NOTES AND NEWS

PARAGENESIS OF ANTHOPHYLLITE AND HORNBLENDE FROM THE BANCROFT AREA, ONTARIO

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There are few records in the literature of the paragenesis anthophyllite-hornblende which have been presented in detail, and I can call to mind only one association which has been the subject of quantitative chemical study. Such is the anthophyllite-tremolite paragenesis of Edwards, St. Lawrence, Co., N. Y., though to judge from the published analytical data of several workers, further study of material of undoubted purity from this locality is still required.

The paragenesis of anthophyllite and cummingtonite on the other hand has been closely investigated in a number of examples and it may be inferred that this association of amphiboles is of commoner occurrence than the one noted above.

Eskola (1950) and Seitsaari (1952) have more recently discussed the association of cummingtonite and hornblende in assemblages from Finland and their studies provide the first quantitative investigation of this particular paragenesis.

In the present note a chemical study is presented of the anthophyllite-horneblende association from an assemblage from near Bancroft, Ontario.

The assemblage in question is a foliated metagabbro forming a facies of the large Mallard Lake gabbro mass of Dungannon Township in Hastings County, Ontario, at a point ¾ mile East of York River Bridge on the East Road out of Bancroft. The north end of this metagabbro intrusion has been mapped by Hewitt in Carlow Township and it is known to extend southwest as far as Egan Chute on the York River near York River Bridge (Hewitt, 1955). The rock is a schistose metagabbro of medium grainsize, rich in black hornblende, conspicuous clove brown needles of anthophyllite reaching a quarter of an inch in length, and plagioclase. Under the microscope the constituents are seen to be green hornblende, light colored anthophyllite, both minerals appearing in independent idioblastic crystals, plagioclase, and as accessories magnetite and apatite. The approximate mode (wt. per cent) is hornblende 65, anthophyllite 10, plagioclase 23, iron ore and apatite 2.

The plagioclase has a composition An_{45} and is not conspicuously twinned or zoned. Of the amphiboles, green hornblende is dominant and shows frequently in longitudinal section conspicuous striation or parting parallel to (001). The anthophyllite forms striking elongated prisms piercing green hornblende aggregates, and though homoaxial growths are recorded they are quite subordinate.

The optical characters of the two amphiboles are summarized below.

Green hornblende: α 1.653, β 1.665, γ 1.675, $2V_\alpha 80°$
$\gamma \wedge c$ 19°, $\beta = b$

Pleochroism marked—α greenish yellow, β green, γ bluish green Absorption $\beta > \gamma > \alpha$.

Anthophyllite: α 1.649, β 1.656, γ 1.665, $2V_\gamma 78°$
$\gamma = c$, $\beta = b$

Pleochroism feeble—α and β colorless to palest yellow, γ smoke grey. Absorption $\gamma > \beta = \alpha$.

The rock and the two separated amphiboles have been subjected to analysis by Mr. J. H. Scoon, the results being presented in Table 1.

The analysis of the rock is distinguished by its low value of potash, but the assemblage presents the chemical features of an olivine gabbro and in Table 2 (columns 1 and 2) is compared with the average olivine gabbro computed by Nockolds (1954).

The amphibole analyses are given in Table 1 (columns 2 and 3), the analysis of the anthophyllite being corrected in column 3(a) for the estimated two per cent impurity of hornblende which remained in the anthophyllite fraction after repeated treatment in heavy liquids in the isodynamic separator.

In Table 2 analyses of chemically comparable amphiboles are set down, the compared anthophyllite of Montana being associated with cummingtonite (Rabbitt, 1948).

When we contrast the anthophyllite and green hornblende of the Ontario metagabbro we note that the hornblende is more highly aluminous and has larger amounts of Fe_2O_3, TiO_2, Na_2O and K_2O in its structure, a feature also revealed in the hornblende member associated with cummingtonite in the Finnish assemblages described by Eskola (1950) and Seitsaari (1952).

It is of interest to set out the relative distribution of magnesium and iron in studied paragenetic amphiboles, and for this purpose the ratio

$$mg = \frac{Mg}{Mg + Fe^{+3} + Fe^{+2} + Mn} \text{ (atom)}$$

is recorded for the following associations.

