

**KANSAS GEOLOGICAL SURVEY
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THE LAVERNE FORMATION

by

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Rocks classified as the Laverne formation of lower Pliocene age crop out in Harper, Beaver, and Cimarron counties, Oklahoma, and Meade and Seward counties, Kansas. This formation was formerly included as a part of the Ogallala formation, but V. V. Waite, in an unpublished manuscript quoted by C. N. Gould and John T. Lonsdale,^{1/} described the occurrence of these beds in

^{1/}C. N. Gould and John T. Lonsdale, "Geology of Beaver County, Oklahoma," Okla. Geol. Surv. Bull. 38(1926), pp. 1-71.

Harper County, Oklahoma, and named them the Laverne formation. In 1936,^{2/} Hesse summarized the literature dealing with these beds, but, on the basis

^{2/} R. W. Chaney and M. K. Elias, "Late Tertiary Floras from the High Plains; with a chapter by Curtis J. Hesse on The Lower Pliocene Vertebrate Fossils from the Ogallala Formation (Laverne Zone) of Beaver County, Oklahoma," Carnegie Inst. Wash. Pub. 476 (1936), pp. 47-51.

of the fauna, referred to them as the Laverne zone of the Ogallala formation.^{3/} Smith first recognized the presence of rocks which unconformably underlie typical Ogallala beds along Cimarron valley in Seward County, Kansas. In 1941,

^{3/}H. T. U. Smith, "Geologic Studies in Southwestern Kansas," Kan. Geol. Surv. Bull. 34 (1940), pp. 37-39.

^{4/} Frye and Hibbard described these rocks in Meade and Seward counties, Kansas.

^{4/} John C. Frye and Claude W. Hibbard, "Pliocene and Pleistocene Stratigraphy and Paleontology of the Meade Basin, Southwestern Kansas," Kan. Geol. Surv. Bull. 38, pt. 13, (1941), pp. 398-403.

and correlated them with the Laverne formation of Oklahoma. The Laverne formation was regarded by them as a distinct formation rather than as a zone of the Ogallala formation for the following reasons: "(1) the nonconformity that separates the Laverne from the Ogallala is the greatest break in sedimentation recorded in the Pliocene and Pleistocene section. The beds of the Laverne dip at angles as great as 15 degrees and are overlain by horizontal beds of the Ogallala; (2) the lithology of the Laverne is distinct from that of the overlying Ogallala--in fact, on casual inspection these beds more closely resemble the underlying Cretaceous rocks than they do the Ogallala; and (3) it is a unit that is easily recognizable and mappable in the field."

Deposits constituting the Laverne formation were deposited in channels, on flood plains, and in discontinuous or partly connected lakes. The sediments were, for the most part, derived from the west and probably represent material derived from the Rocky Mountain region. The even and fine texture of the sandstones and shales and the high percentage of calcium-carbonate rocks in the formation suggest that the rocks of Cretaceous age, rather than the granite areas farther west, probably supplied the bulk of these materials.

The lithology of the chalky limestones and the contained diatoms and ostracodes ^{5/} indicate that the lakes in which these deposits accumulated

^{5/} Frye and Hibbard, op. cit., pp. 401-403.

contained brackish water. This seems to imply a semiarid to arid climate for this region during early Pliocene time. It is possible, however, that the brackish water condition in these lakes was caused by upward migration of brines from the Permian salt beds underlying the area. This hypothesis is given some credence by the fact that throughout most of this area the Laverne strata are folded, and dips of as much as 15 degrees have been measured. If this folding was in part due to solutional phenomena or if the lakes in which these sediments were trapped were formed by deep-seated solution of a type similar to that which occurred during the Pleistocene,^{6/}

^{6/} John C. Frye and Stuart L. Schoff, "Deep Seated Solution in the Meade Basin and Vicinity, Kansas and Oklahoma," Nat. Res. Coun., An. Geophysical Union, Trans. (1942), pp. 35-39.

it is quite possible that some brine might have migrated upward and contaminated fresh-water lakes. The thick section of sandstone seems to imply that a relatively large volume of water moved across this area, which could hardly be possible if the climate were arid enough to cause brackish-water conditions in lakes.

The stratigraphy of the Laverne formation has not as yet been adequately studied. Available data indicate that, in general, the lower part of the formation is composed dominantly of sandstone and shale, and the upper part consists largely of shale, silt, chalky limestone, and limestone. Most of the beds seem to be discontinuous and cannot be traced over the entire area, although certain types of lithology are characteristic and persistent. Hard, fine-grained limestone is the most resistant rock type and is prominently exposed along canyon sides; chalky limestone is well exposed in a few places and has been quarried locally for building stone; shale is best exposed where it occurs under ledges of dipping limestone (fig.); sandstone

is best known from test holes, although the coarse-textured, locally derived channel deposits are well exposed at some localities in Beaver County, Oklahoma. The Laverne formation as studied by me in Kansas and Beaver County, Oklahoma, consists of 25 to 40 per cent sandstone, 30 to 50 per cent shale and silt, and 20 to 30 per cent limestone and chalky limestone. The total thickness of the formation probably exceeds 150 feet.