Depth 88.4 meters 38.3 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 63.30

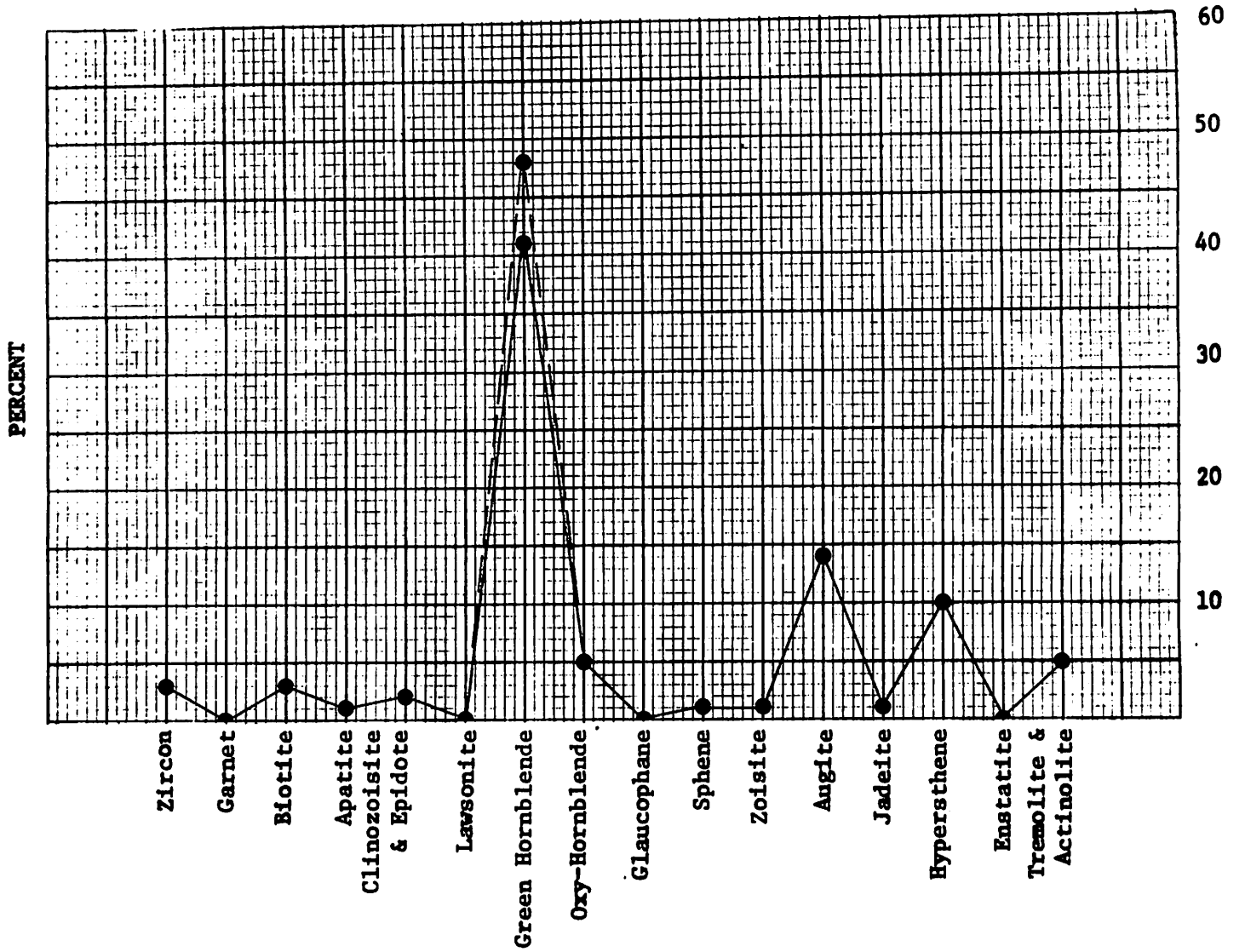
Wt. % of HM/SF 1.99

Total Grains Counted 176

% Transparent Grains 56.8

% Opaques 7.96

% Composite Gr. and Unknowns 35.24



Other Transparent Minerals

Mineral	No. Grains Counted
Rutile	2
Zoisite	1
Allanite	2
Composites - Alterites	60
Unknowns	2

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite	12
Hematite	1
Leucoxene	1

Analyst J. Lee

SAMPLE 2126

Location 37°20.9' 122°34.3'

Depth 88.4 meters 38.3 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 25.7

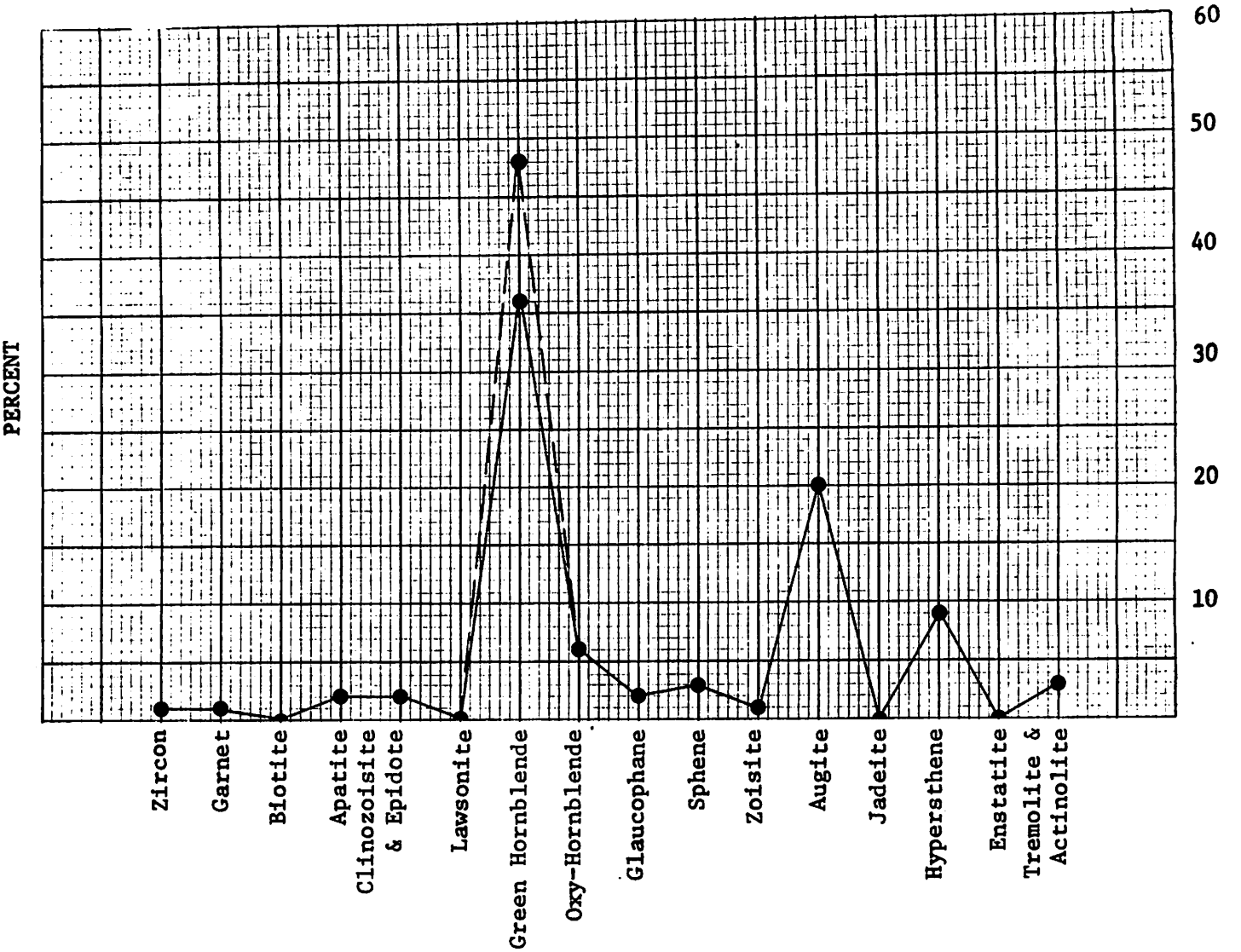
Wt. % of HM/SF 0.99

Total Grains Counted 146

% Transparent Grains 68.48

% Opaques 3.42

% Composite Gr. and Unknowns 28.1



Other Transparent Minerals

Mineral	No. Grains Counted
Pumpellyite	1
Zoisite	1
Composites - Alterites	38
Unknowns	3

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	5

Analyst J. Lee

SAMPLE 2127

Location 37° 22.3' 122° 31.9

Depth 56.7 meters 31.0 fathoms

Size Fraction (SF) .124 - .175 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 27.45

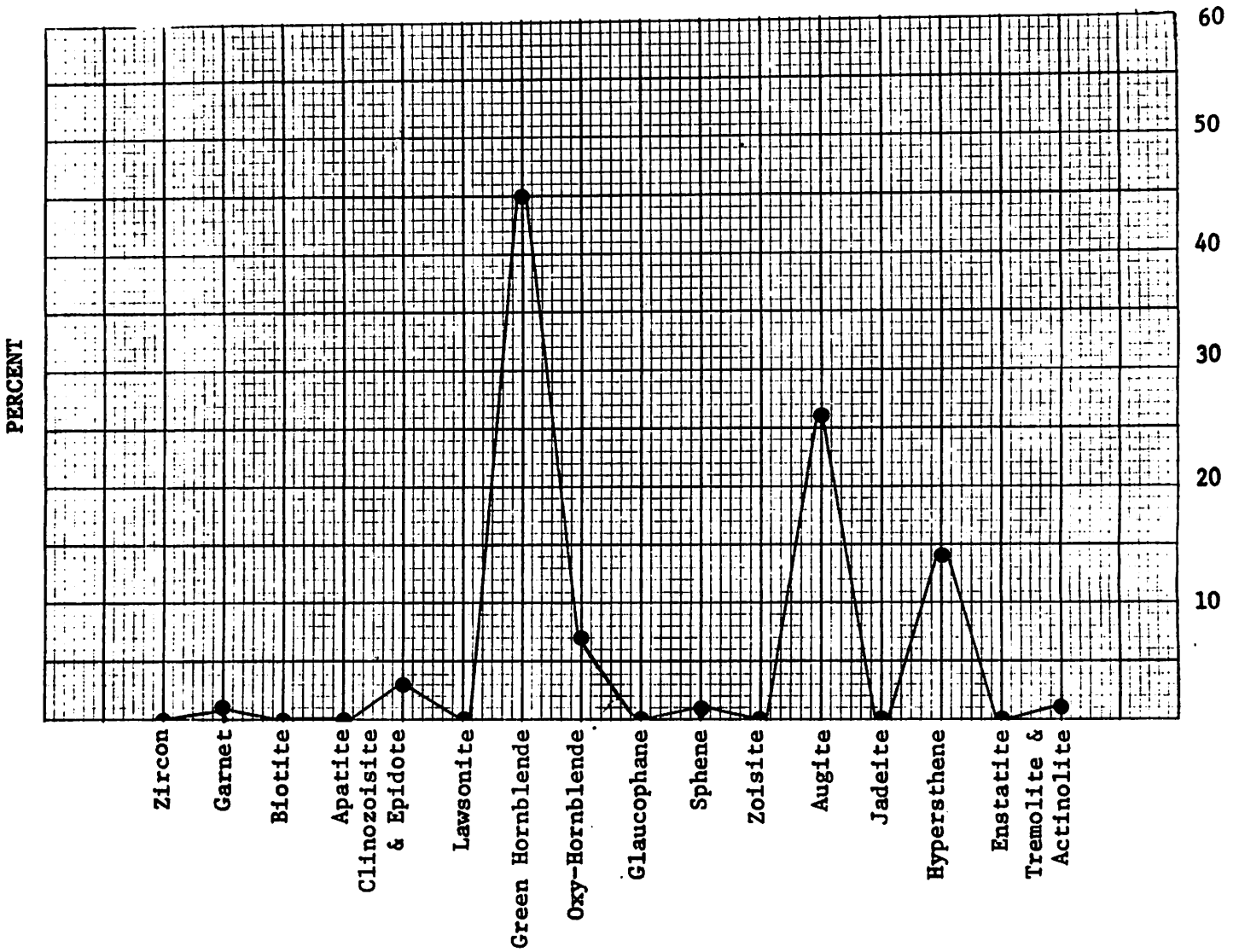
Wt. % of HM/SF 1.54

Total Grains Counted 128

% Transparent Grains 78.13

% Opaques 8.59

% Composite Gr. and Unknowns 14.06



Other Transparent Minerals

Mineral	No. Grains Counted
Pumpellyite	1
Composites - Alterites	15

Other Opaque Minerals

Mineral	No. Grains Counted
Hematite	9
Magnetite	2

Analyst J. Lee

SAMPLE 2128

Location 37°22.9' 122°30.4'

Depth 45.7 meters 25.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 83.19

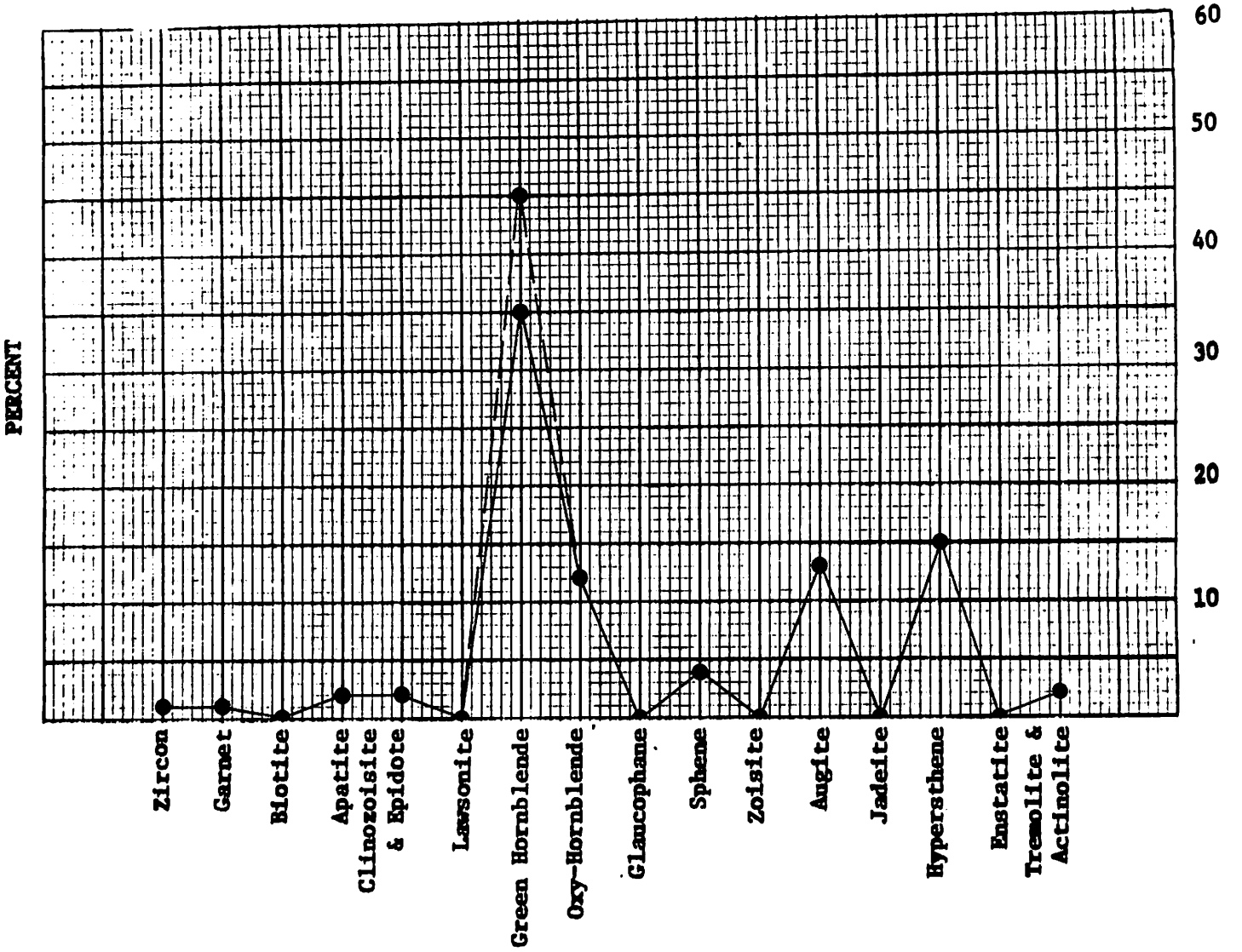
Wt. % of HM/SF 6.14

Total Grains Counted 160

% Transparent Grains 62.5

% Opaques 6.88

% Composite Gr. and Unknowns 30.62



Other Transparent Minerals

Mineral	No. Grains Counted
Pumpellyite	1
Olivene	1
Composites - Alterites	45
Unknowns	4

Other Opaque Minerals

Mineral	No. Grains Counted
Hematite	2

Analyst J. Lee

SAMPLE 2129

Location 37° 22.9' 122° 29.0'

Depth 36.7 meters 20.0 fathoms

Size Fraction (SF) .124 - .175mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 96.96

