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Ferro-hornblende, an iron-rich end member from Simlipal Granite, Mayurbhanj District, Orissa*

S. V. P. IYENGAR AND K. K. BASU
Geological Survey of India, 27, Jawaharlal Nehru Road, Calcutta 700016

Abstract

The occurrence of an iron-rich end member of the ferro-hornblende division of calcic amphiboles is recorded for the first time. The mineral is found in the granite of Simlipal Complex and is associated with ferrohedenbergite around which it occurs as reaction rims and also as independent grains. The $Mg/Fe^{2+}Mg$ ratio of the two analysed samples are 0.017 and 0.027 compared to the earlier recorded values for the mineral which range from 0.20 to 0.49.

Introduction

The paper presents the occurrence of an extremely iron-rich hornblende in the granite. The granite of the Simlipal Complex, Orissa (Iyengar and Banerjee, 1964; Iyengar and Alwar, 1965; Iyengar, 1978) varies from coarse to aplitic and gronophyric types with chilled margins at the floor and at the roof of the intrusions. The coarse granite types are, as a rule, found at the bottom of the intrusion passing upwards into riebeckite granite and granophyre. In thin sections, the granite is seen to be composed of large plates of albite, perthite, quartz, ferrohedenbergite and/or amphibole. The large feldspar grains are, as a rule, turbid and are reconstituted partly into fresh plates by later replacement.

The amphibole generally contains relict cores of pyroxene (ferrohedenbergite) from which it has apparenty developed (Fig, 1). It also occurs as independent grains (Fig. 2).

Figure 1. Ferro-hornblende (dark colour) with relict cores of ferrohedenbergite (light colour).

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Figure 2. Prism of ferro-hornblende (dark colour) developed as independent grains.

Chemical composition

The pure fraction of the mineral were separated from two granite samples with the help of Isodynamic Separator and Clerici solution. Repeated operations of these two processes, particularly fractionation in gradually diluted Clerici solution in centrifuge were necessary for obtaining a pure fraction. Optic and X-ray study of the final fraction did not indicate significant presence of any other mineral phase.

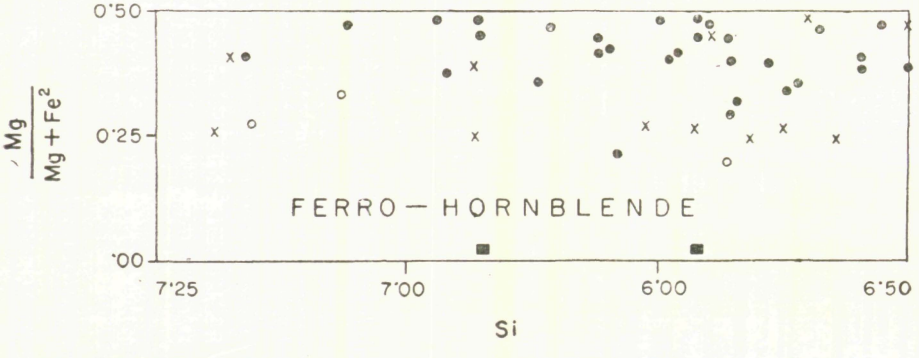

Figure 3. Distribution of ferro-hornblende analyses in the 'ferro-hornblende field' defined by the Amphibole Sub-Committee (Leake, 1978, Fig. 3).

- Data from Leake (1978) corresponding to the Sample numbers 227, 242, 252, 281, 288, 330, 348, 367, 408, 412, 415, 435, 442, 445, 447, 733, 738, 754, 766, 767, 772, 773, 775, 779, 785, 800, 812, 837, 983 and 984 in Table 2.

× Data from Dekker (1978) corresponding to the sample numbers: B 1016(1–2), E3232N, N2402F, R2229(1–3), R1269(1–3), W196B, Y2055(2). Recalculated values of Fe^{2+} and Fe^{3+} used (vide Table IV, 9).

o Data from Deer, Howie, Zussman (1963) corresponding to the sample numbers 33, 34, 36 of Table 40.

▬ Simlipal ferro-hornblende.

