ON APOANALCITE

BY

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1 figure.

A new mineral species, apoanalcite, has recently been described in this Journal[1] by Chr. Oftedahl. The chemical composition is shown in table 1. When calculated on 6 0-atoms (+ 1,51 0) the analysis gives the formula $Na_{0,92}\ Ca_{0,03}\ Al_{1,55}\ Si_{1,59}O_6 \cdot 1,51\ H_2O$, and Oftedahl has accordingly suggested the following gross formula for apoanalcite: $NaAl(Al_x\ Si_y)SiO_6 \cdot 1,50\ H_2O$, where $3x + 4y = 4$, implying that a mutual exchange of Al and Si can take place in the anionic part of the lattice, leaving some of the Al-Si-positions vacant when Si takes the place of Al.

The mineral is classified as a zeolite. Oftedahl has, however, pointed out that there is a certain doubt about his classification as the above mentioned formula does not comply with the general zeolite formula given by H. Berman:[2]

$(Na, K)_m\ (Ca, Ba, Sr)_n\ Al_{2n+m}\ Si_r\ O_{2(2n+m+r)} \cdot s\,H_2O$, characterizing the zeolites chemically as hydrous alumosilicates of the alkali and earth-alkali metals, where every Al replacing Si in the lattice is stoechiometrically balanced by one (Na, K) or ½ (Ca, Ba, Sr). The dehydration properties give further evidence in the same direction. The dehydration curve shown in Fig. 1 is very unlike the dehydration curves of zeolites, and must in the present writers opinion be interpreted in the following way: the vertical part of the curve, B—C on the figure, represents about two thirds of the water content of the mineral, leaving this suddenly at a temperature between 300 and 420° C.

[1] Chr. Oftedahl, Apoanalcite, a new mineral. This Journal, XXVI, pp. 215—218, (1947).

[2] H. Berman, Constitution and Classification of Natural Silicates. Am. Min. XXII, p. 371 (1937).

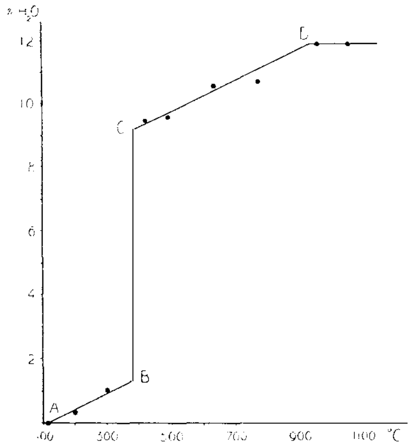

Fig. 1. Dehydration curve of apoanalcite. Reconstructed after Chr. Oftedahl.

	A		B		C	
SiO_2	41.2	0.686	39.21	0.638	38.99	0 649
Al_2O_3	34.0	0.333	31.79	0.311	33.62	0.330
Fe_2O_3	-	-	0.57	0.003	-	-
MnO	-	-	-	-	-	-
MgO	-	-	-	-	-	-
CaO	0.7	0.012	5.07	0.091	0.07	0.001
Na_2O	12.2	0.197	11.55	0.186	13.07	0.211
K_2O	tr	-	-	-	1.12	0.012
H_2O	11.7	0.649	11.71	0.649	12.98	0.720
	99.8		99.90		99.85	

Table 1. A. Analysis and molecular proportions of apoanalcite.[1] L. Lund analyst. B. Analysis and molecular proportions of ranite.[3] S. R. Paijkull analyst. C. Analysis and molecular proportions of hydronephelite.[4] F. W. Clarke analyst.

This water must be water of crystallization. The oblique lines, A—B and C—D on the figure, represent about one third of the water content leaving the mineral continually, and proportionally to the temperature. This part of the water is not completely removed before the temperature has reached about 900° C, which would indeed be very uncharacteristic for zeolitic water, and it must be assumed that this third of the water content is bound as hydroxide groups incorporated in the anionic part of the lattice.

According to this interpretation an apoanalcite formula different from that of Chr. Oftedahl will be offered for consideration. If the analysis is calculated on 14 O-atoms the following formula will appear: $H_{5.62}Na_{1.71}Ca_{0.05}Al_{2.88}Si_{2.97}O_{14}$ or $Na_{1.71}Ca_{0.05}Al_{2.88}Si_{2.97}O_{10.38}(OH)_{1.62} \cdot 2\,H_2O$ The numbers of Na-atoms and Al-atoms in this formula are nearly 2 and 3 respectively. Assuming that the deficiency can be accounted for by vacant Na- and Al-positions in the lattice balanced stoechiometrically by OH replacing O, at the same time assuming Ca isomorphous with Na, a recalculation of the formula accordingly yill give: $Na_2Al_3Si_{2.97}O_{10.93}(OH)_{1.07} \cdot 2\,H_2O$ or very nearly $Na_2Al_3Si_3O_{11}(OH) \cdot$ $\cdot 2\,H_2O$. This formula can be written $N_2Al[Al_2Si_3O_{10}]O(OH) \cdot 2\,H_2O$ indicating that apoanalcite may be an alumosilicate of sodium and aluminium containing water partly bound as water of crystallization, partly as hydroxide groups in the anionic part of the lattice.

As far as chemical composition is regarded apoanalcite is closely related to the minerals ranite[3] and hydronephelite.[4] The analyses of these minerals, quoted in table 1, give when calculated on 15 O-atoms the following formulae:

ranite: $Na_{1.78}Ca_{0.43}Al_{2.98}Si_{3.04}O_{11.80}(OH)_{0.20} \cdot 3\,H_2O$
hydronephelite: $Na_{2.08}Al_{3.06}Si_{3.01}O_{11.32}(OH)_{0.68} \cdot 3H_2O$

It will be observed that these minerals contain more water than apoanalcite, and the calculation above indicates that they contain 3 water molecules as water of crystallization as compared with two molecules in apoanalcite, and at the same time less water bound as hydroxide groups. However, the dehydration properties are unknown and further evidence is necessary before anything can be said with certainty.

Both minerals have been classified as zeolites, but neither agree with the general zeolite formula. May be the three minerals ranite, hydronephelite, and apoanalcite constitute a mineral group, until now not recognized, with the general formula, $Na_{1-3}Al\ (Al_2Si_3O_{10})\ (O, OH)_2 \cdot n\ H_2O$, where $n = 3$ for ranite and hydronephelite, and $n = 2$ for apoanalcite.

[3] S. R. Paijkull, Ranit, eine neues Mineral von Brewig. Ber. d. Deutsch. Chem. Gesell. VII, pp. 1334—1335. (1874).

[4] F. W. Clarke, Minerals of Litchfield, Maine. Am. J. Sc. XXXI, pp. 265—268 (1886).

It is very desirable indeed, that Chr. Oftedahl will continue the investigations of his new mineral species and the lesser known related minerals to find the answers to the many unsolved questions which have arisen from the work he has done so far.

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