[Proceedings of the Iowa Academy of Science](https://scholarworks.uni.edu/pias)

Volume 81 | Number | Article 11

1974

Compositional and Textural Analyses of Kansan and Tazewell Till in a Portion of Northwest Iowa

Kent Van Zant
University of Iowa

Compositional and Textural Analyses of Kansan and Tazewell Till in a Portion of Northwest Iowa

KENT VAN ZANT[1]

VAN ZANT, KENT (Department of Geology, The University of Iowa, Iowa City, Iowa 52242. Compositional and Textural Analyses of Kansan and Tazewell Till in a Portion of Northwest Iowa. *Proc. Iowa Acad. Sci.* 81(3): 122-126, 1974.
Kansan and Tazewell tills can be distinguished by compositional and textural properties throughout portions of Buena Vista, Cherokee, Clay and O'Brien counties in northwest Iowa. Kansan till contains more clay than silt or sand while Tazewell till is composed of nearly equal portions of clay, silt and sand. Coarse sand is more abundant in Tazewell till than Kansan till. Siliceous rounded shale grains are common in Tazewell till but scarce or absent in Kansan till. Igneous and metamorphic rock fragments are more common in the coarse sand of Kansan than Tazewell till. Significantly more carbonate grains occur in the medium sand fraction of Tazewell till than Kansan till. The lithology of Tazewell till suggests ice occupied the Minnesota-Des Moines rivers' lowland by 20.000 radiocarbon years before the present.
INDEX DESCRIPTORS: Till, Tazewell Till, Kansan Till, Till of Iowa.

Two surface tills have been recognized west of the Bemis moraine in northwest Iowa. Previous studies (Carman, 1917, 1931; Ruhe, 1950) have emphasized geomorphic methods for mapping the extent of these tills. But morainic topography is commonly absent, and the amount of surface dissection is similar across the area. Stratigraphic relationships are unclear in many areas because of low relief.

The purpose of this study was to characterize textural and compositional properties useful for differentiating Kansan and Tazewell tills. A previous attempt to distinguish these tills by analyzing two properties (textural and Atterberg limits) was unsuccessful (Ruhe, 1950).

Carman (1917) mapped Kansan till underlying all of northwest Iowa west of the Bemis moraine. Later Carman (1931) mapped Iowan till at the surface between the Bemis moraine and Mill Creek in Cherokee and O'Brien counties. Carman's (1931) till was renamed Tazewell till by Ruhe (1950). West of Mill Creek Ruhe (1950) mapped Iowan till. Later Ruhe (1969) reassigned this till to Kansan age because spruce wood from within the till dated greater than 39,900 radiocarbon years before the present.

MATERIALS AND METHODS

Over 100 samples of Kansan and Tazewell till were collected in a 500-square-mile area between Cherokee, Sheldon and Sioux Rapids, Iowa (Figure 1). Most of the area is within the Little Sioux River drainage basin, although the area near Sheldon is in the Floyd valley.

Till samples were collected from unleached till that was oxidized or unoxidized. At some localities (e.g., SW¼, Sec. 5, and NW¼, Sec. 17, T. 93 N., R. 39 W., Sutherland East topographic quad., Cherokee County) recent grading of county roads along the Little Sioux River valley revealed greater than 20 feet of oxidized till grading downward into more than 20 feet of unoxidized till. Large, fresh exposures such as these, and similar cuts along Waterman and Dog creeks in T. 94 N., R. 39 W., O'Brien County, were sampled vertically at approximately eight-foot intervals. Both oxidized and unoxidized till samples were collected. Differences in clay mineralogy were found between oxidized and unoxidized till (Van Zant, 1973), but textural, mineralogic and carbonate composition did not change with oxidation. In SW¼, Sec. 36, T. 93 N., R. 40 W., Cherokee North topographic quad., Cherokee County, the oxidized and unoxidized till overlies 10 feet of sand which in turn overlies eight feet of unoxidized, unleached till. The textural and compositional properties of this lower till match those of the surface till west of Mill Creek. At this site greater than 60 feet of Tazewell till, the upper till, is exposed.

