A Simple Grid Deviation Technique of Study of the Areal Composition Variations in Granitic Bodies

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Abstract

A method of preparing grid deviation maps for the representation of the areal composition variations in granitic bodies is described. A comparative study of this method and the trend surface method by using the data of forty-five modal analyses of Bahalda hornblende granodiorite indicates greater effectiveness of the former in several respects.

The point count method of modal analysis has made possible the assessment of the areal composition variations in bodies of granitic rocks with reasonable speed and accuracy (cf. Chayes, 1949, 1952 ; Fairbairn, 1951 ; Whitten, 1957 ; Saha, 1959). But attempts to represent such variability have not been altogether satisfactory so far, because of (*a*) rather small scale variations exhibited by such bodies, (*b*) lack of adequately spaced exposures of rocks, and also (*c*) the subjective element involved in contouring irregularly spaced, highly variable sets of data. The technique of fitting least-square trend surfaces, based on the solution of equations involving non-orthogonal polynomials, as introduced by Whitten (1959, 1961), removes effectively the subjective element in contouring, but it has been criticized on several other grounds (Chayes, 1961 ; Saha, 1963).

In the course of detailed statistical studies of the areal composition variations in parts of the composite mass of Singhbhum granite, the writer has used a simple technique of preparing grid deviation maps on the basis of the modal data. This technique is illustrated here by reference to the grid deviation maps of a 15 square miles area of the Bahalda granodiorite (Saha, 1954 ; Saha and Chakraborti, 1963)—one of the constituent units of the Singhbhum granite—on the basis of forty-five careful modal analyses. A square grid pattern (one mile to a side) was superposed on the geological map containing the data points such that (*a*) each of the squares contained at least one datum point and (*b*) there was no undue concentration of the points in any particular grid square, In all, nineteen grid squares covered the entire sampled area (Text-fig. 1). Next, the average values of K feldspar percentage, quartz percentage and colour index within each grid were computed, these averages being assumed to be located at the centre of gravity of the data points in each grid. Using these grid averages, the average values of the three variables for the entire sampled area were computed, half weightage being given to those marginal areas that cover

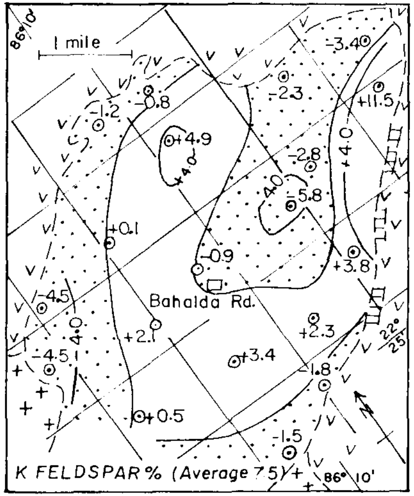

Fig. 1.

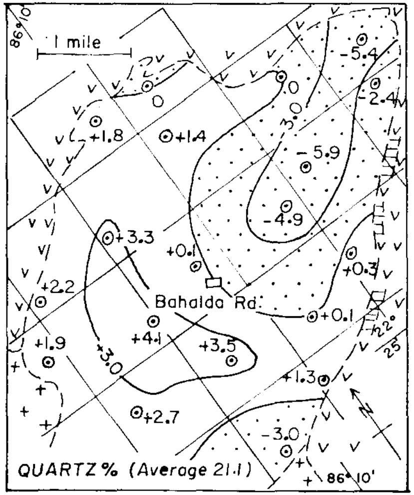

Fig. 2.

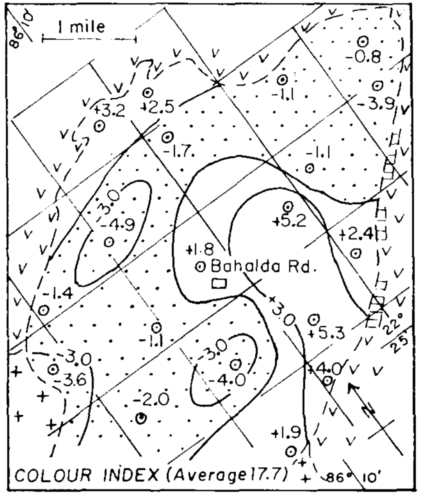

Fig. 3.

TEXT-FIGS. 1–3.—Grid Deviation Maps of K feldspar percentage, quartz percentage and colour index for a part of the Bahalda Road hornblende granodiorite, Mayurbhanj (India), showing the areas of positive (blank) and negative (stippled) deviations and locations of the grid averages (circled dots). Dashed lines demarcate the boundary of hornblende granodiorite; areas of V-ornamentation and dash-ornamentation represent epidiorite and quartzite respectively; plus-ornamentation signifies biotite granodiorite-adamellite areas.

between $\frac{1}{4}$ and $\frac{3}{4}$ part of a particular square. Then the deviations of each grid average from the averages for the entire sampled area were plotted on the maps which were contoured to show the areas of positive and negative deviations for each of the three variables (Text-figs. 1–3). The system of averaging out the individual data in each grid takes care of local fluctuations and also removes largely the subjective element in the contouring process.

