A NOMOGRAM FOR OBTAINING PERCENT COMPOSITION BY WEIGHT FROM MINERAL-GRAIN COUNTS

By Robert Berman

Trace Elements Investigations Report 273

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

October 6, 1952

AEC-378/3

Dr. Phillip L. Merritt, Assistant Director
Division of Raw Materials
U. S. Atomic Energy Commission
P. O. Box 30, Ansonia Station
New York 23, New York

Dear Phil:

Transmitted herewith for your information and distribution are six copies of Trace Elements Investigations Report 273, "A nomogram for obtaining percent composition by weight from mineral-grain counts," by Robert Berman, October 1952.

We plan to publish this report in the Journal of Sedimentary Petrology. We are asking Mr. Hosted whether the Commission has any objection to this plan.

Sincerely yours,

(Jev Head

for W. H. Bradley
Chief Geologist

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Geology - Mineralogy

This document consists of 8 pages.
Series A.

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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Robert Berman

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* This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission

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A NOMOGRAM FOR OBTAINING PERCENT COMPOSITION BY WEIGHT FROM MINERAL-GRAIN COUNTS

by

Robert Berman

ABSTRACT

A nomogram for calculating percent composition from mineral-grain counts reduces several of the more tedious arithmetical operations to two mechanical ones.

The calculation of percent composition by weight from mineral-grain counts of heavy concentrates is laborious. The basic assumption of grain-counting studies is that the volume of the mineral is proportional to the count; therefore, the samples must be sieved into fractions of uniform size, and the grains of each sieve fraction counted separately. Experience has shown that it is unsound to let a single sieve fraction represent the entire sample, for some minerals concentrate in the finer fractions and others in the coarser ones.

Some of the variables in the calculation are:

1. The specific gravity of each of the minerals
2. The grain count for each mineral in each sieve fraction
3. The total number of grains counted in each fraction
4. The weight of each sieve fraction (to determine what portion of the sample it represents). 5. Shape of grains

Accounting for each variable results in a properly weighted factor for each mineral component of each sieve fraction. This factor can be added to the factor for the same component in other fractions, and the total, when prorated to 100, gives the percentage composition by weight of the mineral component in the whole sample.

This weighted factor can be found directly, using the nomogram described here. The nomogram has a separate linear scale for each of the mineral components. These are calibrated in grain counts, and the size of the divisions is proportional to the specific gravity. The scales are fastened together with the zero of one scale placed at the count for the previous component on the previous scale.

To illustrate, figure 1 shows the following data: Ilmenite 40 grains, quartz 71 grains, monazite 36 grains. The quartz scale is placed with its zero end at the 40 mark of the ilmenite scale, and the monazite scale is placedwith its 0 end at the 71 mark of the quartz scale, effecting a simple mechanical addition. On the scales constructed by the author, 1 mm represents one grain of specific gravity 4. These scales are fastened together with paper clips, using a plain card to mark the count of the last component. The total length of the fastened scales now represents the sieved fraction, and the lengths of each component scale represent the proportion by weight of that component.

The fastened scales are then slid over a set of fan-type variable scales in which one unit varies from 1 to 5 cm. The scales are then placed in such a way that the plain card falls at the percent of the fraction in the total sample. The percent of each component can be read off. These are later added to the corresponding figures in other fractions to obtain the percent composition by weight of the sample.

For example, let us suppose that the grain count of a panned placer concentrate gives the following figures:

	Component	Grain counts
+ 130 mesh 3.7 g 14 percent of total sample	Ilmenite	40
	Quartz	71
	Monazite	36
	Garnet	21
	Biotite	12
130-200 mesh 22.6 g 86 percent of total sample	Ilmenite	35
	Quartz	29
	Monazite	47
	Garnet	14
	Zircon	22

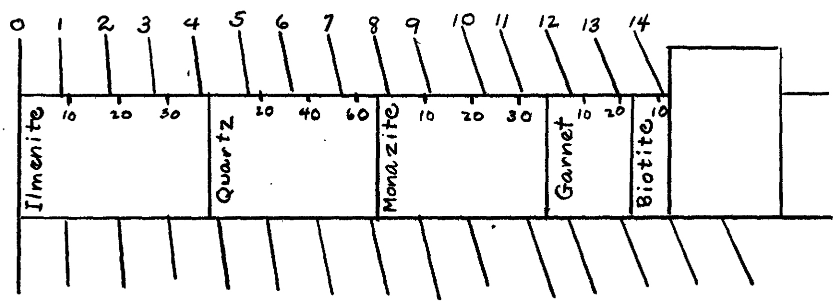

Figure 1.--Component scales set for grain count of +130 mesh fraction and placed on variable scale so that total equals 14 percent.

The individual scales for each of the five minerals in the +130 mesh fraction are overlapped so that the grain count of each mineral shows on the scale for that mineral. The total length of the scales in this example is about 17 cm. The +130 mesh fraction is 14 percent of the sample, and the joined component scales are slid over the variable scale to find a place where they equal 14 units. Figure 1 shows them in the proper position. It can be seen that the ilmenite scale covers 4 units out of the 14 (meaning that 4 percent of the entire sample consists of ilmenite in the +130 mesh sieve fraction), the quartz scale 4 more, the monazite scale about 3 1/2, the garnet 2, and the biotite about half a unit. A ruler may be used as a guide so that each component scale can be read from the nearest line, or from the zero line of the variable scale.

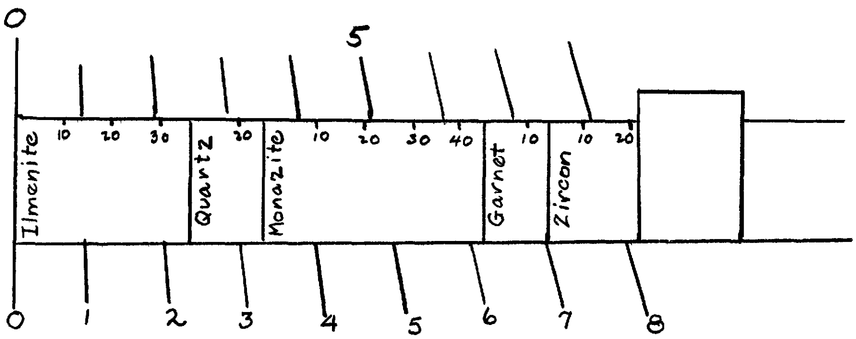

Figure 2.--Component scales set for grain count of 130-200 mesh fraction and placed on variable scale where total equals 86 percent.

In arranging the nomogram for the 130-200 mesh fraction (fig. 2) multiply the readings of the variable scale by 10. It is seldom necessary to use any other factor, unless too few grains have been counted to obtain a proper determination. Using the same methods as before, we get the following percentage results:

Ilmenite	23
Quartz	10
Monazite	32
Garnet	7
Zircon	14
	86

Adding the two sets of percentage results:

	+130 mesh	130-200 mesh	Total
Ilmenite	4	23	27
Quartz	4	10	14
Monazite	4	32	36
Garnet	2	7	9
Zircon		14	14
			100

This nomogram was used in calculating the composition of several hundred samples collected by W. C. Overstreet of the Geological Survey in North Carolina during the summer of 1951. We have found that the calculation time for each sample is reduced from nearly 20 minutes to approximately 7 minutes. In calculating compositions of a large number of samples the nomogram method reduces mental fatigue and thereby minimizes the number of errors.

This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.