NOTES AND NEWS

MEASUREMENT OF THE ALPHA INDEX OF REFRACTION IN MICACEOUS MINERALS*

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The determination of the three indices of refraction of micaceous minerals by the immersion method presents difficulties for the index normal to the plates. Several methods have been proposed. Ferguson and Peacock[1] have outlined a method for determining the alpha index of refraction in micaceous minerals, using the universal stage. In many laboratories the required orientation in minerals with perfect cleavage is obtained by manipulating the cleavage grains against fragments of crushed glass. Ferguson and Peacock have pointed out an objection applicable to this method: "The measurement of the refractive index for the third principal direction, which is nearly normal to the cleavage, is difficult, since it involves setting the plate on edge, and it is not likely to be very accurate, since the conditions are unfavorable for the Becke effect, and the observations may have to be made very rapidly while the plate moves through an upright position." Solid immersion media such as those described by Merwin[2] are used to obtain the optical properties of minerals which have excellent cleavage. This method requires a set of the calibrated solid media. Fairbairn[3] has called attention to the method of Vedeneeva[4] for fixing the position of grains on a gelatin-coated slide.

In this paper a procedure to orient grains is presented so that the alpha index of refraction of micaceous minerals may be measured. The underlying principle is that grains falling at random on a viscous adhesive surface will maintain their position. The alpha index of refraction of micas may then be measured on those grains which stand vertically. The

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[1] Ferguson, R. B., and Peacock, M. A., Measurement of the three principal indices of refraction in micaceous minerals by immersion on a tilting stage: *Am. Mineral.*, **28,** 563–570 (1943).

[2] Merwin, H. E., Media of high refraction for refractive index determination with the microscope; also a permanent standard media for low refraction: *Jour. Wash. Acad. Sci.*, **3,** 35–40 (1913).

[3] Fairbairn, H. W., Gelatin coated slides for refractive index immersion mounts: *Am. Mineral.*, **28,** 396–397 (1943).

[4] Vedeneeva, N., and Melancholin, N., The theodolite immersion method., etc.: *Trans. Sci. Invest. Inst. Industry*, No. **503.** *Inst. App. Miner., Paper* **54** (1932), (Russian and English).

mounting medium must be immiscible with the index oil, in order that the index of refraction of the oil will not be changed while in contact with the mounting medium. Canada balsam, though viscous, is not a suitable medium as it slowly dissolves in the index oils. Water glass does not present this difficulty as it is immiscible with the index oils. The method described here involves spreading mineral particles on viscous water glass, adding index oils and cover glass, and measuring the indices on grains oriented according to the following procedure.

A drop of water glass[5] from the end of a stirring rod is placed in the center of a glass slide. Slides with a shallow well are convenient. The water glass is stirred to prevent a skin from forming on the surface, as it becomes more viscous. At first the water glass will flow back into the path of the stirring rod. The water glass is then too fluid, and a mineral grain dropped on its surface will lie flat. Stirring is continued until the water glass no longer fills in the path of the stirring rod. It is then allowed to set for half a minute. Fine-grained particles of the mineral are then sprinkled on the surface, and the mount is allowed to set for a minute.

If a cover glass were placed directly on the mineral grains, its weight would flatten the grains. A small ring made from a piece of copper wire is therefore used as a suitable support for the cover glass. A wire with a diameter of 1 mm. is curved into a loop, and flattened with a hammer to a third of its thickness and with an inside diameter of about 11 mm., which is slightly less than the diameter of the cover glass. This ring is placed around the water glass and mineral grains. If a glass slide with a shallow well is used, the ring should be approximately the same size as the well. The desired index oil is placed over the grains, and a cover glass with a diameter of 12 mm. is drawn over the wire from one side. If enough oil has been added to fill the ring, bubbles will not form.

The number of micaceous grains standing on end is influenced by the degree of crowding and grain size. A fraction of a per cent to about three per cent may stand upright.

The more crowded the grains are the greater are the chances that a given grain will stand upright. However, with many grains crowded together, conditions are not favorable for measurement of the index of refraction by the Becke line method. The edge of one upright grain should not be obscured by another grain. A little practice will show how much crowding can be permitted in order to obtain a maximum number of upright grains without interfering with the observation of the Becke line.

