TABLE 1. CHEMICAL COMPOSITION OF WHEWELLITE FROM VARIOUS SOURCES

	1	2	3	4	5
CaO	38.38	38.46	38.83	38.36	38.23
C_2O_3	49.28	49.65	49.38	50.28	48.69
H_2O	12.34	12.14	12.31	11.36	Not Determined

1. $Ca(C_2O_4)\cdot H_2O$
2. Pchery, Bohemia
3. Brüx, Bohemia
4. Maikop, Caucasus
5. Milan, Ohio

Note: Analyses 2, 3 and 4 from Palache *et al.* (1951).

This find is of interest for the following reasons:

1. It is the first reported in eastern United States. 2. It is the first of any sizable quantity in the United States. 3. It is found in older rocks than previous finds. 4. The location is readily accessible to interested petrologists.

We are glad to acknowledge the help of Mr. Owen Keim who performed the chemical analysis and Mr. C. R. Tipton, Jr. who made this work possible, both of whom were the authors' associates at the Basic Incorporated Research Center. Of course, special thanks and recognition must go to Mr. Clarence Raver who supplied us with the samples.

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LACUSTRINE GLAUCONITIC MICA FROM PLUVIAL LAKE MOUND, LYNN AND TERRY COUNTIES, TEXAS

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Glauconitic mica from lacustrine sediments in pluvial Lake Mound, Lynn and Terry counties, Texas is identified by *x*-ray diffraction, optical measurements, differential thermal analysis and chemical analysis. Glauconitic mica occurs in Lake Mound as pellets, streaks, or disseminations in clastic sands and lacustrine dolomites with montmorillonite, illite and mixed layer clays. There is no source of detrital glauconite or glauconitic mica in the vicinity. The glauconitic mica is authigenic, formed by fixation of iron and potassium in clay mineral lattices in the lacustrine sediments.

Glauconite is an illite-type clay mineral reported to form in marine waters (Cloud, 1955; Takahashi, 1939); however, Dydchenko and Khatuntzeva (1956) find glauconite in alluvial and elluvial deposits of the Ukraine. Keller (1958) describes glauconitic mica in the Morrison Formation, Colorado which forms by fixation of potassium and iron in montmorillonite. Glauconitic mica, intermediate in composition between glauconite and muscovite, contains more tetrahedral aluminum than glauconite but less than muscovite. Glauconitic mica also contains more octahedral aluminum and less octahedral ferric iron than glauconite but less octahedral aluminum and more octahedral ferric ion than muscovite. A silicate lattice, supplies of potassium and iron, and a favorable oxidation potential are necessary for the formation of glauconite (Burst, 1958) and glauconitic mica. Favorable oxidation potentials are produced in a marine environment by decaying organic material, but silicates may be altered to glauconite in the absence of decaying organic matter in restricted basins, lagoons, or lakes in which semioxidizing conditions exist.

Mound Lake, located on the Terry-Lynn County line 10 miles east of Brownfield, Texas, is one of a number of pluvial lake basins on the Southern High Plains (Reeves, 1962, 1963). Green sand, green clay and green arenaceous clay have been found in 20 auger holes and pits beneath the present playa. There are two persistent stratigraphic occurrences of the green sediments, a shallow zone with a depth range of 3½ to 5 feet and a deeper zone ranging from 12 to 14 feet. The green sediments are always found near the present playa shore line and are commonly associated with gypsum crystals and gravels. Carbonate dates indicate that these sediments pre-date the maximum Wisconsin advance.

Samples were collected from both persistent horizons. Samples were washed and dispersed in distilled water using calgon. Size separation was made by sedimentation and oriented aggregates were prepared by vacuum filtration on porous ceramic plates for *x*-ray examination.

X-ray diffractograms of oriented aggregates (Fig. 1) are similar to diffractograms of well-ordered glauconite (Burst, 1958). Weaver (1965) shows the ratio of the (001) to (002) peak intensity is related to the potassium content in illite clays. Mound Lake glauconite shows an intensity ratio of 4 indicating 5% K_2O (Weaver, 1965, Fig. 1) but chemical analysis

(Table 1) reveals 3.8%. *X*-ray diffractograms (Fig. 1) prove the absence of expandable layers and indicate that potassium content is high enough for a stable mica structure.

X-ray diffractograms of random mounts (Fig. 2) do not show enough diffractions to allow classification of the glauconite as a 1M structure but do suggest the 1Md classification even though there are differences from the 1Md glauconites of Burst (1958). For example, the 3.05 A diffraction peak is missing from the Mound Lake material but is very prominent in the glauconite from the Burditt Formation, Texas, classified as 1Md by Burst. The prominent 3.32 Å diffraction peak in the Mound Lake material is weak or missing in the Burditt glauconite.