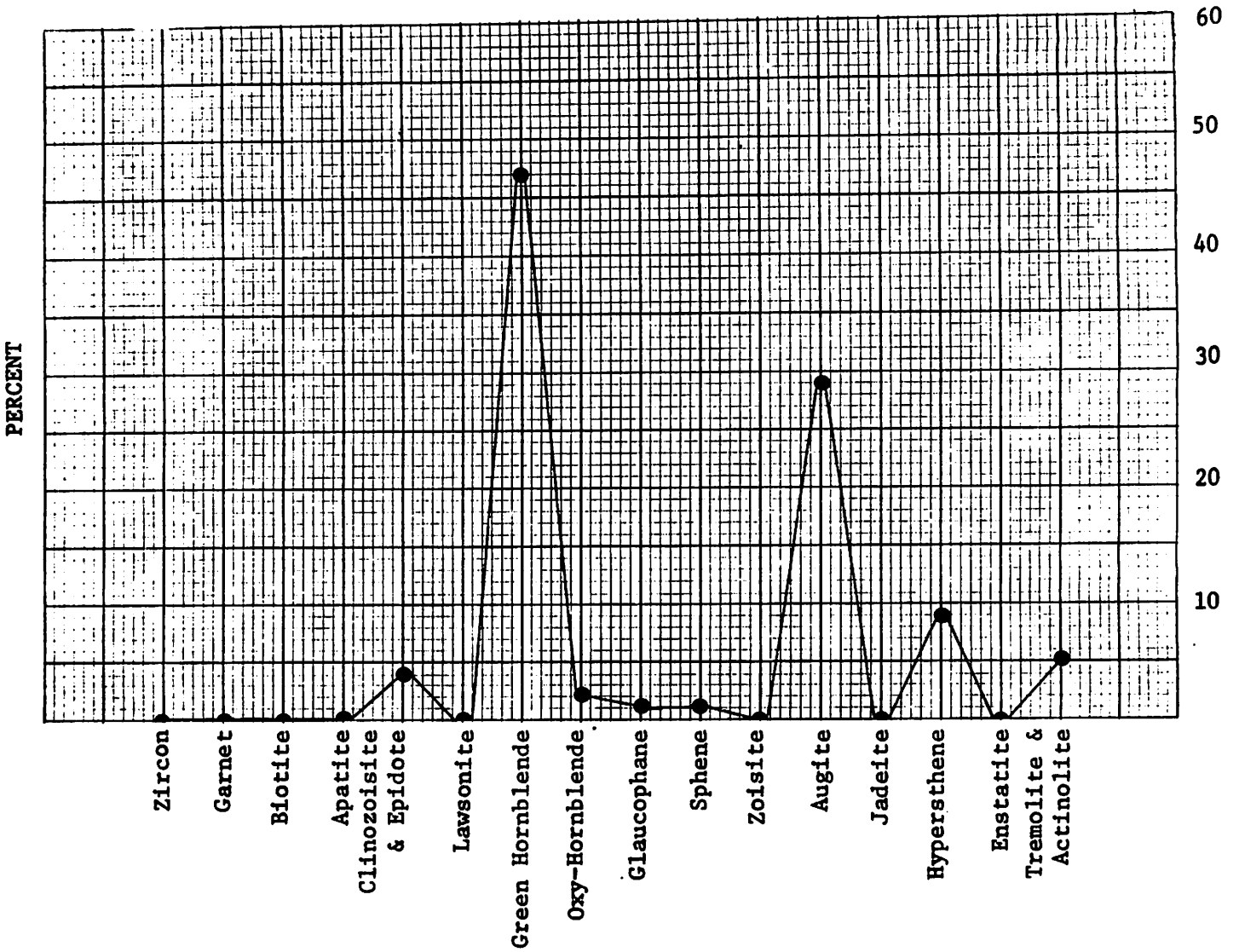
Wt. % of HM/SF 11.72

Total Grains Counted 131

% Transparent Grains 76.34

% Opaques 2.29

% Composite Gr. and Unknowns 21.37



Other Transparent Minerals

Mineral	No. Grains Counted
Pumpellyite	2
Composites - Alterites	24

Other Opaque Minerals

Mineral	No Grains Counted
Hematite	1
Magnetite	2

Analyst J. Lee

SAMPLE 2130

Location 37°23.2' 122°28.0'

Depth 27.4 meters 15.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 97.37

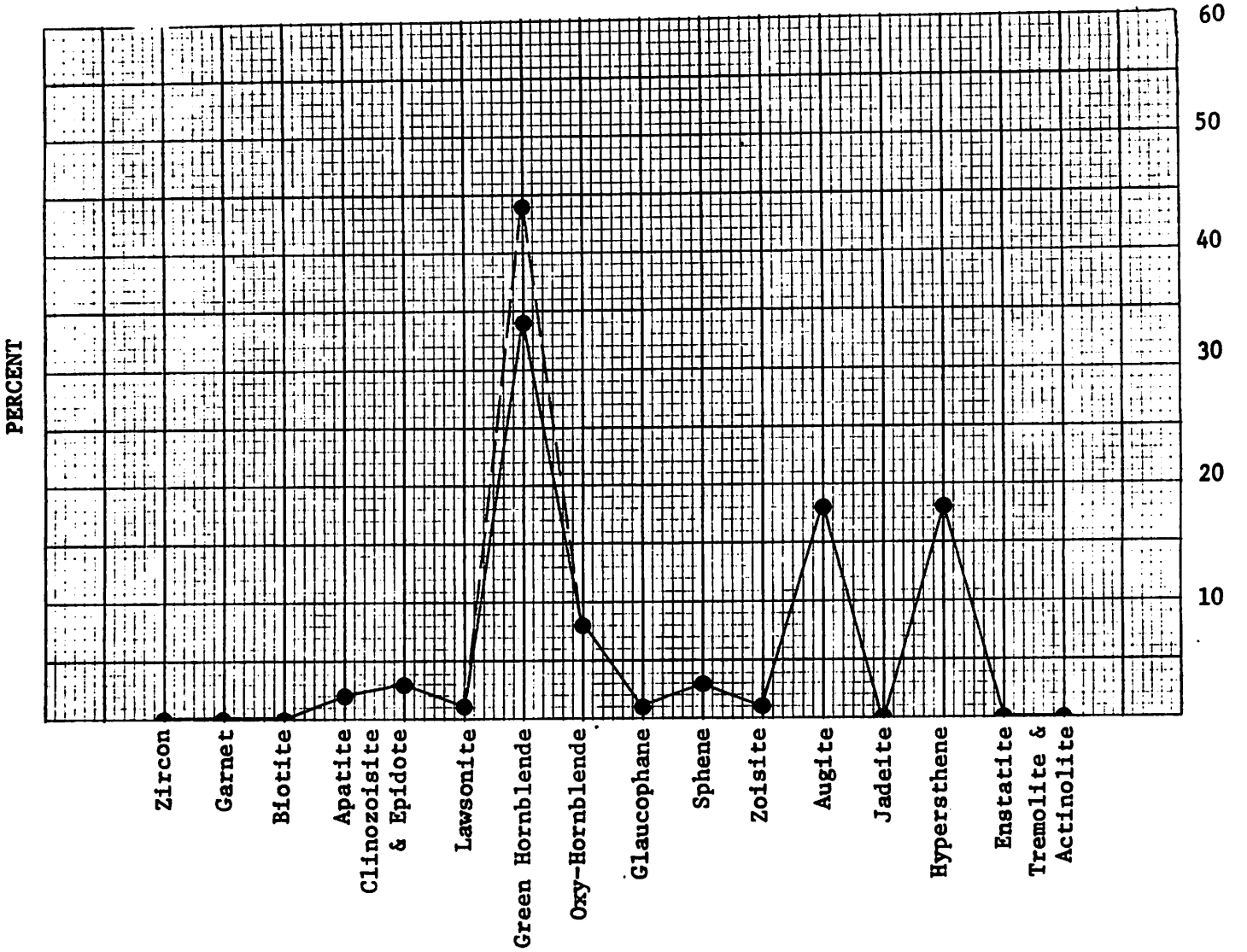
Wt. % of HM/SF 6.44

Total Grains Counted 156

% Transparent Grains 64.0

% Opaques 12.8

% Composite Gr. and Unknowns 23.2



Other Transparent Minerals

Mineral	No. Grains Counted
Zoisite	1
Lawsonite	1
Composites - Alterites	33
Unknowns	3

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	18
Hematite	2

Analyst J. Lee

SAMPLE 2131

Location 37°23.3' 122°26.5'

Depth 18.3 meters 10.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 97.30

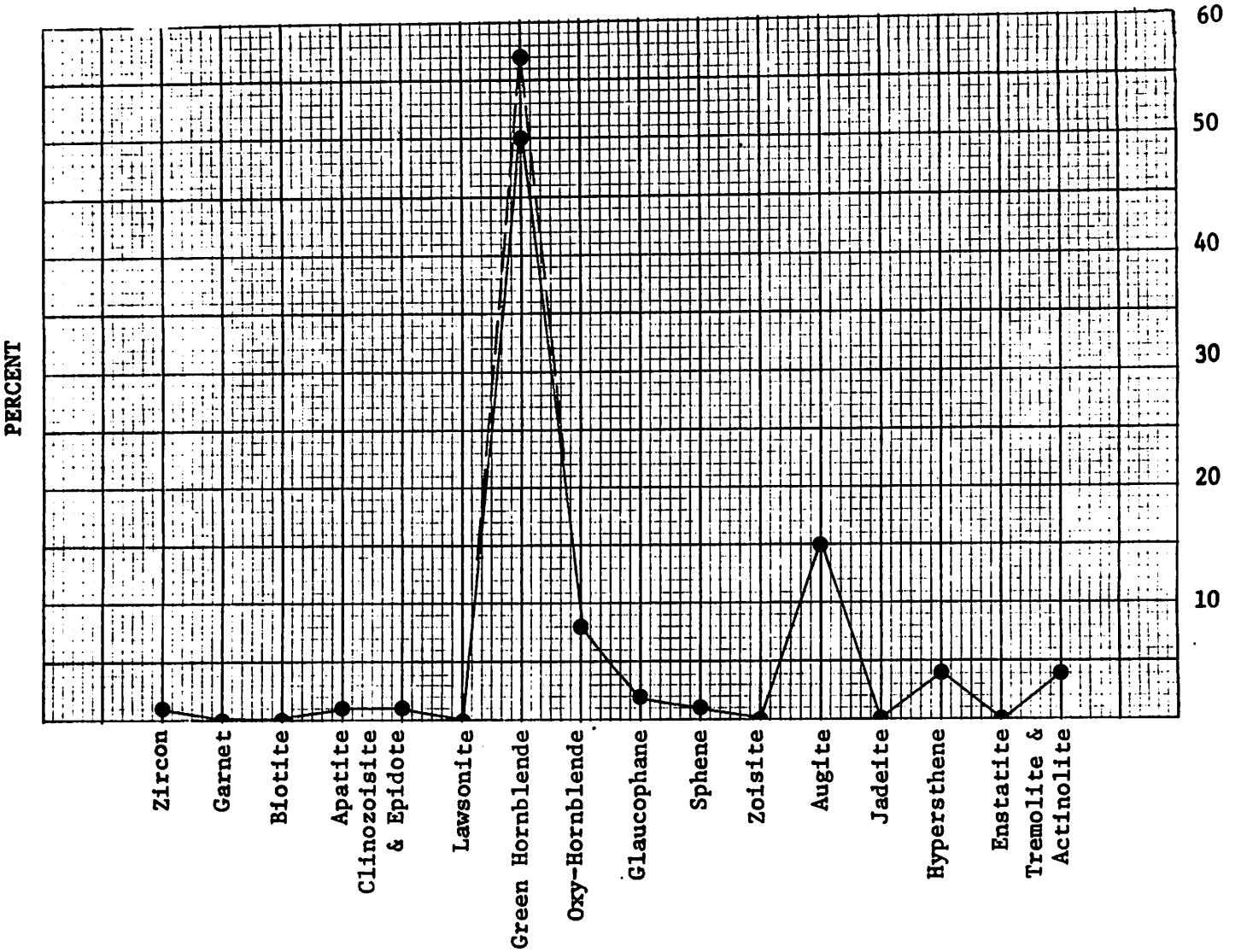
Wt. % of HM/SF 4.44

Total Grains Counted 137

% Transparent Grains 73.02

% Opaques 4.38

% Composite Gr. and Unknowns 22.6



Other Transparent Minerals

Mineral	No. Grains Counted
Allanite	1
Composites - Alterites	29
Unknowns	2

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	6

Analyst J. Lee

SAMPLE 2132

Location 37° 23.5' 122° 25.7'

Depth 9.1 meters 5.0 fathoms

Size Fraction (SF) .124 - .175 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 72.00

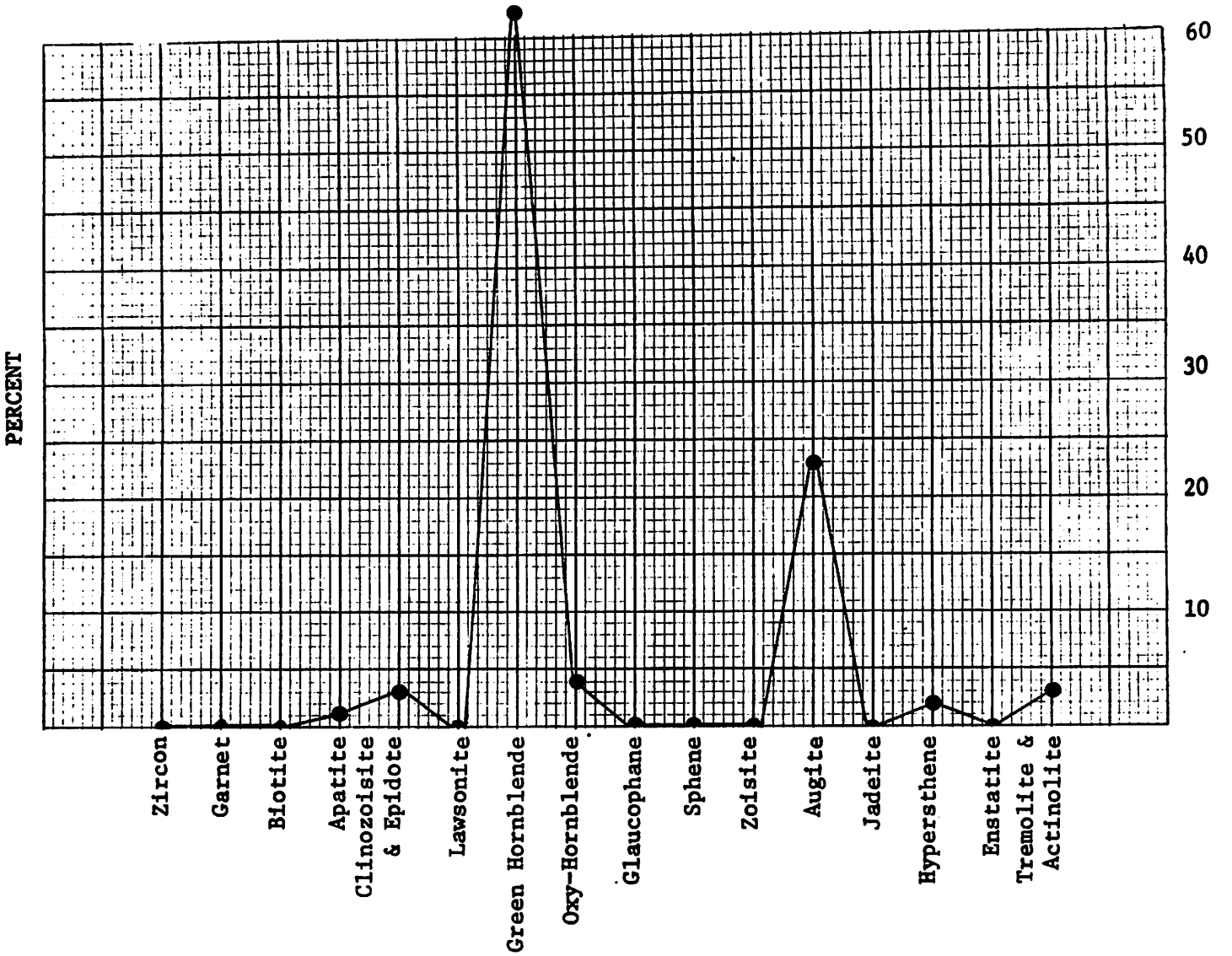
Wt. % of HM/SF 7.15

Total Grains Counted 131

% Transparent Grains 76.34

% Opaques 5.34

% Composite Gr. and Unknowns 18.32



Other Transparent Minerals

Mineral	No. Grains Counted
Carbonate	1
Pumpellyite	1
Composites - Alterites	22

Other Opaque Minerals

Mineral	No. Grains Counted
Hematite	6
Magnetite	1

Analyst J. Lee

SAMPLE 2133

Location 37°26.8' 122°27.9'

Depth 18.3 meters 10.0 fathoms

Size Fraction (SF) .124 - .175 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 61.35