A second factor upon which the number of grains standing on end

[5] Commercial water glasses vary in their strength. The author has used successfully sodium silicate, 40° Bé solution, obtained from the Baker Chemical Co.

depends is grain size. In the various mesh sizes, 65–100, 100–150, and 150–200, the coarsest grains contained the least upright grains; the intermediate sized grains had more; the smallest grains had the most. The lower edge of a mica plate embedded in the water glass will support a small grain standing upright more easily than a large grain.

The water glass in which the mineral grains are partly set does not affect the values obtained for the index of refraction. The Becke line effect depends upon a vertical contact surface between the mineral and the oil.

Since the cleavage of micaceous minerals is perfect in one direction only, in directions perpendicular to this cleavage, mica breaks with a hackly fracture. A cross section through the short direction of the upright mica plate appears under the microscope like a saw tooth edge and it is difficult to tell in which direction the Becke line is moving, because of the proximity of nearby cleavage pieces. It is easier to measure the α index of refraction at the corner of the upright plate than along the length of the plate, as the hackly fracture does not interfere here.

In order to check the accuracy of the procedure given above, the indices of refraction of several micas already determined by others were measured. Comparison of results are given below:

Taeniolite from Magnet Cove, Arkansas

	C. S. Ross[6]	M. L. Lindberg
α	1.522	1.524
β	1.553	1.554
γ	1.553	1.554

Cesium Biotite from Custer County, South Dakota

	J. J. Fahey[7]	M. L. Lindberg
α	1.573	1.573
β	1.620	1.621
γ	1.620	1.621

Lepidolite, Western Australia, Stevens No. 14

	M. E. Jefferson[8]	M. L. Lindberg
α	1.525	1.526
β	—	1.559
γ	1.558	1.559

[6] Miser, H. D., and Stevens, R. E., Taeniolite from Magnet Cove, Arkansas: *Am. Mineral.*, **23**, 106 (1938).

[7] Hess, Frank L., and Fahey, J. J., Cesium biotite from Custer Co., South Dakota: *Am. Mineral.*, **17**, 175 (1932).

[8] Hendricks, Sterling B., and Jefferson, Merrill E., Polymorphism of the micas, with optical measurements: *Am. Mineral.*, **24**, 760 (1939).

LEPIDOLITE, RAMONA, CALIFORNIA, STEVENS NO. 15

	M. E. Jefferson[9]	M. L. Lindberg
α	1.533	1.532
β	—	1.550
γ	1.555	1.554

[9] *Ibid.*, p. 758.

AN OCCURRENCE OF PYROMORPHITE IN ILLINOIS

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Pyromorphite has been identified in a lead ore concentrate from the Alco Lead Company mine in the fluorspar-lead-zinc district of southern Illinois. This mineral has not previously been reported from southern Illinois despite the relatively common occurrence of galena in the ore and the considerable oxidation of parts of some deposits. Failure to recognize the mineral earlier may be due to its scarcity, an inconspicuous mode of occurrence, or insufficient opportunities for a geological examination of the weathered portions of deposits.

The mineral, however, has been reported from the fluorspar district of western Kentucky by W. S. Tangier Smith,[1] who states that pyromorphite "occurs in minute or microscopic green translucent crystals, as individuals or small aggregates. It is comparatively rare, but was noted in small amount on fluorite at the Tabor and Wheeler mines and in druses in a cavity once occupied by galena at the Kentucky No. 4 shaft."

Occurrence

The lead ore containing the pyromorphite came from the open-pit Patrick mine of the Alco Lead Company in the SW $\frac{1}{4}$, NW $\frac{1}{4}$, NW $\frac{1}{4}$, sec. 16, T. 12 S., R. 9 E., Hardin County, about 8 miles northeast of Rosiclare. The presence of an unusual mineral in the ore was indicated by the appearance of a broad fringe of green material at the upper margin of the lead concentrate on a Deister table in the company's mill. A sample of the green material was sent to the State Geological Survey by Mr. W. L. Skinner, Superintendent, in May 1945 and identified as pyromorphite. Later the writer visited the mill and observed a few minute grains of pyromorphite in the finer-grained Deister table concentrates, but was unable to find the mineral in place in the ore deposit. There can

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[1] Ulrich, E. O., and Tangier Smith, W. S., The lead, zinc, and fluorspar deposits of western Kentucky: *U. S. Geol. Survey, Prof. Paper* **36,** 122 (1905).