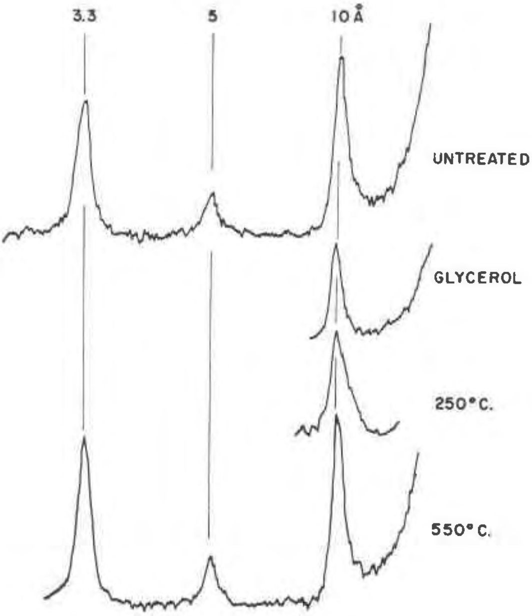

FIGURE. 1. *X*-ray diffractograms of Mound Lake glauconitic mica. Oriented aggregate, Ni-filtered Cu radiation

Glauconitic mica particle size is too small to obtain optical properties of single fragments, therefore oriented aggregates were examined. Glauconitic mica pellets, oriented aggregates, and streaks are deep green in color and non-pleochroic. The deep green color is a result of high ferric iron content.

Index of refraction measurements of oriented aggregates indicate only the average of beta and gamma since alpha is nearly perpendicular to (001) and the *a* and *b*-axes of individual fragments are randomly oriented

TABLE 1. ANALYSIS OF MOUND LAKE GLAUCONITIC MICA

Oxide	Weight Per Cent
SiO_2	41.6
Fe_2O_3	16.1
FeO	0.7
Al_2O_3	11.0
MgO	4.8
CaO	0.9
K_2O	3.8
Na_2O	3.3
H_2O (Released below 115° C.)	3.8
H_2O (Released between 115° C. and 1000° C.)	12.7
Total	98.7

Semiquantitative Spectrographic Analysis

Element	(ppm)	Element	(ppm)
Mo	15	Ni	20
Sn	10	Ti	1200
V	750	Pb	85
Cu	15	Mn	85
Zn	35	Sr	35
Ag	2	Cr	85
Co	1	Ba	85

in the aggregate. The measured index of oriented aggregates of Mound Lake glauconitic mica is 1.592±.005. This is low for glauconite with ferric content indicated in Table 1, but refractive indices of glauconites

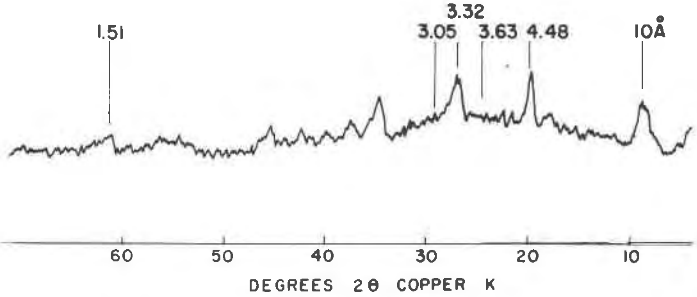

FIG. 2. *X*-ray diffractogram of Mound Lake glauconitic mica. Random mount, Ni-filtered Cu radiation.

are considerably affected by variable content of adsorbed water in the crystals (Sabatier, 1949, in Deer *et al.*, 1962). Chemical analysis (Table 1) shows 12.7% water released between 115° C. and 1,000° C. and differential thermal analysis curves of fine glauconitic mica (Fig. 3) show a pronounced endothermic peak at 150° C. Both measurements indicate adsorbed water which accounts for the low index of refraction.

Results of chemical analysis of the Mound Lake glauconitic mica are shown in Table 1. The calculated formula excluding TiO_2 is:

$$\overset{+1.06}{(Ca_{0.08}Na_{0.51}K_{0.39})}\overset{-0.45}{(Al_{0.44}\overset{+++}{Fe}_{0.99}\overset{++}{Fe}_{0.05}Mg_{0.58})}\overset{-0.61}{(Si_{3.39}Al_{0.61})}O_{10}(OH)_2$$