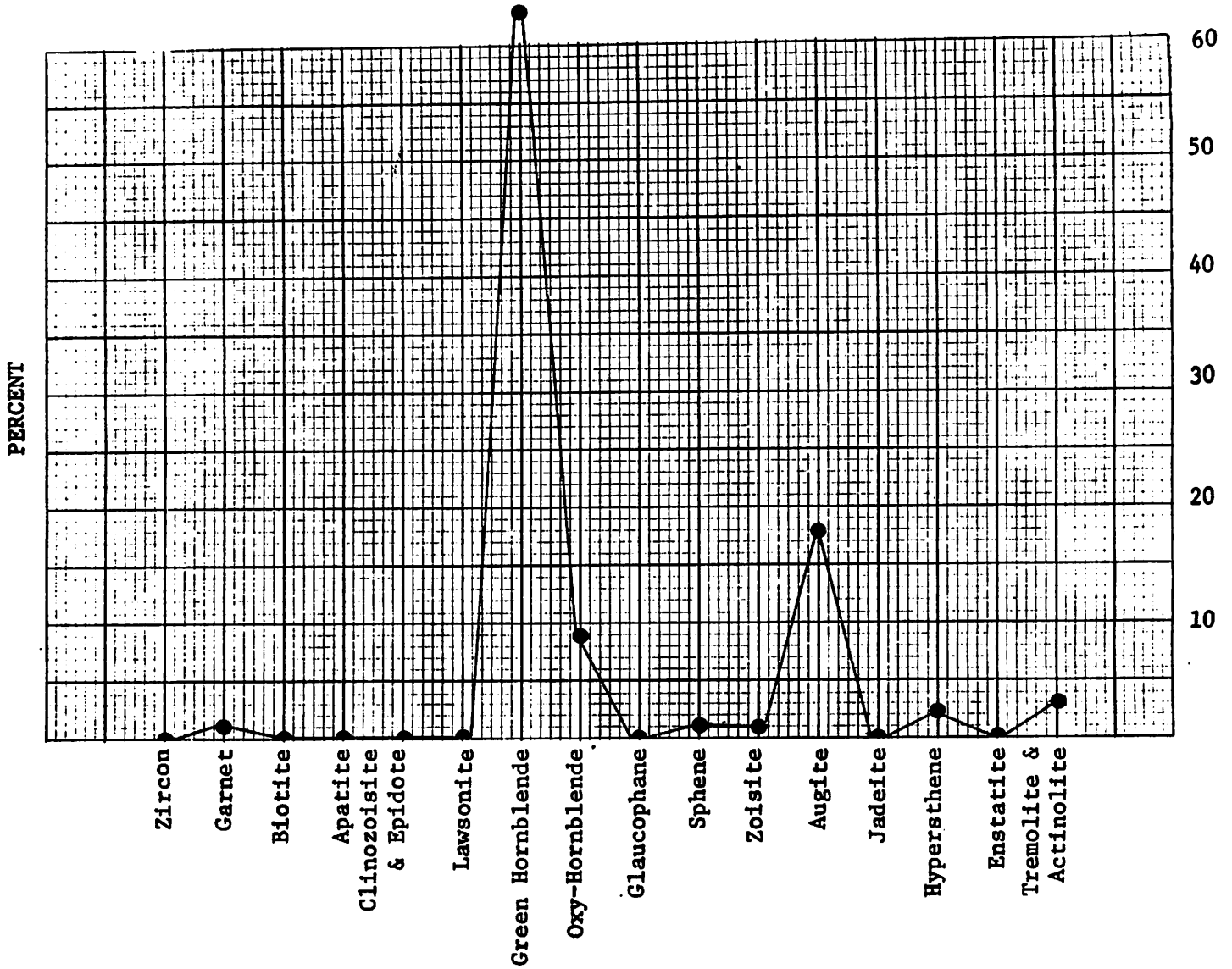
Wt. % of HM/SF 4.79

Total Grains Counted 146

% Transparent Grains 68.48

% Opaques 7.53

% Composite Gr. and Unknowns 23.97



Other Transparent Minerals

Mineral	No. Grains Counted
Allanite	2
Carbonate	1
Composites - Alterites	32

Other Opaque Minerals

Mineral	No Grains Counted
Hematite	3
Leucoxene	2
Magnetite	6

Analyst J. Lee

SAMPLE 2134

Location 37°26.4' 122°28.9'

Depth 27.4 meters 15.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 91.91

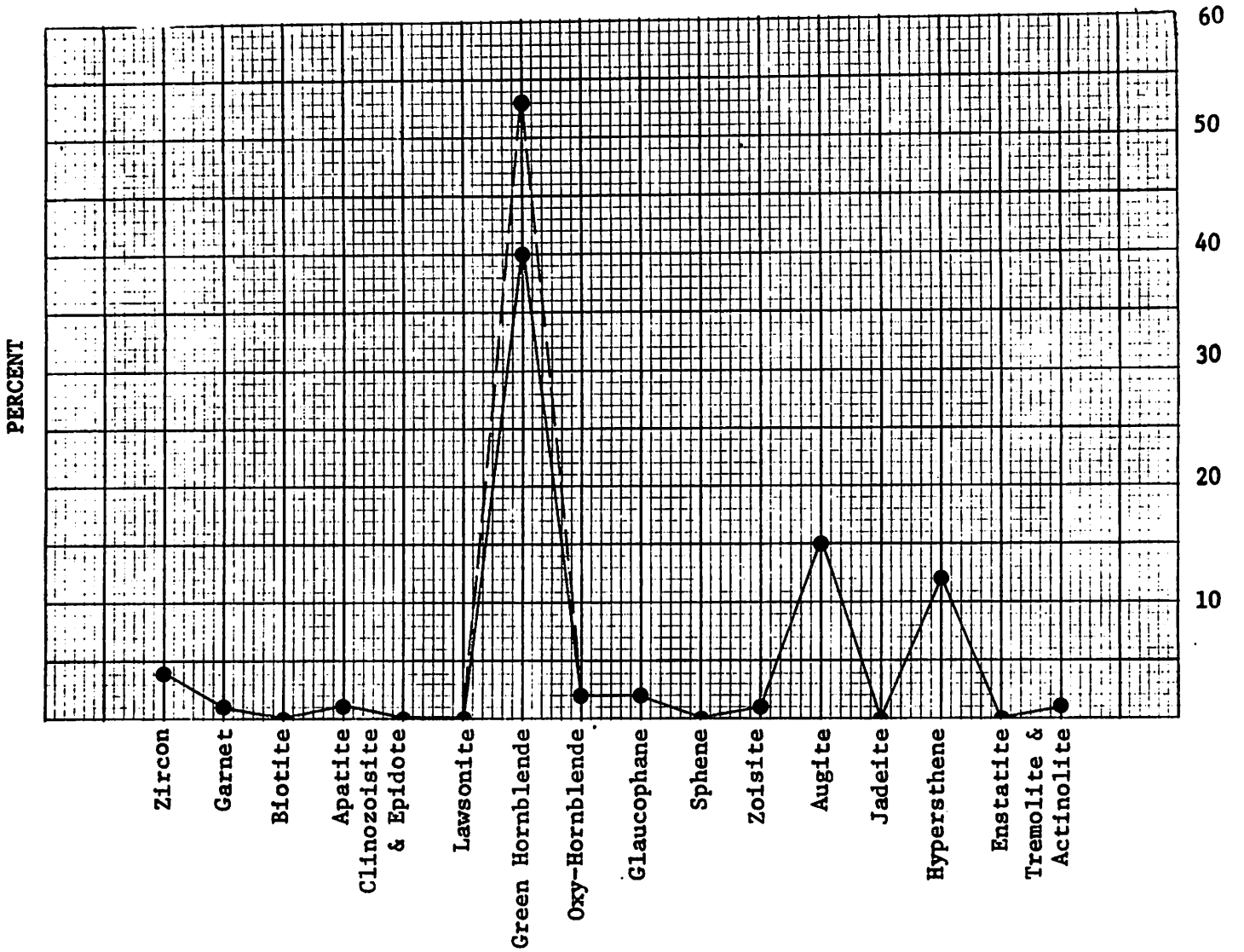
Wt. % of HM/SF 8.22

Total Grains Counted 158

% Transparent Grains 63.5

% Opaques 15.1

% Composite Gr. and Unknowns 21.4



Other Transparent Minerals

Mineral	No. Grains Counted
Rutile	3
Zoisite	1
Composites - Alterites	30
Unknowns	4
Pumpellyite	1

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	22
Hematite	1
Leucoxene	1

Analyst J. Lee

SAMPLE 2135

Location 37°25.9' 122°298'

Depth 36.7 meters 20.0 fathoms

Size Fraction (SF) .124 - .175 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 11.84

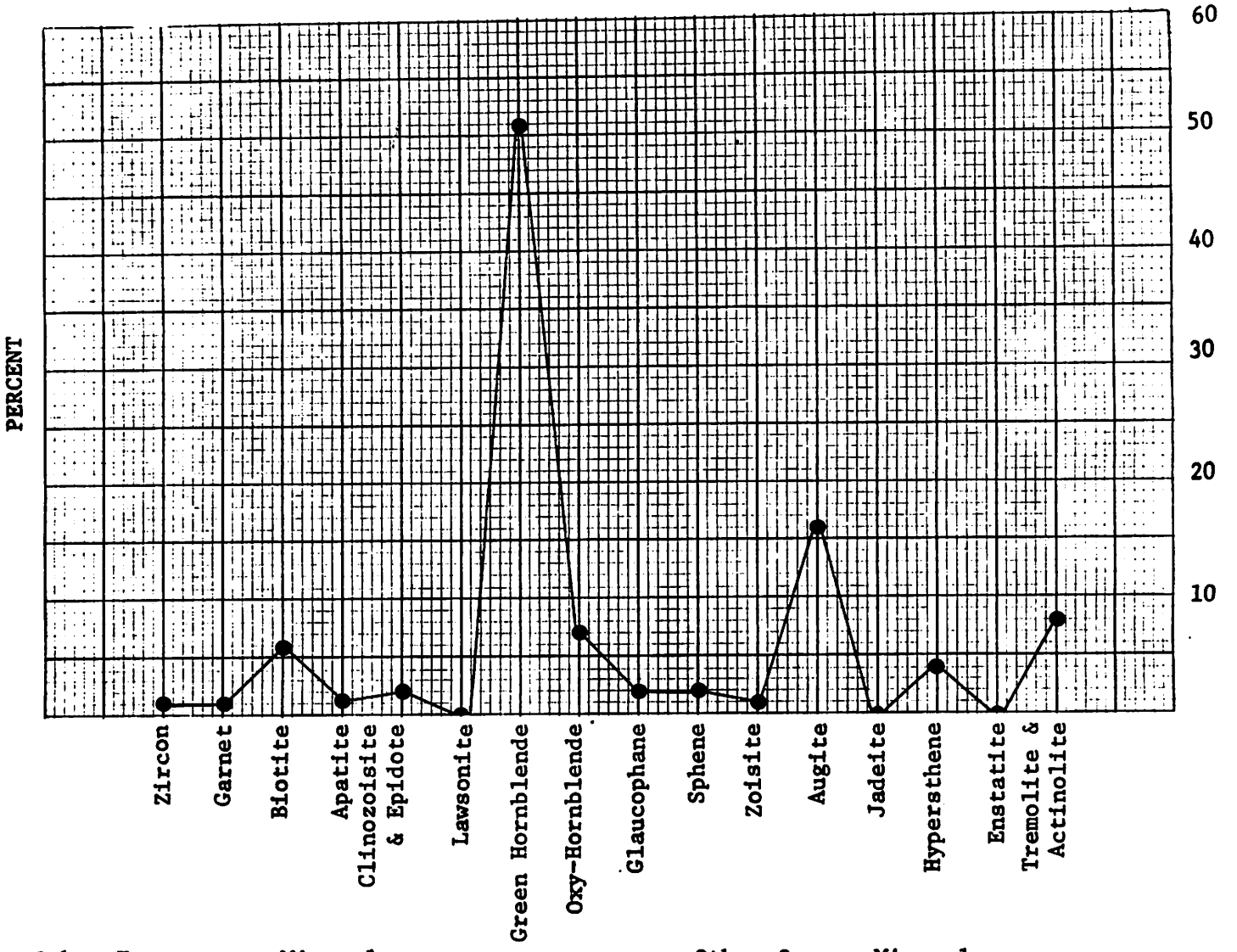
Wt. % of HM/SF 4.36

Total Grains Counted 158

% Transparent Grains 63.29

% Opaques 10.13

% Composite Gr. and Unknowns 24.68



Other Transparent Minerals

Mineral	No. Grains Counted
Carbonate	1
Composites - Alterites	36

Other Opaque Minerals

Mineral	No. Grains Counted
Hematite	6
Magnetite	10

Analyst J. Lee

SAMPLE 2136

Location 37°25.3 122°29.8'

Depth 45.7 meters 25.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 85.94

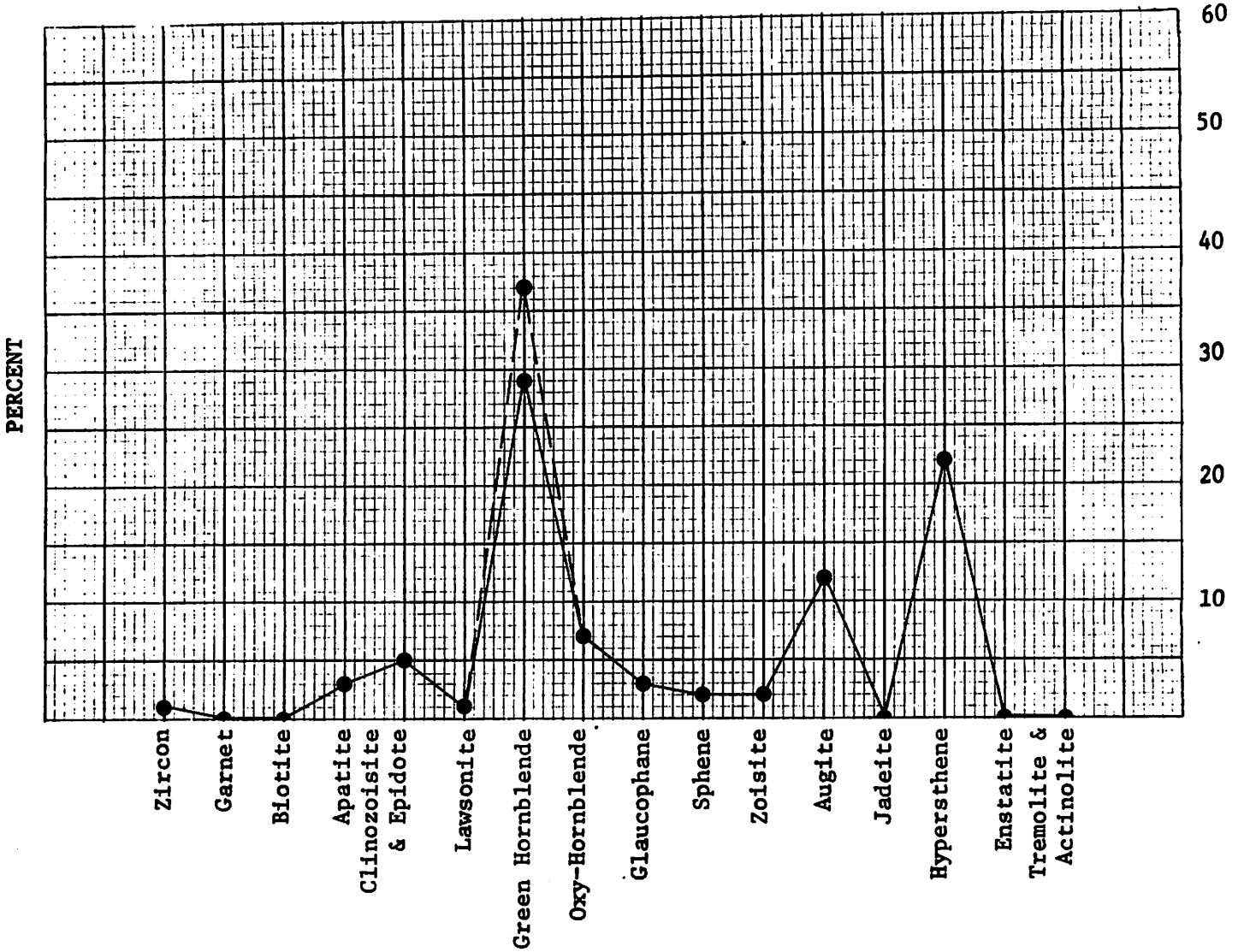
Wt. % of HM/SF 4.14

Total Grains Counted 161

% Transparent Grains 60.85

% Opaques 16.15

% Composite Gr. and Unknowns 23.0



Other Transparent Minerals

Mineral	No. Grains Counted
Rutile	1
Lawsonite	1
Picotite	2
Zoisite	2
Diopside	1
Composites - Alterites	35
Unknowns	2

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	21
Hematite	2
Leucoxene	1

Analyst J. Lee

SAMPLE 2137

Location 37°24.6' 122°32.4'