TABLE I. Analyses of ferro-hornblende, ferrohedenbergite, hedenbergite and Simlipal granite

	1/77 1	2B/73 2	IA 3	3G 4	2D/I 5	R3/57 6	19/51 7
SiO_2	41.00	42.73	47.60	48.20	47.16	73.05	70.76
TiO_2	2.00	3.32	0.22	0.37	1.02	0.25	0.30
Al_2O_3	4.40	7.35	2.80	3.40	1.26	10.80	13.59
Fe_2O_3	10.60	7.05	1.20	0.32	tr	4.76	1.60
FeO	27.18	25.86	27.09	26.00	27.74	2.34	3.64
MnO	Nd	0.48	Nd	Nd	0.80	0.04	0.03
MgO	0.26	0.40	1.67	1.69	0.95	0.52	0.41
CaO	9.60	9.20	18.20	18.26	20.20	2.12	2.55
Na_2O	1 48	1.09	0.80	0.70	0.51	4.40	3.80
K_2O	1.20	0 90	0.30	0.30	0.25	0.08	3.06
P_2O_5	—	—	—	—	—	0.12	0.04
H_2O^+	1.84	0.75	Nd	Nd	0.17	0.40	0.34
H_2O^-	—	—	0 06	0.08	0.02	0.06	0.06
Total	99.56	99.13	99.94	99.32	100.08	98.94	100.18

Chemical analyses were carried out in Central Chemical Laboratories of the Geological Survey of India, Calcutta.

Simlipal Reserve Forest, Mayurbhanj District, Orissa State, India

1. Ferro-hornblende, from coarse grained ferrohedenbergite granite:
   Analyst—B. P. Chatterjee.
2. Ferro-hornblende from coarse grained ferrohedenbergite granite:
   Analyst—N. R. Sengupta and B Guha
3. Ferrohedenbergite from medium to coarse grained granite:
   Analyst—C. K. Ganguli.
4. Ferrohedenbergite from chilled aplitic type:
   Analyst—C. K. Ganguli
5. Hedenbergite from coarse grained granite with ferro-hornblende:
   Analyst—S. Nandy
6. Ferro-hornblende granite:
   Analyst—S. Banerjee.
7. Coarse hedenbergite ferro-hornblende granite:
   Analyst—C. K. Ganguli.

Pleochroic scheme

α = Light brown; β = Light green; γ = Deep green;

R. I.	α	β	γ
Sample No. 1/77	1.704	1.718	1.727
Sample No. 2B/73	1.697	1.717	1.722

Nomenclature

The composition of the minerals when recast according to the method recommended by the Sub-committee on Amphiboles (Leake, 1978) is as follows:

Sample No. 1/77:

$(K_{.25}\ Na_{.15})_A\ (Na_{.32}\ Ca_{1.6})_B\ (Fe^{2+}{}_{3.72}\ Mg_{.06}\ Fe^{3+}{}_{.88}\ Ti_{.25})_C\ (Si_{6.72}\ Al_{.85}\ Fe^{3+}{}_{.43})_T\ (OH)_{2.1}$

$$\frac{Mg}{Mg + Fe^{2+}} = .017$$

Sample No. 2B/73:

$(K_{.19}\ Na_{.21})_A\ (Na_{.13}\ Ca_{1.60}\ Mn_{.06}\ Fe^{2+}{}_{.21})_B\ (Fe^{2+}{}_{3\,30}\ Mg_{.10}\ Fe^{3}{}_{.86}\ Ti_{.40}\ Al_{.34})_C$
$(Si_{6.93}\ Al_{1\ 07})_T\ (OH)_{.81}$

$$\frac{Mg}{Mg + Fe^{2+}} = 0.027$$

In both these amphiboles (Ca + Na) B > 1.34; (Ca) B also > 1.34; (Na) B < 0.67; (Na + K) A < 0.50; $Mg/Mg + Fe^{2+} < 0.50$.

The Fe^{3+} values are 1.31 and 0.86.

Ti values are 0.25 and 0.40.

Thus, amphibole 1/77 is a titanian ferri-ferro-hornblende and 2B/73 is titanian ferrian ferro-hornblende (Leake, 1978, pp. 1026-27).

Discussion

The comparison of the Simlipal amphibole, with those listed by Leake (1978), Deer, Howie and Zussman (1963) and Dekker (1978) clearly indicates that it is highly iron-rich (both Fe^{2+} and Fe^{3+}) with insignificant amount of magnesium, thereby representing an iron-rich end member of the ferro-hornblende division (Fig. 3).

The analysis of granite from which the amphibole was separated and the hedenbergite which is associated with it, is given in Table I. The amphibole is not in equilibrium with the ferrohedenbergite around which it is found as reaction rims. The extreme richness in iron, as also the poverty in magnesium is shared in common between the pyroxene and the amphibole. There is a comparative enrichment of aluminium, alkalis and titanium in the amphibole and depletion of CaO as compared to the pyroxene.

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