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## MERWINITE, A NEW CALCIUM MAGNESIUM ORTHOSILICATE FROM CRESTMORE, CALIFORNIA

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### INTRODUCTION

Some specimens from the contact metamorphic zone at Crestmore, near Riverside, California, thought at first to be montcellite, have proved on microscopic examination to be made up largely of a new mineral. For this new species the name merwinite is proposed in honor of Dr. Herbert E. Merwin, and in recognition of his work in mineralogy and petrography. The writers were assisted in the heavy solution separation of the mineral and in measuring some of the optical properties by Mr. A. R. Martinez, to whom they express their thanks.

### OCCURRENCE AND ASSOCIATION

Merwinite occurs in considerable abundance in the contact metamorphic limestone in the quarries at Crestmore, near Riverside, California. Boulders made up of the minerals described below have at times been common on the quarry floor, but their position on the quarry face has not been determined. The boulders are often coated with a white alteration product, the alteration having penetrated them to the depth of several centimeters by means of veins, but the center of the masses has been found to consist of firm, fresh material. The main occurrence of the merwinite was, as far as known, at the Wet Weather Quarry, and its amount there was measurable in tons. A small mass was also exposed in the Commercial Quarry where it was associated with vesuvianite, well away from the contact and beyond the garnet zone. Specimens were collected as early

<sup>1</sup> Published with the permission of the Director of the United States Geological Survey and the Secretary of the Smithsonian Institution.

as 1913, but were called monticellite at the time. They were then obtainable in abundance at the Commercial Quarry, in the zones more distant from the contact.

The new mineral is intimately associated with gehlenite, spurrite and an undetermined mineral (A), with a little calcite and rarely yellowish or brownish vesuvianite. Merwinite is the predominant mineral in most of the samples examined. Gehlenite is abundant, spurrite somewhat less so, the mineral A is fairly abundant in some specimens, and calcite is present in small amounts. The merwinite, the mineral A, and the gehlenite are in interlocking grains, while the spurrite is interstitial or intergrown with merwinite. The spurrite is found only in close association with the merwinite and commonly forms a corona separating merwinite from calcite. Diopside and wollastonite are less intimately associated with the merwinite, and become abundant associates of the gehlenite where merwinite is absent.

The spurrite is easily identified by its optical properties and by the fact that it effervesces with acid. Its optical properties have been described elsewhere;<sup>1</sup> it has since been determined that  $\alpha = 1.672$  and  $\gamma = 1.676$ .

The gehlenite closely associated with the merwinite and spurrite gives low but normal interference colors and has a considerably higher birefringence than that associated with the diopside and wollastonite, which gives abnormal blue and red interference colors. Both are uniaxial, negative, and have a refractive index of about 1.663. These data indicate a gehlenite made up predominantly of velardeñite with about 25% åkermanite (oakermanite).

The mineral A is closely associated with the merwinite. It is optically negative, has a very large axial angle, with refractive indices:  $\alpha = 1.640$      $\beta = 1.651$      $\gamma = 1.662$ .

#### OPTICAL PROPERTIES

Merwinite has characteristic optical properties with high relief, moderate birefringence and polysynthetic twinning. The refractive indices as measured by the immersion method are:

$\alpha = 1.708 \pm 0.003$      $\beta = 1.711 \pm 0.003$      $\gamma = 1.718 \pm 0.003$   
It is optically positive, has an axial angle measured with the

<sup>1</sup> W. F. Foshag: Thaumasite (and spurrite) from Crestmore, California. *Am. Min.*, 5 (4), 80-81, 1920.

