

Wöhlerite

NaCa₂(Zr, Nb)Si₂O₇(O, OH, F)₂

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Crystal Data: Monoclinic. *Point Group:* 2. Crystals prismatic, to 3 cm, tabular on [100]; granular. *Twinning:* Twin plane {100}, common; may be complex, lamellar.

Physical Properties: *Cleavage:* {010}, distinct; {100} and {110}, poor. *Fracture:* Conchoidal to splintery. *Tenacity:* Brittle. Hardness = 6–6.5 D(meas.) = 3.40–3.44 D(calc.) = 3.42 Blue-green cathodoluminescence.

Optical Properties: Transparent to translucent. *Color:* Pale yellow to yellow, brown, or gray; in transmitted light, colorless to light yellow. *Streak:* Pale yellow. *Luster:* Vitreous, inclining to resinous, dull, and greasy.

Optical Class: Biaxial (-). *Pleochroism:* Weak to moderate; X = Y = nearly colorless to pale yellow; Z = wine-yellow. *Orientation:* Z = b; X ∧ c = 45°. *Dispersion:* r < v, weak. α = 1.700–1.705 β = 1.716–1.720 γ = 1.726–1.728 2V(meas.) = 70°–77°

Cell Data: *Space Group:* P2₁. a = 10.823(3) b = 10.244(3) c = 7.290(2) β = 109.00(4)° Z = 4

X-ray Powder Pattern: Langesundsfjord, Norway.

2.839 (100), 2.998 (70), 3.25 (60), 2.965 (50), 2.014 (40), 1.689 (40), 7.26 (30)

Chemistry: (1)		(2)		(1)		(2)	
SiO ₂	30.12	30.30	La ₂ O ₃	0.06	CaO	26.95	25.35
TiO ₂	0.42	1.22	Fe ₂ O ₃	0.48	SrO		0.02
ZrO ₂	16.11	14.32	Nb ₂ O ₅	12.85	Na ₂ O	7.50	7.67
HfO ₂		0.58	Ta ₂ O ₅		F	2.98	2.61
Al ₂ O ₃		0.01	FeO	1.26	H ₂ O	0.74	
Y ₂ O ₃		0.61	MnO	1.00	-O = F ₂	1.24	[1.10]
Ce ₂ O ₃	0.66	0.27	MgO	0.12	0.27		
Total						99.95	[96.25]

(1) Langesundsfjord, Norway; corresponds to Na_{0.97}(Ca_{1.93}Fe_{0.09}Mn_{0.06}Mg_{0.01})_{Σ=2.09}(Zr_{0.52}Nb_{0.39}Ce_{0.02}Ti_{0.02})_{Σ=0.95}Si_{2.01}O₇[O, (OH), F_{0.63}]₂. (2) Do.; by electron microprobe, corresponds to Na_{1.01}(Ca_{1.84}Fe_{0.10}Mn_{0.05}Mg_{0.03})_{Σ=2.02}(Zr_{0.47}Nb_{0.37}Ti_{0.06}Ta_{0.03}Y_{0.02}Ce_{0.01}Hf_{0.01})_{Σ=0.97}Si_{2.05}O₇[O, (OH), F_{0.56}]₂.

Occurrence: A late phase in alkalic pegmatites; an accessory mineral in nepheline syenites; in fenites associated with alkaline intrusives; and in carbonatites.

Association: Cancrinite, ferro-hornblende, aegirine, astrophyllite, mosandrite, eudialyte, catapleiite, rosenbuschite, låvenite, zircon, pyrochlore, betafite, latrappite, niobian perovskite, niobian zirconolite, albite, nepheline, biotite, fluorite.

Distribution: On a number of islands in the Langesundsfjord, around Brevik, and at Tvedalen, Norway. In Russia, from the Khibiny and Lovozero massifs, Kola Peninsula; in Siberia, in the Burpala massif, about 120 km north of Lake Baikal, at Zaangar'ya, Yenisei Ridge, and in the Sangilene massif. At Kruft and Mendig, Eifel district, Germany. In the USA, at Red Hill, Moultonborough, Carroll Co., New Hampshire, and Magnet Cove, Hot Spring Co., Arkansas. In Canada, at Mont Saint-Hilaire and Oka, Quebec; in the Prairie Lake complex, Ontario. On the Los Islands, Guinea. From the Tchivira Mountains, Quilengues, Angola. In the Muri Mountains, Guyana. From carbonatites at In Imanal and Wadi Anezrouf, Mali.

Name: For Professor Friedrich Wöhler (1800–1882), German chemist, Göttingen, Germany.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 376–377. (2) Vlasov, K.A., Ed. (1966) Mineralogy of rare elements, v. II, 376–379. (3) Nickel, E.H. (1958) The composition and crystallography of niocalite. *Can. Mineral.*, 6, 264–272. (4) Shibaeva, R.I. and N.V. Belov (1963) Crystal structure of wöhlerite, Ca₂Na(Zr, Nb)[Si₂O₇](OH)₂. *Doklady Acad. Nauk SSSR*, 146, 897–900 (in Russian). (5) Mellini, M. and S. Merlino (1979) Refinement of the crystal structure of wöhlerite. *Tschermaks Mineral. Petrog. Mitt.*, 26, 109–123. (6) Mariano, A.N. and P.L. Roeder (1989) Wöhlerite: chemical composition, cathodoluminescence and environment of crystallization. *Can. Mineral.*, 27, 709–720.

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