ON "APOANALCITE" AND HYDRONEPHELITE

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Abstract. "Apoanalcite", proposed by the author as a new mineral, is shown to consist essentially of fibrous aggregates of natrolite, and should thus be discarded. Another component of "apoanalcite" is pseudo-hexagonal. It is supposed that what has been called hydronephelite consists of mixtures of natrolite aggregates and the pseudo-hexagonal mineral which is possibly what truly should be called hydronephelite.

Apoanalcite as a new mineral was proposed by the author (Oftedahl, 1947, p. 215) for a zeolite-like mineral, which was uniaxial positive, $\varepsilon = 1.487$, $\omega = 1.475$, and which had a chemical composition like that of analcite.

Later Neumann (1948, p. 171) pointed out that apoanalcite probably belongs to the mineral group hydronephelite-ranite. Recent x-ray investigations on the analyzed specimen by the present author indicate that the "apoanalcite" consists of natrolite and what is possibly an unknown mineral. Therefore, the term apoanalcite should be discarded.

Optics. Inasmuch as x-ray studies suggest that the specimen consists essentially of natrolite, a reinvestigation of optical properties was carried out. Under the microscope the red aggregate consists of 90 to 95 per cent of an apparently uniaxial mineral (natrolite), and 5 per cent of another zeolite-like mineral in small irregular patches, mostly about 0.05—0.1 mm across. On the universal stage the latter mineral proved to be biaxial, (—) $2V = 70—80°$, one cleavage plane parallel to XZ (i. e. monoclinic or possibly orthorhombic), N greater than Canada balsam, and $\gamma—\alpha$ about 0.013.

[1] The work was done in 1950 when the author was visiting assistant professor at the University of Illinois, Urbana, Illinois.

Careful measurements of the "uniaxial" mineral on the universal stage show that it is actually biaxial. Most of the small patches measured within the grains having strong undulatory extinction seem to be uniaxial according to the three tests described by Ingerson (Knopf and Ingerson, 1938, pp. 242—243). Some grains however, seem to have a dark sector instead of an axis, and two small patches have two axes with (—) 2V=22° and 54°, respectively, thus approaching the axial angle of natrolite (about 60°). The refractive indices are those generally given for natrolite. It is, therefore, logical to assume that the "uniaxial" mineral is an intergrowth of submicroscopical fibres of natrolite. These fibres have parallel c-axes, but have random orientation of their a and b axes, thus creating a pseudo-uniaxial symmetry. Support for this assumption is found from a tiny cylindrical grain (0.2 × 0.03 mm in size), which seems to be just one individual under the microscope. A Weissenberg zero-layer photograph shows that this grain consists of two natrolite individuals, with strictly parallel c-axes, but with the a- and b-axes 2—3° from each other.

This feature explains the observations by Brøgger (1890, II, p. 232) on the weathering products of nephelite from Langesundsfjord in the Oslo region, Norway. Brøgger distinguished between two varieties of "spreustein" formed from nephelite. One variety consists essentially of natrolite with subordinate amounts of hydronephelite, diaspore, analcite, etc.; another variety consists of hydronephelite, with some diaspore, thomsonite, etc. The varieties cannot be distinguished from each other, and even under the microscope they are very much alike, having the same refractive indices and parallel extinction. Only the axial section shows hydronephelite to be uniaxial, whereas natrolite is biaxial. However, the observations stated above by the present author suggest that both types of "spreustein" consist of natrolite, one being pseudo-uniaxial because of intergrowth of fibres.

The natrolite contains, besides small inclusions of iron ore, small patches of a clear, zeolite-like mineral to be discussed below.

X-ray work. The powder pattern of "apoanalcite" is identical with that of natrolite. The amount of the other silicate mineral is not sufficient to give noticible lines.

One little grain, picked out from "apoanalcite" powder gave an x-ray pattern different from natrolite. The pattern is pseudo-hexagonal, orthorhombic, or possibly monoclinic, pseudo-orthorhombic. Obviously it is the same mineral as the one observed as inclusions in the natrolite.

