

NEW DATA ON SCHIRMERITE

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ABSTRACT

Schirmerite from the Treasury mine, Geneva District, Colorado, U.S.A., found in the last century (Genth 1874), has been reinvestigated. Another schirmerite variety, labelled as "beegerite", has been identified in sulphide material from the Old Lout's mine, Ouray, Colorado. The mineral is orthorhombic with $a = 13.448 \pm 0.026 \text{ \AA}$, $b = 44.386 \pm 0.100 \text{ \AA}$, $c = 4.022 \pm 0.012 \text{ \AA}$, and space group possibilities: $Bbmm$, $Bb2_1m$ and $Bbm2$. Guinier powder data, physical and optical properties on the mineral are listed. The following ideal composition is suggested: $\text{Ag Bi}_3\text{Pb}_2\text{S}_7$.

INTRODUCTION

Schirmerite from the Treasury mine, Geneva District, Park County, Colorado, U.S.A. was described by Genth (1874), who determined its composition as $\text{AgBi}_4\text{Pb}_4\text{S}_9$. Later Genth obtained several specimens termed « schirmerite » from the Treasury Vault mine, Summit County, Colorado. He found this schirmerite variety developed as « small particles and patches, the largest about 10 mm in size, disseminated through quartz, associated with cubical crystals of pyrite, very little chalcopyrite, and in some of the cavities, a yellowish earthy coating, probably of bismite » (Genth 1885, p. 37). Chemical analyses gave a formula approximating $(\text{Ag}_2\text{Pb})\text{S.Bi}_2\text{S}_3$, and on this basis Genth concluded that the mineral was not schirmerite but « argentiiferous beegerite ».

Schirmerite from the Treasury mine, Geneva District, was described by Ramdohr (1960) and x-ray powder data of the mineral were published by Berry & Thompson (1962). The data on the mineral presented in this paper are based on a study of the following mineral specimens :

1. Specimen R9714, schirmerite, Treasury Lode, Geneva District, Colorado, and specimen C740, schirmerite, Geneva District both borrowed from the Smithsonian Institution, U.S.A.
2. Specimen ROM M11607, schirmerite, Geneva District, Clear Creek County, Colorado, and specimen ROM M4100, beegerite, Old Lout's mine, Ouray, Colorado, both borrowed from the Royal Ontario Museum, Ontario, Canada.

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3. Polished section 2571, schirmerite, Treasury mine, Colorado, and polished section 6072, beegerite, Old Lout's mine, Ouray, Colorado, both borrowed from Prof. P. Ramdohr, University of Heidelberg, Germany.

MODE OF OCCURRENCE OF SCHIRMERITE

Specimens ROM M11607 and C740 are identical. Polished section studies have shown that schirmerite is not present. Galena and aikinite were identified in specimen C740, and galena, matildite (decomposed schapbachite), pavonite and aikinite in ROM M11607. Additional sulphides are chalcopyrite, pyrite, sphalerite and tennantite. All minerals occur disseminated in fine-grained quartz-rich gangue. The material resembles that described by Genth (1885) from the Treasury Vault mine, Summit County, Colorado.

The schirmerite in specimens R9714 and 2571 is identical. The mineral occurs, as described by Ramdohr (1960), as randomly-oriented crystals up to several mm in size in an aggregate of sugary quartz. Schirmerite is the only primary sulphide present. The individual crystals are sometimes slightly bent and always fractured. Secondary bismuth, silver and lead minerals have developed along cracks and along schirmerite-quartz boundaries.

Polished section studies of material labelled « beegerite » (specimens M4100 and 6072) have shown that this material is characterized by a fine grained intergrowth of galena and matildite, which presumably developed as a result of the decomposition of a high temperature schapbachite. The two minerals occur as hosts for minor pyrite, chalcopyrite, sphalerite and idiomorphic quartz crystals. Schirmerite was found in specimen ROM M4100 but not in 6072. The mineral, present as randomly-oriented laths, constitutes no more than a few per cent of the sulphides. The material in both specimens is no doubt identical with that of the Old Lout's mine described by Koenig (1885) as « argentiferous beegerite ».

PHYSICAL AND OPTICAL PROPERTIES

The reflection pleochroism of schirmerite is weak in air, weak to distinct in oil. The colour of the mineral closely resembles that of galena. Reflectance measurements on one mineral grain in specimen 2571 showing maximum anisotropism gave the results listed in Table 1. The anisotropism is weak to distinct in air, and distinct to strong in oil. The anisotropy colours vary from grey to black.

Microindentation hardness tests with a 50 g load gave values from 150 to 206.

Etch tests for one minute gave negative results with the following reagents: HNO_3 (1:1), KOH (40%), KCN (20%), FeCl_3 (20%), and Hg_2Cl_2 (5%). Treatment for ten seconds with concentrated nitric acid resulted in

TABLE 1. REFLECTIVITY OF SCHIRMERITE *

nm	R_g	R_p	nm	R_g	R_p	nm	R_g	R_p
440	44.4	40.4	520	46.0	42.0	600	43.3	39.7
460	45.0	41.3	540	45.4	41.8	620	41.7	39.0
480	46.1	41.7	560	44.8	41.0	640	41.6	39.0
500	46.2	42.1	580	44.0	40.2	660	40.6	37.9

*Reflectance measurements on 1 grain showing maximum anisotropism in specimen 2571. Measurements obtained with a Zeiss photometer, type 2, using SiC as a standard.

