HEL 2-33

RECENT SEDIMENTS OF MONTEREY BAY

ADDITIONAL MINERALOGICAL DATA

by

T. YANCEY
P. WILDE

HYDRAULIC ENGINEERING LABORATORY
COLLEGE OF ENGINEERING

UNIVERSITY OF CALIFORNIA
BERKELEY
SEPTEMBER, 1971

University of California
Hydraulic Engineering Laboratory

Technical Report
HEL-2-33

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

RECENT SEDIMENTS OF MONTEREY BAY

Additional Mineralogical Data

by

T. Yancey and P. Wilde

Berkeley, California
September 1971

ABSTRACT

The heavy mineralogy of the sand fraction for beach samples reported by Sayles (1966) and 10 new offshore samples from South Monterey Bay was determined optically. For each sample the percentage of the more diagnostic transparent minerals is plotted graphically in order of persistence: zircon, garnet, biotite, apatite, clinozoisite and epidote, lawsonite, green hornblende, oxy-hornblende, glaucophane, sphene, zoisite, augite, jadeite, hypersthene, enstatite, and tremolite & actinolite. Additional data on accessory transparent minerals, composite grains (rock fragments) and opaque minerals are listed with each graph. An updated bibliography is presented to include all new work on the geology and sediment of Monterey Bay.

INTRODUCTION

The increased public interest in environmental problems of the Monterey Bay coastal areas such as the loss of sand from Capitola beach and the posting of bathing beaches due to excessive colloform counts indicates that an up to date regional study of the sediments of the offshore and beaches of Monterey Bay is in order. This report gives mineralogical data in the standard Hydraulic Engineering Laboratory format for beach samples examined by Sayles (1966) and for new offshore samples collected by Prof. Andrews of the Naval Postgraduate School in the fall of 1970. See Fig. 1 for location of samples. This data, along with information on the sediments of North Monterey Bay from Yancey (1968) will form the principle basis for a forthcoming compilation and regional interpretation of sediment transport in Monterey Bay. In addition new work on sediments of the Monterey Bay area reported since Yancey's (1968) compilation are listed below in the References.

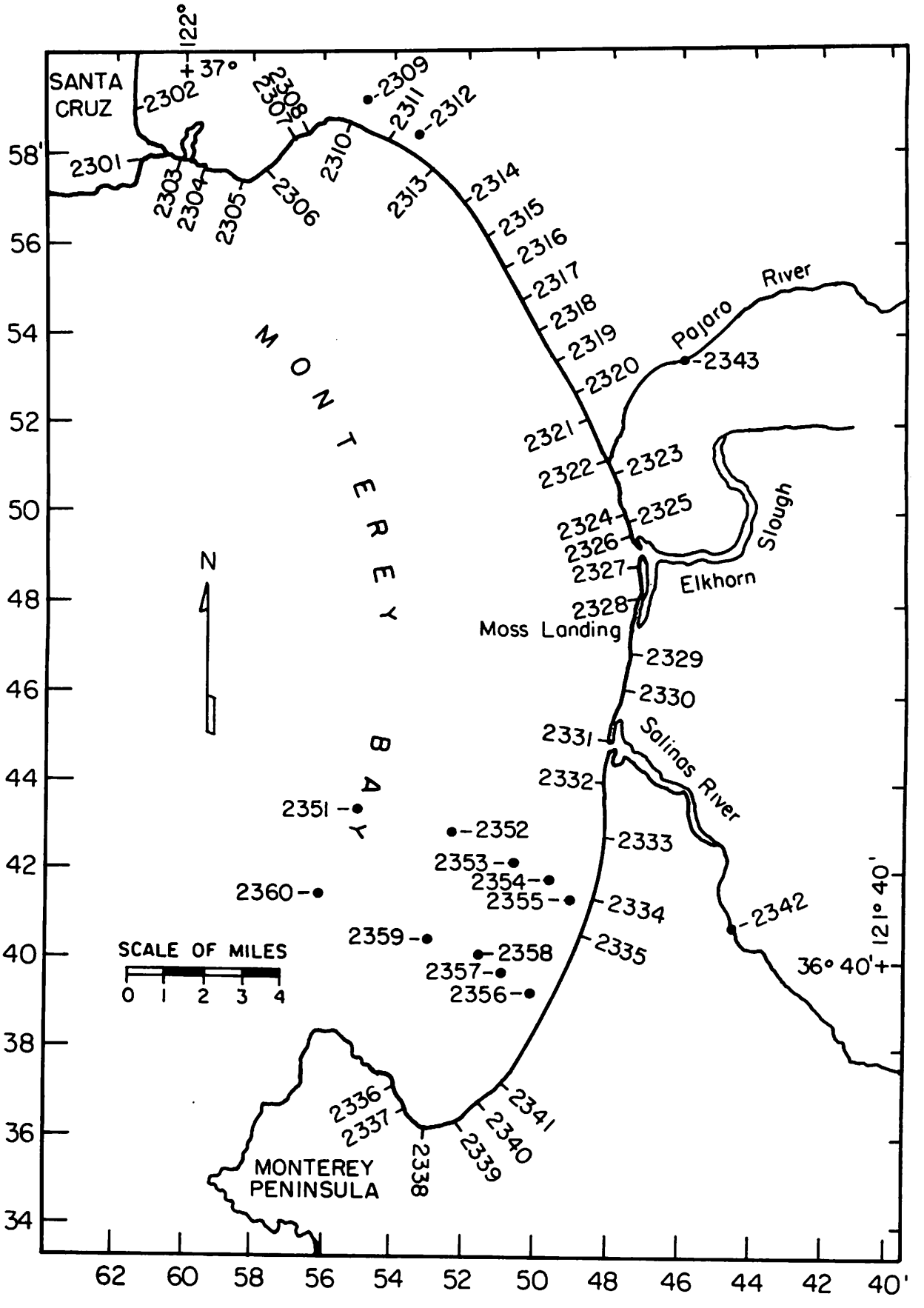


FIG. 1 SAMPLE STATIONS

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 transparent grains. Rock fragments were grains of composite mineral composition. Identifications were checked with reference to diagnostic tables in Krumbein and Pettijohn (1938, p. 412-262); 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.

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

Size Fraction (SF) in millimeters gives the grain size fraction represented by the graph.

Graph % gives the percent of each mineral shown on the graph considering only transparent grains.

Wt. % of SF/Total Sample is the weight percent of the size fraction with respect to the total weight of the sample.

Wt. % of HM/SF is the weight percent of the heavy mineral fraction of the particular size fraction.

% Transparent Grains is the percent of transparent grains with respect to the total grains counted.

% Opaques is the percent of opaque grains with respect to the total number of grains counted.

% Composite grains and Unknowns is the percent of composite grains (rock fragments) and unknown grains with respect to the total number of grains counted.

REFERENCES

Dorman, C. E., 1968, "The Southern Monterey Bay Littoral Cell: a Preliminary Sediment Budget Study," unpublished M.S. Thesis, U. S. Naval Postgraduate School, Monterey, California, p. 234.

Greene, H. G., 1970, "Geology of Southern Monterey Bay and its Relationship to the Groun Water Basin and Salt Water Intrusion," U. S. Geol. Survey, Open File Report, p. 50.

Hunter, W. P., 1971, "Heavy Mineral Analysis of Selected Monterey Bay Cores," M. S. Thesis, U. S. Naval Postgraduate School, Monterey, California, p. 55, unpublished.

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

Malone, M. J., 1970, "A Pebble-Cobble Deposit in Monterey Bay, California," M. S. Thesis, U. S. Naval Postgraduate School, Monterey, California, p. 48, unpublished.

Milner, H. B., 1962, "Sedimentary Petrography, Vol. 2 - Principles and Applications," London, George Allen and Urwin, p. 715.

Monteath, G. M., Jr., "Environmental Analysis of the Sediments of Southern Monterey Bay, California," M. S. Thesis, U. S. Naval Postgraduate School, Monterey, California, p. 87, unpublished.

Normark, W. R., 1969, "Growth Patterns of Deep Sea Fans," Ph.D. Thesis, University of California, San Diego, California, p. 165, unpublished.

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

Sayles, F. L., 1966, "A Reconnaissance Heavy Mineral Study of Monterey Bay Beach Sediment," University of California Hydraulic Engineering Lab. Tech. Rept. HEL-2-16, p. 20.

Van Andel, T. H., 1958, "A Defense of the Term Alterite," Journal Sed. Petrology, Vol. 28, p. 234-235.

Wolf, S. C., 1970, "Coastal Currents and Mass Transport of Surface Sediments Over the Shelf Regions of Monterey Bay, California," Marine Geology, Vol. 8, No. 5, p. 321-336.

Yancey, T. E., "Recent Sediments of Monterey Bay, California," Univ. of Calif., Hydraul. Engin. Lab. Tech. Rept., HEL-2-18, p. 145.

SAMPLE 2301

Location 36° 57.8' 121° 1.6'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample —

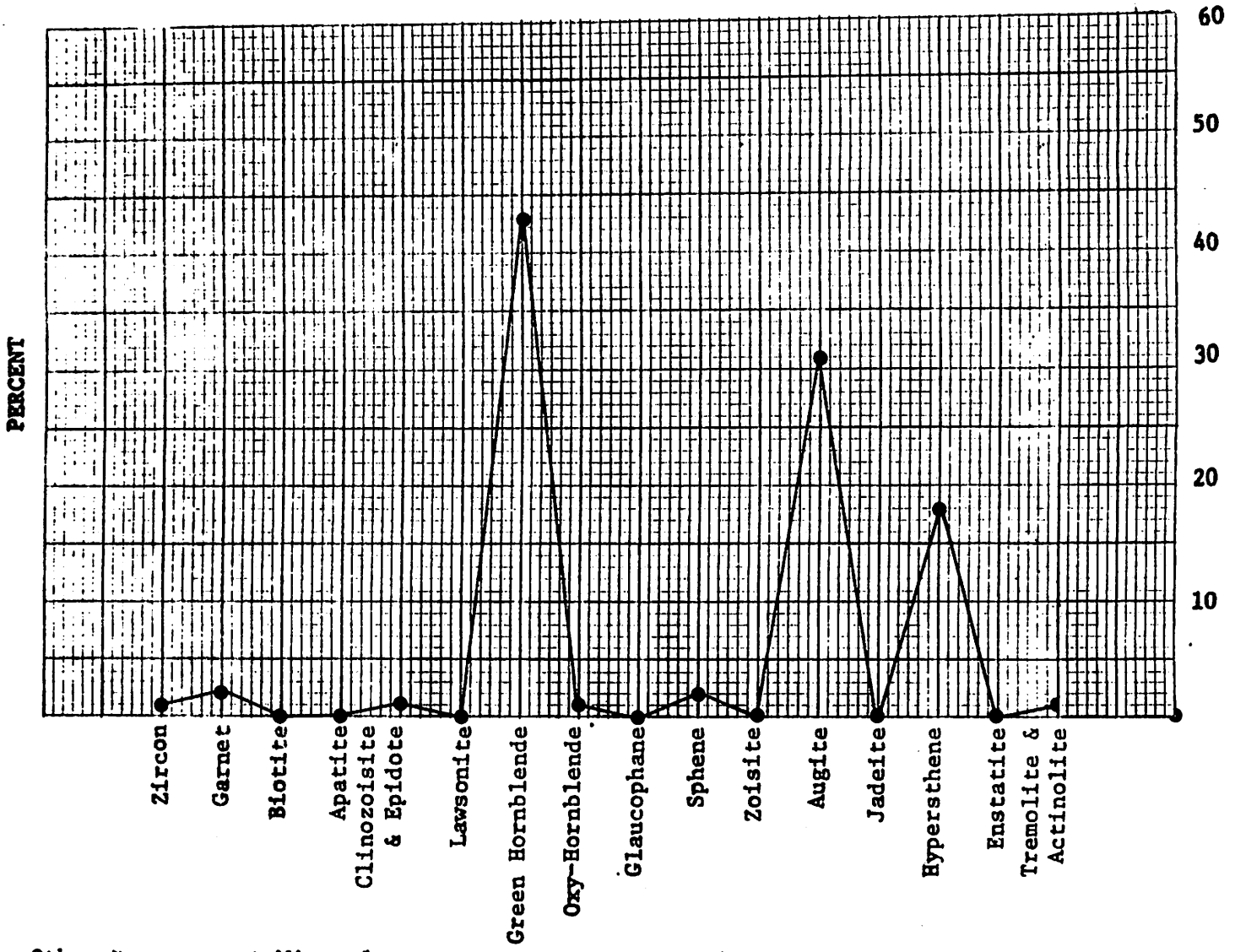
Wt. % of HM/SF —

Total Grains Counted 142

% Transparent Grains 70.6

% Opaques 29.4

% Composite Gr. and Unknowns 0



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	42

Other Opaque Minerals

Mineral	No. Grains Counted

Analyst F. Sayles

SAMPLE 2302

Location 36° 59' 122° 1.1'

Depth stream meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

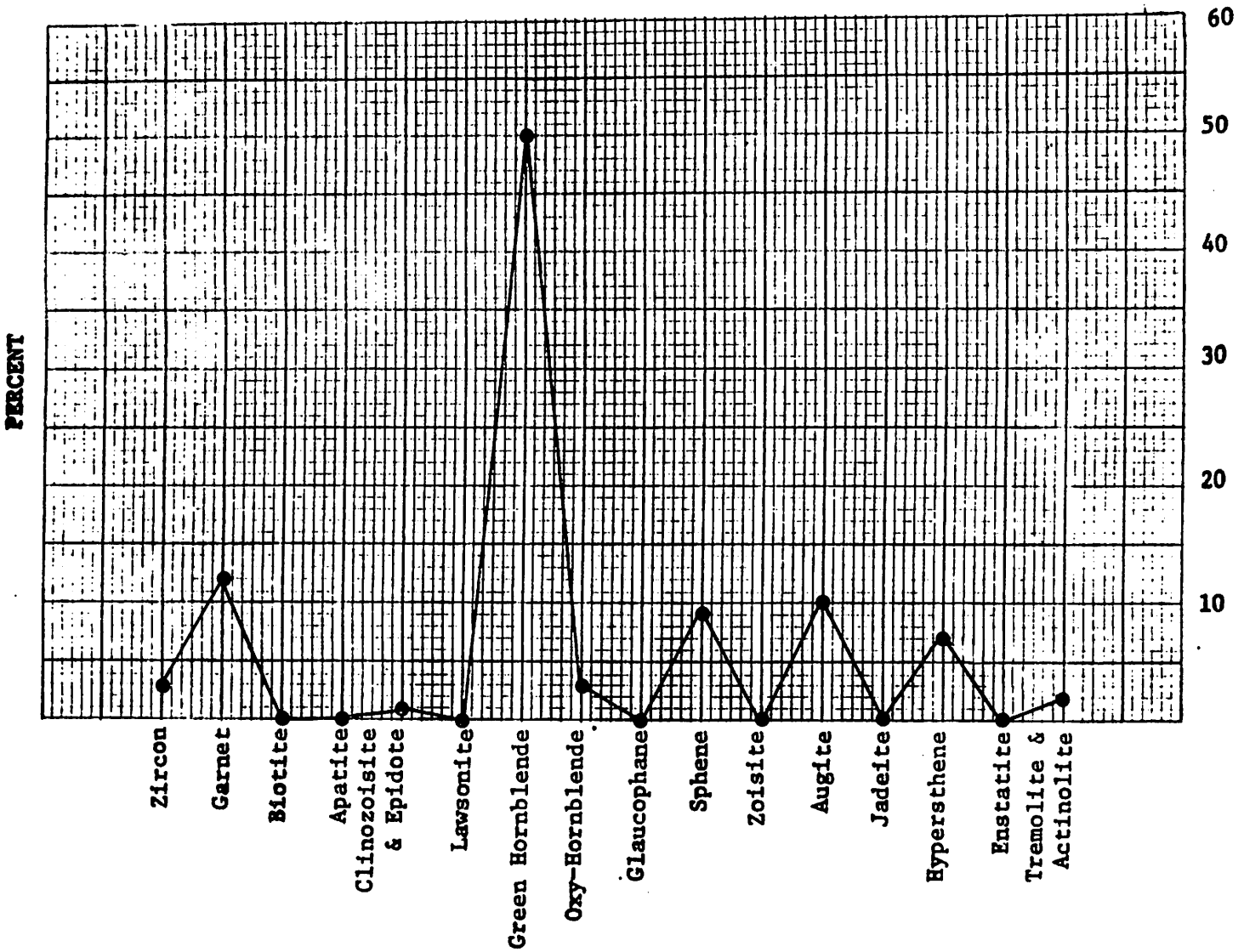
Wt. % of HM/SF --

Total Grains Counted 184

% Transparent Grains 55.0

% Opaques 43.8

% Composite Gr. and Unknowns 1.2



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	82
Unknowns	2

Other Opaque Minerals

Mineral	No. Grains Counted

SAMPLE 2303

Location 36° 57.7' 120° 0.4'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

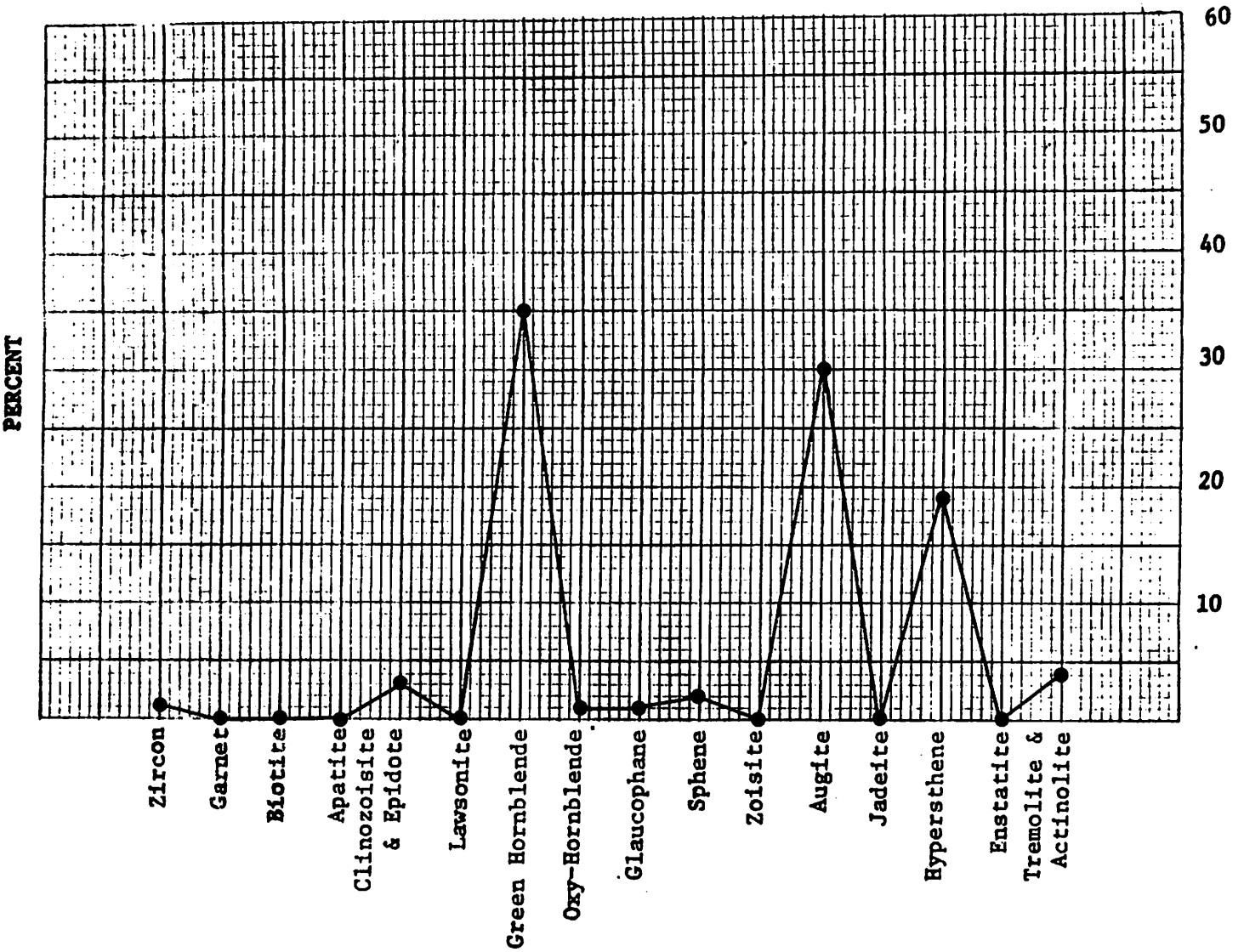
Wt. % of HM/SF --

Total Grains Counted 140

% Transparent Grains 71.4

% Opaques 25.7

% Composite Gr. and Unknowns 2.9



Other Transparent Minerals

Mineral	No. Grains Counted
Unknowns	4
Opaques & Alterites	36

Other Opaque Minerals

Mineral	No Grains Counted

Analyst E. SAYLES

SAMPLE 2304

Location 37° 57.9' 121° 59.8'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

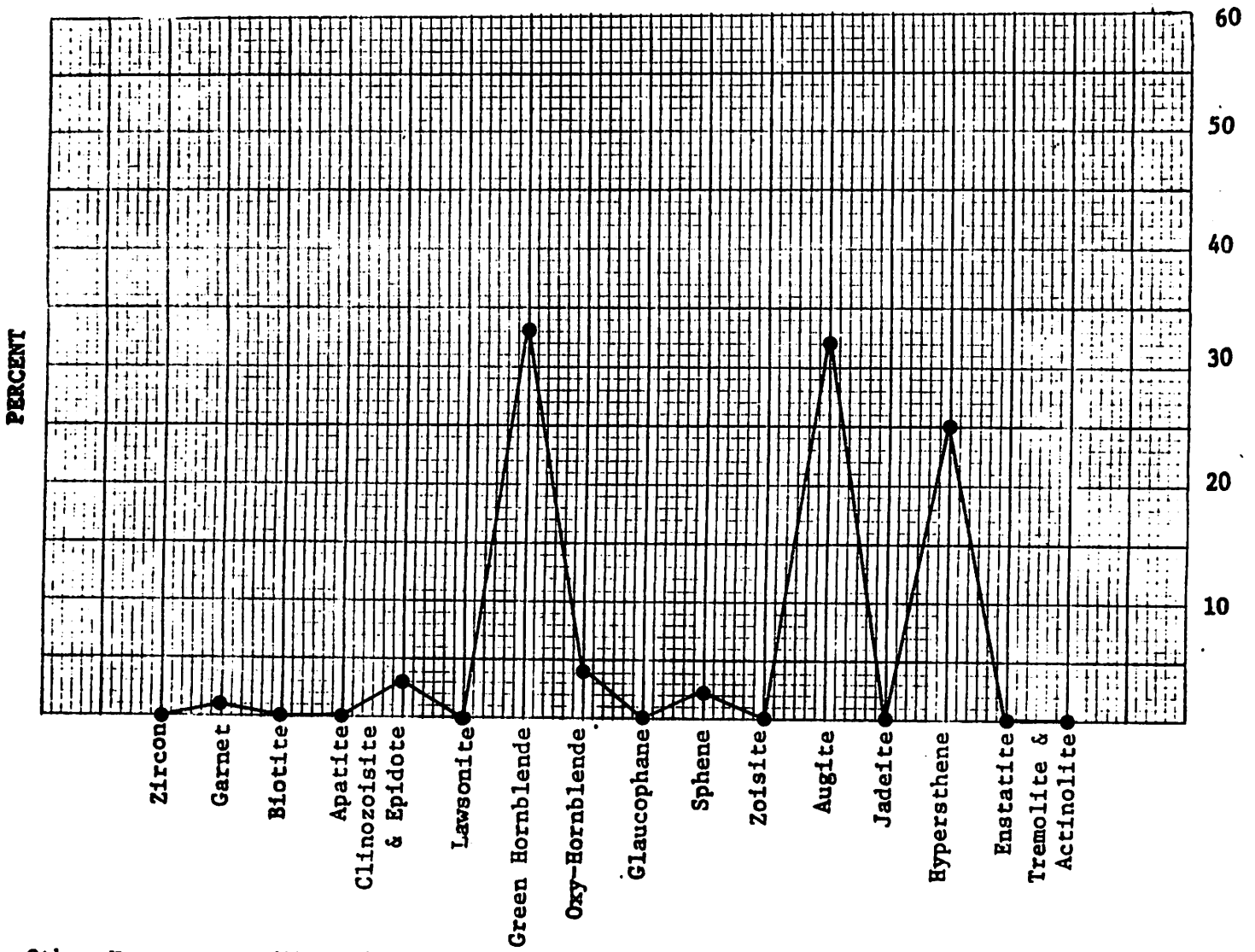
Wt. % of HM/SF --

Total Grains Counted 155

% Transparent Grains 64.6

% Opaques 35.4

% Composite Gr. and Unknowns 0



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	42

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2305

Location 36° 57.3' 121° 58.7'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

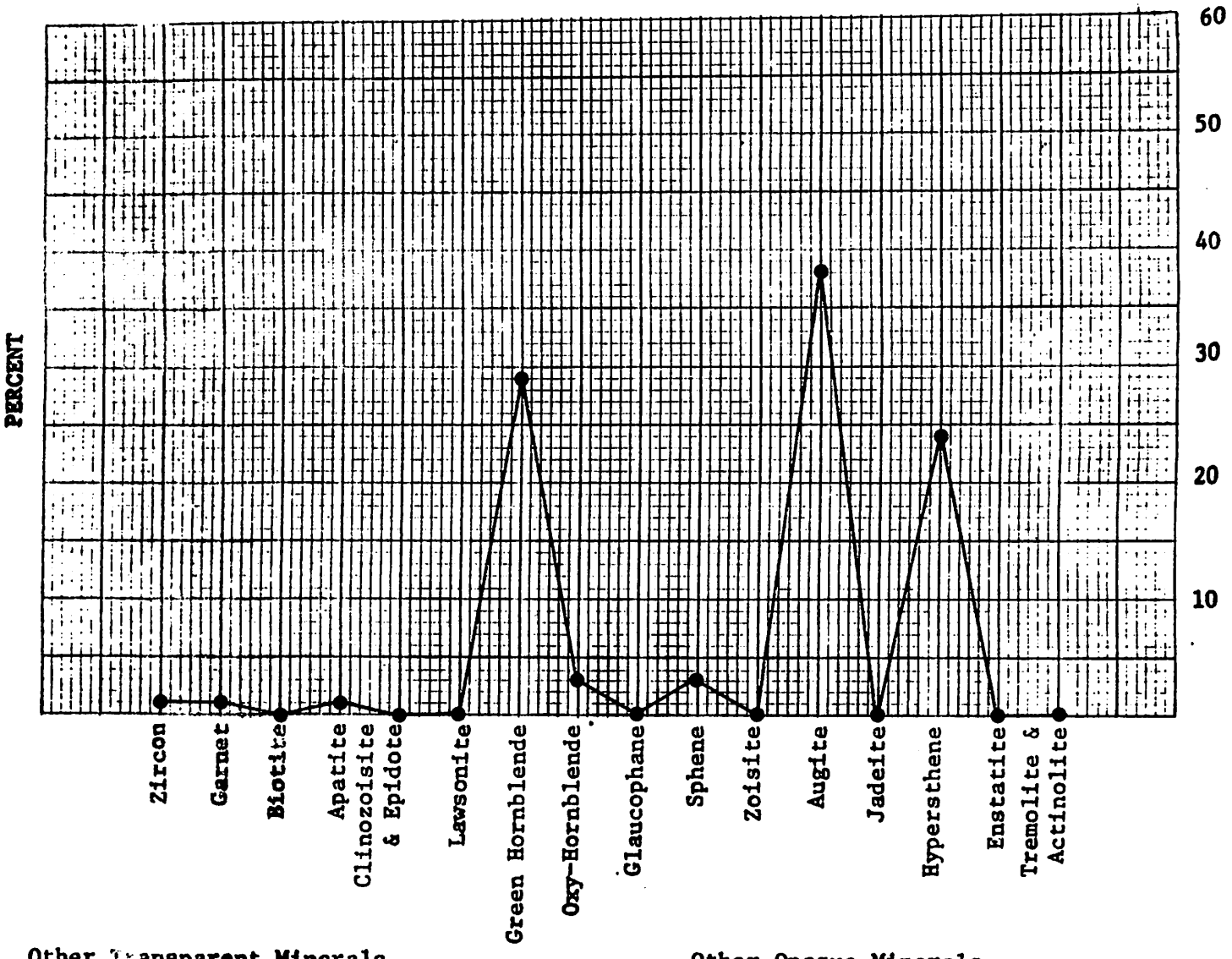
Wt. % of HM/SF --

Total Grains Counted 148

% Transparent Grains 67.6

% Opaques 32.4

% Composite Gr. and Unknowns 0



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	48

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2306

Location 36° 57.6' 121° 57.8'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