Multiple samples of Kansan till were collected from exposures in Sec. 29, T. 93 N., R. 40 W., Cherokee North topographic quad., Cherokee County, and Sec. 15, T. 94 N., R. 41 W., Paullina topographic quad., O'Brien County. At these localities along Mill Creek oxidized till grades downward into unoxidized till.

A similar degree of variability exists between samples collected from a large exposure of one till as exists between samples from several exposures of that same till. Both Kansan and Tazewell till can be treated as lithologic units whose textural and compositional properties remain consistent throughout the 500-square-mile area.

Exposures of Iowan (Tazewell) till described by Carman (1931) are badly overgrown or slumped, but the stratigraphy can be dug out locally. His Doupe Farm Sections (Sec. 13, T. 92 N., R. 40 W., Cherokee North topographic quad., Cherokee County) and an exposure near his Mill Creek Section (Sec. 19, T. 93 N., R. 40 W., Cherokee North topographic quad., Cherokee County) were sampled and contained properties typical of Tazewell till. The till in the Sheldon Section (NE¼, NW¼, Sec. 9, T. 96 N., R. 42 W., Sheldon topographic quad., O'Brien County) (Ruhe, 1950, 1969) is bouldery and less than three feet thick, but the mineralogy and carbonate content of this till compare closely to other Tazewell till samples. Organic carbon from a buried soil A horizon beneath Tazewell till in this section has been dated at 20,500 ± 400 radiocarbon years B.P. (Ruhe, 1969). The other radiocarbon dated site of Tazewell till in Iowa (SE¼,

[1] Department of Geology, The University of Iowa, Iowa City, Iowa 52242.

