# SHORT COMMUNICATIONS

## *Kirschsteinite, a natural analogue to synthetic iron monticellite, from the Belgian Congo.*

IN a recent paper[1] the authors published brief descriptions of two new silicates from a complex melilite–nephelinite lava from the crater of Mt. Shaheru, Nyiragongo area, North Kivu, in the Belgian Congo. For these silicates the names götzenite and combeite, respectively, were proposed. The same nephelinite specimen, numbered S.80, contains another major constituent which could not be identified microscopically. In its optical properties and general appearance the mineral shows some relationships to olivine. It deviates, however, from the members of the forsterite–fayalite series and from monticellite. For this reason the mineral was subjected to a closer study. It proved to be essentially an iron analogue of monticellite, $CaMgSiO_4$, and glaucochroite, $CaMnSiO_4$, and for this natural $CaFeSiO_4$ the name kirschsteinite is proposed, in honour of the German geologist, the late Dr. Egon Kirschstein, who died in the events of the World War I in East Africa. As has been pointed out by Meyer,[2] Dr. Kirschstein was an early pioneer in the geological exploration of the Virunga volcanic field in North Kivu.

The kirschsteinite-bearing specimen from the Shaheru crater contains the following minerals: clinopyroxene, melilite, nepheline, kalsilite, götzenite, sodalite, kirschsteinite, combeite, magnetite, perovskite, apatite, brown hornblende, and pale biotite. In addition, an unknown mineral was found in sparing amounts, a study of which is in progress. Closer characteristics of these minerals and of the rock will be given elsewhere by Meyer and Sahama.[3]

The kirschsteinite was isolated from the rock with heavy liquids and a Frantz-type isodynamic separator. A microscopic test showed the material to be very pure. The result of the chemical analysis is: $SiO_2$ 32·71 %, $TiO_2$ 0·23, $Al_2O_3$ 0·26, $Fe_2O_3$ 0·66, FeO 29·34, MnO 1·65, MgO 4·95, CaO 29·30, $Na_2O$ 0·34, $K_2O$ 0·36, $P_2O_5$ 0·07, $H_2O+$ 0·25, $H_2O-$ 0·06, total 100·18. The analysis corresponds to the following molecular composition: $CaFeSiO_4$ 69·4 mol. %, $CaMnSiO_4$ 4·3, $CaMgSiO_4$ 22·6, excess $Fe_2SiO_4$ 3·7. Accordingly, the mineral is to be called magnesian kirschsteinite. The analysis shows a slight deficiency in calcium in relation to the sum of iron, manganese, and magnesium. The most iron-rich monticellite previously known from natural rocks is that from the Island of

Muck, Scotland, with *ca.* 25 wt. % $CaFeSiO_4$.[4] A pycnometric specific gravity determination of the analysed material yielded $D = 3{\cdot}434$.

The indexed powder pattern, recorded with the Philips Norelco X-ray diffractometer, with filtered cobalt radiation and a silicon standard, is as follows:

| *hkl.* | *I.* | $2\theta_{obs.}$ | $d_{obs.}$ | $Q_{obs.}$ | $Q_{calc.}$ |
|---|---|---|---|---|---|
| 020 | 35 | 18·485 | 5·569 | 0·0322 | 0·0323 |
| 021 | 25 | 24·56 | 4·205 | 0·0565 | 0·0565 |
| 101 | 10 | 26·67 | 3·878 | 0·0665 | 0·0666 |
| 111 | 70 | 28·305 | 3·658 | 0·0747 | 0·0747 |
| 002 | 10 | 32·35 | 3·211 | 0·0970 | 0·0970 |
| 130 | 100 | 35·31 | 2·9492 | 0·11497 | 0·11498 |
| 040 | 25 | 37·495 | 2·7830 | 0·12911 | 0·12912 |
| 131 | 85 | 38·995 | 2·6798 | 0·13924 | 0·13924 |
| 112 | 80 | 40·18 | 2·6040 | 0·14747 | 0·14746 |
| 041 | 15 | 40·985 | 2·5549 | 0·15319 | 0·15338 |
| 140<br>122 | 40 | 43·49 | 2·4143 | 0·17156 | 0·17147<br>0·17167 |
| 210 | 15 | 44·26 | 2·3744 | 0·17737 | 0·17747 |
| 211 | 10 | 47·405 | 2·2251 | 0·20197 | 0·20173 |
| 132 | 10 | 48·635 | 2·1721 | 0·21195 | 0·21202 |
| 240 | 60 | 58·505 | 1·8304 | 0·29847 | 0·29852 |
| 160<br>133 | 10 | 62·16 | 1·7326 | 0·33312 | 0·33287<br>0·33332 |
| 152 | 10 | 62·945 | 1·7132 | 0·34070 | 0·34114 |
| 062 | 30 | 67·65 | 1·6068 | 0·38732 | 0·38756 |

