as the formula of anthophyllite, we can perform this substitution twice, thus $Na_2(Al_2, Fe_2''')$ for Mg_4 and we get the formula $Na_2Mg_3(Al_2, Fe''')_2Si_8O_{22}(OH)_2$ as in glaucophane. If more alkali were to be introduced it would have to enter the vacant spaces in the structure and the substitution would be of another kind, Na(Al, Fe''') for Si. Therefore the glaucophane formula can be regarded that of an end member.

The same substitution in anthophyllite is also possible in the case of holmquistite, except that we are here concerned with LiAl instead of NaAl. Logically it seems most correct to designate holmquisite as a lithium gedrite.

Geologically the determination of the rhombic character of holmquistite is of interest, because the glaucophane is a typical stress-mineral, occurring in folded schists and crystallizing during metamorphism, whereas holmquistite has long been regarded as an exception because it is formed through contact influence from pegmatite without notable influence from stress.

Reference

1. Vogt, T., Bastiansen, O., and Skancke, P. (1958), Holmquistite as a rhombic amphibole: *Am. Mineral.* **43**, 981–982.

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AN INEQUILIBRIUM MODIFICATION OF THE CORUNDUM STRUCTURE

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During the investigation of Devonian K-bentonite and associated Marcellus Shale from Bixler, Perry County, Pennsylvania, it was noted that samples of the shale yielded a 1050° C. endotherm and a post DTA *x*-ray pattern. The *x*-ray spacings resemble corundum but are distinct from it and other published alumina polymorph patterns.

Samples of 1) the Devonian K-bentonite containing illite, mixed layer montmorillonite-illite, chlorite, kaolinite, and gibbsite, 2) Marcellus Shale, 3) 2*M* pegmatitic muscovite, and 4) a mixture of 2*M* muscovite and hydrated alumina were subjected to DTA and *x*-ray diffraction analyses to determine the nature of the material which yielded the observed 1050° C. endotherm and the alumina type *x*-ray pattern.

Post DTA *x*-ray diffraction patterns are compared in Table 1 with a corundum reference pattern by Swanson and Fuyat (1953). The pattern designated as μ_1 was taken from the top two-thirds of the DTA sample well, and μ_2 from the bottom third. The patterns represent a gradual approach toward the corundum structure with increasing time during

Table 1. Comparison of Post-DTA Shale and 2M Muscovite Reflections After Subtraction of Quartz, Hematite and Mullite Spacings with Corundum Reflections

Post DTA						Corundum ASTM Index Swanson & Fuyat (1953)		
Marcellus Shale		2*M* Muscovite						
		μ_1		μ_2				
d Å	I	*d* Å	I	*d* Å	I	*d* Å	I	(*hkl*)
3.6B	(?)	3.51	20	3.495	35	3.479	74	(102)
3.024	1 (?)							
2.913	1							
2.882*	6	2.847	20	2.797	10			
2.518	4	2.570	20	2.560	85	2.552	92	(014)
2.427*	12	2.424	100	2.410	60	2.379	42	(110)
						2.165	<1	(006)
2.100	3	2.101	25	2.090	60	2.085	100	(113)
2.003	1	2.009	10	2.002	1			
		1.755	8	1.744	15	1.740	43	(204)
1.615	1	1.611	18	1.601	50	1.601	81	(116)
1.530	1	1.549	12	1.543	2	1.546	3	(121)
1.419	3	1.419	50	1.419	20	1.510	7	(108)
				1.406	8	1.404	32	(124)
1.385	1	1.388	10	1.382	8			
				1.376	15	1.374	48	(300)

B = Broad reflection.
* Lines also present in K-bentonite clay samples.

which the sample was maintained at elevated temperatures. It is expected that had equilibrium been attained, corundum would have resulted.

The μ patterns illustrate a general contaction of the corundum lattice and an increase in intensity of the reflecting planes common to both μ alumina and corundum. The spacings and intensities of the shale sample did not show any significant variation with sample well depth. Many of the reflections in Table 1 are also present in kappa, gamma, theta, and other alumina polymorphs (eg., a 1.38 to 1.39 Å spacing) but with different relative intensities and with the presence of other major d values not present in this material.

For the four samples analyzed, all except the K-bentonite evidence both a 1050° C. endotherm and a μ alumina *x*-ray pattern. Since the major distinction between the shale and the K-bentonite is the presence of 2*M* muscovite in the shale as contrasted with 1*Md* illite in the K-bentonite, and since $2M$ pegmatitic muscovite does yield a post DTA μ pattern, it is suggested that the presence of a well crystallized mica may govern the appearance of a metastable alumina polymorph immediately previous to the formation of corundum, and having a structure approaching that of corundum. This metastable alumina polymorph has been designated μ alumina for reference convenience, and is an equilibrium modification not to be expected in natural materials.

Reference

SWANSON AND FUYAT, 1953, *NBS Circular No. 559*, **II**, p. 20.

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MAGNETITE IN MICROCRYSTALLINE QUARTZ, LANCASTER COUNTY, PA.

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During a research project on the chromites and serpentines of southeastern Pennsylvania, blebs of magnetite were observed in the silicified contact zone between a serpentinized ultramafic and a later quartz pegmatite dike. The unusual occurrence and non-crystalline, vitreous appearance of the magnetite are of interest.

The magnetite occurs near the Red Pit, two-thirds of a mile southwest of Rock Springs Church near Pennsylvania Route 222 in Lancaster County, Pennsylvania. The magnetite blebs are highly magnetic. It is restricted to hematitic microcrystalline quartz replacing bastite at a quartz pegmatite-chromiferous serpentine contact (Fig. 1).

X-ray powder diffraction patterns indicate that at least some of the magnetite is crystalline with crystallites exceeding 1000 Å. Electron photomicrographs (Fig. 2) indicate that some of the material may be amorphous, since no crystal outlines or cleavage directions are visible.

Composition, determined from a unit cell spacing of $a_0 = 8.352$ Å $\pm .006$ Å and from emission spectrographic analyses, corresponding to one magnesioferrite, one magnetite, and two ferrochromite molecules, is $(Fe_{1.7}Mg_{1.0})(Cr_{30}Fe_{1.3}Al_{0.7})O_{10}$.

Evidence bearing upon the paragenesis and genesis of this magnetite may be summarized as follows:

1. Microcrystalline quartz and chalcedony replace serpentine textures.
2. Silicification increases toward pegmatitic quartz while serpentinization textures and minerals are gradually obliterated.
3. Magnetite is restricted to microcystalline chert which is the chilled contact zone of a quartz pegmatite intrusive into serpentine.