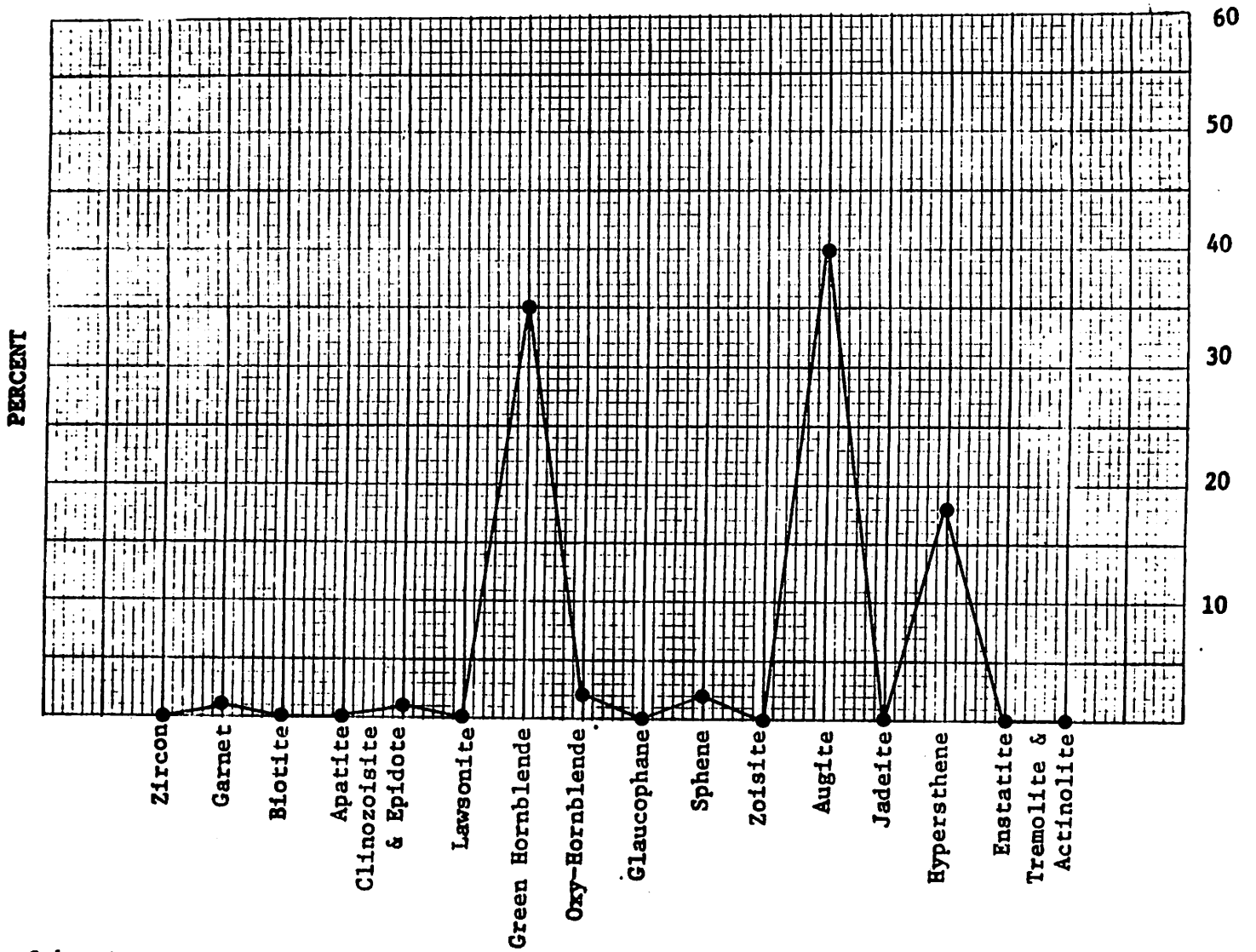
Wt. % of HM/SF --

Total Grains Counted 158

% Transparent Grains 63.3

% Opaques 36.1

% Composite Gr. and Unknowns 0.6



Other Transparent Minerals

Mineral	No. Grains Counted
Opaque + Alterites	57
Unknowns	1

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2307

Location 36° 58.2' 121° 56.9'

Depth intertidal meters ____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

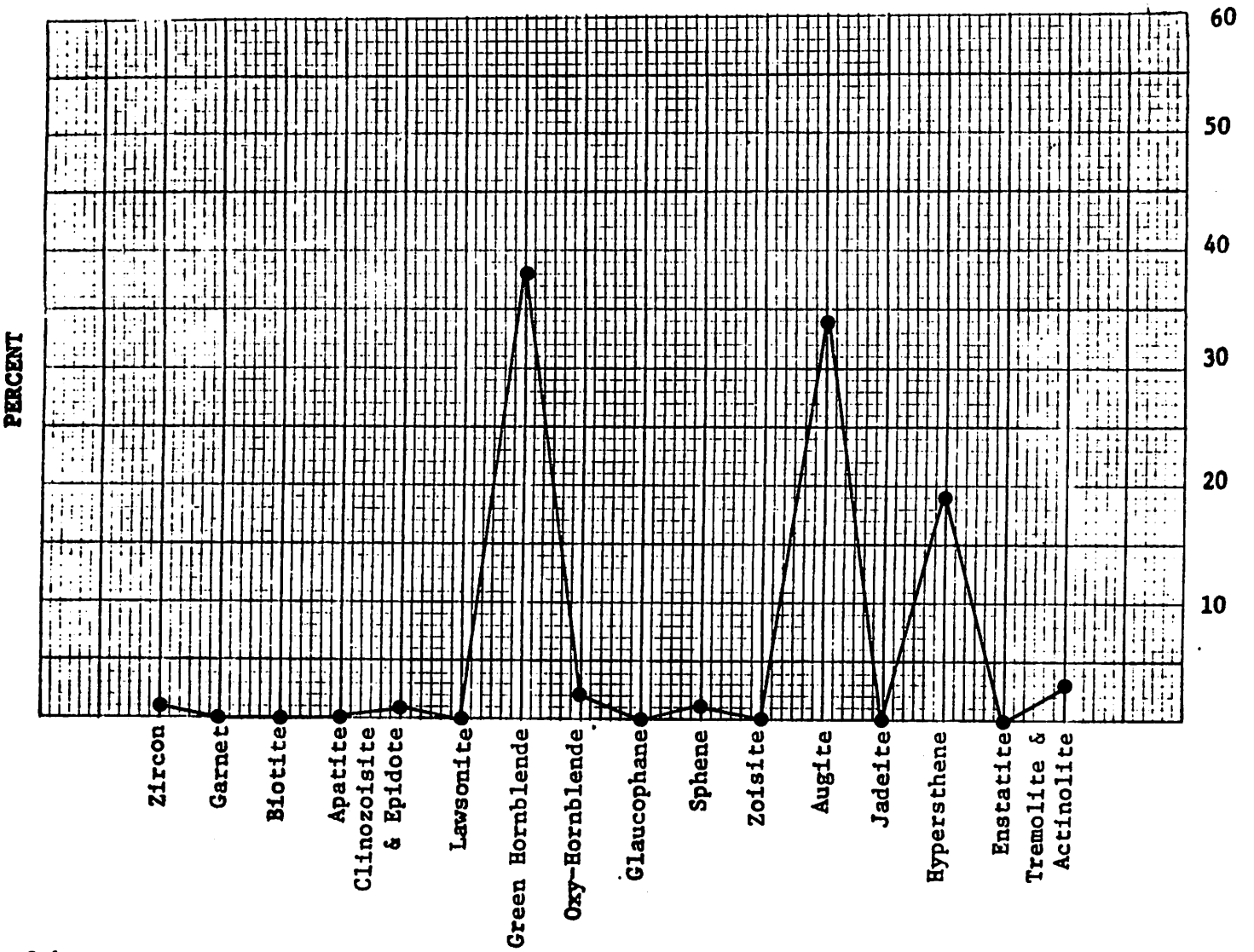
Wt. % of HM/SF --

Total Grains Counted 146

% Transparent Grains 68.4

% Opaques 30.8

% Composite Gr. and Unknowns 0.8



Other Transparent Minerals

Mineral	No. Grains Counted
Opaque & Alterites	45
Unknown	1

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2308

Location 36° 58.3' 121° 56.5'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

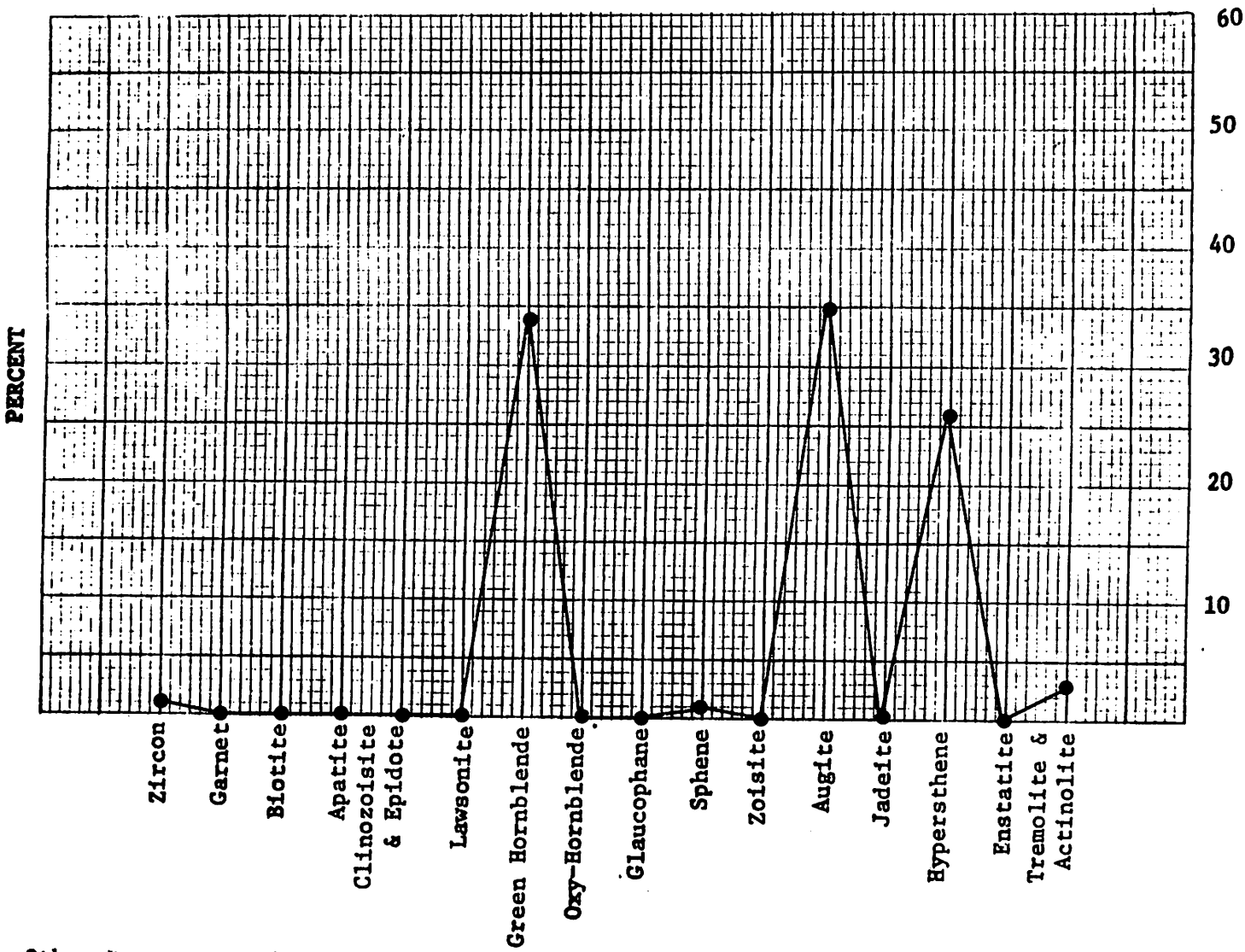
Wt. % of HM/SF --

Total Grains Counted 130

% Transparent Grains 76.9

% Opaques 23.1

% Composite Gr. and Unknowns 0



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	30

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2309

Location 36° 59.0' 121° 55.1'

Depth stream meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

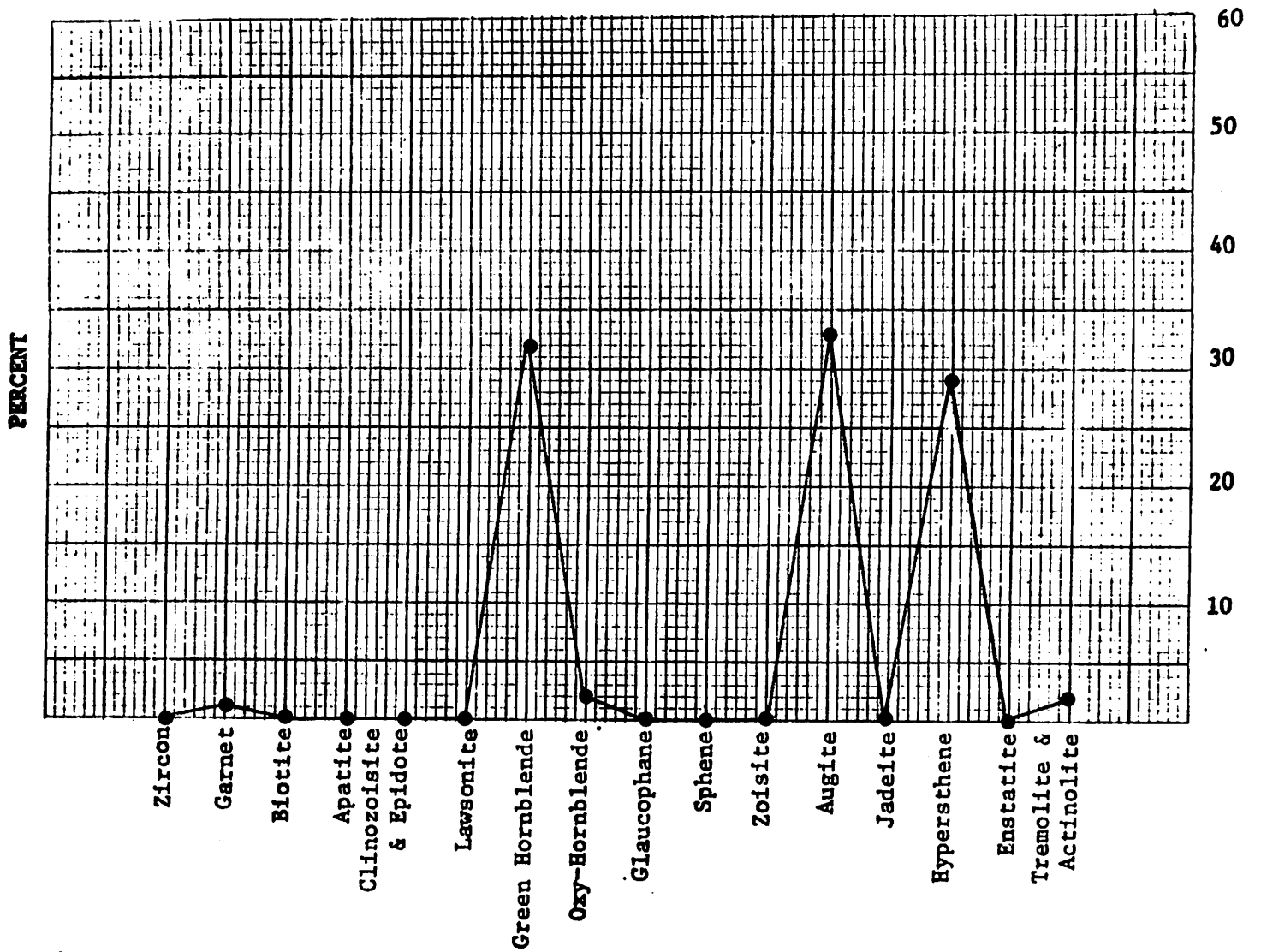
Wt. % of HM/SF --

Total Grains Counted 187

% Transparent Grains 53.4

% Opaques 46.0

% Composite Gr. and Unknowns 0.6



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	86
Unknowns	1

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2310

Location 36° 58.6' 121° 55.5'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

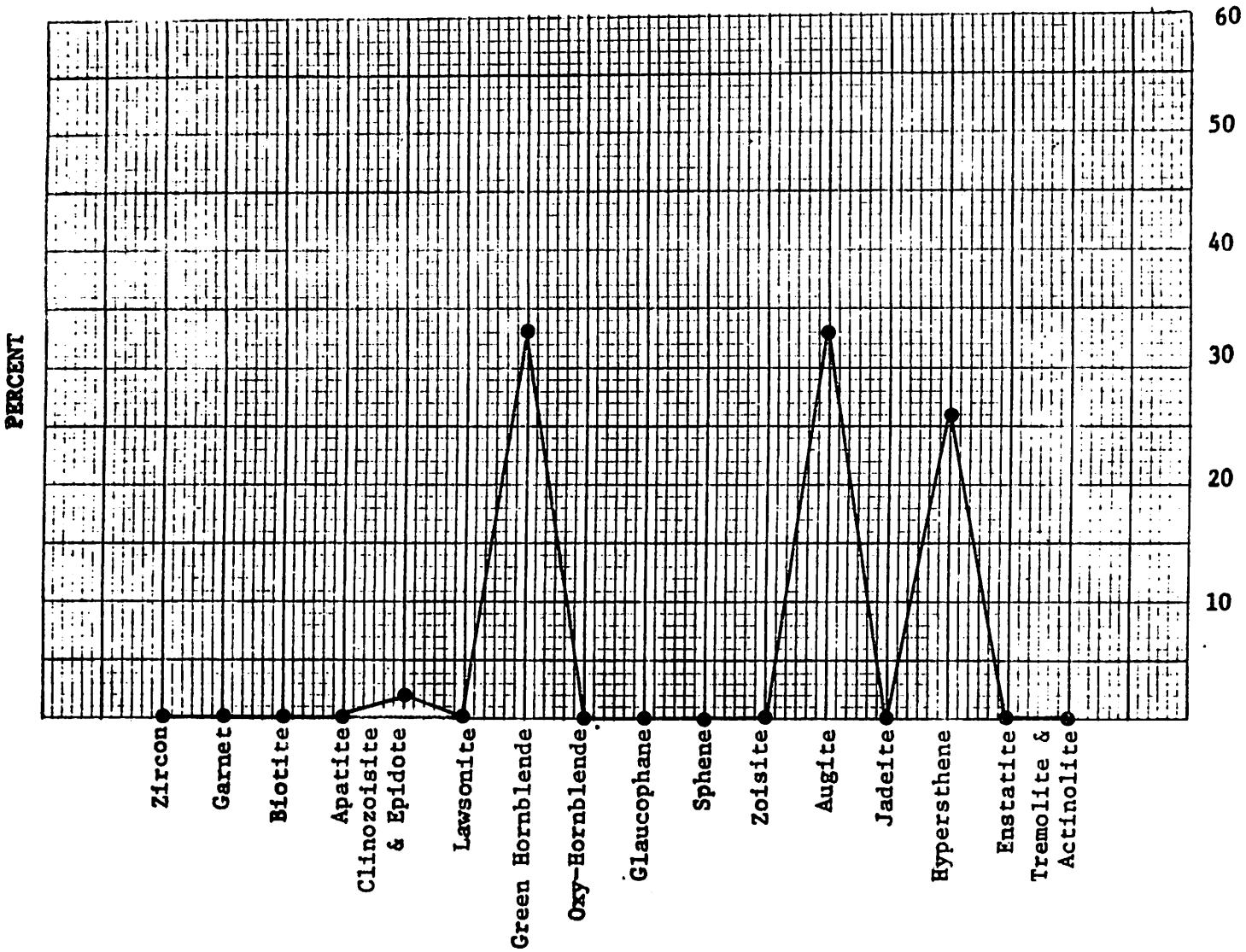
Wt. % of HM/SF --

Total Grains Counted 138

% Transparent Grains 72.5

% Opaques 26.8

% Composite Gr. and Unknowns 0.7



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	37
Unknowns	1

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2311

Location 36° 58.2' 121° 54.2'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

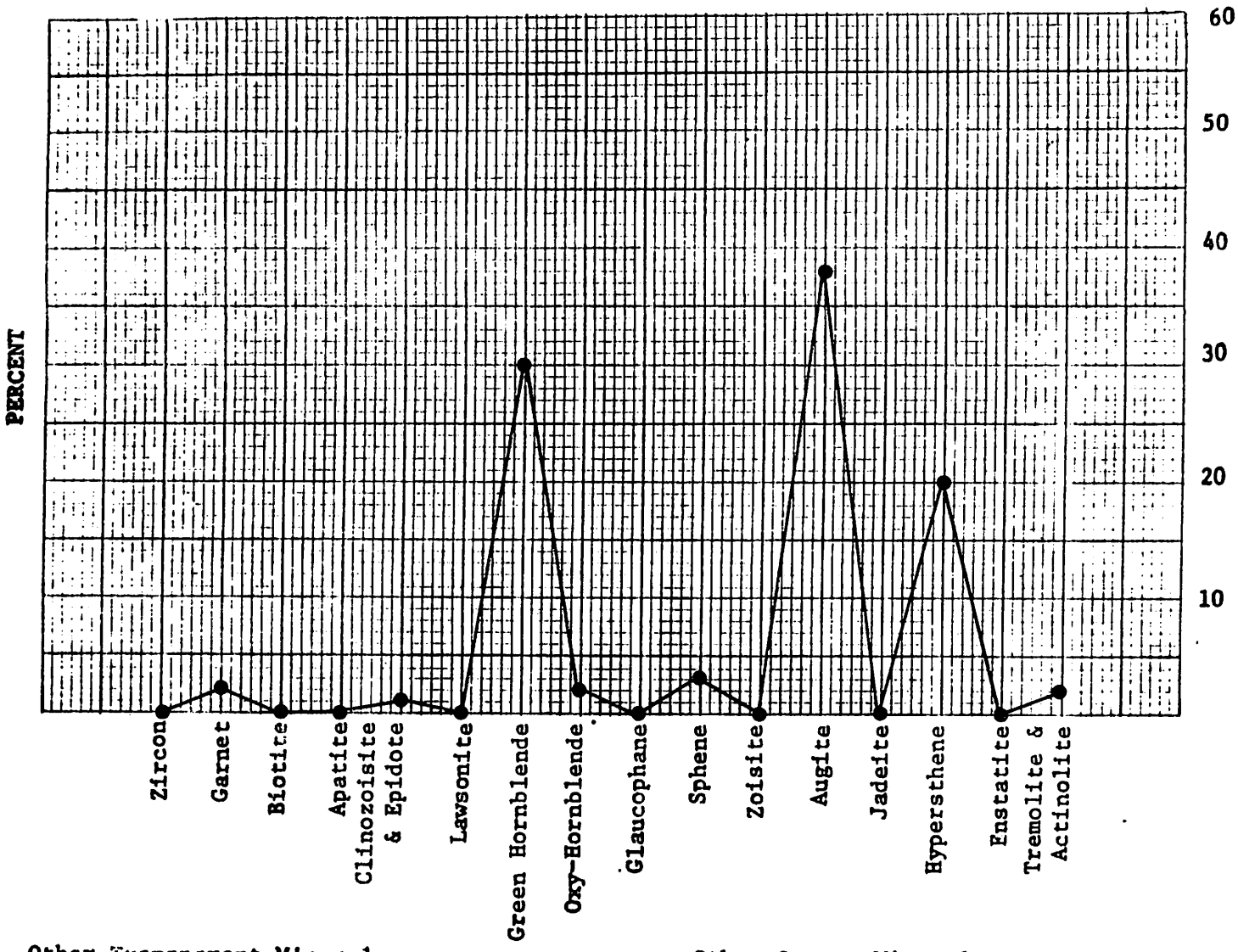
Wt. % of HM/SF --

Total Grains Counted 156

% Transparent Grains 64.1

% Opaques 34.6

% Composite Gr. and Unknowns 1.3



Other Transparent Minerals

Mineral	No. Grains Counted
Opaque & Alterites	54
Unknown	2

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2312

Location 36° 58.3' 121° 53.4'

Depth stream meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

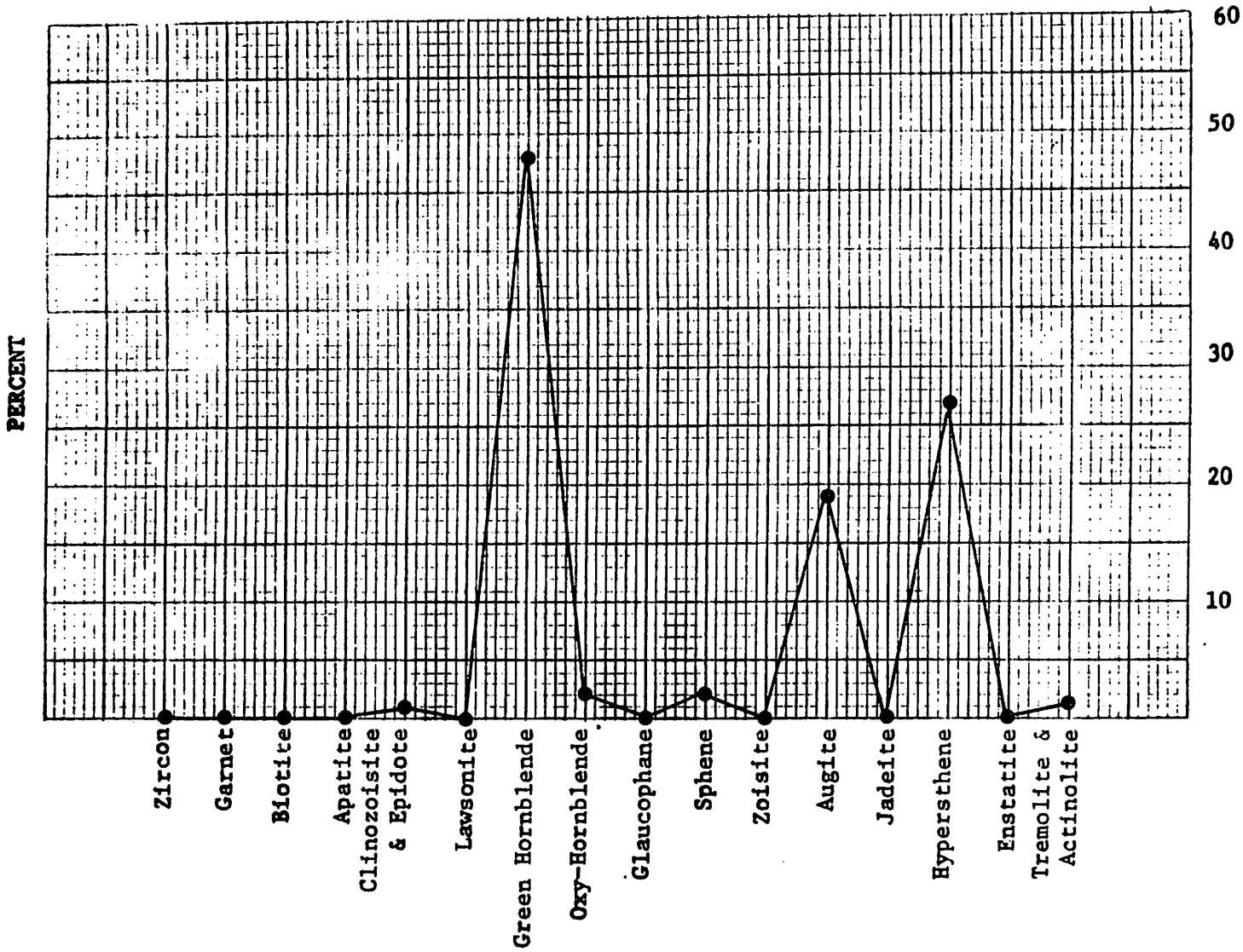
Wt. % of HM/SF --

Total Grains Counted 161

% Transparent Grains 62.1

% Opaques 37.9

% Composite Gr. and Unknowns 0



Other Transparent Minerals

Mineral	No. Grains Counted
Opaque & Alterites	61

Other Opaque Minerals

Mineral	No. Grains Counted

Analyst F. SAYLES

SAMPLE 2313

Location 36° 57.4' 121° 53.2'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

