from which crocidolite is not recorded, the former, pegmatitic, origin is considered to be rather more probable.

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## *A magnesioriebeckite–gorceixite schist from south-west Tanzania*

A schist from the Mkulwe area of south-west Tanzania (Q.D.S.242, International Sheet No. SC.36 C.III) is of interest because of the nature of the alkali amphibole it contains and the presence of a phosphate mineral of the plumbogummite group.

The schist occurs near the Zambian border, in a region occupied by NNW.-striking, sheared, slightly gneissose biotite–muscovite post-orogenic granite, tentatively ascribed to Karagwe–Ankolean age. The granitic terrain is separated by the Kanda fault and a wide eluvial plain from the Ufipa gneisses, which occur in the north-west–south-east escarpment to the north-east. The Ufipa gneisses and other metamorphic groups further to the north and east belong to the Ubendian System. The area has been mapped by van Loenen and Kennerley (1962), who make no mention of the schist in their brief description, and its field relations are uncertain.

In hand specimen the rock is grey, fine- to medium-grained, and somewhat schistose in appearance. The thin section shows the schistosity clearly, resulting from the tendency of the dark minerals, especially biotite, to occur in bands. The predominant mineral is albite, forming a mosaic of small grains. Interspersed in this are large, porphyroblastic crystals of albite, rather smaller crystals of a phosphate mineral and a few grains of quartz. The ferromagnesian bands comprise pale yellow biotite, randomly oriented crystals of alkali amphibole, a few small crystals of aegirine, and accessory apatite, zircon, and iron ore. Scattered irregularly through the rock are fairly large, ragged crystals of rutile. An approximate modal analysis is: albite, 57 % (including large crystals, 3 %); quartz, 3 %; amphibole, 15 %; biotite, 15 %; phosphate mineral, 4 %; apatite, 3 %; rutile, 2 %; aegirine, 0·5 %; iron ore, 0·5 %; and zircon, trace.

TABLE I. Magnesioriebeckite from south-west Tanzania. Anal. A. J. Easton

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $SiO_2$ | 54·81 | *Numbers of ions on the basis of 24* (O,OH,F) | | | α′ (blue) | 1·646 | ±0·005 |
| $TiO_2$ | 0·28 | | | | β′ (pale yellow) | 1·654 | |
| $Al_2O_3$ | 2·04 | Si | 7·786 | 8·00 | γ′ (purple) | 1·659 | |
| $Fe_2O_3$ | 12·35 | $Al^{iv}$ | 0·214 | | $\gamma > \alpha > \beta$ | | |
| FeO | 2·97 | $Al^{vi}$ | 0·127 | 4·73 | $2V_\alpha$ | n.d. | |
| MnO | 0·27 | Ti | 0·030 | | α: [001] | 30° | |
| MgO | 13·52 | $Fe^{3+}$ | 1·320 | | *a* (Å) | 9·859 (±0·010) | |
| CaO | 2·91 | Mg | 2·862 | | *b* (Å) | 17·954 (±0·020) | |
| $Na_2O$ | 5·24 | $Fe^{2+}$ | 0·353 | | *c* (Å) | 5·287 (±0·010) | |
| $K_2O$ | 2·51 | Mn | 0·033 | | β | 104·13° (±0·10°) | |
| $H_2O^+$ | [2·61] | Na | 1·443 | 2·34 | V (Å$^3$) | 907 (±2) | |
| $H_2O^-$ | n.d. | Ca | 0·443 | | | | |
| F | n.d. | K | 0·455 | | | | |
| Total* | [100] | OH | 2·473 | | | | |
| | | $100\ Mg/(Mg+Fe^{2+}+Fe^{3+}+Mn)$ | 62·7 | | | | |

* $H_2O^+$ value by difference; total includes $P_2O_5$, 0·40 and $Cr_2O_3$, 0·09 %; n.d.: not determined.

The amphibole has been analysed by A. J. Easton and the analysis is given in table I, together with its optical properties and cell dimensions (*C*2/*m*). Its structural formula suggests that it is closest to magnesioriebeckite (Deer *et al.*, 1963); that it is nearer to this group than to magnesioarfvedsonite is supported by applying the criteria of Miyashiro (1957). The amphibole's optical properties are somewhat anomalous and in most respects resemble those of the magnesioriebeckite rimming a nearly colourless amphibole from Bizan, Sikoku, Japan, described by Miyashiro and Iwasaki (1957), and also the Lueshe alkalic amphibole (Jans and de Bethune, 1968), although there is only limited indication of the absorption directions differing from the axes of the optical indicatrix. It proved impossible to obtain a value for 2V due to strong dispersion and absorption, and these properties rendered difficult other optical determinations.

The phosphate mineral (mean $n = 1{\cdot}63$) has been identified by X-ray powder photograph as a member of the plumbogummite group. Members of this group are very difficult to identify positively by X-ray, but since a qualitative spectrographic determination showed the presence of barium and lesser amounts of strontium, it may be nearest to gorceixite ($BaAl_3(OH)_7P_2O_7$), with some goyazite ($SrAl_3(OH)_7P_2O_7$) in solid solution. Gorceixite has been found in the weathered rocks surrounding the Mrima Hill carbonatite, Kenya, (Coetzee and Edwards, 1960), where it is considered to have formed from weathered baryte, apatite, and aluminous material. In the Tanzanian rock, however, it is apparently of metamorphic origin.

Little attempt is made to identify the origin of the rock, beyond suggesting that it may belong to a fairly high-grade greenschist facies, possibly derived from pelitic rocks rich in alkalis, BaO, SrO, and $P_2O_5$.

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## *Dielectric properties of hydroxyapatites*

COCKBAIN and Smith (1967, p. 412) attribute the 'good dielectric properties' of hydroxyapatites to the separation and position of hydroxyl ions along the $6_3$ axes, although the OH position they used (in the plane