Proceedings of the Iowa Academy of Science, Vol. 81 [1974], No. 3, Art. 11

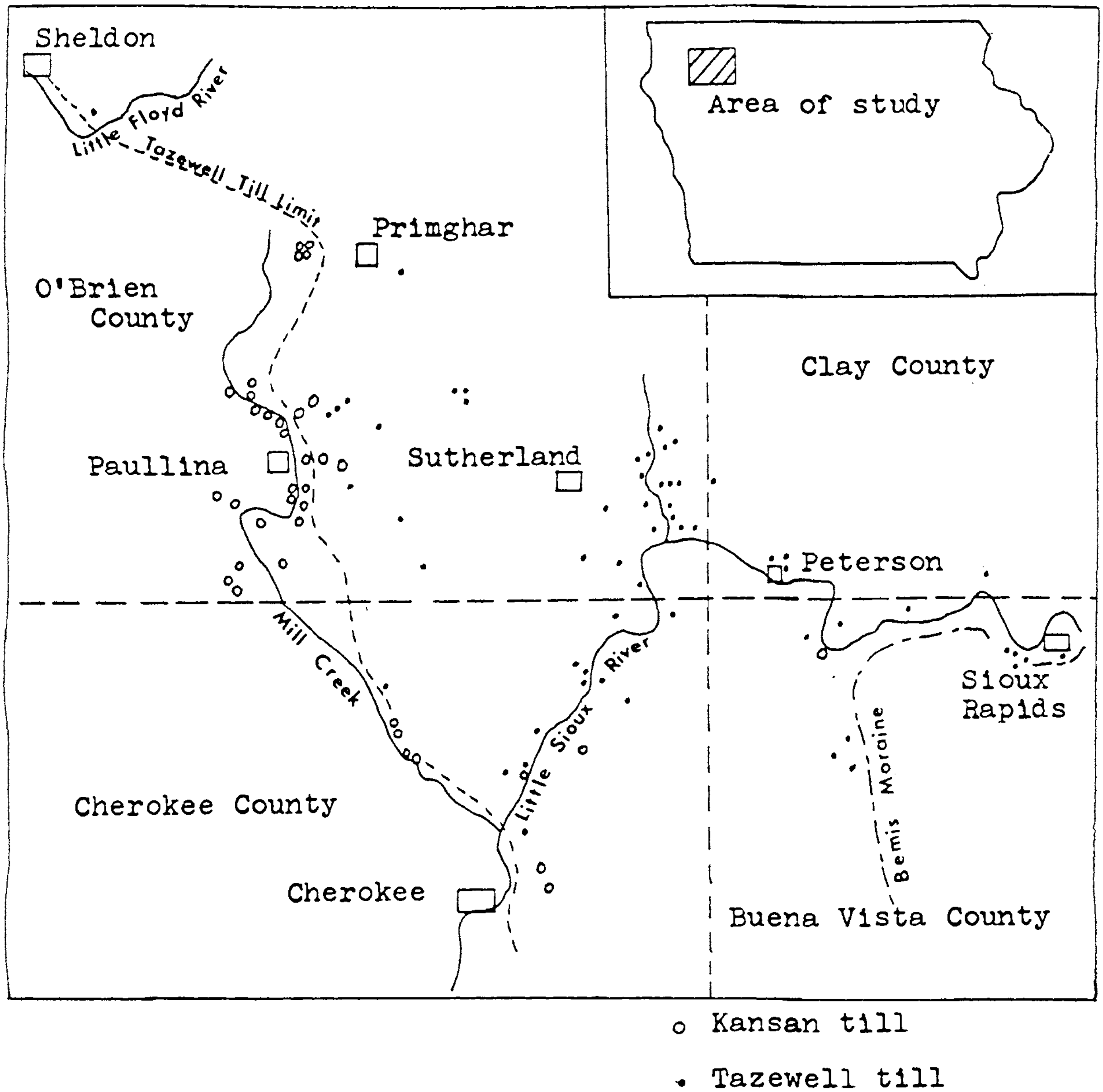

Figure 1. Location of till sampling sites.

SW¼, NW¼, Sec. 25, T. 92 N., R. 40 W., Cherokee North topographic quad., Cherokee County) was dug out locally but was not sampled for lack of stratigraphic control.

Mechanical Analyses

Till samples were dried and crushed with a rolling pin. Pebbles greater than 2 mm were dry-sieved out of the samples. The samples were wet-sieved through a series of five sieves (1.0, 0.500, 0.250, 0.125 and 0.63 mm). Clay and silt percentages were established by settling and pipetting (Folk, 1965).

Lithology

More than two hundred 1 to 2 mm sand grains were identified from each sample with the aid of a binocular microscope.

Carbonate Analyses

The 0.500 to 0.250 mm sand fraction was placed in 10 percent hydrochloric acid for greater than six hours. Percentage weight loss was calculated as percent of carbonate.

RESULTS

Mechanical Analyses

Kansan till contains more clay than Tazewell till. The

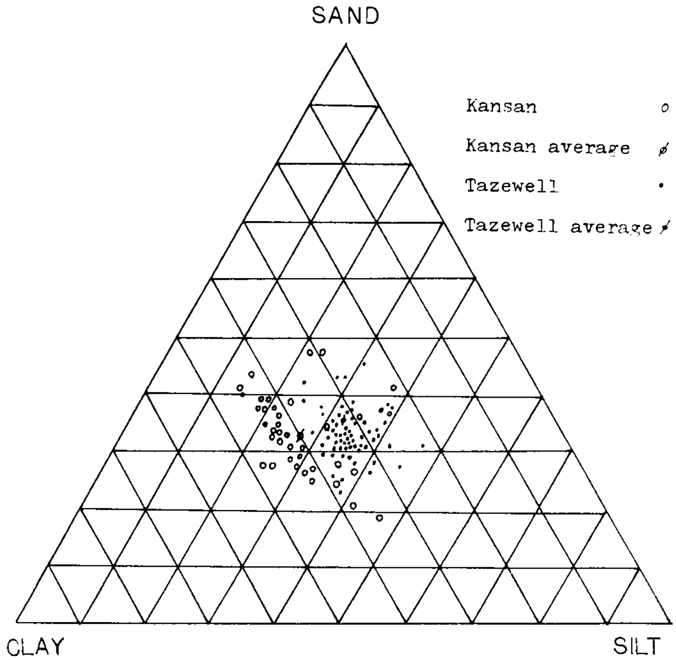

Figure 2. Sand, silt and clay content of Kansan and Tazewell tills.