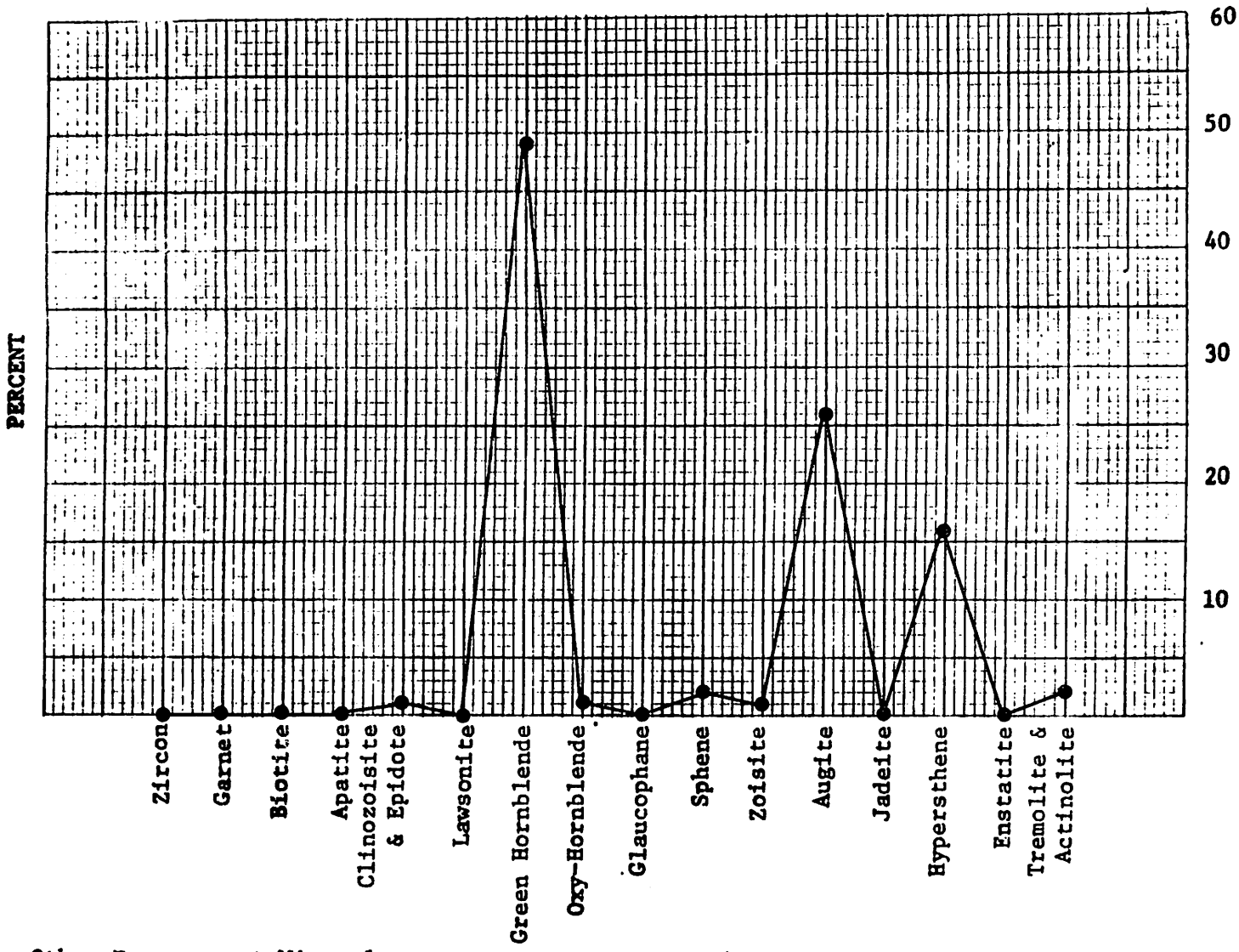
Wt. % of HM/SF --

Total Grains Counted 140

% Transparent Grains 71.4

% Opaques 27.2

% Composite Gr. and Unknowns 1.4



Other Transparent Minerals

Mineral	No. Grains Counted
Opaque & Alterites	38
Unknowns	2

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2314

Location 36° 56.7' 121° 52.1'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

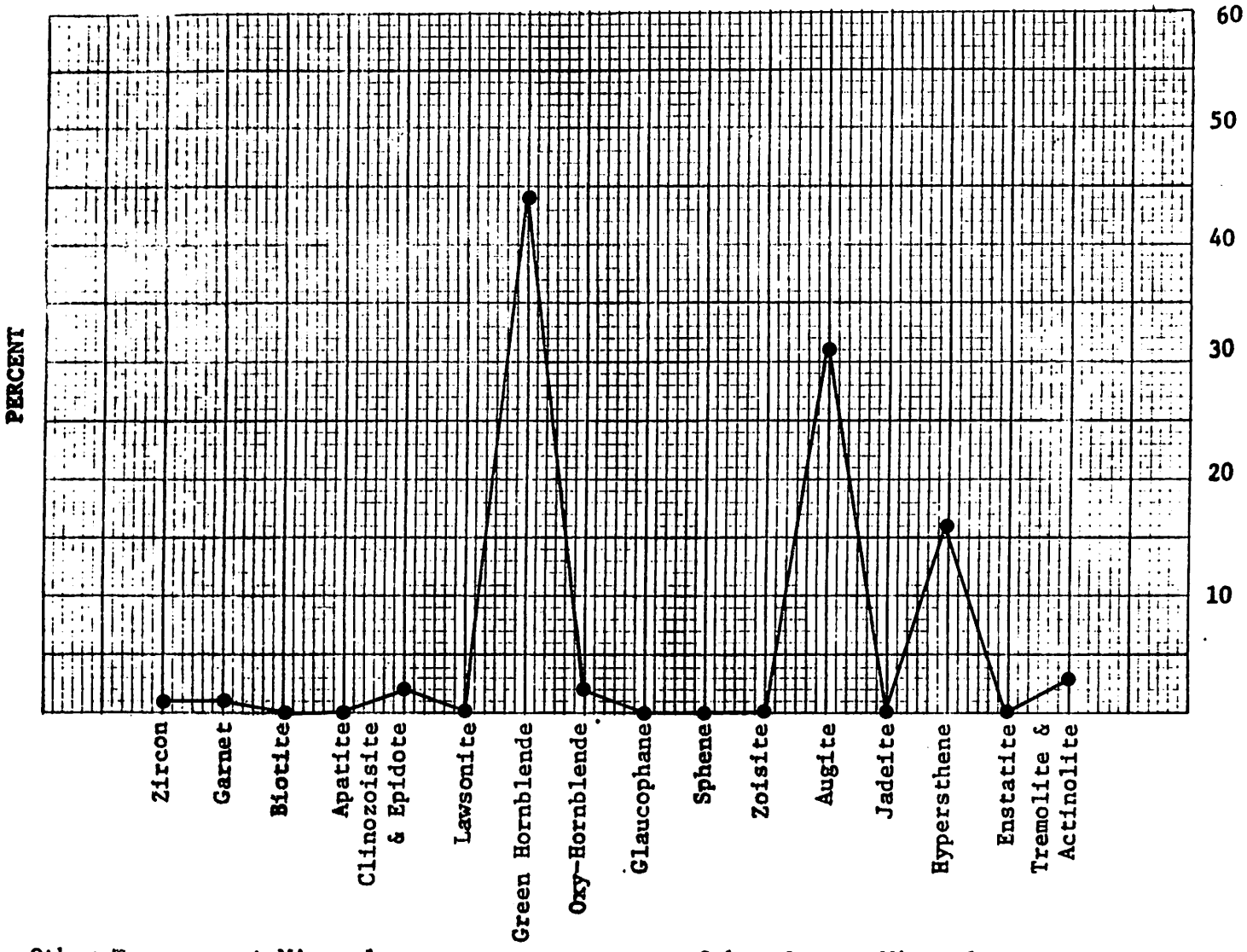
Wt. % of HM/SF --

Total Grains Counted 145

% Transparent Grains 69.0

% Opaques 31.0

% Composite Gr. and Unknowns 0



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	45

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2315

Location 36° 56' 121° 51.5'

Depth intertidal meters ____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

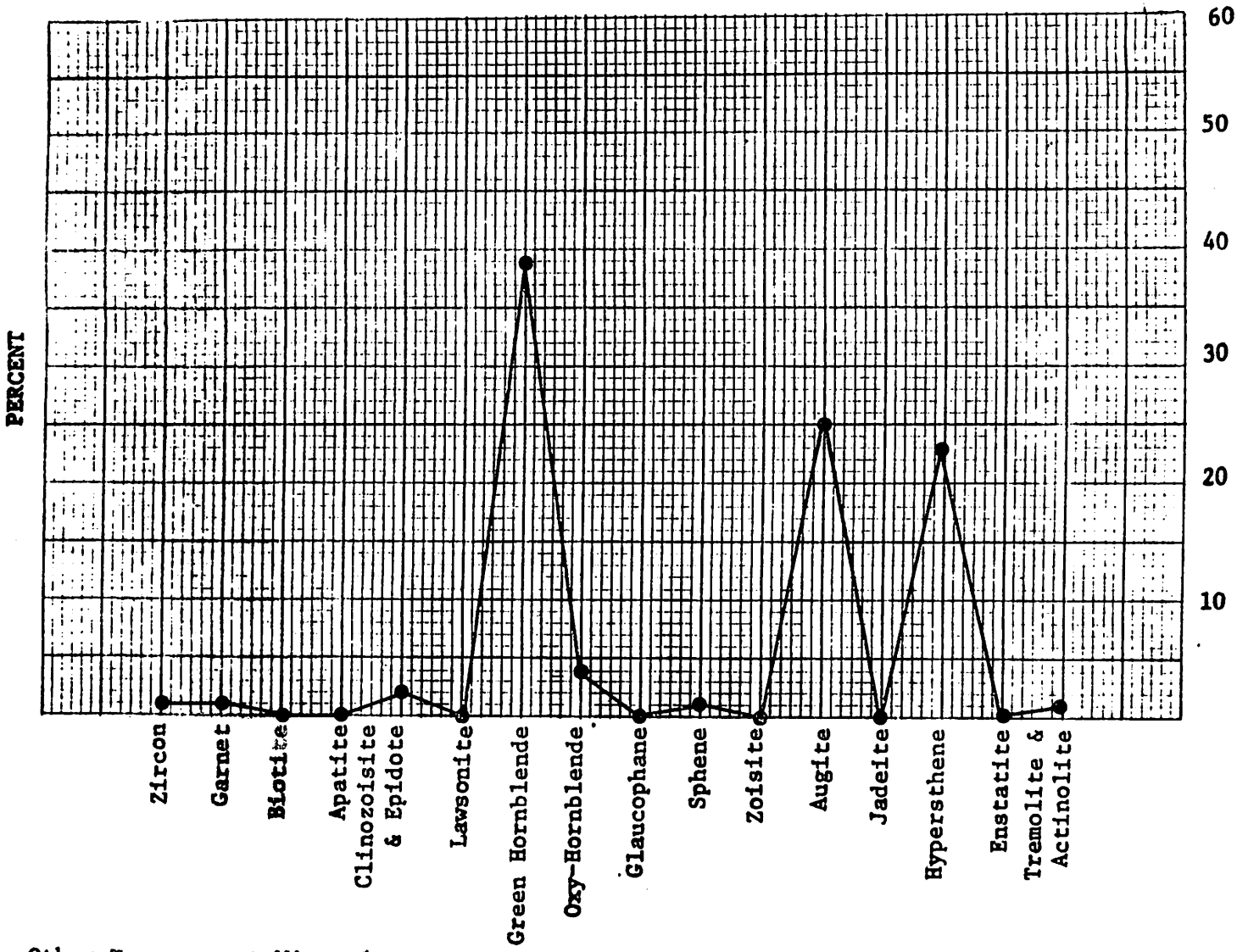
Wt. % of HM/SF --

Total Grains Counted 156

% Transparent Grains 64.1

% Opaques 34.0

% Composite Gr. and Unknowns 1.9



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	53
Unknown	3

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2316

Location 36° 55.3' 121° 51.1'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

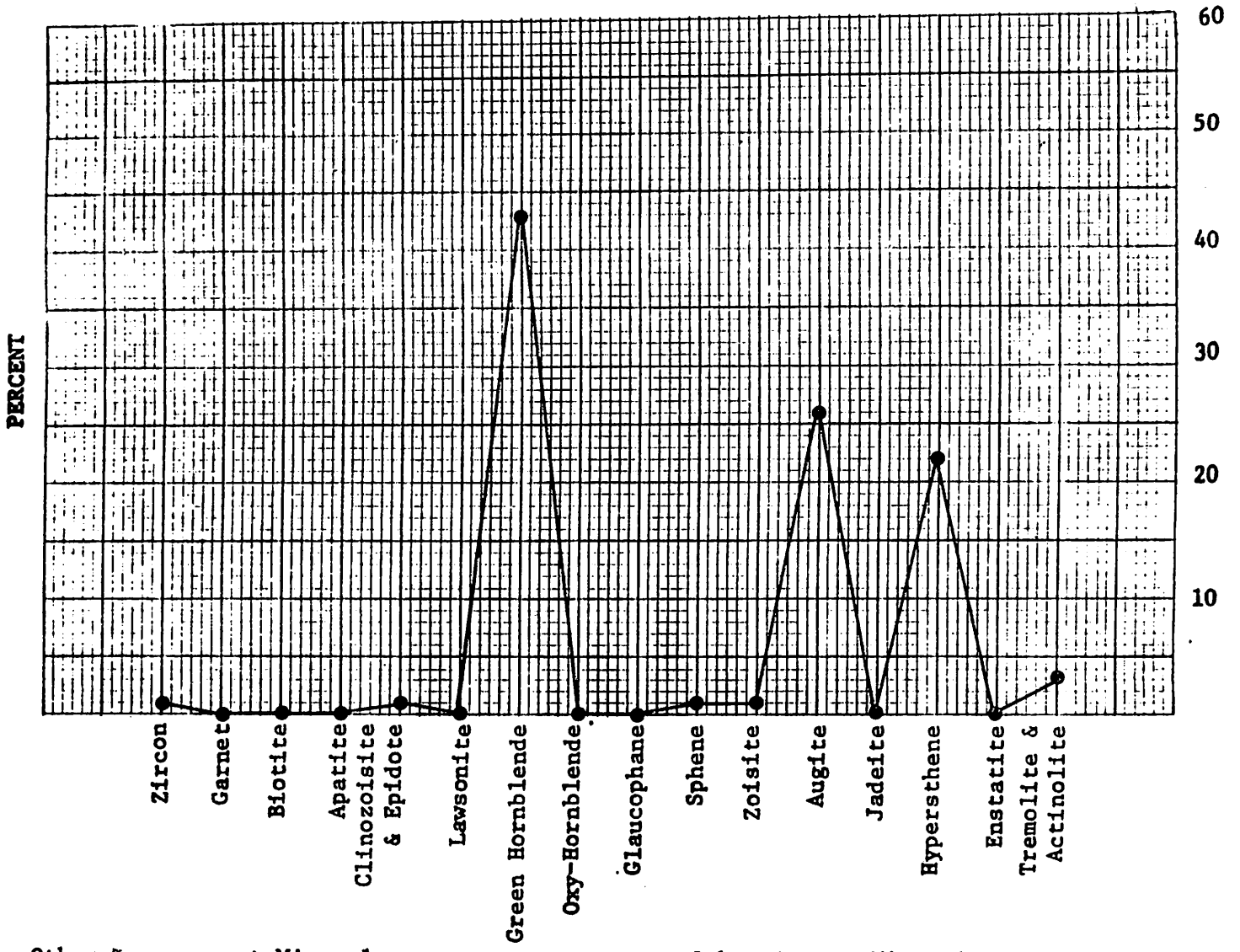
Wt. % of HM/SF --

Total Grains Counted 156

% Transparent Grains 64.1

% Opaques 34.6

% Composite Gr. and Unknowns 1.3



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	54
Unknown	2

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2317

Location 36° 54.6' 121° 50.6'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

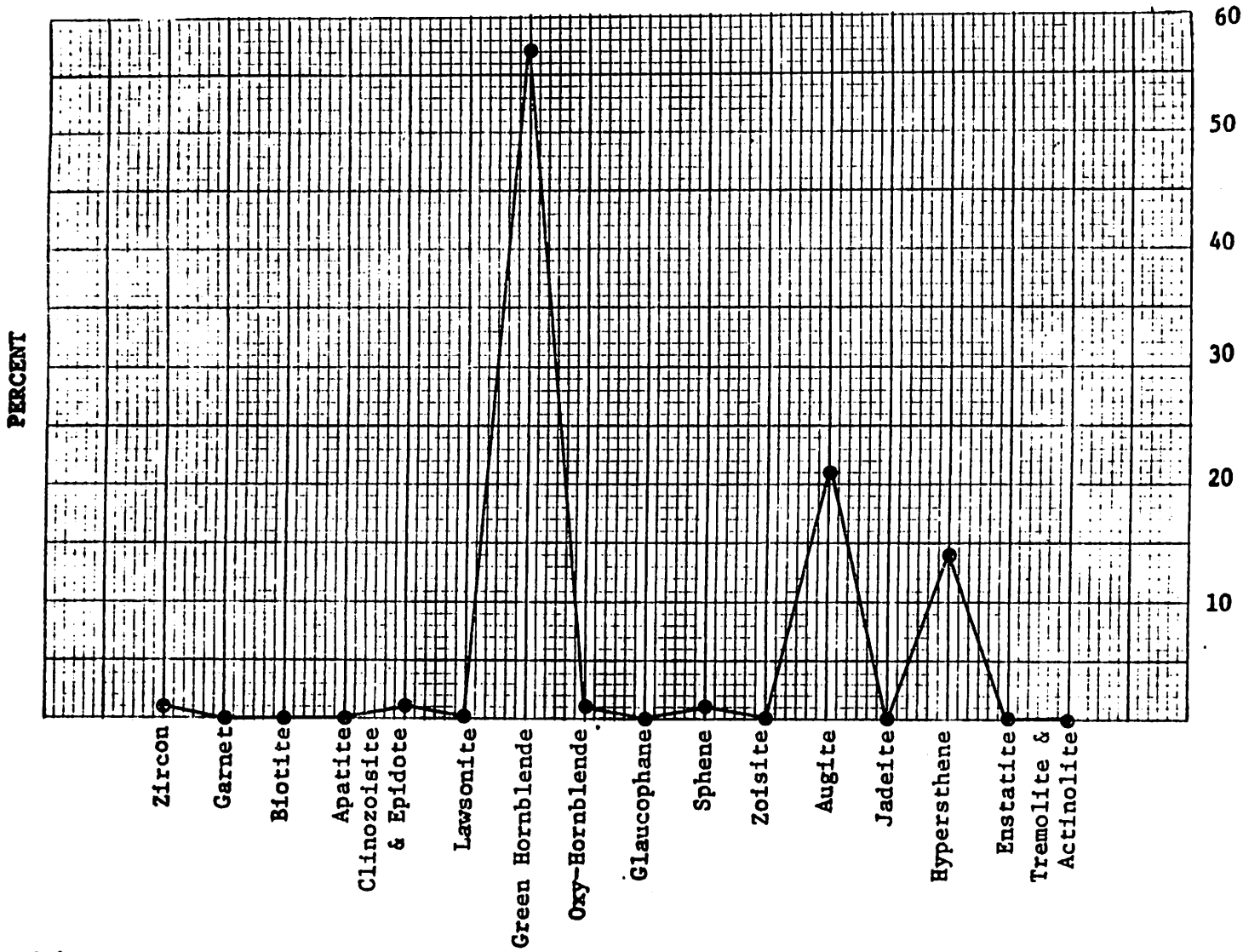
Wt. % of HM/SF --

Total Grains Counted 178

% Transparent Grains 56.7

% Opaques 41.6

% Composite Gr. and Unknowns 2.2



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	74
Unknowns	4

Other Opaque Minerals

Mineral	No. Grains Counted

Analyst E. SAYLES

SAMPLE 2318

Location 36° 54' 121° 50.1'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

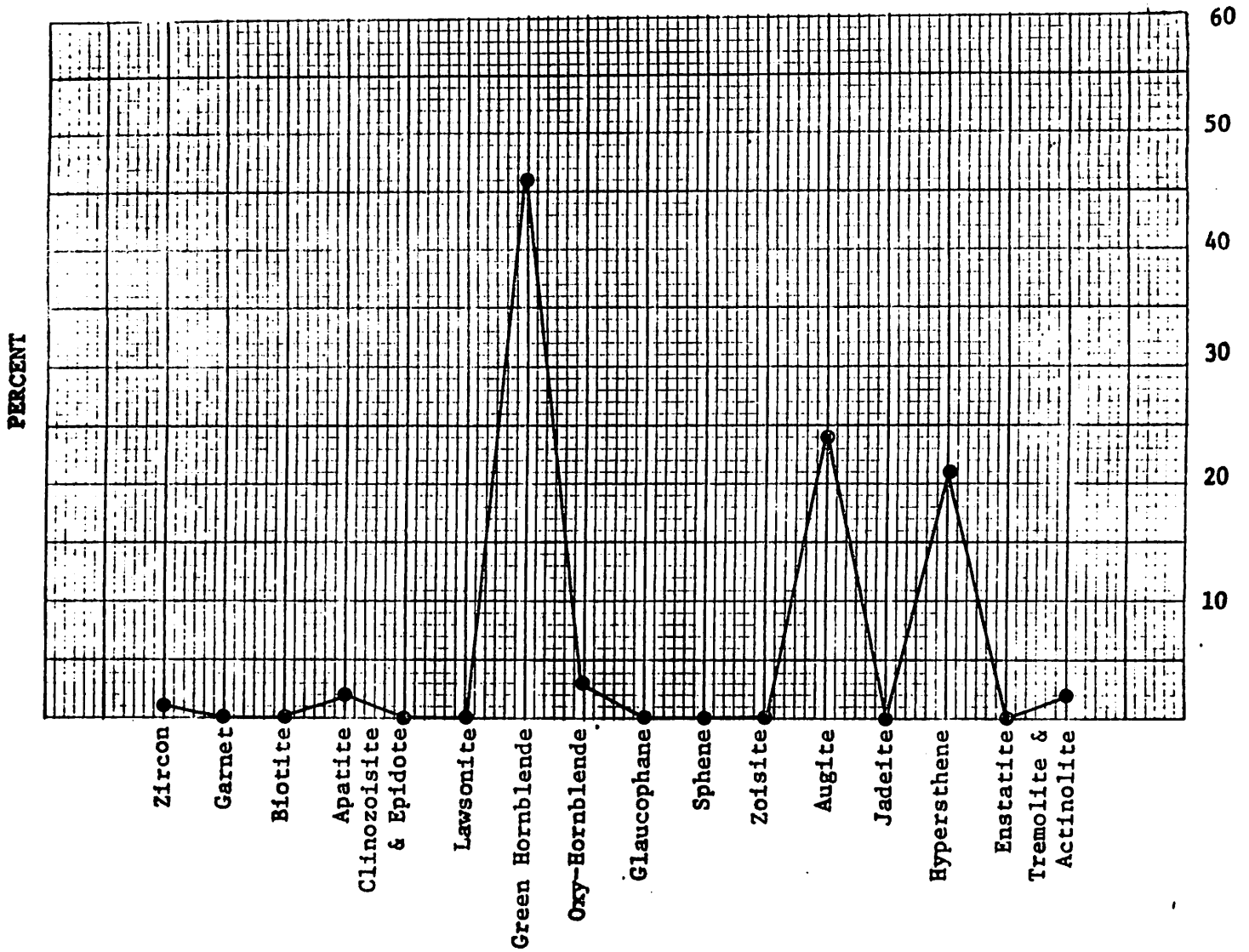
Wt. % of HM/SF --

Total Grains Counted 164

% Transparent Grains 61.0

% Opaques 38.4

% Composite Gr. and Unknowns 0.6



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	63
Unknowns	1

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2319

Location 36° 53.3' 121° 49.6'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

