THE AMERICAN MINERALOGIST, VOL. 44, MARCH–APRIL, 1959

DELRIOITE, A NEW CALCIUM STRONTIUM VANADATE FROM COLORADO*

MARY E. THOMPSON AND ALEXANDER M. SHERWOOD,
U. S. Geological Survey, Washington 25, D. C.

ABSTRACT

Delrioite, $CaO \cdot SrO \cdot V_2O_5 \cdot 3H_2O$, was found on the dump at the portal of the Jo Dandy mine, Montrose County, Colorado. The mine is in a vanadium-uranium deposit in the Salt Wash member of the Morrison formation of Late Jurassic age. The mineral occurs as radial aggregates of pale yellow-green fibrous acicular crystals. Unit cell data for delrioite are not available, but the *x*-ray powder diffraction pattern is unique. The *d*-spacings of the strongest lines are, in Angstroms: 6.5 (S), 4.95 (MS), 4.40 (M), 3.55 (M), 3.45 (MS).

Delrioite is biaxial negative, with indices of refraction $\alpha = 1.783$, $\beta = 1.834$, $\gamma = 1.866$, all ± 0.003, 2V medium to large. It is pleochroic with X colorless, Y pale yellow, and Z slightly deeper yellow. The hardness is about 2; the measured specific gravity is 3.1 ± 0.1.

The chemical analysis shows, in per cent: CaO 13.30, SrO 24.50, V_2O_5 46.00, $H_2O(+)$ 5.64, $H_2O(-)$ 9.24, SiO_2 1.30, total 99.98.

Delrioite is named for A. M. del Rio, who first found vanadium (erythronium) in North America.

INTRODUCTION AND ACKNOWLEDGMENTS

Delrioite was found on the dump at the Hummer portal of the Jo Dandy mine in Paradox Valley, Montrose County, Colorado, in 1955, by Edwin Sharp, a summer field assistant, of the U. S. Geological Survey. The specimen was given to E. B. Gross of the U. S. Atomic Energy Commission, Grand Junction, Colorado for identification, who submitted it to M. E. Thompson for further study. We wish to thank Mr. Sharp and Mr. Gross for supplying us with the specimens of this new mineral.

Delrioite is named for A. M. del Rio (1764–1849), who in 1801 announced the discovery of a new element, erythronium. The announcement was later withdrawn, as he had become convinced that erythronium was really chromium. Erythronium was later shown to be identical to vanadium, the new element described by Sefstrom in 1830. It is, therefore, considered appropriate to name this new vanadium mineral for one of the earliest American mineralogists, whose share in the discovery of vanadium is usually forgotten.

This work is part of a program being conducted by the U. S. Geological Survey on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

OCCURRENCE

Delrioite occurs as an efflorescence on sandstone on the dump at the Hummer portal of the Jo Dandy mine in Paradox Valley, Montrose

---

* Publication authorized by the Director, U. S. Geological Survey.

County, Colorado. The Jo Dandy mine is located in a vanadium-uranium deposit in the Salt Wash sandstone member of the Morrison formation of Late Jurassic age. The occurrence as an efflorescence at the dump suggests that the new mineral is one of the soluble oxidation products of the lower valent vanadium minerals found in the Jo Dandy mine. The new mineral has so far been found only at the one locality, probably because an adequate supply of strontium usually is not available in the ground waters at other localities.

Another vanadium mineral found on the same dump is metarossite, $CaV_2O_6 \cdot 2H_2O$. The two minerals look very much alike, and might easily be confused, unless laboratory tests are made.

X-RAY, PHYSICAL, AND OPTICAL PROPERTIES

Delrioite occurs as pale yellow-green aggregates of fibrous acicular crystals. The aggregates approximate single crystals closely enough so that optical measurements can be made, but the fragments were found, in a preliminary study by *x*-ray rotation and Weissenberg methods, evidently to be twinned, and in addition, to consist of tiny fibers that are somewhat rotated with respect to each other about their mutual axis of elongation. This type of disorder has been observed in other fibrous vanadates (Barnes and Qurashi, 1952). The *x*-ray rotation photographs established, however, that the repeat distance along the fiber axis is 2 times 3.65 Å, a distance typical of fibrous vanadates.

