BIOTITES FROM THE GRANITIC ROCKS AROUND DORANDA IN THE EASTERN PART OF THE BIHAR MICA BELT

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INTRODUCTION

THE eastern part of the Bihar Mica Belt around Doranda (24° 28′ N; 85° 27′ E) in the District of Hazaribagh, consists mainly of granite gneisses, quartzite, hornblende schist and mica schist. The granite gneisses are highly feldspathised with the development of K-feldspar megacrysts in the eastern and western parts of area.

Detailed structural and petrographic studies (Ghosh, 1971) indicate that the granite gneisses are products of metasomatic transformation of pre-existing metamorphites, chiefly mica schist and hornblende schist, while the K-feldspar megacrysts developed due to a later potash metasomatism.

The refractive indices of biotite (N_z) for thirty-one samples (Table I) of these granite gneisses have been determined by liquid immersion method using sodium light; precision of the determination is ± ·002. The values of N_z vary within wide limits (1·624 and 1·662). Three samples of biotite with varying refractive indices were separated by means of a magnetic separator, tapping on glazed paper and finally by hand picking under the microscope for partial chemical analysis (Table II). The final purity of the sample was about 99%.

TABLE I

Refractive index of biotite from thirty-one samples of Doranda granite-gneiss

Sp. No.	N_z	Sp. No.	N_z
1	1·625	400	1·628
291	1·639	63	1·628
15	1·620	402	1·632
2	1·634	60	1·622
30	1·624	246	1·625
55A	1·628	245	1·623
40	1·625	403	1·628
196	1·625	391	1·624
41	1·624	392	1·628
47	1·632	443	1·634
36	1·625	404	1·628
5A	1·623	79	1·662
64	1·628	78	1·642
66	1·625	425	1·625
201	1·625	200	1·628
		401	1·629

TABLE II

Partial chemical analyses and N_z of biotite in three specimens of Doranda granite-gneiss

Oxides	Sp. No. 64	Sp. No. 291	Sp. No. 79
TiO_2	2·25	2·14	2·60
Fe_2O_3	7·30	7·32	7·52
FeO	17·42	18·96	22·03
MgO	5·99	4·26	3·16
Fe^{2+}/Mg	1·60	2·91	3·80
N_z	1·628	1·639	1·662

Analyst: B. P. Gupta.

The biotite is strongly pleochroic and the pleochroic scheme varies with the change of refractive index, *viz.*, grains of lower refractive index have X = Yellow, Y = Yellowish brown, Z = Brown, while for grains with higher refractive index values the scheme is X = Brownish Yellow, Y = Brown, Z = Deep brown. However, the absorption is Z > Y > X in both cases. Pleochroic haloes around allanite inclusions within biotite are common. The proportion of biotite in the granite gneiss varies between 2·20 to 15·91%.

DISCUSSION

Several attempts have been made to demonstrate the quantitative relationship between refractive indices and chemical composition of biotite. Hall (1941) calculated that refractive index of biotite increases by ·0046 with 1% increase in TiO_2. Heinrich (1946) obtained a well-defined curve by plotting the combined weight percentages of $FeO + 2\ (Fe_2O_3 + TiO_2)$ against the refractive indices (Fig. 1). It appeared that the effect of

