

unable to accept the conclusion of Hallimond that the $K_2O:SiO_2$ ratio is 1:6 in all mica molecules and gives the evidence to show that it is 1:7 in phengite and cryophyllite. He believes that the $K_2O:SiO_2$ ratio is 1:5 in protolithionite, partly because he has been unable to find any simple formula for that molecule containing 6 SiO_2 which satisfies the other ratios as well as does the formula with 5 SiO_2 .

This article has benefited by the constructive criticism of Professor R. C. Emmons.

ROEMERITE FROM CALIFORNIA

ROBERT E. LANDON, *University of California.*

Roemerite occurs as one of the interesting sulphates developed by the alteration of pyrrhotite at Island Mountain, Trinity County, California. Several very fine specimens of this rare sulphate were collected by Mr. Vonsen of Petaluma, California, and since no American locality has hitherto been given for its occurrence, it was thought worthy of note. It was mentioned as one of the interesting secondary minerals from the pyrrhotite with claudetite, hieberite, goslarite, fibroferrite, and morenosite by Dr. Eakle¹ in his bulletin, but no description of the crystals was given.

The first report of roemerite appears in 1858,² when it was found in the Rammelsberg mine in the Hartz mountains, near Goslar. Grailich, who was the first to describe the mineral, measured the interfacial angles with a contact goniometer, and concluded that the mineral was monoclinic in crystallization. Chemical analyses were made of the same material by Tschermak. J. Blaas³ reported roemerite from Persia in 1885. His material came in smaller but better crystals, so that it was possible to use a reflection goniometer. The results of Blaas' work showed that the mineral was not monoclinic, but triclinic. In 1888⁴ roemerite was discovered in Chile, where it occurs with several other natural sulphates. The

¹ Minerals of California, A. S. Eakle; *Bull.* 91, *Calif. State Min. Bureau*, p. 280.

² Der Römerit, ein neues Mineral aus dem Rammelsberge, Joseph Grailich; *Sitzungsberichte d. k. Akademie der Wissenschaften, Wien*, 28 (1858), pp. 272-288.

³ Beiträge zur Kenntniss natürlicher wasserhaltiger Doppelsulfate, J. Blaas; *Zeitschr. für Kryst.*, 10, (1885), pp. 409-412.

⁴ Beiträge zur Kenntniss der Sulfate von Tierra ammarilla bei Copiapo in Chile, G. Linck; *Zeitschr. für Kryst.* 15 (1889), pp. 22-26.

study of these crystals confirmed Blaas' work on their crystallization.

California roemerite is cinnamon-brown or chestnut-brown in color, and occurs in stocky to tabular crystals up to 5mm. in length, and 2 or 3mm. in width and thickness. It is commonly associated with a yellowish earthy oxide like coquimbite. The (001), (100) and the (110) faces are the most prominent.

The crystal measurements show beyond a doubt that the mineral is triclinic, although the axial ratios and interaxial angles were not redetermined because of poor terminal faces. In the prism zone, which is the best developed, three new forms were found. No new terminal faces were seen. As a rule the crystals are mounted on the terminal faces, leaving a free development of the prism faces.

Three different orientations have been used in describing roemerite. Blaas used an orientation which made the cleavage parallel the brachypinacoid. Linck made the cleavage parallel the base. Goldschmidt⁵ made the cleavage parallel the front pinacoid. The last two orientations differ essentially from the first, but Goldschmidt's orientation makes the domes in Linck's crystal, prisms, and vice versa. The negative end of the *c* axis becomes the positive end of the *a* axis of the other. This interchange of axes appears in the axial ratios and interaxial angles, as an interchange of the values of the former, and as interchanged supplementary angles in the latter.

TABLE 1. INTERAXIAL ANGLES AND AXIAL RATIOS AS DETERMINED BY EARLY WORKERS.

	α	β	γ	Ratios
Blaas	89° 44'	102° 17'	85° 18'	.8791:1: .8475
Linck	116° 2'	94° 41'	80° 8'	.9682:1:2.6329
Goldschmidt	99° 53'	94° 30'	63° 57'	2.6425:1: .9684

Goldschmidt lists a total of thirteen forms, three of which are pinacoids, six are prisms, two are bracydomes, and two are macrodomes. The California crystals showed three new prisms, one positive, and the other two negative. No pyramids have been reported, and none were found on the new crystals.

⁵ Goldschmidt, Victor; *Krystallographische Winkeltabellen*, Verlag von Julius Springer, Berlin (1897), p. 295.

TABLE 2. FORMS OBSERVED ON ROEMERITE

Number	Miller index	letter	ϕ angle	ρ angle
1	(001)	<i>c</i>	not read	
2	(010)	<i>b</i>	0° 00'	90° 00'
3	(100)	<i>a</i>	114° 53'	"
4	(110)	<i>m</i>	21° 15'	"
5	(210)	<i>n</i>	44° 44'	"
6	(310)	<i>s</i>	62° 42'	"
7	(18·5·0)	<i>t</i>	69° 31'	"
8	(410)	<i>l</i>	75° 50'	"
9	(1 $\bar{1}$ 0)	<i>M</i>	164° 57'	"
10	(023)	μ	not present	
11	(0 $\bar{1}$ 1)	<i>e</i>	present but only approximately read.	
12	(805)	<i>y</i>	" " "	" "
13	($\bar{1}$ 01)	<i>x</i>	" " "	" "
New forms				
14	(120)	<i>f</i>	9° 26'	90° 00'
15	" " (2 $\bar{1}$ 0)	<i>g</i>	156° 47'	"
16	" " (4 $\bar{1}$ 0)	<i>h</i>	143° 5'	"

Forms 1-13 are listed from Goldschmidt, with slight modification in letters used. Forms 14-16 are new. All readings given are from measurements of California roemerite.