Fedorov stage of  $2V = 66\frac{1}{2}^\circ$ , and the dispersion  $\rho > v$  is perceptible. The acute bisectrix Z is normal to the perfect cleavage. The mineral shows polysynthetic twinning after two laws. A drawing of the twins is shown in figure 1. The more common is in two or even more sets that yield cross gratings, "herring-bone" structure, and more complex arrangements. The two sets of lamellas are commonly not equally developed and so add to the complexity. In many grains the twinning resembles the albite twinning of the feldspars and, in one section, the merwinite is in

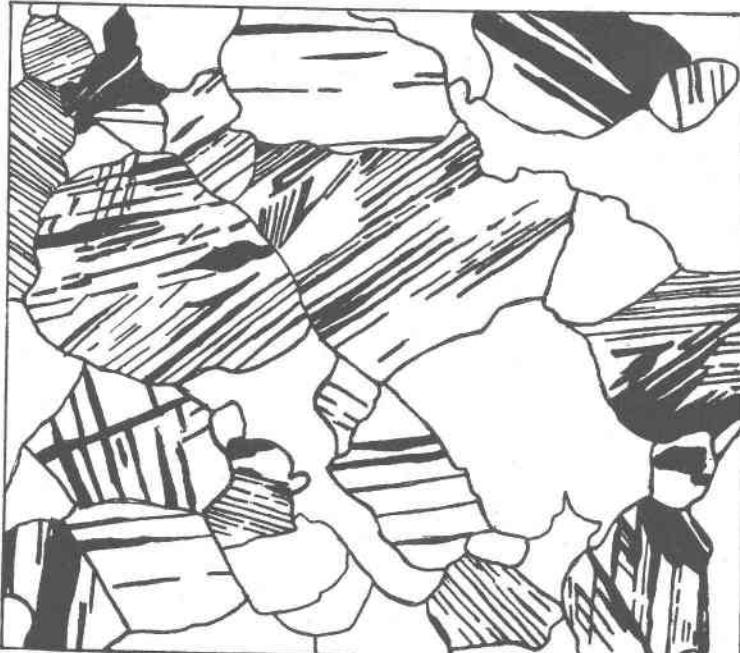


FIGURE 1. Drawing of a thin section of merwinite showing twinning.  
Magnified 40 diameters.

tabular crystals parallel to the best developed twinning, making the resemblance to calcic plagioclase still closer. Sections cut normal to both pairs of the two sets of twin lamellas have an angle between the lamellas of about  $42\frac{1}{2}^\circ$ . Such sections show Z bisecting the obtuse angle between the twin lamellas for all the twin lamellas and X much inclined to the normal of the section. Hence such grains extinguish as a unit, but when not turned to the position of extinction the lamellas show different interference colors. A grain showing both sets of twin lamellas and cut

nearly normal to the planes of both is shown in the lower right hand corner of figure 1. Such a section when turned on the Fedorov stage on an axis parallel to  $Z$  shows symmetrical extinction and in the  $90^\circ$  position gives parallel extinction. Sections cut normal to  $Z$  give an extinction angle  $X$  to the trace of the composition plane of about  $36^\circ$ . For such sections  $Z$  is normal to the plane of the section for all the lamellas but alternate lamellas give symmetrical extinction  $X$  on the opposite side of the composition plane. These data indicate that the mineral is monoclinic; that  $Z = b$ , the composition plane is a prism (110) and the twinning axis is the crystallographic  $c$  axis. The cleavage is 010 and  $X \wedge c = 36^\circ$ . The angle between (110) and (1 $\bar{1}$ 0) is  $42\frac{1}{2}^\circ$ .

The mineral has another less common set of twin lamellas that often appear in sections as lens-like streaks. In sections normal to  $c$  these lamellas bisect the acute angle between the more common sets of lamellas and hence extinction is parallel to them. In rare grains it turns the more common lamellas so as to give a "herring-bone" structure. In sections normal to the  $b$  crystal axis they give symmetrical extinction. This set therefore has the twinning plane and composition plane (100).

#### PHYSICAL PROPERTIES

Merwinite has one perfect cleavage parallel to (010). Its hardness is about 6. The specific gravity, as measured by the pycnometer method, is 3.150. The mineral is colorless to very pale greenish and has a vitreous luster. The mixture has a light greenish to grayish color and somewhat greasy luster and bears a marked resemblance to the original specimens of spurrite from Velardeña, Mexico, now preserved in the United States National Museum (No. 86532). The original spurrite has a similar coating of white alteration products.

#### CHEMICAL PROPERTIES

Material for analysis was carefully separated from the associated minerals with heavy solutions and the resulting product showed under the microscope only one or two per cent. of admixed mineral A, gehlenite, and spurrite.