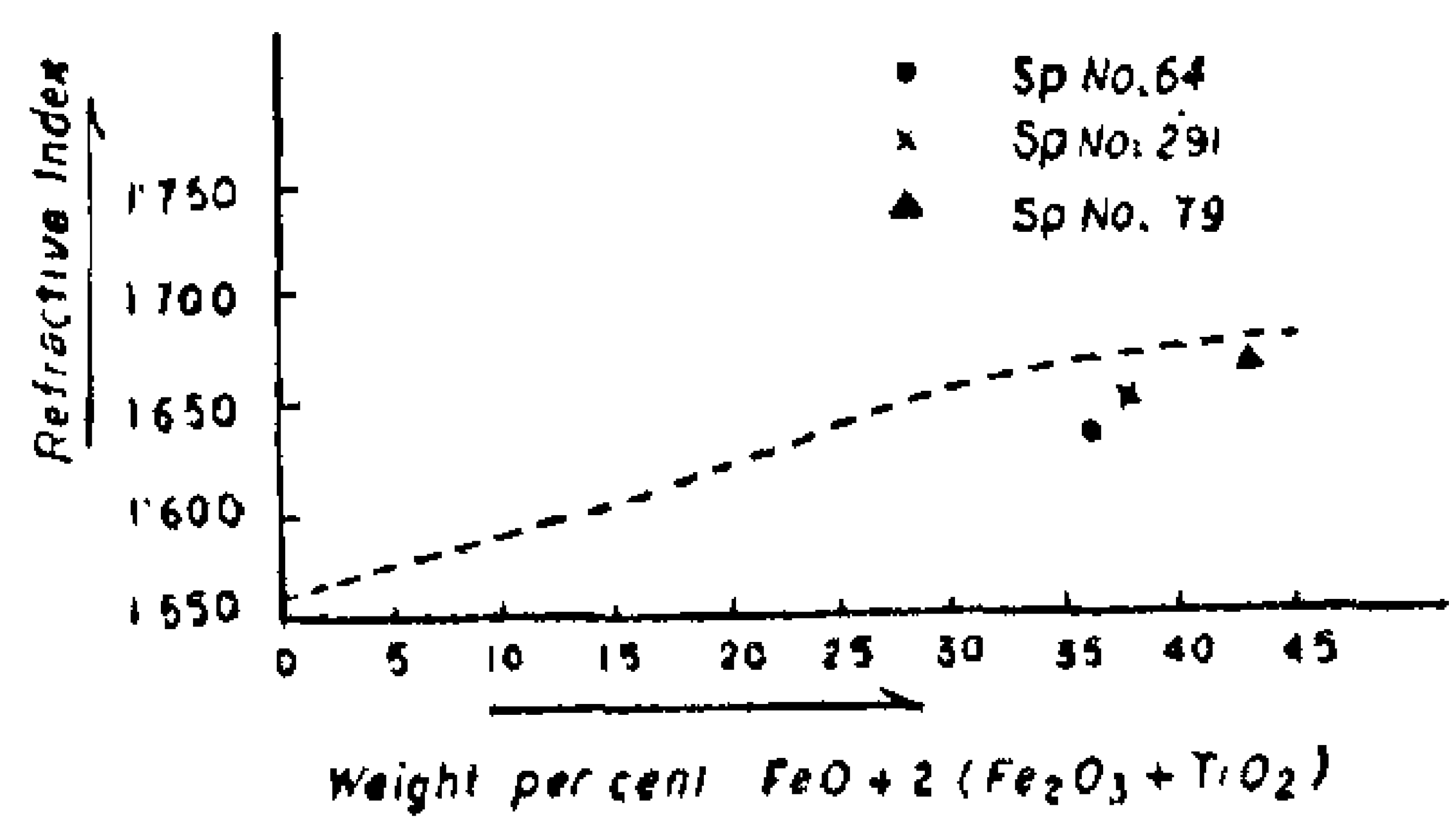
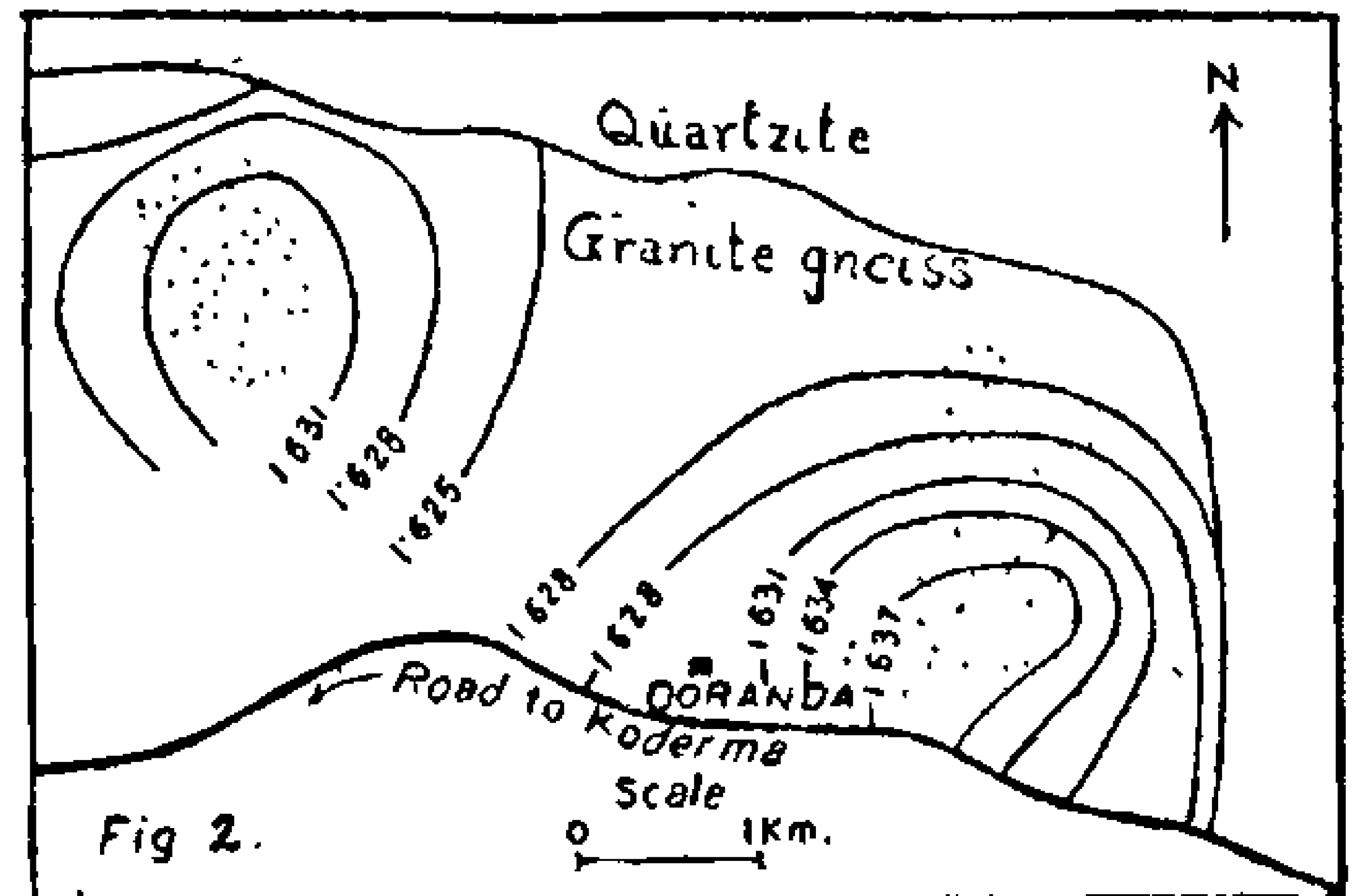


