Larsen, Esper S. and Harry Berman (1934) The microscopic determination of the nonopaque minerals. *U. S. Geol. Survey Bull.* **848,** p. 49.

Stewart, F. H. (1949) The petrology of the evaporites of the Eskdale no. 2 boring, east Yorkshire; pt. 1—The Lower Evaporite Bed. *Mineral. Mag.* **28,** 621–675.

——— (1951), Idem, pt. 3—The Upper Evaporite Bed. *Mineral. Mag.* **29,** 557–572.

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ADDITIONAL NOTES ON MARGAROSANITE

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Armstrong (1963) has reported crystal data on margarosanite, $(Ca, Mn)_2PbSi_3O_9$. The present authors have determined a unit cell in essential agreement with Armstrong's using material furnished by the Smithsonian Institution, U. S. National Museum: Catalogue C6412 (Franklin Furnace, N. J.).

Table 1. Properties of Some Compounds Based on X_3O_9 Rings

A. Hexagonal, Pseudo Hexagonal and Rhombohedral Series

Formula and name		Symmetry	(Å) a	b	c	Reference
$BaTiSi_3O_9$	Benitoite	Hexagonal	6.60	—	9.71	1
$BaTiGe_3O_9$	Low Temperature	Hexagonal	$6.77\times\sqrt{3}$	—	10.0	2
$BaTiGe_3O_9$	High Temperature	Hexagonal	6.77	—	10.0	2
$SrGeO_3$		Rhombohedral	7.29	—	10.55×3	3
α-$CaSiO_3$	Pseudowollastonite	Triclinic Pseudo-Hexagonal	6.82	—	9.825×2	4

B. Triclinic Series

Formula and name		α	β	γ	a	b	c	Z	Reference
α-$CaSiO_3$	Pseudo-wollastonite	90°24′	90°24′	119°18′	6.82	6.82	9.83×2	12[1]	4
$Ca_2BaSi_3O_9$		88°22′	111°03′	102°20′	6.72	6.73	9.70	2[2]	5
$(Ca, Mn)_2PbSi_3O_9$	Margarosanite	88°30′	110°35′	102°0′	6.75	6.77	9.64	2[3]	6

[1] Space group either $P1$ or $P\bar{1}$.

[2] Space group known to be $P\bar{1}$.

[3] Z not stated, but is almost certainly $=2$. Cell axes and angles interchanged to facilitate comparison with other members of this family.

1. Zachariasen (1930).
2. Robbins (1960).
3. Hilmer (1960).
4. Jeffery (1953).
5. Glasser (1961).
6. Armstrong (1963).

The structure of margarosanite is probably very similar to that of synthetic $Ca_2BaSi_3O_9$. This in turn is closely related to other substances containing X_3O_9 rings: compare the cell dimensions given.

These data show the existence of a series of metasilicates of large divalent cations containing X_3O_9 rings. These structures can also exhibit cation ordering; thus the Ca/Ba ratio is known to be fixed in $Ca_2BaSi_3O_9$, and it does not form solid solutions with either α-$CaSiO_3$ or $BaSiO_3$. Water is not an essential constituent of $Ca_2BaSi_3O_9$ as crystals are readily grown from melts at $\sim$1320° C.

The authors hope that other less well characterized metasilicates of large cations will be studied to enable an extension of this classification.

References

Armstrong, R. L. (1963) *Am. Mineral* **48,** 698.
Glasser, F. P. and L. S. Dent Glasser (1961) *Zeit. Krist.* **116,** 263.
Hilmer, W. (1958) *Naturwiss.* **45,** 238.
Jeffery, J. W. and L. Heller (1953) *Acta Cryst.* **3,** 210.
Robbins, C. R. (1960) *Jour. Am. Ceram. Soc.* **43,** 610.
Zachariasen, W. H. (1930) *Zeit. Krist.* **74,** 139.

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THE THORITE→HUTTONITE PHASE TRANSFORMATION AS DETERMINED BY GROWTH OF SYNTHETIC THORITE AND HUTTONITE SINGLE CRYSTALS

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The phase transformation, tetragonal $ThSiO_4$ (thorite)→monoclinic $ThSiO_4$ (huttonite) is contrary to expectation, in that it involves formation of the denser modification at a higher temperature. The transformation and/or synthesis of either phase have been investigated by Pabst (1951, 1952), Frondel and Collette (1957), Fuchs (1958), Harris (1959) and Mumpton and Roy (1961), none of whom restricted the equilibrium transformation to a narrow temperature interval. Pabst, studying impure natural thorite, suggested that the transformation occurred over the temperature range 700–1200° C. Harris, using solid state methods, was able to synthesize only huttonite at temperatures $\geqq$1250° C. Mumpton and Roy indicated the possibility that huttonite is stable at all temperatures, with thorite a metastable phase.

The present authors investigated the transformation using solution growth of the preferred modification of $ThSiO_4$ single crystals as a criterion for phase stability at a given temperature. Experiments designed