The mineral dissolves quickly and completely in hydrochloric acid and upon evaporation gelatinizes perfectly. The analysis was carried out by the standard methods, double precipitations

being made in all cases. The results of a complete analysis and a partial analysis are given below:

TABLE 1. ANALYSIS OF MERWINITE FROM CRESTMORE, CAL.

SiO <sub>2</sub> .....	35.50	35.84
Al <sub>2</sub> O <sub>3</sub> .....	0.66	0.65
Fe <sub>2</sub> O <sub>3</sub> .....	none	none
CaO.....	49.96	49.70
MgO.....	11.62	—
FeO.....	1.22	1.23
Loss at 110° <sup>1</sup> .....	0.12	—
Loss on ignition <sup>1</sup> .....	0.94	—
	100.02	

By calculating FeO to MgO, deducting alumina and loss on ignition as extraneous and recalculating to 100 per cent. we obtain the following composition and ratios:

## RECALCULATED ANALYSIS RATIOS AND THEORETICAL COMPOSITION

## OF MERWINITE

Theor. Compn.	Recalcd. compn.	Ratios.	
SiO <sub>2</sub> .....	36.59	.601	2
CaO.....	51.22	.911	3
MgO.....	12.19	.312	1

The formula for merwinite therefore is 3CaO.MgO.2SiO<sub>2</sub>, which may be written as a normal orthosilicate Ca<sub>3</sub>Mg (SiO<sub>4</sub>)<sub>2</sub>.

## ALTERATION

The surface of the boulders of merwinite-bearing rock is covered with a coating of alteration products and the outer portions are cut by veinlets of secondary minerals. These veins were probably developed during the later stages of the contact metamorphism. Chief of the alteration products is thaumasite occurring in masses of interlaced needles, small crystals lining cracks or silky, fibrous masses. This thaumasite has been described in another paper.<sup>2</sup> Other minerals are a fibrous, weakly birefracting to indistinctly polarizing material that resembles serpentine, and a clear, isotropic mineral with a refractive index of 1.673.

## RELATIONS

The compound 3CaO.MgO.2SiO<sub>2</sub> does not appear in any of the lime-magnesia-silica systems which have been studied.

<sup>1</sup> Part of this was bromoform, used in the gravity separation.

<sup>2</sup> *Am. Min.*, 5 (4), 80, 1920.

Merwinite is therefore probably a low temperature form, breaking down before its melting point is reached. Its association with wollastonite indicates that it crystallizes below a temperature of 1190° C., the inversion temperature of wollastonite. Its occurrence in rocks of pneumatolytic contact metamorphic origin indicates a temperature much lower still.

Merwinite is not closely related to any known mineral. In composition it is similar to the olivine group, but it differs from olivine in crystallization.

### THE MINERALS OF ST. LAWRENCE, JEFFERSON, AND LEWIS COUNTIES, NEW YORK.

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No introduction to the minerals of the western Adirondack region in upper New York State need be given to any one interested in mineralogy. Good crystals from its many localities adorn nearly all mineral collections and most of the easily obtainable show specimens were taken long ago. There is still a great deal left, however, which will repay a trip into the region, and many of the old localities may be made to furnish material nearly, if not quite, as good as that which made them famous. In view of this fact, coupled with the difficulty experienced in locating the exact position of some of the old collecting grounds from such directions as have been previously published, the writer feels that a new set of directions, along with a short account of what may be found at each place, will be welcome.

The region lies on the far western edge of the Adirondack plateau, bordering the heavily forested area, but mostly to the west of it. It is contained within the limits of St. Lawrence, Jefferson, and a corner of Lewis counties (see the accompanying map) and includes parts of the following topographic quadrangles: Hammond, Gouverneur, Lake Bonaparte, Russell, and Canton.

The territory is easily reached by automobile either thru the Adirondacks proper or, with better roads, northward from Utica up the valley of the Black River. The Rome, Watertown, and Ogdensburg R. R. runs north from Utica up the Black River valley, and connections may be had at Carthage for Natural Bridge, and at Philadelphia for Gouverneur, Canton, etc. The