The indexing was based on the data for fayalite that has been given by Yoder and Sahama.[5] Unit-cell dimensions, calculated from the powder pattern, are as follows (±0·005 Å.): *a* 4·859, *b* 11·132, *c* 6·420 Å. The crystallographic axes were selected in a way that corresponds to that generally accepted for the forsterite–fayalite series. A series of rotation and Weissenberg photographs about the three crystallographic axes confirms the unit-cell dimensions given. Systematic extinctions are similar to those for forsterite.

When viewed in specimen under the binocular microscope, the mineral shows a very slight greenish colour. In thin section it is colourless. The optical properties are: $\alpha$ 1·689, $\beta$ 1·720, $\gamma$ 1·728, $\gamma - \alpha$ 0·039 (calc.), $2V_\alpha$ 51°±1° (universal stage), $2V_\alpha$ 53° (calc.). The optical orientation was tested with a thick Berek compensator on crystals mounted on the goniometer head of the Weissenberg camera. Comparison of optical tests and rotation photographs results in the following relationship between the axes of the unit cell and of the optical indicatrix: $a = \gamma$, $b = \alpha$, $c = \beta$. This optical orientation corresponds to that of the forsterite–fayalite series.

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[1] Th. G. Sahama and Kai Hytönen, Min. Mag., 1957, vol. 31, p. 503.

[2] André Meyer, Exploration du Parc National Albert, Mission d'études vulcanologiques, 1955, Fasc. 1.

[3] A. Meyer and Th. G. Sahama (in press).

[4] C. E. Tilley, Compt. Rend. Soc. géol. Finlande, 1947, No. 20, p. 97.

[5] Hatten S. Yoder and Th. G. Sahama, Amer. Min., 1957, vol. 42, p. 475.

## *The nature of batchelorite.*

The name batchelorite was given by W. F. Petterd[1] to a green slaty mineral found in the Mt. Lyell Mine, Tasmania. He gave the composition as $H_2O.Al_2O_3.2SiO_2$, a hydrated silicate of aluminium, but added, in parenthesis, that the analysis[2] was made on green nodules in the schist. It is evident, therefore, that the composition of batchelorite itself was never determined.

A specimen of batchelorite in the British Museum (B.M. 1956, 300), which, although not a type specimen, was collected from the type locality and conforms in appearance with the type mineral, has been shown by its optical properties and X-ray powder pattern to be muscovite schist. A chemical analysis confirmed this and revealed also that the mineral contains a small proportion of chromium. The analysis, given below, corresponds to the formula:

$$(Na,K,Ca,Ba)_{1\cdot 00}\,(Al,Ti,Fe,Cr,Mg)_{2\cdot 03}\,(Si,Al)_4\,O_{10\cdot 04}\,(OH,F)_{1\cdot 98}.$$

There would now appear to be no justification for the retention of the mineral name batchelorite.

Batchelorite from Mt. Lyell, Tasmania (B.M. 1956, 300).

| | | | | | |
|---|---|---|---|---|---|
| $SiO_2$ ... | 45·1 % | CaO ... | 0·7 % | $H_2O(-)$ ... | 0·3 % |
| $Al_2O_3$ ... | 36·4 | MgO ... | 1·2 | $H_2O(+)$ ... | 4·0 |
| $TiO_2$ ... | 0·4 | $Na_2O$ ... | 1·5 | F ... | 1·0 |
| $Fe_2O_3$ ... | 0·5 | $K_2O$ ... | 8·8 | MnO ... | nil |
| $Cr_2O_3$ ... | 0·3 | BaO ... | 0·3 | Total ... | 100·5 |
| | | | | less O for F ... | 0·4 |
| | | | | | 100·1 % |

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[1] Catalogue of the Minerals of Tasmania, 1910, p. 22, no. 39.

