Kôzulite $\mathbf{NaNa_2[Mn_4^{2+}(Fe^{3+}, Al)]Si_8O_{22}(OH)_2}$

Crystal Data: Monoclinic. *Point Group:* $2/m$. As prismatic crystals, to 3.5 mm, in banded aggregates.

Physical Properties: *Cleavage:* Perfect on {110}. *Tenacity:* [Brittle.] Hardness = 5 D(meas.) = 3.30 D(calc.) = 3.36

Optical Properties: Semitransparent. *Color:* Reddish black to black. *Streak:* Light purplish brown. *Luster:* Vitreous.
Optical Class: Biaxial (–). *Pleochroism:* Strong; X = yellow-brown; Y = reddish brown; Z = dark brown. *Orientation:* $Y = b$; $X \wedge c = 25°$. *Dispersion:* $r > v$, weak. *Absorption:* $Z > Y > X$. $\alpha = 1.685$ $\beta = 1.717$ $\gamma = 1.720$ 2V(meas.) = 34°–36°

Cell Data: *Space Group:* $C2/m$. $a = 9.914$ $b = 18.111$ $c = 5.308$ $\beta = 104.50°$ Z = 2

X-ray Powder Pattern: Tanohata mine, Japan.
8.51 (100), 3.15 (65), 2.827 (30), 3.30 (17), 4.53 (10), 3.40 (10), 2.722 (10)

Chemistry:

	(1)	(2)		(1)	(2)
SiO_2	51.38	49.24	MgO	2.71	0.03
TiO_2		0.00	CaO	1.12	0.11
Al_2O_3	1.69	0.02	Na_2O	8.41	8.91
Fe_2O_3	2.85		K_2O	1.36	0.03
Cr_2O_3		0.03	F	0.08	
FeO		0.06	H_2O^+	2.10	
MnO	27.96	37.06	H_2O^-	0.06	
ZnO	0.03		$-O = F_2$	0.03	
			Total	99.72	95.48

(1) Tanohata mine, Japan; corresponding to $(Na_{2.54}K_{0.27}Ca_{0.19})_{\Sigma=3.00}(Mn_{3.69}Mg_{0.63}Fe^{3+}_{0.33}Al_{0.31})_{\Sigma=4.96}Si_{8.00}O_{21.78}[(OH), F]_{2.22}$. (2) Woods mine, Australia; by electron microprobe.

Mineral Group: Amphibole (alkali) group: $Mn^{2+}/(Mg + Fe^{2+} + Mn^{2+}) > 0.33$; $Fe^{3+}/(Fe^{3+} + Al^{vi}) \geq 0.5$; $(Na + K)_A \geq 0.5$; $Na_B \geq 1.34$; $Mn_C \geq 2.5$.

Occurrence: In metamorphosed manganese-rich sediments along the contact of a granodiorite intrusion (Tanohata mine, Japan).

Association: Braunite, rhodonite, manganiferous alkalic pyroxene, quartz (Tanohata mine, Japan).

Distribution: In the Tanohata and Noda-Tamagawa mines, Iwate Prefecture, Japan. From the Woods mine, 30 km north-northeast of Tamworth, New South Wales, Australia.

Name: To honor Shukusuke Kôzu (1880–1955), Professor at Tohoku University, Sendai, Japan.

Type Material: Tohoku University, Sendai, Japan.

References: (1) Nambu, M., K. Tanida, and T. Kitamura (1969) Kôzulite, a new alkali amphibole from Tanohata mine, Iwate Prefecture, Japan. J. Japan. Assoc. Mineral. Petrol. Econ. Geol., 62, 311–328. (2) (1970) Amer. Mineral., 55, 1815 (abs. ref. 1). (3) Kitamura, M. and N. Morimoto (1972) Crystal structure of kôzulite and tetrahedral Al in amphiboles. Acta Cryst., A28, S71. (4) Kawachi, Y. and D.S. Coombs (1993) Namansilite, $NaMn^{3+}Si_2O_6$: a widespread clinopyroxene? Mineral. Mag., 57, 533–538.