

# Notes on ephesite, terskite, Na-komarovite, ceriopyrochlore-(Ce), joaquinite-(Ce) and other minerals from the Ilímaussaq alkaline complex, South Greenland

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The Semenov (1969) memoir on the mineralogy of the Ilímaussaq alkaline massif mentioned a number of minerals under preliminary names. The present status of these minerals is reported together with new data on ephesite, which was mentioned as white mica in 1969. The mineral described as white Zr-silicate is terskite, the white Nb-silicate is the new mineral Na-komarovite, the red Mn-silicate is Mn-Fe-sepiolite, and the Mn-palygorskite should now be termed yofortierite.

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In the memoir on the mineralogy of the Ilímaussaq alkaline massif (Semenov 1969) a number of minerals were described under preliminary names: Ce-pyrochlore, Si-pyrochlore, hydroxyurochlore, Nb-rinkite, Ta-rinkite, avicennite, hydrorinkite, animikite, white Ce-silicate, white Ce-phosphate, white Nb-silicate, red Mn-silicate and white mica mineral. The present status of these minerals is reported below.

## Mineralogical notes

*Brown Ce-pyrochlore*,  $\text{Na}_{0.5}\text{Ca}_{0.5}\text{Ce}_{0.5}\text{Nb}_2\text{O}_6\text{F}$ , should be named ceriopyrochlore-(Ce) (formerly marignacite). The mineral described as hydroxyurochlore is an altered variety of pyrochlore.

*Yellow Si-pyrochlore*,  $(\text{Na,Ca})_2(\text{Nb,Si})_2\text{O}_6$ , is similar to the endeiolite from the Narssárssuk locality and is considered to be an impure pyrochlore as is chalcolamprite (Hogarth 1977; Clark 1993). The Si content may be a mechanical admixture, but it should be examined whether Nb can substitute for Si in this mineral group.

*White Ce-phosphate*,  $\text{HCaCe}(\text{PO}_4)_2 \cdot 2\text{H}_2\text{O}$ , is a Ca-bearing rhabdophane.

*Rinkite group minerals* with low contents of the REE were proposed in the 1969 memoir (Semenov 1969, p. 46) to be called rinkolite or lovchorrite; minerals

with similar contents of Nb and Ti were proposed to be called rinkite, and the Nb-rich member was proposed to be named Nb-rinkite,  $\text{Na}_3\text{Ca}_3\text{CeNbSi}_4\text{O}_{15}\text{F}_3$ . The last-named mineral has subsequently been described as the new mineral nacareniobsite-(Ce) by Petersen *et al.* (1989), who also recommended that this mineral group is best described under the rinkite group. With regard to the mineral nacareniobsite, it should be pointed out that the altered varieties have low contents of Na, Ca and partly Si. Nb-rinkite would, in my opinion, have been a better name, but this name was not approved by the IMA Commission on New Minerals and Mineral Names.

Some of the chemical analyses of rinkite minerals published in 1969 contained up to 10 wt%  $\text{Ta}_2\text{O}_5$  (Semenov 1969, p. 48). These samples should be re-examined.

The mineral described as hydrorinkite is an altered form of rinkite.

*Joaquinite* was originally described as a REE-free Ba mineral (Palache & Foshag 1932), but Semenov *et al.* (1967) discovered the mineral in the Ilímaussaq complex and found that it contains 22.59 wt%  $\text{REE}_2\text{O}_3$ . The pure Ba mineral has later been described by Wise (1982), who established two new minerals in the joaquinite group: strontiojoaquinite and bario-orthojoaquinite and also defined the REE-bearing members joaquinite and orthojoaquinite. The REE-containing mineral from the Ilímaussaq complex should, accord-

Table 1. Microprobe analyses of zoned crystals of steenstrupine from the Ilímaussaq alkaline complex