FIG. 1. Variation of refractive index of biotite with composition after Heinrich (1946).

Fe^{3+} and Ti in increasing the refractive index is greater than that of Fe^{2+}. Both Hall and Heinrich concluded that no accurate correlation can be found between optical parameters and composition of phlogopite biotite series. For the present area samples, the plots of N_z and the parameter $[FeO + 2(Fe_2O_3 + TiO_2)]$ (*cf.* Table II) fall reasonably close to Heinrich's (1946) curve (Fig. 1). But the three samples so plotted have similar proportions of Fe_2O_3 and TiO_2, while the Fe^{2+}/Mg ratios are appreciably different. Thus, it might be suggested that in the present samples, the refractive index variation of biotite reflects at least to a large extent Fe^{2+}/Mg variation in biotite. As biotite is practically the only mafic mineral in the granite gneisses (except for traces of iron ore), it appears that the biotite refractive index variations in the present case reflects the Fe^{2+}/Mg ratio of the granite gneiss.

Polynomial trend surfaces upto fourth degree (*cf.* Krumbein. 1959) have been computed for the biotite refractive indices. The degree 4 map (Fig. 2) has taken into account 33·74% of the total variance. The corresponding deviation map (Fig. 3) shows a spotty pattern. There are several features worthy of note about the trend surface map (Fig. 2): (*i*) there is an overall lack of steep gradient, (*ii*) the trend lines do not parallel the regional foliation ($S_1 = S_2$) but abut against the contact of the country rock and granite gneiss; (*iii*) there are two zones of high values in the east and west, separated by a central zone of low values. It may also be noted that the zones of high biotite N_z values coincide with areas of late stage K-feldspathization (dotted areas in Fig. 2) which led to the development of K-feldspar megacrysts. It is significant that because of the addition of K-feldspar consequent on K-feldspathization, the proportion of biotite in such zones is lower (2·2 to 5·3%) than in the rest of the area. Also, since biotite is practically the only ferromagnesian mineral in this granite gneiss, whose biotite N_z is correlatable to its Fe^{2+}/Mg ratio, it appears that the granite gneiss in the areas of high K-feldspathization have relatively high Fe/Mg ratio. Thus an iron metasomatism appears to have accompanied the potassium metasomatism in the area.