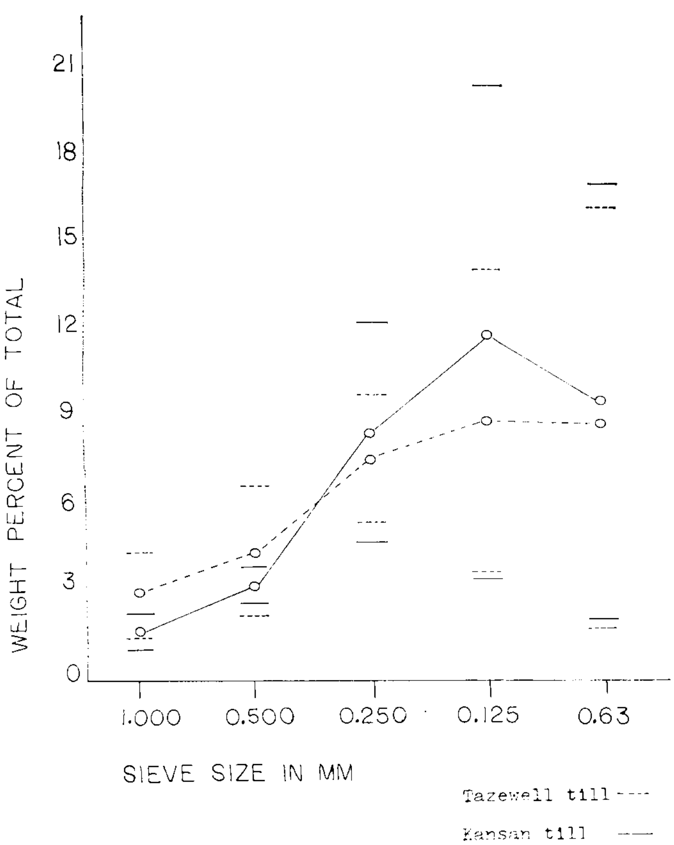

Figure 3. Mean and variability to three standard deviations of weight percent of sand, graphed at sieve intervals, of Kansan and Tazewell tills.

average composition of 45 till samples is: clay 40 percent, silt 28 percent and sand 32 percent (Figure 2).

Tazewell till is composed of nearly equal proportions of clay, silt and sand. Arithmetic means of 64 samples are: clay 33 percent, silt 34 percent and sand 33 percent (Figure 2).

Tazewell till in the sample area contains more coarse sand than Kansan till (Figure 3). The mean percentage of 1 to 2 mm sand grains is 3 percent of the total sample weight. The 0.5 to 1 mm sand is over 4 percent of the total weight. Both of these percentages are higher than the amount of coarse sand in Kansan till. Tazewell till has smaller amounts of fine sand of 0.125 to 0.250 mm and 0.63 to 0.125 mm sizes. Greater variation among till samples exists for fine sand, however (Figure 3).

Lithology

Sand grains were divided into three categories for graphing purposes—grains from igneous and metamorphic rocks, grains of carbonate rocks and rounded shale grains (Figure 4).