Sample No.	50-149.7 centre (5)	50-149.7 rim (6)	50-150.6 centre (2)	50-150.6 rim (1)	199104 centre (4)	199104 rim (1)
SiO <sub>2</sub>	26.94	27.75	27.54	25.96	27.40	27.06
TiO <sub>2</sub>	0.16	0.07	0.28	0.18	0.25	0.20
ZrO <sub>2</sub>	n.a.	n.a.	n.a.	n.a.	1.41	2.33
HfO <sub>2</sub>	3.95	0.42	4.13	1.40	5.04	1.83
U <sub>2</sub> O <sub>5</sub>	n.a.	n.a.	n.a.	n.a.	0.28	0.04
Th <sub>2</sub> O <sub>3</sub>	8.78	12.85	8.94	14.22	11.49	11.79
CaO	14.57	15.53	13.80	13.76	15.74	16.49
Y <sub>2</sub> O <sub>3</sub>	1.29	1.04	1.28	1.54	2.39	2.08
Fe <sub>2</sub> O <sub>3</sub>	3.72	2.80	3.50	2.78	4.01	4.22
3Mn <sub>2</sub> O <sub>3</sub>	0.31	0.19	0.19	0.15	n.a.	n.a.
Li <sub>2</sub> O	1.47	1.05	1.56	0.31	1.05	0.10
NaO	4.34	2.50	3.96	1.85	3.87	3.42
K <sub>2</sub> O	3.61	6.22	3.42	5.69	4.42	5.00
2BaO	2.18	1.58	2.00	1.65	1.88	1.95
3PbO	0.10	0.14	0.07	0.11	n.a.	n.a.
4V <sub>2</sub> O	8.41	12.98	7.88	13.65	2.75	6.59
Cr <sub>2</sub> O	0.05	0.02	0.20	0.31	n.a.	n.a.
2Al <sub>2</sub> O <sub>3</sub>	9.36	11.26	8.50	9.35	11.31	12.30
3V <sub>2</sub> O <sub>3</sub>	0.10	0.24	0.13	0.67	n.a.	n.a.
Li <sub>2</sub> O <sub>6</sub>	n.a.	n.a.	n.a.	n.a.	0.70	0.35
	89.34	96.64	87.38	93.60	93.89	95.75
∑RE <sub>2</sub> O <sub>3</sub>	28.67	32.41	27.71	32.45	33.63	34.58
∑e <sub>2</sub> O <sub>3</sub> /Nd <sub>2</sub> O <sub>3</sub>	2.36	4.59	2.55	5.12	2.86	2.79

Analyses in oxide wt%. H<sub>2</sub>O and F have not been analysed which explains the low totals.

Figures in brackets: number of analyses.

n.a. = not analysed.

Samples 50-149.7 and 50-150.6 are from drill core 50 at 149.7 and 150.6 m, respectively. Analyst: G.N. Nechehlyustov.

199104 is a GGU sample from Makovický & Karup-Møller (1981), recalculated from element wt% to oxide wt%.

ing to the now accepted nomenclature for REE minerals, be termed joaquinite-(Ce) (cf. Clark 1993; Fleischer & Mandarino 1995).

*The white Zr-silicate* in the 1969 memoir (Semenov 1969, p. 75) has been found to be a hydrated Na<sub>2</sub>O-poor version of terskite, Na<sub>4</sub>ZrSi<sub>6</sub>O<sub>15</sub>(OH)<sub>2</sub>·H<sub>2</sub>O (Khomayakov *et al.* 1983). A chemical analysis is presented in Table 1.

*The white Nb-silicate* (Semenov 1969, p. 55) has been found to be the sodium analogue, (Na,Ca,H)<sub>2</sub>Nb<sub>2</sub>Si<sub>2</sub>O<sub>10</sub>(OH,F)<sub>2</sub>·H<sub>2</sub>O, of komarovite which was first described by Portnov *et al.* (1971) from the Lovozero complex, Kola Peninsula. The Ilímaussaq mineral should consequently be termed Na-komarovite (Krivokoneva *et al.* 1979). A chemical analysis is presented in Table 1.