Depth 54.9 meters 30.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 91.01

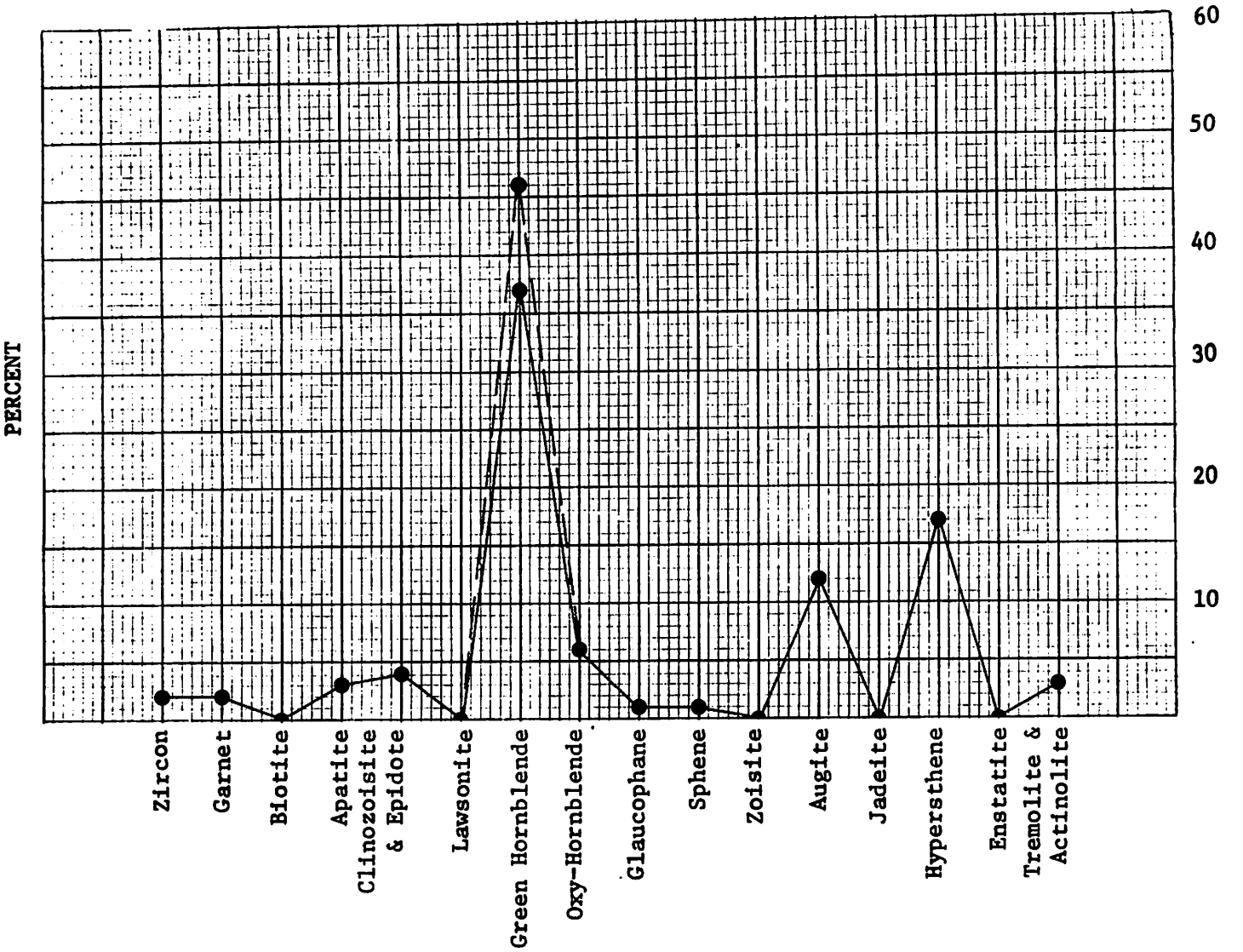
Wt. % of HM/SF 4.06

Total Grains Counted 164

% Transparent Grains 60.90

% Opaques 1.77

% Composite Gr. and Unknowns 21.4



Other Transparent Minerals

Mineral	No. Grains Counted
Picotite	1
Allanite	1
Composites - Alterites	31
Unknowns	4
Zoisite	1

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	22
Hematite	5
Leucoxene	1

Analyst J. Lee

SAMPLE 2138

Location 37°23.5' 122°34.7'

Depth 60.4 meters 33 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 88.43

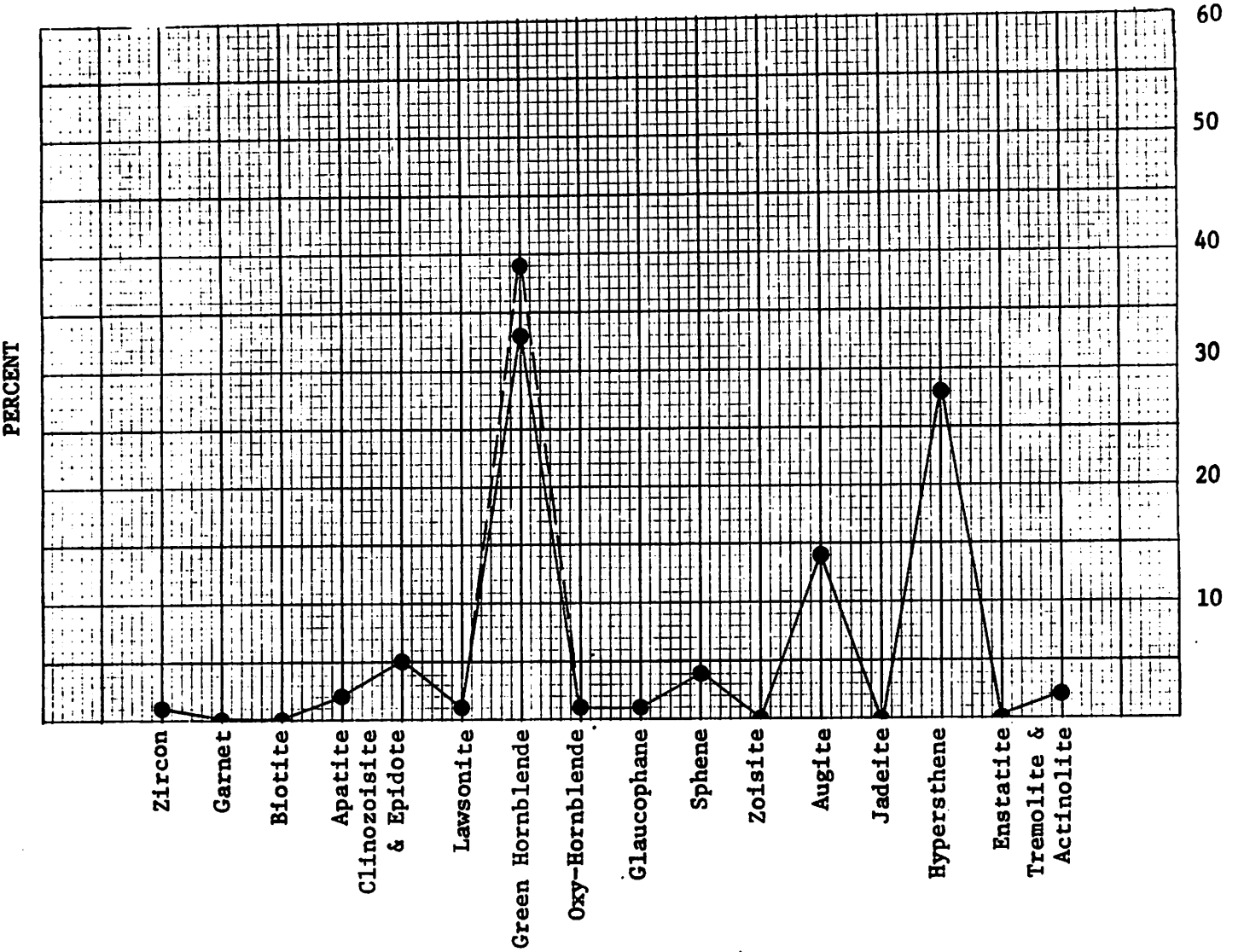
Wt. % of HM/SF 11.04

Total Grains Counted 158

% Transparent Grains 64.0

% Opaques 15.8

% Composite Gr. and Unknowns 20.2



Other Transparent Minerals

Mineral	No. Grains Counted
Picotite	1
Lawsonite	1
Composites - Alterites	31
Unknowns	1
Pumpellyite	1

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	24
Leucoxene	1

Analyst J. Lee

SAMPLE 2139

Location 37°22.5' 122°36.9'

Depth 73.2 meters 40.0 fathoms

Size Fraction (SF) .124 - .175 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 87.88

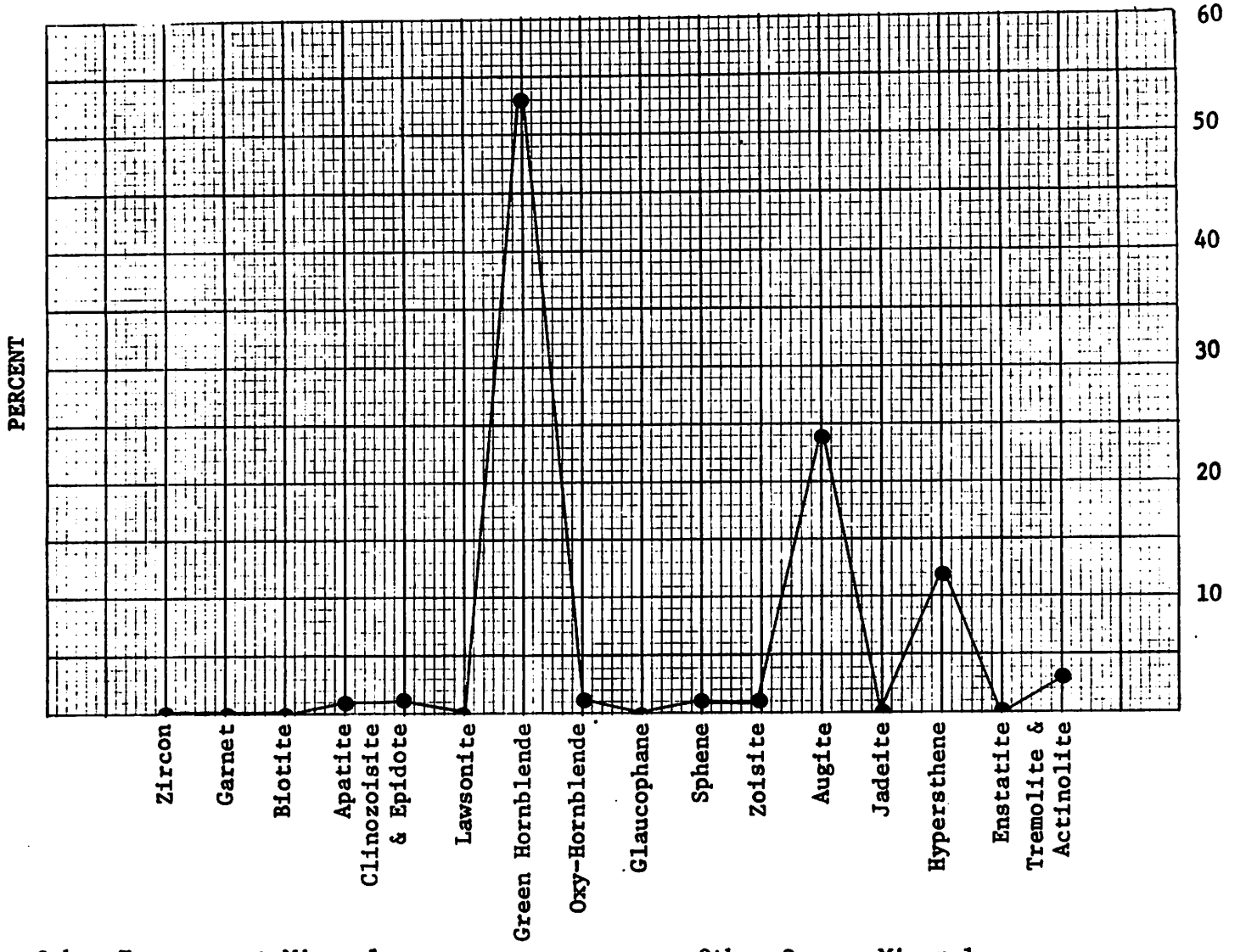
Wt. % of HM/SF 5.39

Total Grains Counted 133

% Transparent Grains 75.19

% Opaques 6.01

% Composite Gr. and Unknowns 18.80



Other Transparent Minerals

Mineral	No. Grains Counted
Allanite	2
Pumpellyite	1
Composites - Alterites	22

Other Opaque Minerals

Mineral	No Grains Counted
Hematite	2
Leucoxene	1
Magnetite	5

Analyst J. Lee

SAMPLE 2140

Location 37°23.9' 122°37.7'

Depth 40.0 meters 73.2 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 76.35

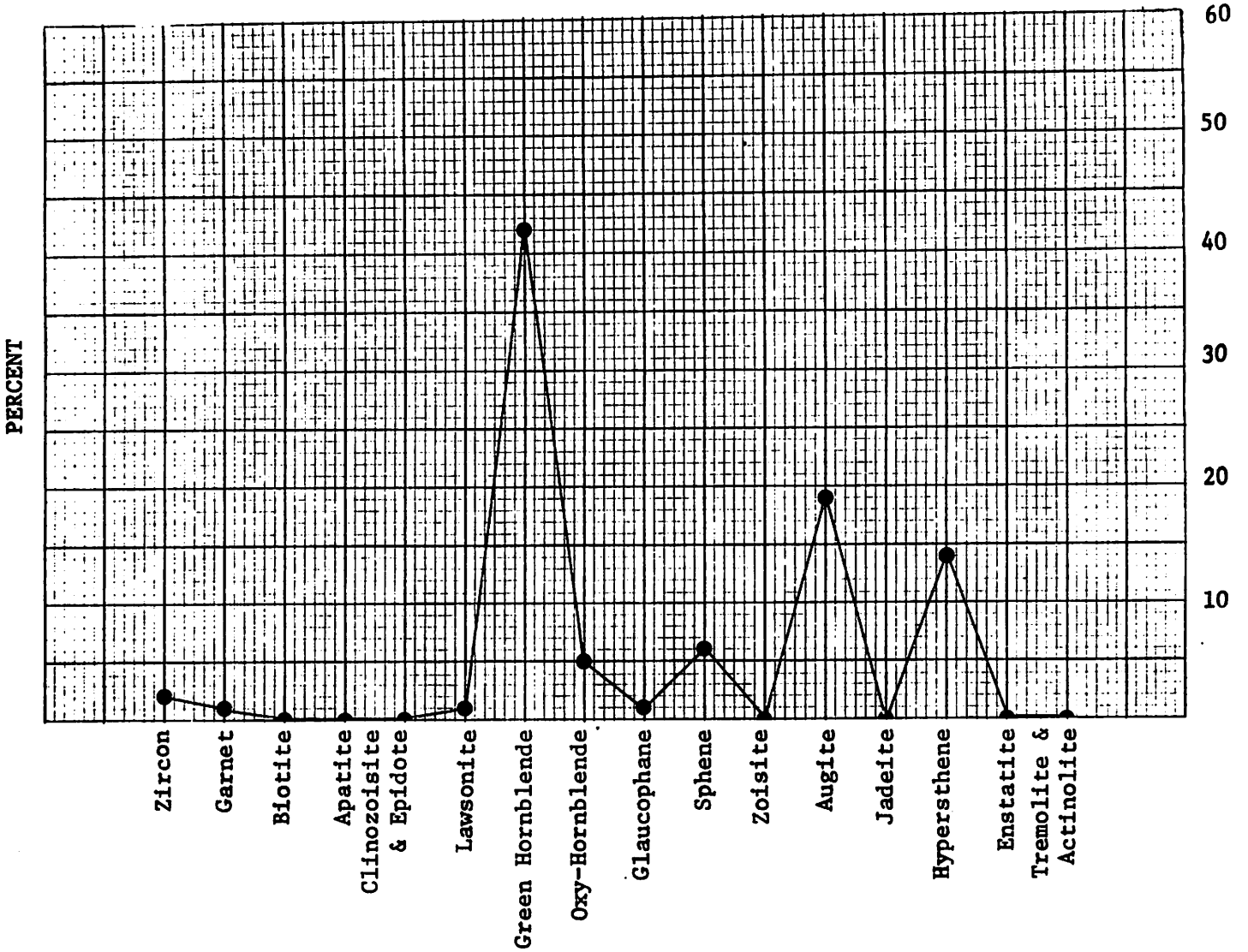
Wt. % of HM/SF 3.71

Total Grains Counted 171

% Transparent Grains 57.35

% Opaques 6.45

% Composite Gr. and Unknowns 36.2



Other Transparent Minerals

Mineral	No. Grains Counted
Composite Grains	59
Unknowns	3
Picotite	1

Other Opaque Minerals

Mineral	No Grains Counted
Hematite	2
Leucoxene	2
Pyrite	1
Magnetite	6

Analyst J. Lee

SAMPLE 2141

Location 37°24.9' 122°37.8'