TABLE 2. GUINIER POWDER DATA (Cu RAD.) FOR SCHIRMERITE (SPECIMEN 2571)

I	$d(\text{meas.})\text{\AA}$	$d(\text{calc.})\text{\AA}$	hkl	I	$d(\text{meas.})\text{\AA}$
1	7.207	7.40	060	1	2.439
1	6.929	6.724	200	1	2.423
1	6.438	6.435	220	7	2.382
1	5.000	4.976	260	7	2.282
6	3.662	3.640	141	4	2.210
4	3.501	3.535	151	3	2.112
5	3.465	3.460	2.11.0	1	2.067
1	3.314	3.324	420	10	2.035
9	3.207	3.218	440	2	1.990
5	3.080	3.061	460	1	1.907
9	2.923	{ 2.934	331	3	1.737
		{ 2.910	1.10.1		
7	2.878	2.875	480	1	1.565
7	2.837	2.837	351	5	1.536
7	2.786	2.787	1.11.1	1	1.454
3	2.665	2.668	1.12.1	5	1.382
5	2.610	2.611	0.17.0		
4	2.580	2.583	4.11.0	5	1.376

the development of a grey precipitate, which was easily removed when repolished with magnesium oxide.

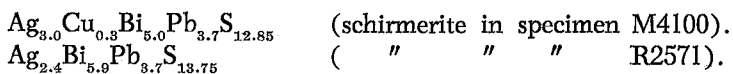
X-RAY CRYSTALLOGRAPHY

A Guinier powder film made on schirmerite isolated from specimen R9714 gave rather poor and diffuse lines. Those representing the mineral in 2571 were sharper and the results are listed in Table 2. Sufficient material could not be isolated from specimen M4100 for similar examination. The powder data listed by Berry & Thompson (1962) on schirmerite are not similar to those listed in Table 2 and are therefore concluded to be unrepresentative for the mineral*.

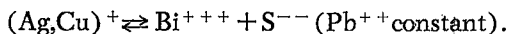
Fragments isolated from specimens R9714, 2571 and ROM M4100 were examined by the Weissenberg method and produced identical results. The cell dimensions, refined on the basis of the Guinier powder data using a program (REFBASE II) written by E. Leonardsen are: $a = 13.448 \pm 0.026$, $b = 44.386 \pm 0.100$, $c = 4.022 \pm 0.012 \text{ \AA}$. Reflection takes place for hkl when $h + l = 2n$, which leads to the space group possibilities $Bbmm$, $Bb2_1m$, and $Bbm2$.

MICROPROBE ANALYSES

Microprobe analyses on three mineral grains in specimens M4100 and 2571 are listed in Table 3. The mineral in the two specimens has a different chemical composition. According to the analyses the following formulae can be written:



The microprobe analyses indicate that the following substitutional relationships may exist:



Ag^{+} and Cu^{+} may occupy substituted Bi^{+++} positions in the crystal structure, while the equivalent S^{--} positions are left empty. The above formulae are constructed so that the metal sum equals 12 in both and the sulphur values are stoichiometric. From the microprobe analyses in Table 3 it is evident that the sulphur values in the last column and the stoichiometrically-determined values in the two formulae are almost identical.

* Editor's note: the data correspond to a mixture of matildite and galena (oral communication from D.C. Harris).

On the basis of the above-mentioned substitutional possibilities, the ideal formula is suggested to be $\text{AgBi}_3\text{Pb}_2\text{S}_7$.

Density and cell content

Sufficient material could not be isolated for density determinations. The ideal formula with $Z \approx 8$ gives a calculated density of 7.58 g/cc. Sulphides with compositions close to that of schirmerite have densities of about 7.

DISCUSSION

The present investigation has shown that schirmerite is an independent and well-defined mineral known from the Treasury mine, Geneva District, and from the Old Lout's mine, both located in Colorado, U.S.A. The mineral from the former locality occurs as laths in quartz. From the latter it is present as laths in a matrix of galena and matildite. These two minerals are considered to have developed from the decomposition of

TABLE 3. MICROPROBE ANALYSES OF SCHIRMERITE

Specimen no : M4100	Wt. %	Mol. %	Wt. %	Mol. %	Wt. %	Mol. %	Sum *
Ag	12.5	11.7	12.3	11.8	12.5	12.1	3.0
Cu	0.8	1.2	0.7	1.2	0.6	1.0	0.3
Bi	42.6	20.7	40.8	20.3	39.8	19.8	5.0
Pb	28.4	13.9	29.8	15.0	31.1	15.6	3.7
S	16.6	52.5	16.0	51.7	15.9	51.5	13.0
Total	100.9	100.0	99.6	100.0	99.9	100.0	
Specimen no : 2571							
Ag	9.1	8.8	9.6	9.2	9.6	9.4	2.4
Cu	0.1	0.2	0.1	0.2	0.1	0.2	—
Bi	45.9	22.7	46.1	22.8	45.3	22.7	5.9
Pb	29.0	14.5	28.4	14.2	28.2	14.2	3.7
S	16.7	53.8	16.6	53.6	16.4	53.5	13.9
Total	100.8	100.0	100.8	100.0	99.6	100.0	
Total	100.8	100.0	100.8	100.0	99.9	100.0	

* Average mol values recalculated so that the sum of the metals equals 12.

schapbachite. The mineral relations show that schirmerite crystallized penecontemporaneously with this mineral, possibly because not all the bismuth present in the mineralizing fluids could be dissolved in the schapbachite lattice. The temperature of formation of schapbachite, and therefore also that of schirmerite, must have been above 225° C, (the temperature at which schapbachite decomposes to matildite and galena).

The microprobe analyses have indicated that the composition of the mineral may vary considerably from one deposit to another.

Schirmerite resembles gustavite ($\text{AgPbBi}_8\text{S}_6$) by having the same space group possibilities and identical a and c dimensions (but different b dimensions : 44.386 Å versus 19.449 Å).

ACKNOWLEDGEMENTS

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