

---

## Diatom Succession in a Laverne (Pliocene) Deposit of Oklahoma

L. R. WILSON, University of Oklahoma, Norman

Pliocene diatomaceous deposits in Oklahoma have been known for many years, but until the publication of Lohman's (1936; see also his Fig. 2) list of diatoms in Beaver County from the Laverne zone of the Ogallala Formation, little attention had been paid to them. Since then only casual mention of Oklahoma's diatomaceous earths has been made in literature.

Within the last year re-examination of both Pliocene and Pleistocene diatomaceous deposits has been undertaken by the Oklahoma Geological Survey to determine their distribution and economic value in relation to possible new uses of diatomite. One of the deposits re-examined is that containing diatoms described by Lohman from Beaver County. The present paper is an outgrowth of field work done by Dr. Mart P. Schemel of the Oklahoma Geological Survey.

The exposure of the Beaver County deposit is in the SW $\frac{1}{4}$ , NE $\frac{1}{4}$  sec. 3, T. 3 N., R. 25 E.C.M. It is approximately 500 ft long and the depth of

the stream valley in which it is exposed is approximately 30 ft. The following section was measured by Dr. Schemel:

East side of intermittent creek. Strata dip N. 45° W.; dip varies between 30 and 40 degrees. Top of section is north (downstream). Eroded surface approximates the dip slope of the main bed.

	Thickness
7. Limestone or hard clay shale, dense flint-like conchoidal fracture, buff to brown, weathers white	0'2½"
6. Shale, clayey, poorly bedded, buff	3'0"
5. "Chalk," diatomaceous marl, white, extremely fine-grained, calcareous, thickness of unit estimated. Deeply eroded but not slumped. Sampled in three 5-ft units	15'0"
4. Shale, clayey, dark-brown to black, plant fragments	0'4"
3. Shale, "chalky," light gray, highly calcareous, discontinuous	0'3"
2. Shale, clayey, poorly bedded, greenish and purplish interbedded	1'10"
1. Shale, clayey, poorly bedded, greenish, with some purple layers	2'10"
Total	23'5½"

This and other similar deposits in Oklahoma and Kansas have been described as diatom-bearing marls by Hanna (1932) and Chaney and Elias (1936) because of the high calcium carbonate content. The following analysis by the Oklahoma Geological Survey shows calcium carbonate content and insoluble residues in each of the three 5-ft samples collected from the main diatomaceous marl bed (unit 5, above). The insoluble residues consist mostly of diatoms and fresh-water sponge spicules.

	% CaCO <sub>3</sub>	% Insoluble Residues
Top 5'	76.8	17.6
Middle 5'	86.4	6.4
Bottom 5'	93.9	1.6

A lower Pliocene age for the deposit is based upon associated vertebrate and plant megafossils determined by Hess (1936) and Chaney and Elias (1936).

Lohman (1936) reported 37 species of diatoms in the Beaver County deposit and probably another 50 species can be added to his list. The large addition of species is due to the fact that Lohman was supplied with a sample from only several inches of the section, whereas the present study was made from 15 ft of sediment. The additions to the diatom flora of the Laverne zone in Beaver County will be published at a later date when the species have been fully studied.

The "chalky" shale (unit 3 in the section) contains the earliest diatoms in the deposit. Approximately 85% of the specimens are *Cymbella ehrenbergii*. Other diatoms are species of *Navicula*, *Synedra*, and *Melosira*.

The dark-brown to black shale (unit 4 in the section) was found to be barren of diatoms, but it contains fragments of angiosperm tissue.

The thickness of the main bed of diatomaceous marl may be slightly greater or less than 15 ft owing to uncertainty imposed by the dip of the deposit. The three 5-ft segment samples consequently may or may not overlap in the collected section. The diatom flora in the bottom 5 ft is 71.9% *Melosira* species of which *M. italica* is the most abundant. In the middle 5 ft, *Melosira* content increases to 78.2%, and in the top 5 ft, it is 81.8% of the flora. Species of *Cymbella*, *Cyclotella*, *Pinnularia*, *Navicula*, *Synedra*, *Surirella*, *Eunotia*, and *Tetracyclus* are common accessory forms. The last named is *Tetracyclus lacustris* and appears to be restricted to Pliocene deposits in Oklahoma. It has not been observed in any Pleistocene or Recent deposits of the state. No specimens were found in bed 3 but in the bottom 5 ft of bed 5 it has a relative abundance of 3.6%, in the middle 5 ft, 2.8%, and in the top 5 ft, 7.4%. Associated with the diatom fossils there is an abundance of fresh-water sponge spicules and chrysomonads.

The ecology of the known extant species of diatoms in the Laverne deposit indicates that the water in which they lived was generally cool and clear. There is little stratification in the diatomaceous marl, which fact would agree with the ecological evidence from *Melosira* that the water was of considerable depth, possibly as much as 100 ft deep. The thickness and uniformity of the deposit and constancy of the *Melosira* species is indicative of a stable environment with little fluctuation in water level, abundance of food materials, silica, and clearness of water over a period of several thousand years.

The source of the silica utilized by the diatoms and sponges apparently came from the volcanic ash which is widely distributed on the Great Plains. Several of the waterlain ash deposits of Oklahoma are rich in diatom frustules.

The calcium carbonate in the marl may be dissolved caliche deposits of the Great Plains. Some of the smaller streams in western Oklahoma now carry considerable calcium carbonate in solution and, where the water flows into temporary pools containing reeds, deposits of lime are formed about the submerged portions of the plants. Hanna (1932) stated that it is difficult to account for the presence of the large proportion of calcium carbonate in the diatomaceous deposits of Kansas and suggested that it was precipitated by such plants as *Chara* and perhaps some other aquatic vegetation. A search was made for *Chara* remains and pollen of other plants but none was found. An alternative suggestion for the precipitating agent may be the diatoms. Diatom-bearing marl might be peculiar to the Great Plains habitat with the associated caliche beds.

The ecology of the Laverne fossil diatoms can be in agreement with the ecological conclusions drawn from other paleobotanical and vertebrate evidence (Hesse, 1936; Chaney and Elias, 1936). This suggests a climate with possibly 15 inches more rainfall per annum than now in Beaver County, but that the temperature was also higher does not appear probable unless the lake was in part spring-fed, or was deep enough to maintain lower temperatures.

A final stage in the Laverne lake is indicated by bed 7, which is a dense, flint-like layer 2.5 inches thick. Thin rock sections of the flint contain partially destroyed sponge spicules and fragments that may be diatom frustules. This layer may have resulted from the solution of diatoms and sponge spicules with subsequent deposition as a siliceous bed.

#### LITERATURE CITED

- Chaney, R. W., and Elias, M. K. 1936. Late Tertiary floras from the High Plains. Carnegie Inst. Wash., Contrib. Paleontol. 476:1-46.