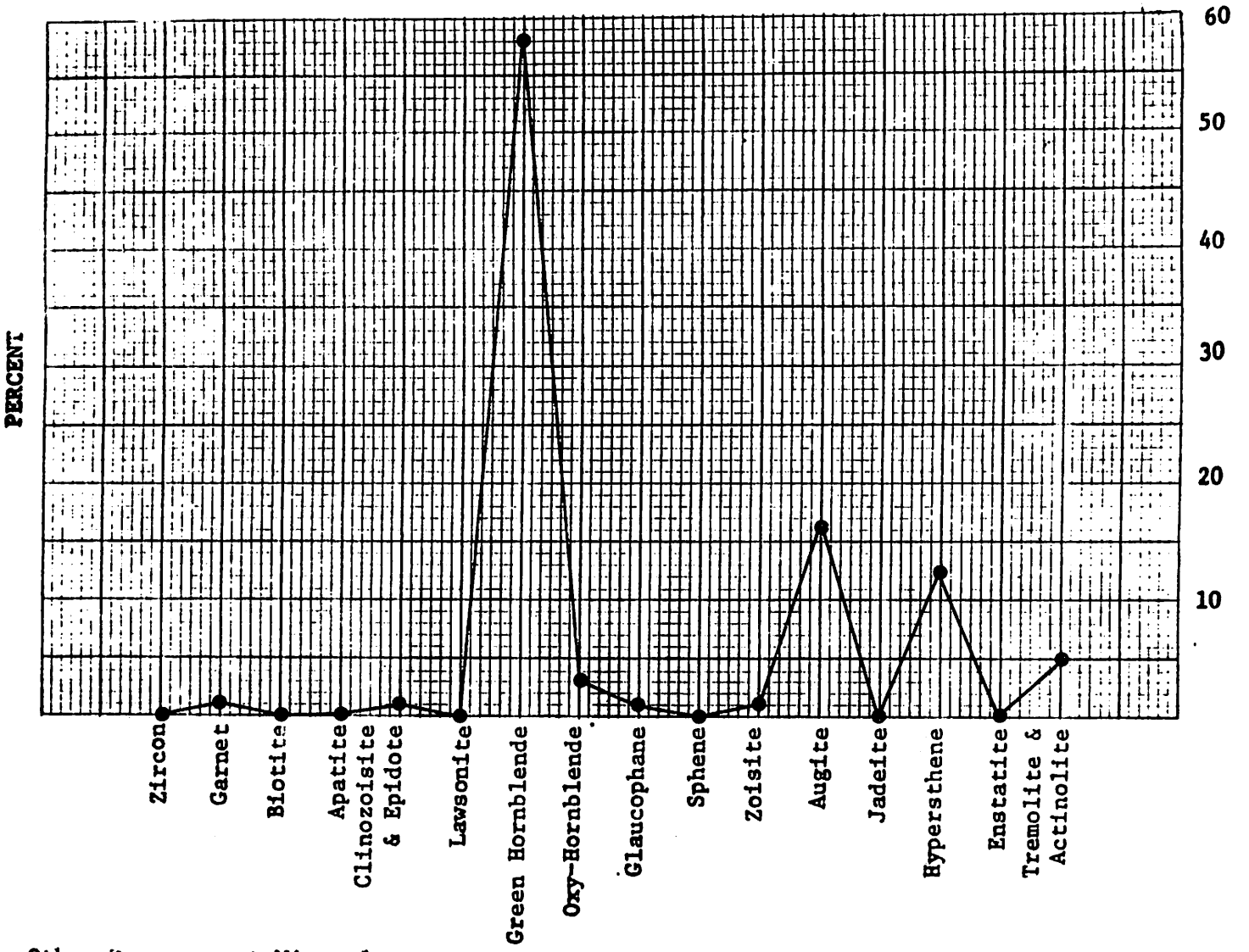
Wt. % of HM/SF --

Total Grains Counted 156

% Transparent Grains 64.1

% Opaques 34.6

% Composite Gr. and Unknowns 1.3



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	54
Unknowns	2

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2320

Location 36° 52.6' 121° 49'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

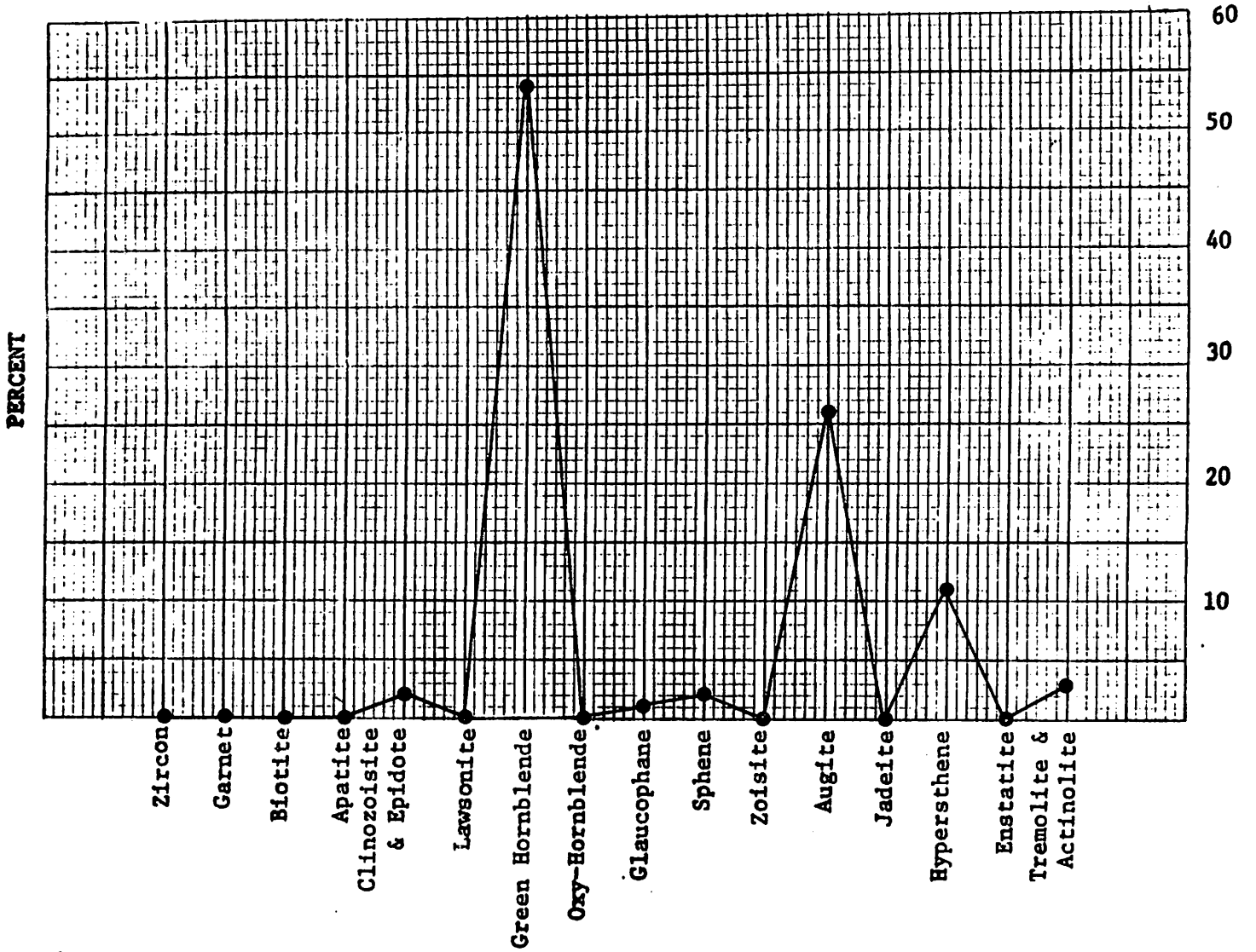
Wt. % of HM/SF - -

Total Grains Counted 141

% Transparent Grains 71.0

% Opaques 28.4

% Composite Gr. and Unknowns 0.6



Other Transparent Minerals

Mineral	No. Grains Counted
Opaque & Alterites	40
Unknowns	1

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2321

Location 36° 52.1' 121° 48.7'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

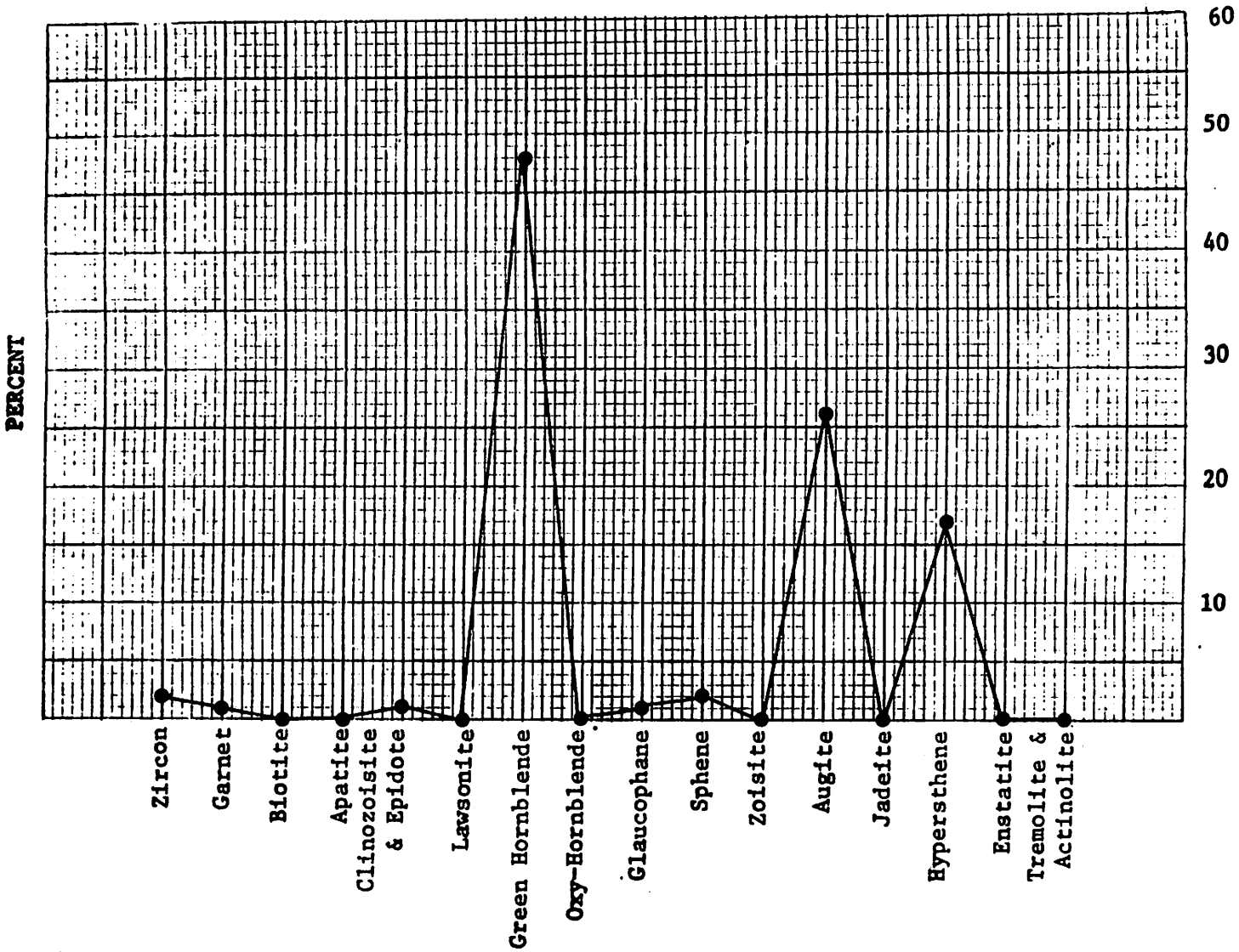
Wt. % of HM/SF --

Total Grains Counted 175

% Transparent Grains 57.1

% Opaques 41.7

% Composite Gr. and Unknowns 1.2



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	73
Unknowns	2

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2322

Location 36° 51.2' 121° 47.8'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

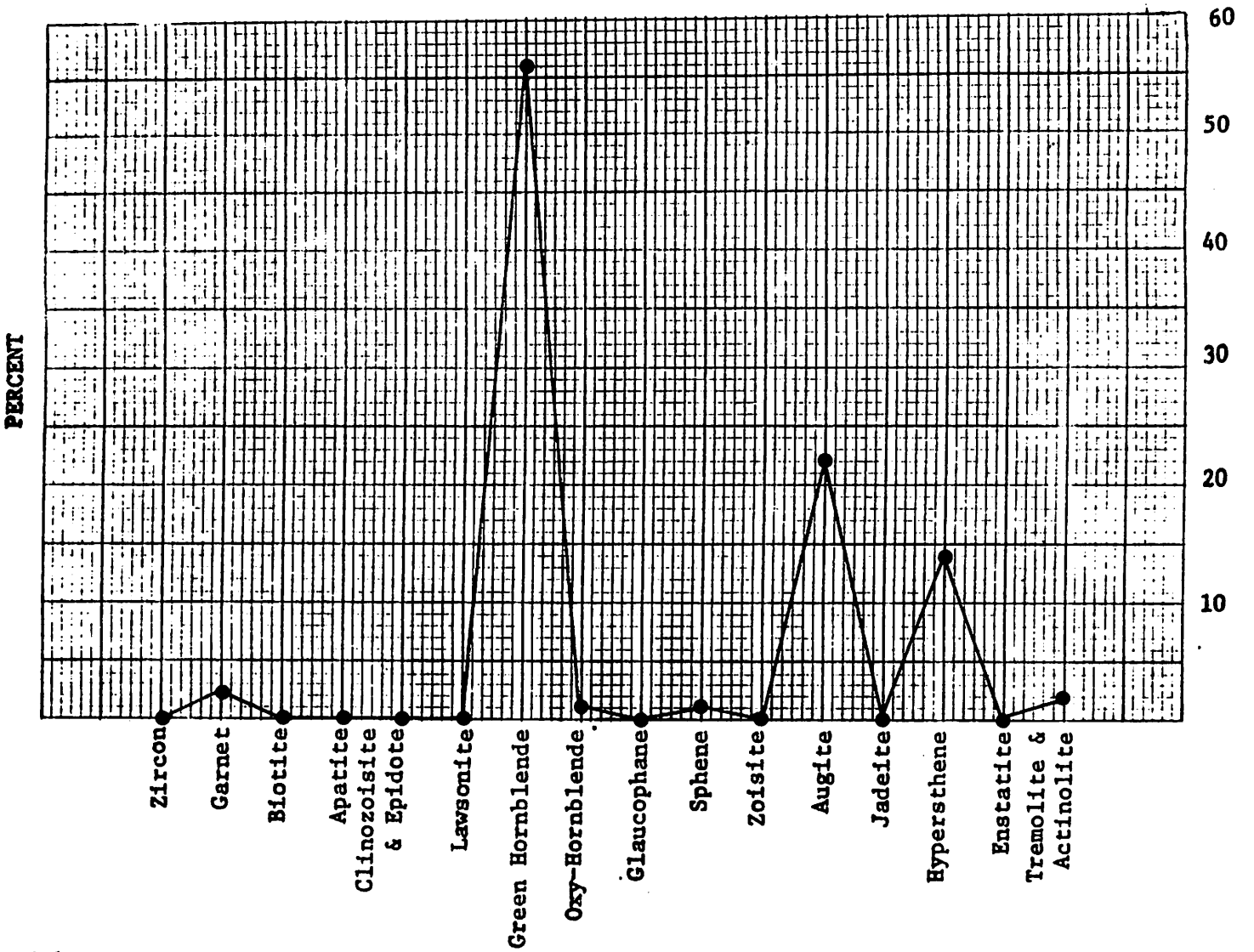
Wt. % of HM/SF —

Total Grains Counted 142

% Transparent Grains 70.4

% Opaques 28.2

% Composite Gr. and Unknowns 1.4



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	40
Unknowns	2

Other Opaque Minerals

Mineral	No Grains Counted

Analyst E. SAYLES

SAMPLE 2323

Location 36° 50.9' 121° 47.8'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

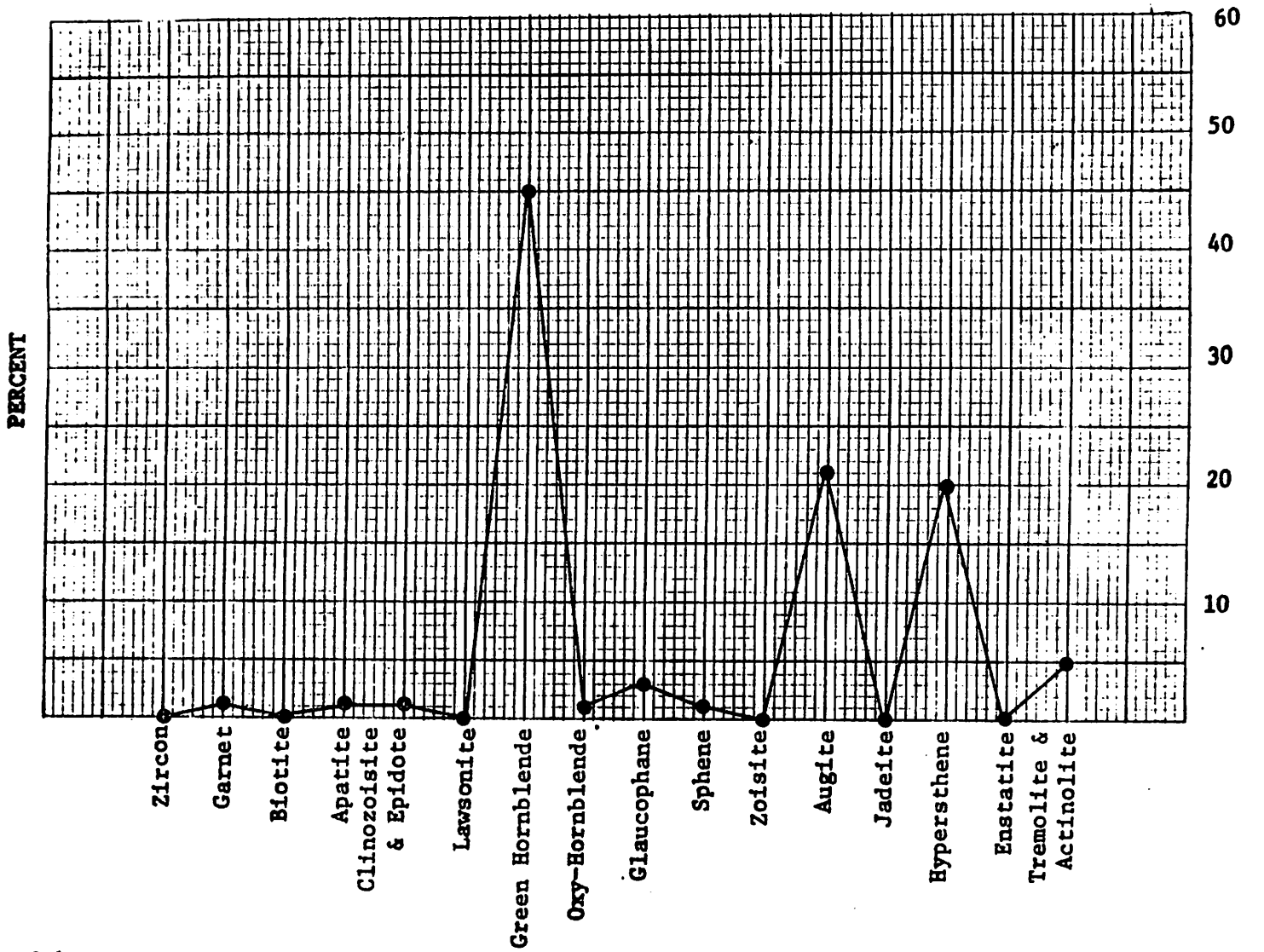
Wt. % of HM/SF --

Total Grains Counted 161

% Transparent Grains 62.1

% Opaques 37.3

% Composite Gr. and Unknowns 0.6



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	60
Unknowns	1

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2324

Location 36° 49.9' 121° 47.7'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

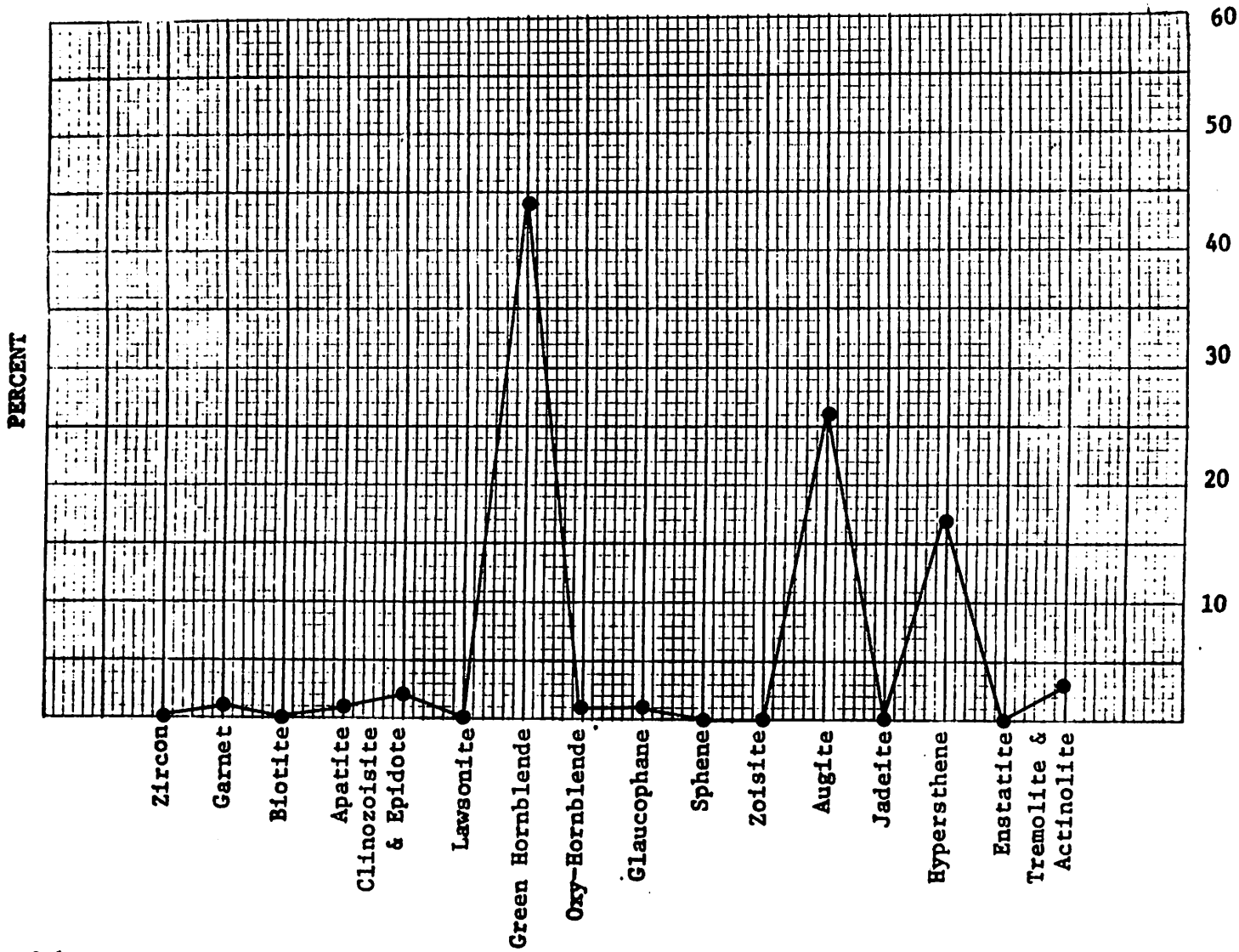
Wt. % of HM/SF --

Total Grains Counted 172

% Transparent Grains 58.2

% Opaques 39.5

% Composite Gr. and Unknowns 2.3



Other Transparent Minerals

Mineral	No. Grains Counted
Opaque & Alterites	68
Unknowns	4

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2325

Location 36° 49.7' 121° 47.7'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

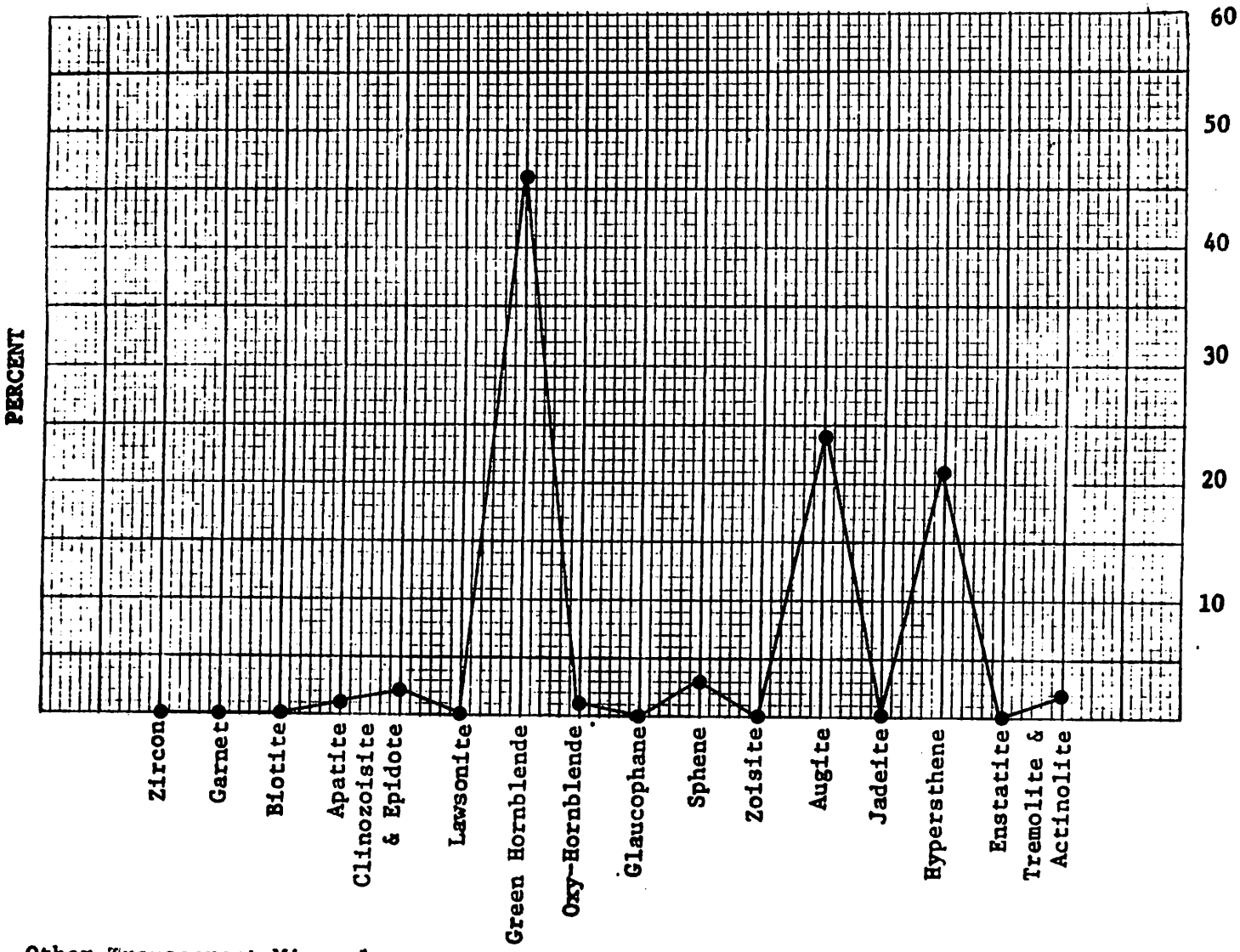
Wt. % of HM/SF --

Total Grains Counted 173

% Transparent Grains 57.8

% Opaques 42.2

% Composite Gr. and Unknowns 0



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	73

Other Opaque Minerals

Mineral	No. Grains Counted

SAMPLE 2326

Location 36° 49.4' 121° 47.6'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