Depth 73.2 meters 40.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 68.34

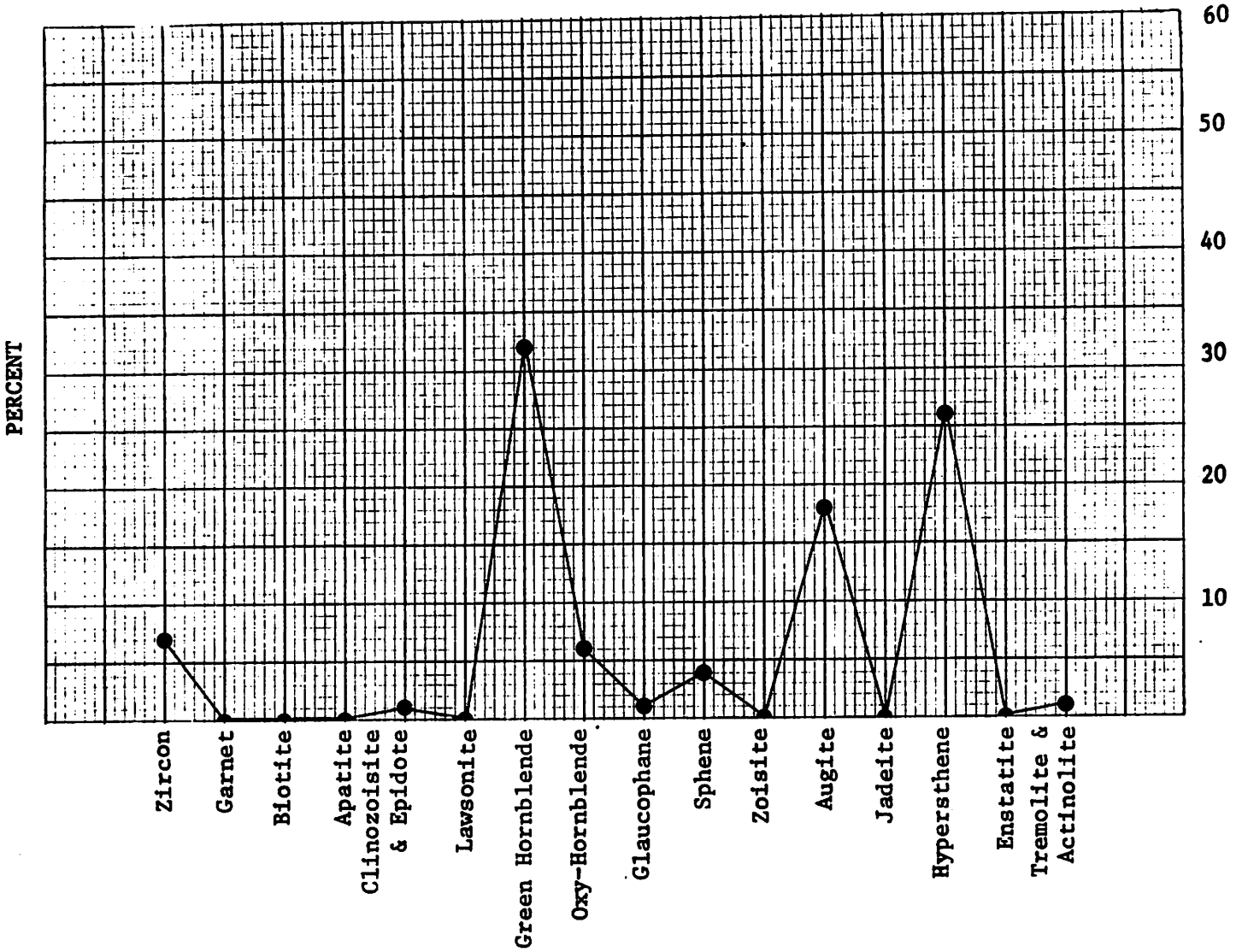
Wt. % of HM/SF 12.42%

Total Grains Counted 207

% Transparent Grains 48.3

% Opaques 26.1

% Composite Gr. and Unknowns 25.6



Other Transparent Minerals

Mineral	No. Grains Counted
Composite grains	50
Unknowns	3
Picotite	1
Monazite	1

Other Opaque Minerals

Mineral	No. Grains Counted
Hematite	5
Magnetite	48
Pyrite	1

Analyst J. Lee

SAMPLE 2142

Location 37°25.8' 122°35.7'

Depth 34.0 meters 62.2 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 70.26

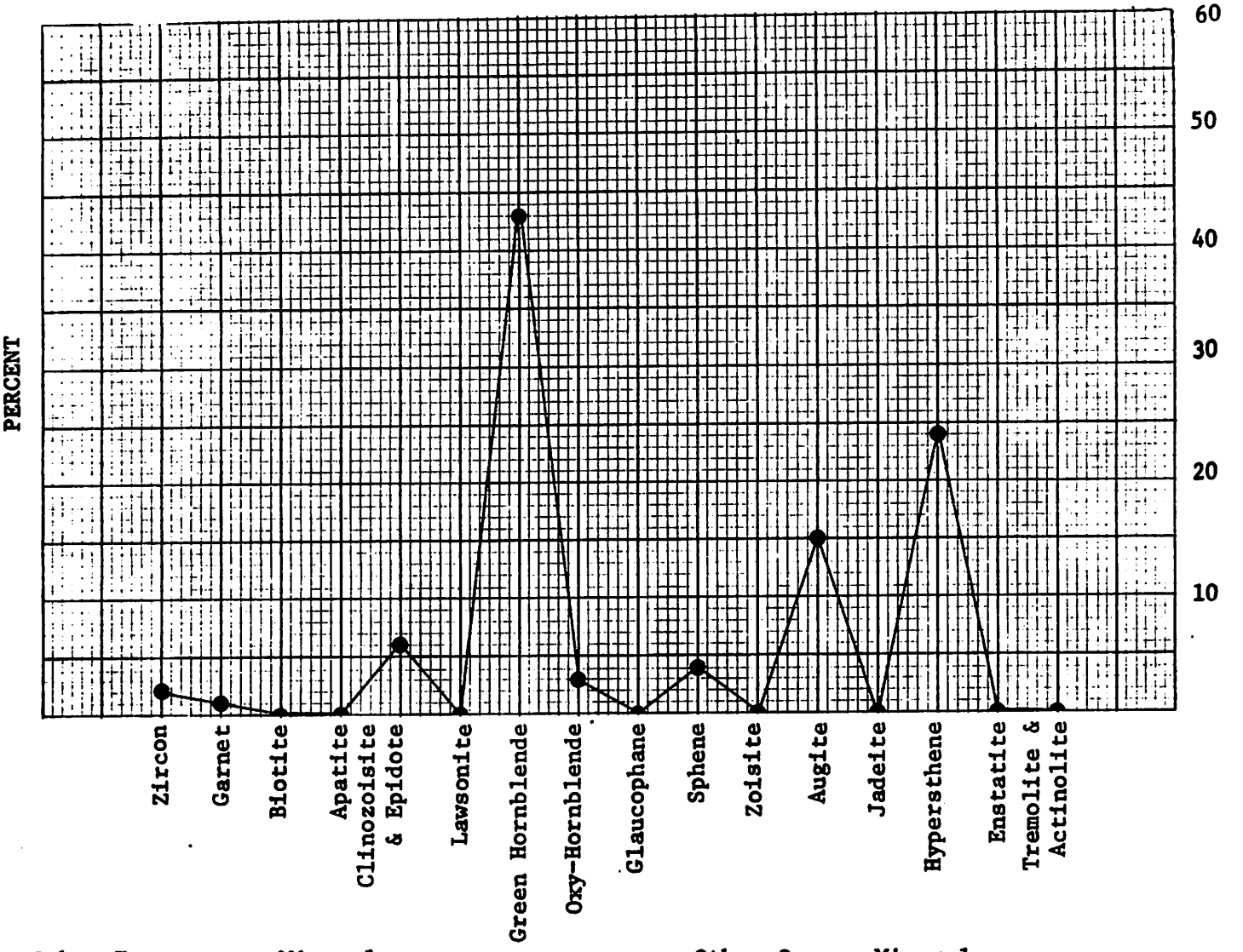
Wt. % of HM/SF 10.26%

Total Grains Counted 172

% Transparent Grains 58.2

% Opaques 19.1

% Composite Gr. and Unknowns 22.7



Other Transparent Minerals

Mineral	No. Grains Counted
Composite Grains	38
Unknowns	1

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	32
Leucoxene	1

Analyst J. Lee

SAMPLE 2143

Location 37°26.7' 122°33.6'

Depth 54.9 meters 30.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 65.91

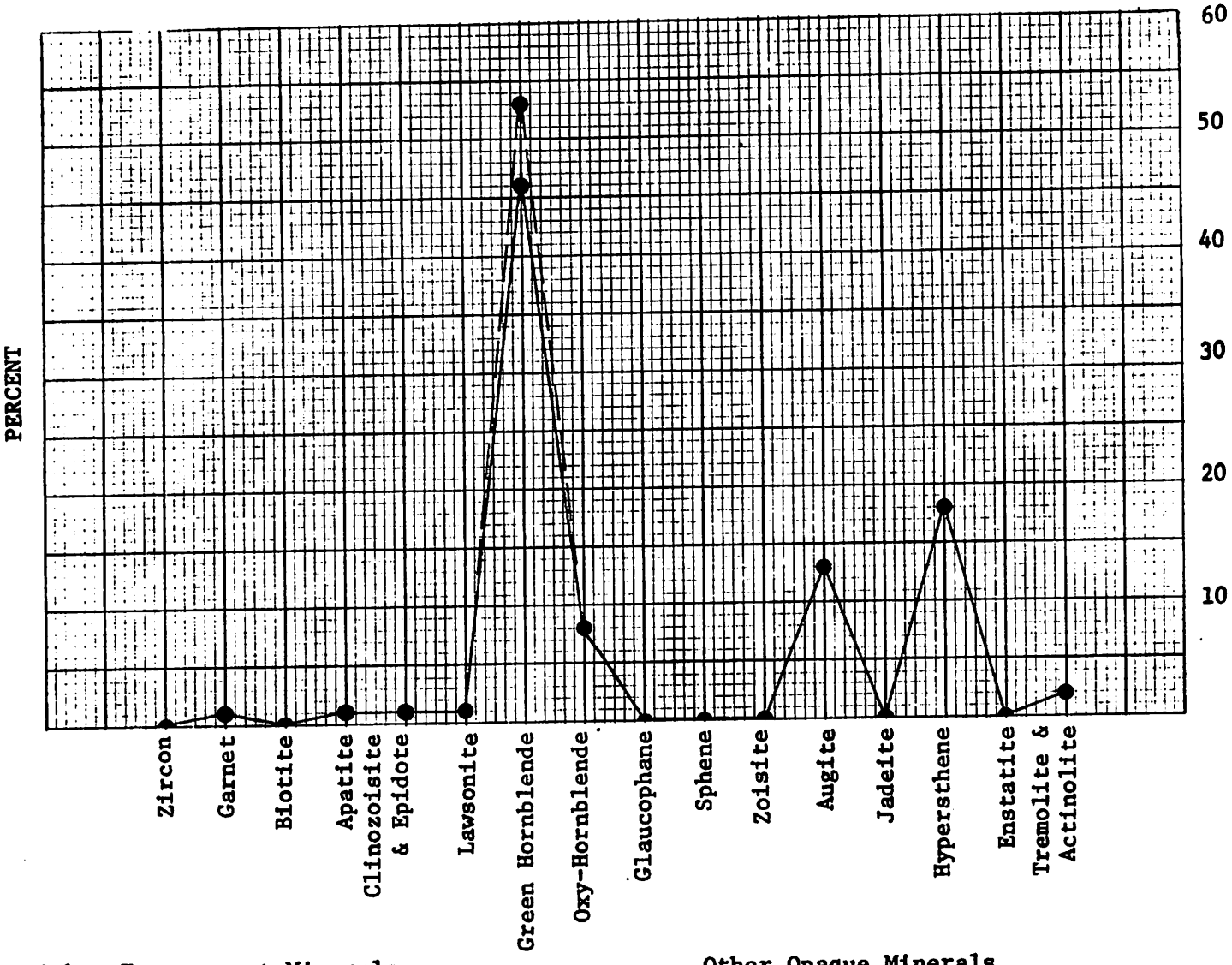
Wt. % of HM/SF 3.54

Total Grains Counted 148

% Transparent Grains 67.5

% Opaques 8.8

% Composite Gr. and Unknowns 23.7



Other Transparent Minerals

Mineral	No. Grains Counted
Andalusite	1
Lawsonite	1
Composites - Alterites	31
Unknowns	4

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	11
Hematite	2

Analyst J. Lee

SAMPLE 2144

Location 37°27.3' 122°32.4'

Depth 45.7 meters 29.0 fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 34.14

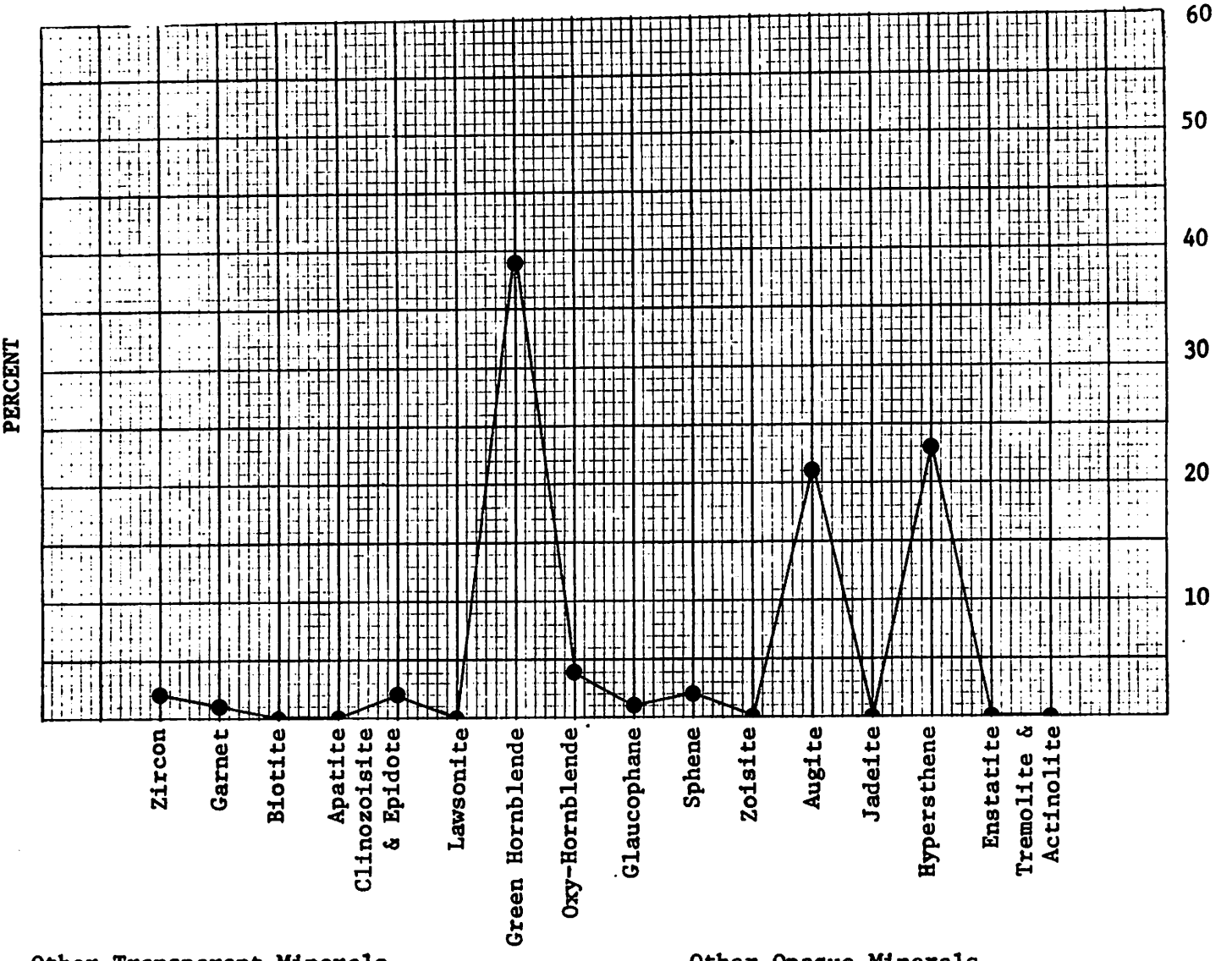
Wt. % of HM/SF 4.9%

Total Grains Counted 154

% Transparent Grains 65.6

% Opaques 12.3

% Composite Gr. and Unknowns 22.1



Other Transparent Minerals

Mineral	No. Grains Counted
Composite Grains	32
Unknowns	3
Aegirine-Augite	1

Other Opaque Minerals

Mineral	No Grains Counted
Hematite	1
Magnetite	18

Analyst J. Lee

SAMPLE 2196

Location 37°13.5' 122°24.4'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 68.53

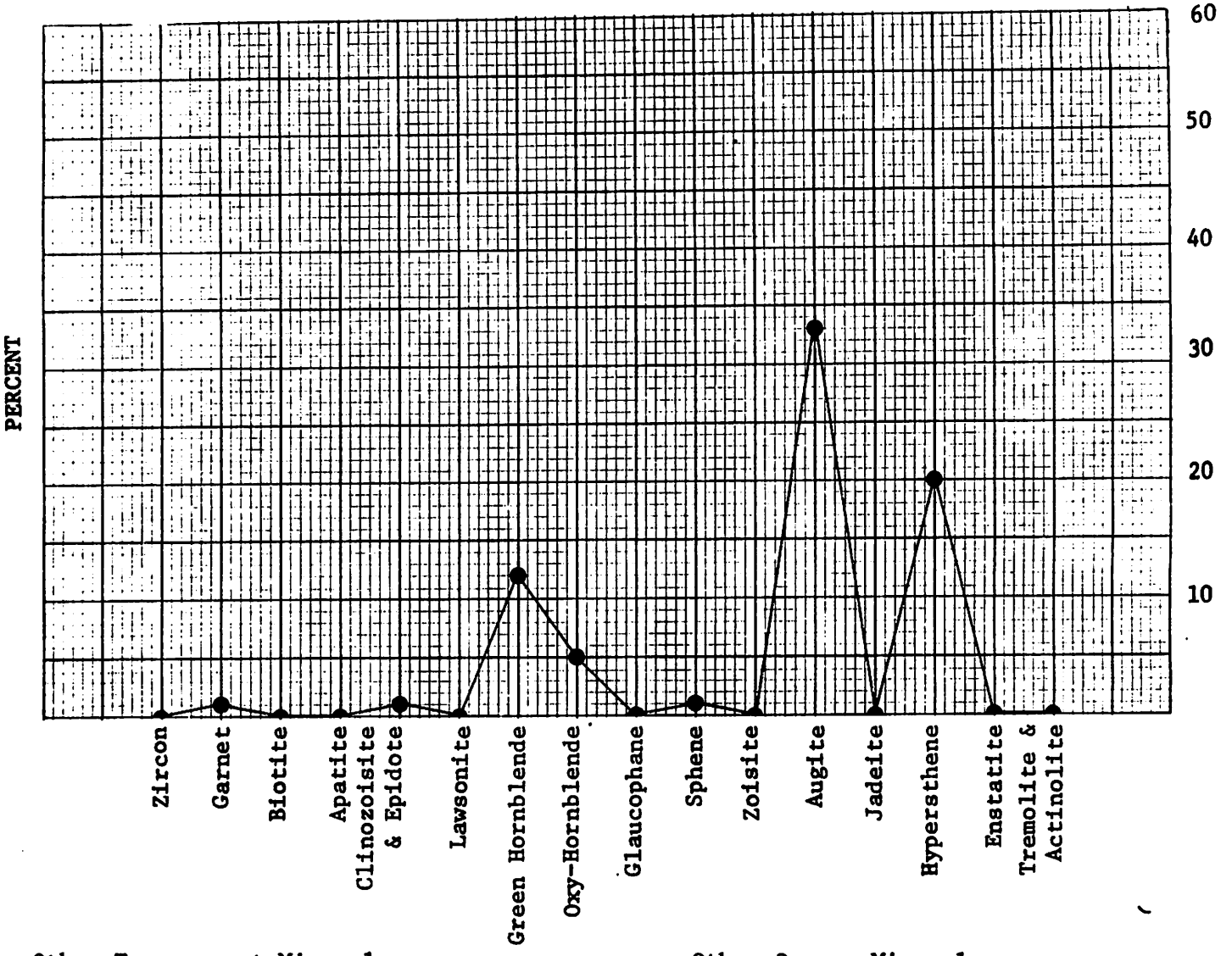
Wt. % of HM/SF 1.32

Total Grains Counted 216

% Transparent Grains 46.2

% Opaques 10.3

% Composite Gr. and Unknowns 43.0



Other Transparent Minerals

Mineral	No. Grains Counted
Rutile	1
Allanite	1
Composite Grains	85

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite	15
Hematite	9

Analyst T. Yancey J. Lee

SAMPLE 2197

Location 37°15.0' 122°23.7'

