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SHORT NOTE

Ramsbeckite, $(Cu,Zn)_{15}(OH)_{22}(SO_4)_4.6H_2O$, a first occurrence for Italy from "La Veneziana" mine, Valle dei Mercanti, Vicenza

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Abstract : Ramsbeckite is described from "La Veneziana" mine, Valle dei Mercanti, Vicenza (first occurrence in Italy). It occurs in a limonitic gangue as euhedral emerald-green crystals up to 0.5 mm in size. X-ray diffraction data yield : a = 16.110(8), b = 15.602(4), c = 7.112(2) Å, β = 90.27(3)°, space group $P2_1/a$. D_{obs} = 3.41(1) g/cm^3 ; biaxial negative, $2V_{obs}$ = 38(2)° with X $\sim$ // c, Y = b, Z // a and n_α = 1.669(2), n_β = 1.703(2), $n_{\gamma\,calc}$ = 1.707(2). Microprobe analysis (H_2O content by difference) results in the chemical formula $(Cu_{10.97}Zn_{4.18})_{15.15}(SO_4)_4(OH)_{22.27}.4H_2O$.

Key-words : ramsbeckite, morphology, optics, chemistry, X-ray data.

Introduction

Ramsbeckite was first described by Hodenberg *et al.* (1985) as a copper-zinc basic sulphate occurring in five localities in FRG ; then it was observed by Peacor *et al.* (1987) at the Ecton Mine, Pennsylvania. Recently Effenberger (1988) has determined the crystal structure of ramsbeckite, which has allowed him to propose a revised chemical formula for it.

Occurrence

Bertoldi *et al.* (1984) reported ktenasite, namuwite, serpierite, brochantite, aurichalcite, for "Trentin" mine and dundasite, brochantite, linarite, serpierite, ktenasite for "La Veneziana" mine. Ramsbeckite is found here in a limonitic matrix which includes also some barite nodules and altered sphalerite. Associate sulphates recently identified are gypsum, langite, posnjakite ; other phases are at present in study in our laboratory. Ramsbeckite is commonly well crystallized as bright emerald-green flattened crystals with dimensions ranging from 0.2 to 0.5 mm.

Morphology and physical properties

Ramsbeckite from "La Veneziana" mine is found as well formed crystals, tabular on {001}, with common {210} and {110} and more rare {100}. Morphology is illustrated in Fig. 1 and 2.

A well formed crystal was used to measure the optical constants by the prism minimum deviation method. We observed that, like in Ecton mine ramsbeckite, Y = b and X $\sim$ // c. Two measurements were made using face pairs of {210} form and values n_α = 1.669(2), n_β = 1.703(2) were obtained. Ramsbeckite is biaxial negative with $2V_{meas}$ = 38°, and shows a faint pleochroism from emerald-green (α) to yellow-green (β). Table 1 reports the optical values of the mineral. A density value of 3.41(1) g/cm^3

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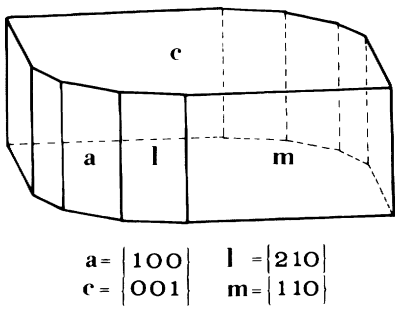

Fig. 1. Crystal drawing of ramsbeckite for "La Veneziana" mine.

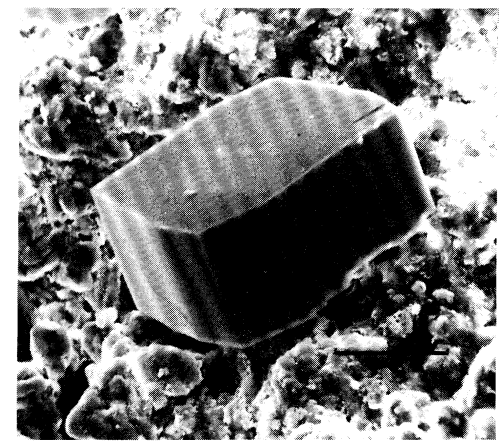

Fig. 2. SEM photograph of a ramsbeckite crystal (scale bar : 50 μm).

was obtained using heavy liquid techniques to compare with a value of 3.40 g/cm^3 calculated for a theoretical composition with Cu/Zn = 2.6.