Delrioite is light yellow green, but exposed surfaces of the mineral may be darker green, probably because of photoreduction of a small part of the vanadium (V). The hardness is about 2; the luster is vitreous to pearly. The specific gravity, obtained by measuring several small fragments together on a Berman density balance, is 3.1 ± 0.1

The new mineral is biaxial negative; 2V is medium to large; 2V calculated from the indices of refraction is $78\frac{1}{2}°$. The fibers exhibit parallel extinction, and the γ index is parallel to the elongation. Indices of refraction and pleochroism are as follows:

$\alpha = 1.783 \pm 0.003$	X colorless
$\beta = 1.834 \pm 0.003$	Y pale yellow
$\gamma = 1.866 \pm 0.003$	Z slightly deeper yellow

Delrioite has a unique *x*-ray powder pattern, for which *d*-spacings are given in Table 1. The mineral was photographed with Ni-filtered Cu radiation ($\lambda = 1.5418$ Å), in a Debye-Scherrer type camera of 114.59 mm. diameter.

CHEMISTRY

A sample of delrioite weighing about 100 mg. was purified by handpicking for the spectrographic and chemical analyses. The spectrographic

TABLE 1. *X*-RAY POWDER DIFFRACTION DATA FOR DELRIOITE

CuKα (Ni filter), $\lambda = 1.5418$ Å, camera diameter 114.59 mm. Measurements not corrected for film shrinkage. Cut-off 15 Å*

I estimated	*d* (Å)	I estimated	*d* (Å)
W	7.2	W	2.96
S	6.5	MW	2.80
F	6.2	M	2.69
MS	4.95	W	2.57
W	4.74	W	2.51
M	4.40	MW	2.18
M	3.55	F	2.12
MS	3.45	F	1.93
F	3.35	W	1.89
W	3.27	F	1.85
F	3.18	M	1.80
M	3.04	W, broad	1.77

S strong, M medium, W weak, F faint

* Two faint lines were recorded with the diffractometer at 8.30 Å and 7.71 Å.

analysis, by K. V. Hazel of the U. S. Geological Survey, showed over 10 per cent Si and V, 1 to 10 per cent Sr and Ca, and <1 per cent Mg and Fe. The large amount of Si was due to admixed quartz, which was mostly removed from the sample before the chemical analysis.

The chemical analysis, by Alexander M. Sherwood, yields the empirical formula $CaO \cdot SrO \cdot V_2O_5 \cdot 3H_2O$ (Table 2). This formula indicates that the mineral is a pyrovanadate, but the suggestion has been made (H. T. Evans, Jr., written communication, 1958) that the conditions of formation would more likely produce a metavanadate, in which case the

TABLE 2. CHEMICAL ANALYSIS AND CALCULATED COMPOSITION OF DELRIOITE
Alexander M. Sherwood, analyst

	Analysis (per cent)	Analysis recalculated to 100 per cent	Atomic ratios	$CaO \cdot SrO \cdot V_2O_5 \cdot 3H_2O$
CaO	13.30	13.5	0.241	14.14
SrO	24.50	24.8	0.239	26.26
V_2O_5	46.00	46.6	0.256	45.96
$H_2O(+)$	5.64	5.7	0.316	4.55
$H_2O(-)$	9.24	9.4	0.522	9.09
SiO_2	1.30			
Total	99.98	100.0		100.00

formula might be written as $CaSrV_2O_6(OH)_2 \cdot 2H_2O$. The *x*-ray powder diffraction pattern, too, bears some resemblance to a synthetic calcium metavanadate (Daphne Ross and Richard Marvin, U. S. Geological Survey, oral communication, 1957).

The mineral is readily soluble in water, giving a yellow-green solution. Upon evaporation, however, a different (unknown) phase is obtained.

The empirical formula is parallel to that of pintadoite, $2CaO \cdot V_2O_5 \cdot 9H_2O$, a preliminary description of which was published by Hess and Schaller (1914). Unfortunately, available specimens of pintadoite seem to be nothing more than faintly stained sandstone so that it has not been possible to compare the two minerals directly.

REFERENCES

BARNES, W. H., AND QURASHI, M. M. (1952), Unit cell and space group data for certain vanadium minerals: *Am. Mineral.*, **37**, 407–422.

HESS, F. L., AND SCHALLER, W. T. (1914), Pintadoite and uvanite, two new vanadium minerals from Utah, a preliminary note: *Washington Acad. Sci. Jour.*, **4**, 576–579.

Manuscript received July 14, 1958