Rhabdoborite-(V) $Mg_{12}(V^{5+}, Mo^{6+}, W^{6+})_{1.33}O_6\{[BO_3]_{6-x}(PO_4)_xF_{2-x}\}$ (x<1)

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.) = 3.39

Optical Properties: Transparent. *Color*: Light to bright yellow. *Streak*: White. *Luster*: Vitreous. *Optical Class*: Uniaxial (+). ω = 1.696(3) ε = 1.740(4) Nonpleochroic.

Cell Data: *Space Group*: $P6_3$. a = 10.6314(4) c = 4.5661(2) Z = 1

X-Ray Diffraction Pattern: Arsenatnaya fumarole, Tolbachik volcano, Kamchatka Peninsula, Russia. 9.17 (100), 2.226 (79), 3.472 (76), 2.763 (64), 1.701 (63), 2.547 (61), 5.301 (44)

Chemistry:

	(1)
MgO	52.25
CaO	0.15
MnO	0.44
Fe_2O_3	0.97
B_2O_3	20.97
P_2O_5	2.75
As_2O_5	1.98
V_2O_5	6.99
MoO_3	5.73
TeO_3	0.28
WO_3	5.43
SO_3	0.03
F	3.44
$-O = F_2$	1.45
Total	99.96

(1) Arsenatnaya fumarole, Tolbachik volcano, Kamchatka Peninsula, Russia; average electron microprobe analysis supplemented by Raman spectroscopy; corresponding to $(Mg_{11.85}Fe^{3+}_{0.11}Mn_{0.06}Ca_{0.02})_{\Sigma=12.04}(V^{5+}_{0.70}Mo^{6+}_{0.36}W^{6+}_{0.21}Te^{6+}_{0.01})_{\Sigma=1.28}[(P_{0.35}As^{5+}_{0.16})_{\Sigma=0.51}B_{5.50}]_{\Sigma=6.01}O_{24.35}F_{1.65}$.

Polymorphism & Series; Continuous solid solution with rhabdoborite-(Mo) and rhabdoborite-(W).

Mineral Group: Rhabdoborite group.

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

Association: Rhabdoborite-(Mo), rhabdoborite-(W), anhydrite, diopside, hematite, schäferite, berzeliite, svabite, calciojohillerite, ludwigite, forsterite, magnesioferrite, baryte, fuorapatite, 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 (*bor*ate) features of the mineral; a suffix indicates the dominant element as the *M* component.

Type Material: A.E. Fersman Mineralogical Museum, RAS, Moscow, Russia (96197).

References: (1) Pekov, I.V., N.V. Zubkova, N.N. Koshlyakova, D.I. Belakovskiy, A.A. Agakhanov, M.F. Vigasina, 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 $Mg_{12}M1_{1/3}O_6[(BO_3)_{6-x}(PO_4)_xF_{2-x}]$ (M=V^{5+}, Mo^{6+} or W^{6+} and x<1). Phys. Chem. Minerals, 47, 44, 1-17.