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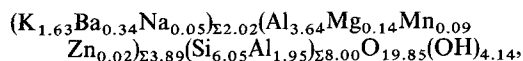
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Barian muscovite from Franklin, New Jersey

A BARIUM-RICH muscovite was reported from Franklin, New Jersey, by Bauer and Berman (1933), who noted its similarity in composition to the barian variety of muscovite which had previously been known as 'oellacherite'. They reported a BaO content of 9.89 wt. % which, being one of the highest reported in muscovite, has been reported in subsequent compendia (Deer *et al.*, 1962). This Franklin mica was subsequently studied by Heinrich and Levinson (1955), who noted that the X-ray powder diffraction data were consistent with the 1M polymorph of muscovite. This muscovite is unlike common micas in appearance. It is fine-grained and thus cleavage is not evident. It has a microgranular texture, a dull lustre, and a deep pink-violet colour. It is associated with hendricksite, euhedral andradite, and native copper. In thin-section, the sample studied by Bauer and Berman (1933) is seen to be an exceedingly fine-grained mixture of many phases: muscovite is predominant and baryte is very abundant, forming lath-shaped crystals which are rimmed by hyalophane; native copper is randomly distributed as microscopic, flattened, skeletal crystals.

Preliminary microprobe analyses of several samples of such material indicated that the previously reported BaO content was in error. Several samples have BaO values varying from 4.8 to 6.3 wt. %. Accordingly, the samples were subjected to additional analyses by microprobe using as standards; hornblende (Si, Al, Fe, Mg, Ca, Na), microcline (K), manganite (Mn), benitoite (Ba), and rhodonite (Zn). Wavelength-dispersive microprobe scans indicated no other elements with atomic number greater than 8. Water was determined using the Penfield method. The samples studied were from the Smithsonian collection (NMNH 105848 and

C6258), the latter being Bauer's sample, and they had very similar compositions. The resultant analysis yielded SiO₂ 43.5, Al₂O₃ 34.1, MgO 0.7, K₂O 9.7, BaO 6.3, Na₂O 0.2, MnO 0.8, ZnO 0.2, H₂O 4.47, sum = 100.0 wt. %. This yields a chemical formula, calculated on the basis of 24 (O + OH), of:



or ideally,



a barian muscovite.

The present analysis, when compared with that of Bauer and Berman (1933), shows a near reversal in the given BaO and K₂O values (they gave 6.33 % K₂O and 9.89 % BaO), suggesting at first reading that the figures might have been switched by accident. However, this is mere conjecture and the abundance of baryte inclusions in the muscovite provides a ready source for excess Ba. In either case, the Ba content of this muscovite is lower than was originally reported and is thus presented here for the record. Ba is present in other Franklin micas; Frondel and Ito (1966) reported it as occurring in hendricksite in amounts varying from 0.6 to 1.5 wt. %. The extent of Ba substitution in other layer silicates at Franklin has also been noted. It has been found in amounts less than 1.0 wt. % in ganophyllite, a mineral with a composition similar to that of a hydrated manganese mica (Dunn *et al.*, 1983), and in amounts up to 1.3 wt. % in lennilenapeite (the Mg analogue of stilpnomelane) and in a Mn-dominant stilpnomelane (Dunn *et al.*, 1984). Recently, Mansker *et al.* (1979) have described high Ba-biotite which, when fully characterized, will be a new species, the Ba analogue of biotite.

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Chromium-bearing kyanite from Mozambique

CHROMIUM-BEARING kyanite occurs in a pegmatite at Serra do Menucué (Mozambique) associated with barium chromium-bearing hydromuscovite (Neiva, 1978), biotite and andesine (An_{36}). The crystals can reach $30 \times 5 \times 3$ mm in size, occurring in pinacoids with {010}, {110} and {110}. They are blue in colour with specific gravity 3.70. In thin section the mineral is slightly pleochroic, γ -very light blue to α -colourless, and contains many inclusions of rutile. The refractive indices are $\alpha = 1.720$, $\beta = 1.730$, $\gamma = 1.753 \pm 0.002$; $2V_{\alpha} = 82 \pm 1^{\circ}$. Optical examination showed that the kyanite contained inclusions of rutile needles.

The unit cell dimensions of the kyanite are: $a = 7.125 \pm 0.006$, $b = 7.846 \pm 0.002$, $c = 5.569 \pm 0.001$ Å, $\alpha = 89.846 \pm 0.027^{\circ}$, $\beta = 101.336 \pm 0.061^{\circ}$, $\gamma = 106.012 \pm 0.043^{\circ}$, $V = 292.965 \pm 0.002$ Å³, calculated from a powder photograph, using Si as the internal standard. An X-ray diffraction photograph of the apparently pure kyanite heated to 1000 °C showed mainly kyanite but with a small amount of muscovite.

The d.t.a. curve up to 1000 °C of the kyanite does not show any peak, in agreement with Eitel (1954). However Houldsworth and Cobb (1923) found an endothermic peak at 850 °C, which may have been due to impurities. At atmospheric pressure, kyanite started to convert to mullite about 1300 °C, the conversion becoming complete by 1400 °C.

The electron probe analysis of the kyanite was obtained on a Microscan 9 wavelength-dispersive

instrument, using the following standards: Al, jadeite; Si, wollastonite; Ti, rutile; Cr and Fe, pure metal. The trace elements were determined with an AEI MS7 spark source mass spectrograph using the technique of Nicholls *et al.* (1967), with Re as internal standard; the limit of detection is 0.01 ppm and a precision of $\pm 7\%$ is obtained. The chemical analysis, structural formulae and the trace elements are given in Table I.

The kyanite from Menucué contains slightly less Cr_2O_3 than the coexisting barium chromium-bearing hydromuscovite. Cr_2O_3 is not common in kyanite, but Ozerov and Bykhover (1936) have reported a green chrome-kyanite with 1.81% Cr_2O_3 ; Herz and Dutra (1964) studied a greenish kyanite with 2200 ppm Cr; Sobolev *et al.* (1968) found blue kyanites with different Cr_2O_3 contents (maximum $Cr_2O_3 = 12.86$ wt. %) and Cooper (1980) reported blue kyanites with Cr_2O_3 from 0.17 to 2.85 wt. %.

Ti can replace Al in the kyanite structure. V (167 ppm) can substitute for Al if V is in the high oxidized state. Ba (82 ppm) and Pb (10 ppm) are almost certainly due to the associated hydromuscovite. Ge (59 ppm) probably substitutes for Si. Sc replaces Al; but Zn, Zr, and Cu are probably too large to replace Al. The V, Zn, Zr, Sc contents of kyanite could not be explained by the hydromuscovite impurities, which are very small.

The kyanite from Menucué has higher specific gravity, refractive indices and b dimensions than