All the three grid deviation maps (Text-figs. 1–3) indicate alternate belts of rise and fall (with N.E. to E.N.E. trends) in the values of the variables ; there is no significant trend of areal variations with respect to the epidioritic borders of the granodiorite. The linear correlation coefficients (r) between the average values of neighbouring grids (calculated on the lines followed by Chayes, 1949*a*, for testing the anisotropy in petrofabric point diagrams) are found to be statistically significant for all the three variables. There is thus a significant anisotropy in the distribution of the grid average values. The grid deviation maps, therefore, represent significant trends of the regional variations.

Linear-plus-quadratic partial trend surfaces for K feldspar percentage, quartz percentage and colour index, based on the nineteen grid average values, have been computed (Text-figs. 4–6) following the method given by Krumbein (1959). Also, the deviations of the actual data from the computed values have been contoured to yield deviation maps. The degrees of fit of the computed surfaces have been tested using the procedure of the analysis of variance (after Whitten, 1961). The computed trend surfaces for K feldspar percentage, quartz percentage and colour index account for 27·3 per cent, 71·2 per cent, and 85·3 per cent respectively of the total sum of squares. F tests (cf. Whitten, 1961) suggest that the degree of fit in the cases of quartz percentage and colour index are very good, but the K feldspar trend surface is not significant statistically.

The trend surface map for K feldspar percentage (Text-fig. 4) indicates gradual increase of the K feldspar percentage towards east and N.E., while the quartz percentage and the colour index surfaces (Text-figs. 5–6) show spectacular domical patterns with the maxima near the central and in the east-central parts respectively. It is significant, however, that neither these trend surface maps, nor the resulting deviation maps bring out the periodic pattern of variation, as indicated in the grid deviation maps (Text-figs. 1–3). As has been pointed out by the writer elsewhere (Saha, 1963), the variations of a periodic nature tend to be masked in the trend surfaces as well as in the resulting deviation maps. The present study demonstrates that the proposed grid deviation maps are particularly effective in portraying such variations.

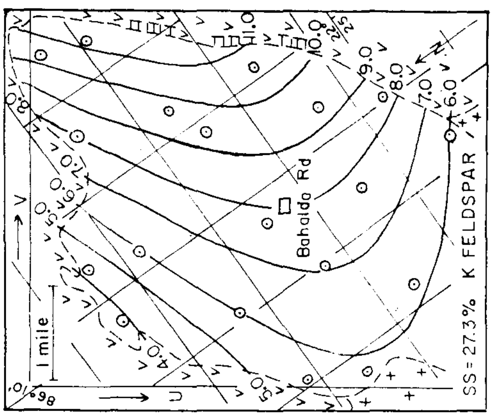

Fig. 4

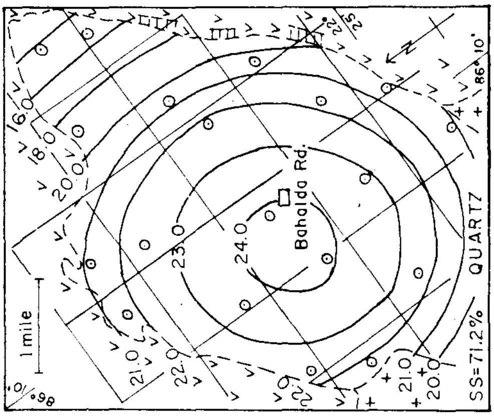

Fig. 5

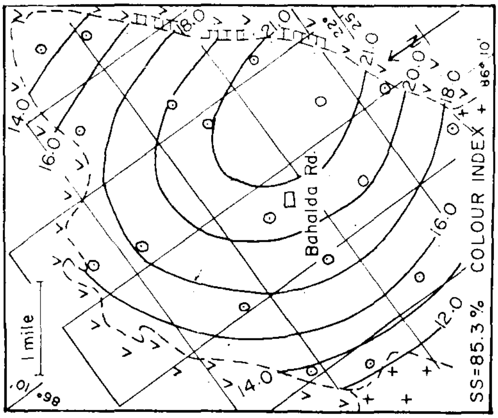

Fig. 6.

TEXT-FIGS. 4–6.—Linear-plus-quadratic partial trend surfaces for K feldspar percentage, quartz percentage and colour index in the Bahalda Road hornblende granodiorite. SS denotes the percentage of the total sum of squares accounted for by the surface.

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