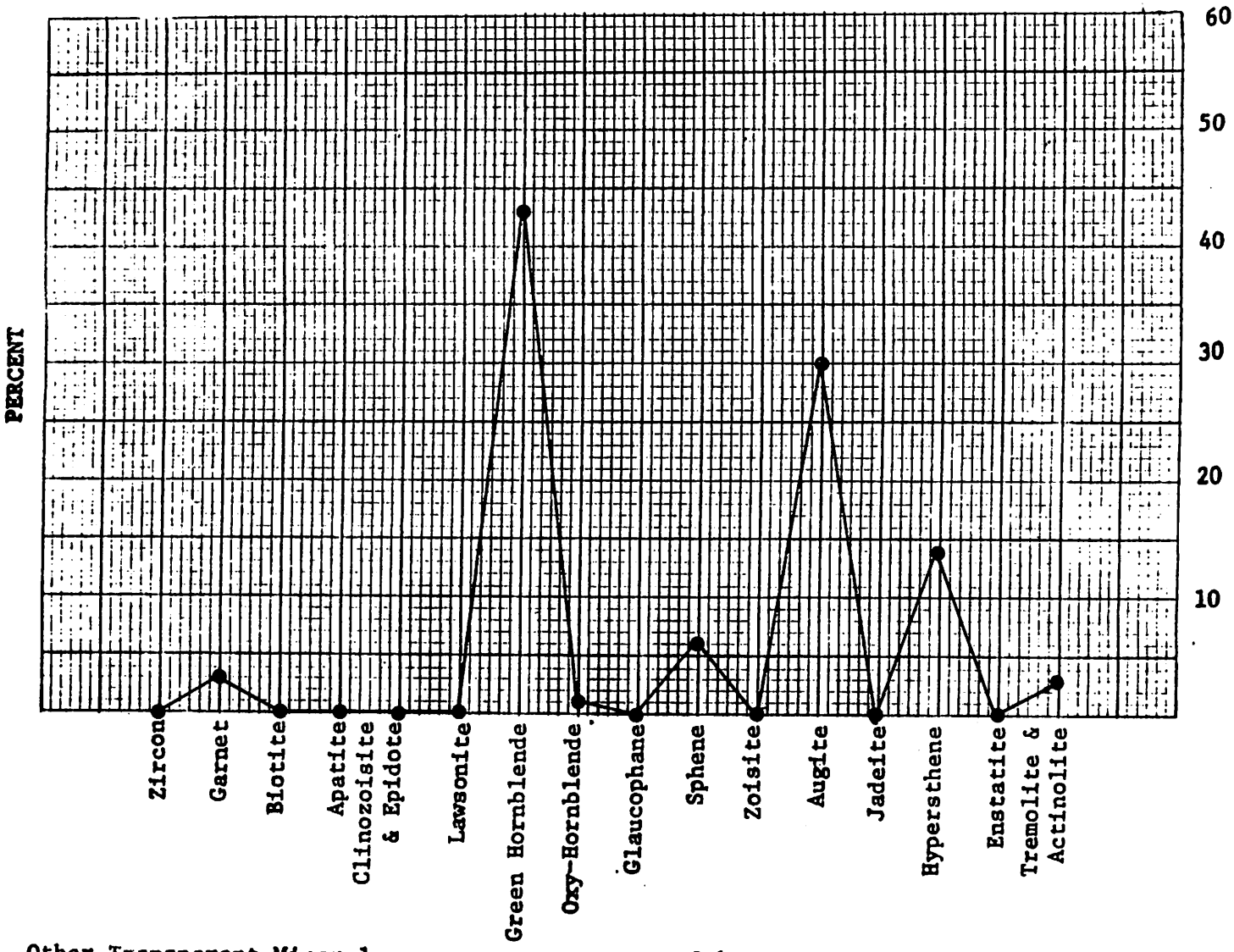
Wt. % of HM/SF --

Total Grains Counted 168

% Transparent Grains 59.5

% Opaques 39.9

% Composite Gr. and Unknowns 0.6



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	67
Unknowns	1

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2327

Location 36° 48.8' 121° 47.2'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

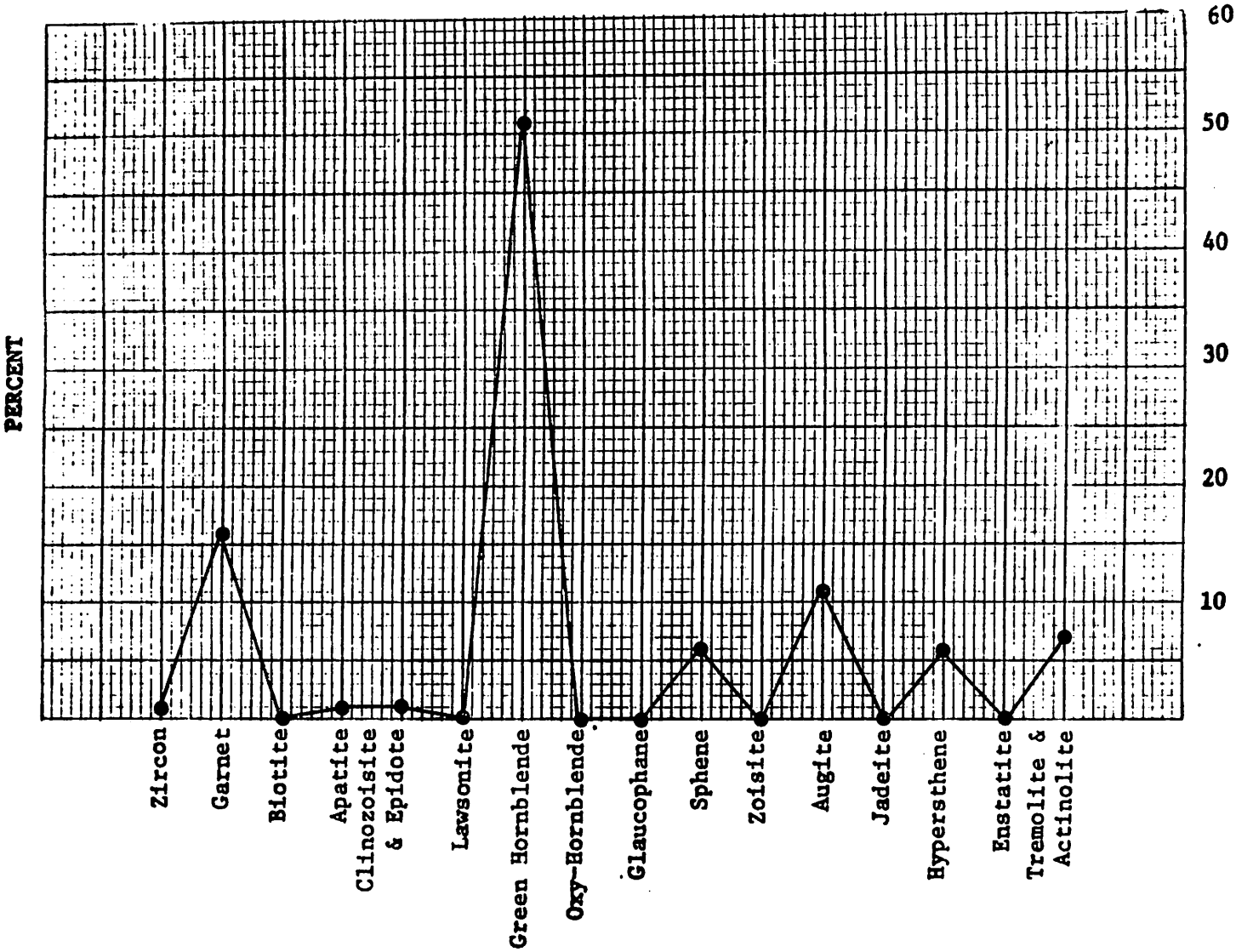
Wt. % of HM/SF --

Total Grains Counted 151

% Transparent Grains 66.2

% Opaques 33.8

% Composite Gr. and Unknowns 0



Other Transparent Minerals		Other Opaque Minerals	
Mineral	No. Grains Counted	Mineral	No Grains Counted
Opaques & Alterites	51		

SAMPLE 2328

Location 36° 48.1' 121° 47.2'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

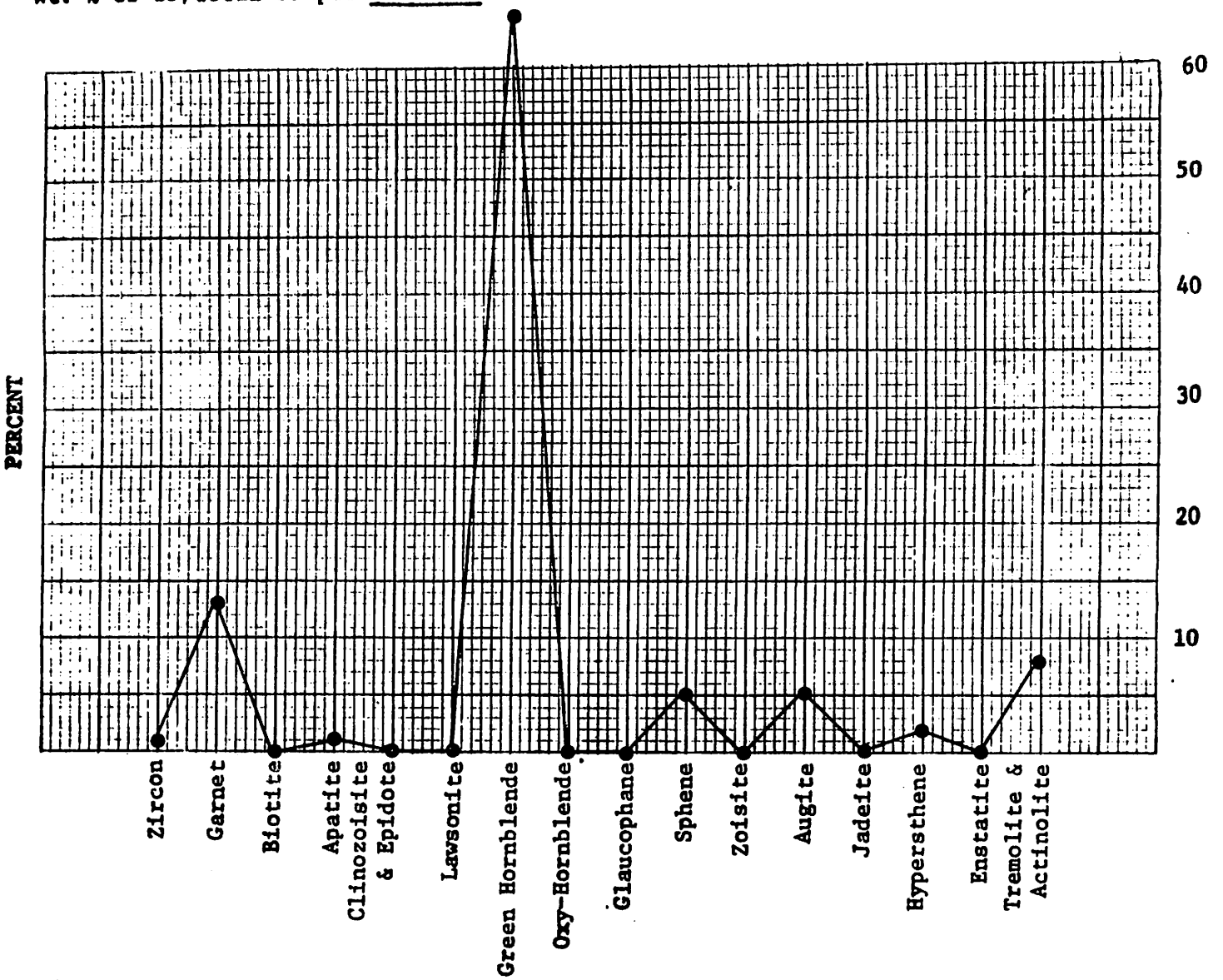
Wt. % of HM/SF --

Total Grains Counted 137

% Transparent Grains 72.9

% Opaques 26.3

% Composite Gr. and Unknowns 0.8



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	36
Unknown	1

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2329

Location 36° 46.9' 121° 47.3'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

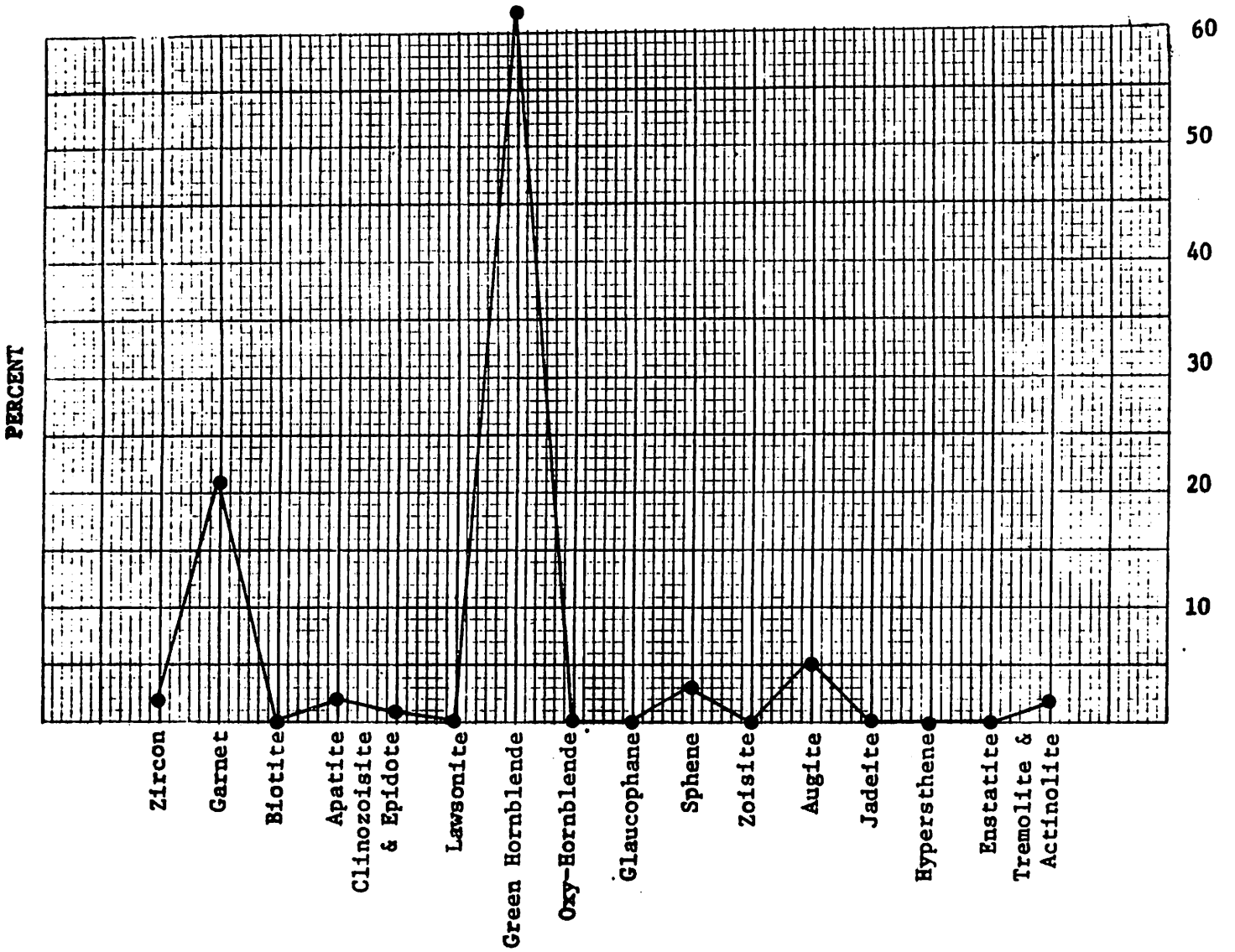
Wt. % of HM/SF --

Total Grains Counted 135

% Transparent Grains 74.0

% Opaques 24.4

% Composite Gr. and Unknowns 1.6



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	33
Unknowns	2

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2330

Location 36° 46.1' 121° 47.5'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

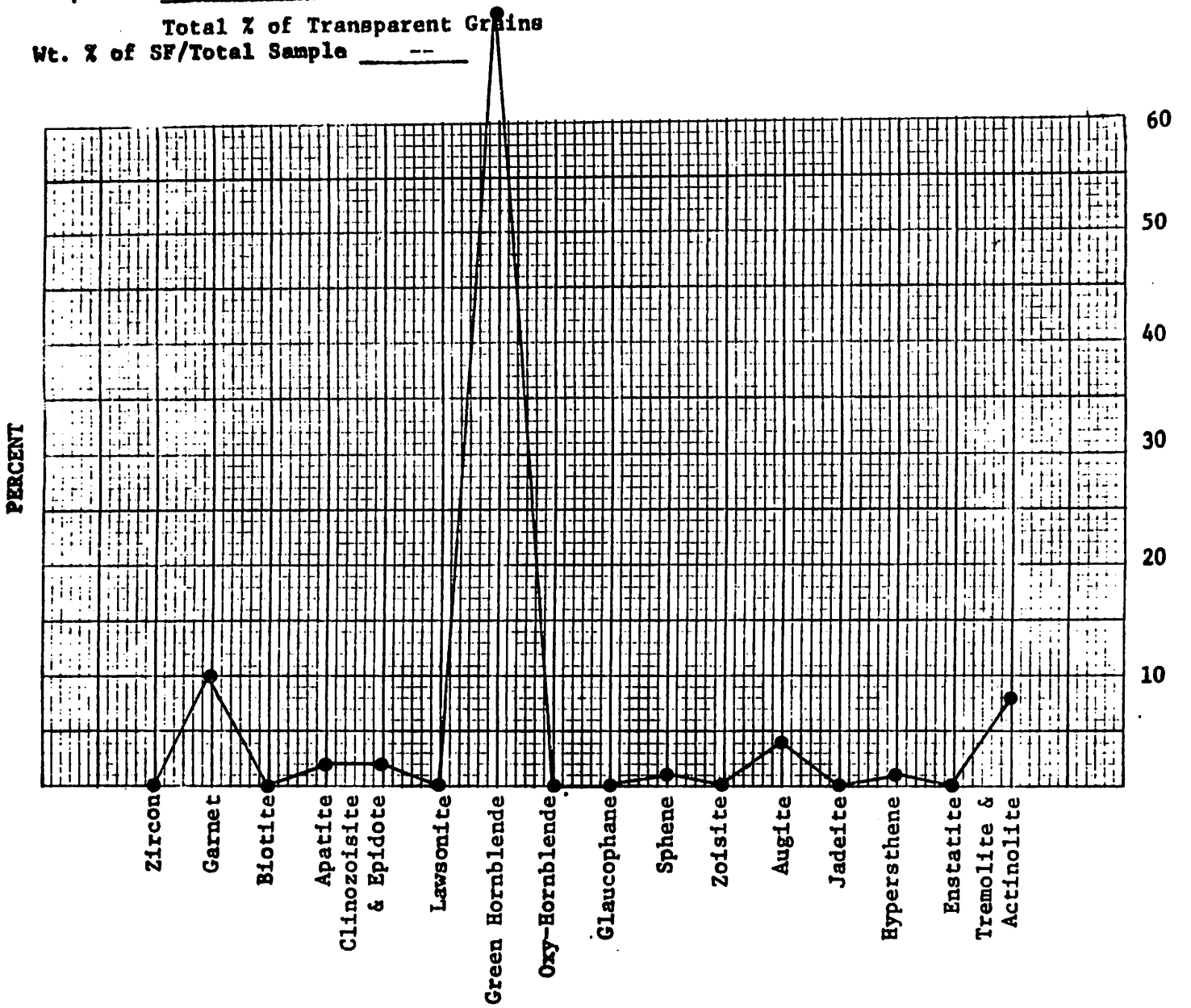
Wt. % of HM/SF --

Total Grains Counted 145

% Transparent Grains 69.0

% Opaques 29.6

% Composite Gr. and Unknowns 1.4



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	43
	2

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2331

Location 36° 44.9' 121° 48'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

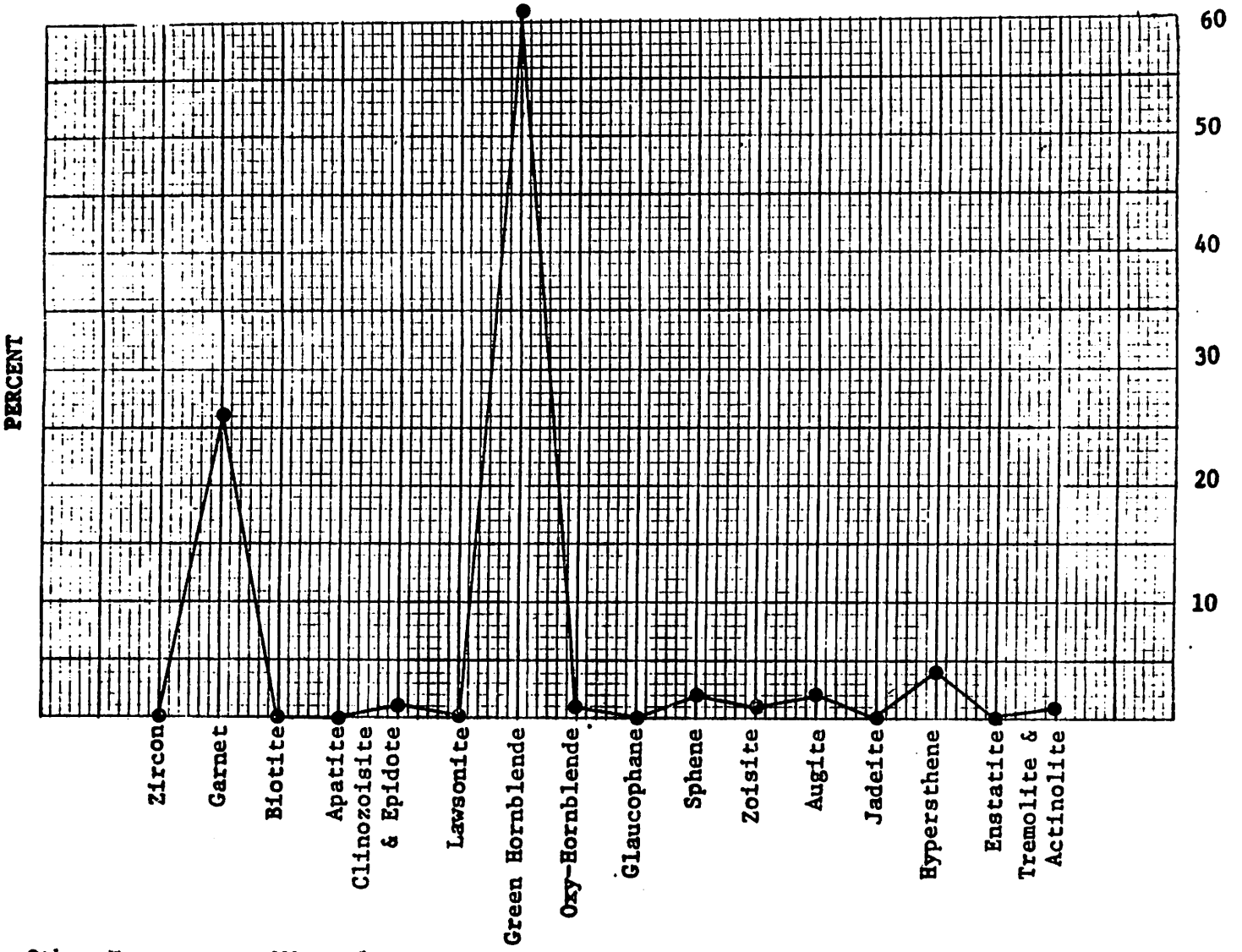
Wt. % of HM/SF --

Total Grains Counted 157

% Transparent Grains 63.7

% Opaques 35.7

% Composite Gr. and Unknowns 0.6



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	56
Unknowns	1

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2332

Location 36° 43.9' 121° 48.1'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

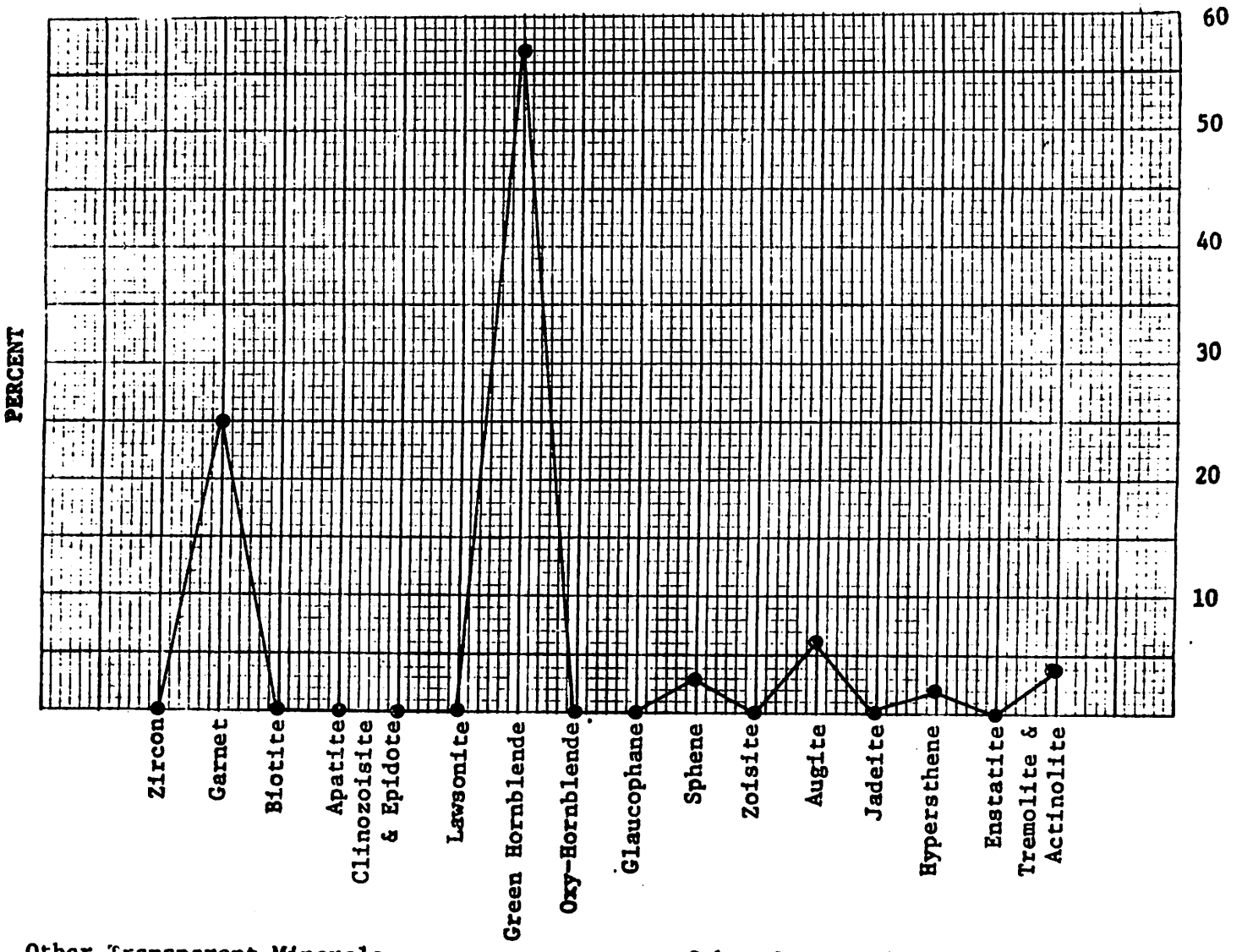
Wt. % of HM/SF --

Total Grains Counted 142

% Transparent Grains 70.4

% Opaques 27.5

% Composite Gr. and Unknowns 1.9



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	39
Unknowns	3

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2333

Location 36° 42.7' 121° 48.1'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