The optical properties of the California mineral, as determined by Mr. Charles Anderson of the University of California, are as follows: Color, yellow-brown in thick grains, colorless in thin grains; slightly pleochroic; X = reddish yellow, Y = pale yellow, Z = yellow-brown; biaxial, negative; $2V = 49^\circ \pm 3^\circ$ (measured). Strong dispersion, $\rho > \nu$; distinctly crossed dispersion. All grains

perpendicular to X show abnormal interference tints due to dispersion; dispersion of the bisectrices marked, sharp extinction in

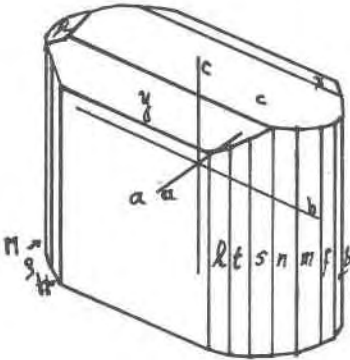


Figure 1. Roemerite crystal in normal position. Magnified 75 X.

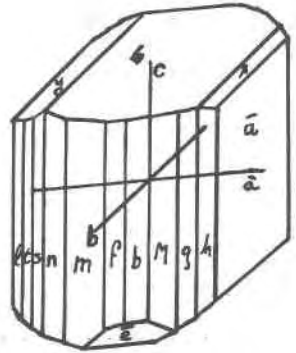


Figure 2. Roemerite crystal rotated 115° to the right of the normal position. Magnified 75 X.

other sections. Indices, $\alpha = 1.526$, $\beta = 1.571$, $\gamma = 1.582$; all $\pm .003$. These determinations are essentially concordant with earlier ones made by Linck, and others.

TABLE 3

Analyst	SO ₃	Fe ₂ O ₃	FeO	H ₂ O	Miscellaneous
Tschermak	41.54%	20.63%	6.26%	28.00	1.97% Zn; 58% Ca.
Blaas	40.95	20.50	4.12	30.82	3.59% MgO
Linck	38.47	17.62	9.06	34.10	1.02% Al ₂ O ₃
Mackintosh ⁶	40.19	19.40	9.52	30.85	0.14% Na ₂ O
Landon	38.30	20.60	6.94	33.40	0.0 % Cao, MgO, or Al ₂ O ₃ .

In the above table Tschermak's analysis represents the original material as given in Grailich's paper, Blaas' analysis represents roemerite from Persia, Linck's and Mackintosh's analyses of material from Chile, and the last represents roemerite from California.

Chemically, roemerite is a double sulphate of ferrous and ferric iron, the ferrous iron of which may sometimes be replaced by zinc

⁶ Iron sulphates from Chile, J. B. Mackintosh; *Am. J. Sc., Third Series*, 38 (1889, vol. 2), p. 243.

and magnesium, and the ferric iron by aluminum. The amount of combined water may be variable.

Although these analyses do not correspond in every detail, they nevertheless indicate a general composition which may be represented by the formula: $\text{FeO} \cdot \text{Fe}_2\text{O}_3 \cdot 4\text{SO}_3 \cdot 12$ to $15 \text{H}_2\text{O}$. The mineral is exceptionally soluble in water, with an acid reaction. It has an astringent taste. It alters to a yellowish white ferric salt, probably coquimbite. Its high solubility, and the ease with which the mineral loses water with the simultaneous oxidation of the ferrous iron, account for its rarity.

PIEDMONTITE FROM THE SULPHUR SPRING VALLEY, ARIZONA.¹

CARL LAUSEN, *University of Arizona.*

A specimen of piedmontite was sent to the Arizona Bureau of Mines for identification, and the locality was visited by the writer and additional material collected for study. The locality is on the southeast slope of the Pat Hills, in the Sulphur Spring Valley, southeastern Arizona. More exactly, it is near the northern edge of T.27 E., R.17 S., Gila and Salt River Base and Meridian.

The volcanic rocks in this region consist of a series of andesitic flows, dark gray in color, and with a porphyritic texture. Both hornblende and plagioclase feldspar occur as phenocrysts in a fine-grained groundmass. In a thin section of the fresh rock the hornblende is of a brownish color, strongly pleochroic, and with a small extinction angle. This is probably a variety of basaltic hornblende. Grains of magnetite are commonly associated with it, especially where the hornblende shows a resorption border. The plagioclase feldspar is present in the slide as rather stout laths which are considerably smaller in size than the crystals of hornblende, and show a more or less parallel arrangement. Polysynthetic twinning is common, and the maximum extinction angle in the symmetrical zone shows them to be basic andesine, near Ab_1An_1 . The groundmass is microcrystalline, and appears to consist largely of minute feldspar laths together with scattered grains of magnetite and a little apatite. The texture is porphyritic.

As the amphibole in this rock is a variety known as basaltic hornblende, a mineral sometimes found in basalt and the more

¹Published by permission of the Director, Arizona Bureau of Mines.