A ZIRCON-STUDY OF AN AUGEN-GNEISS IN THE MENDERES - MASSIVE

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ABSTRACT — By means of a statistical study of a zircon-concentrate obtained from an augen-gneiss of the Menderes-massive it has been proved that this gneiss is of sedimentary origin.

INTRODUCTION

In recent years zircon study of igneous, metamorphic and sedimentary rocks has received considerable interest, mainly stimulated by the work done by POLDERVAART and co-workers (3,4,5). By means of their working method we can now distinguish between ortho- and para-gneisses without resorting to subjective arguments. The properties of zircon make it an excellent tool in such research. Zircon is hard and easy to separate by its high specific gravity and is present in small amounts in almost any important rock-type. Its most outstanding quality, however, is its highly refractory character, which makes that zircons will keep their original shape even under most severe conditions of metamorphism. Only when a metamorphic rock enters the magmatic stage some redistribution of zircon matter may take place, as is shown by idiomorphic overgrowths on old cores (2,5).

DEFINITION OF PROBLEM

As there is considerable divergence of opinion on the origin of the gneisses of the Menderes-massive a zircon-study seemed very promising a way to decide in this question. It may be noted that there are two diametrically opposed opinions :

1. The Menderes augen-gneisses are old, schistose porphyritic granites.
2. The Menderes augen-gneisses are metamorphic sediments, which underwent alkali-metasomatism.

METHOD

A selected representative sample of an augen-gneiss (see Plate I), weighing about 300 gr, from the neighbourhood of Söke was pulverised, sieved, boiled with HC1 dil., dried and put in a separation funnel with bromoform. The resulting heavy mineral concentrate was dried. For the microscopic study every time a part of it was taken and put on a glass slide in a drop of water. This method saved considerable time and expenses over the mounting of the concentrate in Canada balsam on permanent slides. Every zircon grain, if not broken, was measured and the presence or absence of rounding was noted. Overgrowths were not observed, outgrowths one time. Zoning was absent. Some zircons contained inclusions, mostly needle-like. Their nature has not been determined. Metamict zircons were rare, which is in agreement with the low radioactivity found in these rocks (6).

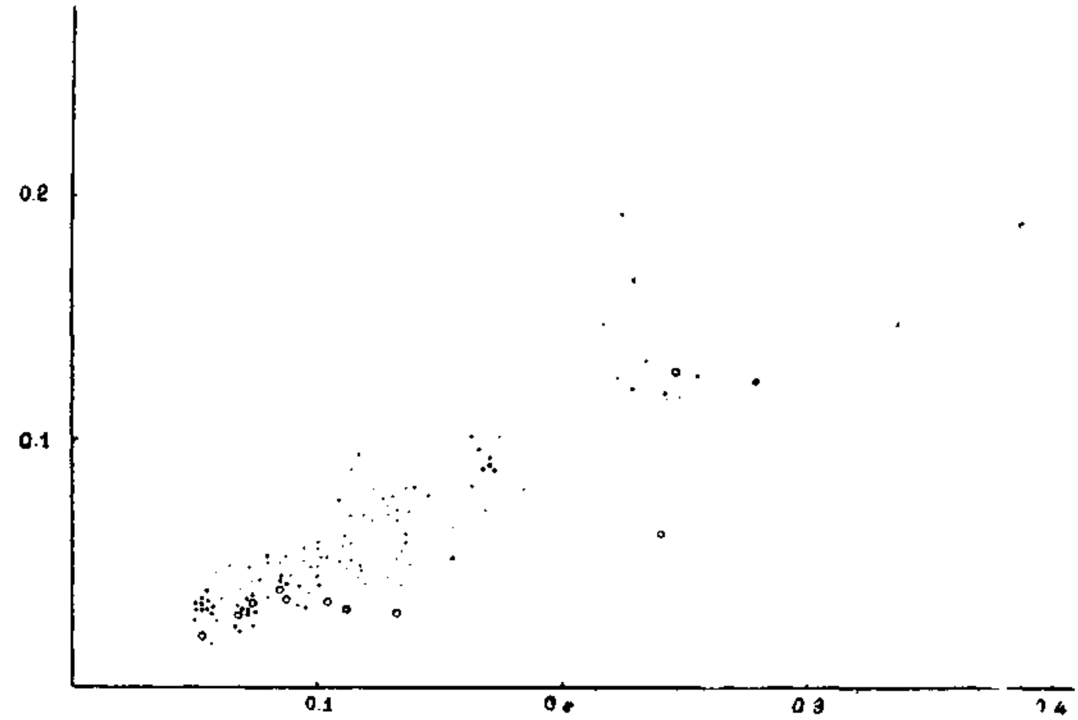


Fig. 1 - Scatter diagram, showing lengths and widths of 150 zircons. Oposition of euhedral zircon

