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COMPARISON OF GLAUCONITE FROM THE MIOCENE BEDS AT LAKES ENTRANCE, VICTORIA, WITH LOW-INDEX "GLAUCONITE" FROM THE MIOCENE BEDS AT MASLIN'S BEACH AND HACKHAM, SOUTH AUSTRALIA.

by

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CANBERRA, A.C.T. 12th November, 1948.

COMPARISON OF GLAUCONITE FROM THE MIOCENE BEDS AT LAKES ENTRANCE, VICTORIA, WITH LOW-INDEX "GLAUCONITE" FROM THE MIOCENE BEDS AT MASLIN'S BEACH AND HACKHAM, SOUTH AUSTRALIA.

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Following is the range of refractive indices for glauconite, as given by Winchell (1 p.436):

$$n_\alpha = 1.590 \text{ to } 1.615$$
$$n_\beta = 1.609 \text{ to } 1.643$$
$$n_\gamma = 1.610 \text{ to } 1.645$$
$$n_\gamma - n_\alpha = 0.02 \text{ to } 0.32$$

A sample of dark green glauconite from the glauconitic sandstone at Lakes Entrance (No. 10 Bore, Parish of Colquhoun, at 1294' 6" to 1300') was found to have refractive indices ranging from about 1.637 to 1.647 and beyond (greater than 1.657). The grains whose refractive indices range above 1.650 are decidedly brownish as seen under the microscope, and it is thought that the explanation of this feature lies in the possibility that they represent various stages of alteration towards limonite. Numerous isotropic, brown grains have a refractive index greater than 1.700, and they appear to be limonite, probably formed from glauconite. On account of the transitional stages noted, it is not possible to say whether the maximum refractive index of the glauconite proper in this sample exceeds that given by Winchell (1.645).

The following ranges of refractive indices were measured on different samples of "glauconite" from the well-known glauconitic fossiliferous Miocene limestone of Maslin's Beach and Hackham:

A. Maslin's Beach, Aldinga Section

1.569 to 1.606
1.562 to 1.582
1.557 to 1.567 (Sample No. 9943 (16))

B. Hackham

1.542 to 1.567

All of these South Australian "glauconites" show aggregate polarization; the Lakes Entrance material, on the other hand, generally appears isotropic or nearly so, but it is not known whether the apparent isotropism is due to the possibility that the fragments studied were cleavage flakes or to the possibility that the interference colours are masked by the strong colour of the mineral.

From the refractive index measurements on the South Australian samples it is quite clear that the mineral cannot be identified with glauconite as at present defined, although it probably is allied to that mineral. Furthermore, as only four samples were examined, it is virtually certain that the upper and lower extremes of indices for the glauconitic mineral will not have been recorded. E. Wayne Gallihor (2) has drawn attention to the fact that the composition of glauconite has been found to be very variable (see analyses on p.1592 and figures quoted elsewhere in his paper), and he has stated (2, p.1589) that the optical characters of the mineral are also variable, and correspond to successive stages in its development from biotite - a process of transformation conclusively demonstrated by him. He considers that it is "hazardous to give optical constants and rigid definitions for glauconite, for they may not apply to all variations" (2, p.1589). In the samples which he studied the average refractive indices of aggregates varied between 1.60 and 1.62; only a small part of the South Australian material studied falls even partly within this range or, for that matter, within the wider range given by Winchell.

On p. 1590 Wayne Galliher writes: "The fact that glauconite is not homogeneous further refutes the idea of endowing it with a chemical formula". The very low refractive indices of the South Australian "glauconites" need explanation. Wayne Galliher has stated that the composition of glauconite varies with the composition of the biotite from which it is derived and also (2, p.1589) with the stage of alteration from biotite which any particular sample has reached.

The first of these considerations has led me to tentatively suggest that the South Australian "glauconites" have been derived from a biotite which is rich in the phlogopite ($H_4K_2Mg_6Al_2Si_6O_{24}$: $\sim\gamma = 1.565$, $\sim\alpha = 1.535$) and/or eastonite ($H_4K_2Mg_5Al_4Si_5O_{24}$: $\sim\gamma = 1.578$, $\sim\alpha = 1.542$) molecule as distinct from the siderophyllite ($H_4K_2Fe_5Al_4Si_5O_{24}$: $\sim\gamma = 1.670$, $\sim\alpha = 1.616$) and/or annite ($H_4K_2Fe_6Al_2Si_6O_{24}$: $\sim\gamma = 1.690$, $\sim\alpha = 1.630$) molecule (data from Winchell (1, p.272). Phlogopitic and eastonitic biotites, then, have refractive indices much lower than those of siderophyllitic and annitic varieties, and so "glauconite" derived from them could reasonably be expected to have indices lower than those of glauconite derived from biotite relatively rich in iron. The low-index South Australian "glauconites" may, therefore, be found to be rich in magnesia and relatively poor in ferric iron, a suggestion which is supported also by their being a much lighter green (commonly yellow-green or very pale green in hand specimens) than is the Lakes Entrance glauconite (dark olive green).

However, it may be found that the suggested richness in magnesia of the South Australian "glauconites" is not so much dependent on the composition of the parent biotite as on some special process of diagenesis which was operative during sedimentation or during the compaction and cementation of the limestone.

The range of refractive indices (1.569 to 1.606) of one of the samples probably does not mean that the double refraction of the "glauconite" is of the order of 0.04, but it would seem, rather, to indicate that this sample is composed of "glauconite" of varying composition, the variation being due to the presence of different stages in alteration from the parent mineral.

Whatever the explanation, the problem posed by the low indices of the samples studied is an intriguing one. It should be capable of solution by detailed chemical and optical work on a large number of samples. Such work may show that there is a "glauconite system" with magnesia-rich and iron-rich end-members and that there is a regular variation in optical, chemical and physical properties in compounds between these extremes. Thus the magnesia-rich varieties would be expected to be light green and to have low indices of refraction, by contrast with the dark-green, iron-rich varieties (glauconite as recognised to date), which have considerably higher indices.

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12th November, 1948.
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1. Winchell, A.N. : Elements of Optical Mineralogy, Part II. 3rd Edition. 1933.

2. Galliher, E. Wayne: Geology of Glauconite. Bull. Amer. Assoc. Pet. Geol. vol. 19 (11); pp. 1569-1601.

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