Depth Stream meters _____ fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample not sized

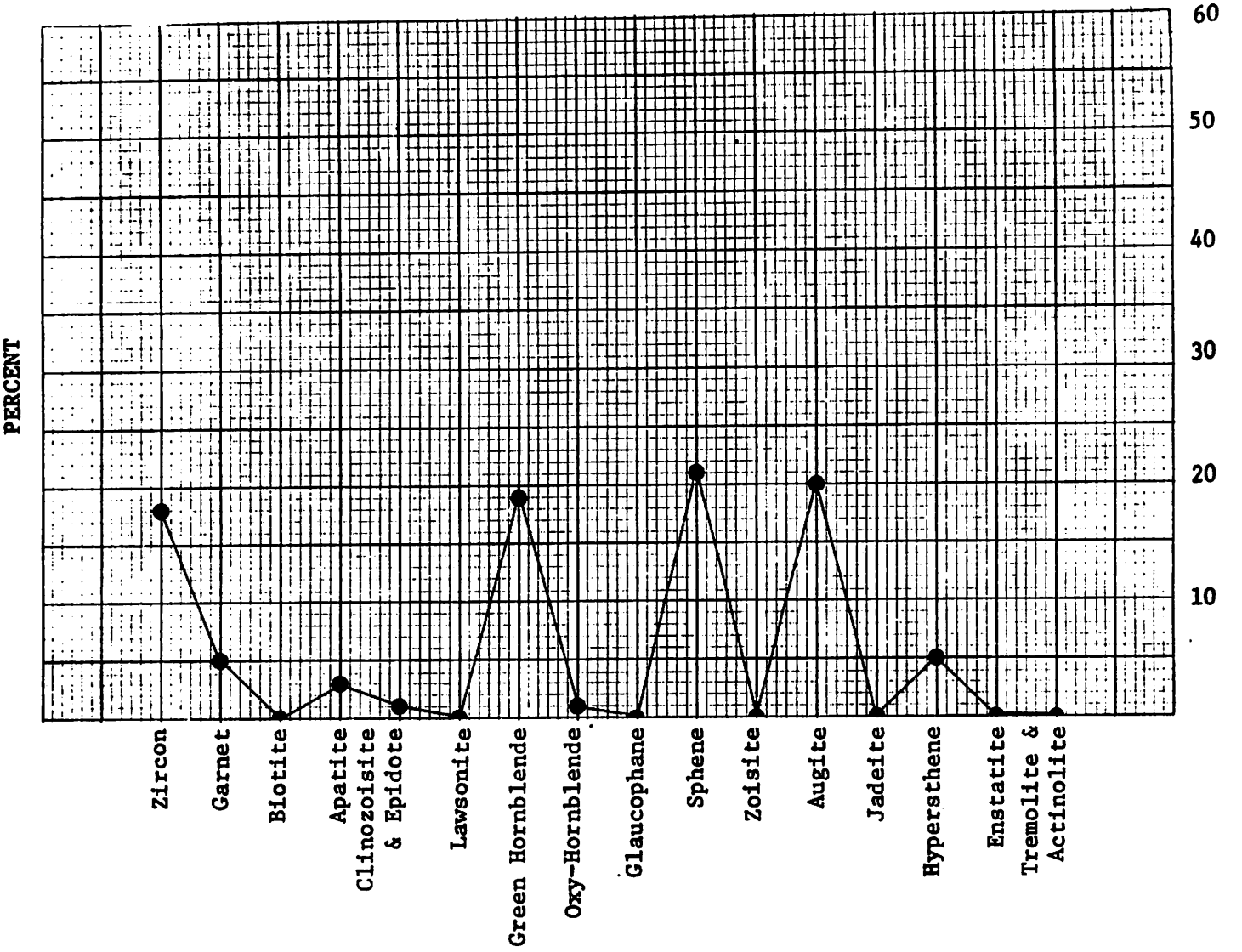
Wt. % of HM/SF 0.90

Total Grains Counted 234

% Transparent Grains 68.9

% Opaques 28.6

% Composite Gr. and Unknowns 1.29



Other Transparent Minerals

Mineral	No. Grains Counted
Rutile	4
Alterites	63
Unknowns	3
Picotite	3

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	30
Hematite	18
Pyrite	3
Leucoxene	16

Analyst T. Yancey

SAMPLE 2198

Location 37°15.6' 122°24.8'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 75.75

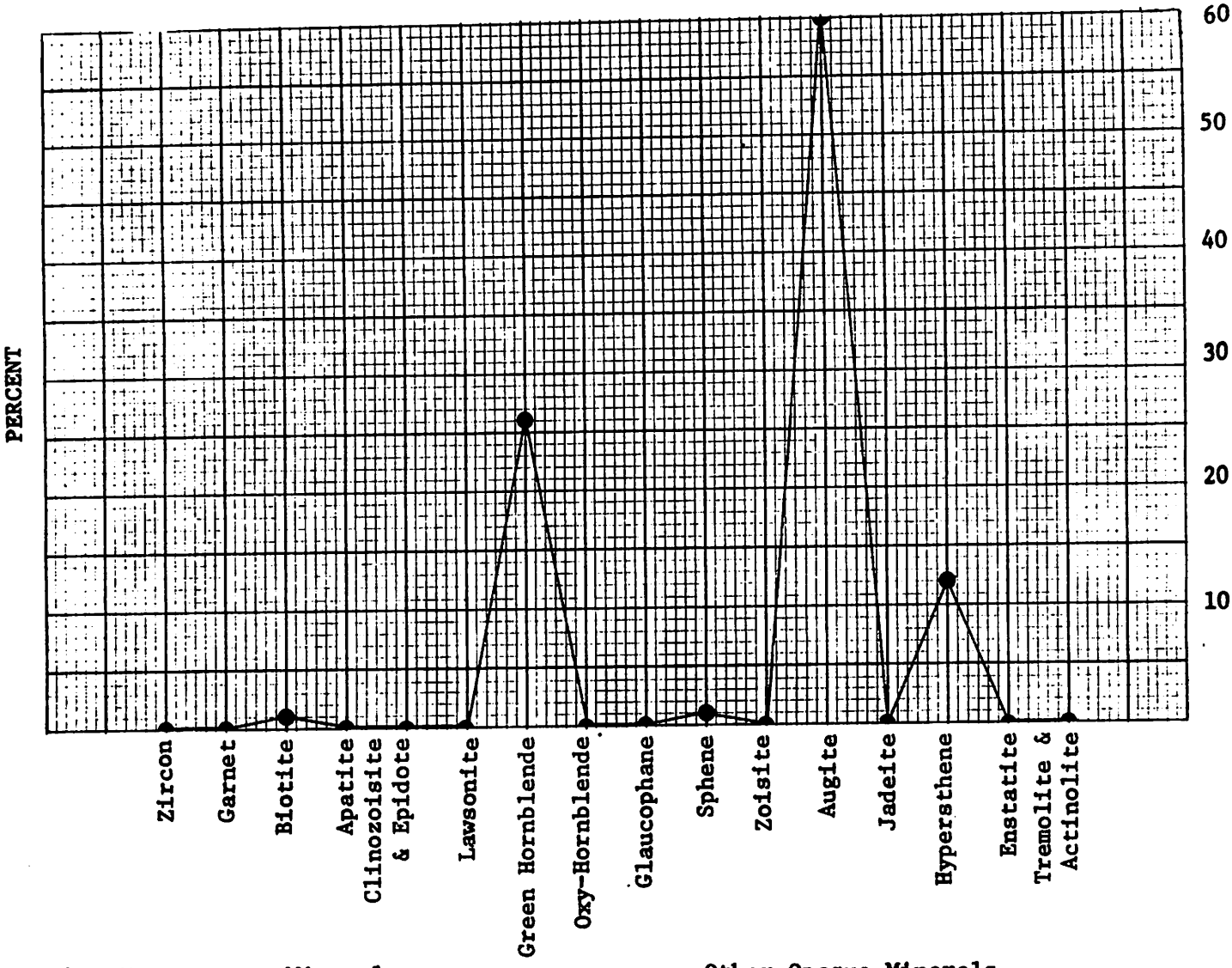
Wt. % of HM/SF 0.32

Total Grains Counted 110

% Transparent Grains 92.82

% Opaques 6.36

% Composite Gr. and Unknowns 0.82



Other Transparent Minerals

Mineral	No. Grains Counted
Rutile	1
Unknowns	2

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite	2
Hematite	5

Analyst T. Yancey

SAMPLE 2199

Location 37°17.9' 122°24.4'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 56.97

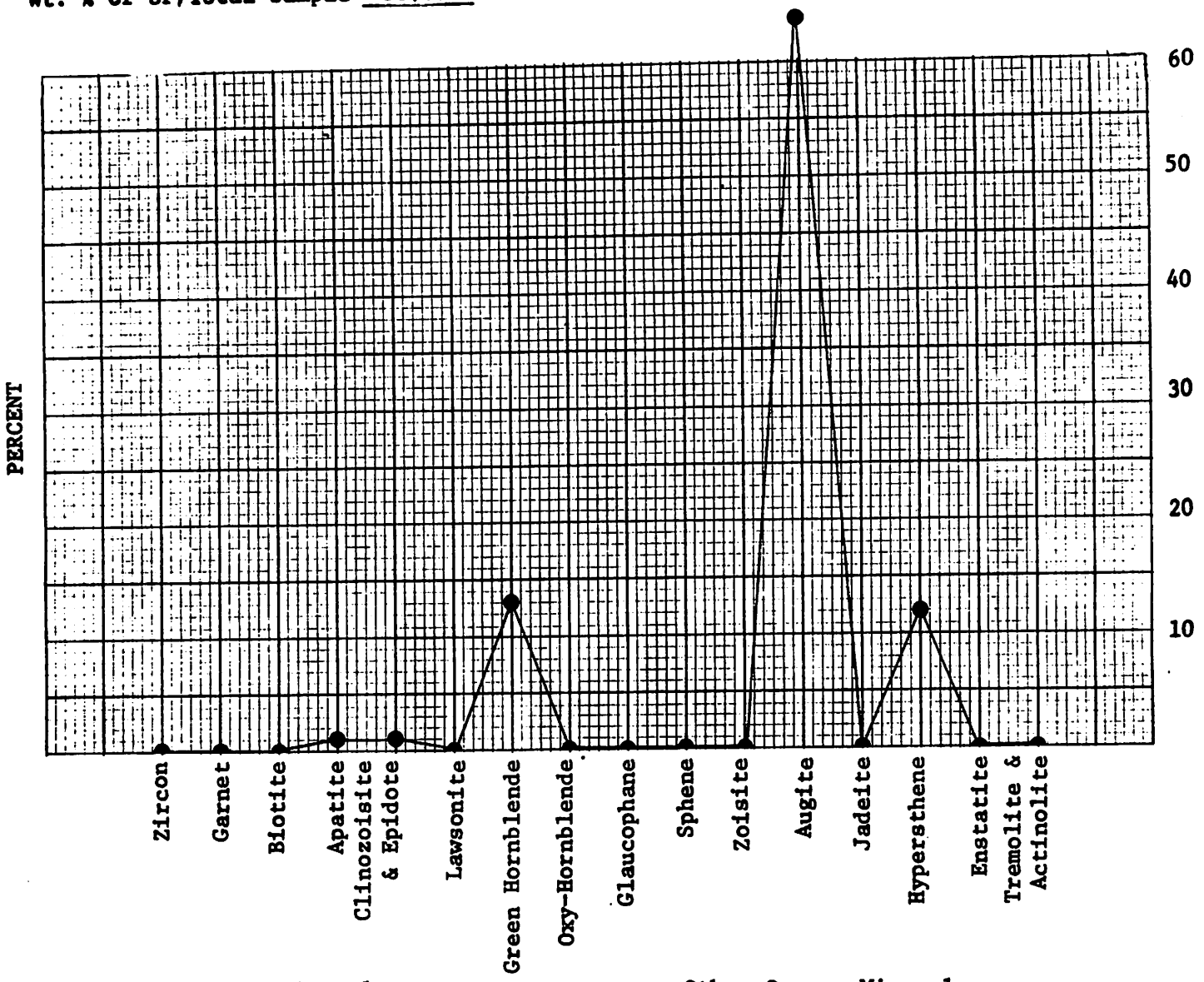
Wt. % of HM/SF 1.15

Total Grains Counted 193

% Transparent Grains 51.8

% Opaques 8.3

% Composite Gr. and Unknowns 39.9



Other Transparent Minerals

Mineral	No. Grains Counted
Alterites	77

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite	12
Hematite	4

Analyst T. Yancey

SAMPLE 2200

Location 37°19.3' 122°24.1'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 62.23

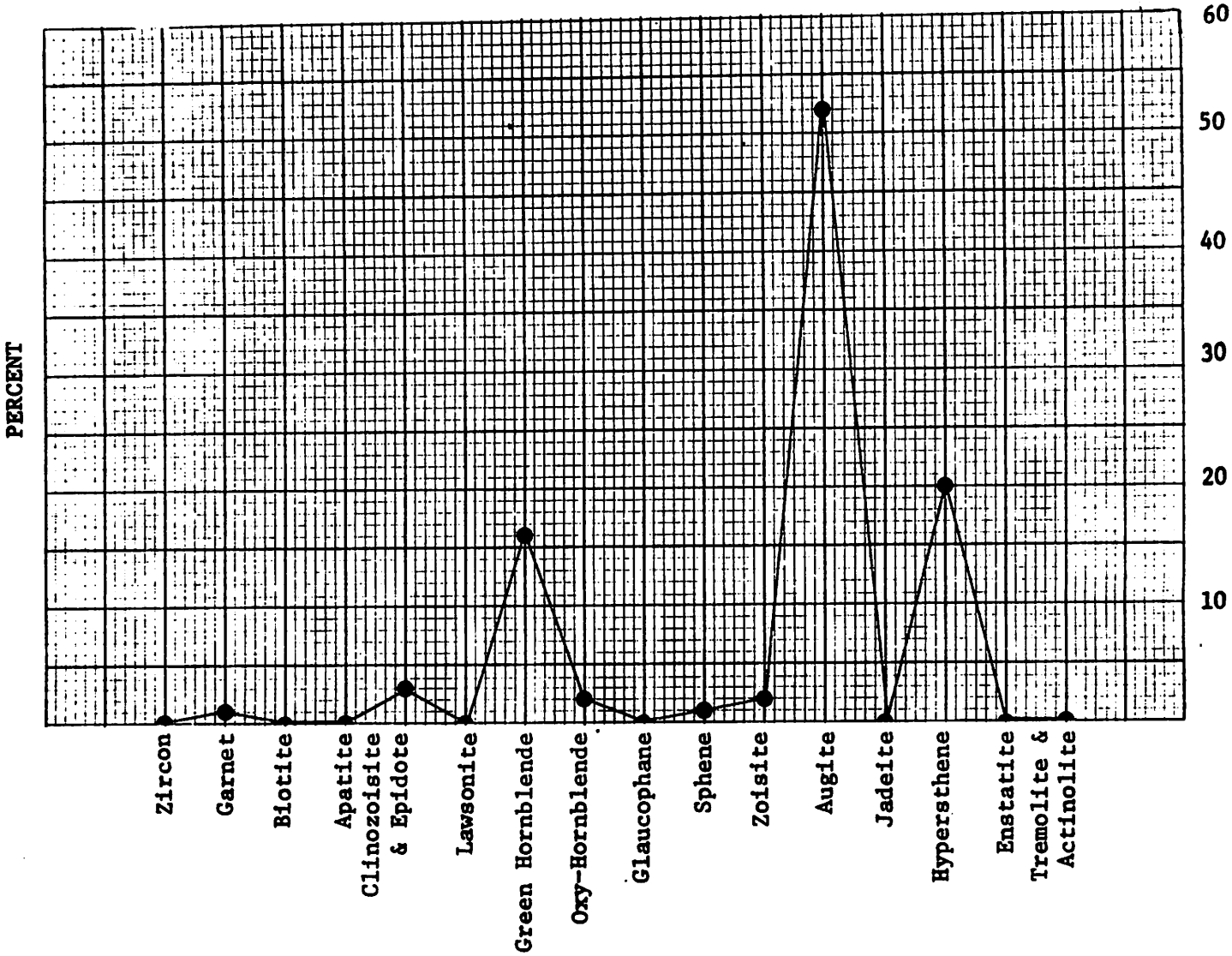
Wt. % of HM/SF 5.46

Total Grains Counted 172

% Transparent Grains 58.54

% Opaques 10.46

% Composite Gr. and Unknowns 31.0



Other Transparent Minerals

Mineral	No. Grains Counted
Alterites	53
Unknowns	1
Calcite	1
Tourmaline	1
Picotite	1
Allanite	1

