Ramsbeckite $(Cu,Zn)_{15}(SO_4)_4(OH)_{22}\cdot 6H_2O$

Crystal Data: Monoclinic, pseudohexagonal. *Point Group:* $2/m$. Crystals are tabular with large {001}, also {210}, {110}, {100}, giving a slightly rounded rhombic outline, to 3 mm. *Twinning:* Observed, repeated, forming cylindrical aggregates.

Physical Properties: *Cleavage:* On {001}, perfect. *Fracture:* Conchoidal. *Tenacity:* Brittle. Hardness = 3.5 D(meas.) = 3.39–3.41 D(calc.) = 3.37

Optical Properties: Transparent to translucent. *Color:* Green, blue-green. *Streak:* Pale green. *Luster:* Vitreous.
Optical Class: Biaxial (–). *Pleochroism:* Weak; X = pale blue-green, emerald-green; $Y = Z$ = blue-green, yellow-green. *Orientation:* $Y = b$; $X \wedge c = 5°$; $Z \wedge a = 5°$. *Absorption:* $X > Y = Z$. $\alpha = 1.624$–1.669 $\beta = 1.674$–1.703 $\gamma = 1.678$–1.707 2V(meas.) = 36°–38° 2V(calc.) = 38.0°

Cell Data: *Space Group:* $P2_1/a$. $a = 16.088$–16.110 $b = 15.576$–15.602 $c = 7.102$–7.112 $\beta = 90.0°-90.27°$ Z = 2

X-ray Powder Pattern: Bastenberg mine, Ramsbeck, Germany.
7.090 (100), 3.549 (25), 1.776 (20), 3.254 (13), 4.400 (12), 3.232 (12), 3.244 (11)

Chemistry:

	(1)	(2)	(3)
SO_3	17.4	17.6	17.51
CuO	44.5	43.8	43.49
ZnO	15.8	18.1	22.25
H_2O	19.3	[20.5]	16.75
Total	97.0	[100.0]	100.00

(1) Bastenberg mine, Ramsbeck, Germany; SO_4 by photometry, CuO, ZnO by AA, H_2O by gas chromatography, $(OH)^{1-}$ computed for charge balance; corresponds to $(Cu_{10.30}Zn_{3.58})_{\Sigma=13.88}(SO_4)_{4.00}(OH)_{19.76}\cdot 9.84H_2O$. (2) Ecton mine, Pennsylvania, USA; by electron microprobe, H_2O by difference, $(OH)^{1-}$ computed for charge balance; corresponds to $(Cu_{10.03}Zn_{4.05})_{\Sigma=14.08}(SO_4)_{4.00}(OH)_{20.17}\cdot 10.64H_2O$. (3) $(Cu,Zn)_{15}(SO_4)_4(OH)_{22}\cdot 6H_2O$ with Cu:Zn = 2:1.

Occurrence: Rarely formed by supergene oxidation in dump materials and slag.

Association: Chalcopyrite, linarite, brochantite, serpierite, schulenbergite, smithsonite, hydrozincite, connellite, chalcophyllite (Germany); linarite, anglesite, pyromorphite, posnjakite, serpierite (Ecton mine, Pennsylvania, USA).

Distribution: In Germany, from the Bastenberg mine, Ramsbeck, North Rhine-Westphalia; at the Rammelsberg mine, near Goslar, the Glücksrad mine, near Oberschulenberg, the Wildemann mine, and elsewhere in the Harz Mountains; from the Friedrichssegen mine, near Bad Ems, Rhineland-Palatinate; and in the Marie mine, near Wilnsdorf, Siegerland. From the Waterbank mine, Wetton, Staffordshire, England. In Wales, at the Dylife mine, Machynlleth, Powys; in the Brynarian mine, Talybont, the Penrhiw mine, Ystumtuen, and the Frongoch mine, Dyfed. In the Veneziana mine, near Torrebelvicino, Veneto, Italy. From the Ecton mine, Audubon, Montgomery Co., Pennsylvania, USA.

Name: For Ramsbeck, Germany, near the location from which the species was first noted.

Type Material: University of Göttingen, Göttingen, Germany.

References: (1) Hodenberg, R.v., W. Krause, G. Schnorrer-Köhler, and H. Täuber (1985) Ramsbeckite, $(Cu,Zn)_7(SO_4)_2(OH)_{10}\cdot 5H_2O$, a new mineral. Neues Jahrb. Mineral., Monatsh., 550–556. (2) (1987) Amer. Mineral., 72, 225 (abs. ref. 1). (3) Peacor, D.R., P.J. Dunn, and B.D. Sturman (1987) Ramsbeckite: an American occurrence at the Ecton mine, Pennsylvania. Mineral. Record, 18, 131–132. (4) Effenberger, H. (1988) Ramsbeckite, $(Cu,Zn)_{15}(OH)_{22}(SO_4)_4\cdot 6H_2O$: revision of the chemical formula based on a structure determination. Neues Jahrb. Mineral., Monatsh., 38–48. (5) Orlandi, P. and N. Perchiazzi (1989) Ramsbeckite, $(Cu,Zn)_{15}(OH)_{22}(SO_4)_4\cdot 6H_2O$, a first occurrence for Italy from "La Veneziana" mine, Valle dei Mercanti, Vicenza. Eur. J. Mineral., 1, 147–149.