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Barian chromium-bearing hydromuscovite from Mozambique

HYDROMUSCOVITE occurs in a pegmatite of Serra do Menucué (Mozambique) associated with biotite, andesine (An_{36}) and kyanite. The flakes of the hydromuscovite can reach 10 × 8 × 1 mm in size, occurring in prismatic crystals of tabular habit with {001}, {110}, and {010}, light green in colour; specific gravity 2·899. In thin section it is very light green. The refractive indices are $\alpha = 1{\cdot}562$, $\beta = 1{\cdot}593$, $\gamma = 1{\cdot}596 \pm 0{\cdot}002$; $2V_\alpha = 27 \pm 1°$.

The mica was separated and the purity was estimated to be 99·8–99·9% by optical examination; the principal contaminant is rutile, which occurs as inclusions. Diffractometer records showed it to have the $2M_1$ structure, which was confirmed by Weissenberg photographs. The basal spacing 9·988 Å was determined following the method of Guidotti (1966), using the internal standard CaF_2, and the measurement of *d* for (002) is accurate to ±0·002 Å. The unit cell dimensions are: *a* 5·19, *b* 9·00, *c* 19·90 ±0·01, *β* 95°, calculated from a powder photograph. Single crystal work did not prove to be accurate due to the difficulty in obtaining a single flake.

The d.t.a. curve was established using a semi-automatic apparatus with alumel and chromel pairs. The first endothermic peak, at about 180 °C, corresponds to the loss of adsorbed water, and this effect also occurs in muscovite and illite. The second endothermic peak occurs between 490 and 530 °C and corresponds to the loss of $(OH)^-$; it is also characteristic of illite. However, the subsequent endothermic–exothermic effects present in illite are missing here, which is more characteristic of muscovite. This d.t.a. curve is similar to that of Kerr and Hamilton (1958) for a chrome mica clay. From X-ray diffractometry it was found that this hydromuscovite did not suffer any major structural change until 1000 °C, which is more characteristic of muscovite.

The chemical analysis was carried out largely by the classical wet method, but Ca, Mg, Na, K, and Li were determined by atomic absorption (the limit of detection for Ca is 1 ppm and for Li is 0·1 ppm in aqueous solution, and the precision obtained is ±2%). Zn, Cl, F, and the trace elements were determined with an A.E.I. MS7 spark source mass spectrograph using the technique of Nicholls *et al.* (1967), with rhenium as internal standard; the limit of detection is 0·01 ppm and the precision of ±7% is obtained. Cr and Ba were determined by the classical wet method and mass spectrography, both techniques giving similar results.

The chemical analysis, structural formulae, and the trace elements are given in Table I. This mica was plotted in the triangular diagram tetrahedral R^{3+}-octahedral R^{3+}-(alkalis + exchangeable ions $+M^{2+}+H_3O^+$) of Yoder and Eugster (1955) and fell in the hydromuscovite and illite field. However, it is an hydromuscovite because it does not have excess silica and several chemical constituents occupy well-defined atomic sites.

Brown and Norrish (1952) consider that in the hydrous micas there is replacement of potassium by oxonium ions. However, this does not seem to apply to this hydromuscovite because the deficiency in potassium is mainly compensated by sodium and barium. In this hydromuscovite there is replacement of $(O)^{-2}$ by $(OH)^{-4}$. It is rich in Cr, but CrAl may be substituting for 3Mg.

The hydromuscovite from Mozambique has greater specific gravity, refractive indices, higher Cr_2O_3, BaO, and Na_2O contents, and lower SiO_2 content than any other hydromuscovite (Brammall and Leech, 1937; Deer *et al.*, 1962—only the oxide contents are considered) or gümbelite (Aruja, 1944—except for *α* and *γ*). The specific gravity is greater than that of muscovite and similar to that found by Whitmore *et al.* (1946) for fuchsite. The refractive indices and unit cell dimensions are comparable with those for fuchsite and the most common polymorph of muscovite, but *β* and *γ* lie just in the low limit of their range for fuchsite. *a* and *b* are similar to those found by Brammall and Leech (1937) for hydromuscovite, but the basal spacing is lower. The results seem to be in accordance with the fact that the refractive indices of chromian muscovites increase with Cr and its content in this barian chromium-bearing hydromuscovite is lower than in fuchsite. The refractive indices are also greater than those found by Kerr and Hamilton (1958) for chrome mica clay. The specific gravity and refractive indices are in the range for illite; however, 2V is much greater than in illite and lower than in the normal muscovites, gümbelite, fuchsite, or chrome mica clay.

No hydromuscovite containing both Cr and Ba

TABLE I. *Barian chromium-bearing hydromuscovite from Mozambique*

Chemical composition		Number of ions on the basis of 24(O, OH, Cl, F)	A	B	Trace elements (ppm)			
SiO_2	42.44	Si	5.787	5.908	Be	*	Tm	*
TiO_2	1.24	Al	2.213	2.092	Ge	0.19	Er	0.13
Al_2O_3	33.53	Al	3.177	3.411	Ga	794	Y	0.08
Cr_2O_3	0.46	Ti	0.127	0.130	W	4	Ho	0.01
Fe_2O_3	0.41	Cr	0.050	0.050	V	29	Dy	0.57
ZnO	0.12	Fe^{3+}	0.042	0.043	Mo	0.14	Tb	0.10
FeO	0.54	Zn	0.012	0.013	Nb	1.1	Gd	0.80
MnO	0.01	Fe^{2+}	0.062	0.063	Zn	975	Eu	0.20
MgO	1.09	Mn	0.001	0.001	Sn	1.3	Sm	0.18
CaO	0.14	Mg	0.222	0.226	Li	25	Nd	0.34
BaO	1.32	Ca	0.020	0.021	Ni	6	Pr	0.09
Na_2O	1.23	Ba	0.071	0.072	Zr	188	Ce	0.59
K_2O	8.02	Na	0.325	0.331	In	1.9	La	0.54
Cl	0.04	K	1.395	1.424	Cd	2.5	U	0.07
F	0.002	H_3O+	—	0.503	Sb	0.11	Th	0.24
H_2O+	5.93	Cl	0.009	0.009	Co	1.1	Sr	62
H_2O-	3.84	F	—	0.001	Cu	4.1	Pb	36
		OH	5.393	4.000	Sc	12	Rb	30
	100.362	O	18.598	19.990	Bi	0.32	Tl	0.20
O ≡ Cl	0.01	ΣX	8.00	8.00	Lu	0.14	Cs	4.2
O ≡ F	0.001	ΣY	3.69	3.94	Yb	0.15		
		ΣZ	1.81	2.35				
	100.351							

Analysts: A. D. Guimarães and A. M. Neiva

A—Classical formulae. B—Formulae according to Brown and Norrish (1952)

Analyst: A. M. Neiva.

has been reported previously. Although the hydromuscovite from Mozambique is richer in BaO (1.32 %) than in Cr_2O_3 (0.46 %), the green colour is thought to be influenced by the presence of Cr because Cr-bearing potassium micas are green (Deer *et al.*, 1962) whereas barium muscovite (oellacherite), with 9.89 % BaO, is pink (Bauer and Berman, 1933). According to Deer *et al.* (1962), Cr-bearing potassium micas containing more than 1 % Cr_2O_3 should be called fuchsite and the term mariposite should be abandoned; so the present hydromuscovite with 0.46 % Cr_2O_3 must be considered Cr-bearing.

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