

**Crystal Data:** Monoclinic. *Point Group:* 2/m. As complex crystals elongate along  $[\bar{1} 02]$ , to ~0.2 mm, showing at least 14 forms.

**Physical Properties:** *Cleavage:* None. *Tenacity:* n.d. *Fracture:* n.d. *Hardness:* = n.d. *D(meas.):* = n.d. *D(calc.):* = 4.77(1) Nonfluorescent.

**Optical Properties:** Transparent. *Color:* Dark blue. *Streak:* Light blue to white. *Luster:* Adamantine. *Optical Class:* Biaxial (-).  $\alpha = 1.76(1)$   $\beta = 1.92(1)$   $\gamma = 1.96(1)$   $2V(\text{calc.}) = 50^\circ$  *Orientation:*  $Z = b$ ,  $X \wedge c = 23^\circ$  in obtuse  $\beta$ . *Pleochroism:* Strong;  $X = \text{violet-red}$ ,  $Y = \text{green}$ ,  $Z = \text{greenish blue}$ .

**Cell Data:** *Space Group:* C2/m.  $a = 12.051(1)$   $b = 12.434(1)$   $c = 7.2662(7)$   $\beta = 117.942(1)^\circ$   $Z = 4$

**X-ray Powder Pattern:** Tolbachik Great fissure eruption, Kamchatka Peninsula, Russia. 3.43 (100), 3.21 (35), 2.683 (30), 2.791 (24), 3.60 (21), 2.696 (18), 2.665 (17)

<b>Chemistry:</b>	(1)
Na <sub>2</sub> O	5.17
K <sub>2</sub> O	0.35
CuO	43.13
Zn	0.79
Fe <sub>2</sub> O <sub>3</sub>	0.38
As <sub>2</sub> O <sub>5</sub>	49.62
V <sub>2</sub> O <sub>5</sub>	0.13
Total	99.55

(1) Tolbachik Great fissure eruption, Kamchatka Peninsula, Russia; average electron microprobe analysis; corresponds to  $(\text{Na}_{1.16}\text{K}_{0.05})_{\Sigma=1.21}(\text{Cu}_{3.74}\text{Zn}_{0.07}\text{Fe}^{3+}_{0.03})_{\Sigma=3.84}(\text{As}_{3.00}\text{V}_{0.01})_{\Sigma=3.01}\text{O}_{12}$ .

**Mineral Group:** Alluaudite supergroup, alluaudite group.

**Occurrence:** Formed in a volcanic fumarole.

**Association:** Hematite, tenorite, lammerite, urusovite, orthoclase, johillerite.

**Distribution:** At the second cinder cone, North Breach of the Tolbachik Great fissure eruption, Kamchatka Peninsula, Russia.

**Name:** Honors crystallographer Hans *Bradaczek* (b. 1940), Free University of Berlin, Germany.

**Type Material:** Mining Museum of the Mining Institute, Saint Petersburg, Russia.

**References:** (1) Filatov, S.K., L.P. Vergasova, M.G. Gorskaya, S.V. Krivovichev, P.C. Burns, and V.V. Ananiev (2001) Bradaczekite, NaCu<sub>4</sub>(AsO<sub>4</sub>)<sub>3</sub>, a new mineral species from the Tolbachik volcano, Kamchatka Peninsula, Russia. *Can. Mineral.*, 39, 1115-1119. (2) (2002) *Amer. Mineral.*, 87, 765 (abs. ref. 1). (3) Hatert, F. (2019) A new nomenclature scheme for the alluaudite supergroup. *Eur. J. Mineral.*, 31, 807-822.