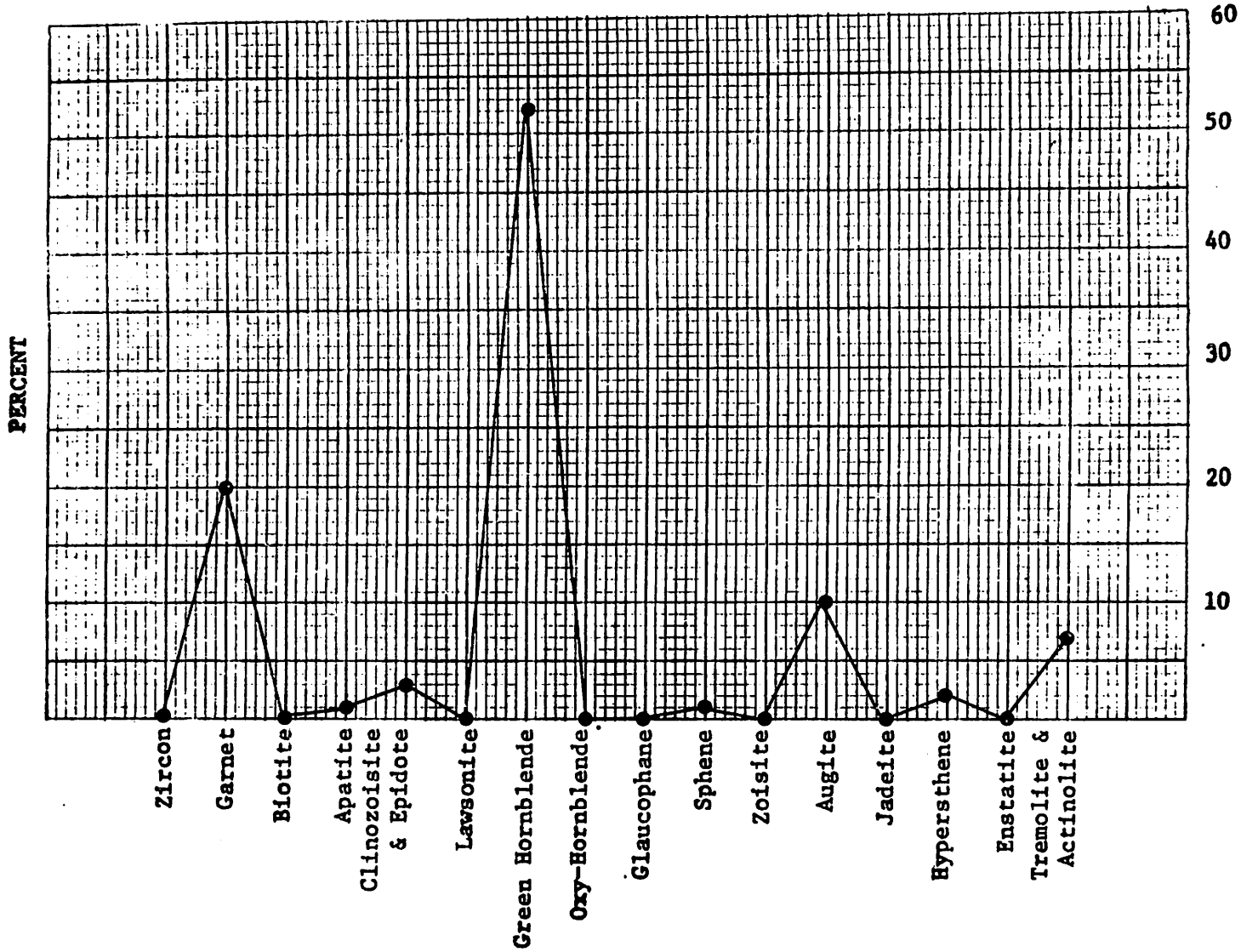
Wt. % of HM/SF --

Total Grains Counted 149

% Transparent Grains 67.0

% Opaques 30.2

% Composite Gr. and Unknowns 2.8



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	45
Unknowns	4

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2334

Location 36° 41.4' 121° 48.4'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

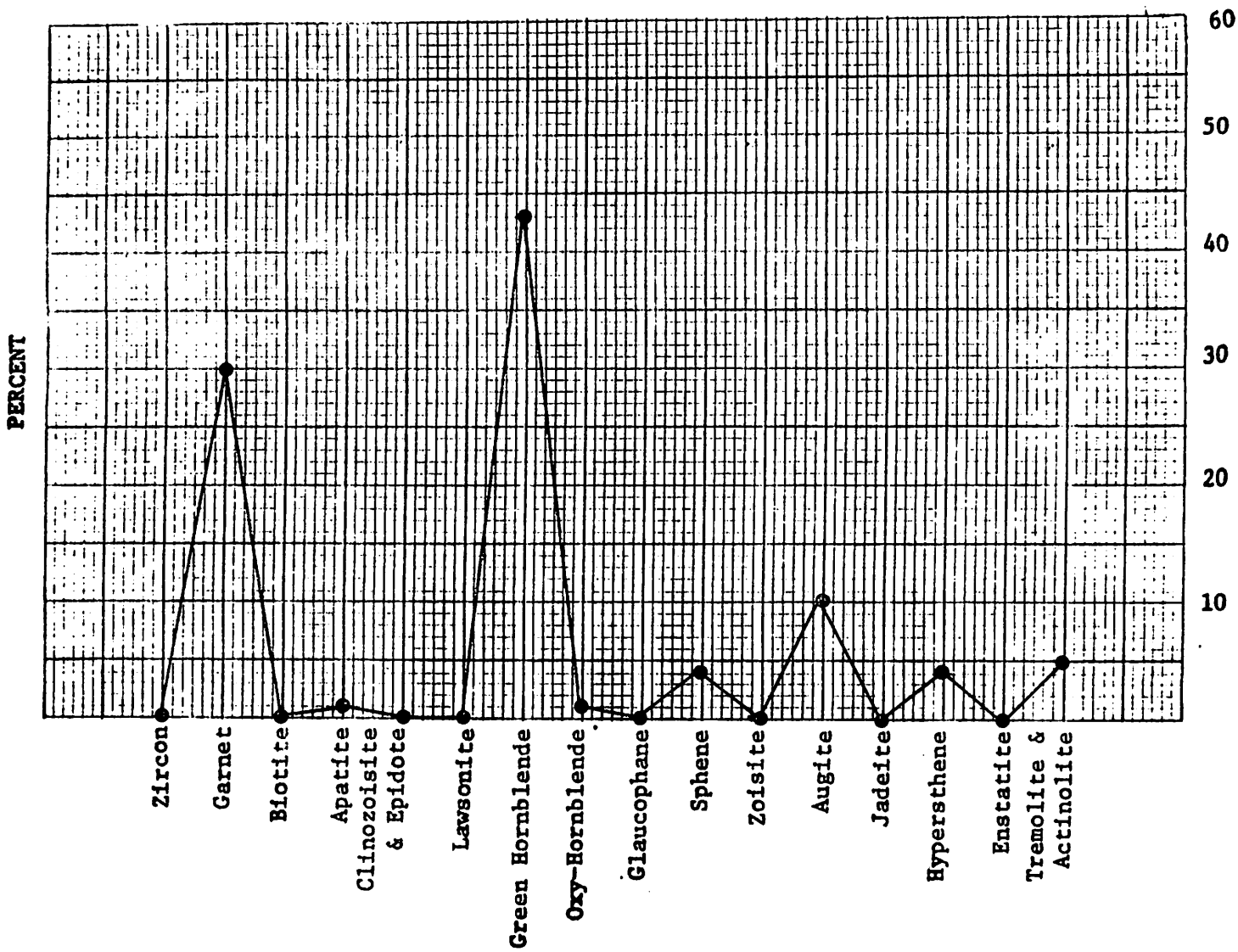
Wt. % of HM/SF --

Total Grains Counted 146

% Transparent Grains 68.5

% Opaques 30.2

% Composite Gr. and Unknowns 1.3



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	44
Unknown	2

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2335

Location 36° 40.7' 121° 48.7'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

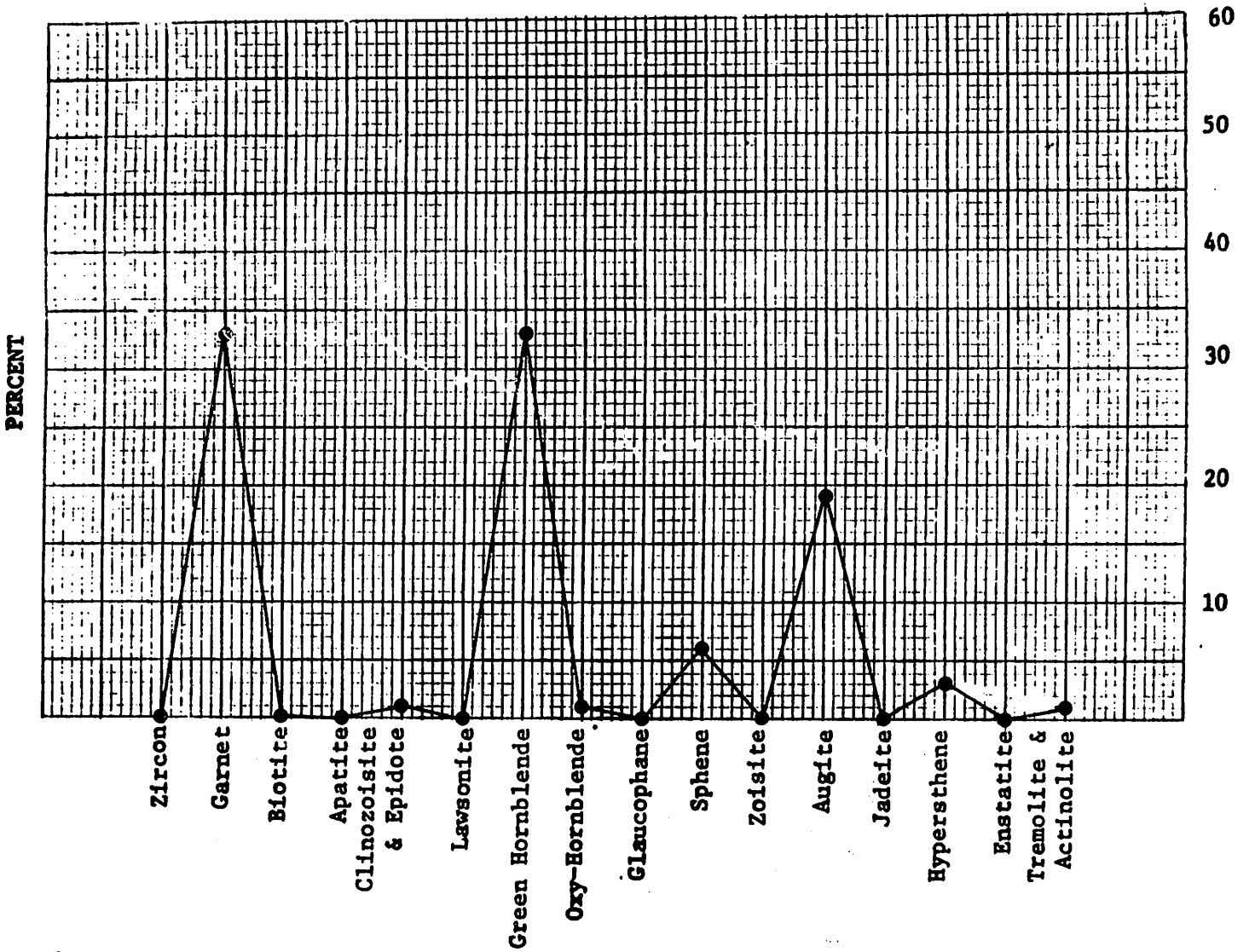
Wt. % of HM/SF --

Total Grains Counted 175

% Transparent Grains 57.2

% Opaques 41.1

% Composite Gr. and Unknowns 1.7



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	72
Unknowns	3

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2336

Location 36° 37.3' 121° 54'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

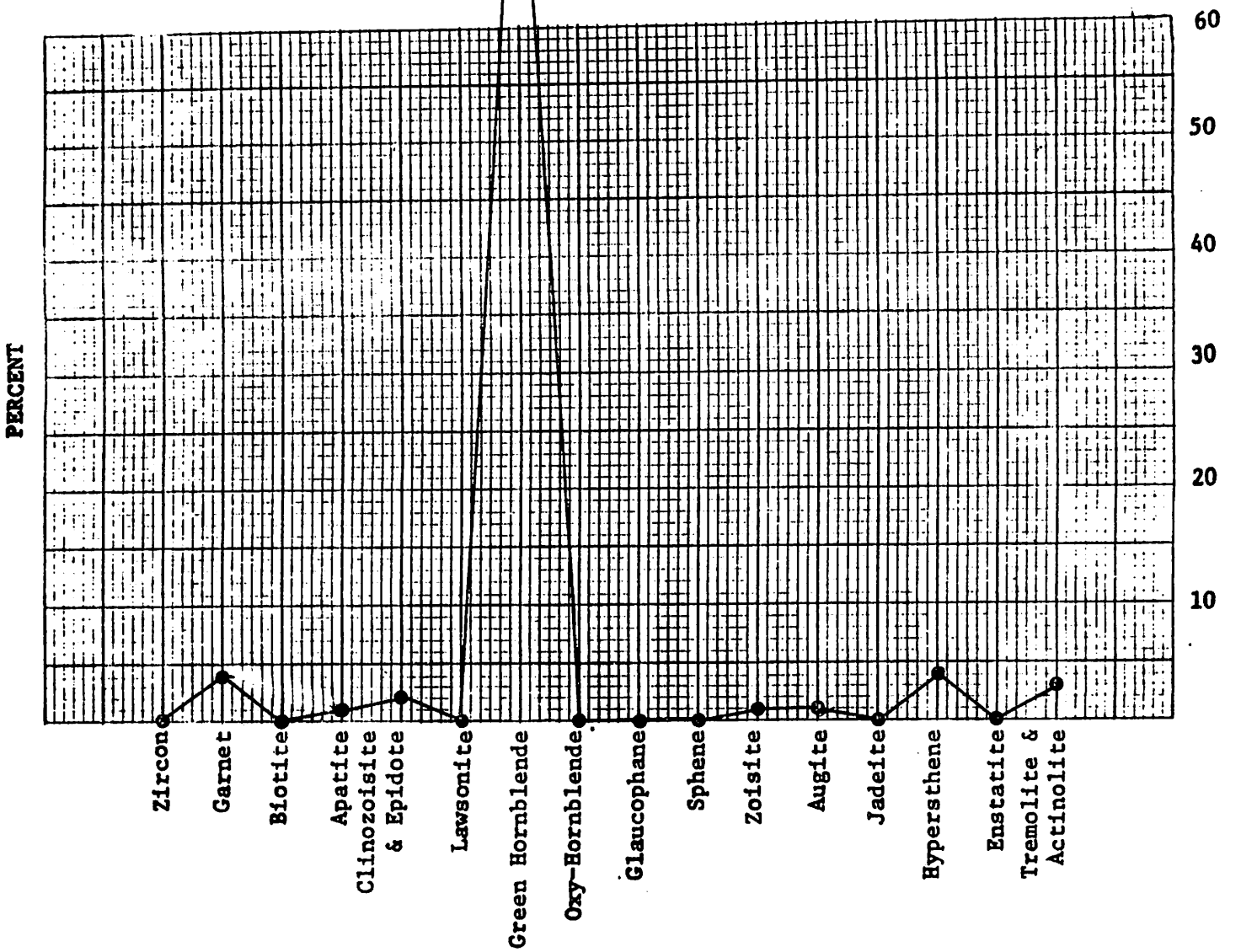
Wt. % of HM/SF --

Total Grains Counted 261

% Transparent Grains 38.3

% Opaques 61.0

% Composite Gr. and Unknowns 0.7



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	159
Unknowns	2

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2337

Location 36° 36.8' 121° 53.7'

Depth intertidal meters ____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

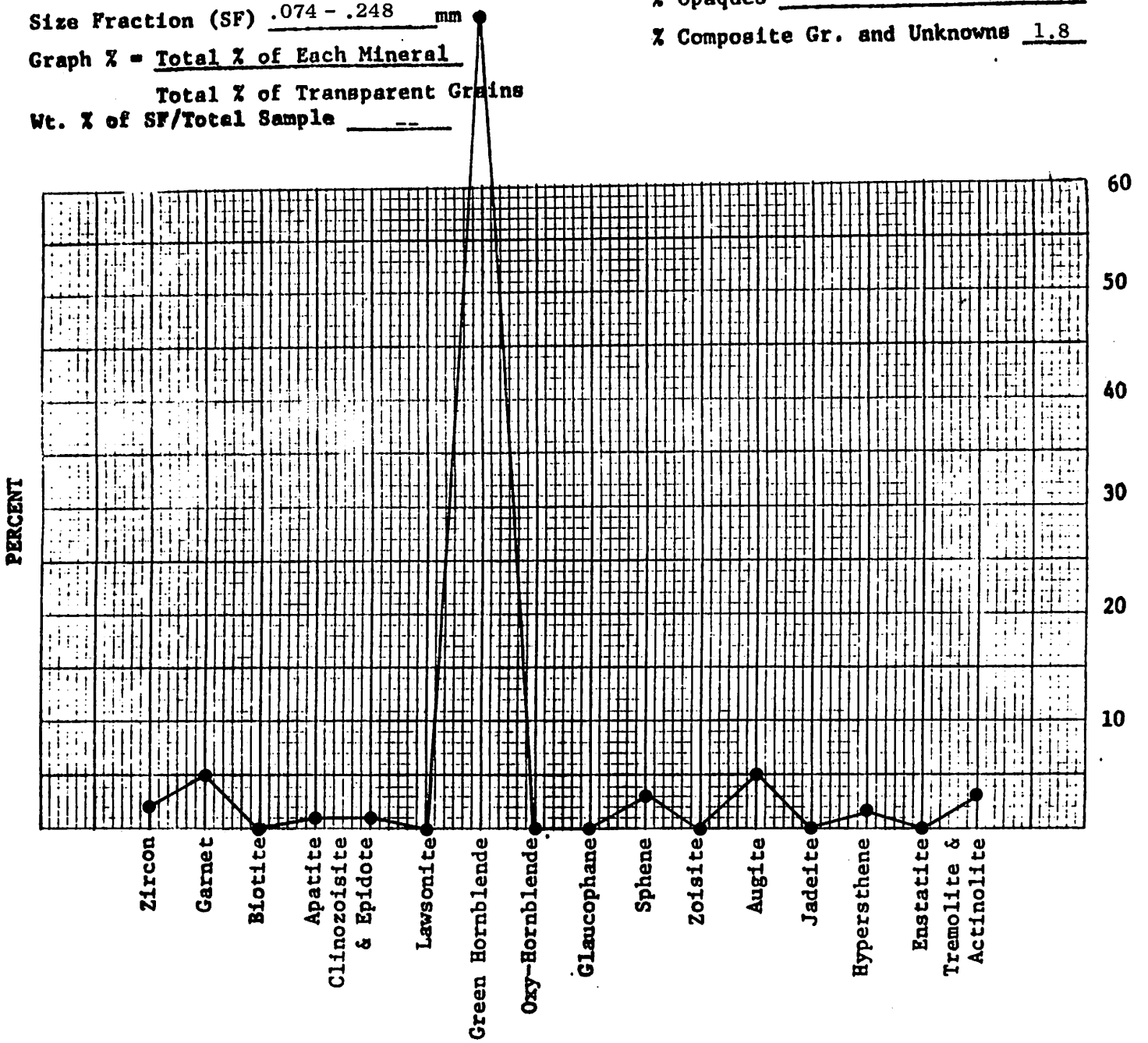
Wt. % of HM/SF --

Total Grains Counted 181

% Transparent Grains 55.2

% Opaques 43.0

% Composite Gr. and Unknowns 1.8



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	78
Unknowns	3

Other Opaque Minerals

Mineral	No. Grains Counted

SAMPLE 2339

Location 36° 36.5' 121° 52.3'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

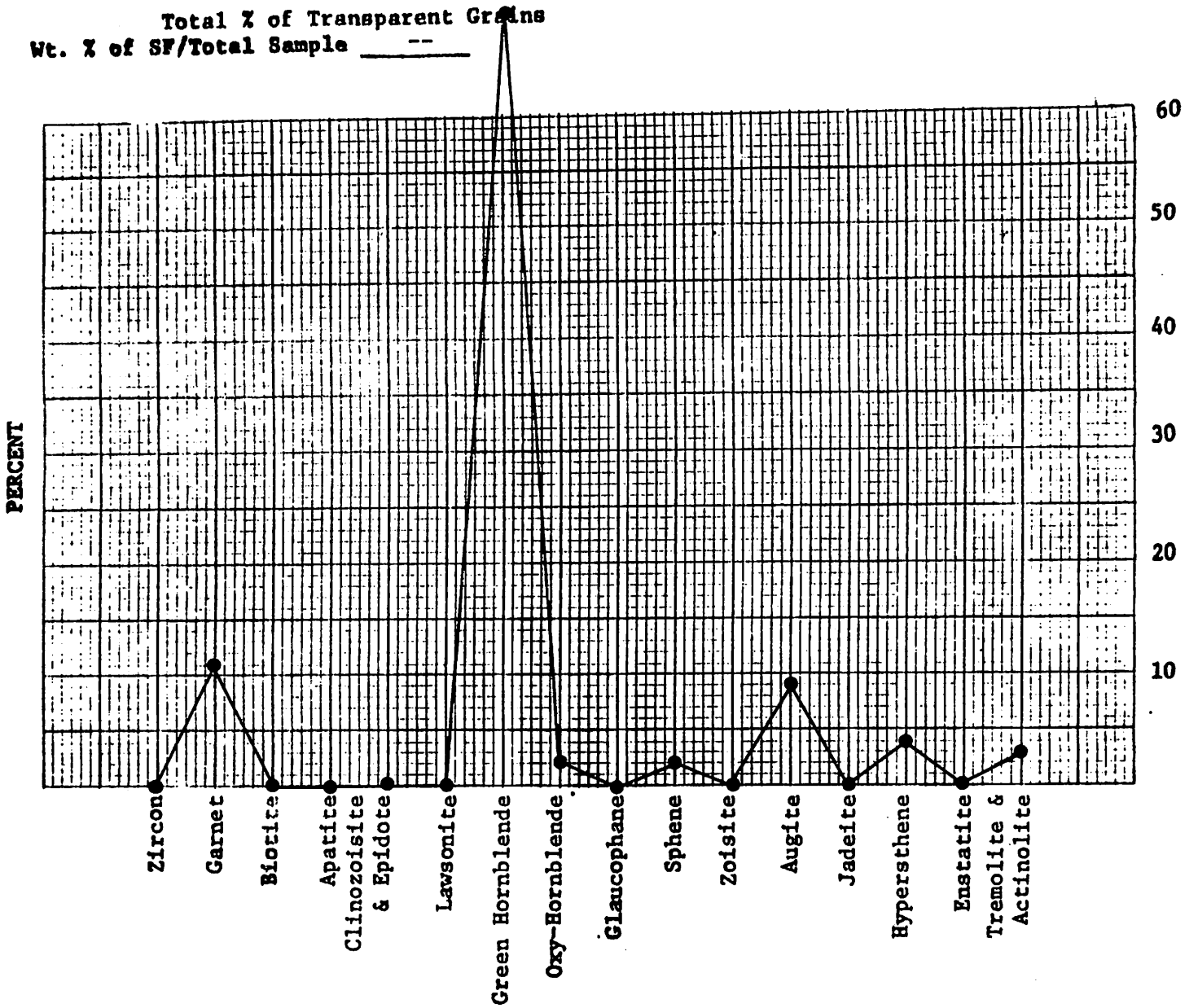
Wt. % of HM/SF --

Total Grains Counted 145

% Transparent Grains 69.0

% Opaques 31.0

% Composite Gr. and Unknowns 0



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	45

Other Opaque Minerals

Mineral	No. Grains Counted

SAMPLE 2340

Location 36° 36.9' 121° 51.5'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

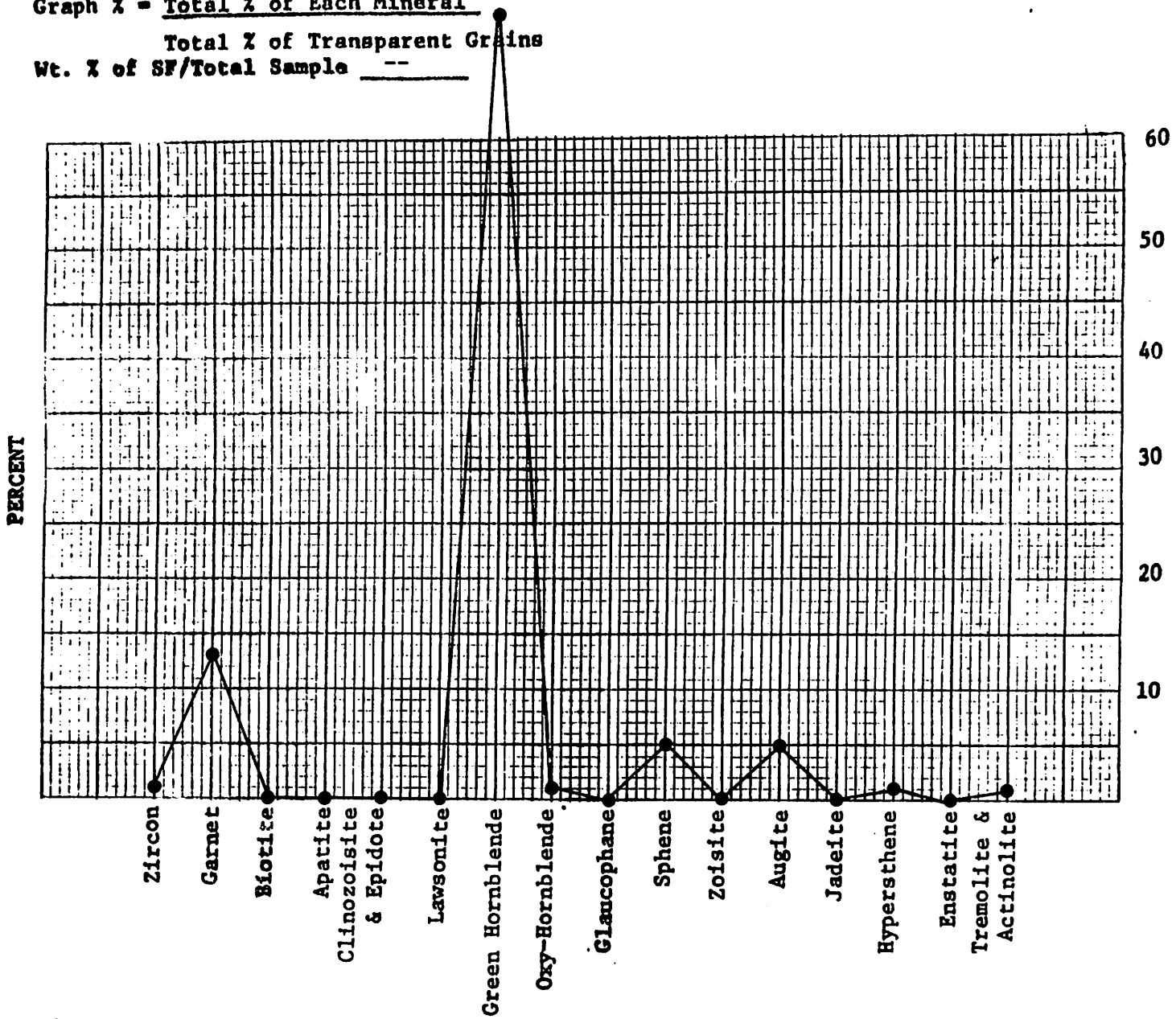
Wt. % of HM/SF --

Total Grains Counted 150

% Transparent Grains 66.6

% Opaques 32.0

% Composite Gr. and Unknowns 1.4



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	48
Unknowns	2

Other Opaque Minerals

Mineral	No. Grains Counted

SAMPLE 2341

Location 36° 37.4' 121° 50.9'