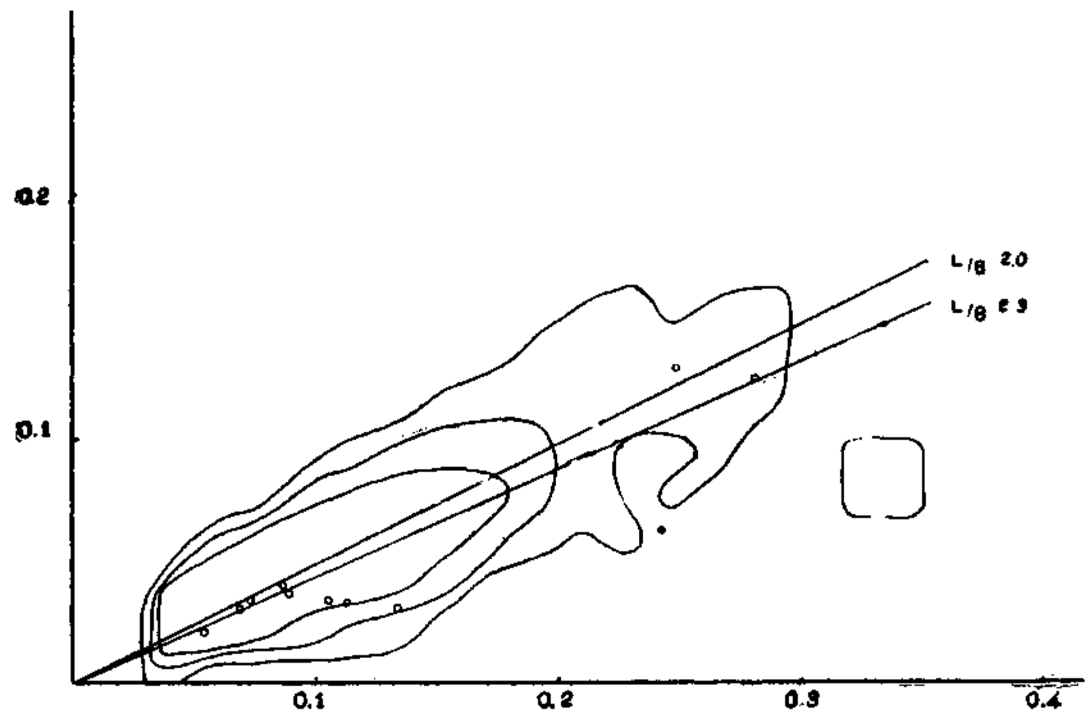
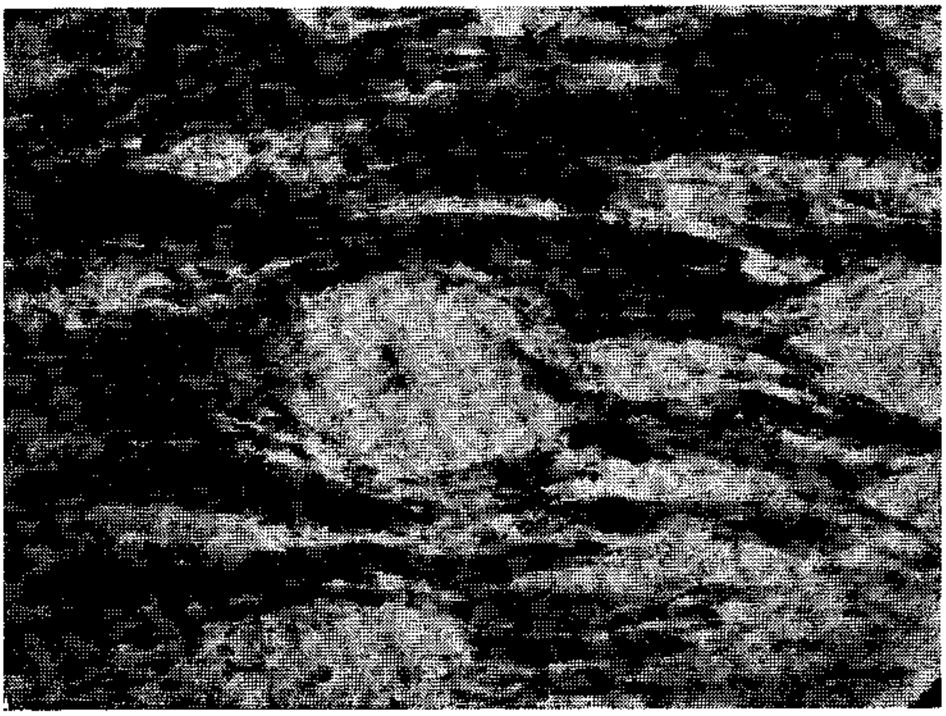


