

The hōgbomite polytypes

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Summary. Single crystal X-ray examination has shown that hōgbomite forms a series of polytypes, designated nH or nR , with hexagonal or rhombohedral lattices and hexagonal unit-cell dimensions a 5.72 Å, c $4.6 \times n$ Å. The polytypes arise by variation, in a manner as yet undetermined, of the stacking sequence of approximately close-packed oxygen layers with interstitial cations on fourfold and on sixfold sites; the composition of $1/n$ th of a unit-cell may be represented as $R_{1.0-1.6}^{2+} Ti_{0.2-0.4}^{4+} R_{3.7-4.3}^{3+} O_{7.6-8.0}^{2-} (OH)_{0-0.4}^{-}$, where $R^{2+} = Zn, Fe, Mg$, and $R^{3+} = Fe, Al$. The polytypes so far observed are $4H$, $5H$, $6H$, $15H$, $15R$, and $18R$. Minerals structurally related to hōgbomite are nigerite ($3H$) and taaffeite ($4H$). A new occurrence of hōgbomite, polytype $5H$, with composition $Ti_{1.7}Fe_{1.6}Mg_{6.3}Al_{18.8}Si_{0.2}O_{40}$, is described from a spinel-free paragenesis in a magnesian skarn at Mautia Hill, Tanganyika. Another new occurrence in an aluminous xenolith in the Cashel gabbro in Co. Galway, Ireland, is recorded. X-ray powder data are given for two of the polytypes.

SINCE its discovery by Gavelin (1917) in iron-rich skarns in Swedish Lapland, hōgbomite has been recorded, described, and analysed from a number of occurrences of widely differing paragenesis. Its morphological crystallography and its X-ray powder pattern have been discussed by various authors, to whose work detailed reference will be made below, but, in spite of the conflicting results obtained by these less fundamental techniques, it has not hitherto been the subject of single crystal X-ray study. The present study arose out of the examination of a new occurrence of relatively coarse, well crystallized hōgbomite in magnesium-rich skarns at Mautia Hill, Tanganyika, in the course of which it became apparent that the X-ray crystallography of hōgbomite presented some interesting and unsuspected complexities.

Material examined. Nine specimens of hōgbomite from seven of the fifteen recorded occurrences have been examined. References to the published descriptions are given in the lower part of table I. It suffices to add here that specimen 4 is off the rock figured by Gavelin (1917, figs. 2, 3), that specimen 8 is the dark variety of hōgbomite designated 'B' by Friedman (1952), and that specimens 7 and 11 are respectively

TABLE I. Unit-cell dimensions and polytype intergrowths in hōgbomite

Locality and no. of crystals examined	Principal polytype				Subsidiary polytypes
	<i>a</i>	<i>c</i>	<i>c/n</i>	polytype	
1 Castor (2)	5.72 Å	18.35 Å	4.59 Å	4H	—
2 Castor (1)	5.72	18.35	4.59	4H	15H
3 August (1)	5.72	18.35	4.59	4H	—
4 Perseus (1)	5.72	18.35	4.59	4H	—
5 Whittles (2)	5.72	18.40	4.60	4H	?15H + D
6 Mautia* (6)	5.718	23.02	4.604	5H	—
7 Transvaal-A (1)	5.72	23.01	4.60	5H	—
8 Macon Co. (1)	5.72	22.95	4.59	5H	4H
9 Cortlandt (2)	5.72	27.53	4.59	6H	?14H
10 Toombeola (2)	5.72	27.5	4.6	6H	4H + 15R
11 Transvaal-B* (1)	5.738	83.36	4.631	18R	—

1. Castor claim, Ruoutevare, near Kvikkjokk, Sweden (Gavelin, 1917). 19541.†
2. Castor claim, Ruoutevare, near Kvikkjokk, Sweden (Gavelin, 1917). BM 1925,1049.
3. August claim, Ruoutevare, near Kvikkjokk, Sweden (Gavelin, 1917). BM 1925,425.
4. Perseus claim, Ruoutevare, near Kvikkjokk, Sweden (Gavelin, 1917). BM 1923,1019.
5. Whittles, Pittsylvania Co., Virginia (Watson, 1925; Friedman, 1952). 79538.
6. Mautia Hill, Mpwapwa District, Tanganyika. 88280.
7. Dentz Farm, Letaba district, Transvaal (Nel, 1949). 19628.
8. Fairview Ridge, Macon Co., North Carolina (Friedman, 1952). 88279.
9. Smith and Ellis Quarry, Cortlandt, New York (Friedman, 1952). 35077.
10. Toombeola, Co. Galway, Ireland. 88283.
11. Dentz Farm, Letaba district, Transvaal (Nel, 1949). 19629.

* Unit-cell dimensions determined by diffractometry (see p. 575). Approximate values derived from single crystal photographs are *a* 5.72, *c* 23.01 Å for Mautia, and *a* 5.72, *c* 83.1 Å for Transvaal-B.

† Specimen numbers refer to the collections of the Department of Mineralogy and Petrology, University of Cambridge, except those prefixed BM, which refer to the collections of the Mineralogy Department, British Museum (Natural History).

from portions of the material separated for analyses A and B of Nel (1949).

Two specimens, 6 and 10, from new occurrences have also been examined. Specimen 6 is from an enstatite-tremolite-chlorite-hōgbomite-dolomite skarn at Mautia Hill, Tanganyika. An account of the hōgbomite- and sapphirine-bearing reaction skarns between the dolomitic marble and the yoderite-bearing schists (McKie, 1959) of Mautia Hill is in course of preparation. Hōgbomite there forms {0001} tablets up to 5 mm long, idiomorphic with respect to all other minerals (fig. 1),

