

**Crystal Data:** Hexagonal; a mixed-layer structure. *Point Group:*  $\bar{3}2/m$ . In crusts of acute scalenohedra and rhombohedra; as rosettes of tablets; as fibrous inclusions in other salts.

**Physical Properties:** *Cleavage:* {0001}, perfect. *Tenacity:* Flexible, in thin foliae. Hardness = 1.5–2 D(meas.) = 1.82–2.08, 1.97–1.98 after leaching in cold H<sub>2</sub>O. D(calc.) = [1.82] Partially leached by cold H<sub>2</sub>O, decomposed by hot H<sub>2</sub>O.

**Optical Properties:** Transparent to translucent. *Color:* Colorless, pale yellow to deep red due to inclusions; reddish brown to colorless in thin section. *Luster:* Pearly on cleavage surfaces. *Optical Class:* Uniaxial (+); may be anomalously biaxial. *Pleochroism:* *O* = red-brown; *E* = colorless.  $\omega = 1.52$   $\epsilon = 1.55$   $2V(\text{meas.}) = < 10^\circ$

**Cell Data:** *Space Group:*  $R\bar{3}m$  [Na<sub>4</sub>(Ca, Mg)<sub>2</sub>Cl<sub>12</sub>]<sup>4-</sup> with  $a = 4.072(2)$   $c = 32.64(0.015)$  and *Space Group:*  $P\bar{3}m1$  [Mg<sub>7</sub>Al<sub>4</sub>(OH)<sub>22</sub>]<sup>4+</sup> with  $a = 3.052(2)$   $c = 10.88(0.005)$   $Z = [1]$

**X-ray Powder Pattern:** Siegfried-Giesen mine, Lower Saxony, Germany; after partial leaching in cold H<sub>2</sub>O.

11.7 (vs), 10.7 (vs), 1.924 (vs), 1.522 (vs), 5.45 (s), 3.68 (s), 3.34 (s)

Chemistry:	(1)	(2)	(3)
SiO <sub>2</sub>		0.63	
Al <sub>2</sub> O <sub>3</sub>	18.25	23.98	16.74
Fe <sub>2</sub> O <sub>3</sub>		0.96	
MnO		0.17	
MgO	23.44	32.49	29.78
CaO		0.18	
MgCl <sub>2</sub>	36.85		
Na <sub>2</sub> O			10.17
Cl		15.52	34.92
H <sub>2</sub> O	21.46	25.30	16.27
–O = Cl <sub>2</sub>		[3.50]	7.88
Total	[100.00]	[95.73]	100.00

(1) Justus I mine, Germany; recalculated to 100% after removal of alkali chlorides.

(2) Jiangcheng, China; after partial leaching in H<sub>2</sub>O, leading to Mg<sub>7</sub>Al<sub>4</sub>Cl<sub>4</sub>(OH)<sub>22</sub>•H<sub>2</sub>O.

(3) Na<sub>4</sub>Mg<sub>9</sub>Al<sub>4</sub>Cl<sub>12</sub>(OH)<sub>22</sub>.

**Occurrence:** In marine evaporite deposits.

**Association:** Hematite, carnallite, sylvite, halite, kieserite, anhydrite.

**Distribution:** At the Justus I, Glückauf-Sarstedt, Wathlingen, and other mines in the Zechstein potash beds, Lower Saxony, and at Stassfurt, 34 km south of Magdeburg, Saxony-Anhalt, Germany. From Pilluana, on the Big Huallaga River, about 25 km south of Tarapoto, Peru. In drill cores from the Prairie Evaporite Formation, Saskatchewan, Canada. At Jiangcheng, Yunnan Province, China.

**Name:** Honors Adolph von Koenen (1837–1915), German geologist of Göttingen, Germany, who discovered the first specimens.

**Type Material:** n.d.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 86–87. (2) Kühn, R. (1951) Zur Kenntnis des Koenenits. Neues Jahrb. Mineral., Monatsh., 1–16 (in German). (3) Richardson, C.B. (1957) Koenenite from Peru. Mineral Explorer, 1(3), 1. (4) Allmann, R., H.-H. Lohse, and E. Hellner (1968) Die Kristallstruktur des Koenenits, eine Doppelschichtstruktur mit zwei inkommensurablen Teilgittern. Zeits. Krist., 126, 7–22 (in German with English abs.). (5) Jinding Liu and Qun Liu (1984) Koenenite from Jiangcheng, Yunnan, China. Yanshi Kuangwu Ji Ceshi, 3(2), 131–137 (in Chinese). (6) (1985) Chem. Abs., 102, 177 (abs. ref. 5).

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