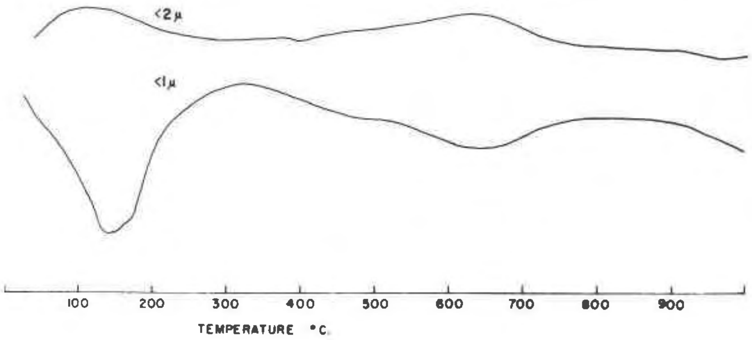

FIG. 3. Differential Thermal Analysis patterns of Mound Lake glauconitic mica. Equilibrated over saturated $CaCl_2$ solution, relative humidity 30%.

The material is clearly dioctahedral with Fe^{3+} as the principal octahedral cation. Foster (1956) indicates the composition of the tetrahedral layer in glauconite is $(Si_{3.67}Al_{0.33})$ and that the range in tetrahedral composition in muscovite is $(Si_{2.98\text{ to }3.11}Al_{1.02\text{ to }0.89})$. The tetrahedral layer of the Mound Lake material is intermediate between Foster's composition for glauconite and muscovite. Foster shows the octahedral layer in muscovite is $(Al_{1.90}Fe_{0.03}{}^{3+}\cdots)$ and the octahedral layer in glauconite is $(Al_{0.18}Fe_{1.1}{}^{3+}\text{ to }_{1.2}\cdots)$. The octahedral layer in the Mound Lake material is $(Al_{0.44}$-$Fe_{0.99}{}^{3+}\cdots)$ which is intermediate between muscovite and glauconite. The term glauconitic mica seems appropriate for the Mound Lake mineral based on the calculated formula, and Keller (personal communication) agrees.

The Mound Lake glauconitic mica contains more sodium and less potassium than any previously reported glauconite. Burst (1958) suggests that Bonne Terre and Franconia glauconites represent an end-point potassium composition ($K_{0.75}$ based on O_{10}) to which the mineral name glauconite should be applied. With diminishing potassium content glauconitic materials resemble the montmorillonites. True disordering also becomes evident in the low potash glauconites (Burst, 1958). Roberson and Jonas (1965) show sodium and calcium stabilize the montmorillonite lattice at 10 A even when saturated with ethylene glycol. The Mound Lake material is a disordered structure but potassium and sodium have high enough binding power so there are no expandable layers of the montmorillonite type. The potassium content of the Mound Lake glauconitic mica ($K_{0.39}$) falls at the lower end of the range indicated for disordered glauconites by Burst (1958).

Table 2. Composition of T-Bar Lakes Brines (Meigs *et al.*, 1922)

	North T-Bar[1] (Double Lake No. 1)	South T-Bar[1] (Double Lake No. 2)
Dissolved Solids	19.10	21.90
KCl	1.22	1.56
$MgCl_2$	2.04	1.12
NaCl	6.19	7.67
$CaSO_4$	0.73	1.93
Na_2SO_4	2.08	1.40

[1] Values in weight percent represent averages computed from the data of Meigs *et al.*, 1922.

A silicate lattice for the formation of glauconite is provided by montmorillonite, illite and mixed layer clays which are common in the lacustrine sediments. Pellets similar to brine shrimp pellets have been observed in thin sections of lacustrine dolomites from Mound Lake (Reeves and Parry, 1965). Similar fecal pellets in the fine-grained lacustrine sediments probably provided the decaying organic matter for formation of the glauconitic mica pellets. The necessary iron was derived from detrital ferromagnesian minerals in the clastic sediments of the lake, the potassium and sodium are supplied by the lake brines. Mound Lake brines were not chemically analyzed because of contamination by oil field waste water. Analyses of brines from the T-Bar Lakes, 6 miles southeast of Mound Lake are shown in Table 2. There is no reason to believe that T-Bar and Mound Lakes were not similar during the time of glauconite formation. An adequate supply of both sodium and potassium is available in the brine for glauconite formation.

Discovery of glauconitic mica in lacustrine sediments of pluvial Lake Mound indicates that formation of glauconitic materials takes place from montmorillonitic materials in environments other than marine. Caution must therefore be exercised in the use of glauconite as an environmental indicator.

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DEHYDRATION OF DIASPORE AT WATER PRESSURES FROM 15 to 15,000 PSI

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The dehydroxylation of well-crystallized diaspore from Chester, Mass. has been investigated by differential thermal analysis at H_2O pressures ranging from 15 to 15,000 psi. Experimental techniques and the methods used to process data taken from the thermograms have been described in detail by Weber and Greer (1965).