Weissenberg zero-layer photographs with c-axis rotation show some interesting details. The grain consists of two mineral individuals with slightly different unit cells. One cell is almost hexagonal in symmetry, with a_1, a_2, and a_3 along the pseudo-hexagonal axes equal to 6.32 Å, 6.35 Å, and 6.39 Å, respectively (± 0,03 Å). The corresponding dimensions of the other cell are 6.67 Å, 6.63 Å, and 6.50 Å, respectively. These dimensions are dependent on the assumption that the corresponding reflections are of first order. They might have to be doubled or tripled. Rotation photographs around the c-axis show that the c period of the two cells are 7.25 Å and 7.14 Å, respectively (± 0.03).

The pseudo-hexagonal symmetry of the above described mineral supports the assumption that it could be properly called hydronephelite, having a cell related to that of the hexagonal nephelite, even though its unit cell seems to be smaller than that of nephelite ($a = 10.1$ Å, $c = 8.5$ Å). At least it is not an ordinary zeolite, or diaspore or boehmite, which are frequently associated with natrolite.

Chemical Composition. If "apoanalcite" is composed of 90 to 95 % natrolite and 5 to 10 % of the unknown mineral, it should be possible to arrive at some approximate composition of the mineral by subtracting 90 % natrolite from the composition of "aponalcite" (see Oftedahl, 1947, p. 216). Such a calculation, however, gives approximately 10 SiO_2. Al_2O_3. 40 H_2O, which can scarcely be any mineral. Therefore, the already published analysis must be somewhat erroneous.

The Hydronephelite Problem. It is still uncertain if the mineral hydronephelite exists. Only two analyses have been published in the later years. Walker and Parsons (1926, p. 11) gave the composition of what they thought was ranite, — a calcium-bearing hydronephelite with 5 % CaO. Later Dunham (1933, p. 373) published the composition of hydronephelite containing 3 % CaO. Dunham considered hydronephelite to be an aggregate, as did Thugutt (1932, p. 141). As suggested by Neumann (1948, p. 173) there might be a series from nephelite to "hydronephelite", that is, from nephelite to mixtures of natrolite and the pseudo-hexagonal mineral. The doubtful species ranite is probably a mixture of natrolite and some Ca-rich mineral.

For comparison, powder patterns were made of two samples of hydronephelite, one from Katzenbuchel, Odenwald, Germany, and one from Wausau,Wisconsin. On both samples the hydronephelite occurred on nephelite crystals as a reddish weathered zone, a few millimeters thick. The powder pattern of both specimens show lines from natrolite and from the pseudo-hexagonal mineral described above, in proportions of approximately 1 : 1. Further x-ray, optical or chemical studies are scarcely possible on these weathered materials. Therefore, investigations must be carried out on more favorable material in order to find out if any mineral like the hydronephelite described by Clarke (1896, p. 265) and Brøgger (1890, II, p. 232) really exists, or if this hydronephelite generally is a mixture of natrolite and a new pseudo-hexagonal mineral. If the latter case is true the name "hydronephelite" may be given to the pseudo-hexagonal mineral.

References.

Brøgger, W. C.: Die Mineralien der Syenitpegmatitgänge der süd-norwegischen Augit- und Nephelinsyenite. Zeitschr. Kryst., vol. *16,* 1890, Part II (Specieller Theil), pp. 1—663.

Dunham, K. C.: Crystal Cavities in Lavas from the Hawaiian Islands. Am. Min., vol. *18,* 1933, pp. 369—385.

Neumann, H.: On Apoanalcite. Norsk Geol. Tidsskr., vol. *27,* 1948, pp. 171—174.

Oftedahl, Chr.: Apoanalcite, A New Mineral. Norsk Geol. Tidsskr., vol. *26,* 1947, pp. 215—218.

Thugutt, St. J.: Sur l'epinatrolite, mineral composant l'hydronephelinite. Archive de mineralogie de la societé des sciences et des lettres de Varsovie, vol. *8,* 1932, pp. 141—144.

Walker, T. L., and A. L. Parsons: Minerals from the new nepheline syenite area, French River, Ontario. Toronto University Studies, Geological Series (Contributions to Canadian Mineralogy), 1926, pp. 5—14.