CARMINITE AND ASSOCIATED MINERALS FROM MAPIMI, MEXICO[1]

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The mineral carminite was first described from the Luise Mine, at Horhausen, near Neuweid, Rhineland, Germany, but the amount of material available for investigation was so meager that the data are unsatisfactory. Carminite has also been reported from Cornwall, England, and Mt. Magnet, Tasmania. The so-called "red olivenite" from Tintic, Utah, found in many collections is carminite. A specimen in the U. S. National Museum from an unknown locality in Colorado also proves to be carminite.

The carminite and associated minerals from Mapimi, Durango, Mexico, were collected on a small dump near the North Shaft of the Ojuela Mine, in the summer of 1927 by Dr. Harry Berman and the writer during a season in the field under the auspices of the Holden Fund of the Harvard Mineralogical Museum, and the U. S. National Museum. The material consisted of blocks of massive to crystalline scorodite containing seams and pockets of arseniosiderite and small areas of dussertite and carminite.

The ores of the Ojuela Mine are replacement deposits in limestone and consist of galena, blende, pyrite and arsenopyrite in a matrix of quartz, dolomite and fluorite. Arsenopyrite is abundant, in some cases forming considerable bodies of sulfides. The oxidized ores are characterized by an abundance of arsenates, largely mimetite, together with wulfenite and the more ordinary oxide ore minerals.

CARMINITE

The carminite occurs in minute crystals, less than one half mm. in length in cavities in either scorodite or arseniosiderite. They are dark carmine red in color and highly lustrous. It also forms heavy masses, with radiated structure, rather intimately mixed with cerussite, anglesite and plumbojarosite. It is almost always intimately associated with arseniosiderite and dussertite and is the rarest of the arsenates in the association.

Chemical Properties. The original chemical analysis of carminite by R. Müller was made on but 0.068 grams of material and the results are therefore unreliable and prove to be much in error. A reasonably pure sample of the Mapimi carminite was obtained, estimated to contain

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not more than 5% of impurities, largely cerussite. Analysis of this material, together with an analysis of the Colorado carminite and the theoretical composition for the formula accepted is given below.

TABLE 1. CARMINITE: ANALYSES FROM MEXICO AND COLORADO

	Mexico	Ratios	Colorado	Ratios	Theory
PbO	37.30	.1675	36.57	.1633	35.38
CaO	0.44	.0078	0.06	.0011	
MgO	0.06	.0015	0.02	.0005	
FeO	0.21	.0029	0.14		
Fe_2O_3	23.43	.1467	23.81	.1491	25.33
Al_2O_3	0.96	.0094	0.43	.0042	
As_2O_5	33.98	.1426	34.49	.1500	36.44
P_2O_5					
H_2O+	2.9	.1687	3.13	.1687	2.85
H_2O-	0.10				
Insol.	0.58		0.46		
	99.96		99.11		100.00

These analyses lead to the formula $PbO \cdot Fe_2O_3 \cdot As_2O_5 \cdot H_2O$, which may also be written $2FeAsO_4 \cdot Pb\ (OH)_2$. This is very much simpler than the formula $Pb_3As_2O_8 \cdot 10Fe\ AsO_4$, given by Dana and based on the old analysis of Müller.

The mineral is slowly soluble in hydrochloric acid with the separation of lead chloride. Before the blowpipe the mineral fuses easily with intumescence, coloring the flame pale blue. The bead obtained is lustrous black and not magnetic. In a closed tube it fuses, turns dark brown in color, and evolves a small amount of water.

Cyrstallography. The crystals of carminite are very small, measurable crystals not exceeding a millimeter. They are flattened parallel to the brachypinacoid, the faces of the unit prism and the brachydome being narrow. There is also a decided tendency of the crystals to group themselves in flat sheaf-like forms so that most of the larger crystals were unsuited for measurement. Further, the faces, especially those of the brachydome, are somewhat etched and hence rather dull. A larger number of crystals were mounted and examined for measurement but only five gave signals sufficiently distinct to be usable in the calculation of the elements. These measurements are given below.

