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WULFENITE AND CERUSSITE AT BETHEL, CONNECTICUT

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Wulfenite and cerussite have recently been discovered in a complex pegmatite associated with the mineral bismutite at Bethel, Connecticut.

More than a score of orange, euhedral crystals of wulfenite of microscopic size were found in tiny vugs in albite associated with quartz, muscovite, and bismutite. These have a prismatic, dipyramidal habit.

Yellowish white crystals of cerussite were found with the wulfenite. In addition to free-growing crystals, the cerussite is also found as megascopic and microscopic crystalline masses and grains embedded in albite. It is more abundant than the wulfenite and many of the crystals can easily be seen without the aid of a hand lens. The predominating crystal habit is equant, dipyramidal, pseudo-hexagonal.

Bismutite occurs as a gray, compact, pulverulent material that is pseudomorphous after an unknown mineral. The original mineral was orthorhombic and lath-like in bent forms with deep vertical striations. suggesting a common habit of stibnite.

A similar occurrence of wulfenite associated with bismutite occurs at the Branchville Pegmatite in Connecticut. No reference to wulfenite or cerussite is made by Schairer (1931) or Sohon (1951).

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DETERMINATION OF MIXED LAYERING IN GLAUCONITES BY INDEX OF REFRACTION

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Clay minerals with mixed-layered structures are quite common (Weaver, 1956). *X*-ray diffraction techniques for quantitatively determining structural types present and their relative percentages have been

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established by Brown and MacEwan (1951). Recently, Burst (1958a, 1958b) has shown that glauconites also occur as mixed-layered structures. The mixing is dominantly between expandable (montmorillonitic) layers and non-expandable 10 Å layers.

In glauconites a linear inverse relationship exists between the per cent of randomly interstratified expandable layers and the refractive index. The data presented here will enable those who do not have ready access to *x*-ray diffraction apparatus to obtain structural information on glauconites by a simple refractive index method.

Methods

Seventeen purified glauconite samples were used to determine the relationship between refractive index and per cent expandable layers. Eight of the samples were also analyzed for total iron calculated as Fe_2O_3. Samples were selected to exclude Burst's "mixed-mineral" variety of glauconite.

The per cent expandable layers was determined by the method described by Brown and MacEwan. The *x*-ray diffraction samples were prepared by disaggregating the glauconite pellets in distilled water in an ultrasonic cleaner and centrifuging the suspension through a porous porcelain plate following the technique described by Kinter and Diamond (1956). The position of the (001)/(001) of the mixed-layered structure was determined both on glycol solvated and potassium treated samples. The per cent expandable layers was then read from Brown and MacEwan's curves.

The refractive index was determined using sodium vapor light and oils 0.002 apart. The index was determined on mineral aggregates and is close to n_z. This index was approached from below. The first oil in which the Becke line was seen to have no component moving into the aggregate was assumed to have the Z index. Single crystal determinations were attempted but, because of small particle size, were obtained only on a few samples. The indices reported were reproducible to ± 0.002 on independent determinations by each writer.

The per cent iron, calculated as Fe_2O_3, was determined by *x*-ray spectrographic analysis. The results were obtained by using the Bashi Formation glauconite as a single standard on a one point working curve. The slope of the working curve was adjusted by calculation following the method outlined by Hower (1959). The iron determinations are thought to be good within ± 10 per cent of the amount present.

Results

The data on per cent expandable layers, refractive index, and iron

TABLE 1. INDEX, PER CENT EXPANDABLE AND TOTAL IRON, CALCULATED AS Fe_2O_3 FOR SEVENTEEN GLAUCONITES

	Formation	Index	Per cent Expandable	Per cent Fe_2O_3
1	Sundance	1.584	29	8.9
2	Colorado Shale	1.584	28	9.4
3	Byram	1.590	36	
4	Moody's Branch	1.596	30	14.2
5	Carrizo	1.606	25	
6	Kinkaid	1.612	14	
7	Folkestone	1.614	13	14.8
8	"B" New Jersey	1.622	10	
9	Park Shale	1.622	8	
10	Gros Ventre (1)	1.626	13	
11	Gros Ventre (2)	1.626	10	
12	Bashi	1.626	10	22.7
13	Franconia	1.628	13	21.5
14	Boone Terre	1.630	6	
15	Birkmose	1.630	8	20.8
16	Reno	1.636	7	
17	Tonto	1.638	0	19.4

are presented in Table I. Figure 1 is a plot of per cent expandable layers against the Z refractive index of the seventeen glauconites. The slope of the regression line was calculated by the least squares method. The correlation coefficient calculated for the data presented in Fig. 1 is −0.94. This compares with correlation coefficients of −0.82 for the data relating per cent iron to per cent expandable layers and 0.91 for