*The white mica* of the 1969 memoir (Semenov 1969, p. 96) was originally found to be related to ephesite, though too low in Li and Na to be assigned to this mineral. New chemical analyses of the alkali metals by flame photometry have, however, shown a practically identical composition to the mineral from Postmasburg, South Africa (Table 2; cf. Schaller *et al.* 1967) and it should therefore be termed ephesite, NaLiAl<sub>2</sub>(Al<sub>2</sub>Si<sub>2</sub>O<sub>10</sub>(OH)<sub>2</sub>).

Table 2. Equilibrium assemblages involving Be minerals and observed reaction textures in the Ilímaussaq alkaline complex (Na-Be-Al-Si-O-H-Cl system only)

Assemblages	
chkalovite + sodalite	
chkalovite + ussingite	
chkalovite + albite	
chkalovite + natrolite (?)	
tugtupite + albite + analcime	
tugtupite + sphaerobertandite + analcime	
tugtupite + chkalovite + analcime + albite (?)	
eucdidymite + epididymite + albite	
eucdidymite + albite + quartz	
epididymite + sphaerobertandite	
bertrandite + analcime	
beryllite + analcime	
Reaction textures	
chkalovite + sodalite → tugtupite + analcime	
chkalovite + albite → analcime + tugtupite (?)	
chkalovite → epididymite + sphaerobertandite	
chkalovite + ussingite → tugtupite + analcime	
chkalovite → beryllite	
chkalovite I → chkalovite II	
eucdidymite + epididymite + albite → tugtupite + analcime	
epididymite → bertrandite (?)	
epididymite → beryllite	
analcime → ussingite	

Compiled from Andersen (1966); Semenov & Sørensen (1966); Engell *et al.* (1971); Sørensen *et al.* (1971) and own observations.

The Ilímaussaq ephesite has been found in luja-vrite pegmatites in their central hydrothermal zones where it is associated with pink cryptocrystalline albite and spherulitic white natrolite. It forms white shining flakes measuring 3 × 2 × 1 mm. The optical properties are similar to those reported for ephesite: 2V ~ 60°, γ = 1.62, α = 1.60. The unit cell dimensions have been determined as: a = 5.11, b = 8.86 and c = 19.14 Å, β = 95°. There is an endothermic reaction at 900°C. It is a mica polytype 2M, but the major part (70%) of the larger flakes of Ilímaussaq ephesite belong to the unordered modification 1Md: a = 5.11, b = 8.86, c = 9.69 Å, β = 100°, that is with half length of the c axis. The mineral thus displays two or three structural modifications.

*Mn and Fe members of sepiolite* (X-ray main reflection 12 Å) and palygorskite (10 Å) are of widespread occurrence in the Ilímaussaq as well as the Lovozero complexes. The Mn analogue of palygorskite has been described as yofortierite by Perrault *et al.* (1975). The Na-Mn analogue was described as raite (Merkov *et al.* 1973) and the Fe variety as tuperssuatsiaite (Karup-Møller & Petersen 1984). Of these minerals yofortierite and tuperssuatsiaite occur in the Ilímaussaq complex.

*The red Mn silicate* of Semenov (1969, p. 103) has been found to be Mn-Fe-sepiolite, Mn<sub>2</sub>Fe<sub>2</sub>Si<sub>6</sub>O<sub>15</sub>(OH)<sub>2</sub>·6H<sub>2</sub>O.

*Discarded minerals.* Some minerals mentioned by Semenov (1969) have later been discarded from the list of Ilímaussaq minerals. They are animikite (p. 22), vudjavrite (p. 52) and zirfesite (p. 77). According to Clark (1993), animikite is a mixture of silver, galena

and nickeline, vudjavrite is an amorphous alteration product of lovchorrite (altered rinkite), and zirfesite is an alteration product of eudialyte.

The mineral mentioned by Semenov (1969, p. 26) as maucherite has been shown to be westerveldite (Karup-Møller & Makovicky 1977; Oen *et al.* 1977).

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