TABLE 1

	1	2	3	3(a)	Norm of 1		Metal atoms to 24 (O, OH, F, Cl)				
SiO_2	46.52	43.82	50.07	50.06				2		3	
Al_2O_3	16.77	14.85	7.45	7.28	Or	0.28	Si	6.351	8.00	7.203	8.00
Fe_2O_3	2.66	3.32	1.01	0.96	Ab	24.89	Al	1.649		0.797	
FeO	9.44	11.15	18.33	18.42	An	32.53	Al	0.874		0.445	
MnO	0.22	0.27	0.56	0.57	Hl	0.06	Fe'''	0.365		0.103	
TiO_2	1.24	0.68	0.21	0.20	Di	9.24	Fe''	1.348	5.32	2.208	
MgO	9.54	12.07	18.33	18.40	Hy	4.82	Mn	0.035		0.069	7.15
CaO	9.04	10.20	1.06	0.87	Ol	20.21	Ti	0.078		0.026	
Na_2O	3.02	1.79	0.78	0.76	Il	2.28	Mg	2.627		3.968	
K_2O	0.05	0.12	0.02	0.02	Mt	3.71	Ca	1.583		0.129	
H_2O+	1.59	1.94	2.32	2.32	Ap	0.34	Na	0.504	2.10	0.207	
H_2O-	0.06	0.06	0.08	0.08	Fl	0.12	K	0.017		—	
F	0.04	0.04	nil	nil	Rest	1.65	OH	1.879		2.225	
Cl	0.04	0.03	0.06	0.06		——	F	0.017	1.90	—	2.24
P_2O_5	0.16					100.13	Cl	0.009		0.017	
	100.39	100.34	100.28	100.00							
Less O	0.03	0.03	0.03				Sp. Gr.	3.21		3.22	
=F, Cl	——	——	——								
	100.36	100.31	100.25								

1. Anthophyllite-hornblende metagabbro (Mallard Lake), East Road, ¾ mile E of York River bridge, 6.7 miles East of Bancroft, Ontario.
2. Hornblende of metagabbro, 3 Anthophyllite of metagabbro, 3(a) Anthophyllite, analysis 3 recalculated after removal of 2 per cent of hornblende (analysis 2).

A = Anthophyllite, C = Cummingtonite, H = Hornblende

A	C	H	Reference
0.60	0.59	—	Sundius (1933)
0.41	0.47	—	Eskola (1936)
0.61	0.30	—	Rabbitt (1948)
	0.70	0.76	Eskola (1950)
	0.40	0.33	Seitsaari (1952)
0.62	—	0.60	Mallard Lake metagabbro

Here we note that in the case of the anthophyllite-cummingtonite associations the most striking disparity in *mg* values is seen in the Montana paragenesis (Rabbitt 1948) but the full description of this association is apparently not yet available. Omitted from the table are the *mg* values of the analyses of anthophyllite (gedrite) and cummingtonite recorded by Collins (1942) from Sutherland, for these analyses are from rocks each containing only one of the amphiboles.

TABLE 2

	1	2	3	4	5	6
SiO_2	46.52	46.83	50.06	50.36	43.82	44.23
Al_2O_3	16.77	17.38	7.28	8.06	14.85	14.62
Fe_2O_3	2.66	1.91	0.96	2.18	3.32	5.11
FeO	9.44	8.20	18.42	18.26	11.15	8.94
MnO	0.22	0.14	0.57	nil	0.27	0.21
TiO_2	1.24	0.97	0.20	0.43	0.68	1.81
MgO	9.54	10.03	18.40	17.57	12.07	10.78
CaO	9.04	11.36	0.87	0.74	10.20	10.81
Na_2O	3.02	2.03	0.76	0.70	1.79	1.51
K_2O	0.05	0.40	0.02	nil	0.12	0.61
H_2O+	1.59	0.63	2.32	1.69	1.94	1.42
H_2O-	0.06	—	0.08	—	0.06	0.08
P_2O_5	0.16	0.12	—	—	—	—
F	0.04		nil	nil	0.04	0.22
Cl	0.04		0.06	—	0.03	—
	100.39	100.00	100.00	99.99	100.34	100.35

1. Anthophyllite-hornblende metagabbro (analysis 1, Table 1).
2. Average olivine gabbro (Nockolds, 1954, p. 1020).
3. Anthophyllite (Analysis 3(a), Table 1).
4. Anthophyllite from amphibolite (cummingtonite-bearing) Madison Co., Montana (Rabbitt, 1948, p. 270).
5. Hornblende (analysis 2, Table 1).
6. Hornblende from hornblende schist, Glen Tilt, Perthshire (Deer, 1938, p. 68).

Values of *mg* are closely comparable for the anthophyllite-hornblende pair of the Mallard Lake metagabbro, but are contrasted in the cummingtonite-hornblende pair described from Finland.

As has been emphasized by Eskola it will be useful to have further amphibole parageneses quantitatively investigated, for their chemical variation may well prove sensitive indicators of the conditions under which these metamorphic assemblages have crystallized.

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PREPARATION OF PETROGRAPHIC SECTIONS WITH BONDED DIAMOND WHEELS

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Introduction

The preparation of thin sections of rocks and minerals for petrographic examination was ably presented in 1953 by Read and Mergner (1) who summarized the development of thin-sectioning techniques together with a detailed description of the established practice of the U. S. Geological Survey. In recent years, the methods of petrography have become increasingly useful in ceramics and other non-metallic and refractory technology. Recently Insley and Frechette (2) have published a comprehensive work in this field of industrial petrography. In many instances standard methods for preparing thin sections may be applied to ceramic microscopy, but there is an increasing number of articles or materials to which they can be applied with only partial effectiveness