

Either $|12\text{Cs} + 4\text{H}_2\text{O}|$ or $|12\text{Cs} + 4\text{Na}|$ must occupy the voids at $\frac{1}{2}\frac{1}{2}\frac{1}{2}$ etc. A Fourier difference synthesis, based upon calculated structure factors, but omitting H_2O and Na, showed residual electron-density peaks near $\frac{1}{4}\frac{1}{2}0$, lying midway between the Cs locations. These represent the H_2O molecules lying between Na ions (or Na and Cs). The final model was refined by least squares to an R value less than 5.7 per cent.

THE QUANTITATIVE X-RAY POWDER DIFFRACTION DETERMINATION OF MINERALS IN SOME METAMORPHOSED VOLCANIC ROCKS

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A method has been developed for the quantitative x -ray powder diffraction determination of minerals in metamorphosed volcanic rocks of the greenschist, epidote-amphibolite, and amphibolite facies. This method exploits the principle that the intensities of x -ray diffraction reflections for any crystalline substance in a mixture vary with the concentration of that substance in the mixture. In this investigation a powdered metallic Cu internal standard was employed. The ratios of the intensities of specific reference reflections for each of the minerals to that of the Cu standard were determined. These ratios were plotted against the known weight percentages of the component minerals in the mixtures. The ratios for the mineral components of metamorphosed volcanic rocks in the above facies may be compared with those for the mixtures and the weight percentages of the minerals in the rocks may be determined.

The minerals selected for this investigation were actinolite, albite, chlorite, epidote, muscovite ($2M_1$), and quartz in the greenschist facies; actinolite, almandine, anthophyllite, biotite, hornblende, plagioclase An30, and quartz in the epidote-amphibolite facies, and almandine, diopside, hornblende, plagioclase An30, and quartz in the amphibolite facies. Reproducibility and accuracy are within $2\frac{1}{2}$ -5 weight per cent of the results indicated by comparative Rosiwal analyses.

A NEW COPPER-IRON SULFIDE*

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A copper-iron sulfide mineral from Noril'sk, Western Siberia, discovered and described as cubic chalcopyrite by Bud'ko & Kulagov (1963), is shown to be a discrete mineral entity and not to be confused with cubic chalcopyrite. The term cubic chalcopyrite does, in fact, refer to a valid phase, which is the face-centered cubic high-temperature polymorph of chalcopyrite.

The new sulfide mineral tarnishes very rapidly in air, changing from the chalcopyrite color to hues of pink and brown, and eventually becoming iridescent. Electron-probe microanalyses of several grains using synthetic standards gave Cu = 36.1, Fe = 31.6, S = 31.9, Ni = 0.7, total = 100.3%. The strongest of the x -ray powder diffraction lines (in Å) are 3.04(10), 2.656(5), 1.879(9), 1.598(7), 1.210(5), 1.079(6), and 1.0193(5). The (110) reflection at 7.52 Å (3) clearly differentiates it from cubic chalcopyrite. Single-crystal x -ray diffraction indicates that it has a large cubic cell with $a = 10.64_2\text{Å}$, possible space group $I43m$, and a probable composition of $\text{Cu}_{18}(\text{Fe}, \text{Ni})_{18}\text{S}_{32}$. This

*The name talnakhite has since been proposed by Bud'ko and Kulagov to the Mineralogical Society of the U.S.S.R.

composition gives a calculated specific gravity of 4.36 (measured value 4.24). High-temperature *x*-ray diffraction, D.T.A., and quench experiments indicate that on heating to about 80 °C the mineral breaks down to "tetragonal" cubanite and minor bornite. On slow cooling the original mineral is reformed.

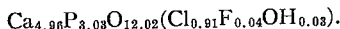
Since this new mineral closely resembles the qualitative descriptions for chalcopyrrhotite in the literature, attempts to find it in specimens from the type chalcopyrrhotite locality were made, but none was found.

MONOCLINIC CHLORAPATITE FROM BOB'S LAKE, ONTARIO

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Chlorapatite was found as a skarn mineral with actinolite, diopside, and calcite at Bob's Lake, Frontenac county, Ontario. Chemical analysis (in per cent) is: CaO—53.4, P₂O₅—41.2, Cl₂—6.18, F₂—0.13, H₂O⁺—0.09, H₂O⁻—0.00, total = 101.00 - 1.45 (0 = F₂ = Cl₂) = 99.55% corresponding to the following formula:



Weissenberg and precession photographs indicate monoclinic instead of the usual hexagonal symmetry found in hydroxyl and fluorapatites, with $a = 2a_{\text{hex}} = 2 \times 9.638$ Å, $b = c_{\text{hex}} = 6.794$, $c = a_{\text{hex}} = 9.638$, space group $P2_1/a$.

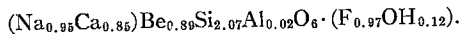
Chlorapatite from Balme, Norway is hexagonal ($P6_3/m$) with a chlorine content of 0.84 atom per formula. This change, from hexagonal to monoclinic symmetry, is interpreted as a result of ordering of Cl ions with the monoclinic form being the ordered form, and ordered arrangement is favoured by high Cl-content.

LEUCOPHANITE, ELPIDITE, AND NARSARSUKITE FROM THE DESOURDY QUARRY, MONT ST. HILAIRE, QUEBEC

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Leucophanite occurs in simple short prismatic to tabular pseudo-tetragonal crystals in the silicate vugs in nepheline syenite. It is usually associated with analcime and serandite. Chemical analysis (in per cent) is: SiO₂—49.72, Al₂O₃—0.80, BeO—8.91, Na₂O—11.78, CaO—18.69, F₂—7.35, H₂O⁺—0.84, corresponding to



The mineral is green and fluoresces pink in short wave ultraviolet. Optically it is biaxial negative with $\alpha_D = 1.565$, $\beta_D = 1.590$, $\gamma_D = 1.593$, $2V = 36^\circ$, $D_m = 2.97 \pm 0.02$. The powder diffraction pattern is identical to that of the Norwegian material.

Elpidite was found as poorly formed prismatic crystals and fibrous aggregates in the altered silicate veins and vugs in nepheline syenite, frequently associated with microcline, catapleite, aegirine, and calcite. Partial analysis (in per cent) gives: SiO₂—58.88, TiO₂—0.05, MnO—0.03, Na₂O—10.38, K₂O—0.1, ZrO₂—20.77, total Fe—0.01. It is orthorhombic with $a = 14.58$ Å, $b = 14.68$, $c = 7.14$, space group $Pmmb$. Optically it is biaxial negative with $\alpha_D = 1.562$, $\beta_D = 1.568$, $\gamma_D = 1.574$, $2V = 89^\circ$. On hand specimens it is white to very pale tan in colour with a silky luster. Its powder diffraction pattern is identical to that of the Norwegian material but differs considerably from that of the material from Kola Peninsula, U.S.S.R.

Narsarsukite occurs as tabular tetragonal crystals with simple forms in the inclusions