THE AMERICAN MINERALOGIST, VOL. 43, SEPTEMBER-OCTOBER, 1958

NOTES AND NEWS

HOLMQUISTITE AS A RHOMBIC AMPHIBOLE

Thorolf Vogt, Otto Bastiansen, and Per Skancke,
Technical University of Norway, Trondheim, Norway.

A. Osann (1913) described holmquistite as a lithium-glaucophane from the island Utö, Södermanland, Sweden. Charles Palache, S. C. Davidson, and E. A. Goranson (1930) described this rare mineral from the second known locality, the Hiddenite mine, Alexander Co., North Carolina. Felix Machatschki (1953, p. 44) regarded holmquistite not as a glaucophane, but rather as an independent member of the amphibole group, and placed the mineral in the same relation to cummingtonite that spodumene has to clinoenstatite, in the pyroxene group. The excellent analysis of the end member from Utö, published by Nils Sundius (1947), gives a formula close to $Li_4Mg_6Al_4Si_{16}O_{44}(OH)_4$, with some divalent and trivalent iron. The North Carolina mineral represents a holmquistite apparently not very far from the end member. All authors regarded holmquistite as a monoclinic amphibole.

One of us (Vogt) has considered holmquistite as derived not from cummingtonite, but from anthophyllite, $Mg_{14}Si_{16}O_{44}(OH)_4$, through the couplet substitution $MgMg = LiAl$. Employing the values of ionic radii in 6-fold coordination of L. H. Ahrens (1952), Mg 0.66, Li 0.68, and Al 0.51 Å, the sums of ionic radii of this substitution are 1.32 and 1.19 respectively. This ratio (111:100) is favorable for the substitution.

The holmquistites from the two localities are relatively poor in divalent iron, giving decidedly the composition of anthophyllite and not of cummingtonite, the Li being reckoned with the Mg. Further, the extinction on 010 is reported to be near zero: Osann gives 2–3°, Sundius 0–2°, and Palache and coworkers parallel extinction or almost so. On material from Utö, kindly placed at our disposal by Professor F. E. Wickman and Dr. N. Zenzén, Riksmuseet, Stockholm, no definite deviation from parallel extinction could be found, and also no dispersion of extinction. A rhombic symmetry could, indeed, be suspected. Crystals of holmquistite with terminal faces are, by the way, unknown.

The *x*-ray study was performed by two of us (Bastiansen and Skancke) on holmquistite from Utö. Oscillation and Weissenberg photographs about the needle axis (*c*) reveal rhombic symmetry, with $c_0 = 5.29$ Å. From the Weissenberg photographs the most probable values for a_0 and b_0 at first seemed to be 9.18 and 17.75 Å respectively. The possibility of doubling of one or both of the axes had still to be considered. Oscillation diagrams around these two axes showed, indeed, that this was the case for the *a*-axis but not for the *b*-axis. From the Weissenberg diagrams around the *b*-axis it could further easily be seen that the *h*00 reflections occur only for *h* equal to 4, 8, 12 etc. The *a*-axis is accordingly 18.36 Å. The numerical values of the *a*- and *b*-axes were determined from the Weissenberg diagrams around the *c*-axis using a very small crystal fragment. The lattice constants of the rhombic unit cell were found to be the following:

$$a = 18.36\ \text{Å}\ (\pm 0.02\ \text{Å})$$
$$b = 17.75\ \text{Å}\ (\pm 0.02\ \text{Å})$$
$$c = 5.29\ \text{Å}\ (\pm 0.02\ \text{Å})$$

According to Osann, the angle $110:1\bar{1}0$ is 55°48′. He used material from Utö, and obviously measured cleavage angles. Palache and coworkers measured 54°39′ on crystal faces. The calculated angle, based on the lattice constants obtained in the present investigation, is 54°41½′, closely conformable to the latter statement.

The conclusion may be that the relation between the holmquistite and anthophyllite in the amphibole group corresponds to the relation between the spodumene and clinoenstatite in the pyroxene group. The lattice constants of the unit cell of these minerals are the following (three of them according to H. Strunz (1957)):

Holmquistite	$a=18.36$	$b=17.75$	$c=5.29$	
Anthophyllite	$a=18.56$	$b=18.08$	$c=5.28$	
Diff.	$+0.20$	$+0.33$	-0.01	
Spodumene	$a=9.52$	$b=8.32$	$c=5.25$	$\beta=110°28'$
Clinoenstatite	$a=9.62$	$b=8.83$	$c=5.19$	$\beta=108°21\frac{1}{2}'$
Diff.	$+0.10$	$+0.51$	-0.06	

The introduction of LiAl for MgMg in both instances involves similar changes.

BIBLIOGRAPHY

AHRENS, L. H. (1952), The use of ionization potentials Part 1. Ionic radii of the elements. *Geochim. et Cosmochim. Acta*, **2,** 155.

MACHATSCHKI, FELIX (1953), Spezielle Mineralogie, Wien.

OSANN, A. (1913), Über Holmquistit, einen Lithionglaukophan von der Insel Utö. *Sitzungsber. d. Heidelberger Akad. d. Wissensch. Math.-nat. Kl.* Abt. A, Jahrg. **1913,** 23.

PALACHE, CH., S. C. DAVIDSON, AND E. A. GORANSON (1930), The Hiddenite deposit in Alexander County, North Carolina. *Am. Mineral.*, **15,** 280.

STRUNZ, HUGO (1957), Mineralogische Tabellen 3 Ed., Leipzig.

SUNDIUS, NILS (1947), Die chemische Zusammensetzung des Holmquistits. *Geol. Fören Förhandl.*, **69,** 51.