## Nabalamprophyllite-2*M* $(Ba, Na)Ti_2Na_3Ti[Si_2O_7]_2O_2(OH, F)_2$

**Crystal Data:** Monoclinic. *Point Group*: 2/*m*. Crystals lamellar prismatic with dominant {100} and minor {010} and {130}. Forms radial sheaf-like and random aggregates, to 10 cm.

**Physical Properties:** *Cleavage:* Perfect on (100). *Tenacity:* Brittle. *Fracture:* n.d.
Hardness = 3 D(meas.) = 3.62(2) D(calc.) = 3.58 (for empirical Formula)

**Optical Properties:** Transparent to translucent. *Color:* Brown to bright yellow. *Luster:* Vitreous.
*Optical Class:* Biaxial (+). $\alpha = 1.750(12)$ $\beta = 1.755$ $\gamma = 1.799(15)$ 2V(meas.) = 40.5°
*Dispersion:* Strong, $r > v$. *Orientation:* $X \wedge c = 10°$, $Y = a$. *Pleochroism:* Weak, green-brown.

**Cell Data:** Space Group: *P*2/*m*. $a = 19.741(5)$ $b = 7.105(4)$ $c = 5.408(2)$ $\beta = 96.67(1)°$ Z = 2

**X-ray Powder Pattern**: Inagli massif, south Yukutsk, Russia.
2.797 (100), 9.87 (96), 3.45 (90), 3.275 (78), 3.75 (65), 2.610 (43), 3.040 (41)

| **Chemistry:** | (1) | (2) | | (1) | (2) |
|---|---|---|---|---|---|
| $Na_2O$ | 11.14 | 11.99 | $Al_2O_3$ | 0.44 | 0.16 |
| $K_2O$ | 0.94 | 1.03 | $TiO_2$ | 27.80 | 27.31 |
| CaO | 0.36 | 0.10 | $Nb_2O_5$ | n.d. | 0.64 |
| SrO | 0.65 | n.d. | $SiO_2$ | 28.75 | 29.08 |
| BaO | 24.12 | 25.32 | F | 1.18 | n.d. |
| MgO | 0.34 | 0.83 | $H_2O$ | 1.83 | n.d. |
| MnO | 1.10 | 1.09 | $-O = F_2$ | [0.50] | n.d. |
| $Fe_2O_3$ | 0.78 | 1.81 | Total | 98.93 | 99.36 |

(1) Inagli massif, south Yukutsk, Russia; average of 20 electron microprobe analyses, $H_2O$ by TGA; corresponds to $Na_{2.95}K_{0.17}Ca_{0.05}Sr_{0.05}Ba_{1.29}Mn_{0.13}(Ti_{2.86}Fe_{0.08}Mg_{0.07})_{\Sigma=3.01}[(Si_{3.93}Al_{0.07})_{\Sigma=4.00}O_{14.00}]O_{1.94}(OH)_{1.67}F_{0.51}$. (2) Kovdor massif, Russia; average of 20 electron microprobe analyses.

**Polymorphism & Series**: Orthorhombic and monoclinic polytypes.

**Occurrence:** In peralkaline pegmatite dikes cutting alkaline ultramafic rocks.

**Association:** Aegirine, albite, ancylite, batisite, diopside, eckermannite, innelite, leucosphenite, lorenzenite, natrolite, neptunite, strontium apatite (Inagli); apatite, cancrinite, eudialyte-group minerals, lorenzenite, lueshite, nepheline, pectolite, pyrrhotite, thomsonite-Ca, titanite, diopside, hedenbergite, aegirine (Kovdor). In cancrinite-bearing pegmatite (Kovdor), it forms aggregates with pectolite and cancrinite, often intergrown with lorenzenite. In nepheline-bearing pegmatite (Kovdor), it forms radial aggregates of lamellar crystals with lorenzenite, titanite and eudialyte group minerals.

**Distribution:** From the Inagli massif, south Yukutsk and the Kovdor massif, Kola Peninsula, Russia.

**Name:** For its composition (*Na* and *Ba*) and relation to other *lamprophyllite*-group minerals; a suffix indicates the monoclinic polytype.

**Type Material:** Geological Museum, Institute of Geology and Geophysics, Russian Academy of Science, Novosibirsk, Russia (XIII-274/1) and the A.E. Fersman Mineralogical Museum, Russian Academy of Science, Moscow, Russia (90837 and 90843).

**References:** (1) Chukanov, N.V., M.M. Moiseev, I.V. Pekov, K.A. Lazebnik, R.K. Rastsvetaeva, N.V. Zayakina, G. Ferraris, and G. Ivaldi (2004) Nabalamprophyllite $Ba(Na,Ba)\{Na_3Ti[Ti_2O_2Si_4O_{14}](OH,F)_2\}$, a new layer titanosilicate of the lamprophyllite group from the Inagli and Kovdor alkaline-ultrabasic massifs, Russia. Zapiski Vseross. Mineral. Obshch.,133(1), 59-72 (in Russian, English abstract). (2) (2005) Amer. Mineral., 90(7), 1230 (abs. ref. 1). (3) Sokolova, E. and F.C. Hawthorne (2008) From structure topology to chemical composition. IV. Titanium silicates: the orthorhombic polytype of Nabalamprophyllite from the Lovozero Massif, Kola Peninsula, Russia. Can. Mineral., 46, 1322-1331. (4) (2009) Amer. Mineral., 94(7), 1083 (abs. ref. 3).