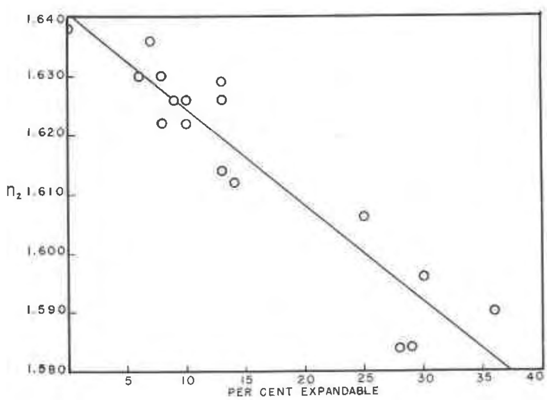

FIG. 1. Relation between index of refraction and per cent expandable layers in glauconites.

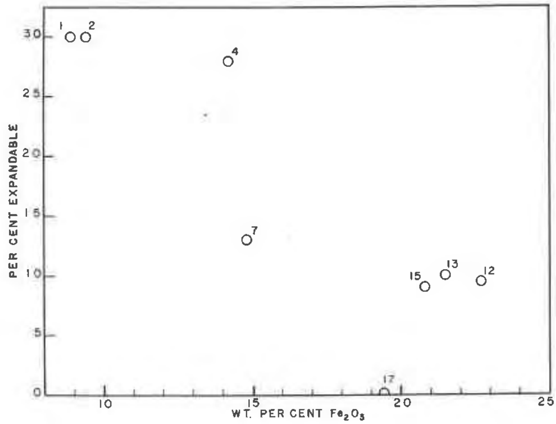

FIG. 2. Relation between per cent expandable layers and per cent Fe_2O_3 for eight glauconites. The numbers beside each point correspond to the glauconites listed in Table I.

the data relating per cent iron to the index of refraction. The curve of Fig. 1 can be used to estimate the per cent expandable layers by the simple aggregate refractive index technique described above.

The decrease in index with increasing percentage of expandable layers is caused in part by the presence of water molecules between the layers and in part because iron decreases with increasing amounts of expandable layers. Figure 2 is a plot of the available data of per cent expandable

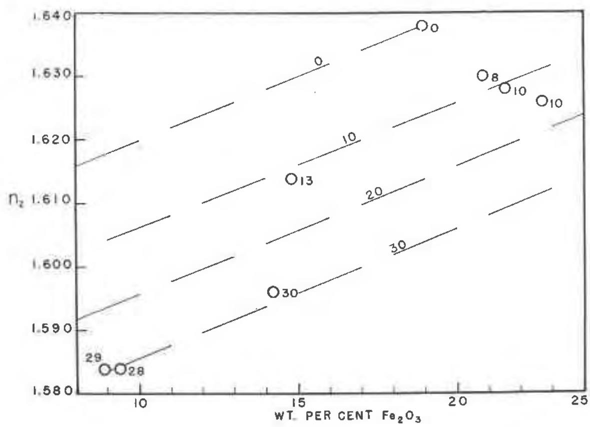

FIG. 3. Relation between index of refraction and per cent Fe_2O_3 in glauconites. The dashed lines are estimated curves for change in n_z with change in Fe_2O_3 for equal amounts of expandable layers. The numbers beside each point correspond to the amount of expandable layers for that sample.

layers against per cent Fe_2O_3. Figure 3 summarizes, on the basis of limited data, the effect of both per cent expandable layers and per cent Fe_2O_3 on the refractive index. Data taken from the literature on n_z versus per cent Fe_2O_3 (Hutton and Seelye, 1941, Hendricks and Ross, 1941) fall in with our points. The number beside each point is the per cent expandable layers for that sample; the dashed lines are estimated curves for increase in n_z with increasing iron for equal amounts of expandable layers. On the basis of Fig. 3 it can be tentatively concluded that the refractive index of glauconite decreases approximately 0.001/per cent expandable layers and increases approximately 0.002/per cent Fe_2O_3. These two factors enhance each other to give the relationship shown in Fig. 1. The writers believe that much of the scatter in the refractive index data of glauconite shown by Winchell (1951) is caused by variable amounts of mixed layering.

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