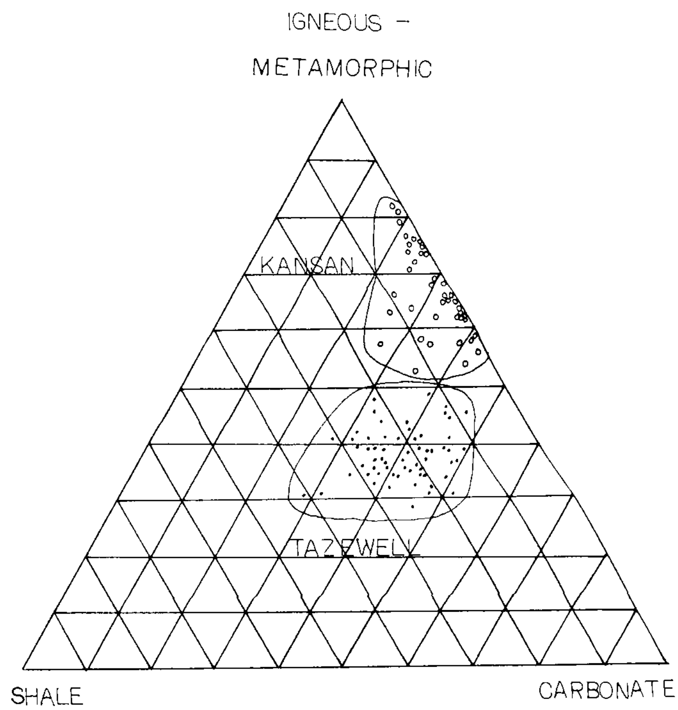

Figure 4. Mineralogy of 1-2 mm size sand fraction of Kansan and Tazewell till samples.

Igneous and metamorphic grains are most numerous in Kansan till. Angular and subangular quartz grains account for greater than 35 percent of all grains counted. Rounded shale grains are not common in any samples.

These data differ from Carman's (1931, p. 106) pebble counts from Kansan till:

> Gray limestone is the dominant rock material among the pebbles of Kansan till, forming more than 70 percent of the total number of pebbles. Other types of limestones

and a few quartzites and shale pebbles increase the number of sedimentary pebbles to about 75 percent of the whole. The remaining 25 percent consists of igneous pebbles, chiefly granites. The large cobbles and bowlders are dominantly igneous; quartzite, which is never abundant in the analyses of pebbles, is common; while limestone bowlders are rare.

No pebbles were counted for comparison with Carman's data. The similarity between the lithology of cobbles and sand may result from phaneritic igneous cobbles crumbling to sand grains upon weathering. Limestone, in contrast, was abraded in transport to pebbles which did not crumble to sand size particles on weathering. Therefore, 70 percent of the pebbles are limestone, but igneous rocks are dominant in the cobble and sand fractions.

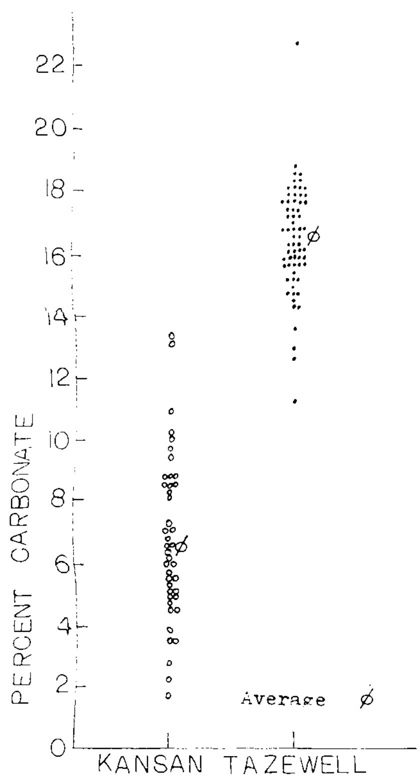

Figure 5. Percent of carbonate in 0.500 to 0.250 mm sand samples of Kansan and Tazewell tills.

A characteristic feature of Tazewell till is the abundance of siliceous rounded shale grains in the 1 to 2 mm sand fraction (Figure 4). These grains vary from 9 percent to 42 percent of the total sand content. Matsch (1971) used similar shale grains to differentiate tills in the Minnesota River valley. Wright, *et al.* (1973) traced the origin of these shale grains to the Upper Cretaceous Pierre Formation in eastern North and South Dakota and southern Manitoba. In northwest Iowa some samples of Kansan till contain these grains but generally in amounts less than 5 percent (Figure 4).

Carbonate Analyses

The abundance of limestone and dolomite in the sand content is indicated by the carbonate analyses. The mean carbonate composition of the 0.250 to 0.500 mm sand samples of Kansan till was 6.64 percent, nearly 10 percent lower than the mean composition of Tazewell till (Figure 5).

DISCUSSION AND CONCLUSIONS

Mechanical analyses are laborious and not particularly helpful in distinguishing Kansan and Tazewell till. Considerable overlap occurs among the samples and the mean compositions are similar (Figure 2). Carbonate analyses (Figure 5) and computation of coarse sand percentages (Figure 3) are rapid analyses that show significant differences between the tills.

