

**Crystal Data:** Hexagonal. *Point Group:* 6. As prismatic to acicular crystals to 7 mm typically in parallel or radial intergrowths, bunches, sheaf- or broom-like clusters to 1 cm.

**Physical Properties:** *Cleavage:* None. *Tenacity:* Brittle. *Fracture:* Uneven. Hardness = n.d. D(meas.) = n.d. D(calc.) = 3.59

**Optical Properties:** Transparent. *Color:* Light yellow, beige. *Streak:* White. *Luster:* Vitreous. *Optical Class:* Uniaxial (+).  $\omega = 1.720(5)$   $\epsilon = 1.750(5)$  *Pleochroism:* Distinct, *E* = yellow with slight greenish tint, *O* = very pale yellow to colorless.

**Cell Data:** *Space Group:*  $P6_3$ .  $a = 10.6366(5)$   $c = 4.5701(3)$   $Z = 1$

**X-Ray Diffraction Pattern:** Arsenatnaya fumarole, Tolbachik volcano, Kamchatka Peninsula, Russia. 9.18 (100), 3.479 (61), 5.304 (38), 2.228 (35), 2.550 (30), 4.595 (25), 1.703 (25)

|                                |        |
|--------------------------------|--------|
| <b>Chemistry:</b>              | (1)    |
| MgO                            | 48.89  |
| CaO                            | 0.15   |
| MnO                            | 0.15   |
| Fe <sub>2</sub> O <sub>3</sub> | 0.78   |
| B <sub>2</sub> O <sub>3</sub>  | 20.33  |
| P <sub>2</sub> O <sub>5</sub>  | 1.80   |
| As <sub>2</sub> O <sub>5</sub> | 1.60   |
| V <sub>2</sub> O <sub>5</sub>  | 4.10   |
| MoO <sub>3</sub>               | 2.48   |
| WO <sub>3</sub>                | 18.04  |
| F                              | 3.10   |
| -O = F <sub>2</sub>            | 1.31   |
| Total                          | 100.11 |

(1) Arsenatnaya fumarole, Tolbachik volcano, Kamchatka Peninsula, Russia; average electron microprobe analysis supplemented by Raman spectroscopy; corresponding to  $(\text{Mg}_{11.74}\text{Fe}^{3+}_{0.09}\text{Ca}_{0.03}\text{Mn}_{0.02})_{\Sigma=11.88}(\text{W}^{6+}_{0.75}\text{V}^{5+}_{0.44}\text{Mo}^{6+}_{0.13})_{\Sigma=1.32}[(\text{P}_{0.25}\text{As}^{5+}_{0.13})_{\Sigma=0.38}\text{B}_{5.65}]_{\Sigma=6.03}\text{O}_{24.42}\text{F}_{1.58}$ .

**Polymorphism & Series:** Continuous solid solution with rhabdoborite-(V) and rhabdoborite-(Mo).

**Mineral Group:** Rhabdoborite group.

**Occurrence:** A volcanic sublimate or, more probably, formed by the interaction between fumarolic gas and basalt scoria.

**Association:** Rhabdoborite-(V), rhabdoborite-(Mo), anhydrite, diopside, hematite, schäferite, berzeliite, svabite, calciojohillerite, ludwigite, forsterite, magnesioferrite, baryte, fluorapatite, udinaite, arsenudinaite, powellite.

**Distribution:** From the Arsenatnaya fumarole, Second scoria cone of the Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka, Russia.

**Name:** Refers to morphological (*rhabdos* is “rod”, in Greek) and chemical (*borate*) features of the mineral; a suffix indicates the dominant element as the *M* component.

**Type Material:** A.E. Fersman Mineralogical Museum, RAS, Moscow, Russia (96198).

**References:** (1) Pekov, I.V., N.V. Zubkova, N.N. Koshlyakova, D.I. Belakovskiy, A.A. Agakhanov, M.F. Viganina, S.N. Britvin, E.G. Sidorov, and D.Y. Pushcharovsky (2020) Rhabdoborite-(V), rhabdoborite-(Mo) and rhabdoborite-(W): a new group of borate minerals with the general formula  $\text{Mg}_{12}\text{M}_{1/3}\text{O}_6[(\text{BO}_3)_{6-x}(\text{PO}_4)_x\text{F}_{2-x}]$  ( $\text{M}=\text{V}^{5+}$ ,  $\text{Mo}^{6+}$  or  $\text{W}^{6+}$  and  $x < 1$ ). *Phys. Chem. Minerals*, 47, 44, 1-17.