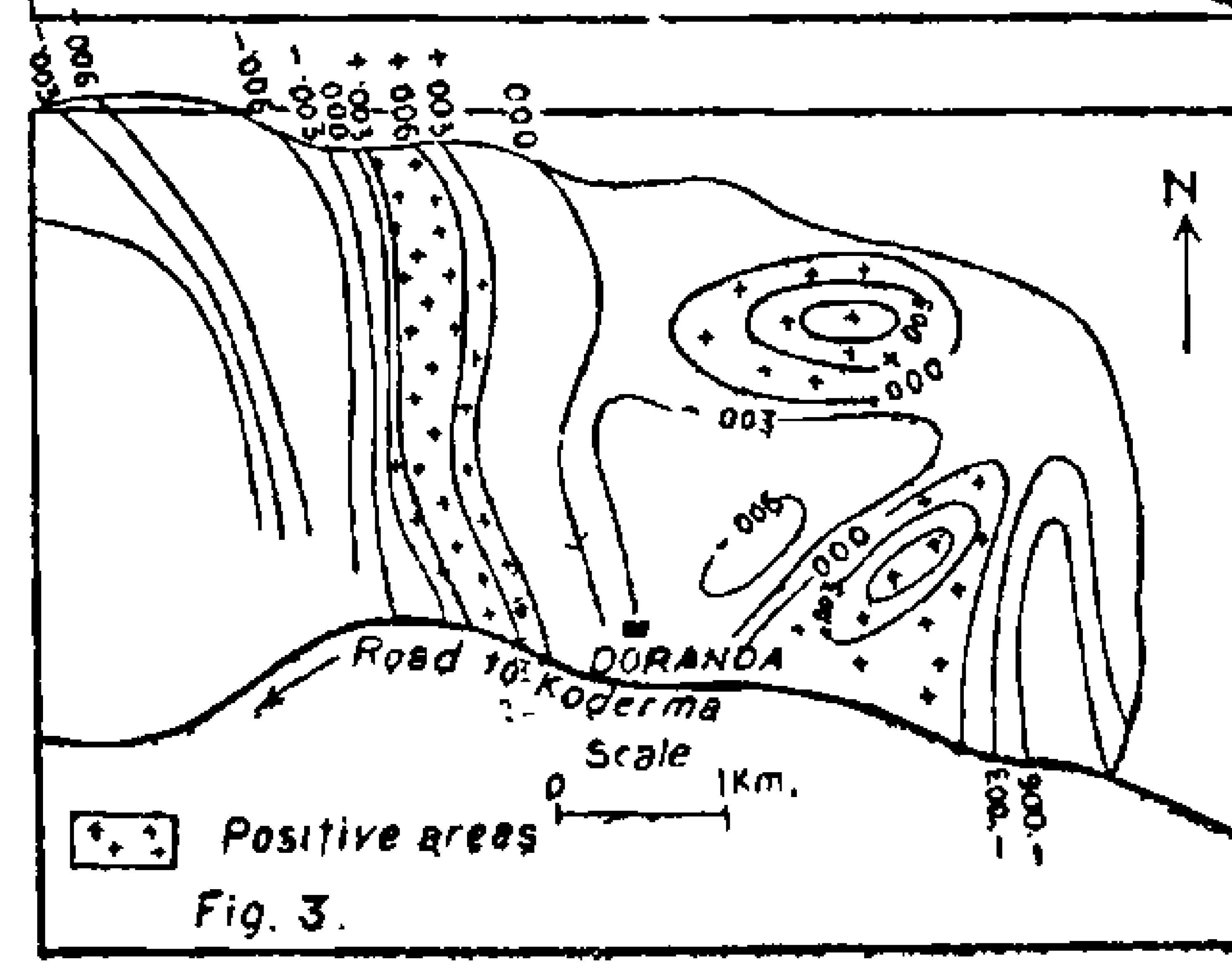


FIG. 2. Trend surface map of fourth degree. The dotted areas indicate zones of K-feldspathization.

FIG. 3. Deviation map of fourth degree surface.

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1. Ghosh, D., *Unpublished M.Sc. Thesis*, Calcutta University, 1971.
2. Hall, A. J., *Amer. Mineral*, 1941, **26**, 34.
3. Heinrich, E. W., *Amer. Jour. Sci.*, 1946, **244**, 836.
4. Krumbein, W. C., *Jour. Geophy. Res.*, 1959, **64**, 823.