Other Opaque Minerals

Mineral	No. Grains Counted
Ilmenite	12
Hematite	3
Leucoxene	3

Analyst T. Yancey J. Lee

SAMPLE 2201

Location 37°15.5' 122°23.1

Depth Stream meters _____ fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample not sized

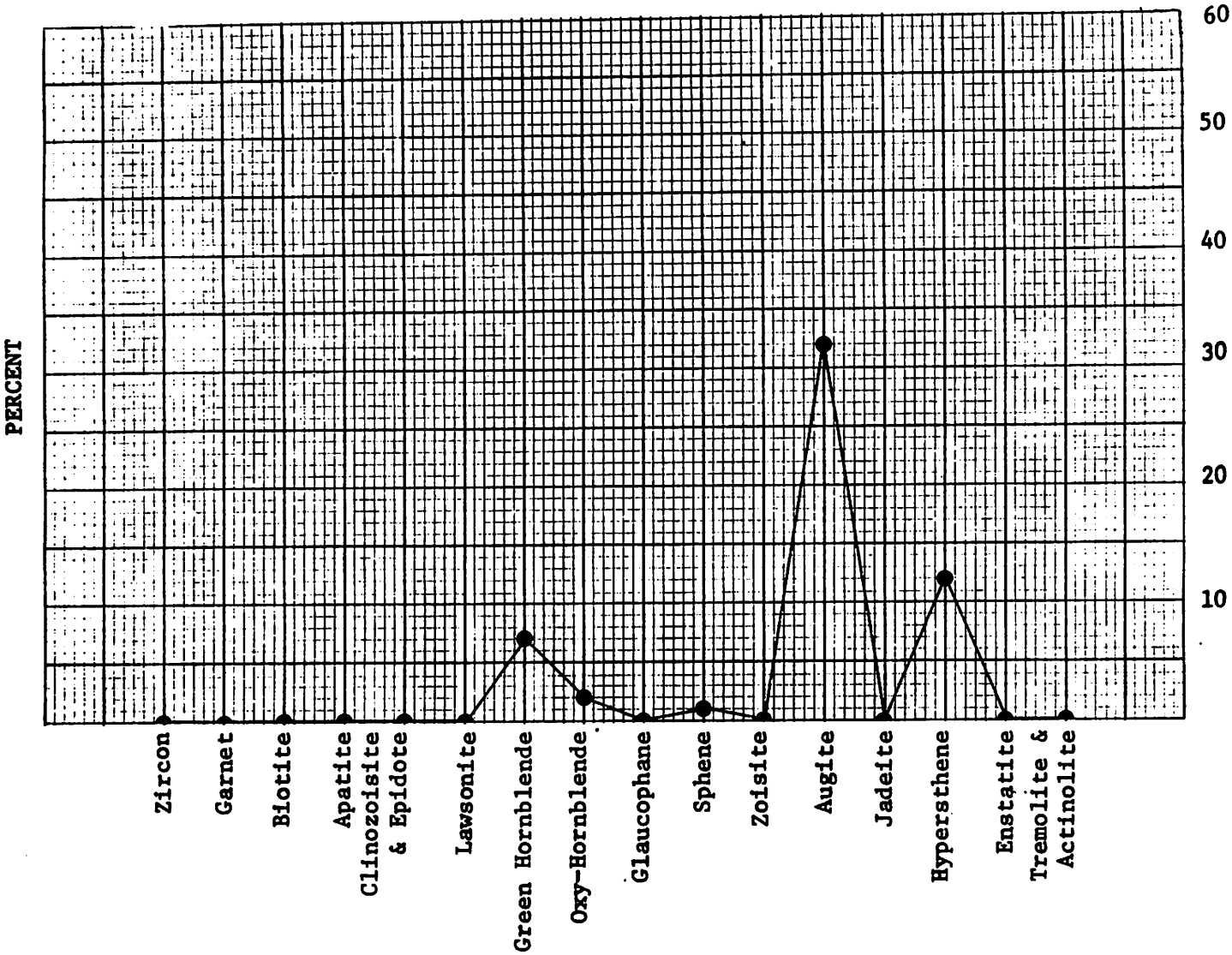
Wt. % of HM/SF 4.72

Total Grains Counted 157

% Transparent Grains 63.7

% Opaques 15.3

% Composite Gr. and Unknowns 21.0



Other Transparent Minerals

Mineral	No. Grains Counted
Alterites	32
Unknowns	1

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	19
Hematite	4
Pyrite	1

Analyst T. Yancey J. Lee

SAMPLE 2202

Location 37°21.4' 122°24.0'

Depth STREAM meters _____ fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample not sized

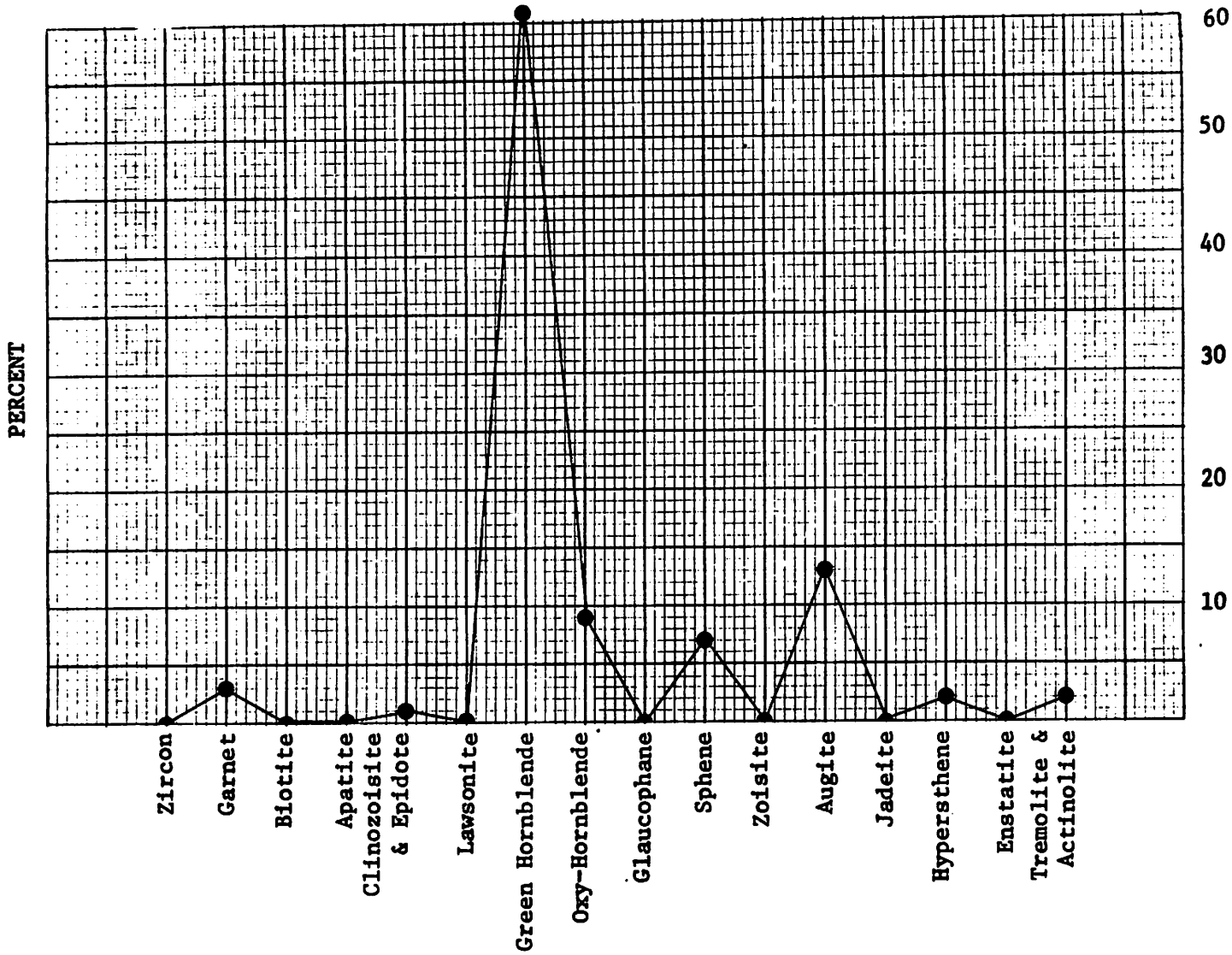
Wt. % of HM/SF 1.18

Total Grains Counted 159

% Transparent Grains 62.0

% Opaques 18.2

% Composite Gr. and Unknowns 18.8



Other Transparent Minerals

Mineral	No. Grains Counted
Alterites	29
Unknowns	1
Picotite	2

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite	27
Hematite	1
Leucoxene	1

Analyst T. Yancey

SAMPLE 2203

Location 37°21.4' 122°23.8'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 13.84

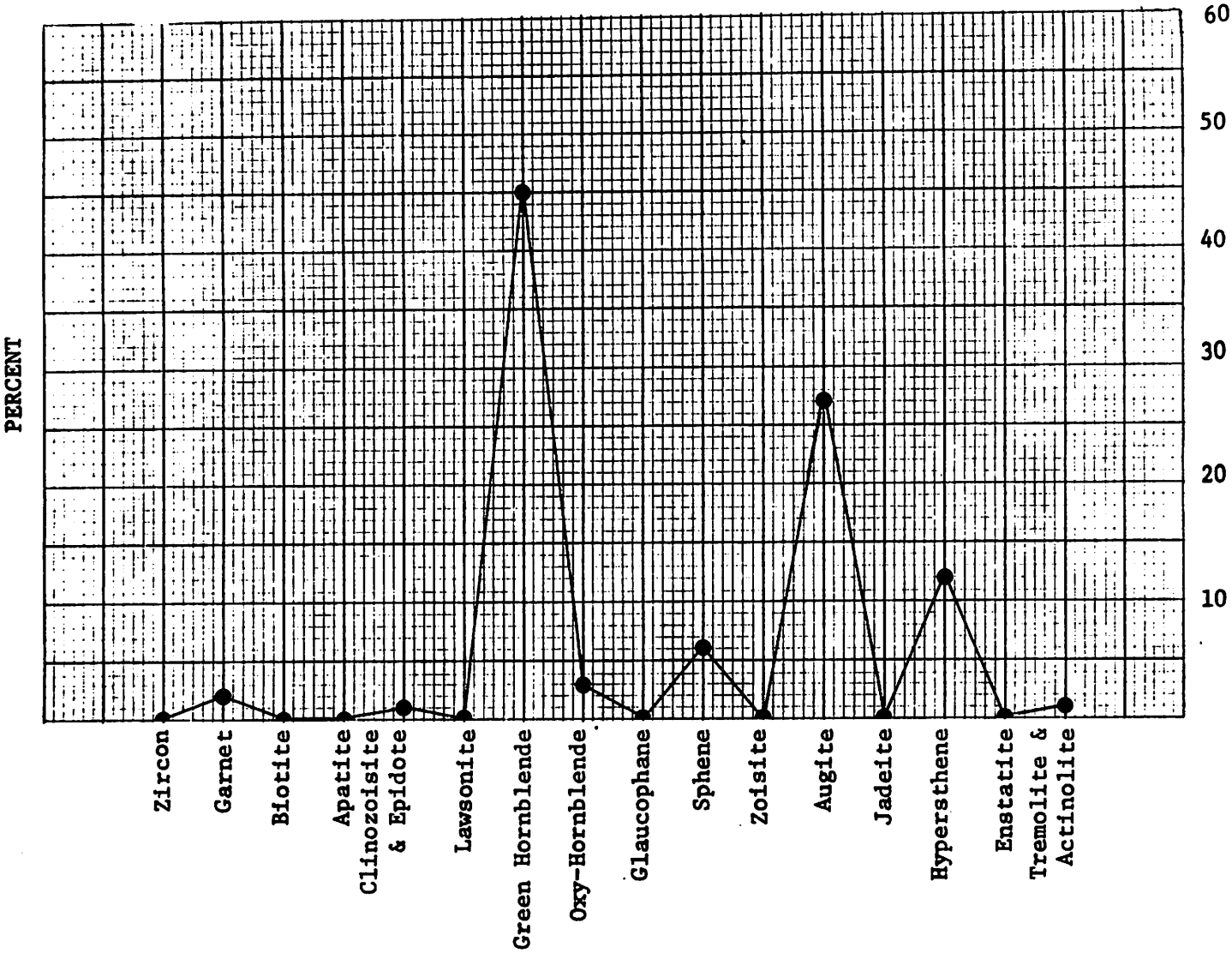
Wt. % of HM/SF 2.09

Total Grains Counted 146

% Transparent Grains 68.6

% Opaques 11.6

% Composite Gr. and Unknowns 19.8



Other Transparent Minerals

Mineral	No. Grains Counted
Alterites	28
Unknowns	1
Picotite	2
Carbonate	1

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	15
Hematite	2

Analyst T. Yancey

SAMPLE 2204

Location 37°22.5' 122°24.5'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 5.69

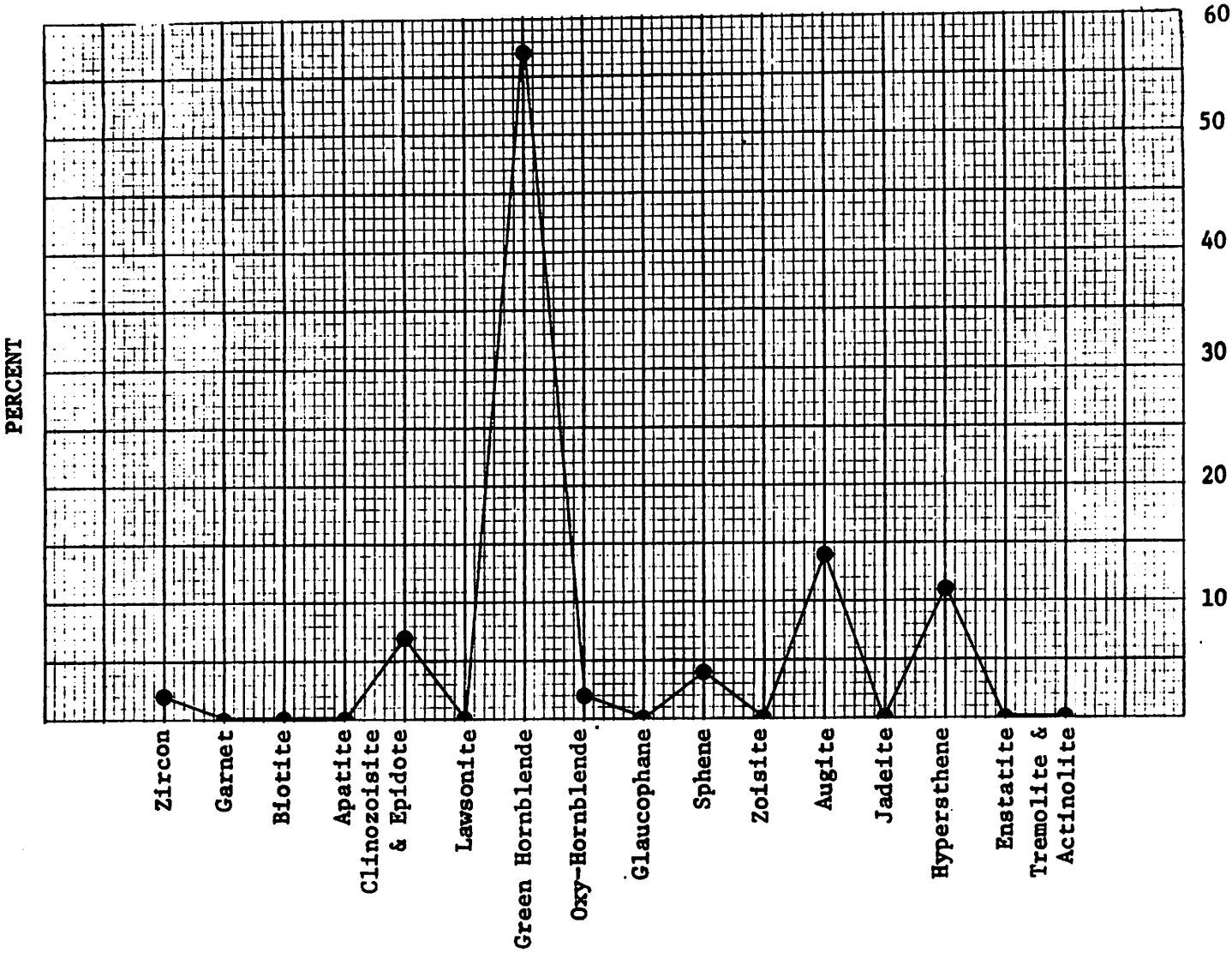
Wt. % of HM/SF 5.16

Total Grains Counted 161

% Transparent Grains 62.2

% Opaques 9.3

% Composite Gr. and Unknowns 28.0



Other Transparent Minerals

Mineral	No. Grains Counted
Picotite	1
Composite Grains	46

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	6
Hematite	7
Pyrite	1
Leucoxene	1