TABLE 2. CARMINITE

Measurements of *m* (110)

Crystal No.	Reflection	ϕ measured
1	Faint	54°03′
1	Faint	52 43
1	Good	54 11
2	Good	53 46
2	Faint	53 52
4	Faint	53 30
4	Faint	53 25
4	Good	53 37
4	Faint	53 09
5	Poor	53 42
5	Poor	53 40
		Average 53°36′

Measurements of *e* (011)

Crystal No.	Reflection	ρ measured
1	Poor	25°06′
2	Fair	24 52
2	Fair	24 33
3	Good	25 28
4	Fair	24 47
4	Good	24 32
5	Faint	25 15
5	Faint	25 15
		Average 25°00′

From these measurements the following elements have been calculated and the angle table prepared.

TABLE 3. CARMINITE, MAPIMI, DURANGO, MEXICO

Orthorhombic

$p_0=0.6325$ $q_0=0.4663$ $a=0.7373$ $c=0.4663$

	Müller	Gdt.	ϕ	ρ	No. faces	Limits
o	010	0 ∞	0	90°00′	8	—
m	110	∞	53°36′	90 00	11	52°43 –54°11′
e	011	01	0	25 00	8	24 32 –25 28

In habit the crystals of carminite are lath-like, prismatic and flattened to the brachypinacoid (010). As already stated there is a tendency for the crystals to be aggregated into sheaf-like forms, and acicular radiated groups are also commonly found. Where doubly terminated crystals are found both ends are equally well developed and show no evidence of hemimorphism.

Optical Properties.[2] The color of carminite is dark carmine red. Under the microscope the pleochroism is strong, X = pale yellowish red, Y and Z = dark carmine red. Absorption Y and $Z>X$. Biaxial, positive, with $2V$ moderately large. Dispersion strong $r<v$. Extinction parallel; elongation negative. Birefringence low; $\alpha=2.070$, $\beta=2.070$, $\gamma=2.080$. The cleavage is perfect.

SCORODITE

The scorodite forms large masses and constitute the main bulk of all the specimens collected. Two forms were found; one in coarse granular masses with numerous small vugs of crystals of a clean gray-green color, and the other in rounded concretionary masses of compact material lighter in color and abundantly veined by brown arseniosiderite, or with pockets and cavities of carminite and dussertite.

The crystals of scorodite are simple in habit, consisting of the pyramid *p* (111) only slightly modified by *a* (100) and small triangular faces of *d* (120), so that the crystals have an almost simple "octahedral" habit. An analysis of selected crystals gave the composition given below.

ANALYSIS OF SCORODITE FROM MAPIMI, MEXICO

F. A. Gonyer, *Analyst*

Insol.	0.12
As_2O_5	48.96
Fe_2O_3	34.20
Al_2O_3	1.60
CaO	0.54
MgO	0.22
H_2O	14.53
	100.17

This scorodite is biaxial, positive, with a medium optical axial angle. Dispersion is strong; $r>v$. The indices of refraction are $\alpha=1.787$, $\beta=1.795$, $\gamma=1.810$. It is, therefore, normal scorodite.

ARSENIOSIDERITE

This mineral occurs as fine grained masses of light to dark chestnut

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[2] Determined by Miss Jewell Glass.

brown color. It forms reticulating veinlets and replacement masses in the compact pale colored scorodite. It also forms purer masses of a darker color, in which original vugs of scorodite crystals have been completely altered to the arseniosiderite, yielding sharp pseudomorphs. This latter type usually carries small cavities lined with fine small carminite crystals and the entire mass is obviously derived from original scorodite.

The massive dark brown material was selected for analysis. Thin sections of this material showed it to be made up of a confused aggregate of crystals and that it carried a few small nests of carminite and perhaps some limonite. The following table gives the analysis, together with the molecular ratios and the theoretical composition for the formula accepted.