Table 1. Optical properties of ramsbeckite.

This work	Hodenberg et al. (1985)	Peacor et al. (1987)
2V (−) = 38(2)°	2V (−) = 37°	2V (−) = 36(2)°
n_α = 1.669(2)	n_α = 1.635(5)	n_α = 1.624(2)
n_β = 1.703(2)	n_β = 1.675(5)	n_β = 1.674(2)
n_γ = 1.707(2)	n_γ = 1.680(5)	n_γ = 1.678(2)
X≈//c emerald-green	X ∧ c bright-blue	X ∧ c =5° pale blue-green
Y=b yellow-green	Y =a bright-blue	Y≈//b blue-green
Z≈//a	Z ∧ b bright-blue	Z ∧ a =5° blue-green
	dispersion r > v	

Table 2. Chemical composition of ramsbeckite.

	1	2	3	4	
CuO	48.3	47.19	44.5	43.8	wt %
ZnO	18.9	18.53	15.8	18.1	wt %
SO_3	17.7	17.53	17.4	17.6	wt %
H_2O	15.1	16.75	19.3	20.5	wt %
	100.0	100.00	97.0	100.0	

1: Microprobe data for ramsbeckite from "La Veneziana" mine. Water is obtained by difference.
2: Theoretical composition for ramsbeckite from "La Veneziana" mine with Cu/Zn = 2.6.
3: Chemical data for ramsbeckite given by Hodenberg et al. (1985).
4: Microprobe data for ramsbeckite from Ecton mine (Peacor et al. 1987)

Chemistry

Electron microprobe analysis has been carried on ramsbeckite, using an ARL-SEMQ fully automated wavelength dispersive analyzer with 15 kV acceleration voltage, 15 nA beam current, 20 μm spot diameter, and barite, gypsum, sphalerite, chalcanthite as standards. Raw data from twelve points were corrected by the MAGIC IV program and averaged to produce the data reported in Table 2, from which the chemical formula $(Cu_{10.97}Zn_{4.18})_{15.15}(SO_4)_4(OH)_{22.27}.4H_2O$ was recalculated on the basis of S = 4. This formula compares satisfactorily with the ideal one $(Cu,Zn)_{15}(OH)_{22}SO_4)_4.6H_2O$, according to the structural results given by Effenberger (1988) and taking into account that here the water content was derived by difference.

X-ray data

Some crystals were tested by means of X-ray diffraction to obtain powder pattern and single-crystal data. The powder diffraction was performed with a Gandolfi camera (114.6 mm diameter) using CuK_α radiation and results were in good agreement with the data reported by Hodenberg *et al.* (1985). Single crystal Weissenberg and precession photographs confirmed $P2_1/a$ as the space group of the mineral. The unit cell parameters were refined to a = 16.110(8), b = 15.602(4), c = 7.112(2) Å, β = 90.27(3)° by least squares fitting of 30 high ϑ reflections, selected in the collected set of intensity data.

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References

Bertoldi, G., Boscardin, M., Mattioli, V. (1984) : Interessante mineralien aus dem Vicentino, Italien. *Lapis,* **9**, 18-20.

Effenberger, H. (1988) : Ramsbeckite, $(Cu,Zn)_{15}(OH)_{22}(SO_4)_4.6H_2O$: revision of the chemical formula based on a structure determination. *N. Jb. Miner. Mh.,* 38-48.

Hodenberg, R., Krause, W., Schnorrer-Kohler, G., Tauber, H. (1985) : Ramsbeckite, $(Cu,Zn)_7(SO_4)_2(OH)_{10}.5H_2O$ a new mineral. *N. Jb. Miner. Mh.,* 550-556.

Peacor, D. R., Dunn, P. J., Sturman, B. D. (1987) : Ramsbeckite, an American occurrence at the Ecton Mine, Pennsylvania. *Min. Record,* **18**, 131-132.

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