Analyst J. Lee T. Yancey

SAMPLE 2205

Location 37°25.1' 122°26.0'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 10.55

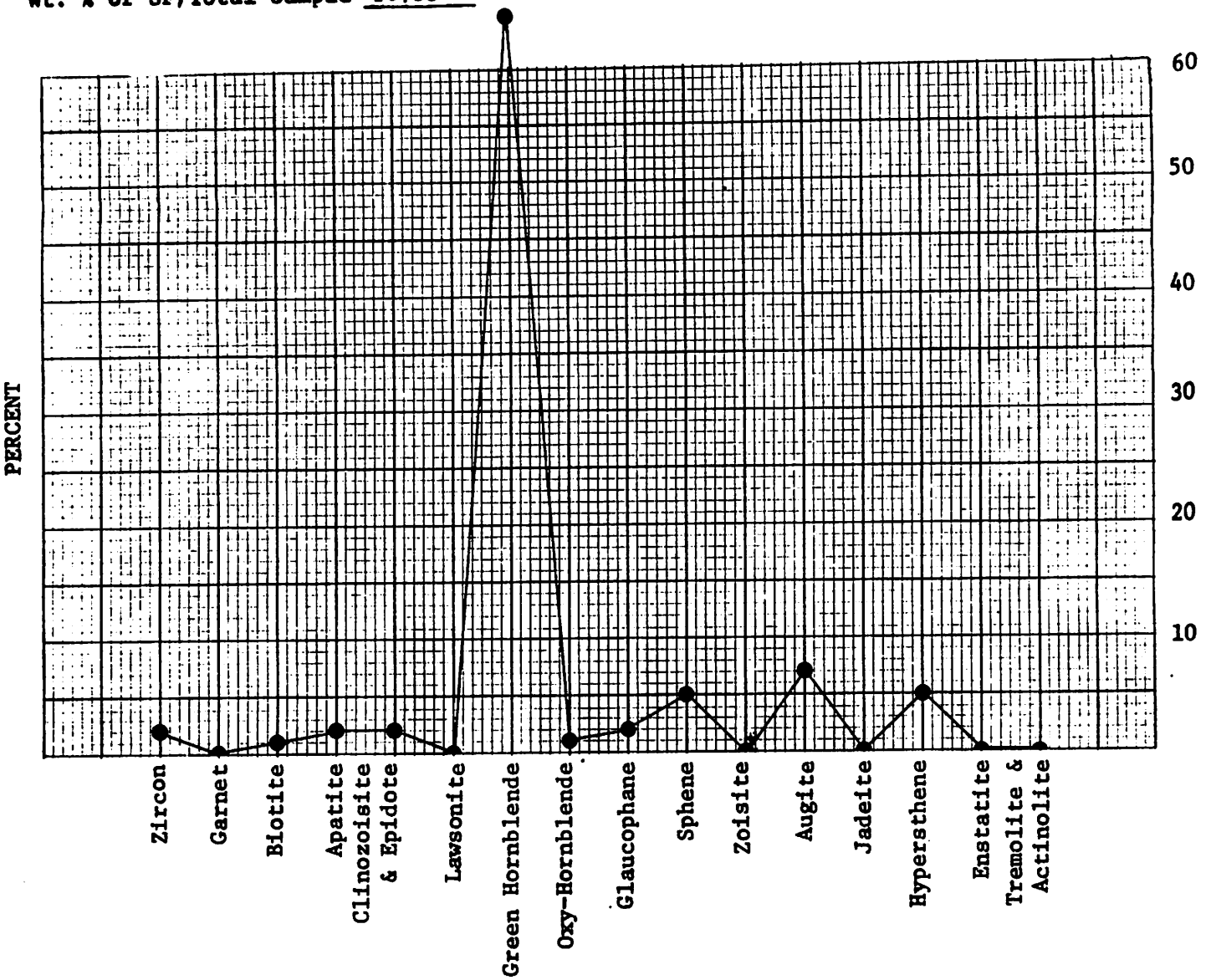
Wt. % of HM/SF 2.51

Total Grains Counted 148

% Transparent Grains 67.6

% Opaques 4.7

% Composite Gr. and Unknowns 27.0



Other Transparent Minerals

Mineral	No. Grains Counted
Unknowns	1
Allanite	1
Composite Grains	

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite	5
Hematite	1
Leucoxene	1

Analyst J. Lee T. Yancey

SAMPLE 2206

Location 37°24.2' 122°25.5'

Depth Intertidal meters fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 49.84

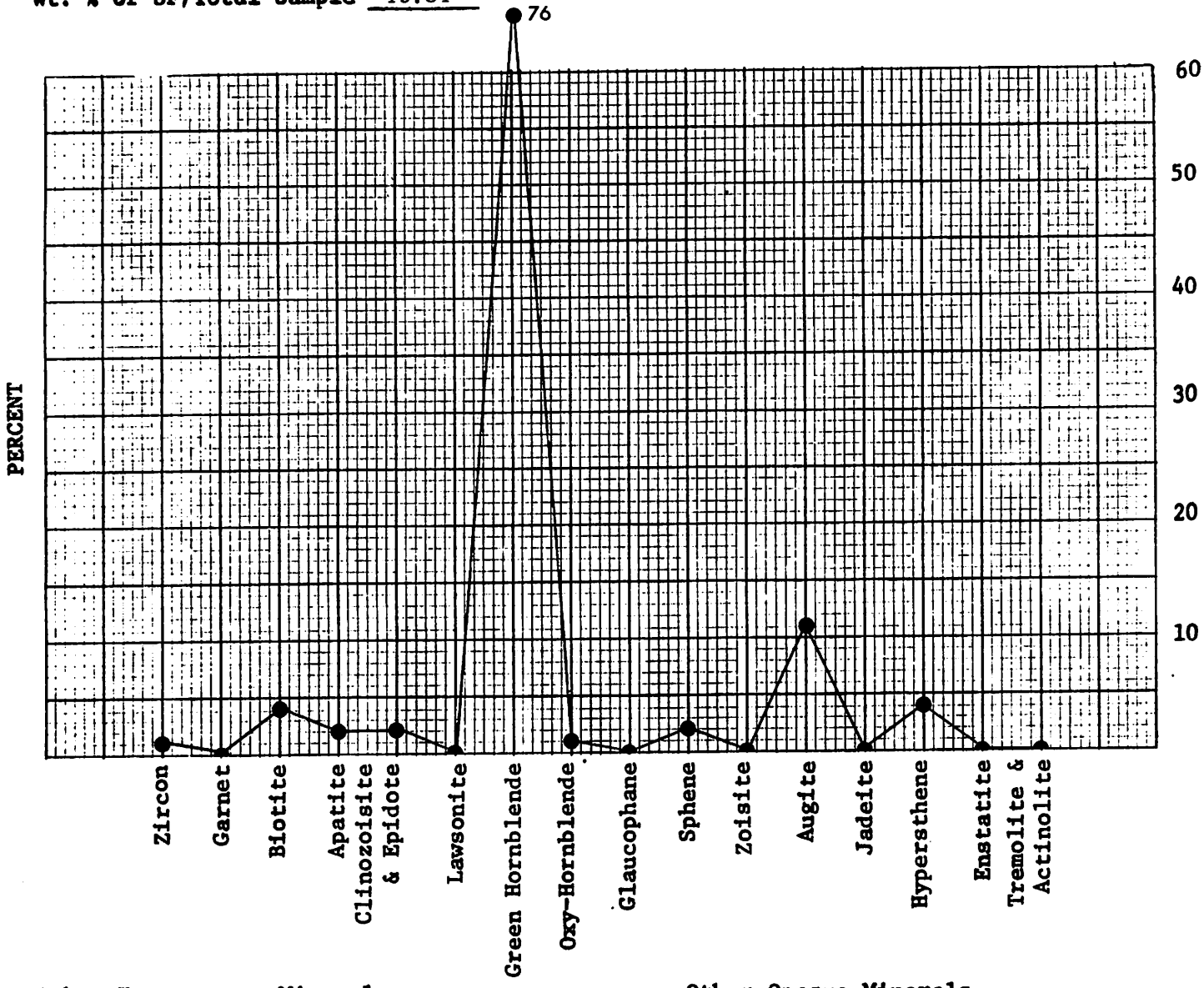
Wt. % of HM/SF 1.48

Total Grains Counted 155

% Transparent Grains 65.8

% Opaques 7.6

% Composite Gr. and Unknowns 26.6



Other Transparent Minerals

Mineral	No. Grains Counted
Picotite	2
Unknowns	2

Other Opaque Minerals

Mineral	No Grains Counted
Composite Grains	40
Magnetite	6
Hematite	10
Pyrite	1
Leucoxene	1

Analyst J. Lee T. Yancey

SAMPLE 2207

Location 37°24.1 122°24.7'

Depth Stream meters _____ fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample _____

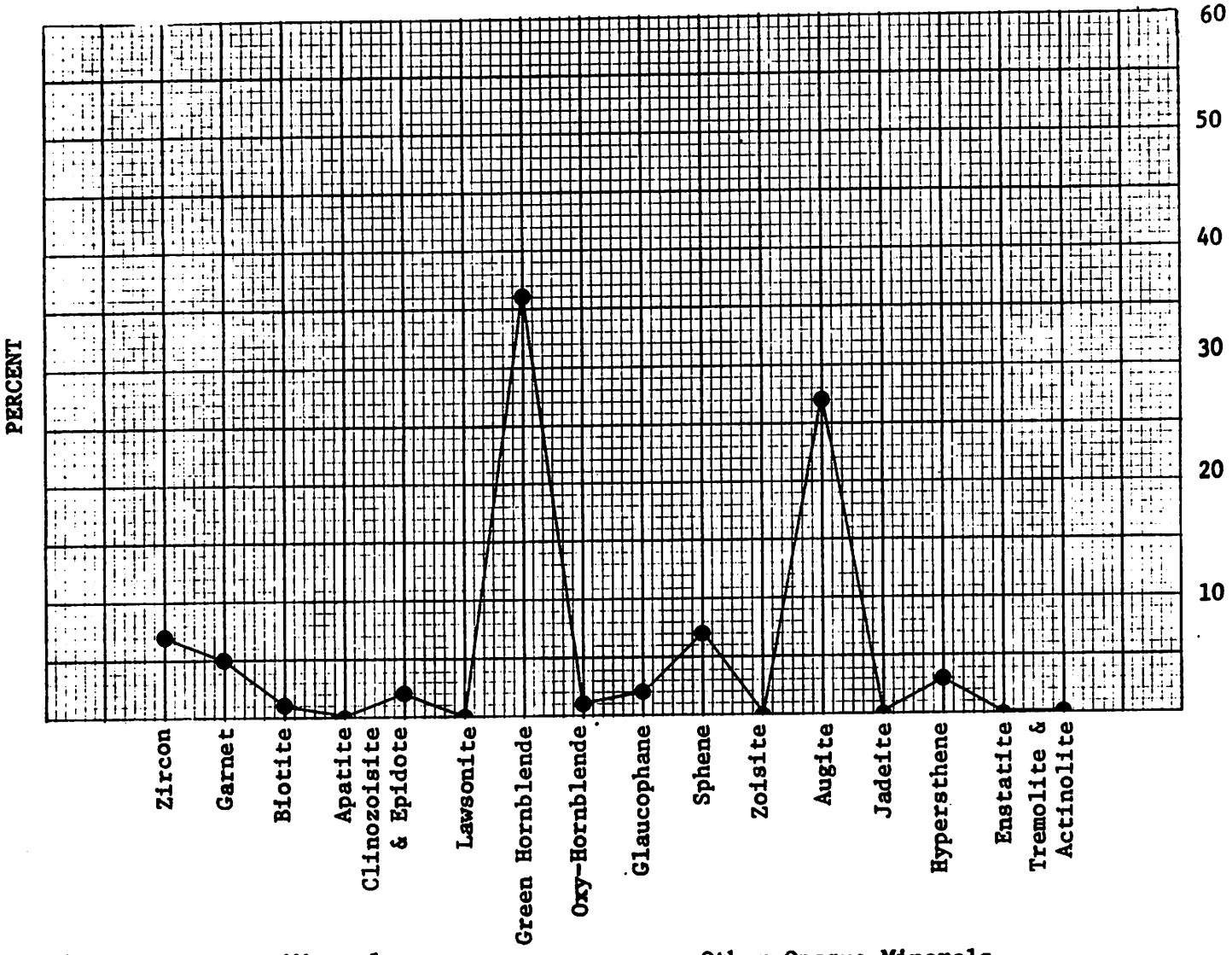
Wt. % of HM/SF 0.52

Total Grains Counted 364

% Transparent Grains 27.8

% Opaques 54.7

% Composite Gr. and Unknowns 17.5



Other Transparent Minerals

Mineral	No. Grains Counted
Composite Grains	60
Unknowns	4
Picotite	3
Andalusite	1

Other Opaque Minerals

Mineral	No. Grains Counted
Hematite	153
Magnetite	25
Pyrite	15
Leucoxene	6

Analyst T. Yancey J. Lee

SAMPLE 2208

Location 37°27.3' 122°26.6'

Depth Intertidal meters fathoms

Size Fraction (SF) .061 - .351 mm

Graph % = Total % of Each Mineral / Total % of Transparent Grains

Wt. % of SF/Total Sample 9.25

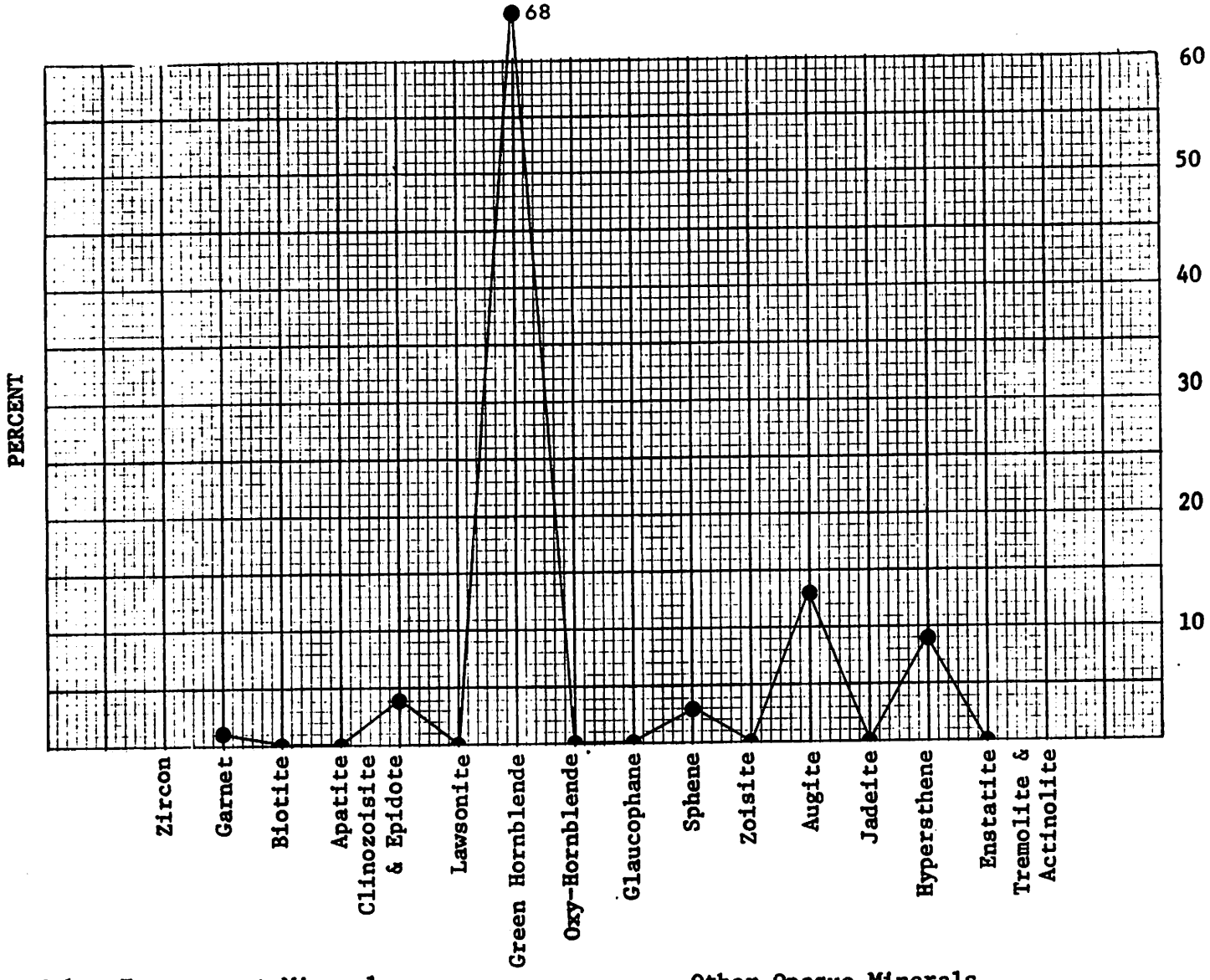
Wt. % of HM/SF 5.18

Total Grains Counted 199

% Transparent Grains 49.5

% Opaques 4.5

% Composite Gr. and Unknowns 45.5



Other Transparent Minerals

Mineral	No. Grains Counted
Unknowns	1
Carbonate	1

Other Opaque Minerals

Mineral	No Grains Counted
Composite Grains	111
Magnetite	3
Hematite	7

Analyst J. Lee T. Yancey