Depth intertidal meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

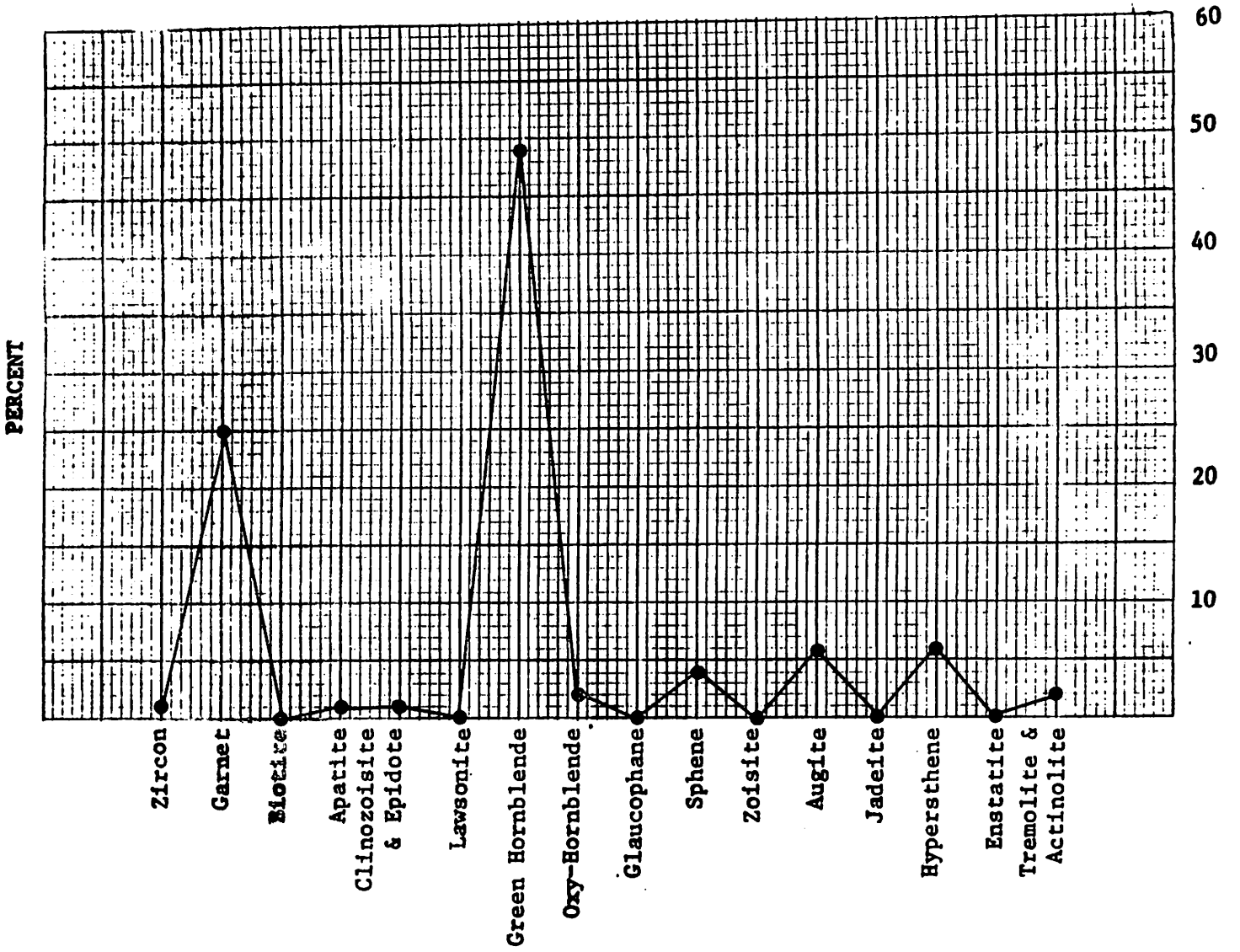
Wt. % of HM/SF --

Total Grains Counted 193

% Transparent Grains 51.8

% Opaques 46.6

% Composite Gr. and Unknowns 1.6



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	90
Unknown	3

Other Opaque Minerals

Mineral	No Grains Counted

SAMPLE 2342

Location 36° 40.7' 121° 44.4'

Depth stream meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

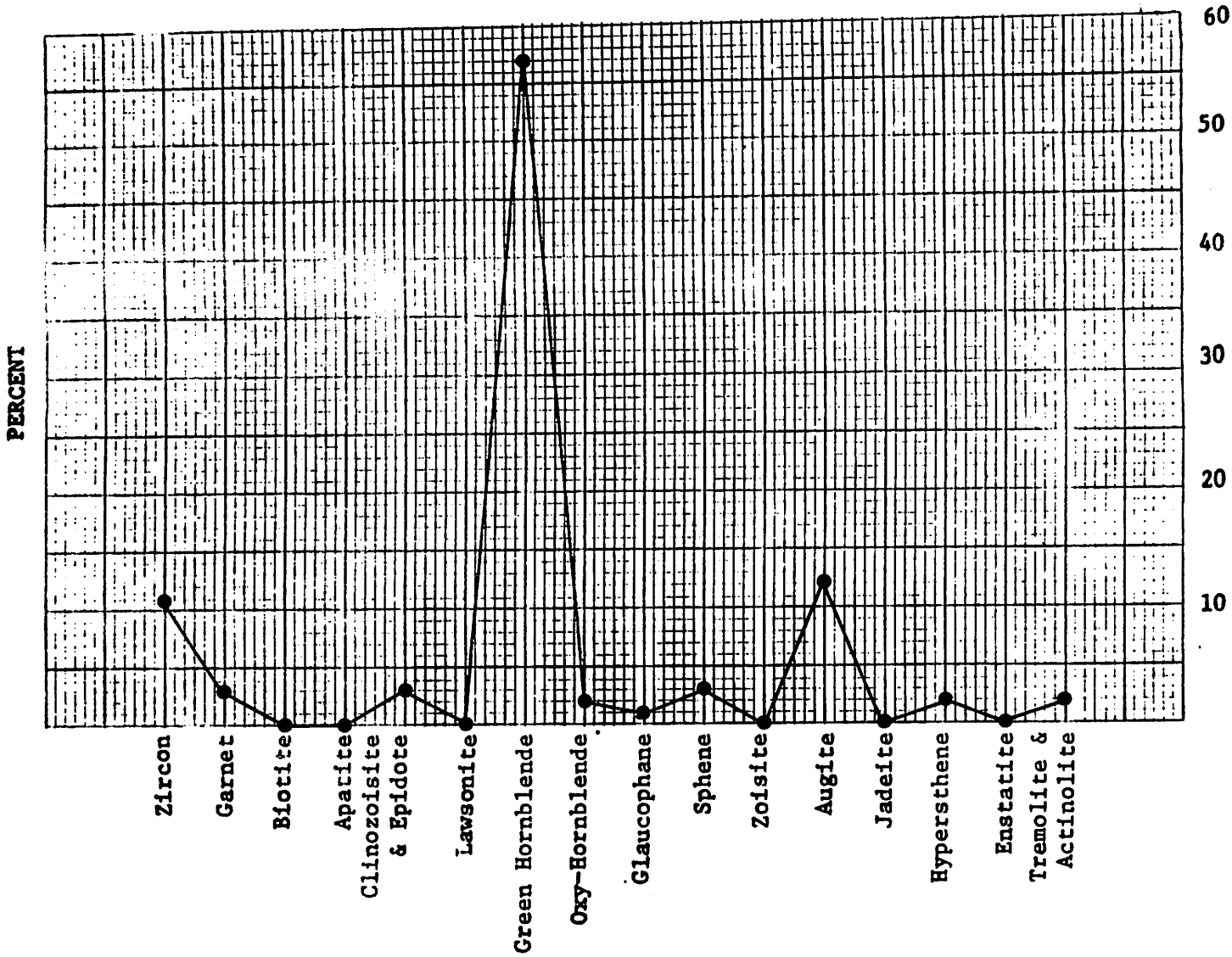
Wt. % of HM/SF --

Total Grains Counted 374

% Transparent Grains 26.7

% Opaques 72.2

% Composite Gr. and Unknowns 1.1



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	270
Unknown	4

Other Opaque Minerals

Mineral	No Grains Counted

Analyst F. SAYLES

SAMPLE 2343

Location 36° 53.5' 121° 45.9'

Depth stream meters _____ fathoms

Size Fraction (SF) .074 - .248 mm

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

Wt. % of SF/Total Sample --

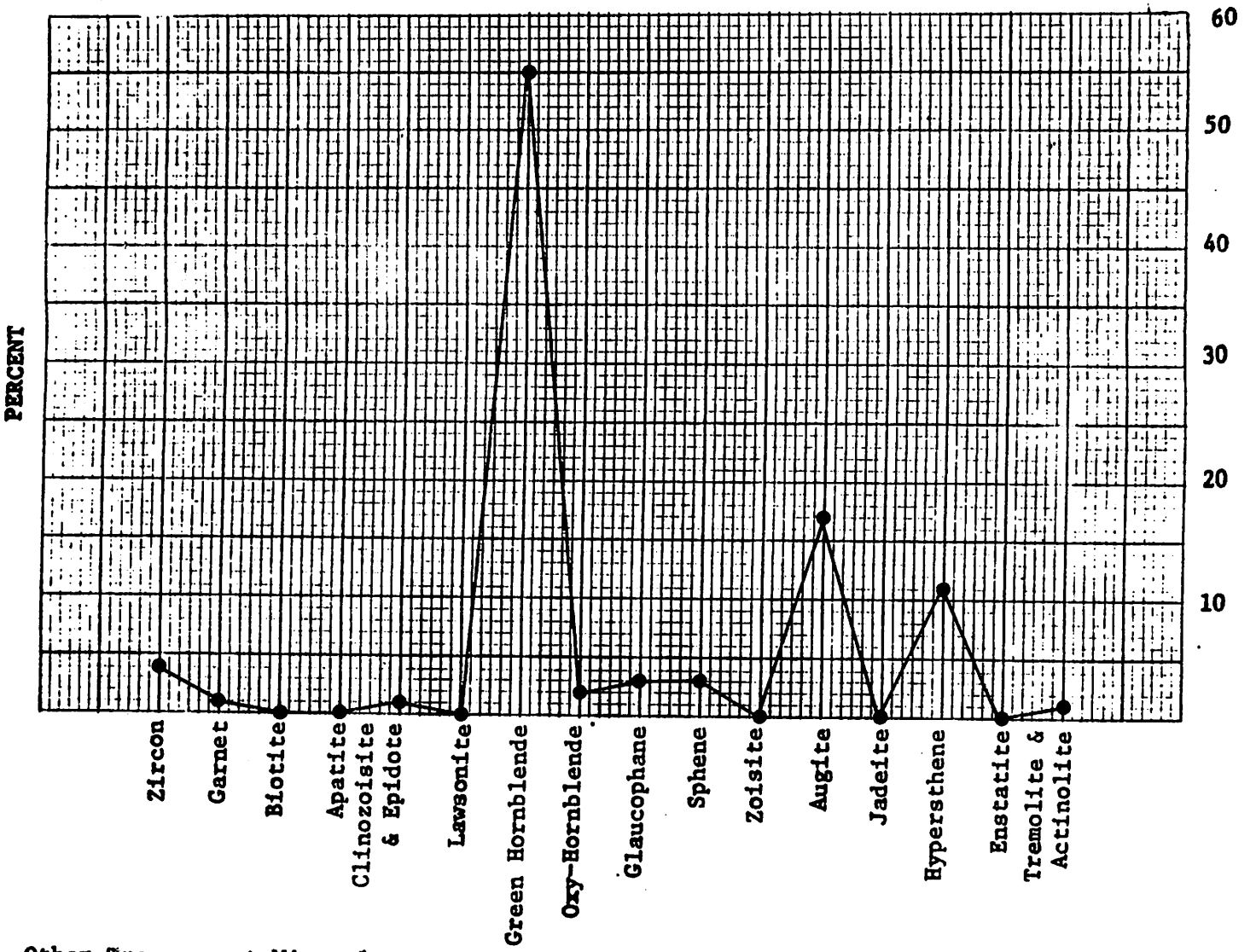
Wt. % of HM/SF --

Total Grains Counted 261

% Transparent Grains 38.3

% Opaques 61.0

% Composite Gr. and Unknowns 0.7



Other Transparent Minerals

Mineral	No. Grains Counted
Opaques & Alterites	159
Unknowns	2

Other Opaque Minerals

Mineral	No. Grains Counted

SAMPLE 2351

Location 36° 42.5' 121° 54.8'

Depth 89.2 meters 49 fathoms

Size Fraction (SF) .062 - .350 mm

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

Wt. % of SF/Total Sample 2.5

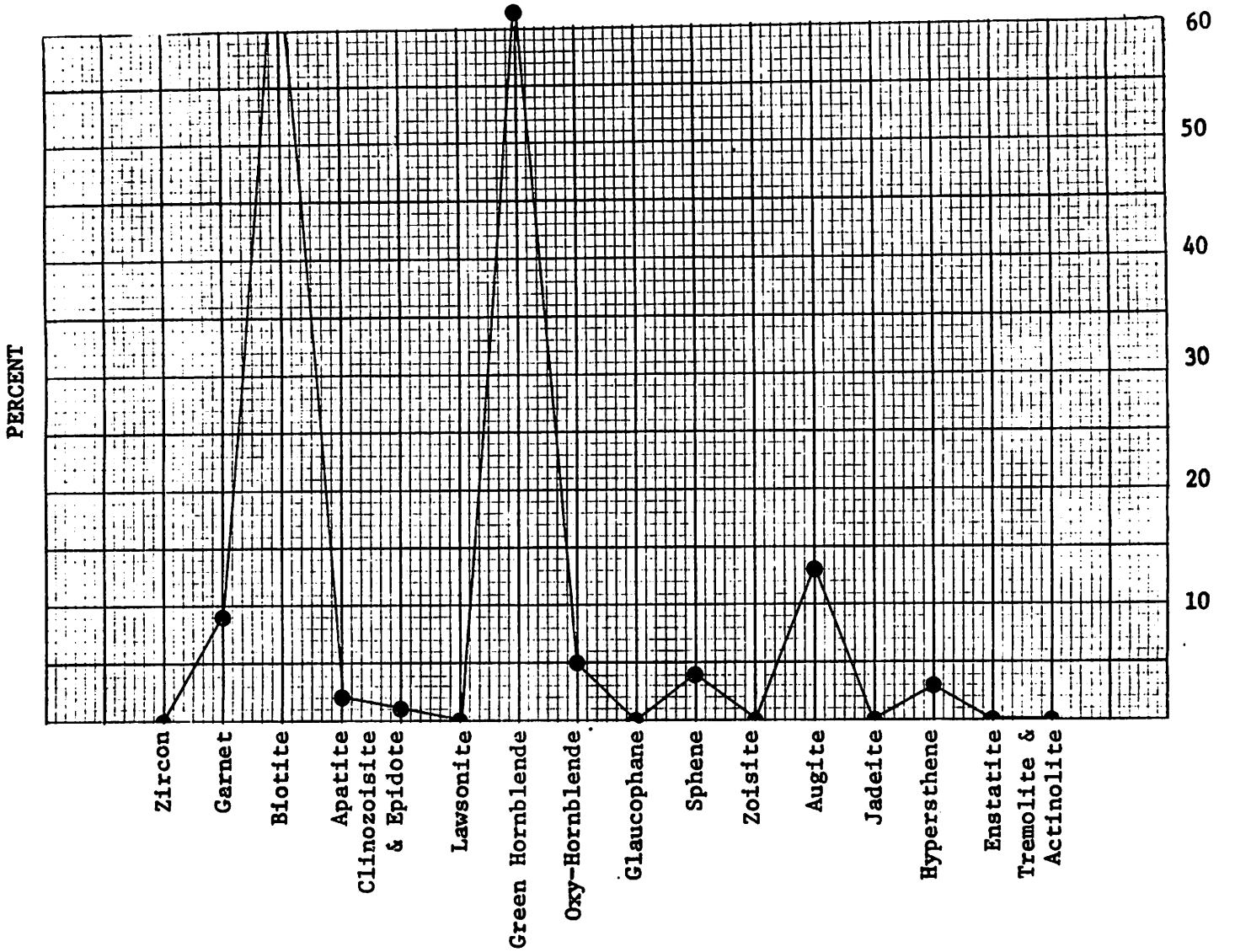
Wt. % of HM/SF --

Total Grains Counted 222

% Transparent Grains 45.0

% Opaques 8.1

% Composite Gr. and Unknowns 12.6



Other Transparent Minerals

Mineral	No. Grains Counted
Detrital Carbonate	1
Unknowns	1
Composites - Alterites	27

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite Ilmenite	15
Hematite - Goethite	2
Pyrite	1

Analyst T. YANCEY

SAMPLE 2352

Location 36° 42.5' 121° 52.5'

Depth 71.0 meters 39 fathoms

Size Fraction (SF) .062 - .350 mm

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

Wt. % of SF/Total Sample 3.3

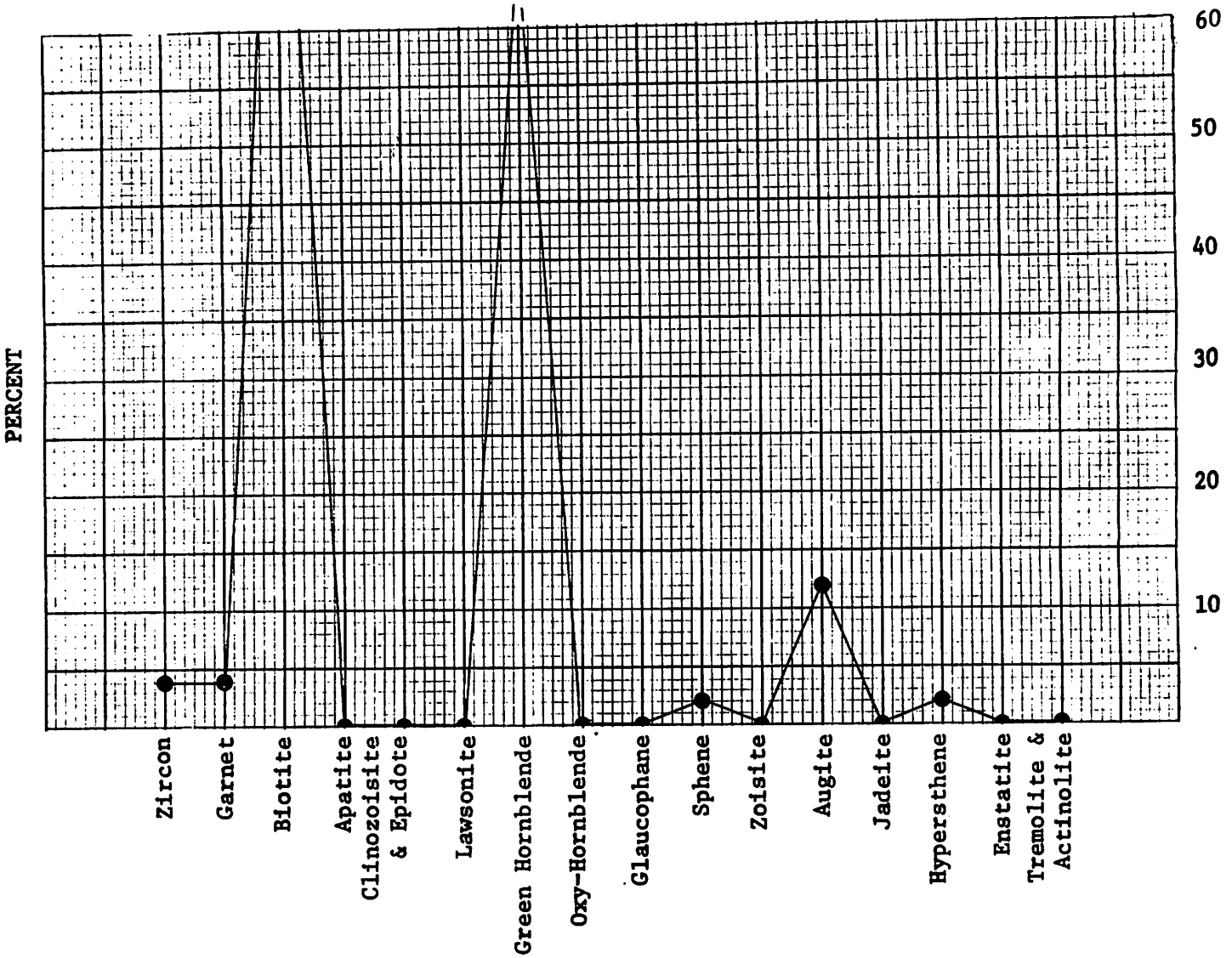
Wt. % of HM/SF --

Total Grains Counted 16.70

% Transparent Grains 6.0

% Opaques 0.1

% Composite Gr. and Unknowns 1.1



Other Transparent Minerals

Mineral	No. Grains Counted
Biotite	1550
Unknowns	2
Composites - Alterites	16

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite - Ilmenite	2

SAMPLE 2353

Location 36° 41.9' 121° 50.8'

Depth 52.8 meters 29 fathoms

Size Fraction (SF) .062 - .350 mm

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

Wt. % of SF/Total Sample 15.0

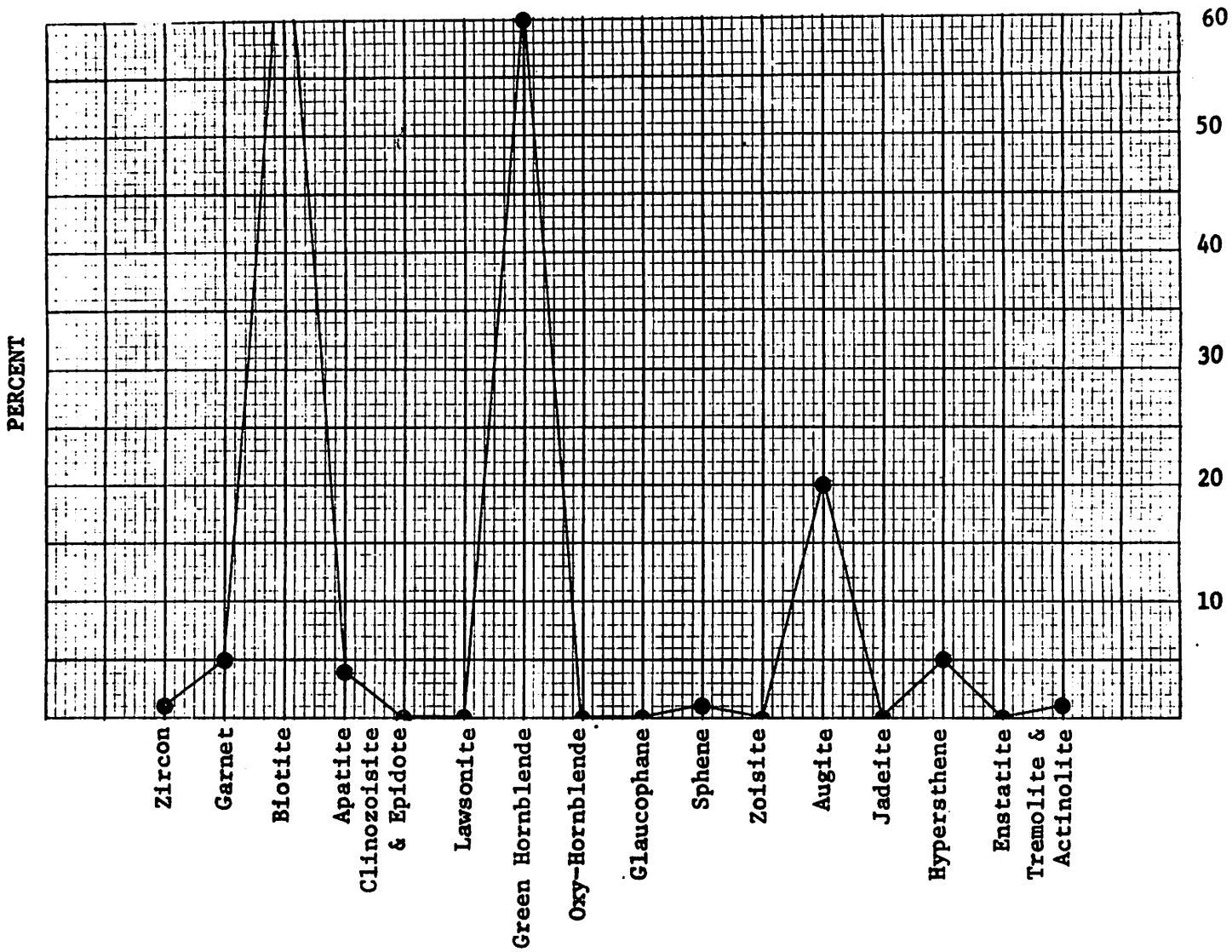
Wt. % of HM/SF --

Total Grains Counted 361

% Transparent Grains 27.7

% Opaques 1.7

% Composite Gr. and Unknowns 36.3



Other Transparent Minerals

Mineral	No. Grains Counted
Detrital Carbonate	3
Unknowns	1
Composites - Alterites	130

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite - Ilmenite	4
Hematite - Goethite	1
Pyrite	1

SAMPLE 2354

Location 36° 41.4' 121° 50.1'

Depth 36.4 meters 20 fathoms

Size Fraction (SF) .062 - .350 mm

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

Wt. % of SF/Total Sample 93.7

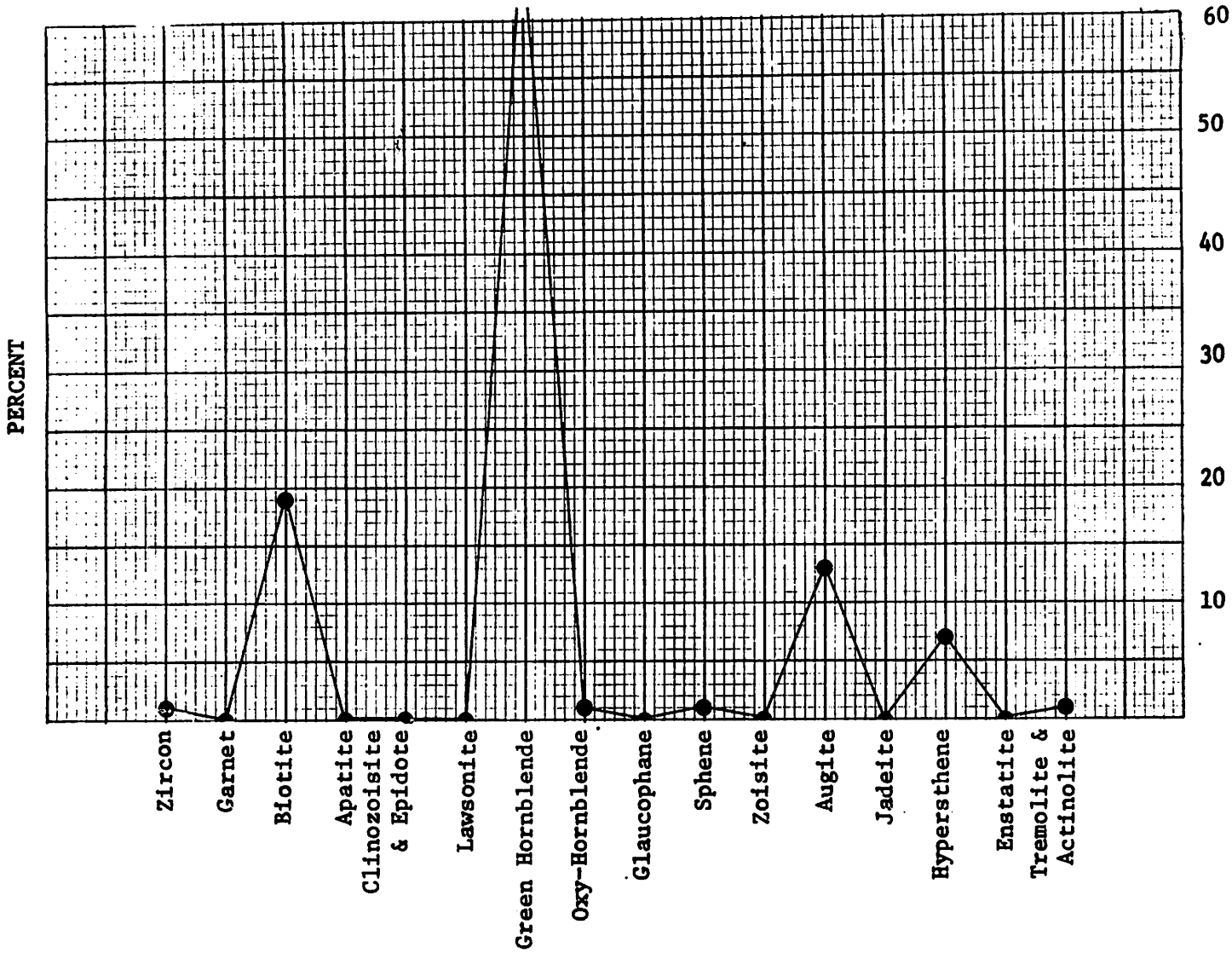
Wt. % of HM/SF --

Total Grains Counted 174

% Transparent Grains 57.5

% Opaques 4.0

% Composite Gr. and Unknowns 27.6



Other Transparent Minerals

Mineral	No. Grains Counted
Unknowns	2
Composites - Alterites	46

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite - Ilmenite	7

Analyst T. YANCEY

SAMPLE 2355

Location 36° 41.0' 121° 49.5'