Arseniosiderite, Mapimi, Mexico
W. F. Foshag, *Analyst*

As_2O_5	42.67	.1778	43.6
PbO	0.28	.0012	
Fe_2O_3	32.71	.2048	30.3
FeO	0.12	.0016	
CaO	14.44	.2574	15.9
MgO	0.61	.0015	
H_2O	9.34	.5172	10.2
Insol.	0.40		
	100.57		100.0

Allowing for a small amount of carminite, the analysis yields reasonably well the formula: $3CaO \cdot 2Fe_2O_3 \cdot 2As_2O_5 \cdot 6H_2O$. An excess of iron, above that necessary for this formula may be ascribed to limonite. This is the formula given to mazapilite but differs from the usually accepted composition for arseniosiderite, based on the original Romanêche material.

The Nature of Mazapilite

Mazapilite was described by König (1889, pp. 85–88) as a new species from the Jesus Maria Mine, Mazapil Mining District, Zacatecas, Mexico. It occurs as well formed crystals embedded in calcite. Their color is deep chestnut brown, almost black and have a brownish red streak. While the crystals are sharp in form, thin sections show that they are not single crystals but a firm mass of interlocking grains. This suggests that they are probably pseudomorphous. The common occurrence of arseniosiderite as pseudomorphs after scorodite at Ojuela suggests that mazapilite is of this nature. A comparison of the crystal angles of mazapilite and scorodite leaves little doubt that this is actually the case.

TABLE 4. SCORODITE AND MAZAPILITE: CRYSTAL ANGLES

Form	Scorodite		Form	Mazapilite	
	ϕ	ρ		ϕ	ρ
a(120)	29°56′	90°00′	*n*(120)	30°03′	90°00′
p(111)	49 02	55 42	*o*(111)	49 10	56 30
n(201)	90 00	65 42	*r*(201)	90 00	66 23
e(012)	0 00	25 40	*d*(012)	0 00	26 17

Larsen (1921, p. 42), from a comparison of the optical properties of arseniosiderite and mazapilite, has already suggested their identity. Mazapilite is, then, arseniosiderite pseudomorphous after scorodite. Unfortunately, the material available is of such a nature that samples of unquestioned purity are not readily obtainable and it is difficult therefore to choose between several possible formulas for arseniosiderite. The more recent analysis suggests that the composition ascribed to "mazapilite" is the correct one for the species.

DUSSERTITE

It was not possible to prepare a sample of this mineral sufficiently pure for analysis but in physical appearance, optical properties, and qualitative composition it is definitely dussertite.

The dussertite is always associated with the late minerals, carminite and arseniosiderite, and is not found in the scorodite without one or the other of these associates. It is fine granular in texture and has a clear pistachio green color, not unlike granular epidote. It is found either as a zone between carminite and scorodite, or is small, rounded masses in arseniosiderite. Crystals appear rhombohedral under the microscope.

Optical Properties.[3] Color deep chrysolite green (Ridegway). Uniaxial to abnormally biaxial with $2V=15°–20°$. Negative. $\epsilon=1.845$, $\omega=1.870$. Barth and Berman (1930, pp. 36–37) give for dussertite from the original locality, Djebel Debar, Algeria; uniaxial, negative. $\epsilon=1.85$, $\omega=1.87$; while Barthoux (1925) in his original description, gives its properties as uniaxial negative, with n between 1.80 and 1.88. This is then the second recorded occurrence of dussertite.

REFERENCES

BARTH, T. F. W., and BERMAN, H. (1930): *Chem. Erde*, **5**, 22–42.
BARTHOUX, J. (1925): *C. R.*, **180**, 299–301.
KÖNIG, G. A. (1889): *Zeits. Krist.*, **17**, 85–92.
LARSEN, E. S. (1921): *U. S. Geol. Surv.*, Bull. **679.**

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[3] Determined by Miss Jewell Glass.