Fig. 2 - Contoured Elongation - Frequency diagram of 150 zircons. Percentage contours 1 %, 4 %, 8 %. L/B = 2.0, mean elongation frequency. L/B = 2.3, approximate elongation frequency of euhedral zircons. Position of euhedral zircons indicated with o.



RESULTS

From the 150 zircons thus measured, 138 showed signs of rounding. The resul ting rounding index is 92.0, computed as the percentage of rounded crystals. The lengths and widths of the individual zircons were plotted on a diagram (fig. 1). To make easier reading, this scatter diagram has been converted into a contoured elongation-frequency diagram by drawing percentage contours (fig. 2). From this diagram a mean L/B frequency, a so - called elongation frequency, can be computed. This turns out to be about 2.0. From the diagram it may be seen that the length-frequency maximum is at about 0.1 mm. Although there are not enough euhedral zircons to permit a statistical evaluation, those present seem to indicate a mean elongation frequency of about 2.3. Figure 3 shows the change in shape when euhedral zircons with L/B 2.3 are rounded to zircons with L/B 2.0.

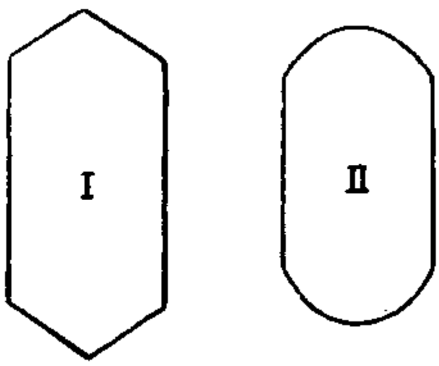


Fig. 3 - Change in shape when euhedral zircon (I) with L/B = 2.3 is rounded to zircon (II) with L/B = 2.

NATURE OF THE ORIGINAL SEDIMENT

These zircons of sedimentary character have probably been derived from magmatic rocks, which contained rather short prismatic zircons. The often only slight degree of rounding makes it probable that the source rock was not too far away; the big size of the zircon crystals (up to 0.35 mm) indicates that the augen-gneiss has been some kind of sand- or siltstone. The original sizes of the main rock building grains have been fully obliterated by recrystallization during metamorphism; by extrapolating, however, from the mean size of the zircons, by using the formula :

$$\frac{r_2}{r_1} = \frac{\sqrt{d_1 - 1}}{\sqrt{d_2 - 1}}$$

for grains which settle out together during sedimentation, we may arrive at an average grain size of the original quartz (and feldspar). If we put 2.7 for the density of quartz, 4.6 for that of zircon and 0.035 for the mean radius of the zircon grains, we arrive at the figure of about 0.05 mm for the mean radius of the quartz grains in the original sediment. This corresponds to a diameter of 0.1 mm of the constituent components of the original sedement. which makes it a fine - medium grained sandstone.

CONCLUSIONS AND FINAL REMARKS

It should be borne in mind that this study concerned only one sample of augen-gneiss. It cannot *a priori* be denied that there are granites in the Menderes-massive, but might be proved or disproved by more zircon studies. Just as ECKELMANN & KULP (1) we must, however, conclude that the rock studied is of sedimentary origin. It probably has been a fine-grained sandstone, derived from (acid) magmatic rocks of an earlier cycle. Their present composition has probably been reached by extensive alkali - metasomatism, as already suggested elsewhere (6).

ACKNOWLEDGMENTS

I wish to thank the Institute of M. T.A. for the opportunity which it gave me to study these gneisses in the field and do subsequent laboratory work on them. I thank the General Director of the M.T. A. Institute for hiskind permission to publish this work. I thank Dr. MARKUS for his help and interest.

Manuscript received January 24, 1958.

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