Depth 21.8 meters 12 fathoms

Size Fraction (SF) .062 - .350 mm

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

Wt. % of SF/Total Sample 98.1

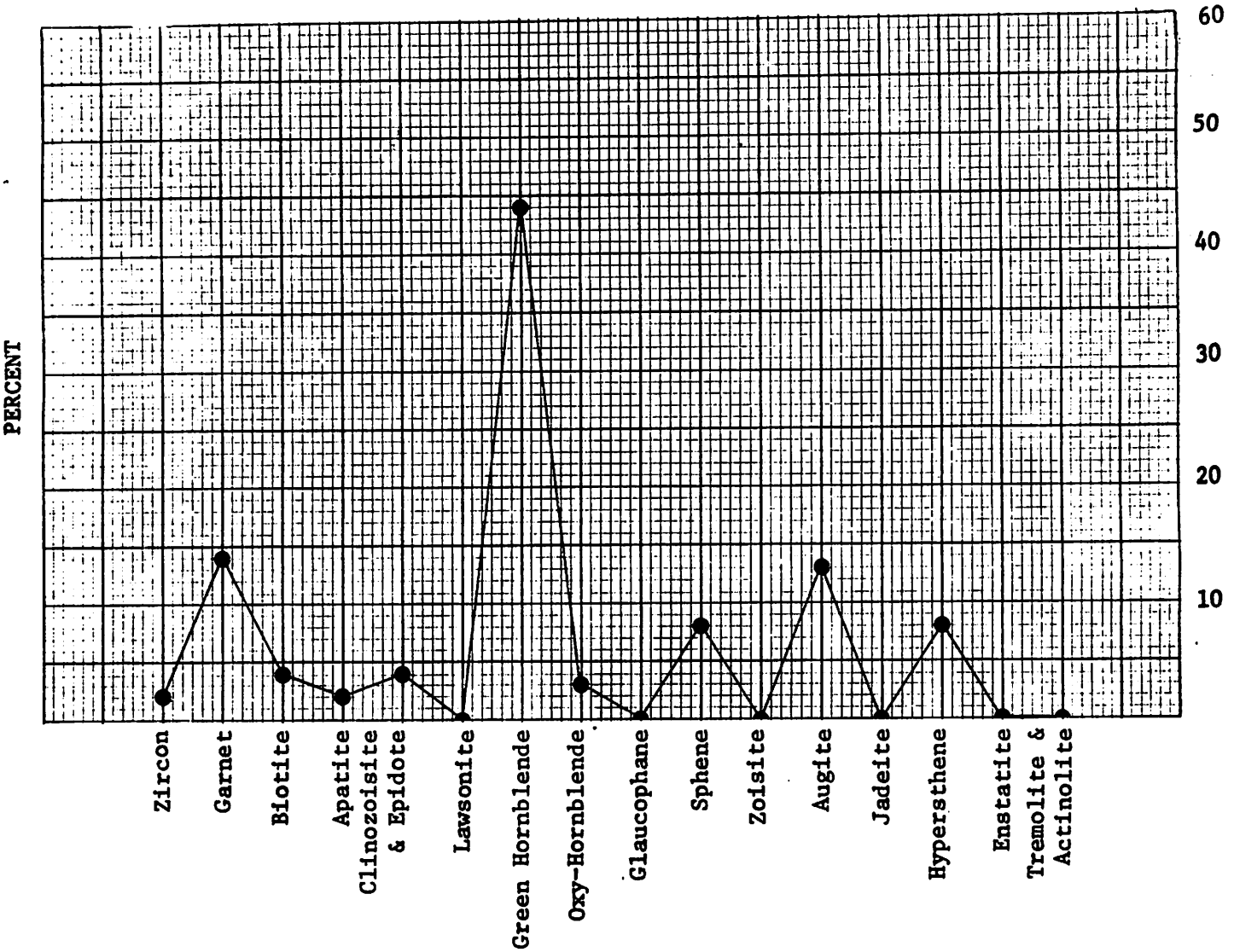
Wt. % of HM/SF --

Total Grains Counted 165

% Transparent Grains 60.6

% Opaques 21.2

% Composite Gr. and Unknowns 16.4



Other Transparent Minerals

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

Other Opaque Minerals

Mineral	No Grains Counted
Hematite - Goethite	34
Picotite	1

SAMPLE 2356

Location 36° 39.2' 121° 50.3'

Depth 23.7 meters 13 fathoms

Size Fraction (SF) .062 - .350 mm

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

Wt. % of SF/Total Sample 99.3

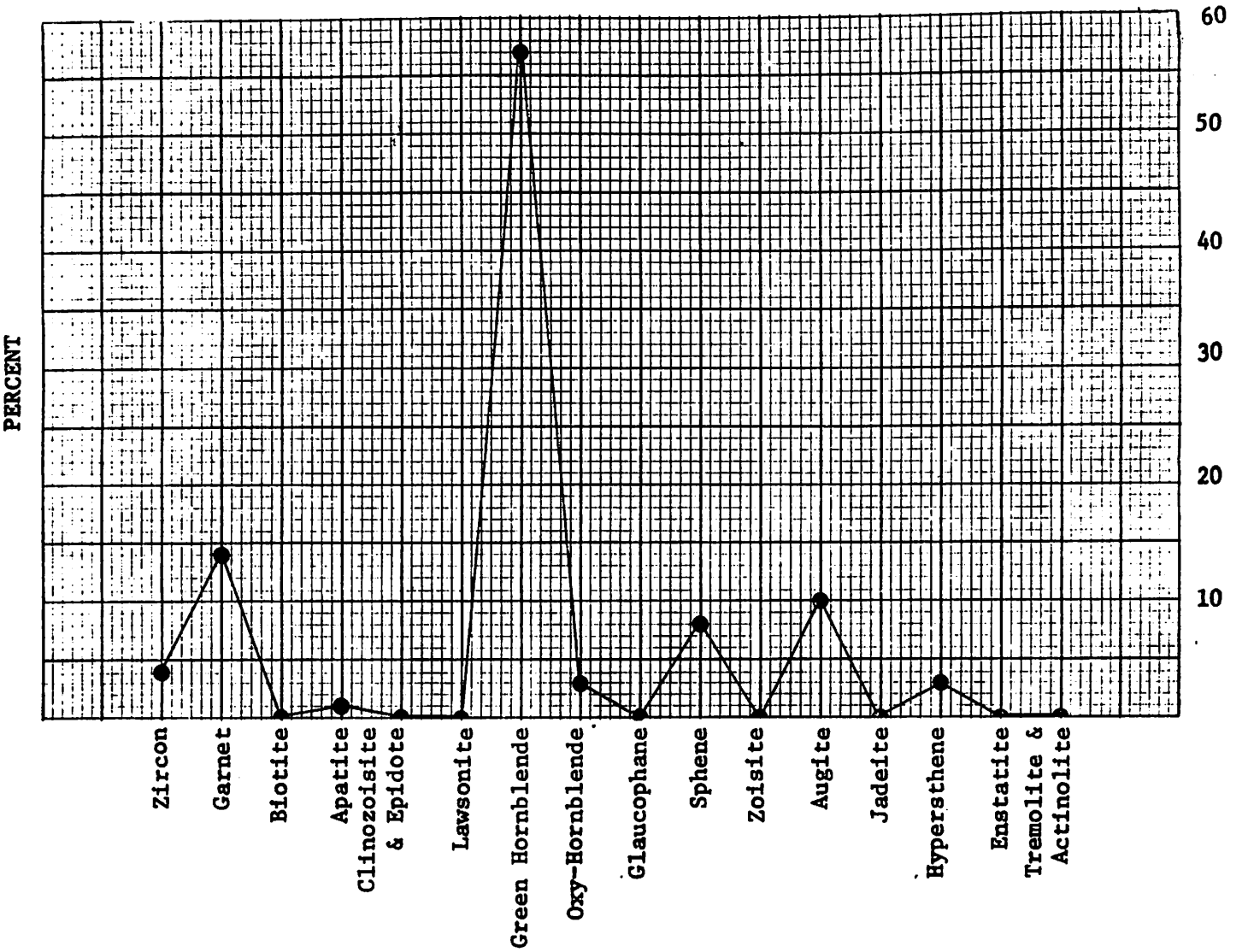
Wt. % of HM/SF --

Total Grains Counted 176

% Transparent Grains 56.8

% Opaques 24.4

% Composite Gr. and Unknowns 18.2



Other Transparent Minerals

Mineral	No. Grains Counted
Unknowns	1
Composites - Alterites	31

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite - Ilmenite	43

Analyst T. YANCEY

SAMPLE 2357

Location 36° 39.6' 121° 51.1'

Depth 43.7 meters 24 fathoms

Size Fraction (SF) .062 - .350 mm

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

Wt. % of SF/Total Sample 93.9

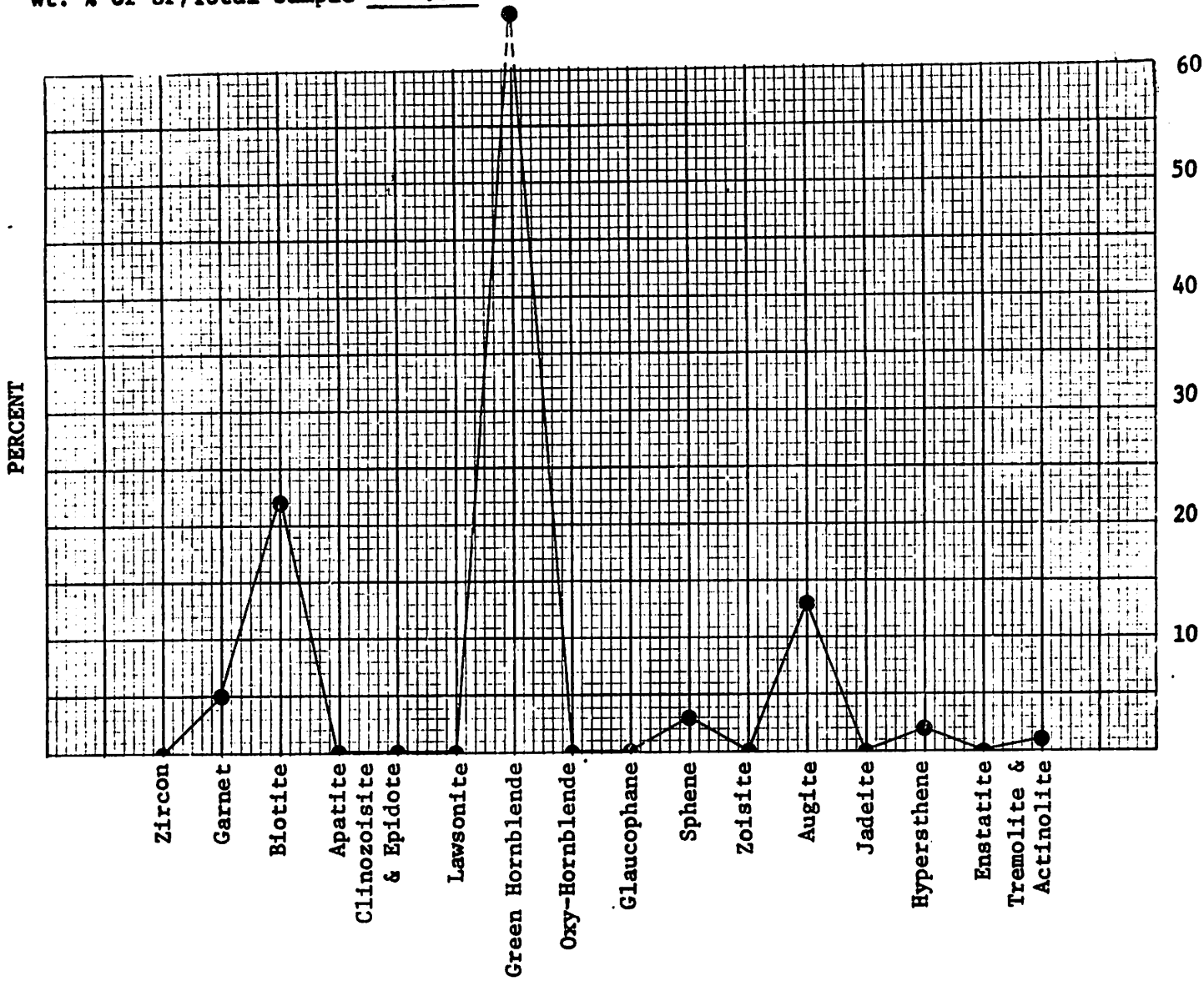
Wt. % of HM/SF --

Total Grains Counted 178

% Transparent Grains 56.2

% Opaques 1.7

% Composite Gr. and Unknowns 29.8



Other Transparent Minerals

Mineral	No. Grains Counted
Composites - Alterites	53

Other Opaque Minerals

Mineral	No. Grains Counted
Hematite - Ilmenite	2
Pyrite	1

Analyst T. YANCEY

SAMPLE 2358

Location 36° 39.7' 121° 51.7'

Depth 54.6 meters 30 fathoms

Size Fraction (SF) .062 - .350 mm

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

Wt. % of SF/Total Sample 92.4

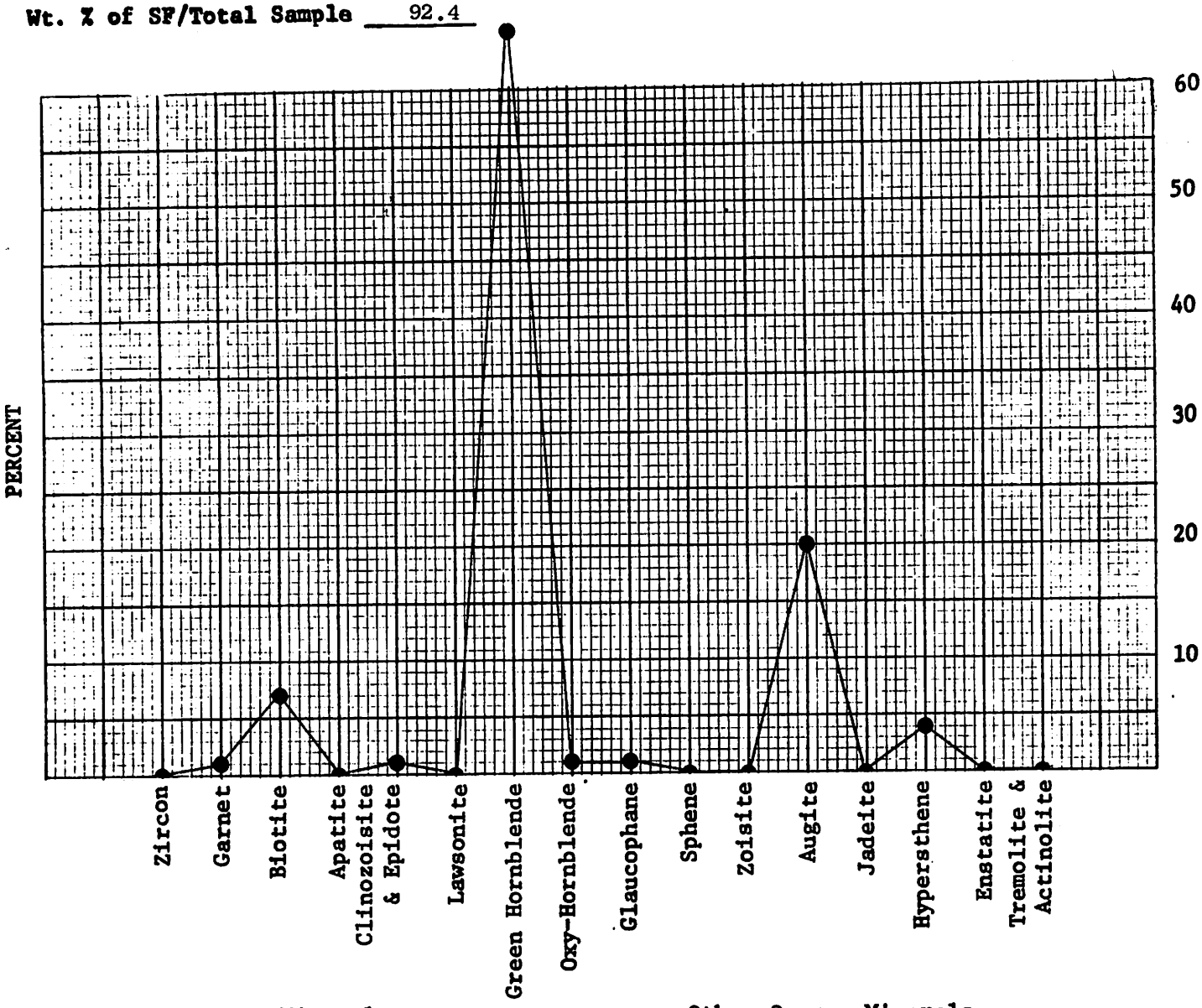
Wt. % of HM/SF --

Total Grains Counted 167

% Transparent Grains 59.9

% Opaques 3.0

% Composite Gr. and Unknowns 32.9



Other Transparent Minerals

Mineral	No. Grains Counted
Composites - Alterites	55

Other Opaque Minerals

Mineral	No Grains Counted
Magnetite - Ilmenite	5

Analyst T. YANCEY

SAMPLE 2359

Location 36° 39.9' 121° 53.4'

Depth 72.8 meters 40 fathoms

Size Fraction (SF) .062 - .350 mm

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

Wt. % of SF/Total Sample 90.4

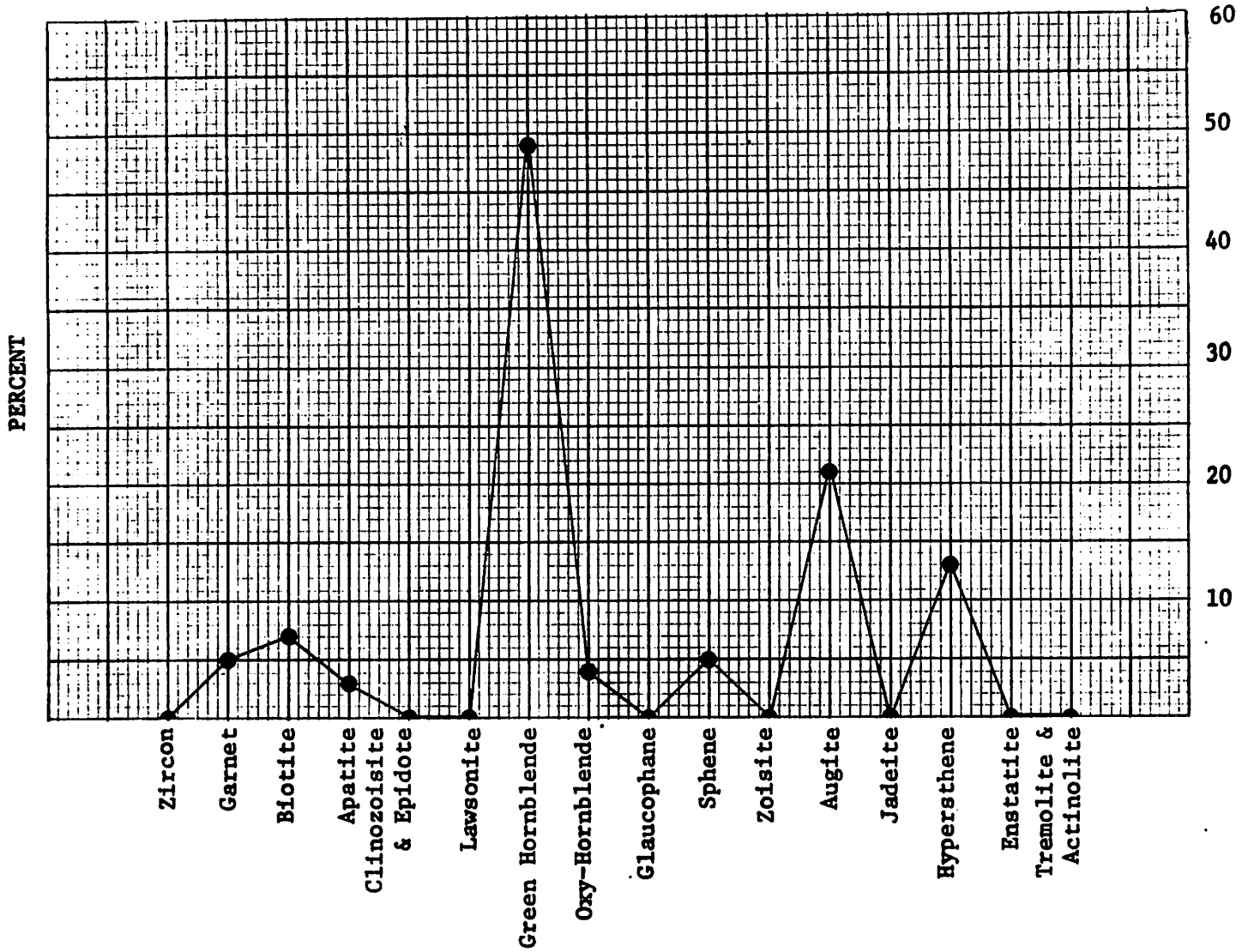
Wt. % of HM/SF --

Total Grains Counted 153

% Transparent Grains 65.4

% Opaques 1.3

% Composite Gr. and Unknowns 28.8



Other Transparent Minerals

Mineral	No. Grains Counted
Unknowns	1
Composites - Alterites	43

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite - Ilmenite	2

T. YANCEY

SAMPLE 2360

Location 36° 41.2' 121° 55.5'

Depth 91.0 meters 50 fathoms

Size Fraction (SF) .062 - .350 mm

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

Wt. % of SF/Total Sample 64.9

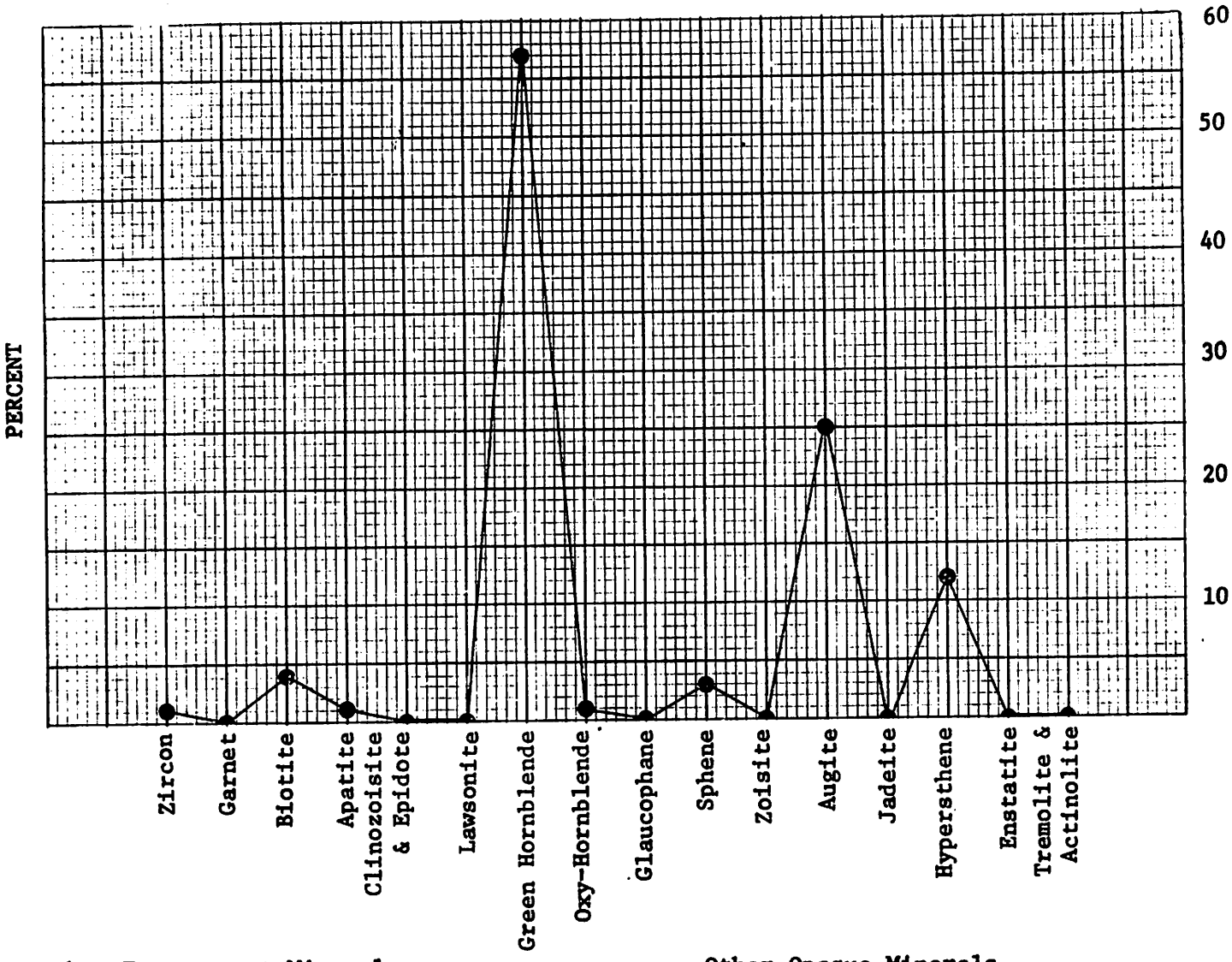
Wt. % of HM/SF --

Total Grains Counted 179

% Transparent Grains 55.9

% Opaques 9.5

% Composite Gr. and Unknowns 32.4



Other Transparent Minerals

Mineral	No. Grains Counted
Composites - Alterites	58

Other Opaque Minerals

Mineral	No. Grains Counted
Magnetite - Ilmenite	16
Hematite - Goethite	1

Analyst T. Yancey