[2] $SiO_2$ 49·4, $Al_2O_3$ 45·1, $H_2O$ 5·6, total 100·1 %.

## *Beaverite from the Lake District.*

Beaverite $(Pb(Cu,Fe,Al)_3(SO_4)_2(OH)_6)$ was first recognized and identified by us as a British mineral in 1949, the occurrence being briefly recorded in 1952.[1] The first suspected specimens were examined spectrographically and they (as well as others found subsequently) were confirmed by powder-photographs showing exact agreement with those of a sample of the type-material from Beaver Co., Utah, U.S.A., supplied by Dr. W. T. Schaller, who first described it.

In all the foreign occurrences so far recorded, beaverite is described as forming powdery aggregates of microscopic hexagonal plates: this is its usual habit in Cornwall and Cumberland, but at one locality in the latter county we have found it in small but well-defined rhombohedra. Examination of a large number of specimens collected in the Lake District has shown that many are derived from alteration of beudantite ($PbFe_3(AsO_4)(SO_4)(OH)_6$), another isomorphous member of the group, and that others are intermediate minerals in various stages of alteration. In addition to some of these intermediate members, well-defined beaverite has been found at the following localities in the Lake District:

*Higher Brandy Gill, Carrock Fell*; first found here in 1949 and subsequently in considerable amounts in the outcrop of an east–west Cu–Pb–As vein on the west side of the gill a short way below its head, as bright canary-yellow powdery aggregates derived from direct alteration of galena and still showing its cubic cleavages (B.M. 1956, 83), also as small, yellow to greenish-yellow powdery masses in cavities in vein quartz originally occupied by sulphides, and as yellow, greenish-yellow, and brownish-yellow drusy, crystalline crusts, derived from alteration of beudantite (itself mainly derived from alteration of carminite, $PbFe_2(AsO_4)_2(OH)_2$), coating cavities and joints both in the vein-material and the wall-rock. The sequence carminite → beudantite → beaverite can be well seen on many specimens.

*Driggith Mine, Caldbeck*; yellow to golden-yellow and golden-brown powdery aggregates on cerussite and altered galena in the outcrop of the vein, associated with other minerals beudantite → beaverite and beudantite → plumbojarosite.

*Netherrow Brow, Caldbeck*; yellow to greenish-yellow, powdery beaverite, with beudantite and other secondary arsenates in oxidized vein-material from a north-west–south-east vein, carrying Pb–Zn–Fe–As–Cu sulphides, tried from an old cross-cut near its outcrop between Sandbed and Potts Gill mines.

*Netherrow Brow, Caldbeck*; yellow powdery aggregates, with earthy brown beudantite and plumbojarosite, in similar vein-material from an old level, half a mile to the north-west of and probably driven on the same vein as the preceding, near the farm of Nether Row.

*Potts Gill Mine, Caldbeck*; in oxidized vein-material from a small Cu–Pb–Zn–As vein cut by the old no. 1 cross-cut (of the barytes mine) near the head of the Gill Beck, beaverite has been found as light canary-yellow powdery aggregates with small brilliant crystals of brochantite (B.M. 1956, 82), and as small (0·5 mm.) brilliant, well-formed yellow rhombohedra in the same matrix. This appears to be the first reported occurrence of beaverite in this habit.

*Ingray Gill, Caldbeck (between the hamlet of Fellside and Hay Gill)*; as light yellow powdery coatings on decomposing galena in vein-material from the northernmost of the two old cross-cuts near the head of the gill. The vein is obscured by drift but appears to run roughly NNW. and, from material on the dumps, apparently contains Cu, Pb, Zn, Fe, As, and traces of Co, Ni, Mo, V.

*Higher Roughtongill, Caldbeck*; as yellow, powdery masses, with jarosite and chrysocolla, in somewhat chalcedonic quartz from the outcrop of the main Roughtongill South Vein along the flank of Balliway Rigg.

At several of these localities, intermediate beudantite–beaverite minerals also occur.

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[1] A. W. G. Kingsbury, Trans. Roy. Geol. Soc. Cornwall, 1952, vol. 18, pt. 4, p. 394.