

## Quadruphite

## Na<sub>14</sub>CaMgTi<sub>4</sub>(Si<sub>2</sub>O<sub>7</sub>)<sub>2</sub>(PO<sub>4</sub>)<sub>4</sub>O<sub>4</sub>F<sub>2</sub>

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**Crystal Data:** Triclinic. *Point Group:* 1. As flakes, flattened on {001}, to 3 mm, some epitaxially overgrown on lomonosovite and sobolovite.

**Physical Properties:** *Cleavage:* {001}, perfect; {110} and {100}, less perfect.

*Fracture:* Steplike. *Tenacity:* Brittle. Hardness = 5 D(meas.) = 3.12 D(calc.) = 3.11

**Optical Properties:** Translucent to transparent. *Color:* Light brown. *Luster:* Vitreous, resinous on fractures, pearly to adamantine on cleavages. *Streak:* White.

*Optical Class:* Biaxial (-). *Pleochroism:* Pronounced; X = colorless; Y = Z = yellowish.

*Dispersion:*  $r < v$ , strong. *Absorption:*  $Z \geq Y > X$ .  $\alpha = 1.630$   $\beta = 1.678$   $\gamma = 1.697$   
 $2V(\text{meas.}) = 62^\circ$

**Cell Data:** *Space Group:* P1.  $a = 5.415(2)$   $b = 7.081(3)$   $c = 20.34(1)$   $\alpha = 86.85(4)^\circ$   
 $\beta = 94.40(4)^\circ$   $\gamma = 89.94(3)^\circ$   $Z = 1$

**X-ray Powder Pattern:** Lovozero massif, Russia.

2.880 (10), 2.702 (8b), 2.636 (7), 2.050 (5), 1.600 (5), 1.662 (4b), 1.713 (3)

### Chemistry:

	(1)		(1)
SiO <sub>2</sub>	16.5	CaO	5.3
TiO <sub>2</sub>	13.7	SrO	0.4
ZrO <sub>2</sub>	4.1	BaO	1.1
Nb <sub>2</sub> O <sub>5</sub>	3.8	Na <sub>2</sub> O	28.1
FeO	0.3	F	3.4
MnO	4.3	P <sub>2</sub> O <sub>5</sub>	19.2
MgO	1.1	-O = (F, Cl) <sub>2</sub>	1.4
		Total	99.9

(1) Lovozero massif, Russia; by electron microprobe, average of three analyses; corresponds to Na<sub>13.21</sub>(Ca<sub>1.38</sub>Ba<sub>0.10</sub>Sr<sub>0.06</sub>)<sub>Σ=1.54</sub>(Mg<sub>0.40</sub>Mn<sub>0.28</sub>Fe<sub>0.06</sub>)<sub>Σ=0.74</sub>(Ti<sub>2.50</sub>Mn<sub>0.60</sub>Zr<sub>0.48</sub>Nb<sub>0.42</sub>)<sub>Σ=4.00</sub>(Si<sub>2</sub>O<sub>7</sub>)<sub>2</sub>(P<sub>0.98</sub>O<sub>4</sub>)<sub>4</sub>O<sub>3.04</sub>F<sub>2.61</sub>.

**Occurrence:** In ultra-alkalic pegmatites in a differentiated alkalic massif.

**Association:** Nepheline, sodalite, analcime, potassic feldspar, albite, arfvedsonite, aegirine, cancrisilite, ussingite, makatite, villiaumite, polyphite, lomonosovite, sobolovite, additional minor minerals.

**Distribution:** On Mt. Alluaiv, Lovozero massif, Kola Peninsula, Russia.

**Name:** From the Latin *quadruplex*, for *four*, and PHosphorus, for the four phosphate anions in the chemical formula.

**Type Material:** A.E. Fersman Mineralogical Museum, Academy of Sciences, Moscow, Russia, p545/5; The Natural History Museum, London, England, 1994,25.

**References:** (1) Khomyakov, A.P., G.N. Nechelyustov, E.A. Sokolova, and G.I. Dorokhova (1992) Quadruphite Na<sub>14</sub>CaMgTi<sub>4</sub>[Si<sub>2</sub>O<sub>7</sub>]<sub>2</sub>[PO<sub>4</sub>]<sub>4</sub>O<sub>4</sub>F<sub>2</sub> and polyphite Na<sub>17</sub>Ca<sub>3</sub>Mg(Ti, Mn)<sub>4</sub>[Si<sub>2</sub>O<sub>7</sub>]<sub>2</sub>[PO<sub>4</sub>]<sub>6</sub>O<sub>2</sub>F<sub>6</sub> - new minerals of the lomonosovite group. Zap. Vses. Mineral. Obsch., 121(1), 105-112 (in Russian). (2) (1993) Amer. Mineral., 78, 1316 (abs. ref. 1). (3) (1994) Mineral. Abs., 45, 240 (abs. ref. 1).