# *Kalsilite in venanzite from San Venanzo, Umbria, Italy.*

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SHORTLY after the discovery of the mineral kalsilite, the pure potash analogue to nepheline, as a natural mineral occurring in some volcanic lavas of SW. Uganda by Bannister and Hey,[4] Professor Arthur Holmes[5] suggested that the nepheline-looking mineral occurring in a very potash-rich lava at San Venanzo, Umbria, Italy, also might be kalsilite. His suggestion was based on the high potash : soda ratio of the bulk rock and on the optical properties of the mineral. No X-ray evidence or chemical analysis on the supposed kalsilite has been presented so far.

During the summer of 1951 one of us (T. G. S.) was able to visit Rome, where Mr. Roberto Palumbo very generously gave him two identical specimens of venanzite from San Venanzo. The constituents and the texture of this rock correspond essentially to the description of ordinary venanzite reported by Holmes, and is different from the 'heteromorph of venanzite' investigated by him. Because of the fact that the specimens available to the present authors also contained a nepheline-looking mineral, it seemed desirable to test whether or not it really is kalsilite.

The two specimens, amounting to about 1760 grams, were crushed with a jaw crusher and a small batch for bulk analysis was put aside. The rest of the material was pulverized with a hammer-mill to a grain-size of about 10 microns. This fine-grained material was subjected to mineral separation by centrifuging it in Clerici solution. After several centrifugings in Clerici solutions of suitable specific gravities, about 4 grams of the supposed kalsilite and about 7 grams of leucite were obtained that were very pure. The material of the supposed kalsilite contained a little colouring matter and a very few grains of leucite. The leucite fraction also contained a small amount of pigments. In both

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[4] F. A. Bannister and M. H. Hey, Min. Mag., 1942, vol. 26, p. 218.

[5] A. Holmes, Geol. Mag. Hertford, 1942, vol. 79, p. 225. [M.A. 8-318.]

cases the amounts of impurities are negligible. Refractive indices for kalsilite and leucite were determined by Mr. Kai Hytönen, Institute of Geology, University of Helsinki, with the following results:

Kalsilite, $\omega$ 1·543, $\epsilon$ 1·537. Leucite, $n$ 1·511.

Chemical analyses of kalsilite, leucite, and of the bulk rock are given in table I.

TABLE I. Chemical analyses of kalsilite and leucite from venanzite, and of the bulk rock. San Venanzo, Italy. (Analyst, H. B. Wiik.)

| | Kalsilite. | Leucite. | Bulk rock. |
|---|---|---|---|
| $SiO_2$ ... | 38·47 | 53·69 | 41·61 |
| $TiO_2$ ... | 0·00 | 0·15 | 0·85 |
| $Al_2O_3$ ... | 30·81 | 22·72 | 8·88 |
| $Fe_2O_3$ ... | 1·63 | 1·01 | 1·76 |
| FeO ... | 0·26 | 0·14 | 5·62 |
| MnO ... | 0·00 | 0·00 | 0·16 |
| MgO ... | 0·63 | 0·21 | 12·63 |
| CaO ... | 0·20 | 0·46 | 16·63 |
| $Na_2O$ ... | 2·09 | 0·30 | 0·98 |
| $K_2O$ ... | 25·65 | 20·69 | 7·62 |
| $P_2O_5$ ... | n.d. | n.d. | 1·33 |
| $H_2O+$ ... | 0·20 | 0·19 | 1·20 |
| $H_2O-$ ... | 0·00 | 0·00 | 0·30 |
| | 99·94 | 99·56 | 99·57 |

X-ray powder photographs of both the powdered kalsilite and leucite analysed by H. B. Wiik confirm their identification. It was also possible to measure the unit-cell dimensions of kalsilite making use of back reflections on a cylindrical film punched so that it could be inserted into the camera with the ends meeting near $\theta = 0°$, instead of the normal arrangement of inserting the film so that the gap in the film occurs near $\theta = 180°$. This method, which will be described in more detail by G. F. Claringbull in his paper on dumortierite, yields cell dimensions more accurate than those previously published for kalsilite and fall nearer to those for the artificial product studied by Rigby and Richardson.[1]

The small amount of mineral available from Uganda permitted only an approximate formula, $KAlSiO_4$, to be derived (column 4, table II). It is possible that the cell contents in column 3 derived from H. B. Wiik's analysis are not only more accurate, but reveal more information about this mineral not previously available. It is clear, for instance, that there is close approach to two atoms of silicon per unit cell and no evidence of replacement of silicon by aluminium. The alkali content is also nearly

[1] G. R. Rigby and H. M. Richardson, Min. Mag., 1947, vol. 28, p. 75.

two atoms and the deficit in oxygen content is unlikely to be due to anything more than experimental error. The cell contents of kalsilite from Italy can be written $2[(K,Na)(Al,Fe)SiO_4]$ with ratio of K/Na = 0·8, and the data so far obtained for the mineral can be summarized as follows:

| Locality. | Refractive index. | | Specific gravity. | Unit-cell data. | |
|---|---|---|---|---|---|
| | $\omega$ | $\epsilon$ | | $a$. | $c$. |
| Uganda ... | 1·542 | 1·537 | 2·59 | 5·17 | 8·67 Å. |
| Italy ... | 1·543 | 1·537 | 2·625 | 5·141 | 8·657 |

Kalsilite, the simplest member of the nepheline group, i.e. the one with the smallest unit cell, remains as rare as kaliophilite, whereas nepheline is a well-known rock mineral that so far is not known to occur in nature in any other form.

TABLE II. Chemical analyses of kalsilite.

| | 1. | 2. | | 3. | | 4. | |
|---|---|---|---|---|---|---|---|
| $SiO_2$ ... | 38·47 | 39·6 | Si ... | 1·99 | | 2·13 | |
| $Al_2O_3$ ... | 30·81 | 21·3 | Al ... | 1·88 | 1·95 | 1·35 | 1·59 |
| $Fe_2O_3$ ... | 1·63 | 5·9 | Fe‴ ... | 0·06 | | 0·24 | |
| FeO ... | 0·26 | — | Fe″ ... | 0·01 | | — | |
| MgO ... | 0·63 | 3·7 | Mg ... | 0·05 | | 0·30 | |
| CaO ... | 0·20 | 5·0 | Ca ... | 0·01 | | 0·29 | |
| $Na_2O$ ... | 2·09 | 1·6 | Na ... | 0·21 | 1·89 | 0·17 | 1·55 |
| $K_2O$ ... | 25·65 | 20·1 | K ... | 1·68 | | 1·38 | |
| $H_2O+$ ... | 0·20 | — | O ... | 7·91 | | approx. 8 | |
| | 99·94 | 97·2 | | | | | |
| Sp. gr. ... | 2·625 | 2·59 | | | | | |

1. Kalsilite, San Venanzo, Umbria, Italy. Analyst, H. B. Wiik; on 4 grams of powder ($\mu$ 10). Specific gravity determined by K. Hytönen using a pyknometer on 1·1 gram of the powder.

2. Kalsilite, Mafuru, SW. Uganda. Analyst, M. H. Hey, Min. Mag., 1942, vol. 26, p. 219; microchemical analysis on 43 and 12 mg.

3 and 4. Contents of the unit cell calculated from analyses, unit-cell dimensions, and observed specific gravities of kalsilite from Italy and Uganda, respectively.

In conclusion, we wish to thank Mr. Roberto Palumbo of Rome for his gift of specimens, Miss E. Fejer for her measurements of the X-ray photographs, and Mr. Kai Hytönen for the measurements of the physical characters.