Mineralogic identifications are time-consuming but useful for differentiation (Figure 4). The high shale content and lack of Superior Lobe indicators in Tazewell till compare favorably with Matsch's (1972) "extra morainic" Wisconsinan till in southwest Minnesota, but distance between study areas makes correlations inexact.

The mineralogy suggests that Tazewell till was deposited by ice moving down the Minnesota-Des Moines rivers' lowlands. Radiocarbon dates indicate this till was deposited approximately 20,000 years before the present (Ruhe, 1969). Therefore, Wisconsinan ice must have occupied the Des Moines River lowland by 20,000 radiocarbon years B.P., 6,000 years sooner than the model of Wright, *et al.* (1973) suggests.

Samples from both tills at Ruhe's (1969) Mill Creek Section (center, Sec. 32, T. 93 N., R. 40 W., Cherokee North topographic quad., Cherokee County) indicate that both tills lack shale and are low in carbonate content in the 0.250 to 0.500 mm sand fraction. The upper till is not Tazewell till but may be Kansan in age.

The lithologic characteristics which distinguish Kansan and Tazewell tills are:

1. Kansan till contains nearly 40 percent clay, 28 percent silt and 32 percent sand by weight. Tazewell till contains nearly equal proportions of clay, silt and sand.
2. The amount of very coarse sand averages 3.0 percent of the total sample weight in Tazewell till and 1.7 percent in Kansan till. Deviation from the mean is slight.
3. Siliceous rounded shale grains range from 9 percent to 42 percent of the very coarse sand fraction of Tazewell till. These grains are absent or scarce in Kansan till.
4. Igneous and metamorphic rocks comprise 52 percent to 83 percent of the very coarse sand fraction of Kansan till and 28 percent to 48 percent in Tazewell till.
5. Greater than 16 percent of the medium sand fraction of Tazewell till is carbonate, compared to less than 7 percent in Kansan till.

ACKNOWLEDGMENTS

Dr. Richard G. Baker, The University of Iowa, offered valuable advice throughout this project, reviewed the field work and read the manuscript. The geology department of Cornell College, Mt. Vernon, Iowa, furnished equipment and space for the carbonate analyses. Warren and Olive Wilson, Primghar, Iowa, provided room and board for the duration of the field work.

LITERATURE CITED

CARMAN, J. E. 1917. The Pleistocene geology of northwestern Iowa. *Iowa Geol. Surv. Ann. Report.* 26:233-445.

———. 1931. Further studies on the Pleistocene geology of northwestern Iowa. *Iowa Geol. Surv. Ann. Report.* 35:15-194.

FOLK, ROBERT L. 1965. *Petrology of Sedimentary Rocks.* Hemphill's. Austin, Texas. 159 p.

MATSCH, CHARLES L. 1971. Pleistocene stratigraphy of the New Ulm region, southwestern Minnesota. Unpub. Ph.D. thesis. University of Wisconsin, Madison. 78 p.

———. 1972. Quaternary geology of southwestern Minnesota, *in* P. K. Sims and G. B. Morey, eds., *Geology of Minnesota: A Centennial Volume.* Minnesota Geol. Surv., p. 548-560.

RUHE, R. V. 1950. Reclassification and correlation of the glacial drifts of northwestern Iowa. Unpub. Ph.D. thesis. The University of Iowa, Iowa City. 124 p.

———. 1969. *Quaternary Landscapes in Iowa.* Iowa State University Press, Ames. 255 p.

VAN ZANT, KENT. 1973. Pleistocene stratigraphy in a portion of northwest Iowa. Unpub. M.S. thesis. The University of Iowa, Iowa City. 52 p.

WRIGHT, H. E., JR., CHARLES L. MATSCH and EDWARD J. CUSHING. 1973. Superior and Des Moines Lobes, *in* Robert F. Black, Richard Goldthwait and H. B. Willman, eds., *The Wisconsinan Stage.* Geol. Soc. America Memoir 136, p. 153-185.